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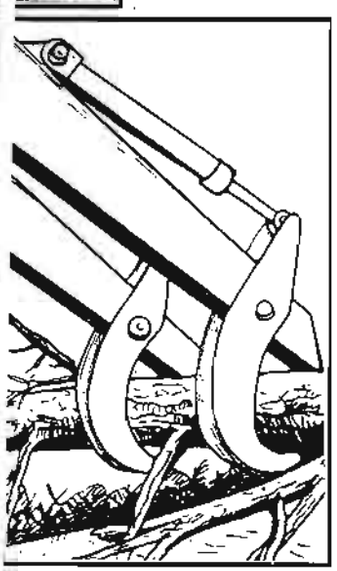
LOGGING REFERENCE MANUAL



Vol.2

W. ZAREMBA

LOGGING REFERENCE MANUAL

by

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Vol.2 - TIMBER SKIDDING BY HIGHLEAD
LOGGING ACCESSORIES
TIMBER LOADERS

G.P.-S (L).

LOGGING REFERENCE MANUAL: VOL 2 (PART 1):

GLOSSARY

"A"-FRAME

An open structure tapering from a wide base to a load bearing top.

BACKSTAY BRIDLE

(Also stayback). Part of the guy rope rigging for stabilising crane or highlead booms.

BIGHT (OF THE ROPE)

A loop or angle formed in a rope.

BOOM PINS

The pins on which a highlead or crane boom pivots.

BULL BLOCK

The main block on top of the highlead boom, through which the main cable passes.

BUTT CHAIN

The chain which connects the choker slings to the rigging butt.

CHOKER

A chain or cable so fastened that it tightens on its load as it is pulled.

CLIMBING IRONS

Spurs which are strapped to one's legs to facilitate tree climbing.

CRAB DRUM

A winch drum operated manually by means of a crank.

DOG CLUTCH

A clutch which operates by projections and slots on two opposed flanges interlocking when the one flange slides axially towards the other.

FLEET ANGLE

The maximum angle between a rope and a line perpendicular to the drum on which it winds.

FLUID DRIVE

A connection between two shafts that transmits torque through a fluid.

HAULBACK CABLE

A small diameter wire rope travelling between the yarder and blocks set in the field, used to return the main cable and attachments to the next log to be skidded.

HEAD TRIP BLOCK

The block attached near the top of the hig lead boom through which the haulback cable pass

HEEL BOOM

A type of crane boom used for leading ex long timber, which allows complete control o the load from the cab.

HIGHLEAD BLOCK

Synonym: Bull block or main line block.

HINGE FOOT

Synonym: Tail stand. A support which is lo ed just under the erected boom to help stabilis the the highlead machine in operation.

HINGE PINS

See Boom pins.

HOT DECKING

This is when skidded logs are sw d or loaded immediately after they are landed.

JIB

Synonym: Boom. Any heavy beam hin at one end carrying a weight lifting device at other.

LINE GUARD

An optional safety device on a block protect the cable passing over the sheave.

McLEAN BOOM

A type of crane boom mounted on spar tree for loading long timber.

MODULUS OF ELASTICITY

The ratio indicating the resistance deflection of a material.

MONTELIUS CLEVIS

A special clevis used in the butt ging assembly of a highlead unit, preventi the choker ferrule from jumping out of the but hain choker hook pocket.

PASS BLOCK

An auxilliary block used in riggi.

PINION SHAFT

A shaft bearing a toothed whee pinion).

RIGGING BUTT

The assembly used to join the main cable and haulback cable of a highlead unit. The logs are also attached to this assembly by means of butt chains.

SHACKLE

A connecting device for lines and drawbars which consists of a "U"-shaped section or round steel pierced on the ends for a cross bolt or a pin.

SHEAVE

A grooved wheel used to support cable, or change its direction of travel (pulley).

SHIFT COLLAR

A collar in the clutch linkage that moves axially on the drive shaft.

SISTER HOOKS

A pair of similar, matching hooks mounted on a swivel and used with the strawline in rigging.

SLINGING

Attaching slings or chokers to the timber.

SPAR TREE

A tree that is debranched and topped, to be rigged and used as a boom for highlead operation.

SPLINE COUPLING

Where two shafts are joined by means of splines.

STAYBACK

See Backstay.

STRAWLINE

A light auxilliary cable used in rigging with a highlead unit.

TAIL HAULBACK BLOCK

The block through which the haulback cable passes in the field, determining the direction of travel of the main cable.

TORQUE CONVERTER

A hydraulic coupling which utilizes slippage to multiply torque.

TORQUE BOLT

Serves for adjustment of chain tension.

TREE IRONS

Metal hooks attached to a spar tree to hold guy lines and block slings in place.

TURN PIPES

A type of horizontal windlass on the front of the Loggers' Dream (highlead unit).

YARDER

A machine used for log skidding using cables.

BANK YARD

Measurement of earth in its original position is in bank yards, and after shaking up is in loose yards.

CUBIC-YARDSTATION

The work required to move one cubic yard of excavated material one station. The distance (station) varies with the size and type of moving equipment, the specification, and type of work.

CROSSFALL OF ROAD SURFACE

Super-elevation of road surface on curves.

DIFFUSION (CAPITAL INVESTMENT)

The spread of innovation throughout industry.

INNOVATION (CAPITAL INVESTMENT)

Innovation follows invention and is the process of bringing the invention into commercial use. It is governed by production, sales and profitability.

LOOSE YARD

Bank yard.

OBSOLENCE (CAPITAL INVESTMENT)

By definition obsolence is an economic inferiority of the equipment in comparison to the more efficient successor.

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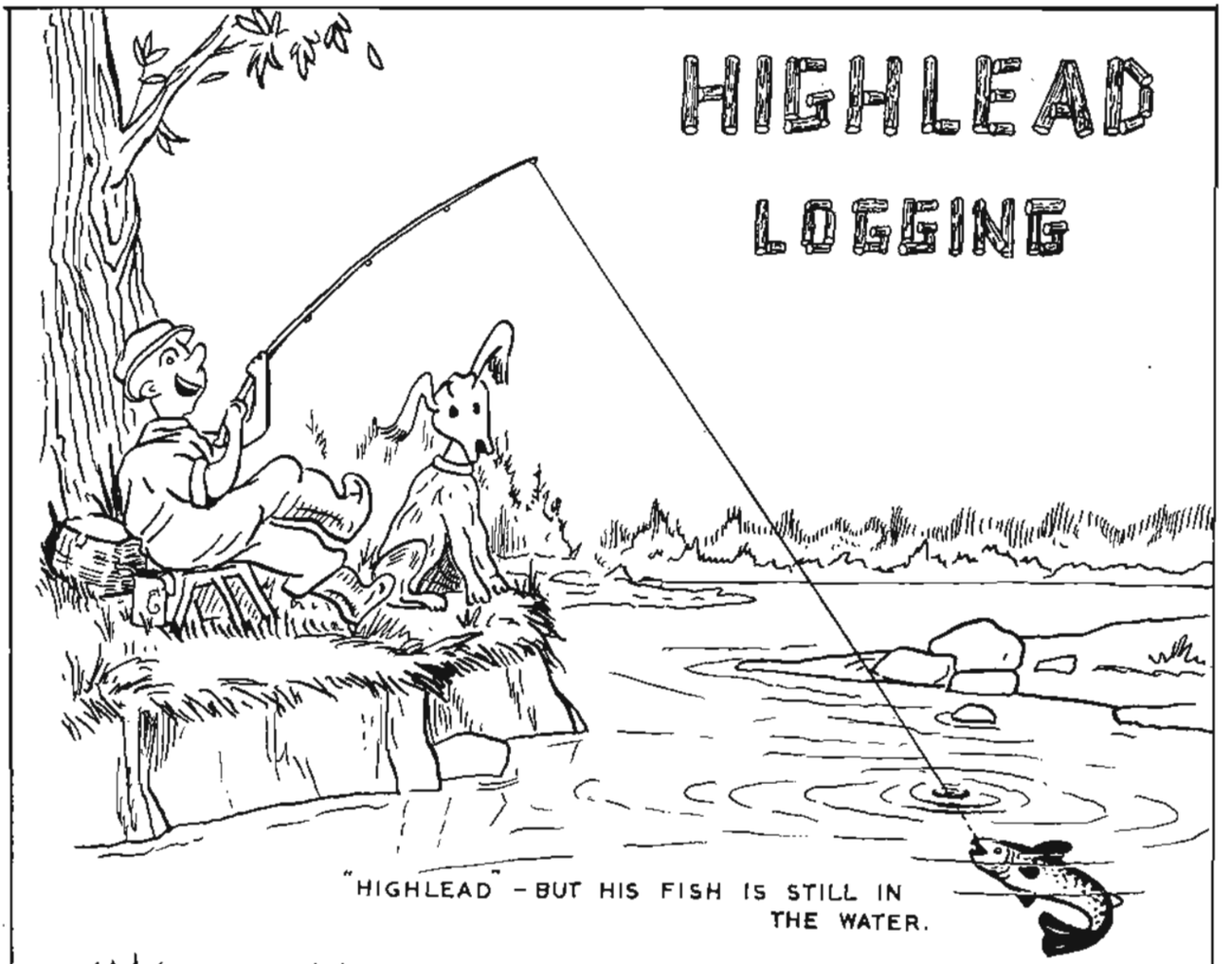
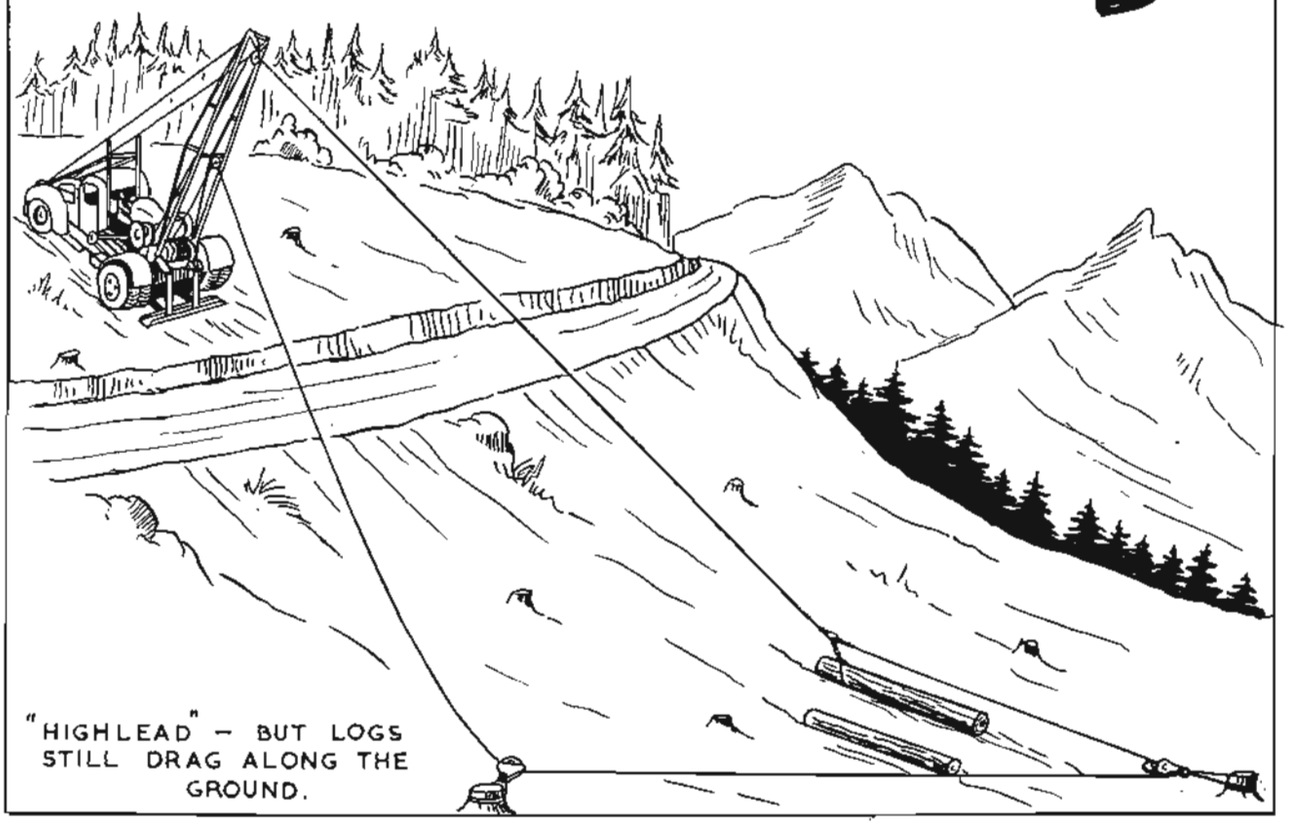
HIGHLEAD LOGGING



"HIGHLEAD" - BUT HIS FISH IS STILL IN THE WATER.



"HIGHLEAD" - BUT LOGS STILL DRAG ALONG THE GROUND.

I. HIGHLEAD LOG YARDING

INTRODUCTION

The highlead is a cable log skidding (yarding) system whereby the load is winched in by a cable which is passed over the sheave of the highlead block to give a slight lift to the heads of yarded logs over ground obstacles.

This system is primarily adopted by the Department for log yarding in areas where conventional towing systems are not applicable owing to steep slopes, rugged topography, or rough ground surfaces. Prior to the modernisation of this system, a spar tree was generally used to suspend blocks, and double- or triple-drum logging winches, wire ropes, and auxiliary equipment specially designed for the system were used. The highlead system serves to its greatest advantage when logs are to be yarded uphill over rough slopes.

The cover title page clearly illustrates the principle of highlead logging where the cable or line is used to reach the desired object, which is then pulled in. At no time is the load raised off the ground.

Three types of highlead assemblies are used in the Department, dependent upon the plantation conditions:

(a) Semi-portable highlead with spar tree and tractor-mounted winches. (Fig. H.L. 1)

(b) Self-propelled tractor-mounted highlead unit. (Fig. H.L. 4)

(c) Self-propelled lorry-mounted highlead unit. (Fig. H.L. 3)

Note: In the cases of (b) and (c) the units carry their own booms.
The above types of machines with double-drum logging winches for log skidding are known as "yarders".

1. HIGHLEAD WITH SPARTREE

This type of highlead system is seldom used in departmental plantations as the self-propelled units equipped with their own booms are more quickly erected. There are, nonetheless, situations in some plantations for which the spar tree cannot be substituted and must be used for the highlead operation, despite inconveniences in erection.

The highlead with spar tree is the fore-runner of present systems equipped with their own booms, but as it is only occasionally used in plantations it will be dealt with subsequent to the latter two systems mentioned above.

2. HIGHLEAD: LORRY-MOUNTED WITH BOOM (Fig. H. L. 8)

A. DESCRIPTION OF UNIT AND AUXILIARY EQUIPMENT

Departmental lorry-mounted highlead units are more powerful (75 kW) and faster working than the tractor-mounted units. Only tractors with 34 kW and 48 kW engines are available for use in highlead operations in the Department.

The lorry-mounted unit consists of three main parts:

(1) A double-drum winch with auxiliary strawline (outboard) drum (Fig. H.L. 7), engine, hinge foot (Fig. H.L. 6) or tail stand, and supports for the boom when in the travelling position (Fig. H.L. 7). All these parts are assembled on one common winch frame. The 75 kW winch engines of the departmental units are petrol driven.

Note: When the winch frame is mounted on the carrier frame, both frames should coincide to the closest possible degree to avoid any interference whatsoever. The capacities of the main and haulback winch drums are 230 metre of 19 mm cable (wire rope) and 600 metre of 13 mm diameter wire rope respectively

(2) The boom (or jib), which is 10 metre high is hinged to the front travelling support. When operating the boom is in an upright position, but it can be folded horizontally over the length of the carrier for travelling. The boom is constructed of 10 cm extra-strong, reinforced piping.

(3) The carrier, which is a 7-8 ton Warford lorry with standard engine, has three axles and six wheels, at least four of which are driven.

The main cable (19 mm diameter) runs from the main winch drum through the swivelling main (or bull) block of 29 cm sheave (Fig. H.L. 8, item 9a), suspended from the support bracket on top of the boom. The haulback cable (13 mm diameter) runs from the haulback drum through the head trip block of 20,3 cm diameter sheave (item 9b), suspended from the boom cross-member below the main block and on the side of the boom facing the operation.

Note: The main block and head trip block are standard as supplied by the manufacturer

Apart from the above-mentioned cables and blocks, the auxiliary equipment used with the unit consists of the following:

(i) One butt rigging assembly (item 6), which is fitted at the junction of the main and haulback cables. It serves for the cables attachment of chokers and takes rotating strain off the ropes.

(ii) Two chokers attached to the butt rigging assembly for slinging the logs, and four chokers to be kept in reserve.

(iii) Three haulback blocks with 15 cm diameter sheaves, easily opening bridges, and line guards (items 7 and 8).

(iv) Three 13 mm diameter wire rope slings (items 3, 4), both ends soft eye spliced (or clamped).

Note: The wire ropes run through haulback blocks, which are attached by slings to the stumps at the lower left and right extremities of the operating sector, so that all logs in the sector fall within the cable range

HIGHLEADS.

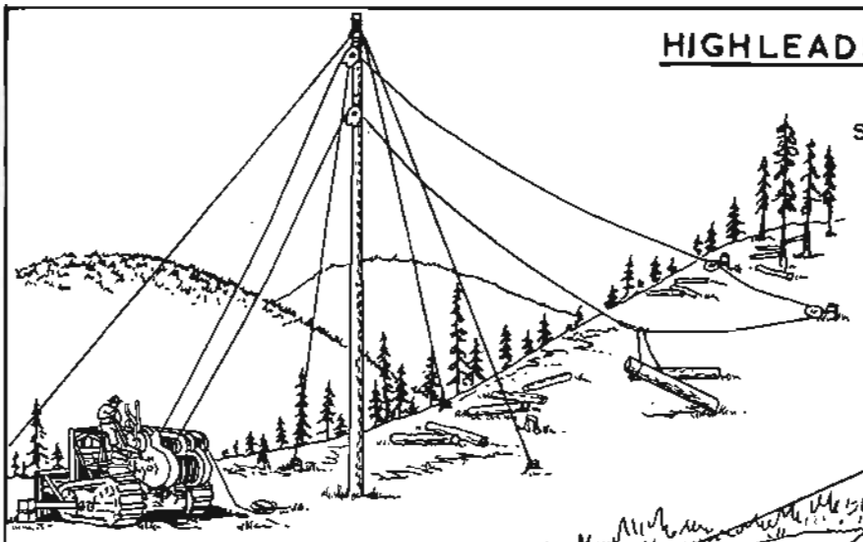


FIG.H.L.1
SPAR TREE WITH TRACTOR MOUNTED YARDER.

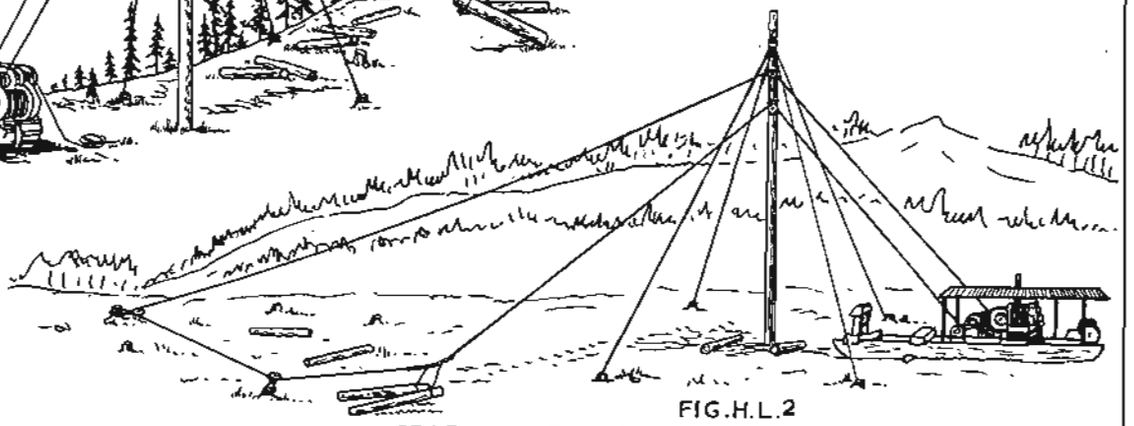


FIG.H.L.2
SPAR TREE WITH SLEDGE MOUNTED YARDER

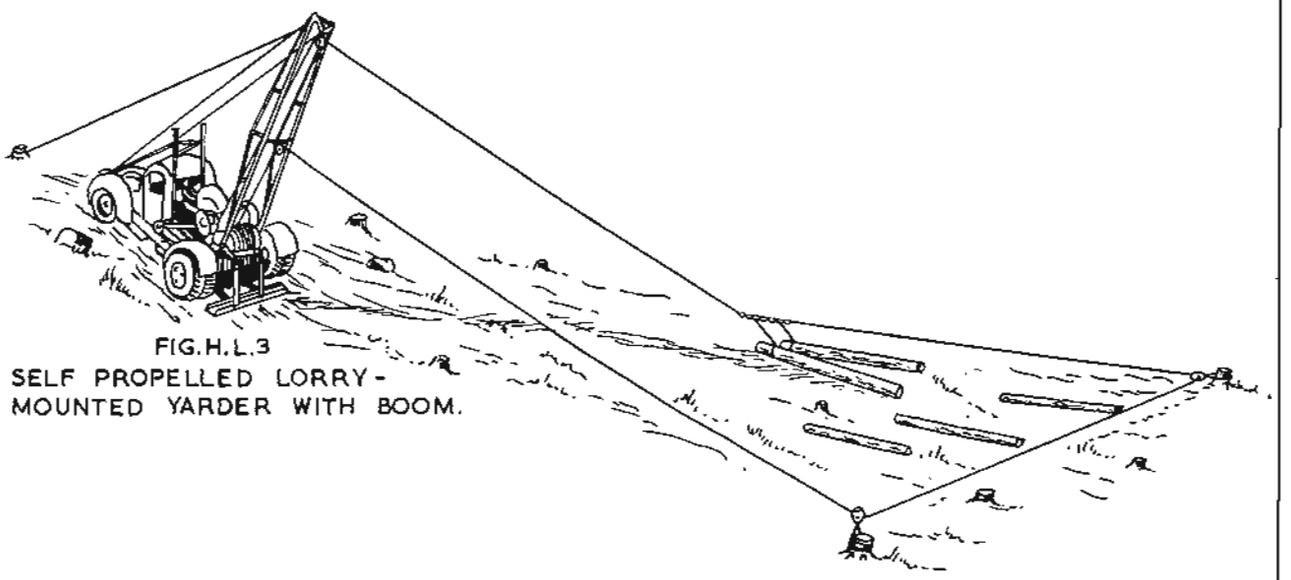


FIG.H.L.3
SELF PROPELLED LORRY-MOUNTED YARDER WITH BOOM.

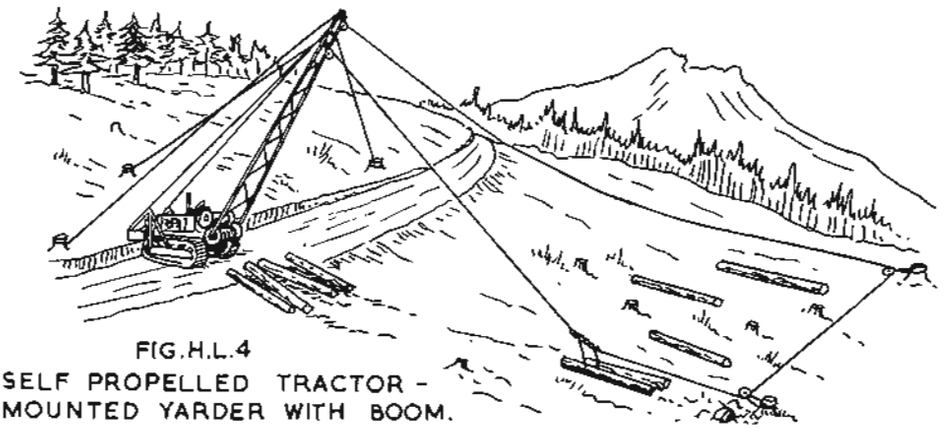
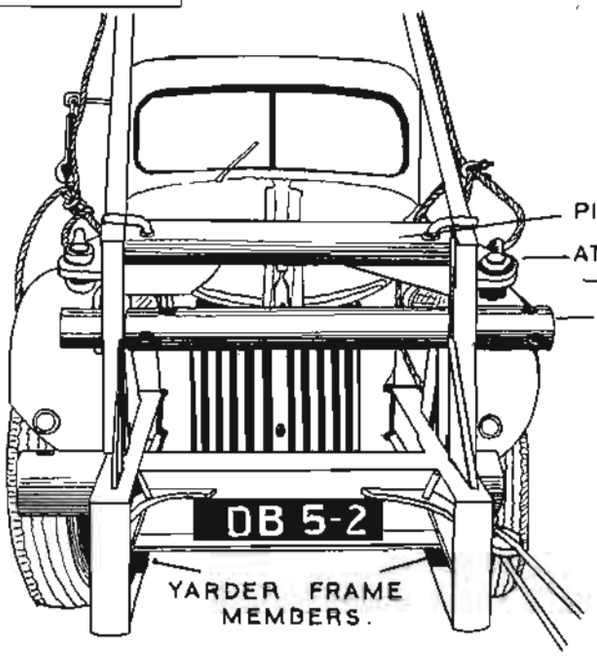


FIG.H.L.4
SELF PROPELLED TRACTOR-MOUNTED YARDER WITH BOOM.

FIG. H.L.5



FRONT OF HIGHLEAD YARDER CARRIER.

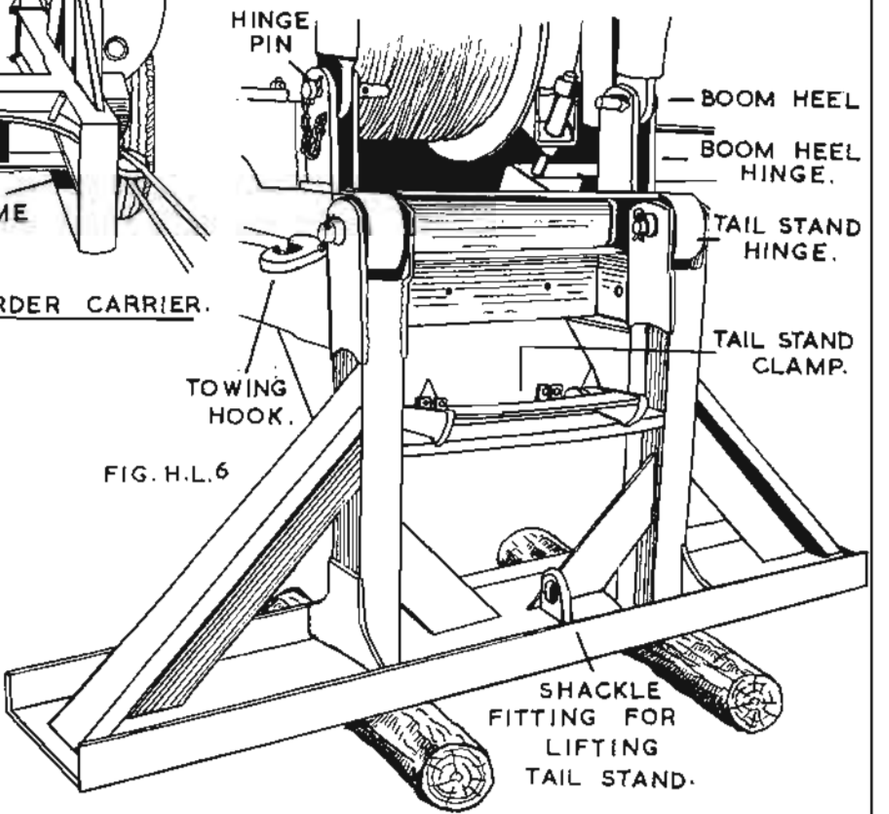


FIG. H.L.6

TAIL STAND OR HINGE FOOT

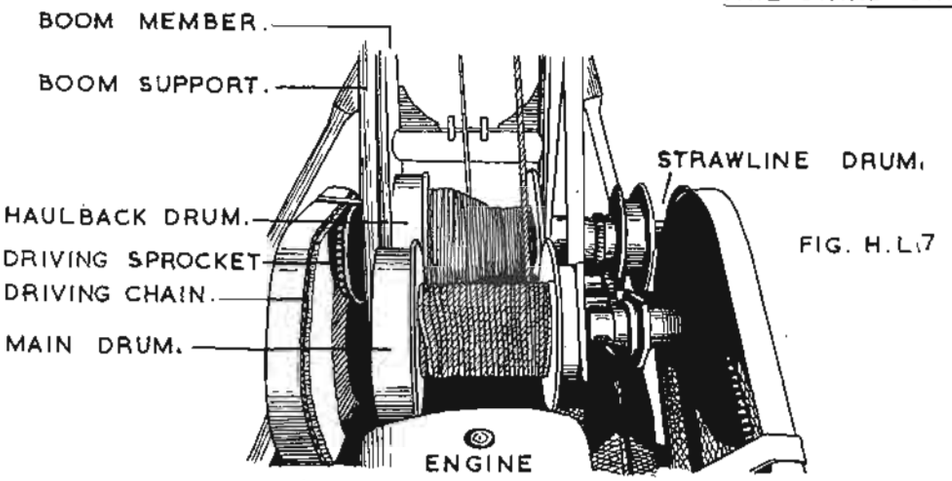


FIG. H.L.7

GENERAL VIEW OF YARDER WINCH DRUMS.

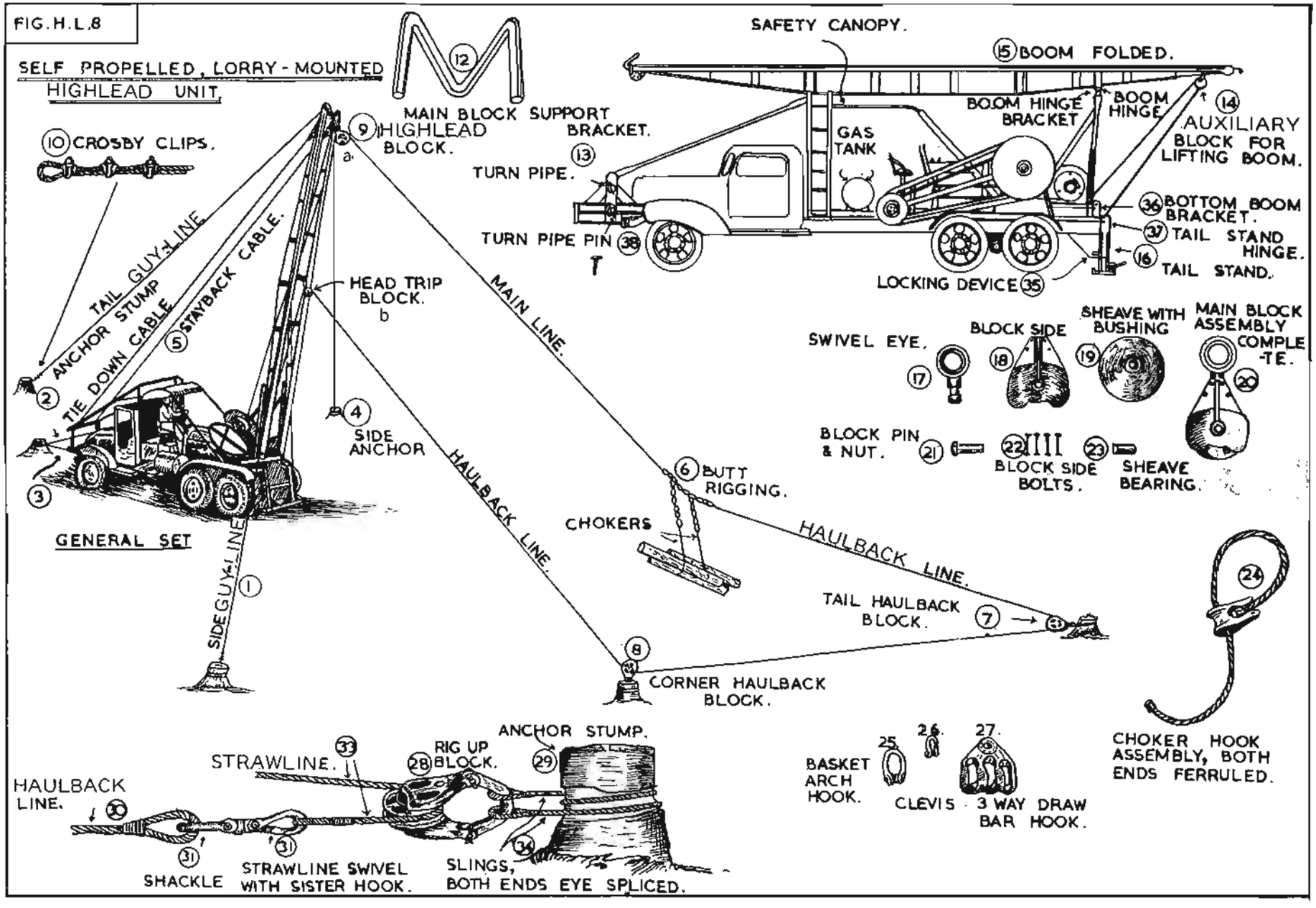
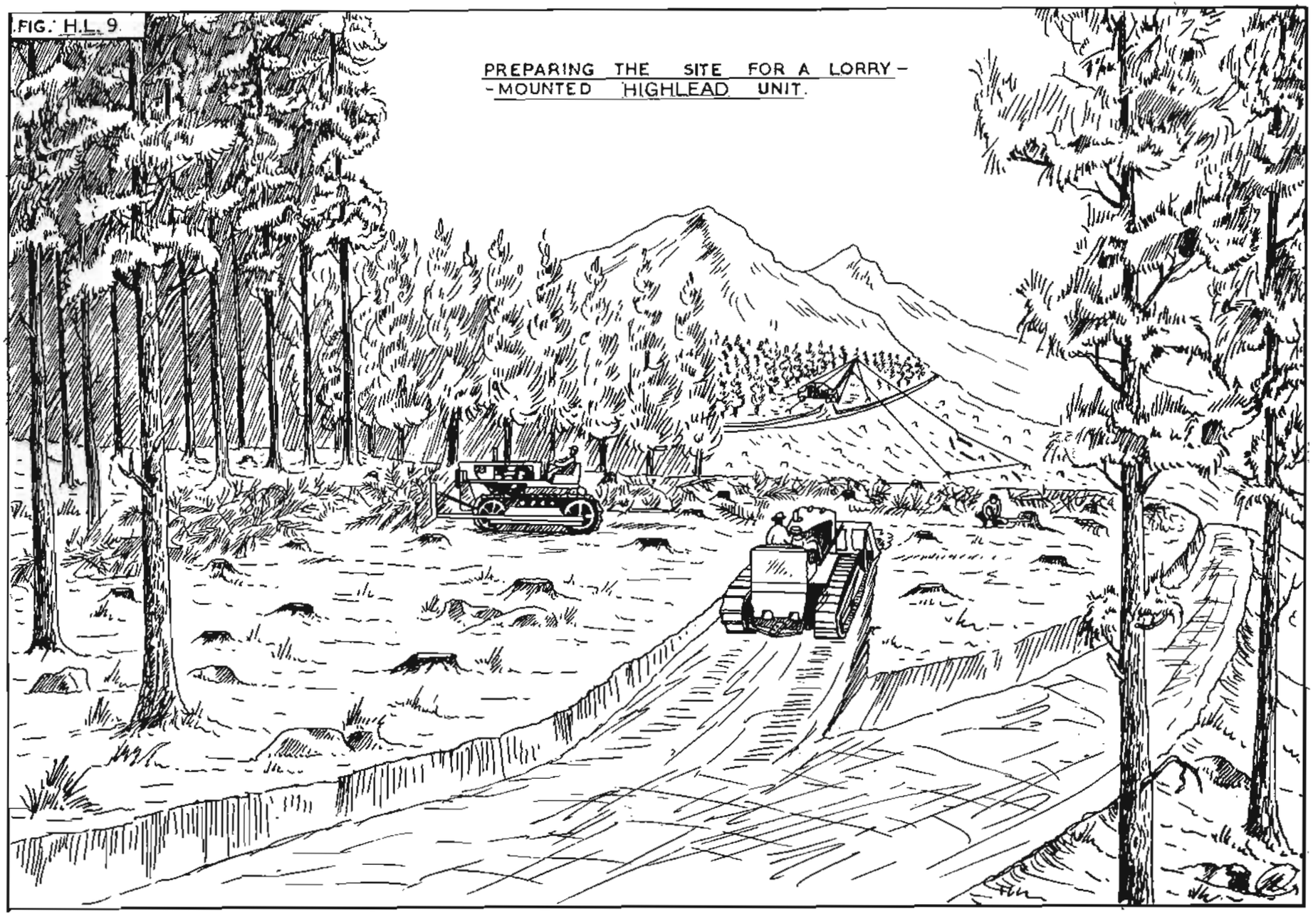


FIG. H.L.8
SELF PROPELLED, LORRY-MOUNTED HIGHLEAD UNIT.
SAFETY CANOPY.
15 BOOM FOLDED.
12
MAIN BLOCK SUPPORT BRACKET.
9 HIGHLEAD BLOCK.
a
10 CROSBY CLIPS.
13 TURN PIPE.
BOOM HINGE BRACKET
BOOM HINGE
14 AUXILIARY BLOCK FOR LIFTING BOOM.
GAS TANK
36 BOTTOM BOOM BRACKET.
37 TAIL STAND HINGE.
16 TAIL STAND.
TURN PIPE PIN 38
LOCKING DEVICE 35
TAIL GUY-LINE
ANCHOR STUMP
TIE DOWN CABLE
5 STAYBACK CABLE.
HEAD TRIP BLOCK.
b
MAIN LINE.
SWIVEL EYE.
17
BLOCK SIDE
18
SHEAVE WITH BUSHING
19
MAIN BLOCK ASSEMBLY COMPLE-TE.
20
2
4 SIDE ANCHOR
HAULBACK LINE.
BLOCK PIN & NUT.
21
22 BLOCK SIDE BOLTS.
23 SHEAVE BEARING.
6 BUTT RIGGING.
3
GENERAL SET
CHOKERS
HAULBACK LINE.
SIDE GUY-LINE
1
TAIL HAULBACK BLOCK.
7
8
CORNER HAULBACK BLOCK.
24
CHOKER HOOK ASSEMBLY, BOTH ENDS FERRULED.
ANCHOR STUMP.
STRAWLINE.
33
RIG UP BLOCK.
28
29
HAULBACK LINE.
30
25
26
27
BASKET ARCH HOOK.
CLEVIS
3 WAY DRAW BAR HOOK.
31
31
34
SHACKLE
STRAWLINE SWIVEL WITH SISTER HOOK.
SLINGS, BOTH ENDS EYE SPLICED.

FIG. H.L. 9.

PREPARING THE SITE FOR A LORRY-MOUNTED HIGHLEAD UNIT.



In addition to the above-mentioned auxiliary operating equipment, there are other tools which will be dealt with in a later section, which are indispensable for the operation and maintenance of the unit.

B. OPERATING RANGE OF THE UNIT

The practical range of yarding by the lorry-mounted highlead unit is 150 metre (cable length 230 m) to the front and to either side of the machine in a semi-circle with an operating angle of 160 degrees. Uphill yarding is better than downhill yarding, as better control can be exercised over the logs.

The logging yarder yards timber to the landing, which is in front of the machine. In order to avoid accumulation of logs at the landing, the logs are usually removed to a roadside, where trucks can be loaded without interfering with yarding. Removing logs in this way is known as swinging.

C. MACHINE SITE

For a yarding operation to be successful it is essential that the machine site be carefully selected. The following factors distinguish a good machine site:

(1) A location within reach of all logs within the operating area.

(2) Sufficient room in front of the machine site for landing the yarded logs or tree lengths.

(3) The slope immediately above the upper road bank and to the sides of the machine site should be of mild gradient in order to permit disposal and stacking of swung logs from the landing to the roadside for loading onto lorries.

(4) Sufficient stumps or trees should be available for anchoring the machine, otherwise artificial anchors will have to be constructed.

(5) The machine site and strips along the road for log stacking must be clear of brush and slash. Stumps at the machine site or roadside log stacking deck which are too high, must be cut down as low as possible (Fig. H.L. 9).

(6) If access to the site is not easy for the machine, an easy entrance should be constructed through the upper road bank to permit access to the site (H.L. 9).

(7) Machine sites should be located approximately every 300 metres along a road with good access to the area by the operating cables.

The above site conditions are ideal, but it frequently occurs that a machine site has to be selected above the upper road bank, too close to the road, on the road itself, or even below the road. In these cases log stacking has to be done either below the road, on the road, or close to the machine site itself, if sufficient space is not available elsewhere.

An inconveniet machine site, log landing or stacking deck may hamper the operation and reduce the yarding output. It is most important that the operation be permitted to continue without interruption or unnecessary delay.

Note: The fire hazard in the vicinity of the machine site must be considered and suitable precautionary measures taken

When the machine site has been selected, the trees, if any, on the site can be felled, and felling can also commence on the area where the yarding operation is to be carried out. The most convenient side of the area on which to commence felling is that nearest to the direction of log transport by lorries to their destination, unless the configuration of the terrain dictates otherwise.

Note: In clearfellings the whole area must be completely cleared of all standing trees or else the shifting of the cables across the area will be severely hindered or virtually impossible

As soon as the 50 m x 50 m square area around the yarder site has been satisfactorily cleared and the trees still to be felled cannot reach the perimeter of the yarder site with their tops, the removal of logs, brush and slash from the yarder site must be completed. Access for the machine through the upper road bank must be excavated if necessary and the machine site levelled, whereafter the machine can be driven onto the site and anchored.

When the machine has been provisionally fastened to an anchor, the tail stand can be dropped and clamped, the boom raised and the guy-lines fastened and tightened to the anchors.

D. ERECTION OF THE UNIT AND SETTING CABLES IN THE FIELD

For full details of the erection, operation and dismantling of the self-propelled highlead unit see Appendix H.L. 1.

A good crew can erect the machine in 1 hour 45 minutes from the time of its arrival on the site, provided that the anchor stumps have been previously prepared and the machine site levelled.

Crew: The lorry-mounted highlead crew consists of the following:

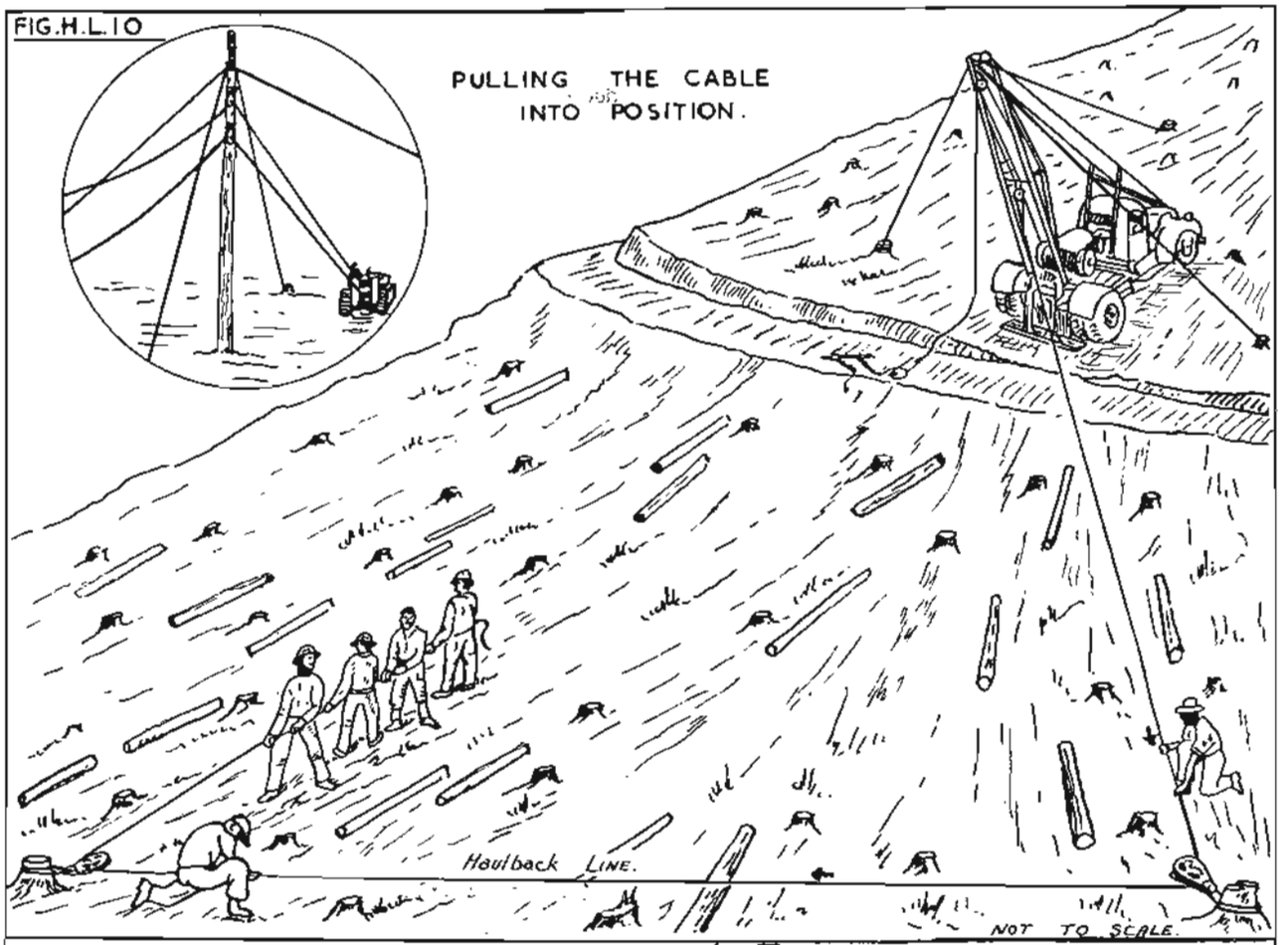
Operator - 1
Choker setters - 2 (or 3) - in the field
Unhookers: - 2 (or 1) - at the log landing

If the felling area has been sufficiently cleared, and the timber prepared for yarding, the cables can be pulled out to the field, the haulback cable passed through the haulback blocks, which have been securely fastened to stumps on the extreme fringe of the first sector of the operating area, and the butt rigging assembly fitted at the junction of the main and haulback cables.

Fig. H.L. 10 illustrates how the haulback cable is pulled into position in the field, with men

FIG.H.L.10

PULLING THE CABLE INTO POSITION.



CHANGING CABLE RUNS FOR HIGHLEAD OPERATION IN OPERATIVE SEGMENTS A. AND B.

FIG.H.L.11

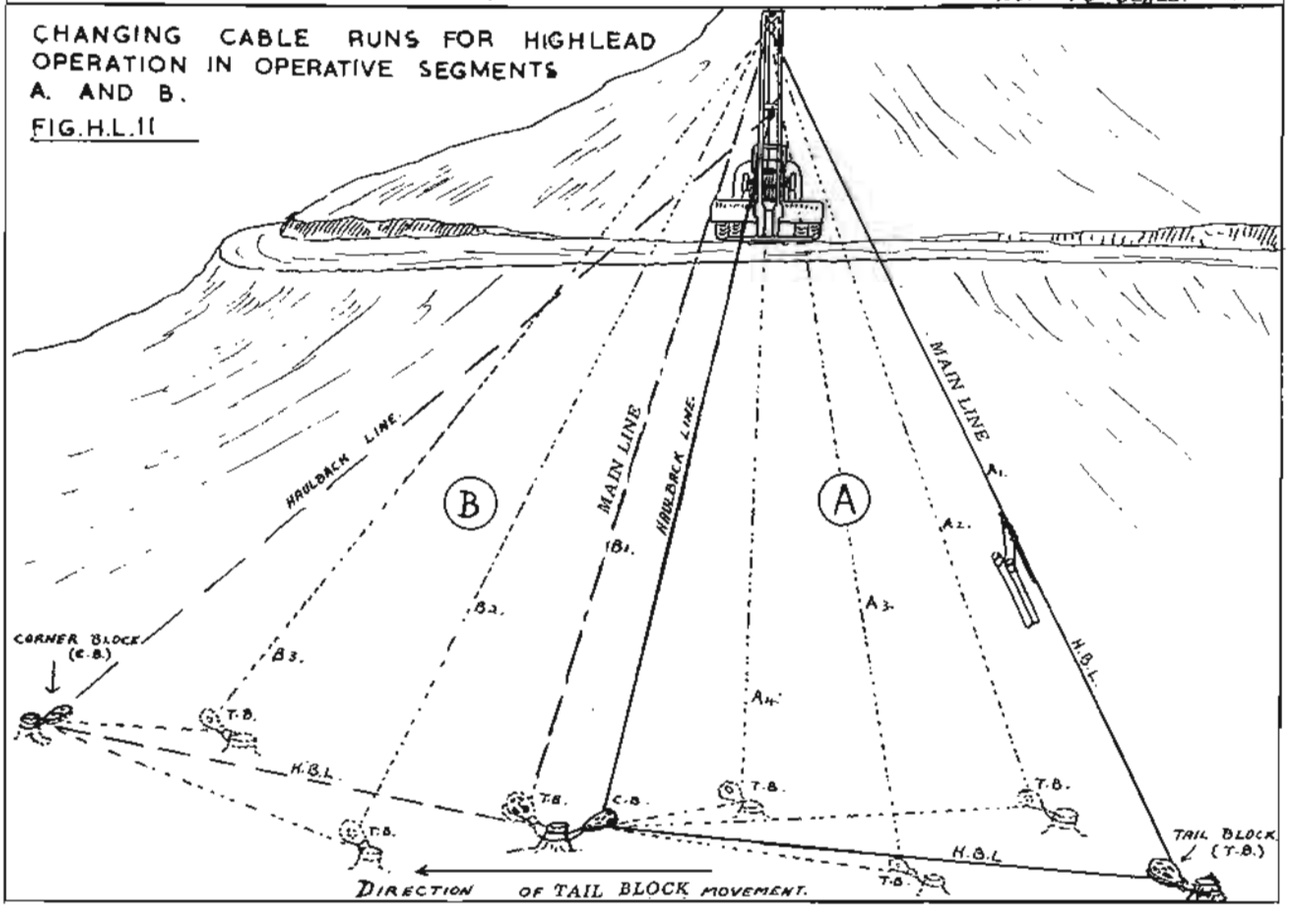


FIG.H.L.12

HIGHLEAD:- SETTING OF LINES (CABLES) IN THE FIELD.

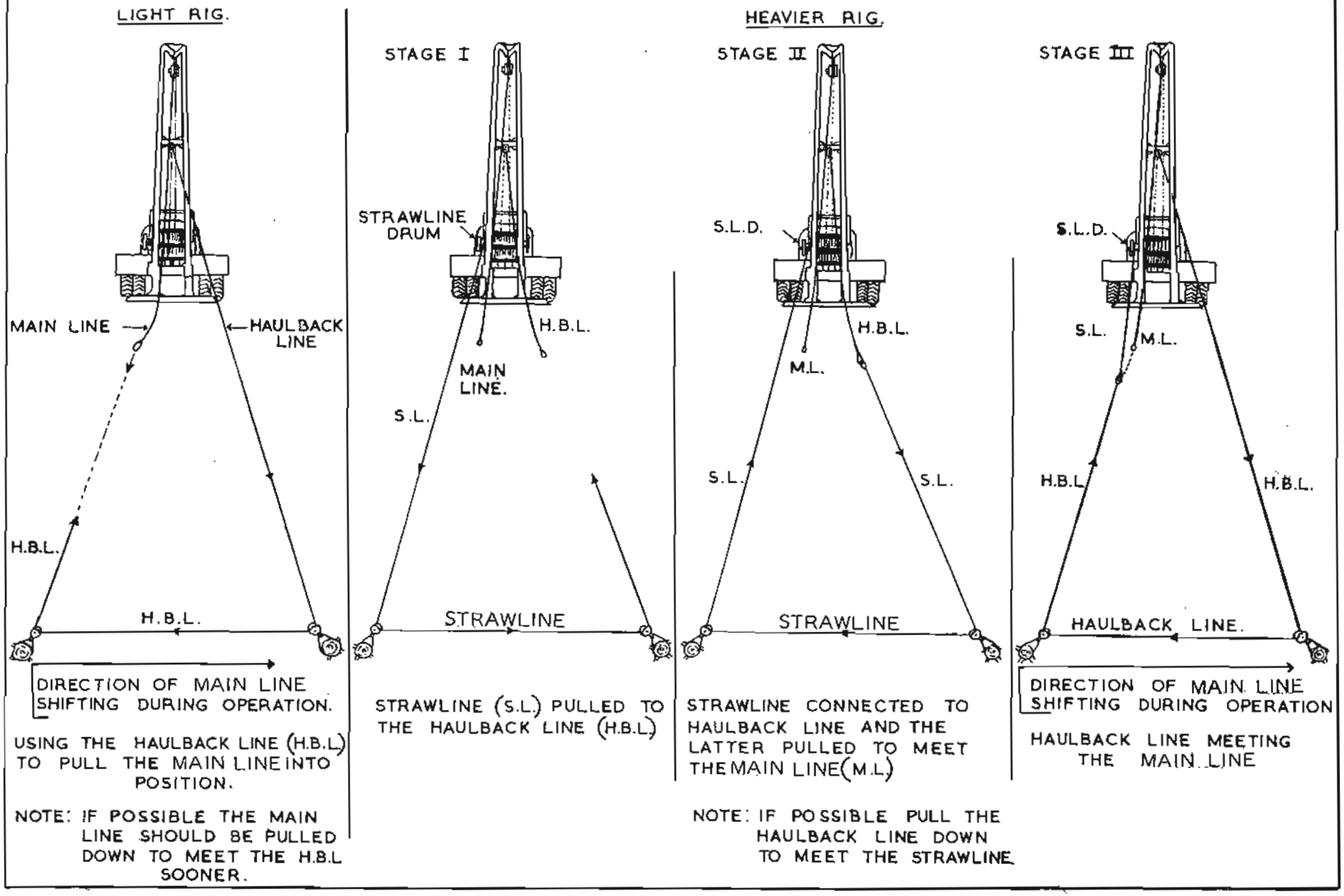
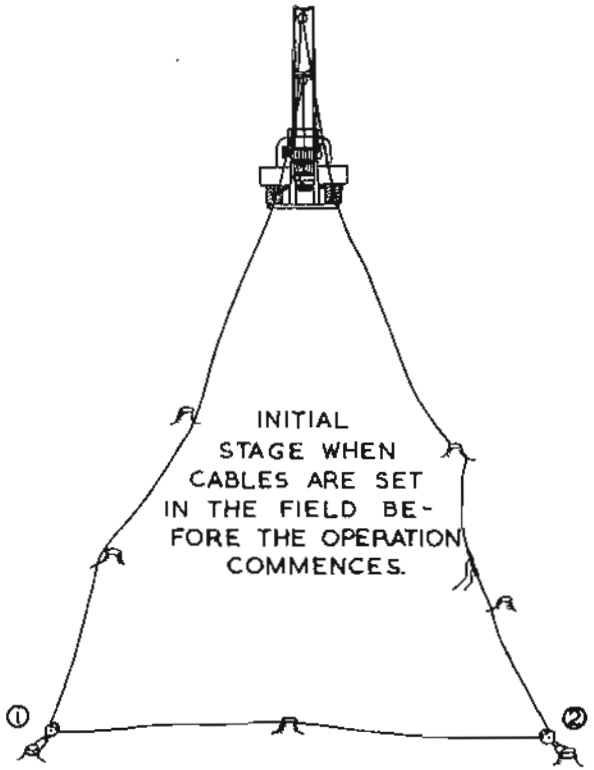
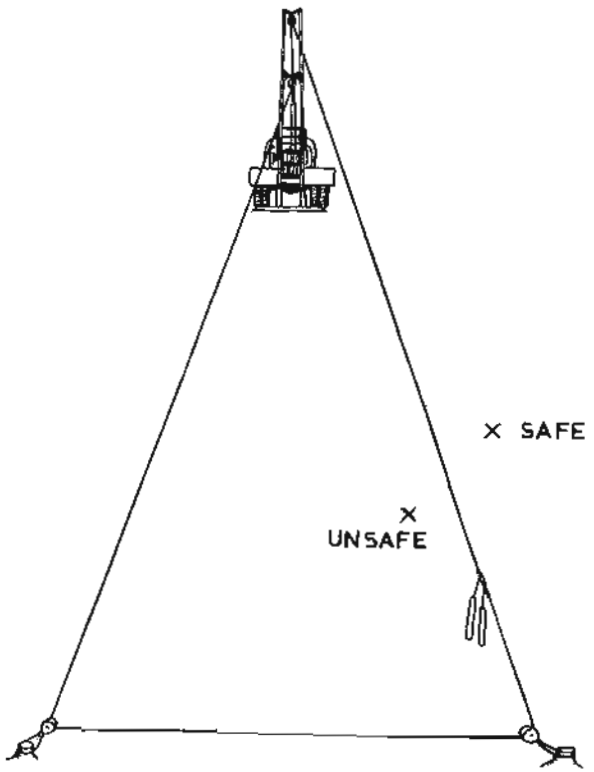


FIG.H.L.13

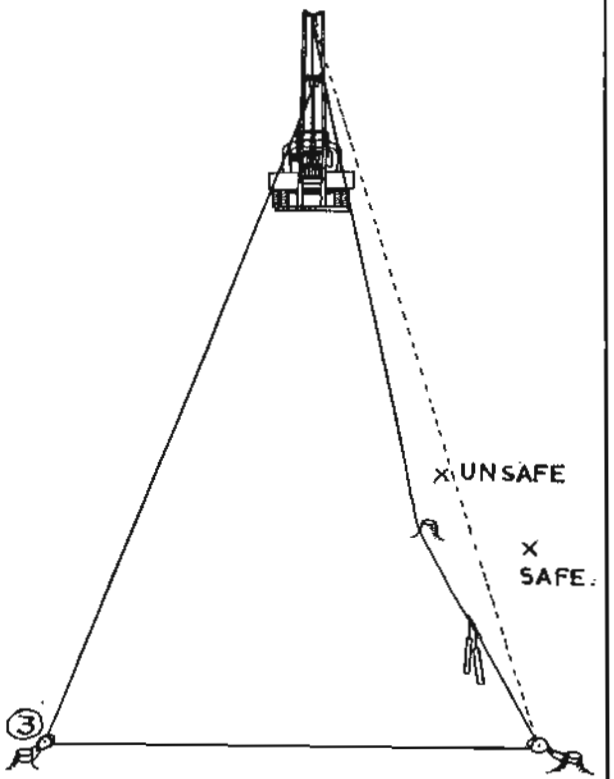
SAFETY MEASURES FOR CHOKER SETTERS IN HIGHLEAD LOG YARDING OPERATIONS



BEFORE THE OPERATION COMMENCES THE CABLE MUST BE STRAIGHTENED BETWEEN THE YARDER AND POINTS 1 AND 2 BY TIGHTENING AND LIFTING IT BY MEANS OF THE YARDER. STRAIGHTENING OF THE TIGHTENED CABLE BETWEEN 1 AND 2 IS DONE BY HAND.



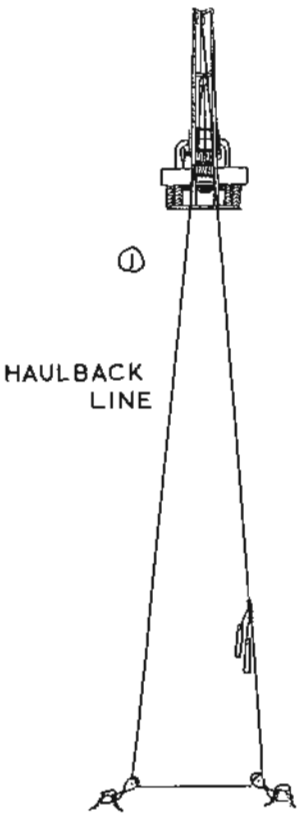
CHOKER SETTERS AND SIGNALMAN MUST STAY AT LEAST 20 FEET OUTSIDE THE CABLE PERIMETER WHILE THE CABLE IS IN OPERATION.



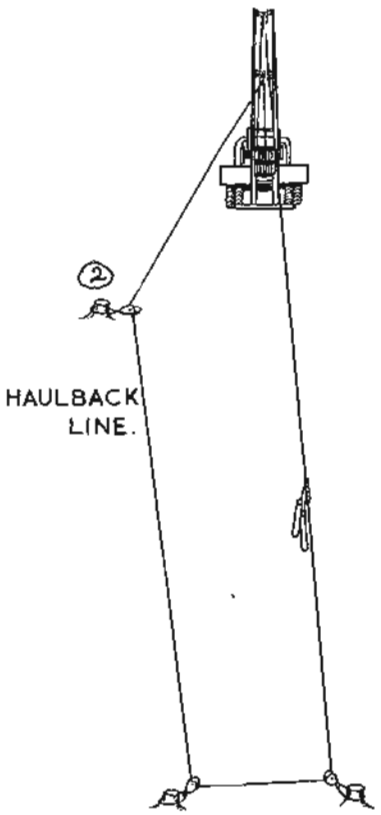
ALTHOUGH THE CHOKER SETTER MAY BE OUTSIDE THE TEMPORARY CABLE POSITION, HE IS ONLY SAFE WHEN HE IS OUTSIDE THE STRAIGHTENED CABLE PERIMETER.

FIG. H.L.14.

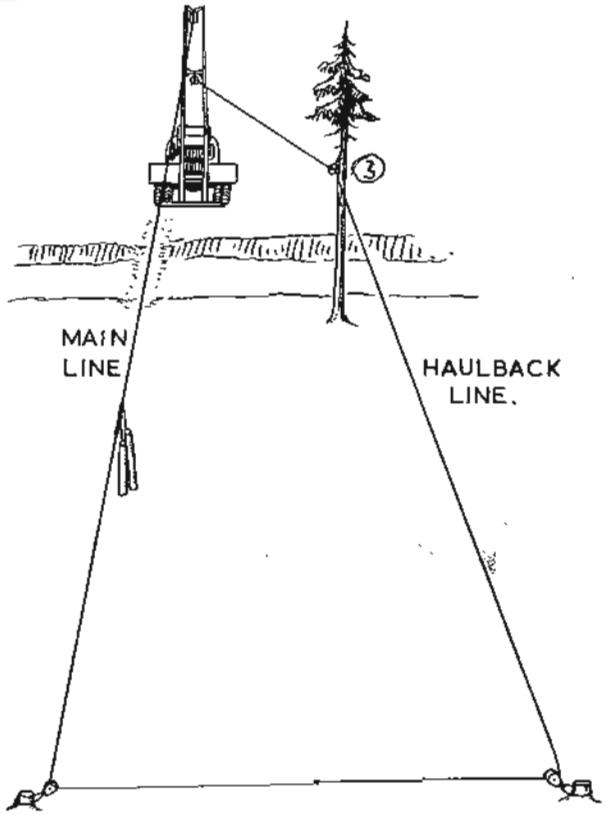
DEVIATIONS OF THE HAULBACK LINE DURING LOG YARDING OPERATIONS



WHEN COMPLETING THE OPERATING SECTOR THE CABLES SOMETIMES COME SO CLOSE TO EACH OTHER NEAR THE YARDER THAT THE YARDED LOGS MAY BECOME ENTANGLED WITH THE HAULBACK LINE AND DAMAGE IT.



AN ADDITIONAL HAULBACK BLOCK MAY BE FASTENED TO A STUMP OR TREE NEAR THE YARDER IN ORDER TO DEVIATE THE HAULBACK LINE.



TO KEEP THE HAULBACK CABLE OFF THE ROAD AN ADDITIONAL HAULBACK BLOCK CAN BE HUNG ON THE TREE AND THE HAULBACK CABLE THREADED THROUGH IT.

FIG.H.L.15

HIGHLEAD LOG YARDING SIGNALS WITH REGARD TO THE CABLE MOVEMENTS.

STOP.
BOTH HANDS
UP.

PULL.
BOTH HANDS STRETCHED
OUT HORIZONTALLY.

SLOW PULL ON MAIN LINE
ONE HAND TO THE SIDE.

SLOW PULL ON HAULBACK LINE.
ONE HAND RAISED.

SLACK THE LINES.
BOTH ARMS EXTENDED TO THE
SIDES AND BROADLY ROTATING.

OVER LONG DISTANCES OR WHERE BRUSH OCCURS THE SIGNALMAN MAY USE FLAGS.

stationed before both the tail and corner haulback blocks to relieve the rope pulling strain. Fig. H.L. 12 (left) shows the layout of the cables in the field, relative to the direction of the main line movement, when the cables are initially pulled into position.

For light rigs the haulback cable may be pulled into position to meet the main cable as illustrated, but with heavier rigs it is advisable to follow a different procedure. Fig. H.L. 12 (stage I and II) illustrates how the strawline is used for pulling the haulback cable into position. In this case the strawline is pulled into position in the same manner as illustrated in Fig. H.L. 10, then attached to the haulback cable and used to pull the haulback cable through the blocks to meet the main line. The strawline is then disconnected from the haulback cable and the butt rigging assembly fitted into place between the haulback and main cables. Chokers can then be attached to the butt rigging assembly.

Fig. H.L. 13 (1) shows the position of the cables after the haulback and main lines have been connected up. Before the operation may commence the lines must be straightened as described in the illustration or the safety of the choker setters may be threatened when the strain is taken for the first load. When this has been done the operation may commence. For safety's sake it is essential that when the cables are in position the choker setters stay at least 6 metres outside the straightened cable perimeter as illustrated in the remaining drawings of Fig. H.L. 13 (II and III).

E. DEVIATIONS OF THE HAULBACK LINE DURING LOG YARDING OPERATIONS

When yarding in a sector reaches the final phase the main cable runs close to the haulback cable near the landing deck, as shown in Fig. H.L. 14(1). An additional side haulback block near the landing deck is attached to a stump away from the main line and the haulback cable passed through this block, thus deviating it away from the main line as shown in Fig. H.L. 14(2).

If it should be necessary to keep the haulback cable above a road, and at the same time deviate it from the main cable [Fig. H.L. 14 (3)], a block may be suspended from a tree and the haulback cable passed through it to obtain the deviation. This arrangement applies particularly to the sector on the extreme left of the operating area.

F. METHOD OF OPERATING

The operator starts the yarder engine then engages the haulback drum, the haulback cable thus pulling the main cable out. The main cable direction is governed by the tail haulback block (Fig. H.L. 8, item 7), which is attached to a stump on the extreme edge of the operating area from the yarder, and through which the haulback cable passes. When the chokers approach the logs to be yarded a hand signal is given and the operator disengages the haulback drum and stops pulling. The chokers are then fastened near the end of each log (say 60 cm from the end), another hand signal is given, and the operator engages the main drum so that the cable pulls the logs in to the landing in front of the machine. The slings are then released from the logs and the process is repeated.

Note: (1) Fig. H.L. 15 illustrates the various hand signals which may be given. Signals must be given clearly and decisively

(2) After the choker setters have choked the logs in the field, they must leave the area enclosed by the cables before pulling starts. No one is permitted to remain within the cable perimeter while the machine is operating. [Fig. H.L. 13, (2) and (3)]

(3) It is important that cross-sticks be placed at the log landing to ensure that there is a space between the landed logs and the ground for log slinging if swinging to the roadside is to be done

(4) When the log swinging crew is engaged in removing logs from near the machine by tractor or animals, the operator is not permitted to pull the ropes out

II. FUNCTIONS OF PARTS AND EQUIPMENT

1. PARTS OF EQUIPMENT

A. THE MAIN DRUM

The main drum of the yarder (Fig. H.L. 3), which operates the 19 mm main cable, is used for yarding logs or tree lengths from the area where they are felled and prepared. The speed of this drum when half full is as much as 120 metre per minute, and its maximum pulling capacity under favourable yarding conditions is 4 tons.

B. THE HAULBACK DRUM

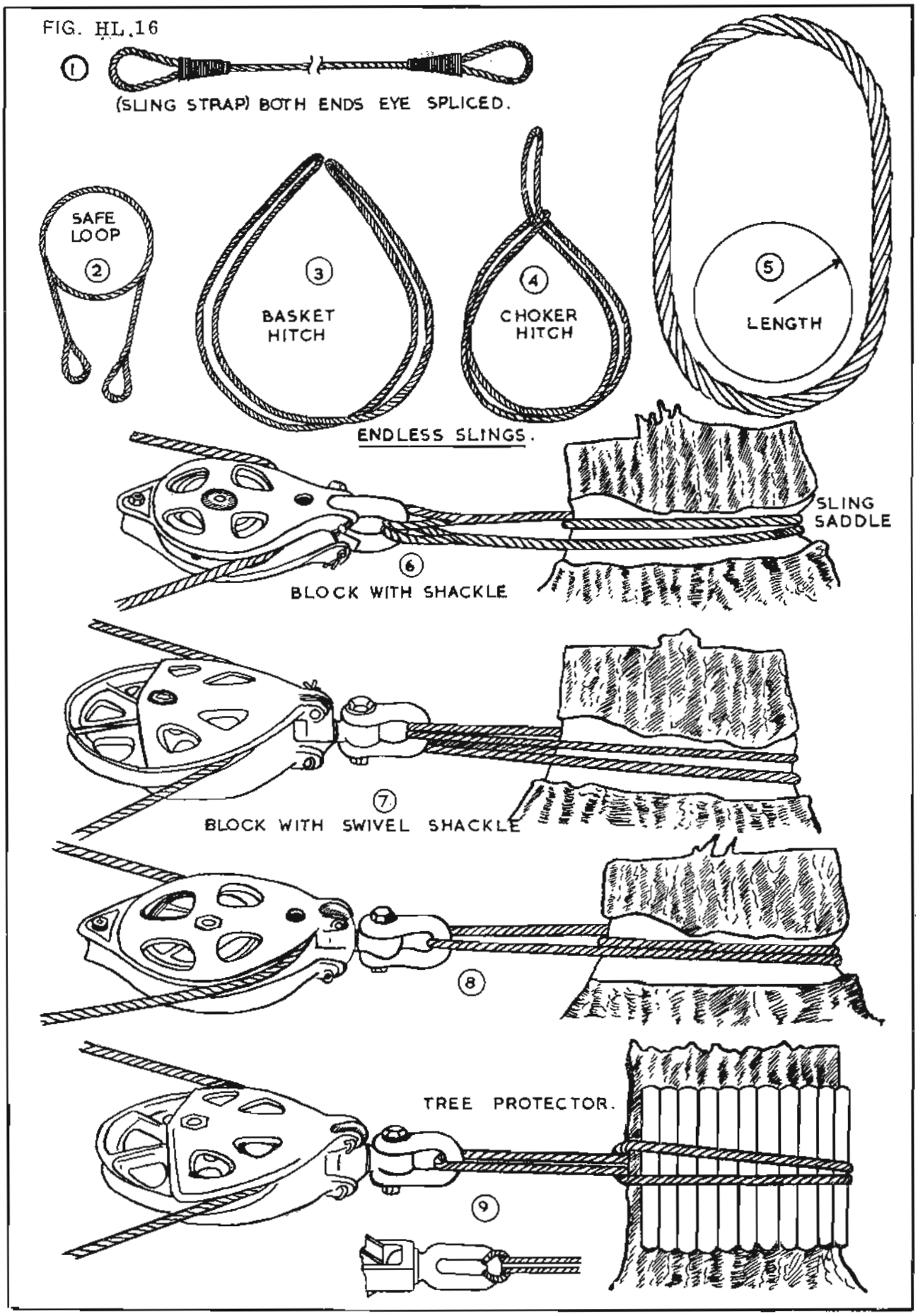
The haulback drum of the yarder, which operates the 13 mm haulback cable, is used for returning the main cable with chokers to the logs to be yarded. This drum has a cable speed of up to 240 metres per minute when half full, and a maximum pulling capacity of 2 tons under favourable conditions.

C. THE HAULBACK CABLE

The haulback cable (Fig. H.L. 8), encompasses the yarding area via the corner and tail haulback blocks, meeting the main cable at the butt rigging.

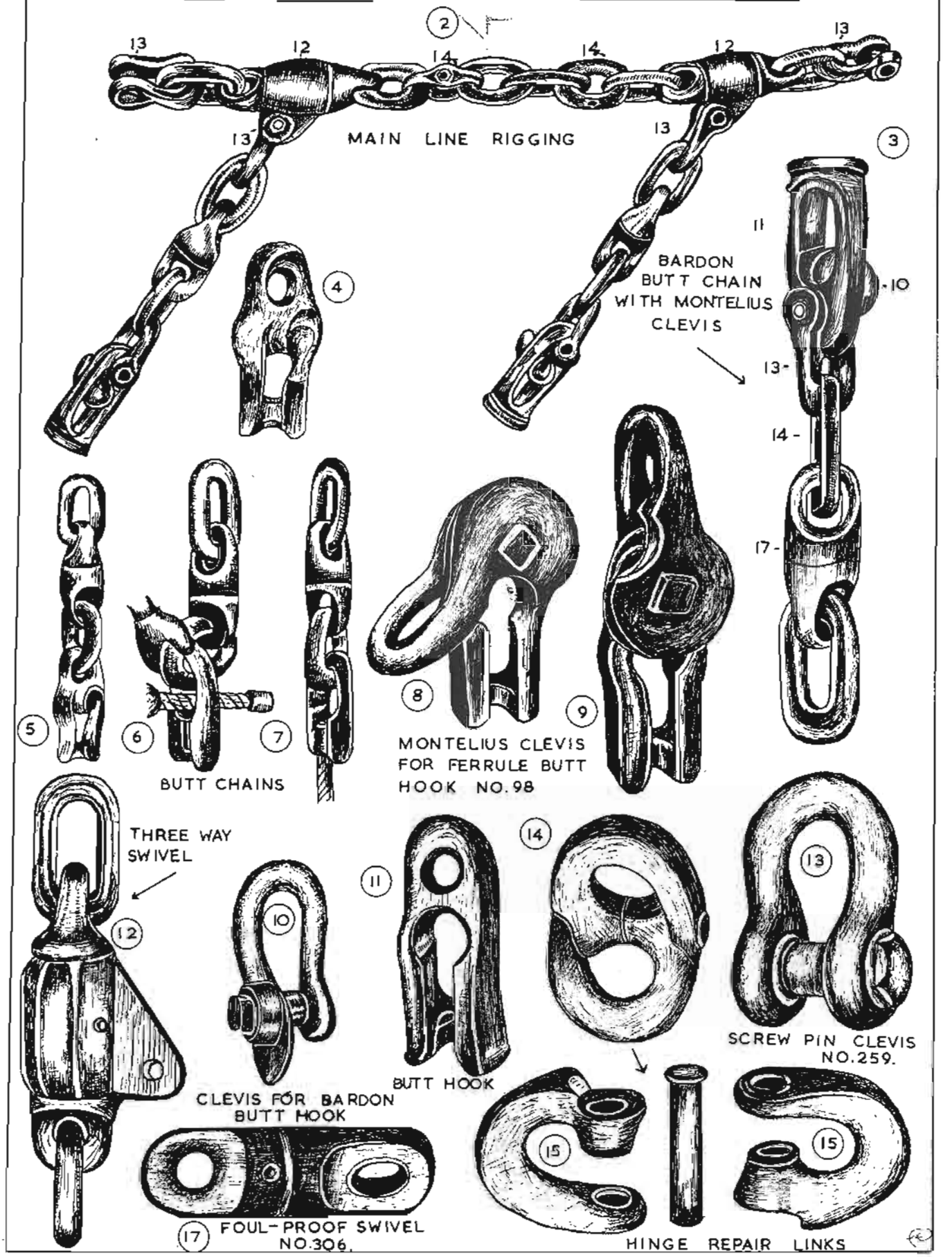
D. THE HAULBACK BLOCKS

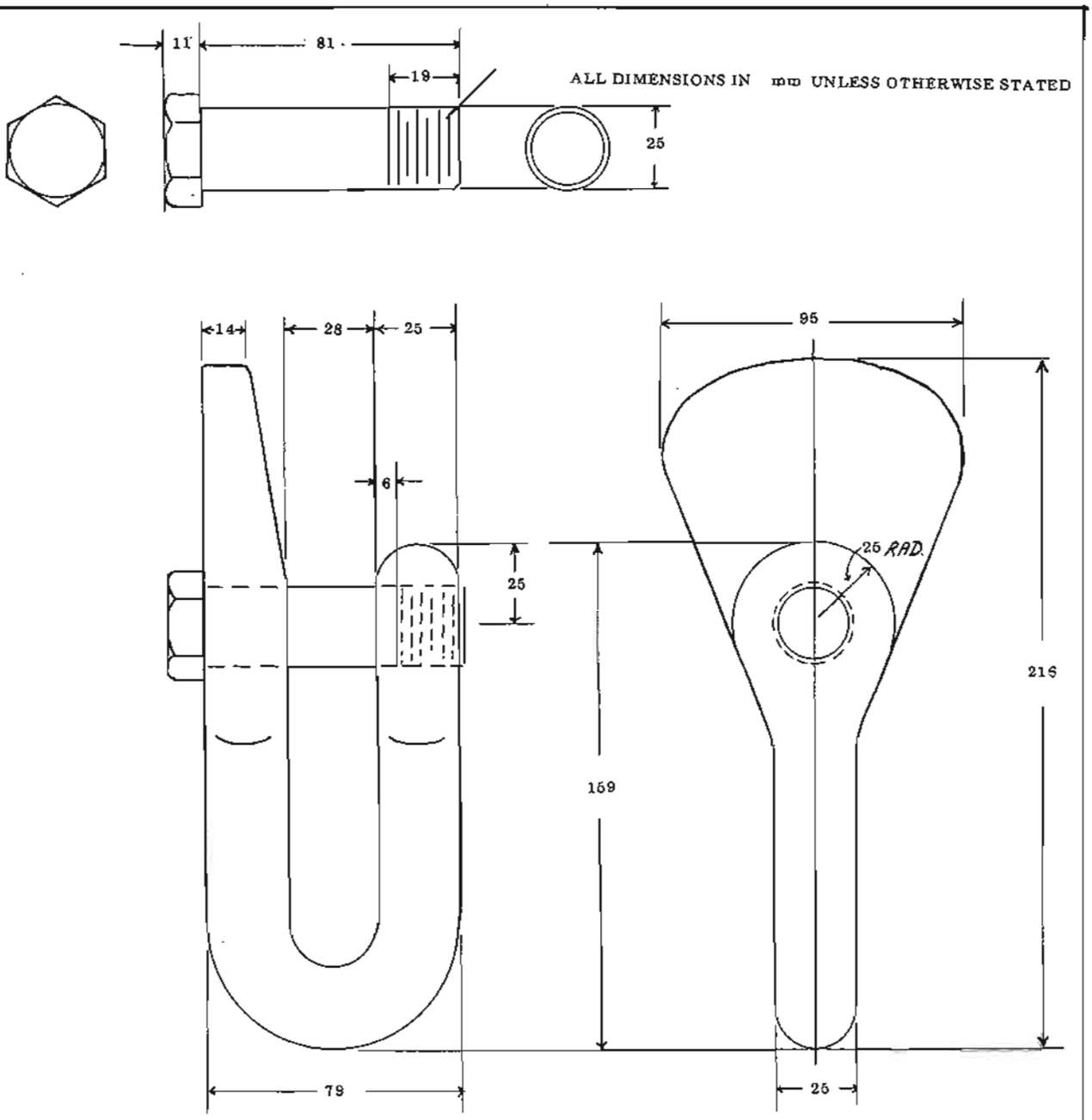
The haulback blocks (a minimum of two) (Fig. H.L. 8, items 7 and 8), are attached to stumps in front and to the left or right of the yarder on the extreme fringe of the sector of the operating area. The haulback cable passes through the haulback blocks to the main cable. The tail block determines the direction of the main cable.



TRACTOR BLOCK ATTACHMENTS TO STUMPS

NOT TO SCALE FIG.H.L.17. BUTT RIGGING FOR HIGHLEAD.





ALL DIMENSIONS IN mm UNLESS OTHERWISE STATED

25 mm CAST (SPECIAL) STEEL MONTELIUS TYPE CLEVIS.

SPECIFICATIONS.

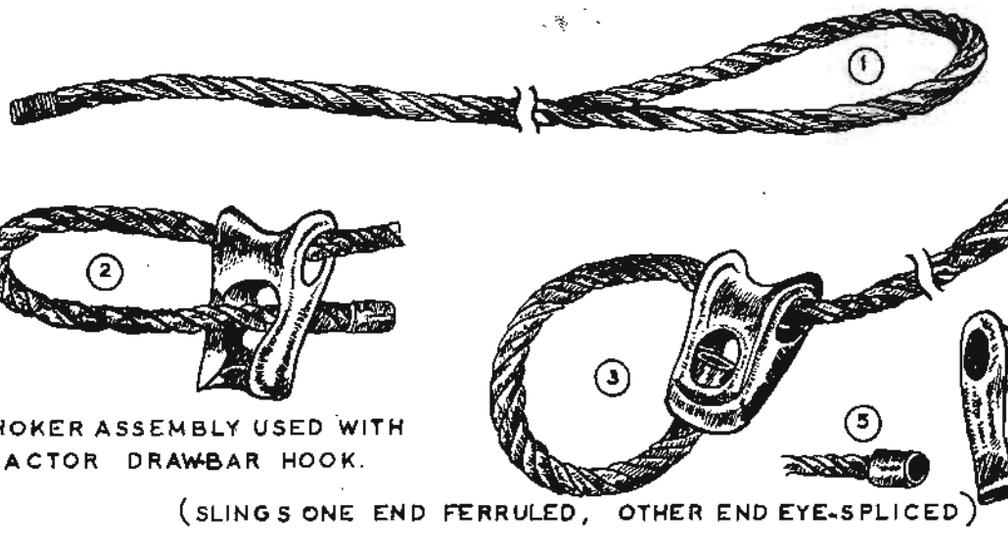
MATERIAL. CAST STEEL TO A-S-T-M-A 148, CLASS 80-40.
TENSILE STRENGTH: 5 600 kg/cm^2
YIELD POINT. 2 800 kg/cm^2
ELONGATION IN 5 cm · 18%
REDUCTION OF AREA. 30 %
ULTIMATE TENSILE STRENGTH OF CLEVIS: 42 400 kg
MAXIMUM SAFE WORKING LOAD: 6 800 kg
APPROXIMATE HARDNESS. NO. 230 BRINELL.
PIN 4140 STEEL OR EQUAL.
TENSILE STRENGTH: 7 000 kg/cm^2
YIELD POINT: 4 570 kg/cm^2

HL.18

SCALE: 1/2 FULL SIZE.

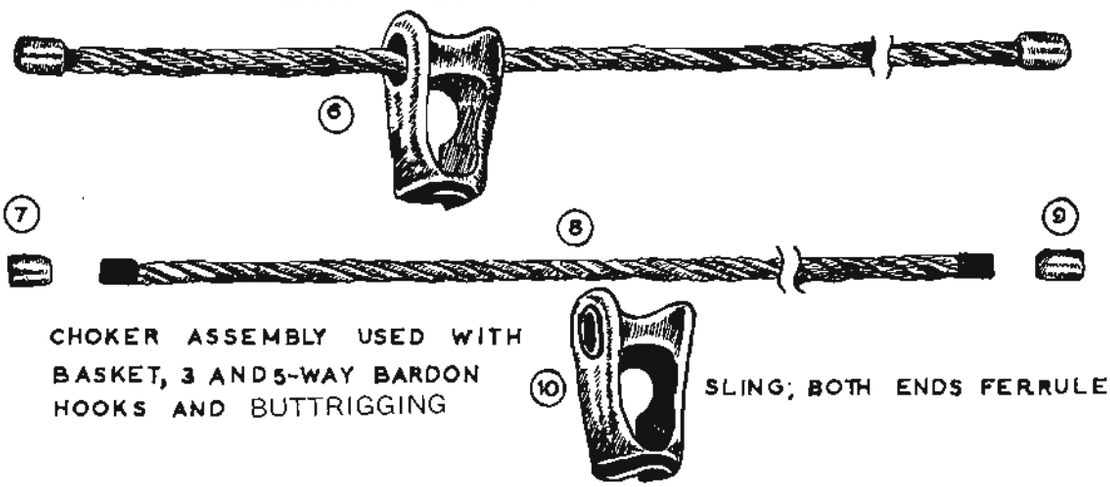
FIG. HL 19

CHOKER ASSEMBLIES.



CHOKER ASSEMBLY USED WITH TRACTOR DRAW-BAR HOOK.

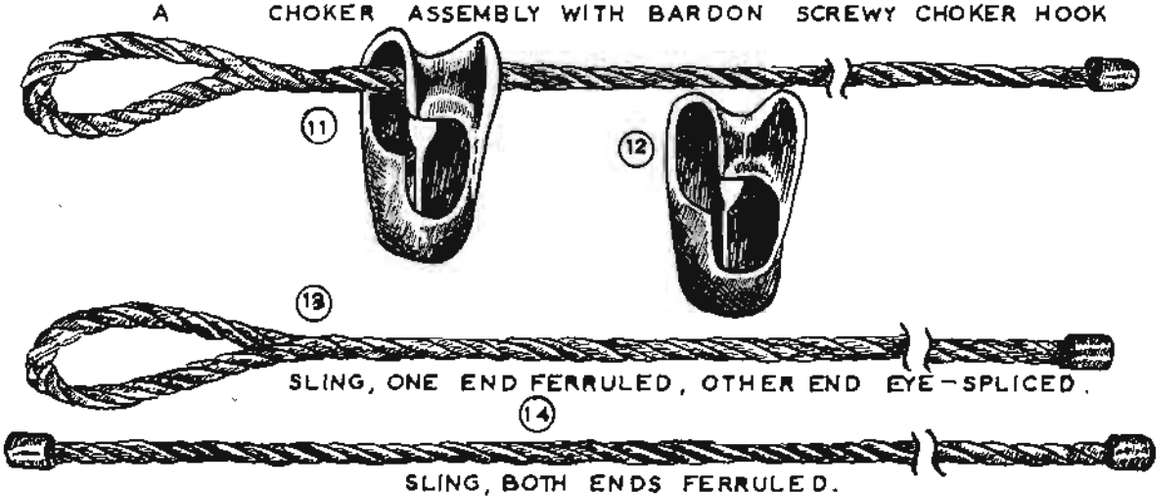
(SLINGS ONE END FERRULED, OTHER END EYE-SPLICED)



CHOKER ASSEMBLY USED WITH BASKET, 3 AND 5-WAY BARDON HOOKS AND BUTTRIGGING

SLING; BOTH ENDS FERRULED.

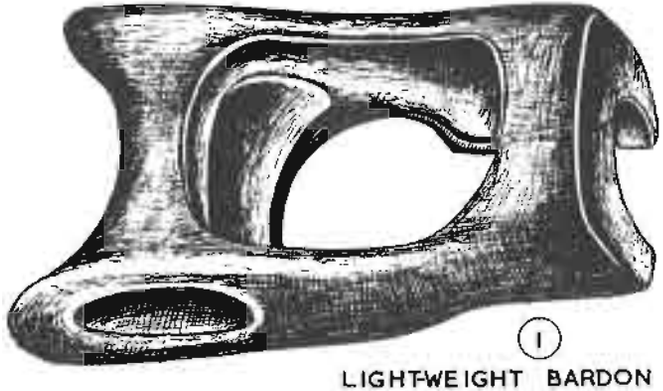
A CHOKER ASSEMBLY WITH BARDON SCREWY CHOKER HOOK



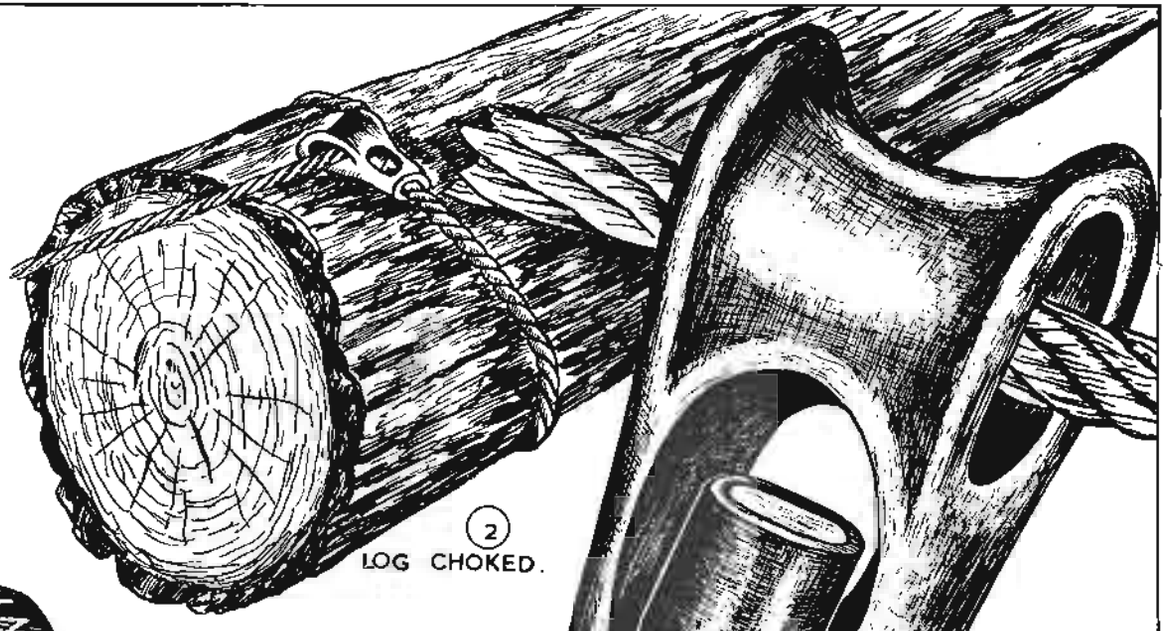
SLING, ONE END FERRULED, OTHER END EYE-SPLICED.

SLING, BOTH ENDS FERRULED.

FIG. H.L. 20

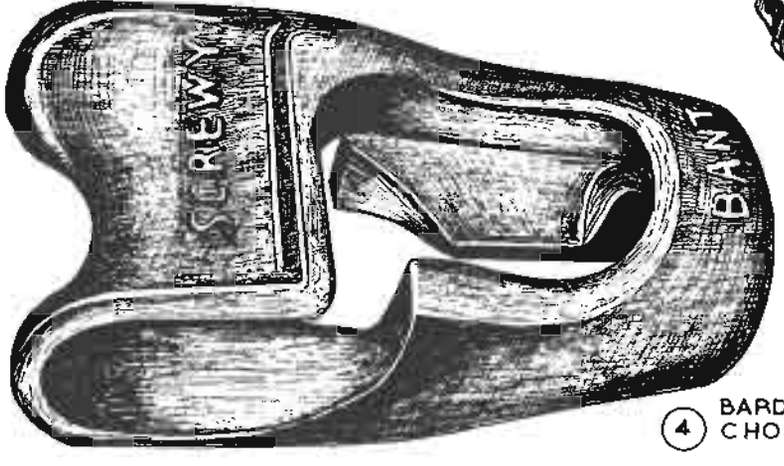


1 LIGHT-WEIGHT BARDON HOOK.

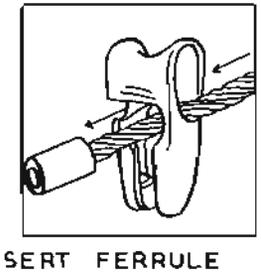


2 LOG CHOKED.

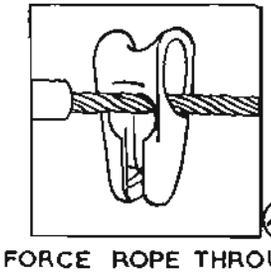
3 BARDON CHOKER HOOK.



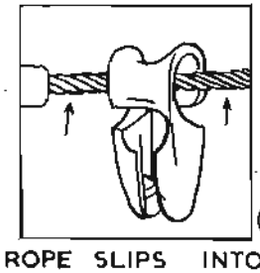
4 BARDON SCREWY CHOKER HOOK.



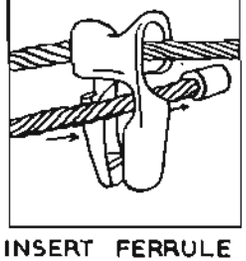
4a INSERT FERRULE THROUGH HOOK.



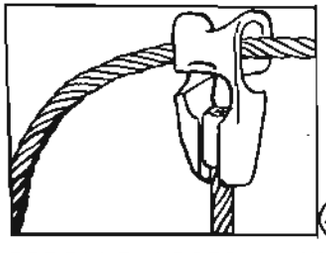
4b FORCE ROPE THROUGH SIDE SLOTS.



4c ROPE SLIPS INTO HOOK EYE.



4d INSERT FERRULE THROUGH HOOK.



4e FERRULE DROPS INTO POCKET.

E. WIRE ROPE SLINGS

Wire rope slings (Fig. H.L. 16) of 13 mm diameter wire rope and 3-4 metres long, with both ends soft eye spliced or clamped, are used for attaching the haulback blocks to stumps.

Note: Re items D and E above; the haulback blocks are named, the one being the "tail" and the other the "corner" haulback block. The tail block directs the run of the main cable and is moved towards the corner block in stages, when all the logs along the previous "run" within the main cable and choker reach have been yarded

F. BUTT RIGGING ASSEMBLY

The butt rigging assembly consists of a number of parts, illustrated in Fig. H.L. 17 and described below.

The Bantam size of butt rigging assembly is used for log yarding in departmental plantations.

The purpose of the rig is:

(1) To allow for twisting on the stretching and contracting of the wire ropes when they work under strain or are released from tension. Without the swivels in the butt rigging they would be liable to kink and consequently get damaged when the kinked rope is used to pull a load.

(2) The rig also serves for the attachment of "butt chains", which are in turn used for connecting the chokers.

(3) The assembly serves to connect the main and haulback cables, which are attached to the clevises on its ends.

The main parts of the assembly are:

(1) Three-way swivels (usually two) with their links (item 12).

(2) Bardon butt chain with links, butt chain swivel (item 17) and butt hook, (item 11), connected to the three-way swivel (item 13).

(a) Details

(1) The three way swivel has a rotating eye at each end, to which is attached a link and shackle for the cable attachment. There is also a rigid eye on the side, which serves for the attachment of the butt chain.

(2) The Bardon butt chain consists of the butt hook with Montelius clevis (item 9), two links, one shackle (item 13) and one butt chain swivel (item 17). The latter permits the choker to rotate freely should the choked log roll on undulated slopes. Were this not possible the logs would become entangled in the choker and cable.

(3) The butt hook (item 11) is attached to the end of the butt chain by means of the Montelius clevis (item 10), which serves to keep the ferruled end of the choker assembly, used for log slinging, in the pocket of the butt hook without it slipping out.

(4) Hinge repair links (item 14) serve for connecting two or more three-way swivels.

Note: Nelson "Screwy" butt hooks (items 4 and 5) and link locks (items 6 and 7) were also tested, but proved to be more suitable for heavier rigs than those used in the Department

(b) Remarks

There are many more types of butt rigging assemblies as good as the one described, but all are either heavier or more complicated to repair. It is important that operators and storemen be familiar with all items of the butt rigging assembly as they sometimes, in ignorance, order a replacement for the whole assembly, whereas only one or two items need in fact to be replaced.

The eye of the butt hook sometimes wears down to such an extent that the Montelius clevis can no longer secure the choker ferrule in the butt hook pocket, resulting in chokers falling out and being lost. These clevises may be substituted by I' anco-type clevises (Fig. H.L. 18), which have a clevis disc of larger radius, which is thus able to adequately and safely cover the butt hook pocket, preventing the choker from falling out.

(G) THE CHOKER ASSEMBLY

The choker assembly (Fig. H.L. 19) consists of a 16 mm diameter wire rope sling, 3-5 metres long, with both ends ferruled and a "Bardon" type choker hook (Fig. H.L. 20) threaded onto the slings between the ferrules. The choker sling is used for slinging (choking) the logs and attaching them to the main cable, through the butt rigging (Fig. H.L. 51).

H. THE HINGED, NON-ROTATING BOOM

The hinged, non-rotating boom, is mounted on the yarder frame slightly in front of the winches and serves two purposes:

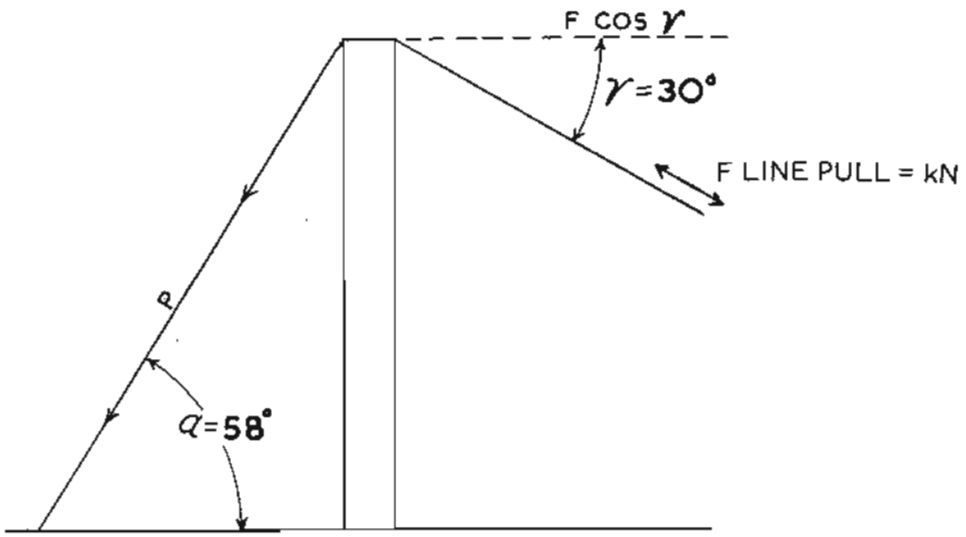
(a) Since the main cable passes through the main (bull) block, suspended at the top of the boom, the log heads are lifted slightly during pulling, which enables them to ride over minor ground obstacles. This lift to the log heads is only provided by the main cable over a limited distance, usually 8 to 10 times the height of the main block. Thus, if the main block is suspended 10 meters above the ground it gives a "lift" over a distance of up to 80 to 100 meters from the yarder. Beyond that the pull is the same as for ground skidding by winch without the boom, as far as ground obstacles are concerned.

(b) The main block and head trip block sheaves ensure even winding of the cables onto the winch drums. In order to do so, however, the distance from the block to the drum must be sufficient to provide the required angle, called the "fleet angle".

The boom is provided with two pairs of hinge attachments, the lower and the upper:

(i) The lower hinge attachments (male brackets) are located at the heel of the boom upright

FIG. H. L. 21.



EXAMPLE

$$P = \frac{F \cos \gamma}{\cos . \alpha} = \frac{44\,482 \text{ kN} \times 0{,}866\,03}{0{,}529\,92} = 7\,250 \text{ kN}$$

FACTORS

NO. OF GUYS.	FACTOR	NO. OF GUYS.	FACTOR.
4	1,00	7	0,65
5	0,90	8	0,55
6	0,75	9	0,50

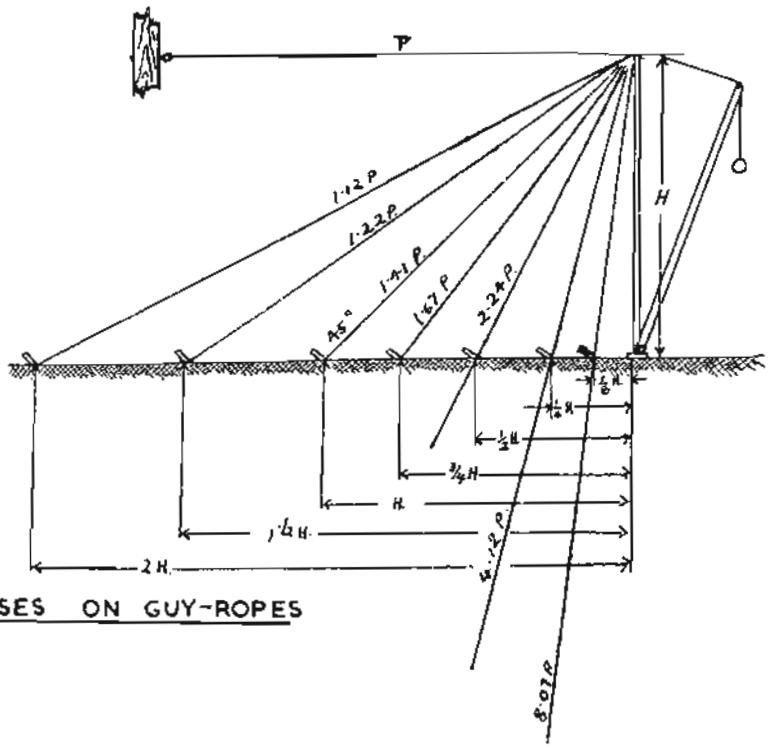
IF 6 GUY-LINES ARE USED.

7 250 x 0,75 = 5 430 kN

DEGREE OF MAIN LINE

DEGREE OF GUY-LINE	10°		15°		20°		25°		30°		35°		40°		45°		50°	
	% OF TENSION OF GUY-LINES IN RELATION TO LOAD PULL OF MAIN-LINE FOR NUMBER OF GUY-LINES SHOWN																	
	4	6	4	6	4	6	4	6	4	6	4	6	4	6	4	6	4	6
30°	114	86	112	84	109	82	105	79	100	75	95	71	88	66	82	62	74	56
35°	120	90	118	89	115	86	111	83	106	80	100	75	93	70	86	65	78	59
40°	129	97	126	95	123	92	118	89	113	85	107	80	100	75	92	69	84	63
45°	139	104	137	109	133	100	128	96	122	92	116	87	108	81	100	75	91	68
50°	153	114	152	114	146	110	141	106	135	101	127	95	119	89	110	83	100	75
55°	172	129	169	127	164	123	158	118	151	113	143	107	134	101	123	92	112	84
60°	197	148	193	145	188	141	181	136	173	130	164	123	153	115	141	106	129	97
65°	233	175	228	171	222	167	214	161	205	153	194	146	181	136	167	125	152	114

FIG. H.L.22



STRESSES ON GUY-ROPES

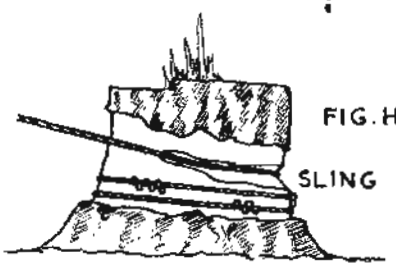
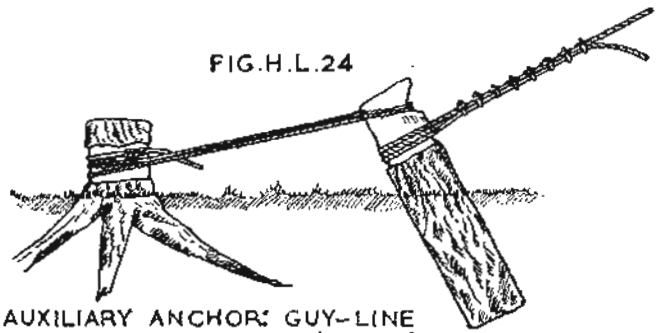


FIG. H.L.23

SLING SADDLE.

STANDARD STUMP ANCHOR, GUY-LINE FIXED BY SPIKES.

FIG. H.L.24



AUXILIARY ANCHOR: GUY-LINE CLOSE TO SPAR TREE (BOOM.)

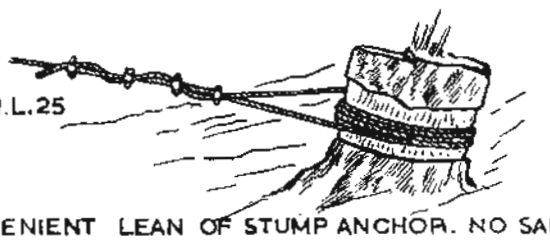
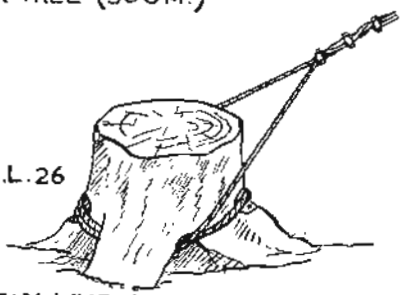


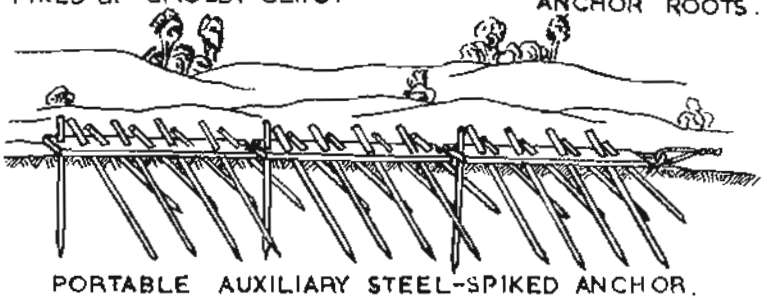
FIG. H.L.25

CONVENIENT LEAN OF STUMP ANCHOR. NO SADDLE REQUIRED; ROPE FIXED BY CROSBY CLIPS.

FIG. H.L.26



GUY-LINE THREADED UNDER STUMP ANCHOR ROOTS.



PORTABLE AUXILIARY STEEL-SPIKED ANCHOR.
FIG. H.L.27.

SPAR TREE, GUY-LINES AND ANCHORS

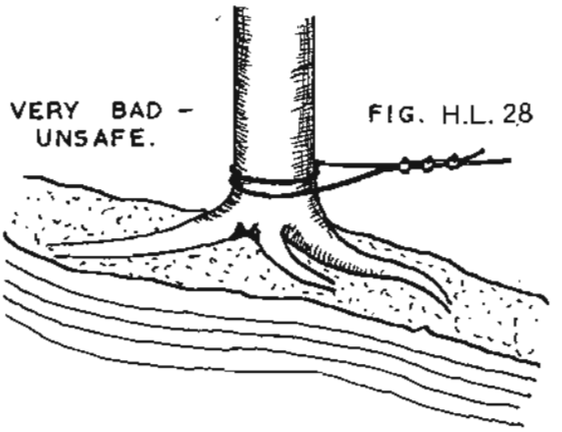


FIG. H.L. 28

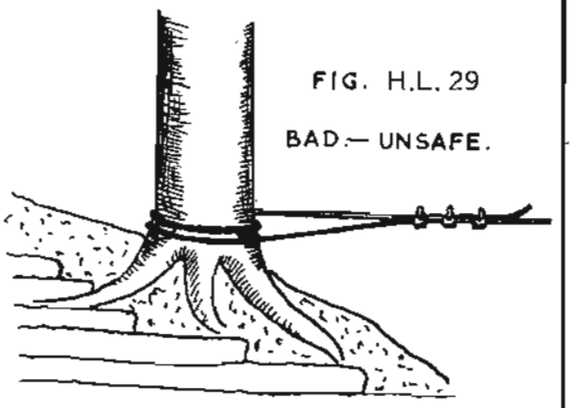


FIG. H.L. 29

BAD.— UNSAFE.

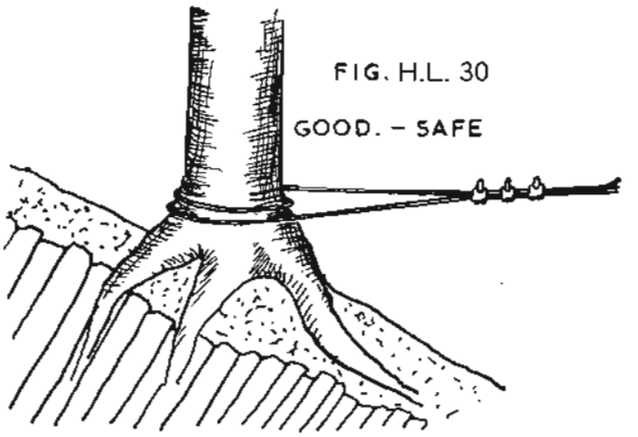


FIG. H.L. 30

GOOD. – SAFE

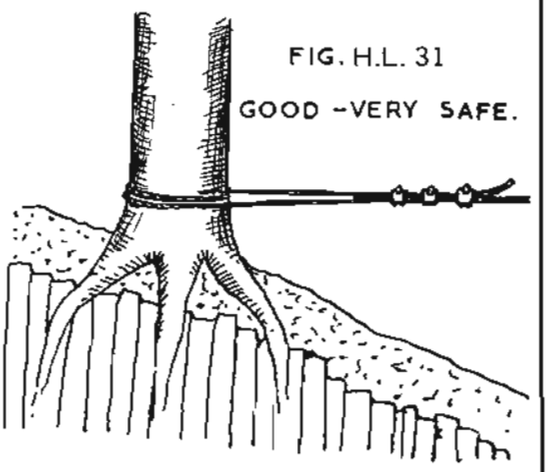
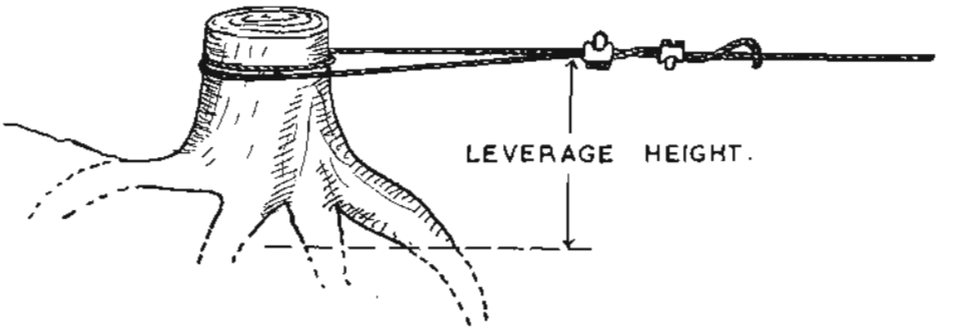


FIG. H.L. 31

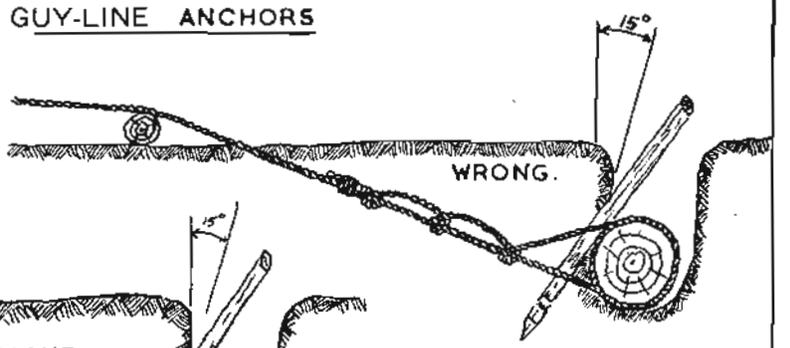
GOOD –VERY SAFE.

FIG. H.L.32



SELECTION OF ANCHOR STUMPS

GUY-LINE ANCHORS



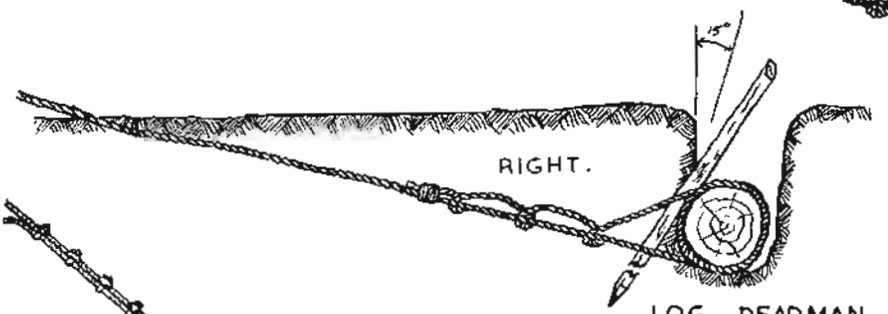


FIG. H.L. 33

LOG DEADMAN

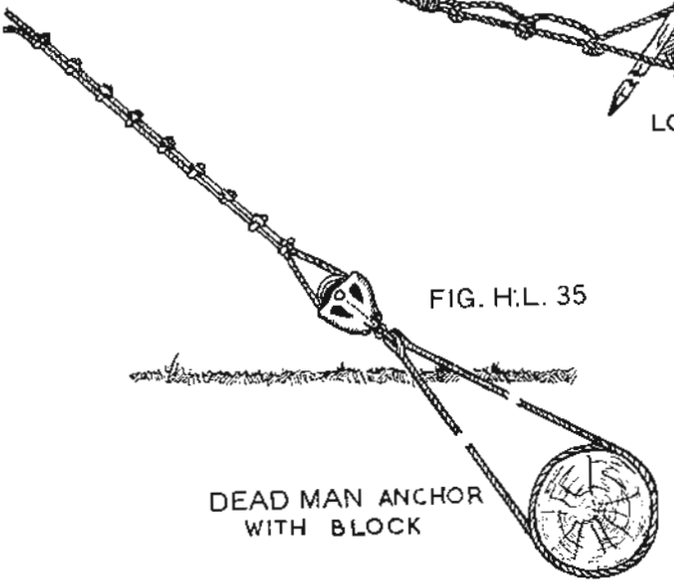
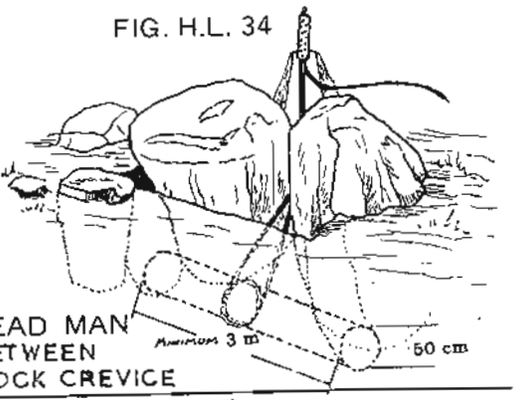


FIG. H:L. 35

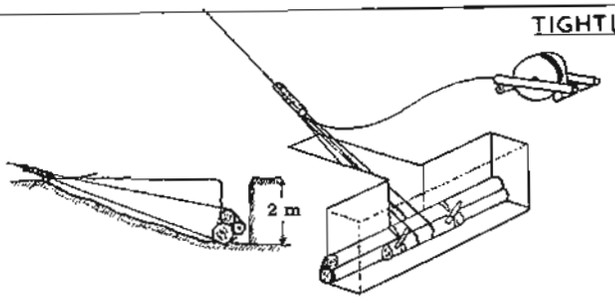
DEAD MAN ANCHOR
WITH BLOCK

FIG. H.L. 34



DEAD MAN
BETWEEN
ROCK CREVICE

TIGHTLINE ANCHORS



MULTIPLE DEAD MAN WITH SMALL LOGS
FIG. H.L. 36

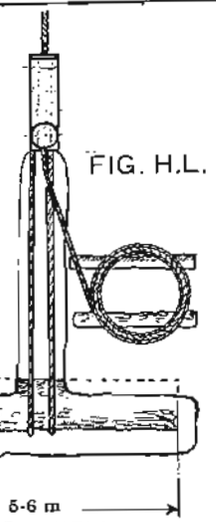
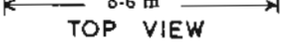
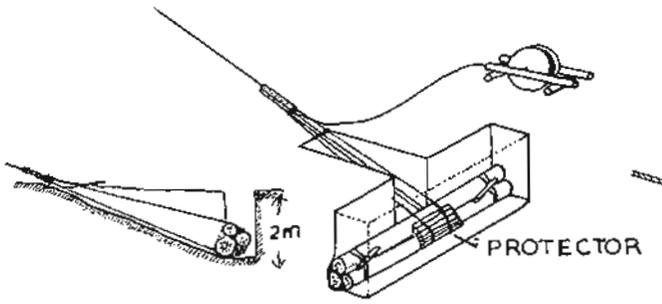
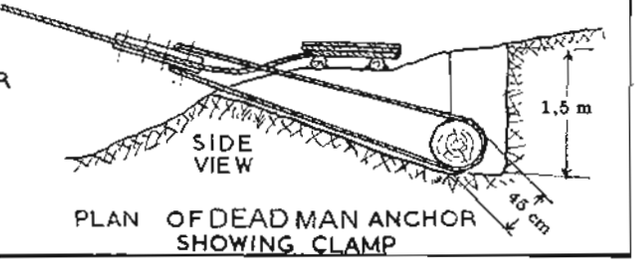


FIG. H.L. 37



TOP VIEW





PLAN OF DEAD MAN ANCHOR
SHOWING CLAMP

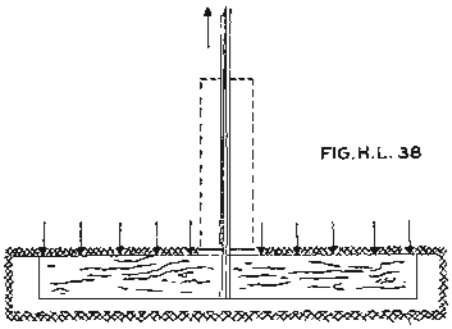
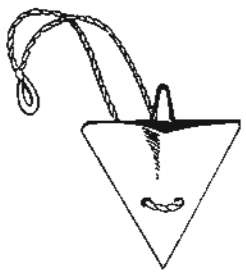


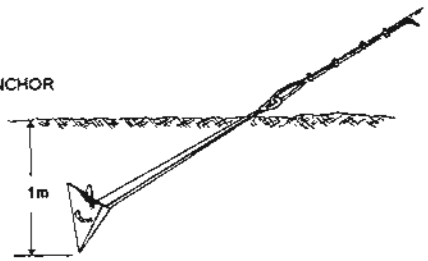
FIG. H.L. 38

FORCES ACTING ON A BURIED LOG ANCHOR



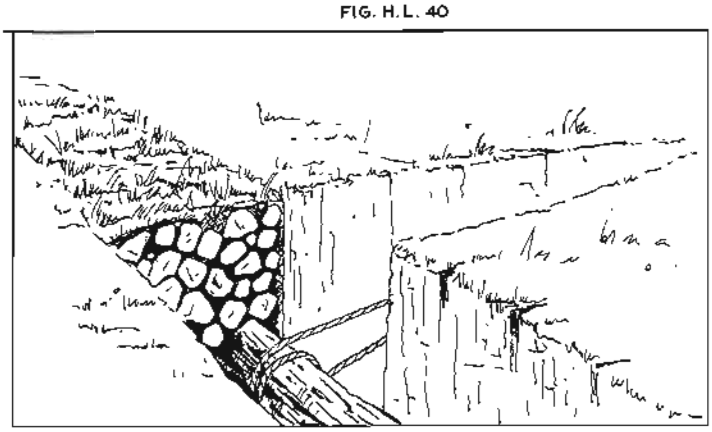
ARROWHEAD GROUND ANCHOR
FOR LIGHT GUY - LINE

FIG. H.L 39



ANCHOR SIZE (cm)	ANCHOR PLATE AREA (cm^2)	APPROXIMATE GUYLINE LENGTH (m)	APPROXIMATE ANCHOR PLATE MASS (kg)	MASS OF ANCHOR WITH ASSEMBLY (kg)	TYPICAL SOIL-ANCHOR HOLDING STRENGTH (kg)		
					SAND	CLAY	HARDPAN
20.3	210	1.2	1.7	±3.5	1,100	3,600	5,000

FIG. H.L. 40



GENERAL VIEW OF THE DEAD MAN ANCHOR - SETTING AND FILLING

E 690.

members and correspond with the female brackets located at the end of the winch frame. These hinges serve to keep the boom in near upright position during the operation (Fig. H.L. 6).

(ii) The upper attachments correspond with the hinge bracket slots fitted on top of the support uprights for travelling, located near the winch on the main frame (Fig. H.L. 8). These hinges serve to keep the boom in a level position while travelling and are also used to raise the boom into the vertical position while erecting.

A number of fittings are located on top of the boom for the attachment of shackles for securing the guy-lines.

2. GUY-LINES AND ANCHORS

The self-propelled highlead yarder with its own boom is designed by the manufacturer to withstand certain strains, pull and shock, and the auxiliary equipment has been selected to meet the same requirements. With guy-lines, however, a certain knowledge is required besides the material and equipment concerned so as not to overstress the lines. Guy-line stress depends mainly on the relation between the height of the boom and the distance from the boom base to the anchor point (stump etc.), as illustrated in Fig. H.L. 22. Fig. H.L. 21 shows stresses acting on the main block of the machine when a load is being pulled in.

Guy-line anchors selected too close to the boom base are not to be recommended, a distance of twice the boom height or more from the boom to the anchor being fairly safe. By reducing this distance to 1/8 of the boom height, guy-line stress is over 8 times the force of the load being pulled.

A. ANCHORS

Various types of logging anchors are illustrated in Fig. H.L. 23, 24, 25, 26, 27, 33, 34, 35, 36, 37, 38, 39 and 40. The simplest and most convenient anchor is a well-rooted stump of suitable size with a good location in relation to the yarder boom or support.

Safe and unsafe stump rooting is illustrated in Fig. H.L. 28 to 32. Anchor lines should be wound as low as possible around stumps, and sling saddles should be made to prevent the rope from slipping over the stump top. A good practice is to pass the cable under the roots, especially when the anchoring stump is close to the boom, as the rope rises at a sharp angle (Fig. H.L. 26).

Next to the stump the "dead man" buried anchorage is the most suitable. (Fig. H.L. 33, 34, 35, 36, 37, 38 and 40). This is a log of suitable size entrenched deep enough to withstand the required pull. The trench with the log at the bottom is positioned at right angles to the direction of the guy-line pull (Fig. H.L. 37, 40). An inclined outlet is provided from the trench for the anchor rope and it is important that the rope pull be straight and not bent (Fig. H.L. 33). The location of the "dead man" anchor trench must be carefully selected in relation to the configuration of the terrain.

"Dead man" anchors should be used for tensions exceeding 10 tons. The front wall of the trench should be as vertical as possible. The cable trench outlet should be 45 cm to a maximum of 60 cm wide and must correspond to the incline of the anchor cable. If necessary the trench wall can be protected or reinforced to prevent the soil from sliding. An additional excavation should be made at the bottom of the trench opposite the cable outlet so that the cable can easily be passed beneath the anchor log.

The anchor log should be gently lowered into the trench by means of fibre ropes. When the cable has been anchored to the log the trench should be filled in with soil, or soil and stones, and well tamped (Fig. H.L. 40). The point where the cable is attached to the anchor log should not be covered, or can be covered with sandbags, so that the cable and anchor log can be inspected at any time.

The strength of this type of anchor depends upon two factors (Fig. H.L. 38):

(a) Soil resistance

(b) Shearing resistance of the logs against the concentrated force of the anchor cable.

B. FACTORS INFLUENCING SOIL RESISTANCE

(i) Mass of the soil in kg per m^3
(ii) Depth of the entrenched log
(iii) Depth in metres at which the wall of the freshly excavated trench ceases to slide
(iv) Grade of incline of anchoring cable.

Resistance of the soil is calculated in kg/per m^2.

The area of soil resistance for an anchored log is equal to the length of the log less 60 cm (width of cable outlet) multiplied by its (log) diameter. The data for table H.L. 1 were determined experimentally, assuming the following:

Mass of the soil: 1 400 kg/m^3
Angle of incline of the trench wall - 30° (From the vertical)
Sliding quality of the soil - 1,2 m B (iii)
Safety factor: 3.

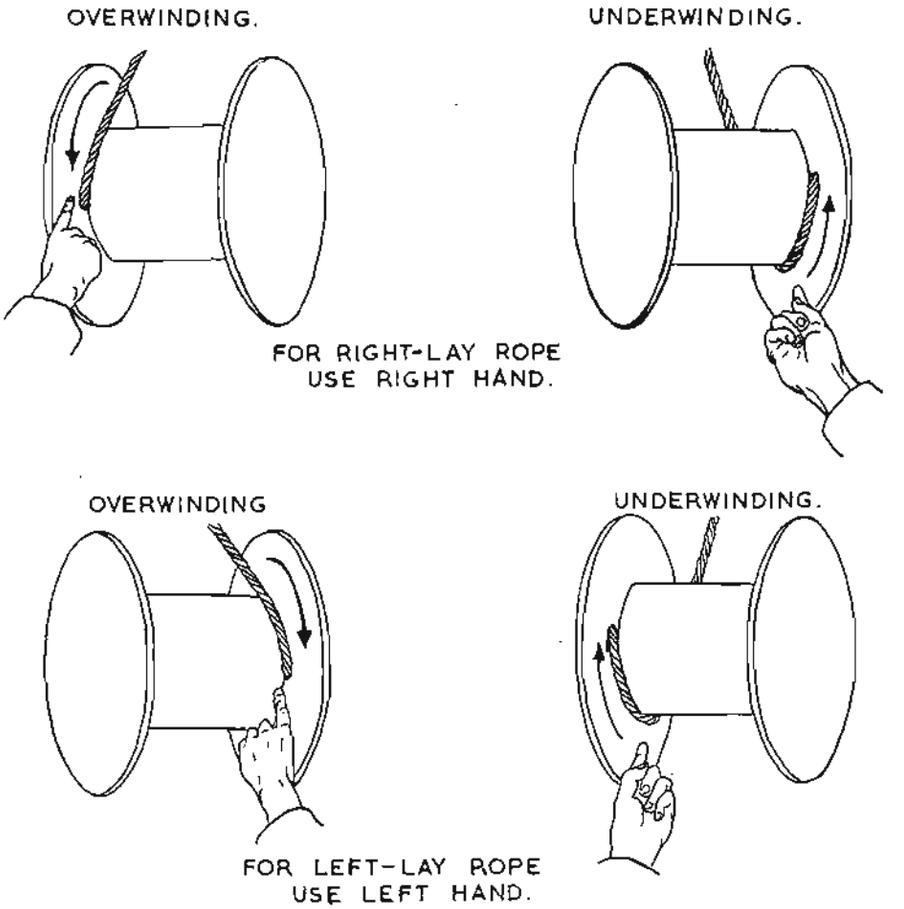
TABLE H.L. 1 - Relation between anchor cable and soil resistance

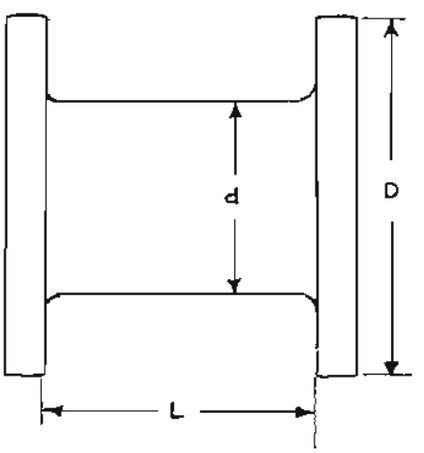
Average depth of anchor log entrenchment metres	Incline of an anchored cable and resistance of the soil in kg per m^2			
	1:1	1:2	1:3	1:4
0,3	535	730	780	850
0,46	1 217	1 560	1 750	1 900
0,61	1 997	2 580	3 160	3 400
0,91	4 626	6 330	7 060	7 300
1,22	8 522	10 700	12 650	13 150
1,52	13 640	17 500	19 500	20 000
1,83	18 500	24 800	28 250	29 000
2,13	24 800	34 100	39 000	40 900

Example

1. How deep is an anchor log of 6 metres by 40 cm diameter to be buried in compact soil to with-

FIG. HL.. 41





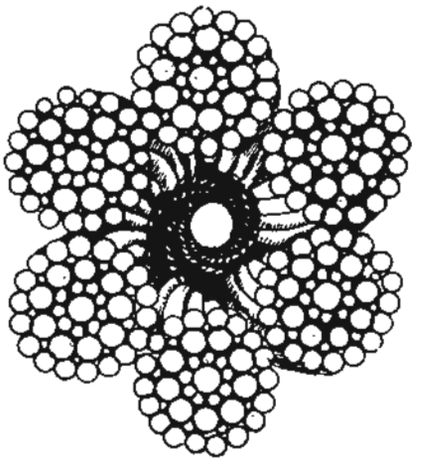
TO FIND THE WIRE ROPE FULL CAPACITY OF A DRUM

LENGTH OF WIRE ROPE (METRES) THAT A DRUM WILL HOLD = $(D^2 - d^2)\,L\,X$

D = DIAMETER OF FLANGE IN cm
d = DIAMETER OF DRUM IN cm
L = INSIDE WIDTH OF DRUM IN cm
X = ROPE FACTOR - SEE TABLE BELOW.

ROPE DIAMETER	ROPE FACTOR	ROPE DIAMETER	ROPE FACTOR
0,6cm	0,018888	1,5cm	0,0031247
0,9cm	0,00866726	1,9cm	0,0021576
1,0cm	0,0063426	2,6cm	0,0012089
1,2cm	0,0048732		

FIG. HL 42



VIEW OF CROSS SECTION AND INSIDE OF WIRE ROPE.
6 X 46 FILLER WIRE.

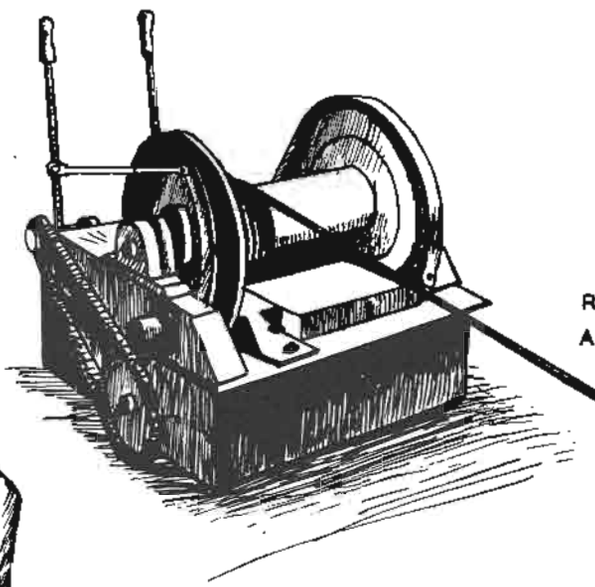
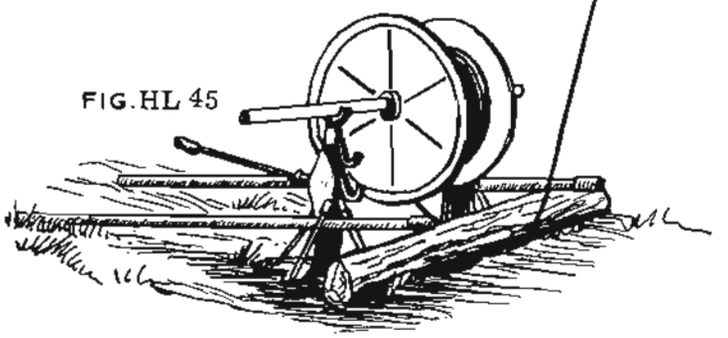


FIG. HL. 43
REWINDING WIRE ROPE FROM A DRUM TO THE REEL.

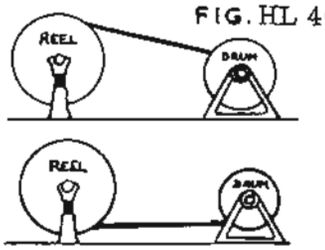
FIG. HL. 44
PROPER METHOD OF UNCOILING WIRE ROPE.

FIG. HL 45



ROPE KEPT TAUT DURING REWINDING BY MEANS OF A LOG AND SPARS.

FIG. HL 46



RIGHT WAY OF TRANSFERRING ROPE FROM REEL TO DRUM.

stand a cable tension of 10 000 kg, with a safety factor of 3?

10 000 x 3 = 30 000 kg;

Assuming the cable to be anchored at a point in the middle of the log the efficient length of the log is reduced by 60 cm (allowing for the cable outlet of 0,6 m width) and will be 5,4 metres. The actual resistance area of the log against the trench wall will be: 5,4m x 0,4 m = 2,16 m^2. Say 2m^2. Pressure in kg/m^2 will be:

30 000 ÷ 2 = 15 000 kg/m^2

Assuming the incline of the cable to be 1:2, the depth at which the log should be buried can be read off from the above table as being ± 1,40 metre.

2. To find the depth of a square beam to safely withstand a given concentrated load (dead man anchor only).

P = 9 000 kg
W = 56 kg/cm^2
b = d (square beam)
l = 457 cm

$$P = \frac{Wbd^2}{l}$$

$$\therefore bd^2 = \frac{Pl}{W}$$

b = d therefore $d^3 = \frac{Pl}{W} = \frac{9\,000 \text{ kg} \times 457 \text{ cm}}{56 \text{ kg}} = 73\,500$

$\sqrt[3]{73\,500} = 41{,}8$ cm

d = 41,8 cm

and b = 41,8 cm

A round log of the same strength must have a diameter of 20% more than the side dimension of a square beam.

diameter = 1,2 x 41,8 = 50 cm

3. The safe working load of a beam supported at its ends and with the load concentrated in the middle is:

$$P = \frac{2Wbd^2}{3l}$$ (legend as before)

C. MAXIMUM CONCENTRATED VERTICAL SHEAR STRESS ON ANCHORING LOG

The distance between the rope (in the centre of the outlet trench) and the outlet trench wall being not less than the diameter of the log, no reduction for shear stress is necessary as it may be considered more or less equal to the breaking stress. It is nonetheless advisable in the case of soft timber (such as P. patula) to protect the anchor log at the point of the cable wrap by means of a small hardwood log, as illustrated in Fig. H.L. 36.

Note: Figure H.L. 35

By using slings around the anchor log the guy-line cable is saved from corrosion caused by moisture in the soil. In order to prevent "over-bending" of the guy-line at the point of attachment to the sling it is a good practice to attach a block to the anchor sling. The guy-line is then threaded over the block sheave and clamped with wire clips (Crosby clips). Cheap but strong blocks of 20 to 25 cm sheave diameter can be used for this purpose in departmental cases.

D. INSTALLING AND SPOOLING WIRE ROPE ON THE WINCH DRUM (Fig. H.L. 41, 43, 45,46)

(1) When the rope arrives be sure it is carefully lowered from the conveyance to the ground and not 'dumped off', which is frequntly done. Subsequent complaint of a "bad spot" in the rope is invariably due to damage to the rope when unloading through falling onto a sharp edge of some hard object.

(2) When installing, the reel on which the rope is received should be set up on an axle as far away from the drum as is practical (Fig. H.L. 43) and a brake acting on the flange of the reel (not on the rope) should be provided so that a tight wind may be secured. Alternatively a log and spar arrangement as illustrated in Fig. H.L. 45 can be used for keeping the cable taut for re-winding. In this case to and fro transverse movement of the reel on the axle upon which it is mounted will occur. If friction is too great the transverse movement should be assisted by hand. Provision should be made for transverse movement when jacks are installed to support the reel. Fig. H.L. 46 shows the two right ways of transferring rope from reel to drum. If rope is uncoiled by hand it should be done as illustrated in Fig. H.L. 44.

(3) The reel should be in line with the winch drum and if the rope is led over a sheave to the drum then all three should be in line. Keep the same direction of bending to obviate harmful reverse bending.

(4) Remember:

(i) Keep the rope taut and do not allow the ends to rotate

(ii) Do not disturb the seizings on the ends of the rope

(iii) Use extreme care when installing Lang lay rope.

(5) Ropes should have at least three full turns on the drum at all times.

(6) It is important that the rope be wound on a plain-faced drum in spiral fashion at the proper angle. This may necessitate a tapered starting piece, preferably of steel, but sometimes of fibre, to fill the space between the first turn and the flange. The only exception to this being when winding more than three layers in which case there are advantages in so-called parallel spooling.

(7) The anchorage on a flat-faced drum should be located in relation to the direction of the lay of the rope because a rope tends to roll either one way or the other across the face of the drum. It is desirable that spooling be such that the turns hug together instead of spreading apart, causing abrasion and crushing from overwinding layers.

(8) It is most essential that the bottom layer is tight, which may be accomplished by tapping the turns together, but not so that the strands interlock, and that the dead turns be under tension. Open and wavy winding will result in premature deterioration.

(9) If the bottom layer on a plain faced drum is not perfectly wound it will be impossible to secure satisfactory winding in successive layers.

10) Make certain that the dead turns are never slack. If this occurs the rope should be run off completely and rewound under good tension. This can, in the case of a hoist, be done by passing the rope over the head sheave, through the sheave connected to the load and back up to the headframe. By lowering with the load on the bight of the rope it is possible to remove all the turns from the drum and rewind under adequate tension. If slackness is allowed to remain in the dead turns overwinding will soon bring about deterioration.

(11) If difficulty is experienced where the rope rises from the first to the second layer and wedging action and abrasion take place, a tapered steel lifter, which may have to be adjusted in position as the rope stretches, will be of help.

(12) When the rope is installed it should be run a few times under light loads in order that wires and strands may adjust themselves to operating conditions. This provides an opportunity for a thorough application of lubricant to prevent the entrance of moisture.

(13) If spooling is difficult, the reason should be determined and the situation corrected because even only a few hours of bad winding can seriously damage a rope.

III. METHOD OF WORKING
(Fig. H.L. 11)

1. METHOD OF WORKING

A. THE OPERATING AREA

(a) The operating area is an area within the range (radius) of the main cable of the yarder, when the latter operates from the same site without changing position. The maximum size of an operating area is approximately 10 hectares, for a main cable length of 200 metres.

(b) Considering the yarder as the apex of a triangle and a line between the haulback blocks as a base, the haulback cable running through the corner and tail haulback blocks and back to the machine will form a triangle. The length of the perimeter of this triangle cannot exceed the length of the haulback cable.

If the main cable has an actual working length of 200 meters and the main cable run is one side of a triangle, then 400 metres of haulback line is required to cover the two long sides of the triangle. As the actual working length of the haulback cable is approximately 600 metres, a maximum 200 metres remains for the base of the triangle, i.e. the distance between the haulback blocks. This distance must always be taken into consideration when placing the haulback blocks in the field.

Because of the limited length of the haulback cable and consequent limited area of the triangle it encloses, large operating areas have to be split into portions, such triangular portions being known as operating sectors. The maximum size of an area encompassed by a haulback cable of 600 metres length is approximately 2,5 ha, which is thus the maximum size or area of a single operating sector.

In order to yard the timber within an operating sector the main cable, with chokers attached, moves between the yarder and the tail block by means of the main and haulback drums, the latter acting through the haulback cable. The route of the main cable between the yarder and tail block is known as the cable run, the area being covered by a 'run' being a strip within the span of the chokers on both sides of the main cable which is about 6 metres wide. In order to yard all the timber along a run, several trips along the same route have to be made with the main cable. The logs closest to the yarder are usually yarded first.

When all the logs along a cable run have been yarded, the tail block is shifted towards the corner haulback block in line with the next row of logs and attached to a suitable stump (Fig. H.L. 11). The main cable is simply redirected to the next run by pulling to the yarder by winch and back again by haulback cable under tension, after which the operation is resumed and the logs of the next run are yarded.

When the last run of a sector has been cleared, the operation is moved to the following sector. During the last run the tail and corner haulback blocks will be very close to each other and there is the danger that the yarded logs may become entangled with the haulback line near the yarder. Fig. H.L. 14 (2) illustrates how the haulback line may be deviated by means of an additional haulback block so as to give the main line a clear run in to the yarder.

Moving the operation to the following sector is accomplished by disconnecting the haulback cable from the butt rigging (at the tail block), after which the haulback cable is pulled back to the yarder. The corner block is then removed to its new position in the adjacent sector, approximately 150 metres along the extreme perimeter of the operating area, and attached to a suitable stump by means of the anchor slings. The haulback cable is then threaded through the haulback blocks again and reconnected to the butt rigging on the main line, which should not have been moved after being disconnected from the haulback line. The tail block usually remains in its position as for the last run yarded. The operation can then be resumed.

The above description applies to a straight forward case of highlead operation. There are, however, many difficult "corners" where the conventional method described above can only be partially adopted.

B. SLINGING LOGS WITH CHOKERS

When logs have been slinged by the chokers, the latter are attached to the butt rigging of the main cable (Fig. H.L. 48). During slinging, how-

LOG YARDING. BY HIGHLEAD

FIG. H.L. 47

ROLLING A LOG LODGED AGAINST A STUMP.

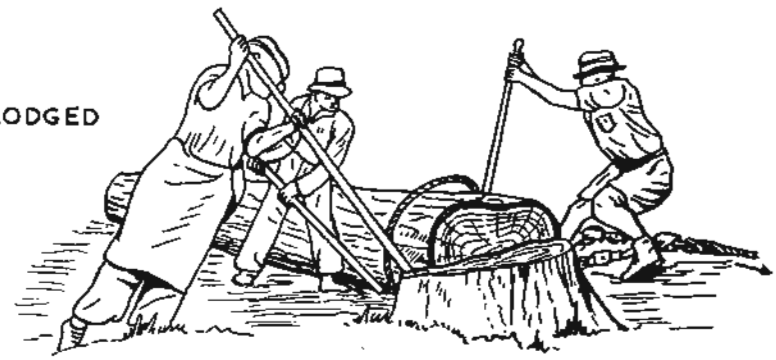
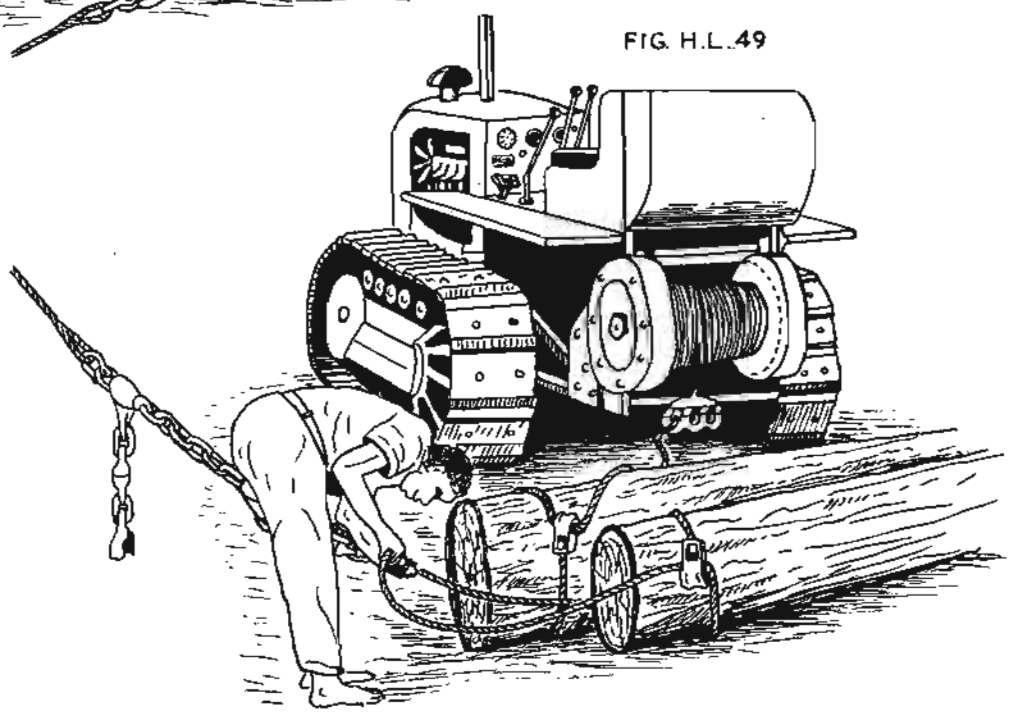


FIG. H.L. 48

HOOKING LOADED CHOKERS TO THE BUTT RIGGING

FIG. H.L. 49



REHOOKING THE CHOKERS FROM THE BUTT RIGGING TO 3-WAY BARDON CHOKER HOOK ON TRACTOR, FOR SWINGING LOGS TO THE ROADSIDE

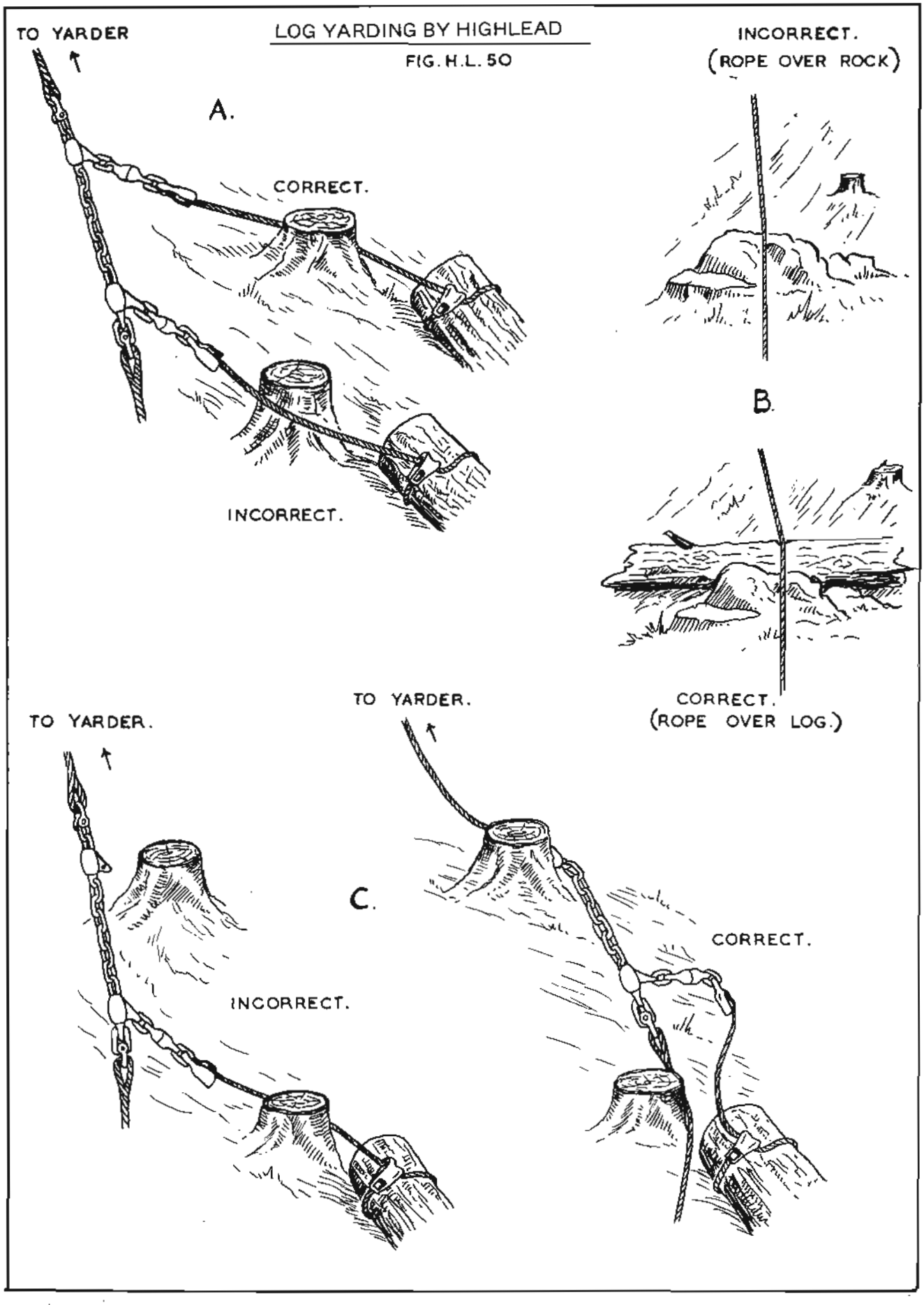

LOG YARDING BY HIGHLEAD
FIG. H.L. 50
TO YARDER
A.
CORRECT.
INCORRECT.
INCORRECT.
(ROPE OVER ROCK)
B.
CORRECT.
(ROPE OVER LOG.)
TO YARDER.
TO YARDER.
C.
CORRECT.
INCORRECT.

FIG. H-L. 51

STANDARD LORRY-MOUNTED HIGHLEAD OPERATION.

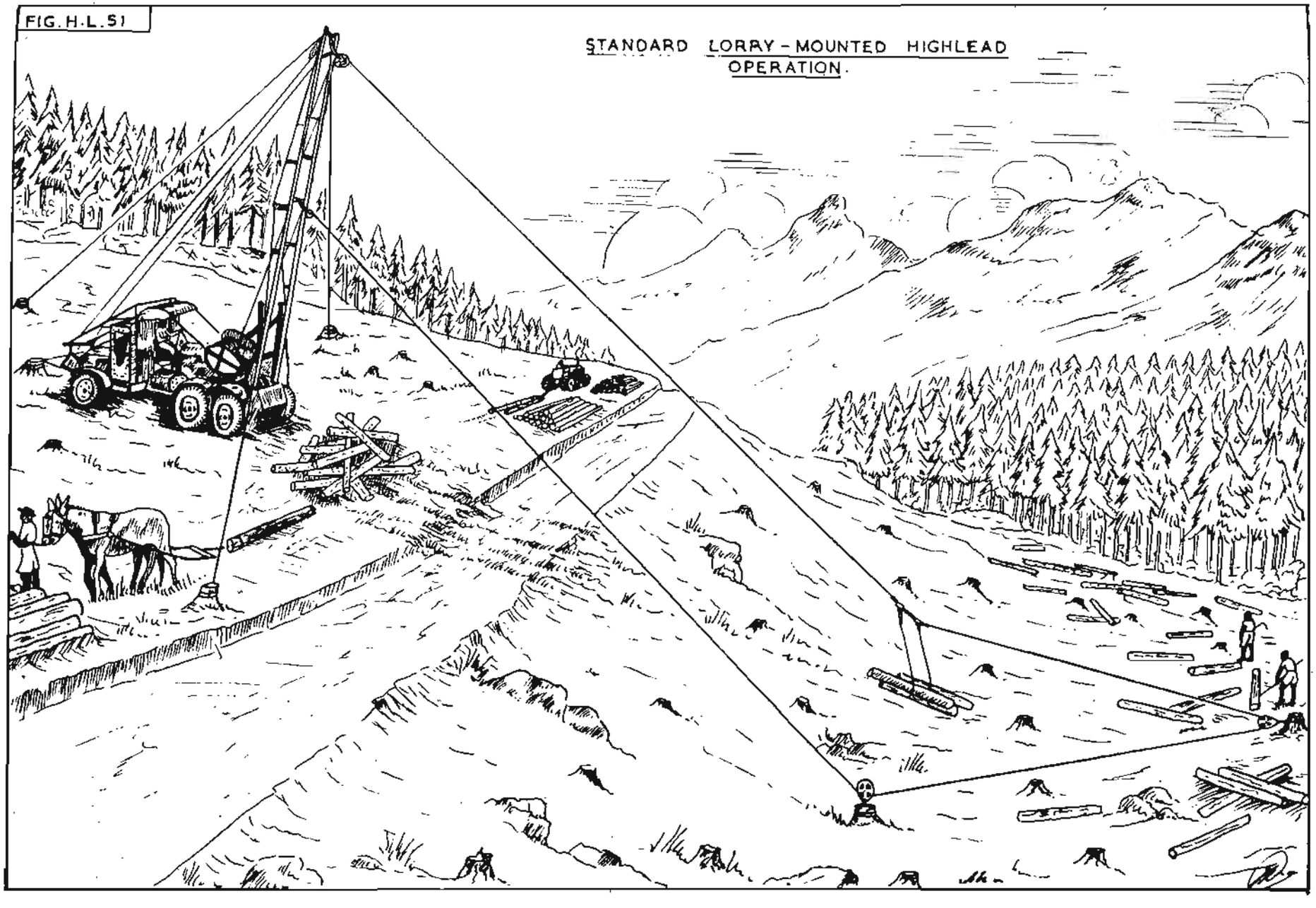
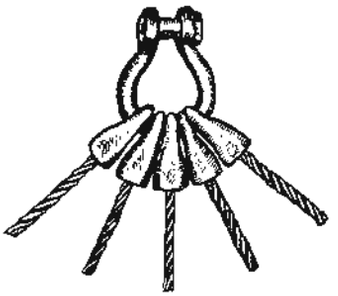


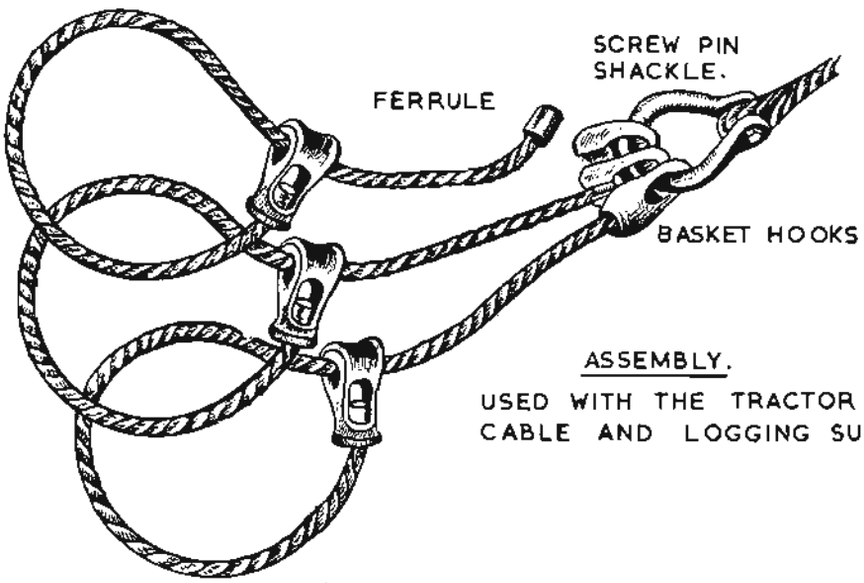
FIG. H.L. 52

BASKET LINE HOOKS.



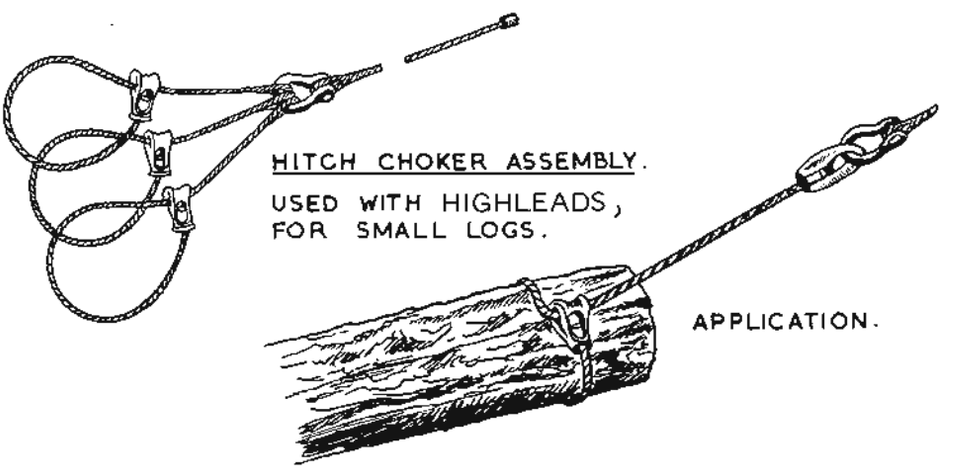
FIVE BASKET HOOKS ON A SPECIAL ASSEMBLING SHACKLE (DETAIL)

BASKET HOOK.



ASSEMBLY.

USED WITH THE TRACTOR DRUM CABLE AND LOGGING SULKY.



HITCH CHOKER ASSEMBLY.

USED WITH HIGHLEADS, FOR SMALL LOGS.

APPLICATION.

FIG. H.L.53 HIGHLEAD LOCATION ABOVE A KRANTZ IN RUGGED COUNTRY.

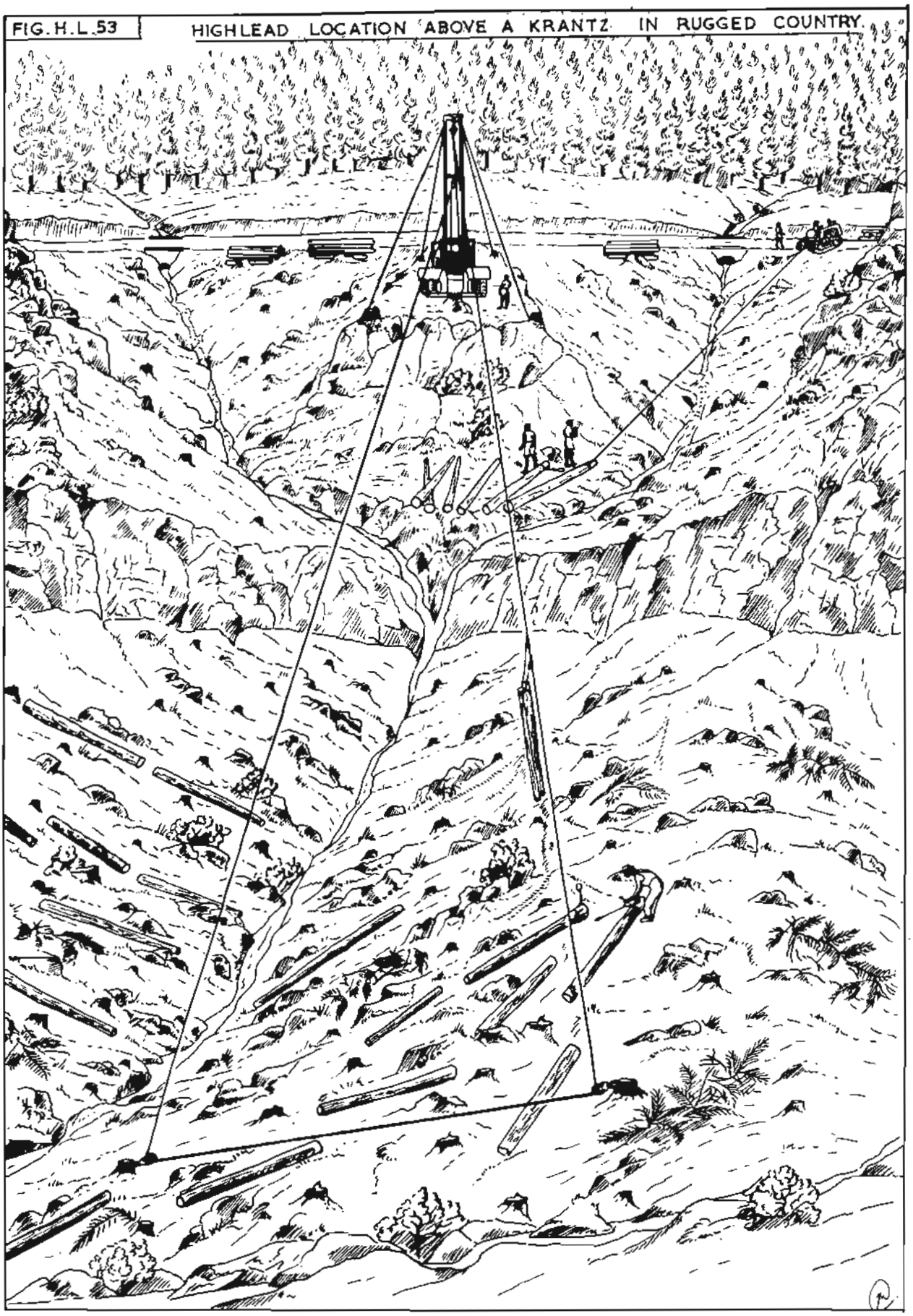
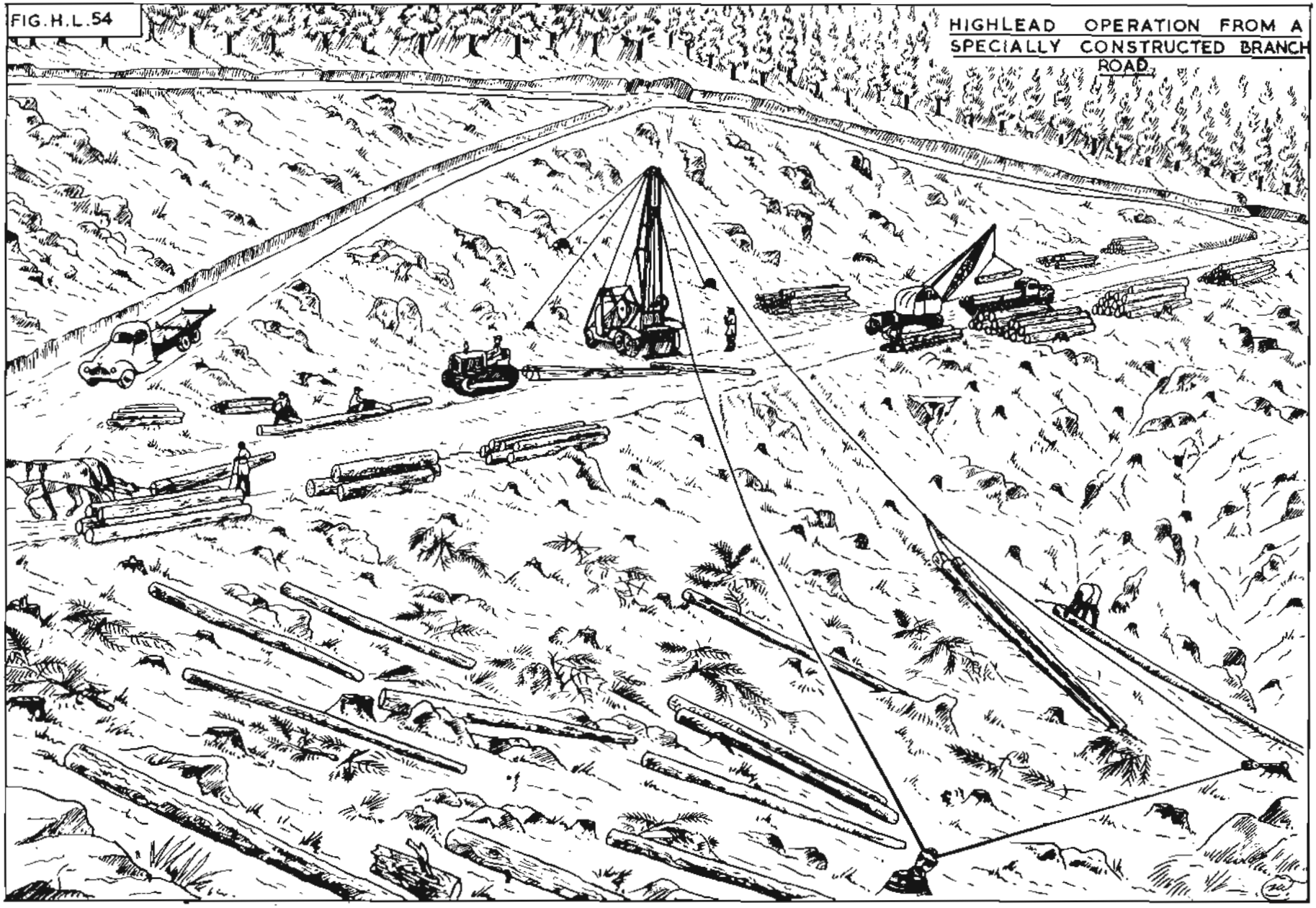
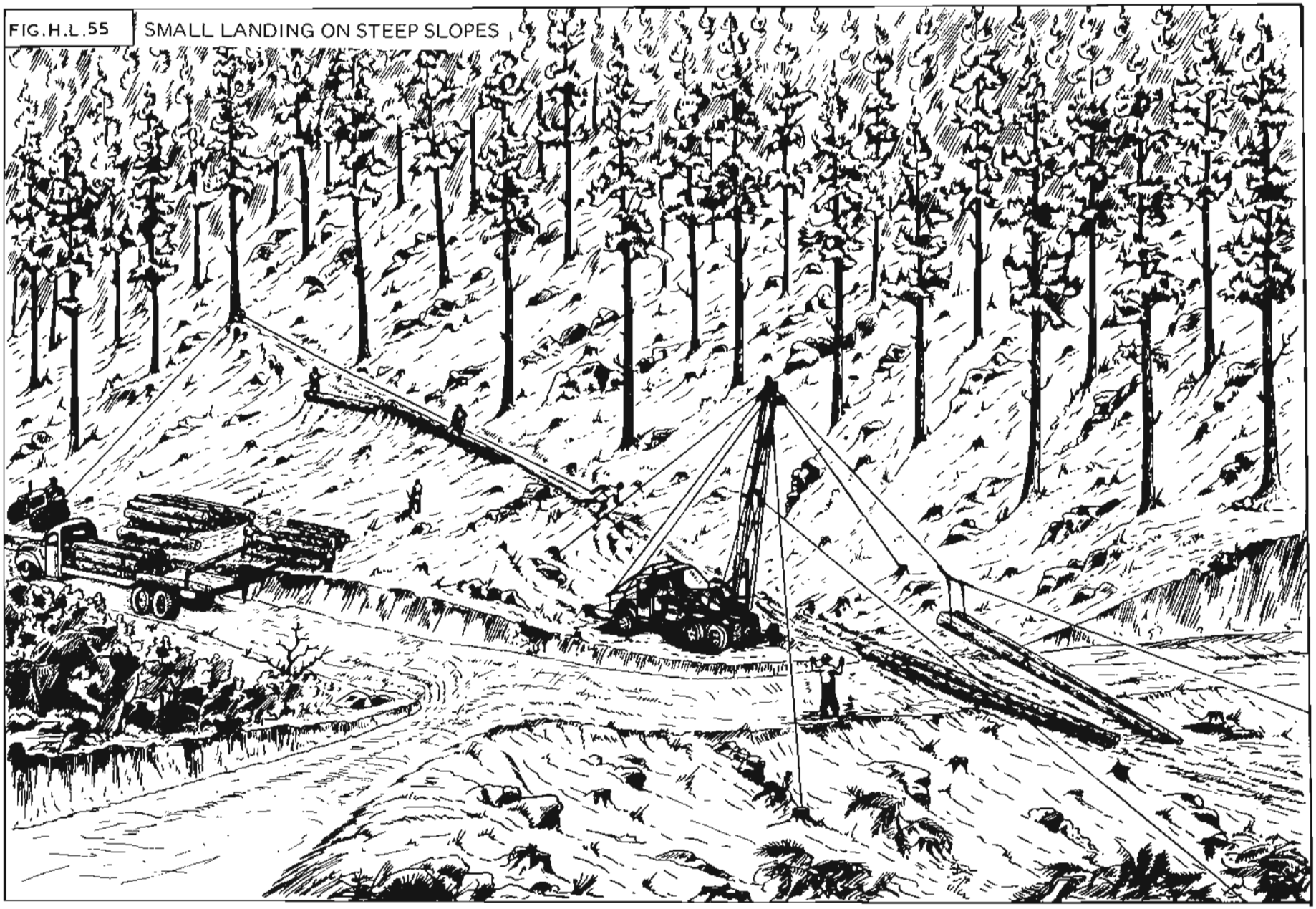


FIG. H.L. 54



HIGHLEAD OPERATION FROM A SPECIALLY CONSTRUCTED BRANCH ROAD

FIG.H.L.55 SMALL LANDING ON STEEP SLOPES



ever, the main cable and chokers must be placed in a convenient position with regard to obstacles which may hinder extraction. Fig. H.L. 50 (A) and (C) illustrate how either the chokers or main cable and butt rigging may be deviated to bypass obstacles. Where large logs are positioned immediately behind obstacles such as large rocks or stumps (Fig. H.L. 47) the logs may have to be rolled aside before they can be yarded.

C. ABRASIVE DAMAGE TO THE HAULBACK CABLE

In some instances the haulback cable must of necessity pass over rocks or rocky outcrops. The continual movement of the haulback cable over the rock may cause considerable wear and tear on the rope, and this may to a large extent be prevented by placing a log (or logs) above the obstacle so that the rope runs over this [Fig. H.L. 50 (B)].

D. LOG SWINGING (Fig. H.L. 51)

In order to avoid a large pile of yarded logs building up at the landing in front of the yarder (Fig. H.L. 69) it is usually necessary to remove the logs to the roadside. This operation is termed swinging. Swinging should be done in both directions from the yarder on the upper road bank in order to reduce the swinging distance and for easier loading. If stacking space along the road is limited the logs can be stacked below the road and a crane used for loading. Provision should be made so that the crane position will not interfere with lorry traffic along the road, and where possible a recess should be excavated in the upper road bank.

The following equipment is used for log swinging from the yarder landing to the roadside:

(1) The standard equipment for log choking by towing tractor is used, i.e. eye-spliced choker sling assemblies hooked to the tractor drawbar or line hook.

(2) In the case of immediate swinging of logs to the roadside as they are landed (hot decking), removal can be speeded up by leaving the choker slings used for highlead yarding on the landed logs and hooking them straight onto the tractor drawbar (Fig. H.L. 49). As the highlead chokers have both ends ferruled, a three-way Bardon choker hook with 'pockets' for hooking the choker ferrules, or "basket hooks" (Fig. H.L. 52), fitted with bow shackles to the winch cable, may be used instead of the standard tractor drawbar or line hooks respectively.

(3) When mules are used for log swinging, the standard mule skidding equipment is used, in which case the highlead chokers are removed and the chained logs are hooked to the mule swingles. Alternatively, basket hooks may be attached to the mule swingles and the highlead chokers fitted into these.

2. VARIOUS LORRY-MOUNTED YARDER SETTINGS AND OPERATIONS

(a) Fig. H.L. 53

This illustration shows the location of the yarder site on a flat section of the narrow branch ridge between two tributary streams. The extraction of timber from this compartment had been postponed for a number of years due to the inaccessibility of the area. The actual skidding area was beyond the reach of the tractor winch cable, apart from which a steep, rocky outcrop (krantz) located below the road and level with the confluence of the two streams, prevented the operation of the tractor winch cable. No lift could have been obtained on the log heads to enable them to negotiate the krantz.

Log yarding was accomplished by the highlead yarder, landing the logs on the flat ledge below the yarder site and just above the confluence of the two streams. Swinging to the roadside stacks was done by the tractor, first winching them to the roadside and then towing them to the log stacks.

The yarder cables received considerable punishment from being dragged over the rocky terrain. The yarding output was greatly reduced due to the difficulties involved and employment of the tractor for log swinging increased the cost of the operation.

(b) Fig. H.L. 54

This drawing illustrates the use of a level linking road between the existing top main road and the branch road descending to the left, constructed as a convenient base for log yarding from the area below.

Trees were topped and then pulled in their length to the yarder, swing from the landing deck by towing tractor, cross-cut by chain saws, sorted by two-mule teams, and finally stacked at the roadside.

On the right of the illustration, logs which had previously been yarded and stacked, are being loaded onto a lorry by crane. The "circular" drive permits an uninterrupted passage for the lorries.

The original operation carried out in practice did not proceed as smoothly as illustrated. Bottlenecks frequently occurred on the cross-cutting and sorting decks, causing yarding and swinging to come to a halt.

Note: The full team for the operation is not shown in the illustration

(c) Fig. H.L. 55

In the operation illustrated in this drawing the yarder site was located on a small, flat spot immediately above the road, with no favourable landing, sorting or stacking decks available due to the steep slopes in the immediate vicinity.

Tree lengths were yarded from the area below the road up a slope of approximately 40°. From the

FIG. H.L. 56

YARDING A "SIDE CORNER" BY HIGHLEAD — FIRST STAGE.

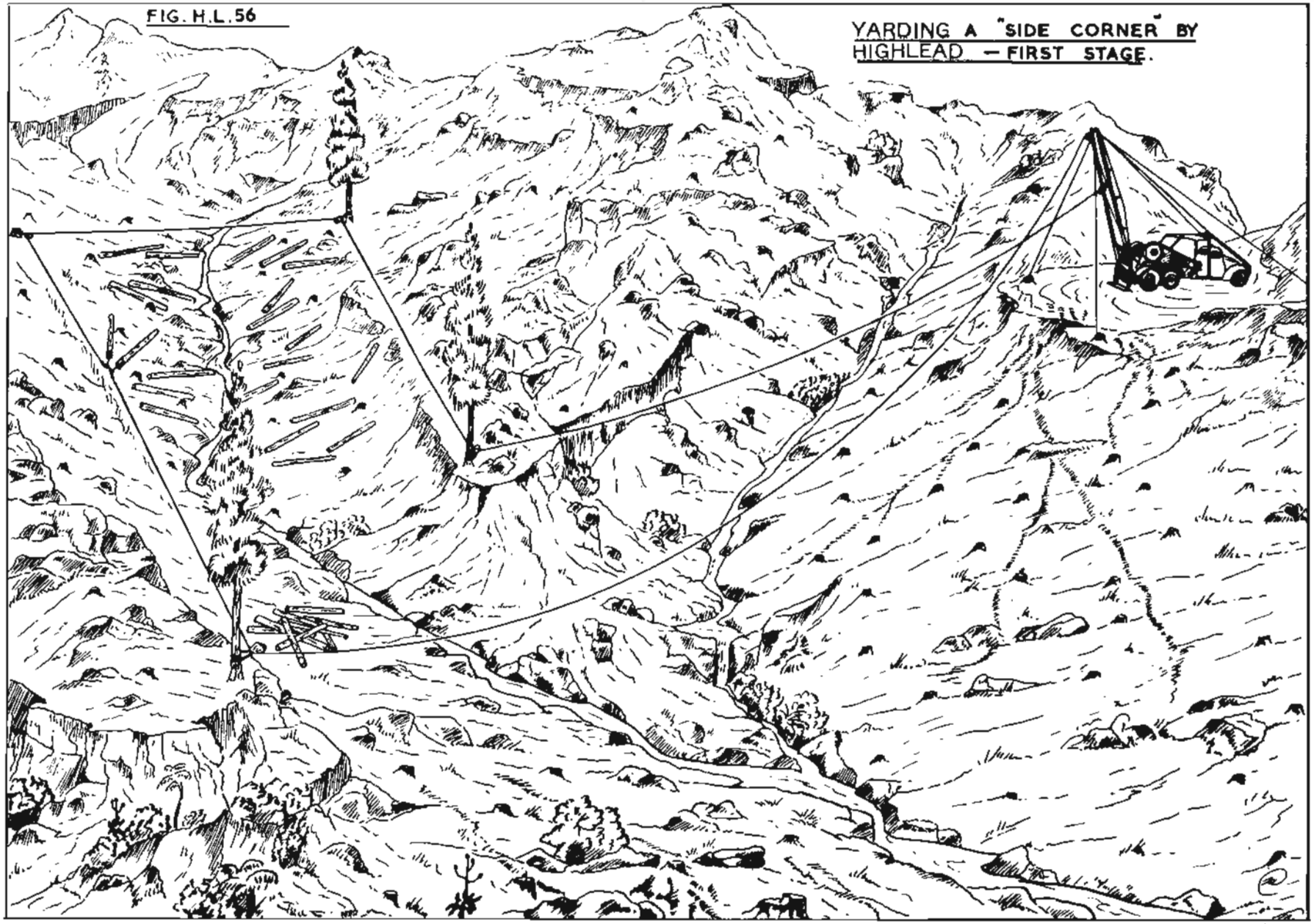


FIG. H.L.57.

YARDING A SIDE CORNER BY HIGHLEAD — SECOND STAGE.

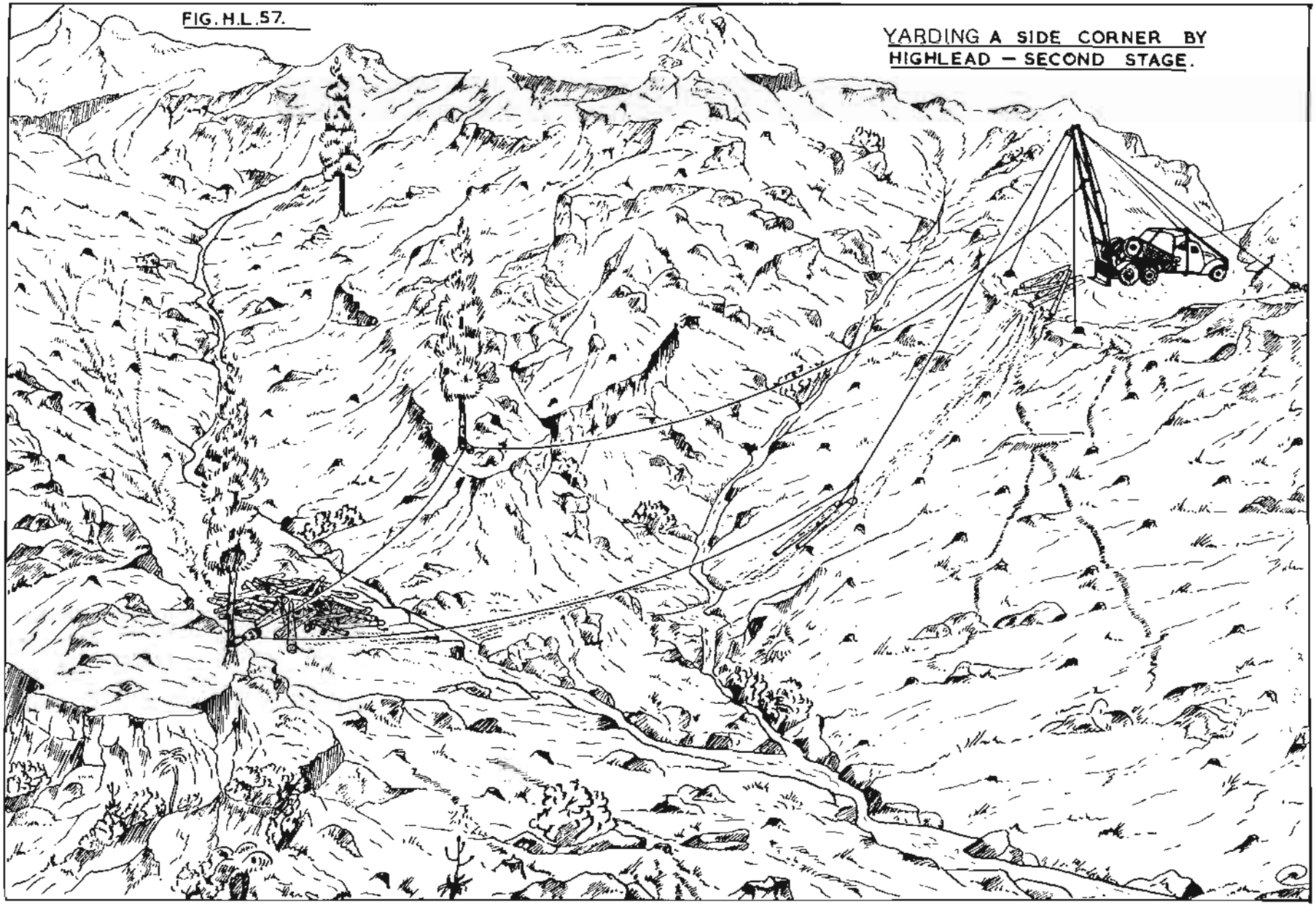


FIG. H.L.58

UNFAVOURABLE TERRAIN FOR TRACTOR SKIDDING.

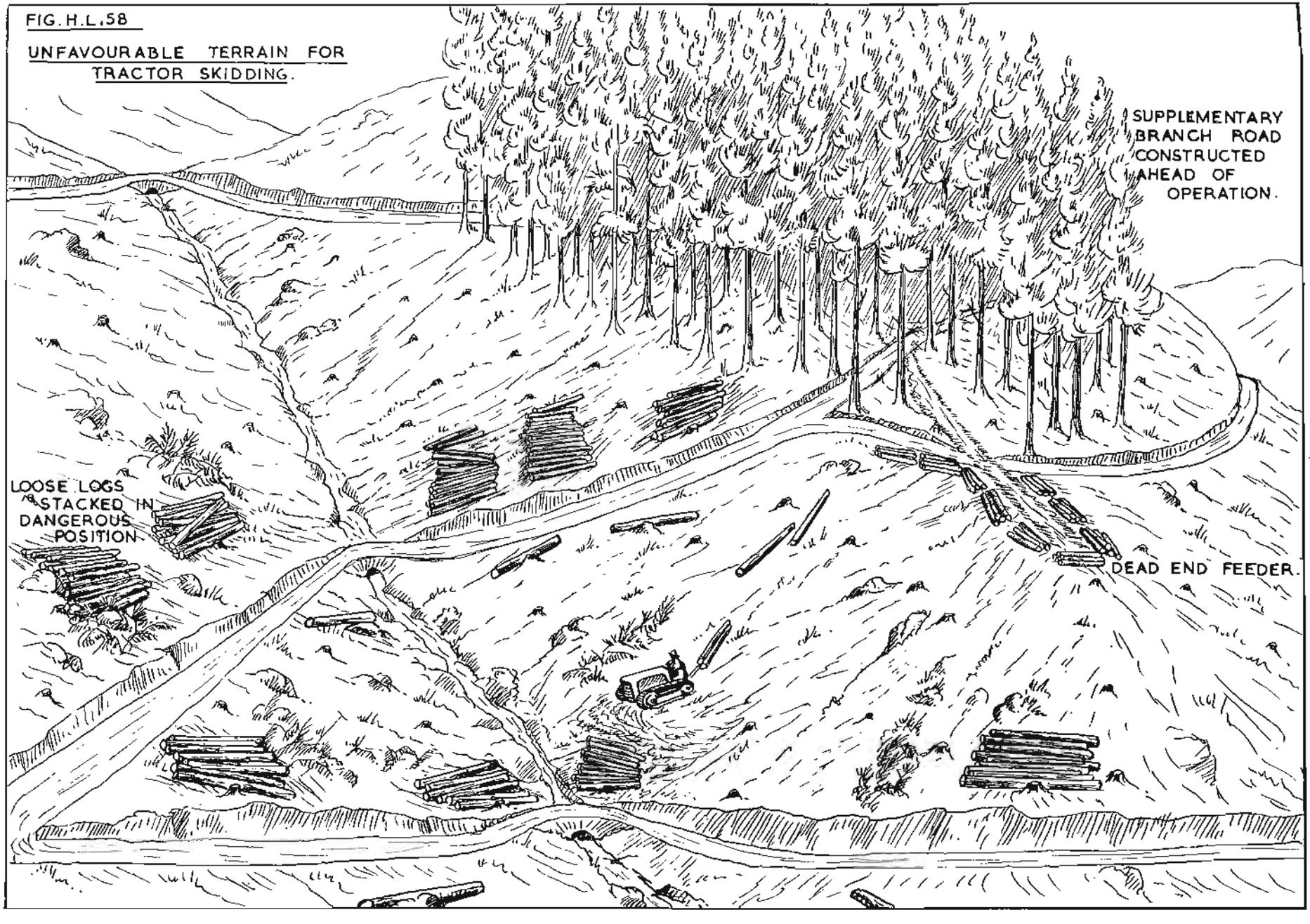
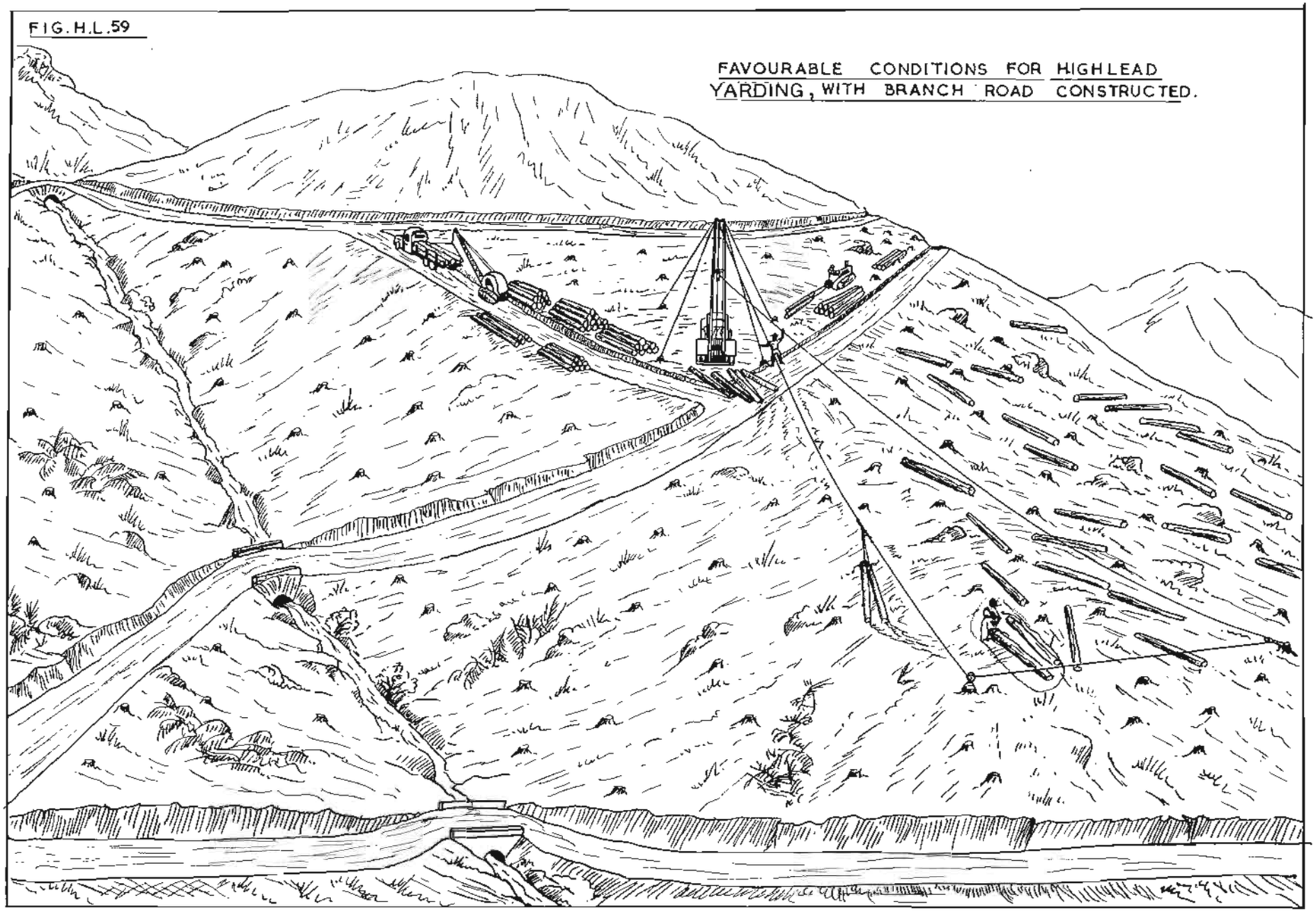


FIG. H.L. 59

FAVOURABLE CONDITIONS FOR HIGHLEAD YARDING, WITH BRANCH ROAD CONSTRUCTED.



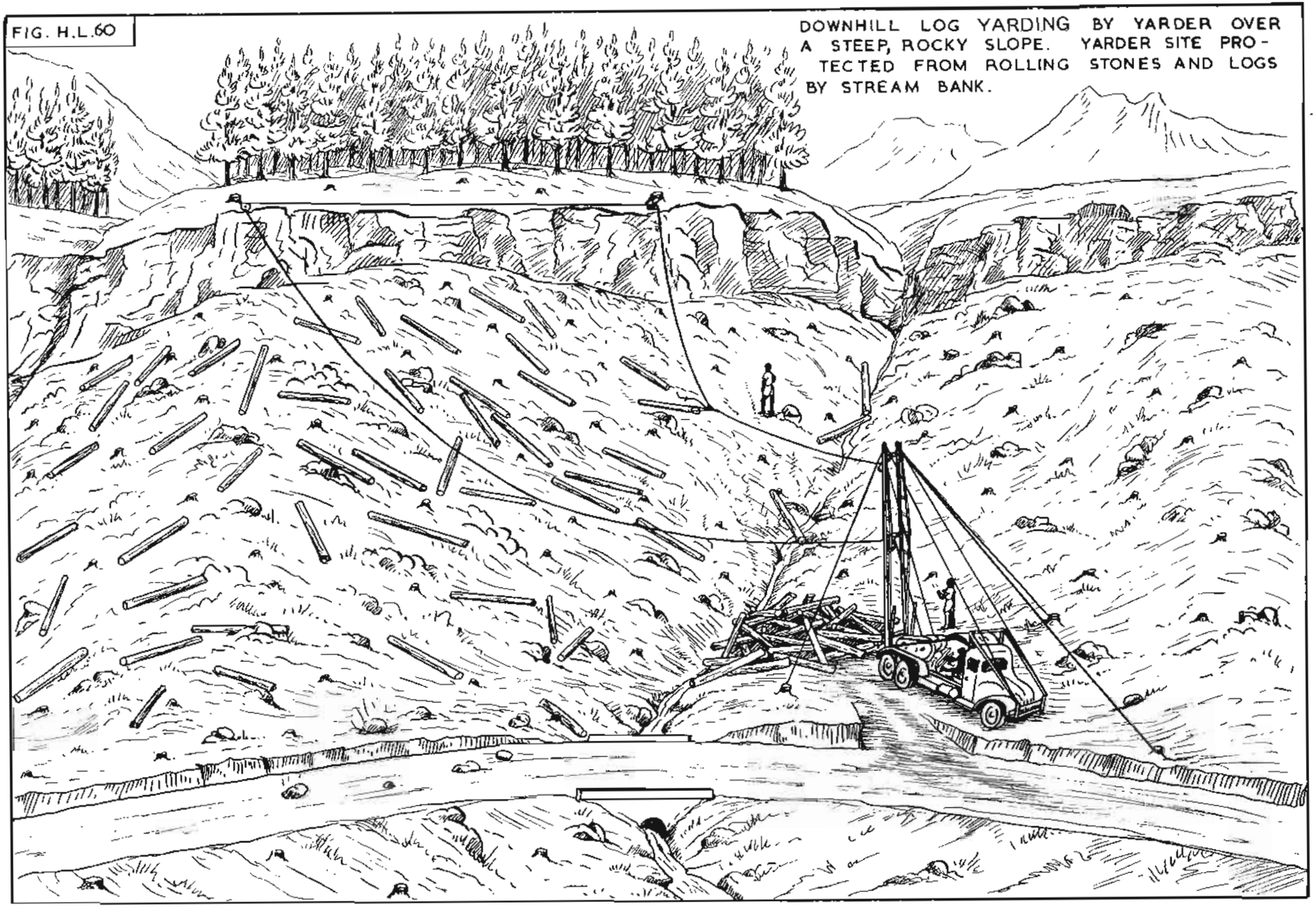


FIG. H.L.60

DOWNHILL LOG YARDING BY YARDER OVER A STEEP, ROCKY SLOPE. YARDER SITE PROTECTED FROM ROLLING STONES AND LOGS BY STREAM BANK.

landing deck, which was on the road, the trees were swung up a path past the yarder by the tractor winch cable, passed through a snatch block. At a suitable point above the stacks the trees were unhooked and cross-cut into logs by chain saw, then rolled to the stacking deck at the roadside and finally loaded. The winch cable was pulled to the log landing by hand.

During the operation logs were only rolled down to the stacks below when no lorries were present at the landing decks.

In practice a "bottle-neck" occurred at the cross-cutting deck as the cross-cutters could not keep pace with the yarded logs, and consequently the landing was often jammed with logs awaiting swinging.

(d) Fig. H.L. 56, 57

The case illustrated in these two drawings was one seldom met with in highlead operations. The area was inaccessible to conventional highlead yarding, and the volume for extraction did not warrant the construction of a special extension road. The access route to the selected yarder site was barred by a narrow ridge, the top of which had to be blasted away before a short branch road could be constructed to the yarder site from the existing road on to the other side of the ridge and close to the ridge crest.

Logs from the area closest to the yarder site, on the right of the drawing, were first easily yarded by the conventional method. Access to the "corner" (top left) of the area for the yarder cable was, however, barred by a rocky ridge.

When the directly accessible area had been cleared of logs the four haulback blocks were set in suitable positions on the other side of the ridge so as to embrace the "corner" in question, and the logs were yarded to a convenient spot (near the lowest tree) where they could be accessible for direct yarding (Fig. H.L. 56).

The second stage of the operation as shown in Fig. H.L. 57 proceeded according to the standard yarding method. The top haulback blocks in the "corner" were removed and the haulback cable passed through the lower two blocks, which remained in position. After the haulback cable had been joined to the main cable, logs were yarded from the pile to the yarder landing.

Note: In order to perform the operation it was necessary to replace the 19 mm main cable with a 16 mm cable and the 13 mm haulback cable with a 9 mm cable so as to lengthen the cable reach of the yarder winch

Remarks

The two-stage operation, over difficult, rocky and steep slopes, yarding mainly small-sized timber, considerably reduced the daily output of the yarder.

(e) Fig. H.L. 58 and 59

The steep, partly rocky terrain shown in Fig. H.L. 58 hampered yarding by tractor. The tractor operator was, on numerous occasions, faced with dangerous situations when turning the tractor in order to approach the logs to be hooked and skidded down. Stacks were dangerously located in an inclined position on the upper road bank. Loading the lorries presented a problem as the logs, when moved from the stacks, often rolled down with considerable force, sometimes passing over the road and landing on the slopes below. For safety reasons small numbers of logs had first to be rolled down to the road and then loaded onto lorries. This necessitated that lorries move frequently to approach the small groups of rolled logs at the roadside.

The situation at the "dead-end feeder" road was equally unpleasant. This road was steep and loaded lorries experienced considerable difficulty in pulling up to the road over the soft surface of the feeder.

By highlead yarding the area (Fig. H.L. 59) and reversing the direction of yarding from downhill to uphill, problems of skidding, stacking and loading could be avoided.

The standing trees in the part of the compartment shown in Fig. H. L. 58 would first have to be clearfelled, the yarder established as illustrated, after which standard highlead yarding could commence.

The tractor's crane, which was available in the plantation at the time, was idle as it could not be employed in loading from the dangerously located stacks shown in Fig. H.L. 58 but could well have been used for loading under the suggested arrangement shown in Fig. H.L. 59.

3. LOG YARDING AND SWINGING BY HIGHLEAD YARDER

A. YARDING DOWNHILL OVER A STEEP SLOPE

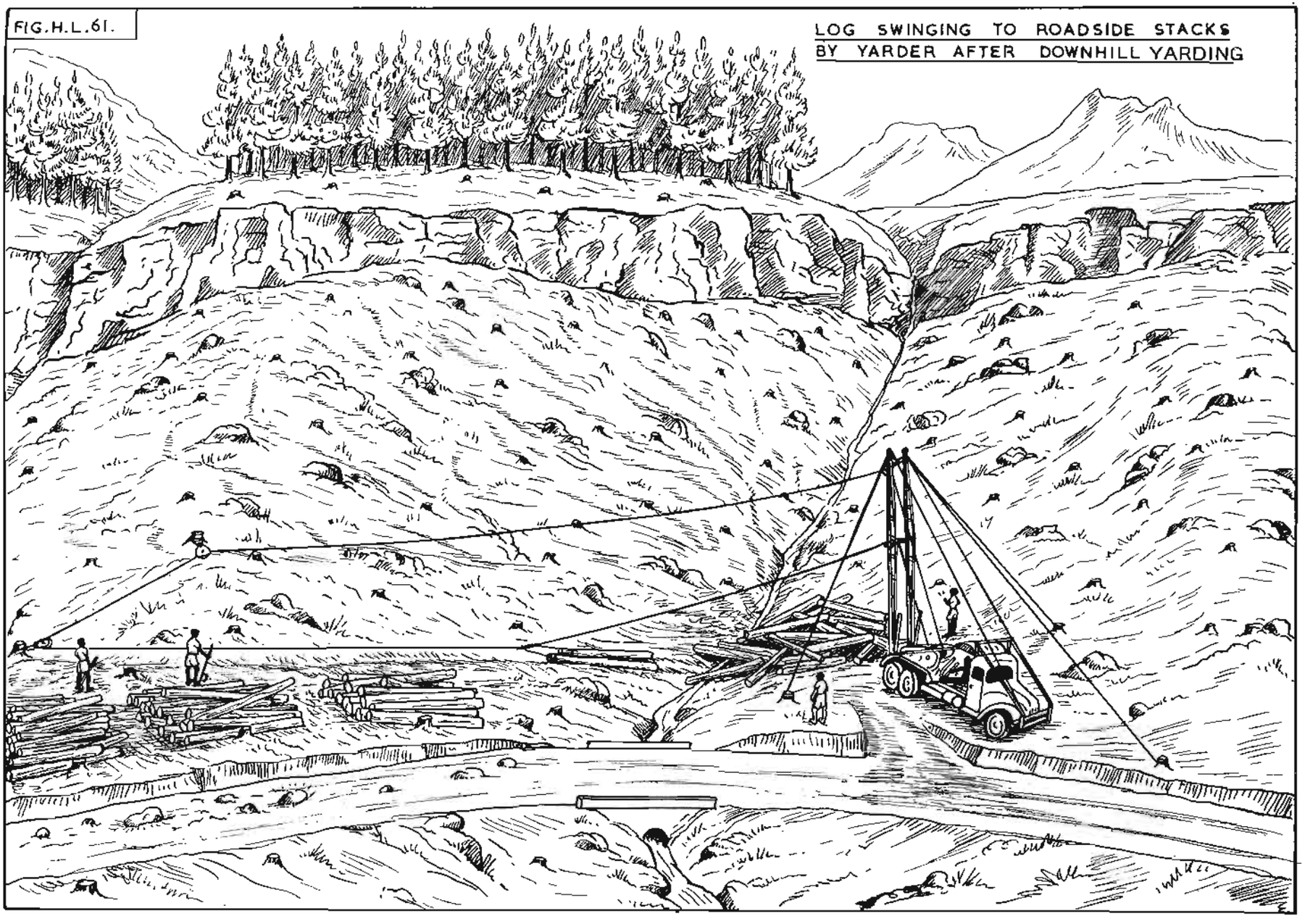
Fig. H.L. 60 illustrates a yarding operation down a steep, rocky slope, with the yarder site on a flat location and separated from the operating area by a small stream.

During the actual yarding a number of logs jerked loose from the chokers and rolled down to the stream-bed. The illustration shows only one log attached to the butt rigging, with the second choker trailing along loosely and the unhooked log left behind. This frequently occurs when yarding downhill over steep slopes, when the load strikes an obstacle such as a stump or rock. The load is brought to a sudden halt, then abruptly jerked forward ahead of the chokers by the increased tension of the main cable, causing the chokers to loosen their grip, thus permitting the logs to roll free. It sometimes helps to temporarily brake the haulback cable while pulling a load over obstacles with the main cable, as the chokers obtain a slight lift and are enabled to grip the logs more firmly, but this method is not always successful.

The illustration shows a number of loose rocks lying in the road below the operating area. These rocks were disturbed by the oncoming load and rolled down the slope, some with considerable force, coming to rest either on the lower slope

FIG.H.L.61.

LOG SWINGING TO ROADSIDE STACKS
BY YARDER AFTER DOWNHILL YARDING



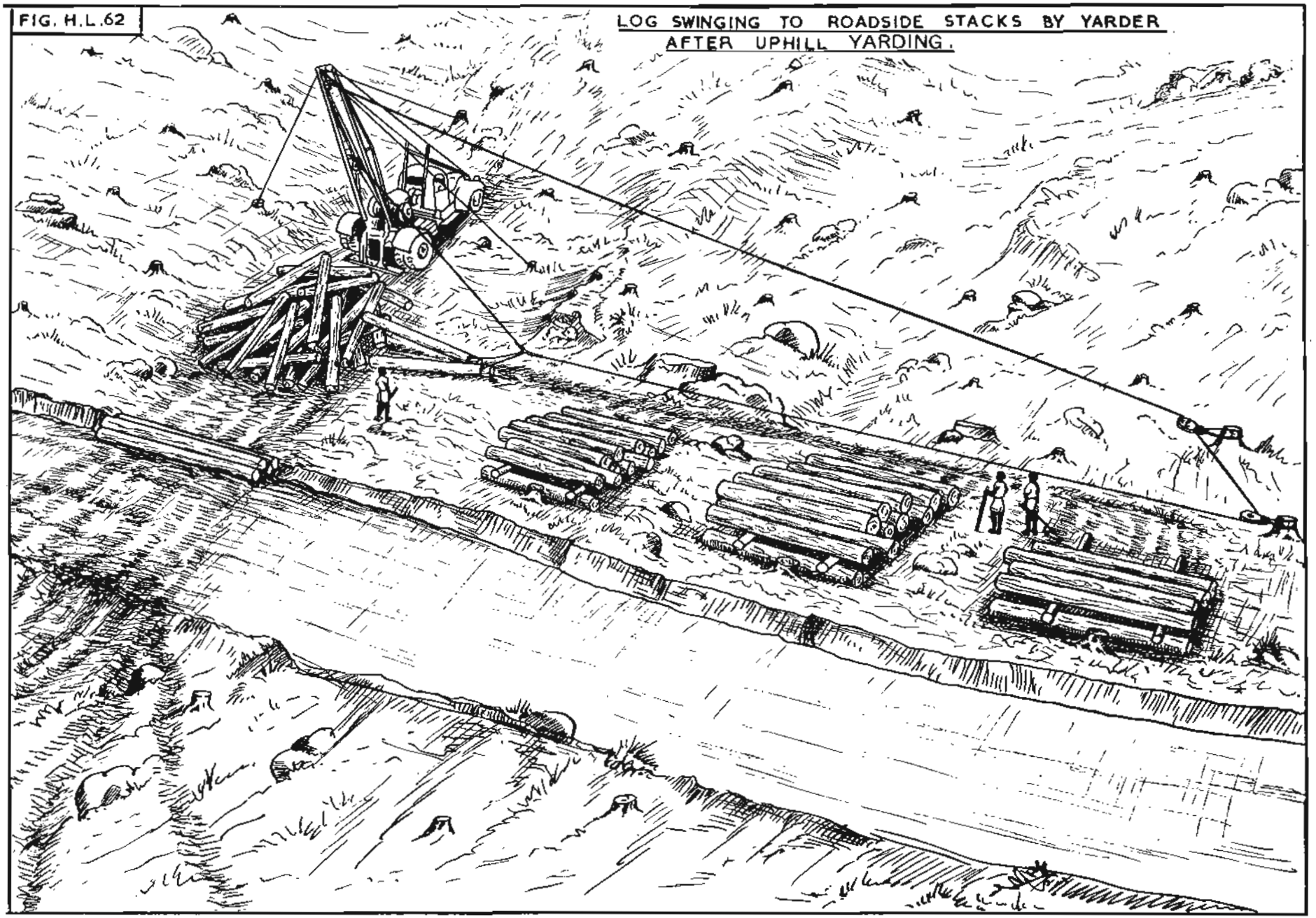


FIG. H.L.62
LOG SWINGING TO ROADSIDE STACKS BY YARDER
AFTER UPHILL YARDING.

FIG. H.L.63

GENERAL TOPOGRAPHICAL CONDITION FOR DUNHAM SYSTEM

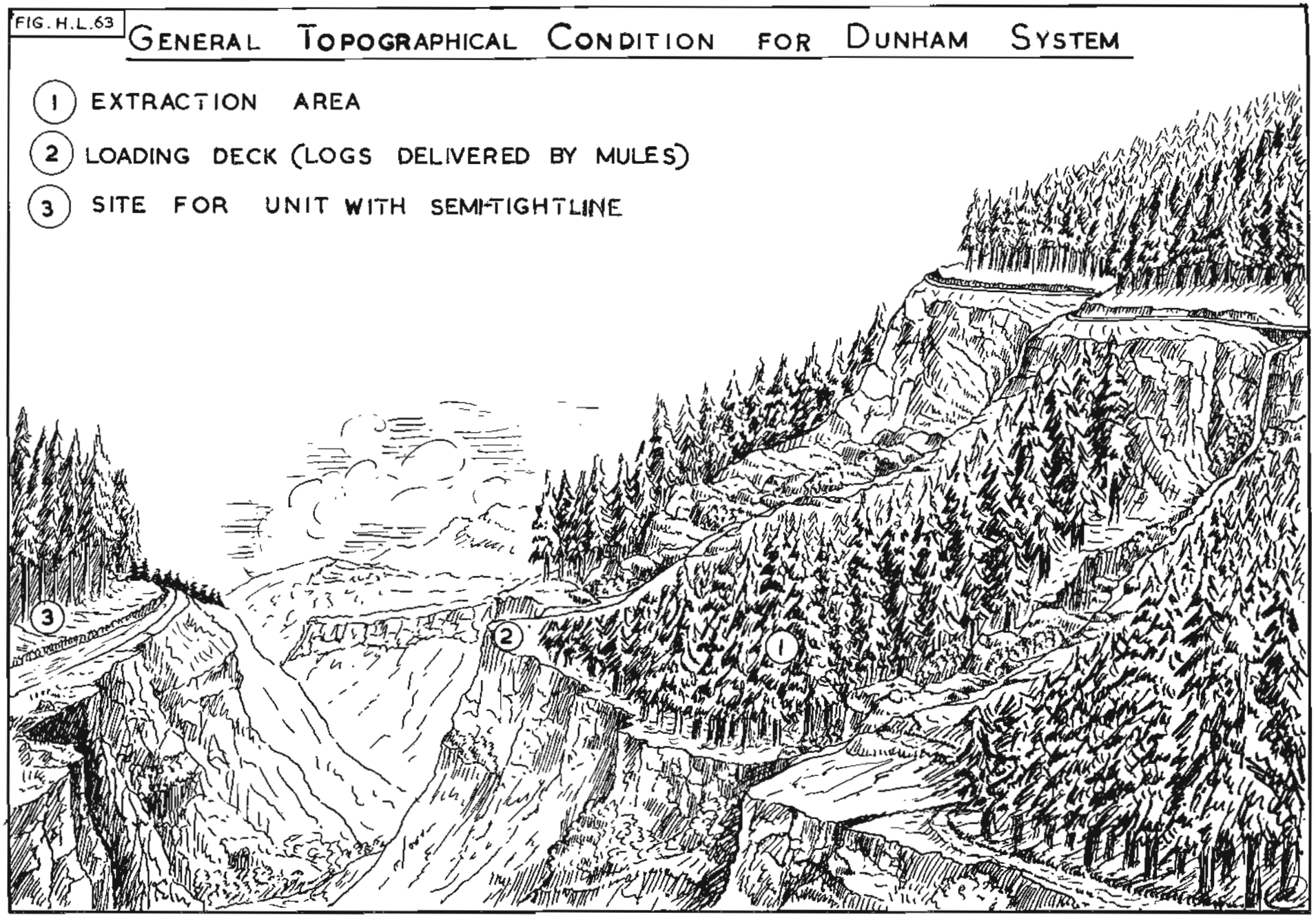


FIG.H.L.64

THE DUNHAM SEMI-TIGHTLINE SYSTEM

APPLICABLE WHEN MAIN BLOCK IS ABOVE HAULBACK BLOCK

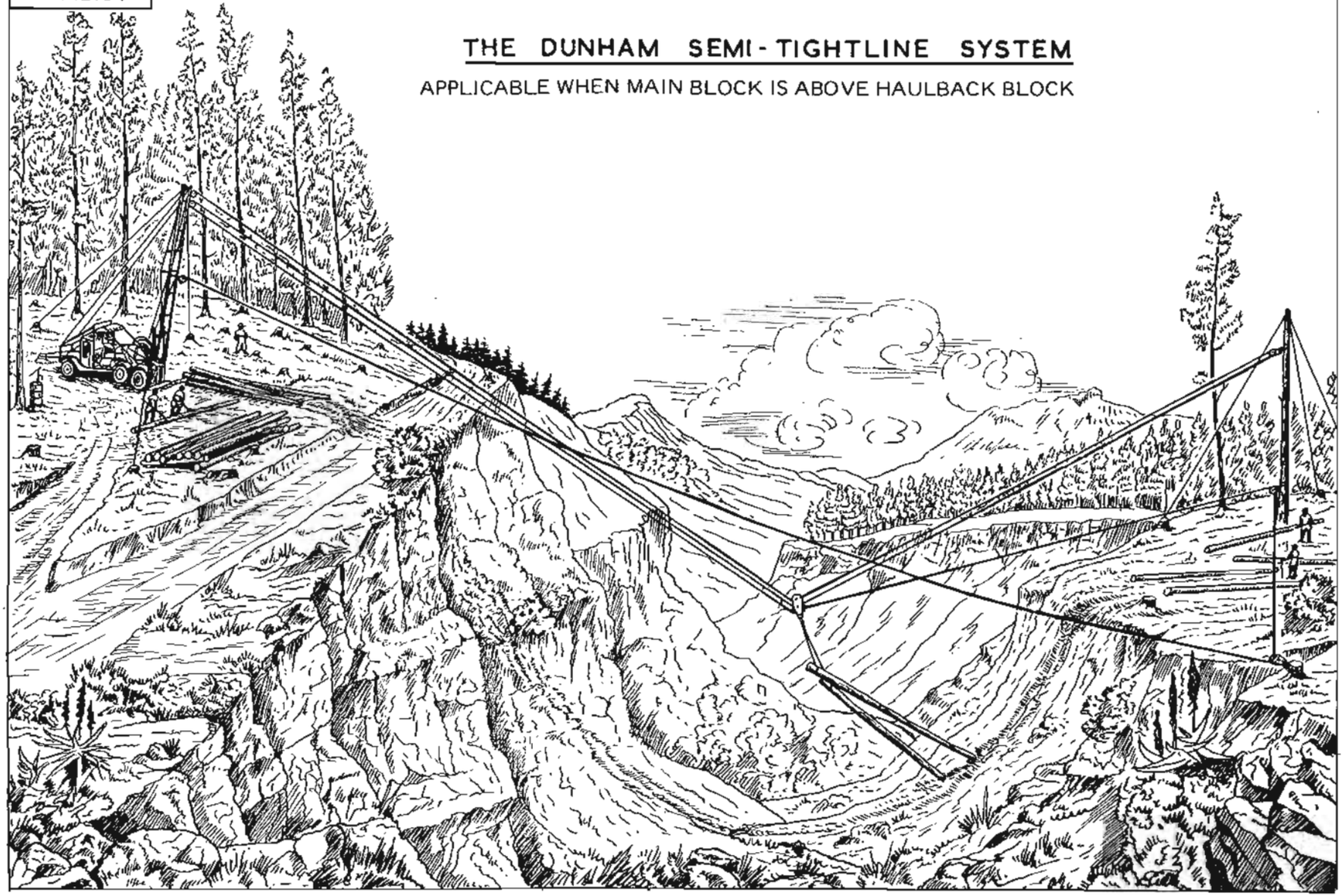
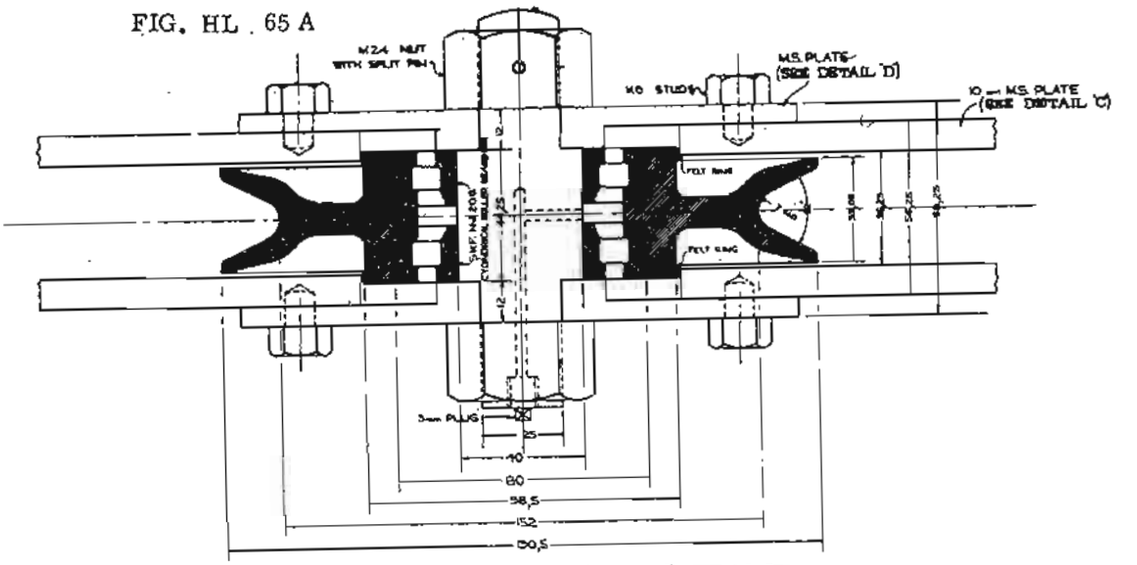
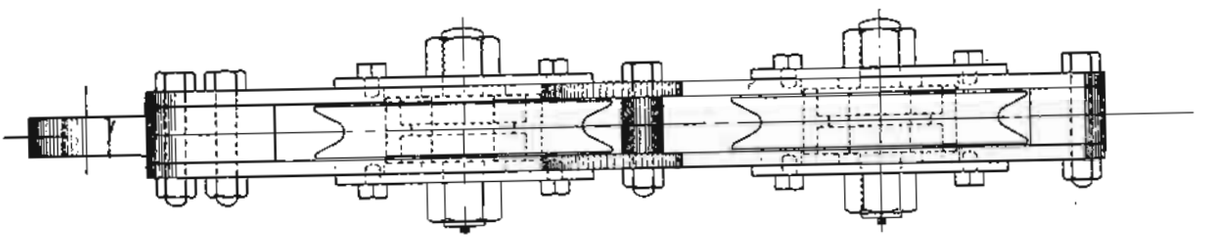


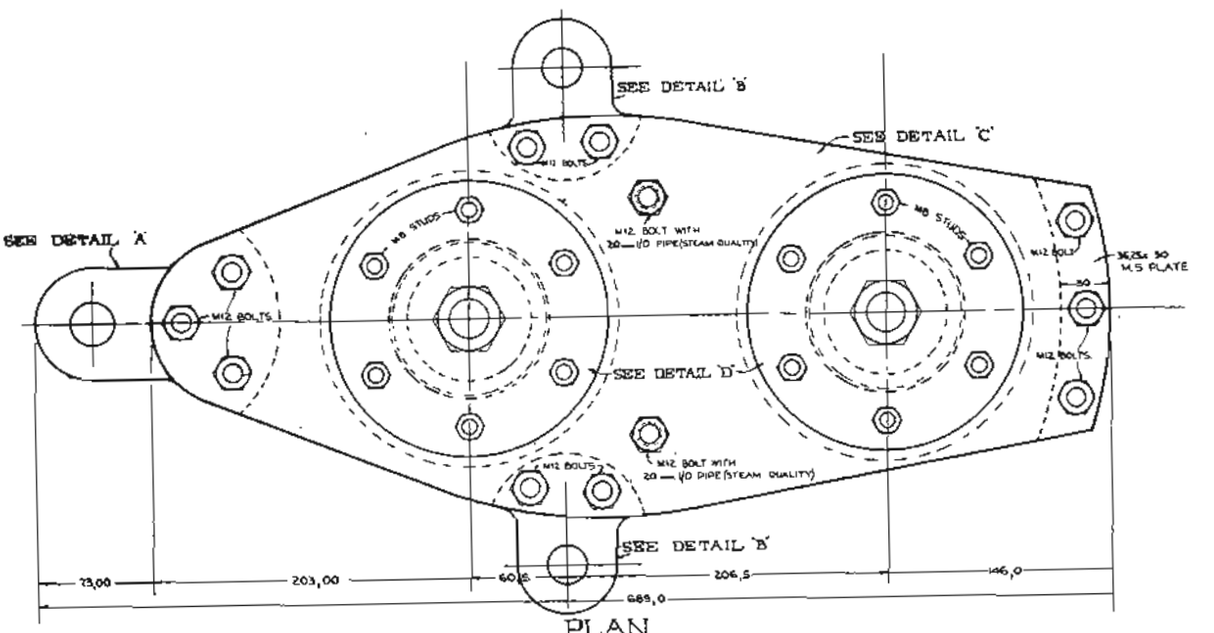
FIG. HL . 65 A



SECTION THROUGH SHEAVE



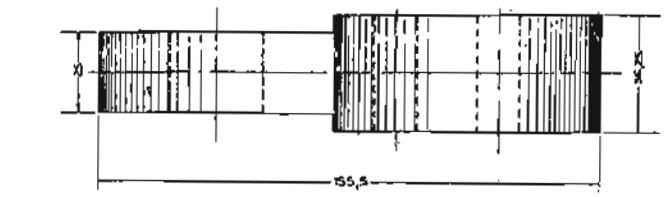
ELEVATION



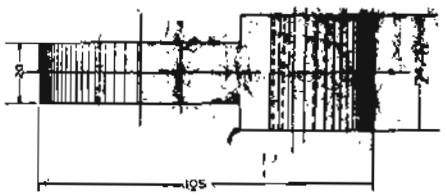
PLAN

← 46 PICES ... →

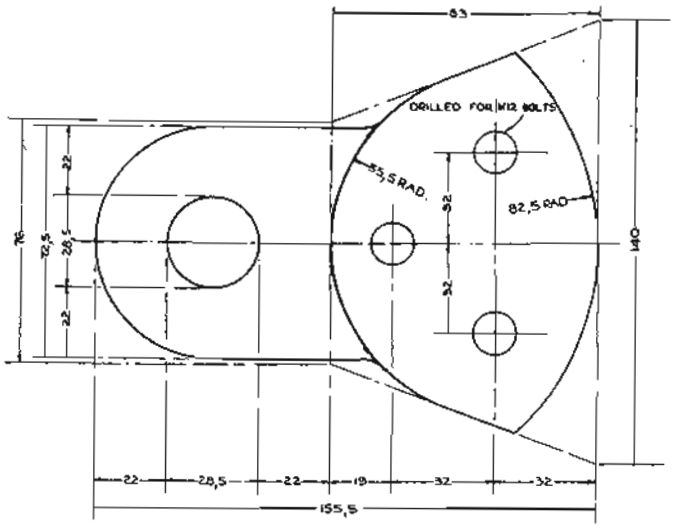
FIG. HL 65 B.



ELEVATION

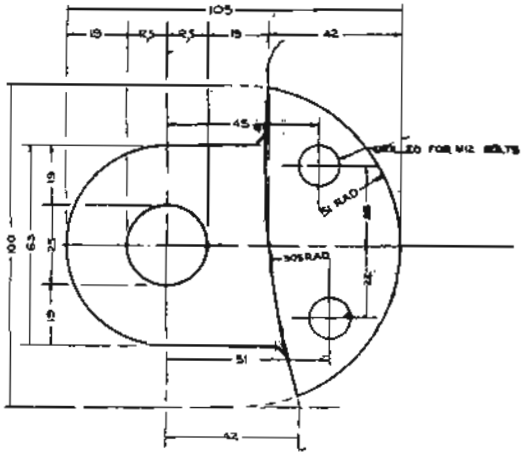


ELEVATION



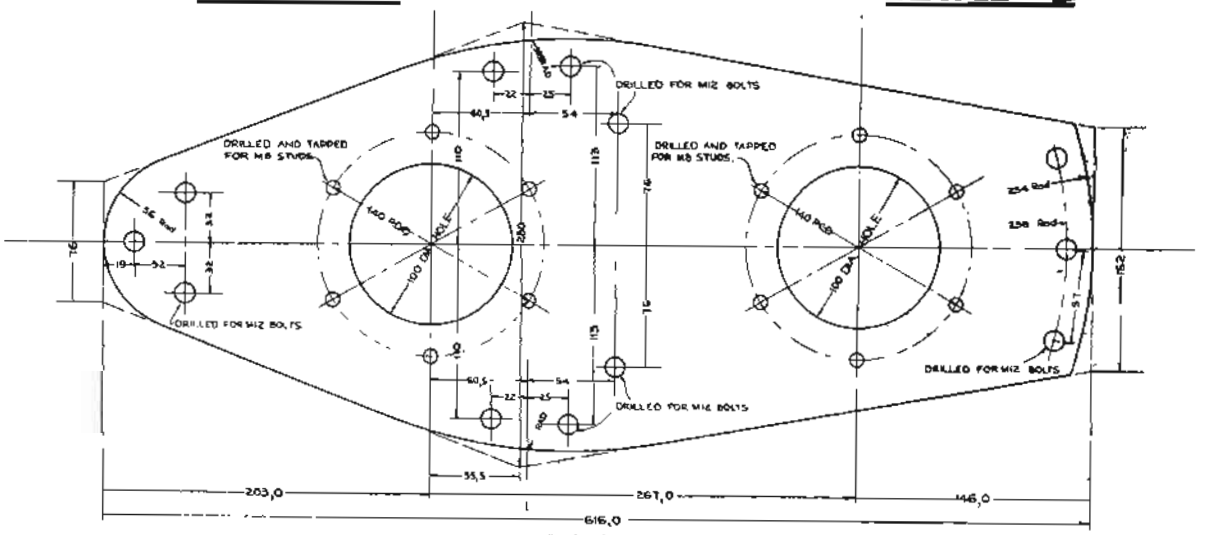
PLAN

DETAIL 'A'

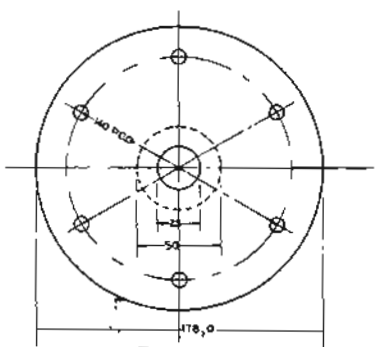


PLAN

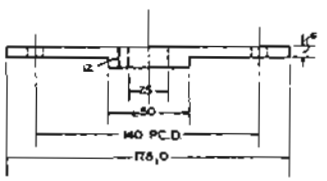
DETAIL 'B'



DETAIL 'C' (10mm M.S. PLATE)



PLAN



ELEVATION

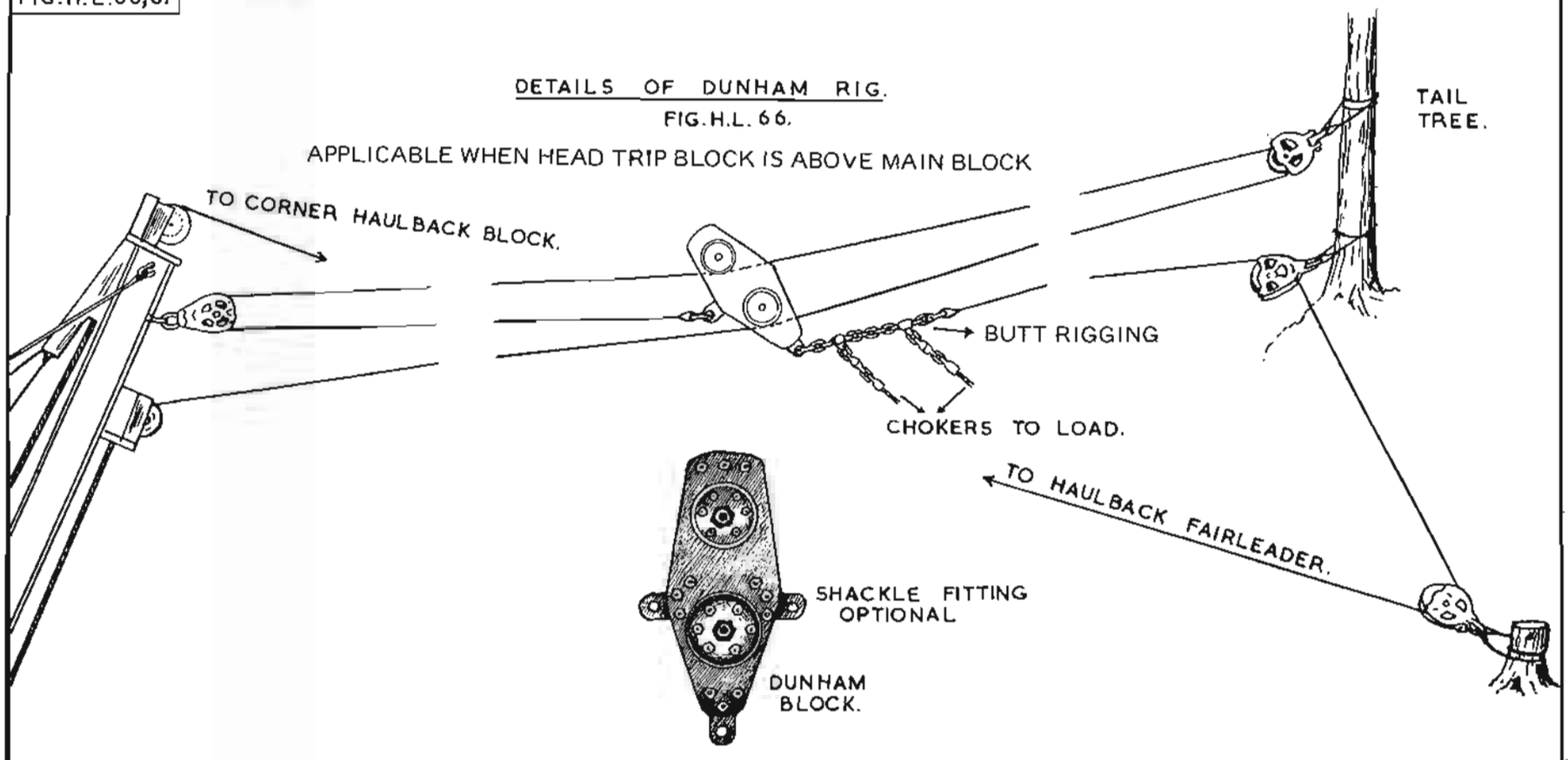
DETAIL 'D'

FIG.H.L.66,67

DETAILS OF DUNHAM RIG.

FIG.H.L.66.

APPLICABLE WHEN HEAD TRIP BLOCK IS ABOVE MAIN BLOCK



BLOCKS MUST BE WELL LUBRICATED.

FIG.H.L.67

or on the road itself. Because of this the yarder site was not selected immediately below the operating area, but rather to the side of the rock rolling line. Located across the stream the yarder was protected by the stream bank from any stray objects which may have rolled down the slope.

The yarded logs were landed on the yarder side of the stream, the main pile extending virtually to the stream-bed itself. This complicated swinging and conventional means could not be applied due to restricted access to the pile, the hazards and difficulties involved in moving the logs from the pile, and size of the logs, which were very large by South African standards.

B. LOG SWINGING TO THE ROADSIDE BY HIGHLEAD YARDER

Fig. H.L. 61 shows the solution to the swinging problem mentioned above, using the yarder itself for swinging. The yarder site, position and operating area remain the same as for the previous drawing. In this case, however, the blocks and cables were moved to the side of the yarder and above and away from the road to give ample space for log stacking. Heavier haulback blocks were used for log swinging, as the main cable had to be threaded through them instead of the haulback cable, which is the standard method. Strong, well-located stumps were selected for the block attachment. As the log stacks extended further back from the road the blocks were also moved back to make room for the oncoming logs from the landing. As the logs arrived opposite the relevant stack the cable was stopped, the logs unhooked and then rolled down to the stacks by the stacking crew.

C. LOG SWINGING BY YARDER AFTER STANDARD UPHILL YARDING OPERATION

Fig. H.L. 62 illustrates a further example of log swinging by yarder. Logs were yarded from the slope below the road to the landing deck above the road. The blocks and cables were shifted aside as described above and the log swinging operation completed by yarder, sorting logs in the correct lengths for the various stacks.

D. GENERAL REMARKS CONCERNING LOG SWINGING BY HIGHLEAD YARDER

The time spent in yarding and swinging the logs was more or less the same, owing to the following factors:

(a) The cable pulling speed for swinging was much slower than for yarding as low gear had to be used because of the short distance involved, and the logs which had to be accurately placed opposite the correct stack.

(b) Log pulling had to be halted for safety reasons while the swung logs were being removed from their slings and rolled down to the roadside stacks by the stacking crew. Only after the crew were safely beyond the reach of the cable could the operation be resumed.

4. THE DUNHAM SEMI-TIGHTLINE SYSTEM

The situation illustrated in Fig. H.L. 63 shows a steep, rocky slope on the right with a bridle-path running along the top, being the boundary of the property. Timber from the slopes below the bridle-path had to be extracted to the road on the opposite side of the deep, narrow valley. This is a typical condition for the Dunham system. Timber from the extraction area (1) must be skidded or rolled to the stacking deck (2), then transported across the valley by cable to the roadside (3).

The solution to this problem by applying the Dunham system is shown in Fig. H. L. 64.

A. APPLICATION

The purpose of the system is to lift the logs high enough to overcome major obstacles. This is achieved as follows:

(1) An additional block is added and suspended on the boom below the main block (Fig. H.L. 65).

(2) A special 2-sheave carriage is used, one sheave being near the top, the other in the middle (Fig. H.L. 65 A.B. and 67). A shackle is fitted to the side for the attachment of the yarding cable and another at the bottom of the carriage for connecting the butt rigging with chokers and haulback line attached.

(3) To produce lift, the main cable is threaded from the winch drum, through the main boom block, under the top sheave of the carriage, through the block suspended on the spar tree on the tail side of the system, back through the carriage under the lower sheave of the carriage, then through the additional block below the main block, suspended on the boom, and finally back to the carriage side shackle closest to the yarder (Fig. H.L. 64).

(4) The haulback line passes from the haulback drum through the head trip block, through the haulback block at the stump to prevent fouling with the main cable, then through the haulback on the spar tree, and it is finally connected to the shackle of the butt rigging, the latter being connected to the side of the carriage closest to the spar tree.

B. OPERATION

When the logs have been hooked to the chokers and the main drum begins pulling on the main cable and tightening it, the carriage with the load attached rises, lifting the log heads. This lift can be increased, if necessary, by holding the carriage slightly with the haulback drum brakes. When the logs have been landed and the choker slings removed, the carriage is returned by haulback cable to the log stack at the tail spar tree for the following load. Maximum range of this system is only 50-80 metres.

The advantage of the system is that only one end of the load is lifted, usually the thin, or lighter end of a tree length, while the heavier end is dragged along the ground. The full load need not be lifted off the ground.

Much less power is needed to operate the semi-tightline, so operation and erection costs are much less than those of tightline operations.

This system has not been tested in departmental plantations.

IV. ESTIMATED COSTS

1. ESTIMATED OPERATING COSTS

A. Self-propelled highlead unit (Logger's Dream)

(a) Purchase cost: (Approximately 1952)

Winch yarder with engine and boom, complete ...	R3 804,00
Delivery - 20% (U.S.A)	760,00
Carrier (second-hand lorry)	300,00
Assembling costs ...	200,00
Estimated repair costs	2 432,00
Total cost of unit ...	R7 496,00

(b) Fuel (petrol) per working hour...	5 l
Engine oil per working hour ...	0,6 l
Transmission oil per working hour	0,015 l
Grease per working hour ...	0,033 kg
Departmental hiring cost for items (a) and (b) per working hour	85c
(c) Hiring of auxiliary equipment (per working hour) (See Appendix H.L. 2 for details) ...	R1,21
Total cost for the yarder, mounted and equipped, per hour ...	R2,06
(d) Labour with yarder (per hour) (See Appendix H.L. 4 for details)	R1,38
Grand total - yarder and crew A	R3,44
(e) Swinging logs from yarder landing to roadside (per hour) (See Appendix H.L. 4 for details) B	R2,78
(f) Stacking logs at the roadside (per hour) (See Appendix H.L. 4 for details) C	R0,60
LOG YARDING COST PER HOUR including swinging to the roadside and stacking: (A) + (B) + (C) =	R6,82

B. Highlead 75 kW self-propelled yarder, lorry-mounted, with 10 m boom

Random test: Operation observed and analysed for one hour.

Conditions: Species: Pinus patula, 34 years old, clearfelled, branches covered one quarter of the tree length.
Average DBH: 44 cm; 267 trees/hectare.
Slope: 17°, undulated, yarding uphill. Surface smooth and clean.
Average stump height: 10 cm. Soil: firm and dry, deep red dolerite.
Trees felled downhill, branches and tops obstructing slinging, hooking, and to a certain extent yarding.

Crew: Yarder operator, 1 signalman, 1 man unhooking, 3 chokermen chokering and hooking.

Average data per return cable trip

Yarding distance	- 100 m (shortest 50 m, longest 120 metres)
Time to the logs	- 27 sec. - 10,5%
Time with the load	- 49 sec. - 19,5%
Hooking the logs	- 2 min. 2 sec. - 47,5%
Signalling	- 11 sec. - 4,5%
Unhooking the load	- 28 sec. - 10,5%
Delay	- 18 sec. - 7,5%
Average: Total time per trip	4 min. 15 sec. - 100%

Average number of logs per load	2,28
Average volume per load	0,78 m^3
Average volume per log	0,34 m^3

The load sizes per trip (turn) during the period of observations were as follows:

Trip

(1) - 2 logs - 0,37 m^3	(8) 4 logs - 0,78 m^3
(2) - 2 logs - 1,29 m^3	(9) 3 logs - 0,64 m^3
(3) - 1 log - 0,45 m^3	(10) 2 logs - 0,64 m^3
(4) - 2 logs - 0,38 m^3	(11) 3 logs - 1,45 m^3
(5) - 2 logs - 1,17 m^3	(12) 2 logs - 0,84 m^3
(6) - 3 logs - 0,93 m^3	(13) 2 logs - 0,70 m^3
(7) - 2 logs - 0,86 m^3	(14) 2 logs - 0,30 m^3

Note: The smallest load was 2 logs of 0,30m^3
The largest load was 3 logs of 1,45 m^3

During the observation the tail block was moved to a new position, employing two men and occupying 18 minutes. This time was not included in the calculations owing to the short time of the observation. At the end of the day the total output for 6 actual working hours was 65,8 m^3.

Cost of daily operation

(a) Log yarding by yarder

Hire of the yarder: 85c x 6 hours	R5,10
Hire of auxiliary equipment: R1,21 x 6 hours	7,26
Operator's wages: 88c x 8 hours	7,04
Labourers' wages: 70c x 8 hours x 4 men	2,80
Total daily yarder cost	R22,20

Total log yarding cost per m^3 with the yarder:
R22,20 ÷ 65,8 m^3 = 33,7 c/m^3 ... (1)

(b) Log swinging from yarder landing deck to roadside

2 men with team of 4 mules: Average distance 46m
Labourers' wages with rations (70c + 10c)x2 = R1,60
Hire of mules: R4,84 ÷ 22 days x 4 mules = R0,88
Total daily cost for log swinging R2,48

R2,48 ÷ 65,8 m^3 = 3,8 c/m^3 ... (2)

(c) Log stacking at the roadside

Crew: 6 men stacking, 1 man tallying
7 men @ 80c = R5,60
R5,60 ÷ 65,8 m^3 = 8,5 c/m^3 ... (3)

Grand total costs for yarding: (1), swinging (2) and stacking (3)

= 46,0 c/m^3

Remarks

The yarding operation described above had an output above average for departmental conditions. Conditions favouring the operation were:

(1) The terrain was virtually without obstacles.

(2) The yarding distance was comparatively short so "hang-ups" seldom occurred.

(3) The site of the yarder and log landing deck was convenient.

(4) The total daily yarder output could be cheaply swung to the roadside by a team of 4 mules.

(5) Log stacking at the roadside was easy, the logs being rolled down to the stacks. Sufficient stacking room was available and the stacks were only 4 logs high.

The following factors were against the operation being fully successful:

(i) Slinging and hooking the logs to the main cable took 47% of the total time per average trip owing to the fact that no prechoking (slinging ahead with spare chokers) had been done. Passing the choker slings beneath the logs proved a time-consuming process as holes had to be dug beneath the logs before the slings could be passed around them. Apart from this, heavy branches and tops littered the area and hampered movement in the vicinity of the logs.

(ii) Owing to the limited number of chokers attached to the main line of the yarder only two logs were generally hooked per trip and consequently the yarder was never evenly or fully loaded. Some of the logs were small.

(iii) The yarder only actually worked for six hours, but the operation was charged with the full days wages of the yarder crew.

(iv) The operator's and crew's working skill was below standard.

2. HIGHLEAD LOG YARDING OPERATION: Data from report for 75 kW Logger's Dream

A. (1) Log yarding in compartment B.32 (a)
(2) There were 57 working days and 312 working hours.
(3) Average working hours per day: 5½
(4) Total volume of tree lengths yarded: 5 080 m^3
(5) Volume yarded per working day: 100 m^3
(6) Volume yarded per working hour: 18 m^3

Note: Conditions for yarding and log landing were favourable

B. (1) Log yarding in Compartment B18 (b) and B25 (d)
(2) There were 19 working days and 99 working hours
(3) An average of 5½ hours was worked per day
(4) Total volume of tree yarded lengths: 890 m^3
(5) Volume yarded per working day: 46 m^3
(6) Volume yarded per working hour: 9 m^3

Note: Yarding conditions were extremely unfavourable

C. The following was the Bantu labour used with the highlead yarding:

(1) Two for slinging tree lengths with chokers.

(2) One signalman, who also assisted with choking.

(3) One at the landing for unhooking the chokers and hooking logs for the tractor swinging to the roadside.

(4) One tractor was used for swinging trees to the roadside where they were cross-cut. Another tractor and oxen, or oxen alone, were used to sort the cross-cut logs and swing them to the stacks.

3. ESTIMATED COST OF LOG YARDING COMPARTMENT B32 (a)

A. Tree lengths yarded by highlead over a maximum distance of 210 m

Hire of the yarder: 85c per hour x 5,5 hours	R4,68
Hire of auxiliary equipment: R1,21 x 5,5 hours	R6,66
Operators wages 88c x 8 hours	R7,04
4 labourers x 70c per day	R2,80
Total yarding cost	R21,18

R21,18 ÷ 100 = 21,2 c/m^3 .... (1)

B. Swinging tree lengths from yarder deck to roadside for cross-cutting

Tractor, B.T.D.6 - hire per hour	R1,59
Auxiliary equipment - hire per hour	R0,17
Cost per hour: tractor plus equipment	R1,76
Hire of tractor per day: R1,76 x 6 hours	R10,56
Operator's wages: 88c x 8 hours	R7,04
Chokermen: 1 x 70c	R0,70
Cost of swinging trees by tractor:	R18,30

R18,30 ÷ 100 m^3 = 18,3 c/m^3 .... (2)

C. Log skidding (swinging or sorting) to the stacks

Tractor as per item (2)	R18,30
Two teams of oxen x 2 oxen x 24c per ox	R0,96
Leaders and hookers 3 x 70c	R2,10
Total cost of log sorting	R21,36

R21,36 ÷ 100 = 21,3 c/m^3 .... (3)

Total cost: 21,2c + 18,3 + 21,3c = 60,9 c/m^3

Note: Log stacking is not included

4. COSTS OF LOG YARDING BY HIGHLEAD IN COMPARTMENT B18 (b) and B25 (d)

Tree lengths yarding by highlead over a maximum distance of 210 m

(a) Yarding by highlead:

Hire of yarder and labour per day:	R21,18

R21,18 ÷ 47,2 m^3 = 44,9 c/m^3 (1)

(b) Swinging the trees to roadside by tractor for cross-cutting:

R18,30 ÷ 47,2 m^3 = 38,8 c/m^3 (2)

FIG. H L 68

HIGHLEAD AND McLEAN BOOM LOADING

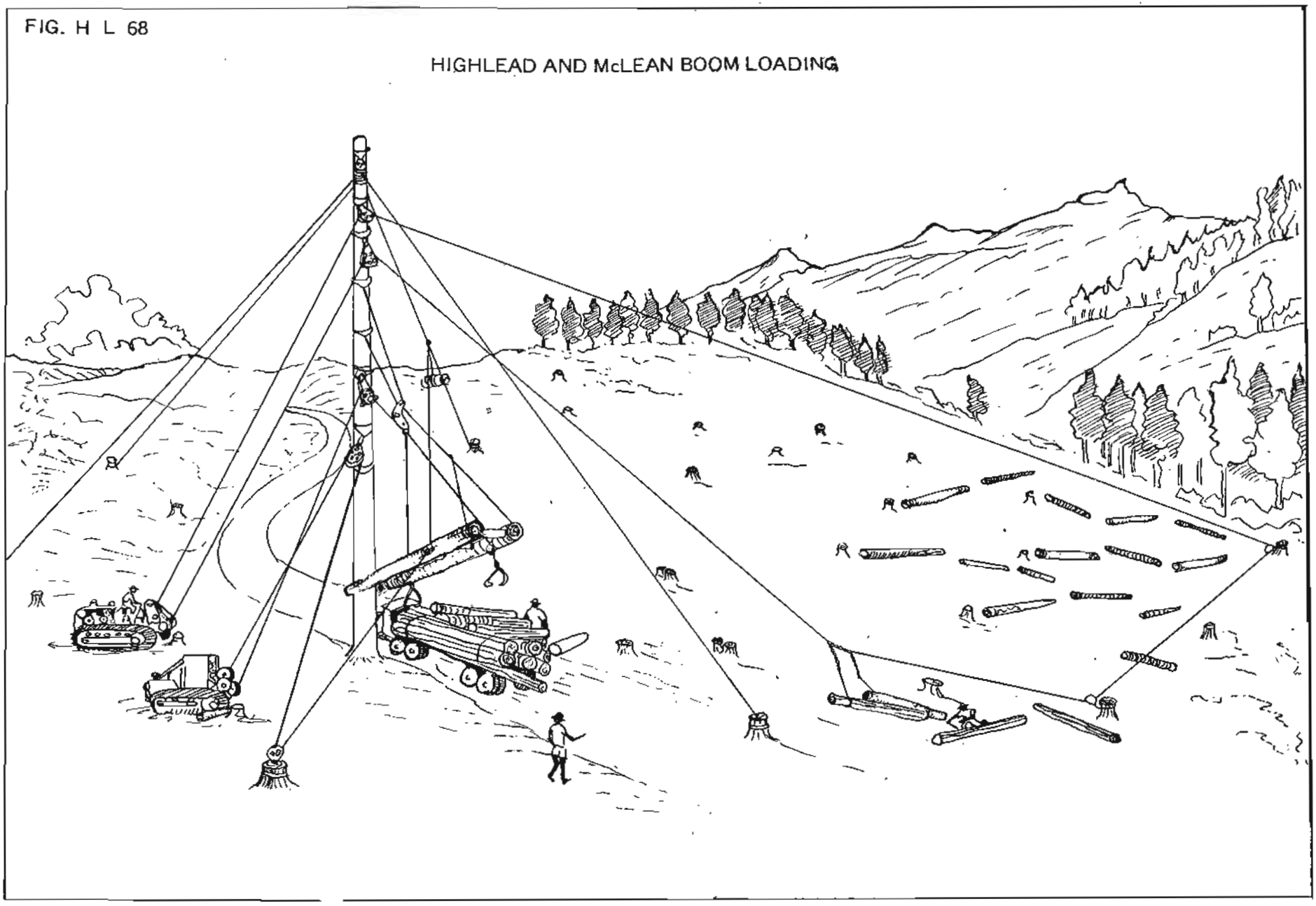
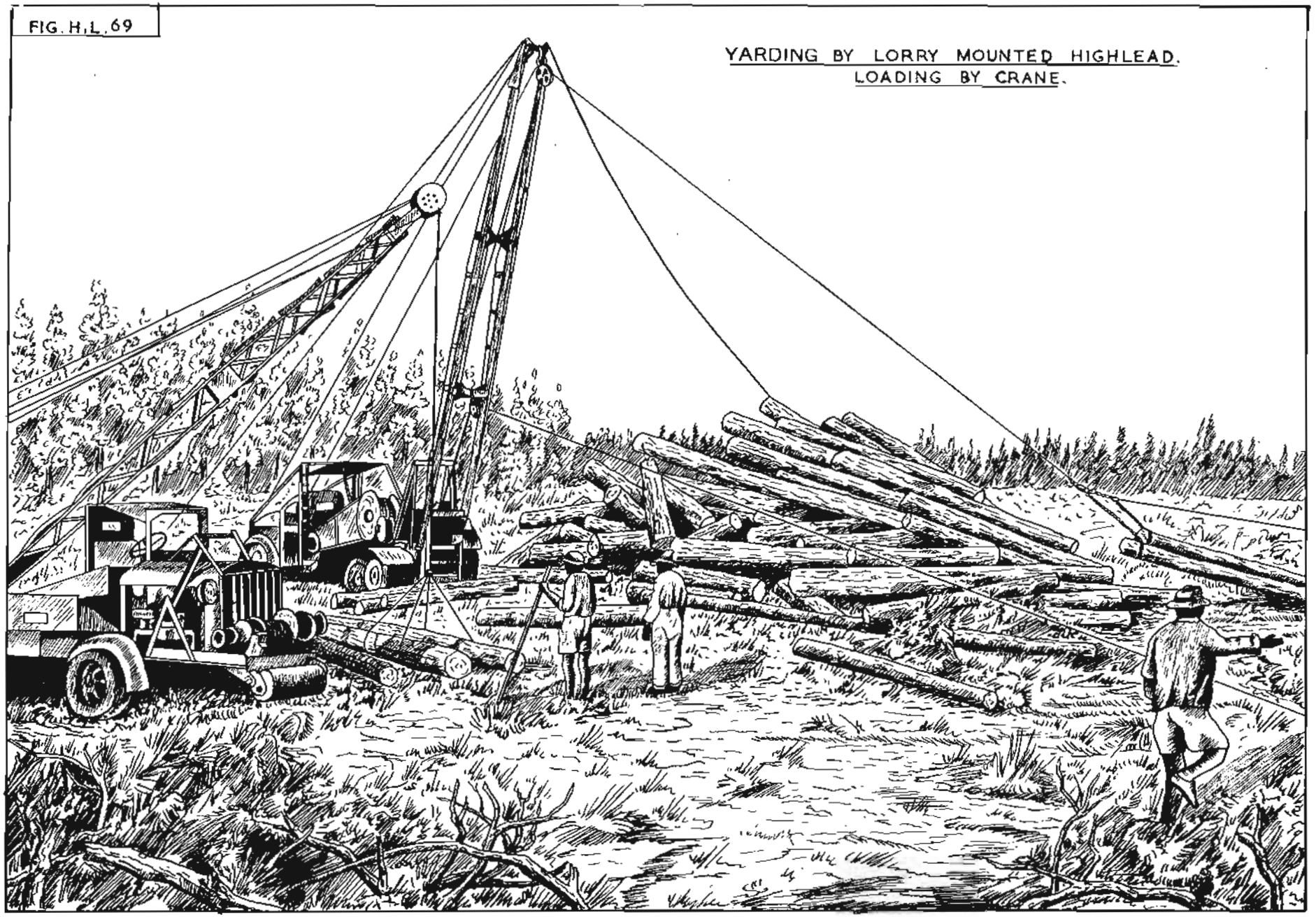


FIG. H.L.69

YARDING BY LORRY MOUNTED HIGHLEAD.
LOADING BY CRANE.



(c) Sorting the logs for stacking at the roadside:
Partly by tractor - cost included under item (2)
Balance by oxen (2 teams)

Hire of oxen	...	R0,96
Labour 4 units	...	R2,10
		R3,06

R3,06 ÷ 47,2 m^3 = 6,5 c/m^3 ... (3)
Total cost: 44,9 + 38,8 + 6,5 = 90,2 c/m^3

Note: 1. The cost of log stacking at the roadside is not included. Six Bantu labourers were used

2. In the case of the above operation in Compartment B. 32(a), only one tractor with a bulldozer blade, and two teams of oxen would probably have been able to cope with the swinging and sorting operation, thereby reducing the cost of the operation by one tractor. This would have considerably reduced the overall cost

V. CONCLUSIONS AND GENERAL REMARKS

The yarding capacity of the highlead yarder is considerable and under favourable conditions the output can be increased to well above the departmental average. The output achieved depends to a large extent on the yarding, landing and swinging conditions, suitability of the equipment used, and planning of the operation. In most cases, however, highlead is used only in adverse conditions. Ground surfaces are usually rough and steep, so there is limited space at the machine site or log stacking and landing decks. In mountainous country logs are frequently small in size, but must, nonetheless, be yarded in the usual manner as "bunch" yarding presents many difficulties. Assembling of logs in sling-sized bunches on the steep slopes is a problem in itself.

The task of the highlead yarder is to yard timber which is inaccessible for other towing means or equipment. The unit is built for that purpose and does the job satisfactorily, with its output dependent upon the size of the yarder, yarding distance, configuration of terrain, surface conditions, size of timber and the skill of the operating crew.

A. YARDING TREE LENGTHS

Yarding tree lengths with the yarder increases the output to such an extent as to be more than that of a tractor skidding over easy ground for only half the distance; although in the case of the highlead additional equipment is required for swinging the logs from the landing to the roadside for cross-cutting, to avoid accumulation of timber at the yarder landing. Although the output may increase, there are numerous disadvantages associated with yarding tree lengths:

(1) Tree lengths can, in the case of medium-sized trees, be yarded by a 75 kW yarder, but larger trees are cumbersome to handle when swinging, cross-cutting, and sorting for stacking at the roadside.

(2) Difficulty is experienced in manoeuvring them over steep slopes from the landing to the cross-cutting, sorting or stacking decks.

(3) Tree lengths must be removed from the landing, cross-cut and the logs then moved again to stacks of various log lengths or dimension classes, for easy loading and transporting to their various destinations. This involves additional time and labour and raises the cost of the operation.

(4) Considerable landing, and swinging, sorting and stacking space is required to accommodate tree lengths.

(5) Convenient conditions are seldom available where highlead operations are necessary, which frequently necessitates that logs be yarded in preference to tree lengths.

B. COMBINED OPERATIONS

In order to eliminate log swinging and sorting, methods have been developed for loading logs directly onto lorries from the yarder landing. The following are the more common among them:

(1) With spar tree:

(a) Guy-line (or spar tree) loading.

(b) McLean boom loading (Fig. H.L. 68);

(c) Heel boom loading.

(2) In the case of a self-propelled yarder with its own boom, the yarder works in conjunction with a self-propelled crane (Fig. H.L. 69).

None of these combinations can work to full capacity as yarding and loading cannot be carried out simultaneously and uninterruptedly. Not only would it be unsafe to conduct the two operations simultaneously, but yarding also requires twice as much time as loading.

The following requirements are necessary for a successful combined operation:

(i) Logs of uniform size are a distinct advantage in the combined type of operation particularly with regard to their length, as this simplifies lorry loading.

(ii) There should always be sufficient space around the yarder and loader to permit access for lorries to the loader.

(iii) A constant supply of lorries is essential to prevent logs accumulating on the landing (Fig. H.L. 69).

Note:

(1) A spar tree rigged with equipment for both yarding and loading requires less space than the combined operation of a self-propelled yarder and crane. This is largely due to the fact that departmental yarders with spar trees (usually tractor-mounted with double-drum winches) need not necessarily be alongside the spar tree. If necessary the yarder can be away from the road as is often necessary in mountainous country, in which case the machine site need not affect lorry traffic on the road, or in the immediate loading area.

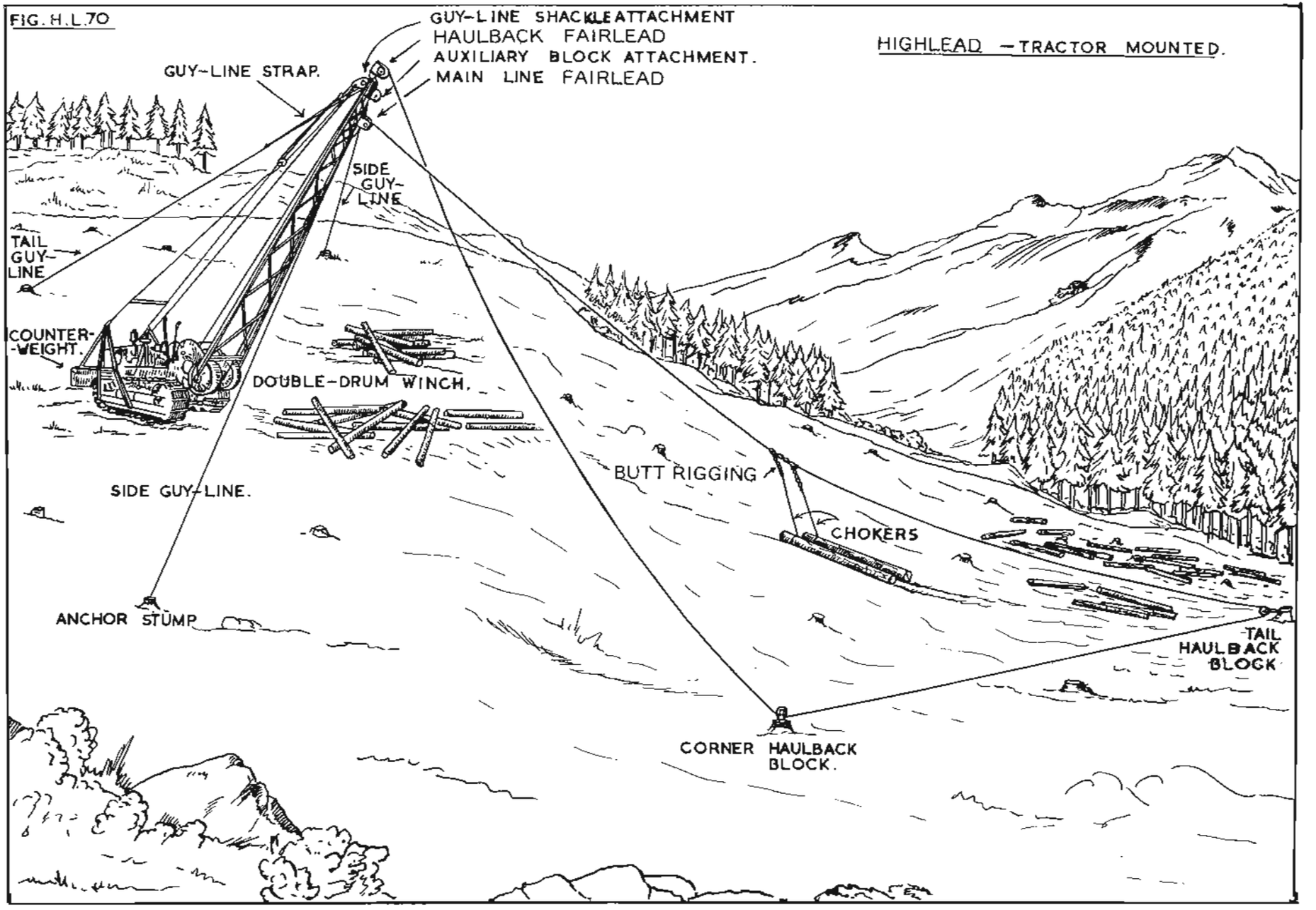
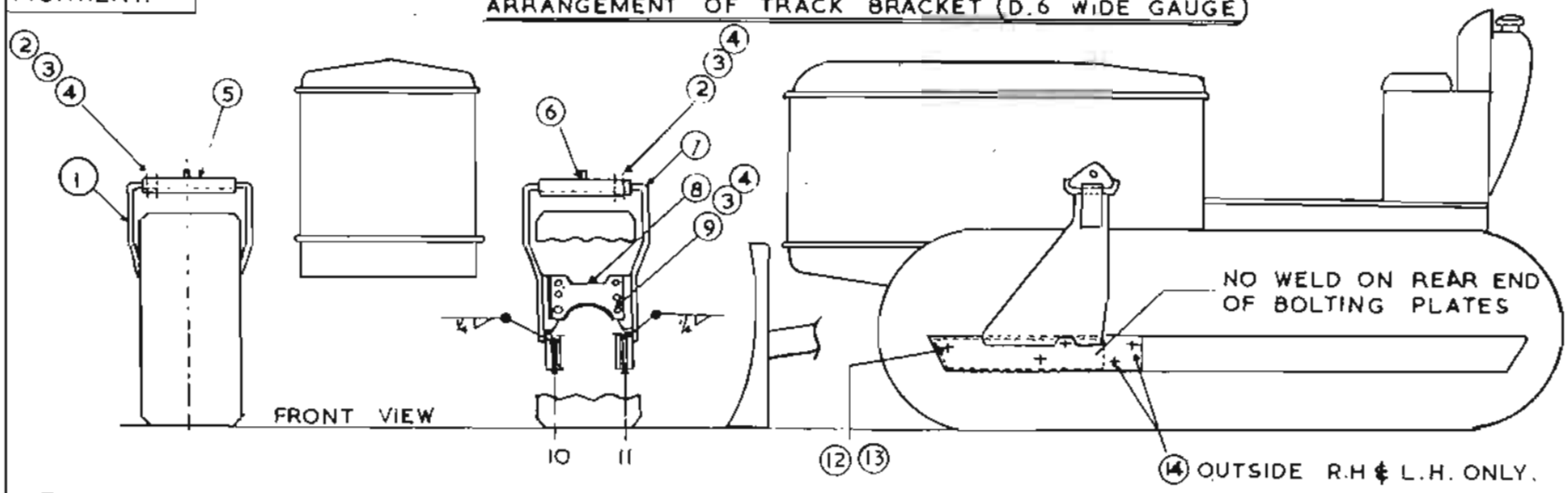


FIG. H.L.70
GUY-LINE SHACKLE ATTACHMENT
HAULBACK FAIRLEAD
AUXILIARY BLOCK ATTACHMENT.
MAIN LINE FAIRLEAD
HIGHLEAD — TRACTOR MOUNTED.
GUY-LINE STRAP.
SIDE GUY-LINE
TAIL GUY-LINE
COUNTER-WEIGHT.
DOUBLE-DRUM WINCH.
BUTT RIGGING
CHOKERS
SIDE GUY-LINE.
ANCHOR STUMP
TAIL HAULBACK BLOCK
CORNER HAULBACK BLOCK.

FIG. H.L. 71.

ARRANGEMENT OF TRACK BRACKET (D.6 WIDE GAUGE)



(1)	1	81934-A	BRACKET-TRACK (R.H. OUTSIDE)
(2)	8	15557	CAPSCREW - 19 U N F x 69 mm
(3)	20	15162	LOCKWASHER -19 mm
(4)	20	15012	NUT-HEX (19 mm U N F)
(5)	1	92575-A	BRACKET-TRACK (R.H. INSIDE)
(6)	1	92576-A	BRACKET-TRACK (L.H. INSIDE)
(7)	1	81924-A	BRACKET-TRACK (L.H. OUTSIDE)
(8)	2	58544	PLATE -CENTRE
(9)	12	15576	CAPSCREW. -19 U N F x 63 mm
(10)	2	81916	PLATE-BOLTING (INSIDE)
(11)	2	81915	PLATE-BOLTING (OUTSIDE)
(12)	20	81922	STUD
(13)	20	81917	NUT
(14)	4	58061	BOLT.

INSTALLING INSTRUCTIONS.

CLEAN OFF TRACK FRAMES. SET STUDS (12) 22mm INTO BOLTING PLATES (10) & (11) AND ATTACH TO RESPECTIVE TRACK BRACKETS REMOVE FRONT TWO BOLTS FROM TRUNNION PLATES AND PLACE OUTSIDE TRACK BRACKET IN POSITION. USE BOLT (14) TO SECURE IT AND LOCATE BOLTING PLATE 6mm BELOW TOP EDGE OF TRACK FRAME. TACK WELD IN PLACE.

BOLT INSIDE TRACK BRACKET TO OUTSIDE TRACK BRACKET WHICH WILL LOCATE INSIDE BOLTING PLATE (10) 6mm BELOW TOP EDGE OF TRACK FRAME. TACK WELD IN PLACE.

REMOVE TRACK BRACKETS AND WELD BOLTING PLATES. SECURELY WITH 6mm FILLET WELD. REASSEMBLE AS SHOWN.

NOT TO SCALE.

FINISH SYMBOLS REFER TO AVERAGE ROUGHNESS - MILLIMETRES

HYSTER CO. NO. 92577.

FIG. H.L 72

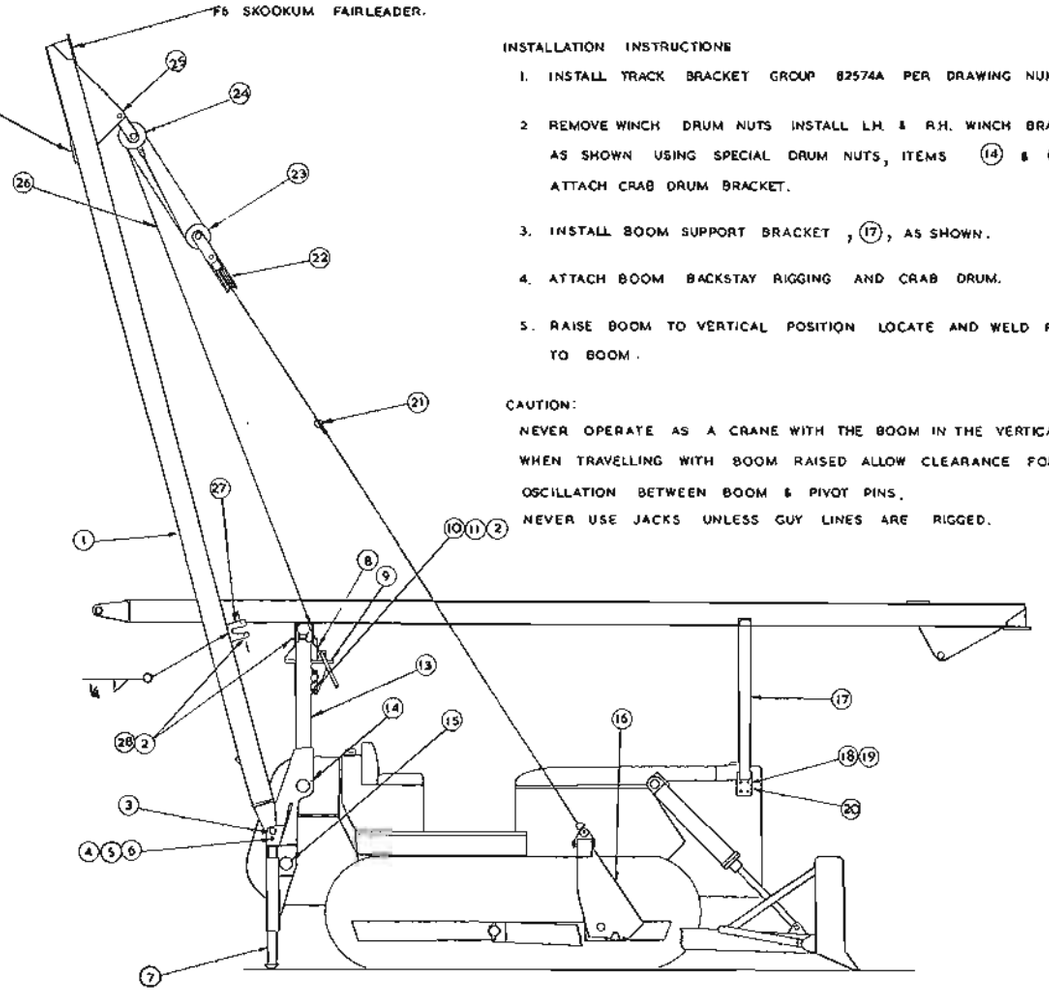
F8 SKOOKUM FAIRLEADER.

SKS 6248 – 38A.

F8 SKOOKUM FAIRLEADER

(1)	1	SKS5248-39W	BOOM
(2)	2	SKS5248-41W	PIN.
(3)	2	SKS524-34	PIN
(4)	2	80926	ANCHOR.
(5)	2	15579	CAPSCREW - 1.5 UNF X 4.4
(6)	2	15160	LOCKWASHER – 1.5
(7)	2	40416B	LEG – JACK.
	2	81185	SCREW – JACK.
	2	80952	ROLL PIN
	2	40416A	JACK PIN ASSEMBLY.
(8)	1	37970A	CRAB DRUM
	4	15500	CAPSCREWS – 1.5 UNF X 3.8
	4	15160	LOCKWASHERS – 1.5
	4	15010	NUT – HEX – 1.5 – NF.
(9)	1	SKS5248-23W	BRACKET – CRAB DRUM
(10)	12	15504	CAPSCREW 1.5 UNF X 3.1
(11)	12	15160	LOCKWASHER 1.5".
(12)	13	15010	NUT – HEX – 1.5 UNF.
(13)	1	SKS5248 3W	BRACKET – R. H
	1	SKS5248 4W	BRACKET – L. H.
(14)	2	SKS5248-33	DRUM NUT – UPPER
(15)	2	SKS5248-32	DRUM NUT – LOWER.
(16)	1	92574A	TRACK BRACKET GROUP.
(17)	1	SKS5248 35W	BRACKET – FRONT SUPPORT
(18)	8	15504	CAPSCREW 1.5 – UNF X 3.1
(19)	8	15160	LOCKWASHER – 1.5
(20)	2	SKS5248-36	PLATES BOLTING
(21)	1	47087	SPREADER BAR
	2	35854B	CABLE CLAMP
(22)	1	36514A	EQUALIZER BLOCK
	1	36090	CONNECTING PIN
	2	15240	COTTERS – .5 X 5.0
(23)	1	36513A	LOWER BLOCK
(24)	1	36512A	UPPER BLOCK
(25)	1	36092	BACKSTAY MOUNTING PIN.
	2	15246	COTTERS .5 X 5.0
(26)	1	36768A	BACKSTAY LINE
	1	38198A	OPEN SOCKET
	1	37998	FERRULE
(27)	2	SKS5248-40	PLATE

*ITEMS TO BE FURNISH BY CUSTOMER



(28) (2) 15246 COTTER – .5 X 5.0

INSTALLATION INSTRUCTIONS

1. INSTALL TRACK BRACKET GROUP 82574A PER DRAWING NUMBER 92577A.
2. REMOVE WINCH DRUM NUTS INSTALL L.H. & R.H. WINCH BRACKETS. AS SHOWN USING SPECIAL DRUM NUTS, ITEMS (14) & (15) ATTACH CRAB DRUM BRACKET.
3. INSTALL BOOM SUPPORT BRACKET, (17), AS SHOWN.
4. ATTACH BOOM BACKSTAY RIGGING AND CRAB DRUM.
5. RAISE BOOM TO VERTICAL POSITION LOCATE AND WELD PLATES, (27), TO BOOM.

CAUTION:

NEVER OPERATE AS A CRANE WITH THE BOOM IN THE VERTICAL POSITION.
WHEN TRAVELLING WITH BOOM RAISED ALLOW CLEARANCE FOR TRACK OSCILLATION BETWEEN BOOM & PIVOT PINS.
NEVER USE JACKS UNLESS GUY LINES ARE RIGGED.

D SKS 5248-38A.
R-

Traced by: G. Brunell 2/14/1963.

MATERIAL LISTED.	SCALE. 12.7mm = 50.0cm	DES. NO T–	PART NO. D SKS5248 38A
	DATE 12-22-61		
	DR. RPA	MODEL 3R CRANE	NAME. GENERAL ARRANGEMENT
			HYSTER COMPANY. PORTLAND OREGON

(2) The practice of heaping logs in front of the yarder to the maximum height in order to avoid log swinging is not really practical or safe, as the task of breaking up such an enormous heap is difficult, costly and dangerous (Fig. H.L. 69).

C. PROBLEMS IN HIGHLEAD OPERATIONS

A smooth, yarding operation by highlead yarder with boom or spar is partly ensured by co-ordinating the yarding distance and boom height, i.e. the height of the main cable block suspension.

The yarding distance should not exceed 9 times the boom height for short booms, or 8 times the boom height for long booms. Distances below 100 metres are regarded as being short and distances exceeding this as long. Thus, if the yarding distance is 80-100 metres, a boom of 10 metres high is adequate, but should the yarding distance be in the vicinity of 150 metres, a boom or spar tree of at least 20 metres high will be required.

If it is attempted to highlead greater distances, breakages of equipment will occur when the load is brought to a sudden stop against an obstacle, and there is no boom "lift" to help it over. When a load being pulled at full speed is abruptly halted against an impassable obstacle such as a rock, stump, etc., the whole yarder unit is jarred and some part is liable to break or give way. In most cases the clutch plate lining is the first to go, as it is torn off and the operation stops. If the original interwoven type of clutch plate lining is replaced by a cork lining, the drum dog clutch is displaced on its shaft at the point of fitting, or the boom gets bent. Machine manufacturers recommend that the drum brake be applied before declutching when hang-ups occur, but this is not always possible.

Alternatively the unit transmission can be fitted with a "fluid drive" or "torque converter". Both of these items, however, only produce about 5% slippage under full speed, which is inadequate to safeguard the mechanism against breakage when the unit while under full speed is jarred to an abrupt stop by a hang-up.

The only solution for pulls over long yarding distances is to ensure that the boom or spar tree is of sufficient height.

Note: Departmental experience indicates that the yarded load should not exceed three or four tons for a 75 kW yarder

VI. HIGHLEAD YARDER WITH BOOM: TRACTOR-MOUNTED

INTRODUCTION

This unit serves the same purpose as the 75 kW highlead, lorry-mounted, but is of a different design.

Two types of tractors have been employed departmentally as carriers for the winches and boom attachments, viz. 48 kW D.6 Caterpillar tractors and 34 kW D.4 Caterpillar tractors, equipped with Hyster type double-drum logging winches, with Gypsey spools.

Before the tractors were converted into highlead yarders by the addition of a double-drum logging winch and boom (jib), they were employed as bulldozers or towing crawler-tractors in the plantations. Some had already worked in this capacity for 17 000 meter hours. One D.4 had twice broken its frame after capsizing on steep slopes when towing logs, while the frame of another was bent and the tracks were apt to fall off. Both the tractors were troublesome and old enough to be written off, but they were instead successfully converted into highlead yarders.

Tractor-mounted yarders are designed for use on narrow roads located on steep, rocky slopes through compartments with small or medium sized timber. The units are primarily used in clear-felling, but may be used in thinnings, although the output is greatly reduced in the latter case due to the frequent changes of operating site. They may also be used for log loading in emergencies when the standard, more efficient mobile crane is not available.

The tractor-mounted yarder consists of a double-drum logging winch with auxiliary spool, supporting jacks and folding boom with "A"-frame, hoist superstructure and boom supports and counterweights, as well as the necessary rigging, all mounted on the tractor as carrier. Counterweights may take the form of fitted boxes housing removable concrete slabs, or the bulldozer blade may be used for this purpose, either rigidly fixed in position or still capable of working by means of the hydraulic lifts.

Details can be seen in Fig. H.L. 70. Instead of a bulldozer blade as counterweight, concrete blocks are shown supported by an "A" frame. Fig. H.L. 71 and 72 show the technical details of the tractor with a blade mounted as counterweight, together with the arrangement of the relevant bracket required.

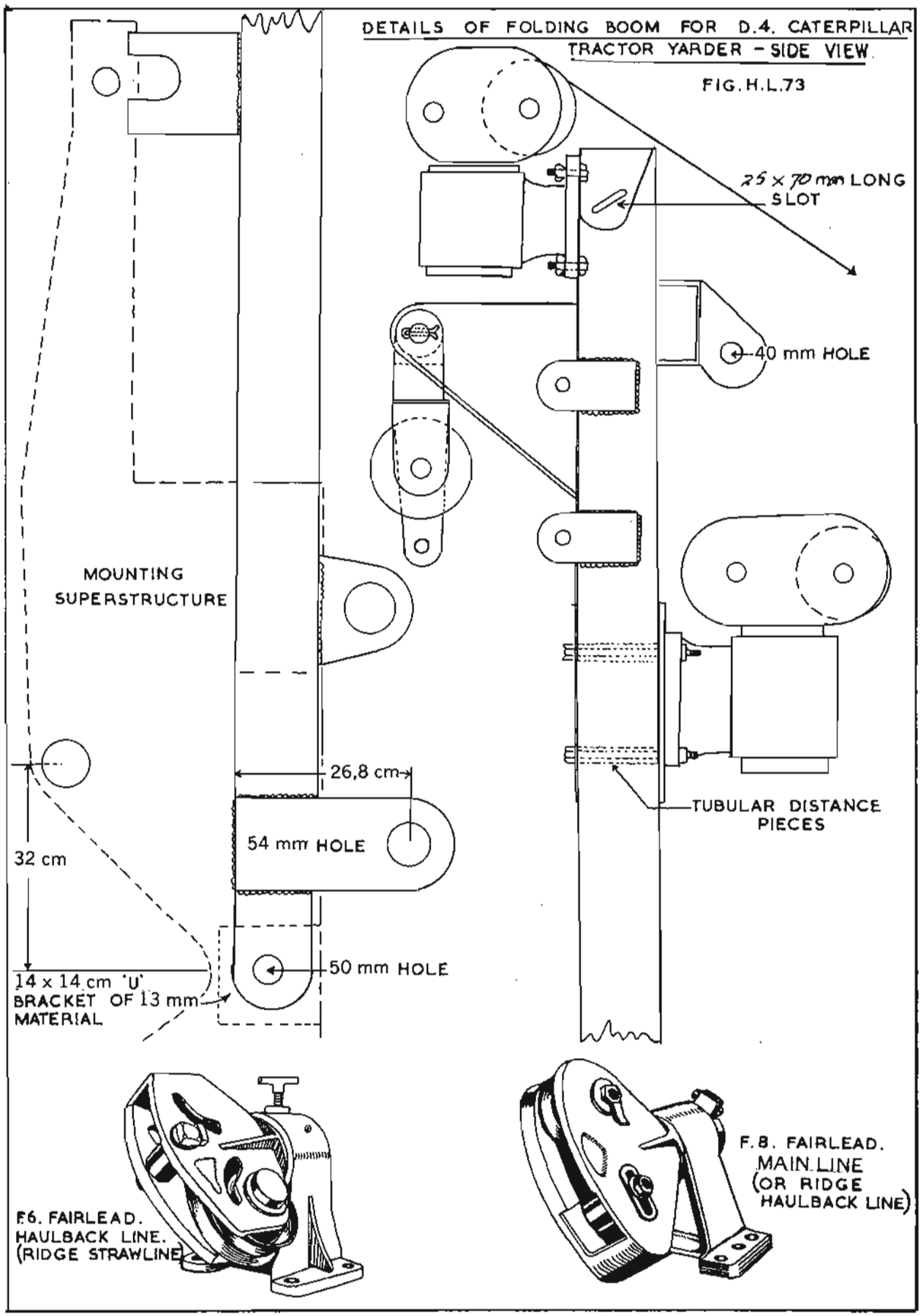
A. DETAILS OF TRACTOR-MOUNTED HIGHLEAD PARTS

(a) The carrier may be a D. 6 or D.4 Caterpillar tractor of 48 kW or 34 kW respectively.

(b) The winch is of the Hyster double-drum logging winch type, mounted on the rear of the tractor, powered by the tractor diesel engine through the power take-off with adapter. The haul-back drum is located above the main yarding drum. The main drum has a "shaft extension" on each side upon which the boom, or jib, rests when erected.

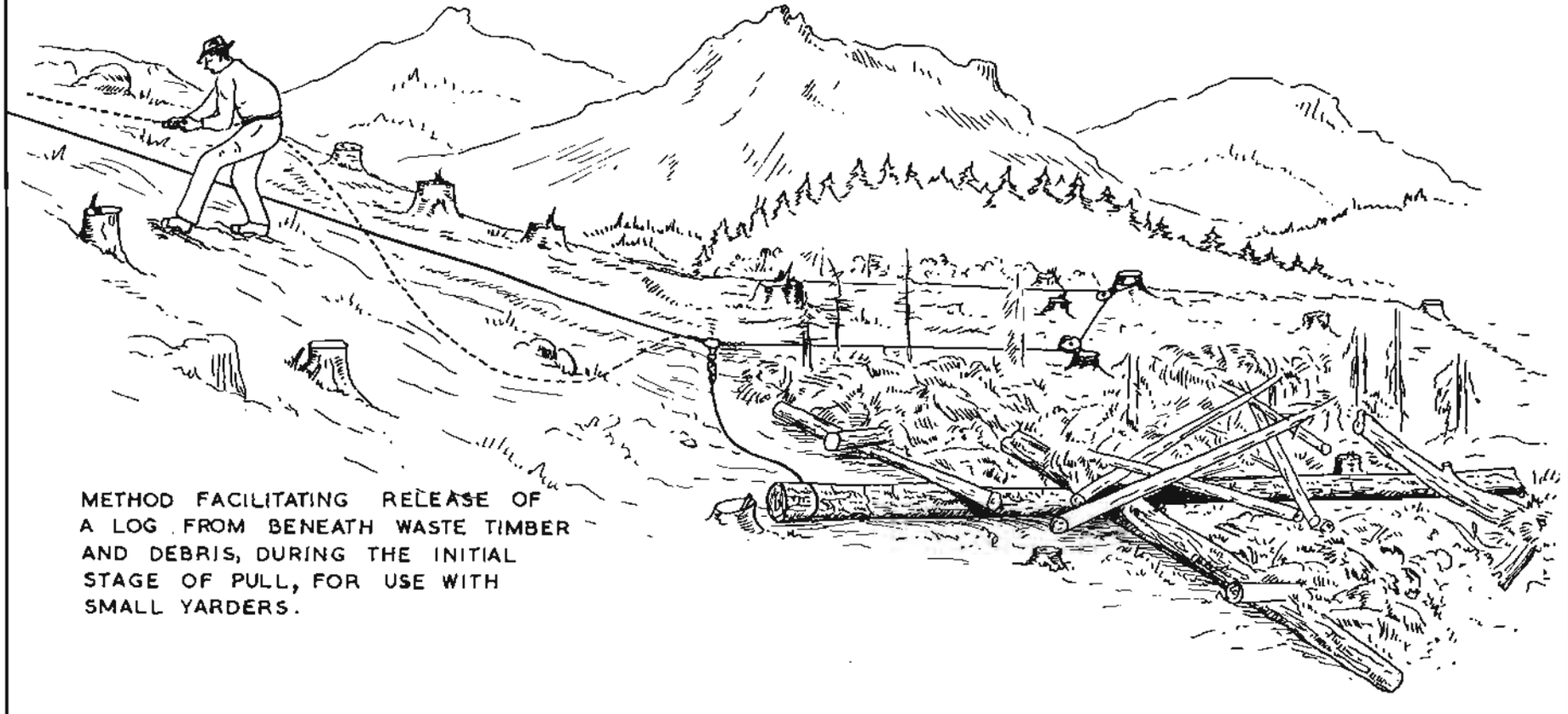
(c) The hoist superstructure, with jack fittings, boom heels and supports for the boom when folded in the travelling position, is attached to the winch.

Note: All the upper working structure rests on the winch shaft, but is supported by the jacks when in the working position


DETAILS OF FOLDING BOOM FOR D.4. CATERPILLAR TRACTOR YARDER - SIDE VIEW.
FIG. H.L.73
25 x 70 mm LONG SLOT
40 mm HOLE
MOUNTING SUPERSTRUCTURE
26,8 cm
54 mm HOLE
32 cm
50 mm HOLE
14 x 14 cm 'U' BRACKET OF 13 mm MATERIAL
TUBULAR DISTANCE PIECES
F6. FAIRLEAD. HAULBACK LINE. (RIDGE STRAWLINE)
F.8. FAIRLEAD. MAIN LINE (OR RIDGE HAULBACK LINE)

LOG YARDING BY HIGHLEAD

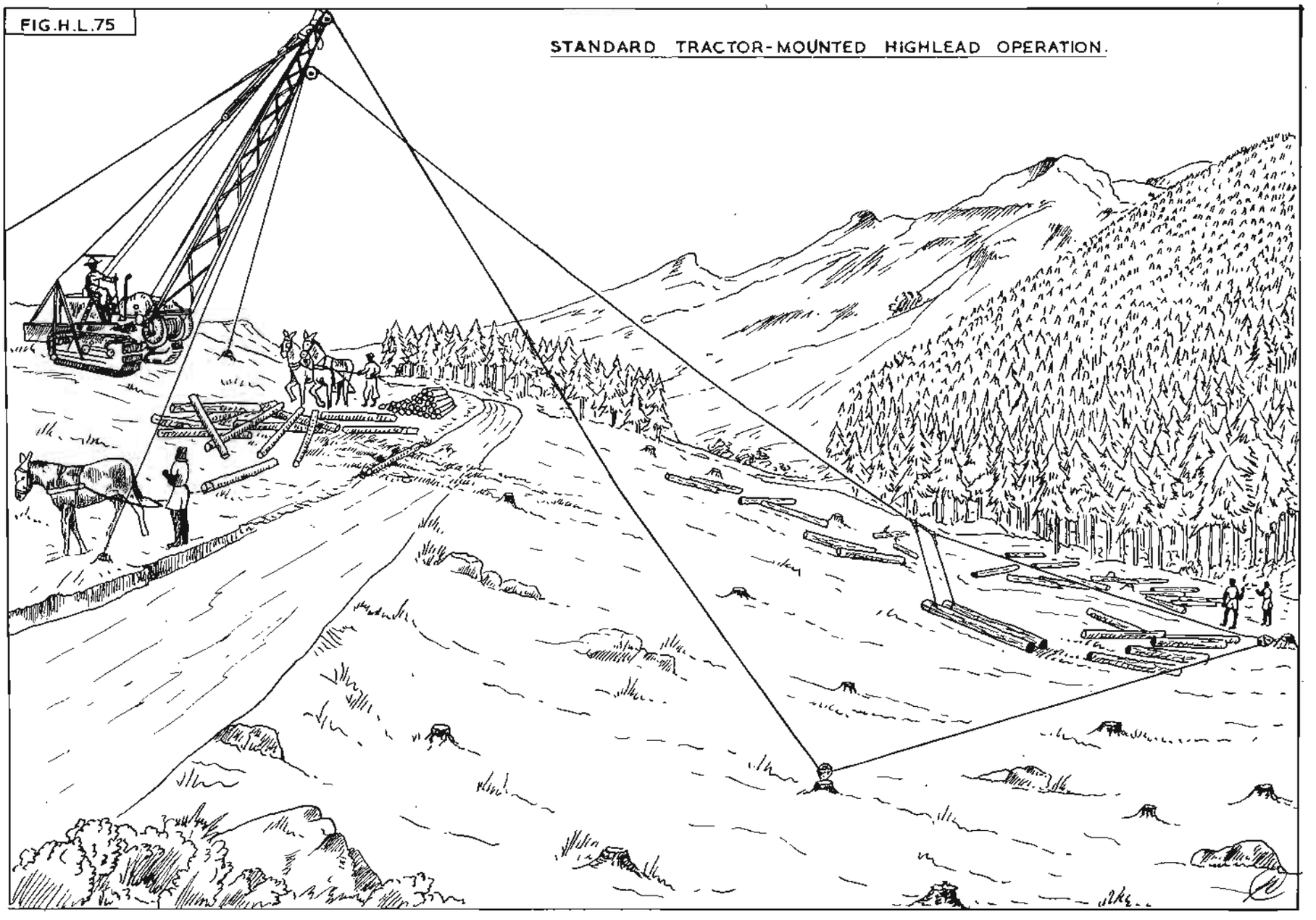
FIG. H.L.74



METHOD FACILITATING RELEASE OF A LOG FROM BENEATH WASTE TIMBER AND DEBRIS, DURING THE INITIAL STAGE OF PULL, FOR USE WITH SMALL YARDERS.

FIG.H.L.75

STANDARD TRACTOR-MOUNTED HIGHLEAD OPERATION.



(d) The boom is 7 to 8 metres long with a lattice type frame, made from channel steel, and fitted with fairleaders for the main and haulback cables. (See Fig. H.L. 73 for technical details of the folding boom and fairleaders.) In view of the winch drum and fairleader location, the main cable runs through the lower fairleader on the side of the boom facing the operation, while the haulback cable runs through the top fairleader on the opposite side of the boom. The incline of the boom is controlled by a hand-operated crab drum, mounted on the hoist superstructure, through the backstay bridle attached to the two 'A' frames. The bases of the latter are rivetted to the tractor frame. A number of fittings are welded to the boom head for the attachment and shackling of guylines to stabilise the boom while operating.

The support upon which the boom rests when in the folded travelling position is mounted on the tractor radiator frame.

(e) The two boxes for counterweights are located one on either side of the engine housing and are fitted to the A-frame supports. Each box contains 4 concrete slabs.

B. GENERAL

The auxiliary equipment and effective range of the unit, are the same as that previously described for the 75 kW lorry-mounted unit, except that the speed of load pull is much slower and load sizes for the D.4 tractors are smaller.

The machine site and access to it can be much smaller and rougher than for the lorry-mounted unit. As the tractor is on tracks it can move across slopes to the site. Being short it can turn easily and be accommodated on small, level sites, in recesses in the road bank, or even on narrow roads themselves.

The erection of the machine on the operating site is as previously described for the lorry-mounted yarder. In the case of the tractor, however, the main drum cable is used for erecting the boom. The counterweight concrete slabs are inserted into their boxes before the operation commences.

Note: The concrete blocks should be taken out of the counterweight boxes before the tractor is moved

The crew for the tractor-mounted highlead yarder consists of:

1 operator
2 choker setters in the field
1 or 2 off-hookers at the log landing deck.
An additional signalman is sometimes required.

The method of operating is identical to that described previously for clearfelled areas. Refer to Fig. H.L. 75 and 76. When operating in thinnings, machine sites are selected every 120 to 180 metres, depending upon the terrain and the volume to be extracted. Both cables are extended along the same selected lane, to which the logs are usually delivered by mules along contour paths. See Fig. H.L. 77 and 78.

C. FUNCTIONS OF ATTACHMENTS AND AUXILIARY EQUIPMENT

Although attachments and auxiliary equipment are virtually the same as already described, there are a few differences worth mentioning.

(1) Drum speeds are approximately half those quoted for the lorry-mounted yarder.

Note: Although speeds quoted for the D.6 yarder drums are nearly the same as those quoted for the lorry-mounted drums, in practice the D.6 highlead winches only develop slightly more than half the lorry-mounted winch speeds

(2) Pulling capacities of tractor winches are also below those quoted in catalogues, probably because old tractors, which have lost 50% of their original power, are used as highlead yarders.

(3) Booms are made of channel steel in the form of an A-frame, 7-8 metres long. Owing to the shorter boom, actual lift over obstacles is only given over a distance of from 60 to 66 metres. Beyond that distance the logs are dragged along the ground in a manner similar to ground skidding. Fairleaders are fitted to the boom instead of blocks, the top one for the 9 mm or 11 mm haulback cable and the lower one for the 16 mm main cable.

(4) Jacks, which give support and stability to the unit, are located on the sides of the winch. They are of the telescopic type with additional adjustable screw-fitted footings.

D. METHOD OF OPERATING

Log yarding is similar to that by the lorry-mounted yarder, but the D.4 tractor winch has a smaller range and operating radius, with a maximum yarding distance of 180 metres, although in practice this is seldom more than 120 to 150 metres. Swinging is done by animals or occasionally by wheel-tractors if the logs are small and the daily yarding output comparatively low.

E. ESTIMATED OPERATING COSTS

Refer to Appendix H.L. 8 for details.

The estimated average cost per hour for operating either the D.4 or D.6 tractor-mounted highlead amounts to approximately R5,00, including the cost of fuel, repairs, hire of auxiliary equipment and labour.

Extraction costs amount to 155 c/m^3 for the D.4 tractor and 95 c/m^3 for the D.6 tractor, including the cost of swinging logs to the roadside stacks and stacking.

F. VARIOUS TRACTOR-MOUNTED HIGHLEAD OPERATIONS AND SETTINGS

(a) Fig. H.L. 74

On occasions logs have to be yarded out from beneath debris and slash, branches, tops, or even

FIG. H L.76

TRACTOR-MOUNTED HIGHLEAD.
FULL SEQUENCE OF OPERATION

FIG. H.L. 77

TRACTOR - MOUNTED HIGHLEAD.
MULES DELIVER LOGS TO CABLE AND SWING LOGS FROM LANDING.

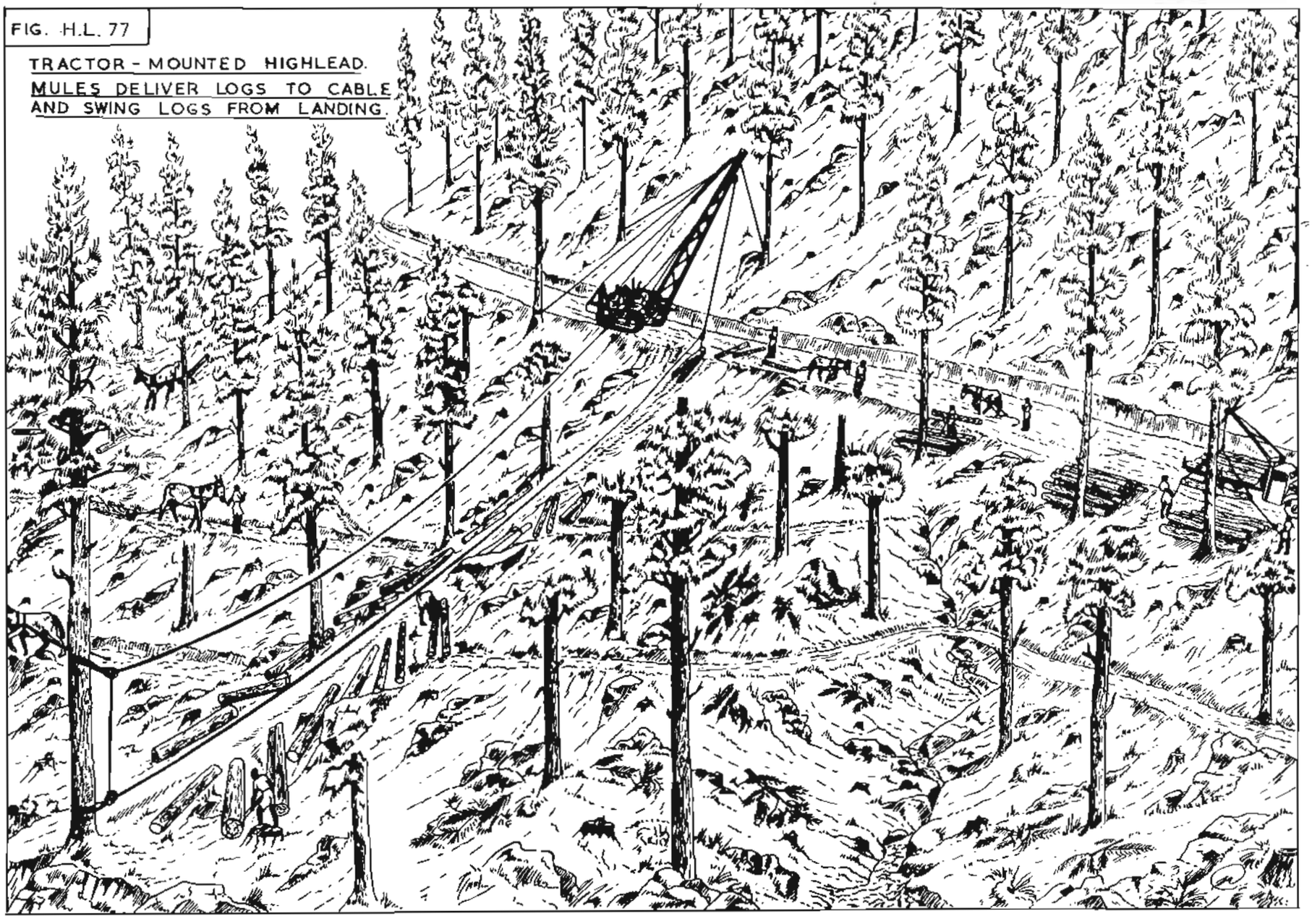
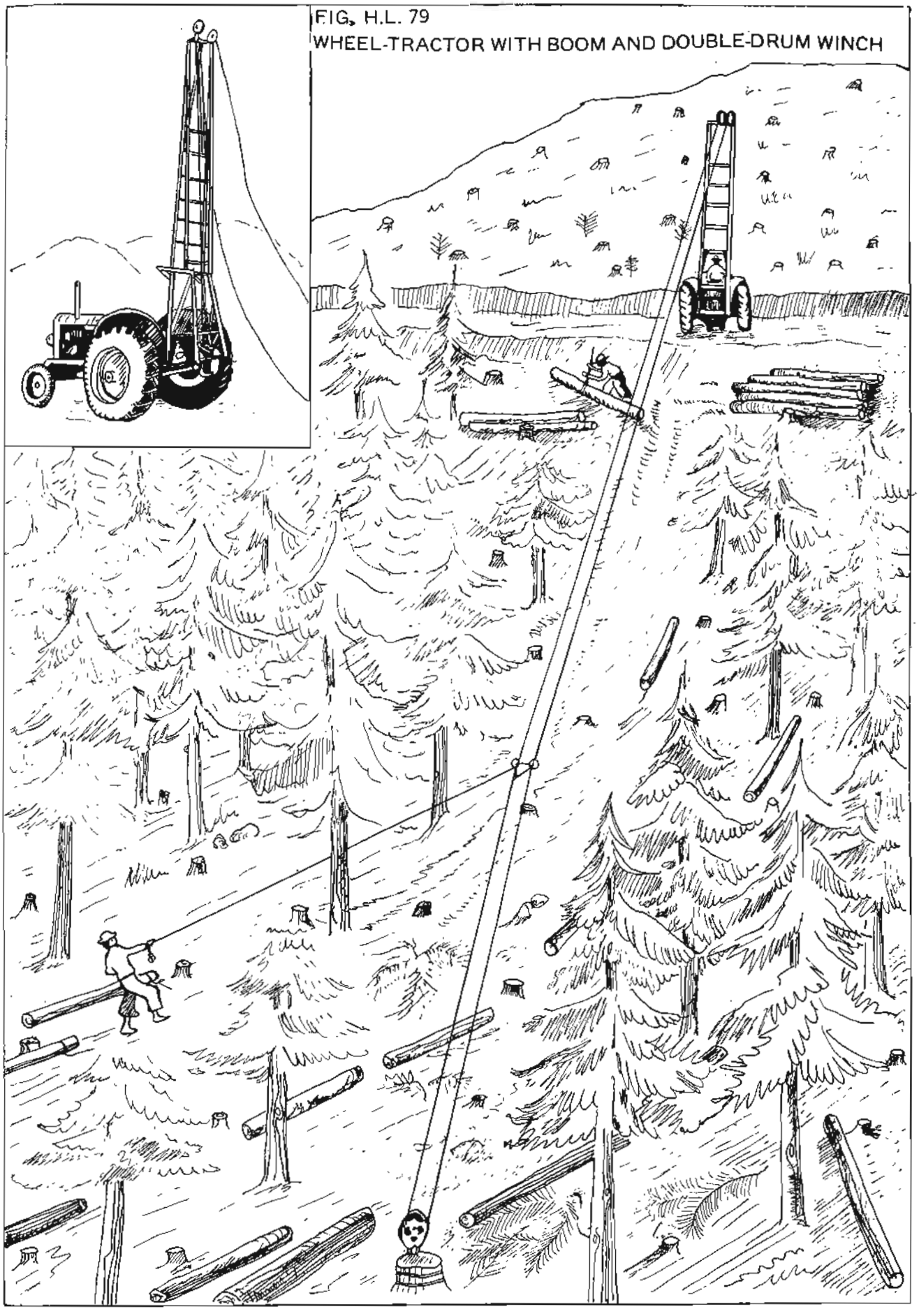


FIG. HL 78

DOWNHILL YARDING BY TRACTOR-MOUNTED HIGHLEAD

FIG. H.L. 79
WHEEL-TRACTOR WITH BOOM AND DOUBLE-DRUM WINCH



the boles of other trees. If the volume of the log to be yarded is close to yarder engine capacity, it will usually be impossible to move the log, as the mass of the debris will produce friction from above, adding to the ground friction from below. By slackening the main cable, then jerking it, the winch can produce a better "torque" on the initial rotating movement to move the log from beneath the debris.

This is a practical solution to the problem when the yarder is of small size, as is the case with the D.4 tractor, and the main cable is no more than 16 mm in diameter. Where this is unsuccessful, the debris must first be removed by hand, which is time-consuming.

(b) Fig. H. L. 75

This is a general view of a highlead setting with tractor-mounted yarder, showing the flat site for the tractor which is equipped with double-drum winch, guying for the boom, location of the haulback blocks, and logs being yarded by chokers attached to the butt rigging. Logs are landed in front of the tractor on the landing deck, then removed and stacked away from the machine in order to prevent a pile of logs building up in front of the machine. Swinging from the landing deck to the roadside stacks is done by mules. Larger logs are swung by a two-mule team (with D.6 tractor) and smaller logs by a single mule.

(c) Fig. H.L. 76

A full sequence of the yarding operation from clearfelling is illustrated.

1. Yarder pulling a load of tree length to the landing.

2. Choker off-hooker signalling the operator to stop the pull.

3. Three men rolling tree length logs away to the cross-sticks in order to clear the landing deck and facilitate marking and cross-cutting.

4. Finally the cross-cut logs being loaded onto a lorry.

Note: If logs are being chokered out of sight of the yarder operator, the labourer listed in (2), apart from off-choking the logs at the landing, also acts as a signalman, relaying the choker setter's signals to the operator. These signals have already been described in the section dealing with lorry-mounted highlead.

(d) Fig. H. L.77

This figure illustrates uphill yarding by the tractor-mounted yarder in thinnings. Convenient lanes 90 to 120 metres apart are selected for pulling the logs out of the compartment. The route of these lanes should be carefully chosen to prevent the yarded logs from rolling to the side, causing "hang-ups" against standing trees.

Slip paths are excavated 45 to 60 metres apart along the contours and are used by single mules for slipping logs to the pre-cut lanes. When the slope on one side of the cable has been cleared and the logs brought to the lane, they are assembled on cross-sticks in choker-sized loads within reach of the chokers attached to the cable butt rigging. Mules should slip in advance to the lanes whenever possible as it is inadvisable for them to slip directly to lanes in which the cable is being operated.

When logs have been brought to the lanes and prepared for yarding, the yarder is positioned at the head of the lane, the cables extended and threaded through the blocks suspended on the tail tree, and the operation commences. Yarded logs are swung from the landing by mules and stacked below the road from where they are loaded by self-loading lorries.

The range of this operation is about 180 meters and a considerable volume can be yarded daily if the logs are properly assembled into choker-sized loads. The increased yarded volume should compensate for the construction of contour slip paths. Slip paths are approximately 1 metre wide and cost from 2 to 3 cent per running metre to construct in moderately compact soil.

(e) Fig. H.L. 78

This illustration shows a tractor-mounted highlead yarder yarding downhill in thinnings. The operation has an effective range of 180 metres. The stand is being second thinned and is on a sustained steep slope which would not permit economic road construction, owing to the low yield available for skidding.

The slope is generally too steep for animal log slipping, but even had this been possible, strain on the animals is considerably reduced by the use of cable yarding as the animals need only slip the logs downhill along easy terrain to the termination of the cable at the tail tree. From there the yarder takes over the extraction. The arrangement is similar to that described for the uphill operation (Fig. H.L. 77), except that the contour slip paths are usually omitted. If the slope is exceptionally steep then slip paths may be needed.

G. BOOM AND DOUBLE-DRUM WINCH, WHEEL-TRACTOR MOUNTED (Fig. H.L. 79)

This unit has not been purchased by the Department but is, nonetheless, worthy of mention.

The winch consists of two drums set side by side on one shaft and driven by the tractor engine through the power take-off. The boom is of light construction tubular type with an additional upper section for height extension. The cables are of small diameter, the main cable being 9 mm to 11 mm and the haulback cable being 9 mm. The practical length of each line is between 60 to 80 meters and the cable speed is moderate. The fairleaders of the main and haulback cables are mounted on top of the boom, side by side, opposite their respective winch drums.

The main and the haulback cables are threaded from the winch drums over their respective sheaves (on top of the frame). The haulback cable

is threaded under the upper sheave of the "riding" double sheave carriage (sheaves are mounted in one plane - one under the other) and over the sheave of the haulback block (attached to the tail tree), then back to the carriage to be finally fastened to it. The main cable is threaded over the lower sheave of the carriage and the hook is attached to it for log chokering.

The main cable is free to be extended (in any direction) to the load (to be chokered) over one (lower) sheave of the carriage, while the other sheave (upper) of the carriage is riding on the haulback cable. Such an arrangement helps to pull the load and at the same time to control it over an obstacle by tightening the haulback cable.

This equipment was developed with the object of replacing the horse or mule, in anticipation of a possible shortage of these animals in the future.

The arrangement and setting of the unit is a modification of the ordinary highlead, but the expected log yarding output would be far below that of either the lorry or tractor (crawler) mounted highlead yarders. The maximum load is about 0,34 m^3. In easy conditions loads of up to 0,85 m^3 have been extracted.

Operating cost

Running charges per hour for wheel tractor. (This covers depreciation over 8 years, repairs, maintenance and fuel and oil) 70c

Estimated cost per hour for winch. (Purchase cost approximately R900. Included in the estimated cost are depreciation, repairs and replacement of ropes) 20c

Daily wages of operator ... R4,00

Daily wages of 2 labourers ... R1,30

Daily operating cost will be:

Machine: 7 hours x 90c	R 6,30
Operator's wages	R 4,00
2 labourers	R 1,30
	R11,60

Estimated daily output: 8,5 m^3

1 160c ÷ 8,5 m^3 = 136 c/m^3

This output is equal to that of say 3 mules in single mule teams and three labourers per day:

Costs: 3 labourers x 65c = R1,95
3 mules x 50c = R1,50
R3,45

345c ÷ 8,5 m^3 = 40,6 c/m^3 for mule teams.

I.e. under the given conditions, mules are three times cheaper if they can move across the slope.

Compared with the costs of highlead yarding by wheel tractor (135 c/m^3) slipping by mules is at least three times cheaper under present conditions.

Extraction with wheel tractor and double-drum winch could only be practical where difficult terrain prevents the use of animals at all; where labour costs are high, or where small timber and short skidding distances do not justify the use of larger equipment.

Note: Only a brief demonstration of the equipment was observed and no indications were given as to how the equipment could stand the strain of prolonged use. The costs quoted, were obtained from an article in the Scottish Forestry Magazine with some alterations to comply with South African conditions

H. HIGHLEAD HYSTER YARDER WITH BOOM - D.4 CAT. TRACTOR MOUNTED

RANDOM TEST

Conditions: Species. P. canariensis, clearfelled
Average volume per tree: 0,13 m
Load per turn: An average of 2 trees
Landing convenient, maximum yarding distance: 180 metres
Yarding up a slope of 30°
Surface smooth but abundantly scattered with slash
Loads partly assembled by hand
Chokers fixed to the butt rigging.

Labour:
With the yarder operator:

Load assembling	:	2 labourers
Choker setters	:	2 labourers
Unhooker	:	1 labourer
Signalman	:	1 labourer

Log deck:

Rolling yarded boles	:	2 labourers
Marking	:	1 labourer
Cross-cutting	:	2 labourers

(a) Details of operation

Return trips completed per day : 108 (max. noted)
Total number of trees yarded : 145
Time to change position of tail haulback block : 25 minutes
Time lost for 39 delays : 2 hours 40 minutes
Machine hours : 7 hours
Fuel used : 36 litres diesel
Volume yarded : 18,4 m^3

(b) Timing reported

Average load - single tree of 0,09 m^3, distance 180 metre
"in" to logs - 1 min. 35 sec.
Out with load - 3 min. 20 sec.
Choking and off-hooking logs - 1 min. 30 sec.
Time per turn - 6 min. 25 sec.

Time taken for load assembly for two trees: 3 min.

Because tree lengths were yarded 9% of the total volume yarded was rejected as waste when the trees were cross-cut into logs.

Load sizes per turn were as follows:

Load	Total volume	Waste
1. Single tree	0,45 m^3	-
2. Single tree	0,30 m^3	0,06 m^3
3. Single tree	0,27 m^3	0,008 m^3
4. Single tree	0,21 m^3	0,04 m^3
5. Single tree	0,51 m^3	0,07 m^3
6. Single tree	0,16 m^3	0,03 m^3

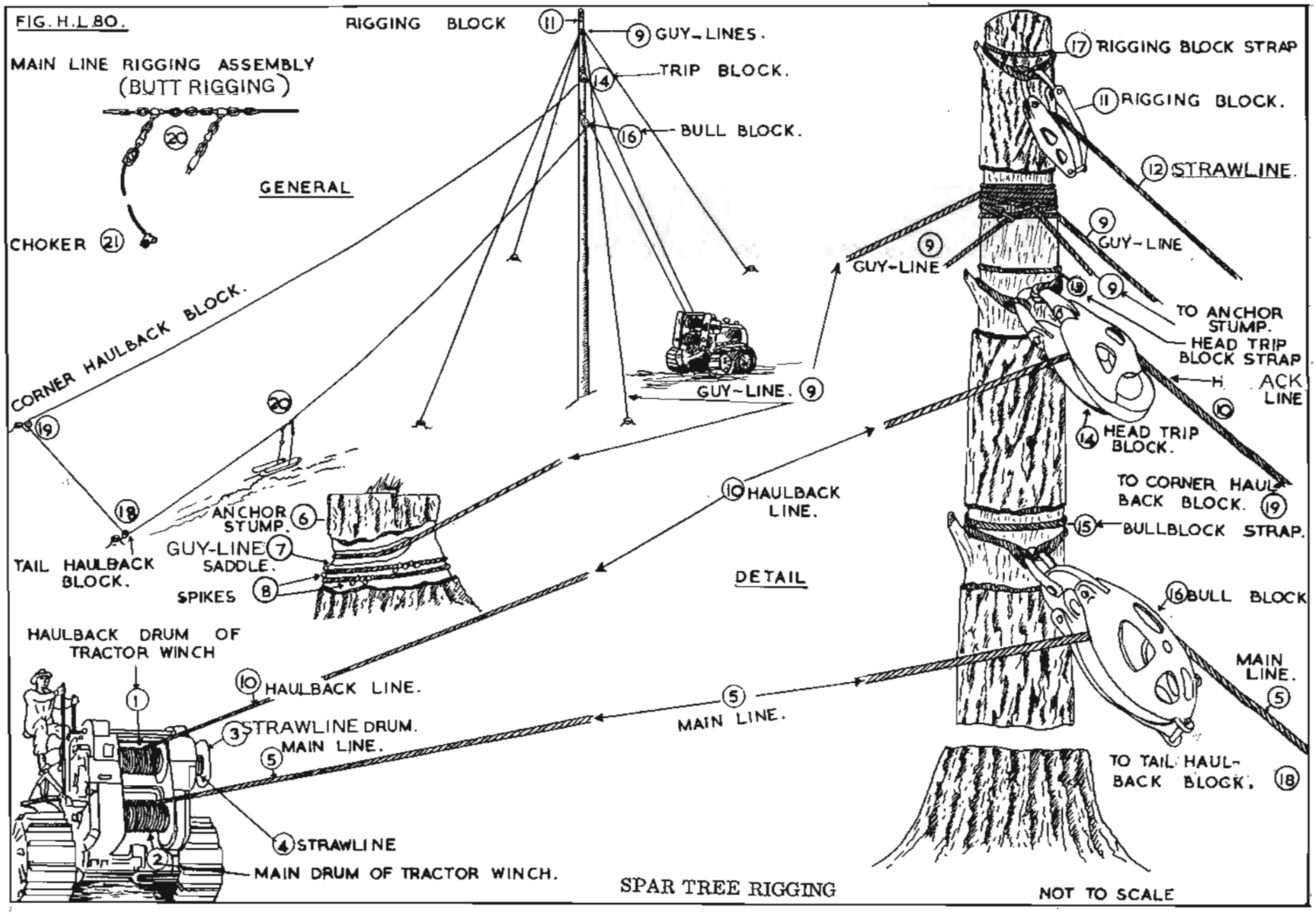
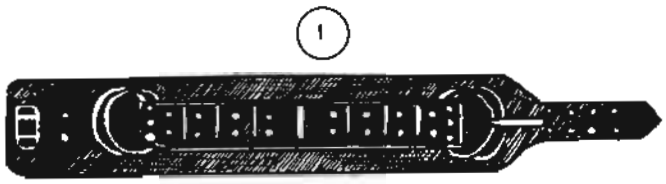


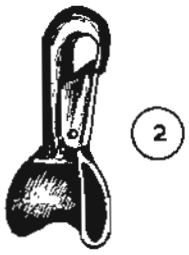
FIG. H.L.80.
MAIN LINE RIGGING ASSEMBLY
(BUTT RIGGING)
GENERAL
CHOKER 21
CORNER HAULBACK BLOCK.
TAIL HAULBACK BLOCK.
RIGGING BLOCK 11
9 GUY-LINES.
14 TRIP BLOCK.
16 BULL BLOCK.
GUY-LINE. 9
ANCHOR STUMP. 6
GUY-LINE SADDLE. 7
SPIKES 8
10 HAULBACK LINE.
DETAIL
HAULBACK DRUM OF TRACTOR WINCH
1
10 HAULBACK LINE.
3 STRAWLINE DRUM.
5 MAIN LINE.
4 STRAWLINE
2
MAIN DRUM OF TRACTOR WINCH.
5 MAIN LINE.
17 RIGGING BLOCK STRAP
11 RIGGING BLOCK.
12 STRAWLINE.
9 GUY-LINE
9 GUY-LINE
TO ANCHOR STUMP.
HEAD TRIP BLOCK STRAP
H ACK LINE
10
14 HEAD TRIP BLOCK.
TO CORNER HAUL-BACK BLOCK. 19
15 BULLBLOCK STRAP.
16 BULL BLOCK
MAIN LINE. 5
TO TAIL HAUL-BACK BLOCK. 18
SPAR TREE RIGGING
NOT TO SCALE

H.L.81.

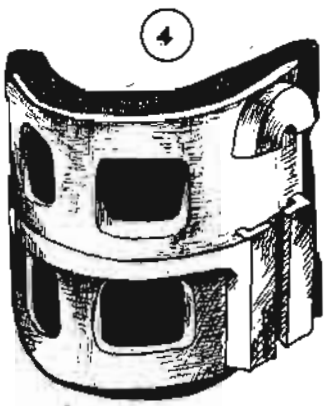
CLIMBER'S RIG.



SAFETY BELT.

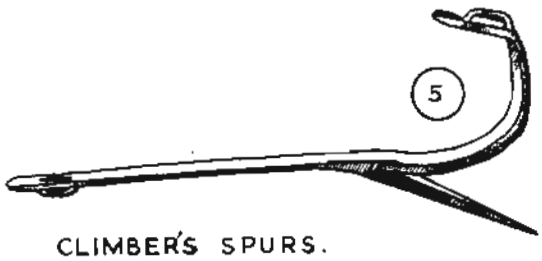


SAFETY SNAP HOOK.

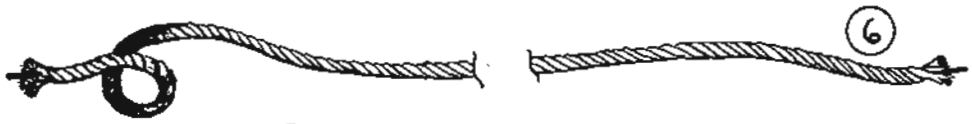


ALUMINIUM RIGGER'S HI-CLIMBERS PAD.

LEG STRAP.



CLIMBER'S SPURS.



WIRE REINFORCED SAFETY ROPE

(c) Remarks

The operation extracted fire-damaged timber in a young compartment where a considerable number of trees was burned to such an extent that they had to be left behind in the field. Difficulty was experienced in finding two good trees side by side for yarding, hence the predominance of single tree yarding.

The volume of the smallest load was 0,15 m^3 and that of the largest load was 0,51 m^3.

I. PROBLEMS ENCOUNTERED IN TRACTOR-MOUNTED HIGHLEAD OPERATION

(a) Problems in yarding with the tractor-mounted yarder are more or less similar to those described for the lorry-mounted yarder, but, owing to the slow pulling speeds, damage to equipment and the clutch plate in particular seldom occurs.

(b) As the double-drum winch is fixed to the back of the tractor a climb against any but a gentle gradient should be made in reverse to safeguard the tractor's balance.

VII. HIGHLEAD DOUBLE-DRUM YARDER - TRACTOR-MOUNTED, WITH SPAR TREE

A. INTRODUCTION

The "spar tree" (Fig. H.L. 80) is a tree used with the highlead yarder instead of the prefabricated boom and serves the same purpose as the normal boom mounted on the yarder, i.e. to provide lift to the yarded logs enabling them to overcome obstacles.

The spar tree is employed when a tractor-mounted yarder equipped with boom is not available or when the yarding conditions are such that a spar tree can be used to better advantage than the tractor-mounted boom. This may occur when the tractor boom is too short for the yarding distances, or the logs have to be delivered to a landing deck inaccessible or unsuitable for the tractor yarder site, i.e. when the logs are to be landed on a steep slope above a road.

The main block must be suspended at a sufficient height on the spar tree to give the necessary lift to the log over the required yarding distance. Approximately 30 cm of block suspension height should be allowed for every 2,5 m of yarding distance. A block suspended at a height of 20 m will thus give a lift over a maximum yarding distance of 150 metres.

The spar tree may be:

(a) Suitably located on the spot for the highlead operation.

(b) Have to be brought to the selected site, raised and fixed in position.

In both cases the spar tree must be guyed and rigged for the operation.

A tree selected to serve as a spar must comply with the following requirements:

(1) It must be sound, straight and strong.

(2) It must be of sufficient height in relation to the yarding distance.

(3) It must be of adequate top diameter. For light logging with a D.4 Cat. tractor the spar tree should have a top diameter of not less than 20 cm, while this should be not less than 30 cm for heavy logging with a D.6 Cat. tractor. In the case of South African trees with a 20 cm top diameter their height will seldom exceed 18-20 metres, and for 30 cm top diameter a height of 12-13 metres. Above these heights there is usually a dense accumulation of knots which weaken the tops to such an extent that they are unsuitable for use as spars, despite their diameters sometimes being sufficient.

(a) Log landings

Log landings should be adequately accessible to the equipment required to handle the logs, and be spaced so that all parts of the area to be felled can be reached from one of the locations without exceeding the working limits of the machine.

The area around the spar tree must be cleared of brush, branches and litter so that there are no obstacles to swinging and loading is safe for the men working on the landing.

(b) Size of logs to be yarded

The size of logs to be yarded determines whether a D.4 or D.6 Cat. tractor is to be used. Logs of up to 0,55 m^3 on steep slopes and 0,85 m^3 on easier slopes can be handled by the D.4 tractor, but larger trees of up to 2,80 m^3 should be yarded by D.6 Cat. tractor.

(c) Equipment required

The erection and operation of the tractor yarder and spar tree require 7 guy-lines (2 for erecting), 2 main working blocks, 4 haulback blocks, 2 auxiliary blocks, a number of slings and the main and haulback cables with the yarder. Full details of all the auxiliary equipment can be obtained from the Appendix.

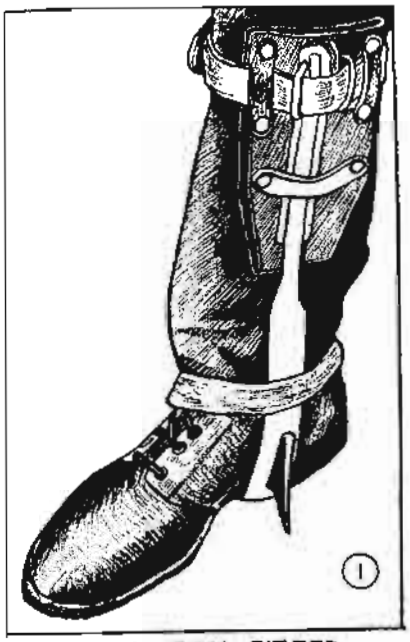
B. RIGGING THE SPAR TREE

Fig. H.L. 80 shows the rigging of a spar tree for highlead log yarding and the setting of the relevant equipment in the field.

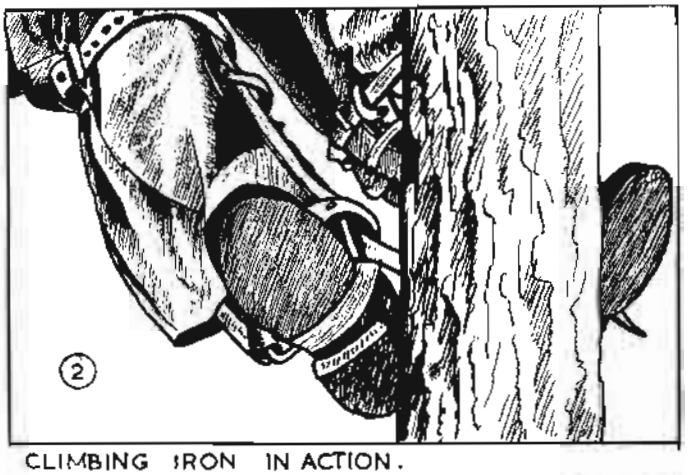
As previously mentioned, a spar tree may be found at the proposed site of the operation in a position suitable for landing and yarding the logs, but it must first be topped and rigged before the operation can commence. Before this is done, however, all trees within falling distance of the proposed spar tree must be carefully felled so as to ensure that no accidental damage is caused to the spar tree.

A labourer trained as a rigger and equipped with the climbing outfit (Fig. H.L. 81), an axe

FIG. H.L.82



CLIMBING IRON FITTED.

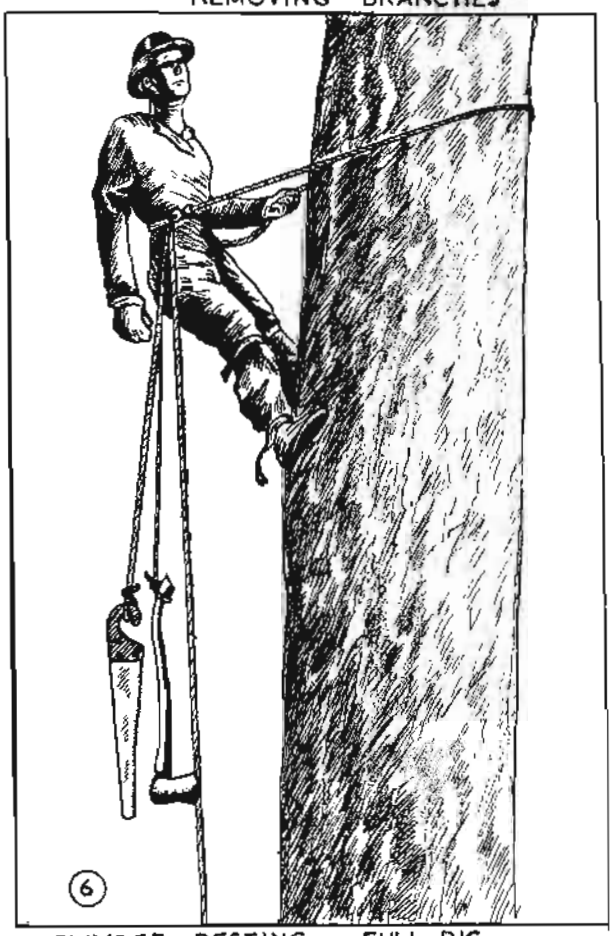


CLIMBING IRON IN ACTION.

REMOVING BRANCHES

CLIMBER THROWING ROPE UPWARDS.

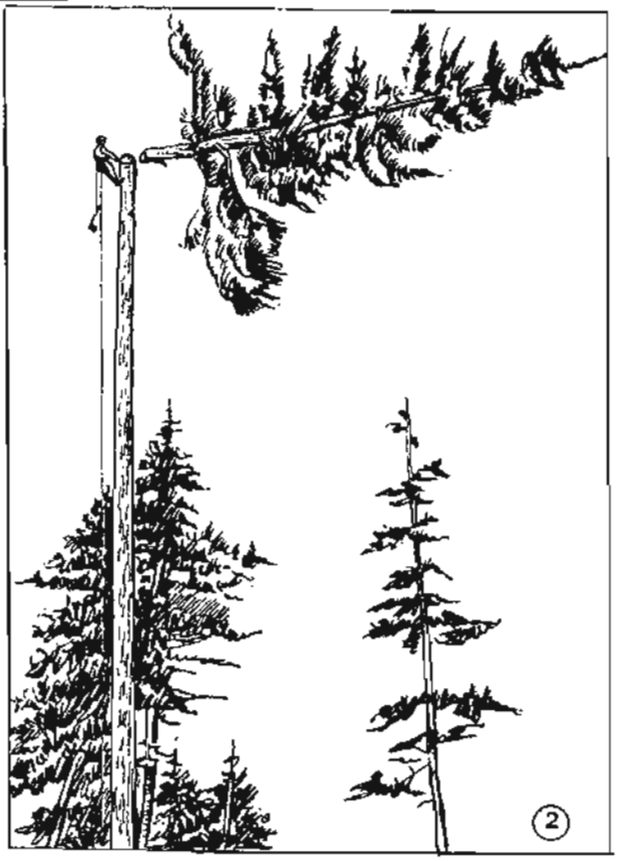
CLIMBING – ROPE TAUT.



CLIMBER RESTING – FULL RIG.

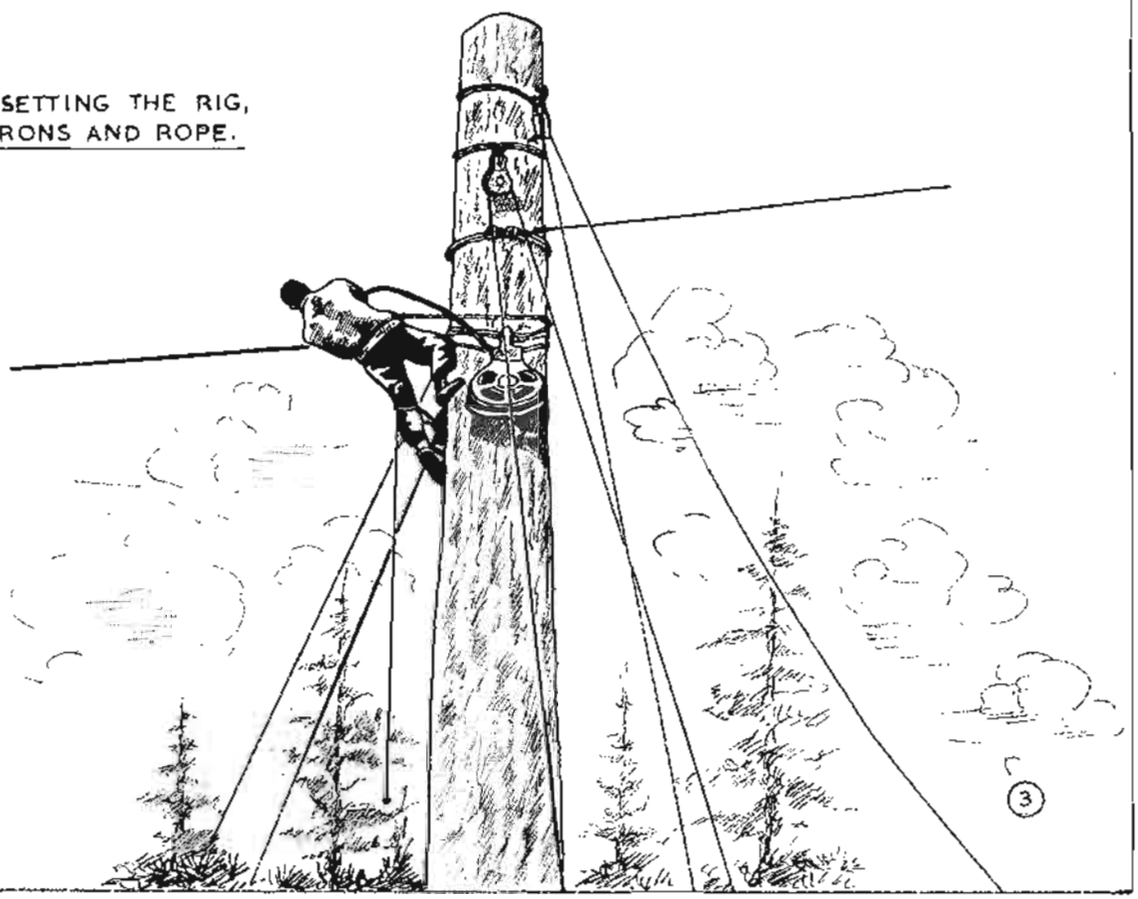
FIG.H.L.83

UNDERCUTTING.



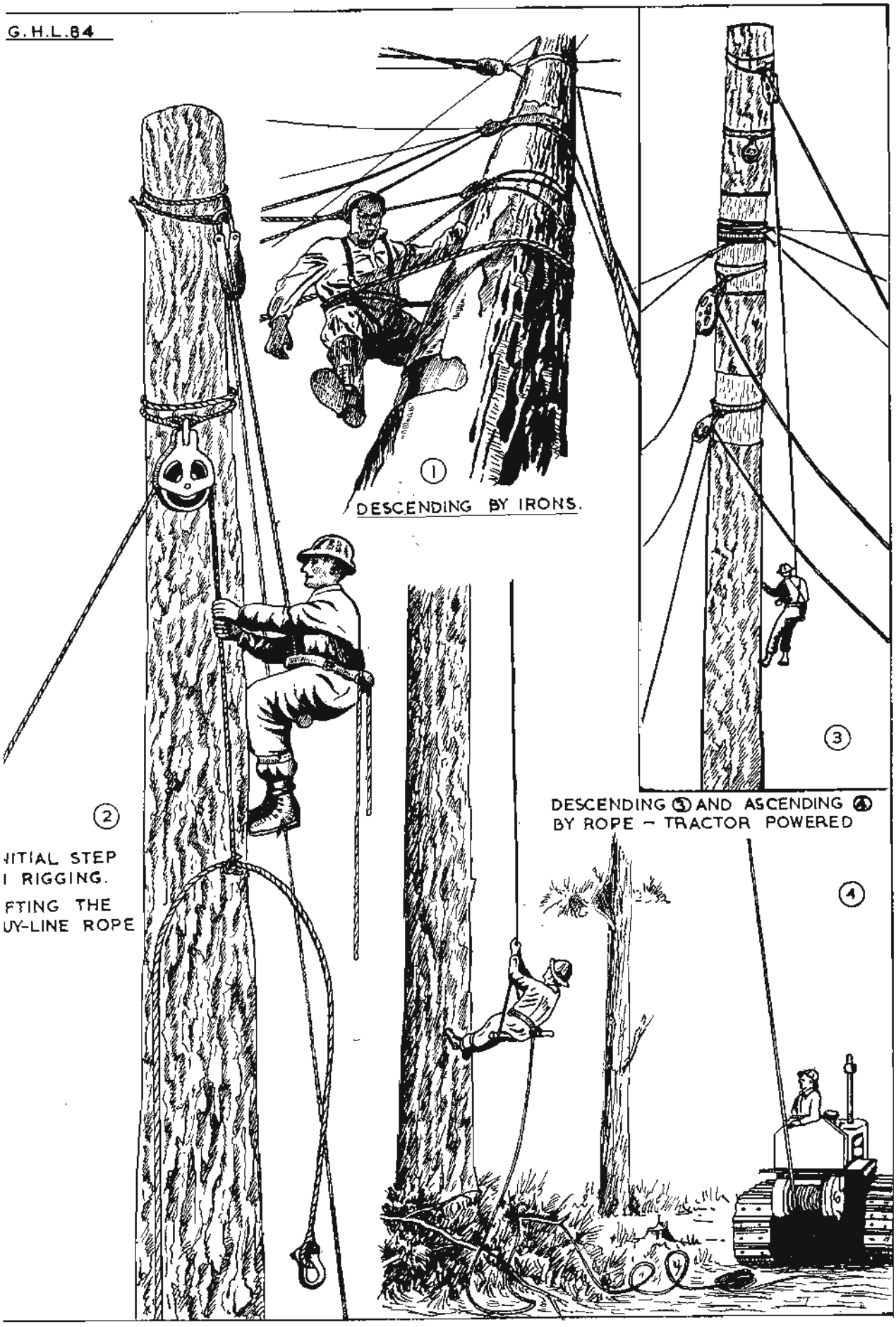
FELLING THE TOP.

RIGGER SETTING THE RIG,
USING IRONS AND ROPE.



TOPPING AND RIGGING

G.H.L.84



① DESCENDING BY IRONS.

DESCENDING ③ AND ASCENDING ④ BY ROPE – TRACTOR POWERED

③

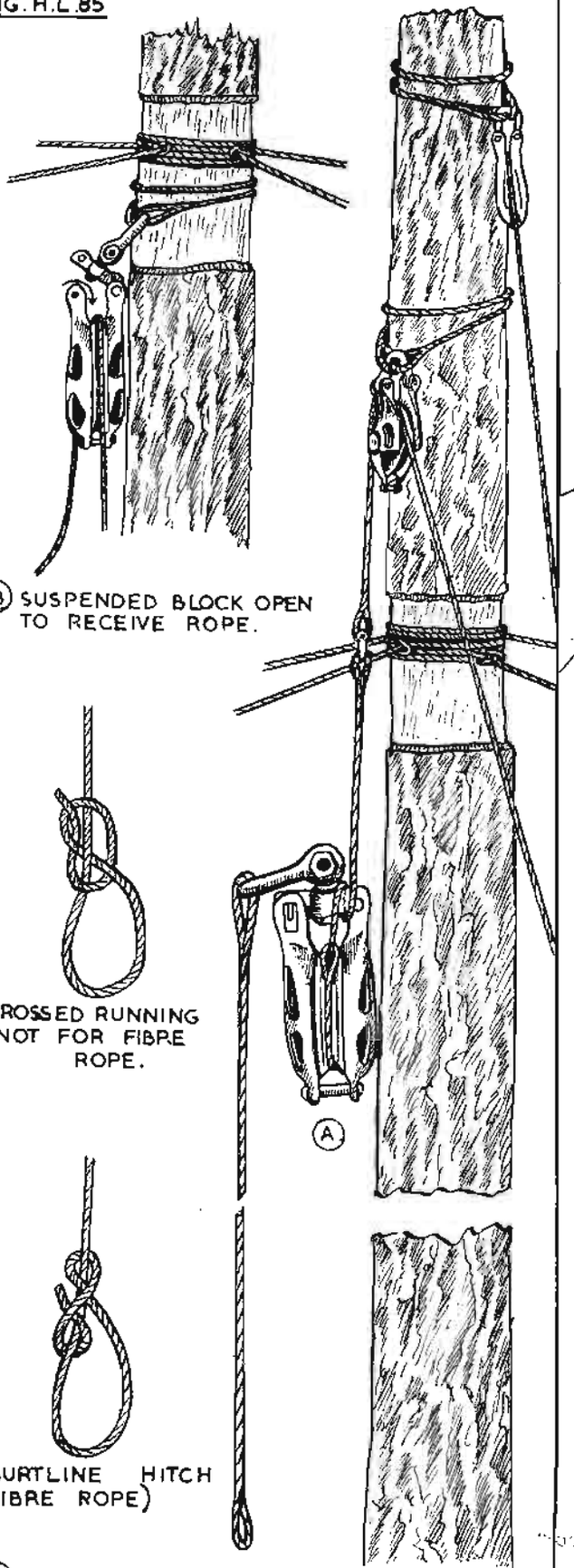
④

②

ITIAL STEP
I RIGGING.

FTING THE
UY-LINE ROPE

FIG. H.L.85

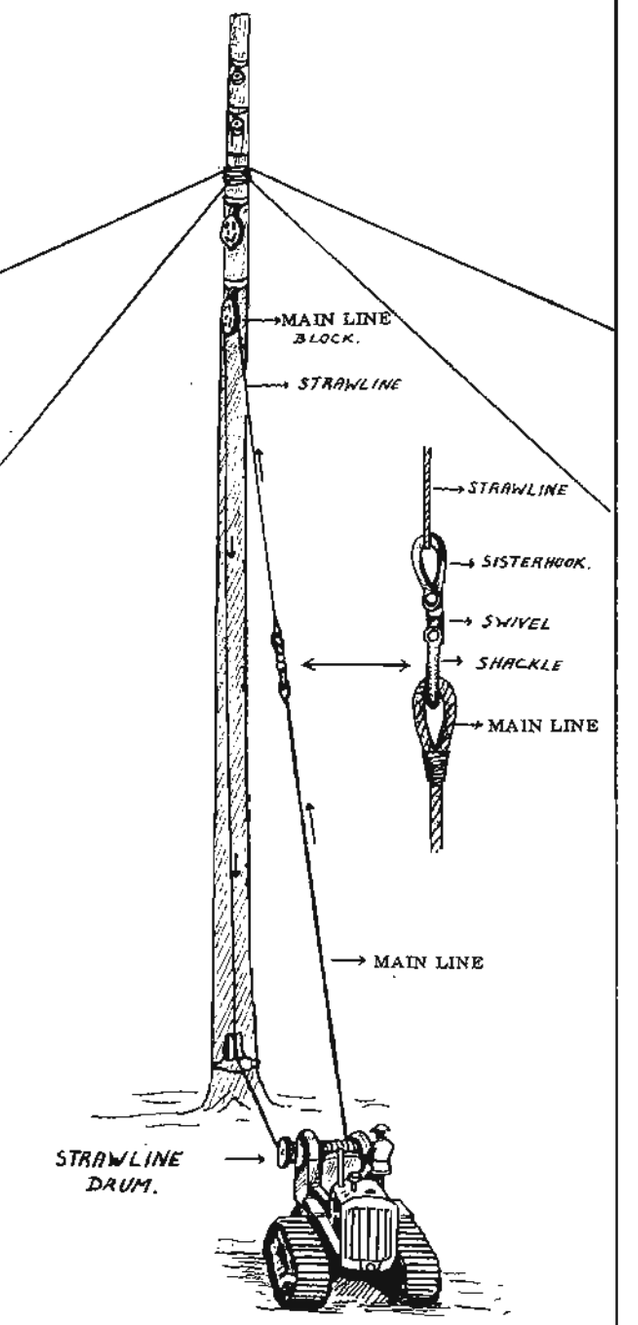


(B) SUSPENDED BLOCK OPEN TO RECEIVE ROPE.

CROSSED RUNNING KNOT FOR FIBRE ROPE.

BURTLINE HITCH (FIBRE ROPE)

(A) LIFTING A HIGHLEAD BLOCK BY MEANS OF AN AUXILIARY BLOCK AND CABLE, PREPARATORY TO FASTENING.



(C) THREADING THE MAIN LINE CABLE THROUGH THE MAIN BLOCK BY MEANS OF A STRAWLINE. (HEAVY RIGGING)

and a hand saw 65-75 cm long, then climbs the tree, tops it and finally rigs it. It is important that a person other than the rigger with a sound knowledge of rigging, be on the spot to supervise the operation from the safety point of view.

(a) Technique of climbing

The climbing irons [Fig. H.L. 81 (5)] are fastened to the legs of the rigger [Fig. H.L. 82 (1)] by means of the leg straps [Fig. H.L. 81 (3)]. He then fixes the safety belt around his waist with the buckle facing the front. One end of the safety rope is fixed to a ring on one side of the belt and the snap hook is threaded onto the other end and fastened [Fig. H.L. 81 (1)], after which the free end of the rope is passed around the base of the tree, then the snap hook is snapped onto the ring on the other side of the belt. The axe, saw and rope are also fastened to the climbers belt before he starts climbing.

Climbing consists of placing the loop of the safety rope as high up the tree as possible [Fig. H.L. 82 (3)], then holding it tight by hand a few steps are taken up the tree, digging the climbing irons deep into the bark [Fig. H.L. 82 (4)]. The climber then pulls his body as close to the tree as possible for balance and throws the rope higher up the tree, repeating the procedure. Branches are pruned off the trunk as he climbs [Fig. H.L. 82 (5)]. At intervals the climber may rest on his rope [Fig. H.L. 82 (6)].

As a safety precaution when topping the spar tree, the rigger may be instructed to clear the branches from the top of the tree as high as possible, to cut the top off in sections until the required top diameter is reached. An experienced rigger would, however, do the job in one go. Topping proceeds as for usual felling, taking the lean of the top into consideration, the undercut being done by axe and the final cut by saw. The rigger rests on his safety rope and climbing irons while working [Fig. H.L. 83(1)].

(b) Topping the spar tree with explosives (Fig. H.L. 86)

Spar trees are usually topped by a high climber using the axe and saw as described above. Sometimes, however, this method is unsafe and it is better to use other means of topping the tree. Explosives may be used for this purpose.

Shooting is advisable: (1) when there is a weak spot in the tree below the point where it should be topped; (2) if the tree is located on a bank where the earth is soft and there is a grave possibility of the tree uprooting under the strain of the swaying motion that follows the breaking away of the top; and (3) if the tree appears to be resting on shale or solid rock, with a shallow root system.

In logging a burned area there may be no green trees suitably located for spar trees, and only snags are available for this purpose. They may be weakened by decay, rot or woodworms. It is quite often difficult to estimate accurately the safeness of such trees when climbing and topping are involved. If the tree under consideration seems to possess one or more of the weaknesses mentioned, then for safety reasons it is best to "shoot" the top.

A satisfactory method consists of using a gelatin base powder in stick form - 40 to 60% strength. It is easy to mould into place, works quickly and smoothly, and requires no strap around the tree to prevent splitting or splintering.

All preparations are best made on the ground. This includes preparing the detonator and powder for safe handling and use. The fuse should be at least 5 metres long since it burns at a rate of 30 cm a minute. The climber must allow himself ample time to get to the ground and far enough away to be out of danger from the concussion and falling top.

(c) Two detonators recommended

It is safer to use two detonators and two fuses; then if one fails to function, the other will in all likelihood be successful. This minimises the chance of having to reclimb the tree under stress of danger.

Blasting caps should be wrapped in burlap in a separate container from the powder. Put powder, or gelatin, in a sack and tie the mouth of the sack.

The climber goes up the tree in the usual manner, carrying an axe and a saw attached with ropes to his climbing belt. When the required height is reached, he uses the saw and axe to prepare a notch 15 - 20 cm deep around the tree, (for very large trees) or 5 - 8 cm in depth for smaller trees. The notch should slant downwards so as to make a good container for holding the powder (Fig. H.L. 86).

A pass block and line should be fastened conveniently below the notch. If there is a limb or protruding knot immediately above the notch, it may be used to good advantage to hang the pass rope over temporarily when the powder is sent to be placed in the recess provided for it. The saw may now be lowered by fastening it to the pass line and the helper on the ground removes it and attaches the sack containing the powder and the container with the detonators. The sack should have a hole cut in the side so that the climber can reach into it to get the powder sticks out easily. This is when the pass rope may be pulled over the limb so as to have the powder near the notch of the tree. Remove gelatin from the sticks and pack snugly into the notch entirely around the tree, using at least two sticks per 2 cm of diameter of the tree at the point of the shot. Now wrap the burlap tightly around the tree over the loaded notch.

If 20% stick powder is used, cut sticks in the middle so that they will fit the curvature of the tree and notch. Wrap with burlap. Mud may be used to pack around the load for better results.

Using either method, when the charge is packed in the notch and wrapped, tuck primer assembly under burlap for secure holding against the charge of powder.

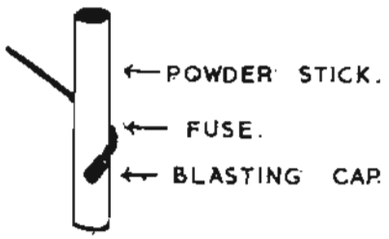
Unroll fuse while descending and ignite when the end is reached. A slanting cut may be made in the fuse while on the ground, but this cut is not opened up until ready to ignite. Now get to the ground and to a place of safety before the shot goes off. Electric blasting caps and wiring may be used for setting off the charge if preferred.

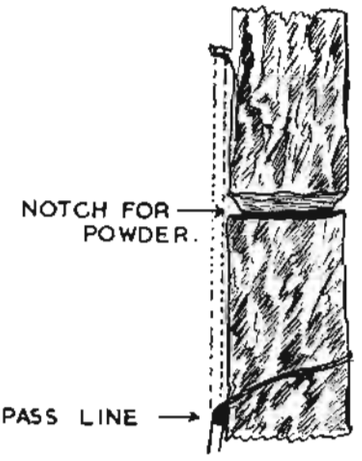
When 40 to 60% gelatin powder is used, the tree top is cut away instantly. It is not lifted as might be expected. About 30 cm of tree is cut away, the top settles back into position, then it falls in the direction of inclination, leaving a spar

FIG.

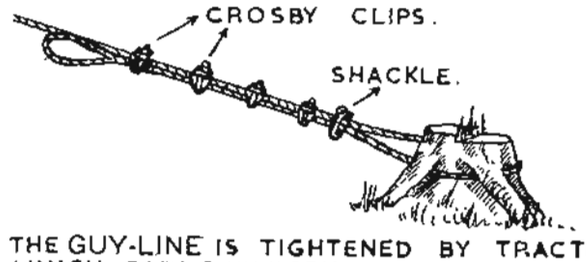
G.H.L.86

TOPPING A SPAR TREE WITH EXPLOSIVES.

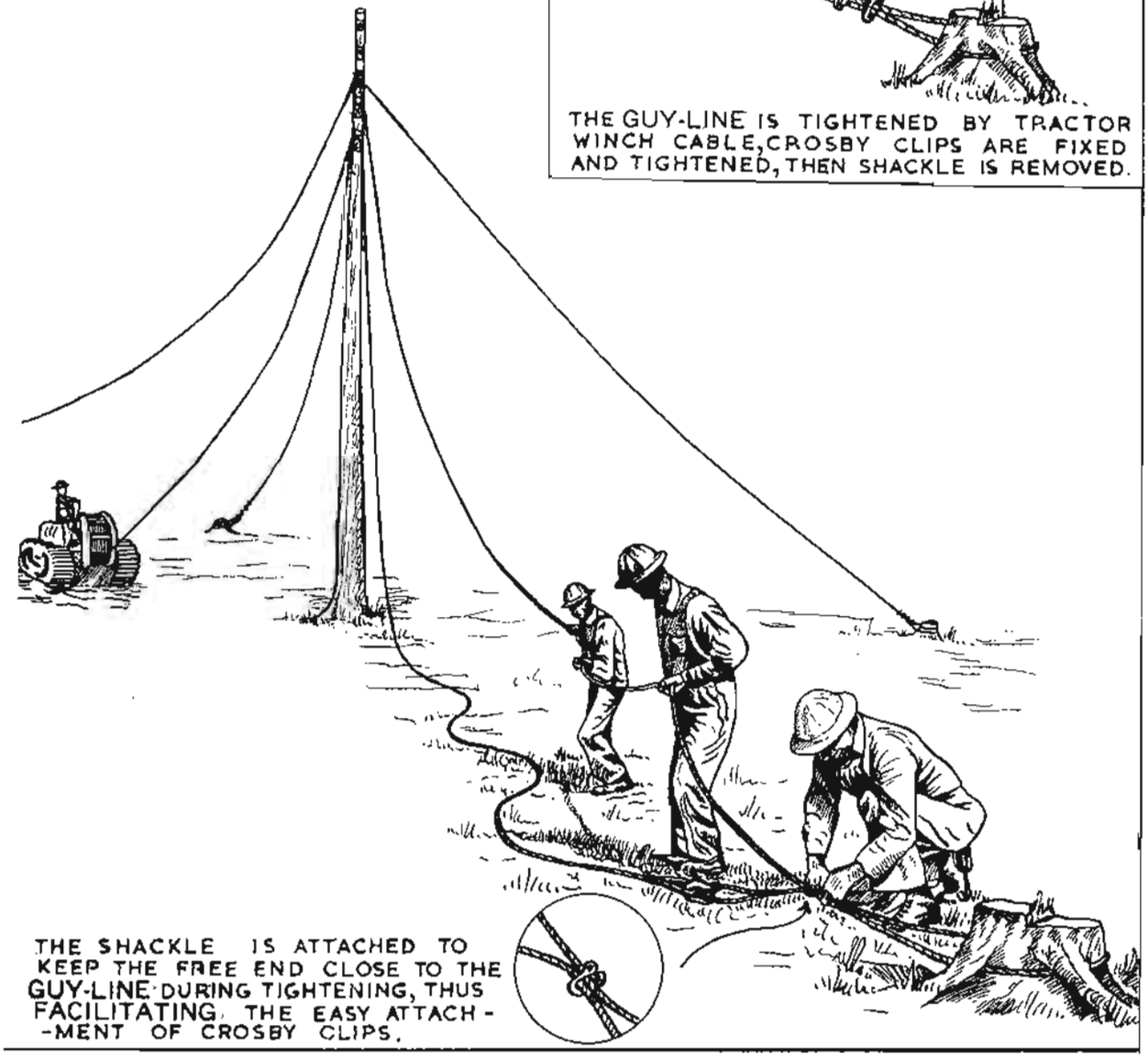




G.H.L.87



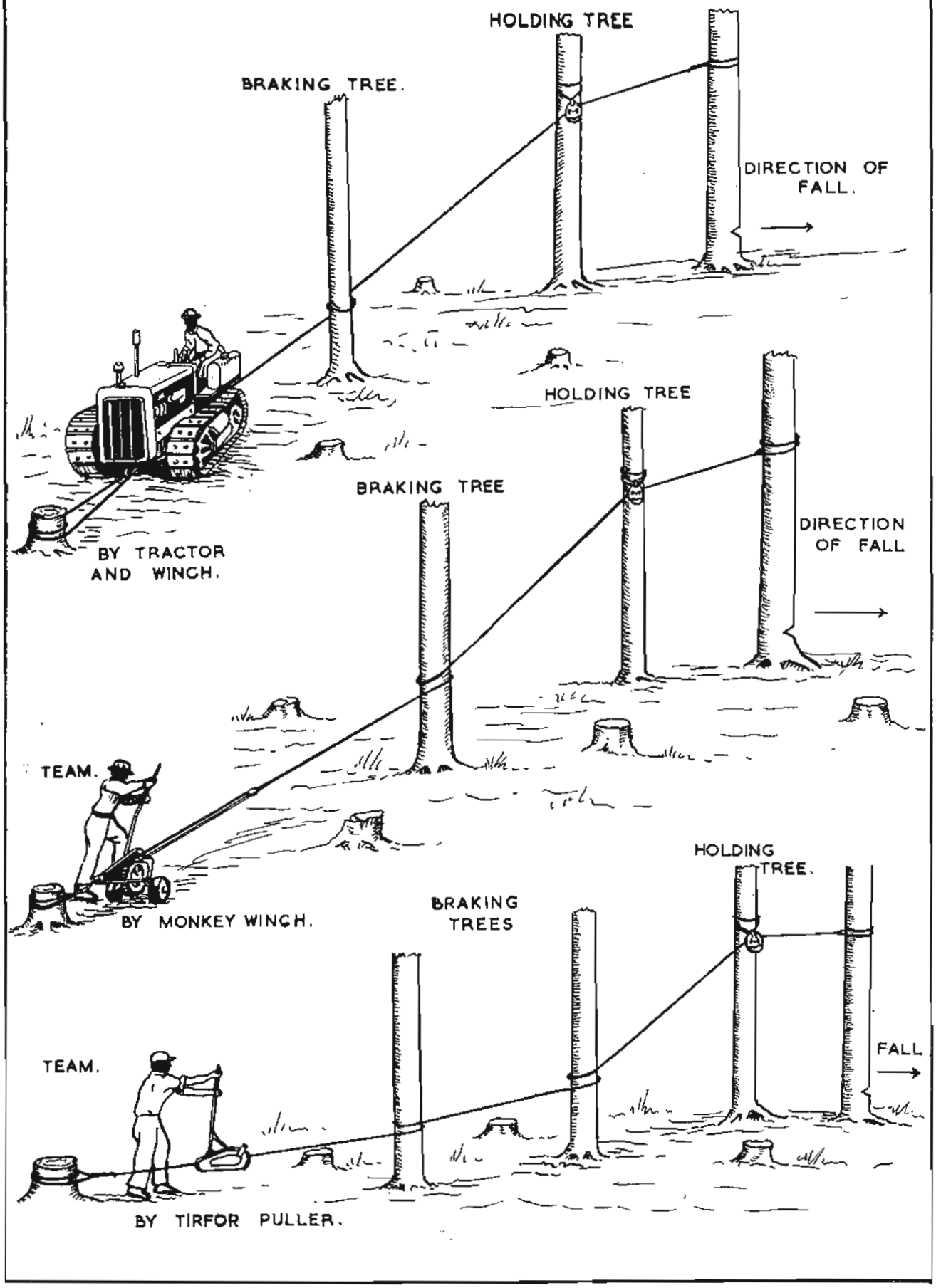
THE GUY-LINE IS TIGHTENED BY TRACTOR WINCH CABLE, CROSBY CLIPS ARE FIXED AND TIGHTENED, THEN SHACKLE IS REMOVED.

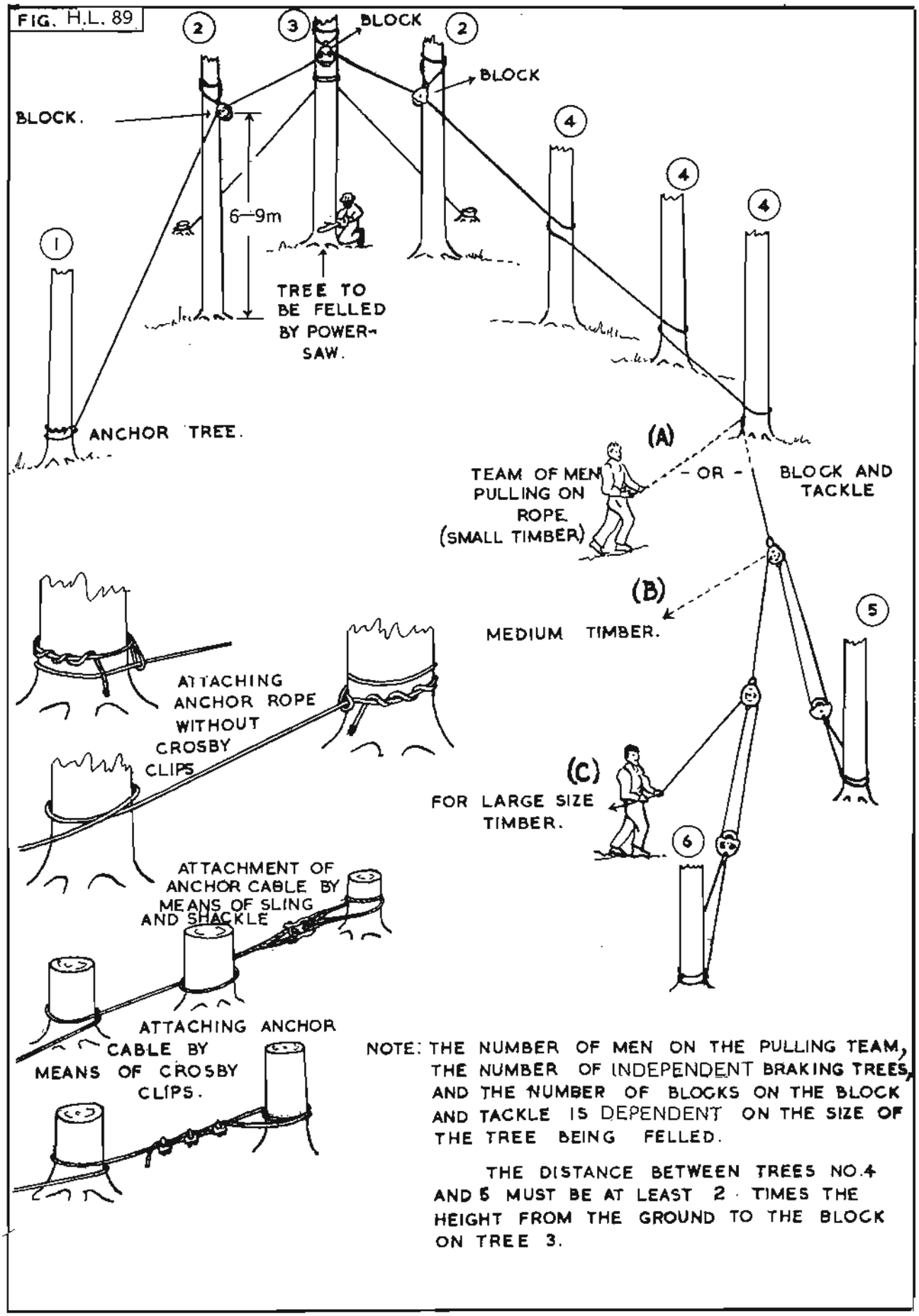


THE SHACKLE IS ATTACHED TO KEEP THE FREE END CLOSE TO THE GUY-LINE DURING TIGHTENING, THUS FACILITATING THE EASY ATTACH-MENT OF CROSBY CLIPS.

FIG. H.L. 88

CONTROLLING THE FALL OF A TREE





CONTROLLING THE FALL OF A LARGE SIZED TREE

with a fairly smooth top end. No more than 30 cm of the stub top will be shattered.

Note: This method has not been used departmentally. The above description was obtained from a professional magazine

(d) Rigging [Fig. H.L. 83 (3)]

After the tree has been topped the rigger pulls up the rigger's block, No. 66, with its wire rope slings, by means of the 13 mm diameter fibre rope which he took up with him, and this block is secured near the top of the tree [Fig. H.L. 84 (2)]. A 19 mm fibre rope with the rigger's seat attached to one end is then brought up; the rope is passed through the suspended rigger's block; the free end is passed down to the ground where it is secured after the rigger's seat at the other end has been brought to a suitable point near the top. By using this seat the rigger may partly work in a sitting position, or may rest occasionally while working [Fig. H.L. 84 (2)].

The rigging block No. 64, follows and is suspended below the rigger's block, No. 66. A 13 mm fibre rope is threaded through the rigging block and lowered to the rigging crew at the foot of the tree, who fasten and hoist the remaining items of rig (tree irons, blocks and guy-lines) as required in sequence, the rigger securing them in the right place at the top of the tree [Fig. H.L. 84 (3)].

When the rigger is ready he clears the bark from around the tree bole at the top and calls for the tree irons to be hoisted. If these are to be used they are fitted and nailed on four sides of the tree at equal intervals, below the rigging block. Guy-lines are secured below the rigging block and rest on the upper hooks of the tree irons. Guy-lines are hoisted in the manner shown in Fig. H.L. 84 (2).

Note: An allowance of rope length on the free end of the guy-line (with shackle) is required in order to embrace the tree with two wraps of each line before securing them with the shackles.

The rigger moves around the tree on his irons [Fig. H.L. 83 (3)] secured by his safety rope, occasionally using the rigger's seat if it is in a suitable position [Fig. H.L. 84 (2)]. The tractor operator or team of workers co-operate by raising or lowering the rigger's seat to the correct height as the rigger requires [Fig. H.L. 84 (3) and (4)].

The method of securing blocks with slings while hoisting is shown in Fig. H.L. 85 A. This ensures that the block remains steady, while its sling is free, and easy to handle, wrap around the tree, and shackle. The working blocks are attached below the guy-lines after the latter have been fastened. If the yarder haulback drum is above the main drum, the head trip block is secured above the main (bull) block, in which case the slings of the former can be secured to the three lower hooks of the tree irons, or vice versa. The above is the case with D.4 and D.6 Hyster winches. When the head trip block is in position the main block follows and is suspended on its slings below the former block.

Guy-line anchors are prepared ahead and the guy-lines may be tightened as soon as they have been secured to the top of the spar tree, provided that the rigger has descended the tree. It is important that they are not overtightened, as this places an unnecessary strain on the spar tree, which has not only to support the mass of all the guy-lines and both working cables and their blocks and slings, but it is also subjected to load pulling strain and jerks produced by the load yarded over ground obstacles.

When guy-lines have been attached to the head of the spar tree, the ground ends are passed round the stump heads or roots, giving no more than one wrap if necessary. The end of the guy-line is then attached to the end of the tractor cable, which passes through the block located nearest to the point of guy-line attachment at the head of the spar tree (Fig. H.L. 86). Prior to tensioning, an auxiliary shackle is set (lower drawing inset), which serves to keep the guy-line end close to the main guy-line cable in order to facilitate the attachment of Crosby clips (Fig. H.L. 86, inset top) after the cables have been tensioned by means of the tractor winch. If a tractor with winch is not available, a monkey winch or wire puller may be used for tensioning.

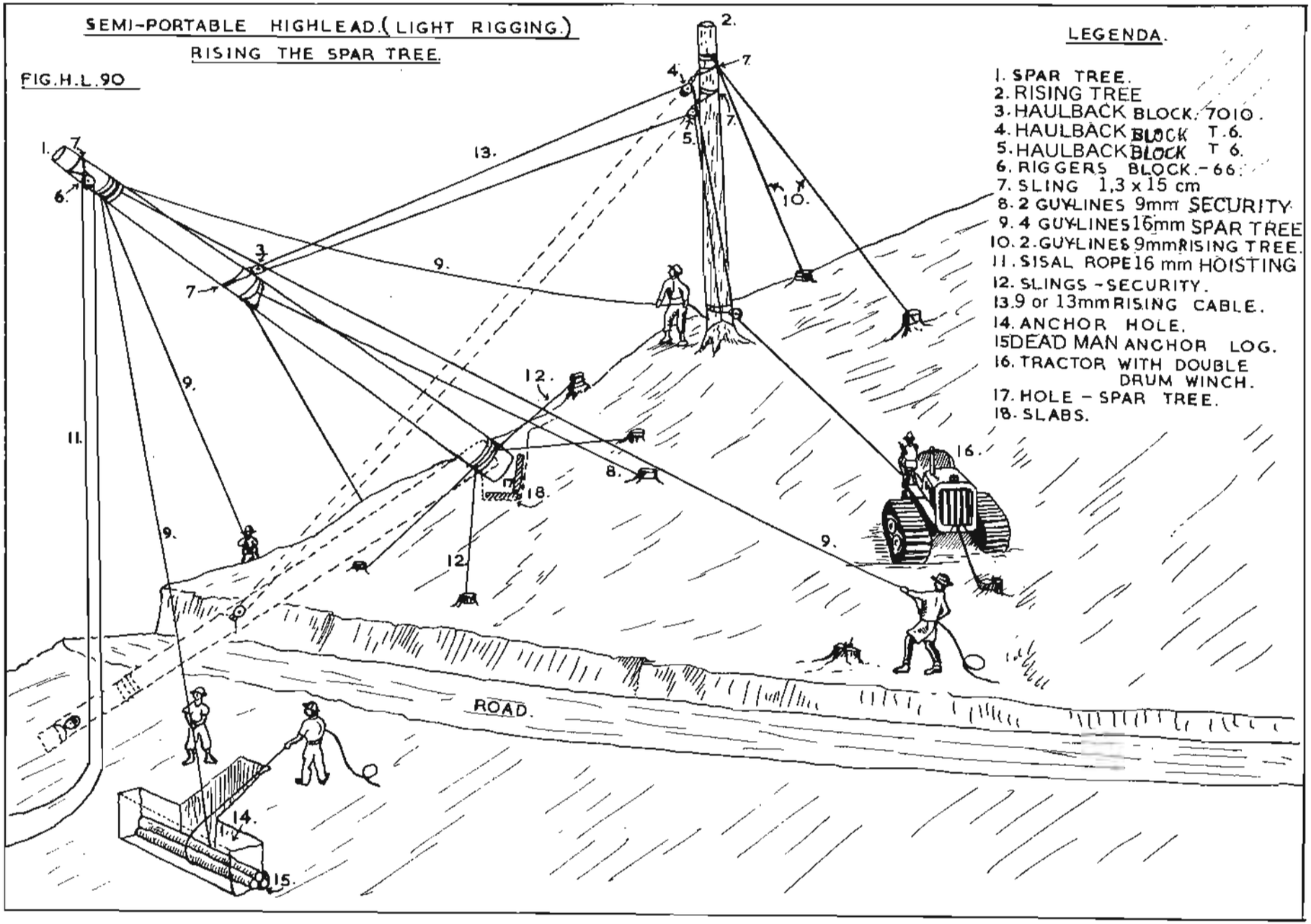
C. ERECTION OF A SPAR TREE FOR HIGHLEAD OPERATION WHEN ONE IS NOT AVAILABLE AT THE RIGHT SPOT

Where no suitable tree is available on the spot a tree must be found somewhere in the plantation, felled, brought to the yarder site and erected in position. The requirements of such a tree have already been given. If the base of the tree is excessively flared it should be cut off.

Felling the proposed spar tree should be done carefully and under control so as to prevent any damage to the tree. Control can be effected by winch and wire rope of sufficient strength to withstand the strain of a gradually leaning tree. A Trewhella winch would normally suffice but the operation can proceed quicker if a tractor of 20 kW or more is available. Should none of this equipment be available, hand labour with a Tirfor puller or block and tackle may also be used. The method of dropping a tree under control is shown in Fig. H.L. 88 and 89.

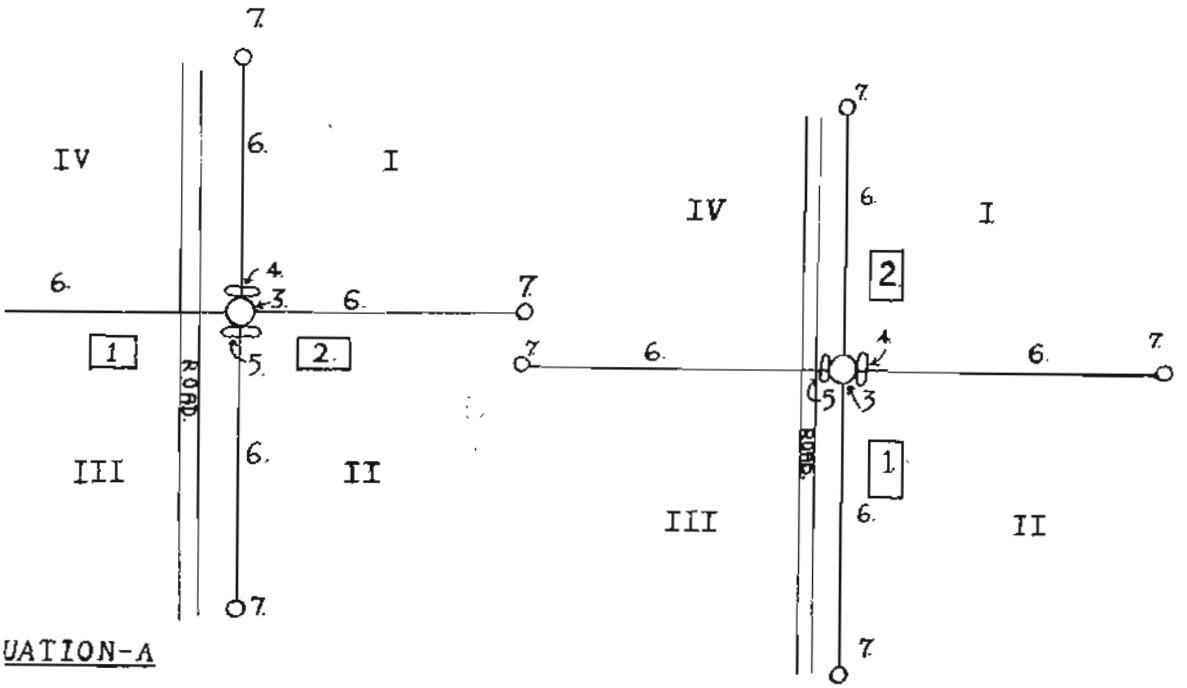
When on the ground the tree must be loaded if it is to be transported by lorry from the compartment where it has grown to the working stand. The tree can, however, be moved by a towing tractor if the distances are comparatively short. If lorry transport is to be used, a special arrangement must be made for loading the tree bole onto the side of a suitable lorry. In order to negotiate sharp curves when transporting the tree by lorry it may be necessary to shift the tree alternately to the rear and front of the lorry bunk if the road is narrow and the road bank is high. The final stage from the roadside to the site of erection can either be accomplished by a towing tractor, or if the slope is too steep, by the yarder cable itself if the yarder is already on the site.

Sometimes substantial outcrops of rock are encountered between the roadside and the site


SEMI-PORTABLE HIGHLEAD.(LIGHT RIGGING.)
RISING THE SPAR TREE.
FIG.H.L.90
LEGENDA.
1. SPAR TREE.
2. RISING TREE
3. HAULBACK BLOCK. 7010.
4. HAULBACK BLOCK T.6.
5. HAULBACK BLOCK T 6.
6. RIGGERS BLOCK.-66.
7. SLING 1,3 x 15 cm
8. 2 GUY-LINES 9mm SECURITY.
9. 4 GUY-LINES 16mm SPAR TREE
10. 2. GUY-LINES 9mm RISING TREE.
11. SISAL ROPE 16 mm HOISTING
12. SLINGS - SECURITY.
13. 9 or 13mm RISING CABLE.
14. ANCHOR HOLE.
15 DEAD MAN ANCHOR LOG.
16. TRACTOR WITH DOUBLE DRUM WINCH.
17. HOLE - SPAR TREE.
18. SLABS.
ROAD.

PORTABLE HIGHLEAD EQUIPMENT WITH SPAR TREE AND DOUBLE-DRUM WINCH.

.91 CHANGE OF TRACTOR & BLOCK POSITIONS.



UATION-A

SITUATION-B

Denotes

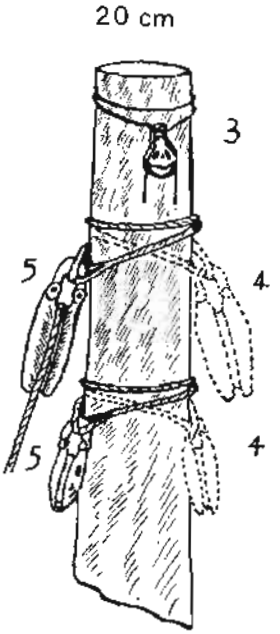
- Tractor position; 3- spar tree; 4 & 5 - blocks; 6-guy-line; .hors; I-II-III-IV- Area yarded.

SITUATION - A.

:or Position 1-(below the road)
position 4 - to extract area I.
position 5 — to extract area II
or position 2- (above the road)
position 5- to extract area III
position 4 — to extract area IV

SITUATION - B.

tor position 1- (above the road)
k position 4 - to extract area I.
position 5 — to extract area IV
tor position 2 - (above the road)
k position 4 - to extract area II
position 5 — to extract area III



The position of blocks is changed from 5 to 4.

FIG. H.L.92

HIGHLEAD – TRACTOR WITH SPAR TREE.

of erection which prevent the tree from being winched or towed directly to the site. This problem can be overcome as follows:

Winch the tree until its head is against the obstacle (eg. long, rocky outcrop), then securely fasten it temporarily to a stump by means of a choker. Sling a block some 100 metres ahead of the tree above the obstacle, but to one side, then thread the yarder cable through this block to the head of the log, where it is fastened. Release the securing choker and pull the tree ahead to the side until the tree is lying approximately along the contour below the obstacle, taking care that its free end will not roll down. When in this position it is controlled by the cable attached to its head while the cable from another yarder drum is threaded under the tree at its point of balance, then back over the tree, over the obstacle and finally secured to a stump some distance ahead. The two cables then alternate to roll or crosshaul the tree over the obstacle. When the obstacle has been negotiated the tree is anchored to prevent it rolling or sliding down again, the cable around its point of balance is removed, and it is finally winched by the yarder cable to the correct position on the site for erection.

Two methods of erecting the spar tree are possible:

(1) If the yarder site is located near a slope of sufficient steepness to provide the required lifting angle to raise the tree from the ground, a snatch block is fastened to a stump up the slope, the winch cable is threaded through it, then through the raising block in the middle of the tree and back to any suitable stump, where its end is fastened.

(2) On a flat site where the tree is inconveniently positioned, an auxiliary tree, approximately half the height of the spar, is used. This tree is topped, guyed and a block is slung near its top. The winch cable is then threaded through the block on the auxiliary tree, through the raising block on the spar tree, and its end is secured to the bottom of the auxiliary tree in readiness for raising the spar tree (Fig. H.L. 90).

It is a good practice to fix the guy-lines and auxiliary rigging blocks to the spar tree before it is raised into position as it is more accessible and the job can be done faster. The tree irons are fastened into position first, then the rigging blocks (No's. 66 and 64) are slung in place with the fibre rope for hoisting threaded through the rigging block (No. 64). A block, T.8, is slung at the approximate mid-point of the tree for raising the tree, and the yarder or tractor winch cable is threaded through it. Two auxiliary guy-lines may be fastened below this block and anchored to the stump. These anchoring stumps must be in one line with the foot of the tree and at right angles to the direction of pull. The foot of the spar tree is fastened to stumps with slings to prevent accidental slipping. It is advisable to excavate a hole for the base of the tree and line the hole with stone slabs to give a firmer footing.

Details of raising the spar tree are shown in Fig. H.L. 90.

The main and head trip blocks are attached in position after the tree has been raised and guyed. The rigging of a standing spar tree takes one full day for a well trained team of four men. In the case of a tree which has first to be brought to the site and then erected and rigged, two days are required, excluding transportation time.

The setting of cables and haulback blocks and the actual yarding operation are the same as previously described for the lorry-mounted highlead yarder with boom. The following differences may, however, be noted:

If well located, the yarder can usually operate a maximum working range of 180° from one site, but for 90° of the operation the working blocks (main and head trip blocks) are positioned on one side of the tree and for the other half of the area they have to be positioned on the opposite side of the spar tree. This moving of blocks is essential to prevent the ropes and blocks from rubbing against the tree (Fig. H.L. 91).

If the opposite side of the area (remaining 180° of the full circle) is to be operated, the yarder site must be changed and the position of the blocks on the spar tree altered.

Note: If the spar tree is of inadequate diameter it may start buckling under the strain of pull. In this case another set of guy-lines will be necessary, their point of attachment being in the middle of the tree

D. OPERATION WITH YARDER AND SPAR TREE

Fig. H.L. 92 shows a highlead operation with yarder and spar tree in a valley with a road only along one slope. The opposite slope had a poor timber yield which did not justify road construction for that particular portion of the slope. The timber was extracted by highlead with tractor and spar tree, sites being selected every 120 m along the existing road. The yarding distance was 180 m across the valley.

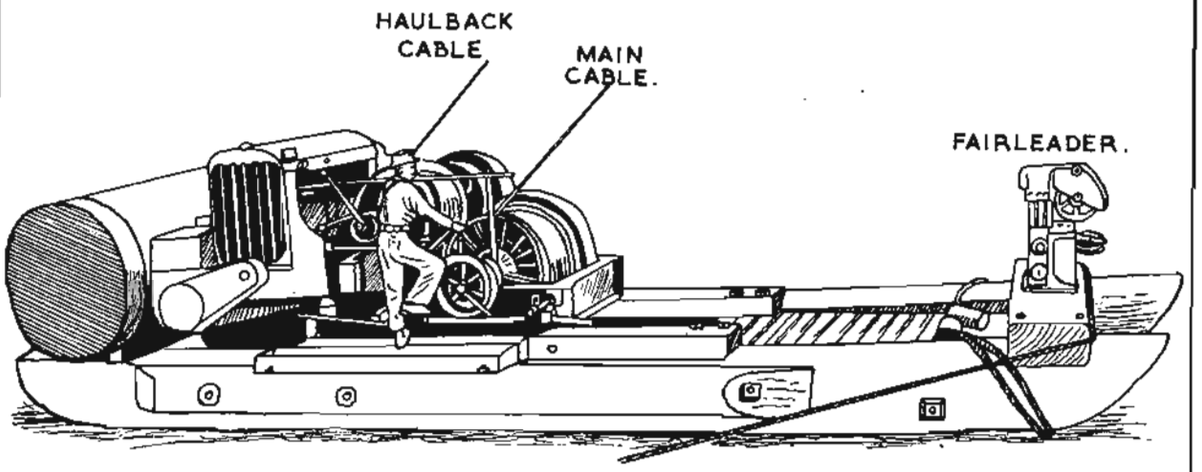
Difficulties were experienced in maintaining an uninterrupted operation. Concentrating timber at the hooking end produced problems as it was dangerous to hook logs from a large pile on the steep slopes, and more labourers were required in order to roll logs into the choking position. Logs were brought to the far cable head by mule. "Hot decking" of the logs delivered by mules was resorted to, which resulted in frequent idle spells for the machine due to a temporary lack of logs at the cable head, particularly as the slipping distance for mules increased.

Logs were yarded across the valley by cable, landed on the slope above the upper road bank, and swung for stacking by mules.

The output of the operation varied from 14 m^3 - 25 m^3 daily. Eight to nine mules were involved in slipping, requiring 6 drivers, and two 2-mule teams with drivers were required for swinging logs to the stacks. Two men choking logs at the hooking end, one man removing chokers at the landing, and two men stacking the swung logs completed the team. Yarding was done by a D.4 tractor with double-drum winch, requiring one operator.

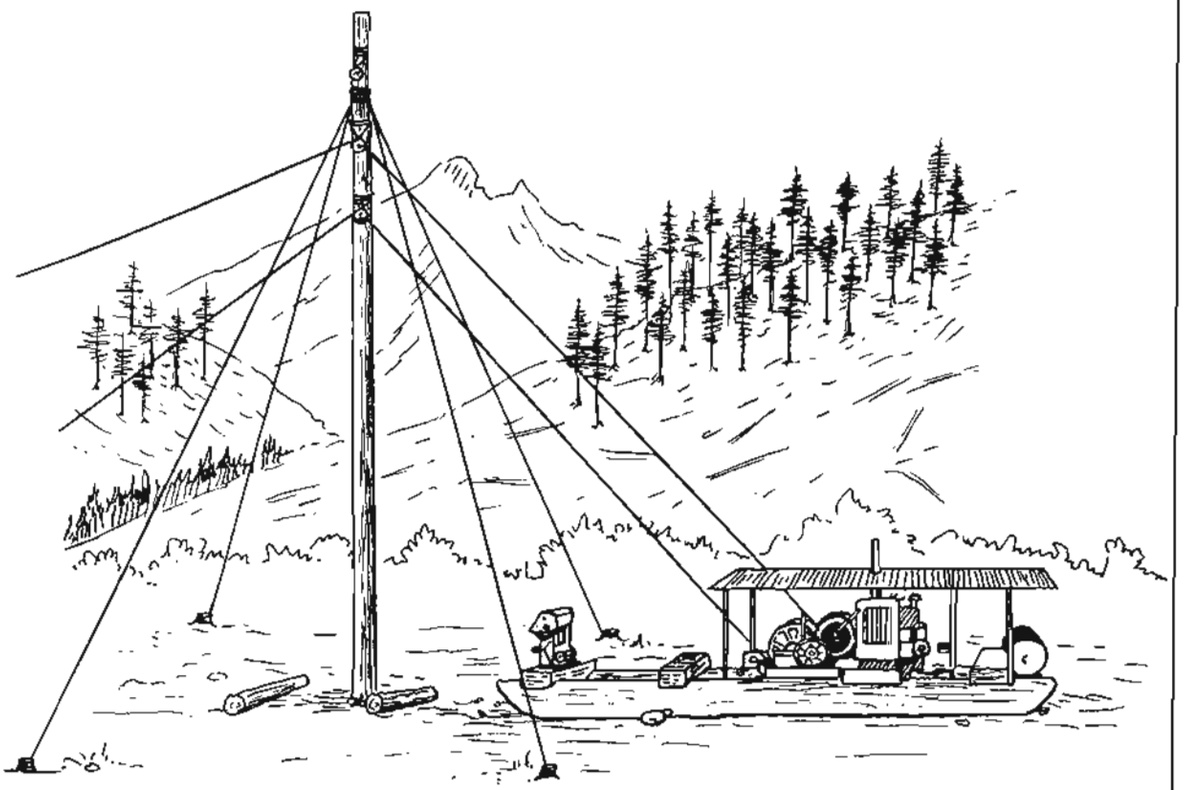
LOG YARDING BY HIGHLEAD.

FIG. H.L.93



HIGHLEAD YARDER, SLEDGE-MOUNTED

FIG. H.L.94



GENERAL VIEW OF HIGHLEAD YARDER, SLEDGE-MOUNTED, AND SPAR TREE.

I.L.95

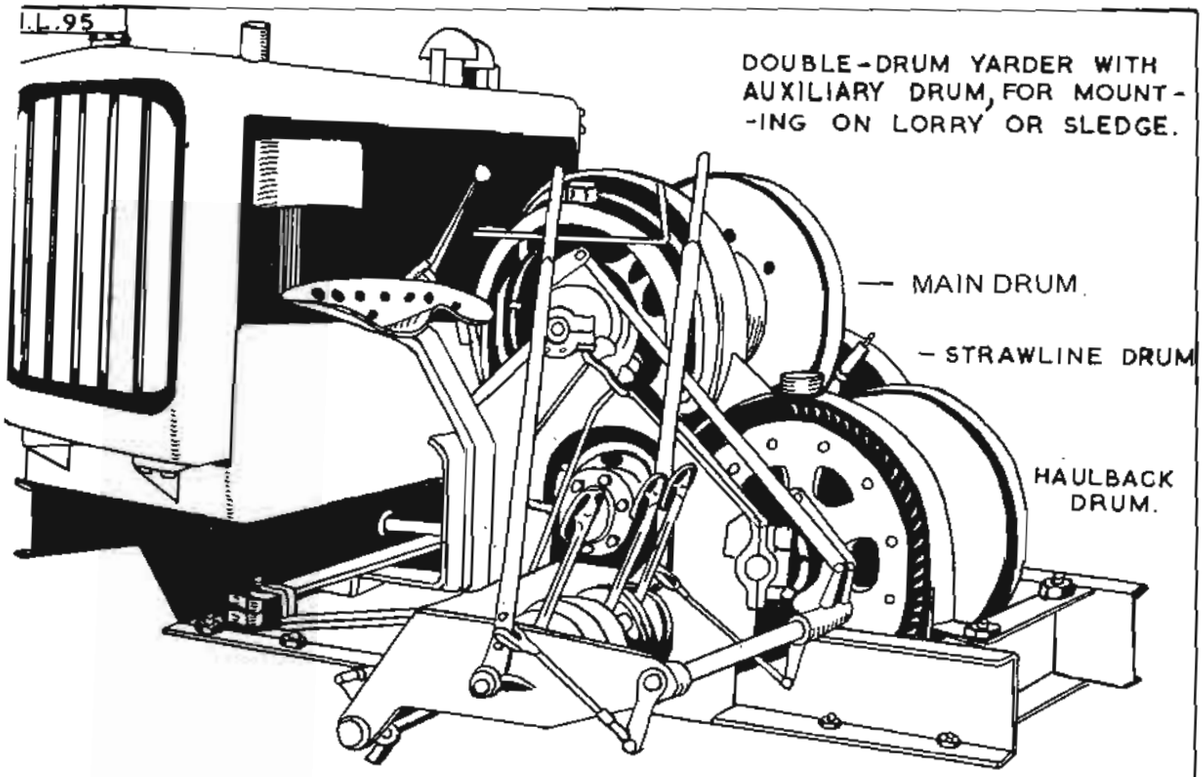
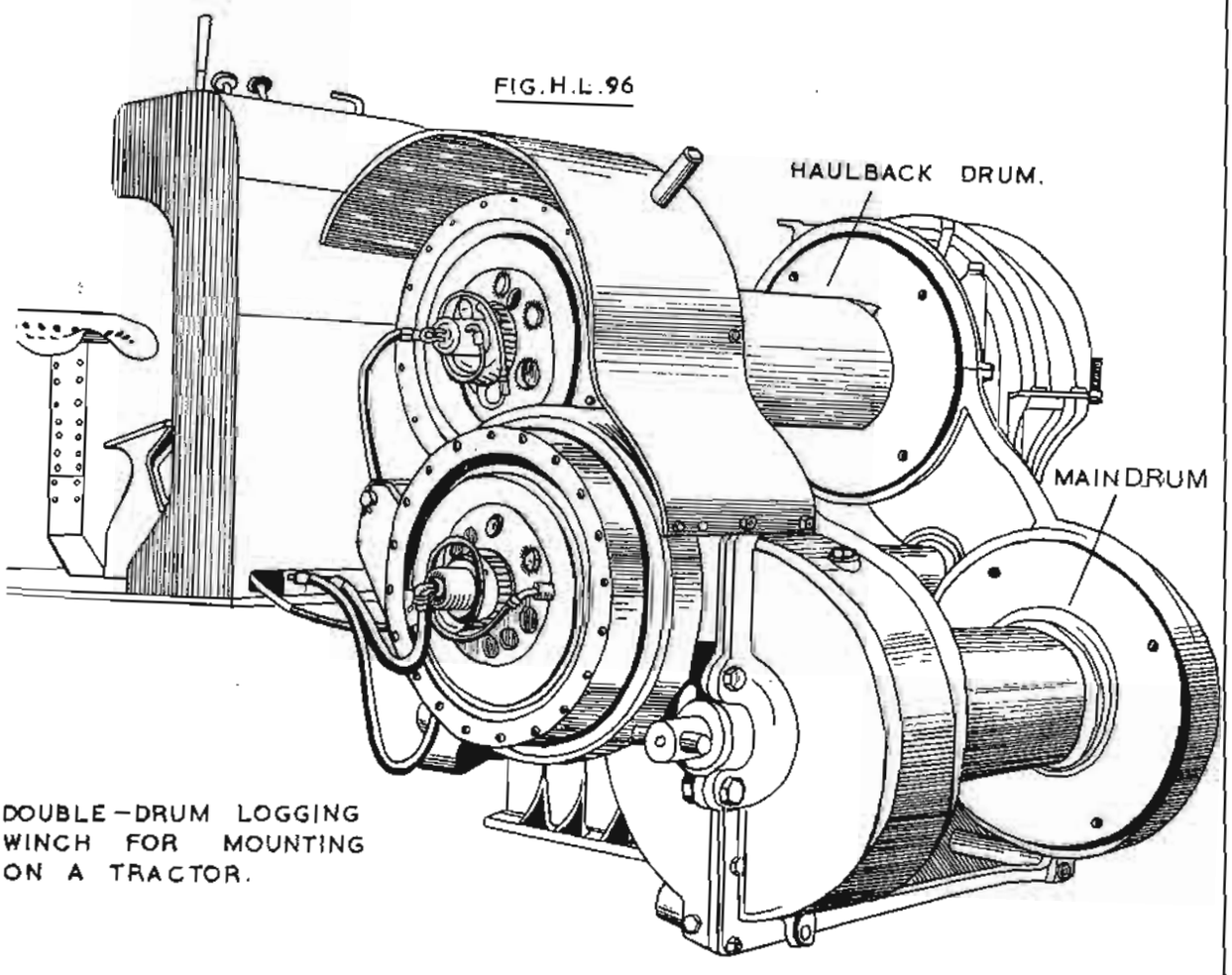


FIG. H.L.96



DOUBLE-DRUM LOGGING WINCH FOR MOUNTING ON A TRACTOR.

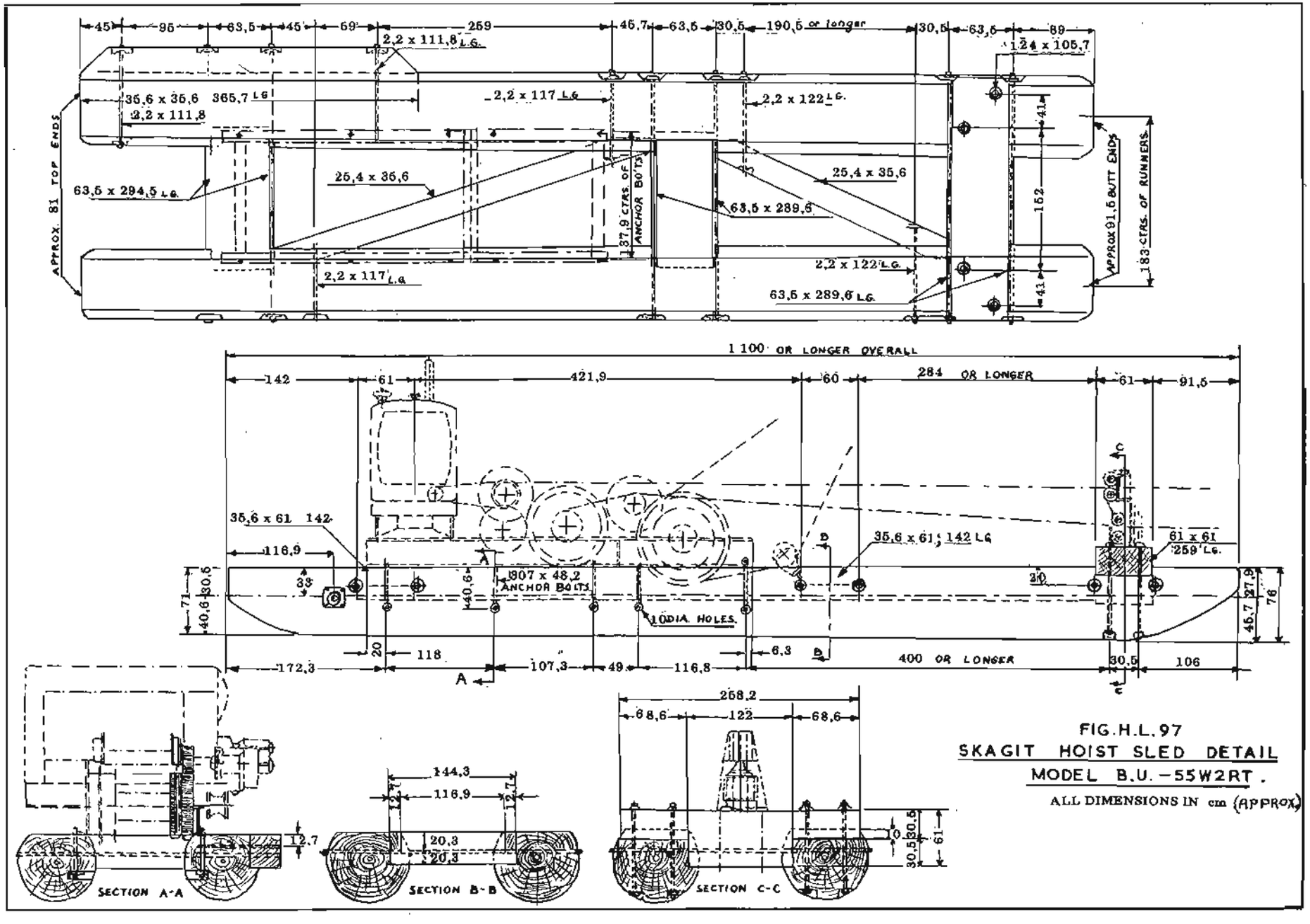


FIG. H.L. 97

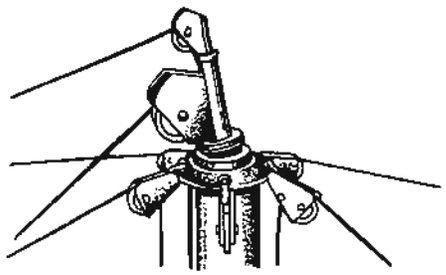
SKAGIT HOIST SLED DETAIL

MODEL B.U. – 55W2RT.

ALL DIMENSIONS IN cm (APPROX)

HIGHLEAD WITH MOBILE SPAR.

FIG. H.L. 98



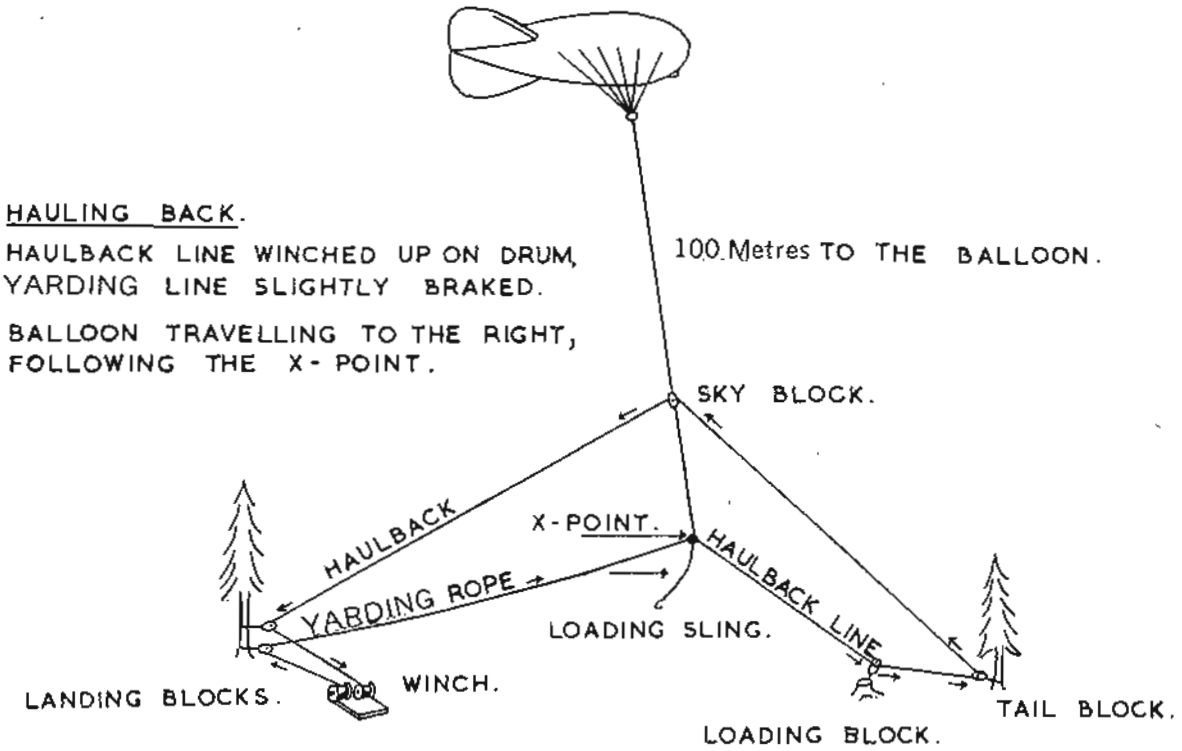
DETAIL OF FAIRLEADER AND GUY-LINE BLOCK ATTACHMENTS.

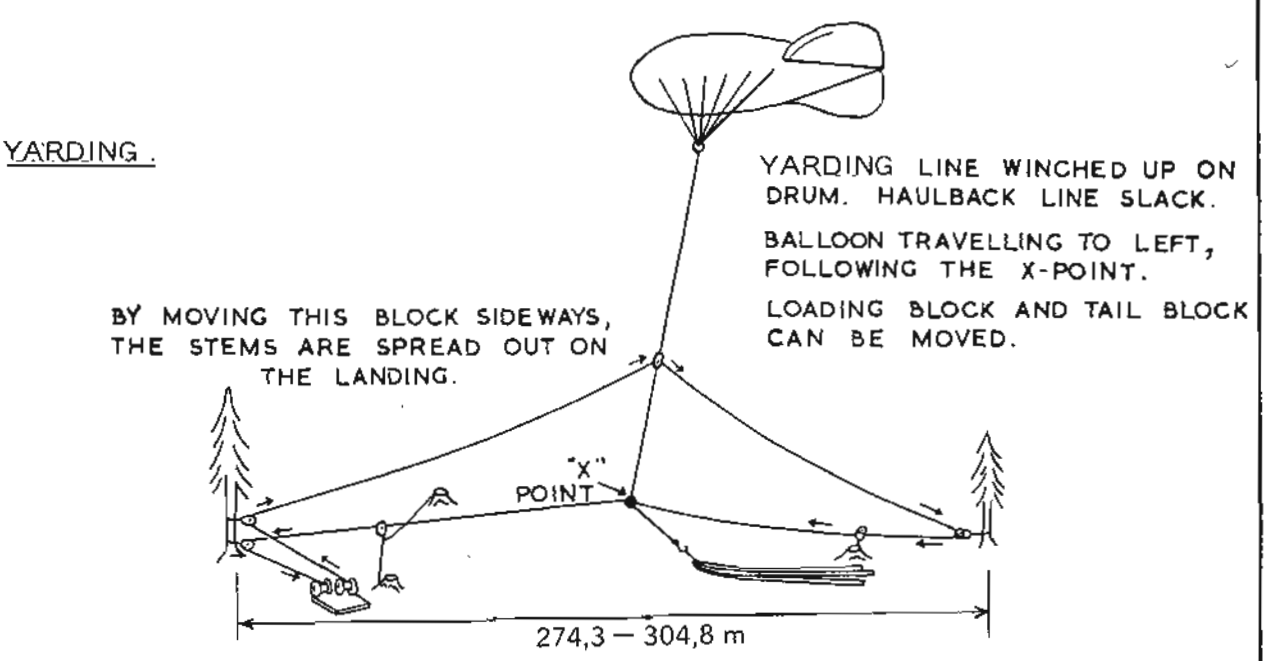
MOBILE SPAR MOUNTED ON TRACK LYING CARRIER.

FIG. H.L.99

OUTLINE OF CABLE YARDING WITH THE AID OF A BALLOON.

(NOT TO SCALE.)





E. YARDER MOUNTINGS FOR SPAR TREE OPERATIONS

Fig. 93 and 94 show yarders mounted in a manner typical of the Canadian North-west logging pattern. Yarders used are of the type illustrated in Fig. H.L. 95. The yarder machine is mounted on a steel frame, which is in turn fitted onto skids of measurements and dimensions shown in Fig. H.L. 97.

Fig. H.L. 93 shows a double-drum yarder with an outboard drum for the strawline. Fairleaders with one sheave for the strawline and one sheave for the main line are mounted on the front end of the sledge, and are used for steering (guiding) the yarder when it moves along the slope under its own power, using the cables.

Fig. H.L. 94 shows the working setting of the yarder and spar tree, with the spar tree rigged. This type of mounting has largely been replaced by yarders as shown in Fig. H.L. 95 mounted on wheel-mounted carriers, or as in Fig. H.L. 96, mounted on crawler-tractors, wherever the terrain permits movement of the carriers or tractors. Tractors or lorries used for yarder mountings have usually served their time previously as bulldozers or logging trucks respectively.

F. MOBILE HIGHLEAD SPAR TREES (Fig. H.L. 98)

In order to cope with timber extraction from difficult topographical areas in the U.S.A., the North-west loggers have resorted to the use of steel towers as spar trees, used with self-propelled units of great size and power. Although timber extraction and conditions in South Africa do not warrant the use of units of the size shown in Fig. H.L. 98, it is nonetheless of interest to know something of the performance, output and specifications of these units.

The following information relates to a mobile spar of the size and type shown in Fig. H.L. 98:

Mass without rig: 30 tons
Mass with rig: 57 tons
Purchase price (Canada) R43 000
Height of the spar: 27 metres
Winch: Maximum main drum capacity: 440 metres of 38 mm wire rope
Maximum haulback drum capacity: 900 metres of 22,2 mm wire rope.

With the tower collapsed in the horizontal position, the unit is 20 metres long and 3,6 metres wide. The tower tube has a bottom diameter of 90 cm.

Mobile spars can easily be moved from one logging setting to another adjacent setting in two hours or under. This elapsed time would be from the time the last log was landed on one setting until the first log was yarded on the adjacent setting.

In raising the spar, a 4-stage hydraulic ram lifts it to a position approximately 60° from the horizontal. The hydraulically-controlled guy-lines lift the spar from the ram and complete the erection to a perpendicular position. Because of by-pass valves set at a particular hydraulic pressure, all guy-lines are equally tensioned.

The average operation would be on ground with a 50° slope, with a maximum yarding distance of 180 m to 210 m. A typical crew consists of 5 men with a radio whistle for signalling.

The average output per day for the unit illustrated would be approximately 36 m^3 per unit of labour, or 190 m^3 per machine unit per day.

Cost figures cannot be given due to the wide divergence of costs and conditions in Canada and South Africa.

VIII HIGHLEAD LOGGING BY BALLOON

During 1956 and 1957 Swedish loggers experimented with highlead type logging using a balloon in place of the spar tree (Fig. H.L. 99). Difficulties arose during the experiments, primarily because the Swedes were not familiar with the use of wire rope in logging, and also because of the multitude of problems which the use of a balloon involves.

The most important equipment for the Swedish experiments - the balloon - was a 15 year old barrage balloon from England. Experiments were conducted in inflating the balloon, observing its lift capacity, pull on the cables, handling and so forth. For instance, the balloon acted like a kite in the wind, so when yarding on a day with a light wind of about 12 metres per second, the balloon's lifting capacity was increased by 30 to 40 %. On the other hand, the crew's need to control the balloon in a fair wind increased by leaps and bounds. It took 15 to 20 men to control the big bag in strong or gusty winds.

Lifting power of the balloon when filled to capacity was furnished by 458 m^3 of hydrogen. It amounted theoretically to around 300 kg, but balloon leakage, wire ropes, rain and snow decreased the lifting capacity; a stable wind condition increased it. The average lifting capacity was 200 - 250 kg.

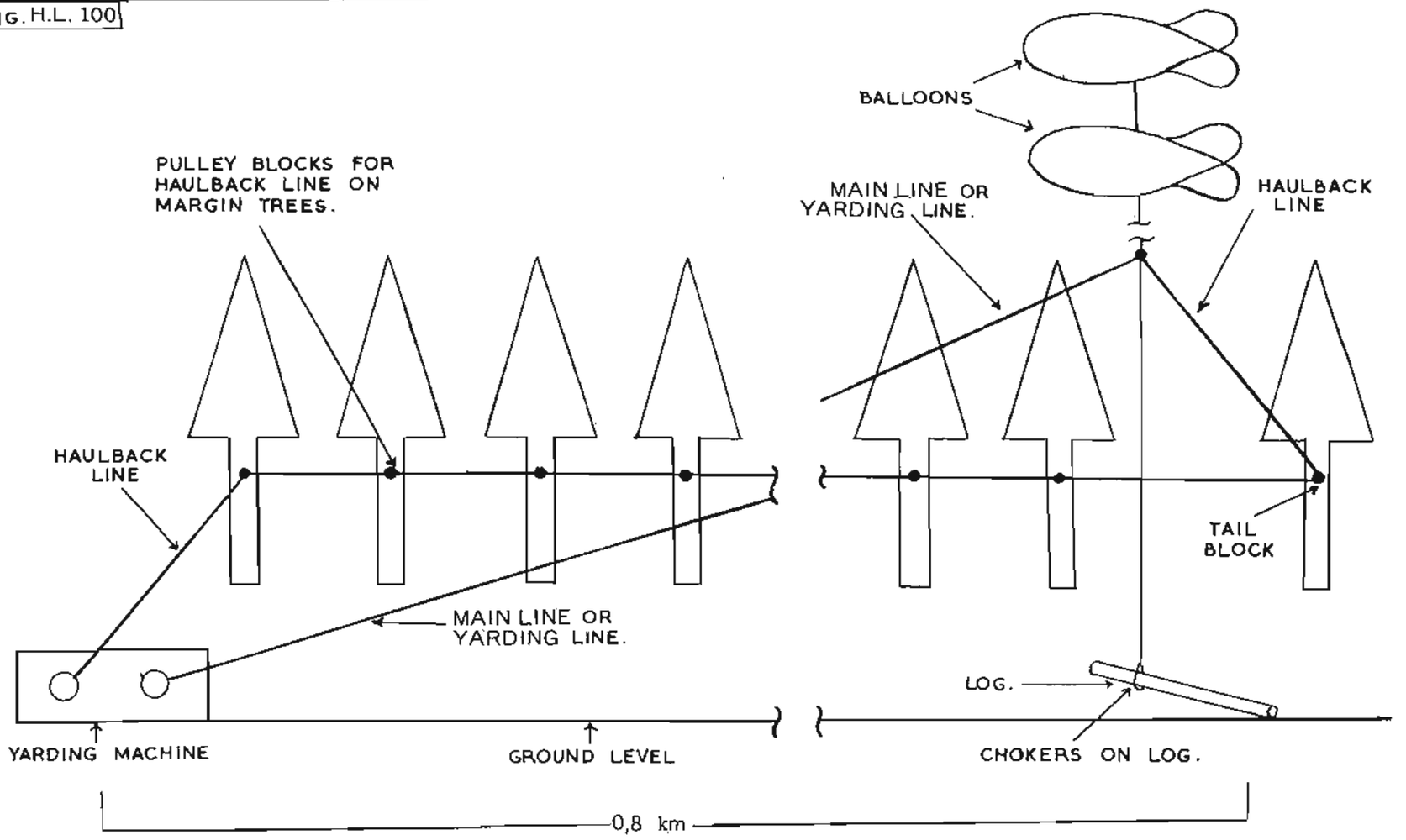
Much time was devoted to making the balloon as effective as a spar tree. Yarding and haulback lines of 6,35 mm rope, 400 m on the yarding drum and 780 m on the haulback drum, were arranged as illustrated in Fig. H.L. 99.

The direction of wire rope travel on the drawing, during both the yarding and return phases of yarding, is indicated by arrows. The loading line is suspended beneath the "X" point. The chokered tree lengths, being yarded, are attached to it.

The yarding machine was a 1956 "Vossa" double-drum winch having a mass of 540 kg and powered by a 16 kW Volkswagen engine.

The Swedes realised that it was not essential for the haulback line to go through the sky block, which is located on the wire rope holding the balloon. The haulback line could just as well run on the ground and follow the border of the cutting area. The sky block arrangement makes it possible, however, to lower the loading sling to any point between the loading and landing blocks. This was found to be of considerable practical value.

FIG. H.L. 100



LAYOUT OF THE BALLOON LOGGING SYSTEM. BALLOONS AND MAIN LINE GO TO THE LEFT IN THE YARDING PHASE AND TO THE RIGHT IN THE HAULBACK PHASE.

FIG.H.L.101

"V" BALLOON FOR LOGGING.

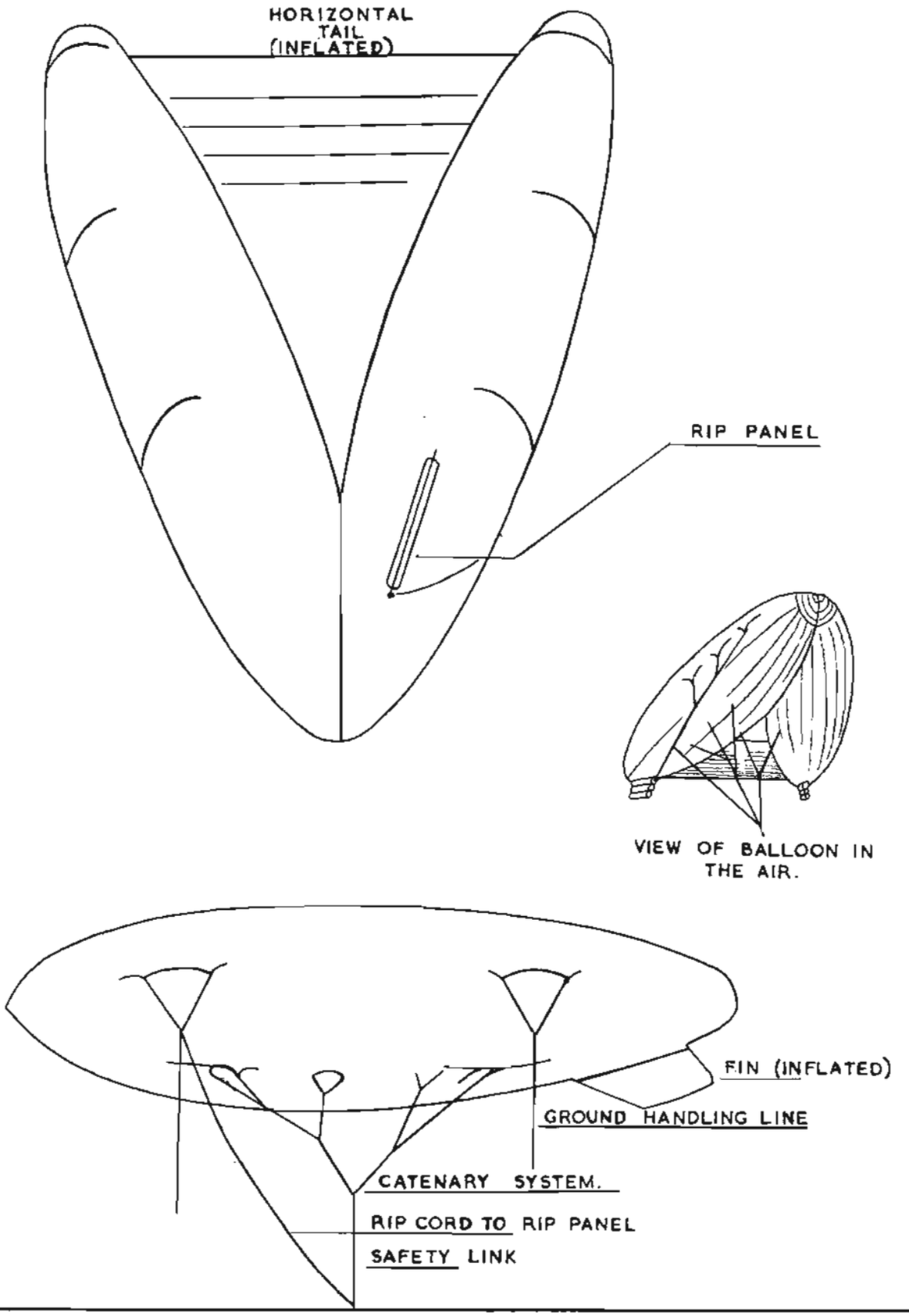
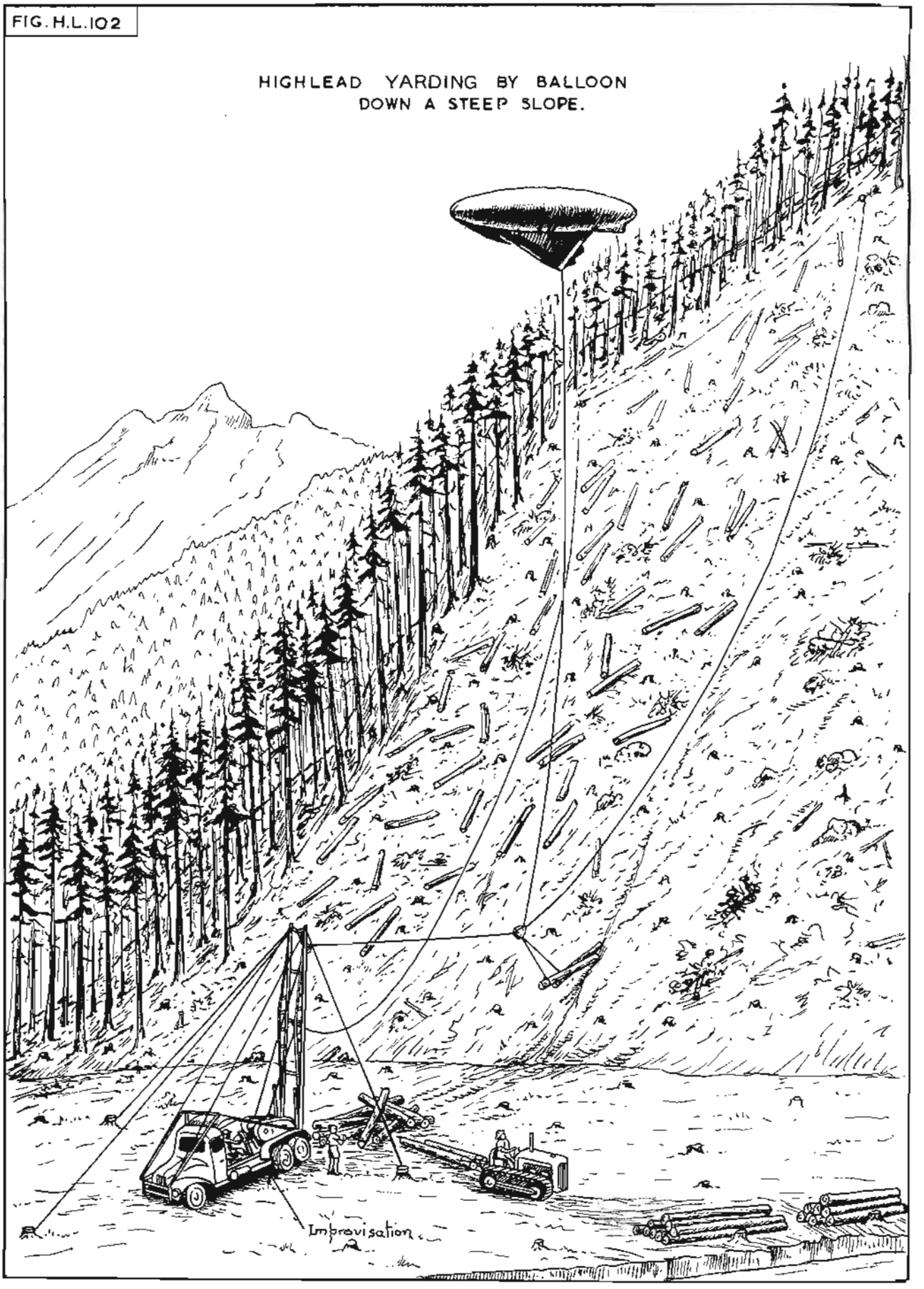


FIG. H.L.102


HIGHLEAD YARDING BY BALLOON
DOWN A STEEP SLOPE.
Improvisation

The balloon was kept about 90 metres in the air for a system of wire ropes extending for about 300 metres. Tests of the balloon and wire rope system with tree lengths were carried out on a Swedish logging show, the logging crew consisting of a winch operator, one off-hooker, and two chokermen.

A summary of a number of balloon logging tests shows that the average yarding distance was approximately 150 metres; average tree size was 0,34 m^3; so the average load per turn amounted to 2,2 trees of approximately 0,75 m^3.

(A) TIME PER TURN

A total of 41 turns, during which the loading block was moved six times, and the tail block was moved once, took an average of little more than 5 minutes each. A break-down of the average turn time in minutes and seconds shows 15% consumed in hooking trees, which had been pre-choked, 17% yarding time, 13% off-hooking at the landing, where the trees were placed side by side; 14% haulback, 21% for moving the blocks and 20% delay time. Production per hour was figured from the above at a little more than 9 m^3.

Scientists of the Forest Research Institute of Sweden concluded from the balloon logging experiments, that the problems of handling and maintaining the balloon in the forest were many. But the problems could be mastered, in view of "certain operational merits" of the system which may increase production on clearcut areas as compared with standard skyline cable systems.

The test was only one method of using a balloon with a wire rope system; it is possible, however, that a more efficient method can be developed. It appears unlikely that in Sweden a combined balloon-wire rope logging system would be able to compete with skidding by tractors and horses. It is however, possible that balloon yarding may have some future applications for yarding over difficult terrain.

B. DOUBLE BALLOON SYSTEM (Fig. H.L. 100)

In British Columbia the balloon yarding system was tested using two balloons instead of one. The results indicate that the system may be a feasible one, particularly in areas where long yarding distances are encountered over rough terrain. The two balloons provided quite a considerable lift to the log heads, enabling them to overcome normally formidable ground obstacles. Another important feature was that much lighter rigging could be used, which facilitated the use of lighter and longer cables, giving the system a reach of up to one kilometre, which far exceeds the reach of conventional yarding systems (200 metres). The balloons again appeared to create a major problem, however, but this problem was solved to a certain extent by using an ex-army stock weapons carrier for controlling the balloon. An old crawler-tractor could also be used for this purpose.

The greatest potential for the balloon logging highlead systems appears to be in areas with rough, mountainous terrain with limited access, sparsely served by logging roads, as illustrated in Fig. H.L. 102, where balloon logging is used to yard logs down a very steep slope. Roads are only necessary in the lower part of the valley, thus construction of roads higher up in the more difficult terrain can be dispensed with.

C. THE "V"-BALLOON

The V-balloon, illustrated in Fig. H.L. 101 has recently been introduced for log yarding, and although still primarily in the experimental stage, it appears very suitable for balloon logging operations. The illustration shows the V-balloon with its inflatable tail piece. The balloon has sufficient lift to raise 1 ton completely off the ground.

The high aerodynamic lift to drag ratio and good directional and longitudinal stability of the V-balloon result in a more vertical position of the tether cable, even in high winds. In this respect the performance of the V-balloon surpasses that of barrage balloons or cylindrical balloons.

Note: Recently the balloon design and rig have undergone changes. This system is still fighting for survival

IX. HIGHLEAD LOG YARDING

1. LOGGING SAFETY

Choker hook assembly

(1) The choker slings should be in good order. The wire rope slings should not be kinked.

(2) The ferrules should be well attached. Under ordinary circumstances a choker wire sling shall not be used when 10% of the wires are broken within a distance of one lay.

Wire rope

(3) Wire rope on highlead logging winch drums should be of suitable length. The crushing stress of too full a winch drum has a destructive effect on the rope.

(4) All line fittings should be of the right size and type.

(5) The yarder should be tied securely to an anchor.

(6) All shackles used for joining the fittings shall have a strength of not less than that of the line they join.

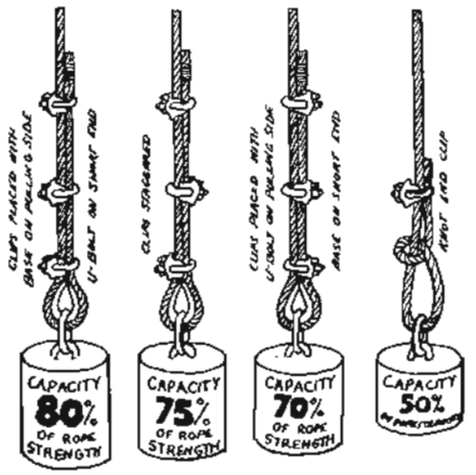
Rigging

(7) All rigging must be correctly selected and fitted to safely withstand maximum likely load.

(8) In no case shall the allowable loading or stress imposed, exceed one half of the breaking strenth of any parts of the rigging.

(9) The placing and condition of rigging shall be such as to ensure safety to those who will be working in the vicinity.

CORRECT WRONG WRONG WRONG



ILLUSTRATING REDUCED EFFICIENCY OF CLIP FASTENINGS CAUSED BY INCORRECT APPLICATION OF CLIPS OR BY BAD DESIGN.

THE USE OF CROSBY CLIPS FOR WIRE ROPE LOOPING.

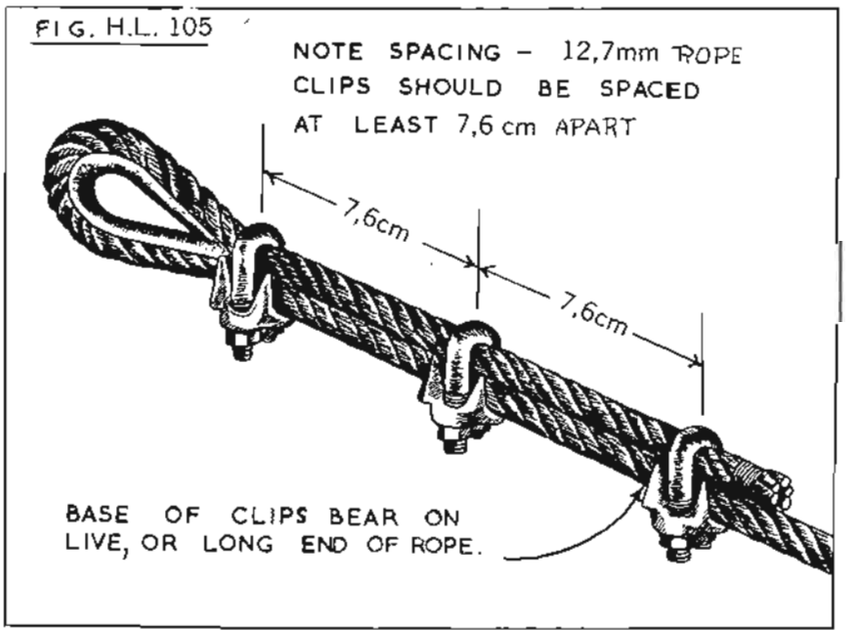
FIG. H.L. 103

FIG. H.L. 104

IMPROPER METHOD OF APPLYING CLIPS.

ROPE DIAMETER mm	NUMBER OF CLIPS	SPACING cm	LENGTH OF WRENCH. cm
12,7—15,8	3	7	30
19,0—22,2	4	10	45
25,4—28,6	4	15	60
31,7—34,5	4	17	60
38,1 TO LARGER	5-7	25	60

FIG. H.L. 105



(10) Workmen shall move out of the bight of lines before the lines are moved.

(11) Running lines shall be arranged so that workmen will not be required to work in the bight.

(12) While a cable is being changed, all men shall be in the clear before the lines are tightened.

(13) A thorough inspection of all blocks, straps, guy-lines and other rigging shall be made before they are used. This inspection shall include an examination for damaged, cracked or worn parts, loose nuts and bolts, and of lubrication and the condition of straps and guy-lines. The repair or replacements necessary for safe operation shall be made before the rig is used. All moving parts to be lubricated.

(14) Fairleads shall be securely fastened and properly aligned at all times, and shall be of a design that will prevent excessive line damage.

(15) Where boom yarder (logger's dream and caterpillar tractor with Hyster winch and folding crane) is used, all rigging on the boom must be inspected, and worn or defective parts replaced, before the boom is raised on each respective occasion.

(16) All employees are prohibited from riding hooks, lines or any other rigging.

(17) While the operator is working on the boom, or spar tree, workmen shall keep a safe distance away. The operator shall give warning in case a shackle, pin, hook, bark or any other material is in danger of dropping, or is to be deliberately dropped.

(18) An experienced man, stationed out of danger of falling objects, shall be assigned to transmit the operator's signals.

(19) Running lines shall not be moved while the operator is working on the boom, except such pulls as he directs.

Equipment

(20) Standard equipment shall be classed according to the manufacturers' ratings.

Cables and fastenings

(21) All cables offered for sale shall be certified as to their breaking strength by the manufacturers, in accordance with the S.A. Bureau of Standards specifications or other acceptable authority, before being used for any hazardous purpose.

(22) Cables or straps which are badly worn, crystalised or kinked shall not be used. Stranded, chafed or sawed lines or straps shall be replaced or repaired upon discovery.

(23) Cables worn or damaged beyond the point of safety shall be taken out of service or properly repaired before further use. Under ordinary circumstances, a cable shall not be used when 10% of the wires is broken within a distance of one lay.

Efficiency of end fastenings (Fig. H. L. 103)

(24) Kind of fastening	Will develop (approximately)
Clips, properly fastened	80-85% of the rope strength
Clips, improperly fastened	50% of the rope strength
Spliced eye and thimble	9,5 mm to 25,4 mm - 95% of rope strength
Spliced eye without thimble	Considerably less efficient than with thimble
Wedge sockets	65% of rope strength
Sockets properly attached	100% of rope strength

(25) The safe margin of line to be used in making a long splice is indicated in the following table. The full length of the splice will be twice that "to be unravelled."

Rope diameter	To be unravelled
6,35 mm	1,5 metres
12,70 mm	2,1 metres
15,87 mm	2,4 metres
19,05 mm	2,7 metres
25,4 mm	3,6 metres

(26) Splices other than eye splices in lang lay loading lines are prohibited.

(27) Eye splices in all lines and straps shall be tucked at least three times. Eyes in lang lay lines shall be tucked at least four times.

(28) Short splices, eye to eye splices, knots, molles, are prohibited except for temporary purposes. They shall not be used where they are subject to strain.

(29) The use of a hard hammer for cutting the cable is prohibited.

(30) Marlin spikes or needles in good condition, large enough for the size of the line being spliced, shall be used.

Cable clips and clamps (Fig. H.L. 103, 104, 105)

(31) The use of cable clips or clamps for joining lines is prohibited. They shall not be used where lines are subjected to any working strain.

(32) U-bolt type clips, properly attached and in conformity with the number and spacing as given in the following table, will be considered as developing 80% of the rated rope strength.

Diameter of the rope	Number of clips required	Minimum space between clips
25,4 mm	5	15 cm
19,0 mm	5	11 cm
9,5-15,8 mm	4	7 cm

(33) All cable clips shall be applied so that the U-bolts bear on the dead or short end of the rope. The saddles shall bear on the "live" or pulling end of the rope. Nuts shall be tightened evenly,

tightening again after application of first sustained load and shall be frequently checked thereafter.

Shackles

(34) All shackles used for joining lines shall have a strength of not less than one and a half times that of the lines they join.

(35) Shackles used to hang blocks or jacks shall have a strength of not less than twice that of the pulling lines.

(36) Shackles used to hang all blocks on yarding booms shall have the pins secured by a nut with a split pin or wire strand. Wire strands so used shall run twice through the pin and with loose ends rolled in.

(37) Shackle pins and nuts shall be replaced when worn or when threads are worn or stripped.

(38) Clevises or shackles used for all other connections shall be of the screw-pin or lock-nut type.

(39) Shackles, swivels, links, etc., shall be replaced or repaired when they are so worn that they will not safely support the expected strain.

(40) Shackles and swivels subjected to heavy strains shall not be built up by welding when worn beyond the point of safety.

(41) The spread of the jaws of a shackle shall be no more than 25 mm wider than the diameter width of the yoke or swivel.

Blocks

(42) Blocks shall not be used for heavier strains or larger lines than those for which they are constructed.

(43) Blocks and sheaves and all parts thereof shall have a designated strength capable of withstanding the force that would be imposed upon them by a tension in the line for which they are designed, equal to its rated breaking strength.

(44) The blocks should be of construction and size as supplied with the unit by the manufacturer.

(45) Sheaves having badly corrugated cable grooves or having grooves which do not fit the lines used on them shall not be used.

(46) All blocks shall be fitted with line guards to prevent falling.

(47) Provision shall be made and used to securely fasten the bearings and yoke pins of all blocks.

(48) All running line lead blocks shall be hung as designed by the manufacturers of the unit.

(49) Tail and side blocks, or any other blocks used in yarding shall be securely fastened by straps to their anchors. The use of threaded straps for running line blocks is prohibited.

(50) The straps shall be made of good material, preferably both ends eye spliced, and made of line equal in strength to the running line.

(51) Blocks and shackle pins shall be securely fastened and inserted so that they will not be knocked out by the butt rigging.

(52) Main lines on highlead systems shall run directly from the drum to the main block.

(53) Auxiliary blocks of small size should not be used for any other purpose, i.e. operation itself.

(54) All haulback block straps shall be of good material and be at least as strong as the line they hold.

(55) Where it is permissible to hang a block on a single eye, the strap shall be at least double the strength of the running line. Cable used for straps other than block hanging straps, shall have at least 80% of the original breaking strength and shall not be used if any of the wires break in splicing.

Guy-lines

(56) Guy-lines shall be of best plough steel material in good condition.

(57) Guy-lines, sufficient in number, condition and location to develop stability and strength equivalent to the ultimate or breaking strength of any component part of rigging or equipment, shall be provided.

(58) The number of guy-lines required with the boom is determined by the manufacturer. Their number can be increased if guy-line anchoring is not satisfactorily strong and more anchors have to be provided to hold the boom safely.

(59) Guys making an angle with the horizontal greater than 60° will be considered less than 50% effective.

(60) Extra lengths necessary to fasten guys at either end must be added to these lengths.

(61) Guy-lines must be fastened by means of shackles equal in strength to the guy-lines. Shackle pins shall be securely fastened with split pins or equivalent.

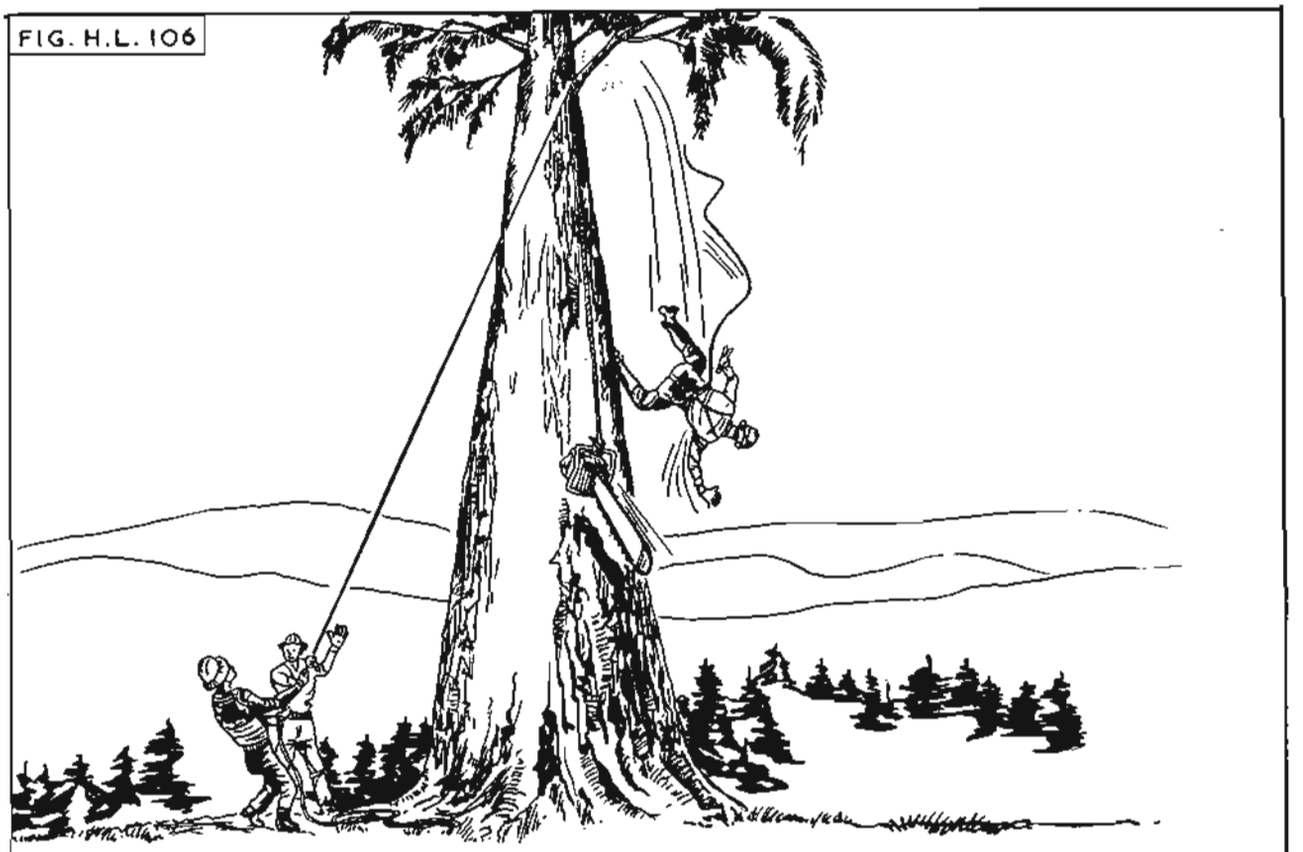
(62) The use of loops for attaching guy-lines is prohibited.

(63) Extensions to guy-lines shall be equal in strength to the lines to which they are attached. Extensions shall be attached only by a regular long splice tucked at least three times, or a shackle connecting two spliced eyes. If connected by a shackle, the shackle shall have at least $1\frac{1}{2}$ times the strength of the guy-line.

(64) All guy-line eyes shall be tucked at least three times.

(65) Stumps used for fastening guy-lines shall be carefully chosen as to position, height and strength. They shall be tied back if necessary.

FIG. H.L. 106



HIGH CLIMBER KILLED WHEN HE FELL 36 METRES FROM A SPAR TREE. HIS SAFETY ROPE SLIPPED AS HE TRIED TO PASS IT OVER A LIMB.

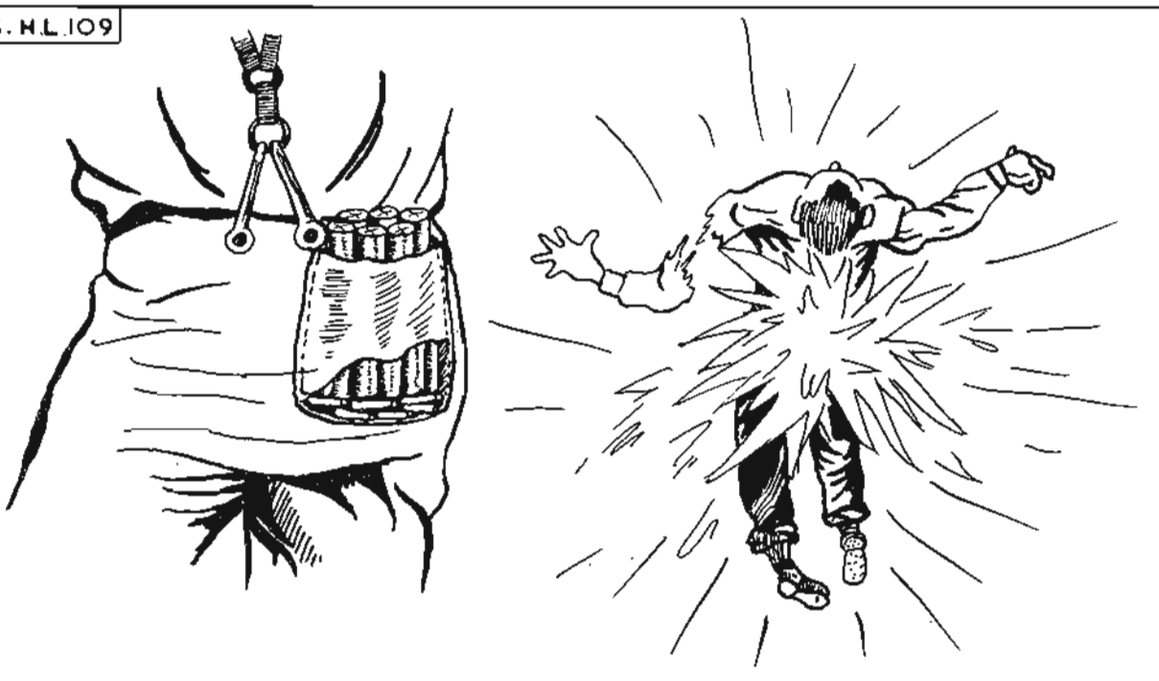
FIG. H.L. 107.

A HIGH CLIMBER WAS KILLED INSTANTLY WHEN HE CUT HIS WIRE CORE CLIMBING ROPE WITH A POWER SAW AND FELL TO THE GROUND. IT IS BELIEVED HE LAID HIS SAW ON THE ROPE TO RESTART IT AND THE ROPE WAS CUT NEAR THE D-RING AS THE SAW STARTED.

FIG. H.L. 108

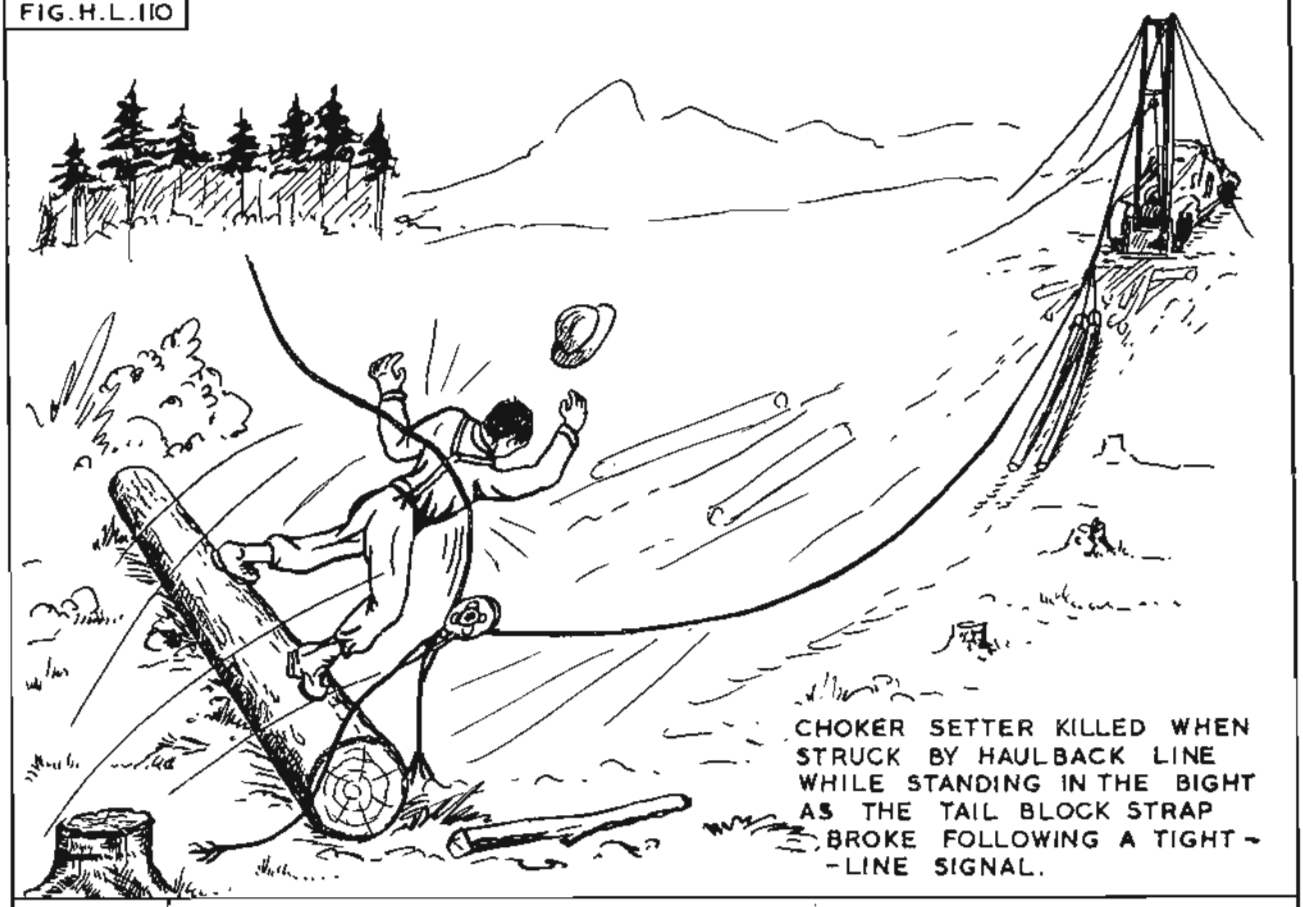
A HIGH CLIMBER WAS KILLED WHEN HE FELL 20 METRES FROM A TREE. HE WAS HANGING A HAULBACK BLOCK IN ORDER TO KEEP THE RIGGING OFF A ROAD AT THE SIDE OF THE YARDING AREA. IT IS BELIEVED THAT HE UN--SNAPPED HIS ROPE TO PASS IT OVER A BRANCH WHEN IT SLIPPED FROM HIS HANDS.

FIG. H.L. 109



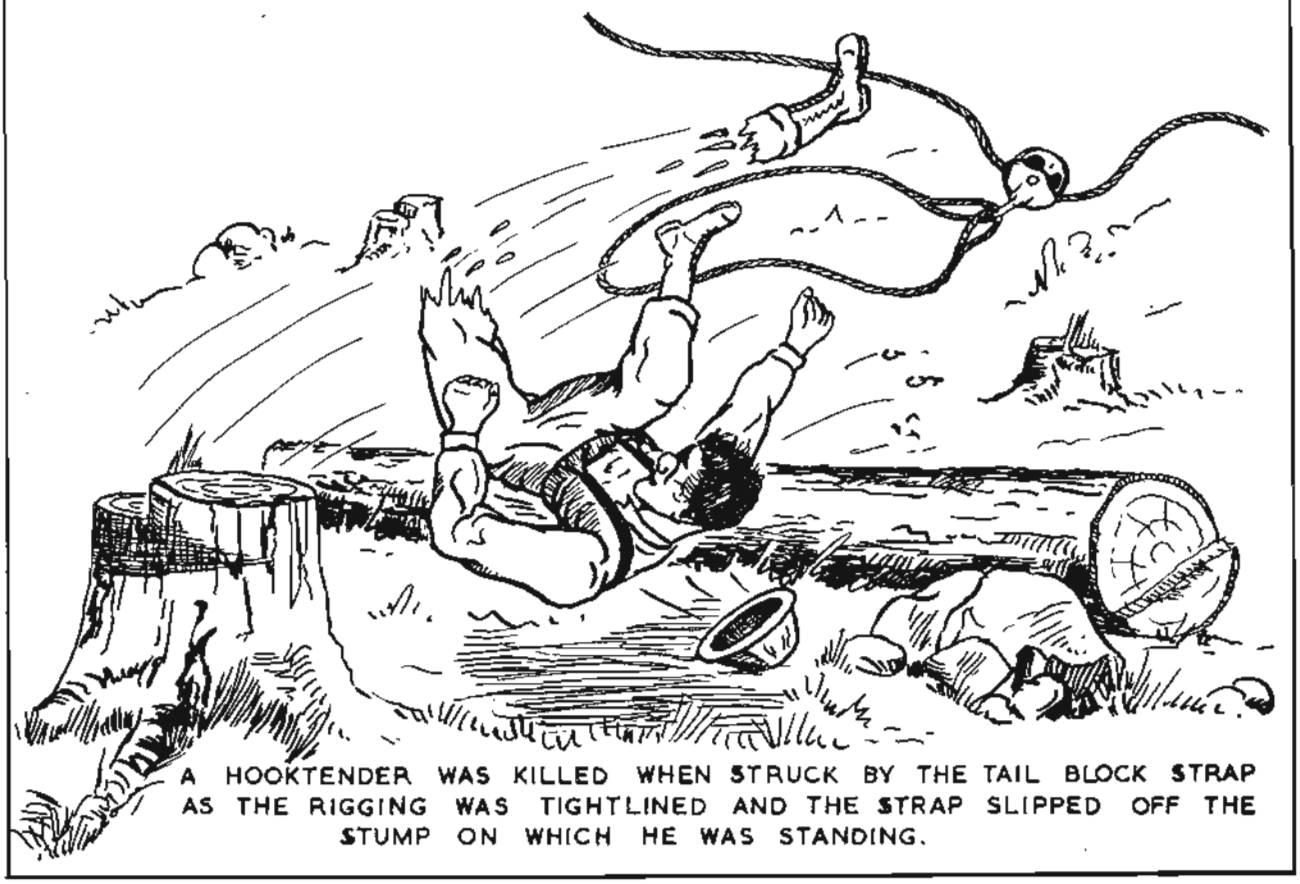
A RIGGER WAS BLOWN TO BITS AS SIX STICKS OF DYNAMITE AND SOME DETONATORS HE WAS CARRYING IN HIS POCKET EXPLODED. THE DETONATORS WERE LOOSE IN HIS POCKET AND HAD NOT BEEN MADE INTO PRIMERS.

FIG. H.L. 110



CHOKER SETTER KILLED WHEN STRUCK BY HAULBACK LINE WHILE STANDING IN THE BIGHT AS THE TAIL BLOCK STRAP BROKE FOLLOWING A TIGHT-LINE SIGNAL.

FIG. H.L. 111



A HOOKTENDER WAS KILLED WHEN STRUCK BY THE TAIL BLOCK STRAP AS THE RIGGING WAS TIGHTLINED AND THE STRAP SLIPPED OFF THE STUMP ON WHICH HE WAS STANDING.

Standing trees shall not be used for this purpose. These stumps shall be inspected from time to time while the operation is in progress.

(66) Stumps shall be adequately barked and notched to provide sling (or strap) saddles where the wraps are to be made. Workmen shall not stand close to the stump while the guy-line wraps are being tightened.

(67) Guy-lines shall be anchored to stumps with at least two and one half wraps, well clamped.

(68) All guy-lines shall be kept well tightened while spar trees are being used for yarding or loading.

(a) In removing guy-lines or skylines from stumps, a reverse safety wrap shall be put on before loosening any clips.

(b) An experienced man shall be in charge of loosening guy-lines, using all precautions, and giving warning before lines are released.

(c) Safety boldbacks shall be used when necessary for the safety of workers.

Butt rigging

(69) Cold shuts shall not be used in butt rigging. All swivels shall be free to swivel.

2. ACCIDENTS IN LOGGING

YARDING

A number of the drawings in this section of accidents in logging is printed by courtesy of the Oregon State Accident Commission, U.S.A., and refer to actual accidents which occurred during logging operations.

(a) Fig. H.L. 106. Climber killed by fall from spar tree

The high climber was instantly killed when he fell 36 metres from the spar tree he was preparing to top. It is believed that he was passing his rope over a limb when it slipped from his hand, for the snap was unfastened from the D-ring.

Preventive measures

(1) Make certain your spurs are securely set, you are well balanced, and you have a good grip on your rope when unfastening it to pass it over limbs or rigging.

(b) Fig. H.L. 107. High climber killed when he cut through safety rope

The high climber was instantly killed when he cut his wire-core climbing rope with a power saw and fell 36 metres to the ground. It is believed that he laid the saw across his rope to restart it and the rope was cut near the D-ring as the saw started.

Preventive measures

(1) Discontinue the use of power saws for topping or limbing unless a 9,5 mm case hardened steel chain is used.

(c) Fig. H.L. 108. Climber killed by fall from tree

The high climber was instantly killed when he fell approximately 20 metres from a tree. He was hanging a haulback block in order to keep the rigging off a road to the side of the yarding area. It is believed that he had unsnapped his rope to pass it over a branch when it slipped from his hands.

Preventive measures

(1) Use a secondary safety attachment or a rope when snaps are used.

Note: Inadequate information to determine exact cause

(d) Fig. H.L. 109. Head rigger instantly killed by dynamite explosion

(1) A head rigger was instantly killed when he was blown to bits as six sticks of dynamite and some detonators he was carrying in his pockets exploded. It is believed the detonators were loose in his pockets and had not been made up into primers.

Preventive measures

(1) Detonators and blasting powder or dynamite should never be carried together.

(2) The rigger should not have been carrying the dynamite at all, as it should have been contained in a sack, which would have been passed up to him when he had reached the top of the tree to be topped.

(e) Fig. H.L. 110. Choker setter instantly killed when struck by haulback line

A choker setter was instantly killed when struck by the haulback line while standing in the bight as the tail block strap broke just following a tightline signal.

Preventive measures

(1) All workers must be at least 6 metres outside the wire rope perimeter when ropes are in movement.

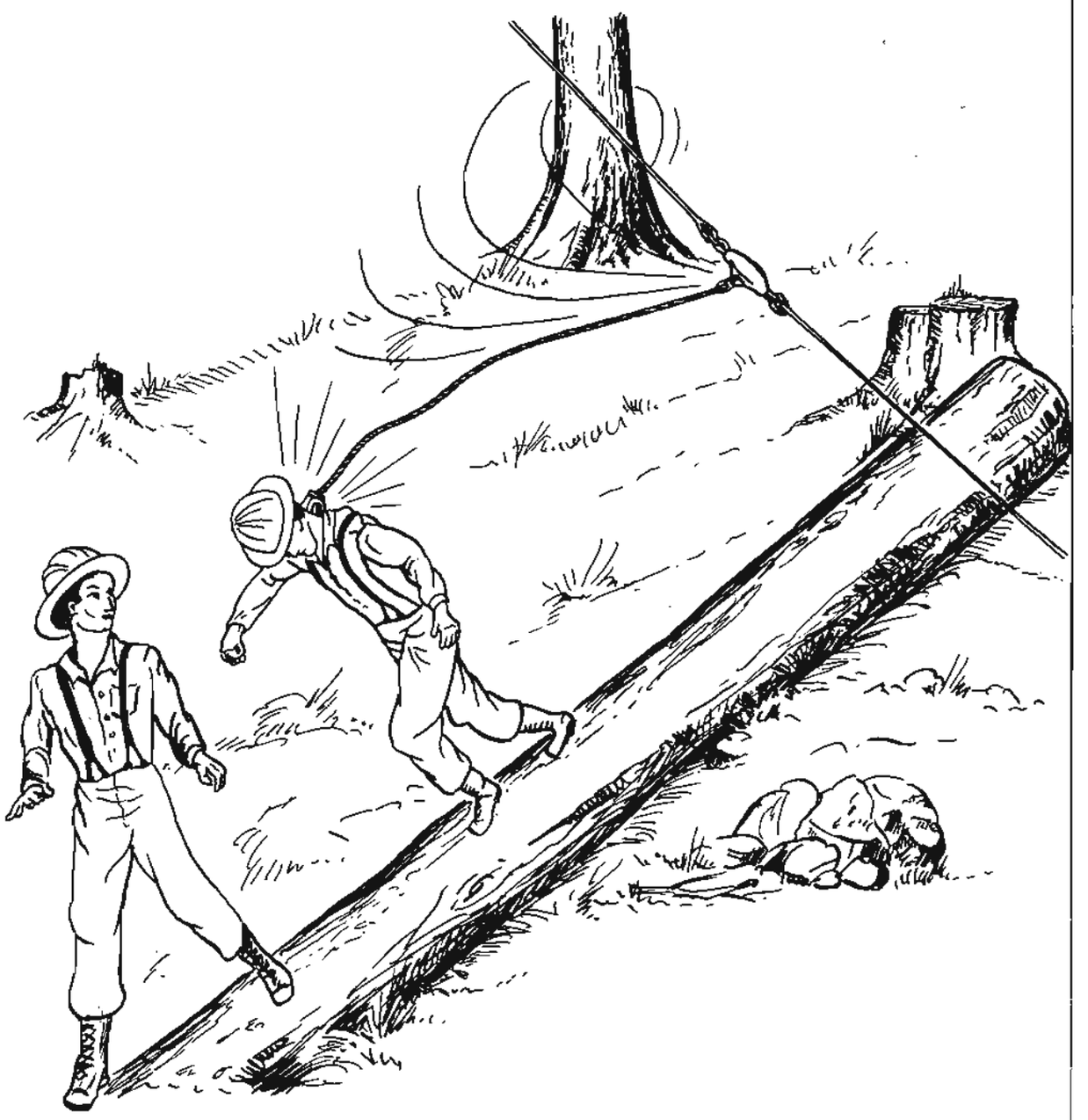
(2) Signalmen must not give the signal to pull until all men are clear of the moving lines.

(3) Inspect block straps periodically and remove or repair before they become unsafe for use.

(f) Fig. H.L. 111. Hooktender instantly killed when struck by tail block strap

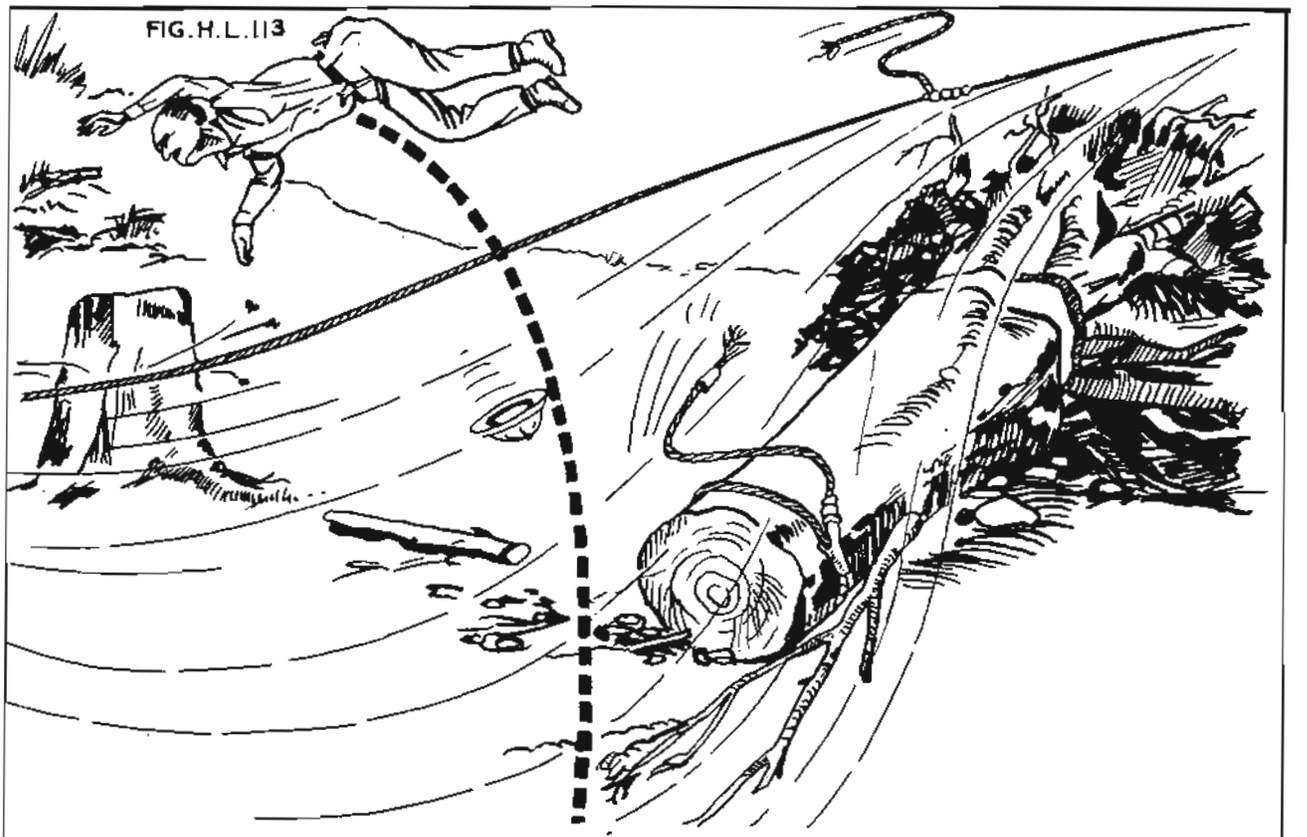
The hooktender was instantly killed when struck by the tail block strap as the rigging was tightlined and the strap slipped off the stump upon which he was standing.

FIG. H. L. 112



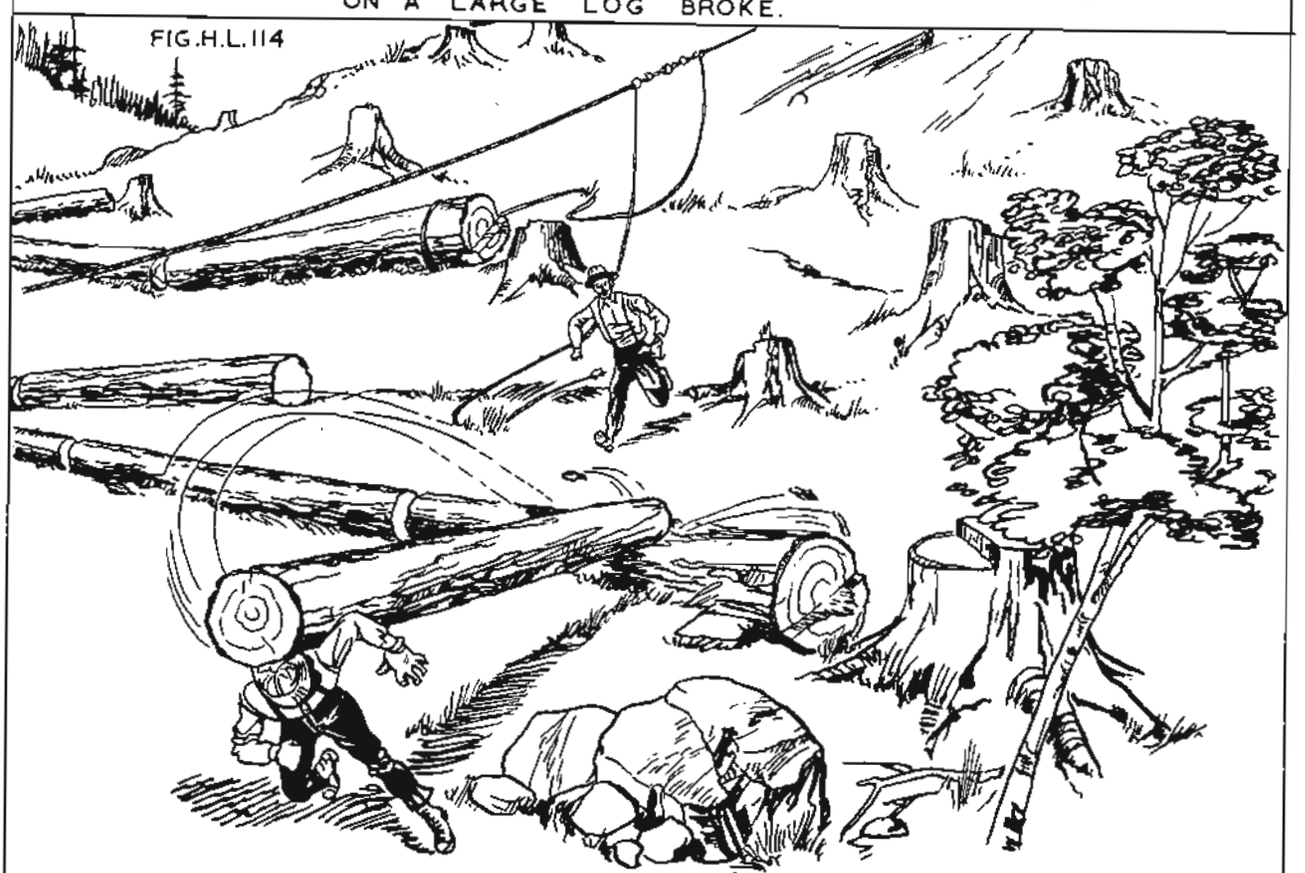
THE CHOKER SETTER DIED AS A RESULT OF INJURIES WHEN HE WAS STRUCK ON THE HEAD BY A CHOKER HOOK THAT SWUNG THE FULL LENGTH OF THE CHOKER AFTER SIDE WRAPPING A RUB TREE.

FIG. H.L. 113



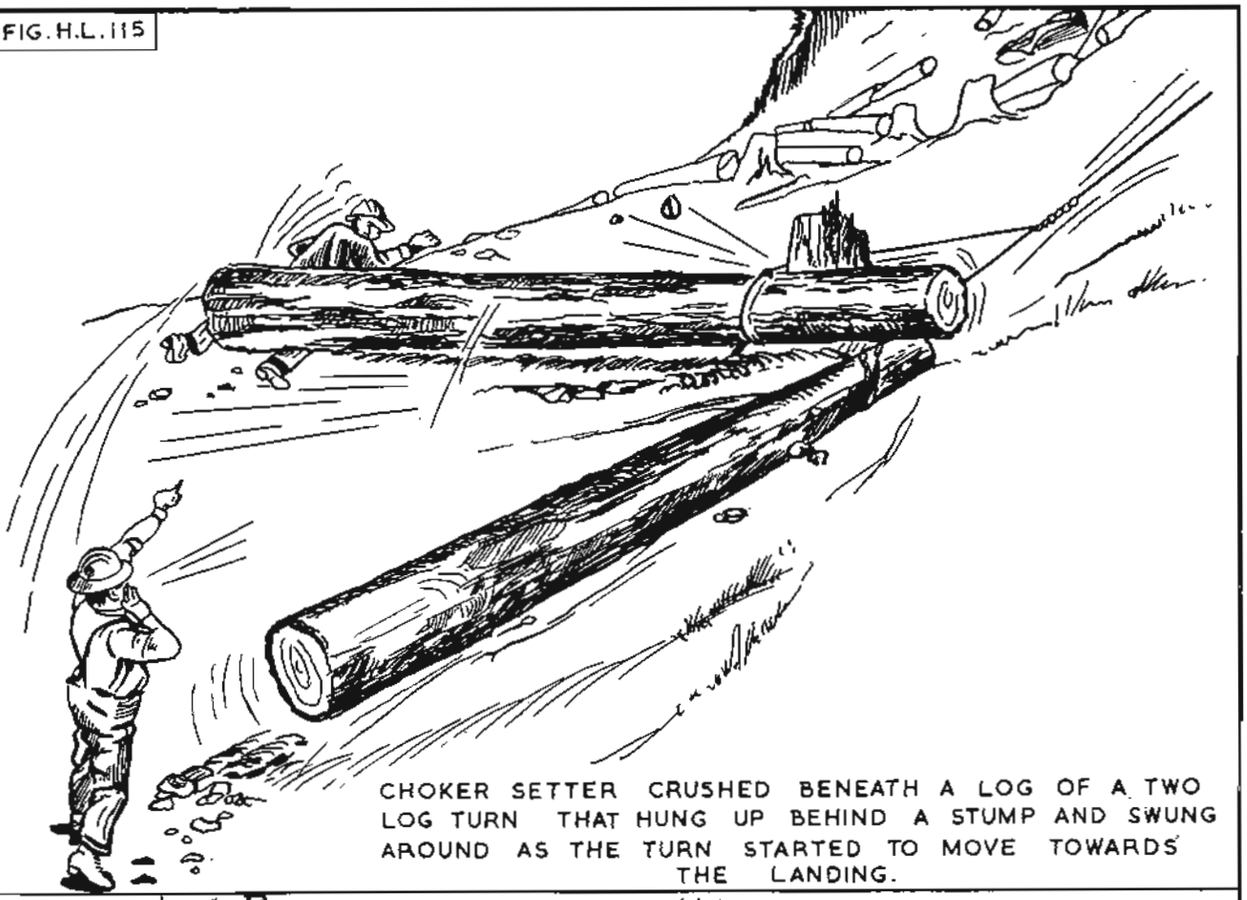
HOOKTENDER STRUCK BY WHIPPING HAULBACK LINE AS THE CHOKER ON A LARGE LOG BROKE.

FIG. H.L. 114



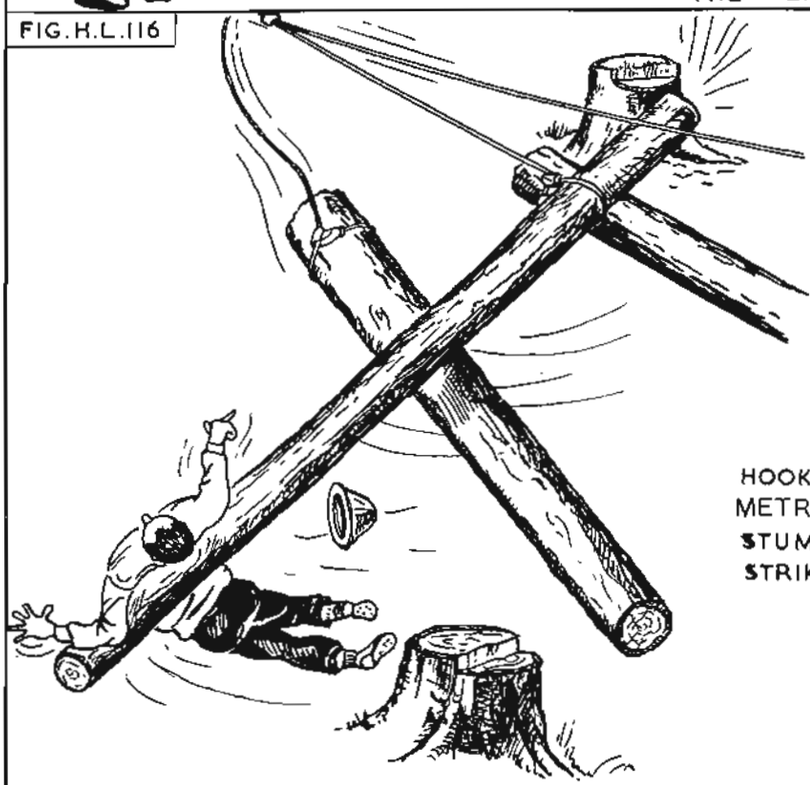
CHOKER SETTER KILLED BY A LOG THAT ROLLED DOWN A STEEP SLOPE, STRUCK ANOTHER LOG, BOUNCED, AND CAME DOWN ON HIS HEAD.

FIG. H.L. 115



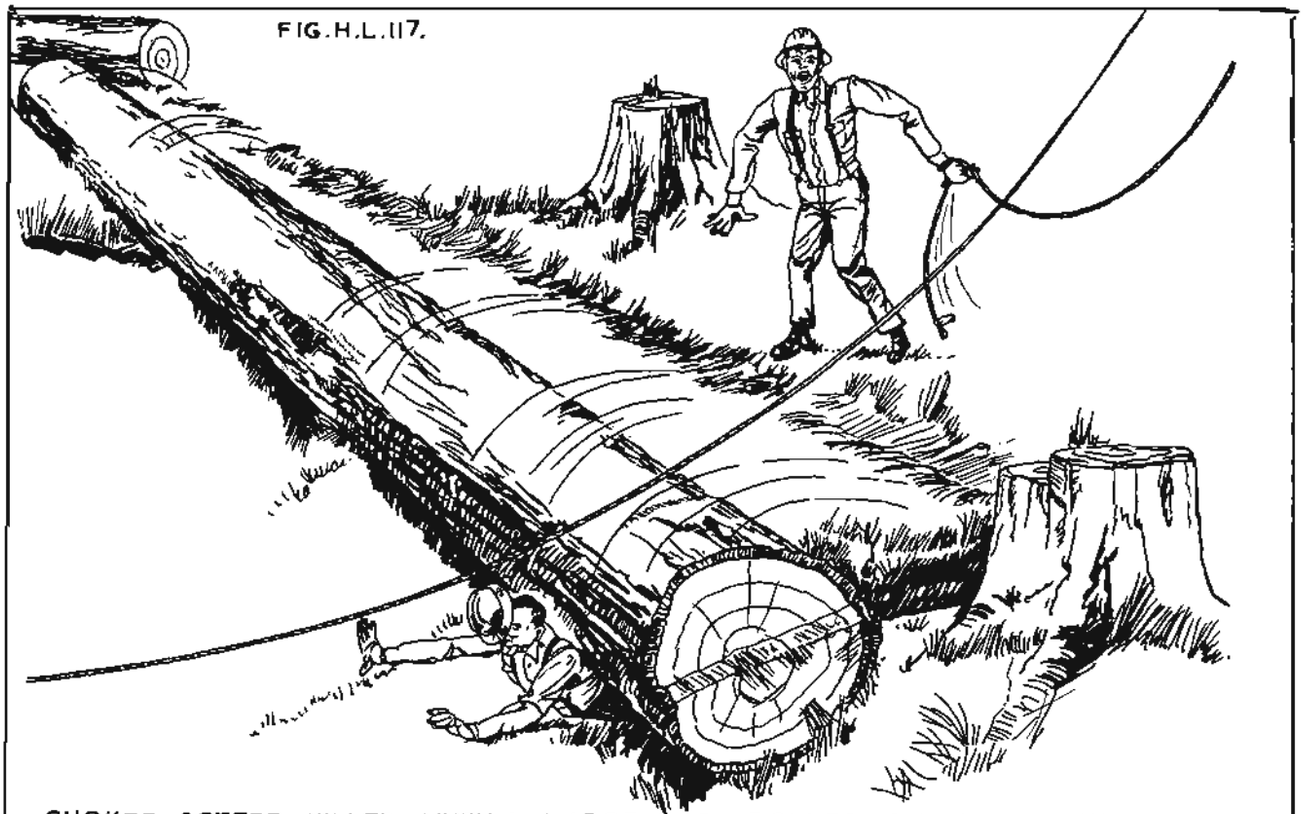
CHOKER SETTER CRUSHED BENEATH A LOG OF A TWO LOG TURN THAT HUNG UP BEHIND A STUMP AND SWUNG AROUND AS THE TURN STARTED TO MOVE TOWARDS THE LANDING.

FIG. H.L. 116



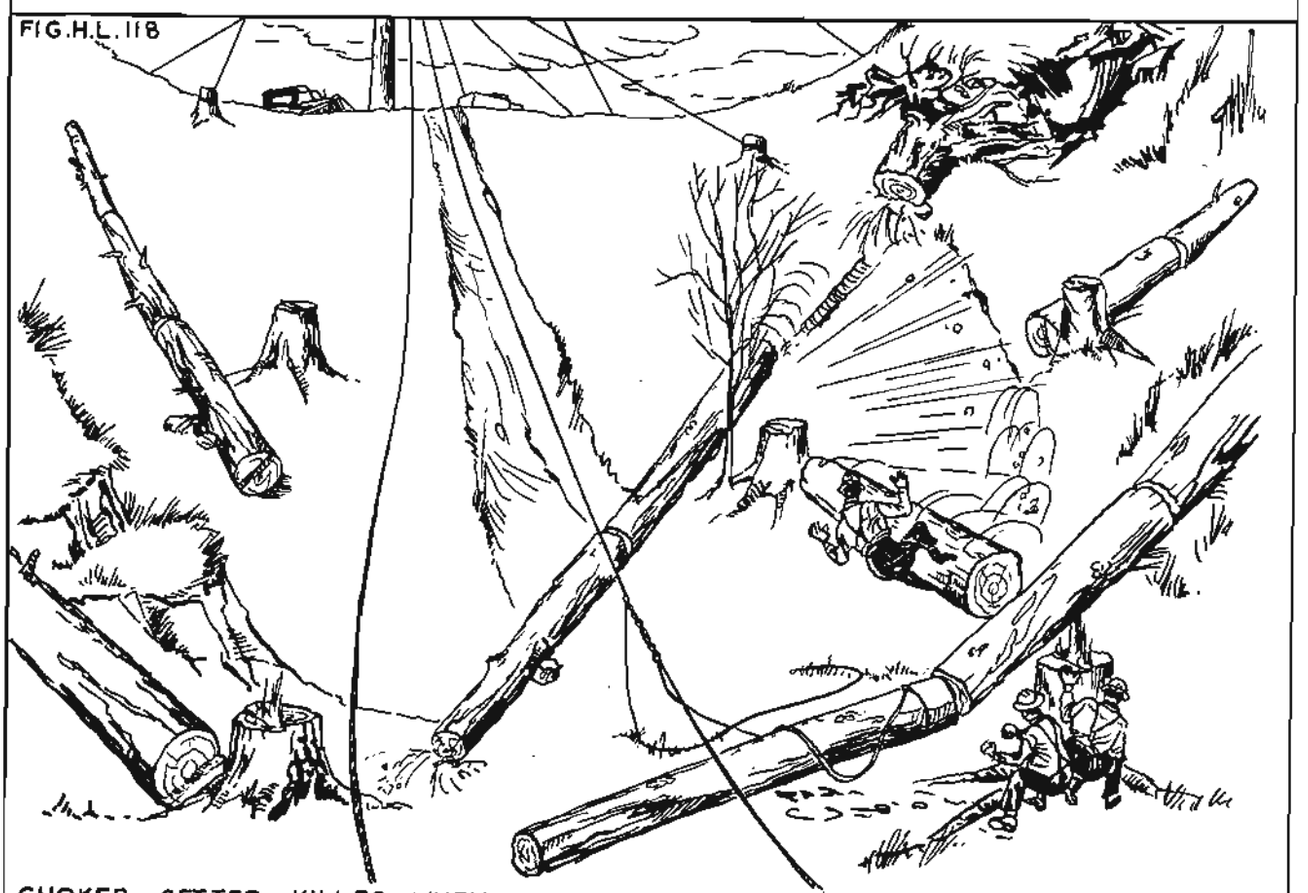
HOOK TENDER KILLED BY A 12 METRE LOG AS IT FOULED ON A STUMP AND SWUNG AROUND, STRIKING HIM ON THE BACK AND SHOULDER.

FIG.H.L.117.



CHOKER SETTER KILLED WHEN A LARGE LOG ROLLED ON HIM AS HE WAS HELPING TO SET A CHOKER.

FIG.H.L.118



CHOKER SETTER KILLED WHEN A WINDFALL LOG BROKE LOOSE, ROLLED DOWN THE STEEP HILLSIDE AND OVER HIM.

FIG.H.L.119

CHOKER SETTER STRUCK ON HEAD AND NECK BY A SMALL, DEAD TREE THAT WAS KNOCKED OVER BY THE HAULBACK LINE AS A TURN OF LOGS WAS BEING PULLED IN.

Preventive measures

(1) As for preventive measures under Fig. H.L. 110.

(2) Men should keep clear of blocks unless actually working with them.

(3) If there is any possibility of the block sling slipping, a sling saddle must be made in the stump or the slings must be passed under the stump roots.

(g) Fig. H.L. 112. Choker setter killed by swinging choker

The choker setter was pronounced dead on arrival at hospital as the result of injuries received when he was struck on the back of the head by the choker hook that swung the full length of the choker to the side after wrapping a rub tree.

Preventive measures

(1) There is no substitute or exception for the saying "stay well clear of moving rigging" - at least 6 metres.

(2) Even when in the clear, choker setters should face the cables so that they can see what is happening.

(b) Fig. H.L. 113. Choker setter killed when caught by the whip of haulback

The bight of the haulback cable whipped over the choker setter's head and more than 10 metres to the side as the rigging tightened on two chokers strung out to reach a large log. The lead choker broke and the bight of the haulback whipped back, striking the hooker and throwing him 20 metres.

Preventive measures

(1) Workmen must make certain that they are in the clear before signals are given to move the rigging.

(2) Signalmen must not give the go-ahead signal until all workmen are in the clear.

(3) Where the cables have been pulled out of the "straight" to reach logs, all men should stand well in the clear to allow for possible slipping.

(i) Fig. H.L. 114. Choker setter killed by rolling log

The choker setter was killed as he was trying to escape from a log that suddenly rolled down a 50 degrees slope while he was setting a choker on it. The rolling log struck another log, bounced into the air, then came down on his head.

Preventive measures

(1) Make certain logs are secure before working below them.

(2) Don't work below insecure logs - block them or pull another log over them to move them into a suitable position.

(j) Fig. H.L. 115. Choker setter killed by swinging log

The choker setter was killed when crushed beneath a log of a two-log turn that hung up behind a stump and swung around as the turn started to move towards the landing.

Preventive measures

(1) Make certain logs are choked near the end.

(2) Provide supervision to make certain that rigging men move well in the clear before a signal is given to move the logs.

(k) Fig. H.L. 116. Choker setter killed by swinging long log

The choker setter died en route to hospital from injuries when he was struck by a 12 metres log that was choked 3 metres from the end. The log fouled on a stump and swung around, striking him on the back and shoulder.

Preventive measures

(1) As for Fig. H.L. 115.

(2) Workmen should preferably stand to the back and to the side of a turn of logs before the signal is given.

(l) Fig. H.L. 117. Choker setter fatally crushed by rolling log

The choker setter died eighteen days later as the result of injuries received when a log rolled on him while he was helping to set a choker.

Preventive measures

(1) Carefully supervise new men to make certain they do not endanger themselves or others.

(2) Take extra precautions when working around logs that may have a tendency to roll.

(m) Fig. H.L. 118. Choker setter crushed by rolling windfall log

The choker setter was instantly killed when a windfall log suddenly broke loose, rolling down the steep hillside and over him.

Preventive measures

(1) Work downward on steep slopes removing all dangerous logs so that the rigging crew will not be working below uncut logs.

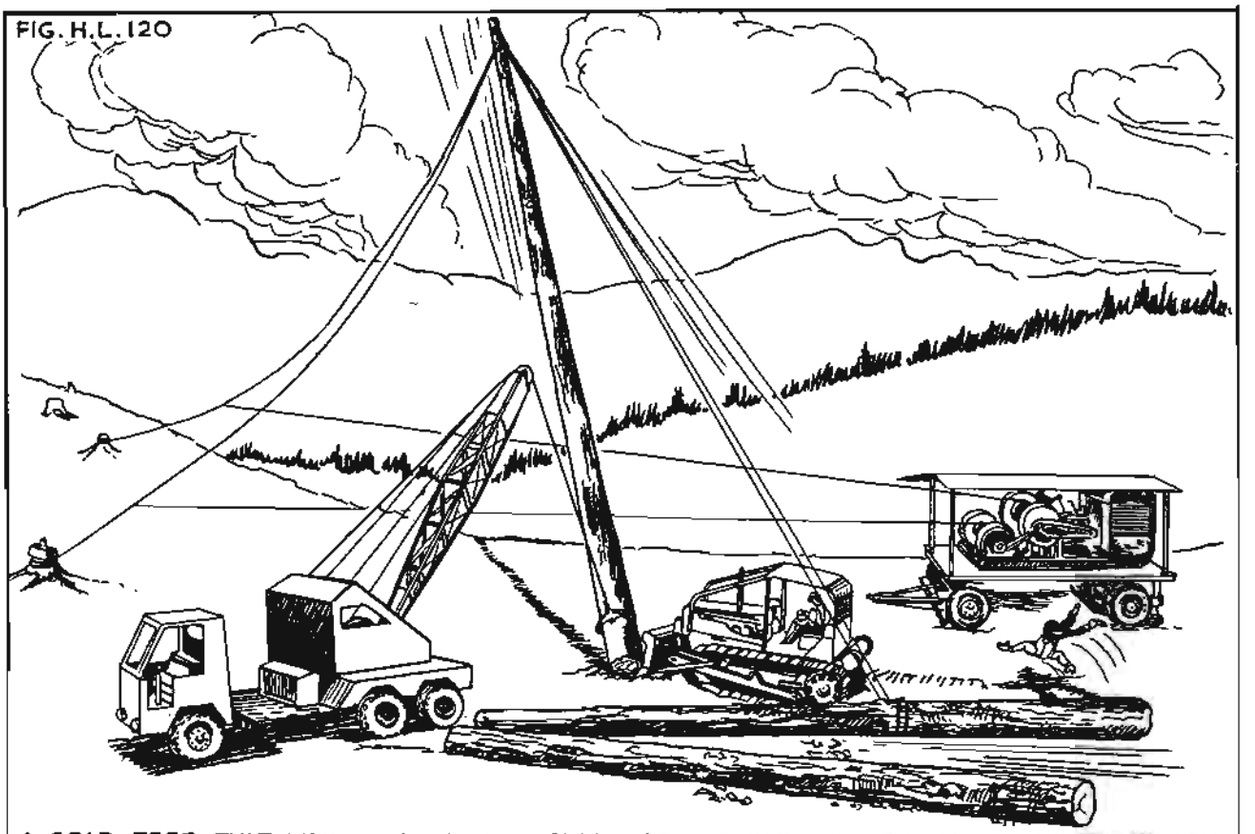
(n) Fig. H.L. 119. Choker setter killed by falling tree

The choker setter died en route to hospital from injuries received when he was struck on the head and neck by a small, dead tree that was knocked over by the haulback line as a turn was being pulled in to the landing.

Preventive measures

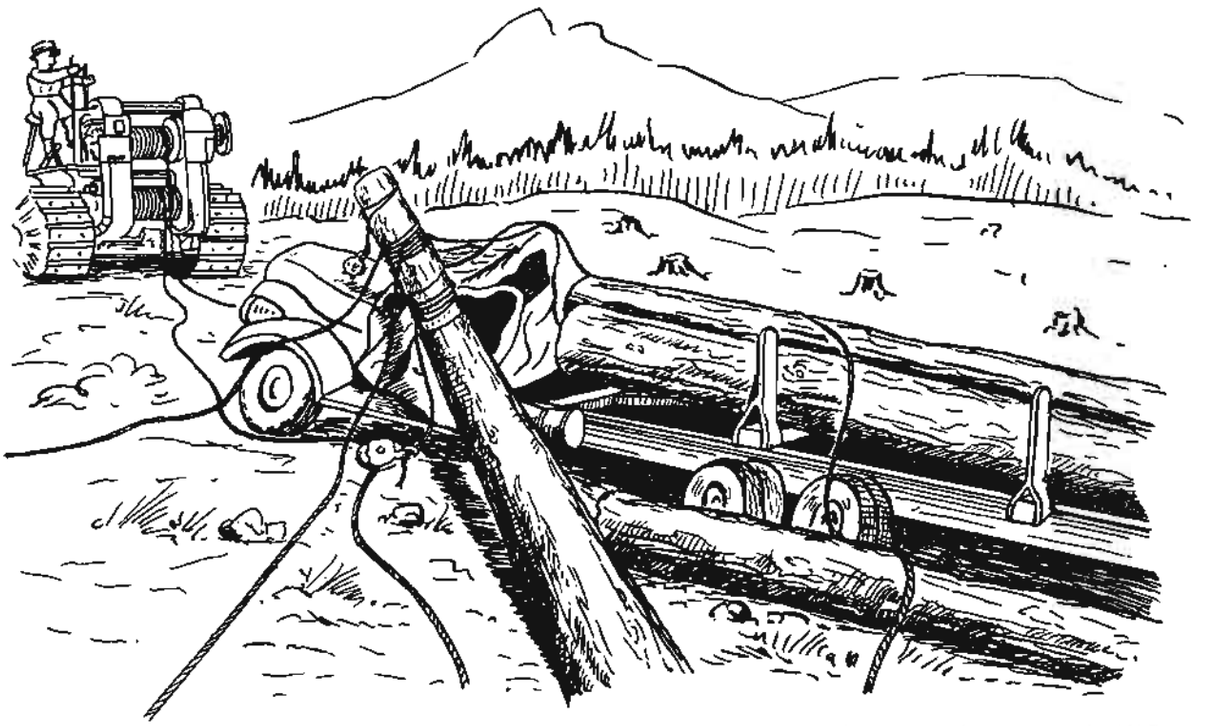
(1) Fell dangerous trees and snags before the regular operation begins.

FIG. H.L. 120



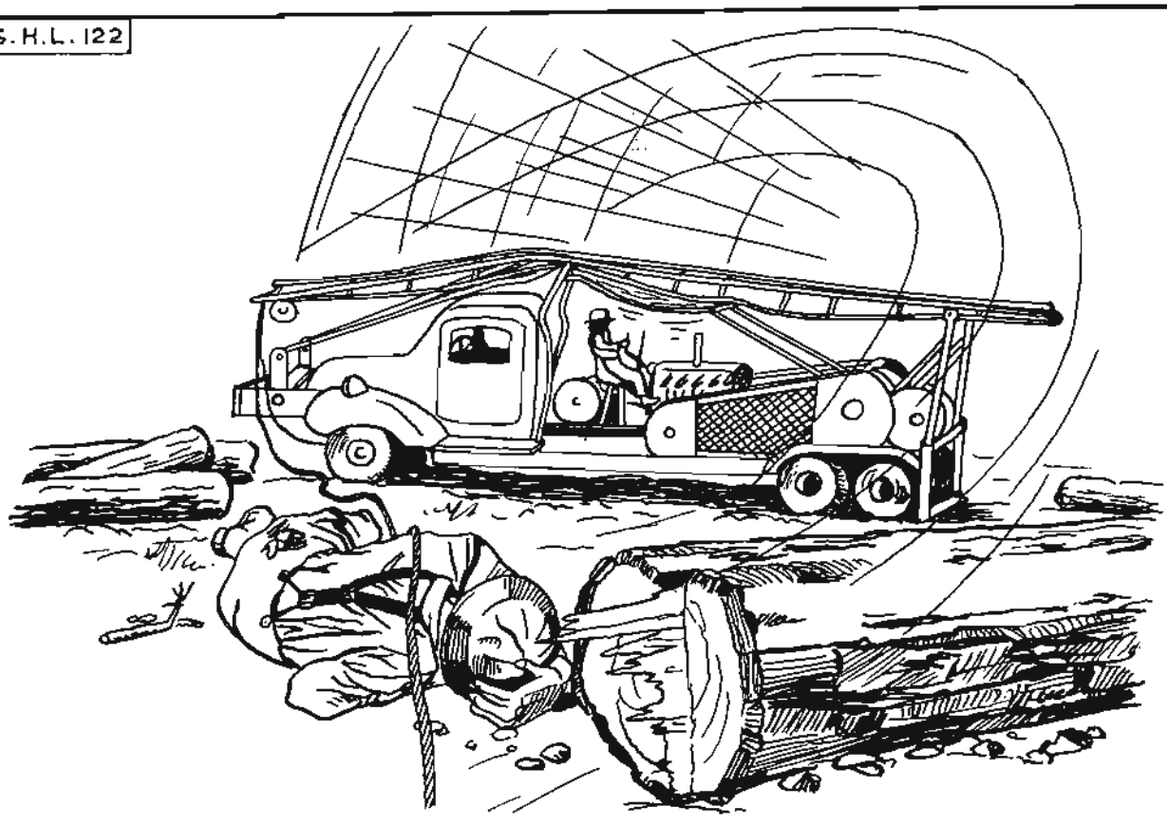
A SPAR TREE THAT WAS BEING RAISED FELL AND THE GUY-LINE SWUNG A LOG, TO WHICH IT WAS TIED, STRIKING THE CHOKER SETTER AND THROWING HIM ON HIS HEAD.

FIG. H.L. 121



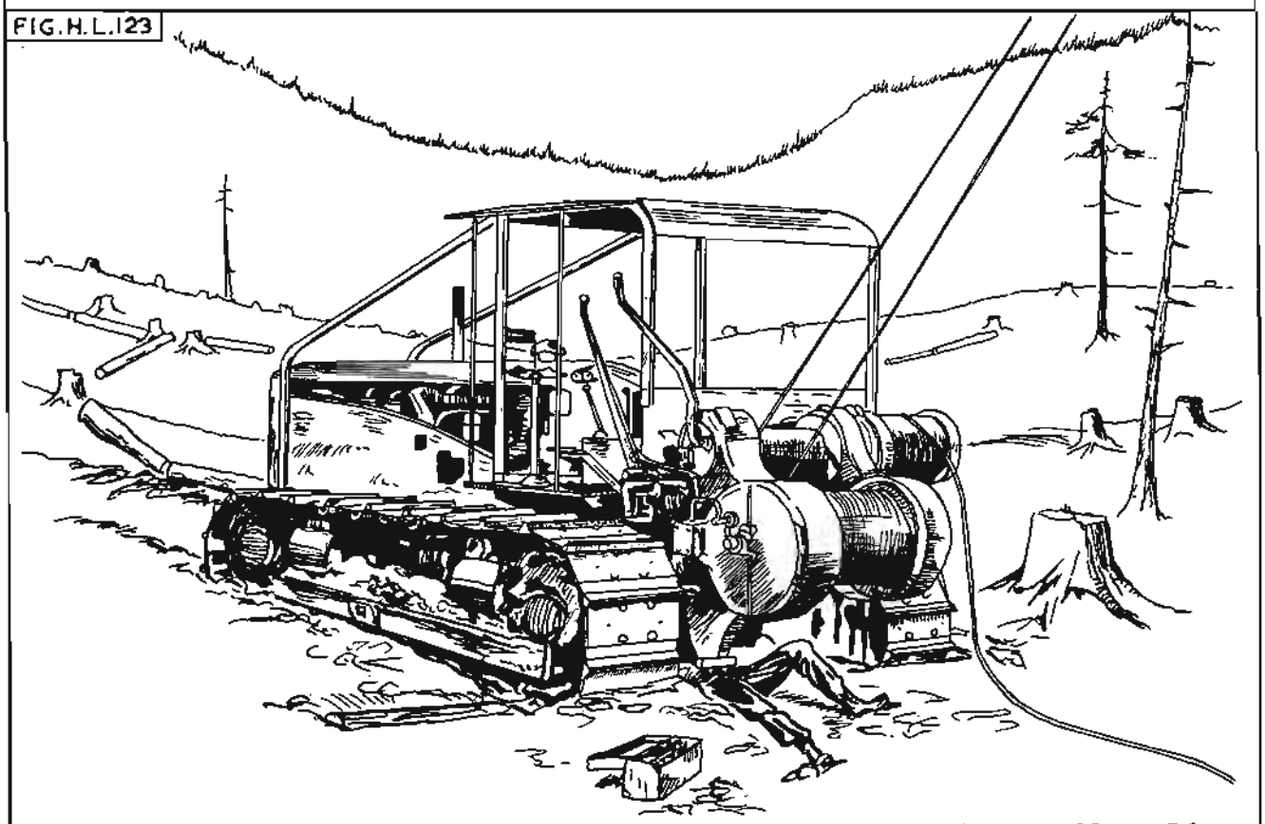
A TRUCK DRIVER WAS KILLED AS THE TRUCK CAB WAS CRUSHED BY A RAISED YARDING – LOADER SPAR THAT FELL AS AN UNDERSIZED GUY-LINE PARTED WHILE A HEAVY LOG WAS BEING LOADED ONTO THE LORRY.

FIG. H.L. 122



CHOKER SETTER KILLED WHEN STRUCK BY A GUY-LINE ATTACHED TO THE BOOM OF A HIGHLEAD UNIT, WHICH FELL AS IT WAS BEING LOWERED.

FIG. H.L. 123



A MECHANIC WAS CRUSHED BENEATH A TRACTOR AS IT SANK INTO SOFT GROUND WHEN HE WAS INSTALLING A BEVEL GEAR IN THE DRIVE ASSEMBLY OF THE TRIPLE-DRUM WINCH

(o) Fig. H.L. 120. Choker setter instantly killed when struck by a log

A spar tree that was being raised, fell and the pass line swung a log, around which it was tied, striking the choker setter and throwing him against the side of the yarder.

Preventive measures

(1) Use enough guy-lines to keep the spar tree stable while it is being raised.

(2) Attach guy-lines to sound anchors such as rocks, stumps, etc.

(3) Every possible safety precaution must be taken when raising a spar tree.

(p) Fig. H.L. 121. Log truck driver killed by falling spar tree

A log truck driver was instantly killed when crushed in the cab of his truck by a raised yarding-loading spar tree that fell as an under-sized guy-line parted while a heavy log was being loaded.

Preventive measures

(1) Use only lines designed to be used with the particular operation concerned.

(2) Check guy-lines and anchors frequently.

(3) Never load or pull a log which will over-stress any part of the rigging.

(q) Fig. H.L. 122. Choker setter killed by whipping guy-line

The choker setter was instantly killed when struck by a guy-line attached to the boom of the highlead yarder that fell as it was being lowered when the haulback cable used for lowering the boom snapped.

Preventive measures

(1) Make sure that all ropes are always in sound condition before putting them under strain.

(2) Make certain that parts of equipment have adequate strength to withstand any loading to which they are subjected.

(3) Only those workmen engaged in the operation of the equipment shall be permitted to remain in the immediate vicinity of a boom that is being raised or lowered.

(4) Workmen, except for the operators of the equipment, should stay in the clear of the boom and other rigging.

(r) Fig. H.L. 123. Mechanic crushed beneath yarder

The mechanic was crushed and instantly killed beneath the tractor as it sank into soft ground while he was installing a bevel gear in the drive assembly of the triple-drum winch.

Preventive measures

(1) Make certain machines are securely blocked to prevent movement before working under them.

(2) When possible, move machines to a place where repairs can be safely made.

APPENDIX H.L. 1

ERECTION, OPERATION AND DISMANTLING:
SELF-PROPELLED HIGHLEAD UNIT
(Fig. H.L.124, 125)

(1) If the winch and power unit are not mounted on a factory carrier, the carrier should only be accepted if of suitable size and power.

(2) If mounted on a lorry the latter must have three axles and be at least four-wheel driven.

Note: Logger's dream unit should preferably be mounted on 7 to 8 ton lorries with 10 tyres - 6-wheel driven, i.e. front and rear drive

(3) No alterations in transmission can be made without advice from the manufacturer. Only minor improvements can be carried out, such as reinforcement of the jib by angle-iron, exchange of auxiliary equipment (blocks, etc.) for better ones.

(4) Fast travelling with the unit along the roads is prohibited: maximum speed on good public roads on straight stretches to be no more than 32 km per hour. On curves and on rough forest tracks no more than 8 km per hour.

(5) Check the rig fastenings before travelling.

(6) If a special branch road to the site has to be constructed, it must have a gradient of no more than 5° rise or fall and must be well graded.

(7) Do not move the machine to site unless a turning of sufficient radius and strong anchor points have been prepared.

(8) Do not move the machine until the jib is folded and all the rig securely fastened.

(9) Do not proceed with the erection before the carrier is securely fastened to the anchor (or anchors).

(10) The erection must be carried out strictly according to the following procedure:

(11) Unfasten the suspension of the hinge foot and drop the lower part to the ground.

(12) Move the machine onto the hinge foot and clamp to the hinge frame.

(13) Fasten the machine frame firmly to the anchor by 15,8 mm wire rope (two wraps).

(14) Undo and drop the free ends of the guy-lines to the ground.

Note: Keep men out of danger when dropping the lines

(15) Fasten the block to the shackle of the folded boom bottom.

(16) Thread the haulback cable through the block and fasten its end to the machine frame. The haulback drum is used for raising the boom.

Note: If the boom is heavy and can affect the engine clutch, work through two lines. In this case the block should have a strong tail becket. A second block must be securely fastened to the cross-member of the chassis frame

(17) Do not raise the boom unless the guy-lines are sorted out and kept away from the machine by the men, in order to avoid tangling of the guy-lines and damage to the machine (Fig. H.L. 124).

(18) Do not lift the boom immediately but make a slight lift in order to test whether everything is in order. The guy-lines must gradually be slackened as the boom is lifted maintaining even tension.

(19) Do not lift the boom before the guy-lines are well guarded by men.

Note: Men should be instructed to follow the pull in order not to add to the strain on the jib by holding the guy-lines too rigidly

(20) When the boom has been raised to the vertical, control it by guy-lines and hold it in position to allow the boom pins to be inserted through boom and bottom frame hinge attachments.

(21) If necessary, release the winch cable slightly to adjust the bottom brackets and facilitate the insertion of the pins. Be in full control: do not let the boom down altogether.

(22) Fasten the bottom of the boom by inserting pins through the hinge fittings.

(23) Fasten the two back stay lines firmly to the frame shackle in front of the carrier engine, making allowances for the boom to be later tilted slightly forward.

(24) Fasten the main (back) guy-line to the ahchor, allowing a little slack in the line for the forward tilting of the boom.

Note: Sometimes it is necessary to use two back guy-lines if the anchor stumps are considered weak

(25) Disengage the pins at the top boom hinges.

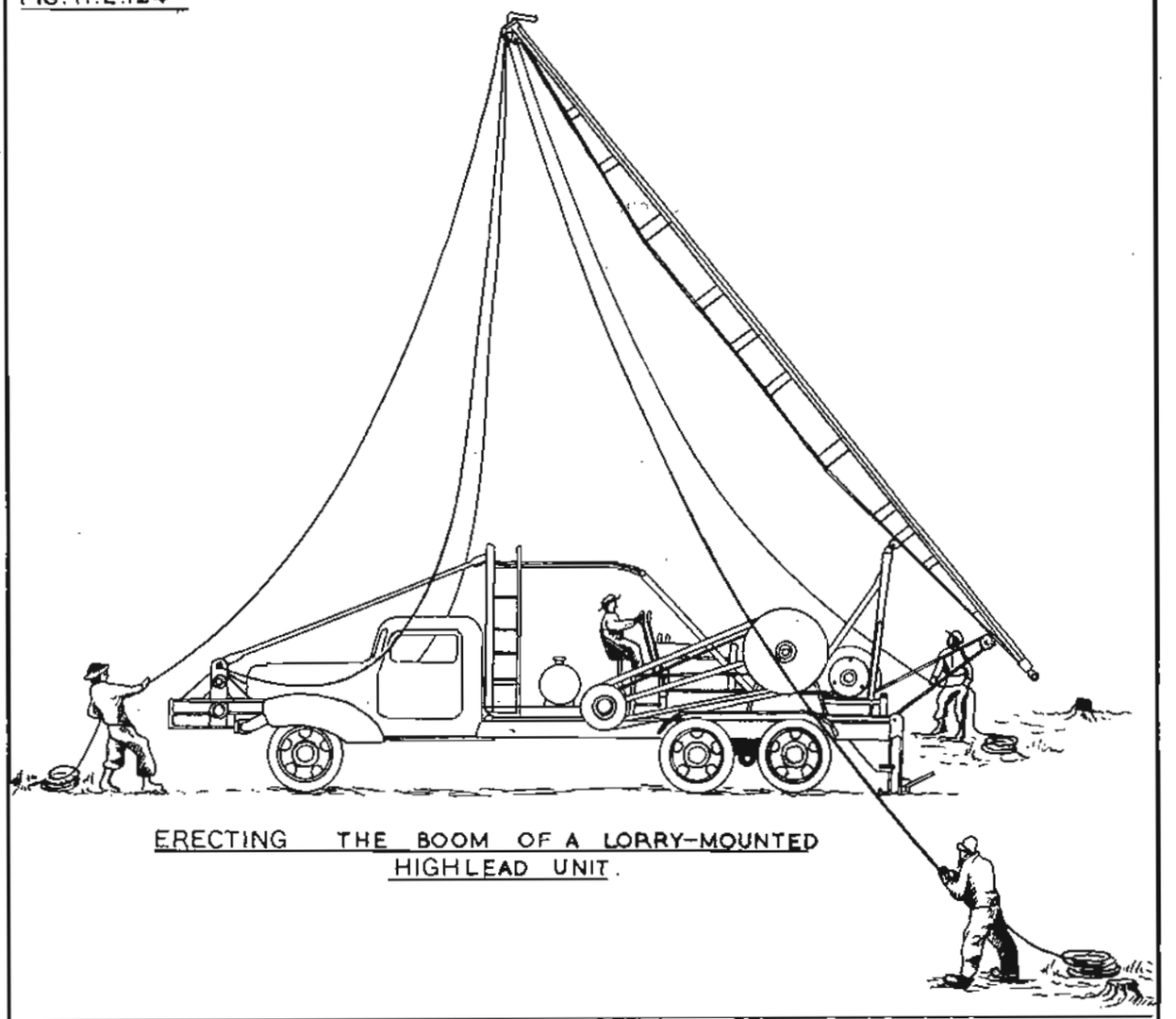
(26) Tilt the boom forwards by means of the two forward (side) guy-lines.

Note: The correct position of the boom is when the upper brackets are slightly out of touch with each other

(27) Replace the pins of the brackets in the top bracket holes where the pin chain is attached.

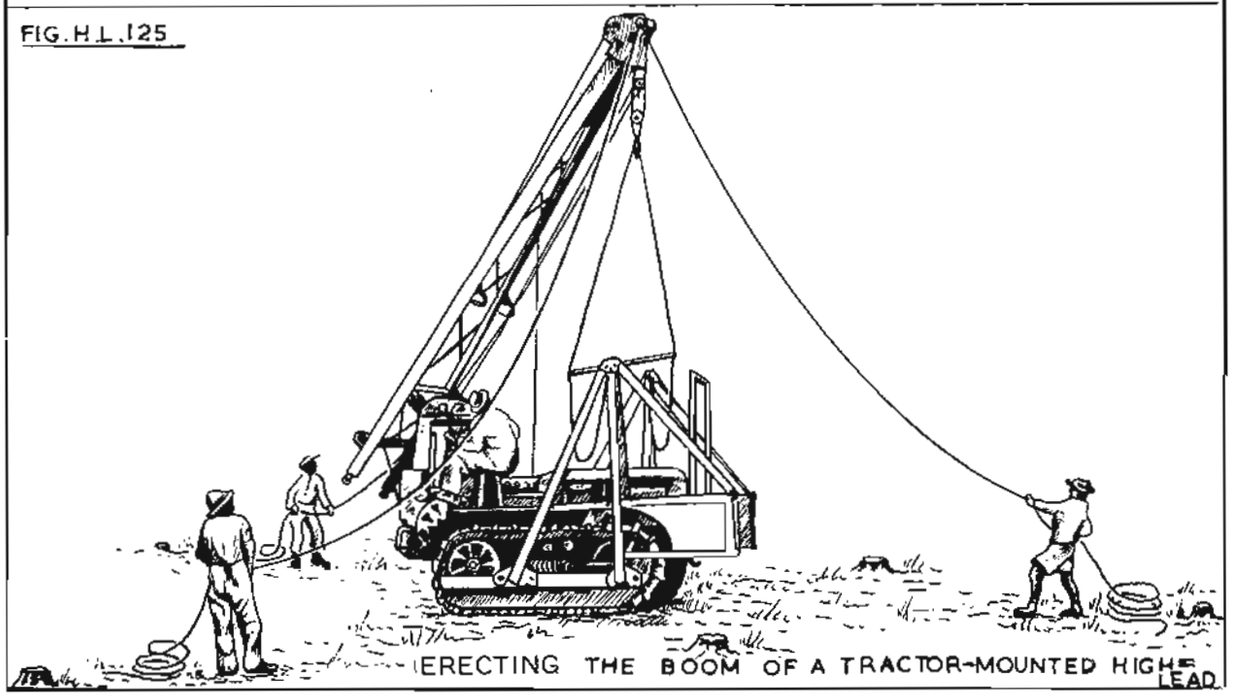
(28) Fasten each side guy-line tightly to the anchors with four wire clips, using the winch and main line for tightening.

FIG. H.L.124



ERECTING THE BOOM OF A LORRY-MOUNTED HIGHLEAD UNIT.

FIG. H.L.125



ERECTING THE BOOM OF A TRACTOR-MOUNTED HIGHLEAD

(29) Fasten the side guy-lines tightly to the anchors.

Note: 1. These side anchors should be located slightly ahead of the tip of the boom

2. Do not overtighten the side guy-lines on one side. Check the location of the boom heels in the brackets

(30) Pull the haulback cable towards the anchor of the corner haulback block. Do not allow the haulback cable to kink when extending (pulling) into the field - do not let too much of it off the drum at once.

(31) Fasten the side corner haulback block to a strong anchor stump by means of the sling. See that a substantial sling saddle is cut to prevent the sling slipping off the stump.

Note: For anchoring avoid stumps leaning towards the machine

(32) Extend (pull) the same haulback line to the tail anchor (stump); again see that the haulback block sling is well saddled.

(33) Do not hang the haulback blocks above the ground on trees, as they should rest flat on the ground when not in motion.

(34) When the haulback cable has been threaded through the tail haulback block it should be pulled back to the machine. It may be necessary to pull the main cable downhill to meet the haulback cable.

(35) When fastening one end of the butt rigging to the main cable and the other end to the haulback cable, see that all the bolts and nuts (of clevises) are well tightened.

(36) Before starting to work, pull the main cable by haulback cable towards the tail block in order to straighten it between the boom and the tail block.

(37) Pull the butt rigging back to the machine.

(38) Insert chokers into butt rigging hooks.

(39) Check butt rigging.

(40) Commence operation.

Dismantling

(1) When logging at the site is completed, the unit must be dismantled to travel to the new site. The following procedure is adopted:

(2) Pull the butt rigging to the machine.

(3) Disengage the butt rigging from both lines.

(4) Remove the chokers.

(5) Pull in the haulback cable.

(6) Remove the haulback blocks with their slings and bring them to the machine.

(7) Disengage the side guy-lines from their anchors.

(8) Pull the boom to the front of the boom travelling support frame so that the top male brackets fit their female brackets.

Note: This can be done with the main cable winch drum or by pulling the guy-lines by hand

(9) Place the hinge pins into the holes of the top hinge attachment.

(10) Disengage the tail (main) guy-line from its anchor.

(11) Attach the block to the shackle at the bottom end of the boom.

(12) Thread the haulback cable through the block and fix its end tightly to the front of the frame shackle attachment.

Note: If the boom is heavy use the double line system for lowering

(13) Tighten the haulback cable slightly using the winch.

(14) Put each guy-line in such a position that it will not tangle with another.

(15) See that men holding the ends of the guy-lines keep the lines away from the machine. They should not release the guy-lines unless told to do so.

(16) Release the pins of the boom hinge attachments.

(17) If the boom does not lean backwards by itself let the man pull it slightly by the main (tail) guy-line to start it.

(18) Brake the fall of the boom by means of the haulback cable and winch brake.

Note: The use of reverse drive of the haulback drum is sometimes useful

(19) Drop the boom gently in the rack of the rear boom travelling support.

(20) Fasten the rig (guy-lines, etc.).

(21) Disengage the machine from the machine back anchor and front anchor (if any).

(22) Lift the hinge foot by means of the haulback cable and fasten it into the travelling position.

(23) Check all loose accessories and pack into the unit box.

APPENDIX H.L. 2

EQUIPMENT USED WITH SELF-PROPELLED LORRY-MOUNTED HIGHLEAD YARDER
(Logger's Dream L.R.W. Model)

A. MAIN PARTS

(1) Carrier. Warford 7 - 8 ton lorry, 3 axles, 6 wheels, 4-wheel driven (6 x 4), or 7 - 8 ton International.

(2) Carrier engine. V.8, 75 kW Ford. Fuel: Petrol.

(3) Winch. Two drum, with outboard auxiliary drum, yarder of all welded construction, designed for mounting on standard truck chassis. Drum location: Haulback drum at the bottom front; main drum at the top rear.

(4) Winch engine. Ford V.8. 75 kW. Fuel: Petrol.

(5) Industrial transmission: Master clutch: dry type.

(6) Drum clutches: Dog pin type, governed by selectors.

(7) a. Winch drums:

	Main drum	Haulback drum
Maximum line speed	120 m/min	240 m/min
Minimum line speed	12 m/min	24 m/min
Diameter of core	22 cm	15 cm
Width of core	53 cm	55 cm
Diameter of sides	66 cm	71 cm
Width of brake band	12,7 cm	12,7 cm
Max. practical capacity:		
19 mm wire rope	230 metres	
12,7 mm wire rope		600 metres
Shaft size:	87,317 mm	87,317 mm
Drive chain size:	No. 100	No. 120
Safe working load	10 tons	5 tons
Departmental regulations	5 tons	2,5 tons

(7) (b)

(i) Lifting capacities of the standard logger's dream

Front end not tied down
Without front counterweights

Truck with cab

Boom at 45°	600 kg	tailstand up
Boom at 45°	1 500 kg	tailstand down
Boom at 70°	800 kg	tailstand up
Boom at 70°	3 000 kg	tailstand down

Truck without cab

Boom at 45°	450 kg	tailstand up
Boom at 45°	1 000 kg	tailstand down
Boom at 70°	680 kg	tailstand up
Boom at 70°	2 700 kg	tailstand down

With front counterweights

Truck with cab

Boom at 45°	900 kg	tailstand up
Boom at 45°	2 200 kg	tailstand down
Boom at 70°	1 450 kg	tailstand up
Boom at 70°	4 500 kg	tailstand down

Truck without cab

Boom at 45°	800 kg	tailstand up
Boom at 45°	1 900 kg	tailstand down
Boom at 70°	1 360 kg	tailstand up
Boom at 70°	3 900 kg	tailstand down

With the front end anchored, machine will handle any load which the 15,8 mm cable will lift.

(ii) Standard logger's dream - average line speeds

Gear ratios - approximate

Transmission high gear	1 to 1
Transmission low gear	6 to 1
Rear end	6,6 to 1
Sprockets, main drive	2 to 1
Sprockets, rehaul drive	2 to 1

Main Drum

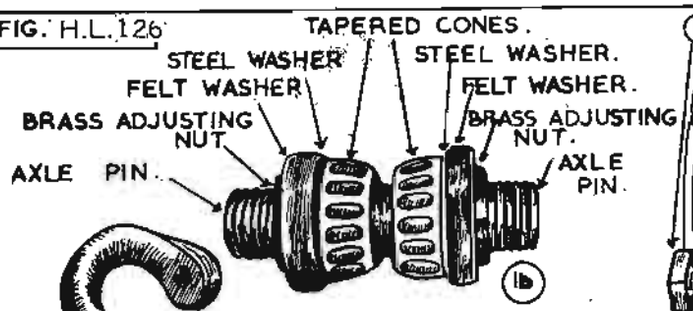
High gear	Metres/min	km/h
Empty drum	106	6,34
Drum half full	131	7,76
Drum full	156	9,22
1st gear		
Empty drum	17	1,05
Drum half full	22	1,34
Drum full	26	1,54

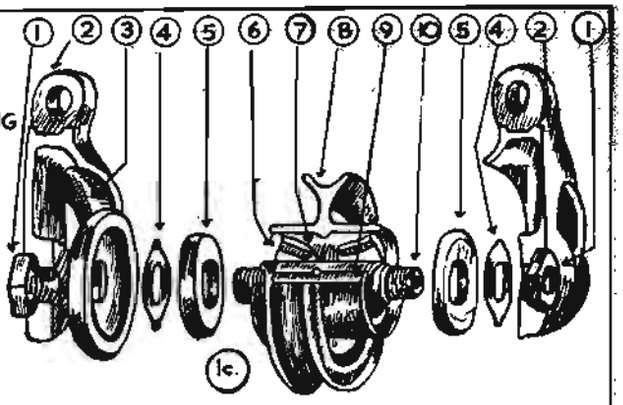
Rehaul Drum

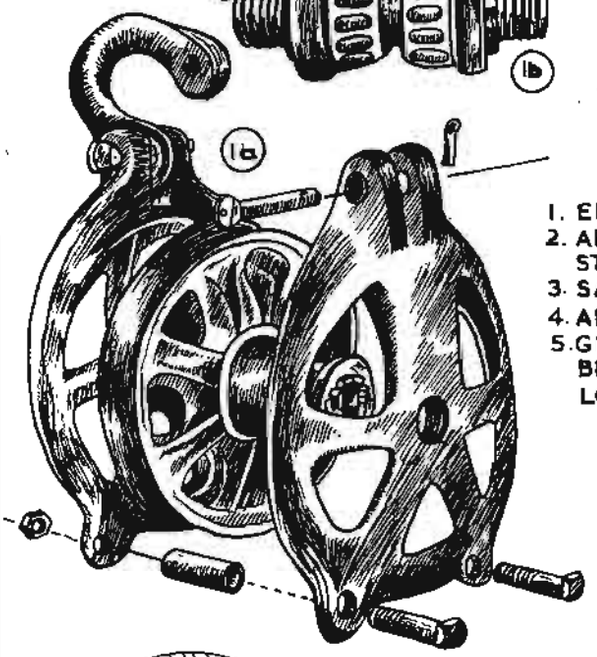
High gear		
Drum empty	212	12,67
Drum half full	262	15,55
Drum full	310	18,43
1st gear		
Drum empty	35	2,11
Drum half full	43	2,69
Drum full	52	3,07

Note: Based on average engine speed of 2 200 r.p.m.

FIG. H.L.126

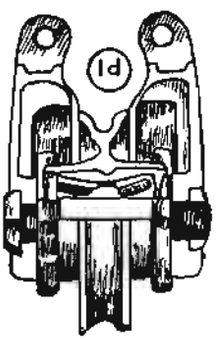


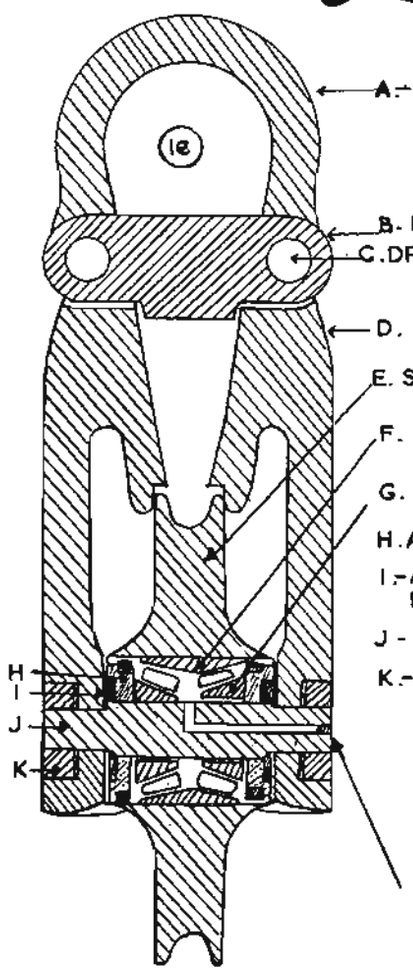


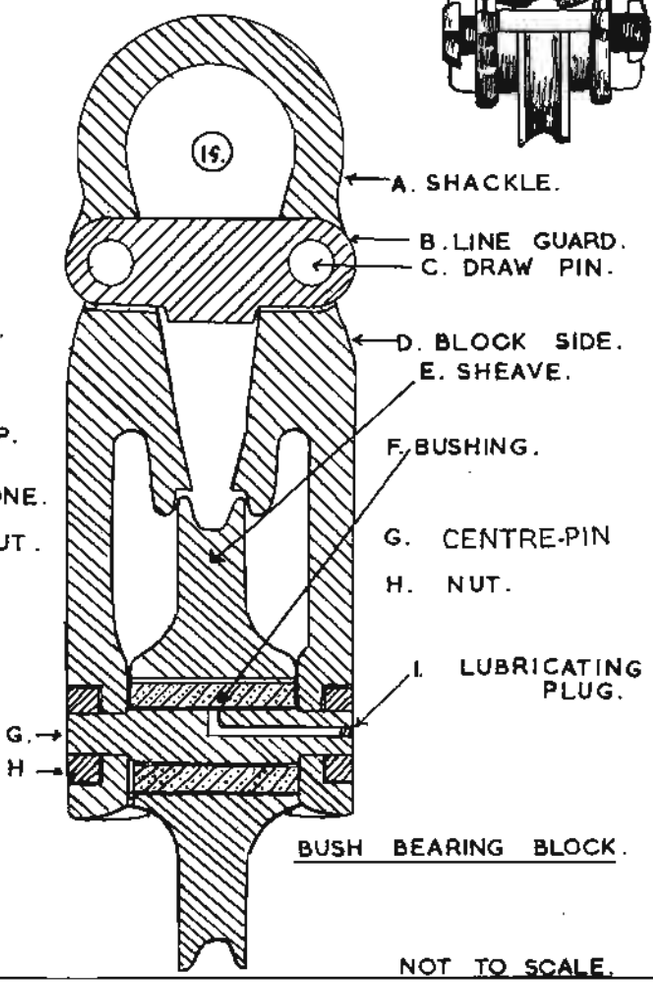


1. END NUTS
2. ANNEALED CAST STEEL SIDES.
3. SAND SEAL.
4. ADJUSTING LOCK NUT.
5. GREASE RETAINER BEARING. ADJUSTING LOCK WASHER.
6. BEARING CONE.
7. BEARING CUP.
8. SHEAVE.
9. CENTRE-PIN
10 SPECIAL SKOOKUM GREASING ARRANGEMENT.

BLOCKS WITH ROLLER BEARINGS







BUSH BEARING BLOCK.

NOT TO SCALE.

FIG. H.L. 127

LOGGING BLOCKS.

4a

PLAIN SHACKLE BLOCK 206. 208.

SWIVEL SHACKLE BLOCK 206. 208.

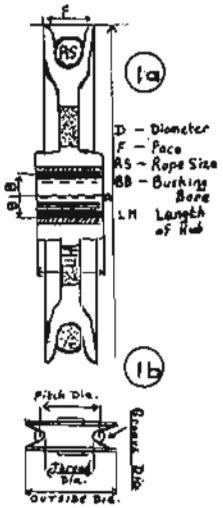
4b

SWIVEL HOOK 206. 208. (BLOCK)

4c

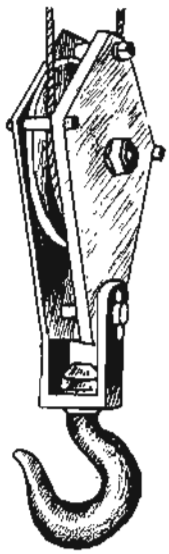
2

PLAIN SHACKLE BLOCK 7010 3122 (WITH LINE GUARD)

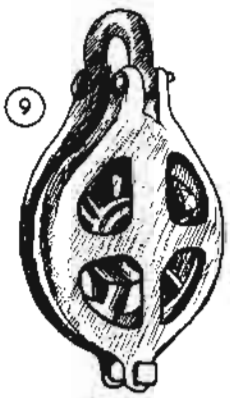


1a

1b



1



9

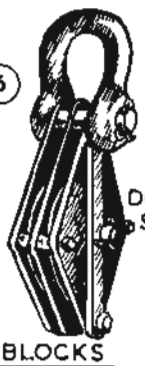
GENERAL PURPOSE BLOCK. 1110

3

HAULBACK BLOCK T-6

5

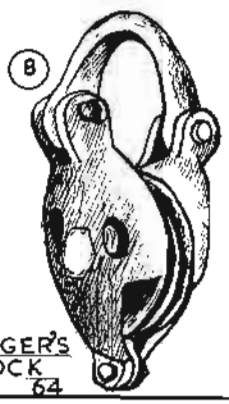
SINGLE SHEAVE



6

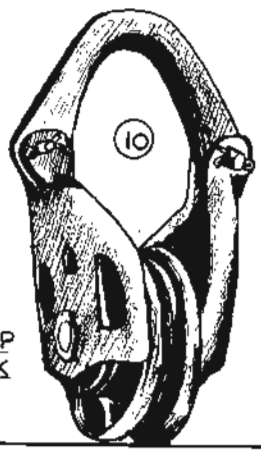
DOUBLE SHEAVE

HOISTING BLOCKS



8

RIGGER'S BLOCK 66 64



10

RIG UP BLOCK 820

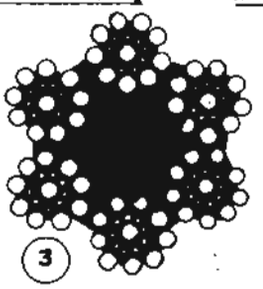
7

HIGH-LEAD BLOCK

11

SULLIVAN SNATCH BLOCK

FIG. HL. 128 WIRE ROPE CROSS SECTIONS.

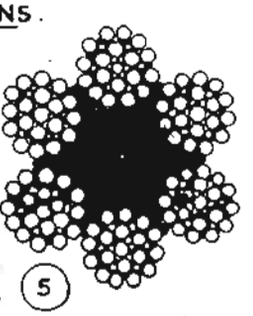


3

6 X 19 SEALE
I. FIBRE CORE

4

6 X 19 SEALE
INDEPENDENT WIRE
ROPE CORE.



5

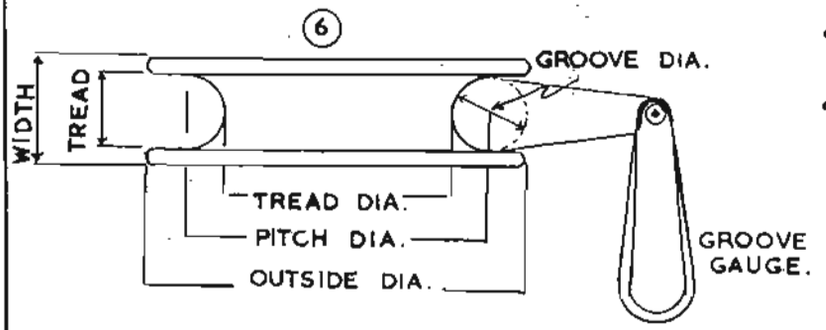
6 X 19 FILLER WIRE
(6 X 25 FILLER WIRE)
I. FIBRE CORE.

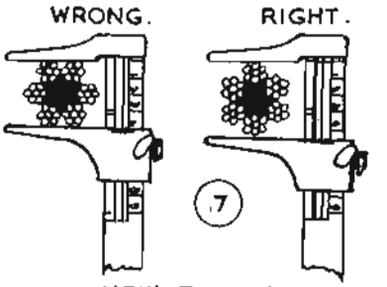
1

RIGHT LAY ROPE.

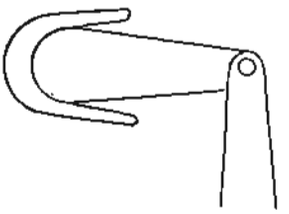
2

LANG LAY ROPE.

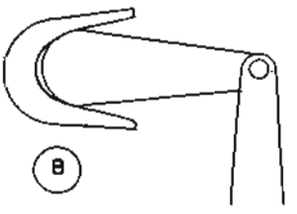




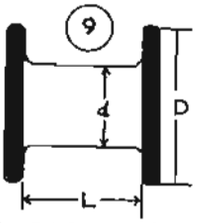
HOW TO MEASURE WIRE ROPE.



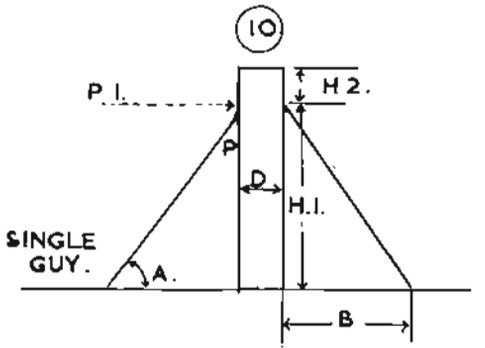
GROOVE CORRECT

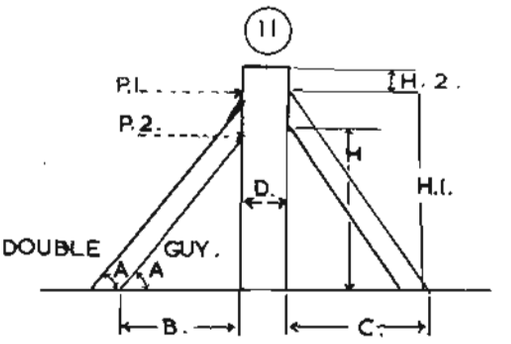


GROOVE TIGHT.



ROPE CAPACITY OF HOISTING DRUM.





STRESSES IN STACK GUYS.

(iii) Main line pull on standard logger's dream with Ford V.8 engine at various r.p.m.

Transmission ratio - 1st gear ..... 6 to 1
Rear end ratio ..... 6 to 1
Sprocket ratio ..... 2 to 1
Total ratio 79,2 to 1 with 21,59 cm O.D. drum centre

I. Engine r.p.m. - 2 200 *
kW developed - 56
Drum r.p.m. - 27

Line pull

Drum empty ..... 18 900 kg
Drum full ..... 8 000 kg

II. Engine r.p.m. - 1 900
kW developed - 50
Drum r.p.m. - 24

Drum empty ..... 18 700 kg
Drum full ..... 8 000 kg

III. Engine r.p.m. - 2 800
kW developed - 67
Drum r.p.m. - 35,4

Drum empty ..... 17 200 kg
Drum full ..... 7 300 kg

IV. Engine r.p.m. - 1 500
kW developed - 35
Drum r.p.m. - 18,9

Drum empty ..... 17 000 kg
Drum full ..... 7 200 kg

V. Engine r.p.m. - 3 300
kW developed - 74
Drum r.p.m. - 41,7

Drum empty ..... 15 800 kg
Drum full ..... 6 800 kg

Note: Breaking strength 15,8 mm cable (standard equipment on machine) - 15 150 kg.

* Maximum line pull developed at this r.p.m. which gives practical maximum engine torque.

(8) Boom. Frame: (H.D. steel tube) - 10,16 cm
Length: (Standard) 10 m (retractable)
Guy-lines: 15 m -19 mm wire rope x 2
30 m - 19 mm wire rope x 1
Supporting cables: 19 mm wire rope

(9) The frame of the winch to be of suitable dimensions for setting the frame members to the carrier chassis. The following are the standard frame attachments for the yarder:

Tail stand : Hinged heel support
Supports : Front and rear, for folding boom when travelling
Turn pipes with pins for anchoring the yarder.

B. AUXILIARY EQUIPMENT

(1) Blocks: (See Fig. H.L. 126 for block details).

Main block (Bull block) with swivel, 29 cm sheave diameter, all steel, all welded design. Reservoir type lubrication [Fig. H.L. 127 (12)].

Head trip block: (For haulback cables) on boom - Skookum 208 - 20,3 cm sheave diameter with swivelling hook. Sheave groove for 12,7 mm diameter rope.

Two haulback blocks: Skookum T.6 with shackle, pin and line guard. Sheave groove for 12,7 mm diameter wire rope [Fig. H.L. 127 (7)].

(2) Slings: (6) 12,7 mm wire diameter, 3 m long with both ends soft eye spliced or overloop clamped, (20 cm x 10 cm).

(3) Auxiliary cables: (2) 15,8 mm wire rope diameter, 150 m long.

(4) Wire rope specification for yarder (Fig. H.L. 128).

a. (i) Main cable: 19 mm diameter - 230 m long - one only.

(ii) Haulback cable: 12,7 mm diameter - 600 m long - one only.

(iii) Tail guy-line: 19 mm diameter - 30 m long - one only.
Construction of the above:
6 x 19 (9 x 9 x 1), Seale, best improved plough, ordinary lay, independent wire rope core (I.W.R.C.), preformed, plain, one end thimbled, the other end seized.

b. (i) Side guy-lines: 19 mm diameter - 20 m long - two only. Both ends soft eye spliced or clamped.

(ii) Stay-back lines: 19 mm diameter - 12 m long, - two only. One end soft eye spliced or clamped, the other end seized.

(iii) Anchoring cable: 15,8 mm diameter - 15 m long - two only. Both ends seized.

(iv) Strawline (outboard drum): 6,3 mm diameter x 600 m long - one only. One end thimbled, the other end seized.
Construction of (i) and (iv) above:
6 x 19 (9 x 9 x 1), Seale, best improved plough, ordinary lay, fibre core, preformed, plain.

(5) Butt rigging assembly with Montelius clevises

Size: Bantam No. 87, Young Ironworks type, standard.

Note: Montelius clevises, Bantam, serve for the safe locking of choker assemblies

(6) Choker assembly: used with butt rigging and Montelius clevises, consists of:

(i) Butt hook - Bantam size.
(ii) Ferrule, dwarf, 44,4 mm long x 38 mm outside diameter, with hole to accommodate 15,8 mm diameter wire rope.
(iii) Slings, wire rope, 15,8 mm diameter x 3,6 m long, both ends ferruled.

Construction of sling wire rope: 6 x 25, Seale, ordinary lay, special improved plough, fibre core, preformed.

Note: For medium sized logs slings with fibre core may be used, but for large logs slings with independent wire rope core must be used

(7) Special additional equipment for log swinging with tractors.

(i) 3-way draw-bar hook, Bantam, - 1.

(ii) Basket hook - Bantam - two.

(iii) 19 mm bow shackle with eye screw pin to accommodate two basket hooks - one.

(iv) Choker hook sling assemblies (15 mm x 3,6 m) - four.

APPENDIX H. L. 3

HOURLY OPERATING COST FOR AUXILIARY EQUIPMENT FOR SELF-PROPELLED LORRY-MOUNTED HIGHLEAD YARDER WITH BOOM

(severe conditions)

Auxiliary equipment - hiring cost per working hour

Wire rope, 19 mm x 230 m	-	R98,65 ÷ 500 hours	= 20,0c
Wire rope, 12,7 mm x 600 m	-	R164,00 ÷ 500 hours	= 33,0c
Wire rope, 6,3 mm x 600 m	-	R60,00 ÷ 2,000 hours	= 3,0c
Anchor line 15 mm x 30 m	-	R8,75 ÷ 500 hours	= 1,8c
1 guy-line (main), 19 mm x 30 m	-	R14,00 ÷ 2,000 hours	= 0,7c
2 guy-lines (side) 19 mm x 60 m	-	R33,60 ÷ 2,000 hours	= 1,6c
2 guy-lines (back) 19 mm x 50 m	-	R22,40 ÷ 2,000 hours	= 1,2c
Butt rigging, Bantam	-	R172,00 ÷ 1,000 hours	= 17,0c
8 choker hooks, No. 500	-	R26,08 ÷ 5,000 hours	= 0,5c
8 wire rope slings, 15,8 mm diameter	-	R8,40 ÷ 200 hours	= 4,2c
16 ferrules, 44,4 mm x 38 mm	-	R11,84 ÷ 200 hours	= 5,8c
16 settings for ferrules on slings	-	R9,60 ÷ 200 hours	= 4,8c
3 blocks, 15,24 cm sheaves	-	R170,07 ÷ 2,000 hours	= 8,5c
6 slings, 12,7 mm dia. both ends eye spliced	-	R18,20 ÷ 200 hours	= 9,0c
3 peavy hooks	-	R18,99 ÷ 400 hours	= 4,7c
36 Crosby clips, 19 mm	-	R17,28 ÷ 400 hours	= 4,3c
12 Crosby clips, 12,7 mm	-	R3,20 ÷ 400 hours	= 0,8c
12 D shackles, 32 mm	-	R12,00 ÷ 2,000 hours	= 0,6c
Total cost per working hour			R1,21c

Note: In cases where there are no surface rocks, the hiring cost of auxiliary equipment will be as much as 30% less

APPENDIX H.L. 4

ESTIMATED LABOUR COST WITH HIGHLEAD UNIT - LORRY-MOUNTED

A.	Yarder operator's wages:	R1 400 ÷ 1 600 hours	...	R0,88c per hour
	Choker setters: 3 x 70c =	210 ÷ 7 hours	...	R0,30c per hour
	Off-hooking men: 2 x 70c =	140 ÷ 7 hours	...	R0,20c per hour
	Total cost of labour with yarder		...	R1,38c per hour
B.	Swinging logs from yarder landing to roadside - costs			
	Tractor cost per hour with auxiliary equipment		...	R1,70c per hour
	Operator (as above)		...	R0,88c per hour
	2 men x 70c = 140c ÷ 7 hours		...	R0,20c per hour
	Total: Tractor and labour		...	R2,78c per hour
C.	Stacking Logs at the roadside			
	6 men x 70c = 420c ÷ 7 hours		...	60c per hour

APPENDIX H.L. 5

LIST OF ACCESSORY EQUIPMENT FOR SELF-PROPELLED LORRY-MOUNTED HIGHLEAD UNIT
(Logger's Dream)

(1)	Clutch plates, Ford Industrial, No. 21 T.S.	...	6 only
(2)	Hats, aluminium	...	4 only
(3)	Nipples, grease, 30° offset: 3,175 mm	...	3 only
	6,350 mm	...	3 only
(4)	Shackles: bow - 15,87 mm	...	2 only
	19,05 mm	...	2 only
	22,22 mm	...	2 only
(5)	Shuts, cold 11,11 mm	...	3 only
(6)	Tarpaulin, 6 m x 6 m	...	1 only
(7)	Tools: a. Cutter, up to 19 mm wire rope, Hardy or Montgomery		1 only
	b. Grease gun, Grace 225-934, lever operated. 15° offset with flexible hose	...	1 only
	c. Hammers: Ball-peen 1 kg	...	1 only
	Sledge, 2 kg	...	1 only
	d. Gloves, leather, stapled	...	4 pairs
	e. Pliers, Crescent 25 cm	...	1 only
	f. Screwdriver, 15 cm	...	1 only
	g. Spanners, adjustable, Crescent 20 cm	...	1 only
	Spanners - ring D/E 4,7 - 6,3 mm	...	1 only
	7,9 - 9,7 mm	...	1 only
	11,11 - 12,7 mm	...	1 only
	14,29 - 15,87 mm	...	1 only
	15,87 - 19,05 mm	...	1 only
(8)	Bow-saw, cross-cut saw, and if necessary, power chainsaw		1 of each
(9)	Spades	...	2 only
(10)	Crow-bar	...	1 only

APPENDIX H.L. 6

HIGHLEAD YARDER: LUBRICATION, HANDLING AND CARE OF EQUIPMENT

(1) Use standard cup grease with a grease gun.

(2) All points are to be greased after every 24 hours of operating time.

(3) Sliding parts etc. that are exposed must be lubricated more frequently and must be cleaned and lubricated after the machine has been idle for a day or more.

(4) Easy operation is secured by applying a little grease as frequently as necessary to the clutch pins on the drums, and also the main shaft section between the shift collar and drive bar.

(5) A grease nipple must be well cleaned before the grease gun is used on it.

(6) The 15 cm sheave diameter haulback blocks used with the haulback rope must be greased every 8 to 12 hours when they operate at high speeds.

(7) Shifting gears will vary the drum speeds, using the clutch pedal as in normal truck operations.

(8) CAUTION: When loaded, never shift gears or depress clutch pedal without holding drum brake.

(9) The winch power unit must idle faster than normal to keep battery fully charged.

(10) The main drum brake must be so adjusted that operator has full control at all times.

(11) The haulback drum brake should be so adjusted that a slight tension is indicated during all operations. This is necessary particularly during rehauling to keep the rope from tangling. When setting out the line (wire ropes) a foot-operated dog allows the rehaul lever to be held off, without the operator having to hold it manually. This dog is engaged during normal yarding operations.

(12) Rope wear must be reduced to a minimum by keeping it clear of rocks, and even the ground where possible. This is ensured by carefully setting out, or by placing logs or poles under the rope.

(13) The risk of accidents must be minimised: ropes must be in good condition and all workers must be out of the area encompassed by the cables before hauling or rehauling commences.

(14) Rigger's gloves with metal protected palms must always be used for handling wire rope.

(15) Aprons are used by workmen when employed in changing the cable location and when required to deflect the cable to a load some distance from the actual line of the rope. Pushing the cable with the thighs rather than by walking ahead and pulling it is faster and less fatiguing.

(16) If possible cables should not be used across a rise in the ground level which causes them to cut into the ground or to chafe logs, over which they run for protection.

(17) Low gear must never be used when hauling a load. Any load that cannot be hauled in second gear is too heavy.

(18) Engine oil is changed after every 70 hours of operation. S.A.E. 40 oil is used. This heavier oil is preferred because the engine is stationary and may at any time heat up unnoticed.

(19) Experience has proved that maintenance costs greatly increase when instruction in the care and handling of any machine is ignored.

(20) The hookers must be absolutely certain that the chokers and load are not against any obstruction before giving the signal for hauling in.

APPENDIX H.L. 7

SPECIFICATIONS OF EQUIPMENT USED WITH DEPARTMENTAL SELF-PROPELLED TRACTOR-MOUNTED YARDER

(1) Carrier. Tractor of 34 kW or 47 kW
Caterpillar tractors, D.4 of D.6, old models.

(2) Engine. Standard Caterpillar Tractor Co. make.
The same engine propels the tractor and drives the winch.

(3) Clutch. Dry type.

(4) Winch drums: D.4 Tractor.

	Main drum	Upper drum
Maximum line capacity	180 m 15,8 mm	400 m 9,5 mm
Available line pulls		
Low gear: bare drum	6 000 kg	3 500 kg
full drum	2 700 kg	1 800 kg
High gear: bare drum	3 400 kg	2 000 kg
full drum	1 800 kg	1 000 kg
Line speeds		
Low gear: bare drum	30 m p. min	53 m p. min
full drum	60 m p. min	100 m p. min
High gear: bare drum	55 m p. min	90 m p. min
full drum	103 m p. min	170 m p. min

D.6 TRACTOR

Maximum line capacity	240 m 19 mm	490 m 11,11 cm
Available line pulls		
Low gear: bare drum	11 600 kg	4 000 kg
full drum	5 500 kg	2 200 kg
High gear: bare drum	5 900 kg	2 000 kg
full drum	2 700 kg	1 200 kg
Line speeds		
Low gear: bare drum	33 m p. min	94 m p. min
full drum	70 m p. min	166 m p. min
High gear: bare drum	64 m p. min	182 m p. min
full drum	136 m p. min	320 m p. min

Note: Line pull is specified as quoted by the manufacturers, but owing to the fact that the Department uses worn tractors, the pulling capacity of their winches will be no more than 50% of that quoted

(5) Boom

Frame: Lattice type, mild steel channel
Length: 6 m recommended

Guy-lines: 15 m - 15,8 mm wire rope - 2 only
30 m - 15,8 mm wire rope - 1 only

Back-stay rigging group - standard assembly.

Note: The fitting for its attachment to the boom head has been modified according to a departmental pattern

Fairleaders

Tractor	Cable	Make	Sheave No. and size	Line diameter	Mass kg	Remarks
D.4 Cat.	Haulback	Skookum	F.6.15,2 cm x 6 cm	9,5 mm - 11,11 mm	31 kg	
D.4 Cat.	Main	Osco	7,6 cm 20 cm	12,7 mm - 15,8 mm	65 kg	Medium duty
D.6 Cat.	Haulback	Skookum	F-6.15,2 cm x 6 cm	11,1 mm	31 kg	
D.6 Cat.	Main	Skookum	F-8.20 cm x 7,6 cm	15,8 mm - 19 mm	84 kg	

Note: When mounting the fairleader base bolt hole, espacements and sizes should be given

APPENDIX H.L. 8

HIGHLEAD YARDER WITH BOOM - TRACTOR-MOUNTED

Estimated operating costs (No allowance made for loss of interest, etc.)

(1) D.4 Cat. tractor with Hyster double-drum winch, folding boom and counterweights.

Cost: R6 672,00
Depreciation. R6 672 ÷ 10 000 hr = R0,66 per hour

Diesel fuel used: 9 litres per hour
Lubricating oils: 0,13 litres per hour
Grease: 0,005 kg per hour

Repairs: 100% of the purchase cost = R0,66 per hour
Total departmental charges per hour for the above R2,40

(2) D6 Caterpillar tractor with Hyster double-drum winch, folding boom and blade.

Cost: R14 310,00
Depreciation: R14 310 ÷ 10 000 hours = R1,43 per hour

Diesel fuel used: 15,9 litres per hour
Lubricating oils: 0,23 litres per hour
Grease: 0,01 kg per hour

Repairs: 100% of purchase cost = R1,43 per hour
Total departmental charges per hour for the above: R2,40

(3) Hire of auxiliary equipment (as for lorry-mounted yarder) (Hard conditions) per hour: R1,21

(4) Labour engaged with the yarder (as for lorry-mounted yarder) per hour: R1,38

(5) Grand total cost for both D4 and D6 yarders per hour R4,99

Total costs per working hour (round figure) R5,00

HIGHLEAD YARDER WITH BOOM - TRACTOR-MOUNTED
LOG YARDING COST

Swinging logs to the roadside by animals; a team usually consists of two mules and two labourers.

Cost of 2 mules x 45c per day	R0,90
2 labourers x 65c per day	R1,30
Cost of log swinging	R2,20

Stacking at the roadside:

4 labourers x 65c per day	R2,60

Total yarding costs

Yarding cost by yarder: 7 hours x R5 per hour	R35,00
Log swinging by mule team	R2,20
Stacking logs at the roadside	R2,60
Total cost per day	R39,80
Expressed in a round figure	R40,00

Maximum volume yarded daily: D4 .... D.4 - 25 m^3
.... D.6 - 42 m^3

Cost per m^3 from stump to roadside: .. D.4 - 160c
.... D.6 - 95c

Note: Although the D.4 and D.6 tractors are both in the same hire class, the yarding efficiency of the D.6 is markedly superior to that of the D.4, consequently the great difference in yarding cost in favour of the D.6

APPENDIX H.L. 10

HIGHLEAD YARDER WITH BOOM - TRACTOR-MOUNTED
ACCESSORY EQUIPMENT WITH THE UNIT

(1) Caterpillar D.4 or D.6
(2) Double-drum Hyster logging winch
(3) Tractor folding crane - Hyster

Auxiliary equipment

(4)	Wire rope, 16 mm x 200 m	....	- 1 main line
(5)	Wire rope, 13 mm x 300 m	....	- 1 main line
(6)	Wire rope, 9 mm x 380 m	....	- 1 haulback line
(7)	Wire rope, 16 mm x 18 m. Both ends eye spliced	....	- 2 side guy-lines
(8)	Wire rope, 16 mm x 30 m. Both ends eye spliced	....	- 2 tail guy-lines
(9)	Slings, 12 mm x 4 m. Both ends eye spliced	....	- 4
(10)	Slings, 16 mm x 3 m. Both ends eye spliced	....	- 2
(11)	Blocks, haulback, T.6	....	- 3
(12)	Butt rigging, Montelius clevises	....	- 1 set with clevises
(13)	Choker assemblies, 16 mm x 3 m	....	- 8 sets
(14)	Clevises, 259 - 19 mm	....	- 5
(15)	Clevises, 259 or 263, 16 mm	....	- 2
(16)	Clevises, 263 - 13 mm	....	- 2
(17)	Clevises, 263 - 19 mm	....	- 6
(18)	Grips, iron (wire clamp)	....	- 4
(19)	Crosby clips, (genuine) 16 mm	....	- 24
(20)	Crosby clips, (genuine) 13 mm	....	- 12
(21)	Crosby clips, (genuine) 9 mm	....	- 24
(22)	Shuts, cold - 9 mm	....	- 6
(23)	Shuts, cold - 11 mm	....	- 6
(24)	Hooks, grab 9 mm	....	- 2
(25)	Spanner, adjustable - 38 cm	....	- 1
(26)	Spanner, adjustable - 30 cm	....	- 1
(27)	Spanner, adjustable - 25 cm	....	- 1
(28)	Spanner, adjustable - 20 cm	....	- 1
(29)	Spanner, ring, 7,9 mm - 11,1 mm	....	- 1
(30)	11,1 mm - 15,8 mm	....	- 1
(31)	15,8 mm - 17,4 mm	....	- 1
(32)	Sledge hammer, 1,8 kg	....	- 1
(33)	Pliers, side cutting, 20 cm	....	- 1
(34)	Wire cutter, Hammerblow model A (up to 19 mm wire rope diameter)		- 1
(35)	Wire cutter, extra blade	....	- 2
(36)	Screwdriver, 266 mm - long	....	- 1
(37)	Screwdriver, 203 mm - long	....	- 1
(38)	Aluminium helmets	....	- 4
(39)	Tool box	....	- 1
(40)	Peavy hooks	....	- 3 sets
(41)	Timber carriers	....	- 3 sets
(42)	Hookaroons	....	- 6 sets
(43)	Counterweights	....	- 6 sets

Note: Grease gun and nipples for lubricating the equipment (blocks, etc.) should be included

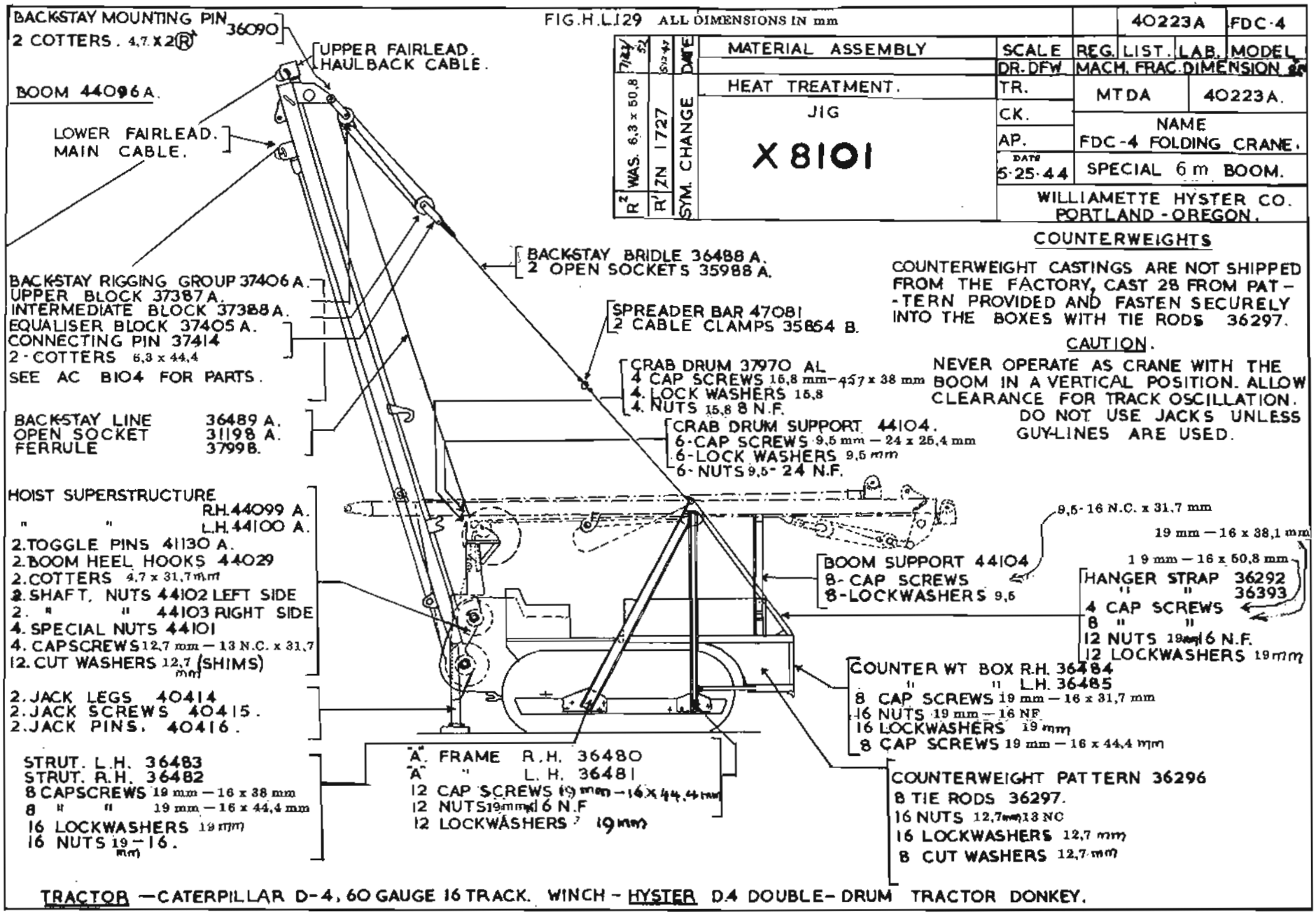


FIG. H.L.129 ALL DIMENSIONS IN mm
40223A FDC-4
MATERIAL ASSEMBLY
HEAT TREATMENT.
JIG
X 8101
SCALE
DR. DFW
TR.
CK.
AP.
DATE 5-25-44
REG. LIST. LAB. MODEL
MACH. FRAC. DIMENSION ±
MTDA 40223A.
NAME FDC-4 FOLDING CRANE.
SPECIAL 6 m BOOM.
WILLIAMETTE HYSTER CO. PORTLAND - OREGON.
SYM. CHANGE
R' ZN 1727
R² WAS. 6,3 x 50,8
BACKSTAY MOUNTING PIN 36090
2 COTTERS. 4,7 x 2®
UPPER FAIRLEAD.
HAULBACK CABLE.
BOOM 44096 A.
LOWER FAIRLEAD.
MAIN CABLE.
BACKSTAY BRIDLE 36488 A.
2 OPEN SOCKETS 35988 A.
BACKSTAY RIGGING GROUP 37406 A.
UPPER BLOCK 37387 A.
INTERMEDIATE BLOCK 37388 A.
EQUALISER BLOCK 37405 A.
CONNECTING PIN 37414
2 - COTTERS 6,3 x 44,4
SEE AC B104 FOR PARTS.
SPREADER BAR 47081
2 CABLE CLAMPS 35864 B.
CRAB DRUM 37970 AL
4 CAP SCREWS 15,8 mm — 457 x 38 mm
4. LOCK WASHERS 15,8
4. NUTS 15,8 8 N.F.
CRAB DRUM SUPPORT 44104.
6-CAP SCREWS 9,5 mm — 24 x 25,4 mm
6-LOCK WASHERS 9,5 mm
6- NUTS 9,5 - 24 N.F.
BACKSTAY LINE 36489 A.
OPEN SOCKET 31198 A.
FERRULE 37998.
HOIST SUPERSTRUCTURE
R.H. 44099 A.
" " L.H. 44100 A.
2. TOGGLE PINS 41130 A.
2. BOOM HEEL HOOKS 44029
2. COTTERS 4,7 x 31,7 mm
2. SHAFT, NUTS 44102 LEFT SIDE
2. " " 44103 RIGHT SIDE
4. SPECIAL NUTS 44101
4. CAPSCREWS 12,7 mm — 13 N.C. x 31,7
12. CUT WASHERS 12,7 mm (SHIMS)
2. JACK LEGS 40414
2. JACK SCREWS 40415.
2. JACK PINS. 40416.
STRUT. L.H. 36483
STRUT. R.H. 36482
8 CAPSCREWS 19 mm — 16 x 38 mm
8 " " 19 mm — 16 x 44,4 mm
16 LOCKWASHERS 19 mm
16 NUTS 19 mm — 16.
"A" FRAME R.H. 36480
"A" " L.H. 36481
12 CAP SCREWS 19 mm — 16 x 44,4 mm
12 NUTS 19 mm — 16 N.F
12 LOCKWASHERS 19 mm
BOOM SUPPORT 44104
8- CAP SCREWS
8-LOCKWASHERS 9,5
9,5 - 16 N.C. x 31,7 mm
19 mm — 16 x 38,1 mm
19 mm — 16 x 50,8 mm
HANGER STRAP 36292
" " 36393
4 CAP SCREWS
8 " "
12 NUTS 19 mm — 16 N.F.
12 LOCKWASHERS 19 mm
COUNTER WT BOX R.H. 36484
" " L.H. 36485
8 CAP SCREWS 19 mm — 16 x 31,7 mm
16 NUTS 19 mm — 16 NF
16 LOCKWASHERS 19 mm
8 CAP SCREWS 19 mm — 16 x 44,4 mm
COUNTERWEIGHT PATTERN 36296
8 TIE RODS 36297.
16 NUTS 12,7 mm 13 NC
16 LOCKWASHERS 12,7 mm
8 CUT WASHERS 12,7 mm
COUNTERWEIGHTS
COUNTERWEIGHT CASTINGS ARE NOT SHIPPED FROM THE FACTORY, CAST 28 FROM PAT - TERN PROVIDED AND FASTEN SECURELY INTO THE BOXES WITH TIE RODS 36297.
CAUTION.
NEVER OPERATE AS CRANE WITH THE BOOM IN A VERTICAL POSITION. ALLOW CLEARANCE FOR TRACK OSCILLATION. DO NOT USE JACKS UNLESS GUY-LINES ARE USED.
TRACTOR — CATERPILLAR D-4, 60 GAUGE 16 TRACK. WINCH - HYSTER D.4 DOUBLE-DRUM TRACTOR DONKEY.

PART NO. 37406 A.	JIG. NO.	A C B-

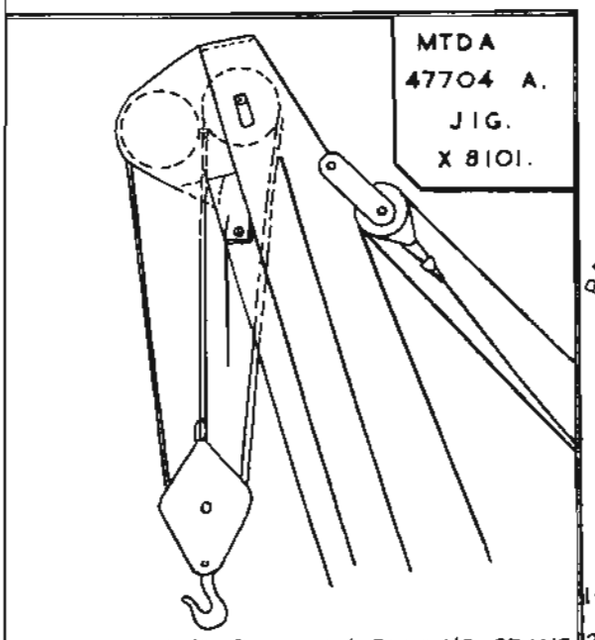
WILLEMETTE HYSTER CO.
PORTLAND OREGON

BACKSTAY RIGGING GROUP. (LIGHT)

SCALE:-	1cm = 4 cm		
DR. C.B.	TR.	CK.	AF.
CHANGED		DATE: 4-20-43.	
R.I	7/1/52.	REDRAWN & REVISED.	
MARK	DATE	REVISION.	

FIG. H.L. 130

37406A.

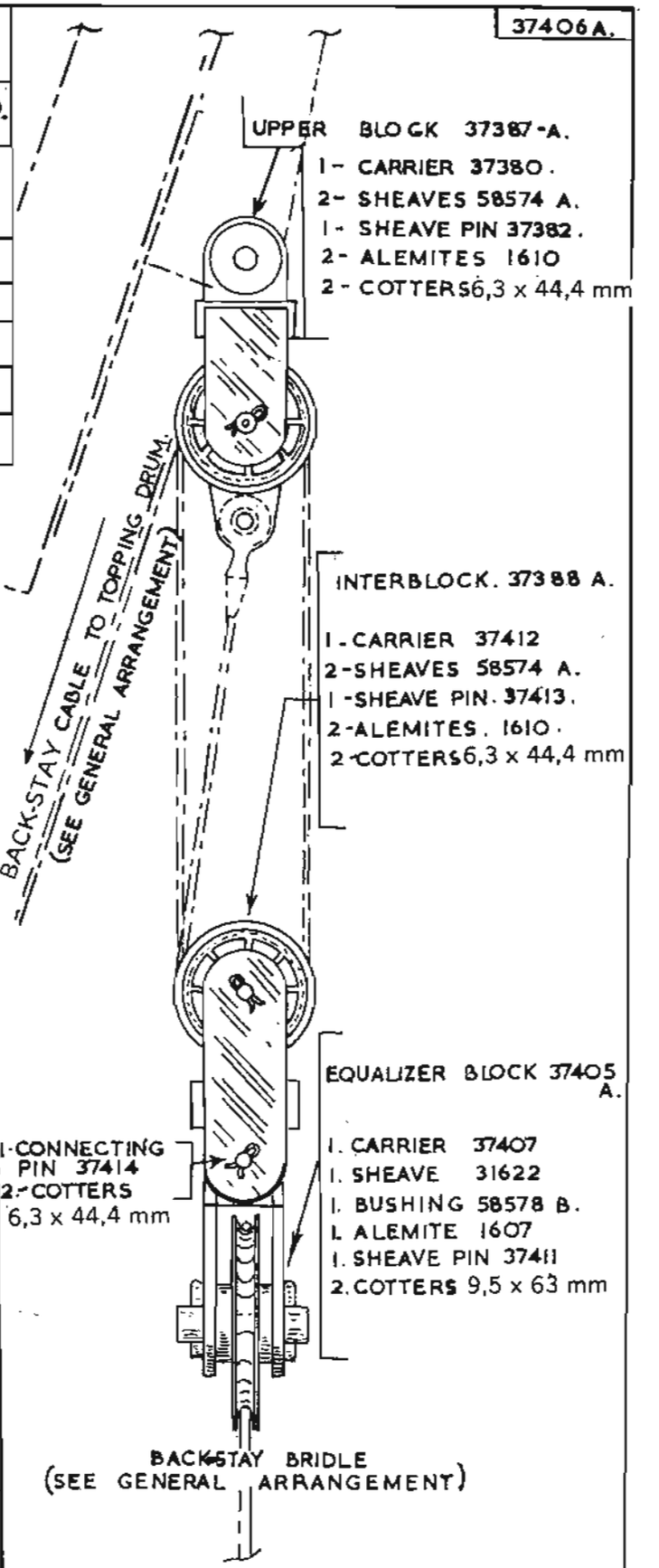


MTDA 47704 A. JIG. X 8101.

FALL BLOCK 48117A — D4-FOLDING CRANE

- 2 - 1610 ALEMITE.
- 4 - 31640 WEAR WASHER.
- 2 - 31622 SHEAVES
- 2 - CR. 832 B. BUSHING
- 1 - 41930 B. SHEAVE PIN.
- 1 - 44023 SHEAVE PIN.
- 1 - 31541 KEEPER.
- 1 - CAPSCREWS 15,8 mm — 18 x 31,7 mm
- 1 - LOCKWASHER 15,8 mm
- 1 - BOOM. 47613 A.
- 2 - COTTERS 6,3 x 50,8 mm
- 1 BACK-STAY MOUNTING PIN 36970
- 1 BACK-STAY RIGGING GROUP 37406 A.

CRANE - HYSTER MODEL FDC-4. (SPECIFICATION 223)



FOR ENTIRE ASSEMBLY (EXCLUDING CABLE & BOOM CONNECTION PIN) ORDER:- GROUP 37406 A.

APPENDIX H.L. 11

HYSTER D.4 DOUBLE-DRUM WINCH WITH CRANE BOOM RECORD OF MOUNTING WORK

(1) The provisional sledge was made for transport of double-drum winch.

(2) The winch and Hyster equipment were transported from sawmill railway ramp to garage.

(3) The support for hoisting equipment was built in the garage in order to lift the double-drum winch.

(4) Tractor seat, transmission gear inspection cover, drawbar guide plates and brackets were removed.

(5) Tool box from right hand fender was removed.

(6) Studs from lower face of draw-bar brackets were removed.

(7) Tractor seat was separated from seat frame.

(8) Rear ends of both fenders were cut off to a line 20 cm from the end.

(9) In bottom flange of hoist side frame, studs were installed (previously removed).

(10) Two studs 14,2 mm x 63 mm were installed in rear face of the tractor transmission case. Transmission was wired to the drum unit.

(11) Final drive plate filler elbow was turned about 15° to the right.

(12) Extension shaft with spline coupling was placed on transmission unit.

(13) Hyster winch was placed square with the tractor face. Spline coupling was fitted to tractor power take-off shaft.

(14) Hoist transmission unit was fastened to tractor with studs and three cap screws.

(15) The nuts and lock washers were placed on studs in order to hold Hyster frames to rear face of the tractor.

(16) Guard was replaced on drum unit (it was found loose).

(17) Hoist superstructure was fitted and fastened.

(18) Fuel feed line was disconnected at start-off valve. The nipple was removed from side of fuel tank.

(19) Fender plate on right-hand tractor fender was installed. The two holes were drilled to match with the holes in the plate. The fender was fastened with three bolts.

(20) The tractor seat was provisionally installed (lack of tie plates).

(21) Bucket seat was mounted on seat bracket and fastened with carriage bolt.

(22) The hoist operating seat was installed.

(23) The toolbox was located on the front of the fender.

(24) Drawbar guide to lower flange was replaced and fastened with studs.

(25) The 15 plugs from the holes in the tractor low side plates were removed.

(26) The left and right "A" frames were installed.

(27) The left and right struts were installed.

(28) The boom support was installed.

(29) The inner rods of counterweight boxes were straightened.

(30) The counterweight boxes were installed.

(31) Back-stay rigging group assembled.

(32) Crab drum was installed.

(33) The Hyster boom was installed.

(34) The cable on the lower drum was removed and again installed.

(35) The fall block was installed and connected with the main hoisting cable (on lower drum).

(36) The left-hand and right hanger (outer) straps were made and two holes drilled.

(37) The left and right (inner) supports to hanger straps were made and two holes were drilled.

(38) The inner rods of left and right frames were remodelled to provide adequate clearance for the motor body play.

Note: For that purpose the whole rear assembly was dismounted, including the counterweight boxes, and mounted again

(39) The two boxes - for forms for concrete slabs, were made.

(40) The eight concrete slabs for counterweight boxes were made.

(41) The tie plates were made and bolted with one of their ends to the hoist frame.

(42) Two holes were drilled in each fender to match the holes in the angle iron. Two bolts were inserted through these holes and tightened.

(43) Two holes were drilled in bottom of seat. The tractor seat was mounted on supports.

(44) Two guy-ropes (from old stock) were provided; the ends were seized with wire, bent and clipped with two clips each.

(45) Two hooks for guy-lines were used.

(46) The plate with two welded eye brackets was made and fixed on the head of the crane boom.

(47) The plate with welded hook to it was made and fixed to the bottom front of the tractor.

(48) Three ferrules for 6,3 mm, 9,5 mm and 15,8 mm cables were made.

(49) The top of the gear case was removed and a larger space for a gear lever was cut.

(50) The bush was inserted into the leaking filter plate.

(51) The new pipe for the oil filter was installed.

(52) The fuel pipe for the fuel filter was installed.

(53) The side opening in the tractor seat was cut to enable the fuel tank pipe to be fitted.

(54) Left-hand floor plate was cut and fitted.

(55) Three straps were made from old rope; the ends were seized with wire, bent and clipped with two clips each.

(56) Attempt was made to provide straps with spliced eyes locally, but without success.

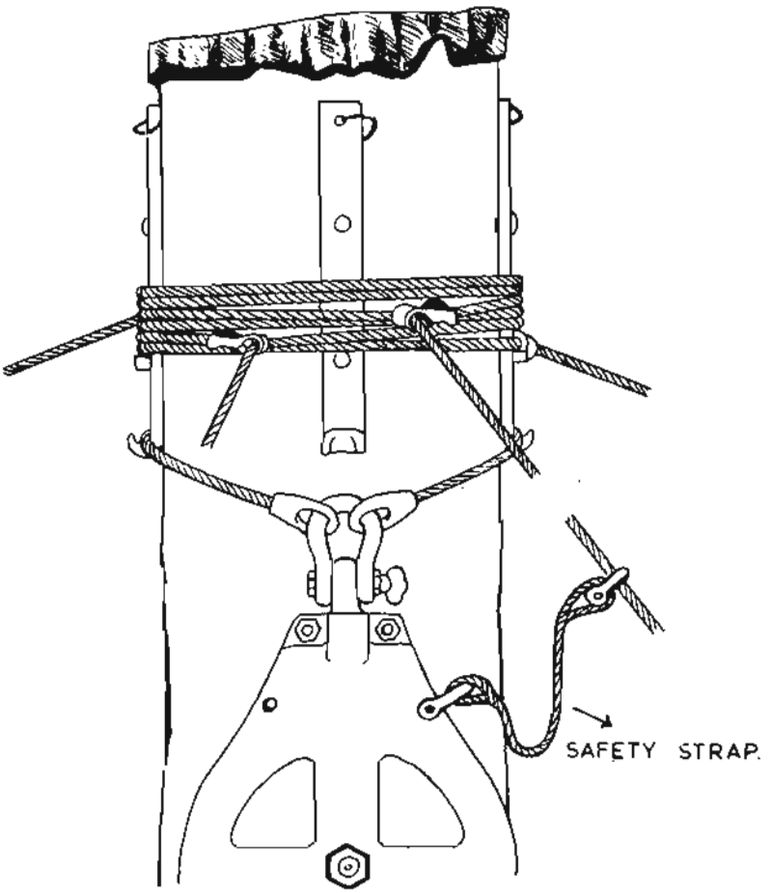
(57) Ninety-six bolts were fitted, inserted and screwed.

The following manual labour was engaged in mounting the Hyster double-drum logging winch and Hyster crane boom on the D.4 Caterpillar tractor:

(1) European labour - 23 man days

(2) Bantu labour - 12 man days.

FIG. H.L. 131



SPAR TREE RIG WITH TREE IRONS.

TREE IRONS.

SINGLE HOOK – NO. 229

BAR SIZE AND LENGTH:	22x75x900 mm	32x100x1000 mm
MASS	20 kg	49 kg

DOUBLE HOOK – NO. 215.

BAR SIZE AND LENGTH:	22 x 75 x 900 mm	33 x 100 x 457 mm
MASS	20 kg	45 kg

HIGHLEAD DOUBLE-DRUM YARDER: TRACTOR-MOUNTED, WITH SPAR TREE

AUXILIARY EQUIPMENT REQUIRED

A. RIG USED EXCLUSIVELY WITH D.6 CAT. TRACTOR YARDER

(1) Main cable, 19 mm diameter wire rope x 225 m long. One end thimbled, other end ferruled (ferrule 5 cm long, 4 cm O.D.) Used for yarding logs. - 1 only.

(2) Haulback cable, 13 mm wire rope diameter x 600 m long. One end thimbled, other end ferruled (ferrule as above). Used for rehauling main cable to logs. - 1 only.

(3) Main (bull) block, Mallory No. 1612, 26 kg, sheave 30 cm x 4,4 cm. To serve the main yarding cable. - 1 only.

(4) Head trip block, Mallory No. 7110, 13 kg, sheave 25 cm x 3,8 cm - 1 only. To serve haulback cable.

B. RIG USED EXCLUSIVELY WITH D.4 CAT. TRACTOR AND YARDER

(1) Main cable, 16 mm diameter wire rope x 200 m long. One end thimbled, other end ferruled. Ferrule 5 cm long x 4 cm O.D. Used for yarding the logs. - 1 only.

(2) Haulback cable, 11 mm diameter wire rope x 360 m. - 1 only.

(3) Main (bull) block, Mallory No. 1610, 23 kg, sheave 25 cm x 4,4 cm. To serve main yarding cable. - 1 only.

(4) Head trip block, Mallory No. 7110, 13 kg, sheave 25 cm x 3,8 cm. To serve haulback cable. - 1 only.

C. CLIMBERS RIG

(1) Safety belt, safety snap hook, climbers pads (2), leg straps (2), climbers spurs (irons) (2), wire reinforced rope (1).

(2) Axe, 1-1,5 kg, hand-saw or light power-saw.

(3) Fibre rope, 13 mm diameter, approximately 36 metres long.

D. COMMON RIG FOR D.4 AND D.6 TRACTOR (CATERPILLAR) YARDERS

(1) Tree irons, double hook, bar 22 mm x 75 mm x 90 cm. For supporting guy-lines. (Fig. H.L. 131). - 4 only.

(2) Haulback blocks, Skookum T.6 (sheave 15 cm). For directing cables in the field. - 3 only.

(3) Rigger's block, Young No. 64 - 3,6 kg. - 2 only.

(4) Rigger's block, Young No. 66 - 7,2 kg. - 2 only. Items 3 and 4 used for rigging spar tree.

(5) Guy-lines, 16 mm wire rope diameter, both ends soft eye spliced, 36 metres long. For guying the spar tree. - 7 only.

(6) Slings, 13 mm x 4 metres, both ends soft eye spliced. For the attachment of blocks. - 4 only.

(7) Slings, 16 mm x 3 metres, both ends soft eye spliced - spares. - 2 only.

(8) Strap, 9 mm x 1 metre wire rope. To secure main block. - 1 only.

(9) Butt rigging, Bantam Butt chain and butt hooks, with Montelius clevises and end clevises - assembly. For choker attachment. - 1 only.

(10) Sister hooks, for temporarily linking rope ends. - 1 set.

(11) Choker assemblies, 16 mm wire rope slings x 3 metres. - 8 only.

(12) Choker assemblies 16 mm wire rope slings x 4,5 metre. - 8 only.

(13) Clevises 259 - 22 mm with screw pin, hexagonal head. - 6 only.

(14) Clevises 259 - 19 mm with screw pin, hexagonal head. - 6 only.

(15) Clevises 259 - 16 mm with screw pin, hexagonal head. - 6 only.

(16) Clevises 259 - 13 mm with screw pin, hexagonal head. - 6 only.

(17) Clevises (shackle) "D" - 22 mm with drop pin and split pin. For guy-line attachment. - 12 only.

(18) Crosby clips, genuine, 16 mm. For guy-line attachment. - 36 only.

(19) Crosby clips, genuine, 13 mm, spares. - 12 only.

(20) Shuts, cold, 9 mm. - 12 only.

(21) Shuts, cold, 11 mm. - 12 only.

(22) Hooks, grab, 9 mm. - 4 only.

(23) Logging chain, 9 mm x 2 metres. - 4 only.

(24) Manilla rope, 13 mm diameter. - 45 metre.

(25) Manilla rope, 19 mm diameter. - 45 metre.

(26) 3-way Bardon arch hook, Bantam. - 1 only.

(27) Basket hook, Bantam. - 5 only.

(28) Lifting jacks with 5 cm diameter shaft for lifting cable-reels. - 2 only.

Wire rope specifications

(1) Main and haulback cables: Rope diameter as specified 6 x 19 (9 x 9 x 1), Seale construction, ordinary lay, independent wire rope core (I.W.R.C.), special improved plough, preformed, plain.

(2) Guy-lines, choker and slings: Specified as above, except that the ropes have a fibre core.

(3) Choker assembly consists of:

a. Wire rope slings, 16 mm x 3 metres or 4,5 metres long, both ends ferruled.

b. Choker hook, dwarf size, (Young 500 or similar).

c. Ferrule, 45 mm long, 38 mm outside diameter to accommodate 16 mm wire rope.

E. TOOLS - LOGGING

(1) Spare wire rope, 16 mm for choker slings	60 metres
(2) Set for ferruling	1 only
(3) Ferruling metal	12 kg
(4) Ferrules, spare	12 only
(5) Wire cutter, Hammerblow, Model A for up to 19 mm wire rope	1 only
(6) Extra blades for wire cutter	6 only
(7) Sledge hammer, 1,8 kg	2 only
(8) Vice (portable) field type	1 only
(9) Wire nuts for 16 mm wire rope	2 sets
(10) Crow-bar, 6 kg	2 only
(11) Spanner, adjustable, 40 cm	2 only
(12) Spanner, adjustable 30 cm	2 only
(13) Spanner, adjustable, 25 cm	2 only
(14) Spanner, ring, 24 mm - 11,1 m	1 only
(15) Spanner, ring, 11,1 mm - 15,8 mm	1 only
(16) Spanner, ring, 15,8 mm - 17,5 mm	1 only
(17) Pliers, side cutting, 20 cm	2 only
(18) Screw driver, 27 cm long	1 only
(19) Screw driver, 20 cm long	1 only
(20) Tool box	1 only
(21) Aluminium helmets	4 only
(22) Peavy hooks	3 sets
(23) Timber carriers	3 sets
(24) Hookaroons	6 only
(25) Counterweights for tractor (If bulldozer blade is not available)	6 only
(26) Spikes 18 cm long	36 only
(27) Axe, 1,8 kg.	2 only
(28) Bow-saws	2 only
(29) Power-driven saw (optional)	1 only
(30) Cross-cut saw	1 only
(31) Grease gun and nipples for lubricating equipment (blocks, etc.) should be included with the tractor tools.	

APPENDIX H.L. 13

HIGHLEAD - WORKING FORCES ON SPAR TREE

Rig Mass

1.	Block-rigging ...	1 ...	3,60 kg
2.	Block-rigger's ...	1 ...	7,20 kg
3.	Block-main ...	1 ...	26,00 kg
4.	Block-head trip ...	1 ...	13,00 kg
5.	Tree iron	4 x 23 kg	92,00 kg
6.	Slings, 13 mm diam. 2 x 3 m = 6 m x 0,72 kg	=	4,32 kg
7.	Slings 16 mm diam. 2 x 3,6 m = 7,2 m x 1,0 kg	=	7,20 kg
8.	Guy line 16 mm diam. 5 x 36 m = 180 m x 1,0 kg	=	180,00 kg
9.	Rope 19 mm diam. 120 m x 1,5 kg	=	180,00 kg
10.	Rope 13 mm diam. 210 m x 0,72 kg	=	152,00 kg
11.	Clevis 22 mm diam. 4 x 1,84 kg	=	7,36 kg

Work pressure

Pressure on main block 2 ton x 2 = 4 ton = 4 000,00 kg

Total pressure = 4 672,00 kg

= ± 5 tons

Pressure which a spar tree (slender column) can withstand

Pinus pinaster : Top diameter - d = 28 cm

Height - L = 1 370 cm

Ratio = 1 370 ÷ 28 = 49

$$p = \frac{0,022771\ E.\ A}{(\frac{L}{d})^2}$$

E	=	Modulus of elasticity = 1 100 000
A	=	Cross-sectional area $\Pi R^2 = 3,1415 \times 14^2 = 615\ cm^2$
L	=	Height of column = 1 370 cm
d	=	Top diameter of tree = 28 cm
Ratio	=	49
p	=	pressure on the tree
Factor	=	0,022771
p	=	$\frac{0,022771 \times 1\ 100\ 000 \times 615}{2\ 401}$
	=	6 415 kg
	=	6,5 ton which is the pressure the column can stand

CONCLUSION

From the foregoing calculations the rig mass and pressure of yarding exert a pressure of 5 tons on the spar tree. Applying a safety factor of 3, the spar tree should be able to stand a pressure of 15 tons.

A Pinus pinaster spar tree of 28 cm top diameter and 1 370 cm high, which would be practically available departmentally for use as a spar tree, can only withstand a pressure of 6,5 ton. For this reason it has been necessary to resort to the use of prefabricated steel booms with logging machines for departmental highlead yarding operations.

APPENDIX H.L. 14

SPECIFICATION

TWO (MAIN) DRUM YARDER-SKIDDER

This unit will be used for log yarding or loading. The unit will be mounted on sled or lorry.

In order to make the unit more versatile it is proposed that apart from the basic set of drums, i.e. main and haulback, straw and swing drums (the latter two outboard mounted), an extra haulback drum assembly will be installed in place of a swing assembly.

In this case the drums in sets of 2 and 3 will be used as indicated in the table below:

FRAME

Unit to be mounted on strong, rigid steel frame as light in mass as practically possible.

A transverse partition plate between the winch and engine as a vertical brace will be an advantage.

Provision should be made to facilitate the bolting of the winch frame to the runners (logs).

Desirable size of the frame:
Width between frame centres - 77,5 cm

Note: A greater width will be acceptable

Length overall, approx: 3,3 metres
Drum shafts to be adequately strong and of rotating or non-rotating type.

Bearings of main drums to be preferably of dual roller type, bearing housing self-aligning; for strawline and swing drums - alloy bearings can be accepted.

Gears and pinions

Drum gears to be heat treated, gear steel casting similar or better.
Pinions to be machined from heat-treated alloy steel.
Drum gears and pinion teeth to be hobbed.

Drums

All drums, preferably, to be heat-treated alloy steel single piece heavy sections casting; strawline and swing drum can be fabricated of structural steel.

The drum barrels and inside faces of the flanges to be machined.

Breakproof ventilated brake flanges, with extra plate dishes, will be considered an advantage.

The drums to be mounted on adjustable bearings.

Friction block and brake band contact surface to be finely machined.

Any heat generated by the brakes should not affect the friction.

A suitable arrangement for anchoring the cable to the drums should be provided.

Drums should be readily accessible and easily removable.

Ratchets and pawls or dogs to be provided for locking main and haulback drum (or drums) at any position.

Sprockets

- Driving sprockets to be machined from heat-treated alloy steel or better.
- Driven sprockets - cast from gear steel or better.

Note: Both with machine cut teeth

Drum arrangement desired

Main drum to be located in front of operation and next to the engine.

Haulback - in front and next to the main drum. Strawline and (one) swing drum on the same shaft in front of the haulback drum.

Name of drum	Drum arrangement		Use of the yarder
	2 main drums in set	3 main drums in set	
1. Main	main	main	2, main drum set as:
2. Haulback	haulback	inhaul	a. Highlead.
3. Swing	swing	not mounted	b. North and South Bend systems
4. Extra haulback	not mounted	outhaul	c. Loader
5. Strawline	Strawline can be mounted on shaft of: a. Main drum b. Swing drum (One swing drum other strawline on same shaft)	Strawline can be mounted on shaft of: a. Main drum b. Not mounted	3-main drums set as: Taylor system

Note: In case of rotating (drum) shafts system, the strawline drum can be located on the main drum shaft and two swing drums on their own (separate) shaft in front of the haulback drum. Additional haulback drum assembly to replace swing drums (if required) to be supplied, to enable use of the yarder as a three (main) drum unit

Drum capacities

Main drum - 225 m of 19 mm diameter cable.
Haulback drum (as inhaul) - 600 m of 12,7 mm diam. cable.
Extra haulback drum (as outhaul) - 750 m of 9,5 mm diameter cable.
Strawline drum - 750 m of 6,3 mm cable.

Note: All three main drums (including "extra haulback") to be overwinding; strawline (with the guard) and loading drums to be underwinding

Approximate desirable line speed and pull

Main and inhaul drums should range from approximately 9 000 kg with line pull at 20 m per minute to 1 800 kg at 150 m per minute.

The outhaul drum should range from approximately 680 kg with the line pull at 390 m per minute to 4 500 kg at 60 metres per minute.

Strawline speed is approximately that of the outhaul.

Brakes

Brakes of sufficient diameter to be foot operated, self energising with woven asbestos lining and considerable brake contact area.

Friction: (to be the most effective having suitable contact).

The friction blocks to be of material resistant to climatic changes, easily removable for cleaning or replacement.

The friction application should be of such design that the shaft will not be weakened by a slot cut through for a key or pin.

Controls

All controls preferably to be manually and foot operated and to be banked and grouped conveniently in front of the operator facing the operation.

Chain drive

The drive from the power unit to the main pinion shaft to be roller chain protected by a sheet steel guard. A torque bolt (or similar device) to relieve the power unit of the chain tension must be installed.

Engine

The engine, with large capacity radiator and heavy duty batteries, of suitable power to drive the required winch unit can be of petrol or diesel type.

Note: Full description of the engine should be enclosed with the tender

Transmission: (Transmission of industrial type, constant mesh, four speed (preferably) with reverse: to match the engine to be used).

Between the engine and transmission, a torque converter should be installed with variable speed ranges on all drums.

Note: The description of the torque converter should be enclosed

The torque converter should permit automatic change to fluid coupling operation.

The converter to be of a self-contained circulating, air cooling systems with oil reservoir. Provision should be made for attaching an external inter cooler when required under severe operating conditions.

Some device to check overheating in the torque converter is desired.

Approximate yarder dimensions - including engine

Overall width - (including banked lever control stand)	-	2 metres
Overall length -	-	3 metres
Overall height -	-	1,2 metres

The engine with radiator should not project to the side beyond the operator's banked lever control stand or auxiliary (straw and swing) drums.

Bare mass of the yarder including the engine to be approximately 1 800 - 2 700 kg (main, one haulback, straw and swing drums).

Fuel and lubrication flow

Engine fuel and lubricant flow should not be interrupted on a 45° slope.

Instruction book and spare parts catalogue

With the yarder three copies of parts and instructions booklets (for engine and winch) must be supplied.

Extras

(1) Extra haulback drum assembly to replace the swing drums, in order to convert double-drum yarder into a three drum one.

(2) Tool kit.

(3) Spare parts for 2 000 working hours or 1 year operation.

(4) Fairleaders - eye type double fairleaders for 19 mm diameter main line and 9 mm diameter haulback line.

APPENDIX T.S. 16

FORMS

FOR RECORDING OBSERVATIONS OF

LOG YARDING

BY HIGHLEAD

LOG YARDING BY HIGHLEAD

DAILY FIELD SHEET

Cable run record

Highlead used: Lorry-mounted with boom .....
Tractor-mounted with boom .....
Tractor-mounted with spar tree .....

F.D. No..... Date ..... F.D. No..... Date .....

Block/compart ..... Crew. N.N. ..... Block/Compt..... Crew. N.N. .....

Time		Logs No.	Winching			Remarks	Time		Logs No.	Winching			Remarks
h	min.		Up	Down	Level	Max. distance metres	h.	min.		Up	Down	Level	Max. distance metres

FOREMAN: .....

COMPILER: .....
RANK: .....

LOG YARDING BY HIGHLEAD

MONTHLY OR COMPARTMENT LOGGING REPORT - CONDITIONS

PLANTATION .....

Logging unit .....

Make ..... F.D. No. .....

Block and compartment ..... area ..... hectares .....

SP ha . ..... Total volume per hectare ..... m^3

Clearfelling, or thinning (from - to) .....

Total volume expected from extraction ..... m^3

Tree length or log yarding operation .....

Approximate average size of trees or logs yarded:

L ..... metres D ..... cm V ..... m^3

Topography .....

Gradient of slope: ..... (degrees)

Undergrowth, slash and stumps (description) .....

.....

.....

Surface .....

Single or double log yarding operation .....

Kind of landing .....

Access to the landing from existing road .....

Play of wire rope: (free, protected or unprotected)

(Main) .....

(Haulback).....

Method of load assembling (advance, cross-stick, etc.)

.....

Supplementary equipment used and its NN .....

Advance load choking (if) .....

Weather .....

Average wages including cost of living and rations: .....

European ..... Bantu .....

Number of crew: European ..... Bantu .....

FORESTER .....

LOG YARDING BY HIGHLEAD

LOG SWINGING AT THE ROADSIDE

DATE: ..... 19...

Plantation ..... Kind of felling ..... Crew ..... Serving team No's .....

Block ..... Compt ..... Bantu .....

Break for breakfast from ..... till ..... a.m. Supplementary equipment .....

Break for lunch from ..... till ..... p.m. UNIT (F.D):.....

Load No.	No. of logs	TIME OF								Remarks
		Load arrival (dispersal)		Load unchoking		Piling of logs		Idle time		
		From	Till	From	Till	From	Till	From	Till	

COMPILER .....

RANK .....

LOG YARDING BY HIGHLEAD

MONTHLY FIELD SHEET

MONTH : ..... 19 ..... PLANTATION: ..... HIGHLEAD: ..... F.D. .....

Driver: .....

Date	Block and Compt.	Max. distance m	Yarding level, up, down	Return trips completed	Yarded		Actual working time	Machine idle Local changes			Lunch break, etc.	Delays	Remarks	NUMBER OF LABOUR UNITS			
					Logs NN	Volume m^3	h min.	Site h min.	line h min.	Erection h min.	h min.	h min.		Unhooking, Hooking Choking signal	Log deck rollers stackers	Log swinging	Load assembling in area

FORESTER ..... COMPILED BY .....

RANK .....

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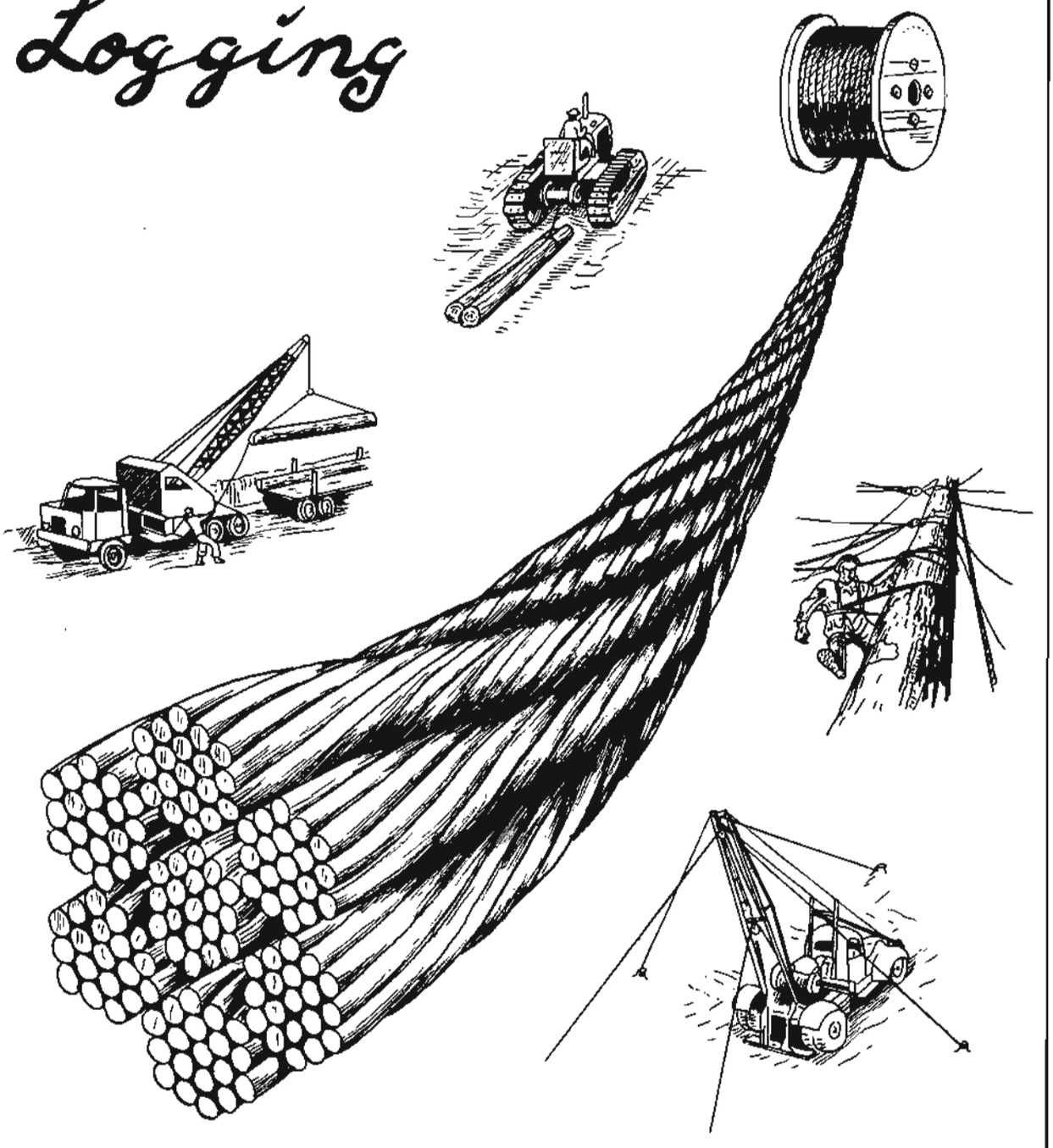
Volume 2, Part 2

The use of wire rope in logging

The use of chain in logging

Log loading and transportation

Wire Rope in Logging



I. WIRE ROPE IN LOGGING

1. THE ROPE

(a) INTRODUCTION

The forest regions of South Africa are, for the most part, located in rough, rugged country, often inaccessible to direct towing means, i.e. animals or towing tractors. The problem of extracting logs from mountain fastnesses which hitherto were regarded as inaccessible, has now been overcome to a certain extent by the use of wire rope in logging. Wire rope is used as a means of extending the reach of logging machines, enabling them to bring logs to the required point by a combination of towing and winching either along the ground or by means of aerial cable systems, or a combination of both.

(b) SELECTING WIRE ROPE FOR THE TASK

Of all the qualities which a logging rope must possess, flexibility, ruggedness and toughness are the most essential. It is important that the rope be selected which is best suited to do the particular job concerned. The rope should possess:

(1) Sufficient strength to cope with the maximum load to be applied, with a proper safety factor.

(2) Ability to withstand repeated bending without failure of wires from fatigue.

(3) Ability to withstand abrasive wear.

(4) Ability to withstand distortion and crushing, or, to put it plainly, the ability to withstand abuse.

A. DETAILS OF WIRE ROPE CONSTRUCTION

(a) GRADES OF STEEL USED IN WIRE ROPE MANUFACTURE

Through the years the material used in wire rope manufacture has progressed from iron to mild steel, with a tensile breaking strength of about 6 tons per cm^2, to cast steel (12-14 tons); mild plough steel (14-16 tons); best plough steel (17-19 tons); special improved plough steel (19-20 tons); and finally extra special improved plough steel (20-21 tons). In South Africa the latter three types are in general use, but only wire rope manufactured from special improved plough steel is used in departmental logging operations.

(b) CONSTRUCTION

(1) Strands

The usual construction of a round wire rope is six strands round an independent wire rope or fibre core. Where ropes are subject to a considerable surface wear, the strands are formed with the outer wires of a larger diameter than the inner wires. The standard constructions of flexible steel wire ropes for cranes, slings and general engineering work are 6 x 19; 6 x 24 and 6 x 37, of which 6 x 19 (Seale type) is generally used under departmental logging conditions.

Seale construction is the name given to a strand in which the centre wire is covered by smaller wires, covered in turn by larger wires. The combination used departmentally in this construction is 19 wires, namely 9 over 9 over 1 (Fig. W.R. 1). Seale construction is used for operations where the rope is subjected to heavy wear, severe crushing loads and excessive shocks.

(2) Core

The centre member of a wire rope is called the core and may be made from either fibre (Fig. W.R. 1) or wire (Fig. W.R. 2). Fibre cores in logging ropes are made from one of the hard fibres such as sisal or manilla. Wire cores are usually composed of a separate 7 x 7 wire rope, termed "Independent Wire Rope Core" (I.W.R.C.). Under normal conditions, a fibre core provides adequate support for the strands. Where heavy loads are involved, however, or overwinding on drums causes excessive pressure of the strands on the core, I.W.R.C. is necessary. For departmental logging conditions, wire rope with fibre core is used where flexibility is required, i.e. for all choker and loading slings, and I.W.R.C. is used for all haulage ropes or ropes passing over sheaves and drums.

When wire ropes are lubricated during manufacture, the fibre core is impregnated with a suitable lubricant to preserve the fibres by keeping them pliable.

(3) Wire rope lays

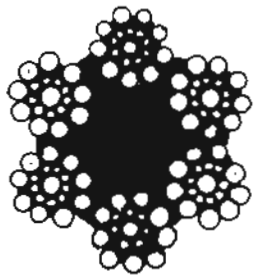
The "lay" of a wire rope is governed by the direction in which the strands are laid into the rope, and also the direction in which the wires are laid into the strand.

(i) Regular lay rope - A regular lay rope is one in which the direction of lay of the strands in the rope is opposite to the direction of lay of the wires in the strands (Fig. W.R. 3). Ropes may be either right or left lay. A right lay rope (Fig. W.R. 3) is one in which the path of the strands in the rope is from left to right in the direction away from the observer. For a left lay rope the path of the strands is from right to left away from the observer (Fig. W.R. 4).

(ii) Lang lay rope (Fig. W.R. 5) is a rope in which the direction of lay of the strands in the rope is the same as the direction of lay of the wires in the strand. Lang lay ropes may be either left or right lay.

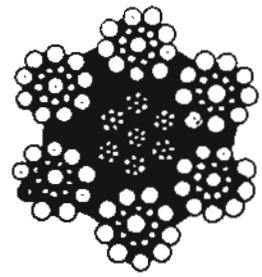
(iii) Regular lay ropes are used for most logging operations, as they have the following advantages:

FIG.W.R. 1



6 X 19 SEALE
I FIBRE CORE

FIG.W.R. 2.



6 X 19 SEALE
INDEPENDENT WIRE
ROPE CORE

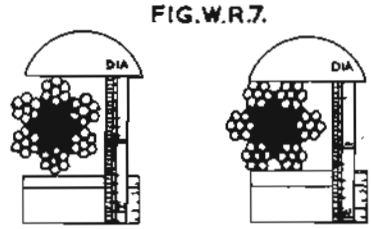
FIG.W.R.3 RIGHT REGULAR LAY

FIG.W.R.4. LEFT REGULAR LAY

FIG.W.R.5. RIGHT LANG LAY

FIG.W.R.6.
PREFORMED WIRE ROPE

FIG.W.R.7.

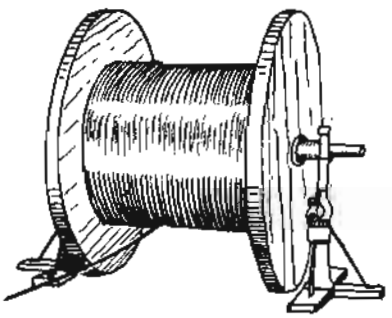


RIGHT WRONG

HOW TO MEASURE WIRE ROPE

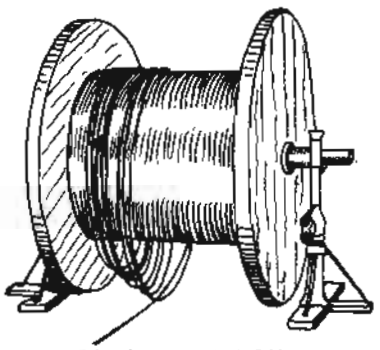
SETTING UP THE REEL FOR REWINDING.

FIG.W.R.8.



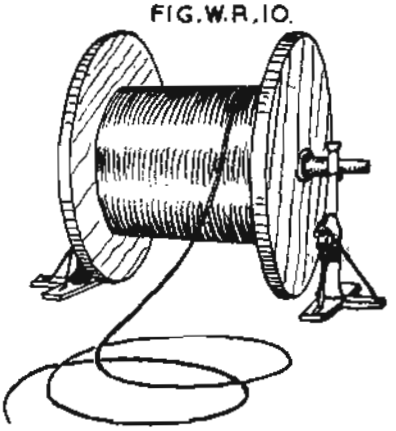
CORRECT - ROPE FROM UNDERSIDE OF REEL.

FIG.W.R.9.



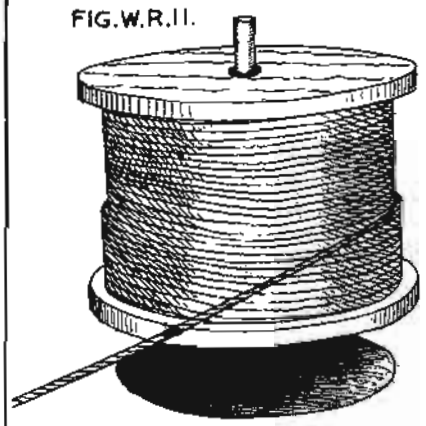
CORRECT – SLACK LOOSENS ON REEL.

FIG.W.R.10.



INCORRECT - ROPE FROM TOP OF REEL; SLACK FORMS KINKS.

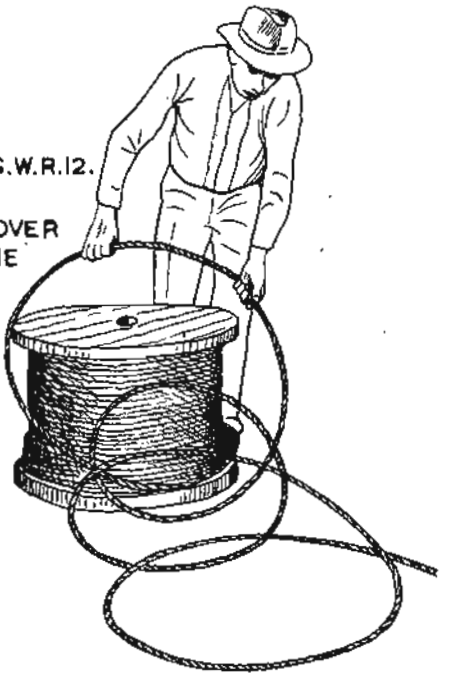
FIG.W.R.11.



CORRECT - REEL ON TURN-TABLE

FIG.W.R.12.

INCORRECT – PULLING ROPE OVER THE SIDE OF THE REEL.



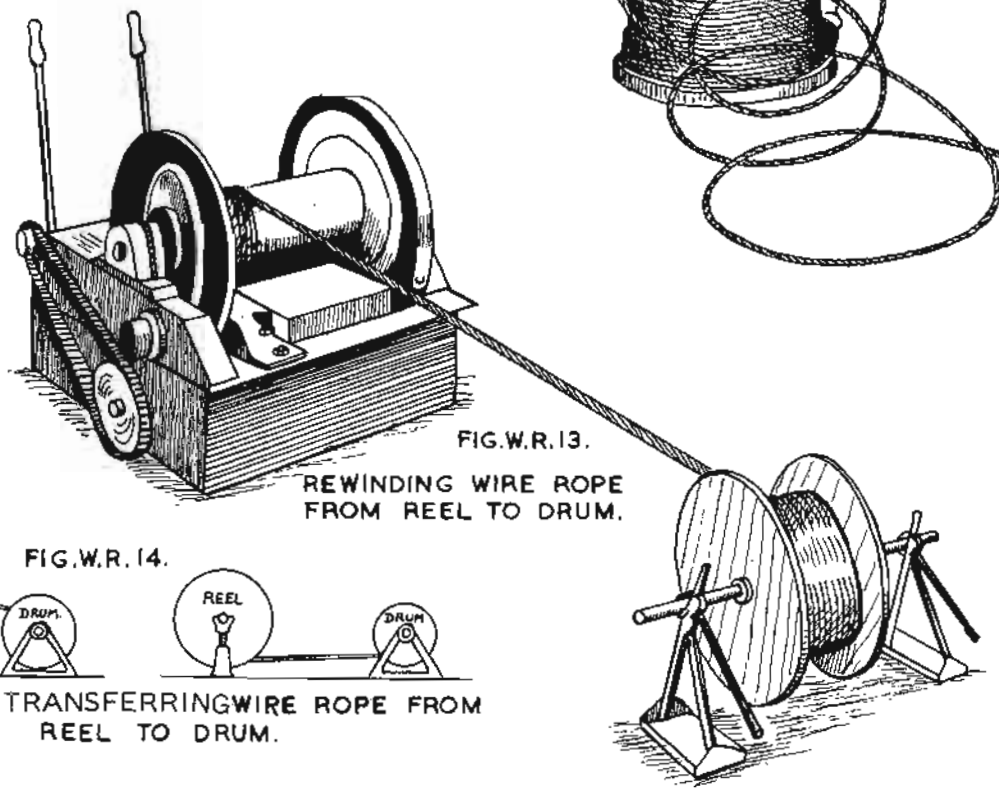
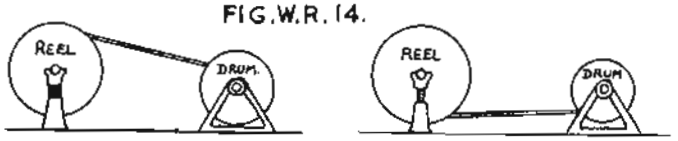


FIG.W.R.13.

REWINDING WIRE ROPE FROM REEL TO DRUM.

FIG.W.R.14.



RIGHT WAY OF TRANSFERRING WIRE ROPE FROM REEL TO DRUM.

(1) More stability
(2) Greater resistance to crushing and distortion
(3) Less tendency to rotate under load
(4) Less likelihood of kinking
(5) Greater ease in handling
(6) They do not fall apart easily when left with loose ends

(c) PREFORMED WIRE ROPE (Fig. W.R. 6)

A preformed wire rope is one in which the individual strands have been preformed into the exact shape they normally assume in the rope when working. When the rope is without a load, the strands lie in position in a relaxed stress-free condition, thus removing the natural tendency to straighten out. Only preformed ropes are used for departmental logging operations.

(d) CHARACTERISTICS OF PREFORMED ROPES

(1) Higher resistance to bending fatigue
(2) Greater flexibility
(3) More freedom from kinking
(4) Equal load distribution on each strand and wire
(5) When the outer wires break, they do not protrude, but lie in place
(6) Operates over sheaves with less rotation around its axis
(7) More resistant to whipping and vibration
(8) Simplifies splicing of endless slings and long splice
(9) Spools more uniformly on the drum
(10) Offers increased use of lang lay rope
(11) Will not unravel when cut or when seizings are removed.

(e) GAUGING WIRE ROPE

The diameter of wire rope is the diameter of the circle which will enclose all of the strands. In the case of strands the diameter is that of the circle which just encloses all the wires. The correct diameter is the greatest diameter of the rope or strand (Fig. W.R. 7).

(f) HOW TO ORDER WIRE ROPE

The following information must be given when ordering wire rope:

Dimensions of rope: 1. Length
2. Diameter
3. Circumference

Construction of rope: 1. Lay
2. Number of strands (6)
3. Class of core (fibre or I. W. R. C.)

Construction of strands: 1. Number of wires (Seale, 19 - 9 x 9 x 1)
2. Diameter of wires, (1,27 mm outer, 0, 737 mm inner)
3. Class of core (steel wire)

Class of steel: Special improved plough
Breaking stress of steel: 19/20 tons
Mass of rope per metre
Estimated breaking load
Use for which the rope is intended
Note: The date of manufacture must be specified by the supplier.

End of the rope: (Seized, clamped, etc.)

B. HANDLING

When unloading do not drop reels to the ground or floor, as the mass of the rope might collapse the reel, or the rope could be damaged by striking against some hard or sharp object. When using a steel bar to roll a reel of wire rope, pry against the reel head, not against the rope.

(a) STORAGE

Wire rope is more susceptible to corrosion and deterioration when not in use than a highly finished motor car. Consequently its storage is of vital importance to rope life. Wire rope should be stored in a fairly well ventilated, comparatively dry building or shed. Do not store on bare ground or expose to the elements. Do not store in a dusty or chemical laden atmosphere. If necessary to store outside, set the reel on blocks, off the ground, and cover with a waterproof covering. The rope should previously have been well lubricated before storing.

Care of idle rope

If possible rope should be removed from "idle" equipment and stored as above, otherwise the wire rope should be well lubricated and covered with a weatherproof covering.

(b) SETTING UP THE REEL AND REWINDING

(1) Set the reel up on jacks, preferably so that the rope will come from the underside of the reel (Fig. W.R. 8).

(2) If the reel should spin faster than the rope is pulled off, the rope will slacken. and successive turns would loosen on the reel, with no injury to the rope (Fig. W.R. 9).

(3) If the rope comes from the top of the reel and the reel overruns, the slack may form loops (Fig. W.R. 10), which are liable to form kinks, which are very injurious to rope life.

(4) The reel may be set on a turn-table (Fig. W.R. 11), which allows the rotation of the reel to pay off the rope.

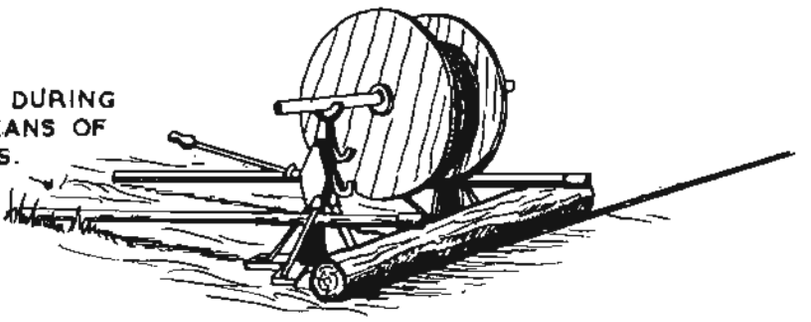
(5) The reel should never be flopped on its side on the ground without a turn-table (Fig. W.R. 12). The rope, when pulled over the side of the reel, will either put in a twist or take out a twist in the rope, depending on which of its sides the reel is set. Such loops produce a kinky rope and reduce rope service.

(6) The end of the rope may be held, and the reel rolled along the ground.

When re-reeling in a horizontal position from a reel to a drum, the rope should travel from the top of the reel to the top of the drum, or from the bottom of the reel to the bottom of the drum. This will avoid putting a reverse bend into the rope being installed (Fig. W.R. 13 and 14).

FIG.W.R.15.

ROPE KEPT TAUT DURING REWINDING BY MEANS OF A LOG AND SPARS.



HANDLING COILS TO BE REWOUND.

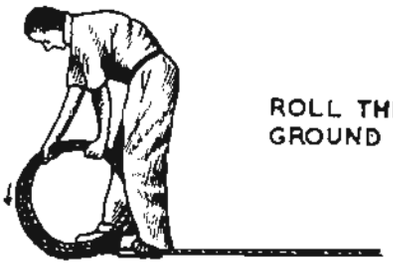
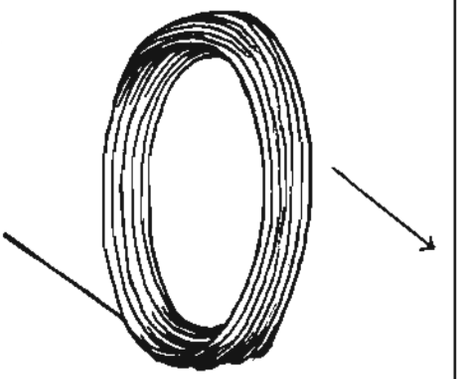


FIG.W.R.16.

CORRECT.
ROLL THE COIL ON THE GROUND LIKE A HOOP.



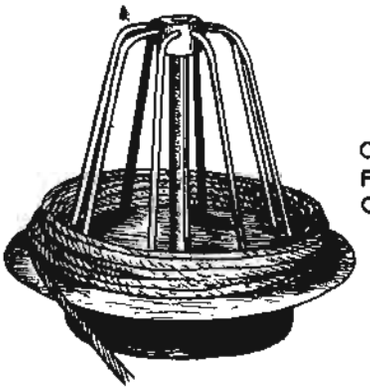


FIG.W.R.17.

CORRECT— UNCOIL FROM A TURNTABLE OR ROTATING COIL.

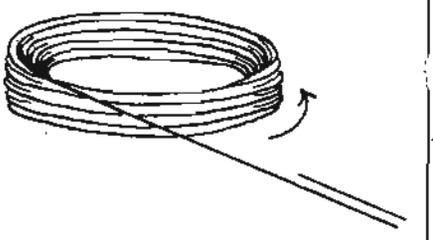
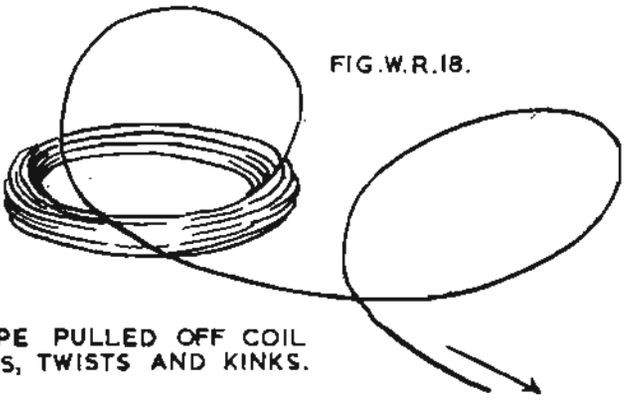
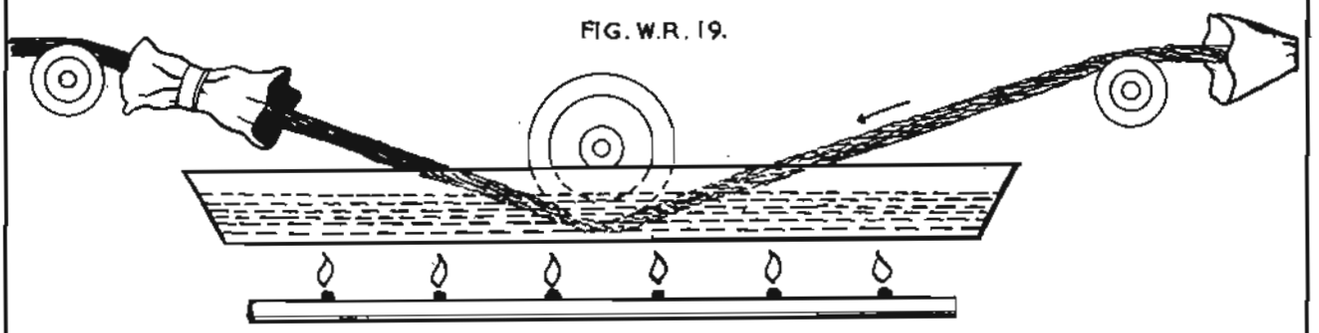


FIG.W.R.18.



INCORRECT — ROPE PULLED OFF COIL PRODUCES CURLS, TWISTS AND KINKS.

FIG. W.R. 19.



HEATED BATH METHOD OF APPLYING HOT LUBRICANT.

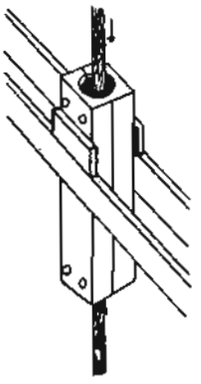


FIG.W.R.21.

BOX BATH FILLED WITH SWABBING AND LUBRICANT.

FIG.W.R. 20.

DRIPPING DEVICE.

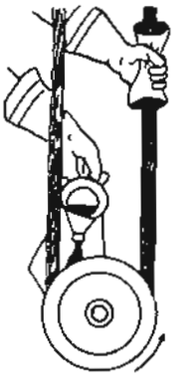


FIG.W.R.22.

POURING.

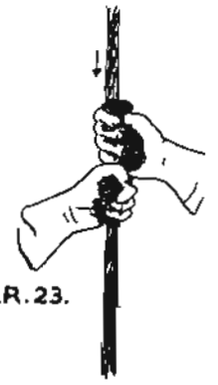


FIG. W.R.23.

SWABBING.

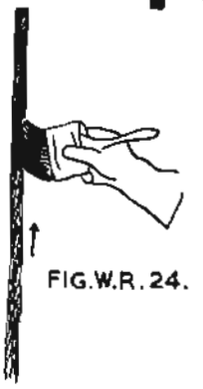


FIG.W.R.24.

BRUSHING.

(c) UNCOILING

If a rope is unwound from a coil, there are only two correct methods of uncoiling: the end of the rope should be held and the coil rolled on the ground like a hoop (Fig. W.R. 16). Do not "flop" a coil flat on the ground and pull the wire rope from it (Fig. W.R. 18). This will put torsion in the rope for every loop pulled from the coil. Another method of unwinding a coil is to place the coil on a turn-table so as to rotate the coil to pay off the rope without kinking it (Fig. W.R. 17).

(d) CUTTING BACK

The object of cutting short lengths of rope from the drum end is to change the position of the rope. Wear and fatigue are usually most severe at certain definite points on equipment using wire rope. The removal of a short length of rope subjects different portions of it to these destructive forces. Cutting back the outer end removes that section, next to the fittings, where maximum fatigue from vibration occurs. In order to take advantage of cutting back, it is advisable to use a length of rope slightly longer than normally required.

(e) BREAKING IN A NEW ROPE

A new rope should be run with a light load, or with no load, for a short period after it is first installed. This gives the component parts of the rope an opportunity to adjust themselves to the operating conditions.

(f) REVERSING ENDS

Changing a rope end for end distributes wear and fatigue from bending and vibration more evenly throughout the rope.

(g) SAFETY FACTOR

The safety factor is the ratio of the catalogue strength of the rope to the total working load. Thus a wire rope with a breaking strength of 4 500 kg and a total working load of 900 kg would be operating with a safety factor of 5.

Safety factor depends on loads applied, speed of operation, type of fitting, acceleration and deceleration, rope length and other elements.

General guide to safety factor

	Minimum safety factor
Guy-lines	3,5
Hoisting lines	5,0
Haulage ropes	6,0
Overhead and gantry cranes	6,0

C. LUBRICATION

Wire rope is lubricated during manufacture, but generally this initial lubrication is not sufficient to last the useful life of the rope. Well lubricated ropes may have two or three times the life of ropes with no lubrication during use, and the strength of rustbound ropes can be increased by up to 25 per cent by lubrication.

The following are characteristics of a good lubricant:

(1) Freedom from either acids or alkalis
(2) Good adhesive strength so that it will stay on the rope.
(3) Excellent penetrating qualities
(4) Non-solubility under most service conditions
(5) A high film strength
(6) Resistance to oxidation, hardening or crystallisation

Wire rope is a complicated machine of many steel moving parts, working round a core. When the rope works, these parts are subject to continual movement and require lubrication to reduce wear. High speed, heavy duty operations require frequent lubrication. Standing ropes need only be lubricated occasionally with a heavy lubricant. Without lubrication the wires may become "rust-bound" and the ropes will become stiff and inelastic. When a load is applied it is concentrated on the rust-bound spots and the wires, or even the whole rope, may break. Lubrication also preserves the fibre core of wire rope and extends the life of the rope.

Wire rope lubricant should preferably be applied when hot. Ropes should be dry and thoroughly cleaned with petrol and a wire brush before being lubricated, or they may be cleaned with a swab.

(a) APPLICATION OF LUBRICANT

Hot lubricant can be most easily applied by pulling the rope slowly through a heated bath as illustrated in Fig. W.R. 19. The rope is passed through the lubricant over sheaves and under a centre guide wheel, which forces it under the lubricant.

The continuous bath method is a good way of lubricating an operating rope (Fig. W.R. 21). The rope is passed through a specially constructed casing that has been packed with swabbing and filled with lubricant. This affords continual lubrication.

A dripping device (Fig. W.R. 20) can also be used to drip lubricant over the rope, preferably as it passes slowly over a sheave, as the strands separate slightly when the rope 'bends' over the sheave, permitting the lubricant to penetrate.

Pouring lubricant onto the rope can also be done, but the rope must be loaded and run slowly while being lubricated (Fig. W.R. 22).

Swabbing or brushing. The lubricant can also be swabbed on with rags or painted on with a brush. Both are quick methods which can be made part of the operating routine (Fig. W.R. 23, 24).

NOTE: Pouring and swabbing or brushing are not recommended unless the rope is stationary.

The object of lubrication is to apply a uniform coating to the entire length of the wire rope.

SHEAVE GROOVES.

FIG.W.R. 25.

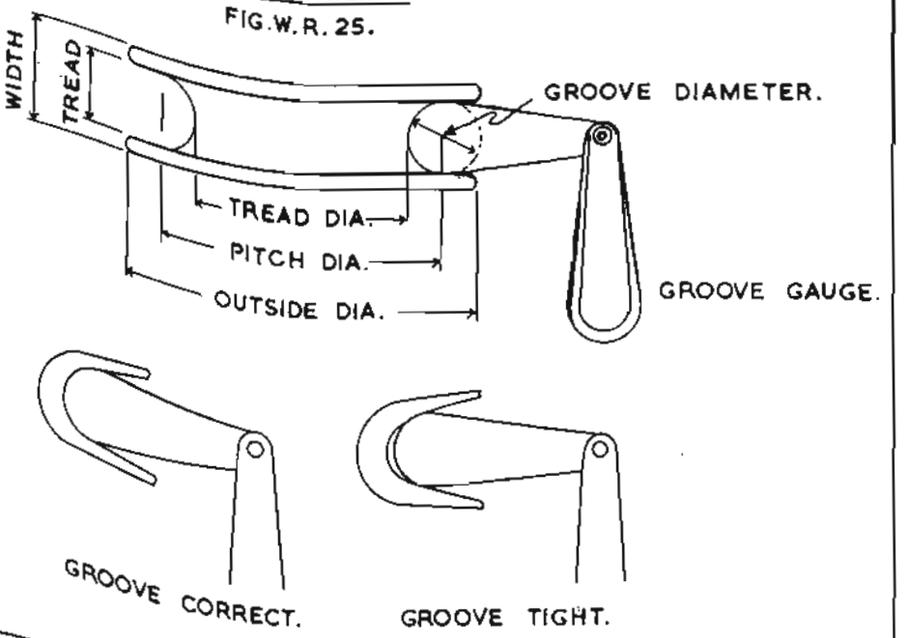
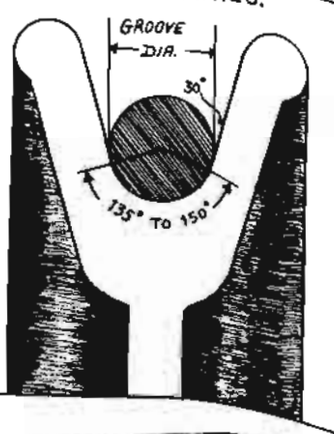


FIG.W.R. 26.



DIAMETER TOLERANCES FOR GROOVES.

NOMINAL ROPE DIAMETER IN mm	GROOVE DIAMETER SHOULD EXCEED NOMINAL ROPE DIAMETER BY: (f mm)	
	MINIMUM	NEW OR REMACHINED GROOVES.
6–8	0,4	0,8
9–19	0,8	1,6
21–28	1,2	2,4
30–38	1,6	3,0

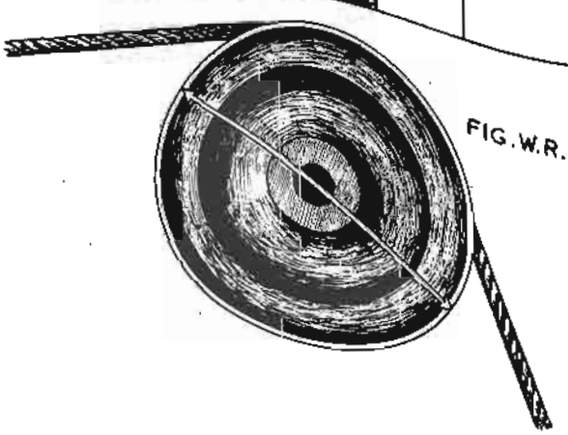


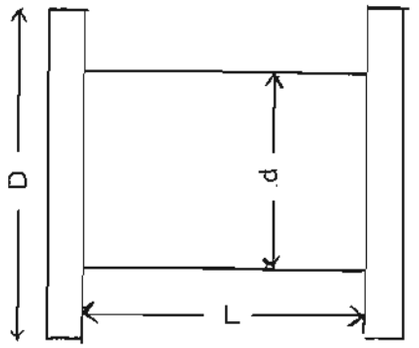
FIG.W.R. 27.

HOW TO SELECT SHEAVES.

RECOMMENDED DEPARTMENTALLY USED TREAD DIAMETERS FOR 6 X 19 SEALE WIRE ROPE.

ROPE DIAMETER.	DRUM OR SHEAVE DIAMETER
9 mm	15 cm
13 mm	20 cm
16 mm	25 cm
19 mm	35 cm

FIG.W.R.28.



TO FIND THE WIRE ROPE FULL CAPACITY OF A DRUM

(FOR CLEARANCE ADD TO D NOT LESS THAN 15 cm)

LENGTH OF WIRE ROPE IN METRES THAT A DRUM WILL HOLD $= (D^2 - d^2)\ LX$

D = DIAMETER OF FLANGE IN CENTIMETERS

d = DIAMETER OF DRUM IN CENTIMETRES

L = INSIDE WIDTH OF DRUM IN CENTIMETRES

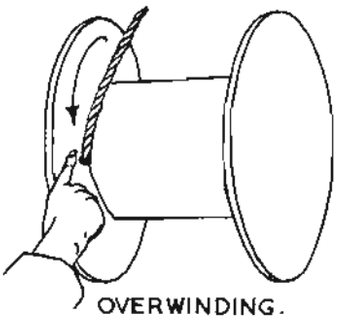
X = ROPE FACTOR — SEE TABLE BELOW

ROPE FACTORS

ROPE DIAMETER cm	ROPE FACTOR	ROPE DIAMETER cm	ROPE FACTOR
0,6	0,018 88	1,5	0,003 156
0,8	0,008 220	1,9	0,002 164
1,0	0,005 752	2,2	0,001 604
1,2	0,004 658	2,6	0,001 529

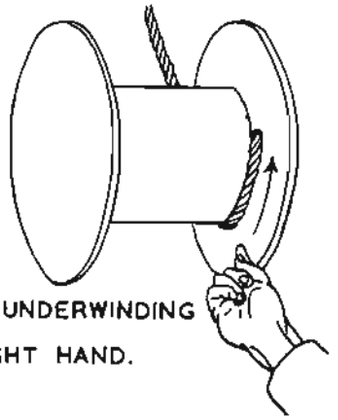
INSTALLING AND SPOOLING WIRE ROPE ON WINCH DRUMS.

FIG.W.R.29



OVERWINDING.

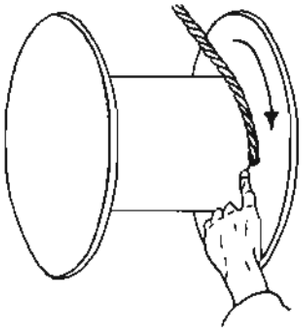
FIG.W.R.30



UNDERWINDING

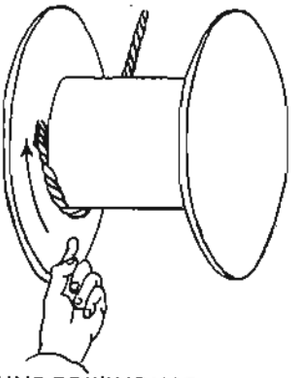
FOR RIGHT LAY ROPE USE RIGHT HAND.

FIG.W.R.31



OVERWINDING.

FIG.W.R.32



UNDERWINDING.

FOR LEFT LAY ROPE USE LEFT HAND.

FLEET ANGLE.

FIG.W.R.33.

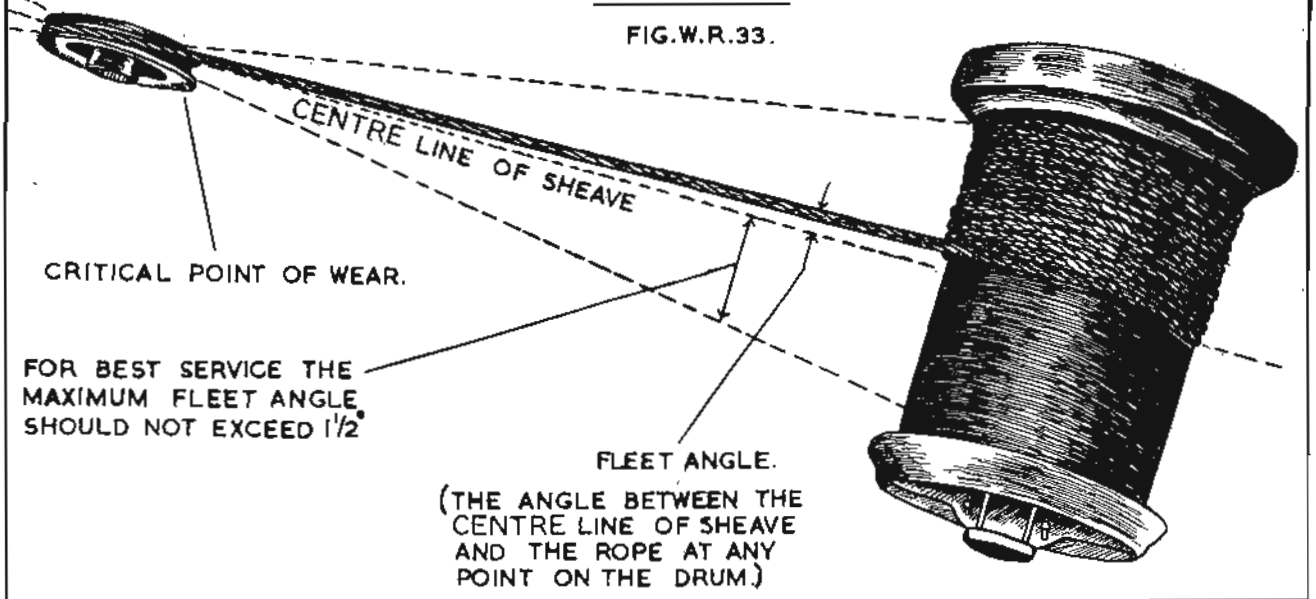


FIG.W.R.34.

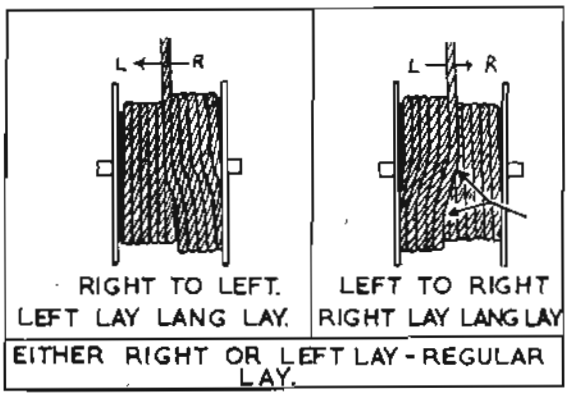


FIG.W.R.35. EFFECT OF WINDING ROPES ON DRUMS AS THE RESULT OF DIRECTION OF WINDING.

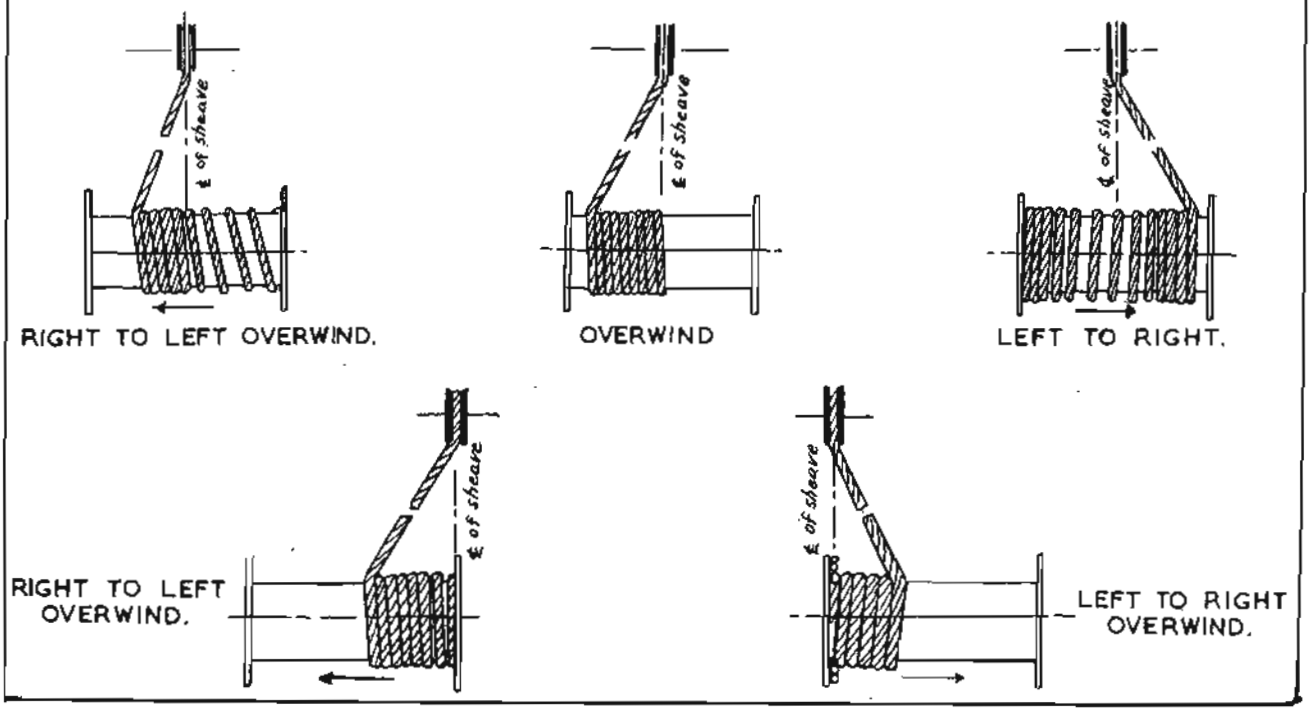
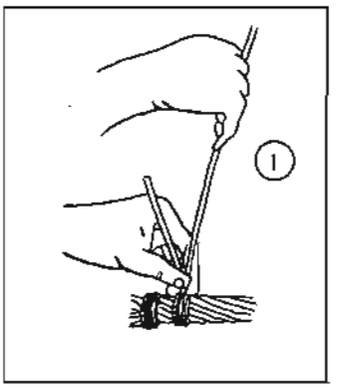
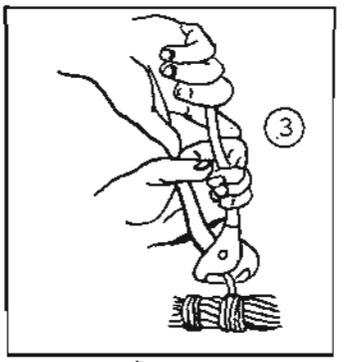


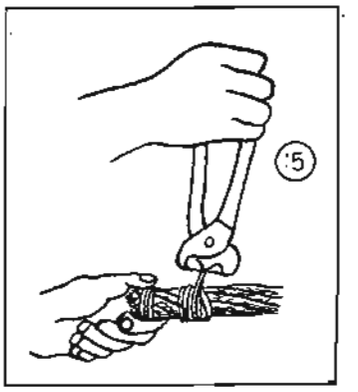
FIG.W.R.36



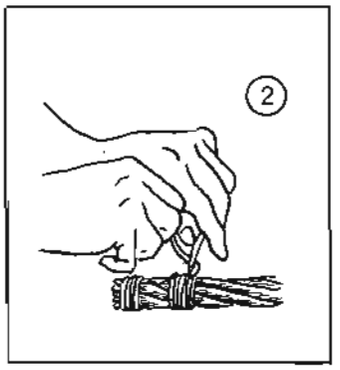
WRAP THE SEIZING WIRE IN A CLOSE HELIX AROUND THE WIRE ROPE AS TIGHT--LY AS POSSIBLE.



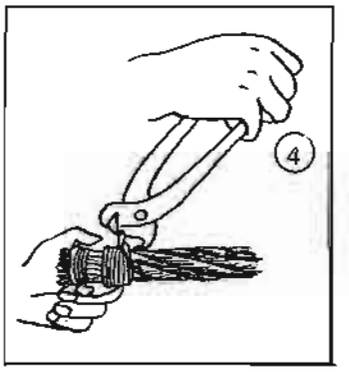
USING "CAREW" CUTTERS, TIGHTEN THE TWIST JUST ENOUGH TO TAKE UP THE SLACK. DO NOT TRY TO TIGHTEN THE SEIZING BY TWISTING.



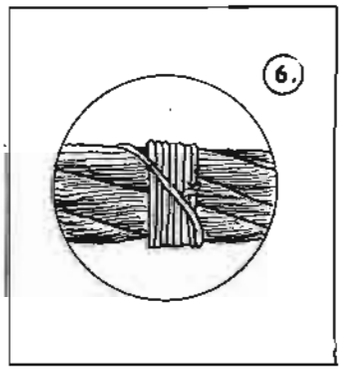
TIGHTEN THE TWIST AGAIN AS IN 2. REPEAT AS OFTEN AS IS NECESSARY TO MAKE THE SEIZING TIGHT. CUT OFF THE ENDS OF THE WIRES AND POUND THE TWIST INTO CONTACT WITH THE SEIZING.



TWIST THE ENDS OF THE SEIZING BY HAND, COUNTER CLOCKWISE SO THAT THE TWIST IS NEAR THE MIDDLE OF THE SEIZING.

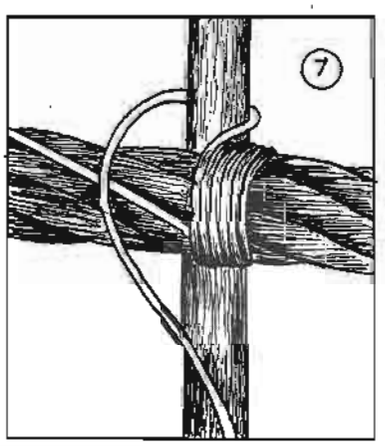


TIGHTEN THE SEIZING BY PRYING THE TWIST AWAY FROM THE AXIS OF THE WIRE ROPE WITH CUTTERS.

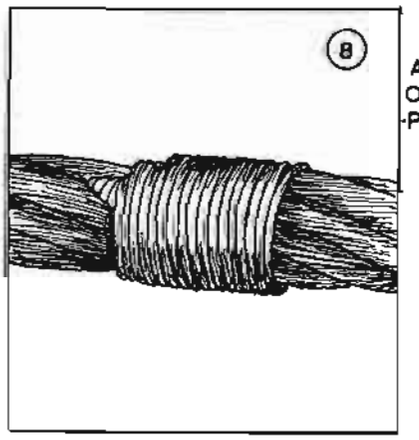


THE APPEARANCE OF A FINISHED SEIZING.

SEIZING THE ENDS OF WIRE ROPES

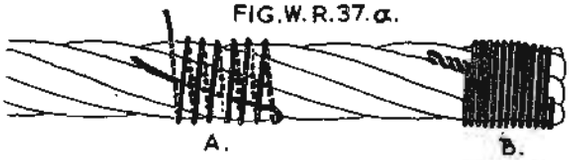


SEIZING A WIRE BY SEIZING IRON METHOD.
USE A SEIZING IRON AS SHOWN TO WRAP THE SEIZING TIGHTLY.



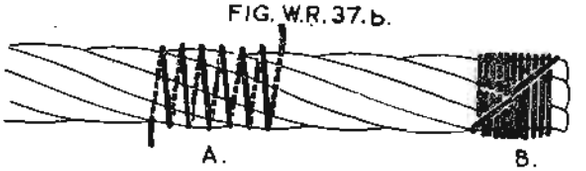
APPEARANCE OF THE COM--PLETED SEIZING.

FIG.W.R.37.a.



FOR ROPES OVER 2,5 cm IN DIAMETER

FIG. W.R.37.b.



FOR ROPES UP TO 2,5 cm IN DIAMETER

A – METHOD OF APPLYING SEIZING. B – COMPLETED SEIZING.

FIG.W.R.38.

TWO SEIZINGS ON WIRE ROPE TO BE CUT BETWEEN SEIZINGS (NON-PREFORMED ROPE)

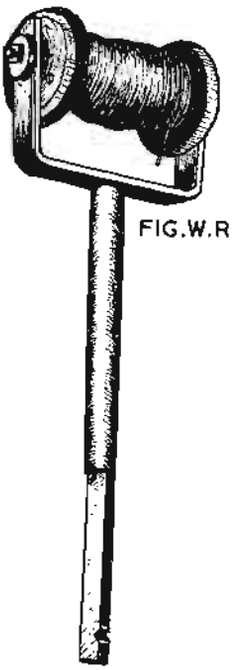
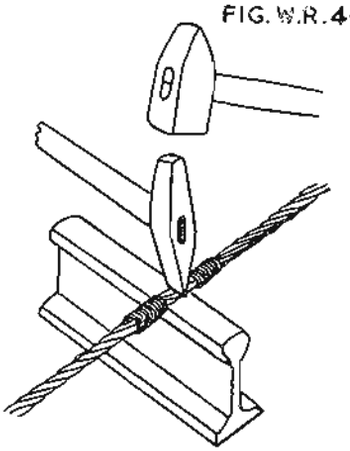


FIG.W.R.39

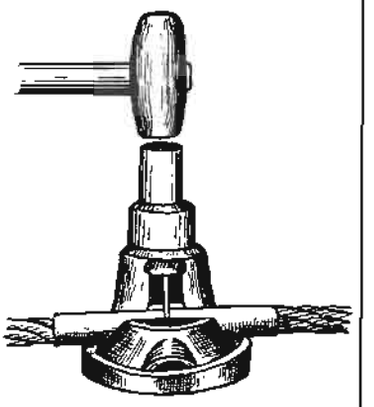
SEIZING IRON.

FIG. W.R.40.



CUTTING WIRE BETWEEN SEIZINGS.

FIG.W.R.41



WIRE CUTTING DEVICE

(b) LUBRICATING FOR STORING

Corrosion is the greatest enemy of "idle" rope. When a wire rope is taken out of service it should be well cleaned of surface grit with a wire brush and petrol, and then thoroughly lubricated before it is stored.

D. SHEAVES

(a) SHEAVE GROOVES

Sheave grooves should be slightly larger than the wire rope. This avoids pinching and binding of the strands and permits the rope to adjust itself to the radius of curvature. Grooved drums furnish better support for the rope than the flat surface of smooth drums, and the more uniform winding results in less abrasive wear on the ropes. Grooves should be smooth. Fig. W.R. 25 illustrates how the sheave groove may be measured with a groove gauge.

(b) SUPPORTING SHEAVES AND ROLLERS

The use of sheaves and rollers to support wire rope decreases wear on the rope and results in increased service. Sheaves should be free to rotate, large enough in diameter to avoid unnecessary bending of the rope, and with a small mass so as readily to start and stop as the rope starts and stops. Guide sheaves and rollers should be at least 6 times the rope diameter if grooved and 9 times the rope diameter if flat faced. All sheaves and rollers should be machined or replaced when scored by rope. Fig. W.R. 27 illustrates where the relative sheave diameters and dimensions are taken.

(c) SHEAVES

Sheaves should be aligned so that the axis of the rope is parallel to a line drawn from the centre of the sheave groove of one sheave to the centre of the sheave groove of the next sheave. Sheaves with broken flanges should not be used.

E. WINDING ONTO DRUMS

(a) CAPACITY OF REEL OR DRUM (Fig. W.R. 28)

The clearance between the wound rope and the edge of the drum flange should be a minimum of 3 cm or two times the diameter of the rope wound. The constant factor (f) used in the formula for determining the capacity of a reel or drum, will vary for even winding and uneven winding.

$$\text{Drum capacity} = \text{Length at the rope} \; (D^2-d^2)\, LX$$

(see Fig. W.R. 28)

Where the length of the rope is in metres and all other measurements are in centimetres. The factors D, d, L and x in the formula are defined in Fig. W.R. 28.

(b) INSTALLING WIRE ROPE ON DRUM

The rule for installing wire rope onto a drum is shown in Fig. W.R. 29 to 32 which illustrate a simple way of determining the correct start and direction of spooling. Use the doubled up fist to represent the drum and the index finger to represent the flange. For a right lay rope use the right fist and for a left lay rope use the left fist. Place the back of the hand uppermost for overwinding rope and the palm uppermost for underwinding rope. The index finger indicates how the rope should lead from the drum and from the flange.

Fig. 34 and 35 show the effect of winding ropes onto drums as the result of the direction of winding.

(c) OVERWINDING AND CROSS-WINDING

It is not a good practice to have more than one layer of rope on a drum. If this cannot be avoided, the succeeding layers should not cross-wind, but should wind regularly in the groove which is formed by the preceding layer of rope.

(d) FLEET ANGLES

Where the wire rope passes over a lead sheave, then onto a drum, it is important that the sheave be located at a sufficient distance from the drum to maintain a small fleet angle at all times. The fleet angle is the side angle at which the rope approaches the sheave from the drum. It is the angle between the centre line of the sheave and the wire rope (Fig. W.R. 33).

Experience has proved that the best wire rope service is obtained when the fleet angle is not more than one and one half degrees. The maximum fleet angle is the angle between the centre line of the sheave and the rope when it is at the end of its traverse travel on the drum. The above fleet angle is the equivalent of approximately 12 m of lead for each 30 cm of rope traverse travel on each side of the centre line of the drum.

F. SEIZING AND CUTTING WIRE ROPE

Seizings are used to prevent the untwisting of all non-preformed wire ropes, untwisting when the rope ends have no other permanent fittings attached. If non-preformed rope is cut, seizings should be applied to both sides of the point where it is to be cut. Inadequate seizings, which permit the strands to untwist, result in an unbalanced condition of the rope. A seizing on each side of the point of cutting on a preformed rope is recommended in order to prevent distortion of the rope ends from pressure applied during cutting (Fig. W.R. 38). Wire rope may be cut by means of a wire-cutting device (Fig. W.R. 41) or by a cold chisel and sledge hammer, using a piece of rail (Fig. W.R. 40). (See Table W.R. 1)

(a) METHOD OF SEIZING (Fig. W.R. 36)

Hand cutters or pliers may be used for seizing wire ropes of 25 mm diameter or smaller, but for larger diameter ropes a seizing iron should be used. A round bar 12-16 mm diameter by 50 cm long is satisfactory.

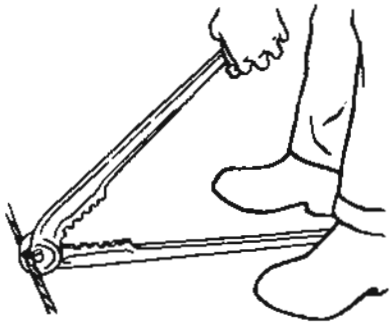
(b) APPLYING SEIZINGS WITH HAND CUTTERS

(1) Wind the seizing wire tightly on rope by hand, keeping the coils together

FIG.W.R.42.

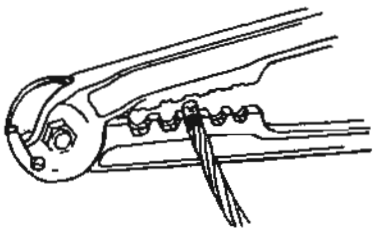
"CAPPING" ENDS OF WIRE ROPE.
(UP TO 13 mm DIAMETER)

WIND TAPE AROUND SECTION OF ROPE TO BE CUT.



CUT IN THE MIDDLE OF THE TAPED SECTION. THE TOOL CAN BE PLACED ON THE GROUND, WITH THE OPERATOR STANDING ASTRIDE. PLACE BOTH HANDS ON THE UPPER ARM AND PRESS DOWN SHARPLY.

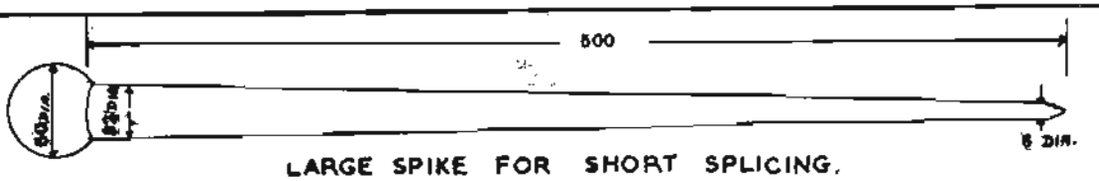
PRESS THE IRON GRIP METAL CAPS OVER BOTH TAPED ENDS OF THE ROPE.



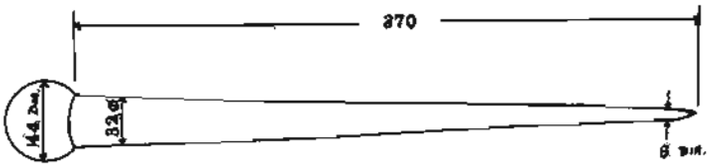
FASTEN IN THE CRIMP JAW OF THE TOOL.

THE OLD METHODS.

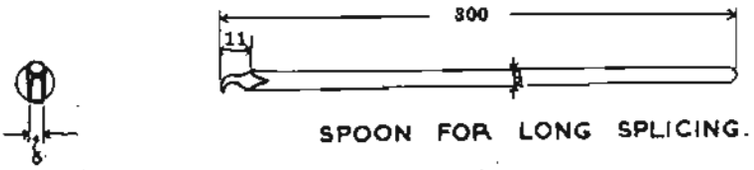
THE NEW METHOD.



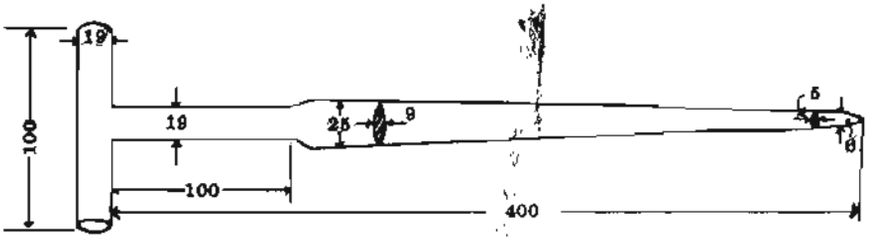
LARGE SPIKE FOR SHORT SPLICING.



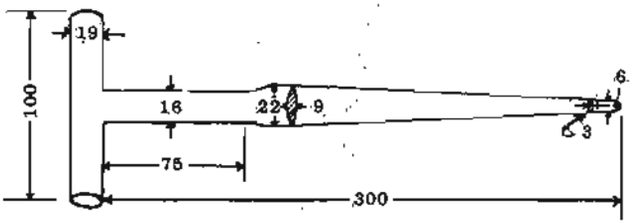
SMALL SPIKE FOR SHORT SPLICING.



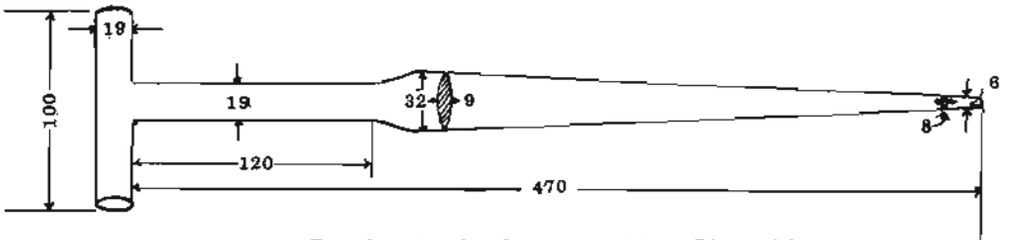
SPOON FOR LONG SPLICING.



LARGE T-NEEDLE FOR LONG SPLICING.



SMALL T-NEEDLE FOR LONG SPLICING.



FLAT SPIKE FOR SHORT SPLICING.

ALL DIMENSIONS IN mm

FIG.W.R.43. SPLICING TOOLS FOR WIRE ROPE.

SPLICING WIRE ROPE – LONG SPLICE.

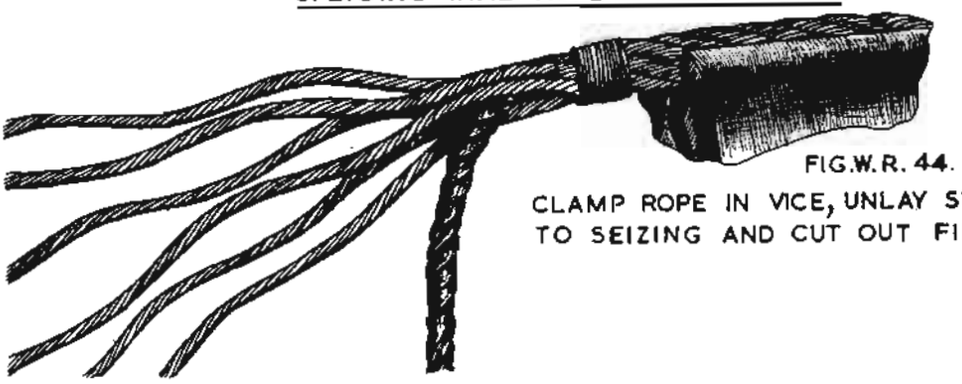


FIG.W.R. 44.

CLAMP ROPE IN VICE, UNLAY STRANDS TO SEIZING AND CUT OUT FIBRE CORE.

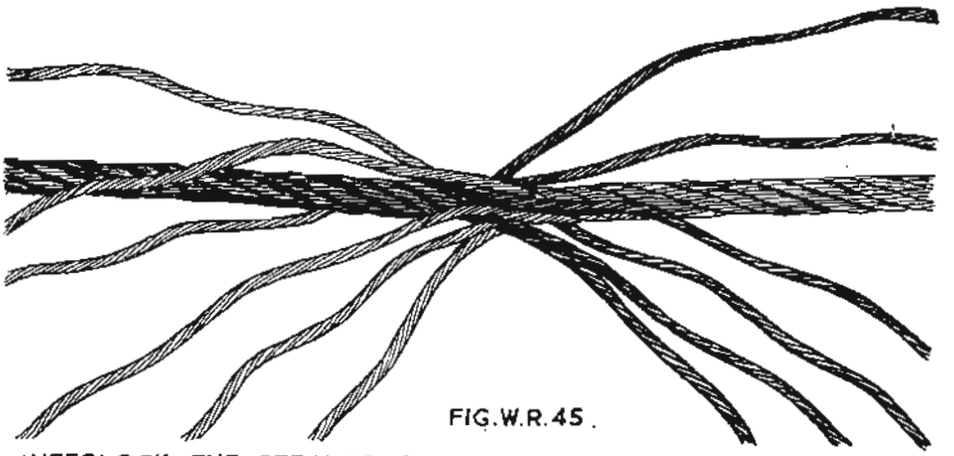


FIG.W.R.45.

INTERLOCK THE STRANDS OF EACH END IN A FINGER LOCK POSITION AND REMOVE SEIZINGS.

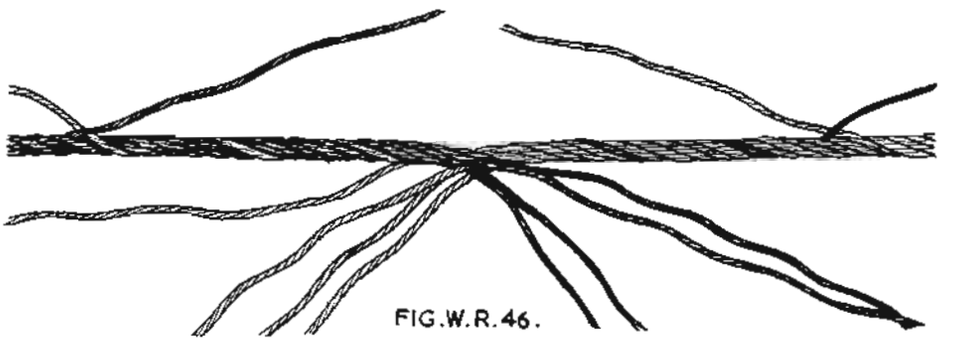


FIG.W.R.46.

UNLAY ONE STRAND FROM EACH ROPE, FILLING THE GROOVE WITH A STRAND FROM THE OTHER ROPE END.

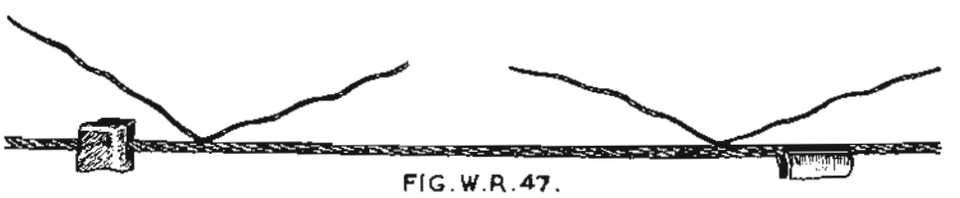


FIG.W.R.47.

TWO OF SIX PAIRS OF ROPE ENDS, CUT TO EQUAL LENGTH.

TABLE W.R. 1 - Seizings for wire rope

Rope diameter	Number of seizings		Length of seizing	Distance between seizings	Approximate size of seizing wire
	Regular lay fibre core rope	18 x 7 non-rotating lang lay and I.W.R.C. ropes			
mm			mm	mm	mm
13 or smaller	2	3	13	25	0,5 - 0,8
9 - 22	3	3	25	50	1,0 - 1,5
25 - 32	3	4	38	50	1,5 - 2,3

(2) Twist the ends of the wire together by hand, counter clockwise, so that the twisted portion of the wires is near the middle of the seizing.

(3) Using cutters, tighten the twist just enough to take up the slack. Do not try to tighten the seizing by twisting.

(4) Tighten the seizing by prying the twist away from the axis of the rope with the cutters

(5) Tighten the twist again as in (3). Repeat (4) and (5) as often as necessary to make the seizing tight.

(6) Fig. W.R. 36, item 6 shows the finished seizing

This method is usually applied to rope of 25 mm or less in diameter. For larger ropes the following method is used to obtain a neater seizing. In this case a seizing iron (Fig. W.R. 39) or round bar may be used instead of cutters, although this method may also be used for smaller ropes, using cutters.

Place one end of the seizing wire in the valley between two strands [Fig. W.R. 37(a)], then its long end is turned at right angles to the rope and wound back over itself and the rope, in a close, tight winding until the right length of seizing is put on. The two ends of the wire are then twisted and tightened. If the seizing iron is used, tension of the seizing wire can be obtained either by tightening the end nuts on the shaft about which the spool rotates, or by wrapping the wire around the handle of the iron or bar. If a bar is used, the free end of the seizing wire should be given one or two twists about the rope. The seize is twisted and tightened as previously described.

Fig. W.R. 42 illustrates a method of "capping" the ends of cut wire rope by means of iron grip metal caps. By using this method seizings are eliminated.

G. SPLICING WIRE ROPE

(a) DIRECTIONS FOR SPLICING A 6 STRAND ROPE

When a rope is spliced endless, or two similar ropes are spliced together, a short length of each of the two ends is consumed in making the splice. This should be considered when ordering the lengths to be spliced. Special tools, illustrated in Fig. W.R. 43, are used for wire rope splicing. Smaller tools must be used for smaller diameter wire rope.

There are two endless splices: the standard short splice used for splicing most six strand ropes, and the long splice used for splicing haulage ropes and long lengths of wire rope operating under heavy loads. The long splice differs from the standard short splice in that the distance between the tucks and length of tuck is greater and more rope is consumed in making the splice. Otherwise the two are the same. The total amount of rope to allow for making the endless splice is:

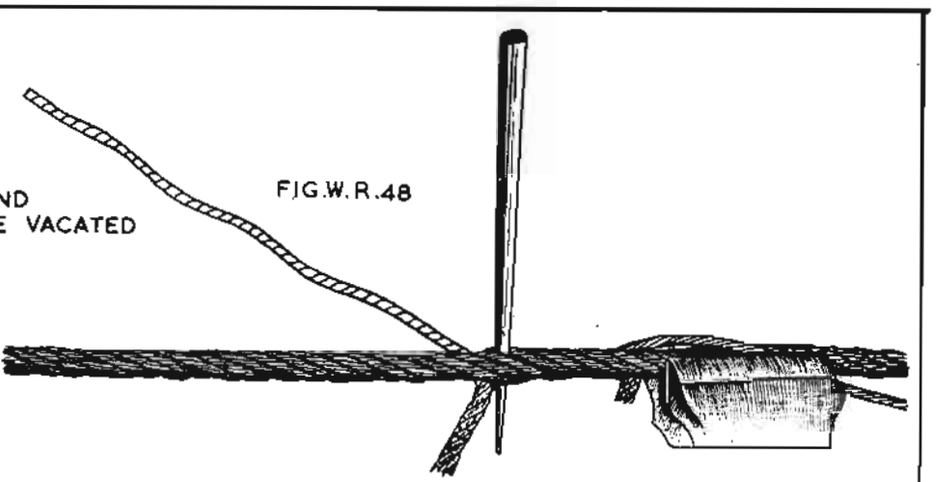
Diameter of wire rope, mm		6 - 9	13 - 16	19 - 22	25 - 28
Length of rope to allow in metres	Standard short splice	4	6	7	8
	Long splice	9	12	15	18

(b) PROCEDURE

Place a seizing on each of the two rope ends to be spliced together at a distance from the end equal to one half the allowance for splicing. As an example, if splicing two lengths of 13 mm diameter rope together by standard short splice, the seizing should be placed 3 metres from the ends. Unlay the strands of each end to these seizings (Fig. W.R. 44). Cut off the fibre cores as near the seizing as possible. Interlock the six strands of each end in a finger-lock position. Force the ends together so that the seizings are as near each other as possible. Remove the seizings (Fig. W.R. 45).

Unlay one strand, filling the groove vacated by this strand from the other rope end. Fig. W.R. 46 shows the first strand from each rope end being replaced by a strand from the other rope end. This process should be continued with the first strand from each rope end until only a length of strand equal to the length of tuck remains. The length of tuck is approximately one twelfth the amount of rope allowed for the splice.

Diameter of rope, in mm		6 - 9	13 - 16	19 - 22	25 - 28
Length of tuck in, cm	Standard short splice	38	50	60	70
	Long splice	76	100	125	150



WRAPPED FIRST STRAND ROTATED INTO PLACE VACATED BY FIBRE CORE.

FIG.W.R.48

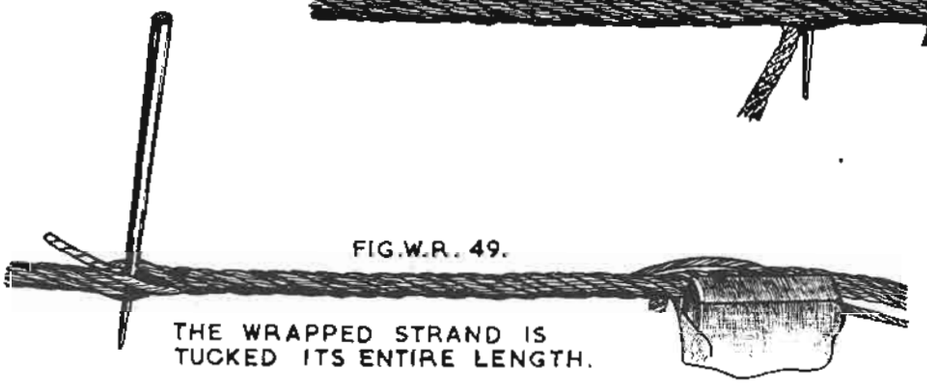


FIG.W.R. 49.

THE WRAPPED STRAND IS TUCKED ITS ENTIRE LENGTH.

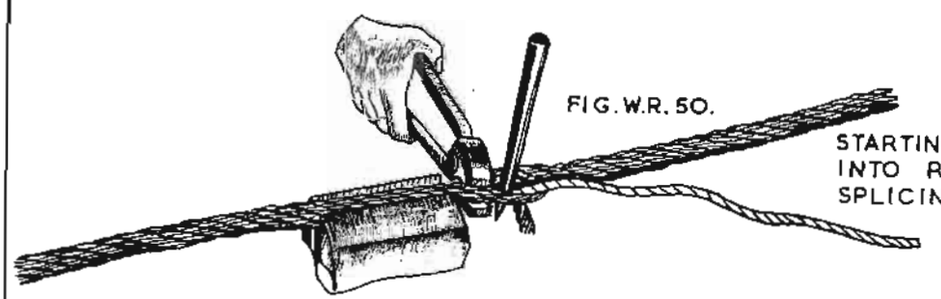


FIG.W.R. 50.

STARTING SECOND STRAND INTO ROPE BY MEANS OF SPLICING TONGS.

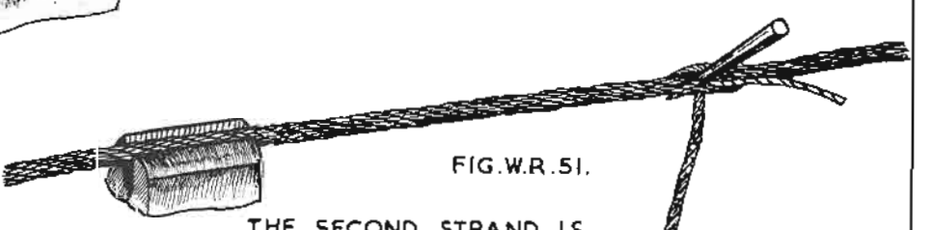


FIG.W.R.51.

THE SECOND STRAND IS TUCKED ITS ENTIRE LENGTH.

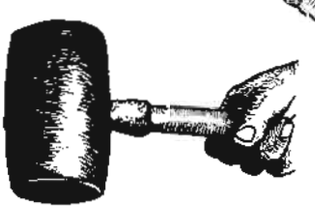
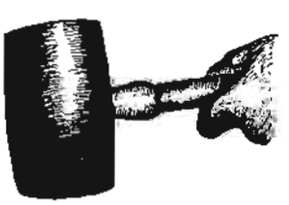


FIG.W.R. 53.

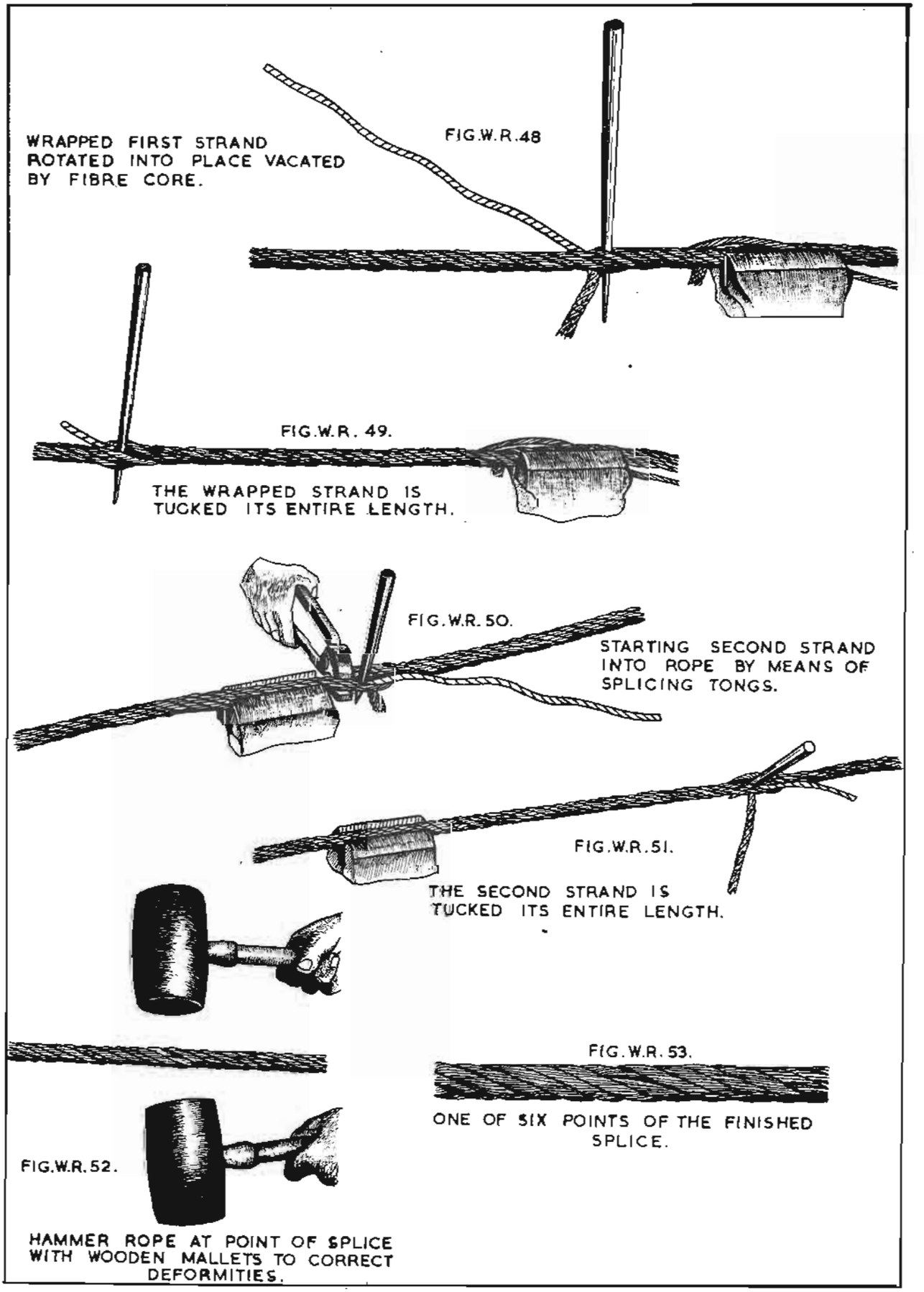
ONE OF SIX POINTS OF THE FINISHED SPLICE.

FIG.W.R.52.



HAMMER ROPE AT POINT OF SPLICE WITH WOODEN MALLETS TO CORRECT DEFORMITIES.

SPLICING WIRE ROPE - LONG SPLICE



SPLICING WIRE ROPE - LONG SPLICE

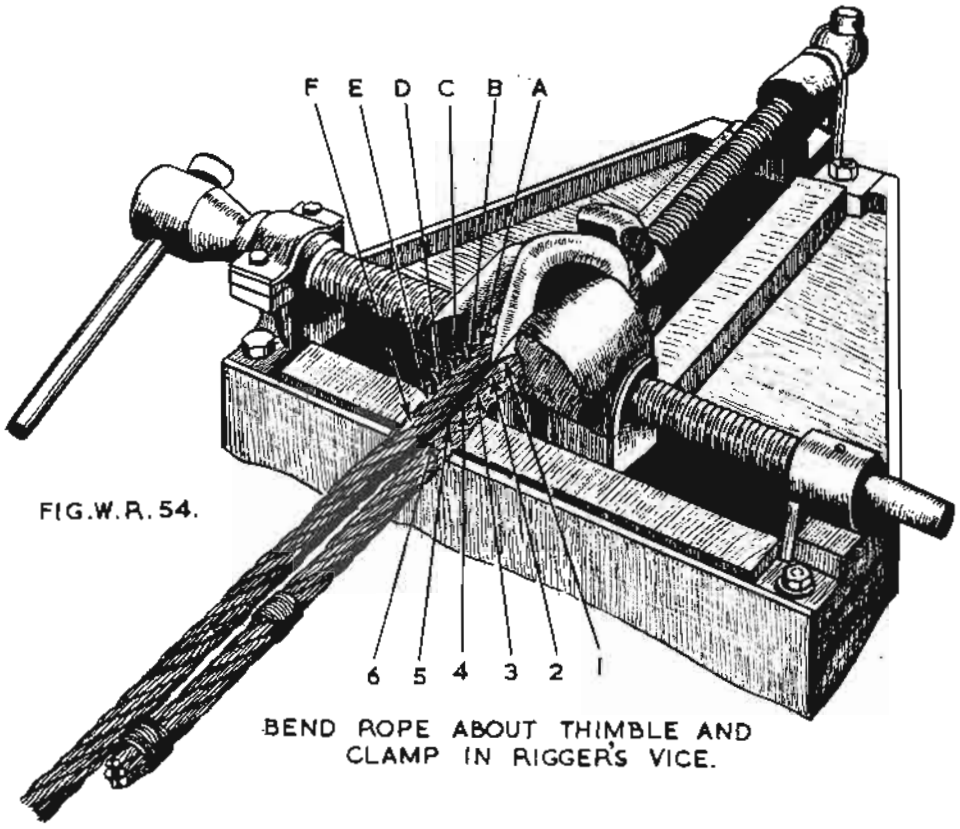


FIG.W.R.54.

BEND ROPE ABOUT THIMBLE AND CLAMP IN RIGGER'S VICE.

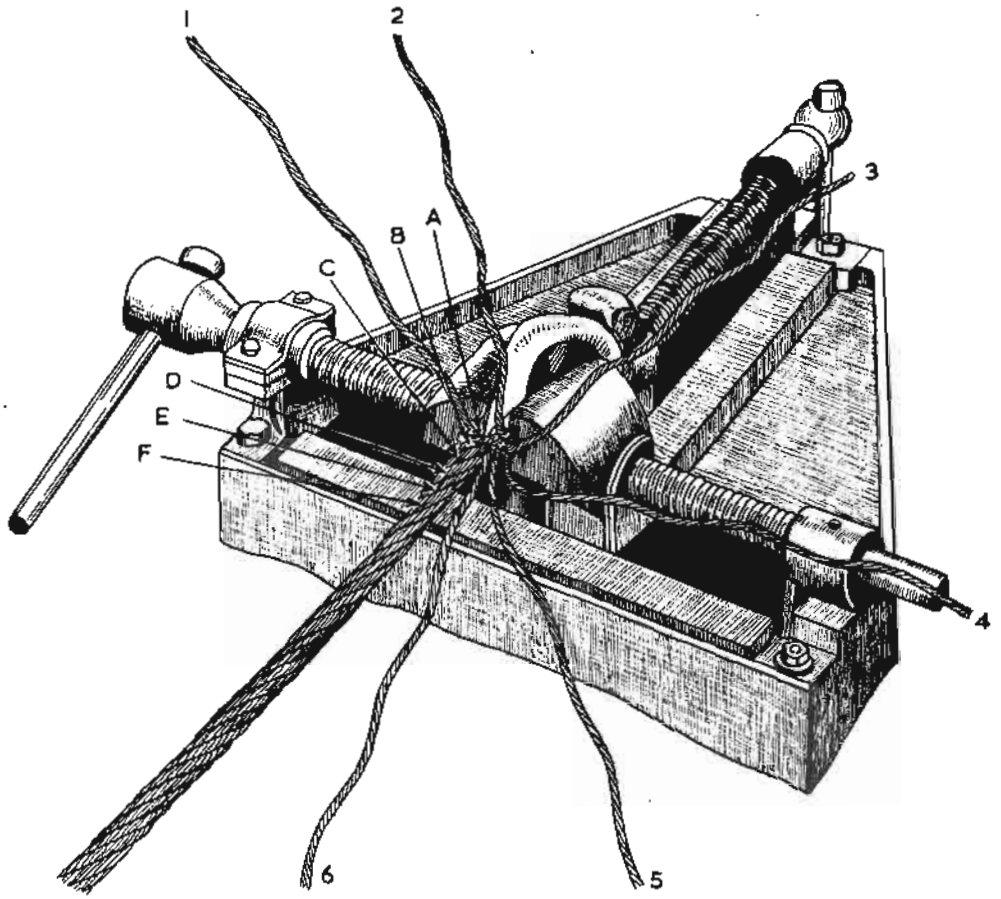
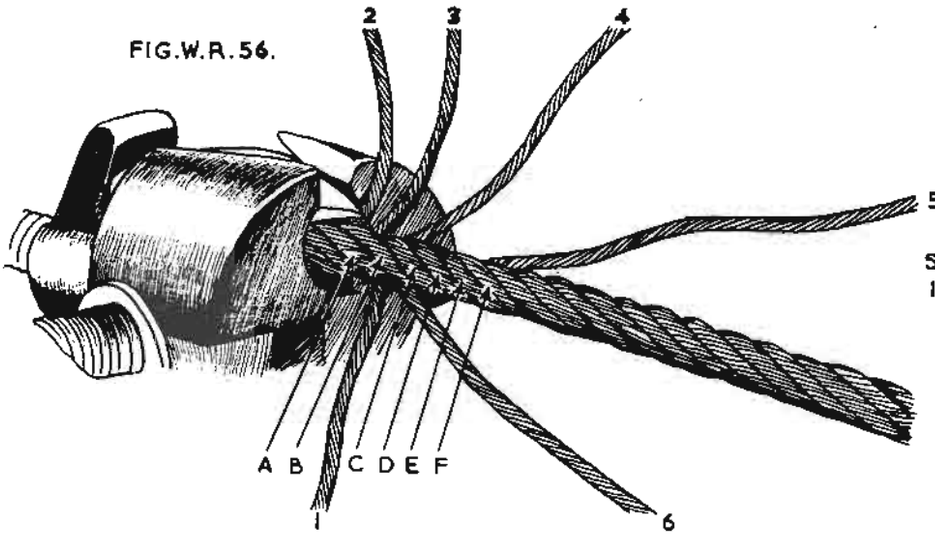


FIG.W.R.55.

REMOVE SEIZINGS FROM SHORT END, SEPARATE STRANDS AND CUT OUT FIBRE CORE.

MAKING AN EYE SPLICE IN WIRE ROPE

FIG.W.R.56.



STRAND 1 GIVEN ITS FIRST TUCK.

STRANDS 6,1 AND 2 HAVE EACH BEEN TUCKED ONCE.

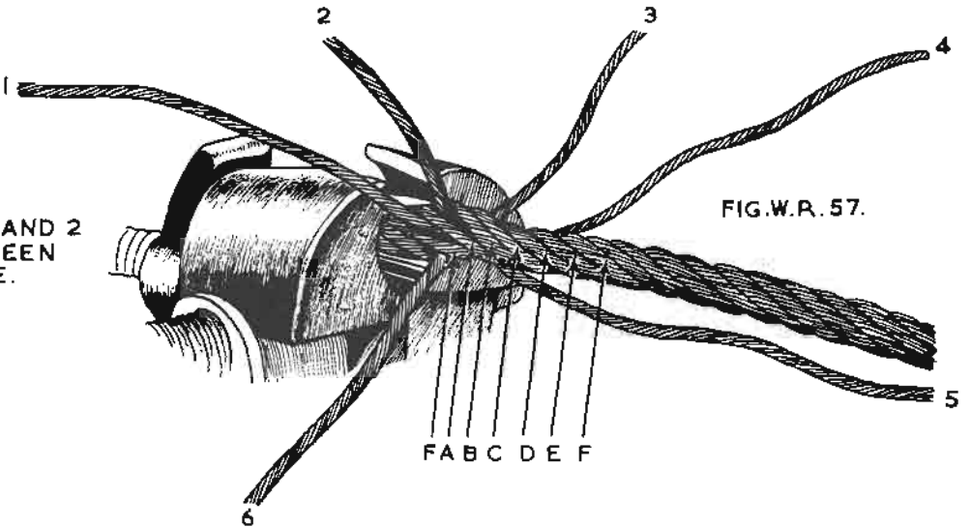


FIG.W.R.57.

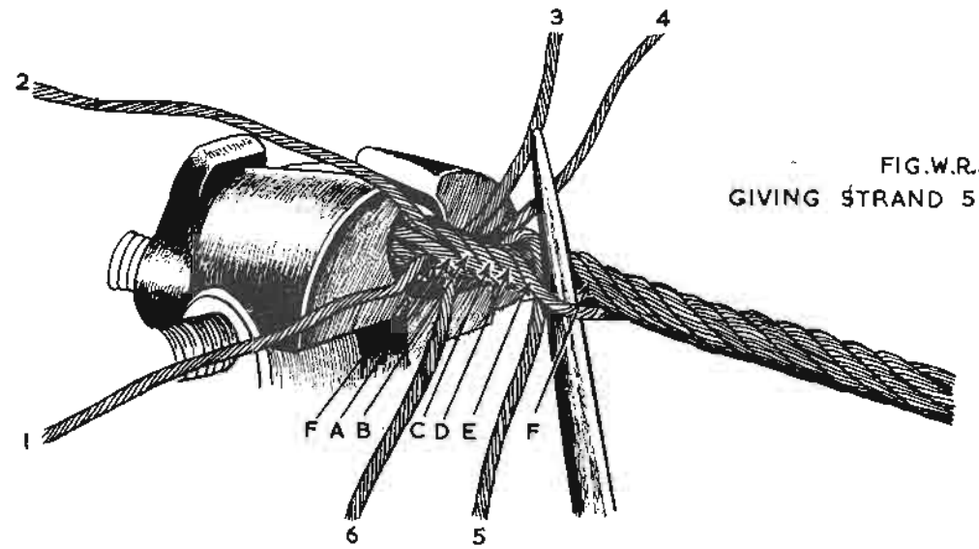


FIG.W.R.58.
GIVING STRAND 5 ITS FIRST TUCK.

MAKING AN EYE SPLICE (CONTINUED)

The second strand from each rope end should be unlayed and replaced by a strand from the other rope end in the same manner, but stopped at a distance of twice the length of tuck from the point where the first pair of strands protrude. In a similar manner, the third strand from each end should be replaced by a strand from the other end for a distance equal to the length of tuck.

The twelve strands now protrude from the rope in pairs at points separated by twice the length of tuck. Fig. W.R. 47 shows two of the six pairs of strand ends.

The strand ends of preformed wire rope should be straightened.

The strand ends should be wrapped with friction tape or twine, which helps to hold the ends in place and makes them larger in diameter and increases the binding action of the outer strands. Do not build up the strands too much so that the rope becomes oversized when the strands are tucked.

The method of tucking is the same for each of the six pairs of strands. If a vice is available it should be used, otherwise a manilla rope sling and a short wooden lever may be used to untwist and open the rope.

Place the rope in the vice so that the vice grips the rope and one of the two strand ends just beyond the point where a pair of strand ends protrude from the rope (Fig. W.R. 47). Drive marlin spike under three strands, opening the rope so that the fibre core may be cut and the end pulled through the opening made by the point of the marlin spike. Start the wrapped strand end into the space left vacant by the removal of the fibre rope core. Rotate the marlin spike so as to force out the fibre core and force the strand end into the centre of the rope (Fig. W.R. 48). By rotating the spike the strand end is tucked its entire length (Fig. W.R. 49). The rope is then regripped in the vice so that the second strand end can be tucked (Fig. W.R. 50). Drive the marlin spike under three strands as before.

In order to start the second strand end into the rope without any slack, a pair of splicing tongs or some other form of clamp should be used to force this strand into its proper position (Fig. W.R. 50). The marlin spike is then rotated forcing the fibre core from the rope and forcing the wrapped strand end into the space vacated by the fibre core. The strand end is tucked its entire length in this manner (Fig. W.R. 51).

When splicing regular lay ropes the strand ends should not cross at the point where the tucks begin, but with Lang lay ropes it is advisable to have the strands cross at this point.

The rope will be somewhat deformed at the point where the tuck starts. This can be remedied by hammering the rope at this point with a wooden mallet (Fig. W.R. 52). Fig. W.R. 53 shows one of six similar points of the finished splice where one pair of tucked strands start. A rope spliced in this manner is nearly as strong as the original rope. After running a few days, a well made splice cannot be detected except by careful examination of the rope.

(c) DIRECTIONS FOR LONG SPLICE IN ROPE WITH INDEPENDENT WIRE ROPE CORE

The same directions are followed as for hemp centre rope except that the strand ends should be spaced equidistant in the total length of splice and should be cut to such a length that they will butt against one another after being tucked. In this way the wire centre need be cut only at each end of the splice - it will be entirely replaced by the strand ends throughout the splice.

(d) DIRECTIONS FOR EYE SPLICING WIRE ROPE

While the following directions cover splicing a galvanised thimble into a six strand rope, the process is also used for splicing eyes into ropes when thimbles are not used.

The process of splicing a thimble into a rope consists of bending the rope about the thimble and fastening the short end by tucking the individual strands under similar strands of the long end of the rope a sufficient number of times to hold them securely. Four tucks are usually sufficient for all ropes containing not more than 19 strands of wire.

A short length of wire rope is consumed in making the eye splice. The amounts required for light and heavy thimbles are shown in the following Table.

Diameter of rope, in mm	6 - 9	13	16 - 19	22 - 25
Length to allow, in metres	0,3	0,5	0,7	0,8

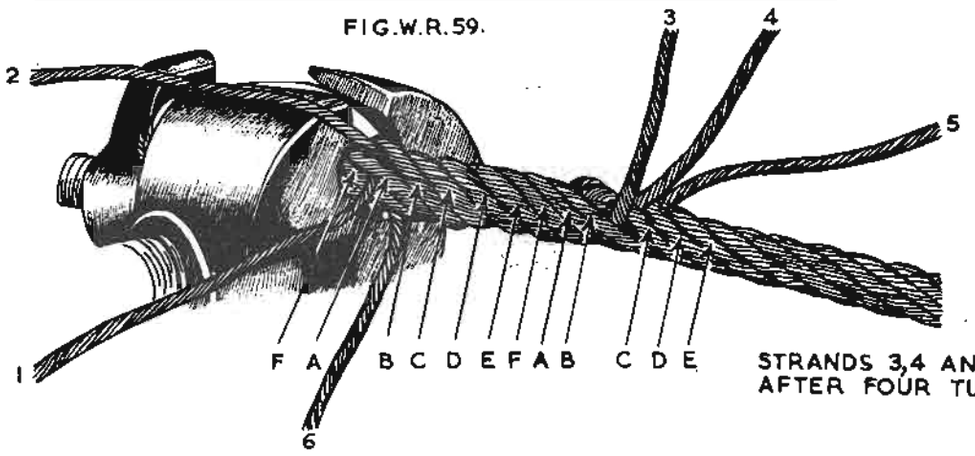
A rigger's vice is best adapted for splicing, but a common bench vice may also be used.

Measure off the amount of rope allowed for making the splice. Bend the rope about the thimble at this point and place rope and thimble in vice (Fig. W.R. 54).

In these illustrations the strands of the short end of the rope have been numbered from 1 to 6 and the strands of the long end of the rope have been lettered from A to F. Strand 1 is to be tucked under strand A; strand 2 under B, etc. Each strand of the short end of the rope is to be tucked under its corresponding strand of the long end of the rope four times.

Remove seizings from the short end of the rope and separate the strands. Cut off the fibre core at the point where the strands separate (Fig. W.R. 55). Insert a marlin spike under the first two strands nearest the point of the thimble, strands A and B, and rotate the spike half a turn away from the thimble. Insert strands 1 through the opening so formed and rotate spike back towards the thimble taking strand 1 with it, and pull strand 1 tight. This gives strand 1 one tuck (Fig. W.R. 56).

FIG.W.R.59.



STRANDS 3,4 AND 5 AFTER FOUR TUCKS EACH.

FIG.W.R.60.

EACH OF THE SIX STRANDS WITH FOUR COMPLETED TUCKS.

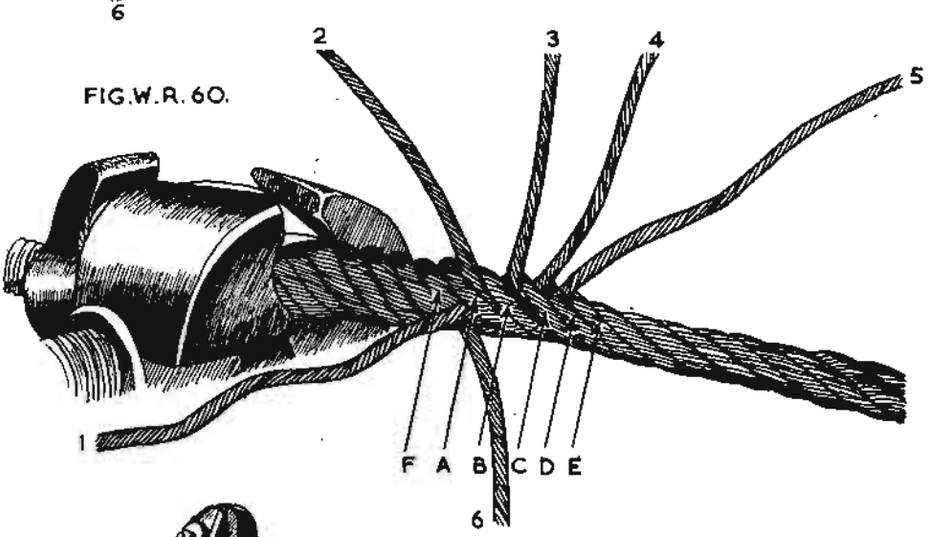
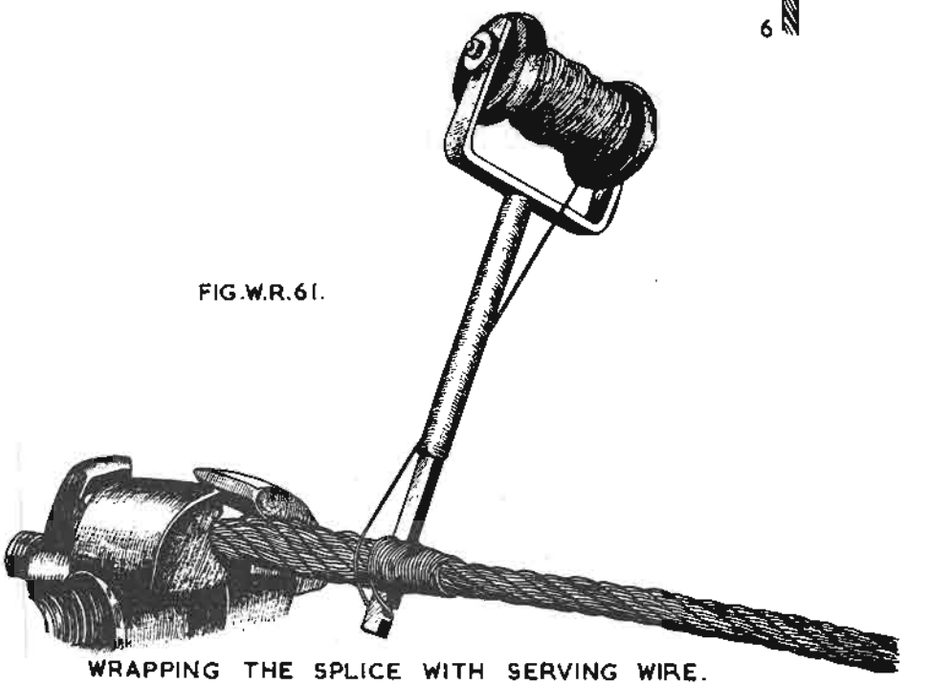


FIG.W.R.61.



WRAPPING THE SPLICE WITH SERVING WIRE.

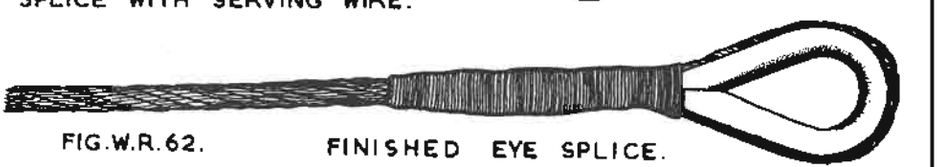


FIG.W.R.62. FINISHED EYE SPLICE.

MAKING AN EYE SPLICE (CONTINUED)

FIG.W.R.63.

UNWINDING ROPE COILED AROUND STUMP CAN PRODUCE KINKS.

FIG.W.R.64.

CABLE IN POSITION TO KINK.

FIG.W.R.65

WIRE ROPE KINKED.

FIG.W.R.66

RESULT OF KINK—WIRE TWISTED.

FIG.W.R.67.

ROPE DAMAGED BY KINKING.

FIG.W.R.68.

FIG.W.R.69.

EXCESSIVE BENDING AROUND SMALL SHEAVES.

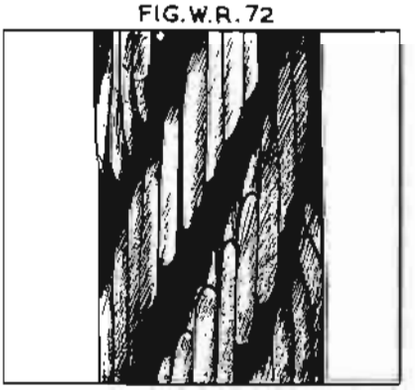
FIG.W.R.70.

DAMAGED BY BAD SHEAVE GROOVES.

FIG.W.R.71.

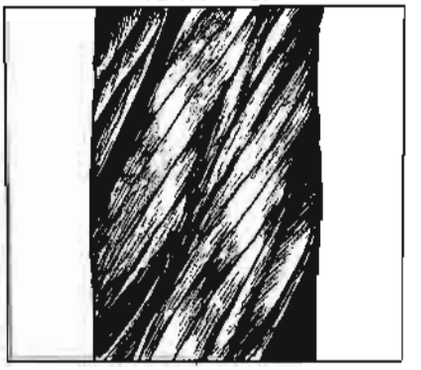
DAMAGED BY HEAVY LOADS ON SMALL, SMOOTH DRUMS.

FIG.W.R.72



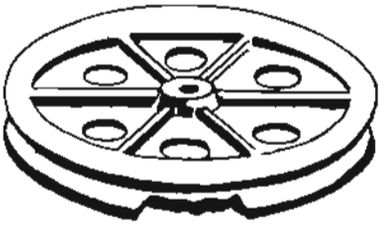
PARTIALLY WORN REGULAR LAY ROPE

FIG.W.R.73.



PARTIALLY WORN LANG LAY ROPE.

FIG.W.R.74.



BROKEN FLANGE.

FIG.W.R.75.

SHEAVE WITH CORRUGATED GROOVE AND FLANGE WORN OFF BY ROPE.

DAMAGE TO WIRE ROPE

Insert marlin spike under next single strand, strand B, and tuck strand 2 by the same method. Omit the next strand, strand C, and insert marlin spike under the two strands beyond, strands D and E, and tuck strand 6 inserting it through the opening in the direction opposite to which strands 1 and 2 were tucked. Rotate the marlin spike back to the point of the thimble, forcing strand 6 with it, and pull strand 6 tight. Fig. W.R. 57 shows the splice at this point. Strands 6, 1 and 2 have been tucked once under strands F, A and B respectively.

Insert marlin spike under strand E and tuck strand 5 in the same manner as strand 2 was tucked. See Fig. W.R. 58. Without removing the marlin spike give strand 5 three additional tucks. This is accomplished by winding strand 5 spirally round strand E three times. Each tuck is made by rotating the spike back towards the thimble to tighten the tuck.

Give strand 4 four tucks by winding it about strand D in the same manner.

Tuck strand 3 four times about strand C

Fig. W.R. 59 shows strands 3, 4 and 5 after these strands have been given four tucks.

Strands 6, 1 and 2 should be given three additional tucks about strands, F, A and B respectively, in the manner outlined for strand 5. Fig. W.R. 60 shows four completed tucks in each of the six strands. If the rope contains more than 19 wires per strand, each strand should be given an additional tuck.

An eye splice made in this manner will have a slight taper as shown in Fig. W.R. 61 and 62. If a more pronounced taper is desired, this can be secured by splitting each strand before the final tuck and cutting off a portion of the wires.

The protruding strand ends are cut off close to the rope. Any inequalities in the splice should be removed by hammering with wooden mallets as shown in Fig. W.R. 52. The splice should be wrapped with serving wire to protect the hands of workmen handling the rope. This is best accomplished by using a serving iron as shown in Fig. W.R. 61. Fig. W.R. 62 shows a galvanised heavy wire rope thimble spliced into the ends of a 6 x 19 wire rope by the method outlined above.

H. DAMAGE TO THE WIRE ROPE

(a) KINKED ROPE

Once a kink has been made in wire rope the damage is permanent. The time to avoid a kink is before it starts - by preventing a loop from forming. Loops form when the rope is allowed to become slack and twisted at the same time (Fig. W.R. 64). A loop must always be "unfolded", not "pulled out", as a little tension will kink it and cause permanent damage (Fig. W.R. 65). Once a wire rope has kinked, the strands and wire, being damaged, will break up quickly at the kink as the wire will wear unevenly. No matter how well a kink may be straightened out, either by pulling or pounding the wires and strands into approximate shape, a "weak spot" remains. The condition of the rope will then be that shown in Fig. W.R. 66.

(b) EFFECTS OF BENDING

All wire rope, except stationary ropes used as guys or supports, are subjected to bending over sheaves or drums. The effects of bending on wire rope may be classified as follows:

Loss of strength due to bending

Fatigue effect of bending

Loss of strength due to bending is caused by the inability of the individual strands and wires to adjust themselves to their changed position when the rope is bent. Normally loss of strength through the rope bending over the sheave found in common use will not exceed 6%. The fatigue effects of bending are manifested by the tendency of the wires in the wire rope to break square off.

Bending a wire rope causes re-adjustment in the position of the strands and wires, and also actual bending of the wires themselves, setting up stress concentration.

The fatigue effect of bending appears in the form of small cracks in the wires. These cracks enlarge under constant use, resulting in broken wires.

Sheaves and drums smaller than 200 times the diameter of the outer wires of the rope will cause permanent set in a heavily loaded rope. Good practice requires the use of sheaves and drums with diameter 800 times the diameter of the outer wires in the rope for heavily loaded, fast-moving ropes.

If loads are light and the speed slow, smaller sheaves and drums can be used without causing early fatigue of the wires than if the loads are heavy or the speeds fast. Reverse bending causes excessive fatigue and must be avoided whenever possible.

(c) BAD SHEAVES OR SHEAVE GROOVES (Fig. W.R. 70 and 71)

Small sheaves cause excessive bending on the part of the wire rope, causing the damage shown in Fig. W.R. 69. Lang lay rope is the best to use with small sheaves as it bends easier with less fatigue. A preformed rope resists bending fatigue better than a non-preformed rope, and will give better service where operating conditions force the use of sheaves that are smaller than they should be.

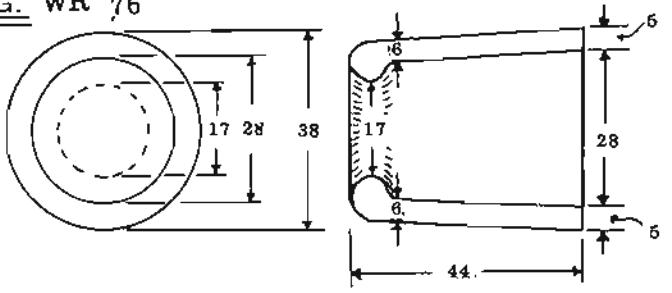
(d) BROKEN FLANGE (Fig. W.R. 74)

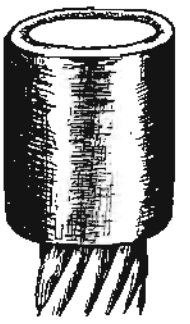
A broken flange may allow the rope to jump the sheave, with disastrous results, particularly as it will suddenly overstrain the rope, or even cause damage to the rope by jamming it between the sheave and other parts of machinery.

(e) TOO HEAVY A SHEAVE

This will allow the rope to slip during the starting and stopping. The sheave thus acts as a grinding wheel, and not only wears out the rope, but sets up frictional heat that will destroy the rope by burning.

FIG. WR 76



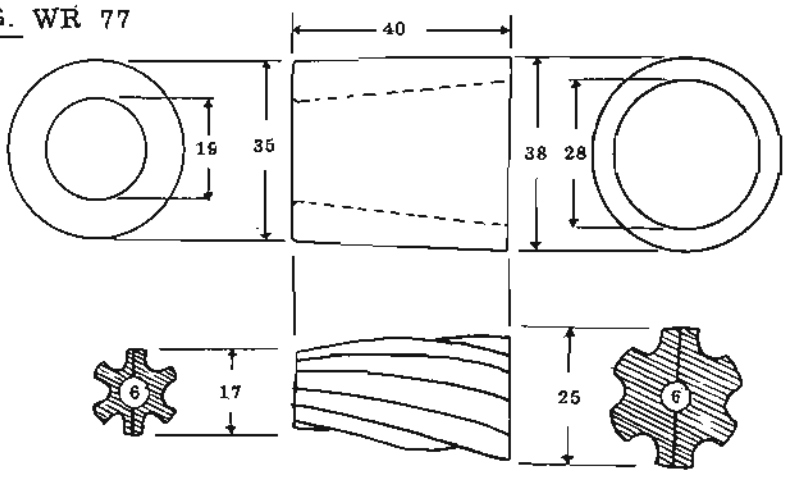


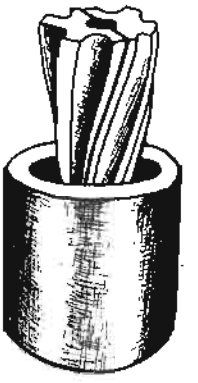
DWARF FERRULE FOR WIRE ROPE SLINGS

MATERIAL: HEAT-TREATED, SHOCK-RESISTANT ALLOY STEEL

ALL DIMENSIONS IN mm

FIG. WR 77





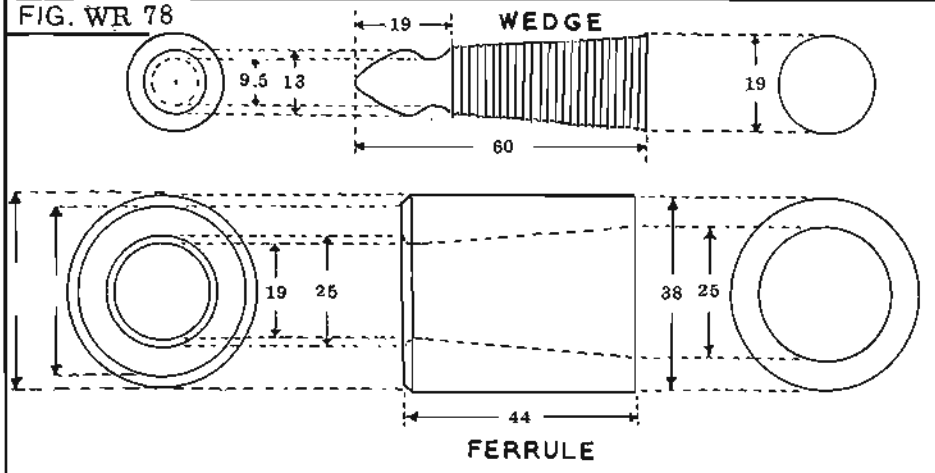
SPIRAL WEDGE FERRULE FOR WIRE ROPE SLINGS

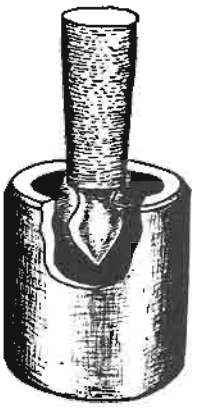
MATERIAL: HEAT-TREATED, SHOCK-RESISTANT ALLOY STEEL.

WEDGES: MANGANESE STEEL

ALL DIMENSIONS IN mm

FIG. WR 78





WEDGE FERRULE FOR WIRE-ROPE SLINGS

MATERIAL: HEAT-TREATED, SHOCK-RESISTANT ALLOY STEEL

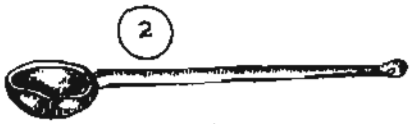
WEDGES: MANGANESE STEEL

ALL DIMENSIONS IN mm

FIG. WR. 79

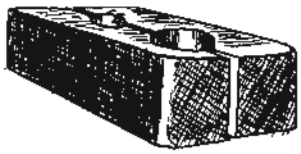
TOOLS USED FOR ATTACHING FERRULE TO WIRE ROPE.

1 MELTING POT



2 LADLE

3 TONGS

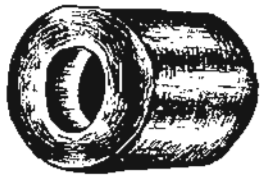


4 NUTS

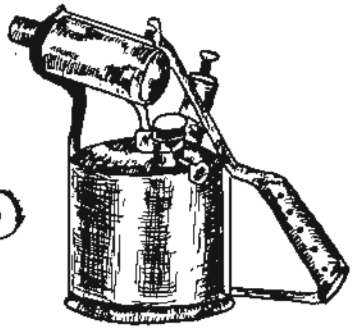
6 SPANNER

5 SOCKET METAL

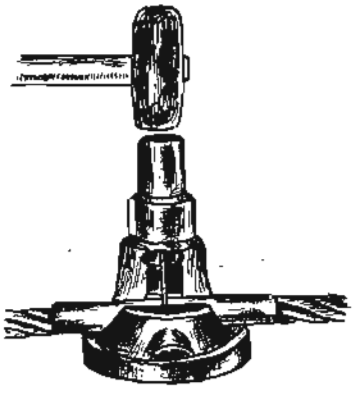
7 CURVED NEEDLE-NOSE PLIERS



8 FERRULE



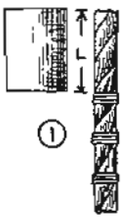
9 BLOW LAMP



10 WIRE CUTTER

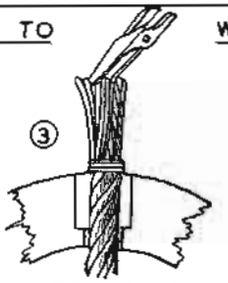
NOT TO SCALE

FIG. WR 80 ATTACHING FERRULE TO WIRE ROPE.



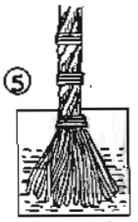
MEASURE FERRULE LENGTH FROM CABLE END. SERVE WITH NOT LESS THAN 3 SEIZINGS.

CUT OUT HEMP CENTRE. IF CABLE HAS WIRE ROPE OR STEEL STRAND CENTRE, DO NOT CUT OUT.

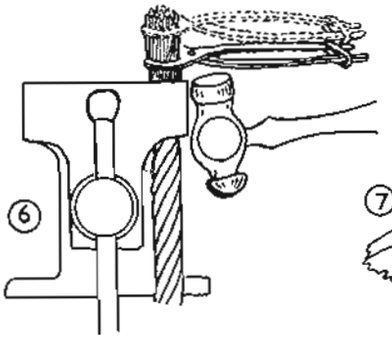


SEPARATE STRANDS OF WIRE AND STRAIGHTEN TO FORM A BRUSH.

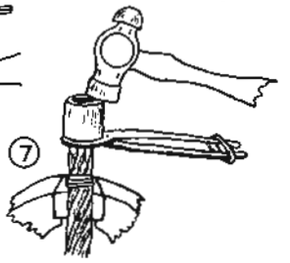
IF WIRES ARE VERY GREASY, CLEAN WITH PETROL. A CHEAP PAINT BRUSH DIPPED IN PETROL CAN BE USED TO REMOVE THE SURPLUS GREASE. DRY THOROUGHLY.



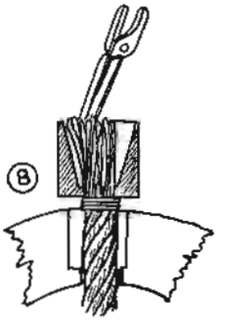
DIP WIRE FOR 3/4 OF THE DISTANCE TO THE FIRST SERVING INTO HYDRO-CHLORIC ACID BATH CONSISTING OF NOT OVER 50% ACID AND 50% WATER.
TAKE CARE THAT ACID DOES NOT GET ON ANY OTHER PART OF CABLE. KEEP IN NO LONGER THAN 4 MINUTES. WASH AND DRY THOROUGHLY.



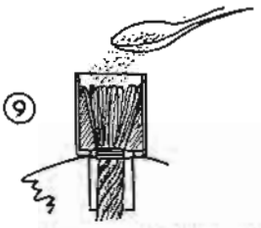
CLAMP THE WIRE ROPE IN A VICE USING NUTS. DRIVE TONGS BACK UP TOWARDS END OF ROPE SO FERRULE CAN BE DRIVEN OVER END OF WIRE.



DRIVE FERRULE ON TO ENDS OF WIRE DOWN TO POSITION AGAINST SERVING WIRE AS SHOWN.



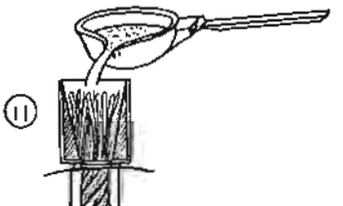
SEPARATE WIRES SO THAT THEY ARE ALL EVENLY SPREAD TO FILL THE FERRULE. DON'T CRIMP THE STRANDS OVER. PLACE ASBESTOS ROPE AROUND BOTTOM OF FERRULE.



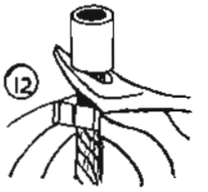
SPRINKLE SAL-AMMONIAC DOWN IN BETWEEN THE WIRES. THE SAL-AMMONIAC WILL ACT AS A FLUX OR CLEANING AGENT.

WITH A TORCH WARM FERRULE INSIDE AND OUT. JUST WARM ENOUGH TO INSURE NO CHILLING OF THE SOCKET METAL AND PREVENT POCKETS.

B. ASBESTOS ROPE AROUND BOTTOM OF FERRULE.



THEN POUR SOCKET METAL, FILLING THE FERRULE SLIGHTLY ABOVE THE TOP TO ALLOW FOR SHRINKAGE OF METAL IN COOLING.



USE SPANNER TO ADJUST FERRULE.

ROPE SERVING.

ROPE SERVING.

(f) WORN GROOVES (Fig. W.R. 75)

As a rope wears its diameter becomes smaller and likewise the grooves in the sheaves over which the rope runs will also become smaller. When a new rope is placed in service the sheave grooves may have worn down to such an extent (Fig. W.R. 75) that they will pinch the rope, resulting in broken wires on two sides of the rope. Grooves which are worn out, or have developed flat or corrugated spots will set up vibrations in the rope that cause early fatigue of the wires.

Seized sheaves may cause the rope to burn out beyond repair. Keep the sheaves and rollers lubricated to avoid this waste.

Heavy loads on small, smooth drums. When the load is heavy and the rope has no support from grooves, it will flatten as shown in Fig. W.R. 71. A wire rope centre would improve the condition.

(g) SUDDEN STRESSES

Loads should be gradually applied to wire rope, as acceleration may put a strain on the rope several times the mass of the load lifted or the resistance of the object moved. Sudden stresses caused by jerking may exceed the strength of the wire rope and break it. Jerks damage the rope.

(h) COMMON CAUSES OF ROPE FAILURE

(1) Ropes of incorrect size, construction or grade.
(2) Ropes allowed to drag over obstacles.
(3) Ropes not properly lubricated.
(4) Ropes operating over sheaves and drums of inadequate size.
(5) Ropes overwinding or cross-winding on drums.
(6) Ropes operating over sheaves and drums out of alignment.
(7) Ropes operating over sheaves and drums with bad groves or broken flanges.
(8) Ropes permitted to jump sheaves.
(9) Ropes subjected to moisture or acid fumes.
(10) Ropes with improperly attached fittings.
(11) Ropes permitted to untwist.
(12) Ropes subjected to excessive heat.
(13) Ropes kinked.
(14) Ropes subjected to severe overloads due to inefficient operation.
(15) Ropes destroyed by internal wear caused by grit penetrating between strands and wires.

I. METHOD OF DETERMINING MAXIMUM LOAD ON WIRE ROPE

In many applications such as log skidding over uneven ground and rough surfaces, it is not possible to accurately estimate the maximum load handled due to the many variables involved. In such cases and approximation may be made by the method set out below.

In order to determine the maximum conditions, the speed at which the rope moves should be determined under the maximum conditions of loading.

$$\text{Rope tension} = \frac{1,5 \cdot kW}{vc}$$

Where 1,5 is the factor providing the 50 percent overload of the motor.

kW - is the power of the motor
vc - is the rope speed of 1 m per second

Example: A winch mounted on a tractor with 30 kW engine, with the rope travelling at a speed of 1 m per second

$$\text{Rope tension} = \frac{1,5 \cdot kW}{vc} = \frac{1,5 \cdot 30}{1} = 45 \text{ kN}$$

Note: Special improved plough rope has a breaking load, on 16 mm wire rope, of 16 tons = 150 kN. When tractor power is expressed in kW the resulting rope tension will be expressed in kN.

2. WIRE ROPE FITTINGS

A CHOKER HOOK ASSEMBLY USED IN LOG SKIDDING OPERATIONS

The choker hook assembly consists of:

(1) ferrule;
(2) Bardon-type choker hook;
(3) wire rope slings, both ends ferruled, or one end ferruled, with an eye on the other end.

(a) Ferrule (Fig. W.R. 76-78)

The ferrule is an alloy steel cylinder with a large-size opening at one end and a smaller opening at the other end, just large enough to accommodate the wire rope end.

Three types of ferrule are known to the Department:

(1) Fig. W.R. 76. This ferrule is fitted to the end of the sling with socketing (Babbitt-metal) metal by a hot process (Fig. W.R. 79, 80). The inner part of the ferrule is a regular cylinder, tapering sharply to a small hole at the bottom end. When this ferrule is correctly set on the rope it can withstand a pull of 90% of the wire rope strength, without slipping. The ferrule can be used with both tractor and highlead chokers.

(2) Fig. W.R. 77. Ferrule with split spiral wedge.

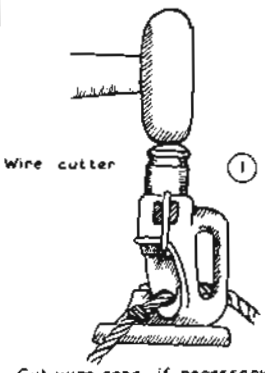
The wedge for this ferrule consists of two halves. The cable is inserted into the ferrule as follows (Fig. W.R. 104):

Step 1: Insert the cable through the ferrule in the usual manner.
Step 2: Spread the strands and lay them in the individual grooves in the wedge.
Step 3: Tap the wedge and cable back down into the ferrule to approximately 9 mm from the top.
Step 4: With the first load the cable and wedge will seat itself in the ferrule pocket.

This setting of the ferrule was tested by a pull of 10 tons without slipping.

FIG.W.R.81.

ATTACHMENT OF WEDGE-TYPE FERRULE TO WIRE ROPE



Wire cutter ①

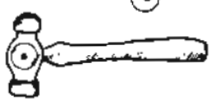
Cut wire rope if necessary. Before cutting, seize wire on both sides of proposed cut.

② Tongs

③ Wire rope nuts

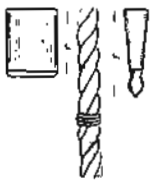
④ Ferrule wedge

⑤ Curved needle-nose pliers



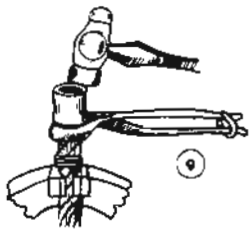
⑥ Hammer

⑦ Ferrule



⑧

Measure 62 mm from the end of cable and seize with wire

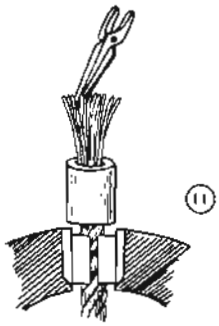


⑨

Place rope in vice, clamping just below seizing with nuts. Clamp near the top of the rope with tongs and drive ferrule onto the end of the wire until against seizing.

⑩

Remove seizing and push ferrule down to expose 75 mm of cable. Cut out hemp centre as shown.

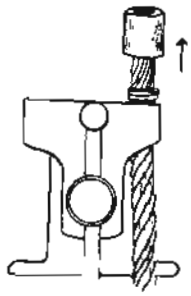


⑪

Separate wires of strands, using curved needle nose pliers, and straighten to form a brush

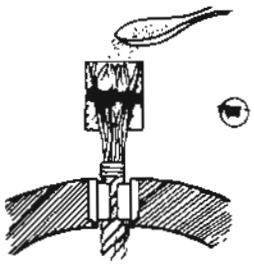
⑫

Clean greasy wires in petrol or paraffin. A cheap paint brush dipped in the petrol can be used to remove surplus grease. Dry thoroughly.



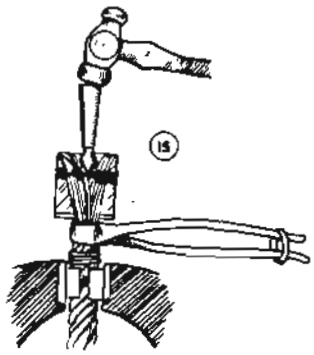
⑬

Raise ferrule slightly and seize again ± 75 mm from end of rope. Now twist the ferrule to end of rope by hand, until wires are level with top of ferrule



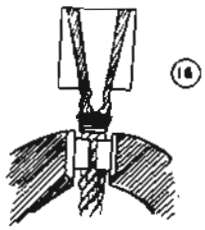
⑭

Separate wires again if necessary, then sprinkle sal-ammoniac powder down in between the wires



⑮

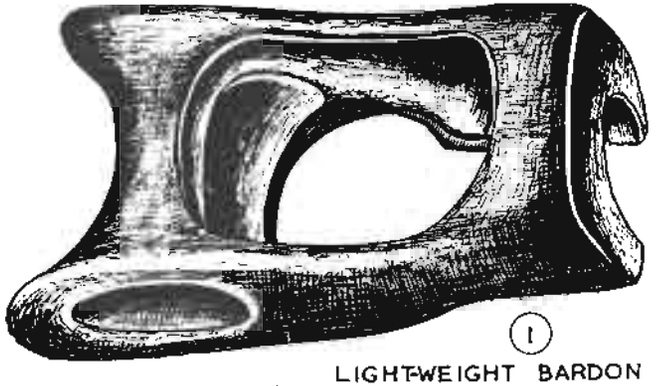
Clamp rope tightly below ferrule with tongs. Insert wedge into centre of strands and drive home with hammer



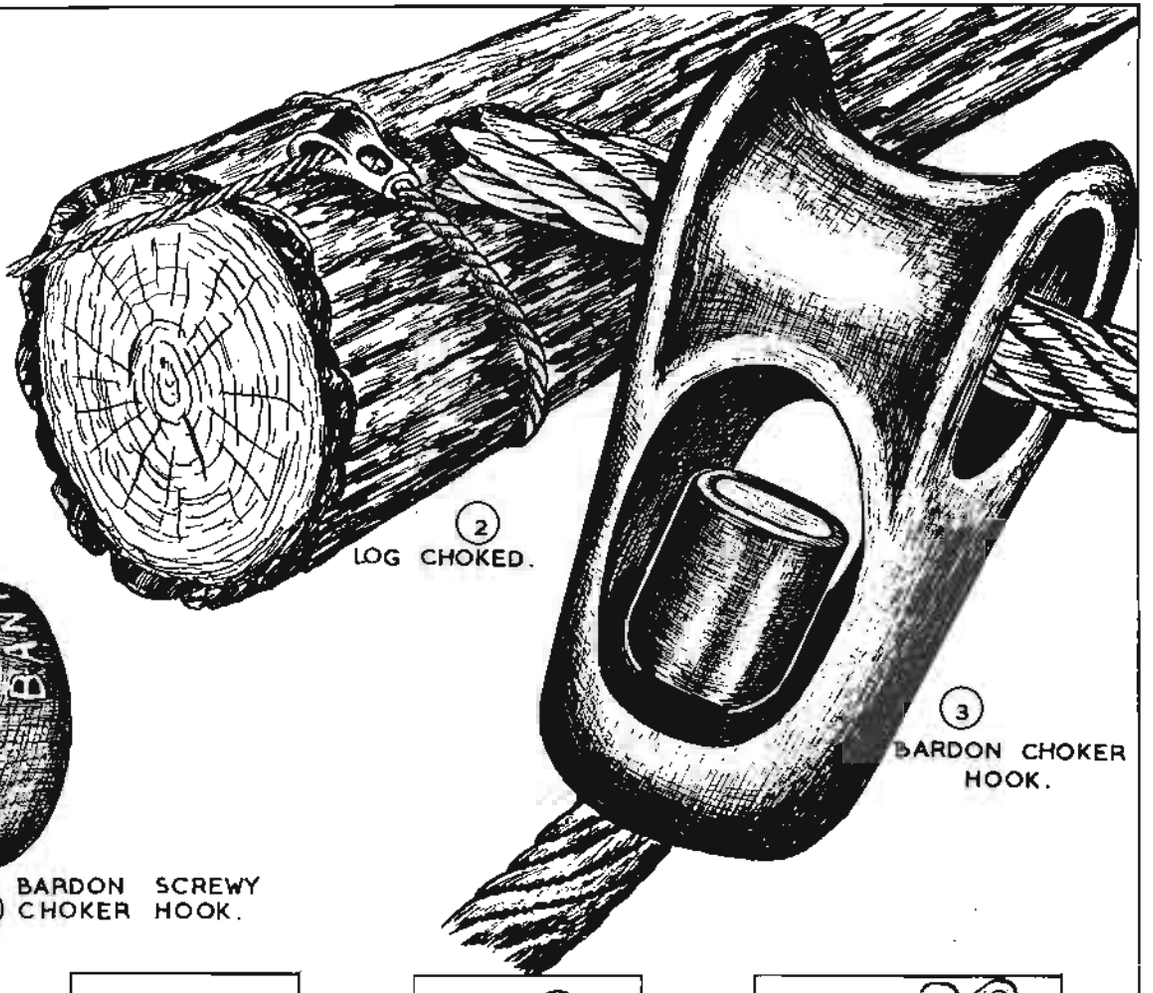
⑯

Ferrule fitted. Remove from vice and remove seizing.

FIG. WR. 82

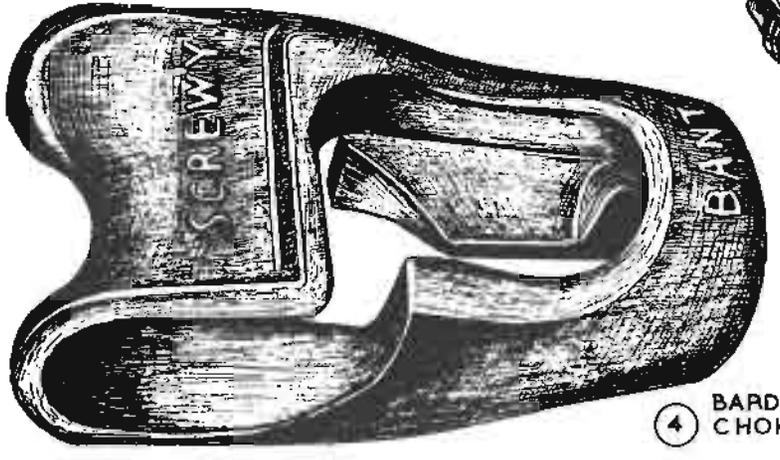


(1) LIGHT-WEIGHT BARDON HOOK.

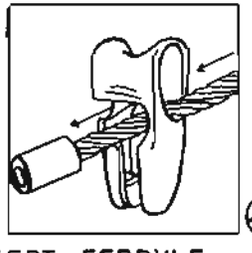


(2) LOG CHOKED.

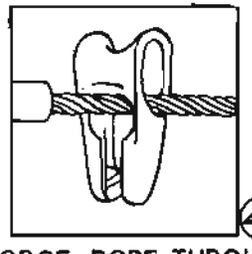
(3) BARDON CHOKER HOOK.



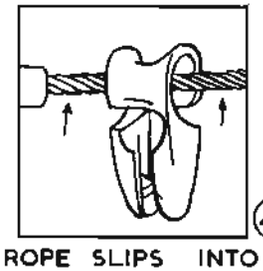
(4) BARDON SCREWY CHOKER HOOK.



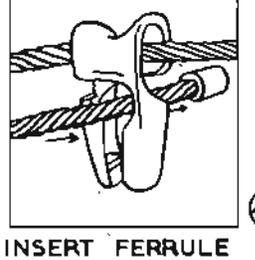
(4a) INSERT FERRULE THROUGH HOOK.



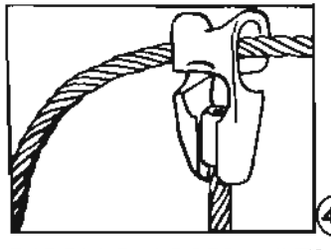
(4b) FORCE ROPE THROUGH SIDE SLOTS.



(4c) ROPE SLIPS INTO HOOK EYE.



(4d) INSERT FERRULE THROUGH HOOK.



(4e) FERRULE DROPS INTO POCKET.

SETTING OF BARDON SCREWY CHOKER HOOK ONTO SLING.

FIG.W.R.83

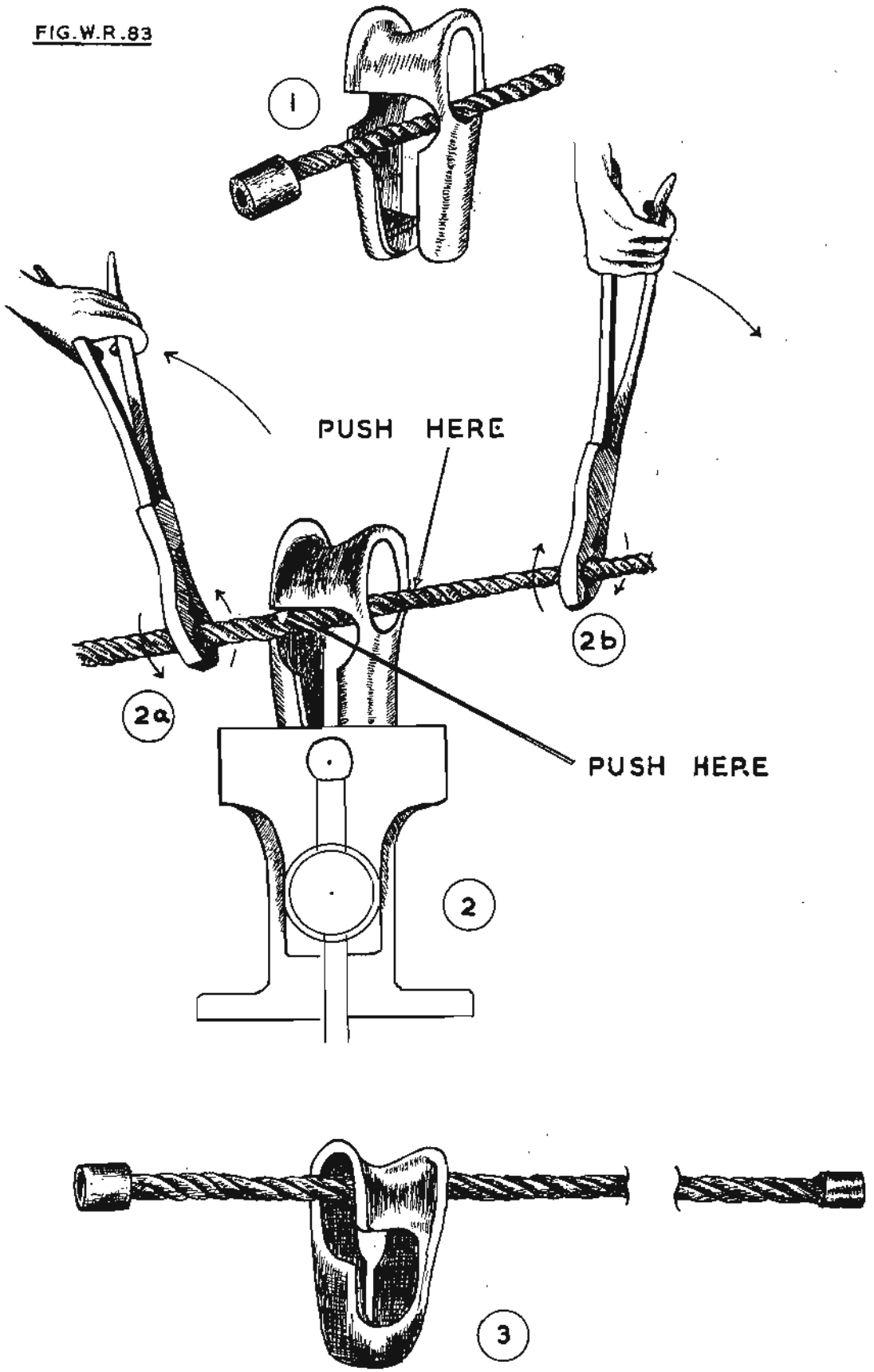
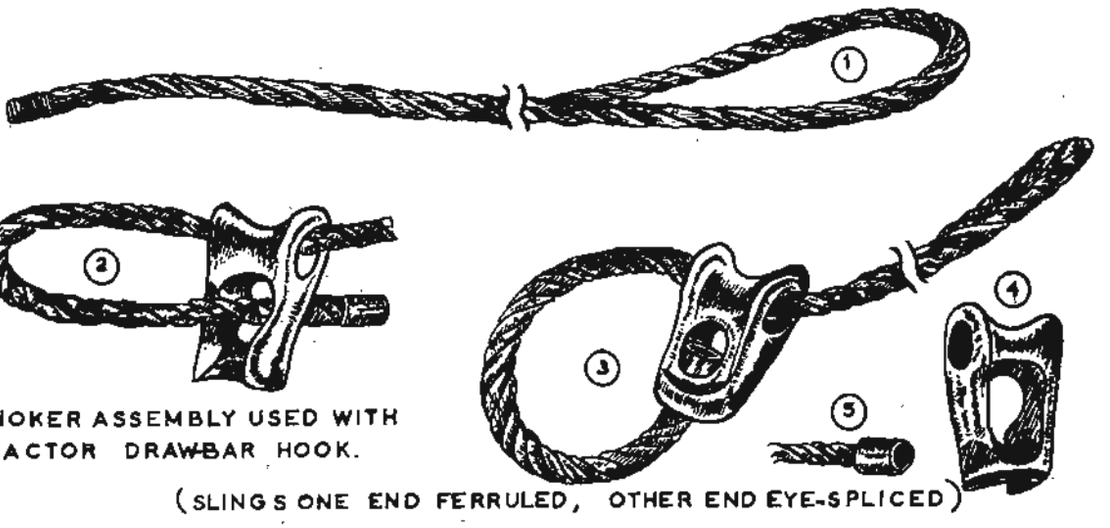


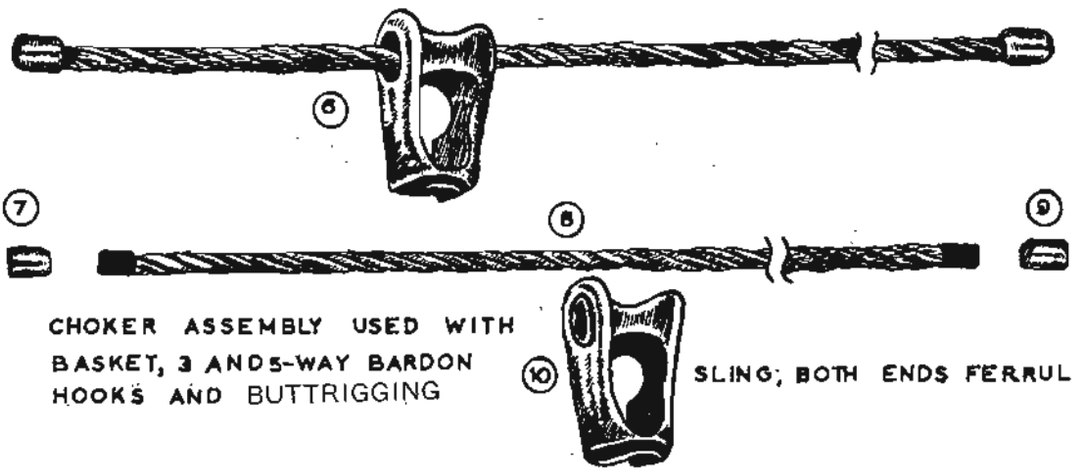
FIG.W.R.84

CHOKER ASSEMBLIES.



CHOKER ASSEMBLY USED WITH TRACTOR DRAWBAR HOOK.

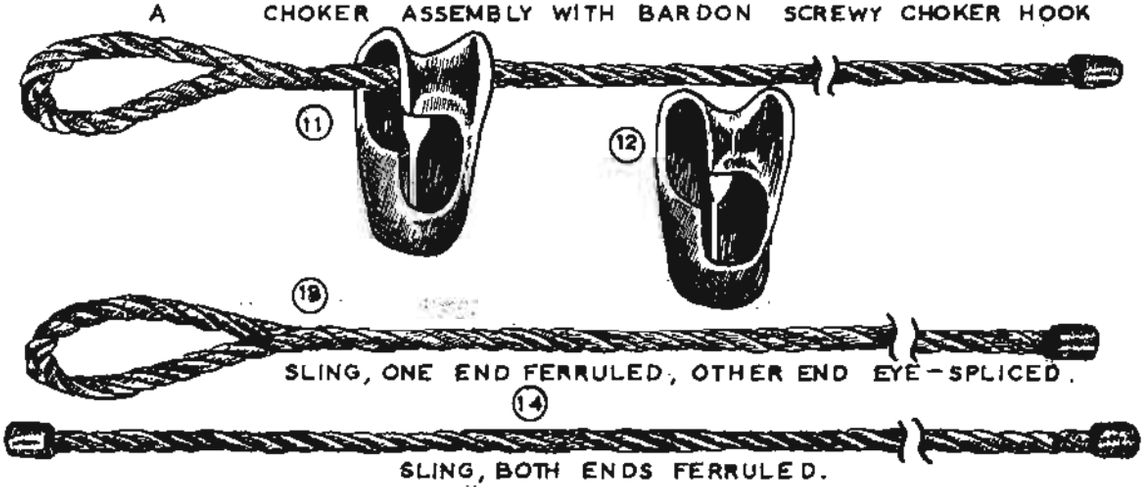
(SLINGS ONE END FERRULED, OTHER END EYE-SPLICED)



CHOKER ASSEMBLY USED WITH BASKET, 3 AND 5-WAY BARDON HOOKS AND BUTTRIGGING

SLING; BOTH ENDS FERRULED.

A CHOKER ASSEMBLY WITH BARDON SCREWY CHOKER HOOK

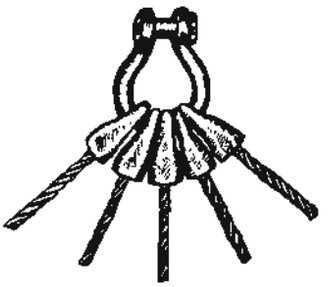


SLING, ONE END FERRULED, OTHER END EYE-SPLICED.

SLING, BOTH ENDS FERRULED.

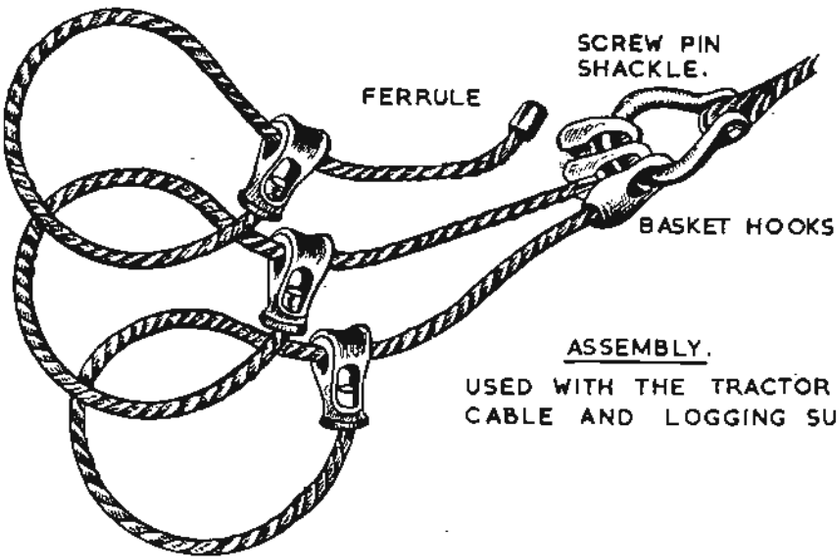
FIG.W.R.85.

BASKET LINE HOOKS.



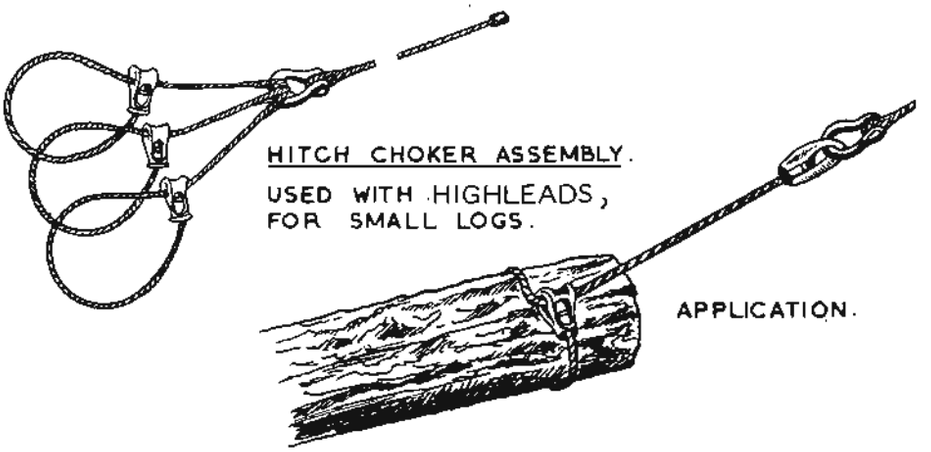
FIVE BASKET HOOKS ON A SPECIAL ASSEMBLING SHACKLE (DETAIL)

BASKET HOOK.



ASSEMBLY.

USED WITH THE TRACTOR DRUM CABLE AND LOGGING SULKY.



HITCH CHOKER ASSEMBLY.

USED WITH HIGHLEADS, FOR SMALL LOGS.

APPLICATION.

When the wire rope of the sling is worn out the above ferrule can be easily removed with one hammer blow, but the possibility also exists of the ferrule being shaken off while the choker is being dragged empty over hard ground, although this has not been proved in a test. It is not advisable to use this ferrule in highlead operations, where chokers fly in the air and strike the ground or obstacles with considerable force.

(3) Fig. W.R. 78. Ferrule with conical wedge.

The end of the sling is fitted by means of a conical wedge applied by a cold-fitting process, as shown in Fig. W.R. 81. When tested, a ferrule fitted to a 16 mm wire rope sling started to slip under a pull of 7 tons. The ferrule with a conical wedge can be recommended for use with tractor chokers.

(b) The choker hook (Fig. W.R. 82)

The second component of the choker assembly is a Bardon-type choker hook. The body of the choker hook consists of a sleeve through which the sling passes and slides, and a pocket into which the ferrule is inserted after forming a loop to choke the logs (Fig. W.R. 82, items 2,3). Three models of the choker hook are used in departmental plantations:

(1) Item 3. This model is the original Bardon choker hook.

(2) Item 1. The above model was found to be too bulky and a shorter model was used to provide a better grip. In this model the partition wall in the choker sleeve was removed without in any way reducing the strength of the hook. With the shorter body of the choker hook a better grip could be obtained on the choked log. The choker is also lighter and easier to handle. This choker hook is universally used in the Department, and is known as Young No. 500, Bantam size.

(3) Item 4. The Nelson screwy choker hook has two slots on each side so as to permit insertion of a sling with the ferrule attached to one end, and with either a ferrule or an eye on the other end. The method of sling insertion into the screwy choker is illustrated in Fig. W.R. 82, items 4, a, b, c, d, e, and also in Fig. W.R. 83. The latter illustration shows closer details of the sling insertion into the hook. By twisting the rope in the opposite direction to its lay it is loosened and it is easier to push the wire through the slots without hammering. This slotted hook was designed to facilitate the replacing of worn slings in the field, thus avoiding having to send choker hooks away for fitting with new slings, the latter having to undergo the lengthy process of ferrule fitting by the hot process. In the latter case a number of spare choker assemblies would have had to be kept in the field at additional expense.

Note: The choker hook itself lasts longer than the working life of the tractor.

(c) Choker wire rope slings with choker assemblies (Fig. W.R. 84)

The third part of the choker assembly is the wire rope sling.

(1) Choker assembly used with tractor drawbar and (winch) line hooks: the sling used in this case has a ferrule at one end (item 5) and an eye or loop at the other end. Item 1 illustrates a soft, hand-spliced sling eye on one end of the sling, with the other end seized or served. This is the form in which spare slings are supplied to the plantations. Item 2 shows how the ferruled end is inserted into the choker hook, item 3 shows the ferrule set in the choker pocket, item 4 shows the choker hook, and item 5 the ferruled end of the choker sling.

(2) Item 6 shows a choker assembly where the sling is ferruled at both ends. If the hot process of ferrule fitting is applied, spare slings are delivered to the plantations with one end already ferruled, but the remaining ferrule has to be fitted in the plantation workshops. In this case an exchange of ferrules between plantations and supplying depots must be arranged so that a sufficient supply of ferrules may be accumulated, thus eliminating unnecessary purchase of additional ferrules.

(3) Choker assembly with Screwy choker hook.

The illustration shows a choker assembly with the Screwy choker hook (item 11) and the hook itself (item 12). In this case spare slings are delivered with a ferrule fitted at one end and a soft eye splice at the other end (item 13), or with ferrules fitted to both ends of the sling (item 14). The plantation has merely to insert the sling into the choker hook, which takes approximately 5 minutes, provided that instructions are followed and a vice is available. (Fig. 82, item 4a, b, c, d and Fig. 83).

Unfortunately in practice the application of the Screwy choker hook with slots has not proved very practical. When the rope stretches and becomes thinner the hook is apt to fall off as the rope slips through the slots, and the hook is inevitably lost. This generally occurs when the empty chokers are dragged behind the tractor. Because of this and since they could not be used for highleading, no more of these hooks were purchased.

Note : The methods of choking, hooking, towing and off-hooking the logs have been illustrated and discussed in the chapter dealing with skidding by tractor and highlead

B. THE BANTAM BASKET LINE HOOK (Fig. W.R. 85)

The body of the basket hook consists of the eye and the ferrule pocket. If choker sling assemblies have both ends ferruled they have to be hooked to a device containing a ferrule pocket. If tractors have only the standard drawbar and line hooks, and choker assemblies have both ends ferruled, the chokers can only be hooked to the tractor if the basket hook is employed. The tractor hook is placed through the eye of the shackle of the basket hook and the choker ferrule secured in the pocket contained in the body of basket hook. If the basket hook is used singly, it is hooked directly to the tractor cable line hook. When a number of ferruled chokers is used, a special assembling shackle is required, as shown in "detail" of the illustration. The shackle may be directly spliced to the end of the tractor winch cable, or may be hooked to the tractor hook.

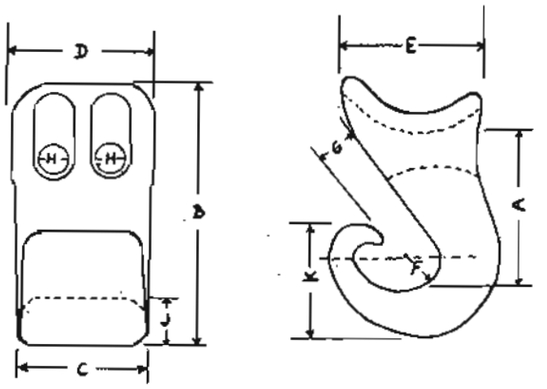


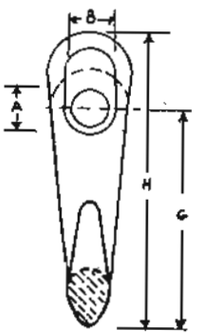
FIG.W.R.86.

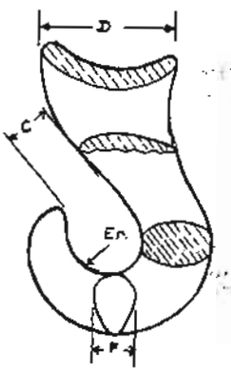
DUAL CHOKER HOOK.

12-14% MANGANESE STEEL
SAFETY FACTOR: 5—1.

ROPE SIZE	RATED LOAD	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	J mm	K mm	MASS† kg
9—11 mm	2 350 kg	60	108	56	58	60	11	16	16	22	54	1,5
13—16 mm	4 600 kg	67	122	63	72	63	13	19	19	25	60	2,3

FIG.W.R.87.





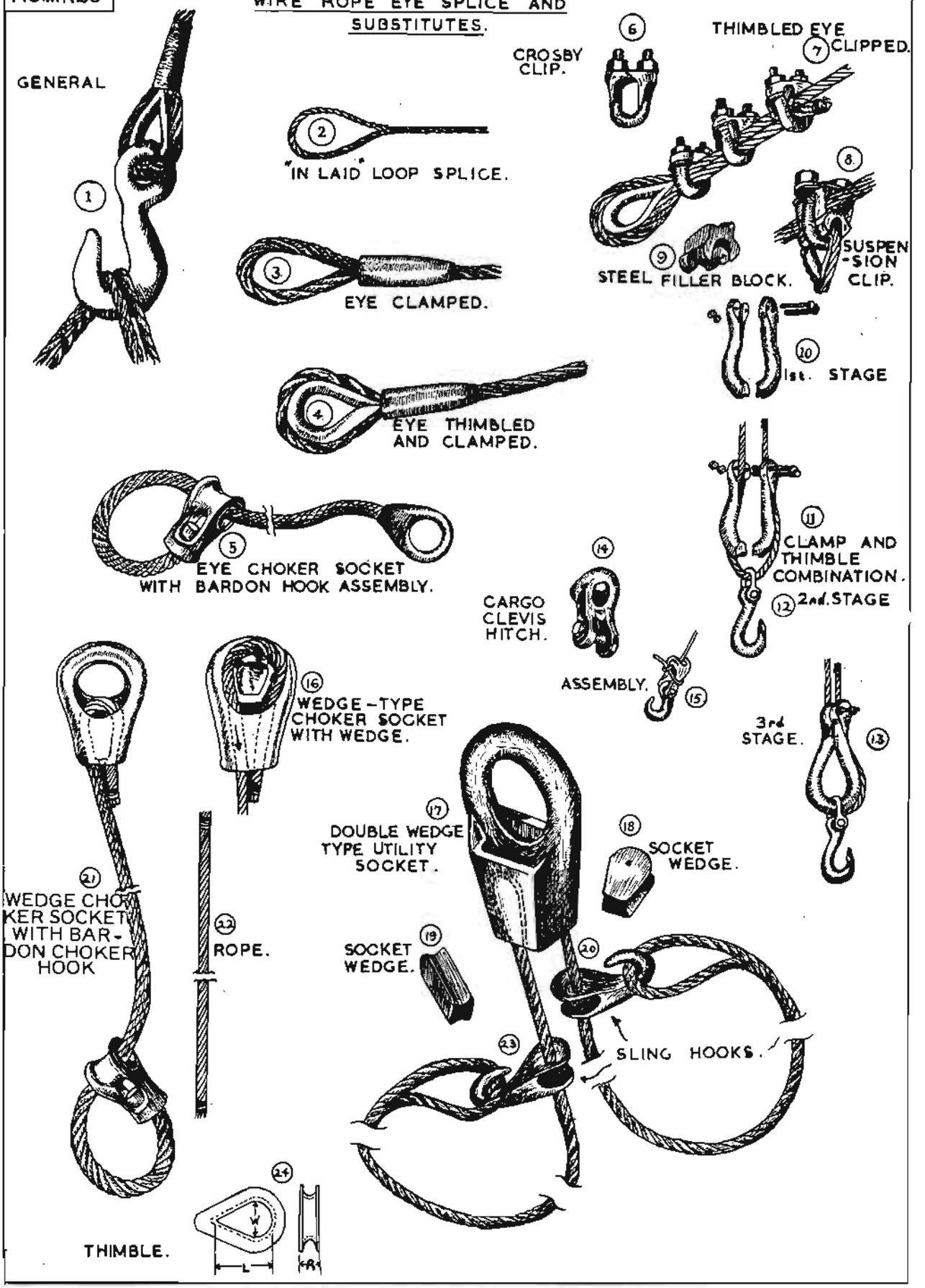
SINGLE SLING HOOK.

12% - 14% MANGANESE STEEL.
SAFETY FACTOR: 5 — 1.

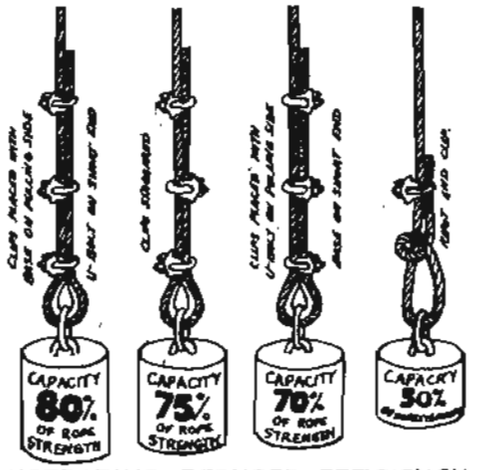
SIZE	MASS kg	A mm	B mm	C mm	D mm	Er mm	F mm	G mm	H mm	SAFE WORKING LOAD
13	0,7	19	19	22	57	13	19	97	128	1 500 kg
16	1,6	19	19	28	73	14	27	114	153	2 250 kg

FIG.W.R.88

WIRE ROPE EYE SPLICE AND SUBSTITUTES.



CORRECT WRONG WRONG WRONG



ILLUSTRATING REDUCED EFFICIENCY OF CLIP FASTENINGS CAUSED BY INCORRECT APPLICATION OF CLIPS OR BY BAD DESIGN.

THE USE OF CROSBY CLIPS FOR WIRE ROPE LOOPING.

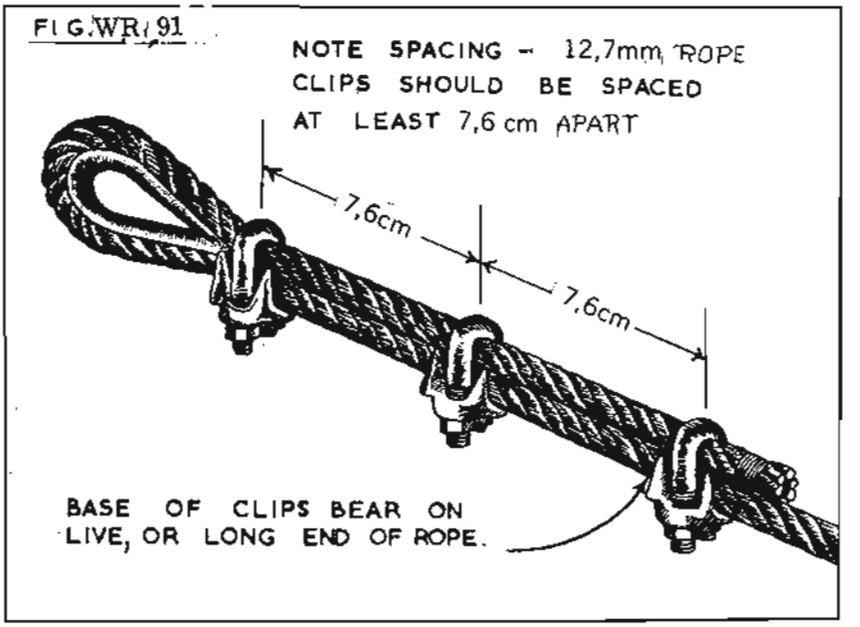
FIG.W.R.89.

FIG.W.R.90

IMPROPER METHOD OF APPLYING CLIPS.

ROPE DIAMETER mm	NUMBER OF CLIPS	SPACING cm	LENGTH OF WRENCH. cm
12,7—15,8	3	7	30
19,0—22,2	4	10	45
25,4—28,6	4	15	60
31,7—34,5	4	17	60
38,1 TO LARGER	5-7	25	60

FIG.WR/91



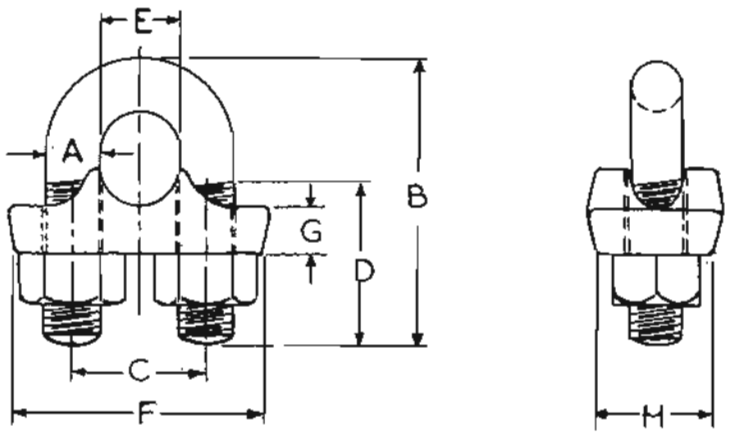


FIG.W.R.92.
BULLDOG GRIP.

TABLE I.

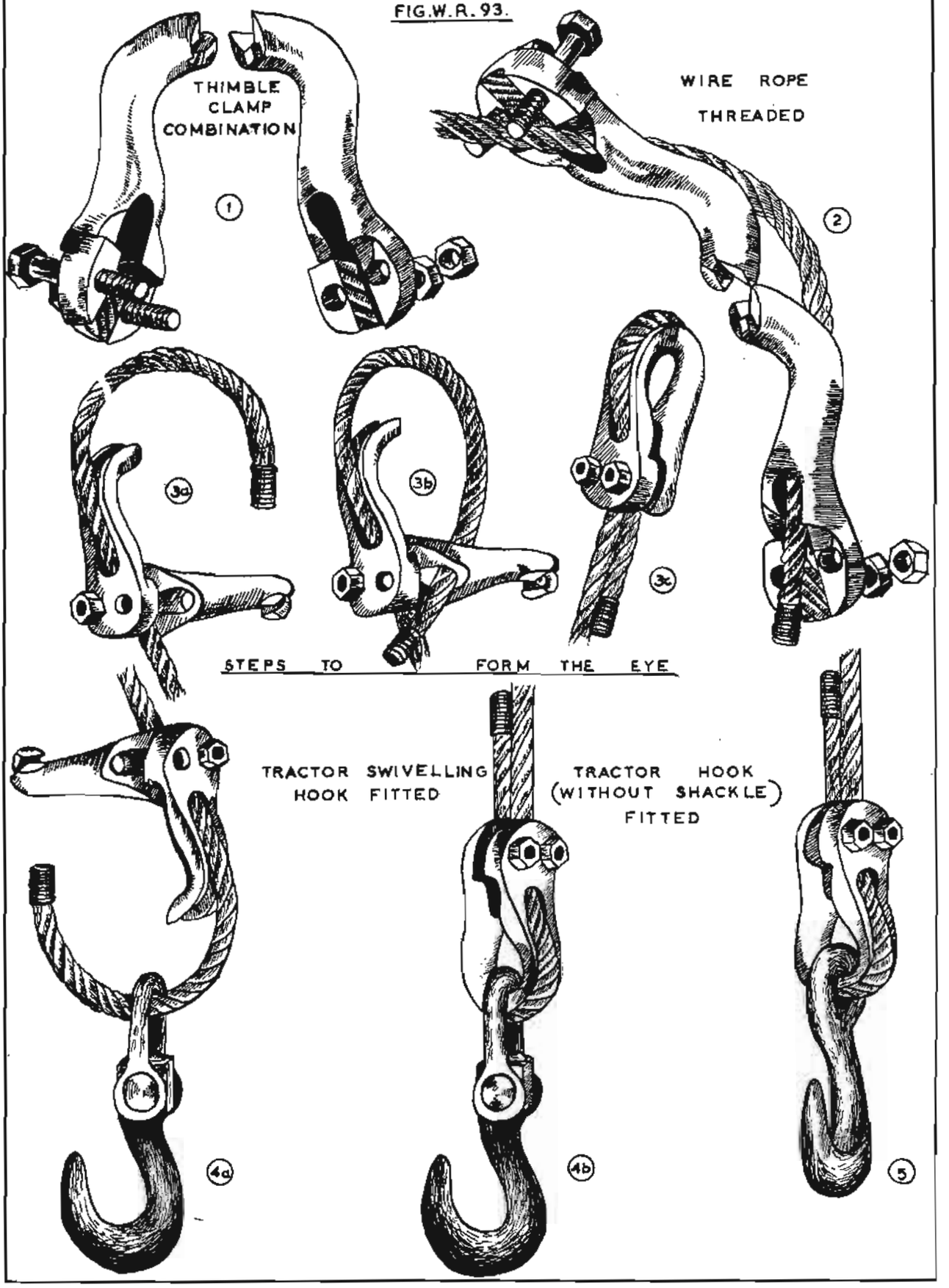
NOMINAL SIZE (DIAMETER OF ROPE)	ROPES SIZED BY CIRCUM-FERENCE.*	A	B	C	D	E	F	G	H
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
8	25	8	41	17	22	9	35	8	22
9	32	9	48	21	25	11	41	9	24
11	35	11	54	24	32	13	51	9	27
13	38	13	63	29	35	16	57	11	29
14	45	13	67	30	35	17	60	13	30
16	51	14	73	33	37	19	63	13	32
19	57	14	79	36	44	22	67	13	33
22	70	16	92	41	51	25	73	16	35
25	79	19	105	48	54	29	82	19	41
28	89	19	114	51	57	32	89	19	43
32	102	19	121	54	63	35	95	19	48
35	114	22	140	63	76	41	108	19	51
38	121	22	140	63	76	41	108	19	51
41	127	25	159	70	89	44	121	21	54
45	140	25	178	73	95	48	127	22	57
51	152	28	190	83	102	54	140	25	60

NOTE: FOR WIRE ROPES OF INTERMEDIATE SIZES THE NEXT LARGER SIZE OF BULLDOG GRIPS SHALL BE EMPLOYED.

* THESE ARE NOT NECESSARILY EXACT CONVERSION, BUT ARE THE RECOMMENDED SIZES OF ROPES, SIZED BY CIRCUMFERENCE, TO BE USED WITH THE APPROPRIATE BULLDOG GRIPS

IRON GRIP THIMBLE CLAMP OR CLAMP AND THIMBLE COMBINATION

FIG.W.R.93.



If logs are of small diameter, the choker hitch assembly is used, thus permitting a number of logs to be hooked to one basket hook, which considerably increases the load per turn.

Note : If the basket hook is attached to a shackle, prestacking of small logs is required in order to accelerate choking

C. SLING HOOK (Fig. W.R. 87)

The single sleeve sling hook consists of a hook and a single sleeve through which the sling passes. The hook is used with a single wire rope sling with both ends eye-spliced, the hook being threaded onto the sling before the second eye is formed, and being able to slide freely between the two eye-spliced ends. Such assemblies are used in pairs for slinging and loading small logs in bundles (Fig. W.R. 88, items 20, 23).

The use of the assembly is dealt with under the relevant chapter relating to log loading.

The dual choker hook (Fig. W.R. 86), which is similar to the above except that it has two sleeves instead of one, is assembled with an endless (gromet) wire rope circular sling, along which it slides freely. The assembly is used for loading short logs in bundles.

D. WIRE ROPE EYE (loop)

To attach any hook, shackle, etc. to wire rope, an eye or loop at its end is required. Fig. W.R. 88 illustrates a number of types of "eyes" used with wire rope in logging. Item 1 shows a loop with a hook, and a sling in the hook. Item 2 illustrates a soft, hand-spliced eye recommended for use whenever flexibility is required; e.g. loading slings which have to be extracted from under a load after it has been placed on the lorry deck. The hand method of end eye-splicing wire rope has been previously described. In order to simplify and accelerate making an eye in wire rope, various clamping methods have been devised (Item 3). There are two main clamping methods in use:

(1) Flemish overloop clamping, where the end of the wire rope is divided into two parts, which are bent over each other in opposite directions to form a loop, the ends then returning to the point of separation. Where the ends of the wire rope meet, the loop is clamped by a cold process in a press machine, using a special ferrule. As friction between the interwound rope end is already great, a light ferrule is sufficient to keep the eye firmly in place.

A rope of 24 wires x 6 strand construction, with fibre core, and ordinary lay is best suited for eye clamping.

(2) Another method of clamping the wire rope eye is much simpler: the end of the wire rope is bent over and clamped to the rope itself without any interwinding. The clamp used is bulky, heavy, and the ends of the wire rope protrude out of the clamp.

When tested, a soft eye clamped in a 16 mm wire rope broke close to the ferrule (clamp) under a pull of 8 760 kg.

Slings with clamped eyes can be used in direct pull, such as behind the tractor, where bending of the eye will not occur. The use of clamps is limited by the diameter of the rope.

E. CHOKER EYE SOCKET (Fig. W.R. 88 item 5, W.R. 95, item 1, 6.

The body of the choker eye socket consists of an eye for hooking and a socket for fitting the choker wire rope slings by means of Babbitt-(ferruling) metal, applied by the hot process. The size of the socket depends on the wire rope diameter. This type of socket has generally been replaced by another type of socket which can be fitted to the sling by the cold process.

F. CROSBY OR WIRE ROPE CLIPS (English: Bulldog grips) Refer to Fig. W.R. 88, items 6, 7; W.R. 89, 90, 91, 92

In logging, the Department uses exclusively Crosby clips manufactured in the U.S.A. or England. Recently a South African product was tested, which was made according to overseas specifications. Wire rope clips serve to secure the end of the wire rope instead of splicing or socketing where skilled labour or the facilities for such work are not available. They are also useful for temporarily securing the ends of ropes which may need adjustment in length. When clips are properly applied (Fig. W.R. 91), they should give good service.

Wire rope clips consist of a "U"-bolt with its ends screw threaded, hex nuts and a bridge (or base)(Fig. W.R. 92). The rope groove surface of the bridge must be a replica of the external surface and lay of the rope. For departmental purposes ropes may be 6 strand, ordinary lay, from 6 - 25 mm in diameter, which is the true pattern of clips available on the market. The form of clips and their dimensions are given in Fig. W.R. 92.

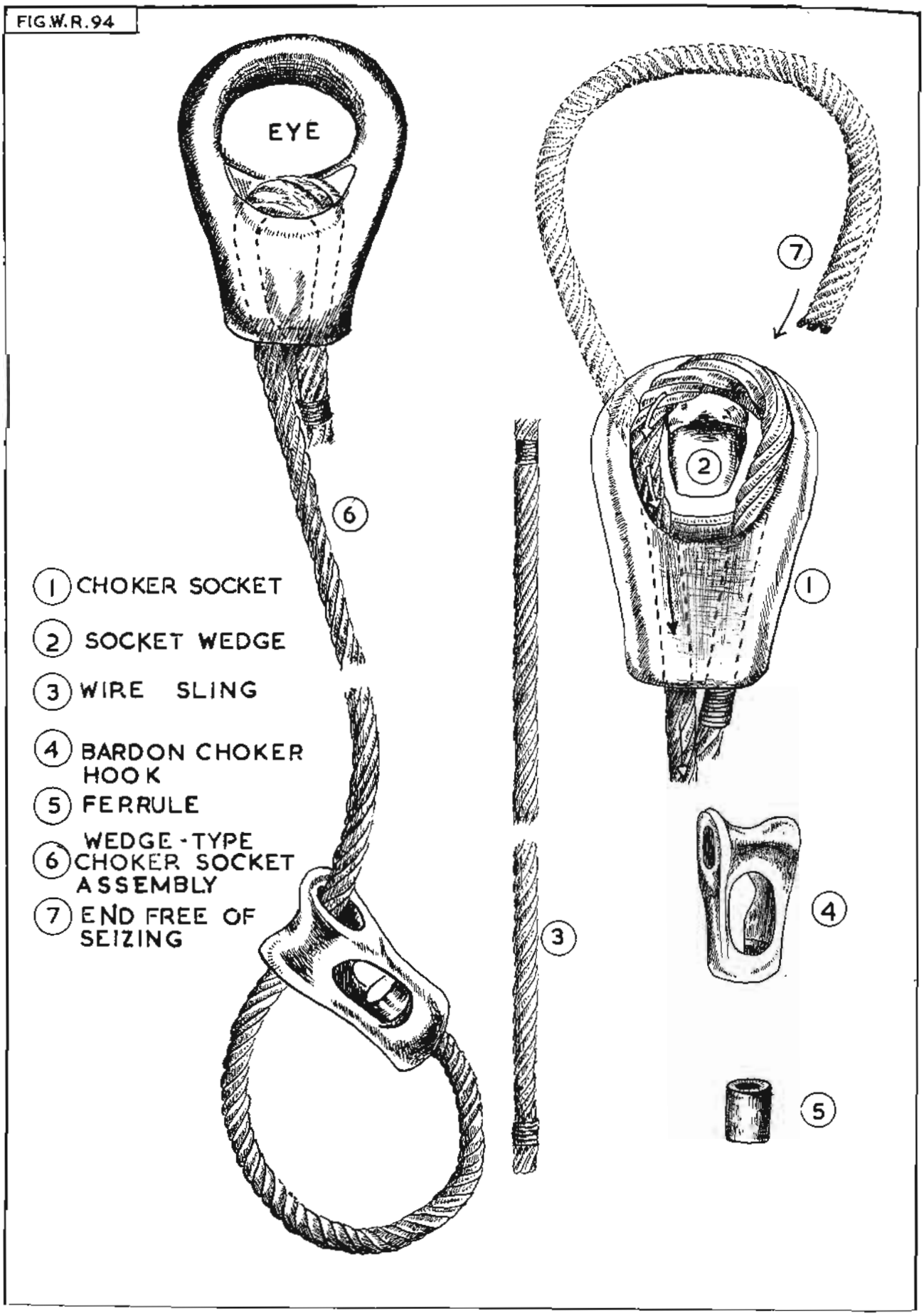
The minimum number of clips to be fitted on each connection up to and including 19 mm wire rope diameter to be not less than 3; over 19 mm and up to 32 mm diameter wire rope, not less than 4. Clips should be spaced at a distance of approximately six rope diameters.

Each nut must be tightened alternately, only a few turns being given at a time so as to maintain even pressure on both ends of the U-bolt, or the thread may be damaged.

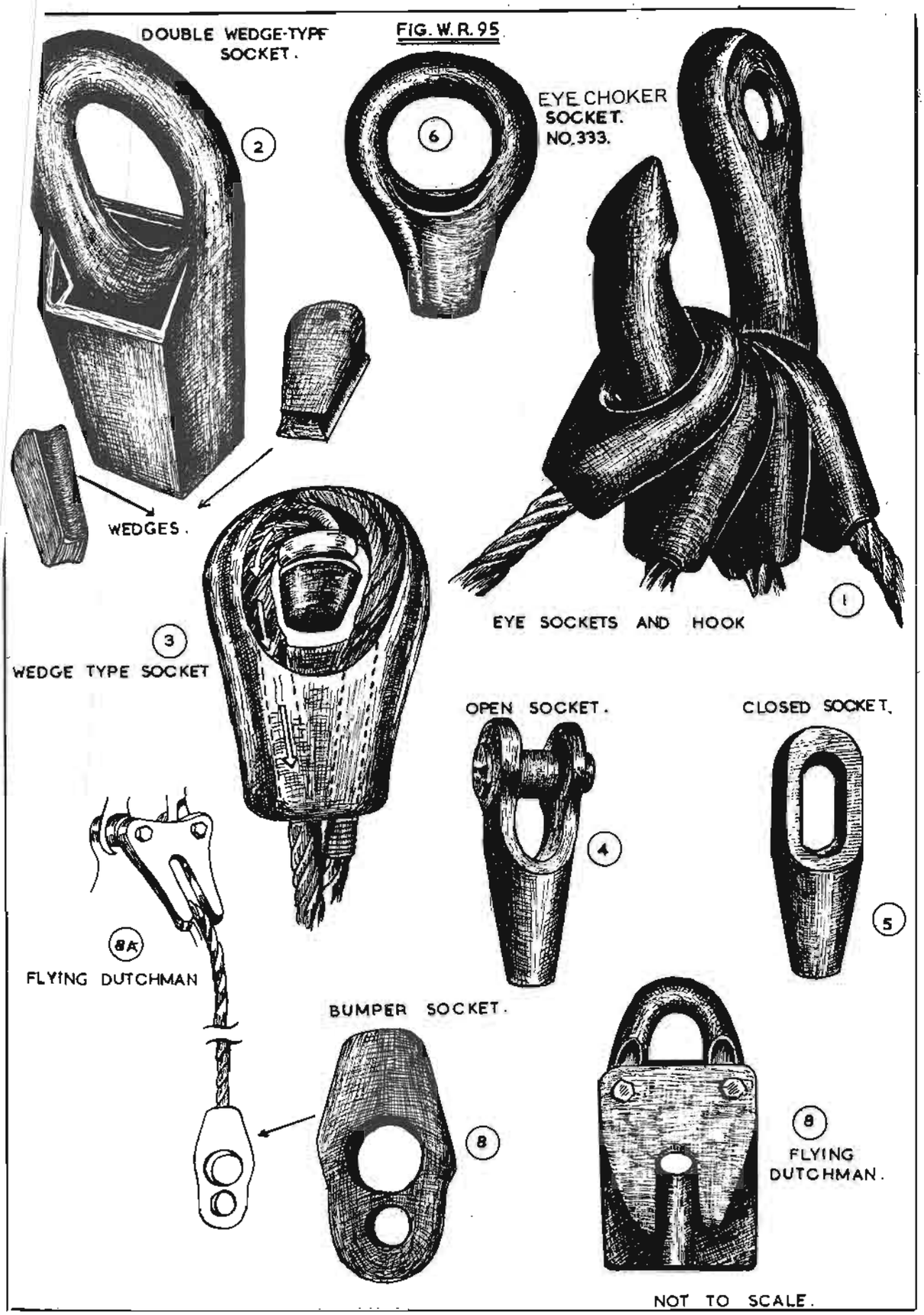
Wire rope clips of special design, with grooved steel filler blocks (Fig. W.R. 88, items 8, 9) are used when suspensions are required (e.g. footbridge or pipe line under spanned wire rope). This seldom applies to logging, but is mentioned as a matter of interest.

G. CLAMP AND THIMBLE COMBINATION (Fig. W.R. 88, items 10 to 13, and W.R. 93)

This device did not prove very suitable for logging purposes. The clamp and thimble are mounted and assembled as in Fig. W.R. 93. The intention was to use the device on the end of the tractor winch line as an eye to fit the line hook without a shackle.

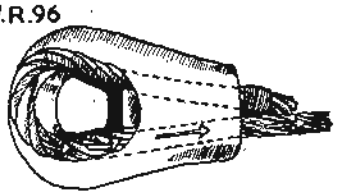


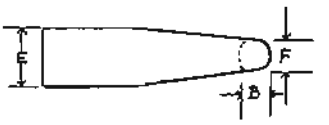
INSTALLATION OF CHOKER SOCKET WITH WEDGE ON SLINGS

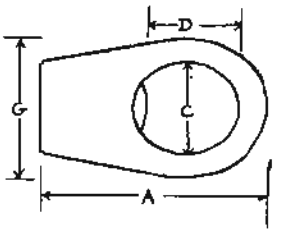


WIRE SOCKETS

FIG.W.R.96







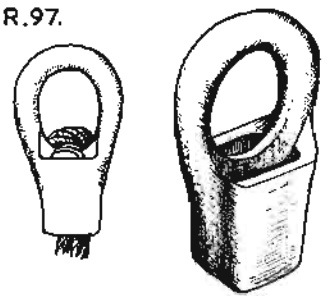
SINGLE WEDGE CHOKER SOCKET.

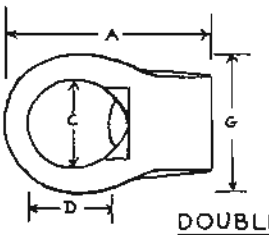
12-14% MANGANESE STEEL.

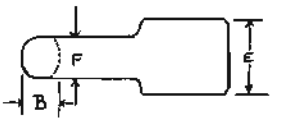
STRENGTH SUFFICIENT TO SURPASS RATED BREAKING STRENGTH OF ROPE.

STOCK NO.	ITEM.	ROPE SIZE mm	MASS kg	A mm	B mm	HOLE C x D mm	E mm	F mm	G mm	USE SLING HOOK mm
405 548	SOCKET	6—11	0,8	140	16	54 x 60	28	13	86	13
405 613	NO.3 WEDGE	8—9	0,1							
405 654	NO.35 WEDGE	11	0,1							
405 555	SOCKET	13—15	1,6	160	19	60 x 57	38	19	102	16
405 621	NO.4. WEDGE	13	0,1							
405 639	NO.5. WEDGE	15	0,1							

FIG.W.R.97.







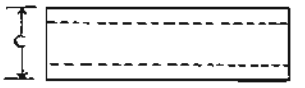
DOUBLE WEDGE UTILITY SOCKET.

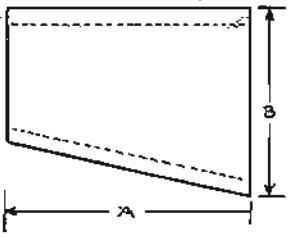
12-14% MANGANESE STEEL.

STRENGTH SUFFICIENT TO SURPASS RATED BREAKING STRENGTH OF ROPE.

STOCK NO.	ITEM	ROPE SIZE mm	MASS kg	A mm	B mm	HOLE C x D mm	E mm	F mm	G mm
405 571	SOCKET	6—11	1,6	160	19	63 x 51	51	22	108
405 613	NO.3 WEDGE.	8—9	0,1						
405 654	NO35. WEDGE	11	0,1						
405 589	SOCKET	13—16	2,4	190	25	70 x 57	63	25	108
405 621	NO.4 WEDGE	13	0,1						
405 639	NO.5 WEDGE	16	0,1						

FIG.W.R.98





DEAD—END SOCKET.

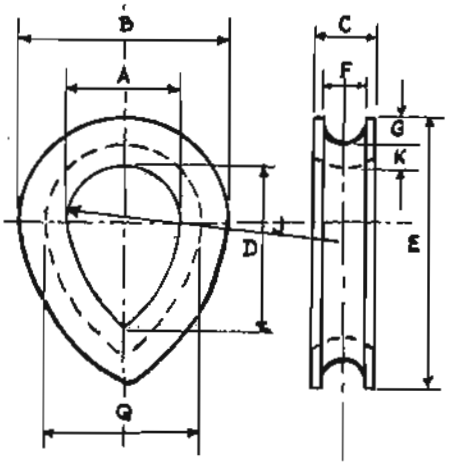
12-14% MANGANESE STEEL.

STRENGTH SUFFICIENT TO SURPASS RATED BREAKING STRENGTH OF ROPE.

STOCK NO.	ITEM	ROPE SIZE mm	MASS kg	A mm	B mm	C mm
411 330	T-1492 SOCKET.	13—16	1,3	133	80	38
410 068	E-8430 A. WEDGE.	13—16	0,2			
411 371	T-1758 SOCKET.	16—19	1,6	110	90	41
410 126	S-3395 WEDGE.	16—19	0,15			

ESCO LOGGING SOCKETS FOR WIRE ROPE

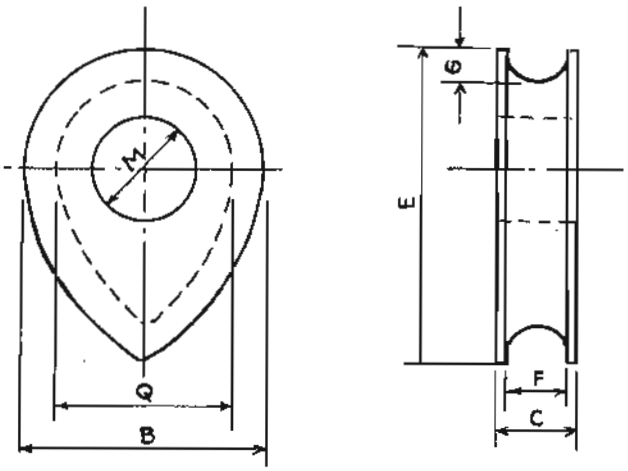
FIG.W.R.99.



ORDINARY THIMBLES.

APPROX. DIA. OF ROPE mm	CIRC. OF ROPE. mm	A mm	B mm	C (MIN) mm	D mm	E mm	F (MIN) mm	G mm	J (APP.) mm	K (MIN) mm	Q mm
8	25	22	39	13	33	54	8	4	63	4	30
9	32	25	48	14	38	63	10	6	76	5	35
11	38	28	54	17	41	73	13	8	76	5	37
13	41	33	59	21	45	79	14	8	89	6	43
16	51	41	74	22	59	98	16	9	110	8	57
19	60	51	92	29	73	124	21	11	152	9	70
24	77	64	110	33	92	146	25	13	178	10	84
25	83	70	119	34	108	162	27	14	203	10	89

FIG.W.R.100.



SOLID THIMBLES.

NOMINAL DIAMETER ROPE. mm	CIRC. OF ROPE mm	Q mm	B mm	C mm	E mm	F (MIN) mm	G mm	M (MAX) mm
10	32	32	44	14	57	11	6	19
14	44	42	60	21	83	14	8	22
16	51	51	69	22	95	16	9	25
18	57	57	79	25	105	19	11	32
21	63	63	86	29	117	21	11	32
22	69	69	95	32	127	22	13	34
24	77	77	105	33	140	25	14	38

NOTE: SHOULD A SMALLER PIN BE REQUIRED IT MUST BE STATED.

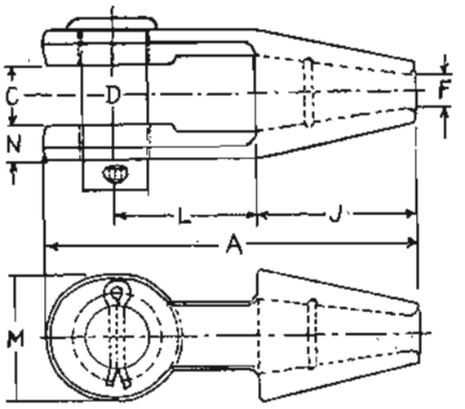
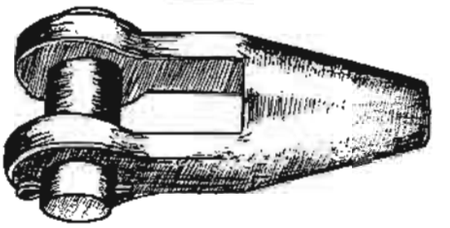


FIG.W.R.101



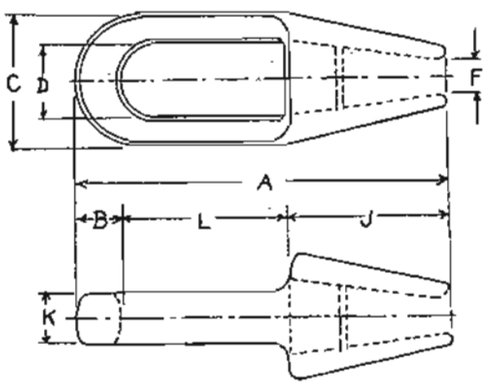
OPEN SPELTER SOCKETS.

FORGED FROM C-1035 FORGING STEEL.

TO BE ACCURATELY ALIGNED TO KEEP ROPE AXIS PERPENDICULAR WITH PIN AND IN LINE WITH BAIL. PIN HOLES TO BE JIG DRILLED TO ASSURE PIN BEARING AGAINST THIMBLE.

BRINELL HARDNESS: 197 – 163.

ROPE SIZE mm	DIMENSIONS IN mm								MASS kg
	A	C	D	F	J	L	M	N.	
8–9	117	21	21	11	51	44	40	11	0,6
11–13	141	25	25	14	63	51	49	13	1,0
14–16	171	32	30	17	76	63	57	14	1,8
19	202	37	35	21	89	76	67	16	2,7
22	235	44	41	25	102	89	79	19	4,5



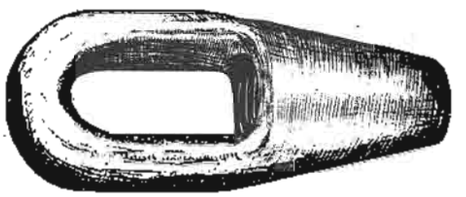


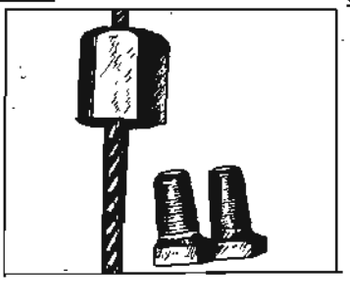
FIG.W.R.102
CLOSED SPELTER SOCKET.

SPECIFICATIONS AS FOR OPEN SPELTER SOCKETS.

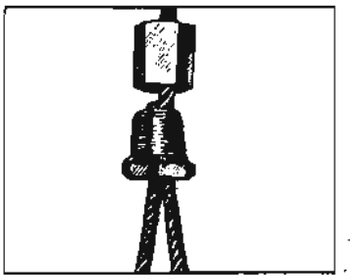
ROPE SIZE mm	DIMENSIONS IN mm								MASS kg EACH.
	A	B	C	D	F	J	K	L	
8–9	117	14	42	24	11	51	16	53	0,4
11–13	140	17	51	29	14	63	22	59	0,8
14–16	162	21	67	35	17	76	25	66	1,5
19	194	27	76	41	21	89	32	78	2,3
22	235	33	92	48	25	103	37	90	3,5

FIG.W.R.103.

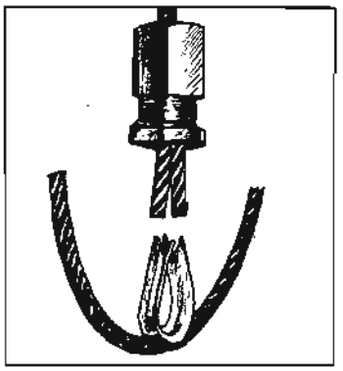
SAFE LINE CLAMP



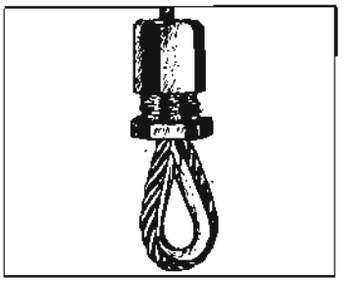
(1) GREASE NUT AND HALF CLAMP THREADS IF DRY.



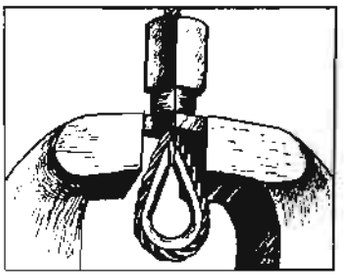
(2) PLACE NUT AND CLAMP ON WIRE ROPE.



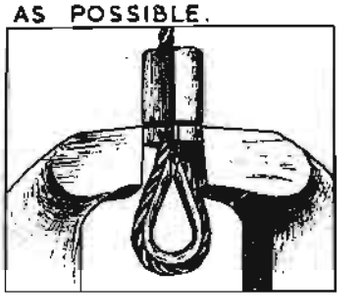
(3) FORM A LARGE LOOP. PLACE HALF CLAMPS ON WIRE ROPE.



(4) HOLD HALF CLAMPS TOGETHER BY HAND. TURN NUT ON BY HAND AS FAR AS POSSIBLE.



(5) HOLD LIVE END OF SLING AND BY PULLING ON CLAMP CLOSE LOOP AROUND THIMBLE. CAUTION KEEP THIMBLE ½ TO 1 DIAM. FROM CLAMP. PLACE IN VICE. CLAMP VICE JAWS.



(6) ALTERNATELY TIGHTEN VICE AND TURN NUT UNTIL NUT IS ASSEMBLED FIRMLY ON THE CLAMP

THE CLAMP SIZE IS SHOWN ON THE INSIDE CLAMP FORGING FACE.

STOCK SIZES FOR		WIDTH ACROSS FLATS. mm	APPROX. MASS kg EACH
4,9 mm	DIA. OF WIRE ROPE	21	0,1
6,5 mm	DIA. OF WIRE ROPE	25	0,14
9 mm	DIA. OF WIRE ROPE	35	0,37
11 mm	DIA. OF WIRE ROPE	41	0,48
13 mm	DIA. OF WIRE ROPE	48	0,9
16 mm	DIA. OF WIRE ROPE	57	1,3
19 mm	DIA. OF WIRE ROPE	67	2,4

H. CARGO CLEVIS HITCH (Fig. W.R. 88, items 14, 15)

The cargo clevis hitch with hook fitted, is used for the quick attachment of a wire rope of 6 - 9 mm diameter with fibre core for a temporary light pull (lifting not permitted).

I. WEDGE-TYPE CHOKER SOCKET (Fig. W.R. 88, W.R. 94, 95, items 2, 3)

(1) With single wedge Fig. W.R. 88 items 16, 21
Fig. 94, 95 item 3

The wedge choker socket is used in departmental plantations with the choker sling assembly, instead of another type of eye on the wire-rope sling. The body of the wedge socket consists of an eye for hooking and a socket to accommodate the end of the wire rope sling, secured by a grooved wedge. The method of fitting the end of the sling by wedge is illustrated in Fig. W.R. 94.

The socket, which is a hooking link to the choker assembly, also protects the choker sling against wear and tear from the tractor hook, as the wire rope has no contact with the hook.

When tested, the wedged end of the 16 mm diameter fibre core rope started to slip from the socket under a pull of 7 tons.

The wedge eye sockets used departmentally can accommodate wire rope of the following dimensions:

13 - 16 mm diameter
6 - 11 mm diameter

Wedges for the choker socket are of different sizes and are grooved according to the wire rope diameter.

Fig. W.R. 96 gives specifications of the single wedge choker socket.

(2) With double wedge (Fig. W.R. 88, items 17, 18, 19; W.R. 95, item 2)

The body of the double wedge choker socket consists of an eye with two sockets below the eye, located side by side, and two wedges for securing the rope ends in the sockets in the same manner as for the single wedge socket.

The double wedge socket is used in conjunction with wire rope loading slings and sliding sling hooks, for loading small logs by the loading apparatus on self-loading lorries. Slings are of six strand wire rope with fibre core.

Fig. W.R. 97 gives specifications of the double wedge choker socket, with dimensions and wedge sizes.

(3) Dead end wedge socket (Fig. W.R. 98)

This socket is used departmentally for securing the overlapping ends of wire rope gripped by means of clamps (grips), so as to prevent slippage.

J. THIMBLES (Fig. W.R. 88, item 24; W.R. 99, 100)

Thimbles serve to protect the wire rope eye (loop) against wear and tear when it is attached to a hook, shackle, or other item of auxiliary equipment. Thimbles used departmentally are of the ordinary type, nominal thimble sizes being the diameter of the steel wire rope for which they are to be used. Thimble grooves are designed for bare rope (i.e. without servings). The thimble specified in Fig. W.R. 99 is suitable for a live load such as when used with towing tractors or lifting cranes. Ordinary thimbles must be made from rolled steel, but they may be forged. They should be well finished, neatly formed, and free of any roughness or sharp edges which may damage the wire rope.

K. SPELTER SOCKETS (Fig. W.R. 95, items 4, 5; W.R. 101, 102)

Two types of sockets are used departmentally, viz. open or closed sockets.

(1) Open socket

The body of the socket consists of two eyes with a securing pin passing through them, while the other end is in the form of a conically shaped socket. The rope is fitted into the opening of the socket and secured in place by means of socketting (Babbitt or ferruling) metal, applied by the hot process.

The open socket with wire rope is used with the crane boom bridle, attached to the A-frame socket fitting.

(2) Closed socket

This socket is similar to that mentioned above, but it has an eye instead of a pin for attachment to other equipment. It is used departmentally when wire rope is to be connected to a chain or wire rope, a shackle being used to connect the wire rope fitted socket with the chain ring, or wire rope eye.

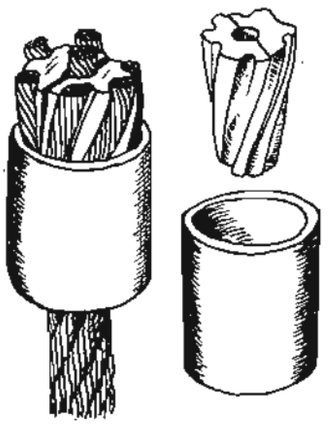
L. SAFE LINE CLAMP (Fig. W.R. 103)

The safe line clamp consists of two threaded, grooved halves which, when placed together, form a conically shaped clamp with an opening down the inside to accommodate the wire rope and its "dead" end side by side. The method of fitting wire rope to form a thimbled eye is shown in the illustration. The device may be used with small sized lines, but it is not really suitable for rough logging handling.

M. SPLICE-MASTER SLEEVE (Fig. W.R. 106 108)

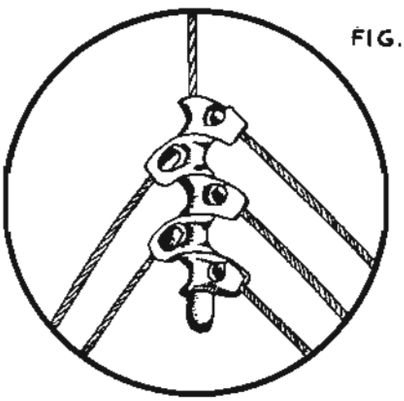
This device provides a simple, low cost method of forming an eye in the end of wire rope. As shown in the illustration, assembling the device to form an eye requires no skill and can easily be done in plantation workshops. The device would be useful for small diameter ropes used for light logging jobs. This device has not yet been tested departmentally.

FIG.W.R.104.



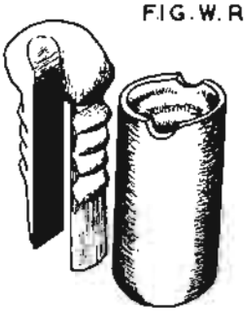
SPIRAL-WEDGE FERRULE

FIG.W.R.105



TAGLINE WITH SLIDES.

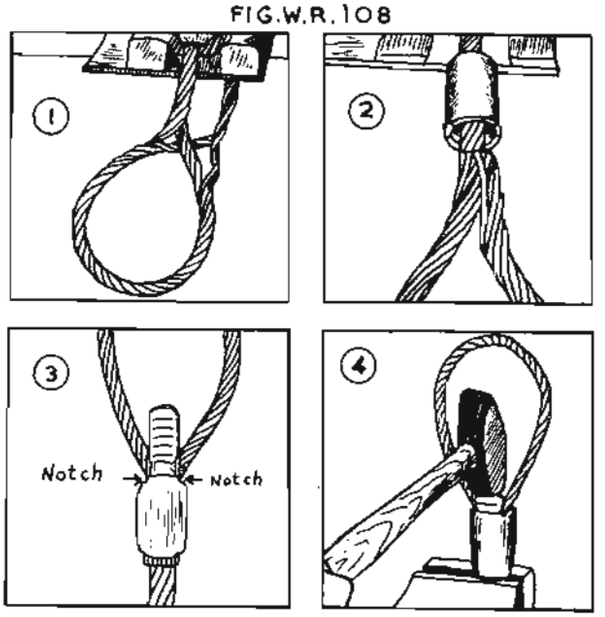
FIG.W.R.106



SPLICE-MASTER SLEEVE.

FIG.W.R.107

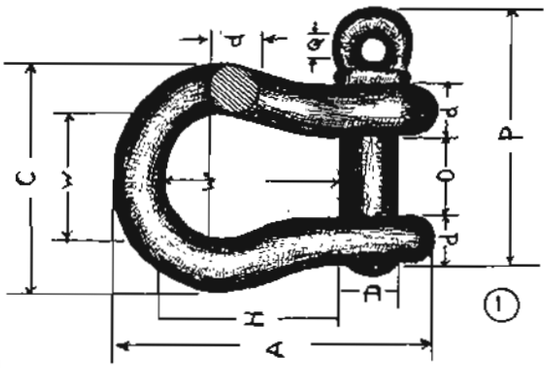
FIG.W.R.108



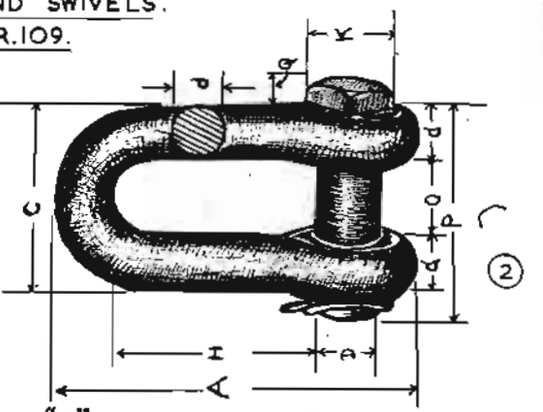
INSTALLATION OF SPLICE-MASTER SLEEVE

SHACKLES AND SWIVELS.

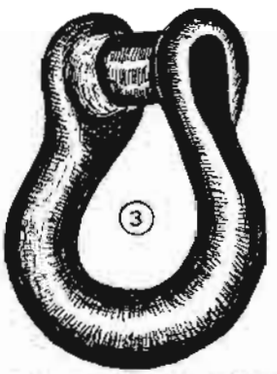
FIG.W.R.109.



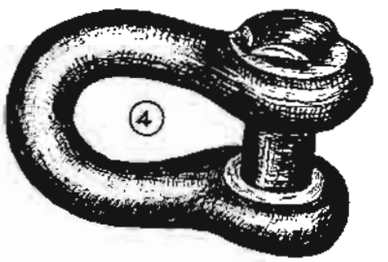
SCREW PIN ANCHOR SHACKLE.



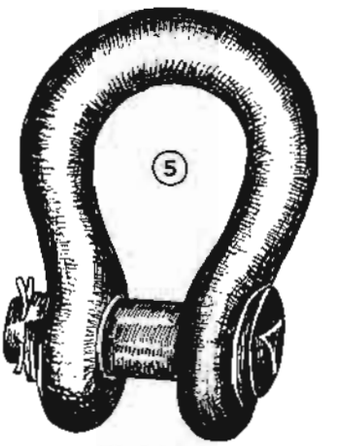
"D" GUY LINE SHACKLE



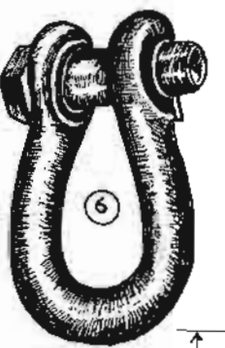
ARCH LINE CONNECTING CLEVIS NO.13.



SCREW PIN CLEVIS NO. 259

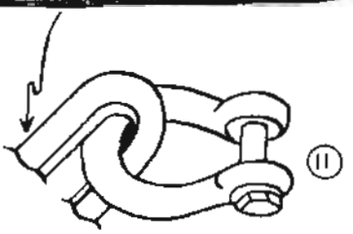


BELL SHAPED CLEVIS. NO. 266

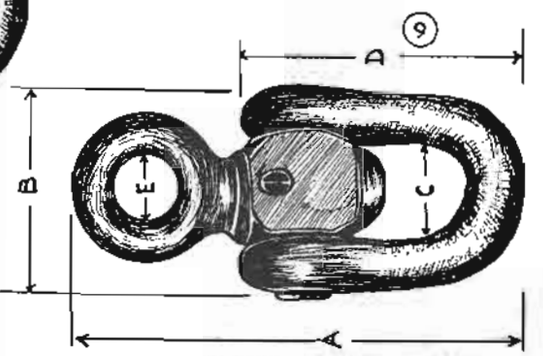


BOW GUY LINE SHACKLE NO.337

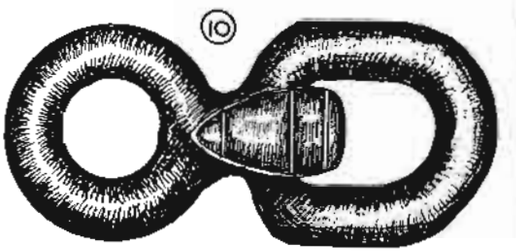
NO. 306 FOUL PROOF SWIVEL NO. 307.



NOT TO SCALE



SHACKLE SWIVEL. NO.361



DROP FORGED STEEL SWIVEL. NO.633

Assembling the Splice Master sleeve. (Fig. W.R. 108).

(1) Split cable in equal halves and wrap to form "farmer's eye".
(2) Distribute strands evenly around joint and slide Splice Master sleeve over ends of cable.
(3) Important. Make sure that cable ends protrude at least 9 mm below bottom of Splice Master sleeve, then insert wedge.
(4) Drive wedge down until head seats on shoulder of sleeve.

N. BUMPER SOCKET (Fig. W.R. 95, item 8, 8a)

The body of a bumper socket consists of a socket, for wire rope end fitting with Babbitt (or socketing) metal by means of the hot process, and two openings: the larger to provide access for socketing, and the smaller for the attachment of the shackle with slings or sling hook. The bumper is used in conjunction with the "Flying Dutchman", which is a guard plate bolted to the block side shackle fittings of loading blocks. This guard plate arrangement prevents jamming of the crane loading rope fitting attaching the loading slings, in the block. Jamming would occur if other connections were used between the slings and the crane winch rope.

O. SHACKLES (Fig. W.R. 109)

A shackle (or clevis) is a "U" or bow-shaped body with a pin through the eyes at the end of the body. U-shaped shackles are called "D" or "Dee"-schackles, and bow-shaped shackles are called bow, bell or anchor shackles. Shackles may be classified as either small or large, with different size ratings for each classification.

Shackle pins may be of the following types: eye screw pin with collar; hex screw pin; drop pin with split pin or cotter. Solid one-piece drop pins, or screw pins with nuts, are seldom used in logging.

The nominal size of a shackle is the diameter of the material of the body.

Logging shackles receive severe punishment, consequently only the best and most reliable makes may be accepted for the job. Manganese steel is the alloy best able to resist breakage or fatigue. Pins are of heat treated alloy steel, and are usually of a slightly larger diameter than the steel wire of the body.

Note: Shackles used with animal slipping gear may be locally made as no great power or speed is involved.

P. SELECTION OF THE SHACKLE (CLEVIS) FOR THE JOB

(1) "D"-shackles are usually used with animal gears as they are generally small in size (9 - 13 mm), seldom having a material diameter of as much as 19 or 22 mm. The pin used with a "D"-shackle is the eye screw pin with collar.

(2) "D" or bow-shackles with eye screw pins are used in mechanical logging when they are not subject to dragging along the ground. Where dragging does occur, the head of the pin is inclined to get bent, which makes disconnection of the shackle impossible. "D"-shackles may be used to tie down guy-lines if bow shackles are not available. They are also used in cases where a line has to be connected to the shackle fittings on the body of a machine, e.g. the crane boom bridle.

Bow, bell or anchor shackles are generally used in preference to "D"-shackles under the following conditions:

(i) When they are dragged along the ground, the bowed side of the shackle body protects the head of the shackle pin against damage.

(ii) The bow body has more accommodating space, so when two or more wire rope eyes or shackle hooks are to be attached, the bow shackle is the answer. This applies to all loading sling assemblies where two grab hooks and two slings are connected to a shackle when the latter is used instead of a ring.

(3) One-piece shackles with solid pins are used with logging arches or sulkies where a bunch of choker slings is dragged under strain with the tractor winch cable, and must pass through a fairleader. The whole rig must be as smooth as possible so as to be able to pass through without a jerk.

(4) Hex-screw pin shackles are used with the butt rigging assembly in highlead log yarding operations. The butt rigging receives severe punishment as it bumps and jerks at high speed over rocks, stumps, etc., so only clevises of the best quality and shape may be used. The head of the screw pin is well protected by the bow-shaped shackle body.

(5) The bow-shaped shackle with nut and split pin is used when fool-proof security is required for holding a sling load. This shackle is used with cranes, but is not very popular with crane operators.

(6) The bow guy-line shackle with drop pin and split pin, is used with guy-lines. The pin can be quickly inserted or knocked out by the rigger if necessary, while he is rigging the spar tree and securing the guy-lines. His working position on the tree is often extremely uncomfortable, and this type of shackle ensures that the work is done as quickly as possible.

Q. SWIVELS (Fig. W.R. 109, items 7, 8)

Swivels are used to take the twisting strain out of wire rope, when the rope stretches under the strain of a skidded load, or when the rope contracts as a load is released. Should a swivel not be used, the rope would immediately kink.

Item 7 of the illustration shows a foul-proof swivel, used whenever a slim, smooth or short swivelling link is required. The swivel is departmentally used under the following conditions:

(1) When a cable rig is pulled through the rigging block as a highlead spar tree is being rigged.

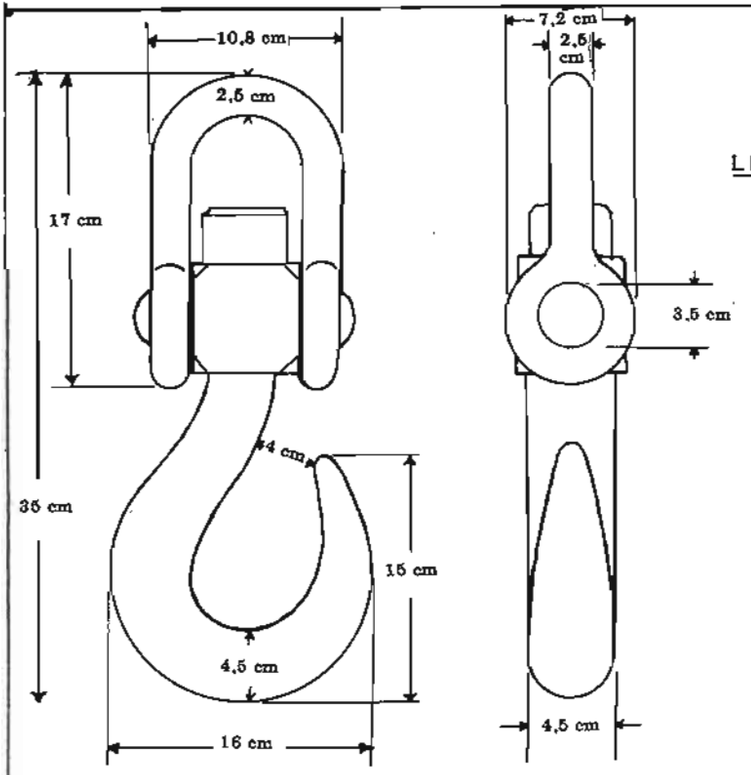


FIG.W.R.110.
LINE HOOK WITH SWIVEL AND SHACKLE.

HOOKS OF TOOL STEEL.
CROSSHEADS AND SHACKLES OF MACHINERY STEEL.
MASS : 8 kg

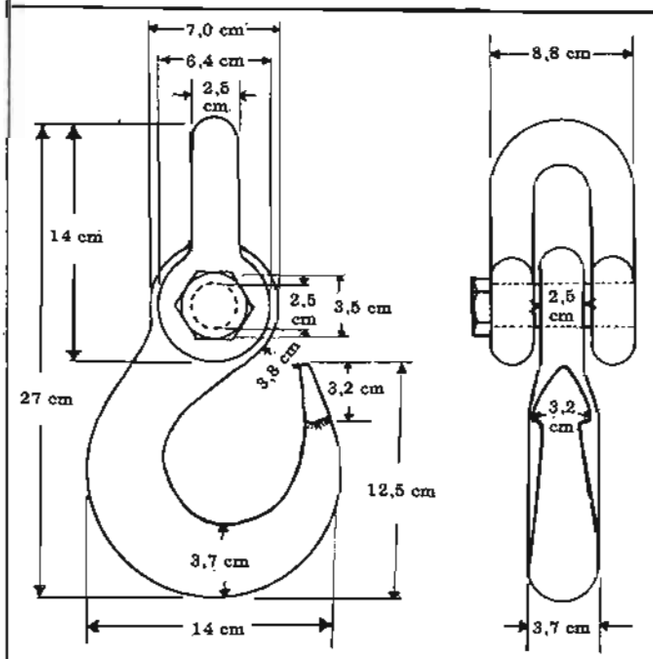


FIG.W.R.111
"ARROW POINT" LINE HOOK WITH SHACKLE.

FORGED OF SPECIAL ALLOY STEEL.
CAREFULLY HEAT TREATED.
MASS : 5 kg

FIG. WR 112

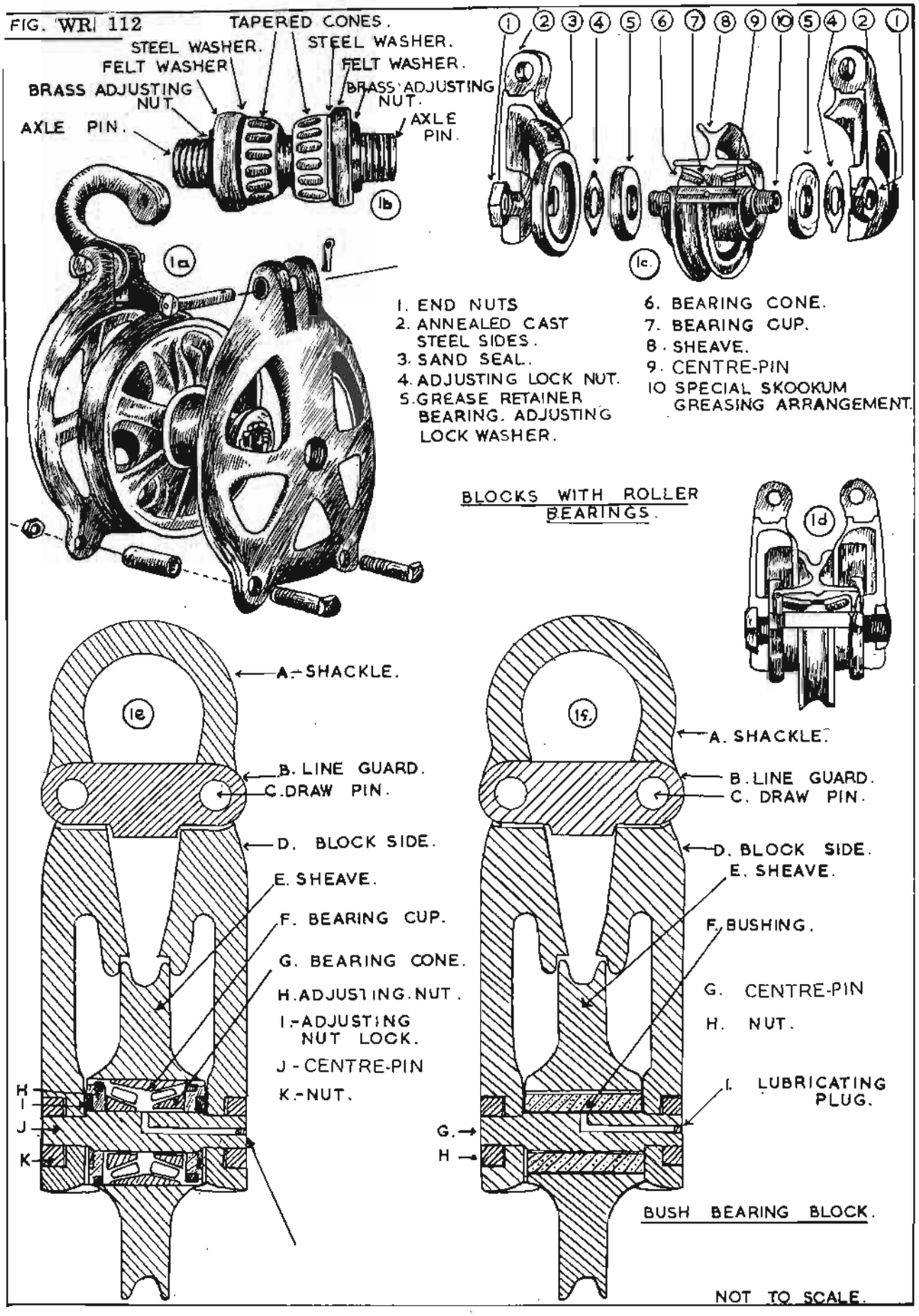

TAPERED CONES.
STEEL WASHER.
FELT WASHER
BRASS ADJUSTING NUT
AXLE PIN.
STEEL WASHER.
FELT WASHER.
BRASS ADJUSTING NUT.
AXLE PIN.
1b
1a
1c
1. END NUTS
2. ANNEALED CAST STEEL SIDES.
3. SAND SEAL.
4. ADJUSTING LOCK NUT.
5. GREASE RETAINER BEARING. ADJUSTING LOCK WASHER.
6. BEARING CONE.
7. BEARING CUP.
8. SHEAVE.
9. CENTRE-PIN
10 SPECIAL SKOOKUM GREASING ARRANGEMENT.
BLOCKS WITH ROLLER BEARINGS.
1d
1e
A.-SHACKLE.
B. LINE GUARD.
C.DRAW PIN.
D. BLOCK SIDE.
E. SHEAVE.
F. BEARING CUP.
G. BEARING CONE.
H.ADJUSTING NUT.
I.-ADJUSTING NUT LOCK.
J - CENTRE-PIN
K.-NUT.
H
I
J
K
1f
A. SHACKLE.
B. LINE GUARD.
C. DRAW PIN.
D. BLOCK SIDE.
E. SHEAVE.
F. BUSHING.
G. CENTRE-PIN
H. NUT.
I. LUBRICATING PLUG.
G.
H
BUSH BEARING BLOCK.
NOT TO SCALE.

FIG. 1 WR 113

LOGGING BLOCKS.

1

PLAIN SHACKLE BLOCK 206. 208.

SWIVEL SHACKLE BLOCK 206. 208.

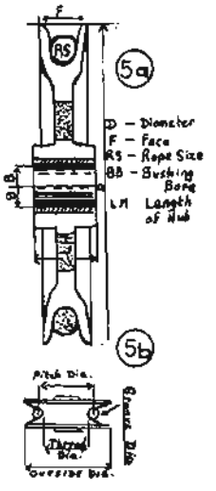
2

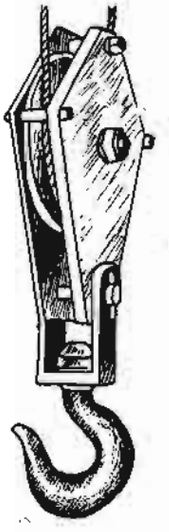
SWIVEL HOOK 206. 208. (BLOCK)

3

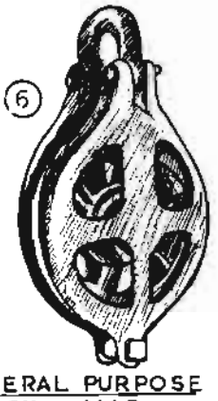
4

PLAIN SHACKLE BLOCK 7010 3122 (WITH LINE GUARD)



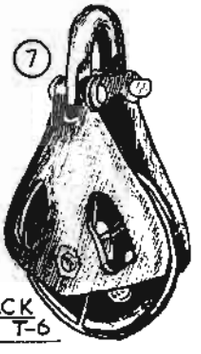


5c



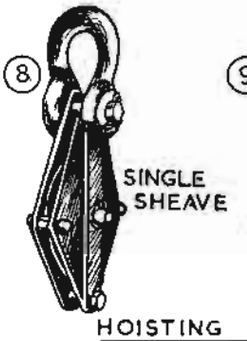
6

GENERAL PURPOSE BLOCK. 1110

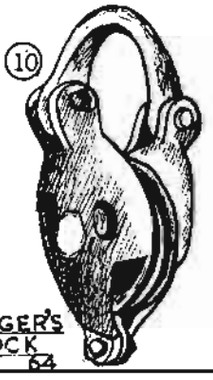


7

HAULBACK BLOCK T-6

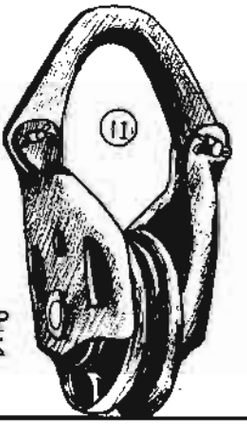


HOISTING BLOCKS



10

RIGGER'S BLOCK 66 64



11

RIG UP BLOCK 820

12

HIGH-LEAD BLOCK

13

SULLIVAN SNATCH BLOCK

(2) In the butt rigging of a highlead operation, to permit the yarded logs to roll without twisting the cables.

Items 8 and 11 of the illustration show a similar swivel which is used when a shackle must be spared in order to shorten the rig.

R. SHACKLE SWIVEL (Fig. W.R. 109, item 9)

Whenever a swivelling motion is required with a wire rope rig, the shackle swivel is used. The swivel shown in item 9 is used for log lifting by crane when a swivelling hook is not provided. The hook or slings are attached to the swivel.

The shackle swivel consists of a shackle body with an eye at each end, between which a spacer with a swivelling eye is inserted. A regular shackle can be fitted to the eye, and additional fittings such as hooks, slings, etc., can, in turn, be fitted to this shackle.

Item 10 shows a similar swivel of light construction, which is used with animal gears. The hook is fitted by means of an additional shackle to the swivel eye and this assembly is then attached to the mule swingle shackle, either directly to the second swivel eye, or by means of another shackle. Should the log in tow start to roll or twist for any reason, the rolling will not affect the swingle.

S. THE SWIVEL LINE HOOK (Fig. W.R. 110)

The swivelling line hook consists of a hook, the shank of which is embedded into the axled free rotating spacer fitted between eyed sides of the shackle body. This permits the hook to swivel in two directions, and the hook is attached with a shackle to the cable thimbled eye used with the tractor winch cable. Its swivelling ability permits the winch cable to rotate freely when under a load, or when relieved of a load, so rope kinking is avoided.

T. THE ARROW POINT LINE HOOK (Fig. W.R. 111)

The arrow point line hook consists of an eyed hook fitted with a pin between the eyed sides of the shackle body. This hook is usually used on the winch cable, but it may also be used as a general purpose hook for lifting loads. The hook sometimes used with a towing tractor in preference to the drawbar hook. The arrow point of this hook securely keeps the choker sling eyes on the hook.

Note: The hook's size depends on the size of the wire rope used. Usually a hook with a material diameter of 44 mm is used with 16 mm wire rope.

U. BLOCKS (Fig. W.R. 112, 113)

A block (pulley) is used to facilitate lifting or pulling of a load. The main parts of a modern block are:

(1) Sides - forged alloy steel.
(2) Sheave - manganese steel.
(3) Bearings - roller bearings with permanent adjustment.
(4) Hinged shackle (or bridge) - easy to open.

Note: Instead of item 4 a swivel eye with hanging clevis is used if a swivelling motion of the block is required. All parts of the modern logging block are shown in Fig. W.R. 112.

Logging blocks may be classified as follows:

(1) With regard to the rotating speed:

(i) fast rotating with roller bearings.
(ii) slow rotating - bush bearings may be accepted.

(2) With regard to application:

(i) Snatch blocks with animals and tractors.
(ii) Highlead blocks: main, head, trip and haulback blocks.
(iii) Loading blocks:

(a) Single sheave.
(b) Two or more sheave.

Note: The subject is more fully covered when the use of blocks is dealt with in conjunction with machines and their uses, in the section on log loading.

Fig. W.R. 113

Items 1, 2, 3: Block No. 206, 208, 17 kg mass, full sides, safe working load of 5 000 kg and safety factor of 5 to 1, 20 cm diameter sheave mounted on roller bearings.

Item 1: Block with plain shackle used in plantations as a snatch block when the tractor skids by winching.

Item 2: Block with swivel shackle used in plantations for loading with tractor winch and cable.

Item 3: Block with swivelling hook is supplied as a head trip block with the lorry-mounted highlead unit.

Item 4: Block No. 7010 and 3122. This is a plain shackle block with the sheave on roller bearings. Most of these blocks have been replaced, but those still available may be used as follows: No. 7010 - 16 kg mass. This block may be used as a haulback block or auxiliary block in highlead operations. Sheave diameter: 15cm, line diameter: 16 mm.

Items 5(a), (b): This illustrates the cross-section of a sheave with bush bearings. When a replacement for the sheave is required the listed data with dimensions must be supplied in addition to the make and model of the block.

Item 5(c): This shows a loading crane fall block used when a two-line operation is required. The sides of the block are long so that the block cannot turn over. A plain shackle or swivelling hook may be used with this block.

Item 6: General purpose block - replaced. Block No. 1110, full sides. Sizes from 15 - 25 cm sheave diameter.

Item 7: Plain shackle block with line guard; T.6 - 10 kg for 13 mm diameter line, with a 15 cm diameter sheave. The safe working load of this block is 4 000 kg, and it has a safety factor of 5 to 1. It is used as a haulback block with the highlead log yarding units.

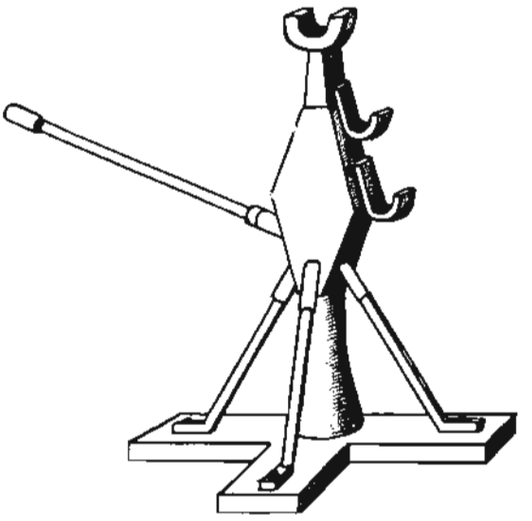


FIG.W.R.114

LIFTING JACK.

SPECIFICATIONS.

1. THE JACKS ARE REQUIRED FOR USE WITH CABLE DRUMS OF UP TO 2 METRES IN DIAMETER.

2. THE JACKS SHALL BE OF THE RATCHET LIFTING TYPE, AND SHALL BE FITTED WITH LIFTING HOOKS CAPABLE OF ACCOMMODATING SPINDLES OF 6,3 cm DIAMETER.

3. THE JACKS SHALL BE FITTED WITH "T" TYPE BASES SUITABLE FOR USE ON UNEVEN FOOTINGS.

4. THE HEIGHT OF THE JACKS WHEN LOWERED SHALL NOT EXCEED 76,2 cm AND THE LIFT SHALL BE SUCH AS TO CLEAR A DRUM OF 2 METRES BY AT LEAST 5 cm (I.E. THE MAXIMUM EFFECTIVE WORKING HEIGHT SHALL BE NOT LESS THAN 1½2 cm FROM THE GROUND LEVEL.)

5. THE CAPACITY OF EACH JACK SHALL BE NOT LESS THAN 5 TONS.

6. THE JACKS SHALL BE SUBSTANTIALLY CONSTRUCTED AND THE LIFTING MECHANISM SHALL BE SIMPLE AND RELIABLE.

Items 8,9: Hoisting blocks. A set of two is available in the Department. The set consists of a two-sheave hanging (boom) block and a one-sheave fall block. The fall block has weighted sides in order to overcome the friction of lines in the assembly and to facilitate rapid descent of the block without a load. The sheave is for 15 mm line. Both blocks are shackled, but a detachable swivelling hook may also be used.

Item 10: Rigger's block, bronze bearings, steel sides with tail hold. These blocks are used for rigging due to their small mass and wide throat clearance. No. 64. Sheave 10 cm, mass 3,6 kg Line size 9 mm diameter. The block is used to hoist rigging up the spar tree. No. 66. Sheave 15 cm, mass 7,2 kg. Line size 13 mm. Used departmentally to lift the rigger, or heavy rig.

Item 11: Rig up block, No. 820, designed for rigger's use where a wide throat is essential for passing eye splices or rope fittings. The sheave is of manganese steel, and is mounted on roller bearings. Sheave 20 cm in diameter, mass 14 kg.

Item 12 (i): Highlead block No. 1610. This block was selected for use with the D. 4 tractor-mounted yarder as a main block, when a spar tree is used. Sheave diameter: 25 cm. Mass: 26 kg. Wire rope diameter: 16 mm.

(ii) Highleadblock No. 1612 is similar to the above, but was selected for use with the D.6 tractor-mounted yarder and spar tree, as a main block. Sheave size: 30 cm. Mass: 26 kg. Rope size: 19 mm. (Not illustrated)

Item 13: Sullivan snatch block. 20 cm sheave for 13 - 16 mm wire rope diameter; bronze bushing or similar, with easy-open bridge (shackle). Used as a snatch block with animals.
Note: See the Ref. Table W.R. 113 at the end of the chapter.

V. LIFTING JACKS (Fig. W.R. 114)

The lifting jack illustrated in the above figure was selected for lifting wire rope reels when rewinding of logging cables is necessary. The use of these jacks is both time and labour saving, but they also prevent damage to the reels, especially when tightline mounting (skyline) is involved.

For departmental purposes a lifting jack of 5 ton lifting capacity is the maximum necessary, i.e. 2 jacks - 10 tons.

The advantages of this type of jack are its well spread base and the number of lifting supports allowing one to work with large or small sized reels.

W. MAINTENANCE OF BLOCKS

Blocks should be kept clean and well lubricated. If one knows in advance that the block will be subjected to dirt a special sealed bearing should be installed when the block is purchased.

Overheated bearings may result from a number of causes, such as incorrect design of bearing, use of an unsuitable lubricant, or improper application of lubricant. When a bearing suddenly becomes overheated, it is advisable to immediately apply a good quality, fatty oil, as the viscosity of oil of this kind does not diminish with a rise of temperature to the same extent as is the case with mineral oils. Olive oil is good for such emergencies. Sometimes a bearing runs hot because it has been without oil for a short time.

When a bearing which usually runs cool (thus showing that the design is not at fault) repeatedly becomes heated, it should be taken apart and examined carefully. The boxes may be adjusted too closely, or the bearing surfaces may be scored or grooved. Sometimes a surface crack in the bearing will cause heating as it intercepts the oil film and allows the lubricant to escape. If the bearing is apparently in good order, the lubricant may be the cause of the trouble. If the viscosity is too low, the oil film does not form properly and there is direct contact between the rubbing surfaces. A bearing also tends to become heated if the viscosity of the oil is too high.

Note: Logging blocks are machines and need to be looked after.

(a) FINAL REMARKS

The blocks mentioned and specified in the foregoing paragraphs are blocks which have been bought and used in the Department. They were originally purchased because of their adaptability for departmental logging, which may be classified as light or medium logging. Apart from this, many blocks were supplied with the machinery (cranes, highleads, etc.) and were selected by the equipment manufacturers. Other blocks were bought on tender, where price decided the purchase.

There are many similar blocks of a design and quality equal to and sometimes superior to the blocks used departmentally, but for the above reasons they were not purchased.

(b) LIFTING CAPACITY ON A SINGLE BLOCK

It should be pointed out that the load strain on a single block with a single line is a minimum of twice the load mass. As a safety factor of 2 to 3 applies to a load skidded along the ground, so the breaking strain of block has to be 4 to 6 times that of the skidded load. In the case of lifting, the safety factor is 4 to 5, so breaking strain of blocks used in lifting operations should be 8 to 10 times that of the lifted load.

3. THE USE OF WIRE ROPE IN LOGGING

Only brief information on the use of wire rope in logging will be given in this section, as specific and detailed information is given under the sections of the manual relating to particular equipment.

Note: Expressions such as wire rope, cable or line, when used in this manual, may be considered as having the same meaning.

FIG.W.R.115

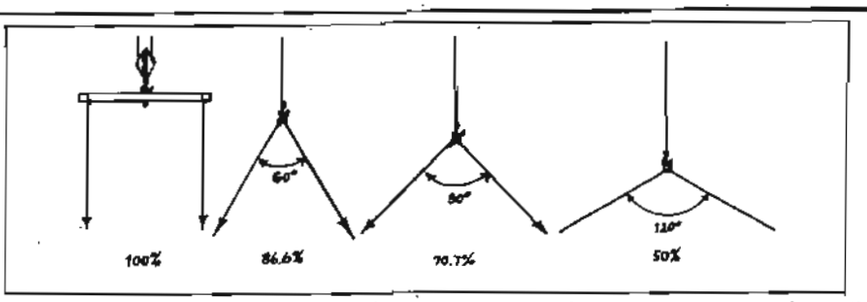


CHART 1. THIS CHART SHOWS HOW THE RATED CAPACITY OF A BRIDLE SLING DECREASES AS THE ANGLE OF THE LEG SPREAD INCREASES, APPLIED TO ROPES OF GIVEN DIAMETERS.

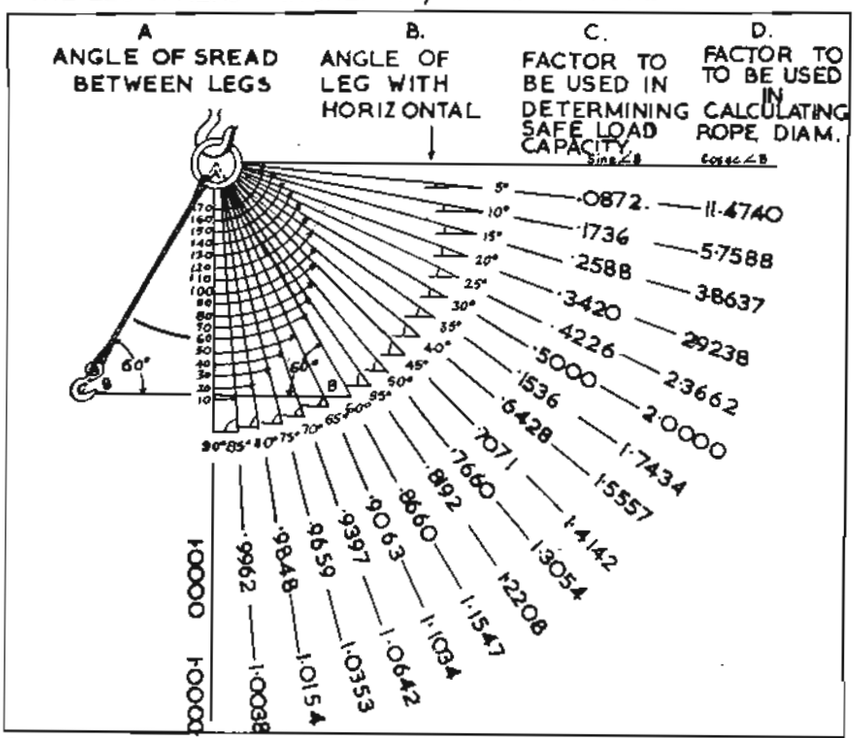


CHART 2. MAY BE USED IN DETERMINING THE RATED CAPACITY OF A GIVEN SLING OR IN CALCULATING PROPER ROPE TO USE FOR A GIVEN LOAD. THE ANGLE CORRESPONDS TO THE LEGS OF THE SLING TAKEN AT INTERVALS OF FIVE DEGREES.

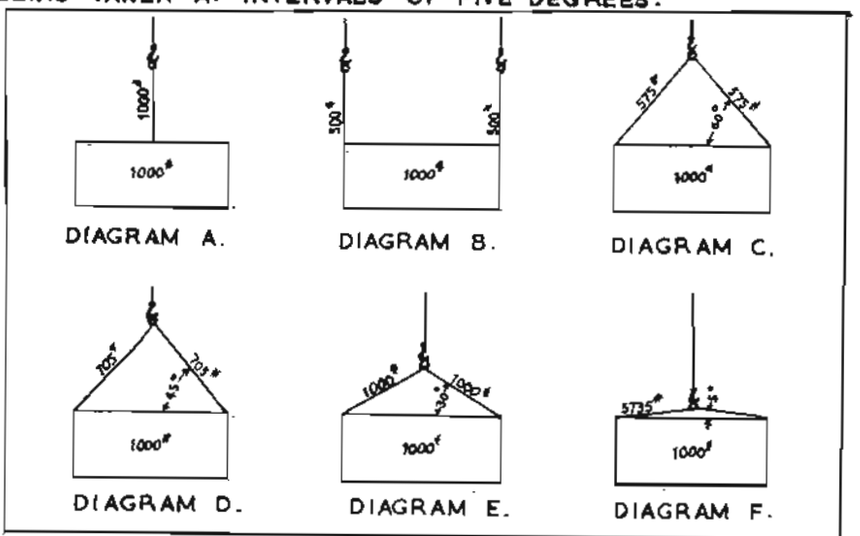


CHART 3. SHOWS HOW TENSION IN A SLING INCREASES AS THE ANGLE WITH THE HORIZONTAL PLANE INCREASES. IN (A) A 454 kg TENSION ON VERTICAL CENTRE LIFT. (F) DEMONSTRATES THE HIGH TENSION PRODUCED WHEN SLING IS USED AT FLAT ANGLE.

FIG.W.R.116

TESTS OF WIRE ROPE FITTINGS.

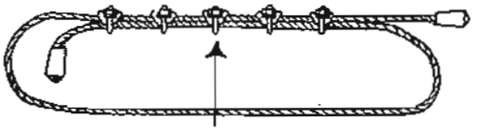
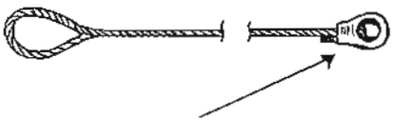
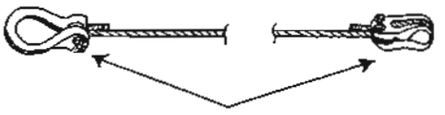
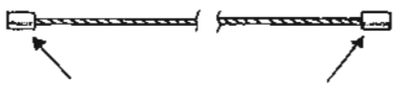
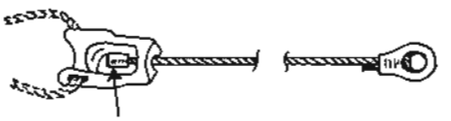
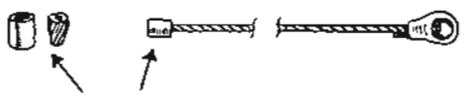
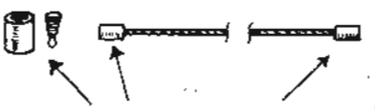
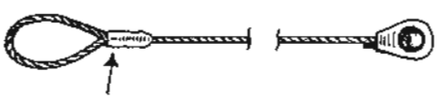
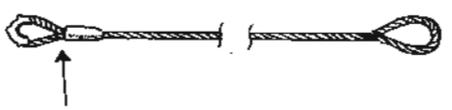
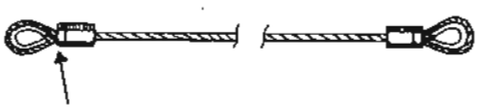
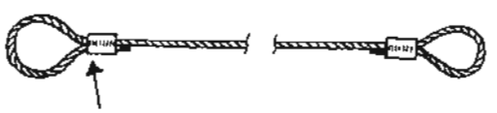
PART TESTED.	LOAD kg	WIRE ROPE DIAM. mm	PART BROKEN	REMARKS
 CROSBY CLIPS.	21 000	16	WIRE ROPE	—
 WIRE ROPE IN WEDGE SOCKET 13—16 mm	7 656 13 018	13 16	WIRE ROPE	BROKE NEAR WEDGE
WEDGE CHOKER SOCKET. 6—8 mm	6 800	9	NONE	TEST STOPPED.
" " " 6—8 mm	12 500	11	WIRE ROPE	BROKE NEAR WEDGE.
" " " 13—16 mm	13 600	13	WIRE ROPE	DO.
" " " 13—16 mm	20 000	16	NONE	TEST STOPPED
 CLAMP AND THIMBLE COMBINATION. 6 mm	1 800	6	NONE	CLAMP AND THIMBLE SLIPPED.
DO. 9 mm	3 700	9	NONE	DO.
DO. 11 mm	6 160	11	NONE.	DO.
DO. 13 mm	7 000	13	NONE	DO.
DO. 16 mm	11 100	16	NONE	DO.
DO 19 mm	15 400	19	NONE	DO.

FIG.W.R.117

TESTS OF WIRE ROPE FITTINGS.

PART TESTED	LOAD kg	WIRE ROPE DIAM. mm	PART	REMARKS
 FERRULE SET WITH BABBITT-METAL.	8 150	13	WIRE ROPE	ROPE BROKE BETWEEN THE TWO FERRULES
 CLAMPED FERRULE	6 800	16	NONE	FERRULE SLIPPED.
 FERRULE WITH SPLIT SCREWY WEDGE.	(6 300) 9 100	16	NONE	SOCKET WEDGE STARTED TO SLIP. SOCKET WEDGE DISPLACED.
 FERRULE WITH CONICAL WEDGE.	SLIP STARTED. 600 500 1,000 1,500	3 400 7 000 7 900 5 300	16 NONE	FOUR TESTS. AT ULTIMATE LOAD FERRULE AND WEDGE WERE DISPLACED.
 CLAMPED EYE.	8 700	16	WIRE ROPE	BROKE NEAR SOCKET
 SUPERLOOP CLAMP AND STIRRUP.	8 100	13	WIRE ROPE	ROPE BROKE JUST ABOVE CLAMP.
 NUT-TYPE CLAMPS.	4 200 3 600	13 16	NONE	CLAMPS SLIPPED.
 TALURIT CLAMPS.	8 500	13	WIRE ROPE	BROKE JUST ABOVE CLAMP.

Wire ropes used departmentally have the following construction:

(a) GROUP A

(1)(i) Material: Special improved plough steel wire rope of 1896 MPa tensile breaking strength.
(ii) Rope construction: Seale.
(iii) Number of wires per strand: 19.
(iv) Number of strands: 6.
(v) Lay: Ordinary.
(vi) Core: Independent wire rope core (I.W.R.C.)
(vii) Preformed.
(viii) Plain (not galvanised).

(2) Used with:

(i) Tractor single-drum winch up to 40 kW - diameter ..... 16 mm
length ..... 75 m
(ii) Highlead yarder double-drum winch:
(a) Lorry-mounted - 75 kW - main line - diameter ..... 19 mm
length ..... 230 m
(b) Lorry-mounted - 75 kW - haulback line - diameter ..... 13 mm
length ..... 600 m
(c) Cat. tractor: D. 6-mounted - 50 kW - main line - diameter ..... 19 mm
length ..... 230 m
haulback line - diameter ..... 13 mm
length ..... 600 m
(d) Cat. tractor: D. 4-mounted - 35 kW main line - diameter ..... 16 mm
length ..... 200 m
haulback line - diameter ..... 11 mm
length ..... 380 m
(3) Wyssen Skyline yarder: 20 kW-operating cable - diameter ..... 9 mm
length ..... 1 500 m
main cable - diameter ..... 21 mm
length ..... 1 500 m

(4) Guy-lines for all the above-mentioned units are of the same construction as their main lines, but for lighter logging, guy-lines with fibre cores may be accepted.

(b) GROUP B

(1)(i) Material. Same as in Group A.
(ii) Rope construction: Seale.
(iii) Number of strands: 6.
(iv) Number of wires: 19.
(v) Lay: Ordinary.
(vi) Core: Fibre.
(vii) Preformed.
(viii) Plain (not galvanized).

(2) Used with

(i) Tractor and highlead - choker hook slings - diameter: ..... 13 - 16 mm
standard length: ..... 4 m
(ii) Wyssen Skyline yarder - tripping line: diameter - ..... 9 mm
length - ..... 60 m

Note: For heavier logs and hard soil surface, slings with independent wire rope core will be more suitable.

(c) GROUP C

(1)(i) Material: As in Group A.
(ii) Rope construction: Seale.
(iii) Number of strands: 6.
(iv) Number of wires: 25.
(v) Lay: Ordinary.
(vi) Core: Fibre.
(vii) Preformed.
(viii) Plain (not galvanized).

(2) Used with

(i) Hoist - loading line: diameter: 13 - 16 mm
length: ..... 60 m
(ii) Hoist - loading slings: diameter: 13 - 16 mm
length: including spliced eyes: 4 - 5 m.
(iii) Log skidding: Choker hook sling:
diameter: ..... 13 mm
length: ..... 2,5 - 3 m

(For small timber with choker hitch assembly - preferably on soft ground).

(d) GROUP D

(1)(i) Material: As in Group A.
(ii) Rope construction: Seale.
(iii) Number of strands: 6.
(iv) Number of wires: 19.
(v) Lay: Lang.
(vi) Core: Fibre.
(vii) Preformed.
(viii) Plain (not galvanized).

(2) Used with

Wyssen Skyline: Skyline, load carrying -
diameter: ..... 21 mm
length: ..... 1 500 m

Note:

(i) Used with 4-wheel carriage.
(ii) This cable can untwine easily, so it must be rigidly anchored at both ends. No slings, shackles or swivels are allowed between cable and anchors.

(e) REMARKS

Comparing the four specifications of wire rope mentioned above, one notices the following: material, construction, number of strands, preformation and plain finishing are common for all wire ropes used departmentally. Ropes differ in the following respects:

(1) Number of wires per strand: 19 or 25.
(2) Kind of lay: Ordinary or Lang lay.
(3) Core: Independent wire rope core (I.W.R.C.) or fibre.

Fibre core, more wires in the strand and Lang lay are accepted for flexibility, and independent wire rope core and 19 wires in the strand for sturdiness. Ordinary lay is preferred as it resists untwining, permitting the use of swivels if necessary.

A. SLING SAFETY (Fig. W.R. 115)

The stress on loading slings is not only dependent on the mass of the load lifted, but also on the angle under which the pair of slings is working. In wire rope manufacturers' catalogues, tables are given which show the stresses on slings working in pairs in relation to the load mass and angle of application.

Three simple self-explanatory charts have been selected to show the stresses on slings, and are illustrated in Fig. W.R. 115. These charts may be used to determine:

(1) The sling strength required to lift loads, when the lifting cable is at a given angle, according to which the correct size of rope or chain can be selected. The angle depends on length of the slings and length of the load.

(2) Whether slings available are able to withstand the mass of the load to be lifted with safety, and if so, under what maximum angle the slings may be used. An angle of between 60 and 90 degrees at the junction of the slings is regarded as being the optimum.

Sling strength is to a large extent dependent on the fittings, i.e. the rings, hooks, shackles, etc. which must consequently be selected in accordance with the strength of the wire rope used.

When slings are to be passed around the load, care must be taken that they do not touch any sharp edges, as these may permanently damage slings. Loads must be lifted gradually, and jerking the load is not permitted.

B. TESTS OF WIRE ROPE FITTINGS

Figs W.R. 116 and 117 illustrate various wire rope fittings which were tested by the laboratories of the South African Bureau of Standards. The illustrations also give the ultimate loads sustained by the fittings and the part of the assembly which broke. The ultimate loads as indicated should never be regarded as the loads which the fittings are able to take. The safe load for which they may be used can be found by applying the relative safety factor for the type of operation in which the fittings are used.

LOGGING BLOCKS, FIG. W.R. 113

Item No.	Power unit			BLOCK SPECIFICATIONS					REMARKS
	Kind	kW	Purpose	Make	No.	Mass. Kg.	Safe working load. Ton.	Wire rope dia. mm.	
1	Tractor with single drum winch	up to 40	Snatch block	Skookum	208	17,2	6,0	16	Standard schackle Fast rotating sheave
2	do	40	Loading	do	208	17,2	6,0	16	Swivel schackle, fast rotating sheaves
3	Yarder-highlead (Loggers dream)	75	Head trip block	do	208	17,2	6,0	13	Swivelling hook
4	Yarder-highlead D.6 tractor	50	Main block	Young Co.	3122	31,7	5,5	19	With spar tree rigging-replaced
4	do	50	Haulback	do	7010	16		13	do
5 a b	Spare part		Sheave						Measurements to be specified
5c	Loading		Fall block	Young Co.					Size depends on load crane or tightline
6	Auxiliary block		General	Timberland Co.	1110				Size depends on load - replaced
7	Yarder-highlead	35 75	Haulback	Skookum Co.	T.6	10	4,5	13	Standard schackle Fast-rotating sheave
8	Hoist		Fall block	Skookum					Size depends on load Standard shackle One line
9	Hoist		Lifting	do					Standard shackle. Two lines Size as above
10	Yarder-highlead	35 , 75	Riggers	Young Co.	64	3,6		6-9	Auxiliary in rigging
10	do	do	do	do	66	7		13	do
11	do	do	Rigging	do	820	18		13	Flared shackle
12	Yarder-higblead D.6 tractor	50	Main block	Mallory Co.	1612	26	5,5	19	Swivel shackle, fast rotating sheave. Used with spar tree
12	do D.4 tractor	35	Main block	do	1610	23	4	16	do
13	Animals		Snatch	Sullivan			4	13-16	Sheave diameter 150-200mm slow rotating. Standard shackle

The use of chain in logging

II. THE USE OF CHAIN IN LOGGING

INTRODUCTION

The chain and chain fittings are discussed in this section of auxiliary equipment, in order to facilitate the correct chain selection for the logging job where chain is to be used.

It should always be borne in mind that a chain is as strong as its weakest link. The weakest link is not always easily recognisable, but weaknesses of the chain and attachments, damage to the chain, and preventive maintenance are fully discussed under the relevant sections.

The use of chains in logging can be divided into two catagories: towing and lifting. A certain tolerance in chain make and condition is permitted when it is used for log towing, provided that there is no danger to living beings or machinery should the chain or its fittings break. In the case of lifting loads, however, only prime quality chain and fittings should be selected. Chain and attachments should be purchased with a full guarantee for their lifting capacities, and should bear the manufacturer's markings. Economy does not pay if cheap chain of inferior quality is purchased.

Chain is susceptible to jerking when the load in tow hangs up against ground obstacles. For this reason chain is not very suitable for use when towing logs by tractor, as severe jerks occur which damage the chain, causing the links to break, unless they are thick and of heavy material construction. A set of 5 such heavy chains cannot easily be carried and handled by one chokerman and it is necessary to employ at least one additional labourer for the job, which is uneconomical.

When draught animals are used for log towing and hang-ups occur, virtually all the punishment is taken by the animals and chain breakages seldom occur, unless the links have been weakened.

Chain of 9 mm link material diameter is satisfactory for log slipping with animals, and one or two chains are sufficient to chain a load for a team of animals, so handling of the chain by one labourer presents no problems.

Apart from the suitability of chain for animal slipping, the grip of the chain on logs is not as good as that of wire rope choker sling assemblies, especially when logs are skidded thin end forward, or logs are debarked or have thin or wet bark.

A. DEFINITIONS AND INSTRUCTIONS

(1) Working load limit (safe working load)

The "working load limit" or safe working load, is the maximum load which, at any time or under any conditions, should ever be applied to chain, even when the chain is new and in the same condition as when it left the factory, and when the load is evenly applied only in direct tension to a straight length of chain.

(2) Proof load

Proof load is the tensile test applied to a chain during, or subsequent to, the process of manufacture, for the sole purpose of detecting defects in the material or manufacture. It is the load which the chain has withstood, in the condition and at the time it left the factory, under a test in which the load has been applied in direct tension to a straight length of chain, at a uniform rate of speed, on a standard horizontal chain testing machine. The load applied varies with the size and type of chain being tested, but is sufficient to provide the necessary proof test.

FIG. C. 1.
HOW TO MEASURE CHAIN.

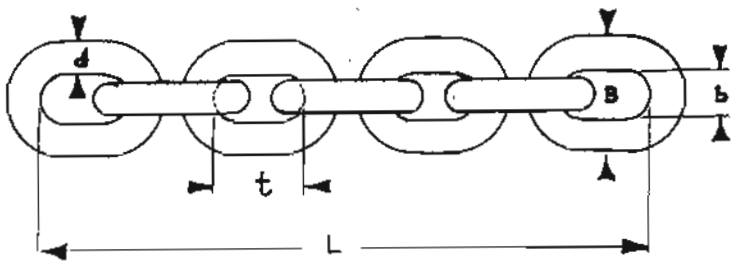


FIG. C.2.

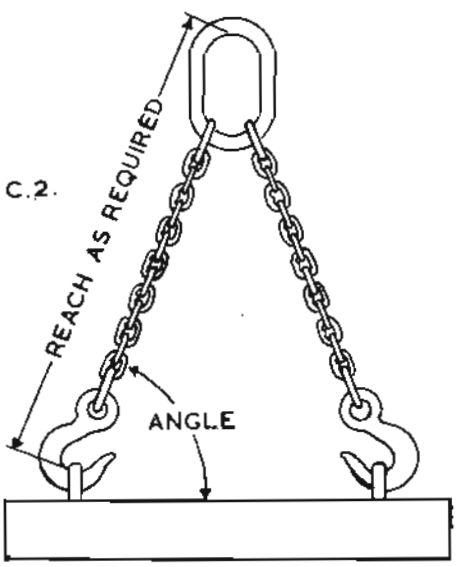


FIG. C.3.

SHORT LINK.

FIG.C.4.

LONG LINK.

FIG.C.5.

LADDER LINK.

FIG.C.6. TWISTED LINK

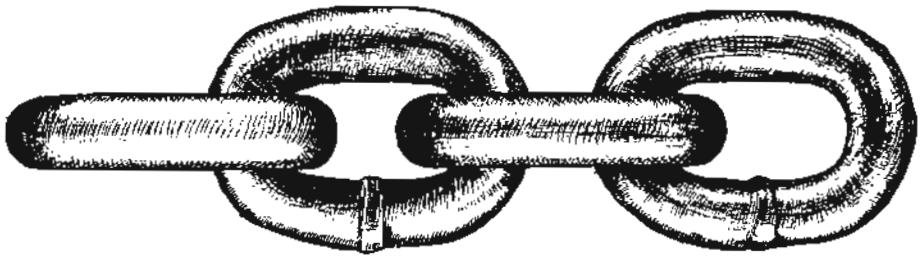
FIG. C.7.

8 LINKS.
LADDER LINK

TWISTED LINKS.

MULE TRACES.

NOT TO SCALE.



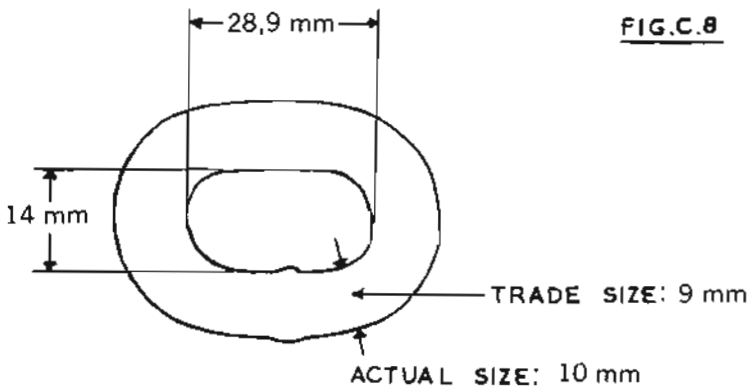


FIG.C.8

ALLOY STEEL CHAIN.

SPECIFICATIONS.

ALLOY STEEL CHAIN MUST BE MADE FROM SPECIAL ANALYSIS ALLOY STEEL FORMED INTO STRESS FREE LINKS AND ELECTRICALLY FLASH WELDED. IT MUST BE HEAT TREATED TO A BRINELL HARDNESS OF FROM 265 TO 285, IN A CONTROLLED ATMOSPHERE FURNACE, TO ASSURE UNIFORM PHYSICAL PROPERTIES THROUGHOUT THE CHAIN, AND A MINIMUM BREAKING STRAIN OF APPROXIMATELY 56 699 kg PER 6,45 cm^2. IT SHOULD NEVER REQUIRE ANNEALING. IT SHOULD BE HIGHLY RESISTANT TO SHOCK, GRAIN GROWTH AND WORK HARDNESS. ITS SHORT, NARROW LINKS SHOULD INSURE MAXIMUM FLEXIBILITY, MINIMUM WEAR, BENDING AND GOUGING.

FINISH: BRIGHT OR SELF-COLOURED.

TOLERANCE: MASSES AND DIMENSIONS ARE SUBJECT TO A TOLERANCE OF PLUS OR MINUS 4 %.

MASS PER METRE: 2,396 kg

WORKING LOAD LIMIT. 2 500 kg (PROOF TESTED TO DOUBLE WORKING LOAD LIMIT.)

LINKS PER METRE: 32,9

BREAKING LOAD: 9 500 kg.

(3) Average ultimate (breaking) load

Average ultimate (breaking) load is the average load, at which the chain, in the condition it would leave the factory, has been found by experience to break, under tests in which the load is applied in direct tension to a straight length of chain, at a uniform rate of speed, on a standard horizontal chain testing machine. Data showing "average breaking load" are not published in catalogues as this may lead to confusion or misuse.

(4) Instructions regarding attachments

Where attachments, such as hooks or rings, are designed for use with chain in sustained loads, care should be taken to select the attachments of the recommended type, size and grade for use with the type, size and grade of chain with which such attachments are used.

When this is done, the "working load limit" of such chain, in the sense that the term is defined above, will apply to the chain and the attachments thereon.

(5) Method of measuring chain (Fig. C. 1)

To determine the dimensions of the link in a chain measure:

(1) The thickness of the link, "d". From this we can determine the thickness of the wire from which the chain is made. This is the "size" of the chain, specified in catalogues as "chain size, millimetres."

(2) The inside length, "L". When this figure is divided by the total number of links comprising the chain, the quotient gives us the inside length, "t", which is the essential factor in determining the number of links required to make up a given length of chain.

(3) The inside width, "b". It should be large enough to allow the adjacent link to bottom with sufficient clearance and can be calipered.

(4) The outside width, "B". This can be determined by adding to the inside dimension "b" the diameter of the material "d", multiplied by two.

(5) "Reach" (Fig. C. 2) is measured from the upper bearing surface of the master link to the lower bearing surface of the hook when the sling is hung in position and "branches" dropped vertically.

B. TYPES OF CHAIN USED IN LOGGING

(a) PROOF COIL OR MILD STEEL CHAIN

This type of chain, often referred to as common chain, is made from basic open hearth steel. It is not intended for use as a sling or overhead lifting chain. Mild steel chain is electric butt welded.

There are various types of mild steel chain used in logging:

(1) Short link chain (Fig. C. 3)

This chain is primarily used in logging for animal slipping as a log-towing or "logging" chain, fitted with a special logging hook. Two sizes of chain are used, the one a 9,5 mm chain with a mass of 72 kg per 30 metres and a safe working load (S.W.L.) of 1 170 kg and the other a 9,5 mm chain with a mass of 61 kg per 30 m and a safe working load of 1 135 kg. The latter chain is preferred because of its lightness which makes for easier handling.

An 8 mm short link chain, with a S.W.L. of 1 170 kg is used for log load binding on lorries and sledges.

(2) Ladder link chain (Fig. C. 5, 7)

Eight millimetre ladder link chain is used with traces in mule harnesses. This chain has a S.W.L. of 860 kg.

(3) Long link chain (Fig. C. 4)

Nine millimetre long link chain with a S.W.L. of 900 kg is used for ox trek chains.

(4) Twisted link chain (Fig. C 6)

Unhardened electric butt-welded mild steel chain is used for twisted links. Twisted link chains are machine twisted and are not subsequently proof tested as such a test would deform the links. The actual twisting proves the soundness of the weld. As they are not proof tested, the actual safe working load cannot be specified. Five millimetre twisted link chain is used in mule harnesses for traces (Fig. C. 7).

(b) HIGH TENSILE CHAIN (Hi-test chain)

This chain is electric butt-welded from C.1017 steel (American Standard), and is heat treated. Characteristic of this chain is the finer grain of its metal, higher tensile strength and longer wearing qualities.

The Department has tested this type of chain with the possibility in mind of using it for log skidding operations with tractors, a 9 mm chain being used with a mass of 228 kg per 100 metres and a S.W.L. of 2 310 kg.

Note: Mild steel chain is used for log skidding with wheel-tractors. Nine millimetres chain, long or short link, is used, depending on the drawbar thickness where slots are located for chain attachment.

(c) ALLOY STEEL CHAIN (Fig. C. 8)

Alloy steel chain is made from special analysis steel formed into stress-free links and electrically welded. It is heat-treated to a Brinell hardness of from 265 to 285, acquiring an ultimate tensile strength of approximately 861 MPa. It is highly shock resistant and resistant to grain growth and work hardness. Wear, gouging and bending are reduced to a minimum because of the chain hardness and the short, narrow links. This chain is used in logging for loading slings, as an overhead lifting chain. A 9 mm chain is used with a mass of 222 kg per 100 metres and a S.W.L. of 3 000 kg.

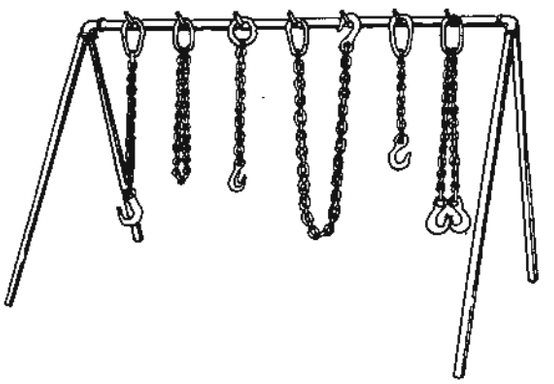
FIG. C.9.

THE ANGLE OF THE LOAD.

SAFE WORKING LOADS(kg)

CHAIN SIZE.	0°	30°	60°	90°	120°	150°
9 mm	2 300	2 270	2 040	1 666	1 178	610

FIG. C. 10.

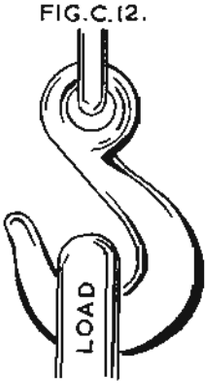


"A" FRAME FOR STORING CHAIN.

FIG. C.11.

ALWAYS BE SURE A CHAIN HANGS STRAIGHT.

FIG. C.12.



THE LOAD MUST BE PROPERLY SEATED ON THE HOOK.

C. TWO-LEG CHAIN LOADING SLINGS

IMPORTANCE OF THE ANGLE

When loads are to be lifted, the size of the sling chain must be determined by the mass of the load to be lifted, but consideration must also be given to the angle between the legs of the sling chain or the position in which it is used. It is often assumed that a two-leg sling chain will lift a load equal to the safe load of one leg multiplied by 2, whereas this is only strictly true when both legs are in a vertical position and the load is distributed equally.

The load reduction factor for double-branch sling chains at different angles between the legs is as follows:

0 degrees ...	1,00000	90 degrees	0,70711
30 degrees ...	0,96593	120 degrees	0,50000
60 degrees ...	0,86603	150 degrees	0,25882

The load lifted by multi-branch sling chains should be reduced as the angle between the legs increases, or, alternatively, heavier sling chains should be used.

If the legs of a two-leg loading sling chain are inclined at an angle of 60 degrees to the vertical (that is, an included angle of 120°), the tension or load on each leg is doubled and the safe working load of the sling is reduced by half.

Fig. C. 9 shows how the safe working load decreases as the angle increases. Double branch sling chains should never be used at an angle exceeding 120° and a much smaller angle is preferable. A maximum angle of 90° is recommended.

The table below shows the difference in safe working loads for a 9 mm alloy steel chain for angles of 60° and 90°, with even mass distribution of load between the legs.

Main ring outside diameter	Hook	Safe working load in kg at 60°	at 90°
2,5 cm x 10 cm	9 mm	1 800	1 580

D. STORING THE CHAIN

"A"-frames provide an excellent method of storage (Fig. C. 10). The chains are hung from pins at the top of the frame and looped so that no part touches the floor. Sling chains are often damaged when not in use. If thrown on the floor they collect grit that causes undue wear. Chain should be cleaned and oiled before prolonged storage and hung in a clean, dry place.

(a) PRECAUTIONS AND CARE OF THE CHAIN

The terms "working load limit", "proof test" and "ultimate breaking load" contain no implication of what load the chain will withstand if any of the above factors are changed.

Any change in the above factors, or any abuses, will lessen the load that the chain will withstand. Some examples of such changes and abuses are as follows:

- Twisting of the chain.
- Disfigurement or distortion.
- Deterioration of the chain by strain, usage, weathering, corrosion or lapse of time.
- Acceleration in the rate of application of the load, or jerking.
- Chain used for a purpose other than that for which the particular type of chain was intended.
- Application of loads in excess of recommended safe working load.

Note: The following precautions apply not only to the load, but also the attachments.

Always . . .

- remember that a chain is as strong as its weakest link.
- maintain frequent and careful inspections - clean and lubricate the chain regularly, as rust and dirt cause wear and weakness at the interlock points.
- check the length - if the chain has stretched, it has been overloaded.
- know the safe working load of the chain you use.
- use the correct type of chain for the work required.
- take special care to avoid snatch or sudden jerks.
- take special precautions or use a larger size chain when:

(a) The exact load is not known.
(b) There is a liability to shock.
(c) Conditions are abnormal or severe.
(d) There is exceptional danger to life or limb.

Never . . .

- subject a chain to more than the safe working load.
- raise a heavy load suddenly.
- allow a chain to pass round sharp corners without protection.
- allow twists, kinks or knots in the chain.
- insert a hook into a chain link.
- rest the load on the point of the hook (Fig. C. 12)
- nick or stamp a link for identification.
- drop a chain from a height.
- use excessively corroded or pitted chain or a chain with stiff or stretched links - scrap it.
- use a sling chain to roll over loads.
- hammer a chain to straighten a link or to force a link into position.
- forget that the safe working load of a two-leg sling decreases as the angle between the legs increases.

(b) INSPECTION OF CHAINS

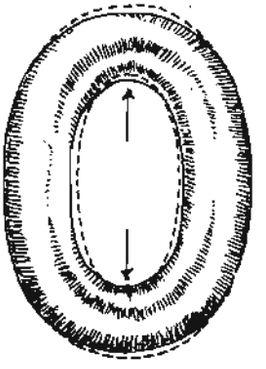
A chain record card should be kept, showing the following data:

DEFECTS IN CHAIN LINKS

FIG. C.13

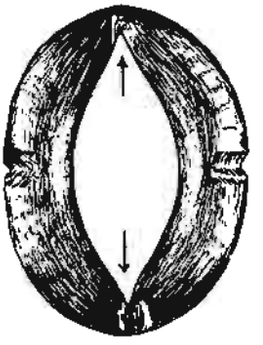
CHAIN SHOWING INTERLINK WEAR.

FIG. C.14.



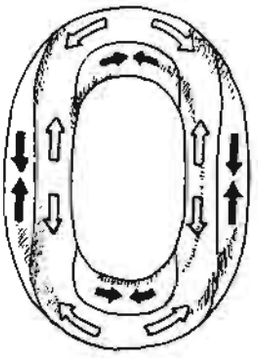
CHANGE IN SHAPE OF LINK UNDER AXIAL TENSION LOAD.

FIG. C.15.



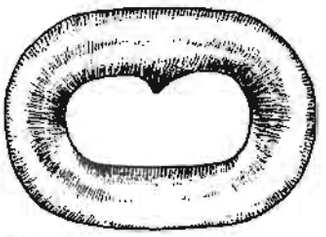
INNER TUBE ILLUSTRATING EFFECT OF AXIAL TENSION OF A CHAIN LINK.

FIG. C.16



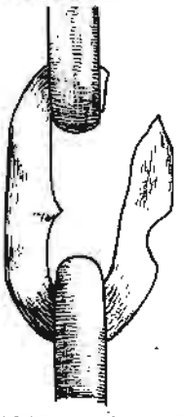
LOCATION OF STRESSES IN CHAIN LINK.

FIG. C.17.



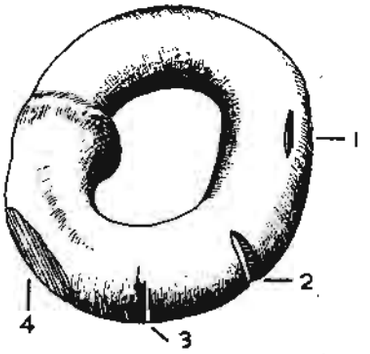
LINK OF SAFE DESIGN WITH INSWELL WELD.

FIG. C.18



GROOVED LINK BROKEN AT THE NORMAL LOCATION DUE TO SHEAR FAILURE.

FIG. C.19.



CHAIN LINK SHOWING NICKS OF VARYING DEGREES OF SERIOUSNESS.

CHAIN REPAIR LINKS.

FIG.C.20
SPLIT LINKS FOR TEMPORARY USE.

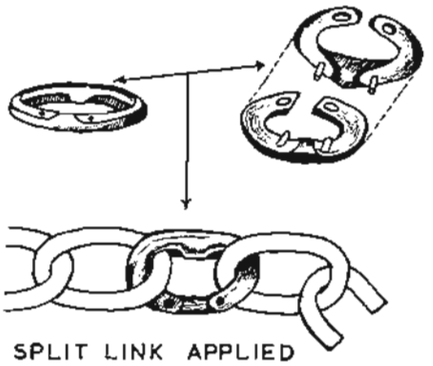


FIG.C.21
COLD SHUT LINKS.

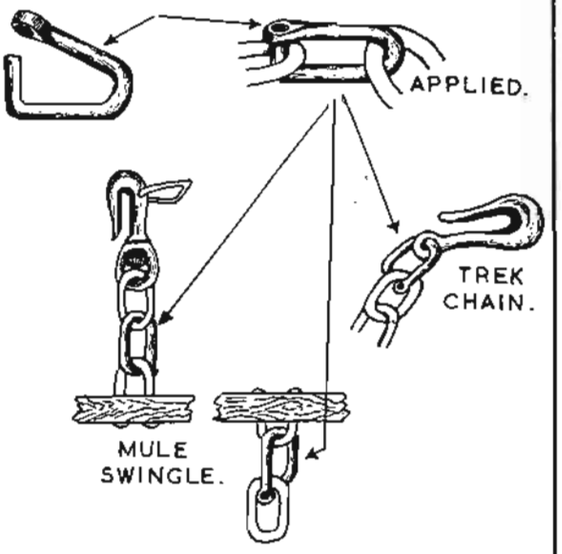


FIG.C.22
"WEDGLOK" REPAIR LINKS.

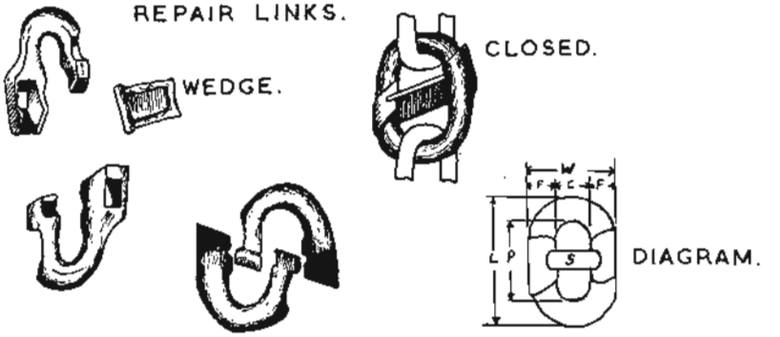


FIG.C.23.

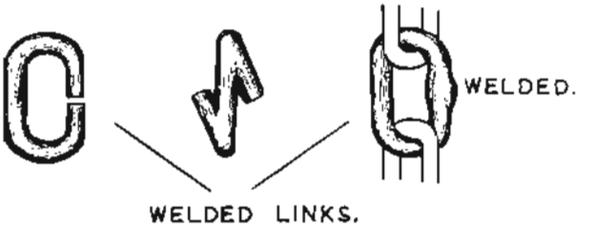


FIG.C.24

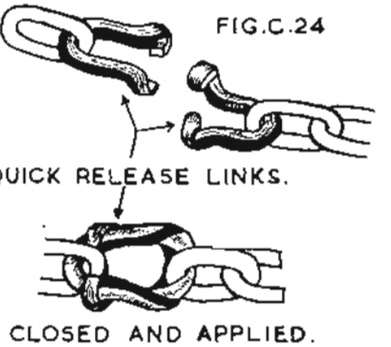
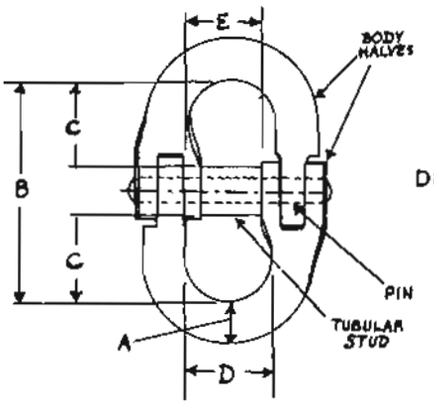


FIG. C.26

"HAMMERLOK"
COUPLING LINKS

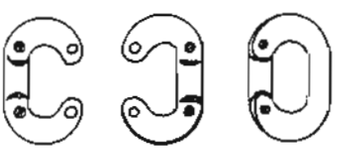


DROP-FORGED ALLOY STEEL
-SELF COLOURED-

MASSES AND DIMENSIONS ARE APPROXIMATE AND ARE SUBJECT TO PLUS OR MINUS TOLERANCE OF 4%

CHAIN SIZE mm	WORKING LOAD LIMIT. kg	A. mm	B. mm	C. mm	D. mm	E mm	MASS EACH. kg
9	3 000	11	61	22	23	20	0,22
13	5 100	16	85	32	33	28	0,63
16	7 500	19	103	39	40	34	1,04
19	10 400	22	122	45	48	41	1,66
22	13 000	25	138	51	58	46	2,69

FIG. C.25



CONNECTING LINKS.

DROP-FORGED STEEL WITH INTERLOCKING LUGS.

MASSES AND DIMENSIONS ARE APPROXIMATE AND ARE SUBJECT TO PLUS OR MINUS TOLERANCE OF 4%.

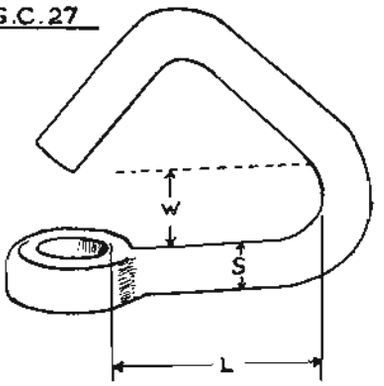
NOTE: THE INTERLOCKING LUGS ARE OMITTED IN THE 8 mm SIZE.

FINISH: SELF COLOURED. IF GALVANISED IS DESIRED, ORDER MUST SO SPECIFY.

INTERLOCKING LUGS IN CONNECTING LINKS SHOULD BE EXACTLY MATCHED IN THE FACTORY: COUNTERSUNK HOLES MUST BE PROVIDED FOR BACKING AND HEADING THE RIVETS. THE LINKS SHOULD NOT OPEN OR SPREAD AND SHOULD PROVE STRONGER THAN THE PROOF CHAIN ITSELF.

TRADE SIZE. mm	OUTSIDE DIMENSIONS. mm	MASS PER 100 PIECES kg.
8	44 x 32	4,53
9	50 x 35	9,07
11	60 x 38	13,60
13	66 x 44	19,22

FIG.C.27



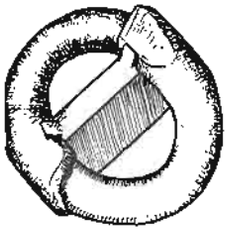
DROP-FORGED STEEL COLD-SHUT LINKS.

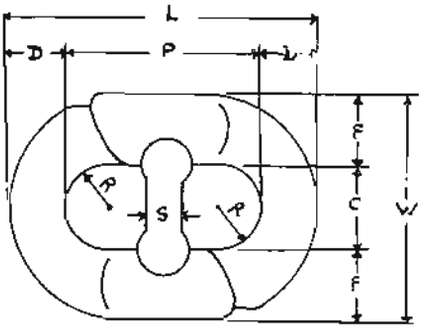
NOTE: FOR CONNECTING AND REPAIRING COIL CHAIN. IN ORDER TO ASSURE AN EXTRA FACTOR OF SAFETY IT IS RECOMMENDED THAT A COLD SHUT BE USED, ONE SIZE LARGER THAN THE CHAIN TO BE REPAIRED OR CONNECTED.

MASSES AND DIMENSIONS ARE APPROXIMATE AND ARE SUBJECT TO A PLUS OR MINUS TOLERANCE OF 4%
FINISH: SELF COLOURED UNLESS OTHERWISE SPECIFIED.

TRADE SIZE. (S) mm	INSIDE LENGTH (L) mm	INSIDE WIDTH. (W) mm	MASS PER 100 PIECES kg
4,8	29	11	1,4
6,3	29	11	2,7
7,9	32	13	4,5
9,5	35	16	8,1
11,1	38	17	12,2
12,7	41	19	17,2
15,9	51	22	38,1
19,0	60	25	63,5
22,2	70	32	104,3
25,4	76	35	158,8

FIG.C.28





STANDARD "WEDGLOK" CONNECTING AND REPAIR LINKS.

HI-CARBON, HI-TEST.

SIZE mm	FOR USE WITH ALLOY CHAIN. mm	APPROX. MASS g	SAFE WORKING LOAD kg	C	D	E	F	L	P	R	S	W
				mm								
9	8–9–11	14	2500	14	9	14	13	54	35	7	8	40

1. Serial number of chain
2. Size, type and reach
3. Date when placed in service
4. Date of each inspection
5. Date of any repairs
6. Reason and nature of repairs
7. Date of return to service
8. Final entry. Date of discard

For proper inspection the chain should be cleaned so that marks, nicks, wear and other defects can be seen. A link by link inspection should be made where a high degree of safety is required to determine the following:

1. Twisted or bent links
2. Nicks or grooves
3. Excessive wear at bearing points of links
4. Stretched links
5. Spread in throat openings of hooks
6. Distortion or damaged master links, coupling links or attachments

Stretch.

A stretched chain indicates overloading. Stretch can be determined by measuring the chain, but while the overall stretch may be within the permissible limit, a small portion of the chain may be dangerously stretched and individual links may be elongated. A link by link inspection is then necessary. If a link is of good appearance and hinges freely with adjoining links it may be considered fit for further use. The least sign of binding at juncture points indicates collapse of sides of links due to stretch. Such chains should be withdrawn from service.

(c) DEFECTS IN CHAIN LINKS

(1) Chain surface wear

Any portion of a chain link, subject to rubbing contact with another surface, will become worn. Wear points are chiefly confined to the bearing points of interlink contact and to the outer surface of the links, which may be damaged from dragging the chain along hard surfaces or from under loads.

Fig. C. 13 illustrates interlink wear. Wear can be detected by collapsing the chain to separate each link from the adjoining links. Wear is measured by means of a caliper, and a maximum tolerance of $12\frac{1}{2}\%$ is permitted on the original material dimensions.

Wear has relatively little effect on the strength of chain, due to the pattern of stress distribution in a chain link supporting an axial tension. Fig. C 14 shows, in an exaggerated manner, the change in shape that takes place under such loading conditions. It will be seen that the ends of the link move further apart, while the sides move closer together. If the link was originally in a condition of neutral stress, the loaded link, shown in "dotted" outline, will now contain stresses of compression and tension. This is illustrated more clearly in Fig. C. 15 which shows an inflated inner tube, sustaining a load in the manner of a chain link. The wrinkled sections clearly indicate the areas of compression. Fig. C. 16 shows the location of these stresses in a chain link. Tensile stresses are represented by arrows pointing away from each other and compression stresses are depicted by arrows pointing towards each other. Link wear usually occurs at the points of compression in the link, and these surfaces play a lesser role in supporting the tensile load on the chain.

Fig. C. 17 shows the safest link design, with an "inswell" weld. The weld is at the side of the link where the weld is in a straight tension and where the weld bears only half the load.

Fig. C. 18 shows a link with a groove milled to a depth of about one third of the chain material diameter. This sample link was pulled until it broke, and in spite of the significant loss of gauge at the groove, rupture of the link occurred in the normal location as a typical shear failure and at the normal strength expected of new chain.

(2) Nicks and gouges

The outside surface of links is exposed to contact with and, therefore, damage from, foreign objects. More often than not, nicks and gouges occur on the sides, rather than on the ends of links. Fig. C. 19 shows nicks of varying degrees of seriousness.

(i) Longitudinal mark in a compressive stress area. Both type and location limit the harmful effects, but the defect should be filed out.

(ii) Deep nick in an area of high shear stress.

(iii) A similar nick located in the zone of maximum tensile stress. Both of the above two nicks are dangerous and must be removed by filing or grinding.

(iv) A nick in this position has been removed by filing. Although the final cross section is smaller than before filing, the link is stronger because the stress-increasing effect of the notch has been removed.

(3) Repairs

Chains should be sent to chain manufacturers for repairs, if they cannot be safely repaired with repair links. Chains for repair can be packed in barrels, drums or heavy gunny sacks.

E. CHAIN REPAIR AND CONNECTING LINKS

(a) CONNECTING (SPLIT) LINKS (Fig. C. 20, 25)

Interlocking lugs in connecting links are matched exactly at the factory. To install press back and head rivets well into the countersunk holes provided. This link will not open or spread, but will prove weaker than the proof chain.

(b) COLD SHUTS (Fig. C 21, 27)

Cold shuts are used for connecting and repairing chain in the field. In order to ensure an additional safety factor it is recommended that a cold shut be used one size larger than the chain to be repaired or connected. Cold shuts are NOT to be used for repairing loading slings.

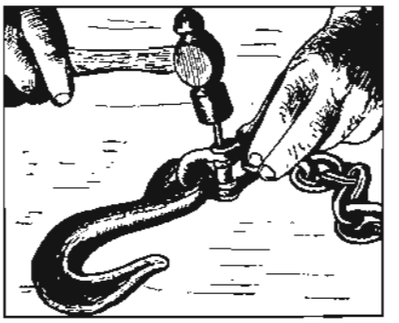
FIG.C29

HAMMERLOK" COUPLING LINK

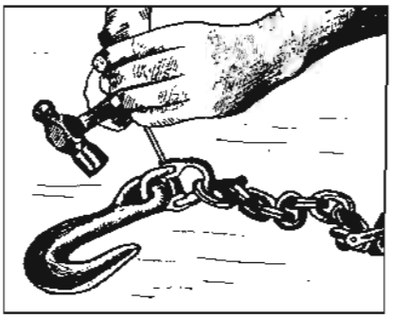
① HOOK ONE HALF THROUGH CHAIN AND OTHER HALF THROUGH ATTACHMENT.

② BRING THE TWO COUPLING LINK HALVES TOGETHER AS SHOWN.

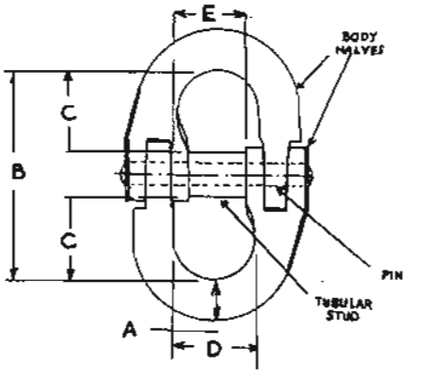
③ PLACE THE TUBULAR STUD AND TOUGH, HARDENED PIN IN PLACE AS SHOWN.



④ DRIVE PIN INTO PLACE. THE ASSEMBLY IS COMPLETE AND READY FOR USE.



⑤ TO DISASSEMBLE, DRIVE OUT PIN.



⑥

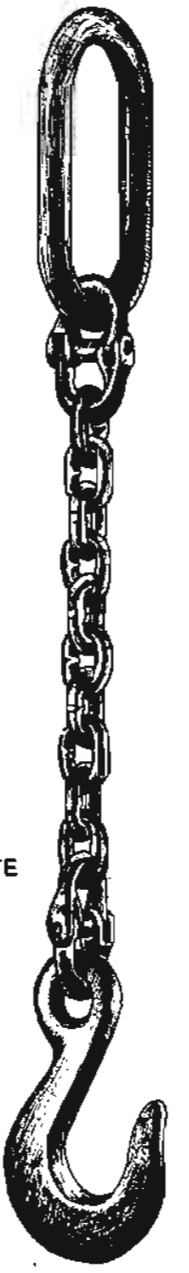
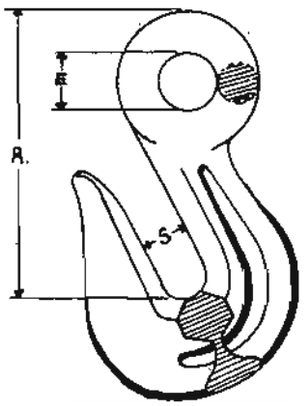


FIG.C.30



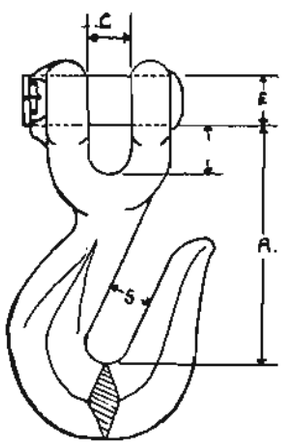
ALLOY STEEL GRAB HOOK

HEAT-TREATED: DROP-FORGED STEEL.

FINISH: SELF COLOURED.
MASSES AND DIMENSIONS ARE APPROXIMATE AND ARE SUBJECT TO A PLUS OR MINUS TOLERANCE OF 4%.

SIZE OF CHAIN mm	HOOK SIZE (S) mm	REACH. (R) mm	HOLE IN EYE(E) mm	MASS EACH. kg
6	9	57	14	0,2
9	13	76	17	0,4
13	17	114	24	1,2
16	20	126	27	1,8
19	24	159	36	3,4
22	27	184	43	5,2
25	30	208	48	7,8

FIG.C.31



CLEVIS GRAB HOOK.

HEAT-TREATED: DROP-FORGED STEEL.

FINISH: SELF COLOURED.
MASSES AND DIMENSIONS ARE APPROXIMATE AND ARE SUBJECT TO A PLUS OR MINUS TOLERANCE OF 4%.
THE HOOK MUST BE PROVIDED WITH A SPECIAL RECESS HOUSING ON THE CLEVIS TO PROTECT. THE END OF THE PIN AND COTTER.

SIZE OF CHAIN mm	HOOK SIZE.(S) mm	REACH (R) mm	HOLE IN EYE (E) mm	CLEVIS OPENING (C) mm	MASS PER 100 PCS. kg
6	9	52	11	9	23
8	11	57	14	10	34
9	13	67	16	13	54
11	15	79	17	14	77
13	17	90	21	17	118
16	20	102	22	21	186

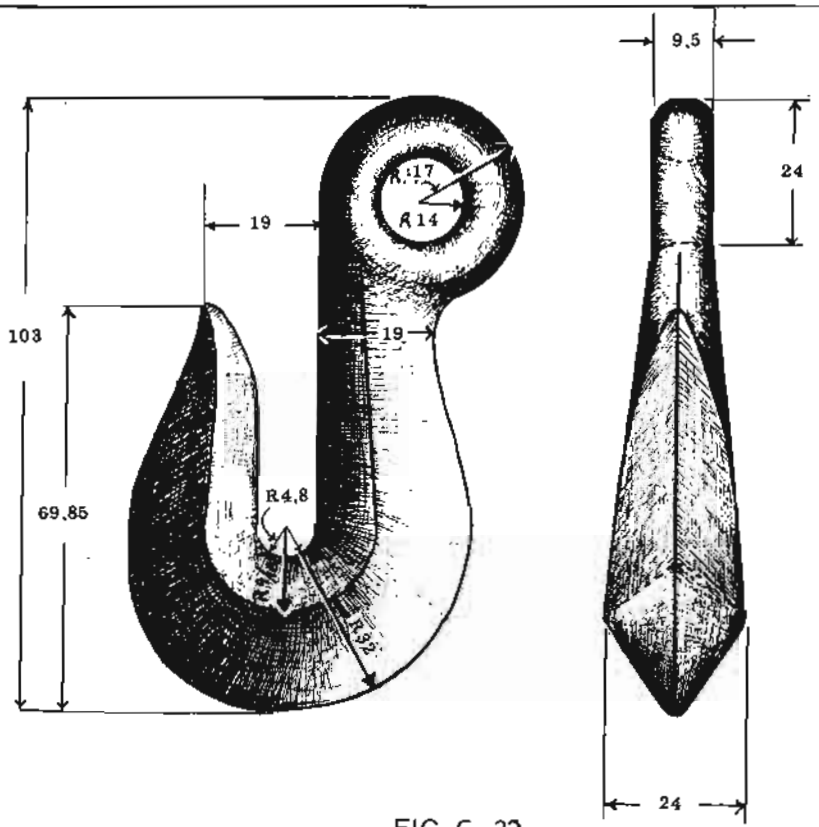


FIG. C. 32

ALLOY-STEEL GRAB HOOK.

HEAT-TREATED DROP-FORGED STEEL.

ALL DIMENSIONS IN mm

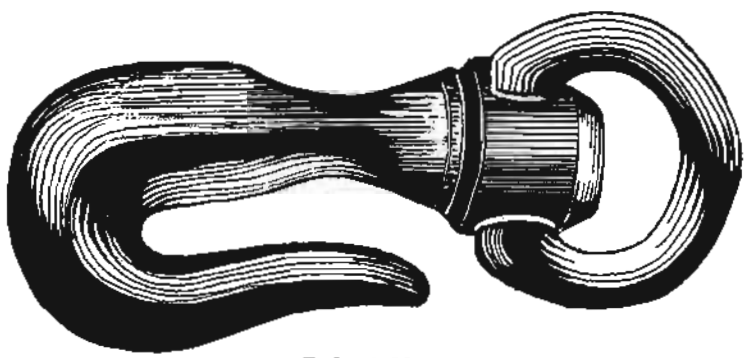


FIG. C 33

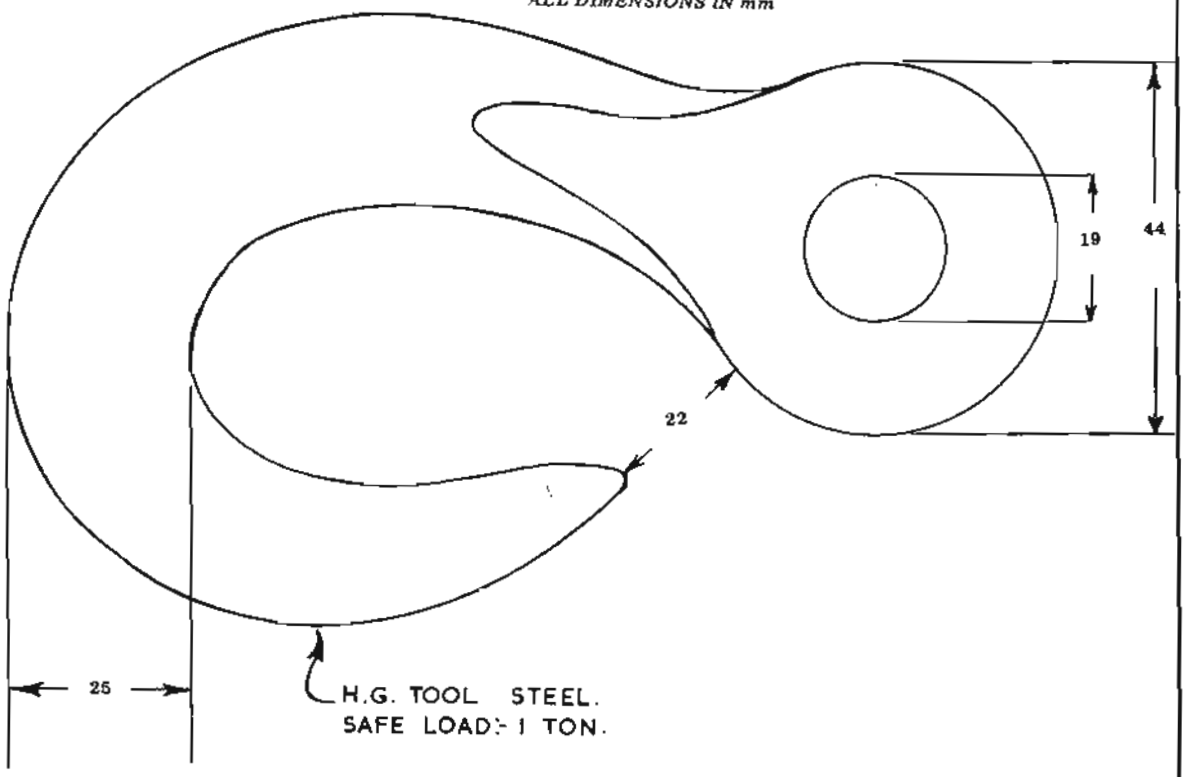
SWIVEL GRAB HOOK.

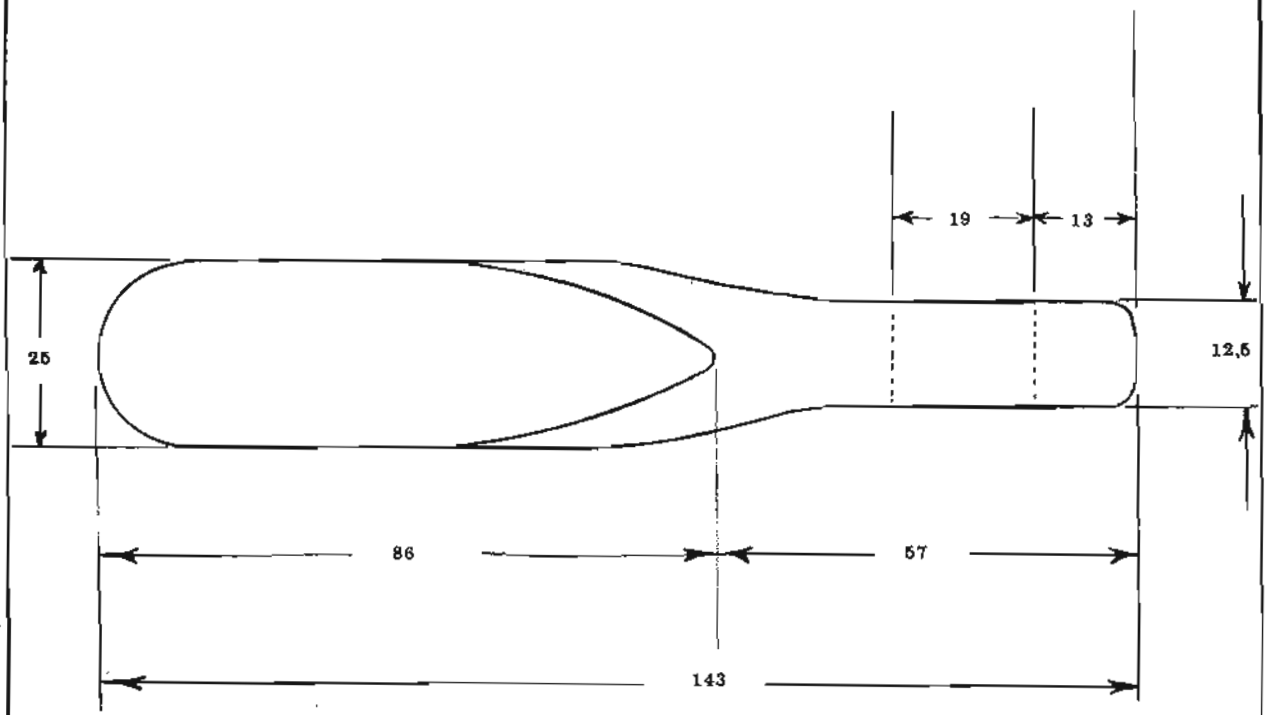
DROP-FORGED STEEL.

FIG. C.34

LOGGING SLIP-HOOK.

ALL DIMENSIONS IN mm





SCALE:- FULL SIZE.

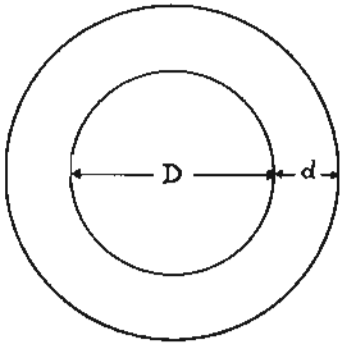


FIG.C.35

RINGS – TYPES A, B, C, AND D

RINGS

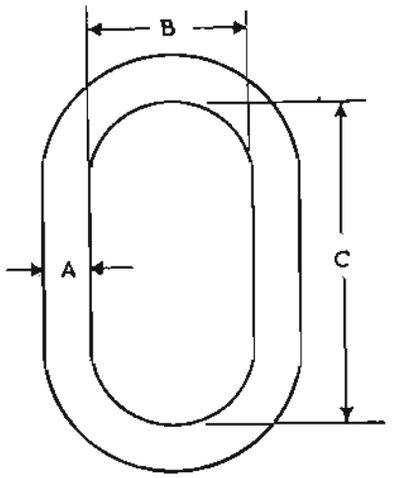
SHORT LINK CHAIN. (B.S. 394)		TYPE A SINGLE SLING.			TYPE B TWO-LEG SLING.			TYPE C THREE-LEG SLING			TYPE D FOUR-LEG SLING.		
NOMINAL SIZE. d_c	PROOF LOAD	PROOF LOAD	$D=6{\cdot}50\,d_c$	$d=1{\cdot}79\,d_c$	PROOF LOAD	$D=8{\cdot}00\,d_c$	$d=2{\cdot}42\,d_c$	PROOF LOAD	$D=9{\cdot}00\,d_c$	$d=2{\cdot}89\,d_c$	PROOF LOAD	$D=11{\cdot}00\,d_c$	$d=3{\cdot}40\,d_c$
mm	kg	kg	mm	mm	kg	mm	mm	kg	mm	mm	kg	mm	mm
8	1 125	1 125	51	14	2 250	63	19	3 375	70	24	4 500	89	28
9	1 625	1 625	63	17	3 250	75	24	4 875	89	28	6 500	108	32
11	2 250	2 250	95	19	4 500	89	29	6 750	102	32	9 000	121	37
13	3 000	3 000	82	24	6 000	102	32	9 000	114	37			
14	3 750	3 750	95	25	7 500	114	35						
16	4 625	4 625	102	28	9 250	127	37						
17	5 625	5 625	114	32									
19	6 750	6 750	127	35									
21	8 000	8 000	133	37									
22	9 125	9 125	146	41									
24	10 500	10 500	152	44									

D = INTERNAL DIAMETER OF RING.
d_c = NOMINAL SIZE OF SHORT LINK CHAIN.
MAXIMUM PERMISSIBLE LOAD (SAFE WORKING LOAD) NOT TO EXCEED ONE HALF PROOF LOAD.

FIG.C.36.

OBLONG MASTER LINKS.

ALLOY STEEL.

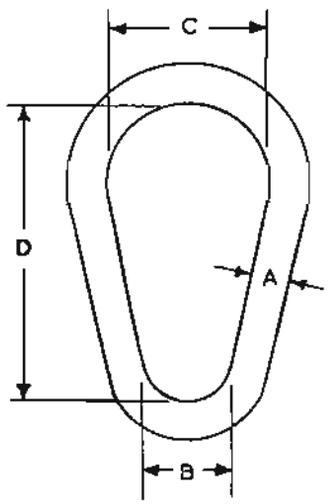


LINK SIZE mm			MASS EACH kg
MATERIAL DIAMETER. A.	INSIDE WIDTH B	INSIDE LENGTH C	
13	63	127	0,4
19	70	140	0,9
25	89	178	2,1

FIG.C.37.

PEAR-SHAPED MASTER LINKS.

ALLOY STEEL.

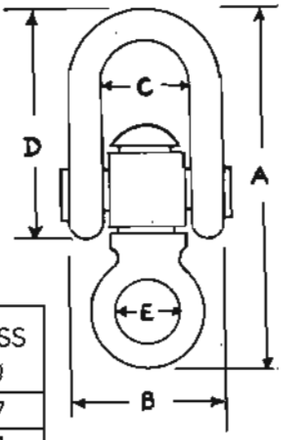


LINK SIZE mm				MASS EACH kg
MATERIAL DIAMETER. A	INSIDE WIDTH B	C	INSIDE LENGTH. D	
13	32	63	127	0,3
19	35	70	140	0,9
25	45	89	178	2,0

SHACKLE SWIVEL. (GOLD STD)

• ALLOY STEEL •

• ELECTRICALLY HEAT TREATED •



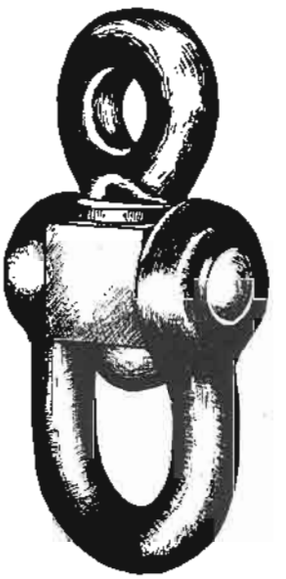


FIG.C.38

DIMENSIONS IN mm

SWIVEL SIZE.	RECO-M'D LINE SIZE	A.	B.	C.	D.	E.	MASS kg
13	6	133	70	37	89	17	0,7
16	9	165	82	51	114	20	1,1
19	12	184	89	51	121	23	1,6
22	16	209	102	57	146	26	2,7
25	19	229	114	57	159	29	3,2
28	22	260	127	63	184	33	4,5
32	25	267	140	63	184	37	5,9
35	28	305	152	76	216	40	7,2
38	32	330	165	82	229	42	10,0
41	35	356	165	89	254	46	13,6
45	38	381	184	89	273	49	15,8
51	45	432	216	114	365	56	24,9

DOUBLE CLEVIS LINK.

FOR USE WITH ALL TYPES OF CHAIN INCLUDING ALLOY.

ALLOY AISI 4130 STEEL.

HEAT TREATED.

BRINELL HARDNESS 302-269.

ALL PINS, AISI-4130 STEEL - HEAT TREATED.

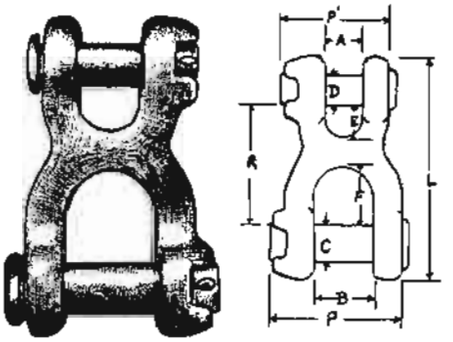


FIG.C.39

SIZE. mm	DIMENSIONS IN mm											MASS EACH kg	BREAKING STRENGTH RATED IN kg
	A	B	C	D	E	F	L	P	P	R			
8—9	14	25	16	11	12	25	90	57	32	48		0,4	10 000
11	17	28	17	14	15	28	103	62	57	55		0,6	14 000
13	21	32	19	16	17	32	115	70	57	63		0,8	19 000

FIG. C.40 MULE HARNESS

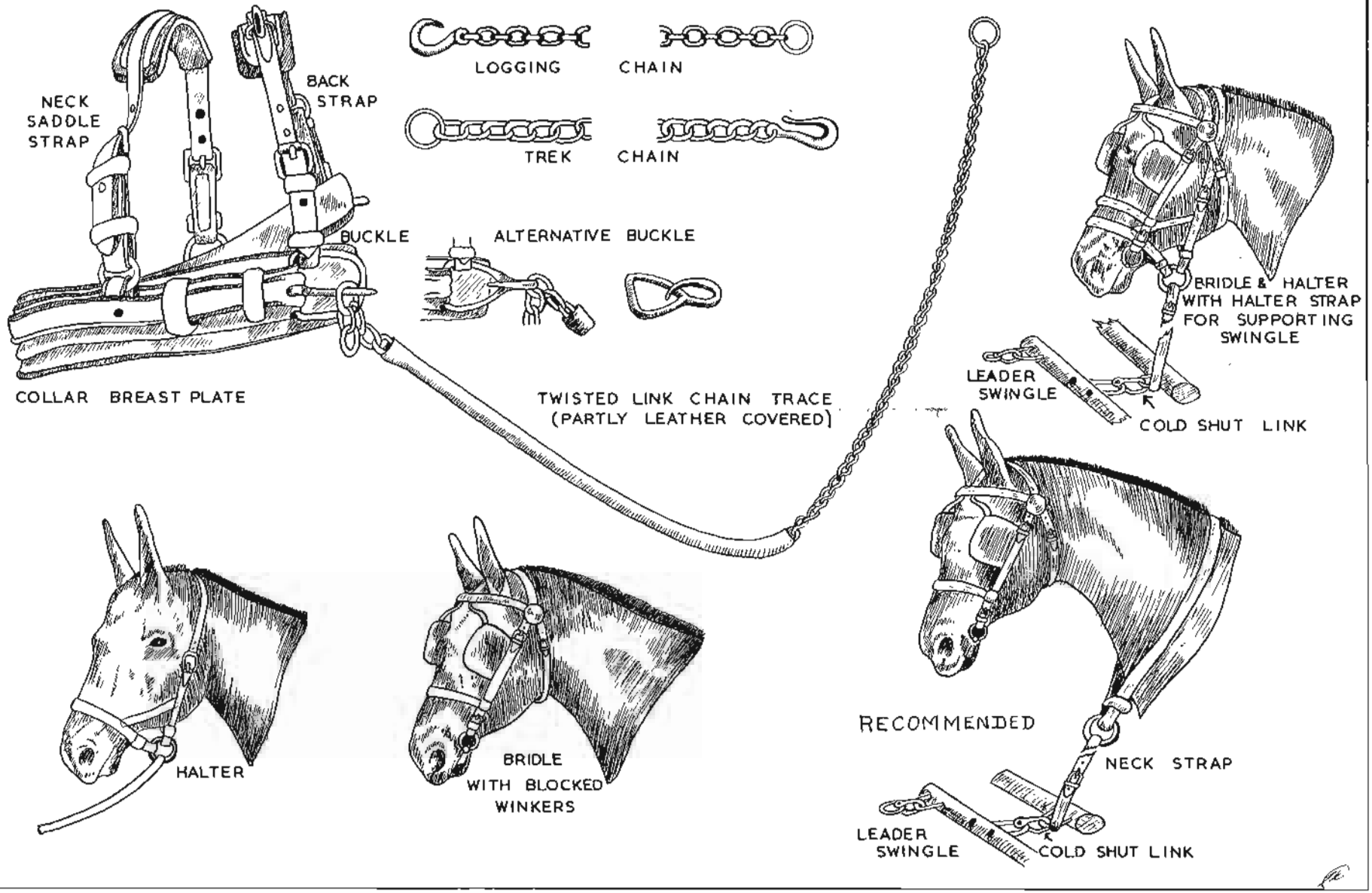


FIG.C. 41

TREK GEAR FOR OXEN

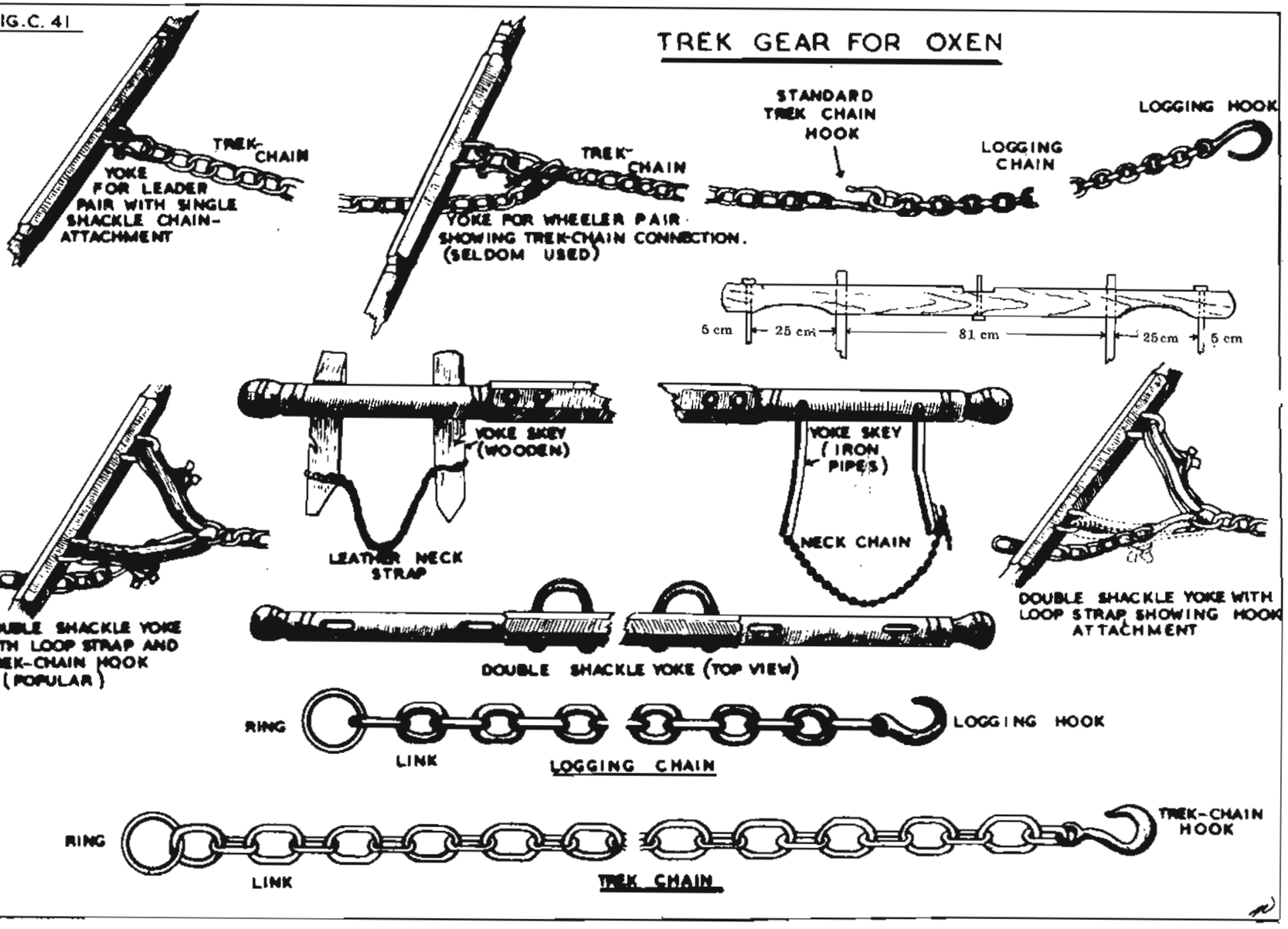


FIG. C. 42

ALL DIMENSIONS IN mm

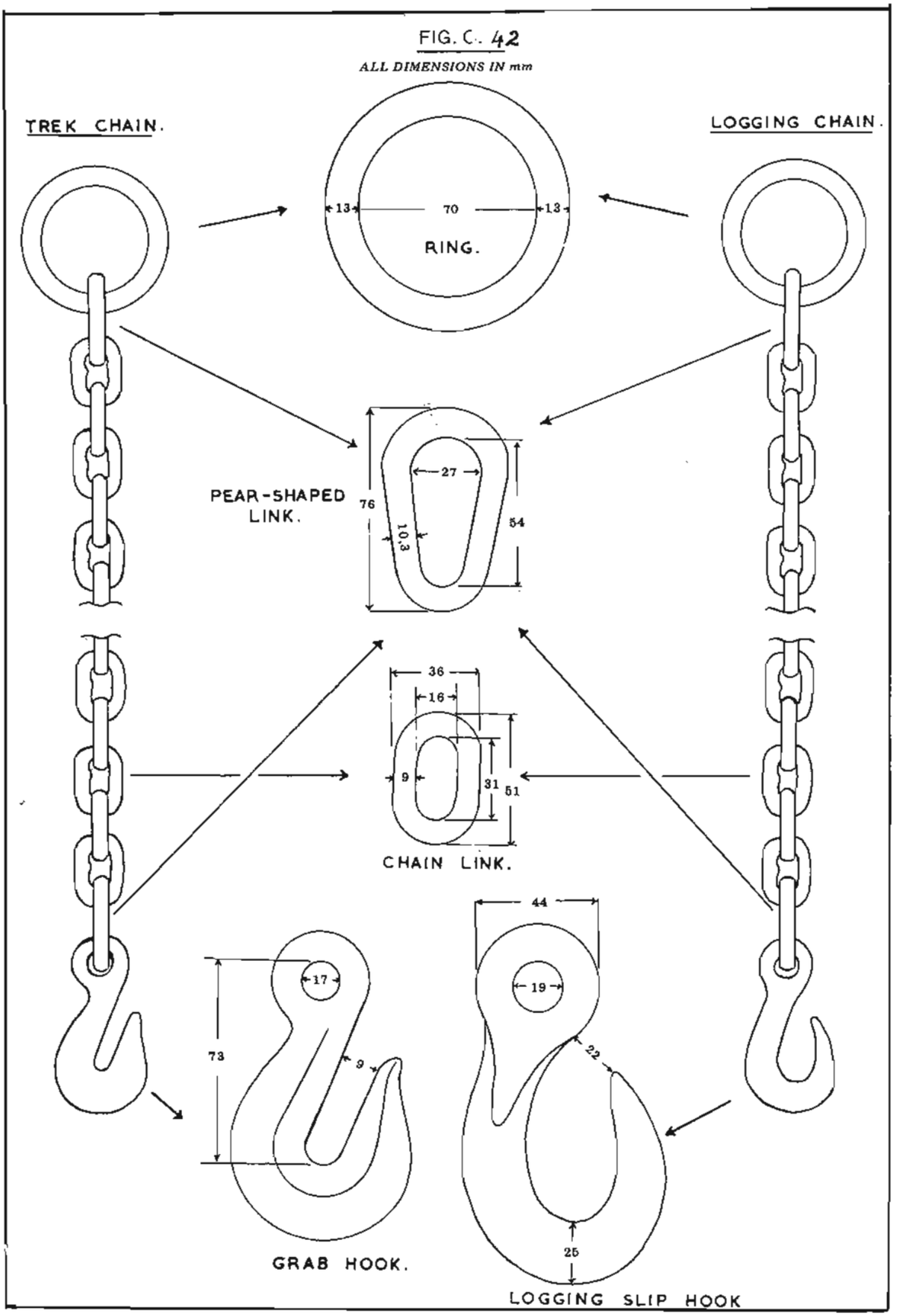
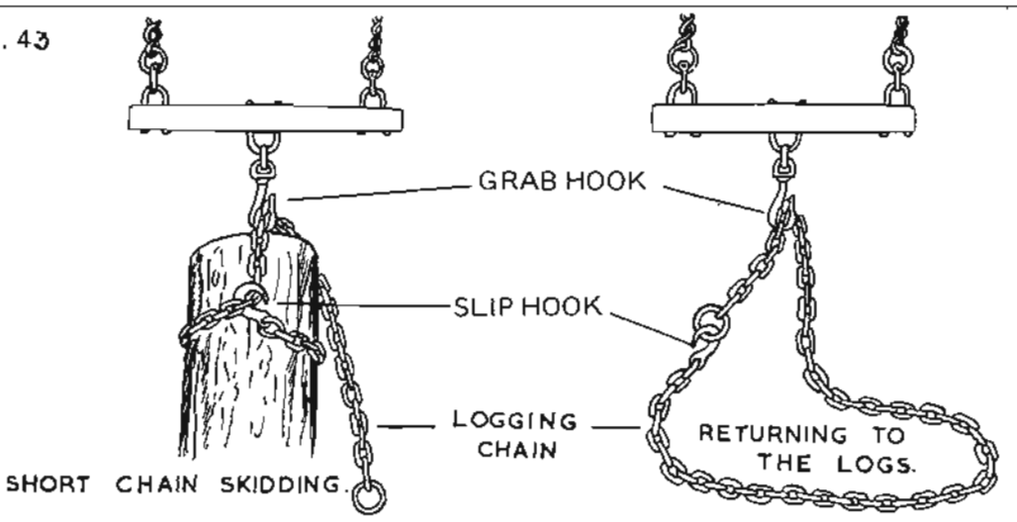
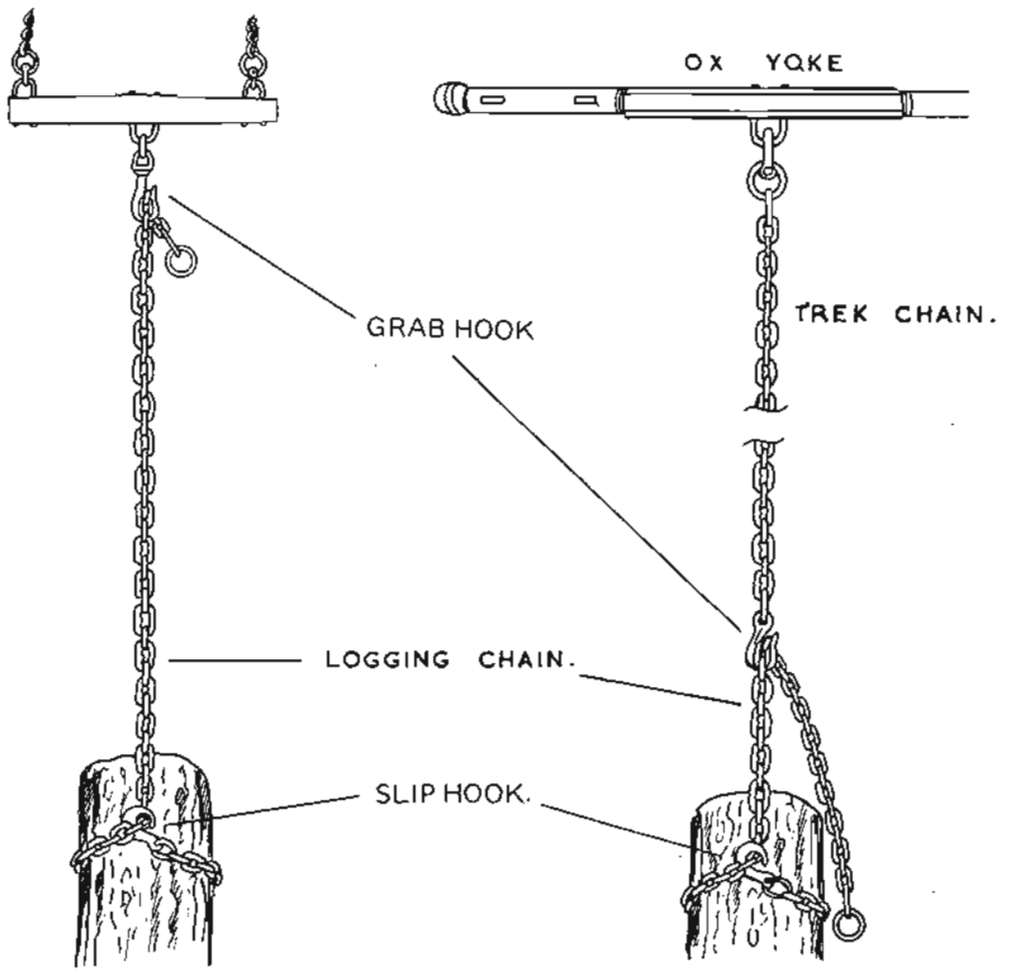


FIG. C. 43



MULE SWINGLE WITH GRAB HOOK



MULE SWINGLE WITH GRAB HOOK.
LONG-CHAIN SKIDDING.

TREK CHAIN WITH GRAB HOOK.
SHORT-CHAIN SKIDDING.

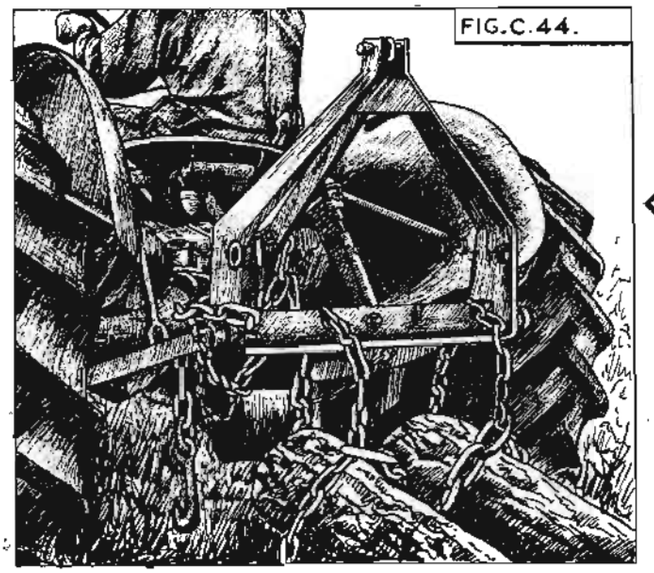


FIG.C.44.

TRACTOR WITH THREE LINKAGE DRAWBAR SUSPENSION FOR LIFTING THE HEADS OF THE LOGS.

FIG.C.45.

TRACTOR TOWING LOGS SUSPENDED ON THE DRAWBAR.

(c) "WEDGLOK" CONNECTING LINKS (Fig. C. 22, 28)

These links are ideal to have on hand for permanent connections or quick emergency repairs. They are manufactured from drop-forged alloy steel and are as strong as the alloy steel chain. They can be assembled anywhere to make up slings and replace links, etc., without special equipment.

(d) "HAMMERLOK" COUPLING LINKS (Fig. C. 26)

This coupling link enables the chain user to assemble his own chain slings without having to wait for custom made assemblies from the factory. The links are forged from alloy steel and are heat treated. Their breaking strength is greater than that of the alloy steel chain with which they are used. The link is locked by the tough, hardened steel pin, which bites into the tubular stud. The location of the locking arrangement minimises exposure to wear or damage.

Assembly of the Hammerlok links is simple, as shown in Fig. C. 29.

Hammerlok coupling links have been designed for the high working loads listed for alloy chain. When used under severe conditions, the links should be inspected regularly with special emphasis on replacing the spacer stud when the knurled surface is peened due to battering.

F. CHAIN ATTACHMENTS

(a) GRAB HOOKS (Fig. C. 30, 31, 32, 33)

Grab hooks are usually drop-forged from alloy steel, and are designed so that when used with the correct size of chain the links will be held in the throat of the hook with no chance of slipping. Alloy steel grab hooks are stronger than ordinary hooks, particularly as some hooks have "I-beam" construction (Fig. C. 30), larger eyes, and are highly shock resistant.

(b) SLIP HOOKS (Fig. C. 34)

Slip hooks are drop-forged and are designed for use with a size of chain that will pass freely through the bowl of the hook.

(c) RINGS (Fig. C. 35)

Many chain catalogues specify the rings to be used with specific chains.

(d) OBLONG LINKS (Fig. C. 36)

The oblong link is used as a master link with loading slings when the sling assembly is to be hung on the crane hook, the latter usually having a considerable material diameter. As the master link has to accommodate the rings and shackles of the slings as well as the grab hooks, besides being hung on the crane hook, the shape of an oblong link serves the purpose better than would a ring.

(e) PEAR LINKS (Fig. C. 37)

The pear link is used when a chain is to be connected to a ring of larger material diameter than the chain link. One end of the pear-shaped link has a narrow inner diameter to fit the chain, while the other end of larger diameter fits the ring (or oblong link).

(f) SHACKLE SWIVEL (Fig. C.38)

The heat-treated alloy steel shackle swivel can be attached to the chain loading slings if a swivelling hook is not available. They can be used in every case where swivelling is necessary, but they cannot be dragged along the ground or abused in any way.

(g) DOUBLE CLEVIS LINK (Fig. C. 39)

This link, which can safely be used with alloy steel chain, is used in the assembling of chain loading slings to connect the chain and rings or loading hooks. The head of the link pin has been altered to prevent rotation. The split pin must be checked frequently for safety.

G. USE OF CHAIN IN LOGGING

(a) LOG SLIPPING BY ANIMALS

Fig. C. 40 illustrates the use of chain in the mule harness, with ladder link chain and twisted link chain comprising the traces. The twisted link chain has a ring attached to one end, to facilitate attachment of the trace to the swingle, while a few links of ladder link chain are attached to its other end for connecting to the harness buckle.

Fig. C. 41 illustrates the use of chain in trek gear for oxen. Long link chain is used for the trek chain and connecting chain between leader and wheeler pairs of oxen. The sizes of the chain link material depend on the number of pairs of oxen used in the team.

Fig. C. 42 shows details of the assembly of both trek and logging chains, together with the rings and hooks used. In the case of the trek chain, a standard hook is usually attached, but for log slipping purposes it is advisable to replace this hook with a grab hook, to facilitate shortening or lengthening the logging chain with load at will.

Fig. C. 43 shows the application of the chain for log slipping, as well as the use of a grab hook for shortening or lengthening the logging chain. The use of the logging slip hook for choking the logs is clearly illustrated.

(b) LOG SLIPPING BY WHEEL-TRACTOR

Fig. C. 44 shows how logs choked with chains are hooked to the tractor. Slots have been cut in the special tractor drawbar to exactly accommodate the 9 mm chain used. The three-linkage drawbar can be lowered for hooking, and when the chain is firmly grasped in the slots, the drawbar is raised, thus lifting the log heads off the ground. Fig. C. 45 shows a wheel-tractor skidding chained logs from a compartment.

LOADING CHAIN SLINGS WITH SALISBURY LOADING HOOKS AND GRAB HOOKS

FIG. C. 46.

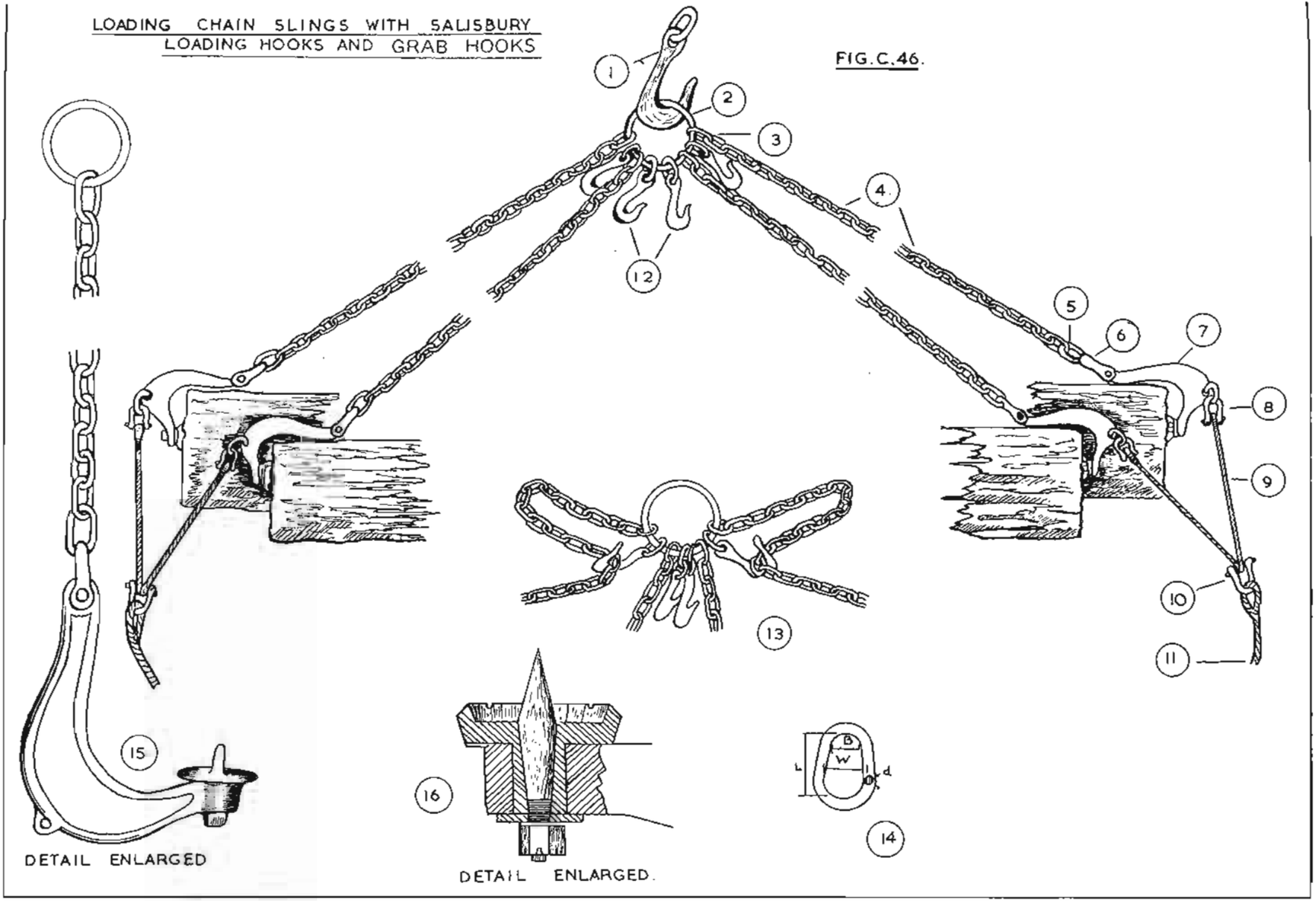


FIG.C.47.

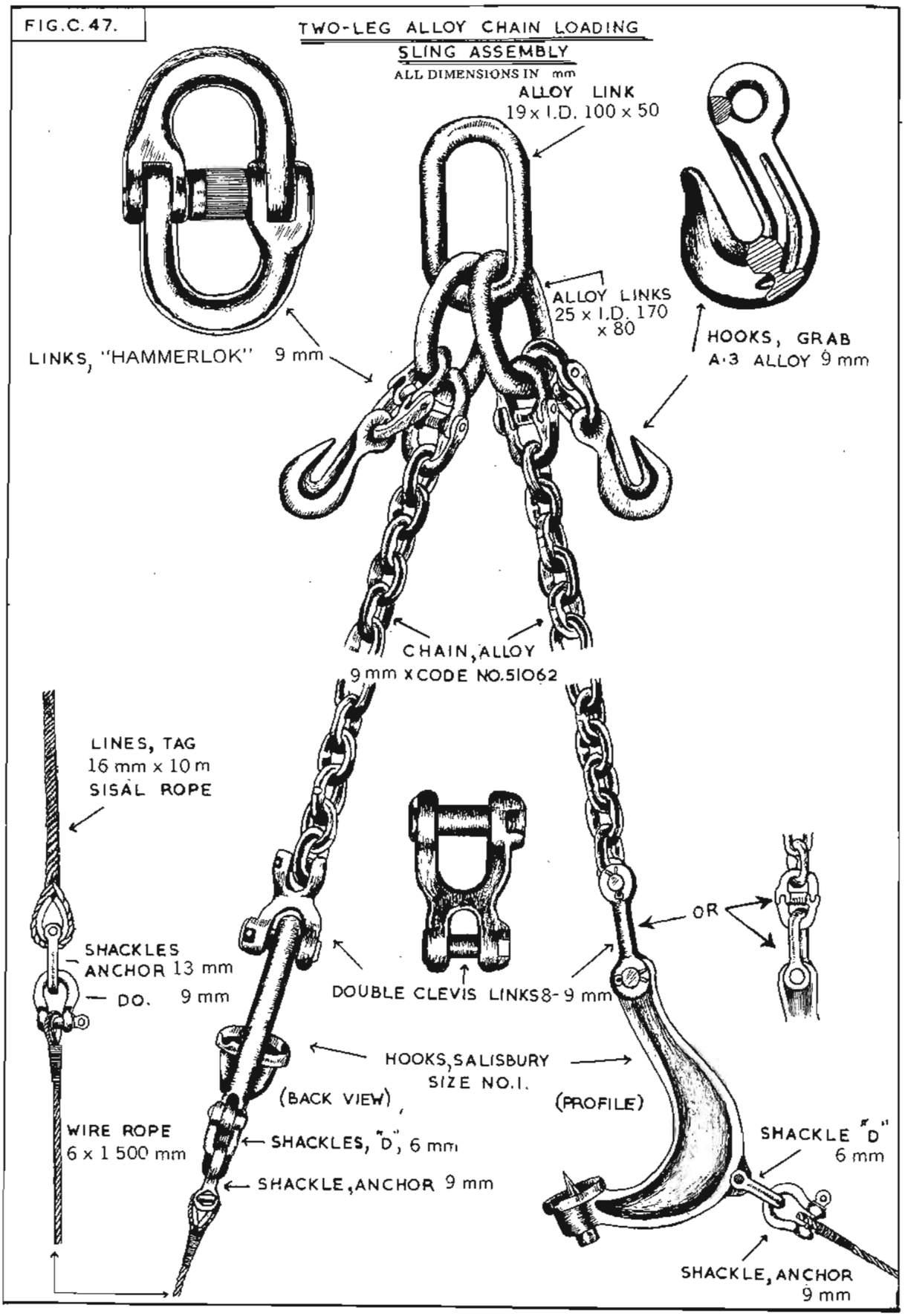
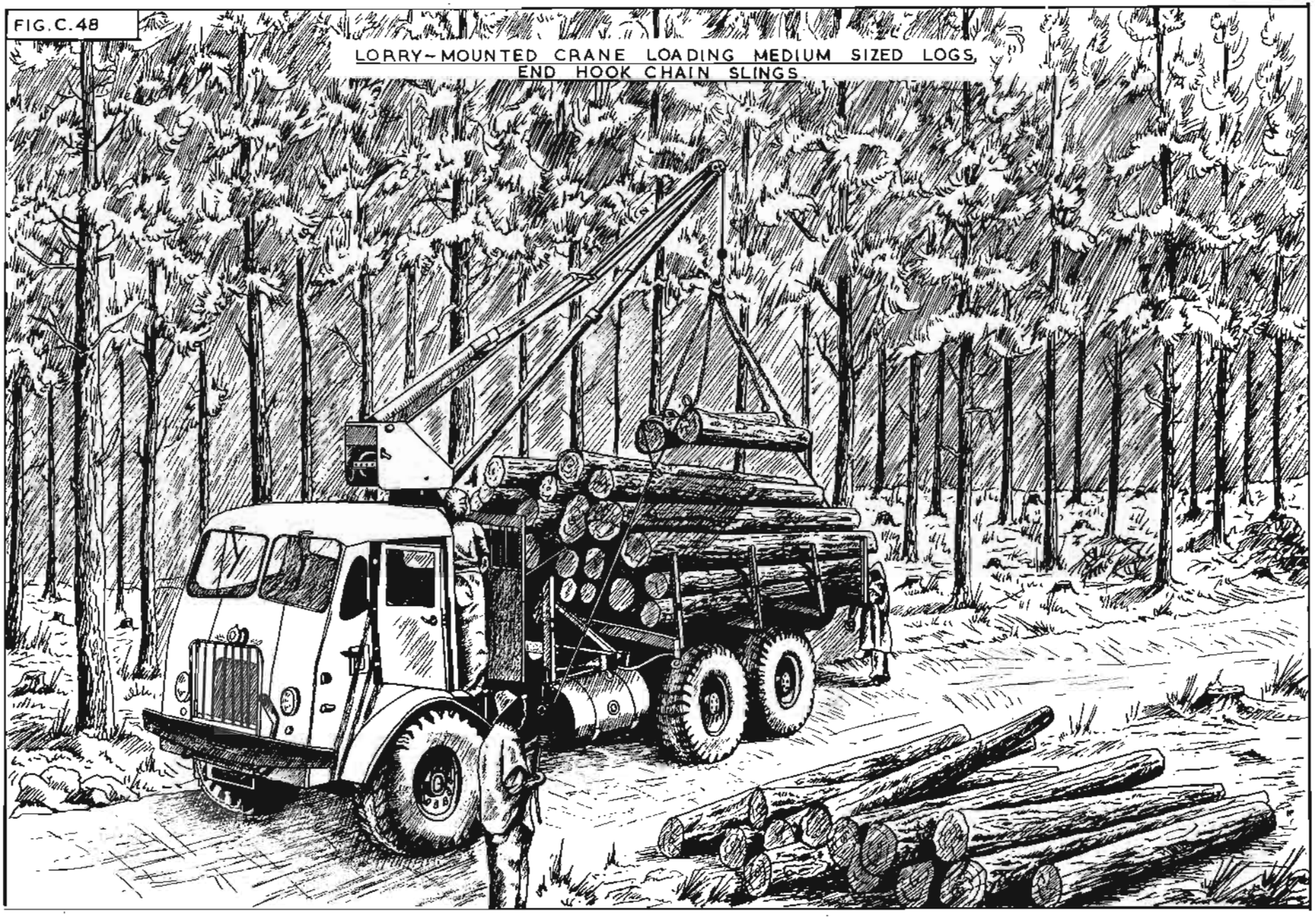

TWO-LEG ALLOY CHAIN LOADING
SLING ASSEMBLY
ALL DIMENSIONS IN mm
ALLOY LINK
19 x I.D. 100 x 50
ALLOY LINKS
25 x I.D. 170
x 80
LINKS, "HAMMERLOK" 9 mm
HOOKS, GRAB
A-3 ALLOY 9 mm
CHAIN, ALLOY
9 mm x CODE NO. 51062
LINES, TAG
16 mm x 10 m
SISAL ROPE
SHACKLES
ANCHOR 13 mm
— DO. 9 mm
DOUBLE CLEVIS LINKS 8-9 mm
OR
HOOKS, SALISBURY
SIZE NO. 1.
(BACK VIEW)
(PROFILE)
WIRE ROPE
6 x 1 500 mm
SHACKLES, "D", 6 mm
SHACKLE, ANCHOR 9 mm
SHACKLE "D"
6 mm
SHACKLE, ANCHOR
9 mm

FIG. C. 48

LORRY-MOUNTED CRANE LOADING MEDIUM SIZED LOGS, END HOOK CHAIN SLINGS



LOAD BINDERS.

COMPLETELY FORGED, HEAT-TREATED ALLOY STEEL.

LINKS AND HANDLES - C.1035 SPECIAL BAR QUALITY STEEL.

HOOKS: 8630 STEEL, HEAT-TREATED TO A BRINELL HARDNESS OF 321-293.

EACH BINDER SHALL BE PROOF-TESTED IN THE FACTORY.

THE HEEL OF THE BINDER SHALL TOGGLE AWAY FROM THE LOAD TO PERMIT EASY RELEASE.

BALL AND SOCKET SWIVEL JOINTS SHALL BE INCORPORATED WITH THE HOOK ASSEMBLY TO PERMIT A STRAIGHT LINE PULL FOR EASY USE.

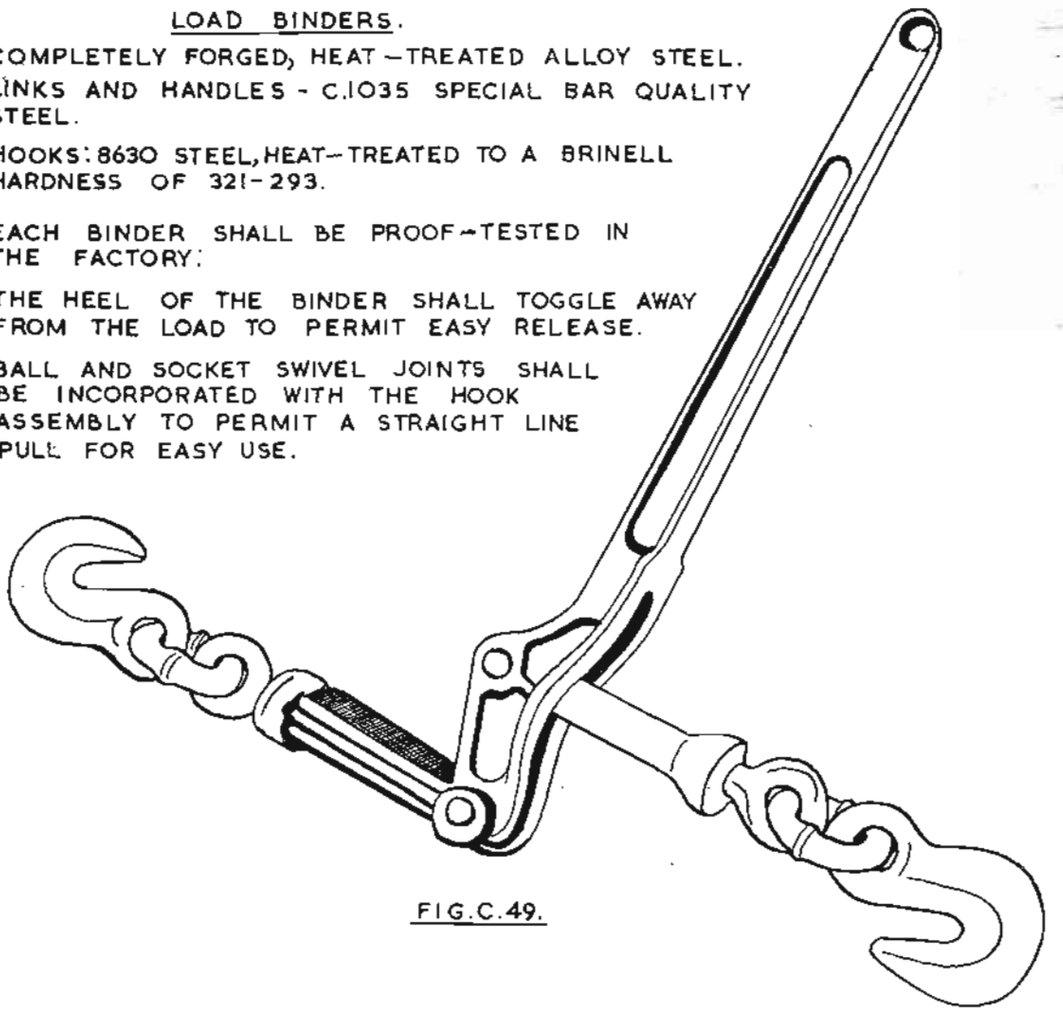


FIG.C.49.

MAX. CHAIN SIZE mm	MASS kg EACH	HANDLE LENGTH cm	TAKE-UP cm	BINDER PROOF LOAD kg	MIN. BREAKING STRENGTH HIGH TEST CHAIN kg
9	4,1	51	11,4	4 600	7 300
13	6,3	56	11,4	7 400	11 800
16	7,7	56	11,4	10 400	16 700
19	9,1	59	12	14 700	22 800

FIG. C.50

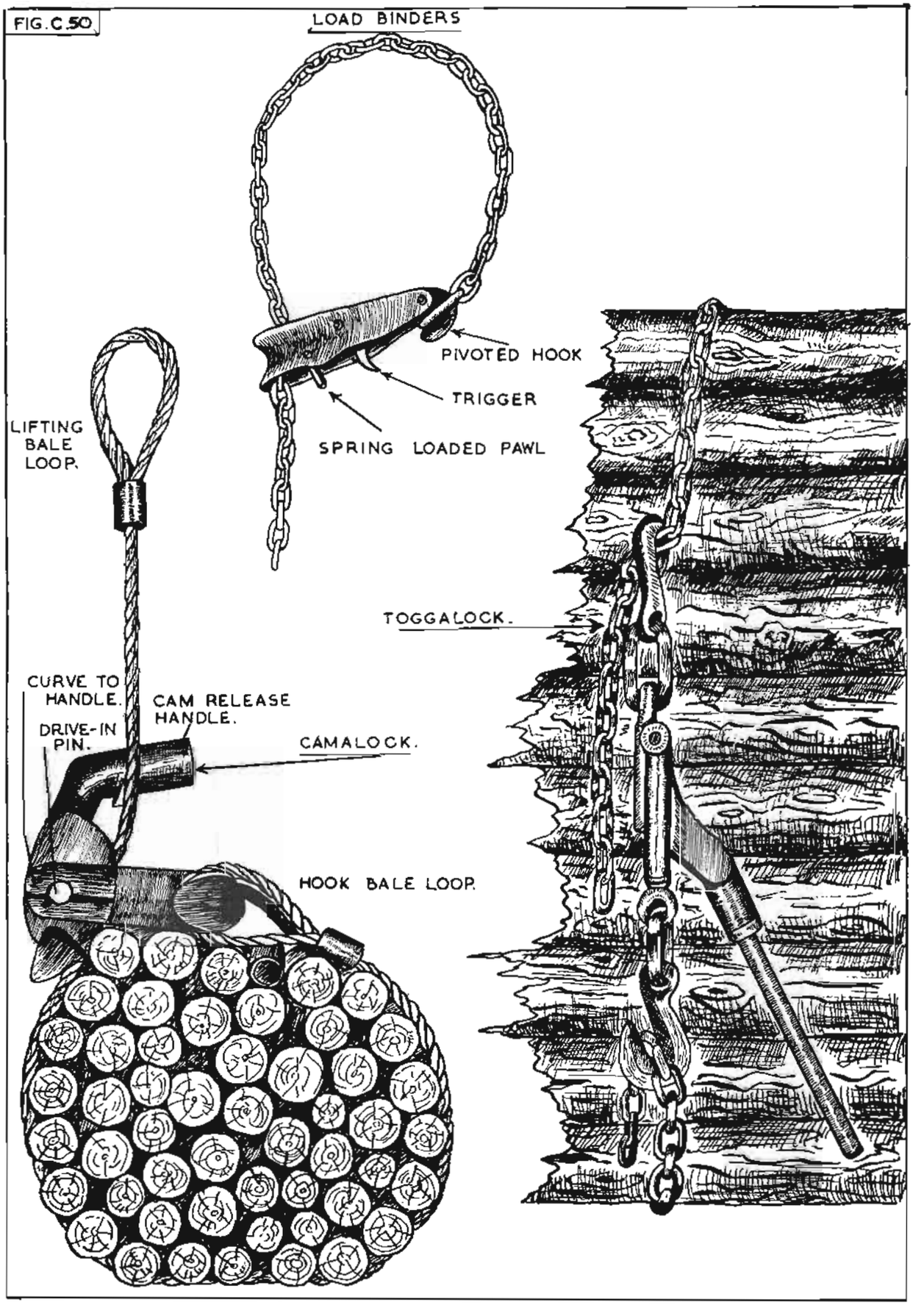
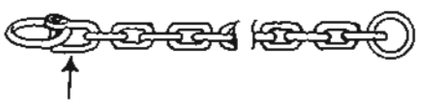
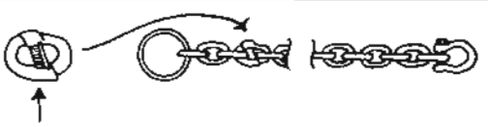

LOAD BINDERS
PIVOTED HOOK
TRIGGER
SPRING LOADED PAWL
LIFTING BALE LOOP.
TOGGALOCK.
CURVE TO HANDLE.
CAM RELEASE HANDLE.
DRIVE-IN PIN.
CAMALOCK.
HOOK BALE LOOP.

FIG.C.51.

TESTS OF CHAIN FITTINGS

PART TESTED		LOAD kg	CHAIN mm	PART BROKEN	REMARKS.
GRAB HOOK WITH SWIVEL AND HAND LINK 9 mm		3 697	9	CHAIN	HOOK BENT.
SPLIT LINK	8 mm	1 882	9	LINK	
SPLIT LINK	9 mm	2 159	9	LINK	
SPLIT LINK	13 mm	2 631	9	LINK	
SPLIT LINK	16 mm	4 540	9	LINK	
 COLD SHUTS	11 mm	4 354	9	COLD SHUTS	
COLD SHUTS	13 mm	6 033	9		
 "WEDGLOK" REPAIR LINK 9 mm		5 942	9	–	SHACKLE BROKE TEST STOPPED

(c) LOADING

Fig. C. 46 gives details of the standard, factory-made chain sling loading assembly, with Salisbury end hooks. Details of the numbered parts are given below.

1. Lifting hook
2. Main ring
3. Connecting (pear) links
4. 9 mm alloy steel chain
5. Connecting (peer) links
6. Shackle
7. Salisbury end loading hook
8. Anchor shackle
9. Tagline strap (wire rope)
10. Shackle
11. Fibre rope tagline
12. Grab hooks
13. Method of shortening the loading chain slings
14. Pear link detail
15. Enlarged detail of a complete chain sling leg of the assembly
16. Cup and pin of the Salisbury end loading hook

Fig. C. 47 shows details of two-leg chain loading sling assembled by the Department, using shackles, Hammerlok links and double clevis links. Assembly of such slings is so simple that it can be done without workshop facilities, the only tools required being a hammer, pliers and a piece of rail, anvil or sledge hammer upon which to place Hammerlok links when driving the pin home. If spare shackles or coupling links are available, such slings can easily be repaired in the field with little loss of time.

The illustration shows one of a number of combinations for assembling a chain loading sling. If double clevises are not available, shackle combinations or Hammerlok links may be used as substitutes.

Fig. C. 48 illustrates a log loading operation using a four-leg chain loading sling with end hooks.

(d) LOAD BINDERS

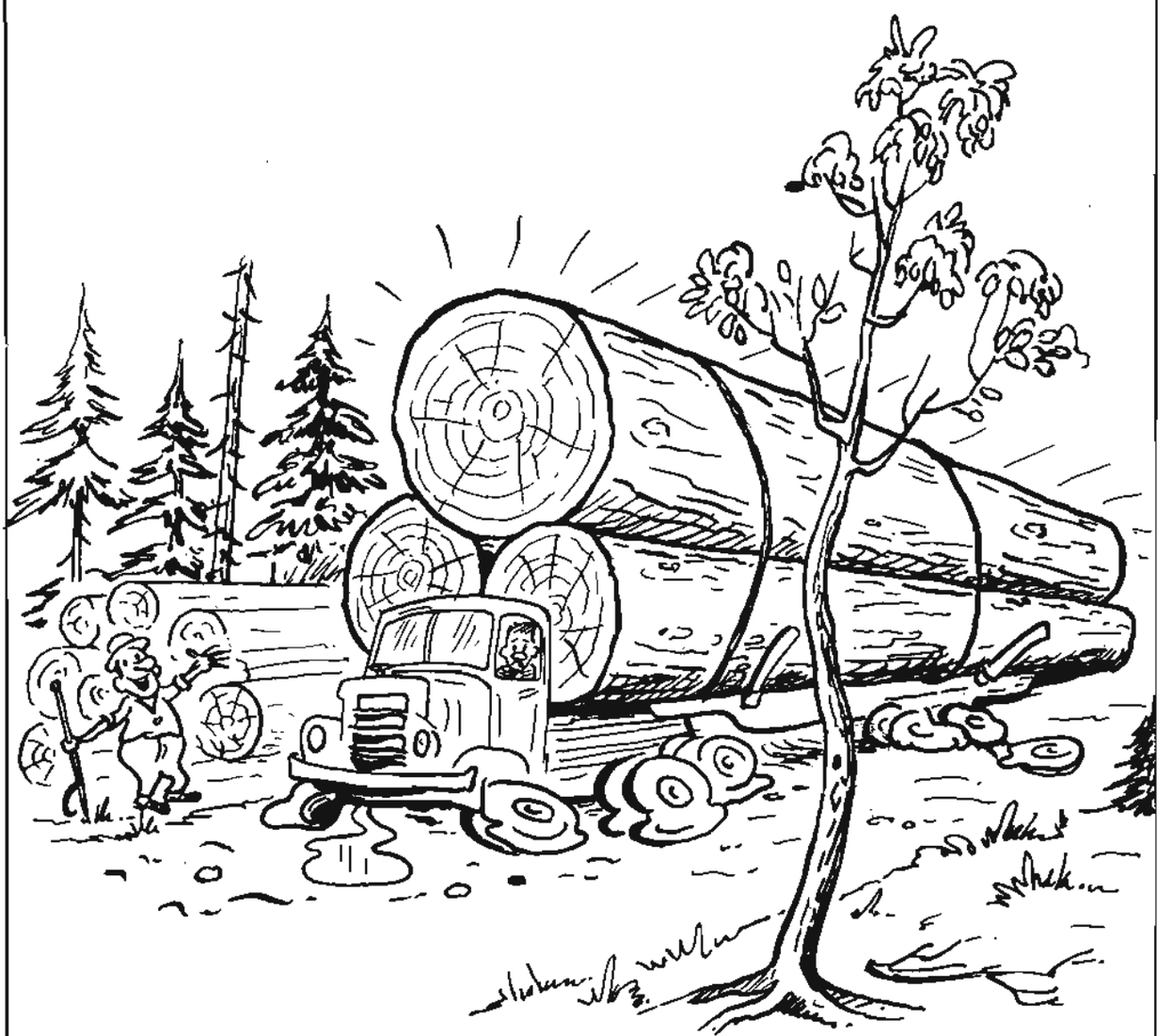
Fig. C. 50 shows chain used with load binders for securing loads on to lorries or sledges. The most popular of the load binders in use in the department is the Toggalock type (specifications given in Fig. C. 49), the application of which is shown in Fig. C. 50.

Eight millimetre short link, mild steel chain is used with load binders.

H. TESTS OF CHAIN FITTINGS

Fig. C. 51 illustrates chain fittings which were tested by the South African Bureau of Standards laboratories, and the relevant details of the test are given. The tests indicate that the fittings are sufficiently strong for the purpose for which they are used in logging, i.e. animal slipping, but they should not be used with any chain that is used for lifting purposes.

LOG LOADING AND TRANSPORTATION



One too many!

III. LOG LOADING AND TRANSPORTATION

INTRODUCTION

Prior to the actual transportation of timber from the plantation to the sawmill or some other destination, it must be loaded onto a vehicle. On occasions it may even have to be reloaded, from a sledge onto the lorry, or from the lorry into a railway truck. In most cases the timber to be loaded must be lifted. If logs are large, then special lifting equipment is required, but small-sized timber can be loaded by hand.

Log loading has developed steadily through the years from manual loading to modern methods, using fully mobile, fast and fully-rotating cranes. This development occurred because of the increased area of afforestation and maturing of stands, i.e. large logs. Small quantities of small, short logs and poles, derived from early thinnings, are easy to handle and do not present much of a problem when they have to be loaded onto 3 or 5 ton lorries. Since the department now has to handle large-sized logs, in considerable volumes derived from clearfellings in mature plantations, some other method of loading had to be employed. To further complicate the loading process, 10 ton diesel-driven trucks were introduced in order to reduce transport costs, and it was found that hand loading crews could not complete a load with sufficient height to reach the full truck load capacity.

Despite the problems involved in hand loading, there was at first some hesitancy in purchasing mobile cranes, as they were considered to be too expensive for economical timber handling. When great fires occurred, however, it was necessary to handle a considerable volume of timber during a very short period, which hastened the introduction of fast, mobile loaders. The usefulness of these loaders soon became apparent and over a period of a few years many types of loaders were tested. In this way the loading development was experienced in departmental plantations.

Since many departmental and privately owned plantations will undergo a similar stage of development, tools and equipment of both simple and advanced patterns may be used, and consequently the use of most of these loading devices and equipment is dealt with in this manual.

The manual covers the following types of truck loading:

(a) MANUAL LOADING

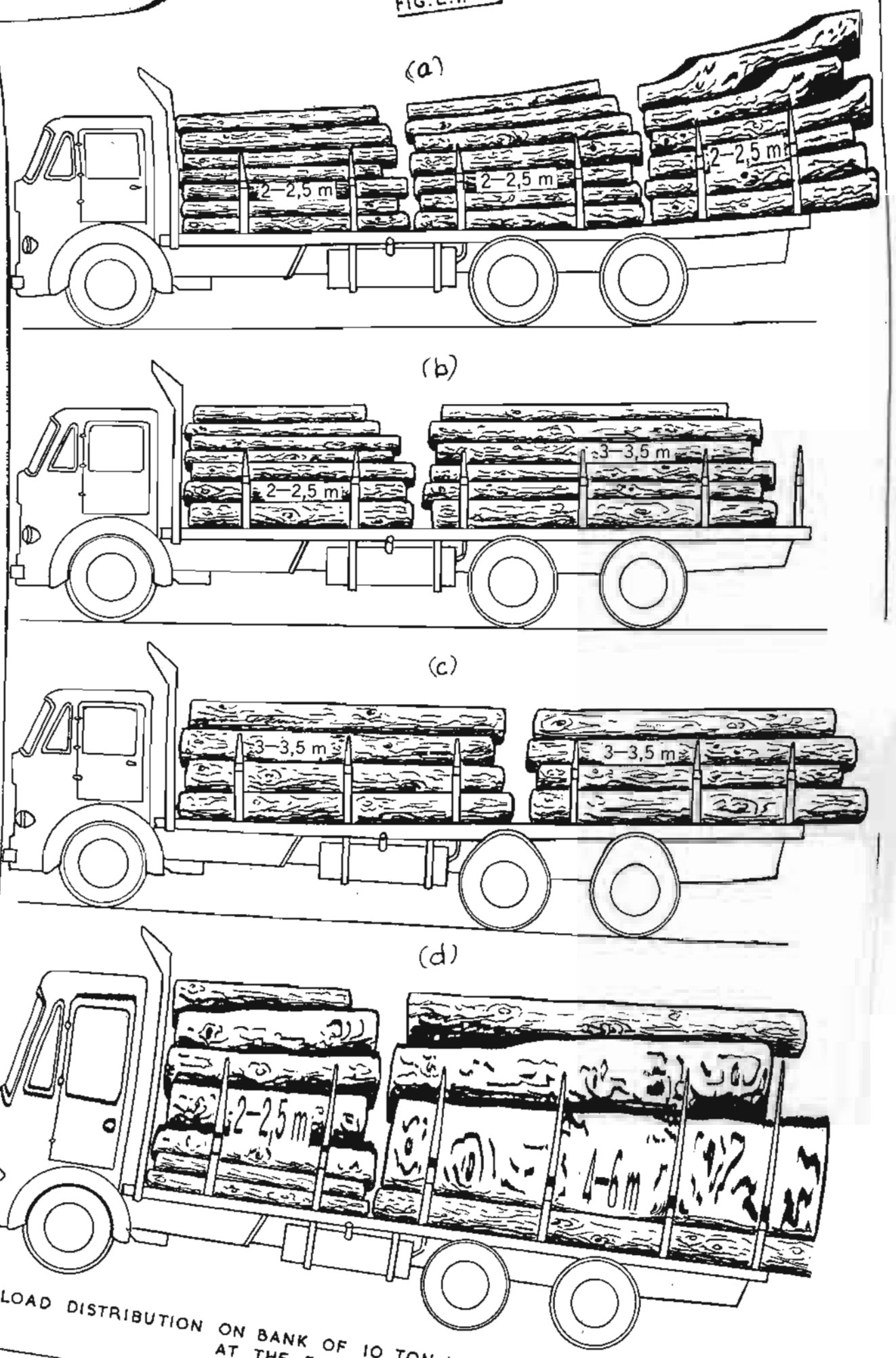
(i) By hand, bodily.
(ii) By hand, with skid spars.
(iii) By hand, cross-haul.

(b) MECHANICAL LOADING

(1) Mobile crane

(i) Truck-mounted crane, petrol driven or diesel driven, with revolving boom.

FIG. L.1.

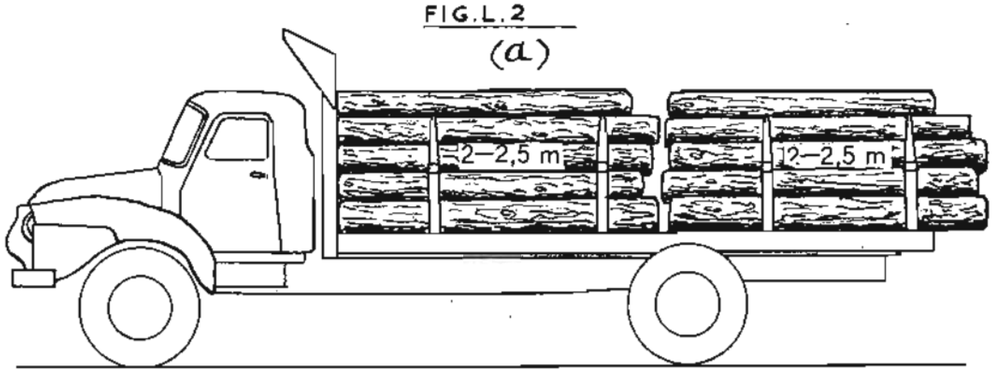


LOAD DISTRIBUTION ON BANK OF 10 TON LORRY FOR LOGS STACKED AT THE ROADSIDE IN LENGTH GROUPS.

LOAD DISTRIBUTION ON THE BANKS OF 7 AND 10 TON LORRIES FOR LOGS STACKED AT THE ROADSIDE IN LENGTH GROUPS.

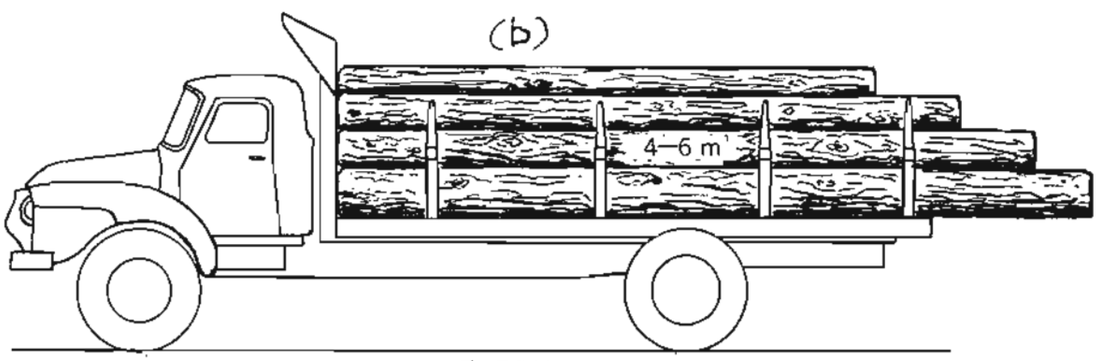
FIG.L.2

(a)



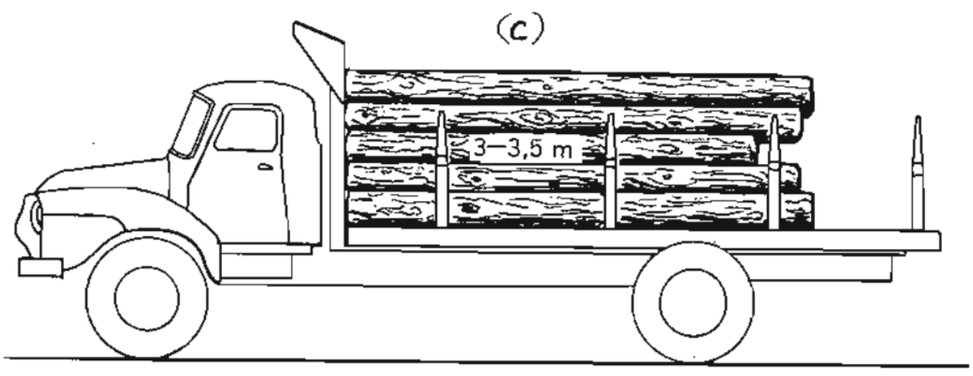
7 TON.

(b)



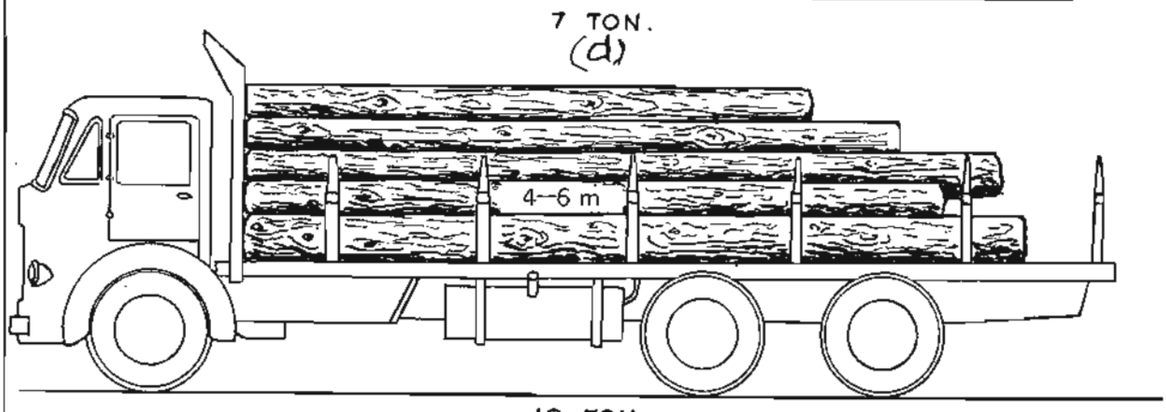
7 TON

(c)



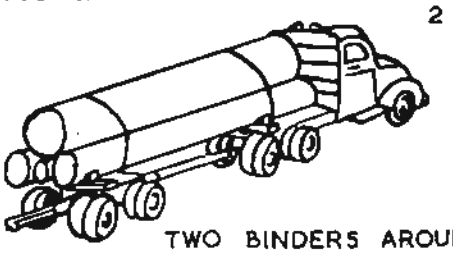
7 TON.

(d)



10 TON.

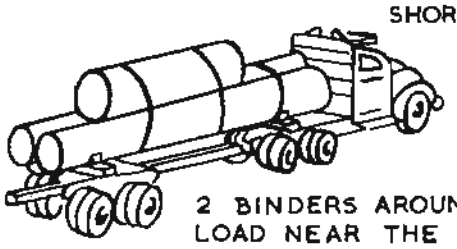
FIG.L.3



2 OR 3 LOG LOAD.

TWO BINDERS AROUND THE LOAD NEAR THE BUNKS.

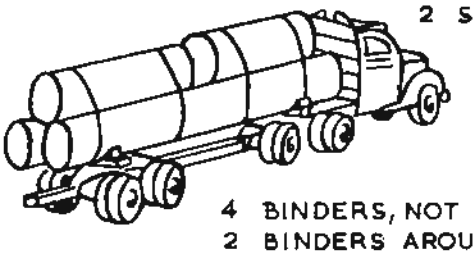
FIG.L.4



3 LOG LOAD. SHORT PEAKER.

2 BINDERS AROUND THE LOAD NEAR THE BUNKS TO INCLUDE ALL LOGS, OR EXTRA BINDER ON SHORT LOG.

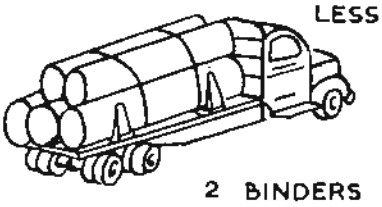
FIG.L.5



4 LOG LOAD, 2 SHORT PEAKERS.

4 BINDERS, NOT LESS THAN 2 BINDERS AROUND ANY LOG LOADED ON TOP.

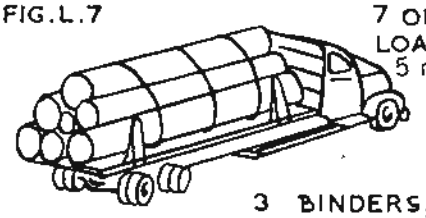
FIG.L.6



5 OR 6 LOG LOAD, LESS THAN 5 m IN LENGTH.

2 BINDERS NEAR BUNKS.

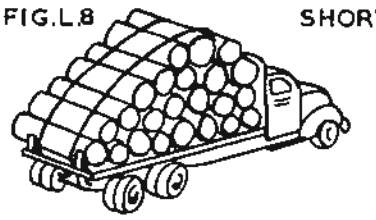
FIG.L.7



7 OR MORE LOG LOAD, LESS THAN 5 m IN LENGTH.

3 BINDERS, 2 NEAR BUNKS.

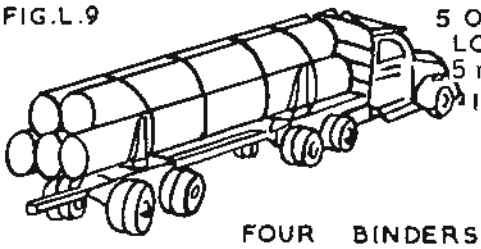
FIG.L.8



SHORT LOGS LOADED CROSSWISE.

TWO BINDERS AND TWO CHOCKS OR STAKES AT OPEN END.

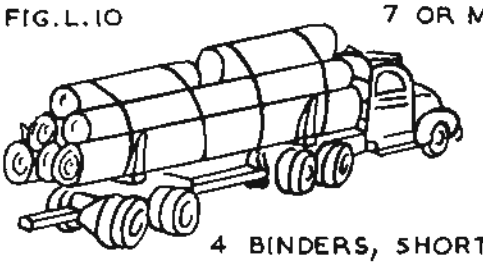
FIG.L.9



5 OR MORE LOG LOAD, 5 m OR MORE IN LENGTH.

FOUR BINDERS.

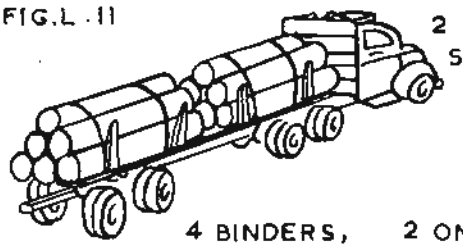
FIG.L.10



7 OR MORE LOG LOAD.

4 BINDERS, SHORT LOGS SECURED BY NOT LESS THAN TWO BINDERS.

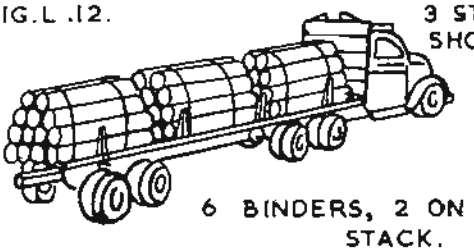
FIG.L.11



2 STACKS OF SHORT LOGS.

4 BINDERS, 2 ON EACH STACK NEAR BUNKS.

FIG.L.12.



3 STACKS OF SHORT LOGS.

6 BINDERS, 2 ON EACH STACK.

TRUCK LOAD BINDER REQUIREMENTS

(ii) Carrier-mounted cranes, petrol or diesel driven, hydraulically operated with telescopic, rotating booms.

(iii) Tractor-mounted cranes with folding booms and double-drum winches.

(2) Truck-mounted, self-loading apparatus

(i) Truck-mounted, self-loading apparatus with articulating boom, hydraulically operated.

(ii) Self-loading truck apparatus for side loading, with winches.

(iii) Self-loading truck apparatus for side loading with hydraulically operated tossing arms.

(c) SEMI-PORTABLE LOADERS

(1) "A" frame with single-drum, petrol driven winch.

(2) Cross-haul with tractors.

For loading purposes, logs or poles are divided into three catagories:

(i) Short logs : up to 2 metres
(ii) Medium logs: 3-4 metres in length
(iii) Long logs : 4-7 metres in length

Long transmission poles of up to 15 metres in length require special attention and often special loading methods.

(d) DISTRIBUTION OF LOGS OF VARYING LENGTHS ON LORRY LOG DECKS OR BUNKS

Figures L. 1 and 2 illustrate a theoretical approach to determining the most suitable combination of various log lengths and their most economical distribution on the lorry deck, dependent upon the deck length, which permits the lorry to be loaded to full capacity. The illustrations show examples of load distributions for 7 and 10 ton lorries. Fig. L. 1(a) shows three stacks of short logs located on a 10 ton truck deck, one behind the other. Objections may be raised as to the position of the rear stack from the safety point of view, as it could be shaken off on the bumpy forest roads. The remedy would be to employ a 7 ton truck with the shorter deck so that only two stacks of short logs are loaded, as in Fig. L. 2(a), or a combination of log lengths can be arranged as in Fig. L. 1(b) and (d). In Fig. L. 2(c) and (d), the decks of the 7 and 10 ton trucks are not fully occupied, and with the standard load height they would probably not be loaded to the full truck carrying capacity. In this case the remedy would be to add extensions to the truck stanchions and load higher than usual.

Although departmental plantations are generally scattered throughout the country, loading methods are standardised to a large extent, and the same equipment is used, but local conditions generally dictate what specific equipment should be used.

Loading actually plays a key role in the logging operation, and the method chosen is of great importance. Efficient log transportation by lorry is largely dependent on the efficiency of the loading and off-loading operations. As logging is a team operation involving skidding, loading and transportation, it is important that the three operations be closely synchronised to obtain maximum efficiency, and for this reason operation synchronisation is also dealt with.

Before logs loaded onto trucks can be transported they must be secured with binders. When a full load is completed, chains are thrown over each separate stack of logs on the log deck and the chains tightened with Toggalock binders. Where long poles or logs extend the full length of the log bunk or truck deck, a minimum of two sets of chains with Toggalocks must be used to secure the load. If a logging truck has a full deck overlying the log bunks, load tightening chains must be placed across the log deck before the first logs are rolled onto it. Fig. L. 3 to 12 illustrate binder requirements for various types of loads, as recommended by the State Industrial Accident Commission (U.S.A.).

Note : In the Department tightening chains are not attached to the lorry deck.

Where seasoned poles are being loaded, a greater volume must be loaded on the truck in order to obtain a capacity load (due to the lightness of the dry poles), which results in a load extending above the tops of the stanchions. In order to secure such a load, iron pipes or strong steel rods may be inserted into the tops of the stanchions te keep the load firm.

Hauling and transportation are also dealt with in this manual, including matters relating to load sizes, overloads, efficiency of the hauling operation, and prescribed daily outputs.

1. LOG LOADING BY HAND

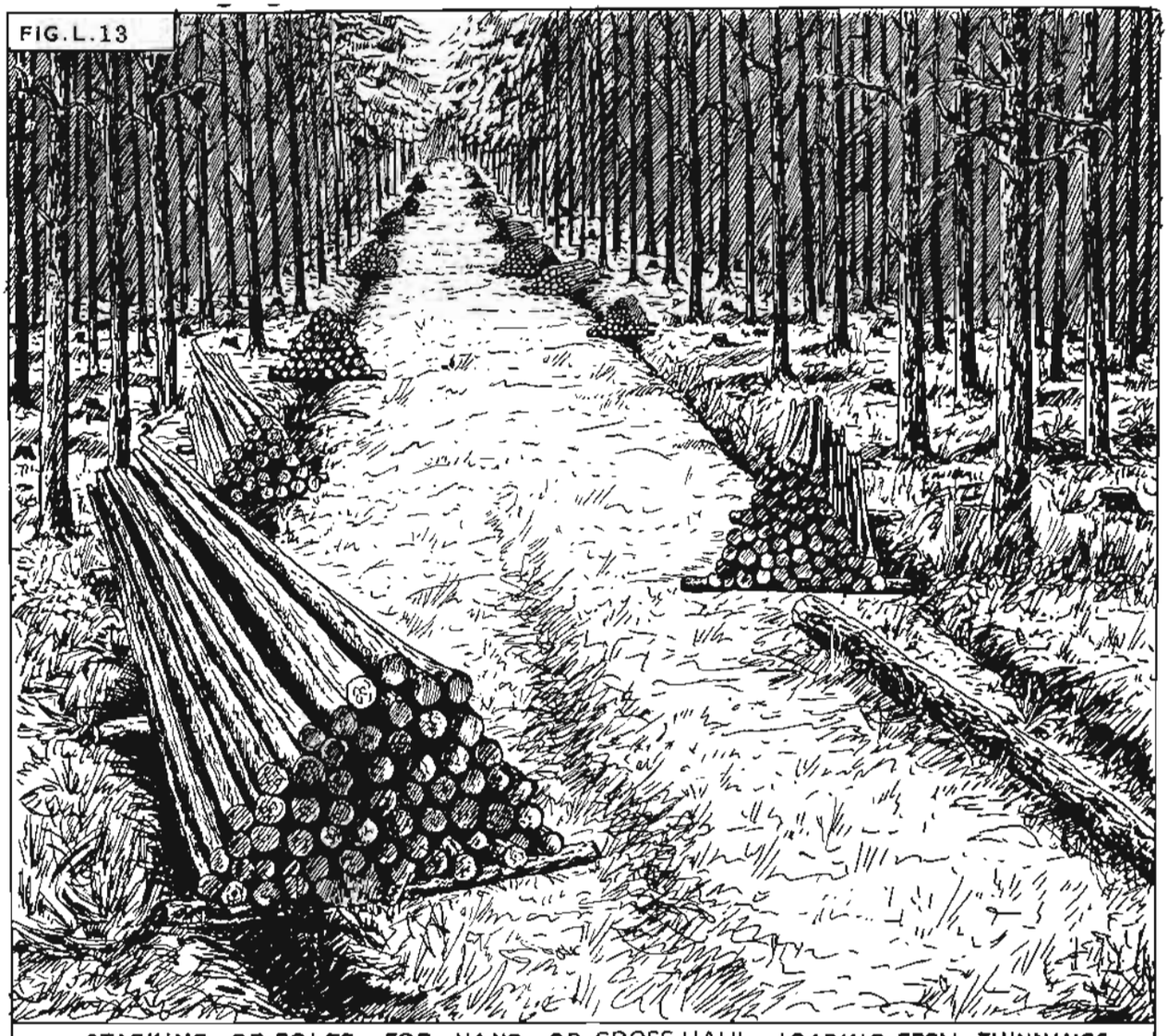
Most short logs of 2 - 2,5 metres long, derived from early thinnings, are loaded by hand in departmental plantations. These logs have volumes up to 0,07 m^3. Logs may be loaded at stump, or may first be skidded to an assembly point or to the roadside where they can be concentrated in large stacks for convenient loading. Special loading equipment is usually used to deal with large quantities of timber. If accessible for the transporting vehicle, logs may be loaded directly from the stump if carrying distances are not too great, or they may be stacked first to facilitate faster loading afterwards, in order to economise on the standing time of the vehicle.

(a) LOG STACKING

(1) For hand loading, logs 2 - 2,5 metres in length are considered to be "short logs", and are usually stacked together.

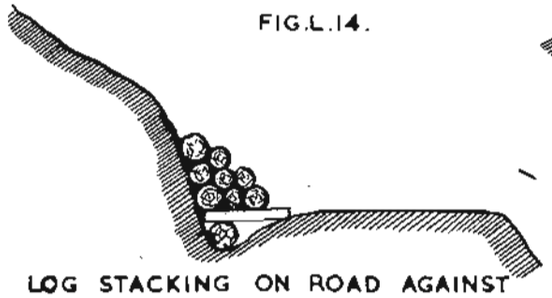
(2) Logs are stacked parallel to and close to the roadside, so as to be conveniently located for loading by hand, i.e. the shortest distance from the stack to the lorry for easy loading, so that logs can be pushed or tossed onto the lorry with the minimum of movement by the labourers.

FIG.L.13



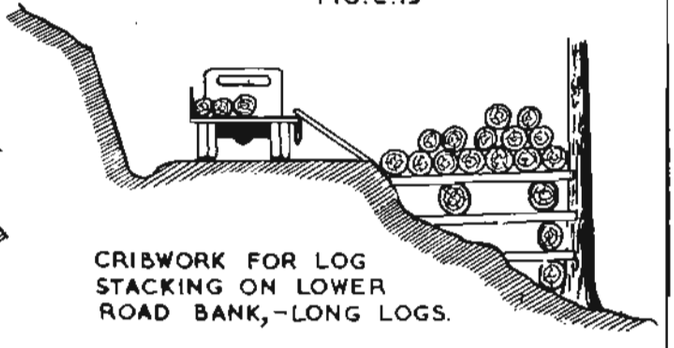
STACKING OF POLES FOR HAND OR CROSS-HAUL LOADING, FROM THINNINGS ON FLATS.

FIG.L.14.



LOG STACKING ON ROAD AGAINST UPPER ROAD BANK, - SMALL LOGS

FIG.L.15



CRIBWORK FOR LOG STACKING ON LOWER ROAD BANK, - LONG LOGS.

FIG. L. 16

STACKING LOGS AT THE ROADSIDE, USING HAND AND SKID SPARS.

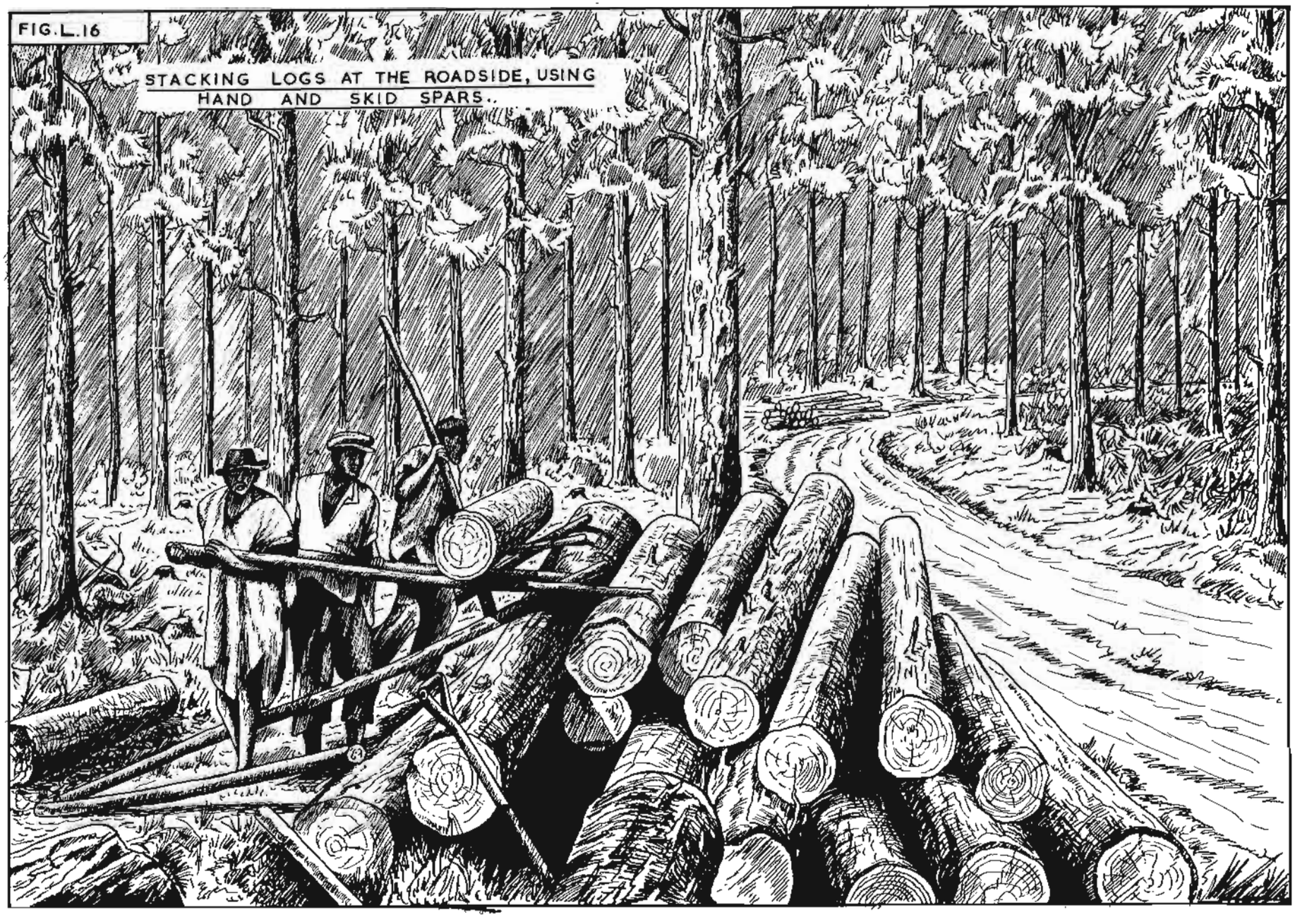
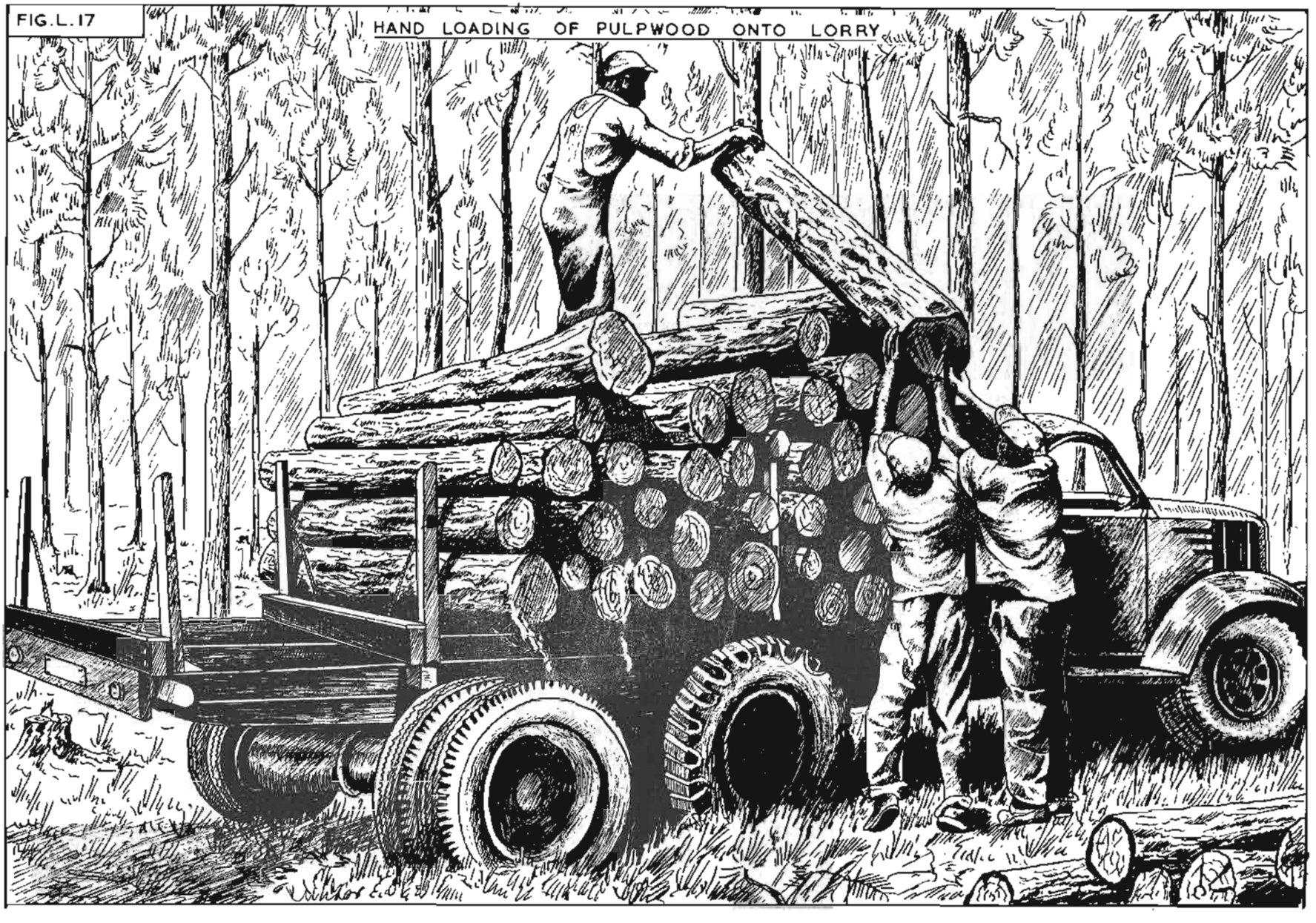


FIG.L.17 HAND LOADING OF PULPWOOD ONTO LORRY



(3) Short, but heavy logs (of medium diameter) should be located at the top of the stack so that these large logs are loaded first, directly onto the lorry deck, thus avoiding having to lift them to the top of the lorry load.

(4) If there are open drains running along the side of the road where logs are to be stacked, cross-sticks should be placed across the drains, and some of the logs be stacked on them in order to have the stacks as close to the roadside as possible (Fig. L. 13). This refers to cases where the sides of the road are level with the road surface.

(5) If the road is narrow with high banks, logs are roughly stacked against the road bank (Fig. L. 14), but such logs must be loaded quickly.

(6) Logs should be stacked with their thick ends in the direction of transport so that the thick ends can be placed towards the driver's cab.

(7) If the logs are to be stacked on the lower road bank it is advisable to build a "cribwork" up to the road surface level prior to log stacking (Fig. L. 15).

(b) LOG STACKING BY HAND AND HAND SPARS (Fig. L. 16)

Light, short logs of say up to 0,06 m^3 and up to 2,5 metres long can be stacked by hand, but the hand spar must be used if larger logs are to be stacked after they have been skidded to the roadside. Stacked logs simplify the loading operation considerably.

The hand spar is a length of strong, round, smooth timber, preferably of a hardwood species, approximately 1,5 metre long and 6 cm in diameter, flat sharpened at one end. It is a primitive tool, yet the most commonly used tool in plantations for moving logs over short distances. The most efficient method of moving logs by hand spars is by rolling. Pushing logs longitudinally by hand spars is seldom done.

In order to use the hand spar efficiently, it is essential to have a support where the sharpened bottom end of the spar can be propped as a fulcrum, so that leverage can be exerted against the log.

When the first layer of logs of the stack has been positioned tightly against each other, either on the ground or on cross-sticks, and it is necessary to place a second layer of logs on these, two short spars are placed in an inclined position with one end on the ground and the other end on the edge log of the stack, closest to the side from which stacking is to proceed. The hand spars are then thrust under the log to be stacked and it is rolled up the inclined stacking spars to the top of the logs of the first layer. It is advisable to place short cross-sticks over the first layer of logs so that the second layer can easily be rolled into place. If the stack is of more than two layers the process is repeated until the limit of permissible height for stacked logs has been achieved. The height of a log stack should never exceed 1,5 metre, and the interval between two stacks should never be less than 0,6 metre.

The best stacking results are obtained when two or more men work as a team with hand spars. While some men support the log in position up the inclined stacking spars, others pry with the ends of their spars beneath the log and roll it further up the incline. The first team again supports the log and the process is repeated until it reaches the top of the stack.

Hand spars are used throughout the logging field:

(1) For removing "hang-up" trees after felling.

(2) For supporting logs during cross-cutting to prevent the saw from pinching.

(3) To roll cross-cut logs aside to facilitate debranching of the undersides.

(4) To facilitate load assembling in skidding.

(5) To break up a load of logs lying tightly side by side after skidding, in order to provide access to the chain hook or chokers so that they may be undone.

(6) For stacking logs at the roadside.

(7) For placing loaded logs in an orderly fashion on the truck deck.

(8) For off-loading logs from the truck at the sawmill off-loading deck.

Note: All the cases of hand spar application have been illustrated under the relevant section of the manual.

A. LOADING PROCEDURE

(1) Small logs are usually pushed onto the lorry deck by hand, then rolled to the side where they are positioned in an orderly fashion against the stanchions, parallel to the length axis of the lorry. Stanchions are placed in an upright position on the opposite side of the lorry to the loading operation before loading commences.

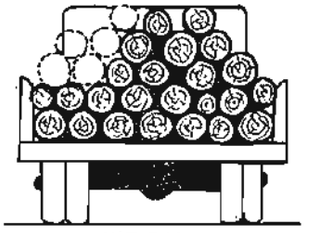
(2) One man alone can load light logs, but two men are required for heavier, short logs (Fig. L. 17).

(3) Loading should commence from the driver's cab end, the next stack to the back being commenced when the first reaches the required load height, and likewise with the third stack if the log deck is long enough and logs are short.

(4) An interval of at least 30 cm must be maintained between stacks of loaded logs on the lorry, and also between the first stack and the driver's cab protector. This is important from both the loading and off-loading point of view.

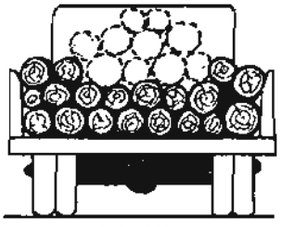
(5) When the far side of the lorry has been loaded, the stanchions on the loading side are placed upright and the near side is then loaded.

HAND LOADING



WRONG.

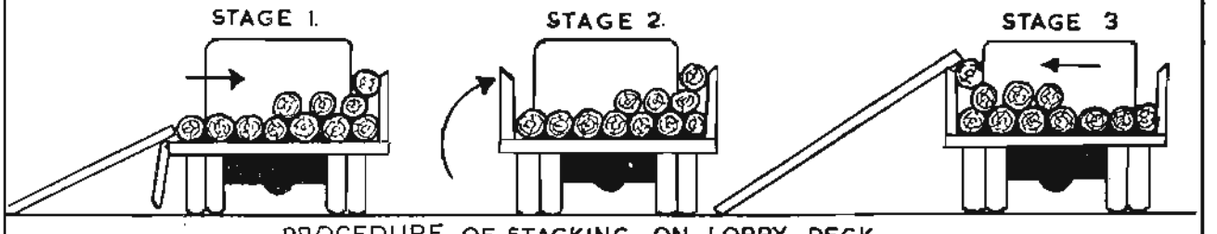
FIG. L. 18



RIGHT

FILLING UP THE LOAD

FIG. L. 19



PROCEDURE OF STACKING ON LORRY DECK.

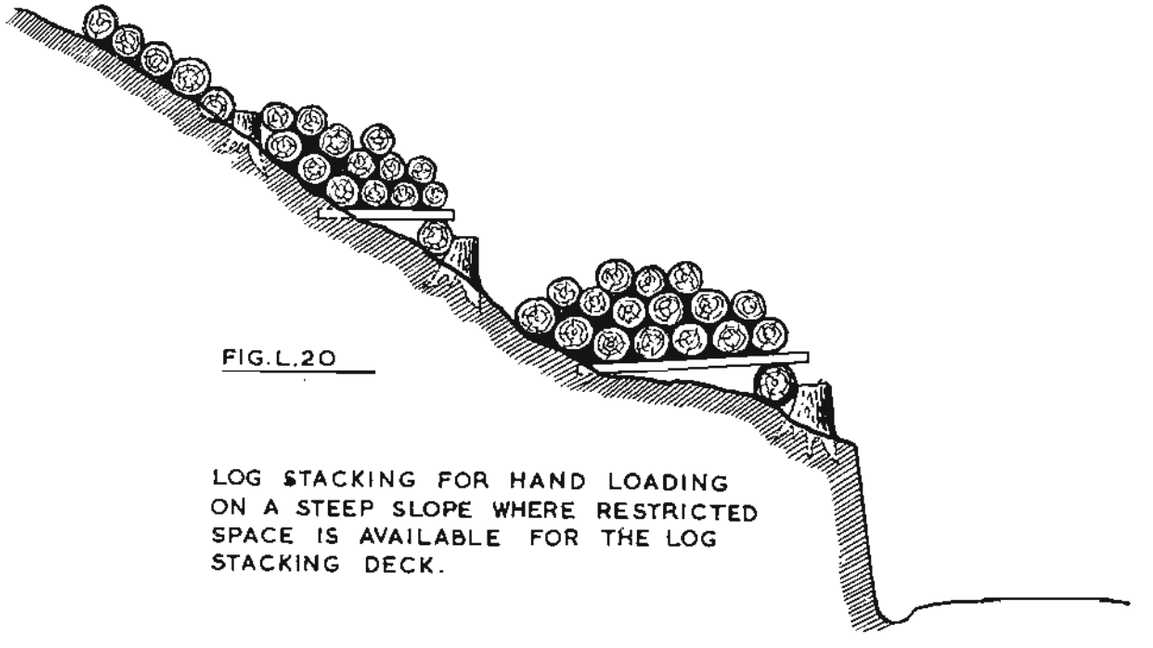


FIG. L. 20

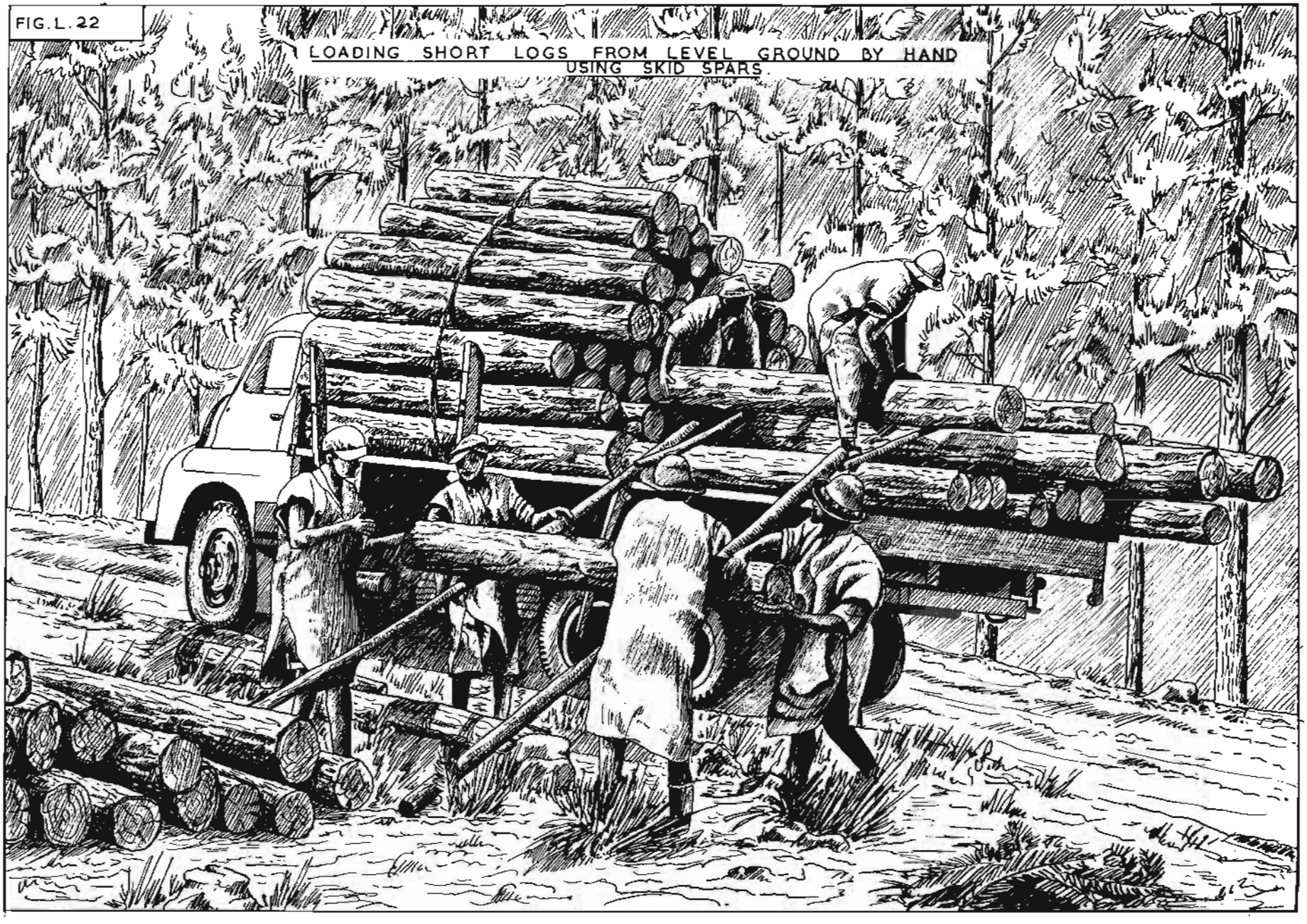
LOG STACKING FOR HAND LOADING ON A STEEP SLOPE WHERE RESTRICTED SPACE IS AVAILABLE FOR THE LOG STACKING DECK.

FIG. L. 21

LONG LOGS LOADED BY HAND — ONE END FIRST.

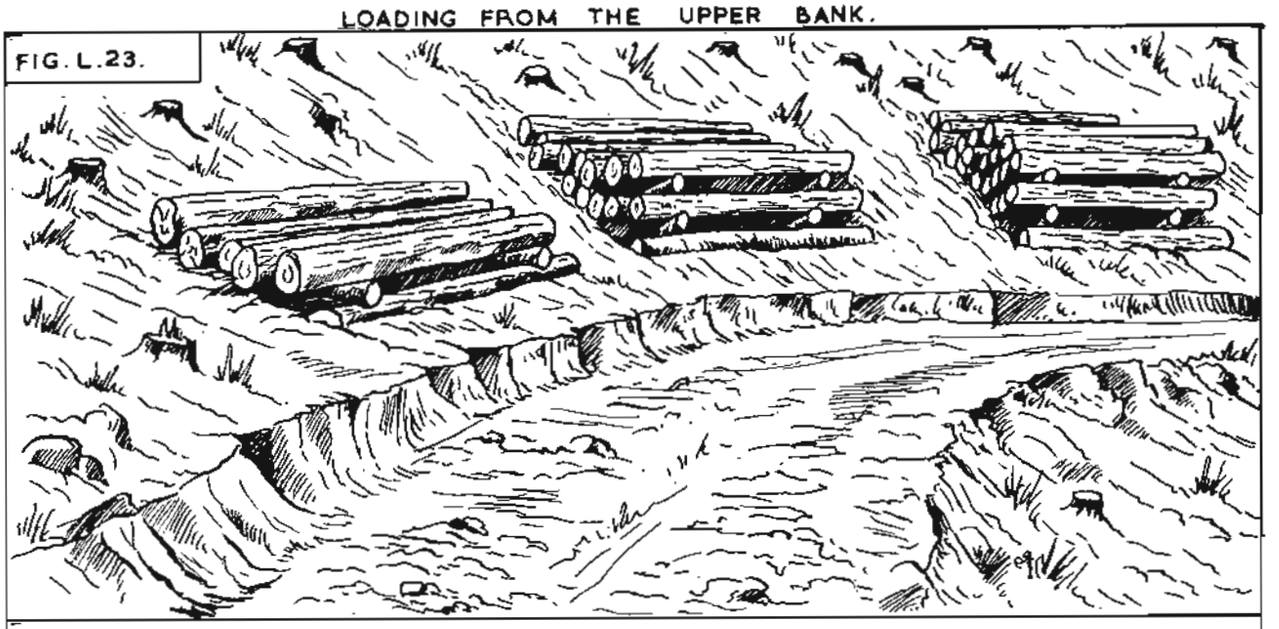
FIG. L. 22

LOADING SHORT LOGS FROM LEVEL GROUND BY HAND USING SKID SPARS.



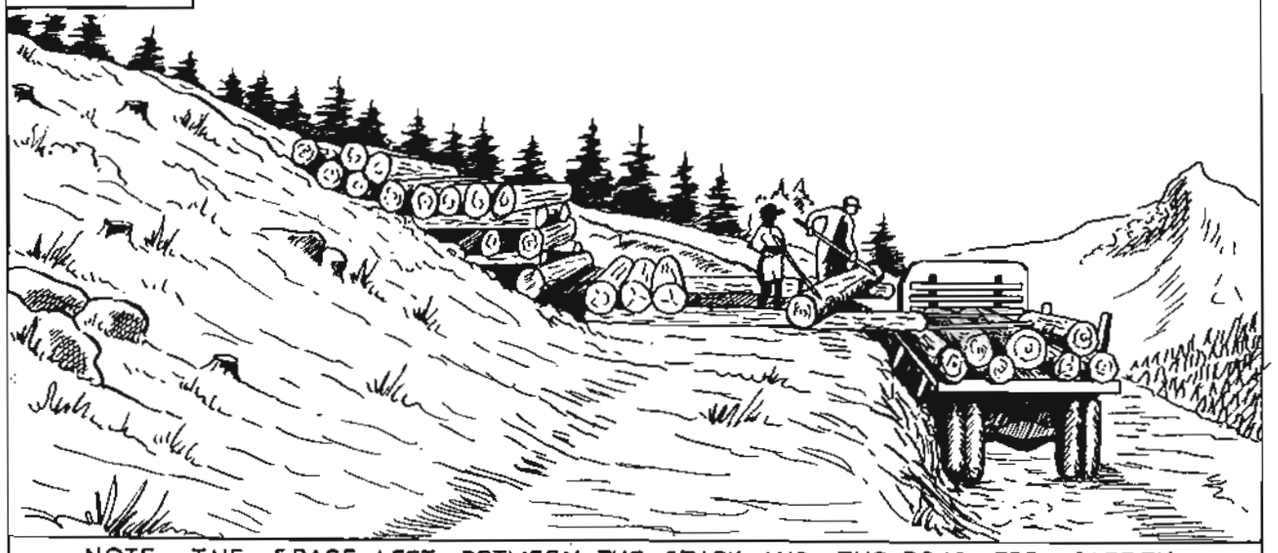
LOADING FROM THE UPPER BANK.

FIG. L.23.



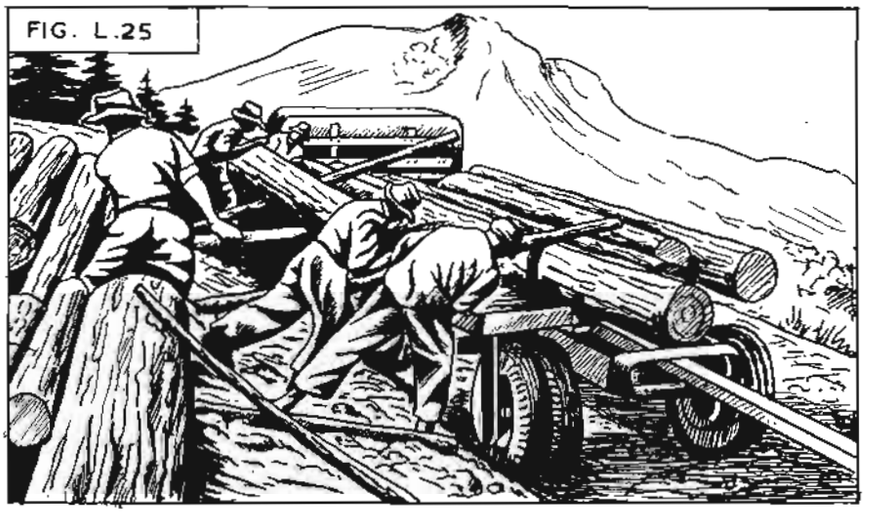
NOTE THE LOCATION OF THE BROW LOGS.

FIG. L.24



NOTE THE SPACE LEFT BETWEEN THE STACK AND THE ROAD FOR SAFETY.

FIG. L.25



EASY LOADING OF LARGE LOGS ONTO THE LORRY FROM THE UPPER BANK.

(6) It is advisable to maintain a slight concave load shape in the middle of the lorry while loading so that the logs are secure at all times. This space is filled in with logs which are loaded last (Fig. L. 18).

(7) Whenever a narrow gap occurs between two logs of the same layer of the stack on the truck deck, a log of suitable diameter should be selected to fill the gap as compactly as possible, thus saving space on the truck deck and producing a more compact load.

(8) If logs are to be loaded so that part of their length overhangs the rear end of the lorry, the protruding section may not exceed 120 cm, which is in accordance with road regulations. This does not apply to short logs, however, as logs of 2,5 metre long can only protrude some 60-70 cm (one third of their length) for safety purposes and balance.

(9) Seven ton lorries should be loaded from an optimum of 3 or 4 roadside stacks for efficiency with regard to the movement of the trucks and men.

GENERAL

(1) Logs in large stacks require more walking and carrying time, but smaller stacks with all logs close to the roadside necessitate frequent lorry movement, and thus lower productivity.

(2) Hand loading is a practical proposition for small or part time loading operations where the purchase of mechanical equipment is not justified.

(3) Loading large logs by hand, bodily (Fig. L. 21) is not to be recommended as it is both unsafe and uneconomical, exept when only a few loads are involved. Such logs generally require a large gang of labourers, and even then there may not be sufficient space on the log for all of them to grasp the log firmly.

B. LOG LOADING BY HAND USING SKID SPARS

Loading skids are sturdy poles of suitable length and diameter, dependent on the kind (species) of timber from which they are made, and the location of the log stacks in relation to the position of the truck to be loaded. Two skids are usually used for log loading. One end of the spar is sometimes notched, or fitted with an iron spike or horseshoe so as to secure a better hold on the lorry log bunk or log deck while loading. Skids are placed parallel to each other, the spacing being dependent on the log lengths, with one end firmly resting on the edge of the log bunk or deck and the other end embedded in the ground so that the skids are secure and it is easy to push logs up them.

Skid spars are employed for loading medium or large logs (Fig. L. 22).

If loading is to be done from the ground, and level with the road surface upon which the truck is standing, skids must be of sufficient length to form a gentle angle between the ground and the edge of the truck deck, to permit easy rolling of the logs to be loaded. Long skids, of up to 5,5 metres in length, should be used for heavy logs, and shorter skids for medium sized logs, to facilitate easier and faster loading.

The truck stanchions on the loading side must be dropped. Logs are first rolled towards the far side of the truck deck and placed against the stanchions. When the load has a triangular cross-section, with the highest point against the far stanchions, the stanchions closest to the loading activities are placed in the upright position. Logs from the far side are then rolled against the near side stanchions, thus forming a firm supporting wall of logs against which the ends of the skids can be rested to facilitate rolling of logs over the near stanchions and onto the lorry deck or bunk (Fig. L. 19).

The most efficient log loading with skids can be achieved when logs are stacked in stacks of truck load capacities, on the slope above the road, where the road bank is of a suitable height, but no more than 30 cm above the height of the truck deck (Fig. L. 23, 24). Under these conditions logs can easily be rolled from the log stacks onto the truck (Fig. L. 25). The logs can be easily controlled, the operation is fast and cheap, and the labour can be reduced to the minimum.

Peavy hooks or hand spars can be helpful for loading (Fig. L. 24), especially where logs are cylindrical in shape and are stacked in layers on cross-sticks. One man acting on only one end of the log can roll it towards the foot of the skids where the loading men take over.

In the event of a great accumulation of logs on a deck, with limited stacking space on a steep slope, stacking may be arranged along the following lines:

The most convenient approach to the edge of the road bank should be selected for the loading deck, provided that it is close enough to the logs for skidding purposes. The deck selected should have as much depth from the road as possible, to hold an ample supply of logs, but at least three logs should be accommodated on it. The deck is constructed as follows:

The first log, preferably one of large diameter and not shorter than the logs to be loaded is positioned parallel and close to the roadside and prevented from rolling down the slope by a low stump, or stumps (Fig. L. 20), or the log may be partly embedded in the ground to secure it. On top of the first log, two logs are placed crosswise at right angles to the roadside, with one end over the secured log and the back end embedded in the ground, on the slope, but in such a way that the front end is slightly higher than the back. Logs placed across these cross-sticks will then be prevented from rolling down the slope. The two cross-sticks should be placed apart at such a distance that the logs resting upon them have at least 45 cm overhang on each side, which will ensure that they can be safely handled.

Above the basic loading deck described above, logs are stacked parallel to the roadside in stacks, with each stack secured against a stump or stumps, or logs (Fig. L. 20). The bottom logs of the stacks may rest on the ground. Stacks should not be large, and should be independent of each other.

FIG. L.26

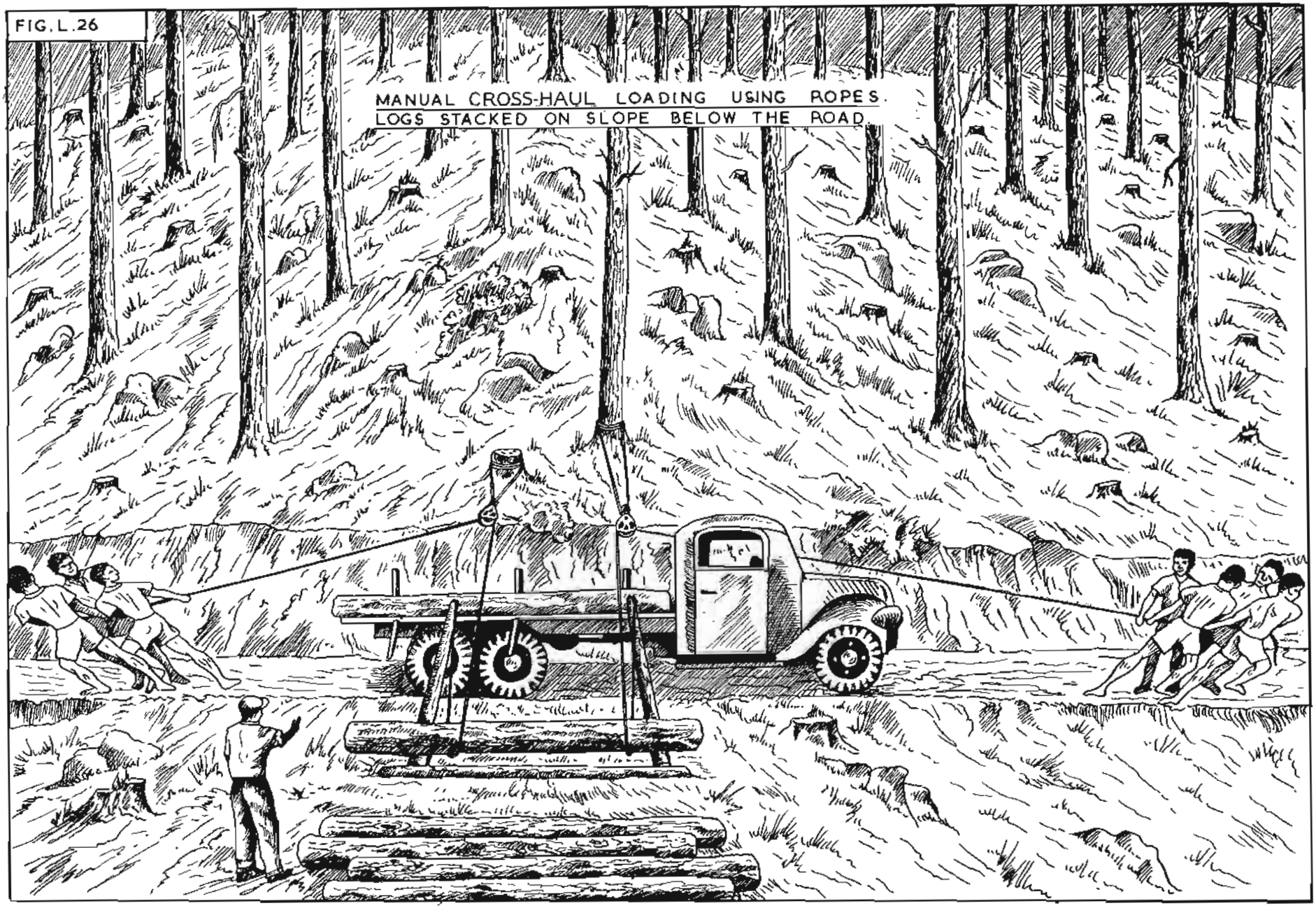

MANUAL CROSS-HAUL LOADING USING ROPES.
LOGS STACKED ON SLOPE BELOW THE ROAD

FIG. L. 27

CROSS-HAUL LOADING, USING ANIMALS.

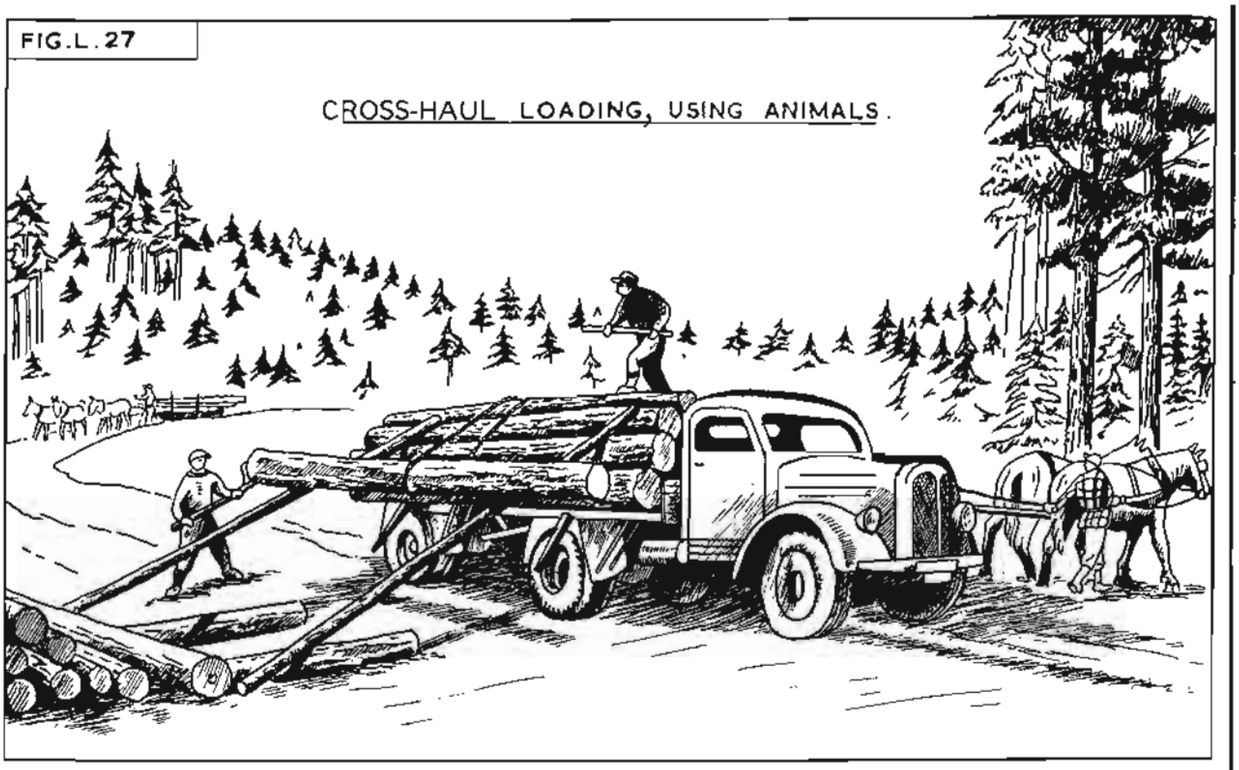
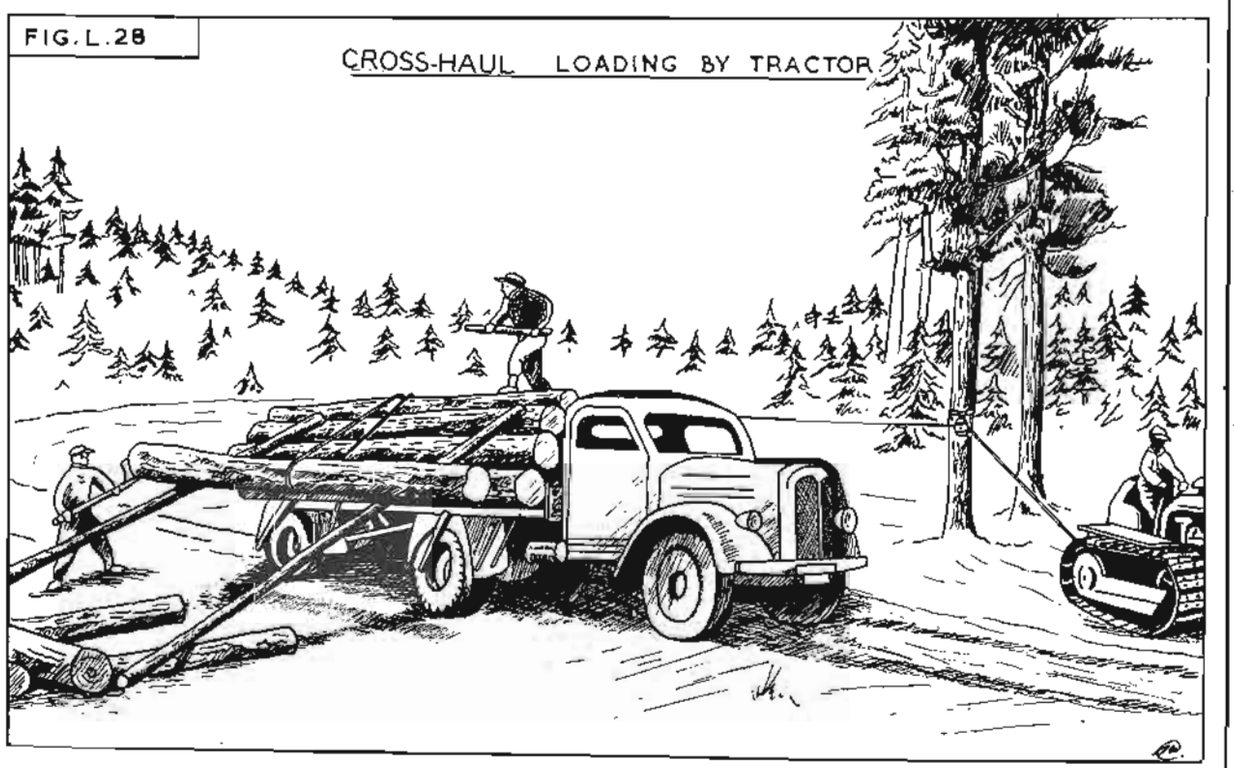


FIG. L. 28

CROSS-HAUL LOADING BY TRACTOR.



When logs from the basic loading deck have been loaded (usually by means of skid spars) the logs from the nearest upper stack are carefully rolled onto the cross-sticks of the basic loading deck (Fig. L. 24), and so on for any succeeding stacks.

Loading logs from the lower road bank, using skids

Where logs are to be loaded from the lower road bank, a "crib-work" must first be built up so that logs are stacked level with the road surface. Skids are positioned as for normal loading from ground level. Where logs are loaded from below the road level, without crib-work, loading is done in two stages; first the logs must be rolled up to the road one at a time, and then they are rolled up the skids onto the truck. The latter method is slow, strenuous and expensive, as an increased number of labourers is required.

C. CROSS-HAUL LOADING BY HAND (Fig. L. 26) (seldom used)

The practice of log loading by means of the cross-haul system has sometimes been used in plantations in conjunction with hand loading. One or two ropes may be used. If one rope is used, it is located near the point of balance of the log; if two ropes are used they are located near the ends of the log. Snatch blocks, fastened to trees or stumps on the side of the road opposite to the loading operation, may be used for added convenience.

Each rope consists of two parts: (1) a short wire rope sling (or strap) of 9 mm diameter with both ends eye spliced, with one end anchored to the tree or stump opposite to the loading operation. The sling passes over the lorry deck with its other end extending just beyond the loading side of the truck; (2) to the free eye of the wire rope sling is fitted a fibre rope of 19 mm diameter, with one end thimbled and the other end served. A shackle or sister hook with shackle is attached to the thimbled end, which is connected to the eye of the wire rope strap passing over the lorry deck.

The fibre rope is threaded under the log to be loaded, then over it again and back over the truck deck and through the snatch block attached to the tree or stump. A gang of labourers pulls on the rope, as in Fig. L. 26, and rolls the log up the skids and onto the lorry deck. When the first layer of logs on the lorry deck is completed, the wire rope sling, which rested on the deck, is pulled out from beneath the logs. This method of loading is usually applied to logs of large diameter where one layer of logs generally suffices to complete the load to the full lorry capacity.

Should smaller (i.e. medium) logs be loaded and it is desirable to load a second layer of logs on top of the first, the withdrawn wire rope sling, which has been disconnected from the fibre rope, is laid over the top of the first layer of logs. A cross-stick, or cross-sticks, of about 7 cm diameter, is laid across the load at right angles to the logs to be loaded, in order to facilitate the easy withdrawal of the wire-rope sling from beneath the loaded rig. If this is not done the sling could be so tightly squeezed between the loaded top log and the bottom layer of logs that considerable effort would be required to extract it. Cross-sticks must be of different lengths, as they are withdrawn after each log has been loaded and the cable withdrawn and placed in position for the next log. As loading progresses the space between the last log loaded and the side of the lorry facing the operation will decrease, which will necessitate the use of shorter cross-sticks as the distance decreases. Logs are rolled onto the cross-sticks over the first layer of logs, the sling is withdrawn (after the fibre rope has been disconnected); the log is rolled off the end of the cross-stick onto the first layer of logs, the sling is passed over the log and again connected up to the fibre rope, and the cross-stick of suitable length is placed in position for loading the next log. The speed of loading depends on the size of the logs and the number of labourers engaged. Loading time varies from 30 minutes to one hour.

Direct cross-haul loading of logs stacked below the road, with a single rope, is an extremely dangerous operation. The log taper requires careful adjustment to the rope position as the end of larger diameter tends to roll faster than the end of smaller diameter. A labourer, standing below the log being loaded across the skids, must adjust the position of the log, and as the skids rise at a steep angle due to the adverse slope, logs can easily slip and cause a serious accident.

Note : Fig. L. 27 shows a cross-haul operation similar to the one described, using animals instead of hand labour to provide the loading power. This method has not been applied in practice in departmental plantations. Fig. L. 28 illustrates the cross-haul loading method described, but using a tractor to provide the loading power.

D. CROSS-HAUL LOADING BY MEANS OF WIRE PULLERS

The above method of loading has only once been employed in the Department when a spar tree of 20 m long and 25 cm top diameter was loaded onto a long truck with a special lorry arrangement for long pole transportation. Two Tirfor wire pulling assemblies, operated by two men, were used for loading the tree. The operation is similar to ordinary cross-haul loading in all other respects.

Note : The tree was felled and lowered to the ground under control of the same pullers.

Some data relating to this operation are, however, available from professional literature from abroad, where logs of various diameters were loaded onto a lorry using skids, a single wire rope, and a wire puller.

Mass of logs kg	Volume m^3	Loading time per log seconds	Loading time per m^3 seconds
100	0,1	40	413
200	0,2	79	409
300	0,3	111	385
400	0,4	137	357
500	0,5	158	328
600	0,57	172	297
700	0,68	180	265
800	0,76	183	240

Three men were required for the above operation, and the logs were positioned on cross-sticks in the stacks for easy cable threading.

(a) LOADING NORMS

Loading norms for manual loading under different conditions are dealt with under the relevant section relating to crane loading, in conjunction with transportation by lorries.

(b) GENERAL

Disorderly log stacking at the roadside adversely affects the truck loading time. Delays in loading increase the lorry standing time, while it waits for the load to be completed.

In departmental log stacks, logs are grouped according to their length, as follows:

Group A	Group B
1. 2 to 3,5 m	1. 2 to 2,5 m
2. 4 m and over	2. 2,7 to 3,6 m
	3. 4 m and over

Note : Group B logs are regarded as the practical best for intensive truck loading as they are easier to stack to the full capacity of the truck length, but this length classification may affect tractor skidding efficiency.

(c) STACK SIZES

Stacks should be of the optimum depth and size so as to reduce unnecessary truck and labour movement from stack to stack, but at the same time labourers should not have to roll logs for any appreciable distance from the stack extremities to the roadside. In general stacks should comprise a full lorry load - no more and no less, if the loading area permits.

E. RANDOM OBSERVATIONS

The organisation of truck movement, and log loading onto trucks, has been dealt with in the chapter relating to log loading by crane, and is very similar for loading by hand. As the human element is involved to a greater extent, however, the hand loading process has its own problems. The man is not a machine, and he has to rest. If 50 - 60% of the working time is actually spent in loading, this should be considered satisfactory.

When more than two lorries with the same loading and off-loading points are carting along the same route, they sometimes spend considerable time waiting to be loaded.

Lorry transportation costs are dependent on:

(1) Loading.

(2) Transportation by lorry.

(3) Off-loading.

Lorry occupation must necessarily be affected by these three factors, which should be considered collectively.

Loading factors consist of:

(1) The cost of labour - the loading crew.

(2) Cost of waiting time of the lorry while:

(i) Being loaded.

(ii) Waiting to be loaded.

(3) Cost of additional arrangements used with the loading operation, such as log decks, etc.

(a) LOADING CREW

(1) Eight trucks were used for carting single units, each along different routes. Twenty-seven labourers, organised into 6 teams, unequal in number, and engaged in loading the above lorries, worked 30 per cent of the working hours.

Note : This was partly due to the fact that some of the lorries left the plantation early, as log loading by hand took a long time; and sometimes insufficient time was left to load a full load, with only an hour or so of working time remaining.

(2) A similar loading crew occupation time was noted when 3 trucks were carting along the same route and 4 trucks simultaneously along a different route. In this case 43 labourers organised into 5 teams were engaged in log loading.

Note : The cost per man day varies from area to area, and ranged from 60c upwards.

Under the present departmental organisation, waiting time costs will be:

(i) The cost of the idle loading crew if no lorries are at hand for loading.

(ii) The lorry driver's wages.

The Department pays for lorry services on the basis of kilometres run, so there will be no charge for the lorry waiting time.

The average load achievement per day is one 7 ton lorry per labour unit. The following data relate to loading performances where 3 lorries were involved:

A. Average number of 6 ton vehicles.	3 in a group on the same route.
Single trip distance.	8,8 km.
Number of trips per day.	3 per truck.
Total daily kilometres per vehicle.	53 km (3 return trips).
Speed, empty (average).	18 km/h.
Speed, loaded (average).	15,8 km/h.
Total time in motion per trip.	58 min. (empty 28 min. loaded 30 min.)
Loading time per truck load.	33 minutes.
Loading time per truck, daily.	99 minutes - 3 loads.
Total loading time for 3 vehicles.	4 hrs 5 minutes - 9 loads.

Unloading time per lorry load.	21 minutes.
Unloading time per vehicle, daily.	63 minutes - 3 loads.
Total daily unloading time - 3 trucks.	3 hrs 15 minutes - 9 loads.
Waiting and delay time per load.	33 minutes.
Waiting and delay time per truck per day.	99 minutes.
Total waiting time per day.	5 hrs - 3 vehicles.
Lunch and breakfast.	3 hours for 3 vehicles.

Note : Loading gang: 12 labourers in the plantation.
Unloading gang: 2-3 labourers at the sawmill.

B. Transport data for one day's performance by 3 trucks of 6 ton average capacity. Figures refer to the 3 trucks together. All trucks were carting along the same route all day.

Trips done per day.	9 trips.	
Total kilometres completed (9 km trip).	159 km.	
Running empty, daily.	4 hrs 26 min.	18%
Running loaded, daily.	5 hrs 04 min.	20%
Total time in motion.	9 hrs 30 min	38%
Loading time (12 men for 3 trucks).	4 hrs 55 min.	20%
Unloading time (2, 3 men for 3 trucks).	3 hrs 15 min.	14%
Meals.	3 hrs	12%
Waiting time.	3 hrs 50 min.	16%
Delays.	10 min.	
Total		100%

Total delivery: 54 tons - 944 logs - 57 kg average log.
Approximately 0,057 m^3 per log = 48,4 m^3.
12 Labourers @ 70c = 840c ÷ 48,4 m^3 = approximately 17,3c per m^3.
48,4 m^3 ÷ 12 labourers = 4 m^3 per labour unit.

C.1. 3 Days observed with a single lorry carting logs daily

Number of lorries:	1 (3 days)	
Total return trips completed	22	
Total kilometres completed	108 km	
Average speed	17,6 km/h	
Empty run (including time to and from garage).	3 hrs-29 min.	15,4%
Loaded run.	1 hr-44 min.	7,6%
Total time in motion.	5 hrs-13 min.	23,0%
Loading time.	11 hrs-39 min.	51,3%
Unloading time.	1 hr-16 min.	5,5%
Meals.	2 hrs	8,9%
Waiting time for loading.	None.	
Delay time.	2 hrs-34 min.	11,3%
Total time out of garage.	22 hrs-42 min.	100 %

Delivered 151 m^3 - 465 logs = 0,31 m^3 per average log.
151 m^3 ÷ 3 days = 50,4 m^3 daily.
50,4 m^3 ÷ 12 men = 4,2 m^3 per man/day.
Loading time took 11 hours = 51,3% of the total time.
Loading team: Loading logs from stacks located level with the road surface; 11 to 13 labourers were used.

C.2. International 7 ton truck

Six men loading from stacks on convenient upper bank, using skids.

In motion	Loading	Unloading	Waiting/delays	Meals
24,2%	47%	6,6%	12%	10,2%

Average log 0,3 m^3 = 6,8 m^3 per load = 22 logs per load.
Carting distance: approximately 1,6 km.
Loaded daily: 11 loads.
Total daily output delivered: 75 m^3.
75 m^3 ÷ 6 men = 12,5 m^3 per man.

C.3. 3 Trucks observed

Eleven men loading from stacks located level with the road surface.

In motion	Loading	Unloading	Meals	Waiting/delays
38%	20%	14%	12%	16%

5 ton truck - average load 125 logs - loading time 32 minutes.
7 ton truck - average load 133 logs - loading time 38 minutes.
7 ton truck - average load 156 logs - loading time 38 minutes.

Average log: 0,03 m^3.

C.4. Single lorry carting, observed for 3 days.

Average of 12 men loading from stacks located level with the road surface, using skids for hand loading.

In motion	Loading time	Unloading time	Meals	Waiting/delays
21%	49%	5%	7%	18%

Average log: 0,34 m^3.

(b) CONCLUSIONS

From the above data one must come to the conclusion that hand loading is a slow operation, and expensive. Hand loading should only be applied where small quantities of small sized timber are involved and where labour is cheap and plentiful.

FIG.L.29

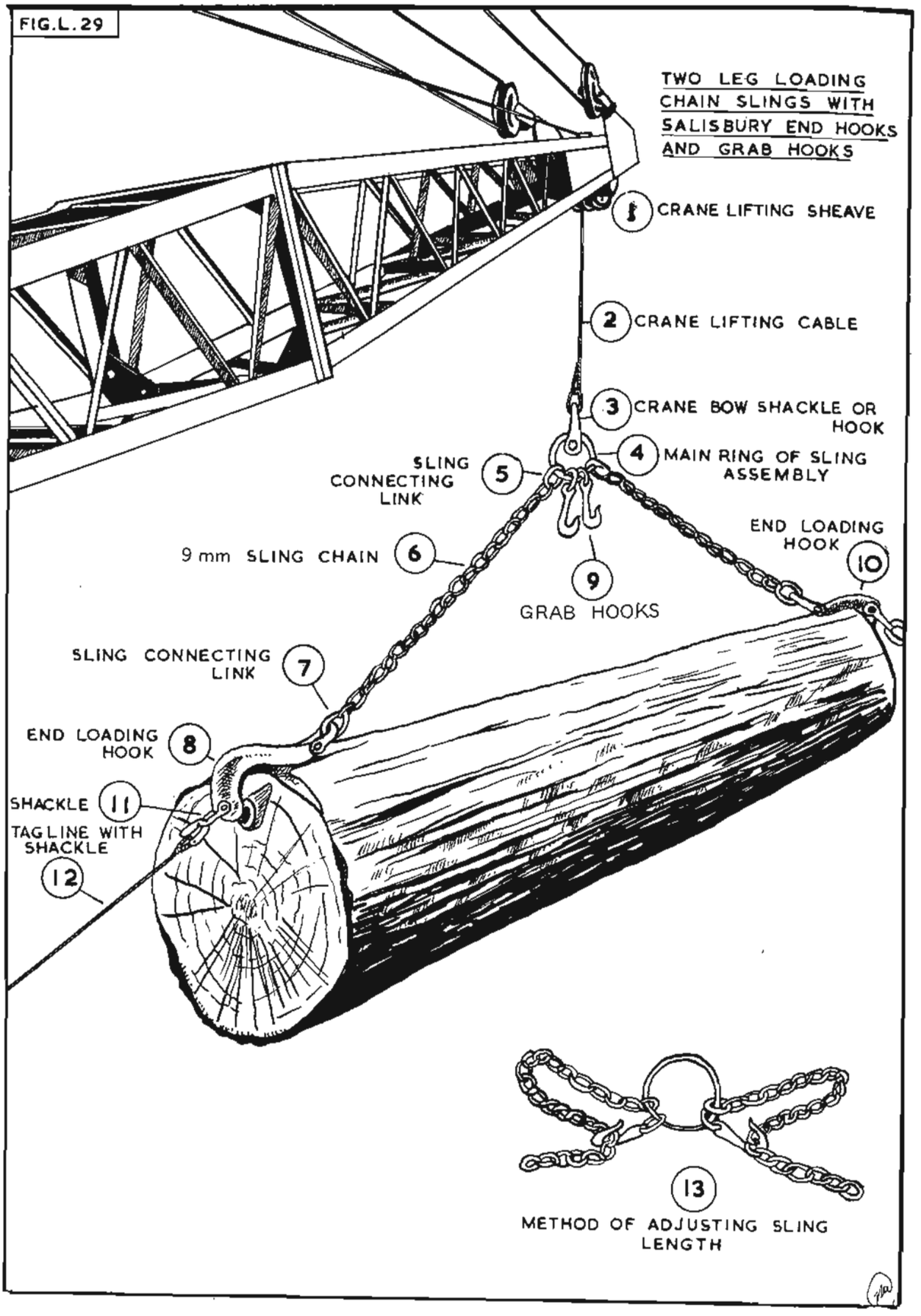
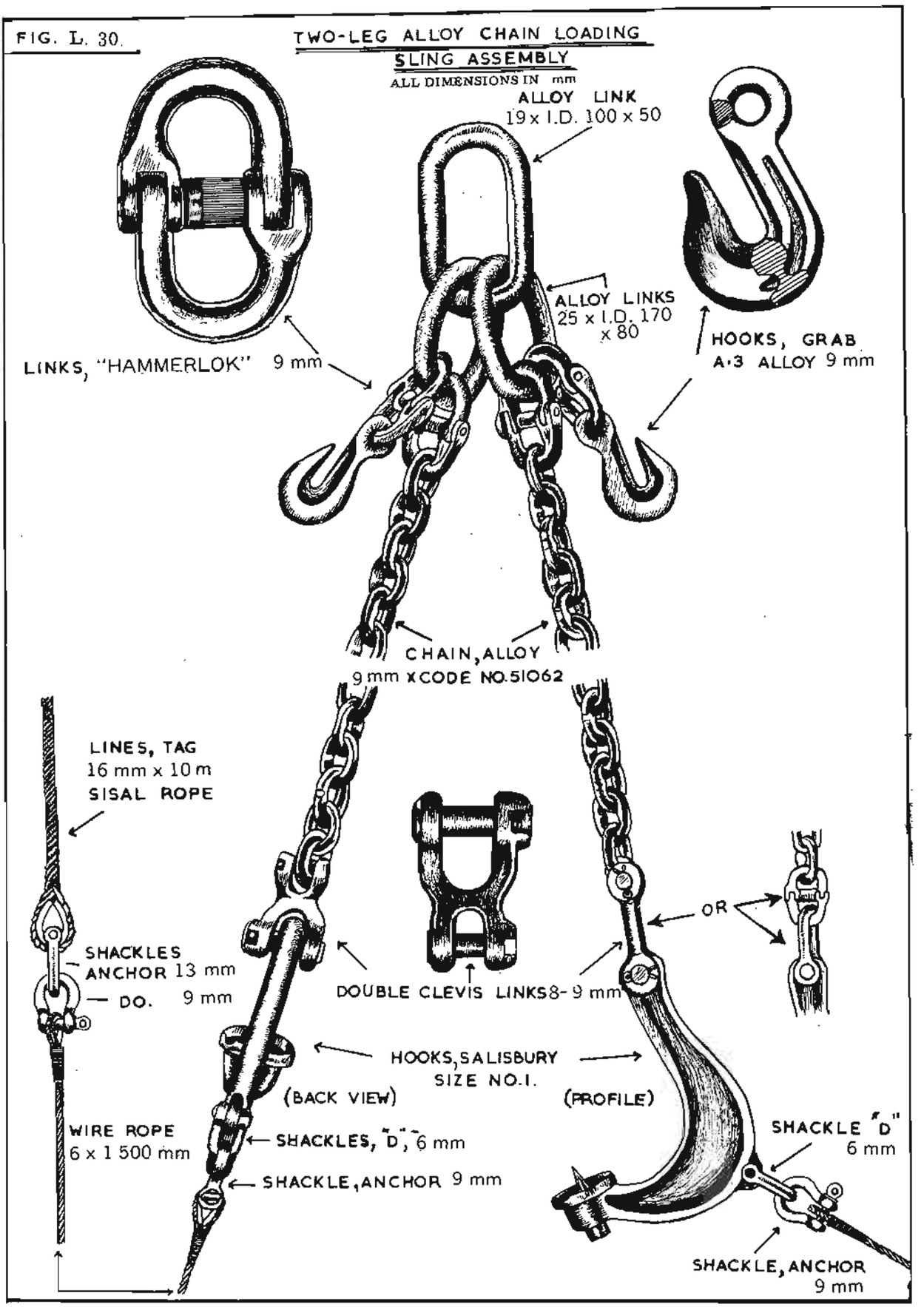

TWO LEG LOADING CHAIN SLINGS WITH SALISBURY END HOOKS AND GRAB HOOKS
1 CRANE LIFTING SHEAVE
2 CRANE LIFTING CABLE
3 CRANE BOW SHACKLE OR HOOK
4 MAIN RING OF SLING ASSEMBLY
5 SLING CONNECTING LINK
6 9 mm SLING CHAIN
7 SLING CONNECTING LINK
8 END LOADING HOOK
9 GRAB HOOKS
10 END LOADING HOOK
11 SHACKLE
12 TAG LINE WITH SHACKLE
13 METHOD OF ADJUSTING SLING LENGTH

FIG. L. 30.

TWO-LEG ALLOY CHAIN LOADING SLING ASSEMBLY

ALL DIMENSIONS IN mm



DOUBLE CLEVIS LINK.

FOR USE WITH ALL TYPES OF CHAIN INCLUDING ALLOY:

ALLOY AISI 4130 STEEL.

HEAT-TREATED

BRINELL HARDNESS 302-269.

ALL PINS, AISI-4130 STEEL -HEAT-TREATED.

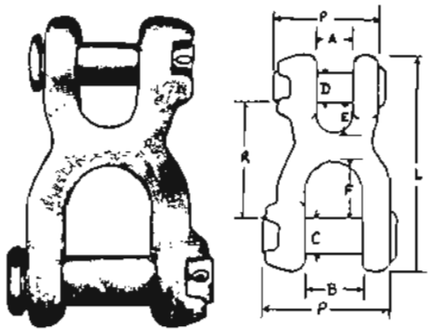
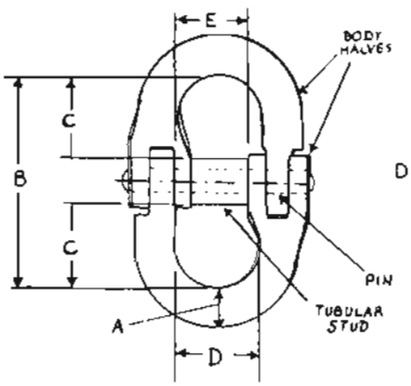


FIG. L. 31

SIZE. mm	DIMENSIONS IN mm											MASS EACH. kg	BREAKING STRENGTH RATED IN kg
	A	B	C	D	E	F	L	P	P'	R			
8—9	14	25	16	11	12	25	90	57	32	48		0,4	10 000
11	17	28	17	14	15	28	103	62	51	55		0,6	14 000
13	21	32	19	16	17	32	115	70	57	63		0,8	19 000

FIG. L.32.

HAMMERLOK COUPLING LINKS



DROP-FORGED ALLOY STEEL -SELF COLOURED-

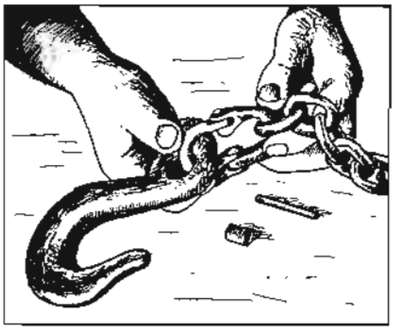
MASSES AND DIMENSIONS ARE APPROXIMATE AND ARE SUBJECT TO PLUS OR MINUS TOLERANCE OF 4%

CHAIN SIZE mm ϕ	WORKING LOAD LIMIT. kg	A. mm	B. mm	C mm	D. mm	E mm	MASS EACH kg.
9	2 990	11	61	22	23	20	0,2
13	5 100	16	85	32	33	27	0,6
16	7 470	19	103	38	40	34	1,0
19	10 400	22	122	45	48	41	1,6
22	13 000	25	138	52	58	46	2,7

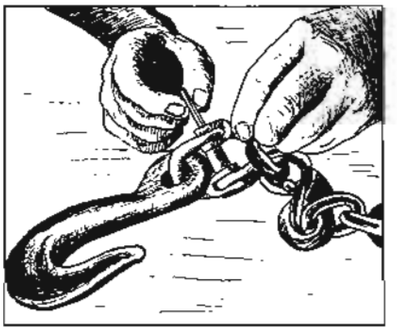
FIG L 33

"HAMMERLOK" COUPLING LINK

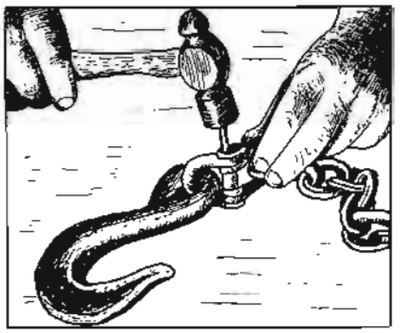
① HOOK ONE HALF THROUGH CHAIN AND OTHER HALF THROUGH ATTACHMENT.



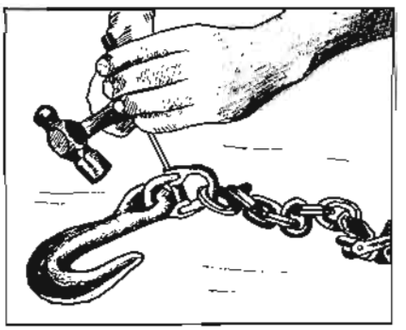
② BRING THE TWO COUPLING LINK HALVES TOGETHER AS SHOWN.



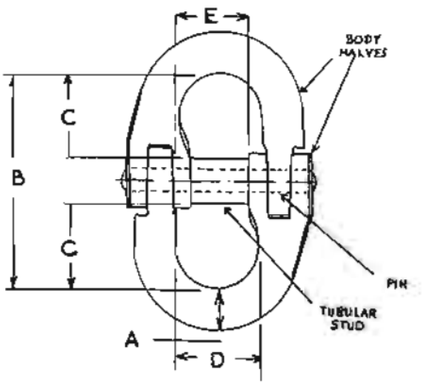
③ PLACE THE TUBULAR STUD AND TOUGH, HARDENED PIN IN PLACE AS SHOWN.



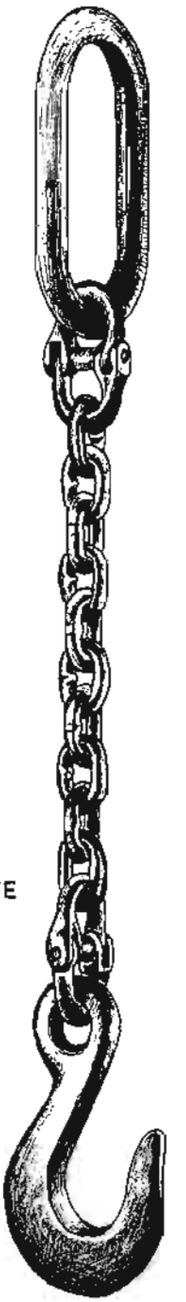
④ DRIVE PIN INTO PLACE. THE ASSEMBLY IS COMPLETE AND READY FOR USE.



⑤ TO DISASSEMBLE, DRIVE OUT PIN.



⑥



2. AUXILIARY EQUIPMENT (RIG) USED WITH DEPARTMENTAL LOG LOADERS

The auxiliary equipment used with timber loaders depends on the type of loader used, size of logs loaded and loading methods, all of which may be affected to a large extent by the nature of the terrain. Some loaders with their respective rigs require special methods of log stacking.

The main types of loading auxiliary equipment selected for departmental conditions have been indexed, and will be dealt with in detail below.

A. CHAIN SLINGS (Fig. L. 29)

(a) TWO-LEG CHAIN SLINGS WITH END LOADING HOOKS

These slings are used for loading single logs of up to 6 m long. They offer a sure grip on the log, are easily adjustable to the length of the log, and are easy to secure or remove from the logs. Logs may be snatched from almost any position within the crane reach. Chain loading slings are safer than the log grab rig as men can stay safely away from the log which is being loaded, while the hook is being engaged, or the log is lifted or disposed of by the crane.

Details of the two-leg chain loading sling assembly are set out in Fig. L. 30, and are listed below according to the item numbers on Fig. L. 29.

1. Crane lifting sheave.
2. Crane lifting cable.
3. Crane bow shackle (or hook) on crane cable.
4. Main ring of sling assembly.
5. Sling connecting link, linking the chain to the end hook shackle.
6. 9 mm Sling chain.
7. Sling connecting link, linking the chain to the end hook shackle.
8. & 10. End loading hooks.
9. Grab hooks attached to the main sling ring.
11. Shackle to connect end loading hook and tag line.
12. Tag line with shackle, which serves to control the log during loading.
13. Method of adjusting in length of the chain loading slings.

Note : Item 13 shows the use of "grab hooks".

(1) Remarks relevant to two-leg chain loading slings

Fig. L. 30, apart from illustrating the assembly, gives the nomenclature and sizes of all items involved. Some items of the assembly require further comment.

(2) Double clevis link (Fig. L. 31)

This item was incorporated in the assembly in order to link the shank of the hook directly to the chain of the assembly. Despite being recommended by a recognised safety commission, the link has a certain weakness - the pins of the double shackle move under pressure of the load, causing the split pins in the shackle pins to break, and they consequently require frequent replacement. A recommended alternative is to attach a bow shackle (clevis) to the hook shank and connect the chain and bow shackle by means of a Hammerlok link (Fig. L. 32). Fig. L. 33 shows how a Hammerlok link is installed between the hook and chain.

(3) End hooks

When end hooks were initially introduced, home-made hooks were used, manufactured from a single piece of steel (Fig. L. 35). These hooks blunted quickly, however, and were apt to break under heavy loads, endangering the lives of workmen. The Salisbury type of hooks (Fig. L. 34) were then introduced and proved far superior. The latter hooks have exchangeable pins and cups; the pins can be kept sharp; and the cups offer a better grip on the lifted log, as they cannot slip. In Fig. L. 34, item B is the pin and item C is the cup.

(4) Tag lines (Fig. L. 29 and 30)

Tag lines are fastened to the hook tag shackle attachment by means of a shackle to control the loaded logs. They consist of two parts: a wire rope strap with both ends thimbled, and a fibre rope, as shown in detail in Fig. L. 30.

(b) FOUR-LEG CHAIN SLING ASSEMBLY (Fig. L. 36)

These slings are used for loading medium logs in pairs, in order to increase the load size for the crane. In this case logs should not differ much in their length, a difference of more than 1 m being excessive. Logs should be located on the stack for convenient hooking. If single large logs have to be lifted occasionally, two hooks of the sling must be hooked into each end of the log, to prevent one pair of hooks from flying loose.

Note : It should be noted that two slings hooked on each side of the log do not always increase the lifting capacity, as the exact adjustment of the two pairs of slings is not easy.

Details of the slings are set out in Fig. L. 36, and are listed below according to the item numbers on the drawing.

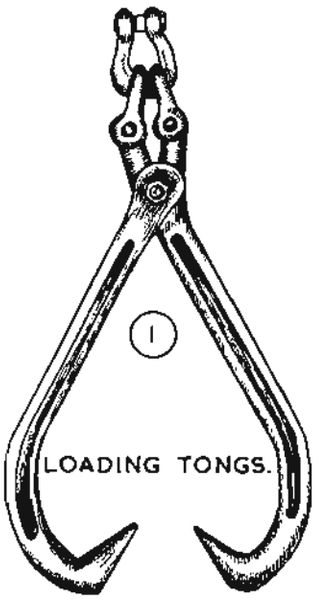
1. Crane hook to which the slings are hooked.

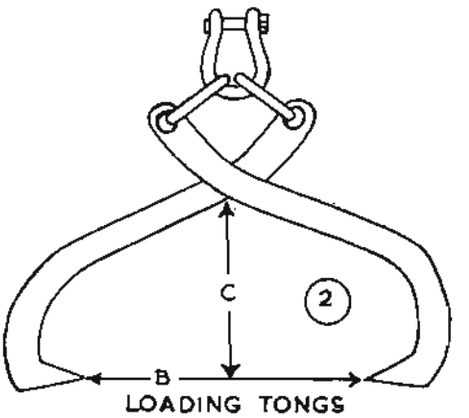
Items of the sling:

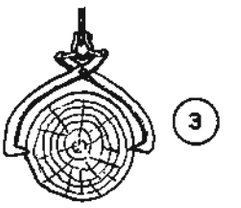
2. Main ring - 22 mm material diameter.
3. Link 11 mm material diameter, linking the chain and main ring.
4. Chain 9 mm link material diameter, short type, high tensile steel.
5. Link 11 mm material diameter, linking the chain and Salisbury hook.
6. Bow shackle, 16 mm material diameter, hex-pin 19 mm material diameter.
7. Salisbury hook, No. 1.
8. Bow shackle, 13 mm material diameter, 16 mm diameter hex-pin.
9. Strap, 6 mm wire rope.

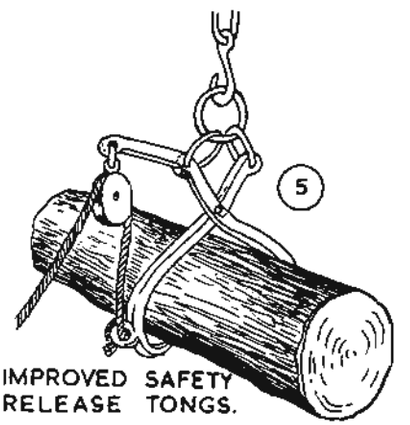
FIG.L.37.

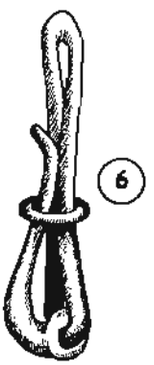
LOADING HOOKS.

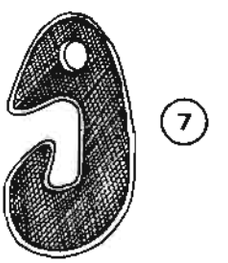


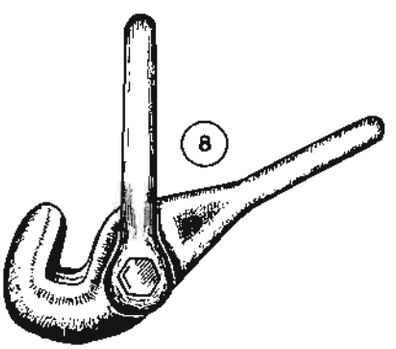


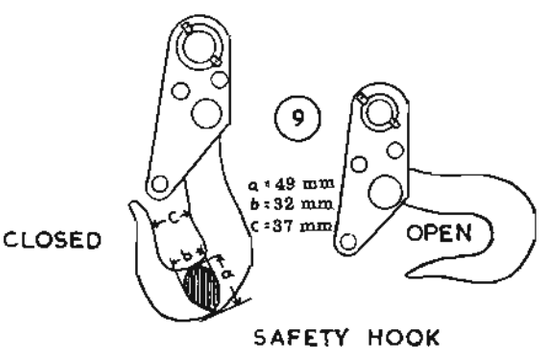












AUXILIARY EQUIPMENT WITH TRUCK-MOUNTED CRANE FOR SELF-LOADING LORRIES

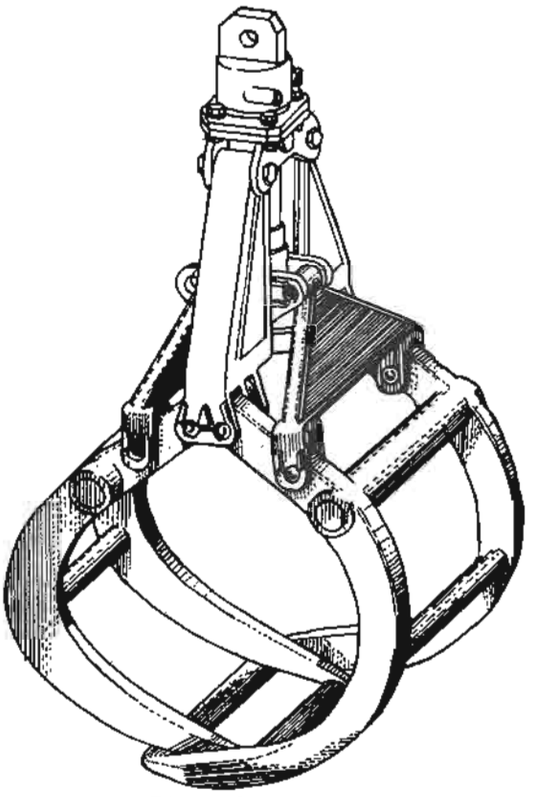
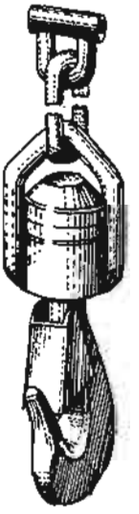


FIG. L.38
HYDRAULICALLY-OPERATED GRABS.

FIG. L.39

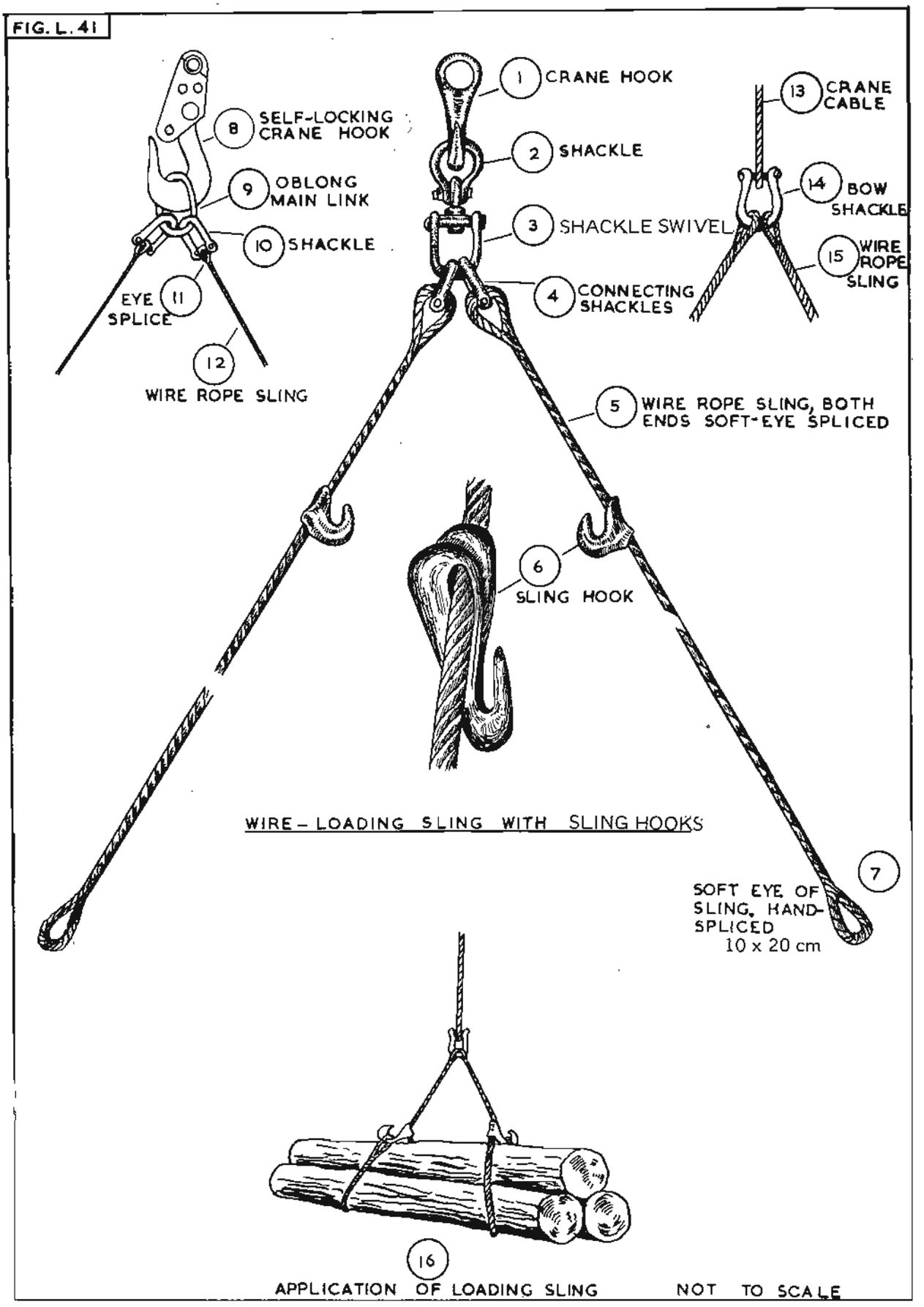
LOADING SWIVEL LINE HOOK WITH SAFETY CATCH.

FIG. L.40



JIB-ATTACHED SWIVEL LOADING HOOK.

FIG. L. 41



WIRE – LOADING SLING WITH SLING HOOKS

APPLICATION OF LOADING SLING NOT TO SCALE

(10) Bow shackle, 13 mm diameter material, 16 mm diameter hex-pin.
(11) Tag lines, fibre rope.

Note : All remarks relevant to the two-leg chain slings also apply to the four-leg sling assembly.

(1) Operation of the chain sling assembly

To load the logs with end hook slings, whether two or four-legged, will require two men. When the sling hooks have been placed in the end of the log a signal is given by the sling operator and the crane lifts the log, placing it on the lorry log bunk. The crane lifting cable is then slackened and both men pull the end hooks out of the ends of the log by means of their tag lines. The procedure is repeated until the loading of the truck is completed.

Note : It is important to place the end hooks correctly in the ends of the log, i.e. not too shallow and not too far from the edge, in order that a firm grip and the correct line of hook pull can be obtained. Ideally the hook shank should just touch the surface of the log parallel to the log length. The load must be lifted gently, without a jerk. Slings are adjusted by means of grab hooks attached to the master link of the sling assembly.

(2) Loading tongs (Fig. L. 37, items 1 to 5)

Tongs consist of two hinged bow arms joined near their tops by means of a pin. The bottoms of the arms are sharply bent up to form a hook with a sharp tip.

At the top of the tongs, above the pin, the arms are linked by the links and main shackle, which is hooked to the crane (line) hook. Tongs are used for loading single logs, usually of a large size, depending upon the crane capacity. Tongs must be placed at the balance point on the log to enable the labourer to hold it horizontally. When a log is firmly jammed between other logs in the stack, hooking is sometimes inconvenient, but this difficulty may be overcome. The points of the tongs must be placed at the widest point of the log diameter, or slightly below it, and at the point of balance of the length of the log. This arrangement facilitates control of the log by the labourer while the log is being loaded, and unhooking is easier and safer as the tongs grip the log firmly [see Fig. L. 37 (3)].

If the logs being loaded differ much in diameter, two or three tongs of different sizes should be readily available for exchange.

If logs are taken from the stack located close to the road and are then lifted immediately after being hooked, without having been first dragged along the ground, tongs with the top of one arm longer than the other can be used [Fig. L. 37(4)]. A fibre rope is attached to this longer arm, and when the log has been loaded on the lorry bunk, the tong setter can disengage the tongs by pulling on the fibre rope. An improved tong, illustrated in item 5, has also been invented to simplify disengaging. A block with a sheave of small diameter is attached to the eye of the longer arm of the tong. A fibre rope is then attached to an eye welded on the lower end of the opposite tong, and passed through the block to the tong setter, who releases the tongs by pulling on the rope.

After the tongs have been properly set and the log balanced by the tong setter, the log is lifted and then lowered onto the lorry log bunk; the crane line is slackened, and the tong setter releases the tongs and retrieves them without having to climb onto the load. The danger of climbing onto the load and retrieving the swinging tongs is thus nullified.

The simplified method of relase is not always possible, however, as logs often roll to one side and pinch the lower end of the tong arm. In this case the tongs must be freed by hand, either by means of spars or cant hooks.

In order to avoid pinching when the log is loaded, the tong setters often attach the tongs above the widest point of the log diameter. This practice is dangerous and is forbidden by regulations. Most accidents in loading occur when tongs are used.

Note : Safety regulations require that the bark be removed from the log at the point where the tongs are to be hooked, and that the correct size of tongs be used relative to the mass and diameter of the log. Fig. L. 37(2) shows how tongs must be selected with regard to the log diameter.

Tongs are not popular in departmental plantations. It is of importance, however, that only one man, other than the crane operator, is required to hook and control the logs loaded by means of tongs.

(3) Grabs (Fig. L. 38)

Grabs consist of two pairs of bow-bent arms, hinged together, hydraulically operated, and suspended from the hook attached to the end of the boom or drum cable of the crane.

Grabs have the advantage that they grab and firmly hold the logs while they are being lifted, slewed, and lowered onto the lorry log bunk, with no labour assistance other than that of the crane operator. They have the disadvantage that they are heavy and cannot be brought to the logs stacked beyond the reach of the crane boom. Logs must be sorted and stacked according to their length, with thicker ends flush with each other. Because of the mass and spread of the arms of the grabs, picking up the log off the point of balance is less important than when tongs are used.

Mounting grabs on the boom takes about 20 minutes and dismantling 10 minutes or less, depending on the crew.

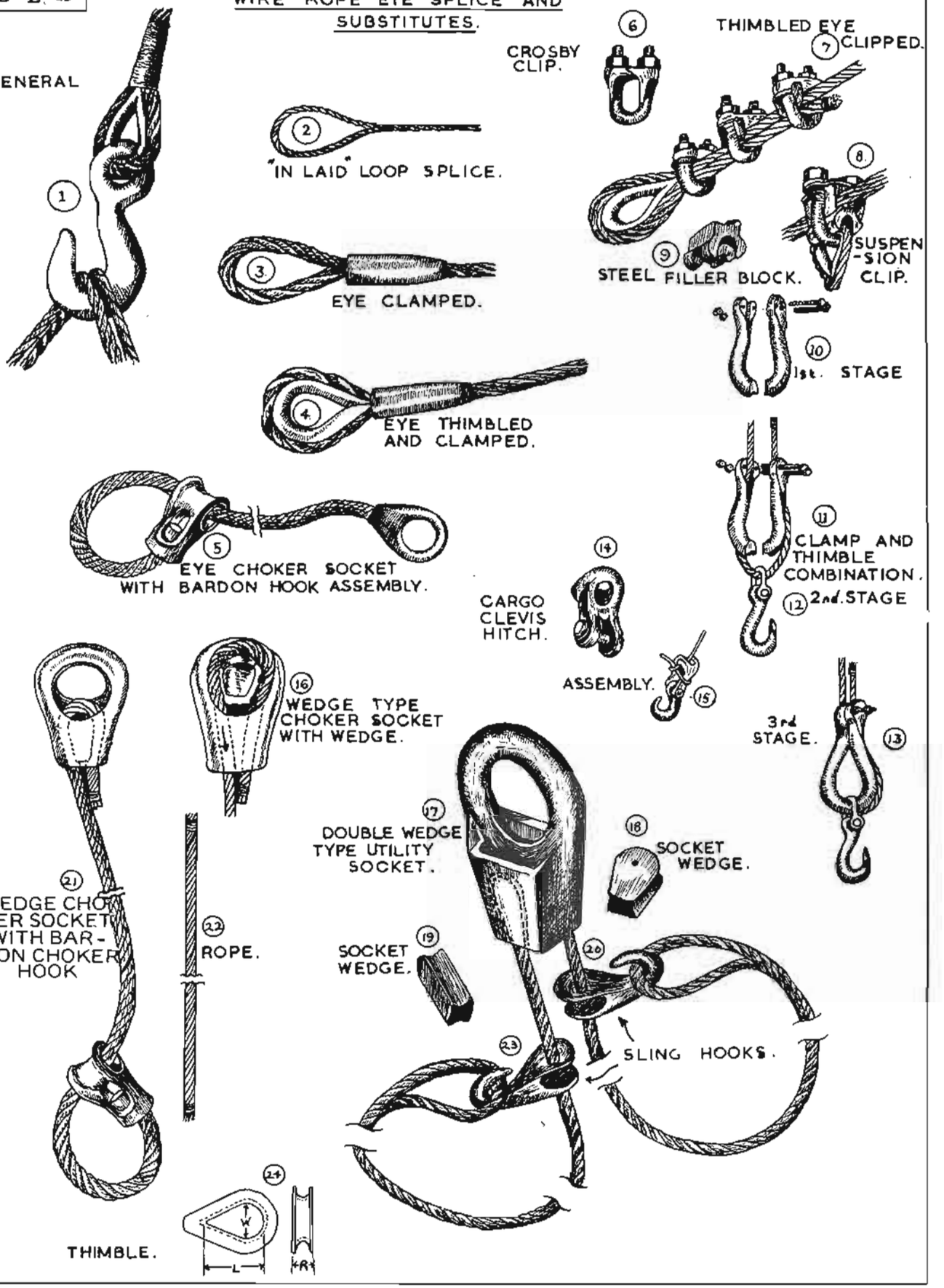
Grabs are not very popular in departmental plantations as the accumulation of logs is often great, necessitating wide stacks, often stretching beyond the reach of the crane boom. Two pairs of grabs were originally purchased, but were hardly used. This does not mean, however, that grabs are of no use, as it simply takes time and practice to make them popular. As the cost of labour increases, the man used to set tongs will become increasingly uneconomical and grabs more attractive.

(4) Wire rope slings (Fig. L. 41)

Wire rope slings are used for loading logs in bundles. They generally consist of two slings 13-16 mm in diameter, with both ends eye spliced,

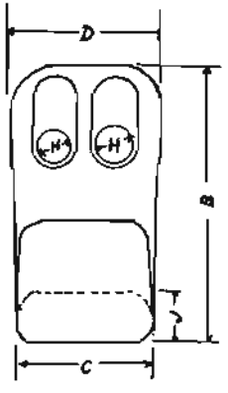
FIG L. 42

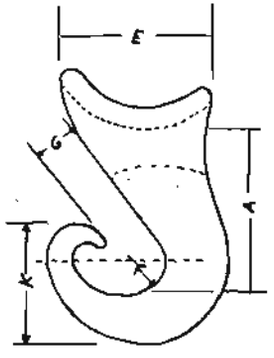
WIRE ROPE EYE SPLICE AND SUBSTITUTES.



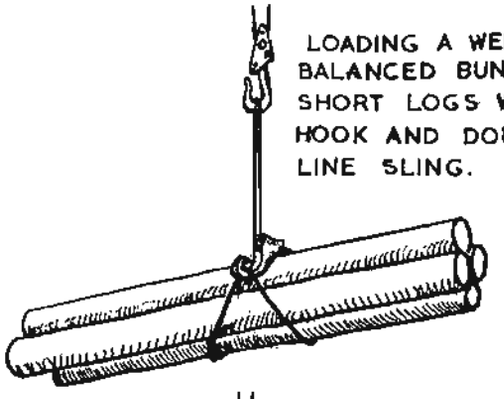
NEWCO DUAL CHOKER HOOK

FIG. L.43

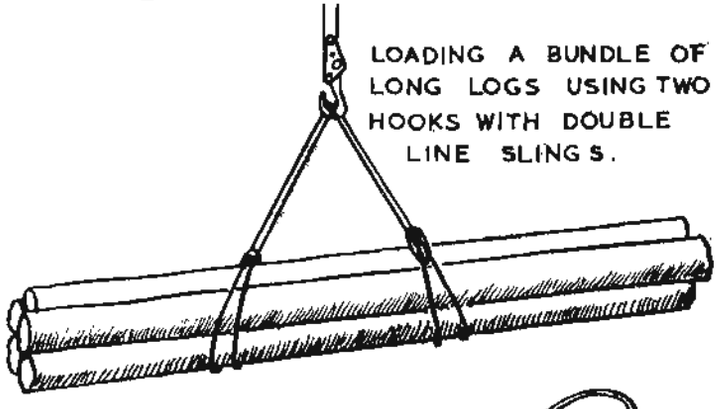




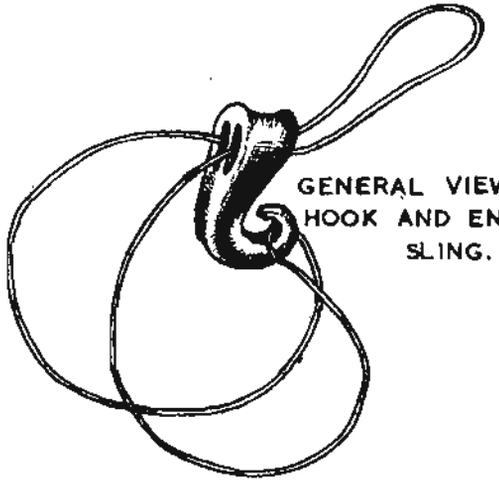
	mm	TONS	mm	mm	mm	mm	mm	mm	mm	mm	mm mm	MASS Kg	
PART NO.	ROPE SIZE	RATED LOAD	A	B	C	D	E	F	G	H	J K		LIST PRICE
DC-6	9—11	5	60	108	56	59	60	11	16	16	22 54	14	
DC-8	13—16	10	66	121	64	73	63	13	19	19	25 50	23	



LOADING A WELL-BALANCED BUNDLE OF SHORT LOGS WITH ONE HOOK AND DOUBLE LINE SLING.



LOADING A BUNDLE OF LONG LOGS USING TWO HOOKS WITH DOUBLE LINE SLINGS.



GENERAL VIEW OF HOOK AND ENDLESS SLING.

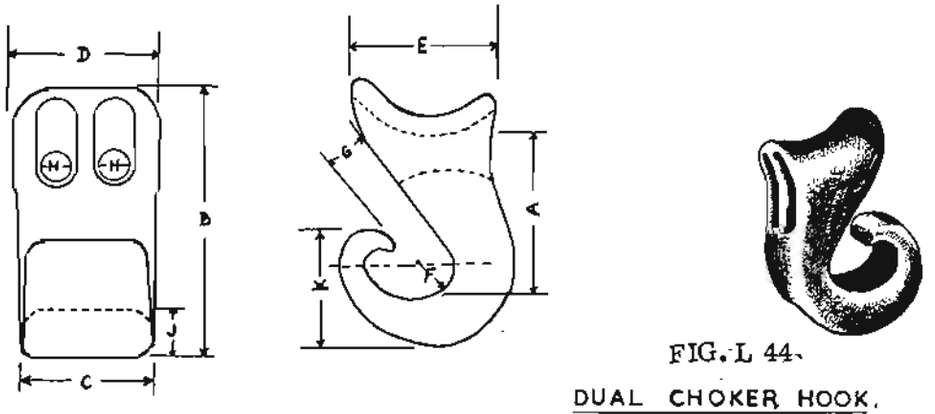


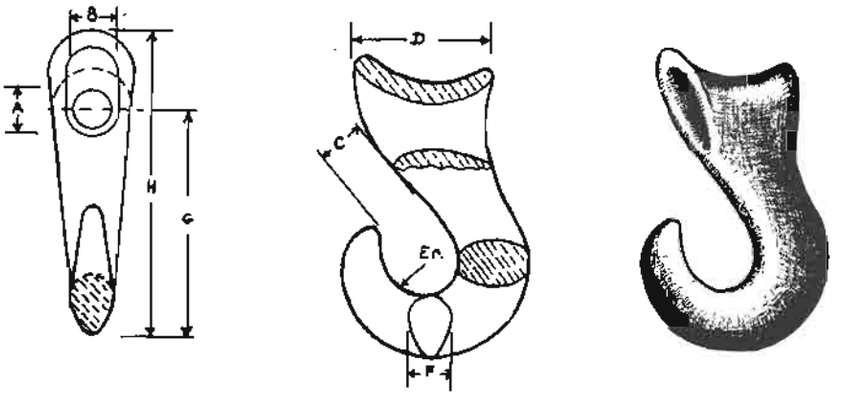
FIG. L 44.

DUAL CHOKER HOOK.

12-14% MANGANESE STEEL
SAFETY FACTOR: 5-1.

ROPE SIZE	RATED LOAD	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	J mm	K mm	MASS kg
9—11 mm	2 350 kg	60	108	56	58	60	11	16	16	22	54	1,5
13—16 mm	4 600 kg	67	122	63	72	63	13	19	19	25	60	2,3

FIG. L 45



SINGLE SLING HOOK.

12% - 14% MANGANESE STEEL.
SAFETY FACTOR: 5 - 1.

SIZE	MASS kg	A mm	B mm	C mm	D mm	Er mm	F mm	G mm	H mm	SAFE WORKING LOAD
13	0,7	19	19	22	57	13	19	97	128	1 500 kg
16	1,6	19	19	28	73	14	27	114	153	2 250 kg

FIG.L.46

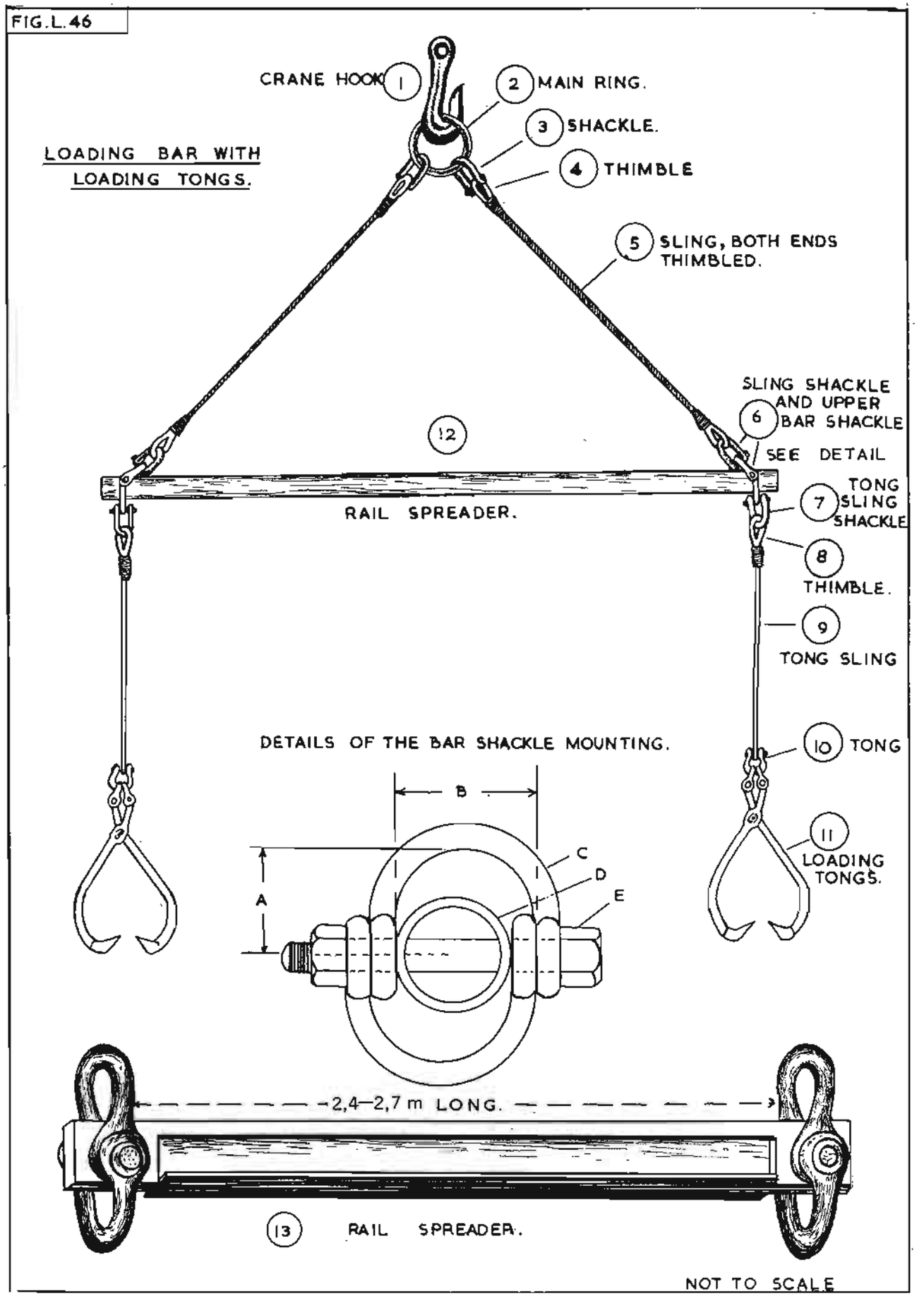
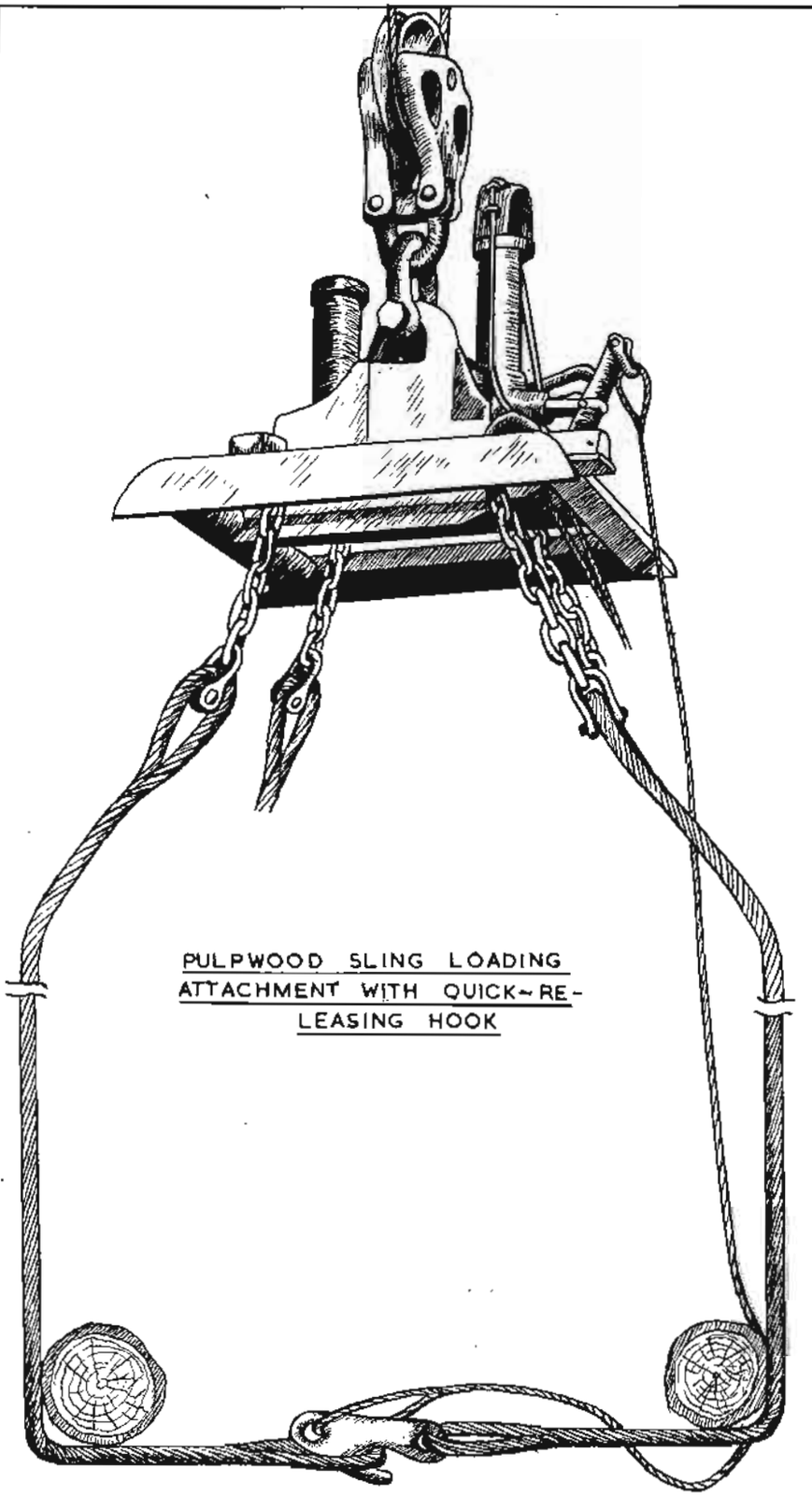
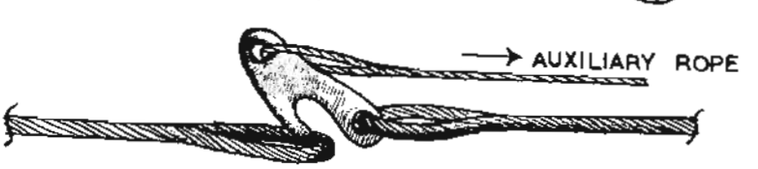

LOADING BAR WITH LOADING TONGS.
CRANE HOOK 1
2 MAIN RING.
3 SHACKLE.
4 THIMBLE
5 SLING, BOTH ENDS THIMBLED.
SLING SHACKLE AND UPPER 6 BAR SHACKLE
SEE DETAIL
12
RAIL SPREADER.
7 TONG SLING SHACKLE
8 THIMBLE.
9 TONG SLING
10 TONG
11 LOADING TONGS.
DETAILS OF THE BAR SHACKLE MOUNTING.
B
A
C
D
E
2,4–2,7 m LONG.
13 RAIL SPREADER.
NOT TO SCALE

FIG. L.47



PULPWOOD SLING LOADING ATTACHMENT WITH QUICK-RELEASING HOOK



RELEASING THE QUICK-RELEASING HOOK USING THE AUXILIARY ROPE — UNHOOKING POSITION

and a sling hook threaded between the eyes. Instead of slings having both ends eye spliced, slings with one end served can be used with single or double-wedge choker sockets (Fig. L. 42, items 16 to 20, and 23). Slings are connected to the main ring, shackle, hook or shackle swivel if the crane hook is not of the swivelling type, by means of a shackle if the hook is too large.

Fig. L. 41 shows details of wire rope slings, and the following descriptions apply to the numbered items:

1. Crane hook

Sling consisting of:

2. Shackle attached to the shackle swivel
3. Shackle swivel
4. Shackle connecting the slings to the shackle swivel
5. Wire rope sling, both ends soft eye spliced
6. Sling hook (for 13 mm or 16 mm wire rope) (Fig. L. 45)
7. Soft eye of sling, hand spliced (Size 10 cm x 20 cm)

Note :

(i) Wire rope used: 13 mm or 16 mm diameter wire rope, 6 x 25, Seale construction, fibre core, improved best plough, ordinary lay, preformed, plain.

(ii) Shackles are bow- or bell-shaped with hex screw pins. The shackles connected directly with the single slings are 19 mm material diameter for 13 mm wire rope and 22 mm material diameter for 16 mm wire rope.

(iii) The shackle linking the two slings (if sling hook is too big): 22 mm material diameter for 13 mm wire rope and 25 mm material diameter for 16 mm diameter wire rope.

(iv) Oblong links may be preferred to rings in the top left detail on Fig. L. 41.(item 9)

The top right detail of Fig. L. 41 (items 13 to 15) shows the simple attachment of the pair of wire rope slings to the crane (winch) line by means of a bow shackle.

(5) Operation with wire rope slings

Two men are required to set slings, tag lines being used to control the loading. Logs must be prestacked at the roadside on cross-sticks in sling-sized bundles in order to allow the slings to be passed beneath the stacks. The actual slinging must be done in such a way that the hooks on the end of each sling are facing in opposite directions. When the slings are loosened and threaded out from under the logs after loading on the lorry bunk, each leg of the sling will move up on the opposite side of the logs, thus keeping them in position on the lorry.

Slings must be placed around the bundles with a certain amount of play as the bundle is apt to spread when dropped on the lorry log bunk, so the perimeter of the bundle will grow longer than when the logs were stacked in an orderly fashion.

(6) Endless wire rope slings with newco dual choker hook (Fig. L. 43, 44)

The above drawings are self-explanatory.

The duel choker hook is similar in shape to the sling hook used with wire rope slings, as previously described, but is of a more sturdy construction, and instead of one sleeve, there are two, through which the endless wire rope sling passes. This assembly is mainly used for loading bundles of short, small logs. The assembly has the following advantages:

(i) It can be used alone, but still keeps the load balanced, as the rope can be spread apart.

(ii) It can be used in pairs to lift longer logs and loads with a greater mass.

(iii) It can be made of small diameter wire rope which offers a better grip due to the flexibility of the smaller diameter slings. The assembly has the disadvantage that a skilled rigger is required to splice an endless sling.

Note : Loads loaded by wire rope slings can also be controlled by tag lines. Sister hooks may be used with the tag lines, as they can simply hook over the wire-rope slings. A stick with a hook fitted to its end is also useful for controlling a loaded bundle of logs.

B. SPECIAL LOADING RIGS

(a) RAIL SPREADERS (Fig. L. 46)

Rail spreaders are not used at present on account of the introduction of chain and wire rope slings, but it is worth giving some information regarding the rig.

The rig was originally used to load long logs, loading tongs being used with it for single logs, and slings for bundled logs, with a sling hook if necessary. The size of each item used depends on the load mass and lifting capacity of the crane. The items involved are illustrated in the drawing.

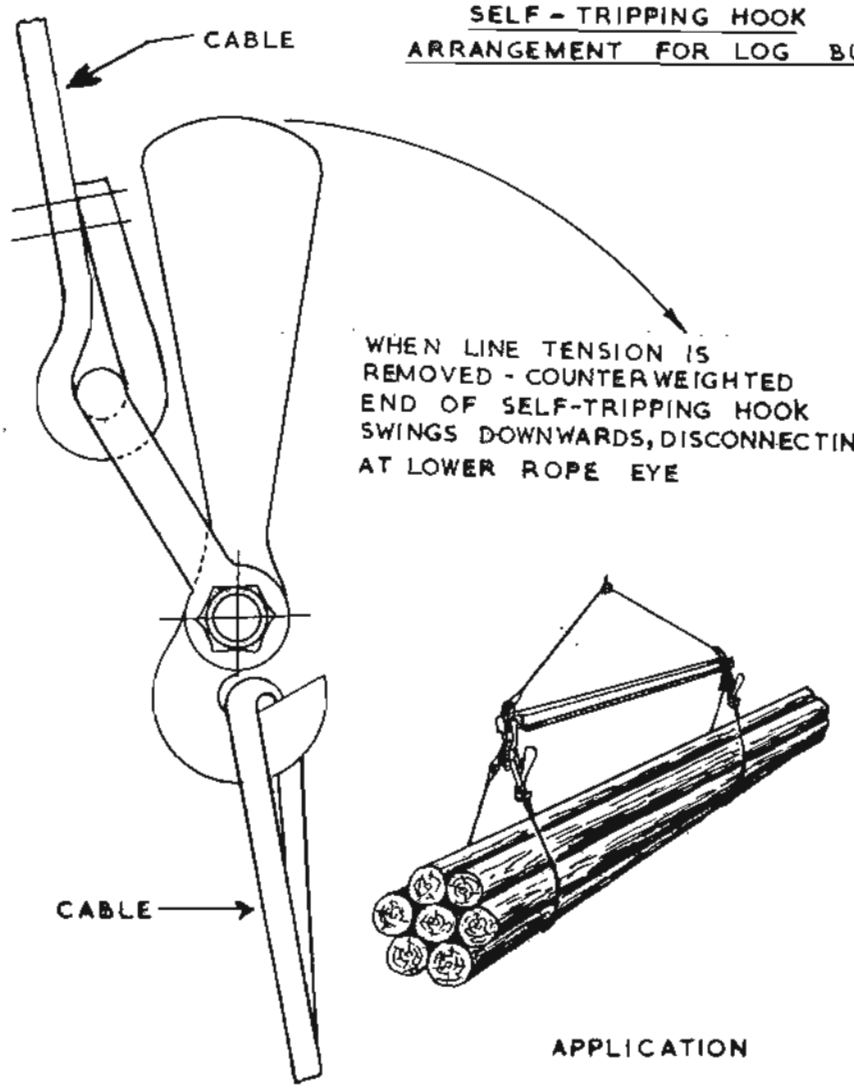
(b) PULPWOOD SLING LOADING ATTACHMENT WITH QUICK RELEASE HOOK (Fig. L. 47)

This attachment serves for loading pulpwood in large bundles by crane. Logs must be prestacked on substantial cross-sticks to allow the sling assembly to be passed beneath the stacks and hooked. The length of the slings is usually adjusted to suit the size of the stacks, i.e. the crane lifting capacity and the crane boom length.

There are two pairs of slings with both ends eye spliced, and shackled at one end to the top plate of the assembly by means of short chains. A quick-release hook is fitted to the free end of one sling of each pair to facilitate manual connecting of slings when slinging the stack for lifting. This hook is actuated by a wire rope controlled mechanically or hydraulically by the crane operator when it is to be unhooked.

FIG. L. 48

SELF - TRIPPING HOOK
ARRANGEMENT FOR LOG BUNDLES



DESCRIPTION AND REMARKS	
SCHEMATIC OF TIMBERLAND	
SELF-TRIPPING HOOK ARRANGEMENT.	
CUSTOMER:- SOUTH AFRICA DEPARTMENT OF FORESTRY	SKETCH: BY O.K.D.
SCALE:- APPROX: 1/4 FULL SIZE	DATE 2·4·54
TIMBERLAND MACHINES LIMITED WOODSTOCK ONTARIO.	SKETCH NO T- 955.

FIG L.49

LOAD BINDERS

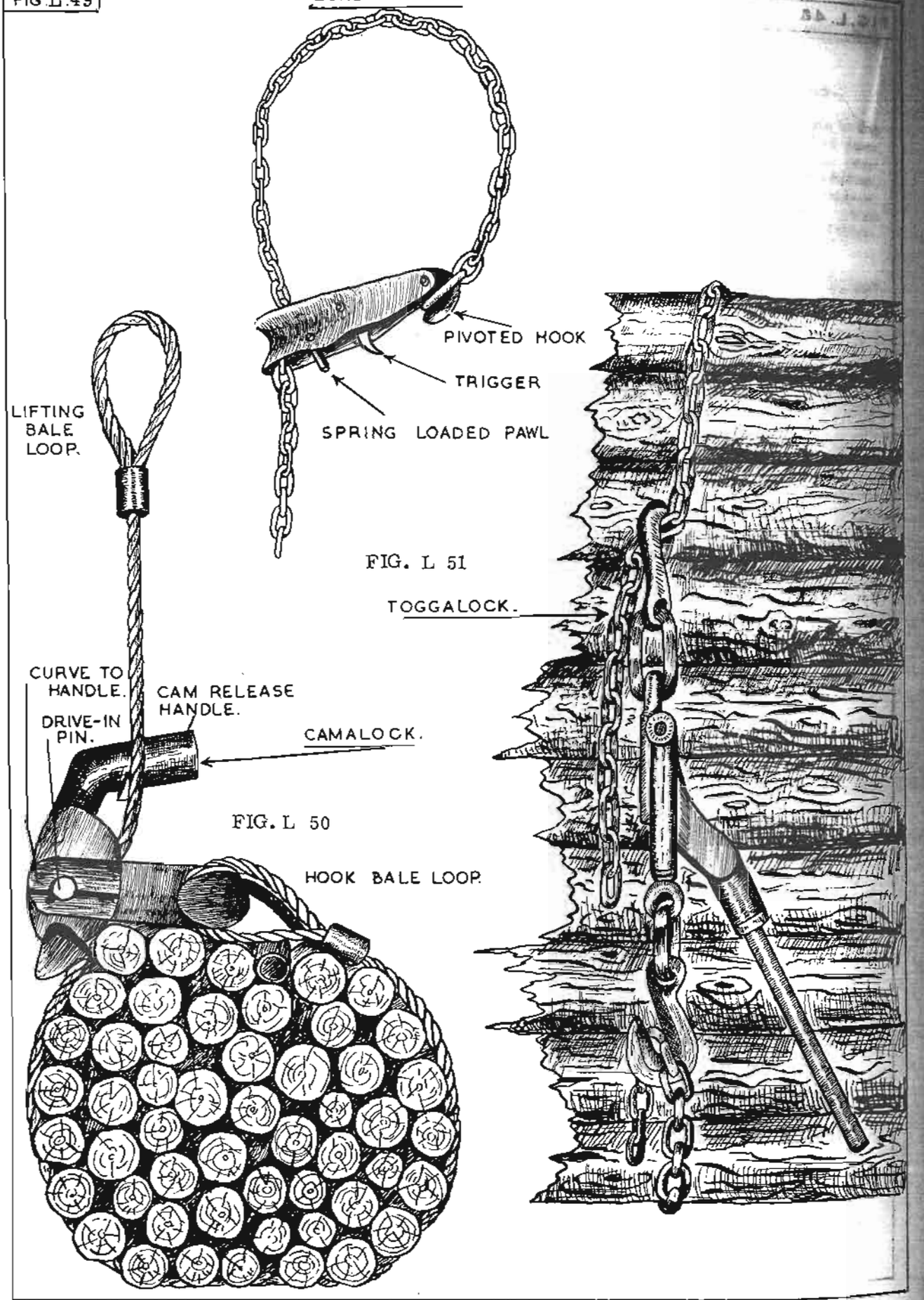


FIG. L 51

FIG. L 50

LOAD BINDERS.

COMPLETELY FORGED, HEAT-TREATED ALLOY STEEL.

LINKS AND HANDLES - C.1035 SPECIAL BAR QUALITY STEEL.

HOOKS: 8630 STEEL, HEAT-TREATED TO A BRINELL HARDNESS OF 321-293.

EACH BINDER SHALL BE PROOF-TESTED IN THE FACTORY.

THE HEEL OF THE BINDER SHALL TOGGLE AWAY FROM THE LOAD TO PERMIT EASY RELEASE.

BALL AND SOCKET SWIVEL JOINTS SHALL BE INCORPORATED WITH THE HOOK ASSEMBLY TO PERMIT A STRAIGHT LINE PULL FOR EASY USE.

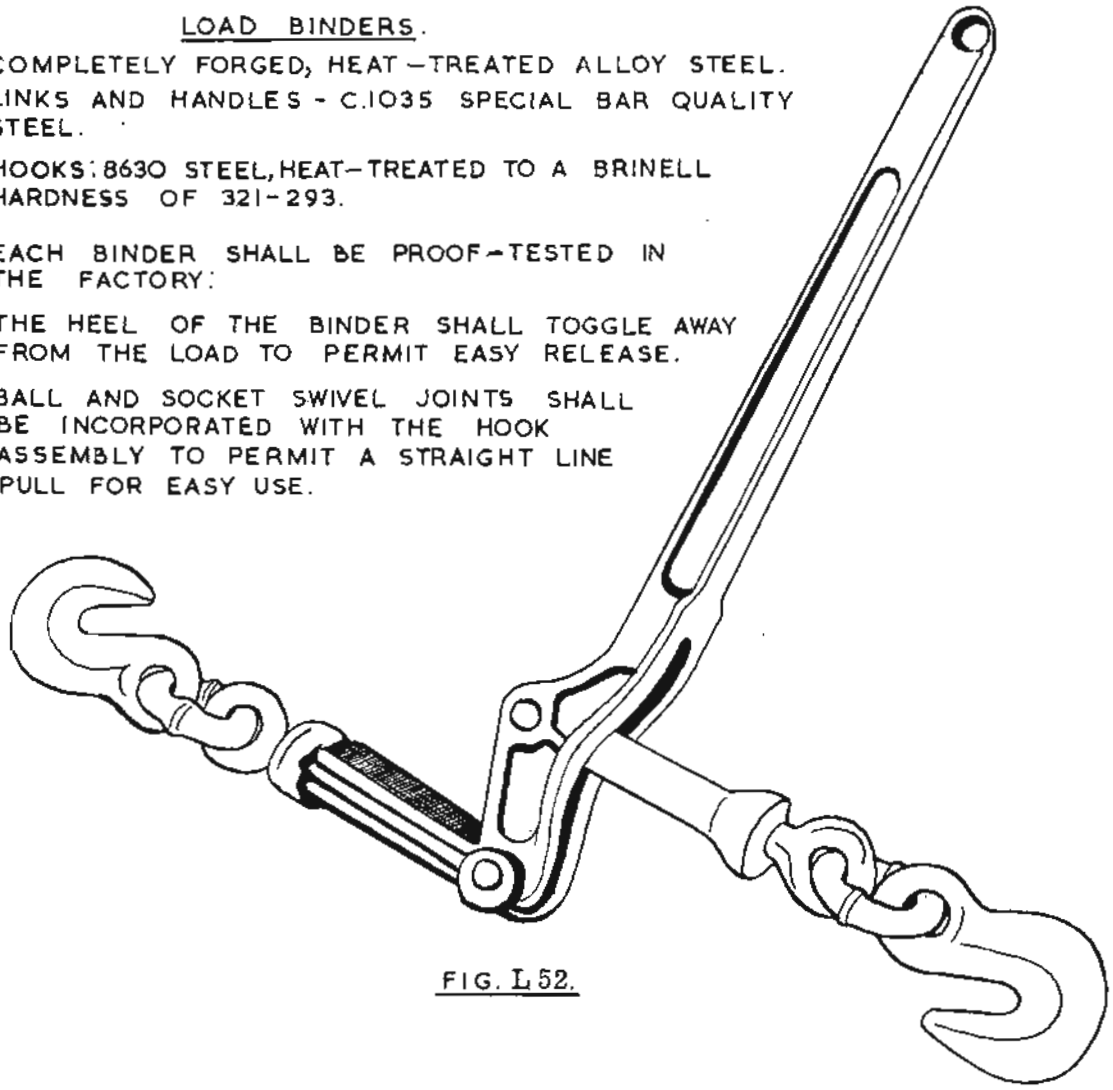
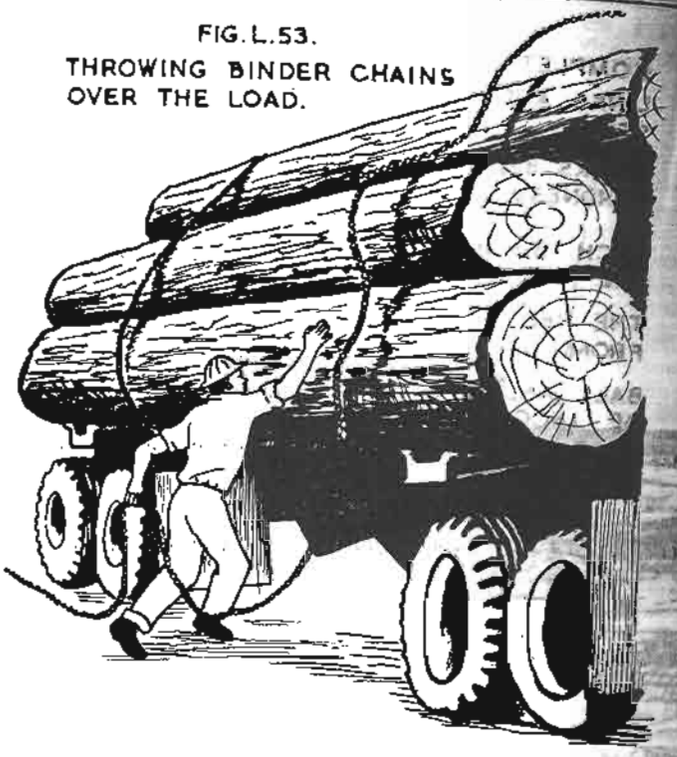


FIG. L 52.

MAX. CHAIN SIZE mm	MASS kg EACH	HANDLE LENGTH cm	TAKE-UP cm	BINDER PROOF LOAD kg	MIN. BREAKING STRENGTH HIGH TEST CHAIN kg
9	4,1	51	11,4	4 600	7 300
13	6,3	56	11,4	7 400	11 800
16	7,7	56	11,4	10 400	16 700
19	9,1	59	12	14 700	22 800

FIG. L.53.
THROWING BINDER CHAINS OVER THE LOAD.



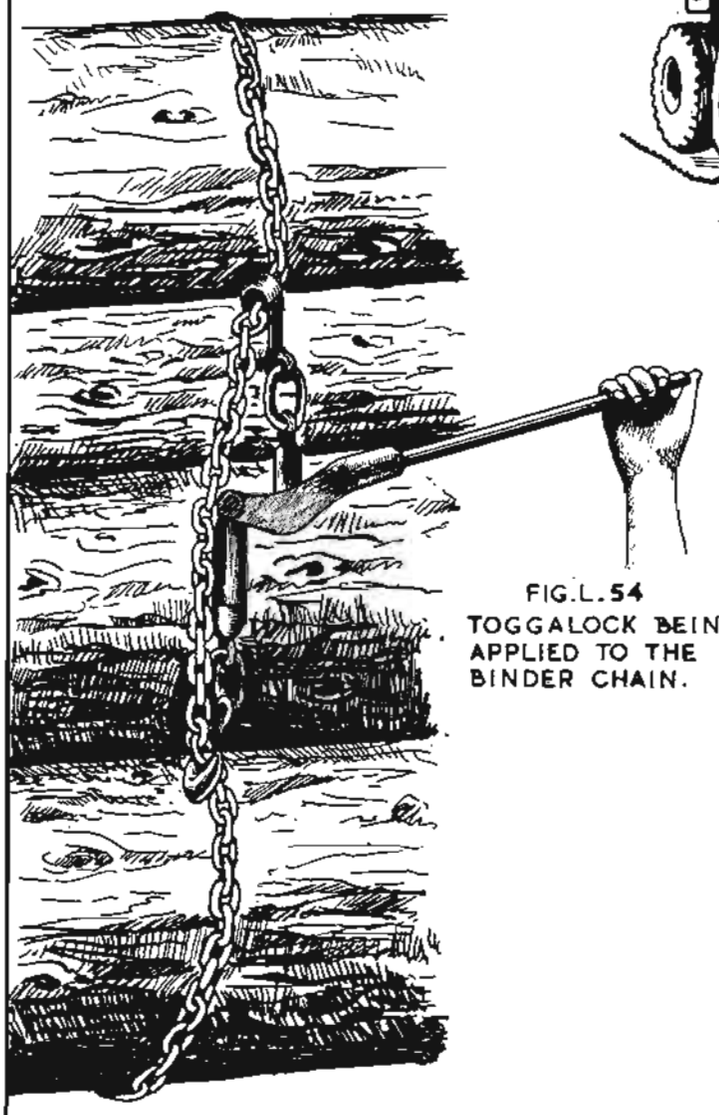


FIG. L.54
TOGGALOCK BEING APPLIED TO THE BINDER CHAIN.

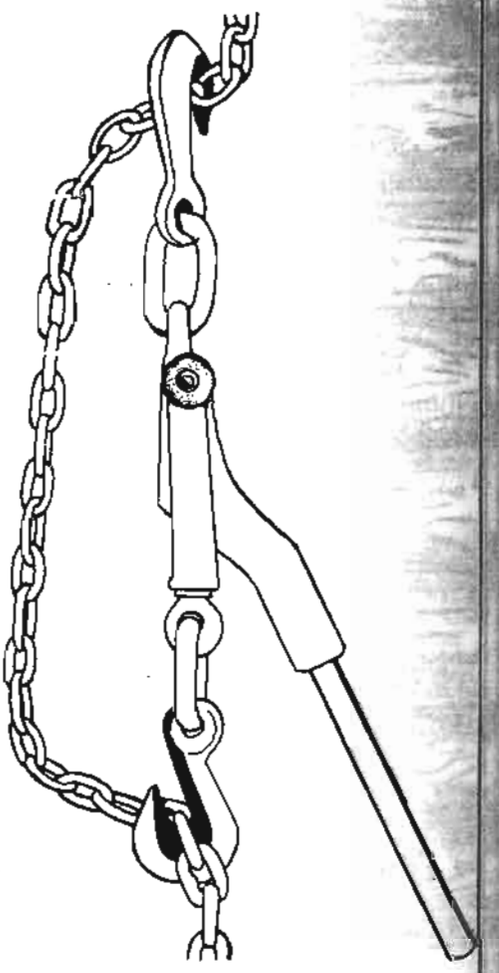
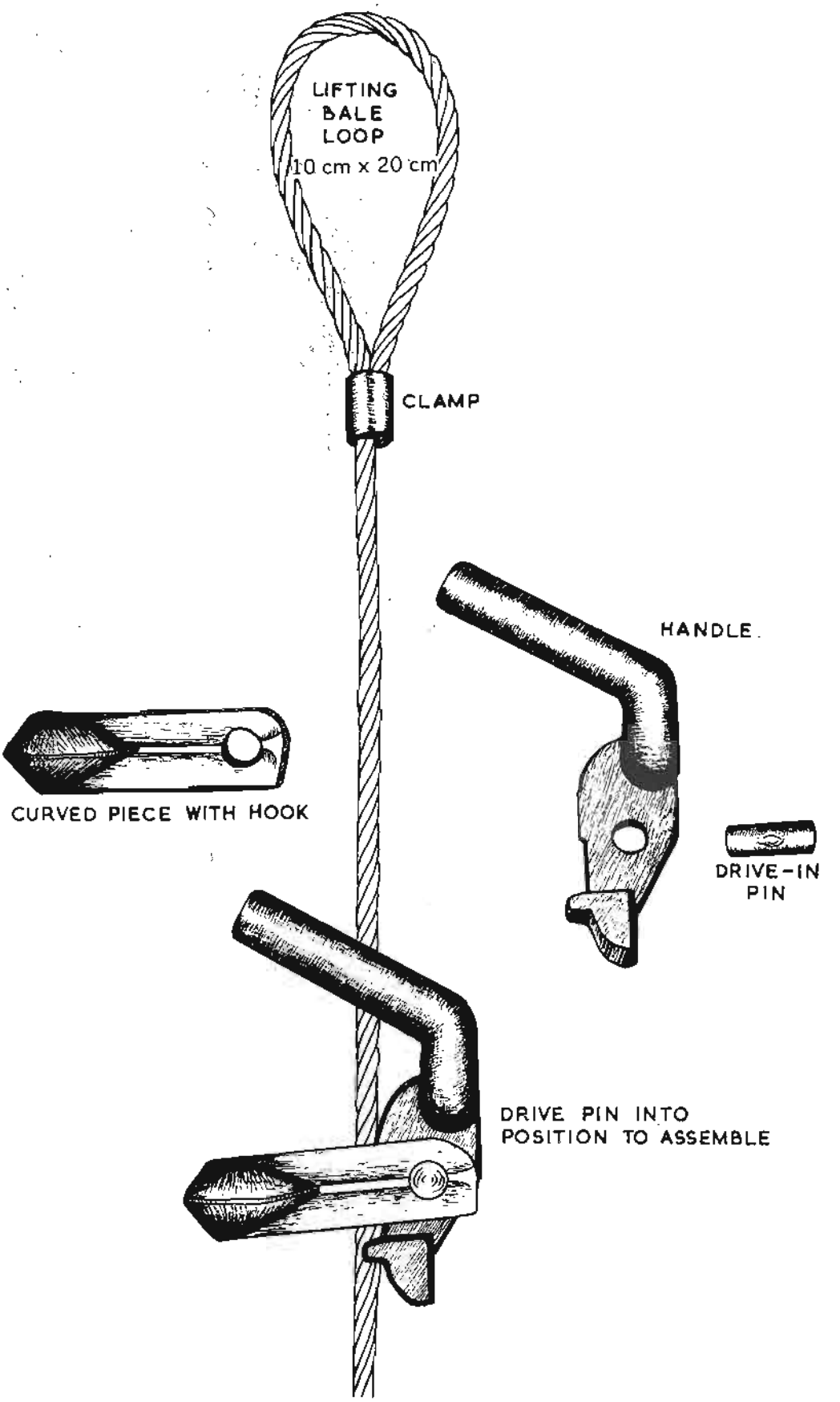


FIG. L.55 TOGGALOCK CLOSED.

FIG.L.56.

DETAILS AND ASSEMBLY OF CAMALOCK LOAD BINDER



The slings embracing the bundle of logs are shorter than the conventional full length slings, as they consist of two parts linked by the hook, thus they require less space when they are to be pulled from beneath the load. Consequently a larger load can be taken by a short jib, which is important from the point of view of the loading capacity of the crane.

The main disadvantage of this loading rig is that the logs have to be neatly and uniformly stacked on substantial cross-sticks, close to the roadside.

The rig has not been used by the Department, but it should be useful if large scale pulpwood preparation is undertaken, when large bundles of small logs are to be loaded by crane.

(c) SELF-TRIPPING HOOK (sling release hook) (Fig. L. 48)

These hooks are used in pairs, with a pair of slings, usually with the spreader bar, under conditions where access to the load is difficult or dangerous. Such conditions may apply where a load has to be disposed of in water, or on top of a high pile of logs, where the danger of rolling logs may make access to the load for unhooking dangerous or impossible.

Logs are slinged loosely, and not in tight bundles, and an allowance should be made in the sling length for increase of the load circumference when logs are deposited. This particularly applies to disposal in water, where the logs will float, and so spread considerably.

One eye of the loading sling is attached to the spreader bar shackle, and the other to the self-tripping hook. When the load lands, tension is removed from the hook and the counterweight swings downwards, releasing the rope. The sling is pulled free when the spreader bar is raised.

(d) PELICAN HOOK (Fig. L 37, item 6)

The pelican or "finger" hook consists of:

(1) Long link, narrowed in the middle, with an eye at each end.

(2) The "finger" hook hinged to one eye of the link.

(3) A ring which slides between the eyes of the link, and serves to retain or release the finger, which locks the eye of the cable or guy-line.

This hook is usually used for the attachment of guy-lines of standard length, where their frequent or rapid release is necessary. In logging it can be used with "A"-frame guy-lines, when the frame is in the travelling position. The use of pelican hooks to hold the guy-lines while loading, is not recommended. The free eye of the hook is fixed to the "A"-frame sledge.

(e) DOG LOADING HOOK (Fig. L. 37 item 7)

These hooks were supplied with the first purchase of self-loading lorry apparatus (cranes), where the jib could not be raised high enough to remove the slings from beneath the load on the lorry deck. The dog hook was attached to one end of the winch cable, which was also used for slinging the log bundle, the hook then being hooked over the same cable when the logs had been slinged. After loading on the lorry deck, the hook was released and the cable pulled out from beneath the logs by means of the crane winch. As the hook was small and flat it followed the cable under the logs without disturbing the load.

The use of this hook was discontinued, however, for the following reasons:

(1) The hook was soft-eye spliced to the winch cable, and the sharp edge of the narrow hook damaged the wire rope at the splice.

(2) Rapid wear was noted on the winch cable at the point where the hook was applied for slinging, due to the pressure of the narrow hook at this point.

The hook would, nevertheless, be a most useful item of equipment whenever it is necessary to snake the cable with attached hook from beneath a pile of logs. As the hook is small and flat there is the minimum disturbance of the pile of logs, while it is being removed.

C. LOAD BINDERS (Fig. L. 49-51)

The binding devices illustrated serve different purposes, but with the common task of keeping logs, pulpwood or brush in bundles while loading or transporting.

(a) TOGGALOCK (Fig. L. 51, 52)

The Toggalock is used to firmly bind the logs loaded onto a lorry for safe transportation. The device consists of a handle with two hook assemblies attached to one end. One of the assemblies is hinged at the tip of the handle and the other a short distance behind it at the bend of the handle. Because of the handle bend and the interval between the points of attachment of the hook assemblies, the hook assemblies move towards or away from each other when the handle is moved. When the chain is attached to the hooks, its circumference around the load is shortened or lengthened by acting on the Toggalock handles.

All departmental lorries are equipped with two Toggalocks and two chains, 8 - 9 m long. The chain used is of the short link type, 8 mm - 9 mm in material diameter, of electrically welded mild steel.

Chains are not fastened to the lorry bunk. Before loading commences, the ends of both chains are thrown across the empty lorry bunk at the point to the best advantage for securing the logs. After loading, the other ends of the chains are thrown over the load, and the chains are tightened by means of the Toggalocks (Fig. L. 53, 54, 55).

(b) CAMALOCK (Fig. L. 50, 56)

The Camalock sling assembly has been devised to keep a pre-arranged load of small logs in bundles, in order to accelerate loading, to save space at the loading deck, and to permit secured

FIG. L. 57.

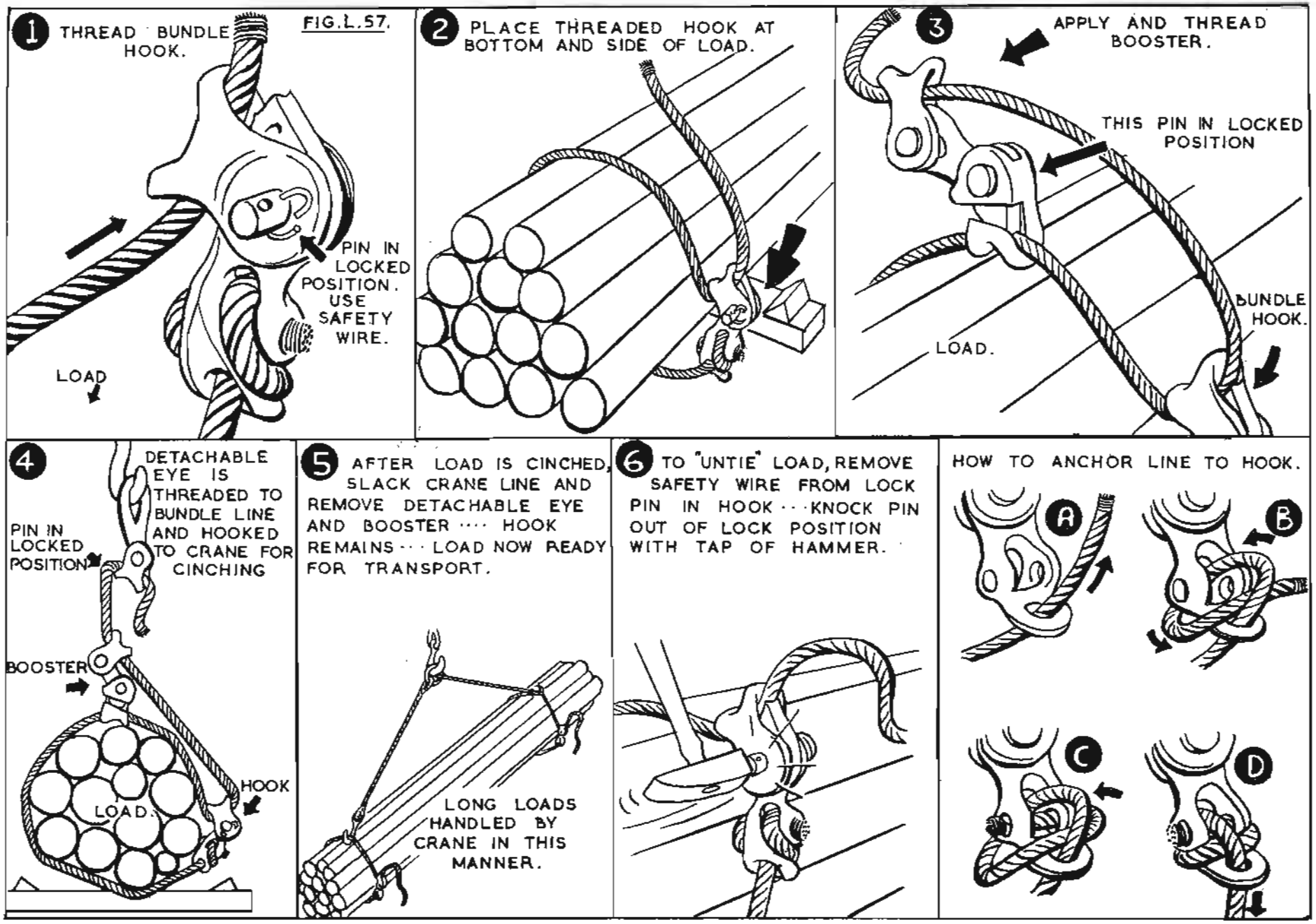
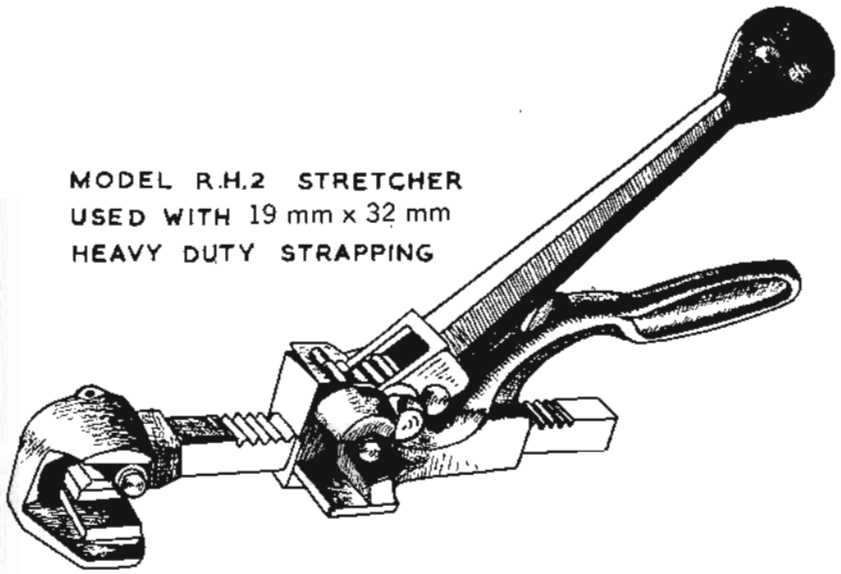
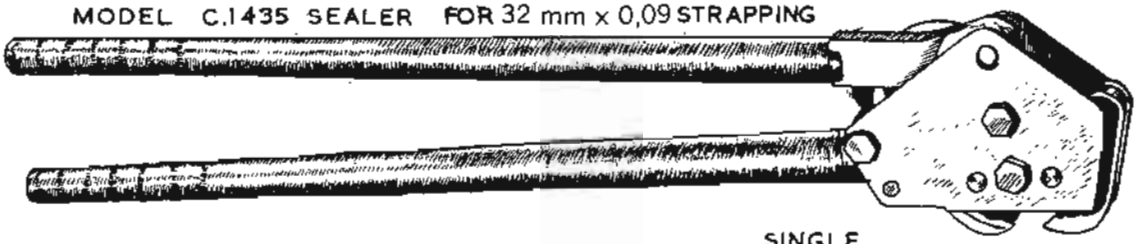

1 THREAD BUNDLE HOOK.
PIN IN LOCKED POSITION. USE SAFETY WIRE.
LOAD
2 PLACE THREADED HOOK AT BOTTOM AND SIDE OF LOAD.
3 APPLY AND THREAD BOOSTER.
THIS PIN IN LOCKED POSITION
BUNDLE HOOK.
LOAD.
4 DETACHABLE EYE IS THREADED TO BUNDLE LINE AND HOOKED TO CRANE FOR CINCHING
PIN IN LOCKED POSITION
BOOSTER
HOOK
LOAD.
5 AFTER LOAD IS CINCHED, SLACK CRANE LINE AND REMOVE DETACHABLE EYE AND BOOSTER .... HOOK REMAINS ... LOAD NOW READY FOR TRANSPORT.
LONG LOADS HANDLED BY CRANE IN THIS MANNER.
6 TO "UNTIE" LOAD, REMOVE SAFETY WIRE FROM LOCK PIN IN HOOK ... KNOCK PIN OUT OF LOCK POSITION WITH TAP OF HAMMER.
HOW TO ANCHOR LINE TO HOOK.
A
B
C
D

FIG.L.58.

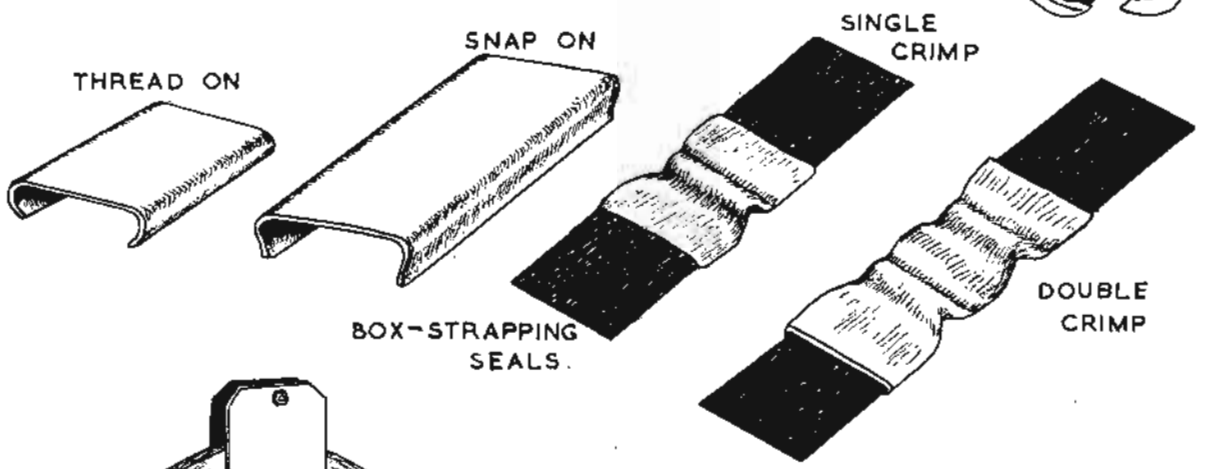
SIGNODE STEEL–STRAPPING SYSTEM



MODEL R.H.2 STRETCHER
USED WITH 19 mm x 32 mm
HEAVY DUTY STRAPPING



MODEL C.1435 SEALER FOR 32 mm x 0,09 STRAPPING



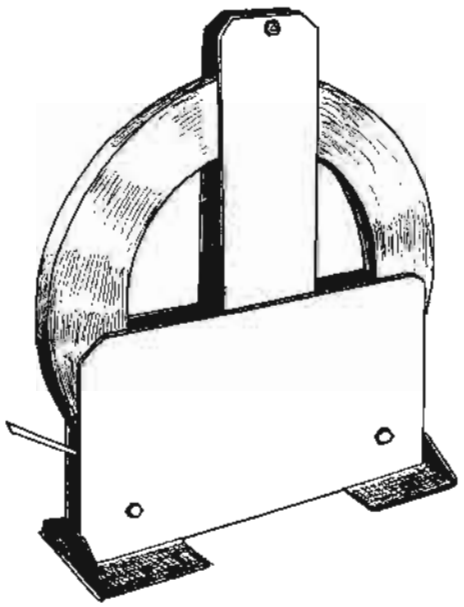
THREAD ON

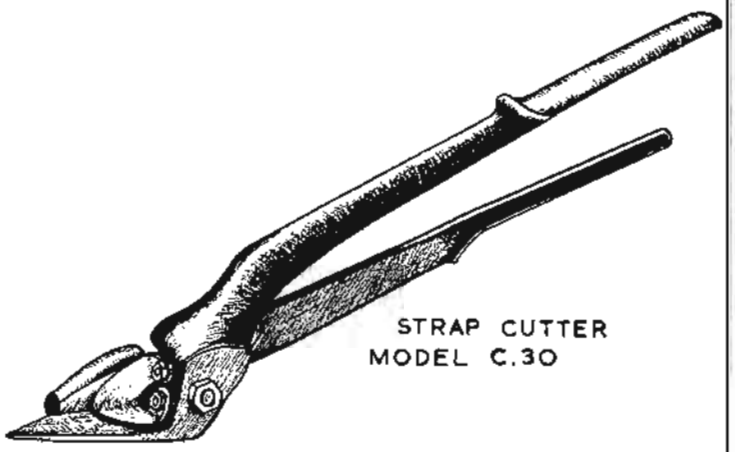
SNAP ON

SINGLE CRIMP

DOUBLE CRIMP

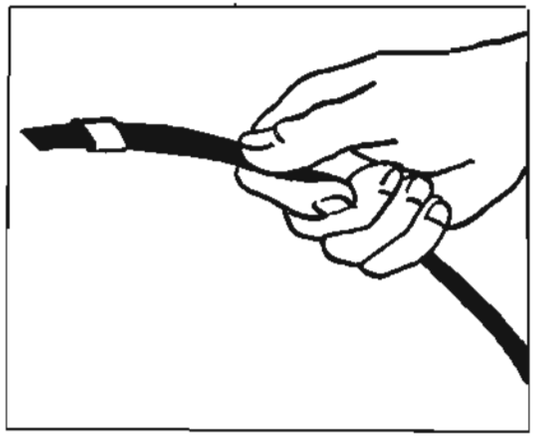
BOX–STRAPPING SEALS.



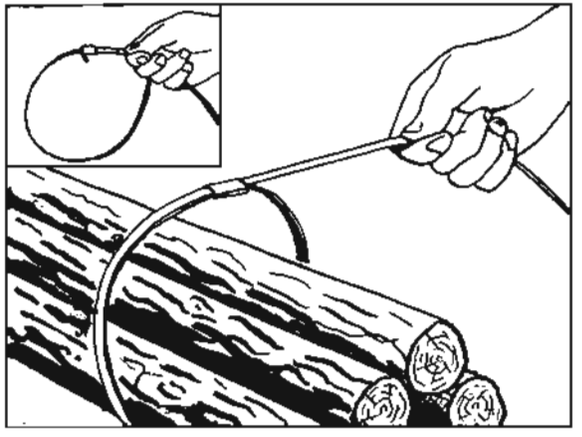


STRAP CUTTER
MODEL C.30

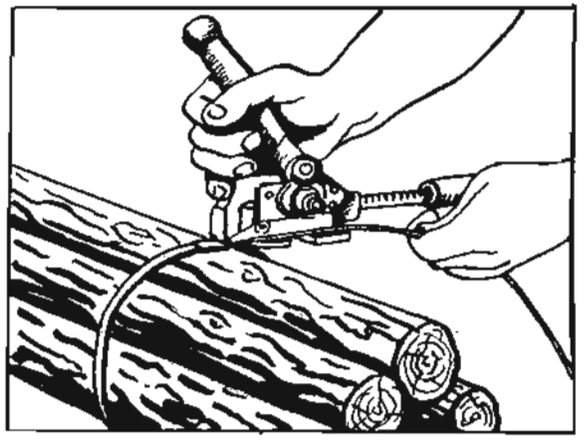
MODELS D.H.34, D.H.114, D.H.2.
HEAVY DUTY STRAPPING DISPENSER



1. WITH COIL OF STRAP BEHIND OPERA--TOR, THREAD SIGNODE SEAL OVER END OF STRAP.

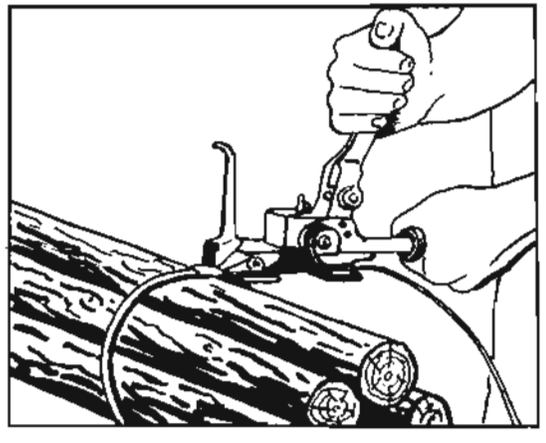


2. ENCIRCLE BUNDLE WITH STRAP, INSERT--ING LOWER STRAP END BACK THROUGH SEAL. BEND STRAP END BACK SHARPLY UNDER SEAL. NOTE: UPPER DRAWING.

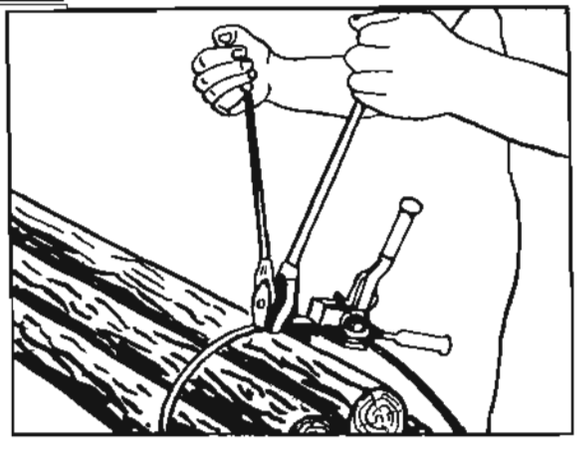


3. GRASP TOOL IN RIGHT HAND. PULL OUT EXCESS STRAP SLACK WITH LEFT HAND. THREAD STRETCHER ONTO STRAP ALLOW--ING STRAP TO ENTER INTO FRONT NOSE OPENING AND REAR GRIPPER OPENING. KEEP TOOL BUTTED AGAINST SEAL.

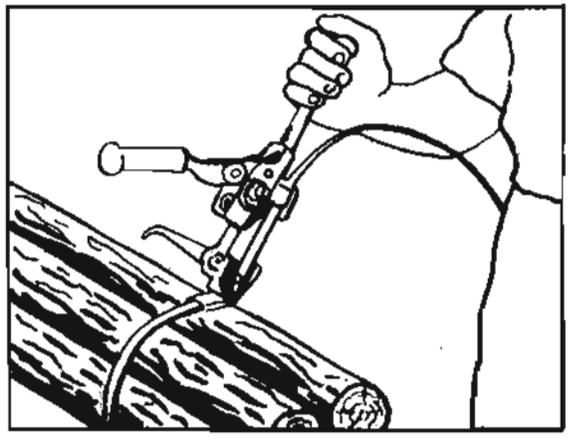
OPERATING INSTRUCTIONS FOR SIGNODE MODEL "P" STRETCHER.



4. TENSION STRAPPING THROUGH FOR--WARD AND BACKWARD MOTION OF HANDLE.



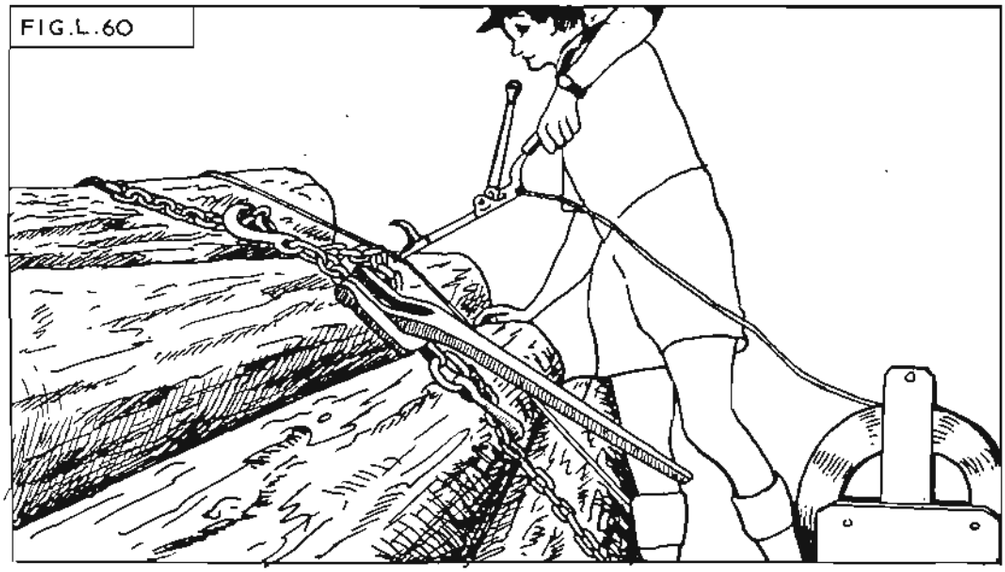
5. HAVING REACHED DESIRED TENSION, CRIMP SEAL WITH SEALING TOOL.



6. BREAK OFF STRAP AT SEAL BY RAISING AND LOWERING STRETCHER AS ILLU--STRATED MAKING SURE NOT TO RE--LEASE TENSION ON STRAP BETWEEN SEAL AND GRIPPER.

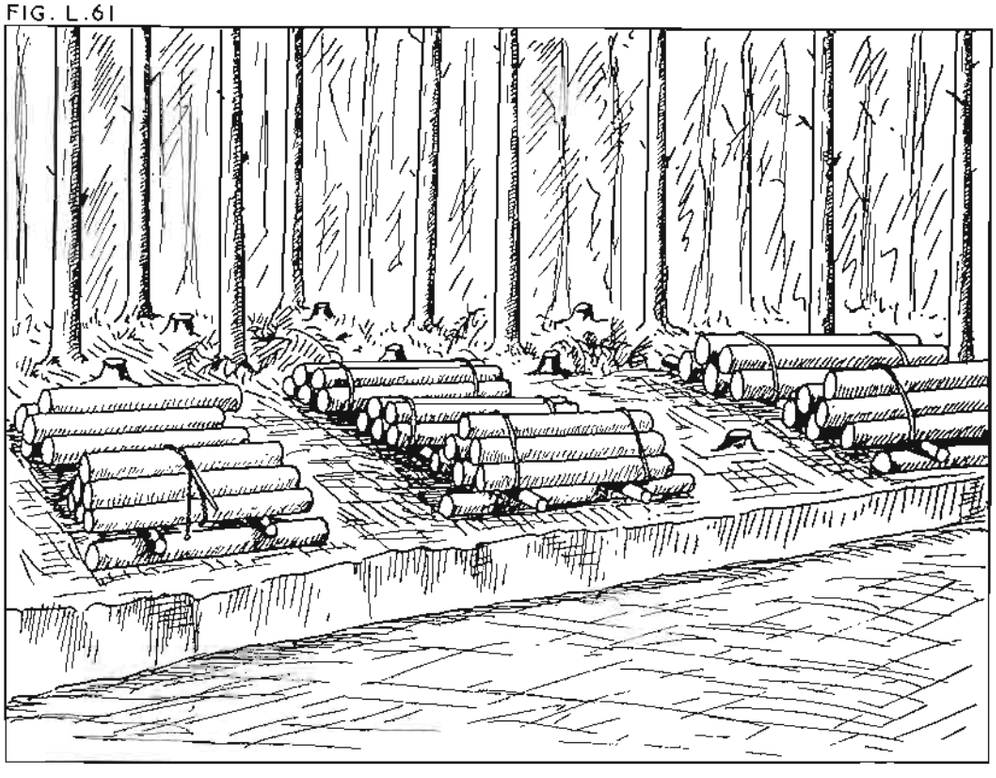
FIG. L. 59.

FIG.L.60



APPLYING STRAPPING TO A STACK OF LOGS PRETIGHTENED WITH A CHAIN AND TOGGA LOCK.

FIG. L.61



STRAPPED BUNDLES OF LOGS STACKED AT ROADSIDE FOR LOADING.

bundles of logs to be transferred from the transporting lorries to railway trucks if necessary. Logs for slinging have to be prestacked.

The assemblies consist of:

(1) A sling, with both ends soft eye clamped (i.e. with two loops).

(2) Cam release handle.

(3) Curved piece with hook attached to handle.

(4) Drive-in pin.

Note : The size of assembly used will depend on the purpose for which it is to be used. There are two sizes of the assembly: 9 mm or 22 mm, depending on the sling diameter.

(1) Procedure

(i) Prestack the logs on cross-sticks in bundles suitable for slinging.

(ii) Pass the slings beneath the stack and position them so that the Camalock hook loop is exposed at the edge of the stack to be bundled.

(iii) Engage the Camalock hook with Camalock hook bale loop.

(iv) When the load is lifted by lifting the bale loop, the material is "rolled" into a bundle by the time the Camalock fitting assumes the position on the vertical axis of the load.

(v) When the bundle so formed is set down, the Camalock fitting secures the load in the desired bundle shape.

(vi) The bundle of logs can be loosened to any degree by lifting the cam release handle. For increased leverage a pipe can be fitted over the straight cam release handle, or a secondary line run from the crane operator to the notch in the cam release handle.

Only a few samples of the Camalock sling assembly were purchased for the purpose of testing of their application in small log transportation in bundles, should preloading be necessary under special logging conditions.

(2) Device for cinching a load with bundle hook and booster (Fig. L. 57)

This device was developed for loading, transporting and reloading medium sized logs in large bundles, in order to economise on the loading and preloading time. The drawing is self-explanatory. This sling device was not recommended for use in departmental plantations because of its complexity.

(3) Chain for bundling (Fig. L. 49)

The drawing illustrates a chain intended for use in bundling brush for reclamation work at driftsand areas along the sea front. The chain has a small mass and is made from 7 mm special alloy steel, heat-treated. The mass of the chain is about that of the conventional 9 mm chain.

The chain gripping assembly is actually a modified choker slide with a quick-releasing hook. A spring-loaded pawl allows the chain to slide through the device as it is pulled tight around a bundle, but prevents the chain from slipping back.

After the bundle has been delivered to its destination the chain is removed. An eccentrically-pivoted hook is locked firmly in place by a spring-loaded trigger. When the chain is to be released, the trigger is displaced by a sharp blow, permitting the hook to pivot and release the chain from around the bundle.

(Forests Products Laboratory, U.S.A. Dept. of Agriculture).

D. LOG BUNDLING BY MEANS OF THE STEEL-STRAPPING SYSTEM

Refer to Fig. L. 58 to 63.

The log strapping equipment consists of: (Fig. L. 58)

(i) Non-expendable: Stretcher.
Sealer.
Dispenser for steel strap.
Strap cutter.

(ii) Expendable: Seal.
Heavy duty strap (Steel 32 mm x 0,09 mm).
Estimated mass per running 30 cm of 32 mm wide strap: 0,06 kg.

(1) Strapping procedure (Fig. L. 59, 60)

Logs must be stacked in independent stacks of the required circumference size, and must be easily accessible for the labourers from at least three sides. Cross-sticks under the log stacks are indispensable to allow the strap to pass beneath the stacked logs. Stacks must be within reach of the crane.

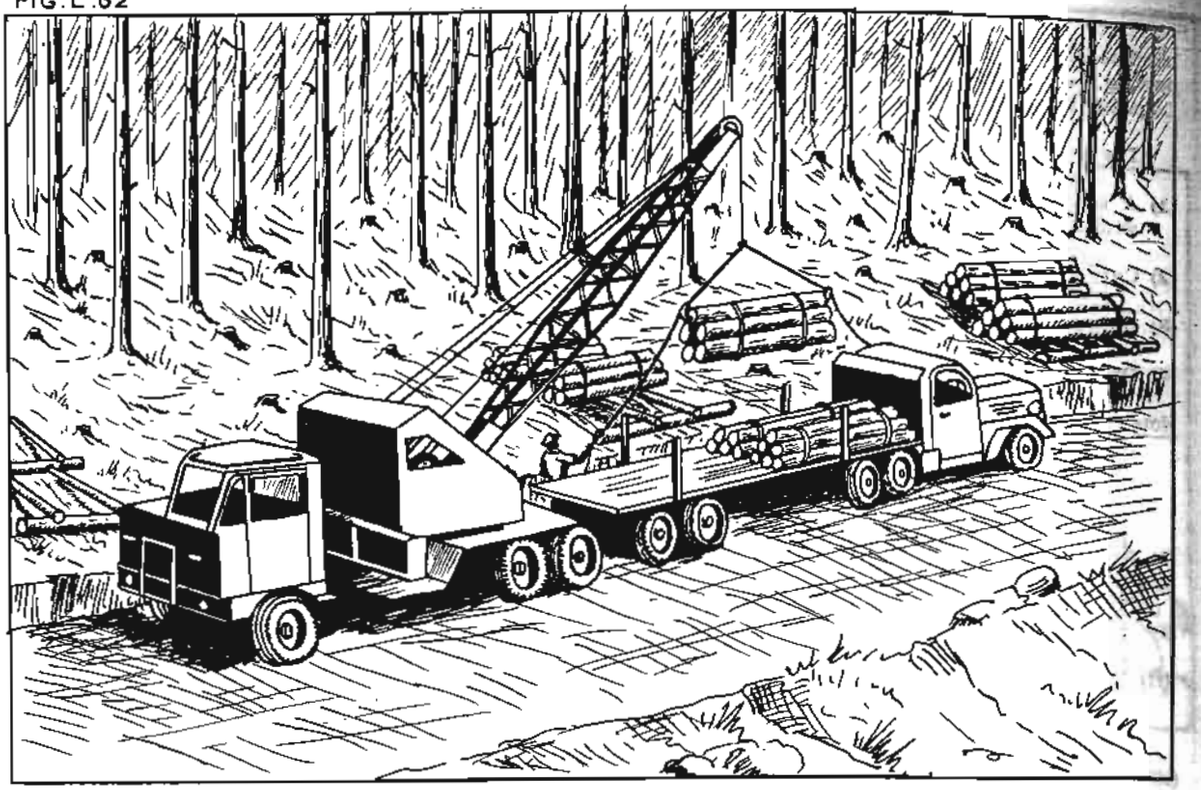
The maximum lifting capacity of the straps appears to be about 700 kg, thus the amount of strapping used varies with the load mass. Before strapping, the stacked logs are pulled tightly together by means of the Toggalock chain binder, placed in the middle of the stack. When tested, the process of stacking, i.e. setting the seal, tightening the stretcher, and sealing the sealer, occupied 15 minutes when done by one man alone. The process can be accelerated by splitting the operation into elements, handled by separate workers in sequence.

(i) Bundling the stack by means of Toggalock chain binders, which entails passing the chain around the stack, setting the load binder on the chain, and tightening the chain.

(ii) Strapping entails: (a) pulling the strap from the dispenser, passing the steel strap around the the stack and cutting it to size; (b) the seal is then set on the strap, the stretcher is used to tighten the strap, and (c) the seal is sealed.

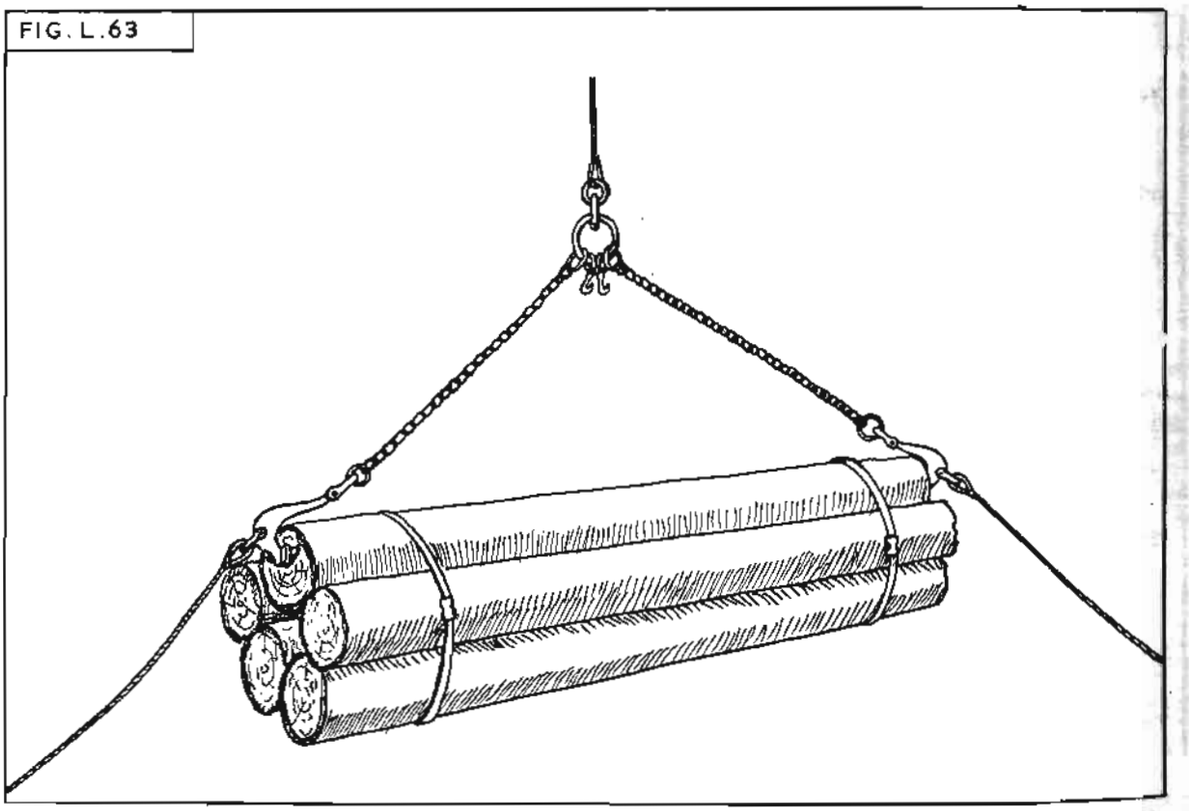
If four or five men are used and the process split as indicated above, the completed process should take no more than 5 minutes per stack, if the men work efficiently. Walking time is not included. Four or five men working as a team should

FIG. L.62



LOADING A STRAPPED BUNDLE OF LOGS FROM A ROADSIDE STACK.

FIG. L.63



DETAIL OF END LOADING HOOK POSITION FOR LOADING A STRAPPED BUNDLE OF LOGS.

FIG L. 64

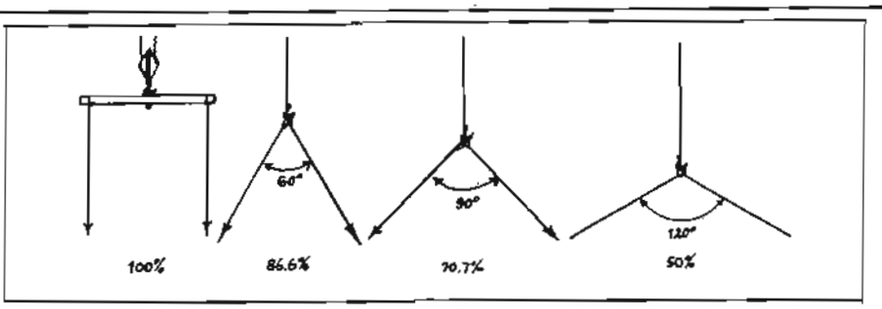


CHART I. THIS CHART SHOWS HOW THE RATED CAPACITY OF A BRIDLE SLING DECREASES AS THE ANGLE OF THE LEG SPREAD INCREASES, APPLIED TO ROPES OF GIVEN DIAMETERS.

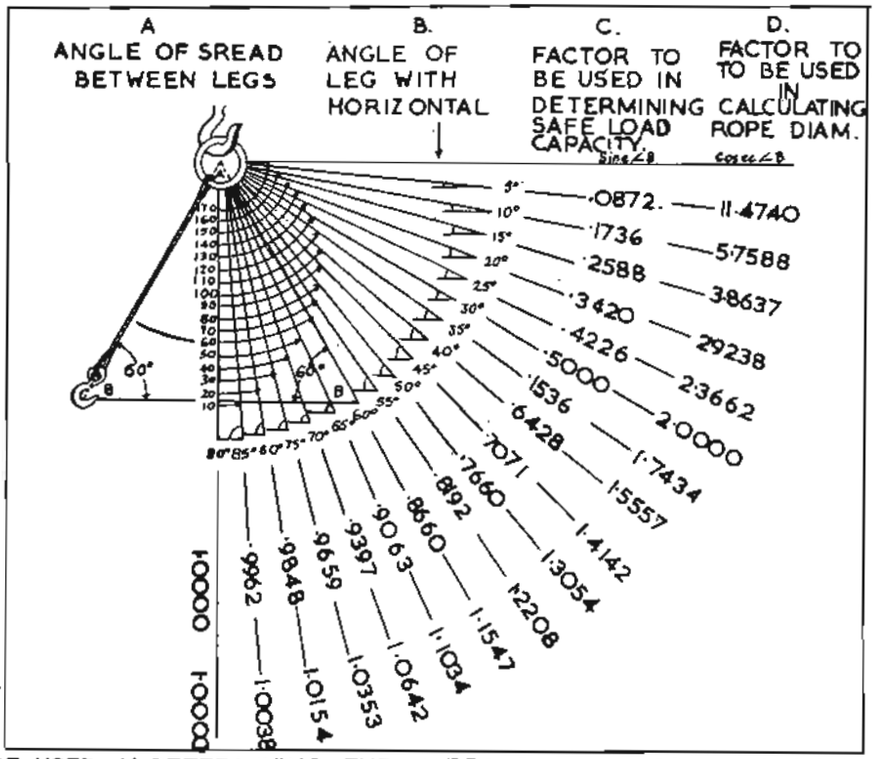


CHART 2. MAY BE USED IN DETERMINING THE RATED CAPACITY OF A GIVEN SLING OR IN CALCULATING PROPER ROPE TO USE FOR A GIVEN LOAD. THE ANGLE CORRESPONDS TO THE LEGS OF THE SLING TAKEN AT INTERVALS OF FIVE DEGREES.

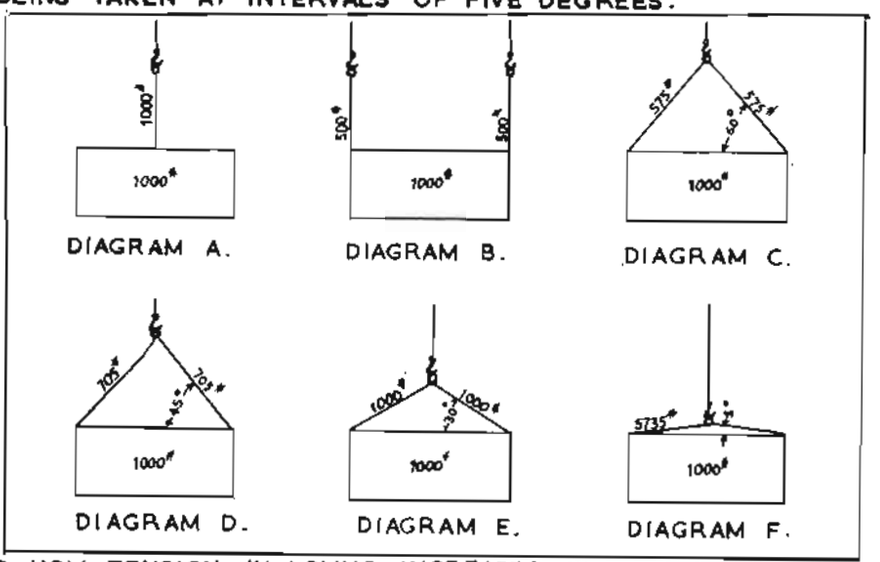
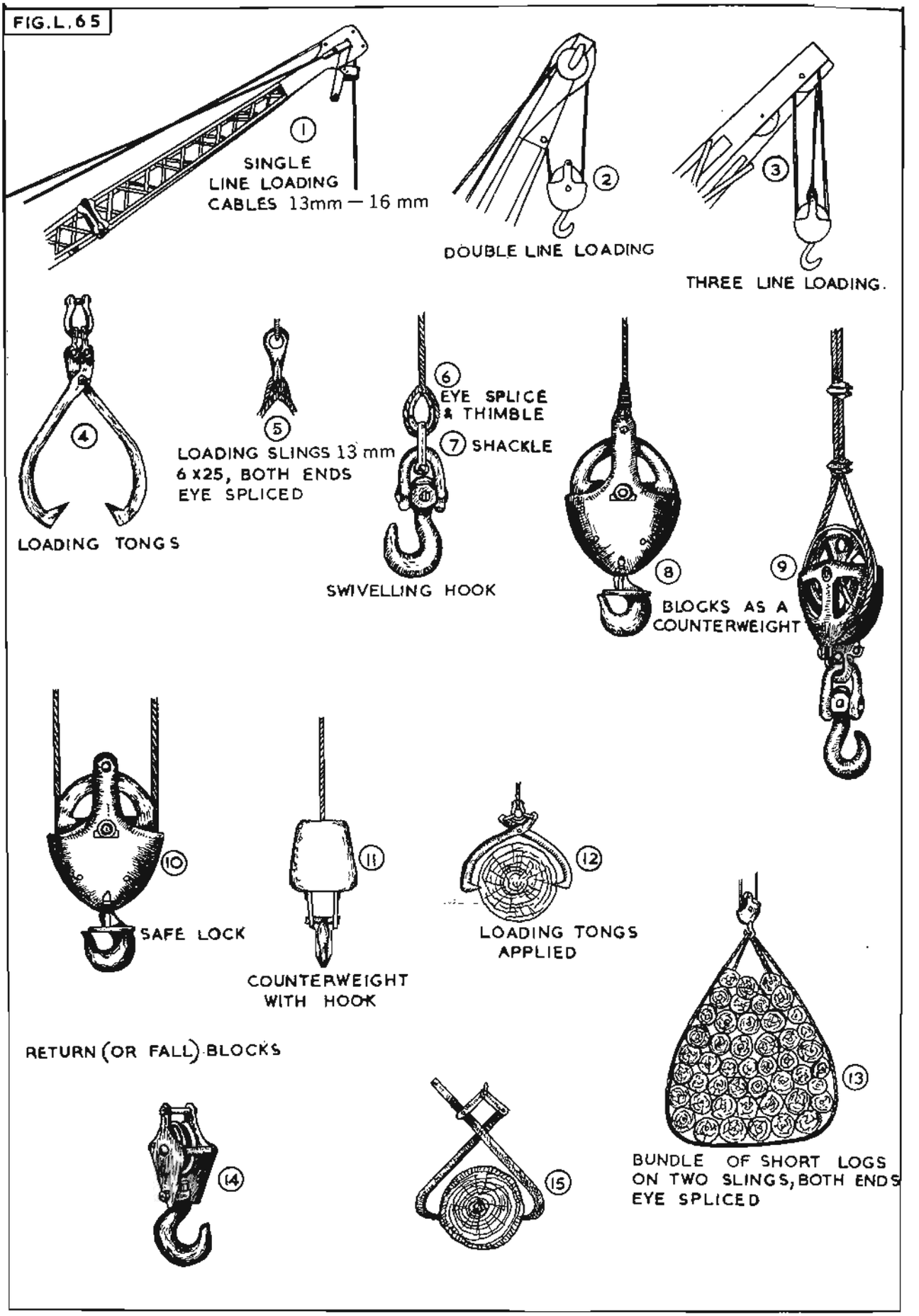
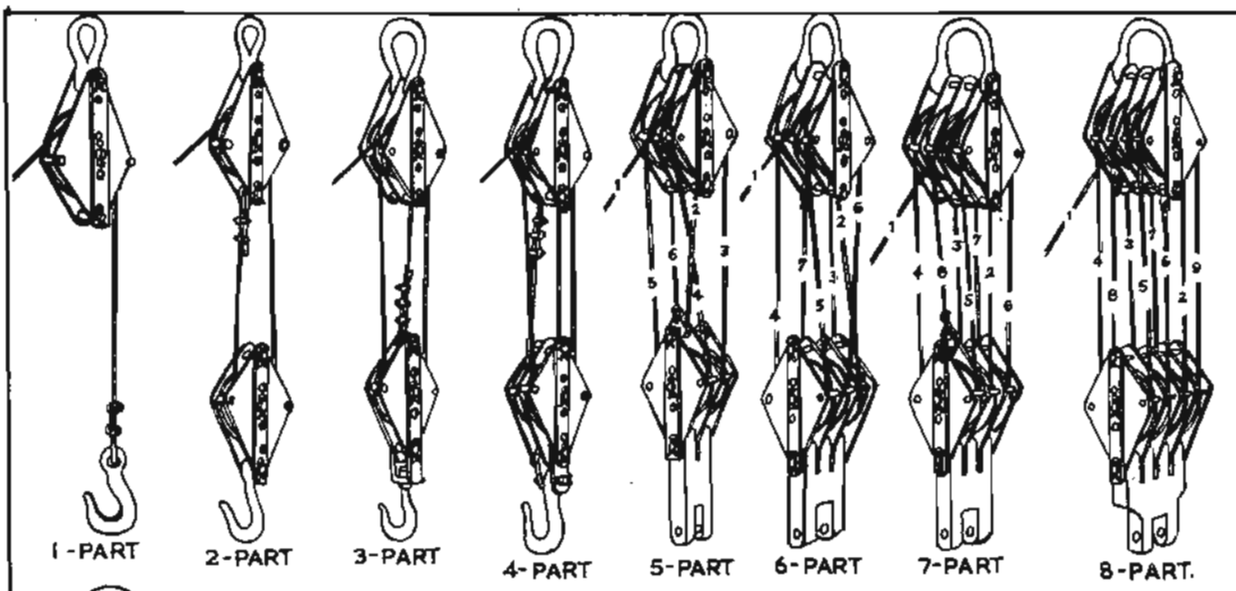
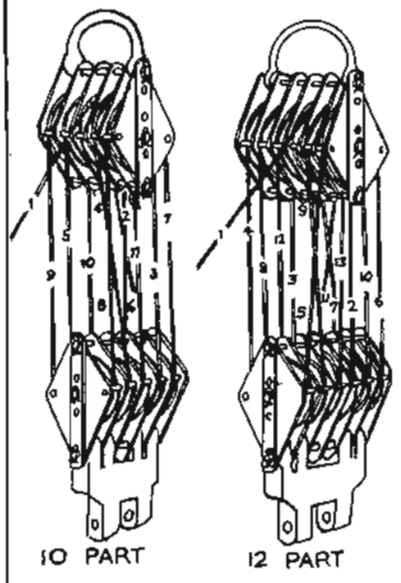


CHART 3. SHOWS HOW TENSION IN A SLING INCREASES AS THE ANGLE WITH THE HORIZONTAL PLANE INCREASES. IN (A), A 454 kg TENSION ON VERTICAL CENTRE LIFT. (F) DEMONSTRATES THE HIGH TENSION PRODUCED WHEN SLING IS USED AT FLAT ANGLE.



LOGGING CRANE JIB RIG





IN REEVING A PAIR OF TACKLE BLOCKS OF MORE THAN 2 SHEAVES, THE HOISTING ROPE SHOULD LEAD FROM ONE OF THE CENTRE SHEAVES OF THE UPPER BLOCK. WHEN REEVED IN THIS MANNER, THE HOISTING STRAIN COMES IN THE CENTRE OF THE BLOCK.

STRENGTH EFFICIENCY UNDER STATIC LOAD.

WHEN SHEAVE DIAMETER IS:	EFFICIENCY OF ROPE
10 TIMES ROPE DIAMETER	79% OF STRENGTH OF STRAIGHT ROPE
12 TIMES ROPE DIAMETER	81% OF STRENGTH OF STRAIGHT ROPE
14 TIMES ROPE DIAMETER	86% OF STRENGTH OF STRAIGHT ROPE
16 TIMES ROPE DIAMETER	88% OF STRENGTH OF STRAIGHT ROPE
18 TIMES ROPE DIAMETER	90% OF STRENGTH OF STRAIGHT ROPE
20 TIMES ROPE DIAMETER	91% OF STRENGTH OF STRAIGHT ROPE
24 TIMES ROPE DIAMETER	93% OF STRENGTH OF STRAIGHT ROPE
30 TIMES ROPE DIAMETER	95% OF STRENGTH OF STRAIGHT ROPE

NOTE: THE ABOVE TABLE IS NOT INTENDED TO APPLY TO SHEAVES, ROLLS, FAIRLEADS, ETC, USED AS LINE GUIDES WHERE LOADING OR ANGLE OF LINE DEPARTURE SUBTRACTS ONLY A SMALL PER CENT OF LINE STRENGTH.

NUMBER OF PARTS OF LINE.	RATIO BRONZED BUSH SHEAVES
1	0,96
2	1,87
3	2,75
4	3,59
5	4,39
6	5,16
7	5,90
8	6,60
9	7,27
10	7,91
11	8,52
12	9,11
13	9,68
14	10,02
15	10,7
16	11,2
17	11,7
18	12,2
19	12,6
20	13,0
21	13,4
22	13,8
23	14,2
24	14,5

FIG.L.66

USE OF RATIO TABLE.

$$\frac{\text{TOTAL LOAD TO BE LIFTED IN kg}}{\text{SINGLE LINE PULL IN kg}} = \text{RATIO}$$

EXAMPLE 1; TO FIND NUMBER OF PARTS OF LINE NEEDED WHERE MASS OF LOAD AND SINGLE LINE PULL ARE ESTABLISHED.

$$\frac{10\,000 \text{ kg (LOAD TO BE LIFTED)}}{4\,000 \text{ kg (SINGLE LINE PULL)}} = 2{,}5 \text{ (RATIO)}$$

REFER TO RATIO 2,5 IN TABLE — INDICATING 3 PARTS OF LINE.

EXAMPLE 2. TO FIND SINGLE LINE PULL NEEDED WHEN MASS OF LOAD AND NUMBER OF PARTS OF LINE ARE ESTABLISHED.

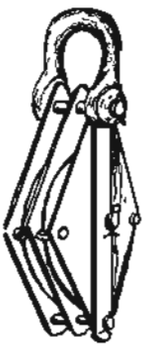
$$\frac{8\,000 \text{ kg (LOAD TO BE LIFTED)}}{1{,}80 \text{ (RATIO OF 2-PART LINE)}} = 4\,444 \text{ kg}$$

*(SINGLE LINE PULL)

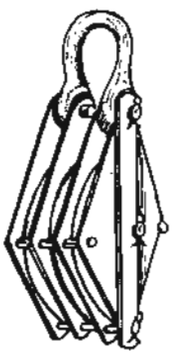
SKOOKUM CO.

FIG. L. 67.

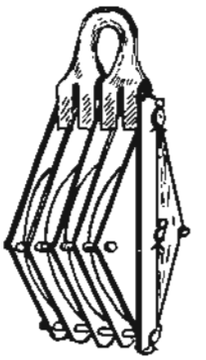
SINGLE SHEAVE. DIAMOND.



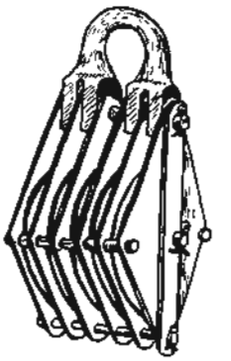
DOUBLE SHEAVE DIAMOND



TRIPLE SHEAVE. DIAMOND.



QUAD SHEAVE DIAMOND



QUIN SHEAVE DIAMOND

SKOOKUM CO.

5 TO 1 SAFETY FACTOR.

M.S. MANGANESE STEEL.
C.S. CAST STEEL.

BB – BRONZE BUSHING.
OB – OILITE BUSHING
GBB – GRAPHITE BRONZE BUSHING.
RB. – ROLLER BEARING.

SIZES RECOMMENDED.

CATALOGUE NUMBER	BLOCK SIZE.	SHEAVE DIAM.	SHEAVE MATERIAL	RECOM-MENDED LINE SIZE	MAX. LINE SIZE	SAFE WORKING LOAD	APPROX. WT. WITH LASHING & SHACKLE	AVAILABLE WITH FOLLOWING BEARINGS
	cm	cm		mm	mm		kg	
6-1 MN.	15 SINGLE	15	M.S.	9 TO 13	19	2 TONS	18	BB-OB-GBB-RB.
6-1 C.S.	15 SINGLE	15	C.S.	9 – 13	16	2 TONS	18	BB-OB-GBB-RB.
6-2 MN.	15 DOUBLE	15	M.S.	9 – 13	19	4 TONS	27	BB-OB-GBB-RB.
6-2 C.S.	15 DOUBLE	15	C.S.	9 – 13	16	4 TONS	27	BB-OB-GBB-RB.
6-3 MN	15 TRIPLE	15	M.S.	9 – 13	19	6 TONS	36	BB-OB-GBB-RB.
6-3 C.S.	15 TRIPLE	15	C.S.	9 – 13	16	6 TONS	36	BB-OB-GBB-RB.
6-4 MN.	15 QUAD	15	M.S.	9 – 13	19	8 TONS	45	BB-OB-GBB-RB.
6-4 C.S.	15 QUAD	15	C.S.	9 – 13	16	8 TONS	45	BB-OB-GBB-RB.
8-1 MN.	20 SINGLE	20	M.S.	13 – 16	28	3 TONS	20	BB-OB-GBB-RB
8-1 C.S.	20 SINGLE	20	C.S.	13 – 16	19	3 TONS	20	BB-OB-GBB-RB.
8-2 MN.	20 DOUBLE	20	M.S.	13 – 16	28	5 TONS	31	BB-OB-GBB-RB.
8-2 C.S.	20 DOUBLE	20	C.S.	13 – 16	19	5 TONS	31	BB-OB-GBB-RB.
8-3 MN	20 TRIPLE	20	M.S.	13 – 16	28	8 TONS	38	BB-OB-GBB-RB.
8-3 C.S.	20 TRIPLE	20	C.S.	13 – 16	19	8 TONS	38	BB-OB-GBB-RB.
8-4 MN	20 QUAD	20	M.S	13 – 16	28	10 TONS	47	BB-OB-GBB-RB.
8-4 C.S.	20 QUAD	20	C.S.	13 – 16	19	10 TONS	47	BB-OB-GBB-RB.
8-5 MN.	20 QUIN	20	M.S.	13 – 16	28	12 TONS	57	BB-OB-GBB-RB.
8-5 C.S.	20 QUIN	20	C.S.	13 – 16	19	12 TONS	57	BB-OB-GBB-RB

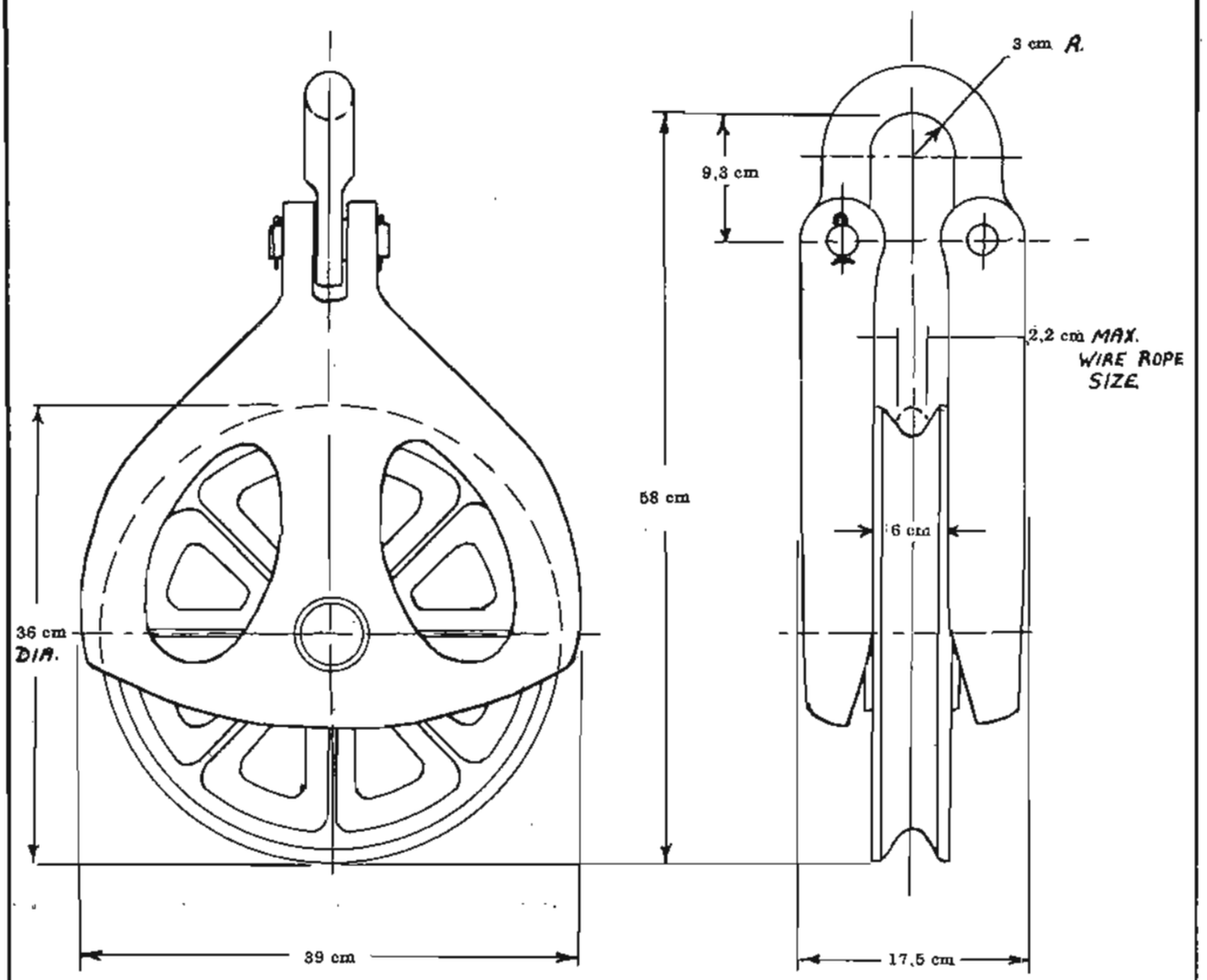


FIG.L.68.

LOADING BLOCK, WITH SHACKLE

RATED LOAD: 9 600 kg
MASS : 40 kg

THE SHEAVES SHALL BE ENCLOSED IN AN ALL-STEEL WELDED CASE

SHEAVES SHALL BE MOUNTED ON HIGH CAPACITY BRONZE BUSHINGS TURNING ON GROUND ALLOY STEEL SHAFTS

TIMKIN ROLLER BEARINGS ARE OPTIONAL

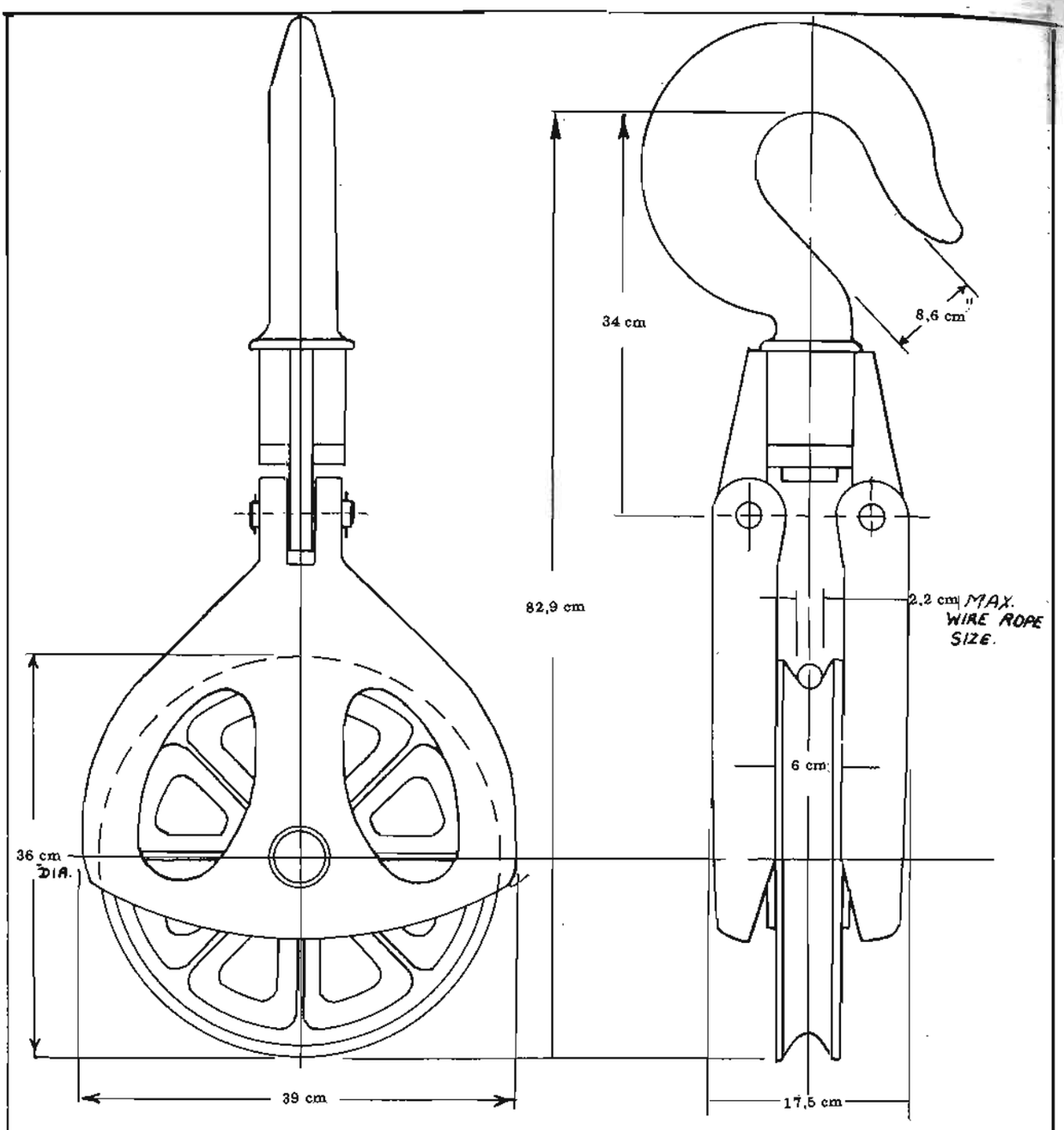


FIG.L.69

LOADING BLOCK WITH HOOK

RATED LOAD: 9 600 kg
MASS 59 kg

THE SHEAVES ARE ENCLOSED IN AN ALL-STEEL WELDED CASE

SHEAVES SHALL BE MOUNTED ON HIGH CAPACITY BRONZE BUSHINGS TURNING ON GROUND ALLOY STEEL SHAFTS.

TIMKIN ROLLER BEARING MOUNTED SHEAVES ARE OPTIONAL

be able to double strap 50 to 60 stacks per day. Fig. L. 61 shows strapped stacks at the roadside, and Fig. L. 62 and 63 show the strapped logs being loaded.

(2) Output and cost of log strapping

Costs are based on 60 stacks of 1,2 metre in diameter, containing 1,8 metre logs.

(i) Strap used per stack: 5,5 m @ 1c per 30 cm = 18c, say 20c per stack.
60 Stacks @ 20c = R12,00 ..... (A)

(ii) Seals: approx. 1,5c per seal.
60 Stacks x 2 seals @ 1,5c = R1,80 ..... (B)

(iii) Hire of equipment per day. 50c ..... (C)

(iv) Labour: 5 units @ 62c = R3,10 ..... (D)
(A) + (B) + (C) + (D) = R17,40 (say R20,00).
1 Stack of 3/4 ton approx. 0,7 m^3
Volume strapped: 0,7 m^3 x 60 stacks = 42 m^3
47c per m^3
Output per labour unit: 8,5 m^3

E. SLING SAFETY (Fig. L. 64)

NB : Same comments as with Fig. W.R. 115.
See page 213

F. LOADING BLOCKS

Loading blocks are divided into two main catagories: lifting and fall blocks. Lifting blocks are usually located at the tip of the loading crane boom and may be built into the boom tip in the form of sheaves, or may be suspended from a fitting on the boom tip. Fall blocks are used when more than one line is applied for load lifting. Modern fall blocks usually have a swivelling hook fitted at the bottom for holding the loading slings, and a shackle at the top if three loading lines are to be used. Single line loading counterweights with loading hooks may also be used (Fig. L. 65, items 8, 9).

Fig. L. 65 Details

Item 1. - Crane boom with built-in sheave for single line loading.

Item 2. - Crane boom with an arrangement for double line loading with a fall block. The end of the crane loading line is attached to a bolt below the boom sheave.

Item 3. - Crane boom arrangement for three line loading. The end of the loading line is attached to the block bolt, fitted to the top of the block sides.

Item 10. - Crane fall block with safe lock on the hook.

Item 14. - A standard crane fall block usually supplied with cranes by the crane manufacturers.

Item 11. - This illustrates a counterweight seldom used in logging. Counterweights serve to drop the end of the single crane loading line down for the next load. In plantation log loading the end of the crane line has often to be taken to the logs by hand, and counterweights would be inconvenient. The loading rig (slings, tongs, grabs, etc.) are usually heavy enough to accelerate the descent of the crane line. If necessary, blocks fitted to the crane line may be used as counterweights (items 8 and 9).

Items 5 and 6 illustrate the standard method of sling attachment by means of a hook fitted to the end of the crane loading line. Item 5 shows the ordinary loading hook to which the loops (or eyes) of the loading slings have been hooked. Item 6 illustrates the thimble end of the crane loading line to which the shackled swivelling loading hook (item 7) is attached. A plain loading hook without the safe lock is preferred for log loading, as loading proceeds much faster if loading slings are to be replaced with spare slings for every load when preslinging is done. This is also the case if different log lifting devices (slings, tongs, grabs, etc.) are used during a loading operation and changed frequently.

The safety lock on a loading hook is, none the less, an advantage from the safety point of view.

Hoisting blocks (Fig. L. 66 and 67)

Some information relating to hoisting blocks may be found useful, if not at present, then possibly in the near future when larger loads have to be handled. Groups of sheaves in one assembly are known as hoisting blocks, and their construction is far more simple than that of blocks used in everyday logging. The advantage of using multi-lines in two-block assemblies is that a cheap winch of small size and power may be used to lift a load instead of the larger, more expensive winch which would be required for lifting the same load if one line were used. Fig. L. 66 shows the application of hoisting block assemblies with varying numbers of sheaves.

It is important to note: (1) The method of reeving the cable in order to obtain the strain in the centre of the block. This is shown in the top part of the illustration where the rope positions are numbered for each sheave; (2) The strength efficiency of the rope with regard to the sheave diameter. (3) The ratio of bronzed bush sheaves, and the application of this ratio.

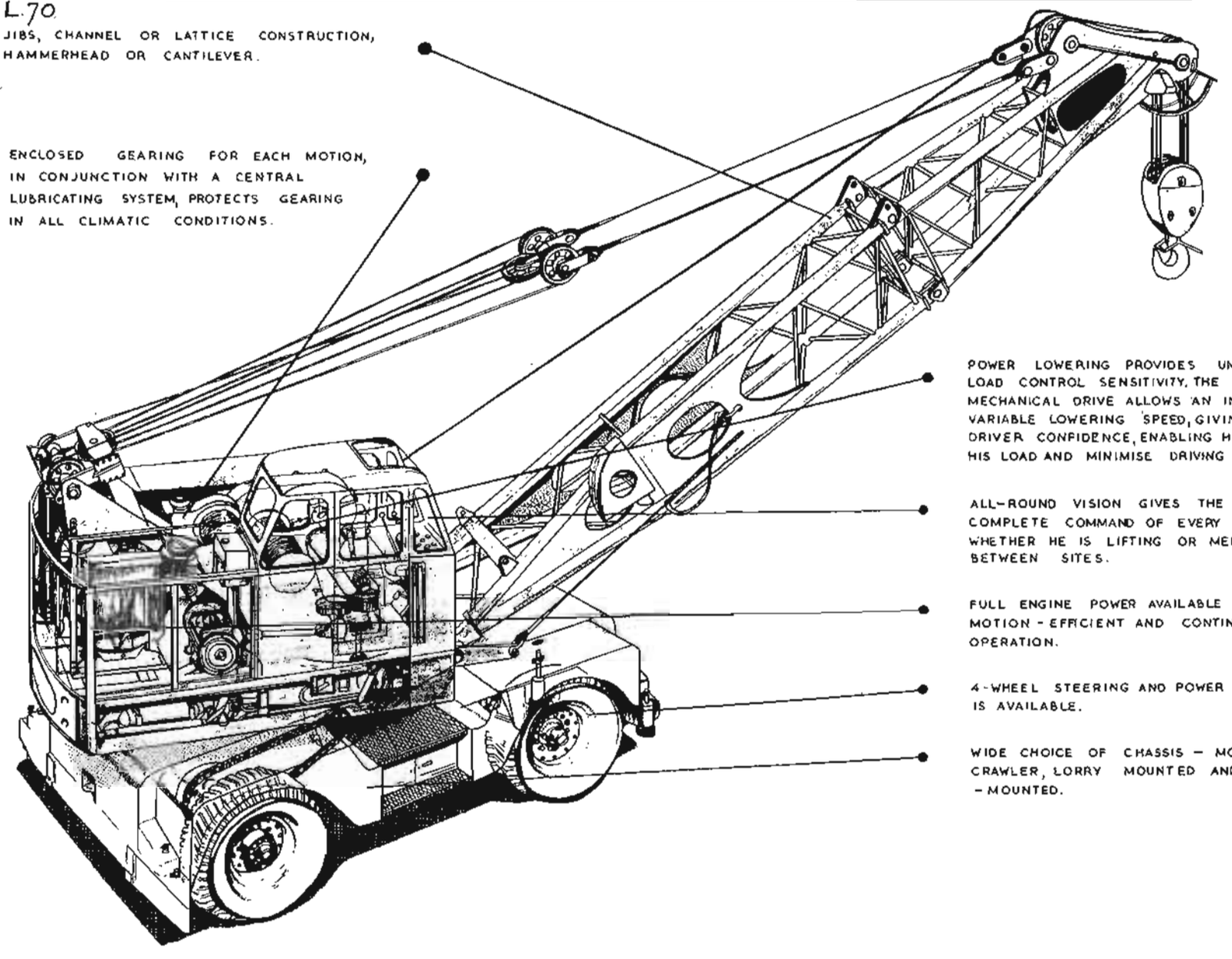
Fig. L. 67. - This illustration refers to the selection of the block size with regard to the diameter of the line, mass of the load and kind of bearing used.

Fig. L. 68 and 69. - Blocks of the same shape (but not lifting capacities) illustrated in the above figures were delivered with a crane purchased for log loading. With the introduction of blocks with sheaves fully encased within the block shell, the blocks were used as counterweights in order to accelerate the descent of loading slings when slewing the crane boom for the next load.

FIG. L.70

JIBS, CHANNEL OR LATTICE CONSTRUCTION, HAMMERHEAD OR CANTILEVER.

ENCLOSED GEARING FOR EACH MOTION, IN CONJUNCTION WITH A CENTRAL LUBRICATING SYSTEM, PROTECTS GEARING IN ALL CLIMATIC CONDITIONS.



POWER LOWERING PROVIDES UNEQUALLED LOAD CONTROL SENSITIVITY. THE DIRECT MECHANICAL DRIVE ALLOWS AN INFINITELY VARIABLE LOWERING SPEED, GIVING THE DRIVER CONFIDENCE, ENABLING HIM TO 'FEEL' HIS LOAD AND MINIMISE DRIVING FATIGUE.

ALL-ROUND VISION GIVES THE DRIVER COMPLETE COMMAND OF EVERY SITUATION, WHETHER HE IS LIFTING OR MERELY BETWEEN SITES.

FULL ENGINE POWER AVAILABLE TO EVERY MOTION - EFFICIENT AND CONTINUOUS OPERATION.

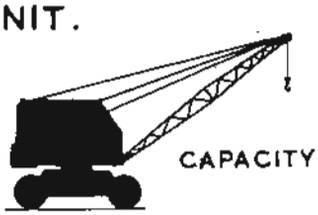
4-WHEEL STEERING AND POWER ASSISTANCE IS AVAILABLE.

WIDE CHOICE OF CHASSIS – MOBILE, CRAWLER, LORRY MOUNTED AND RAIL-MOUNTED.

LIFTING CRANES

DEFINITION OF A COMMERCIAL UNIT.

FIG.L.71.

ANY CRANE.....4 TON TO 10 TON  CAPACITY.

MOUNTED ON CRAWLER OR RUBBER

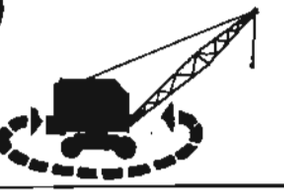
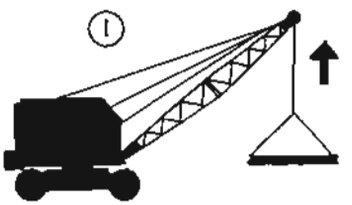
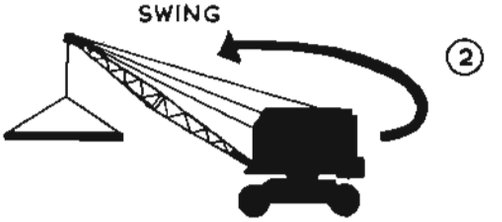
THAT IS FULL REVOLVING. 

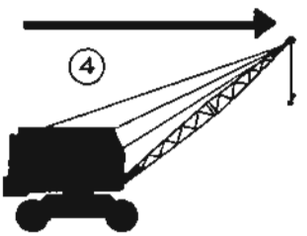
FIG.L.72. THE FOUR BASIC OPERATIONS

HOIST



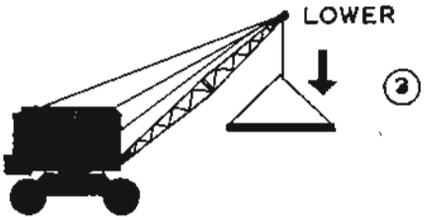
SWING





TRAVEL.

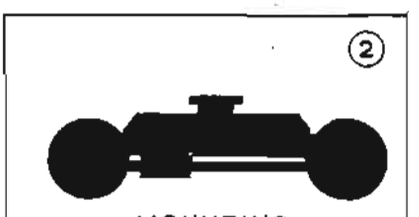
LOWER



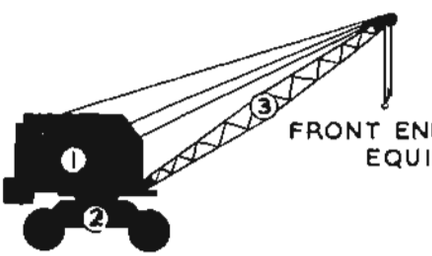
MAJOR COMPONENTS OF BASIC MACHINES

FIG.L.73.

THE REVOLVING SUPERSTRUCTURE.



MOUNTING.

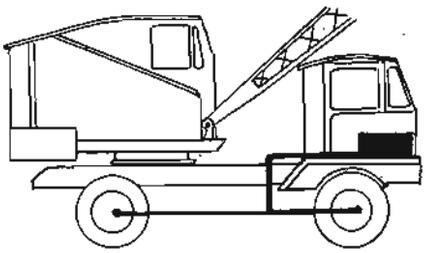


FRONT END OPERATING EQUIPMENT.

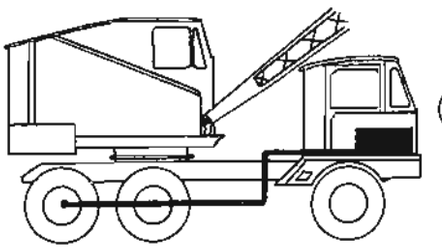
FIG. L.74 DIFFERENT TYPES OF DRIVE FOR CRANE UNITS.

MOTOR CRANE UNITS.

1



FRONT AND REAR AXLE DRIVEN.

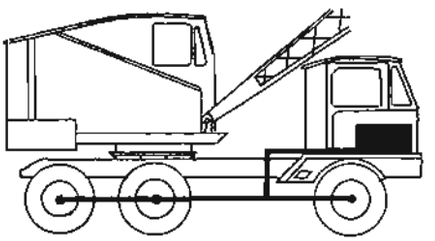


2

3 AXLES, 6 WHEELS, DRIVING POWER ON BOTH REAR WHEELS.

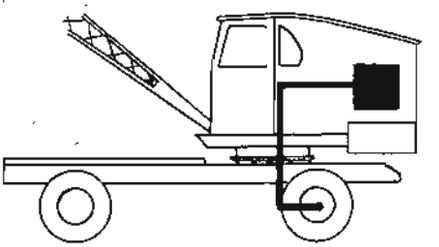
MOTOR CRANE UNIT

3



3 AXLES, 6 WHEELS, DRIVING POWER ON ALL 3 AXLES.

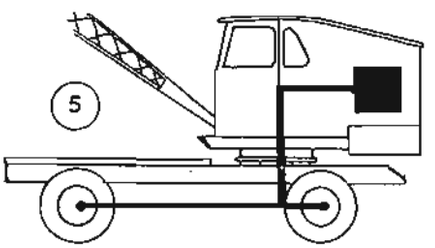
SELF-PROPELLED UNIT.



4

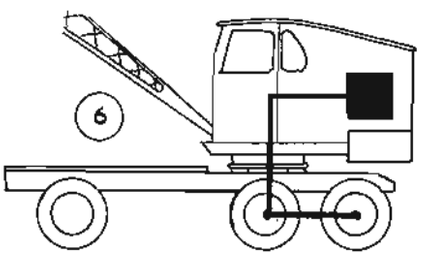
2 AXLES, 4 WHEELS, DRIVING POWER ON REAR AXLE.

SELF PROPELLED UNITS.



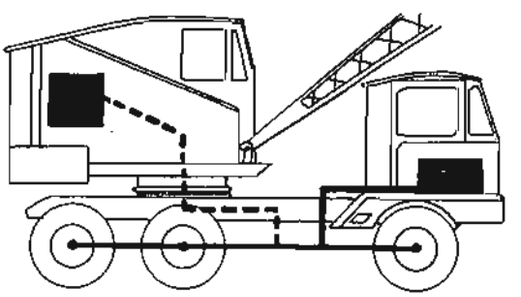
5

2 AXLES, 4 WHEELS, DRIVING POWER ON BOTH AXLES.



6

3 AXLES, 6 WHEELS, DRIVING POWER ON 2 REAR AXLES.



7

DUAL CONTROL

3. LIFTING CRANES USED IN LOGGING

(a) INTRODUCTION

Since the beginning of time man has been extracting timber from the depth of the forest and using the timber thus obtained for the essentials of civilisation. Originally man's loading methods were crude, hand labour being essentially employed, but today machines of great power do the job. Power cranes, either diesel, petrol or electrically driven, have become an essential in departmental logging operations, and this section will be confined to these machines.

The functional designs of power cranes must be dealt wiht, explaining what the machines are and how they function. This purpose is two-fold; first to acquaint the reader with the proper names, definitions and nomenclature of the various major elements and components which comprise power cranes, and secondly to describe the function of components. It is essential that one be well acquainted with the safe application and field uses of the machine.

(b) DEFINITION OF THE CRANE AS A COMMERCIAL UNIT (Fig. L. 71)

A commercial crane unit is a unit which by virtue of its capacity, versatility, investment, etc., is best adapted to the usual run of work. The field of commercial sizes for departmental forestry consists of machines having a maximum lifting capacity of from 4 to 8 tons. Such units may be mounted on crawler or rubber-tyre mountings, and it is desirable that they be full revolving, i.e. capable of being rotated through 360°.

A. TYPES OF CRANES

The various types of mechanical cranes used departmentally in the past or present fall into the following categories:

(1) Rubber tyre mounted, fully mobile, full-slewing cranes

Cranes having a superstructure capable of slewing through unlimited revolutions in either direction, able to handle loads up to the maximum for which they have been designed, and able to travel under their own power with such loads suspended at any point in their full circle of slewing. The above cranes fall into two classes for departmental purposes:

(i) Truck-mounted (Fig. L. 74, items 1, 2, 3)
(ii) Wheel-mounted (Fig. L. 74, items 4, 5, 6)

(2) Rubber tyre mounted, fully mobile, part-slewing cranes

Cranes as described above, with a similar superstructure, but with a limited arc of slewing.

(3) Tractor-mounted fully mobile non-slewing cranes

Cranes with a non-slewing superstructure, which obtain the slewing effect only by manoeuvring the complete crane by means of its steering and travelling mechanism.

Note : These cranes are no longer used departmentally.

(4) Portable cranes

Cranes which are unable to travel under their own power, but which have a power-driven hoisting motion and no slewing motion.

B. CRANE MOUNTINGS

(a) TRUCK-MOUNTED CRANES (Fig. L. 74, items 1 to 3)

A heavy-framed, rubber-tyred carrier supported by two or more axles and having the general characteristics of a heavy duty truck, upon which is mounted a revolving superstructure with appropriate front end equipment, and which is controlled for road travel from a cab mounted on the carrier. It generally has a separate engine for carrier and superstructure. Such units, are known as 2-engine truck mountings.

The carrier has a chassis with characteristics substantially the same as those of a lorry and possessing the usual lorry arrangement of engine transmission, and road wheels with or without springs. Truck mountings usually have a range of from 4 to 10 speeds forward and 2 reverse. The maximum road speed is usually approximately 50 km/h.

(b) WHEEL-MOUNTED CRANES (Fig. L. 74, items 4 to 6)

A heavy-framed rubber-tyre carrier supported by two or more axles, upon which is mounted a revolving superstructure with appropriate front end equipment, and which is controlled for travel from the cab on the revolving superstructure. The carrier is generally driven by the engine of the superstructure, but may have a separate engine. Wheel mountings require a specially designed chassis. Also all travel controls for steering, braking, gear shifting, etc., are located at the operator's position in the superstructure cab.

Wheel mountings usually afford a range of 1 to 4 speeds, with a top speed of approximately 15 to 30 km/h.

(c) WHEEL AND AXLE ARRANGEMENTS (Fig. L. 74)

Arrangements are designated by the standard automative practice, and refer to both truck and wheel mountings. Any axle may have two or more wheels.

Truck mountings may be supported by 2 or 3 axles with drives as follows:

(1) two axles, with rear axles driven is 4 x 2; (2) two axles with front and rear axles driven is 4 x 4; (3) three axles with the two rear axles driven is 6 x 4; (4) three axles with all three axles driven is 6 x 6. In other words, the first number identifies the total number of wheels of the mounting (with paired wheels counting as a single wheel) the second number indicating the number of those wheels which are powered.

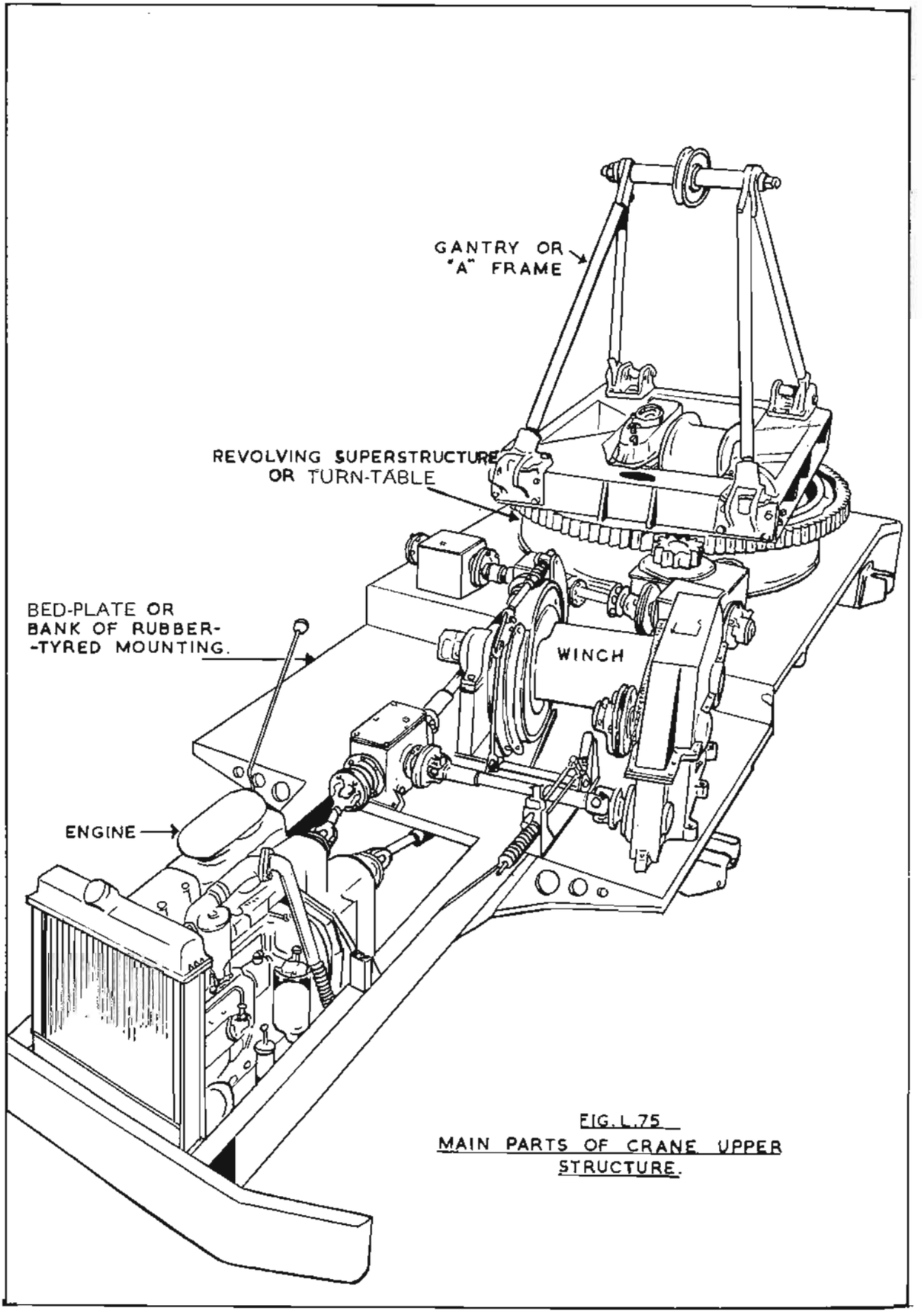


FIG. L.75
MAIN PARTS OF CRANE UPPER STRUCTURE.

LIFTING CRANES

FIG. L.76

REVOLVING SUPERSTRUCTURE

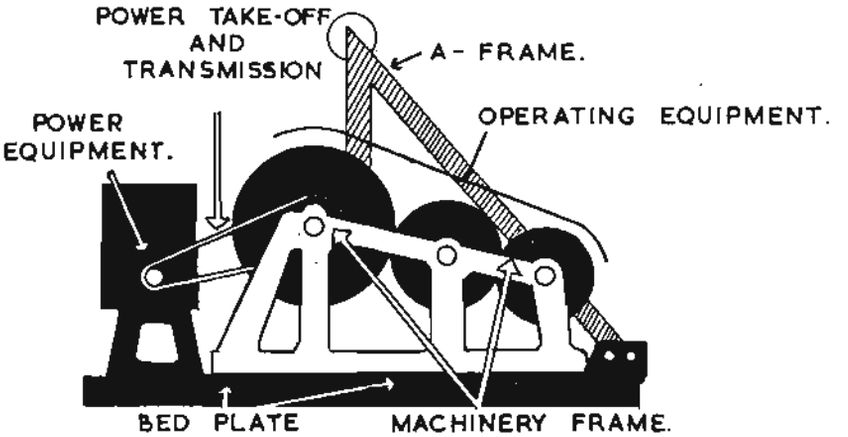


FIG. L.77

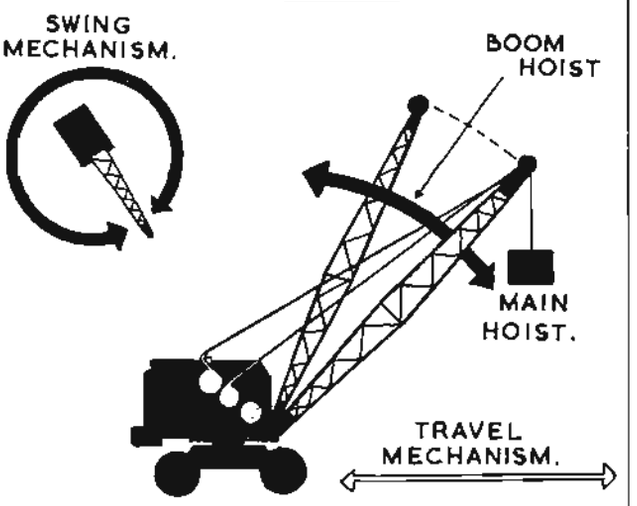
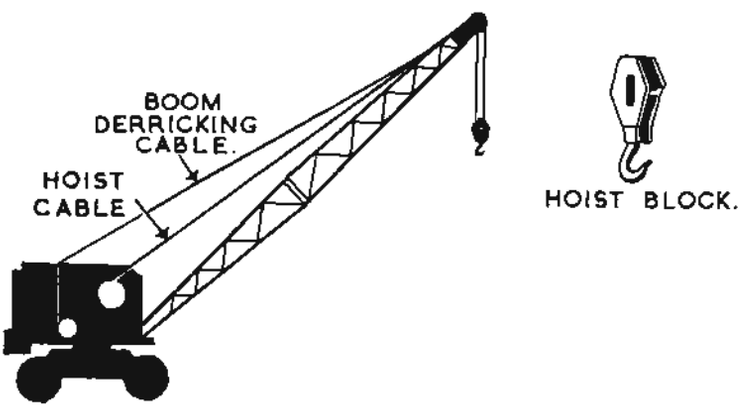


FIG. L.78.

BASIC EQUIPMENT



C. FOUR BASIC OPERATIONS (Fig. L. 72)

Cranes lift timber and move it to a different location, such as onto a lorry bunk, railway truck, etc. The four basic operations are: (1) hoisting the load; (2) swinging to move the load laterally to a new location; (3) lowering and (4) travelling, so that the entire unit can be moved to and about the job.

D. BASIC COMPONENTS (Fig. L. 73)

Every crane is made up of three basic major parts or components. (1) The turn-table or revolving superstructure which provides the power and mechanism for all loading operations. (2) The revolving superstructure is placed on a mounting or base which may be either of the crawler or rubber-tyred type. Only rubber-tyred mountings are used departmentally. (3) There is the front end operating equipment. This consists of various boom and loading equipment.

(a) THE REVOLVING SUPERSTRUCTURE (Fig. L. 75 and 76)

The revolving superstructure is defined as the rotating frame and machinery located thereon for operating the machine, and is a platform on which is mounted the engine and mechanism which permits the hoisting and swinging as well as the transmission of travel power. It is made up of the following elements:

(1) The bed plate which is the foundation on which is mounted all the operating mechanism. This bed plate may be of cast steel or welded construction; boom hinge brackets are provided at the front end of the bed plate for attaching the front end operating equipment.

(2) Upon this bed plate must be erected an "A"-frame and machinery frame. The A-frame or gantry is a structure mounted on the revolving superstructure of the machine to which supporting cables are attached. A-frames may be either fixed or folding. The A-frame consists of a triangular structure made up of the bed plate, a vertical member and slanting front struts. The A-frame provides the elevated position for the boom derricking lead sheaves and cables which support the boom equipment. It also helps to absorb the stresses of the boom pull. The machinery frame furnishes the means of attaching the power shafting, operating equipment, etc.

(3) Power equipment. The power equipment in departmental cranes is petrol or diesel driven. The internal combustion engines used are the heavy duty commercial or industrial types with high torque characteristics and speeds of 800 to 1800 r.p.m. (electric motors of any standard commercial types may be used).

The following terms are used to define engine speeds:

(i) High idle speed: the top engine speed at which the engine will run at no load, governor controlled.

(ii) Full load governed speed: The highest speed, under load, at which the governor has fully opened the throttle or fuel pump.

(iii) Maximum torque engine speed: The speed at which the engine develops its maximum torque.

The rated kilowatt of an internal combustion engine is the nett brake kilowatt at the flywheel under the following conditions:

(i) At sea level or at a specified altitude.

(ii) At full load governed speed with the engine fully equipped with generator, fan, air cleaner, and other regular equipment.

Power take-off. - The power take-off is the method of transmitting power from the engine to the operating mechanism of the revolving superstructure. The first step is a power take-off which may be through a plate disc clutch or a hydraulic coupling. Power then goes through a speed reduction assembly consisting of (1) a train of gears or (2) a chain drive, or (3) a combination of gear and chain drive.

(4) Revolving superstructure operating equipment

The boom on any machine may be raised or lowered through an arc, pivoting about its point of attachment at the front of the bed plate. This is known as boom derricking or lowering and a boom hoist or derricking device must be installed on the revolving superstructure.

Hoist (Fig. L. 77) is the function of lifting and lowering the load in a vertical plane, for which two main hoist drums are provided, mounted side by side on separate shafts in tandem. Each hoist drum is controlled independently by a clutch and brake. The controls actuating the clutches may be straight mechanical (mechanical with booster clutches), hydraulic, air or vacuum. Usual lifting operations require using only one drum, which is called the main hoist. However, two drums are provided to accommodate additional services, the second drum being known as the secondary hoist drum.

Line pull is defined as the maximum pull in kilograms at the drum at full load governed speed, for the first layer of rope.

Line speed is defined as the maximum speed in metres per minute at the drum at full load governed speed, with the specified pitch diameter of drum for the first layer of rope.

Boom hoist (Fig. L. 77) is defined as the hoist drum for controlling the angle of the boom. Braking mechanism is required regardless of the type of drive.

Swing (slew) (Fig. L. 77) is the function of revolving the superstructure of the machine, by which the entire turn-table or revolving superstructure may be revolved through 360° in either direction. (This is accomplished by the swing mechanism, which consists of a reversible vertical swing shaft and the proper mechanism and clutches on the superstructure so that the vertical shaft and consequently the superstructure may be rotated in either direction.)

LIFTING CRANES – EXTENSION EQUIPMENT

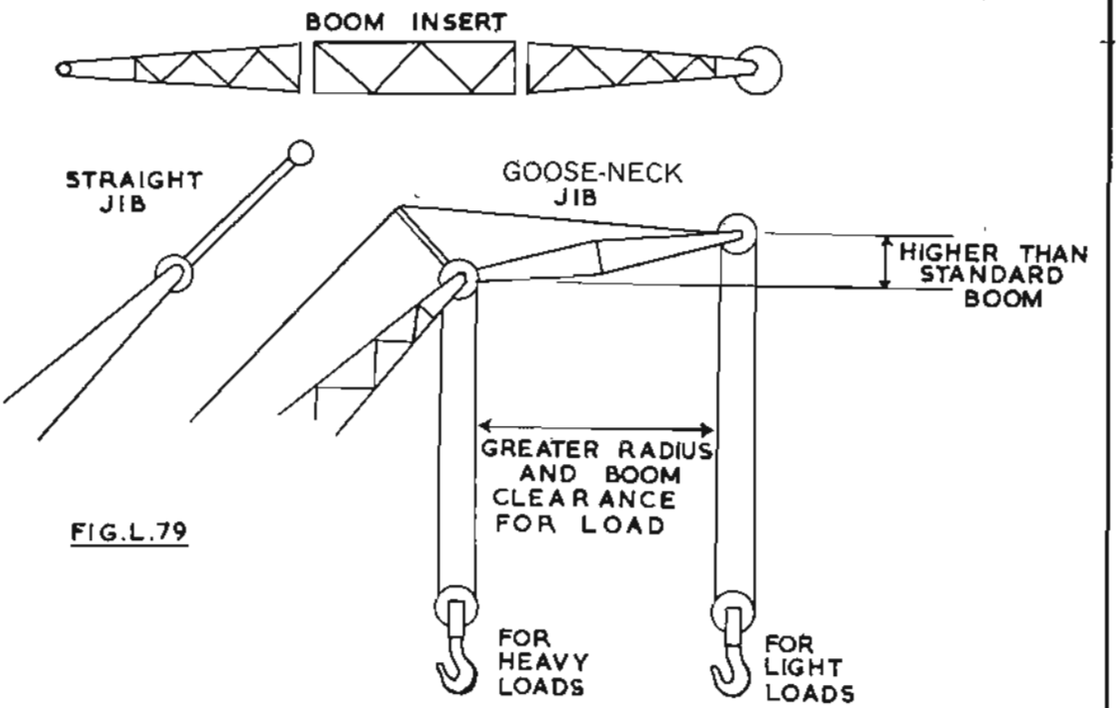


FIG.L.79

FIG.L.80

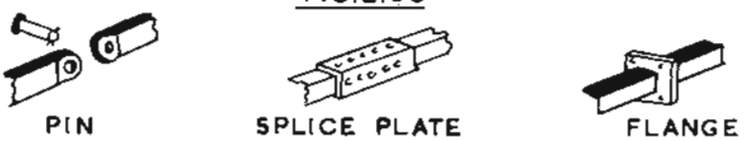
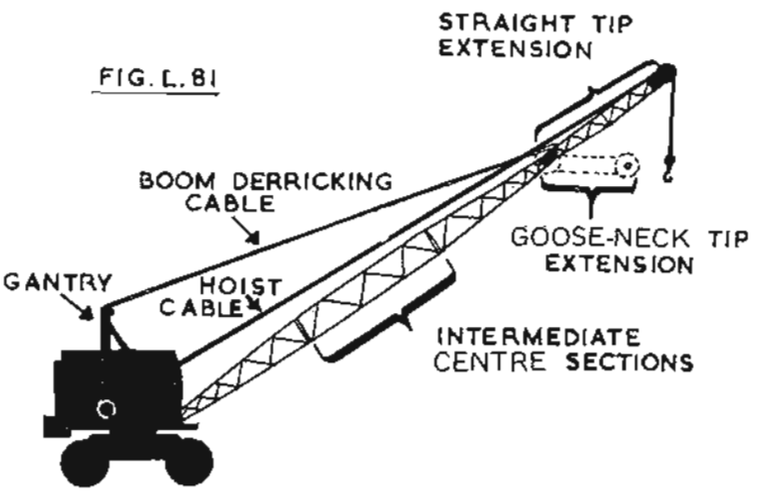
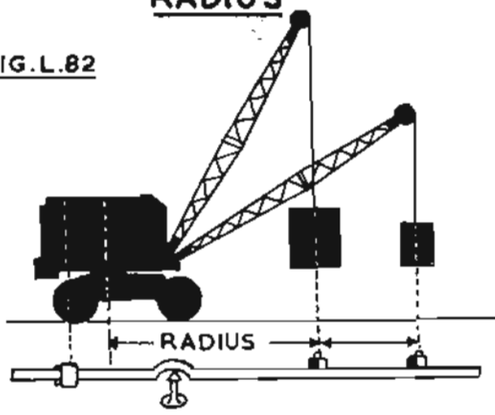


FIG.L.81



OPERATING RADIUS

FIG.L.82



CRANE WORK RANGES.

HEIGHT RADIUS

FIG.L.83

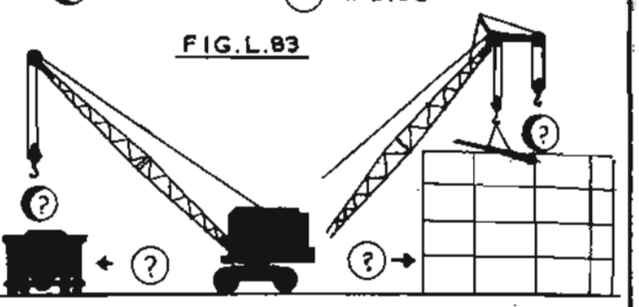
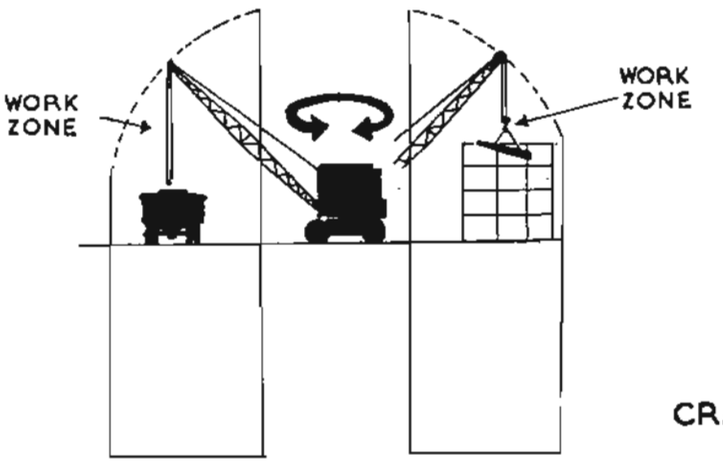


FIG.L.84

WORK ZONES



① UNLOAD RAILWAY TRUCKS AND LORRIES.

② LIFT LOADS FROM BELOW GROUND LEVEL.

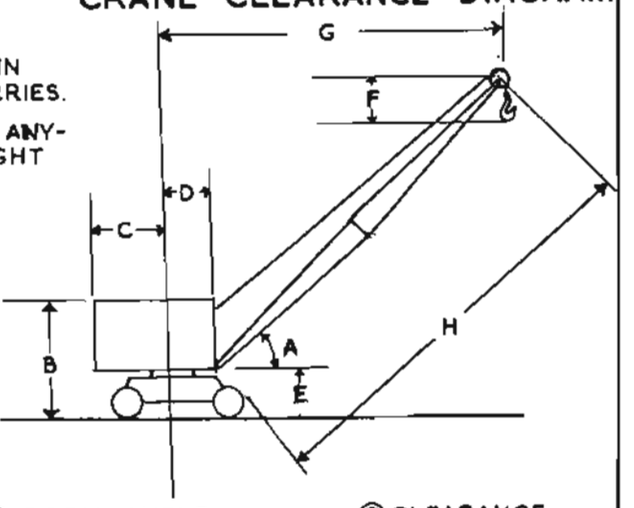
③ LIFT LOADS ANYWHERE IN LEFT AREA

① PLACE LOADS IN TRUCKS OR LORRIES.

② PLACE LOADS ANYWHERE IN RIGHT AREA

FIG.L.85

CRANE CLEARANCE DIAGRAM



Ⓐ BOOM ANGLE.

Ⓑ MAXIMUM CLEARANCE HEIGHT OF CAB

Ⓒ MAXIMUM RADIUS OF TAIL SWING

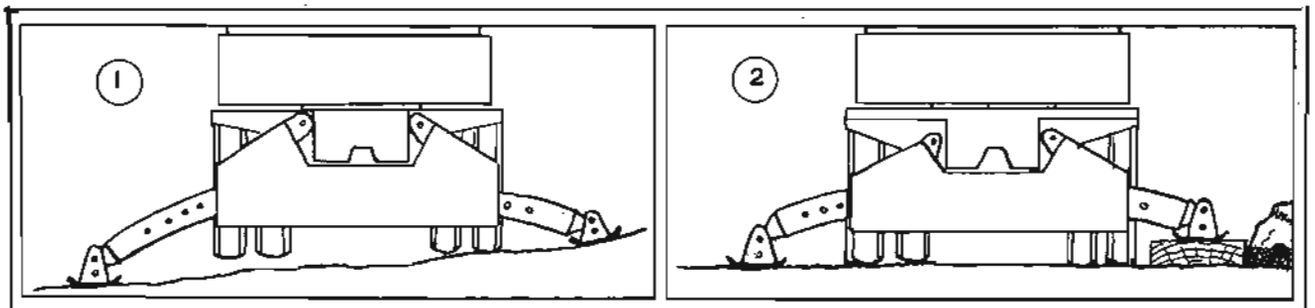
Ⓓ CENTRE OF ROTATION TO BOOM FOOT PIN

Ⓔ HEIGHT FROM GROUND TO BOOM FOOT PIN

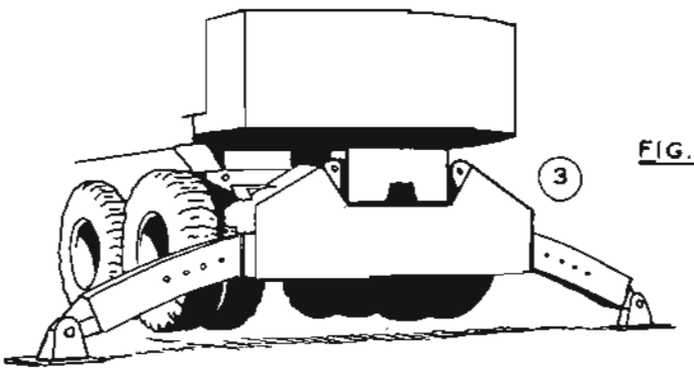
Ⓕ DISTANCE FROM CENTRE OF BOOM POINT SHEAVE TO BOTTOM OF HOOK

Ⓖ CLEARANCE RADIUS OF BOOM

Ⓗ LENGTH OF BOOM

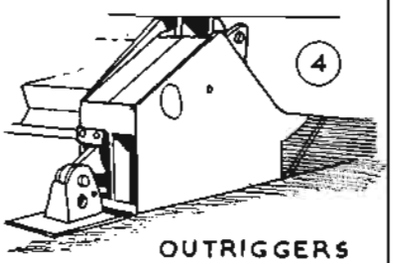


FULLY HYDRAULIC OUTRIGGERS AND JACKS WITH FLOATS — ADAPTABILITY OF THE OUTRIGGERS TO SURFACE CONDITIONS.

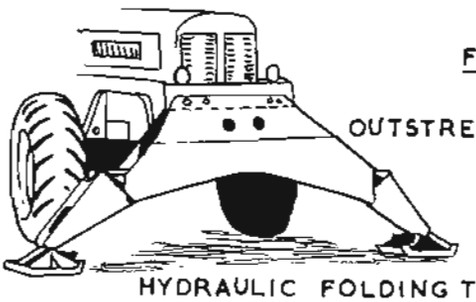


OUTRIGGERS OUTSTRETCHED ON LEVEL GROUND.

FIG. L.86

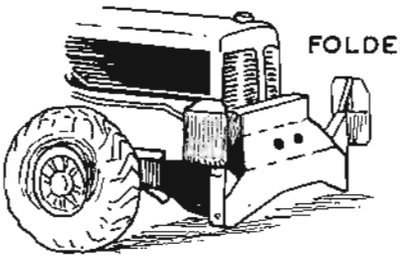


OUTRIGGERS WITHDRAWN.



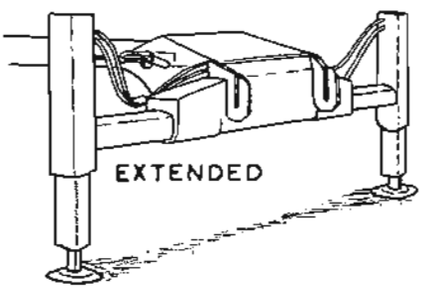
OUTSTRETCHED.

FIG. L.87



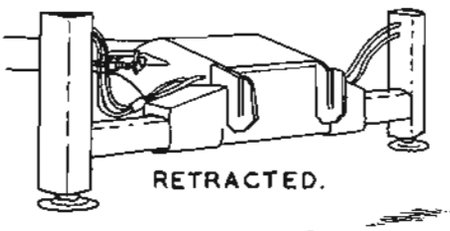
FOLDED

HYDRAULIC FOLDING TYPE OUTRIGGERS WITH FLOATS.



EXTENDED

FIG. L.88



RETRACTED.

MANUALLY-OPERATED OUTRIGGERS WITH HYDRAULICALLY OPERATED JACKS. JACK HEELS ARE RIGID.

MORE COMMON TYPES OF OUTRIGGERS AND JACKS USED WITH TRUCK MOUNTED CRANES

Swing (slew) speed is the speed, in revolutions per minute, at which the revolving superstructure rotates with the engine operating at full load speed.

Swing lock and swing brakes: A swing lock is a mechanical device to lock the superstructure rigidly to the mounting in a selected position. A swing brake is a control device to retard the swing of the revolving superstructure and/or to hold it from swinging.

Swing data: Manufacturers should specify swing speed and state whether or not swing lock, swing brake, or both, are furnished.

The power mechanism and control clutches for propelling or travelling wheel mountings are provided by the travel mechanism on the revolving superstructure.

The transference of propelling power from the superstructure into the mounting requires a vertical shaft, much like the vertical swing shaft. This shaft is located at the axis or centre of rotation of the superstructure. Through suitable clutches the operator may select the proper direction of rotation of the travel shaft to provide forward or reverse travel.

(5) Definition of superstructure motion

(i) Hoisting: The raising of the load by means of a rope which passes over a pulley fitted to the jib.

(ii) Swinging or slewing: The rotary motion of the crane jib in a horizontal plane.

(iii) Derricking: The movement of the crane jib when it is pivoted in a vertical plane.

(iv) Jib centre distance or length: The distance between the pivoting point of the jib and the centre of rotation of the jib head pulley.

(b) FRONT END OPERATING EQUIPMENT (Fig. L. 78)

The front end operating equipment consists of the boom equipment attached to the boom hinge brackets at the front of the bed plate. The common crane boom is used primarily for lifting purposes. Basic lifting crane equipment consists of the crane boom, hoist drum laggings for desired line speeds and pulls, and a hook block to provide the required parts of line for the lifting services required.

Common crane boom

- Common crane boom equipment (Fig. L. 78)

The basic boom structure usually consists of two sections, upper and lower, between which additional sections may be inserted to lengthen the boom. The crane boom is pivotally mounted at the front end of the rotating frame and is adjustable for angle. The boom structure is equipped with the head shaft, sheaves and other parts as required. The boom is raised and held suspended by boom hoist or derricking cables.

The crane boom upper and lower sections may be fastened together by three methods (Fig. L. 80): (1) by pin and clevis connections; (2) by splice plates; (3) by bolted flange connections.

In Fig. L. 81 the lower line represents the hoist cable which raises and lowers the hook block and load, and the upper line represents the boom derricking cable by means of which the crane boom may be raised or lowered.

- Boom length (Fig. L. 85)

The boom length (item H) is the straight line distance from the centre line of the boom foot pins to centre line of boom head main sheave pin.

- Boom angle (Fig. L. 85, item A)

Boom angle is defined as the angle between the horizontal and a straight line joining the centre of the boom foot pin and the bottom head main sheave pin.

- Boom extension equipment (Fig. L. 79)

The standard lengths of the common crane boom will often not be sufficient for the job to be done. To increase working ranges and reaches the boom may be lengthened by inserting intermediate sections between the top and lower sections of the boom proper. Intermediate centre sections may be used in multiples up to any maximum boom length specified by the manufacturer.

Centre sections are inserted by the same method of boom connection used on the standard boom crane.

Jib or boom tip extensions (Fig. L. 79) are extensions attached to the boom head for further lengthening the boom beyond the main head sheaves. The jib may be straight or offset (goose-neck). Manufacturers shall specify the load rating of the jib.

When booms are lengthened to a certain point, some manufacturers require the installation of a gantry or high A-frame. This is simply an extension added to the standard A-frame to elevate the derricking lead sheaves.

- Boom hoist cables (also called derricking cables) (Fig. L. 78)

(a) Continuous boom hoist cables - those cables which lead without interruption from the gantry to the boom head. If the boom is lengthened by a considerable amount, it may be necessary to supply a longer boom hoist cable.

(b) Floating boom harness (sometimes called bridle) - a floating frame or spreader equipped with sheaves and connected to the boom head by stationary cables usually called pendants. The boom hoist cable or cables then lead from the gantry to the floating frame. To change the boom length it is necessary to change the pendants.

E. OPERATING TERMS, DESCRIPTIONS AND DEFINITIONS

(a) OUTRIGGERS: (Fig. L. 86, 87, 88)

Outriggers are members attached to the carrier frame, which may be blocked up to increase stability; when extended they further increase stability by increasing the size of the supporting base. Manufacturers shall specify whether outriggers are fixed, or may be extended; whether telescoping or

hinged; whether front or rear outriggers, or both are supplied, and if jacks and supporting floats are available.

(b) TIPPING CONDITIONS WITH OR WITHOUT OUTRIGGERS

With the machine in working order and on firm, level and uniform supporting surface, a tipping condition shall be considered to exist when all tyres on one or more wheels leave the supporting surface.

(c) OPERATING RADIUS (Fig. L. 82)

Radius may be defined as the horizontal distance measured from the centre or axis of rotation of the superstructure to a vertical line extended down from the outside edge of the crane boom head sheave.

Rated loads at specified radii shall be furnished by the manufacturers. The rating shall be the minimum loads covered by the manufacturer's warranty, with the crane in working order standing on firm, level and uniform supporting surface.

All cranes are rated on the basis of safe lifting capacities established as follows:

Rubber-tyre cranes are rated with capacities for operation with and without outriggers. The safe rated lifting capacity at any given radius is based on 85% of the tip-over load at that radius with the unit standing on firm, level ground. We often hear of a crane referred to as a 5 or 10 ton crane. The basis of this classification is as follows:

Rubber tyre or truck-mounted and wheel cranes are classified and identified by their rated lifting capacity at 3 metres radius, with outriggers set and with minimum length of boom. Notice that the rating or classification of the crane is dependent upon the lifting capacity at a 3,6 or 3 metres radius and with minimum length of boom. Therefore, this means that a so-called 10 ton crane will lift 10 tons at 3,6 metres radius, but not at any other working radius, as the load lifted decreases in proportion to the increase of radius.

Radius of load: (Fig. L. 82).- Radius of load is defined as the horizontal distance from the axis of rotation of the machine to a vertical line through the centre of gravity of the suspended load.

Tail radius (Fig. L. 85). - The maximum distance from the centre of rotation to the tail of the revolving superstructure.

Outreach. - The horizontal distance from the centre line of the lifting hook to the nearest point of the chassis.

Stability reach. - The distance of the jib head pin from the point of intersection of the nearest base line and the vertical plane passing through the centre line of the jib.

Stability base. - The effective span of the supporting base.

Margin of stability. - The percentage additional load required to bring the crane to the condition of tipping when it is handling the safe working load at any radius.

Backward stability. - The mass distribution shall be even for a rubber-tyred machine standing on firm, level and uniform supporting base, with outriggers unsupported, and with the crane boom of basic length placed at its maximum radius without a load. Excessive or unsafe counter-weighting of the machine on pneumatic tyres must be avoided to ensure proper backward stability when the machine is used as a lifting crane.

(i) With the axis of the revolving superstructure at 90° to the axis of the carrier, the total load on all wheels on the side under the boom shall be at least 15% of the total mass of the crane and carrier.

(ii) With the axis of the carrier, the total load on all wheels on the end under the boom shall be at least 5% of the total mass of crane and carrier.

Blocking up base.- The effective span of the supporting base when outriggers, jacks or blocks are used to increase stability by virtue of making contact with the ground at points further from the centre line of the crane than the normal wheels or tracks.

Power equipment.- Crane carriers may be powered by internal combustion engines of various types. The following information shall be supplied:

(i) Manufacturer's name, model, number and type.

(ii) Number of cylinders, bore, stroke and displacement in centimetres.

(iii) Rated kilowatt (kW).

(iv) Manufacturer's recommended maximum full-load governed speed in revolutions per minute.

(v) Type of starting equipment.

Travel speed. - Manufacturers shall specify the number of gear speeds in forward and reverse, and the vehicle speeds in lowest and highest gears for full load engine speed when travelling on a firm, smooth, level surface.

Gradability. - Gradability is defined as the maximum grade in percentage which the machine can climb safely on a smooth, dry surface, free from loose material.

Remote control. - When supplied, remote control provides control of the carrier functions from the revolving superstructure of a truck-mounted machine. Carrier functions controlled from the revolving superstructure shall be specified.

Nett load. - All auxiliary load-handling devices, such as blocks, slings, spreader bars, loading tongs, hooks, etc., shall be considered part of the load and their mass shall be subtracted from the crane rating to determine the nett load capacity.

Safe working load. - The user is expected to make due allowance for his particular job condition in determining the safe working load. These include factors affecting stability, hazardous conditions, experience of personnel, etc.

F. JOB APPLICATION AND JOB ANALYSIS

(a) WORK ZONES (Fig. L. 84)

Cranes are built with different booms or front end operating equipment so that they may be mounted on one of two types of rubber-tyre mountings, viz. truck or wheel mountings. In this age of specialisation, competition and the necessity of low cost operation, no one size of machine or type of boom will fit every job efficiently and profitably. The most efficient job application can be achieved through job analysis, which has two component parts:

1. Selection of the right type of equipment,
2. selection of the right size of equipment.

Like other units the crane has its own "work zones" as shown in Fig. L. 84. Crane work area is shown in Fig. L. 83, and is the area in which the cranes are usable. The crane may be used to lift loads from below ground level or lift loads anywhere in the working zone (left). In depositing loads (right) the crane may place loads onto trucks or lorries; place loads anywhere in the right-hand working zone. Because of the ability of the crane to extend its reach by lowering the boom this width of working area is available. If the crane is full revolving, its actual working area may be thought of as a ring or cylinder around the machine having the cross-section of the working zone.

(b) CONDITIONS FOR UTILISING CRANE

The crane is utilisable under the following conditions:

Where the load is to be placed well above ground level (stacking timber); when the load is handled at ground level (stacking logs or loading logs onto lorries), or when loads are taken from, or placed below, crane ground level (logs loaded from the lower road bank in steep terrain).

Cranes may handle a wide variety of materials simply by changing the device on the end of the hoisting line to adapt it to the conditions required. Accessories relative to timber handling include grabs for handling pulpwood, slings for handling logs and poles, grapples for handling stacked pulpwood or bundles of small poles, the hook block which must be used in conjunction with many of these items, and tongs or loading hooks for handling large logs.

(c) TRAVEL ZONES

(1) Wheel-mounted travel zones

Departmental logging conditions require constant on-the-job movement or movement from job to job, and rubber-tyre crane mountings best meet these requirements. The single engine on wheel mounting usually provides travel speeds up to 30 km per hour. All controls for such units are located in the operator's cab and steering, braking and gear shifting are effected from this position.

(2) Truck-mounted travel zones

Since this type of mounting is automative in character it provides the maximum in mobility both as to speed and distance. Units usually have a travel speed of up to 45 km/h. Such vehicles are generally built with multiple axles and with dual wheels to provide "soft ground floatation" which enables the unit to be used as an "off the road" vehicle. As such it is not limited to hard surfaces, but can be used within reasonable limits, for cross-country, off the road travel, at lower speeds.

G. SIZING THE CRANE

Every loading operation consists of a complete movement of timber from the roadside (usually) to another location such as the sawmill, railway station, etc. Crane and hauling units (trucks) must therefore be regarded as combination units for the operation, synchronised to achieve the maximum output.

In this section we deal with the following:

(1) Size of crane.

(2) Size of the hauling equipment.

(3) Synchronisation of the hauling fleet to obtain minimum delay and maximum output or production.

The size of the job to be done during a certain period and the volume and size of logs to be loaded determine the size and number of cranes to be used. The transportation distance determines the number of trucks used, and ultimately their size and capacity.

Every new case of loading and timber transportation should be analysed to determine the most efficient combination of crane and haulage equipment required for the job. The employment of modern equipment should be borne in mind.

The sizing of the crane is of major importance because:

(1) There is a wide variation in the basic cost per cubic metre for loading with the smallest and largest crane, depending on the size of the logs to be loaded.

(2) There are large production variations within the crane sizes due to varied lifting capacities and reach.

(3) The equipment which can operate with the minimum of swing can greatly increase production.

(4) The size and stack depth of the logs at the roadside or loading site, may limit the use of certain types and sizes of equipment.

(5) Movement about the job, or from job to job, may be so extensive as to nullify other factors favouring more efficiently loading, but less mobile machines.

(6) The proper crane size may achieve a more efficient balance of the haulage cycle and so utilise hauling equipment more efficiently, e.g. by loading trucks quickly, congestion at the landing is avoided and log hauling is uninterrupted.

(7) The volume of timber to be loaded, with the anticipated future use for similar loading equipment, should be considered when investing in loading equipment required for existing emergencies.

(8) The financial aspect of the whole operation, i.e. extraction loading and hauling, should be thoroughly analysed.

Timber loading should be regarded as an operation requiring teamwork. Equipment sizes and operation timing should be carefully studied and the most favourable combination adopted within the limits of the work to be done and equipment available. Consideration should also be given to purchasing additional loading and hauling equipment, should this be economically justified by the operation.

Loading efficiency is closely linked with timber skidding and hauling, and these three stages of the operation must be synchronised.

Note : This problem is further aggravated if logging is split between the department and private contractor's, i.e. log skidding and stacking at the roadside may be done departmentally, while loading and hauling are done by a contractor on behalf of the private sawmill owner. For example, delay may occur in the removal of timber from the roadside by the contractor, which chould adversely affect timber skidding in the plantation.

Suggestions for the selection of a crane of the correct capacity

The following factors are to be considered when selecting the correct size of crane for the job:

(i) Size of timber (logs, poles, pulpwood, etc).
(ii) Depth of the stacks.
(iii) Angle of swing of the crane boom.
(iv) Clearance involved.
(v) Moving requirements.
(vi) Volume of work available.
(vii) Financial considerations.

The order of importance of the above factors will vary for different jobs, depending on local conditions.

(i) Type of timber

Large sawlogs of up to 2,8 m^3 are to be loaded individually.

Medium logs can be loaded in pairs, if of the same length, and if stacked with their ends more or less flush.

Small logs (pulpwood) or poles may be loaded in bundles, although poles are much longer than logs, transmission poles being up to 13 metres in length.

Note : Different auxiliary equipment will have to be used with the crane, dependent on the volume, size and length of timber to be loaded.

(ii) Depth of stacks

If timber stacked at the roadside extends for quite some depth into the compartment, which often occurs if limited stacking space is available at the roadside, the length of the crane boom is of importance. In this case a larger crane with extended reach is required in order to avoid dragging logs with the crane line before hoisting, as the latter operation is a delaying factor in loading. Besides this, dragging logs down steep slopes is dangerous.

Stack depth and height should be co-ordinated with the crane boom reach and frequency of the crane (and loaded truck) movement from stack to stack to complete the loading of a truck. The optimum loading conditions should always be considered.

(iii) Angle of swing

The shorter the crane boom swing, the faster the loading cycle. The shortest crane swing can be achieved when the crane is positioned behind the truck to be loaded. Any other position, such as loading from the side of the truck, requires greater swing. In order to be able to load from the rear of the lorry, a longer crane boom is required, particularly as many plantation trucks are of 10 ton capacity, with log bunks of up to 7 metre in length.

(iv) Clearance involved

Apart from particular cases which limit the crane activities, such as operations along public roads open to traffic, under overhead wires, or near railways, etc., logging cranes must generally move and operate along narrow plantation logging roads with high, rocky banks. Excavated recesses in the side of the upper bank, limited log stacking space on the slopes of the upper road bank, or unavoidable stacking of logs below the road on the lower road bank sometimes considerably reduce the loading potential of the crane. Under such circumstances one is compelled to select a special type of crane for the particular operation. Working in tight quarters is not efficient from the production point of view.

Limited rear end clearance is of great importance when working in thinnings where the canopy of trees above may present a limit to the boom height for derricking and swinging. The same problem may be encountered when the machine has to work or travel under overhead wires (railway stations or sidings), particularly if wires are power lines. Under such conditions it may be advisable to use self-loading lorries, as the boom or jib may be folded with these units.

(v) Moving requirements

When considerable on-the-job or from job-to-job movement is required, which is usually the case for cranes working under departmental forestry conditions, travel speeds and mobility should be considered. Efficient rubber tyre mounted cranes of high mobility, are available.

Frequent job-to-job moves involve height and width clearance limits. Departmental crane units are usually no more than 2,5 metres in width, which is standard for cranes on wheels. Shipping clearance height should be no more than 4 metres, with the A-frame removed, if the A-frame extends above the height of the crane roof, otherwise the crane loaded on low-bed railway trucks will not pass through some of the tunnels of the S.A. Railways.

Working mass is of great importance: from the loading and stability point of view the machine with a greater mass has the advantage, but a machine with a smaller mass is cheaper and faster to move. The unit selected should have the optimum advantages regarding performance for the particular working condition.

(vi) Balancing haul cycles

As conditions for loading vary with the change of operation and timber size, log stacking methods, road widths and length of haul, planned organisation for present methods may not be applicable to future conditions. It may even be advisable in the future to replace large sized cranes with the lighter type of truck-mounted cranes for self-loading lorries, or vice versa.

When two or more operations are involved, work can be so planned that haul cycles may be balanced to utilise the hauling fleet to the maximum efficiency. For example, with one crane in a plantation loading for a long haul job, and another in an adjoining plantation loading for a short haul job, the hauling fleet can be divided with more trucks or lorries serving the long haul operation. If the same plantations are served with a single crane, the plantation with the longer lorry haul will either be worked short, or more lorries will have to be employed. When the crane moves to the plantation with the short haul, most of the hauling fleet will stand idle, unless transferred elsewhere.

Note : In plantations where the crane is idle for some time between loading lorries it may be profitably occupied with stacking logs skidded to the roadside. This will assist in considerably decreasing the loading time as logs will be placed in stacks of sufficient size to provide a full lorry load. At the same time, if the tractor is skidding logs to the same log deck, the improved stacking facilities provided by the crane would enable the tractor to increase its skidding output, as less time would be spent at the stacking deck.

(vii) Volume of work available

The employment of a crane, especially an expensive one of 6 to 8 ton lifting capacity, is only justified if sufficient work is available for a long enough period to make the investment profitable.

The useful life of a crane working under departmental conditions can be accepted as being 12 years, in which case depreciation of the machine can be calculated accordingly. During this period the crane will actually work for from 7 000 to 9 000 hours. A 6 to 8 ton crane loads 1 700 m^3 per month under departmental conditions, so during its life span it should load the following:

12 years x 12 months x 1700 m^3 = 245000 m^3.

In the above calculation allowance is made for on and off-the-job delays, and delays due to the weather, etc. The calculation is based on crane returns data.

(viii) Financial considerations

The size of the crane depends on the size of the logs to be loaded and the volume of work available. The size and height of departmental timber to be handled differs considerably.

The smallest timber to be handled is 1,8 metres long with a top diameter of 7 cm, while the largest is logs of up to 7 metres long with a top diameter of as much as 84 cm. Cranes must be selected according to the size of the logs (i.e. their volume) and the size of the loading operation.

The lorries used for transportation have a capacity of up to 10 ton and log bunk length of up to 7 metres. Loading is generally done with the crane standing behind the lorry.

In order to be able to dispose a bundle of the shortest logs near the driver's cab of the lorry, with the crane boom lowered to near its maximum radius, a 6 to 8 ton capacity crane must be available in mature plantations.

The crane has a fixed production capacity under optimum conditions, but the hauling fleet consists of separate units, so their number can be adjusted to suit current operating conditions.

After the crane has been selected to the best advantage it may occur that it is not used to its full capacity due to the following:

(i) Inadequate volume available for the full employment of the crane during the working day or working period.

(ii) Logs may be of a size too small for efficient single log loading, but too large to be taken in pairs or in bundles.

(iii) Logs may be stacked in an inaccessible or disorderly fashion at the roadside.

(iv) Logs differing appreciably in length may be found in the same stack.

(v) Stacks may be of considerable depth, with logs extending beyond the direct boom reach, necessitating dragging before the logs can be hoisted.

(vi) The stacks may be small and spaced far apart, so frequent movement of the crane and truck is necessary to secure a full load.

(vii) Logs of different species, diameter or length, to be directed to different destinations, may be mixed in the same stack, which will necessitate sorting to obtain a load of the required logs.

(viii) Roads may be of inadequate width without preplanned recesses excavated ahead to facilitate bypasses at the right spots. Consequently much time will be lost positioning the crane and lorry for convenient loading.

(ix) Due to inadequate intake capacity at the receiving point, lorry arrival at the crane loading point may be irregular or sporadic.

(x) There may be insufficient hauling units, or units of too small a size.

(xi) The crane may have too much idle time.

(xii) There may be insufficient stand-by hauling units in case of breakdowns, etc.

(xiii) There may be inadequate synchronization due to poor traffic control.

The volume of timber available and required for delivery must be backed up by the hauling capacity of the rolling fleet. Loading and delivery must be perfectly timed to prevent loss of time and efficiency.

The crane size generally makes relatively little difference to the fixed costs, but marked production losses may occur due to inadequacy in:

The haul unit size.
Mechanical efficiency of the hauling units.
Rolling fleet capacity.

The above factors gain in importance as the size of the crane increases.

In departmental logging, the size of the crane and truck can be closely related, as the crane size depends largely on the volume of the largest logs, so the loading capacity of a crane suitable for large logs is usually much higher than the volume of timber to be loaded and transported.

Most departmental cranes have a lifting capacity of from 2 to 3½ tons, on a 4,5 metres radius, so the relation between the lifting crane capacity and an 8 to 10 ton truck capacity is 1: 4.

H. FREE-MOVING CRANES IN LOGGING

Increased speed and efficiency in logging operations has, to a large extent, been made possible by the increased use of free-moving cranes. These are lifting cranes which have two basic characteristics: (1) ability to revolve through 360° and thus to handle loads in any position of swing, and (2) a mobile mounting, wheel type, which is free to move at will. They are thus able to reach all parts of the log decks or stacking yards, where the surface is sufficiently firm to support them and permits traction.

Free-moving cranes with lifting capacities of 5 to 10 tons lend themselves to the efficient production handling of all sizes of departmental timber, whether singly or in bundles, the only limitation being the handling attachments, which may be attached to the crane hoist. The attachments previously mentioned serve to give the loading crane widespread adaptability to virtually all timber loading operations.

(a) ADVANTAGES OF FREE-MOVING CRANES IN LOGGING OPERATIONS

(1) They go practically anywhere. They can travel from stack to stack, log deck to log deck, or loading site to loading site.

(2) Diversified application. The wide variety of lifting and handling attachments available adds to the free-moving crane's versatility.

(3) Increased work range and capacity of log decks. The free-moving crane enables piling on each side of the road. It can also rehandle economically to the full diameter of its working range.

(4) Pooled use of cranes for small plantations. Just as the free-moving crane can go anywhere there is work to be done in a single, large operation, the advantages of this versatile working tool can be shared by a group of small plantations in a common location by dividing time and cost of operation. Rubber-tyred units are especially suitable if travel over public roads is involved.

(b) SUMMARY - ECONOMIES AND OPERATING ADVANTAGES OF FREE-MOVING CRANES

(1) They can go anywhere there is work to be done.

(2) They are multi-purpose tools, can lift all types of timber, have attachments for all kinds of loads to be lifted.

(3) Swinging loads 360°, they increase work range and add capacity to log decks.

(4) They can serve numerous plantations or log decks in one operating area.

I. CRANE ATTACHMENTS AND THEIR USE

The main crane attachment of importance for forestry purposes is the crane-type boom, to which is fitted the auxiliary loading equipment.

(a) CRANE-TYPE BOOM ATTACHMENTS

As previously illustrated the crane boom is used in conjunction with a wide diversity of equipment for loading purposes. However, the basic principles of crane hook operations apply as the element of lifting is always involved.

For lifting purposes only, the crane boom is equipped with a single line (main hoist cable) leading from the main hoist drum to the load carrier or whatever device is used to attach the line to the load. This is the fastest and most effective arrangement. Two-part or multipart lines increase the lifting capacity (within limits of stability and boom capacity), but slow down speed of vertical travel. With two or more lines it is impossible to reach logs from beyond the boom radius due to the resistance (friction) of the blocks and mass of the fall block.

Most timber crane work makes use of the boom hoist for setting the boom vertically (under angle) in order to adjust itself exactly to the position of the lorry and length of the logs to be loaded. Tag lines are used for loading to control against swinging.

Drum arrangements that can apply power for lowering the load (or "backing it down") as well as raising it are desirable where exacting control of loads with a great mass is needed in placing. This permits slower lowering, also eliminates heavy wear on clutch and brake bands and ensures that the load can be exactly and safely controlled at all times.

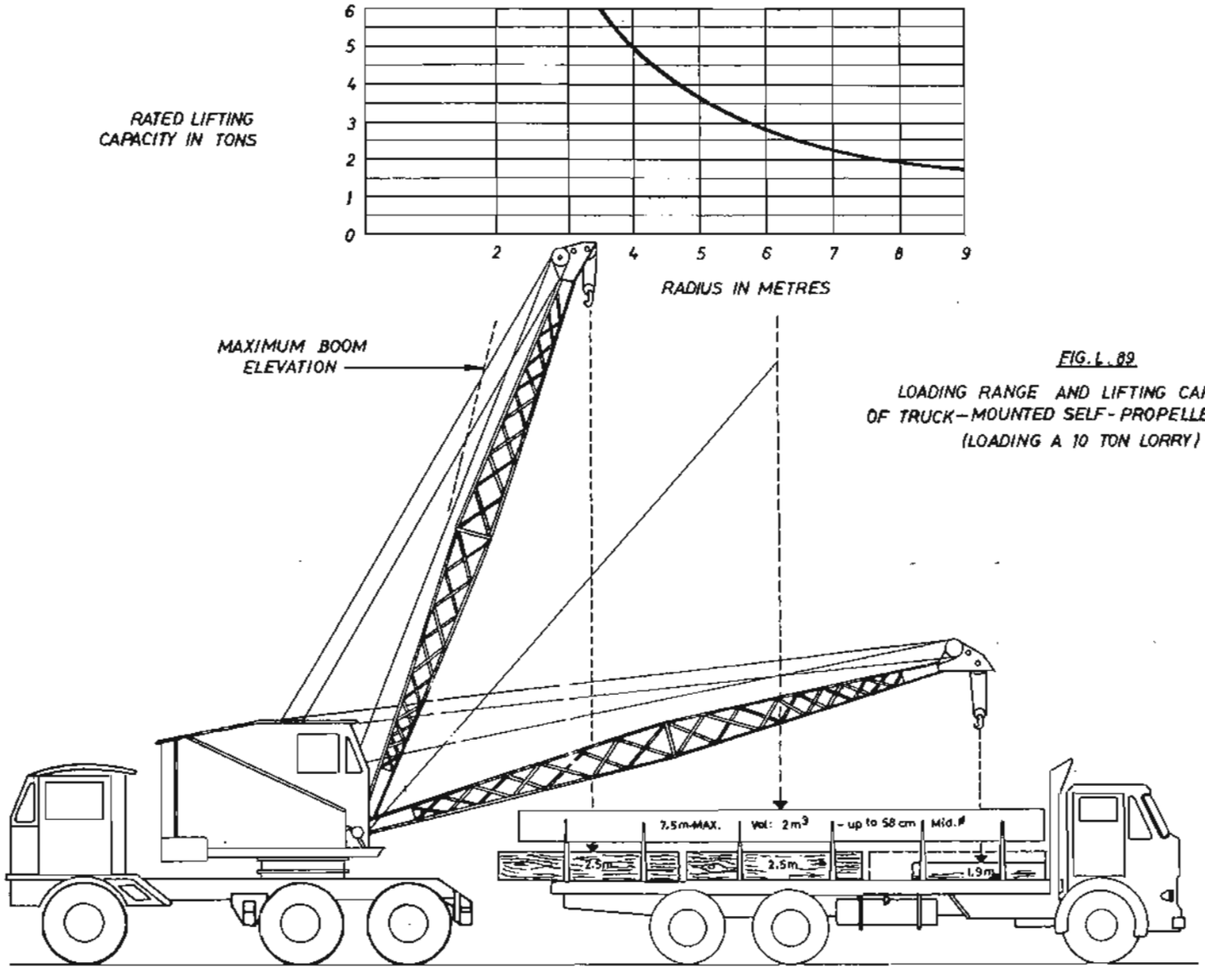


FIG. L.89

LOADING RANGE AND LIFTING CAPACITY OF TRUCK-MOUNTED SELF-PROPELLED CRANE (LOADING A 10 TON LORRY)

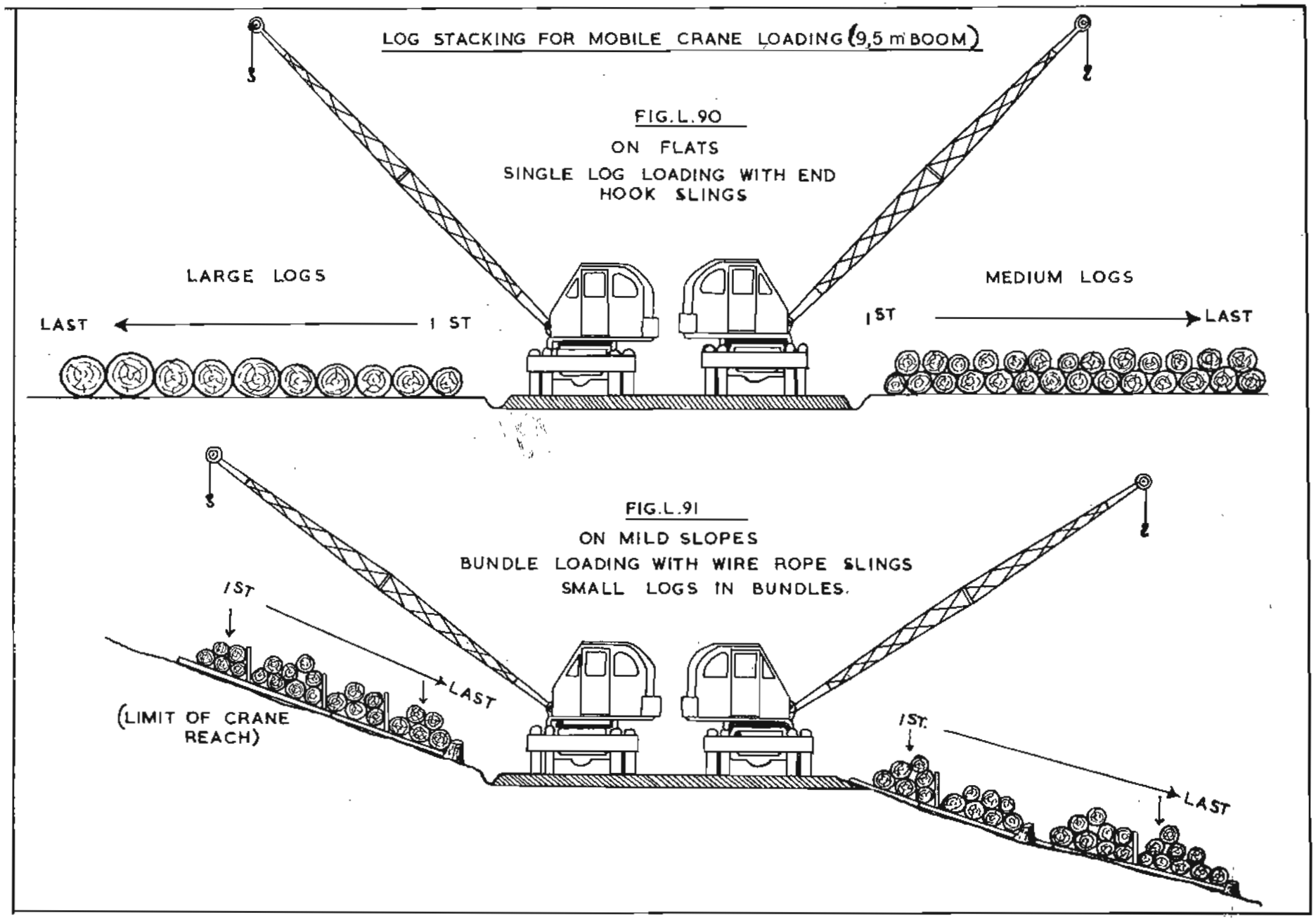
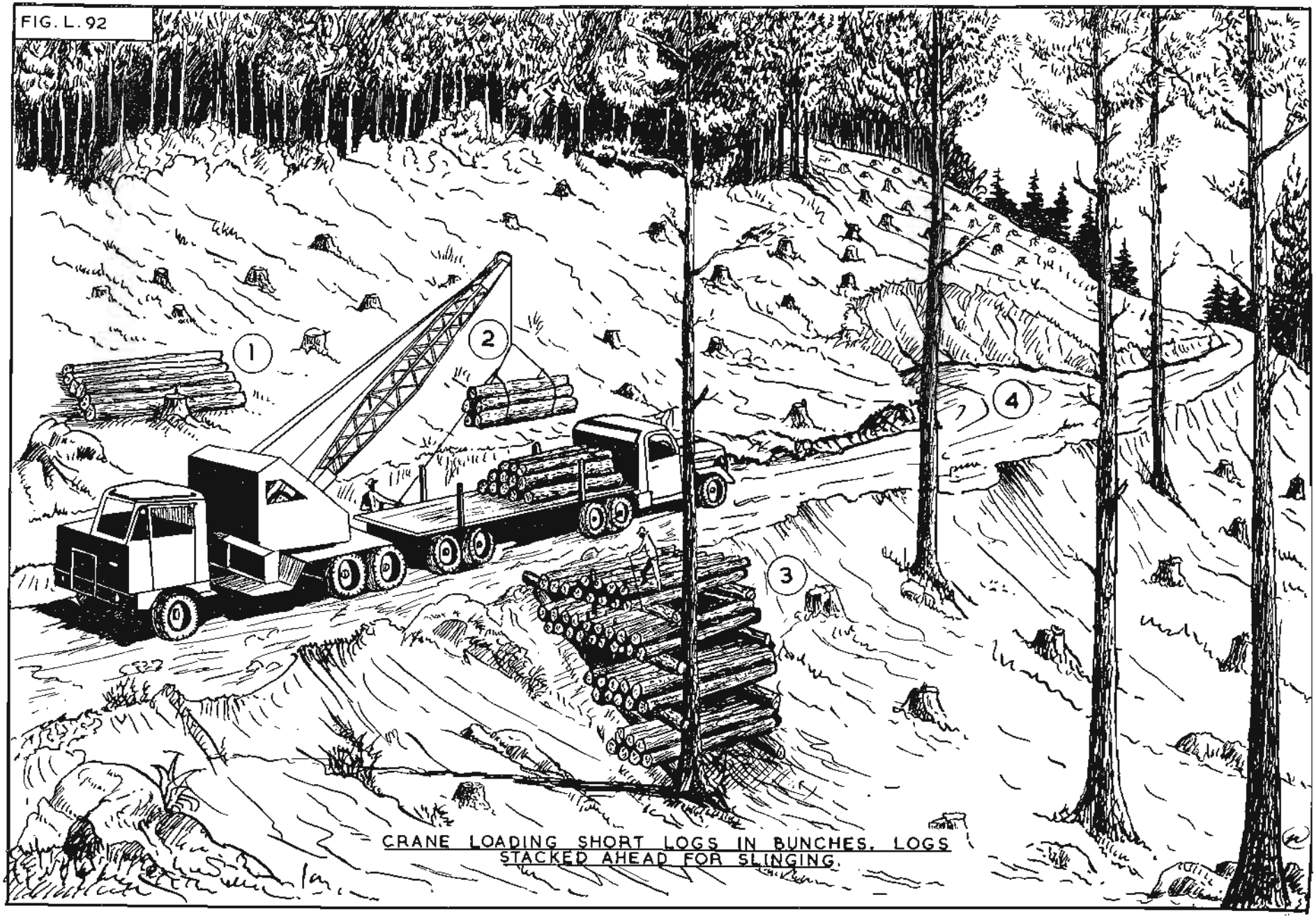

LOG STACKING FOR MOBILE CRANE LOADING (9,5 m BOOM)
FIG. L. 90
ON FLATS
SINGLE LOG LOADING WITH END HOOK SLINGS
LARGE LOGS
LAST
1 ST
MEDIUM LOGS
1ST
LAST
FIG. L. 91
ON MILD SLOPES
BUNDLE LOADING WITH WIRE ROPE SLINGS
SMALL LOGS IN BUNDLES.
1ST
LAST
(LIMIT OF CRANE REACH)
1ST.
LAST

FIG. L. 92



CRANE LOADING SHORT LOGS IN BUNCHES. LOGS STACKED AHEAD FOR SLINGING.

FIG. L.93

LOADING BY TIMBERLAND CRANE
FROM UPPER ROAD BANK.

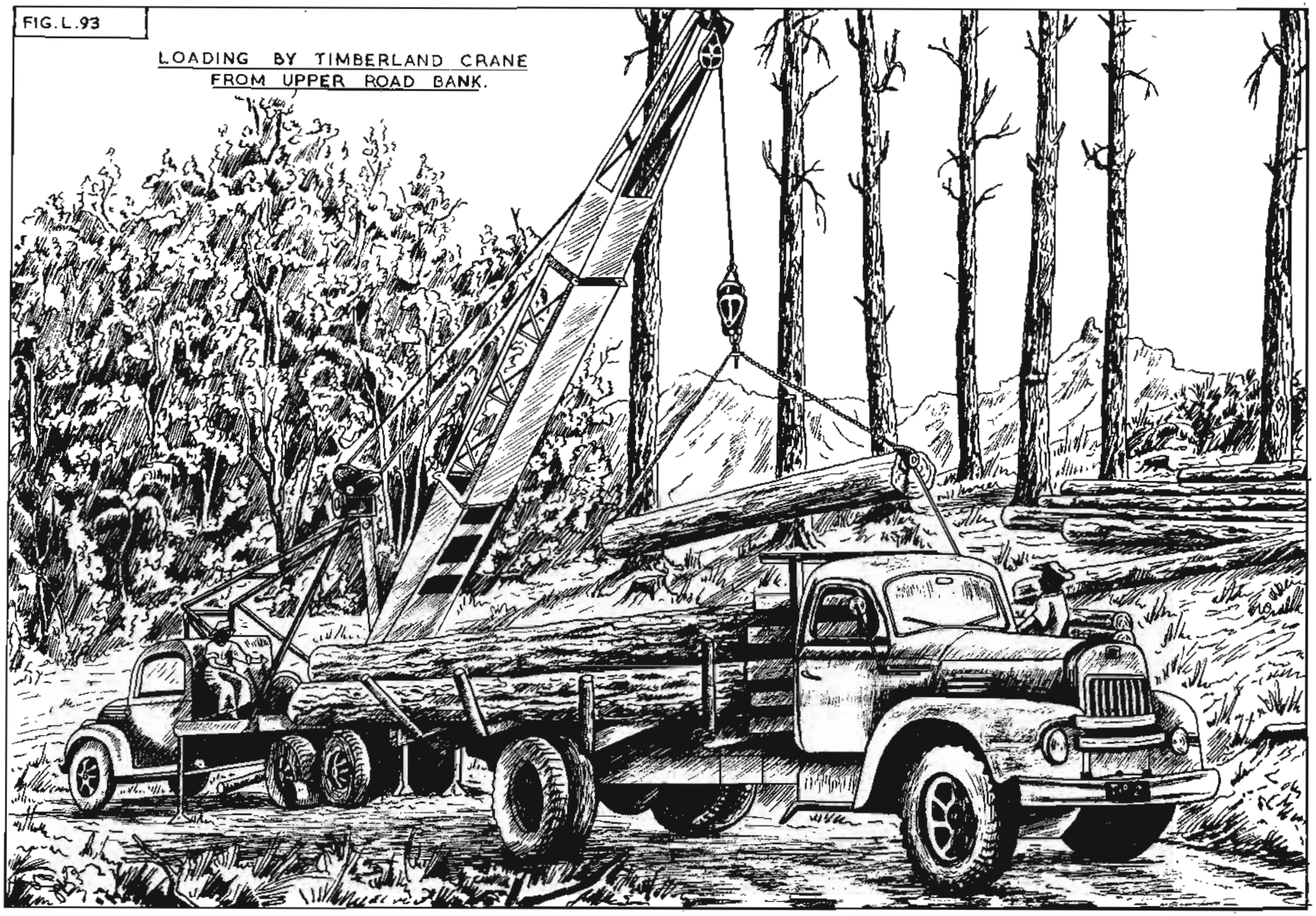
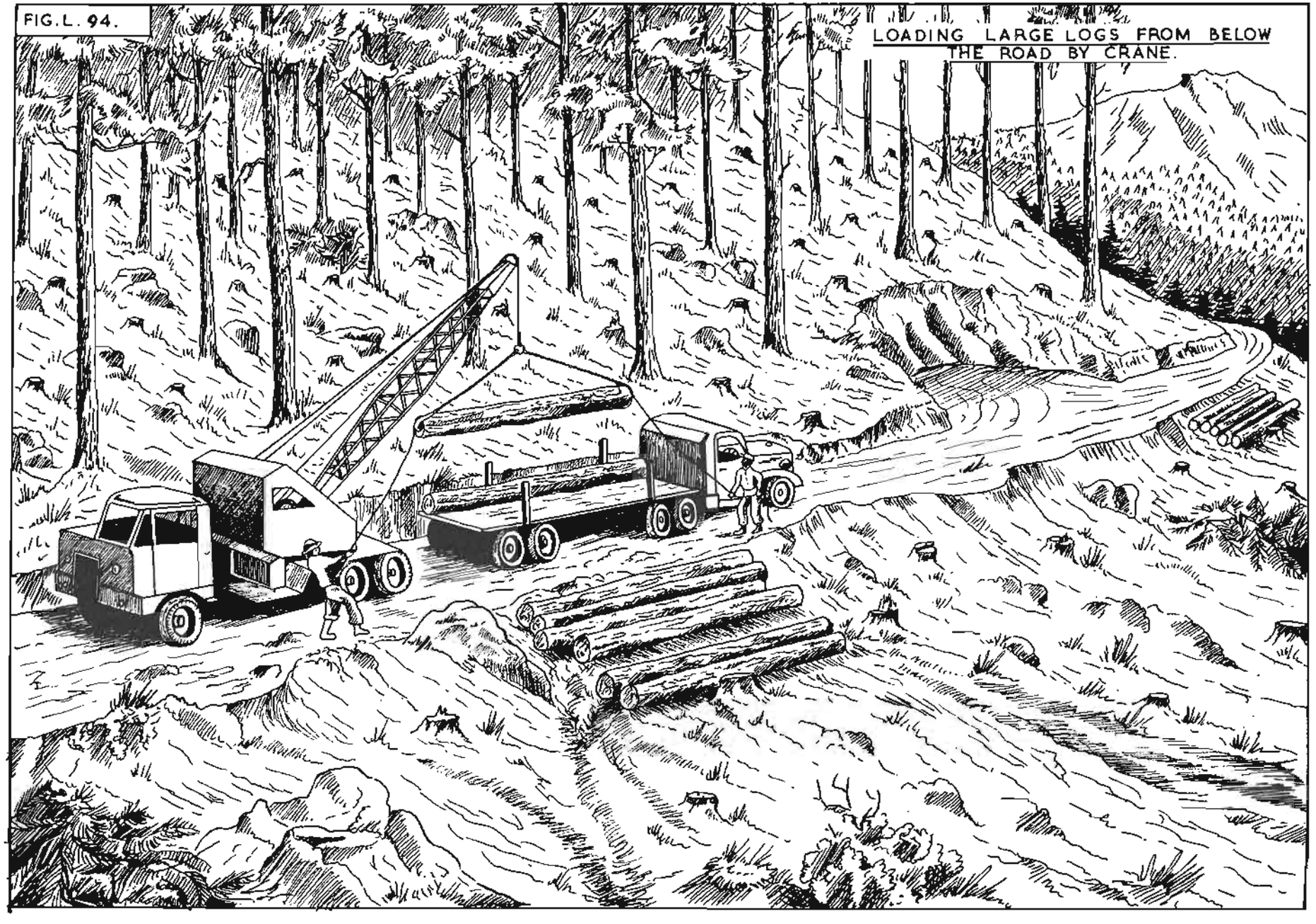


FIG. L. 94.

LOADING LARGE LOGS FROM BELOW THE ROAD BY CRANE.



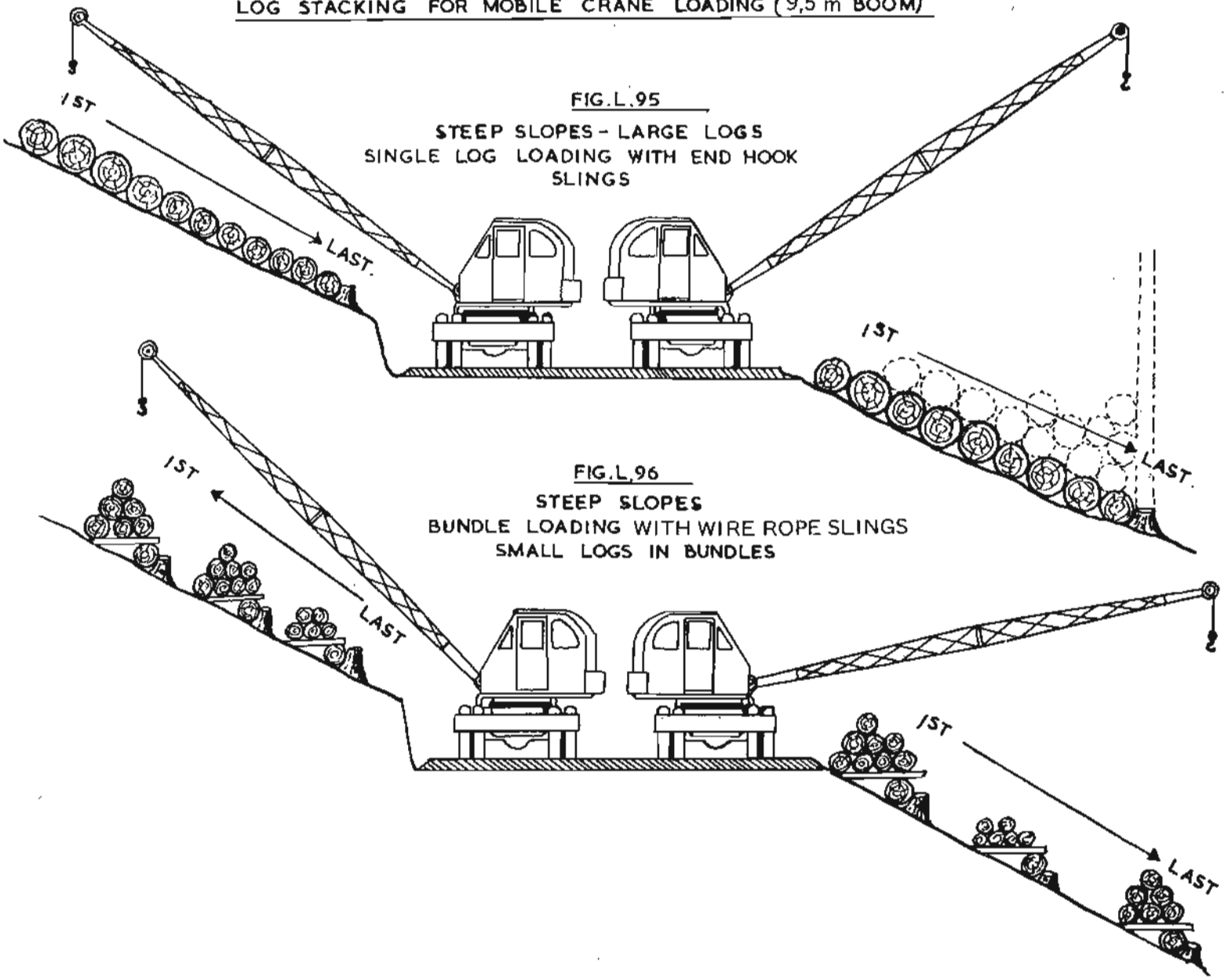


FIG.L.95

STEEP SLOPES - LARGE LOGS
SINGLE LOG LOADING WITH END HOOK SLINGS

FIG.L.96

STEEP SLOPES
BUNDLE LOADING WITH WIRE ROPE SLINGS
SMALL LOGS IN BUNDLES

All cranes have two large drums for load lines. These are the drums used for "hoist", and for operating grabs in logging.

Crane booms can be extended for high lifts by inserting standard sections in the centre of the boom. These extensions provide an increase in vertical and radial lifting range. Since the jib adds mass at the outer lifting radius and extends the working range, it has a limiting effect on lifting capacity.

Note : Two departmental cranes (wheel mounted) are available with the "goose-neck" jib extensions.

Load capacities of cranes depend on:

(1) Stability of footing

A longer or wider mounting increases relative stability on any footing. Extended outriggers improve stability.

(2) Strength of boom

Manufacturer's load ratings should not be exceeded under any circumstances. Cable condition should be checked when raising heavy loads.

(3) Counterweight

Increasing counterweights within limits increases the stability and permits the handling of loads with a greater mass within rated capacity limits.

The use of cranes in the timber industry is limited to lifting and transferring logs, poles and small size timber. Working ranges of cranes are limited horizontally for maximum lift only by the boom length. Reach below footing level is limited only by the length of the hoist cable of a suitable diameter to carry the loads involved, and the amount that can be spooled on the drum. Fig. L. 89

(b) APPLICATION

(1) Conditions under which wheel mountings are applicable

(i) Where the ability of the machine to transport itself quickly from one location to another is important.

(ii) Where ground conditions or working floor are sufficiently firm and level to permit moving and working on rubber tyres.

(2) Methods of log stacking for loading by mobile crane

Refer to Fig. L. 90 to 96.

Fig. L. 90, 91, 95 and 96 illustrate some convenient locations of log stacks for loading by mobile crane with a rotating turn-table boom. Although the drawings are self-explanatory, some important details deserve additional mention.

(i) Fig. L. 90 - Large or medium logs stacked on both flat sides of the road

- Large logs, which are difficult to pile on top of each other unless mechanical means are available, should be left side by side in a single layer. Medium sized logs may be stacked in two or more layers, but also side by side and close to each other. No cross or spacer sticks are required if loading is to be done soon after.

- Slings suspended from the crane boom line hook have a comparatively small mass and the line pays off easily from the winch drum, so there is no difficulty in pulling the slings by hand to logs located in a deep stack. This means that even logs up to 15 metres away are within reach of the crane boom. Stacks should be no higher than the labourer's neck.

Note : For both large and medium logs, chain loading slings with end loading hooks or grabs (in preference to tongs) should be used.

For large logs two-leg slings are used, single logs being loaded each time, and for medium logs four-leg slings are used, two logs being loaded each time. Fig. L. 92 shows large logs stacked on the upper slope, and Fig. L. 93 illustrates the loading of logs stacked on a mild slope above the road. Fig. L. 94 shows loading of large logs stacked on a mild slope below the road.

(ii) Fig. L. 91 - Small logs stacked on a mild slope

In order to facilitate the loading of bundled small logs with wire rope slings, logs are pre-stacked parallel to the road on cross-sticks in sling-size stacks, with vertical spacer sticks placed between them. This arrangement permits the loading slings to be quickly passed around the stacked logs. The arrows show the order of lifting and loading the bundles of stacked logs.

(iii) Fig. L. 95 - Large logs stacked on steep slopes for loading by mobile crane

- On the upper slope logs must be stacked alongside one another in one layer.

- On the lower slope they may either be stacked in a single layer; or, if a tree is available (in thinnings) as a retainer for the stack, within close proximity to the road, the logs may be stacked in a substantial pile, up to say 6 metres from the road in depth, but no higher than the labourer's neck. Logs stacked in a large pile are shown in dotted lines in the illustration.

(iv) Fig. L. 96 - Small sized logs stacked on steep slopes for mobile crane loading

The diagram of log stacking is self-explanatory.

Note : In both instances shown in Fig. L. 95 and 96, logs stacked on steep slopes should not extend beyond the horizontal reach distance of the inclined crane boom. This eliminates dragging of the load along the ground and immediate lift may be applied to the sling load. This is important from the safety point of view.

Fig. L. 92

Item 1. - Large logs stacked in a single layer on a mild slope above the road.

Item 2. - Small log loading in bundles with wire rope slings.

Item 3. - The method of stacking small logs below the road, using spacer sticks between the log layers. When the two loading slings are correctly threaded round a suitable number of logs to produce a sling load, the logs will roll together from the flat (horizontal) position into a bundle with a pear-shaped cross-section when initial lifting pressure is applied by the crane. The loaded bundle shape is ideal for disposal on the lorry deck.

Item 4. - A recess excavated in the upper bank of the road to provide a convenient turning, for reversing the lorry towards the crane when passing the crane on the narrow road is impossible.

(c) HOW TO SET UP THE CRANE ON THE JOB

As mentioned previously, the crane boom accommodates extensive use of such working tools as crane hooks, grabs, slings, etc., and in so doing permits broad application of the basic unit. For maximum effectiveness it is essential to first analyse the job to be done by determining the following job factors:

(i) Type of load.
(ii) Size and shape of load.
(iii) Location of load.
(iv) Height of lift.
(v) Radius of work zone.
(vi) Load masses interpreted into basic unit capacities.
(vii) Clearance for boom and rear end.

(1) Determining the type of load to be handled

In forestry this is simple, as loads may be either poles, logs or pulpwood, and the timber to be loaded immediately suggests what auxiliary equipment should be used, i.e. log grabs or slings for bundles of small logs; grabs, grapples, tongs or loading hooks for handling single or multiple units that are more or less regular in size and shape, such as pulp, logs, etc.

(2) Size and shape of load

This is important in determining necessary clearance. Normally, large, bulky loads require greater clearance than small concentrated loads. Load interference with the boom must be avoided, as this could cause boom failure.

(3) Location of the load

Location of the load relative to its ultimate position, and whether there will be any likely repetitive loads, has a direct and important bearing on positioning the basic unit and the boom length required.

(4) Height of lift dimension

Height of lift dimension is also necessary to determine the length of the boom and position of the basic unit.

(5) Load mass

Load mass should be determined, as it has a direct bearing on the capacity of the basic unit. Footing for cranes in lifting position must be considered since ratings are established for solid, level footing.

(d) HELPFUL HINTS FOR EFFECTIVE CRANE OPERATION

(1) Where repetitive lifting is involved, the crane should be positioned for the shortest possible swing cycle, to reduce cycle time. For lifts with a great mass, crane should be positioned to lift over end of mounting, where it has maximum lift capacity.

(2) Crane footing should be checked carefully before lifting capacity or near capacity loads.

(3) All overhead obstruction should be inspected carefully before moving a crane or starting lifting operations. Power wires should be located so as to avoid contact with the boom, hoist cable, boom supporting rigging, or A-frame.

(4) In attaching loads, a secure hitch must be made and lift started only when all helpers are in the clear.

(5) Operators should swing the crane slowly enough to avoid outward throw of load and overswing when the machine stops. A tag line can be attached to loads to control outward swing of the load.

(6) Loads should be placed on solid footings, that have no tendency to overbalance, before helpers release the hitch.

(7) In figuring height of lift, the block, hook and any sling slack between hook and load must be included. It takes less time to check clearances and position than to lift and try then reposition and try again. Besides, it is safer.

(8) Organise work for minimum travel time. All needed lifts possible in one area should be completed before moving to another location.

(9) Derricking lengthens the cycle and should be avoided as much as possible on repetitive cycles.

(10) With truck cranes, outriggers should be securely set before undertaking any near capacity loads. Footings under jacks must be level and solid.

(11) Jerky operations on crane work should be avoided. It is hard on the cable and also dangerous.

(12) Adding an extension jib to the boom increases the working range both vertically and horizontally, but materially decreases lifting capacity.

(13) With a given boom length, the steeper the working angle, the shorter the working radius. The nearer the boom moves to the vertical, the greater the loss in radius for each degree of increase of boom angle.

(14) Level operating footing avoids up or downhill swinging. It requires less power, is faster and safer.

(15) When moving a load with a great mass from a high position, to be lowered to a lower position, it is of prime importance that adequate length of hoist cable is ensured to enable block travel to the lowest point.

(e) COMMONLY ACCEPTED RULES FOR POSITIONING THE BASIC UNIT

Regardless of the handling tool being used in conjunction with the crane, the following basic factors should always be considered when positioning the basic unit.

(1) The unit should always be on a firm ground from which to work, to ensure proper stability.

(2) The boom should always have proper clearance with both the load being handled, and the vehicle to be loaded.

(3) The crane should be so positioned that working tools and loads do not have to be handled above the heads of workmen, or over equipment.

(4) The load to be lifted should be determined, remembering that the loads with a greater mass should be handled slower as they involve greater safety precautions.

(5) The load should be handled at the shortest radius, always keeping in mind the boom length, height of lift and boom clearance at all points in the swing cycle. On repetitive lifting, more than usual precaution should be exercised in determining clearance, to eliminate necessity for raising and lowering the boom on each cycle.

J. JOB MANAGEMENT CONDITIONS AFFECTING PRODUCTION

There are two sets of factors on every job which have a great deal to do with the output of equipment used. They are the job factor and the management factor.

Job factors are physical conditions pertaining to a specific job which affect the production rate, and are the following:

(1) Topography and volume of work.

(2) Surface and weather conditions.

(3) Specific requirements, such as loading logs in various lengths, etc.

Management factors include:

(1) Selection, training and supervision of men.

(2) Selection, care and maintenance of equipment.

(3) Planning, laying out the job, supervising and coordinating the operations.

K. LOADING AND HAULING TIMBER

Logging is a team operation with the following sequence: timber skidding - loading - hauling (by truck). Each operation will consequently affect the others.

Skidding may affect loading operations in two ways: insufficient timber may be delivered at the roadside due to insufficient skidding units, or too much timber may be delivered at the loading landings. The latter may occur due to crane breakdowns or hauling difficulties. Where too little timber is available the loading operation may have to be halted, and in the second case loading costs will rise as logs will have to be piled high in stacks. This may in turn cause skidding operations to be temporarily suspended or transferred.

Loading delays may be caused by the following factors:

(1) Shortage of trucks over increased haulage distances.

(2) Breakdown of trucks.

Note : If stand-by units are available both of the above cases could be remedied.

(3) Crane breakdown may cause delays in the loading operation, unless the crane is replaced or hand-loading is resorted to.

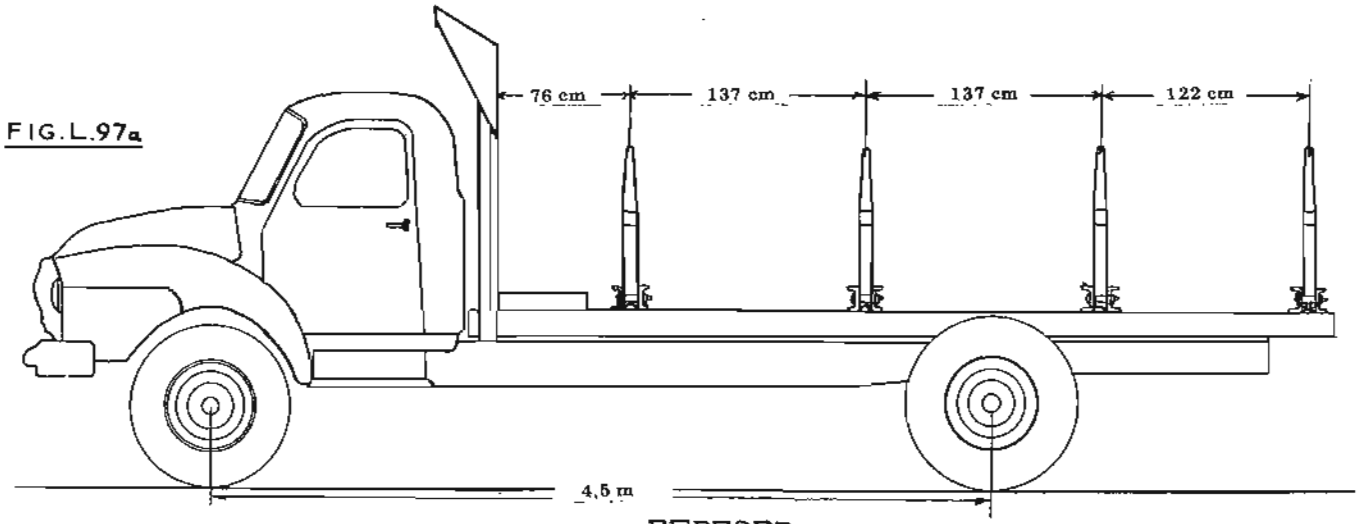
In view of the above it is important that attention be given to the part played by the hauling units.

The capacity of the hauling fleet should be based on the field performance required for the operation under consideration. A shortage of haulage units slows down the operation, while production increases with the use of an optimum fleet. The use of larger trucks simplifies job synchronisation.

Departmental conditions are such that the standard self-propelled cranes have a much higher loading capacity than the volume of timber actually available, so cranes can always cope with the loading quota required for the lorries available during at most 3 working hours daily. Crane idle time can, however, be cut down where organisation is flexible and the crane can be diverted at the right time to the right spot. For example, there is a belief that timber from clearfelled areas has priority for loading due to an accumulation of large size logs, yet when the daily loading quota of logs from clearfellings has been loaded, the crane may, under favourable conditions, be diverted to load logs from thinnings and thus speed up operations in adjoining compartments or plantations. Such an operation must, however, have been foreseen and planned.

It is important to notice that the number of lorries for timber hauling is reduced when cranes are employed for loading, due to increased loading output when compared to slower loading by other means. This economy does not affect the department, however, as lorries are hired from the Government Garage at a "per-kilometre" tariff and there is no strict limit to the number of lorries available. For this reason it is immaterial to the department how many lorries are employed, and it is advantageous to have more trucks on hand for the immediate replacement of breakdown units.

FIG.L.97a

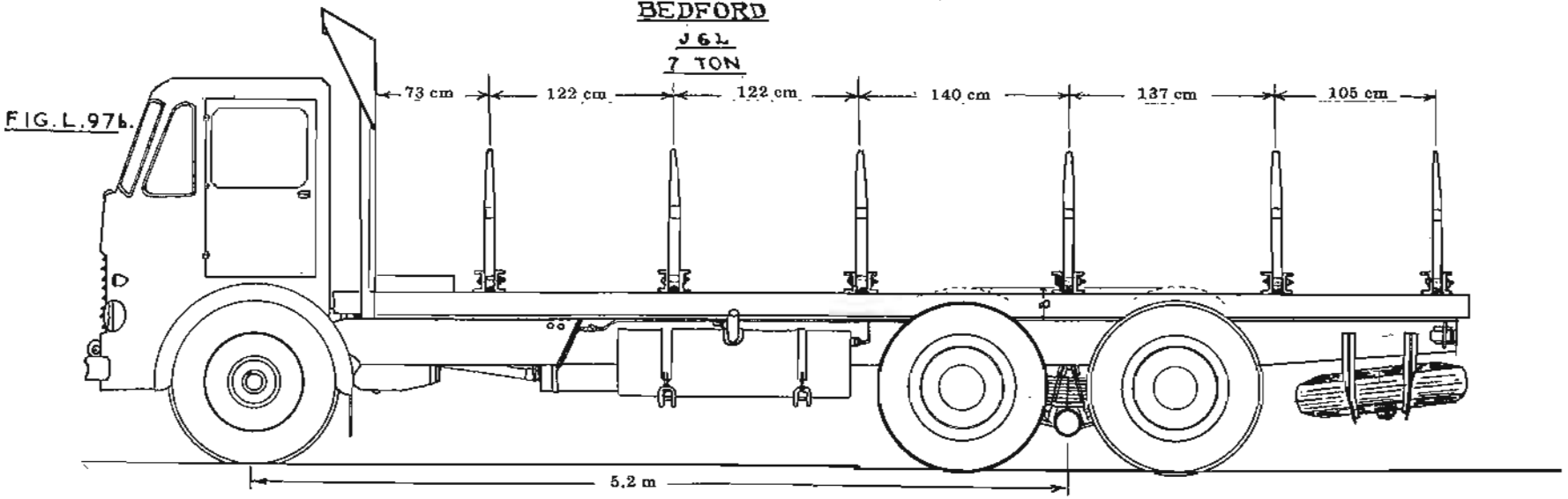


BEDFORD

J6L

7 TON

FIG.L.97b.



LEYLAND

19-H 7AE 'HIPPO' CHASSIS

10 TON

SPACING OF STANCHIONS ON 7 AND 10 TON TRUCKS

Note : Government Garage regulations require that lorries must be employed for not less than 650 km per month.

An operation with a small fleet of trucks requires more stand-by units, by comparison, than an operation with a large fleet, to maintain a steady output. For every five trucks in operation one stand-by unit is regarded as normal, which is the case for the majority of departmental operations in mature plantations.

(a) TYPE OF HAULING UNITS

The types of hauling units adopted for timber transportation are as follows:

(1) Seven to eight ton carrying capacity petrol-driven trucks with log bunks up to 5 metres long.

(2) Ten ton carrying capacity diesel-driven trucks with log bunks of up to 7 metres long.

(3) Seven to ten ton carrying capacity semi-trailer units with carrying lengths extending to 12 metres.

In order to obtain the maximum and safest load capacity, stanchions are provided on hauling units. Fig. L. 97 shows the bunk length and stanchion arrangements for 7 to 10 ton lorries. The following are additional information and specifications relating to the truck hauling units employed.

(i) Two and three axle units used.
(ii) Dual or single wheels used on rear axles.
(iii) Single wheels on front axles.
(iv) Two-rear-wheel or four-rear-wheel drives.
(v) Only rear, or front and rear driven.
(vi) Front wheel steering.

(b) HAUL DISTANCE

When selecting hauling units and the number of units to be employed, the following factors must be considered:

(1) Length of the haul
(2) Speed range of the hauling units
(3) Relation between power and load mass
(4) Grades encountered on both the loaded and empty cycles
(5) Rolling resistance of haul road
(6) Turning time
(7) Time for adjusting to the log stack and crane position
(8) Loading time
(9) Off-loading time
(10) Road scheme plan along which operations will proceed

It is generally accepted that trucks of moderate size are more suitable for short distances, as they are more manoeuvrable and faster on forestry roads. They can also negotiate sharp curves and steep gradients with more ease, and a shortage of one truck in a fleet is not so acutely felt, while in small fleets a shortage of one unit will only cause a short delay. On the other hand, large units have distinct advantages on long hauls, apart from economy in the timber hauling cost, as larger units mean simplification of management problems, fewer men and trucks to supervise and synchronise, fewer units to repair and less spare parts to keep in stock.

(c) SYNCHRONISATION OF TIMBER-HAULING FLEET

If an ample volume of timber is available for loading, and daily delivery is not restricted, consideration should be given to the synchronisation of the hauling fleet so as to enable the crane to load to its maximum output capacity. Numerous problems must, however, be solved before this can be achieved.

(1) Co-operation between drivers, as they have to provide a steady flow of hauling units arriving at the crane at the correct intervals. The crane operator must in turn co-operate to load the lorries to the best of his ability.

(2) Starting all trucks simultaneously in the morning and after the lunch break, and breaking at the same time for lunch and at the end of the day will obviously not contribute to the success of a synchronised operation.

If truck drivers or crane operators slow down to adjust spacing and avoid bottle-necks, the operation may outwardly appear smooth and orderly, but the production problem remains unsolved as the rate of loading will still not attain maximum output. The solution to the problem lies in maintaining an even spacing of trucks operating at a reasonable speed. If this process starts to break down, steps should be taken to remedy the situation as soon as possible. Below are some factors which may disrupt the synchronised process, and ways of remedying the faults:

(1) Faulty truck: Exchange the truck for a stand-by unit, and have the maintenance section check, repair or adjust the faulty vehicle.

(2) Fast driver: Admonish the driver, or dismiss him if he will not follow orders. Excess speed throws the hauling fleet out of order, is unsafe and hard on equipment and causes delays.

(3) Slow unloading: Arrange for a side-tilt approach at the landing deck.

(4) Truck stuck in the mud: Pull the truck out of the mud and have the haul road improved by the correct maintenance.

(5) No trucks at the crane: The crane operator should stack logs at the roadside, correctly positioning them with their thick ends in the travel direction so as to speed up loading when the trucks arrive in a bunch, as will inevitably occur.

(6) General suggestions:

(i) Insist on co-ordination so that truck drivers and crane operator work as a team.

(ii) When correcting faulty spacing caused by truck breakdown, speed up the loading unit rather than slow down haul units.

(iii) An incentive system will help, especially in bonus form for volume delivered over the quota, with the whole team participating.

(d) EFFICIENCY OF TIMBER LOADING

The full occupation of the timber crane, and loading to full lifting capacity, may be considered as the most efficient operating cycle. This will only be possible when a hauling unit is constantly available at the crane for loading. In logging an ideal operating cycle will be impossible to achieve for the following reasons:

(1) Logs are not of a standard size and only the occasional log is of the full crane capacity.

(2) Hauling distances are usually long and it is difficult to perfectly synchronise the rotation of trucks, as their positioning in relation to the crane takes time, as also is the case when moving from stack to stack.

(3) Departmental conditions are such that there will seldom be sufficient timber available for the full-time occupation of the crane.

To determine loading time it is necessary to consider two factors; active loading time and travel time.

(1) Active loading time

Active loading time is the time the truck is in position for loading. The average time of the "lifting cycle" of the crane multiplied by the number of timber loads on the truck gives the loading time per truck.

A single lifting cycle consists of:

(i) Slinging or hooking the logs.
(ii) Lifting.
(iii) Slewing with the logs towards the truck.
(iv) Depositing the load on the truck log bunk.
(v) Releasing the slings or hooks from the logs.
(vi) Slewing the boom back to the stack for hooking the next load.
(vii) Lowering the slings or hook for the next load.
(viii) Delays.

Note : Loading time may also include the occasional movement from stack to stack and the adjustment of the lorry to the crane position, and possibly also time for adjusting the boom angle.

Below are actual times for a crane log loading cycle split into the elements of the loading cycle listed above.

A two-leg loading hook chain assembly with two tag lines was used, with two men operating the tag lines. The crane had a 3 ton lifting capacity at a 2,4 metres radius, and was equipped with a 9 metres rotating boom. Logs were stacked close to the road. The crane was positioned behind the loaded truck. A boom swing arc of 60° had to be used.

		Remarks
(i) Hooking	- 4 sec.	
(ii) Lifting	- 6 sec.	
(iii) Slewing	- 5 sec.	The data were based on 6 observations, and no delays occurred during the observations
(iv) Depositing load	- 3, 5 sec.	
(v) Releasing	- 3 sec.	
(vi) Slewing	- 3 sec.	
(vii) Dropping slings	- 2 sec.	
Total	$26\frac{1}{2}$ sec.	

Note : Data of a full return loading cycle observed on a total of 15 cycles (not split) revealed an average time of 24 seconds per cycle.

Under identical conditions:

(i) A crane of 6 ton lifting capacity was observed to have an average loading cycle time of 28 seconds.

(ii) A crane of 8 ton lifting capacity loaded 18 logs, approximately 8,5 m^3 in total volume ($\pm$10 tons), in 4 minutes, completing 16 cycles at an average of 15 seconds per cycle.

Note : The first two cranes mentioned above were petrol-driven and the third was diesel-driven.

(iii) An hydraulically-operated crane of 7 ton lifting capacity, performed a job similar to that described in (ii) above during a loading time of 7 minutes, loading a similar lorry.

The number of single crane cycles depends on the log volume and the method of loading (single logs, if large enough; two logs at a time, if of medium size; bundles, if logs are small). If logs are short they require double stacking on the lorry log bunk. The total loading time when the truck is under the crane boom depends on the size of the truck, the size of the crane and crane cycle time, the size of logs and the method of loading.

General formula for loading time:

Loading time = crane cycles to load the truck x average crane loading cycle in minutes.

This formula is not fully applicable to the timber crane, as the volume of a load per cycle is not always constant.

(2) Determination of travel time

The second important time factor is the "travel cycle", i.e. the truck travelling time from the time it leaves the crane to the unloading area and back to the crane for another load. The necessary data for the determination of the travel cycle are provided for several types of hauling units by the manufacturers of such units. There are many factors affecting the travel cycle, such as the type of truck, its range of travel speeds, its grade-ability, its tractive effect, etc., and, of course, the condition of the road over which it travels.

(3) Determining the maximum number of hauling units to serve the crane

If conditions of timber delivery are such that the crane may be kept continually occupied, then sufficient hauling units must be available so that

there is always a truck being loaded under the crane boom. A sufficient number of trucks must, therefore, be available in operation to keep the crane busy until the first truck returns to the crane, its time for the return trip being equal to the "travel cycle". If the travel cycle time is divided by the loading time, it will indicate the number of trucks required to serve the crane during the time that the first truck is completing its travel cycle and returning to the crane. The number of trucks required during the first cycle period can be calculated by the formula:

$$\frac{\text{travel cycle}}{\text{loading time}} = \text{number of trucks}$$

To this number must be added one, for the first truck travelling on its first cycle, giving the maximum number of trucks required to keep the crane fully occupied. When "loading time" exceeds the "travel cycle", the first truck will be back before the second truck has been loaded, or if the first truck is back well before the last truck has been loaded, it will indicate that the number of trucks exceeds requirements.

(e) GENERAL NOTE AND SUMMARY REMARKS

Unfortunately for the timber hauling operation, the crane size is selected according to the size of the largest logs, too few of which are available for loading to give the crane a constant capacity load. The daily volume quota supplied by the majority of plantations is well below the full loading capacity of departmental self-propelled carrier-mounted cranes, and the full capacity operation of the crane in a single plantation is, with few exceptions, impossible.

The greatest improvement can be achieved if the loading is organised so that the crane can serve two plantations together. Some operational improvement can also be achieved if timber from both thinnings and clearfellings is loaded, if log loading from the latter is completed early in the day.

It has been observed that cranes occupied in log loading in clearfelled compartments are often idle due to a lack of trucks and the small daily volume quota available for truck loading from these compartments. Loading can be intensified by the employment of more trucks to complete the operation as soon as possible, after which the crane can be diverted to compartments where thinning operations are being carried out, if the daily delivery quota so permits.

Loading in fellings and thinnings can be adjusted daily or weekly, adjustments also occurring between plantations where the daily timber quota in each plantation does not justify the full occupation of the crane, but logs are large and difficult to load.

With the introduction of 10 ton lorries, experience has shown that hand labour is incapable of loading such lorries to capacity due to the height of the load, so crane employment for loading has become increasingly necessary. The use of the self-loading lorry apparatus of suitable lifting capacity may solve the problem of loading large logs.

L. OUTPUT AND COST DATA FOR DEPARTMENTAL TIMBER LOADING BY CRANE

Quoting: Direct or fixed costs - the same meaning.
Indirect or operating costs - the same meaning.
Crane: 5-6 ton lifting capacity on 2,4 m radius, loading 21 m^3 per working hour in plantation conditions.

	R
(a) Purchase costs with delivery	7 800
Chassis costs with delivery	4 000
Spare parts and repairs	5 900
Transport (S.A.)	300
	18 000

Depreciation per working hour: R18 000 ÷ 10 000 hours ..... R1,80 .. (A)

(b) Fuel and lubricant per working hour

Fuel - petrol, litre - 4,0	@	5,5c	= 22c
Engine oil, litre - 0,036	@	28c	= 1c
Grease, kg - 0,001	@	43c	= 0,04c
Total fuel and lubricant hour			23c

..... R0,23 .. (B)

(c) Auxiliary equipment - Estimated costs

Wire rope: 13 mm x 60 m	12,00
Sling chain, with hooks 9 mm	26,00
Sling wire, with hooks 12 mm x 3 m	7,00
Tag lines, hemp rope, 16 mm x 10 m	2,00
Sister hooks - 2 only	1,50
Loading tongs, 45 cm	6,00
Total auxiliary equipment	54,50

Depreciation per working hour: R54,00 ÷ 1 000 hours ..... R0,05c .. (C)

(A) + (B) + (C) = Total machine operating cost per working hour R2,05

(d) Labour (operating crew) : Daily wages

Operator	R5,00
Labourers 3 @ 70c	R2,10
Total	R7,10

3 hours working per day: R7,10 ÷ 3 = R2,37 ..... R2,37
Total cost per hour: machine and labour R4,42

(e) Overhead charges, per cent of capital

R4,42 @ 30% = R1,33

Total cost: R4,42 + R1,33 = R5,75
R5,75 ÷ 21 m^3 = 27c per m^3

DATA AVAILABLE FOR A SIMILAR CRANE FOR 3 YEAR PERIOD

(i) During the period - 1966 working hours
(ii) Total volume loaded - 40 300 m^3
(iii) Volume of timber loaded per working hour - 20,4 m^3

1. Fixed costs (Direct costs)

(iv)	Purchase cost (total - second hand)	R6 300
(v)	Depreciation	R1 541
(vi)	Interest	R 786
	Total fixed costs	R2 327.. R2 327 .. (A)

2. Variable costs (Indirect or operating costs)

(vii)	Spares, repairs, maintenance	R 424
(viii)	Fuel, lubricant	R 844
(ix)	Operator's wages	R2 048
(x)	Labour	R1 566
	Total variable costs (items 7 to 10)	R4 882.. R4 882 .. (B)
	Total cost (A) + (B) for period	R7 209
	Cost per hour: R3, 66	
	Cost per m^3 17,9c	

Note: No insurance and overhead charges are included in the above costs. Departmental charges for the renting of crane: R4, 39 per hour

M. LOGGING SAFETY

(a) LOADING BY CRANE

(1) Conditions of lines, blocks and equipment shall conform to the requirements of relevant safety codes.

(2) The crane should be brought to the loading site, set up safely for work and supported on outriggers, if available.

(3) The main loading crane cable and stay back cables should be of the size selected by the manufacturer of the unit.

(4) The crane jib should be inspected every day before the unit starts work; apart from this the operator must examine the boom for possible damage every time it is accidentally struck by the load.

(5) If there is any doubt about the safe use of the crane boom, the case should be reported to the local officer in charge.

(6) The mass of the load should never be more than the manufacturer's specified safe lifting capacity for the unit.

(7) The position of the boom should be adjusted (lifted or lowered) to the length of the loaded logs to prevent bumping of the jib by the load, but not over the safety lifting margin.

(8) Jib and fall blocks, weights and fastenings shall be made secure and frequently inspected.

(9) Loading slings, chains, tongs and spreader bars should be of the correct size and be securely attached to the loading line, and the use of the hook without the safety catch should be prohibited.

(10) Ends of lines attached to drums shall be securely fastened. Not less than two wraps of line should be maintained on drums at all times.

(11) Logs should be securely hooked or choked before lifting.

(12) To prevent the load from swinging, tag lines should be used.

(13) A tool handle, stick, or similar object shall be used to guide lines onto drums if necessary. Guiding lines by hand is prohibited.

(b) WORKMEN

(14) Workmen shall stay away from running lines and swinging choker slings. Workmen shall stay on their feet until load is on the lorry.

(15) Care shall be taken in working around logs which are propped up, or show a tendency to roll. Men in charge shall carefully watch for such hazards when looking over the work area.

(16) In approaching or working around hang-ups, workmen shall watch carefully for the danger of logs rolling or sliding, or tops falling.

(17) Beware of standing on or near anything which may be moved or pulled by the log being loaded.

(c) OPERATORS

(18) Operators shall thoroughly examine all their equipment each day before starting work. All repairs and adjustments necessary for safe operation shall be made before any strain is placed upon the equipment.

(19) Engines shall be started and operated only by experienced men.

(20) Petrol and diesel oil shall be handled and stored in closed containers.

(21) Engines and other equipment shall not be refueled while running.

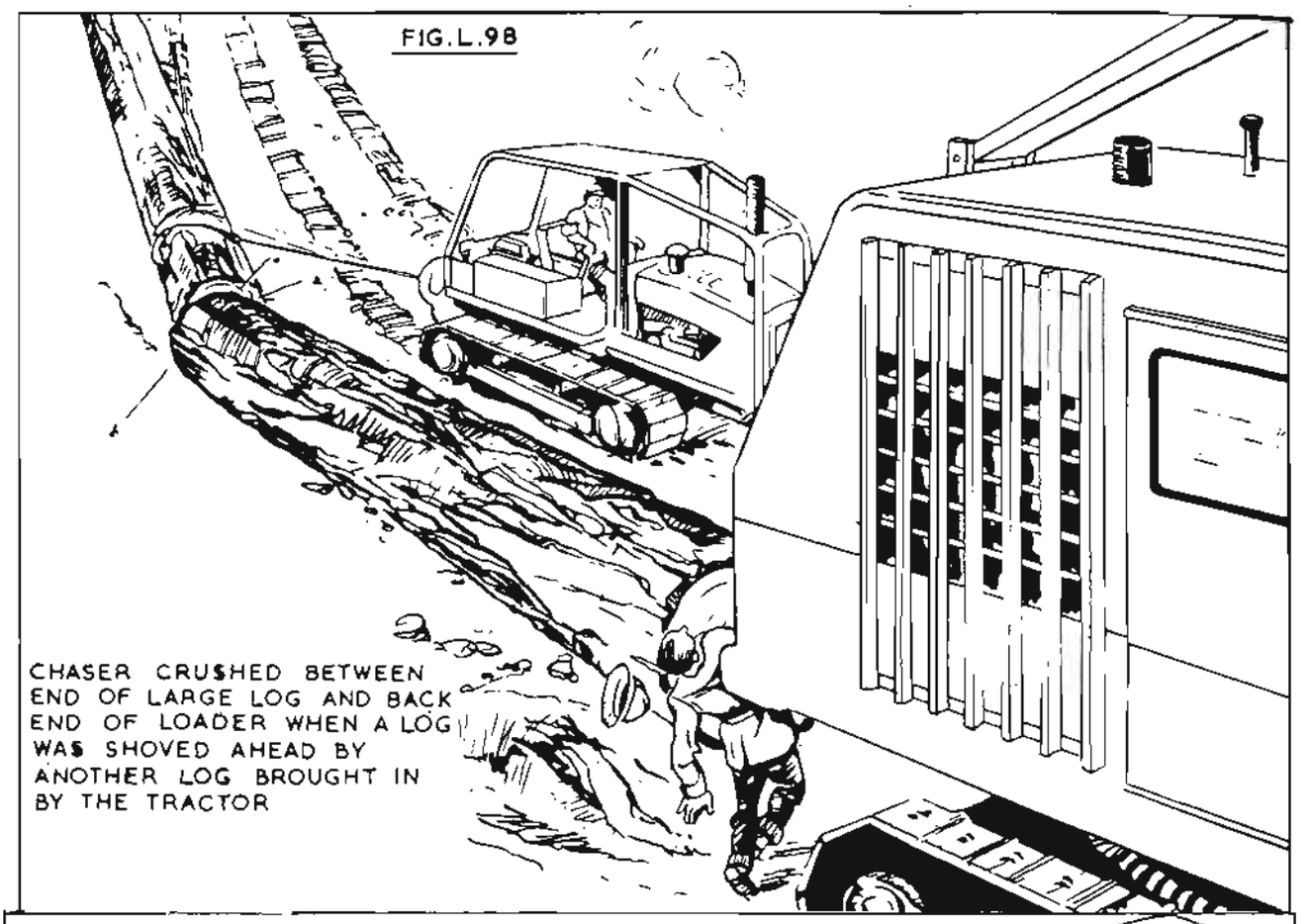
(22) Smoking when refueling is prohibited.

(23) Loading operators shall have an unobstructed view of the landing and the trucks being loaded.

(24) Loading operators shall be experienced men. The safety of the loading crew depends very largely upon the expert handling of loading machines. Talking to the operator while he is handling levers is absolutely forbidden.

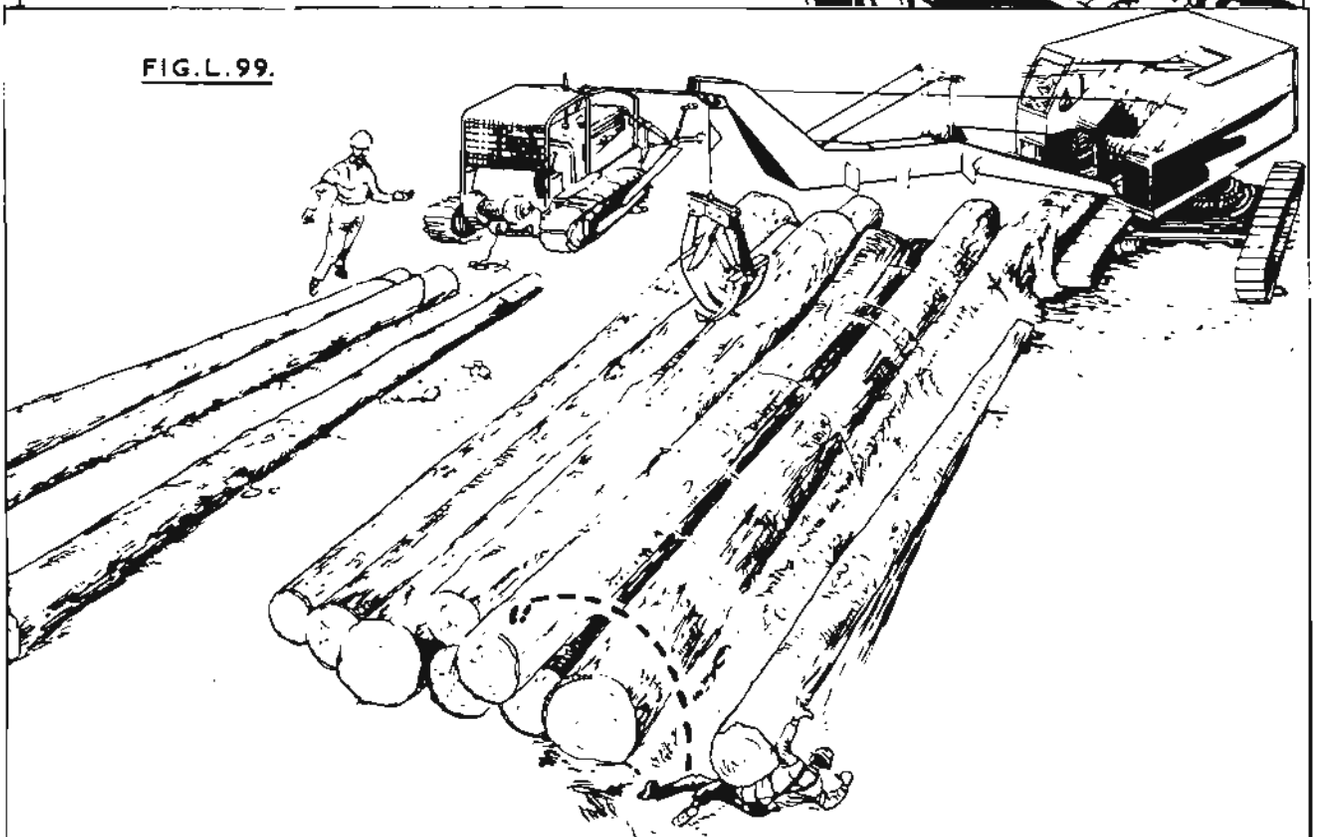
(25) All members of the crew should be supplied with safety helmets and leather gloves with protected palms. A first aid kit should be available on the spot.

FIG.L.98



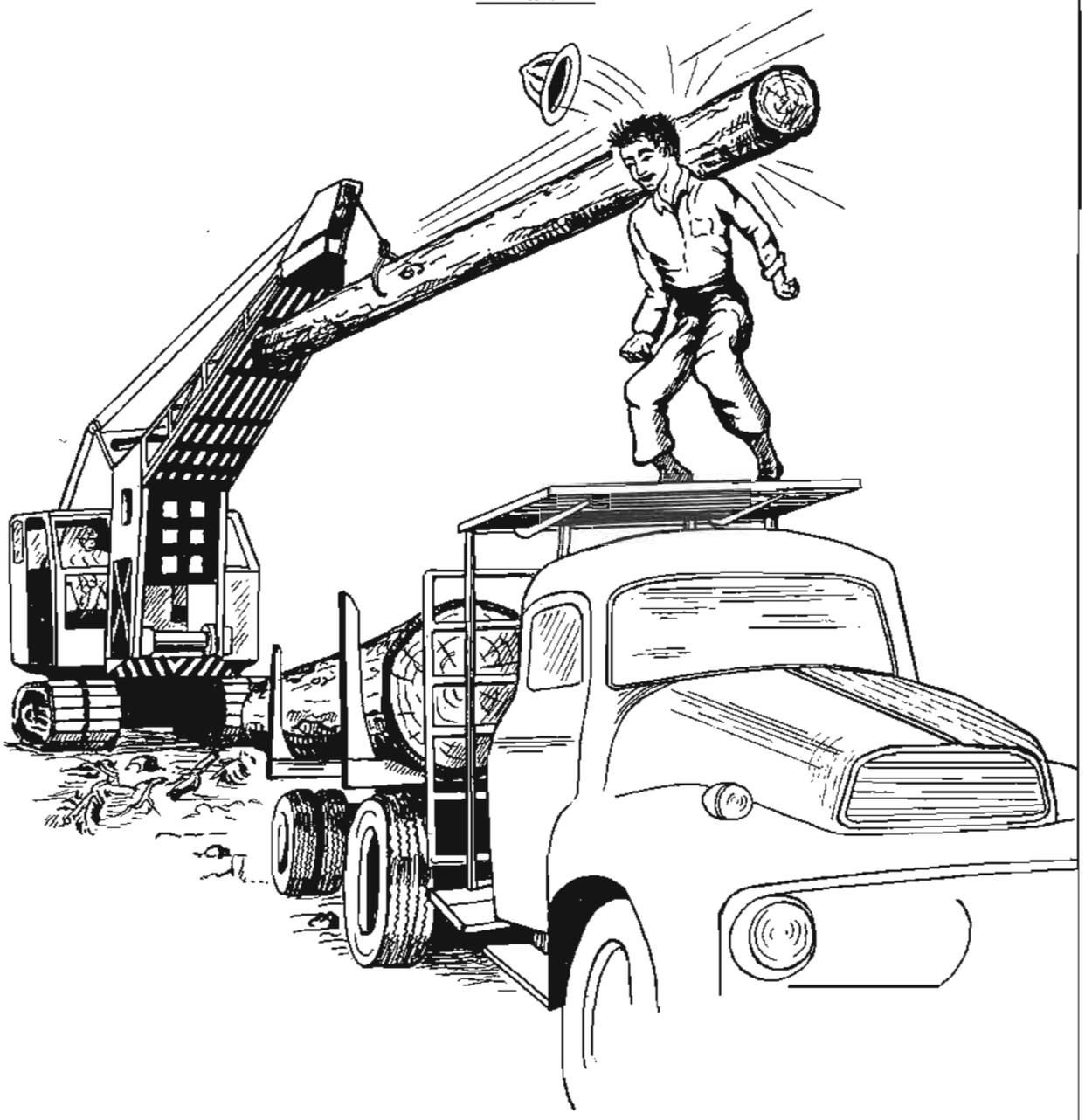
CHASER CRUSHED BETWEEN END OF LARGE LOG AND BACK END OF LOADER WHEN A LOG WAS SHOVED AHEAD BY ANOTHER LOG BROUGHT IN BY THE TRACTOR

FIG.L.99.



A CROSS-CUTTER AT THE LANDING DECK WAS KILLED WHEN THE LOG ON WHICH HE WAS STANDING ROLLED, THROWING HIM OFF BALANCE AND INTO THE PATH OF THE SAME LOG, WHICH STRUCK HIM.

FIG. L.100



THE SECOND LOADER WAS KILLED WHEN HE WAS STRUCK ON THE HEAD AND NECK AND KNOCKED FROM THE CAB PLATFORM BY A 10 METRE LOG, 25,4 cm IN DIAMETER, THAT WAS BEING LOADED

(d) LANDINGS

(26) Landing for loading logs shall be prepared and arranged to provide maximum safety for all employees.

(27) Logs should not be loaded until all workmen (apart from the loading crew), tractors or animal skidding teams are in the clear.

(e) BROW LOGS

(28) Sufficient brow logs, blocking or equivalent, shall be installed to prevent logs from rolling into the road or against trucks.

(f) LOADING LOGS

(29) Head of loading crew shall be an experienced man and physically active.

(30) Men with physical handicaps should not be subjected to the hazards of this position.

(31) Loaders shall stand in the clear while logs are being hoisted, or while logs or loads are being shifted or swung towards trucks.

(32) Logs on motor trucks shall be loaded so that not more than one third of the mass of any log extends beyond the trailer bunk. Thick ends of the logs should be located towards the driver's cab.

(33) Logs shall not be lowered to the bunk while bunk or blocking adjustments are being made or until the man making these adjustments is in the clear.

(34) Care shall be taken to properly balance the load on the centre plates of truck and trailer.

(35) Logs shall be well situated without crowding, so that there will be no excessive strain on the binder or bunk chains.

(36) Stacking at the log deck for loading should be such that it will prevent accidental rolling, with damage to the crew and vehicles.

(g) MOVING LOGS

(37) When logs are delivered to the close vicinity of the crane at the loading site, all possible safety precautions should be undertaken to prevent accidents.

(38) Logs should not be swung over workmen.

(39) Riding on logs suspended in the air or being moved on the landing is prohibited.

(h) TONGS - HOOKS

(40) In carrying loading tongs, they shall not be rested on both shoulders with points around the neck. When there is a danger of loading tongs or hooks pulling out of logs, loading slings or straps should be used instead.

(41) Tongs may be used on large logs, provided the logs are barked and notched sufficiently to provide a secure hold.

(42) The use of plain spiked end hooks, without a bell, is prohibited. Loading hooks shall be kept in good repair and equipped with tag lines at all times.

(i) FATAL ACCIDENTS IN LOGGING (LOADING)

The material in this section is published by courtesy of the Oregon Industrial Safety Commission of the U.S.A., and depicts actual accidents which occurred during log loading operations.

Fig. L. 98. - Unhooker crushed between log and loader

The unhooker was instantly killed when he was crushed between the end of a large log and the back end of the loading machine, when the log was shoved ahead by another log that was being brought onto the landing by tractor.

Preventive measures

(i) Move logs to a position where they will not be shoved forward by incoming turns of logs.

(ii) Train workmen to stay in the clear as logs are being brought in to the landing.

Fig. L. 99. - Cross-cutter killed by rolling log at log landing

The cross-cutter at the landing deck was killed when a log on which he was standing suddenly rolled, throwing him off balance and into the path of the same log, which struck him.

Preventive measures

(i) Workmen should be required to stay in the clear of operations where they are not assigned to work.

(ii) If cross-cutting is done at the landing deck, cross-cutting and loading operations should not be carried out simultaneously at the same deck, unless safety precautions have been taken.

(iii) Stay in the clear of logs that show a tendency to roll.

Fig. L. 100. - Second loader fatally injured when struck by a swinging log

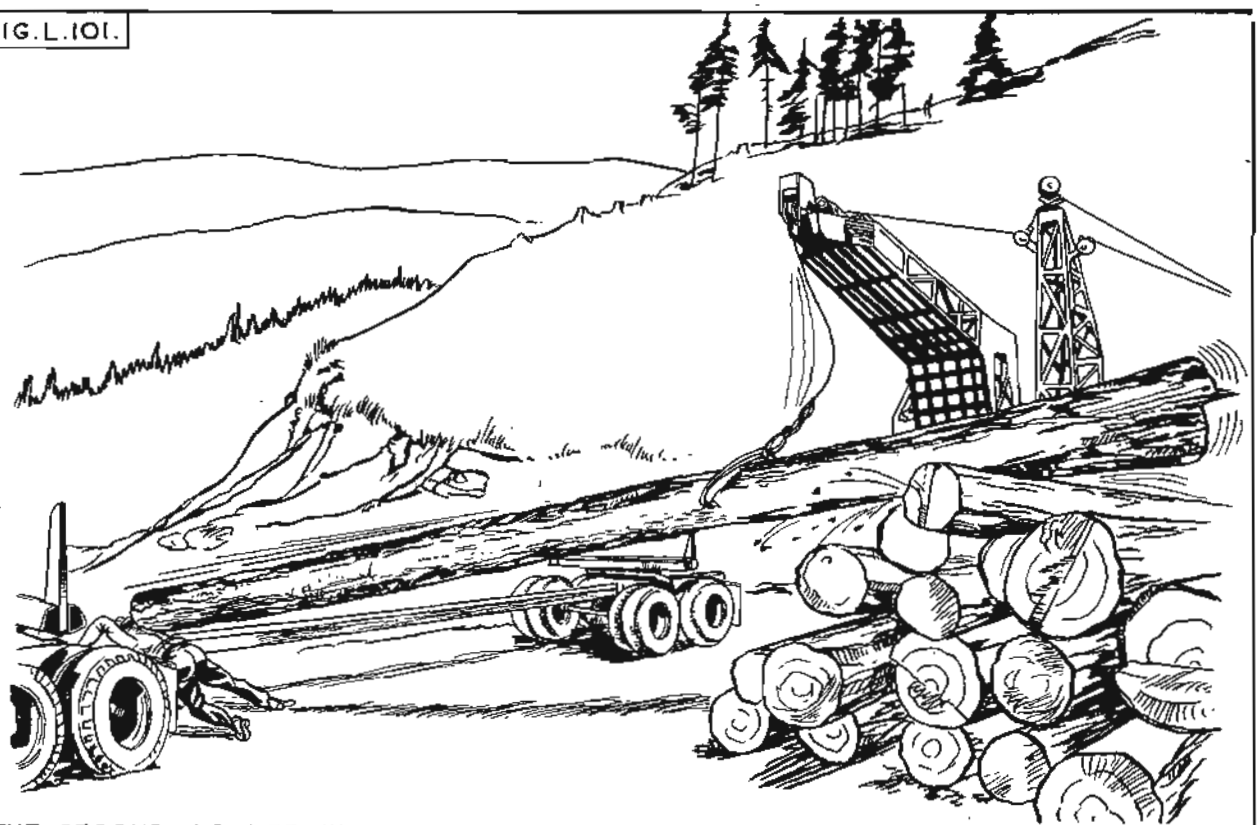
A truck driver, acting as second loader, died about two hours later from injuries received when he was struck on the head and neck and knocked from the cab platform by a 10 m log, 25 cm in diameter, that was being loaded.

Preventive measures

(i) Only experienced men should assist with loading operations.

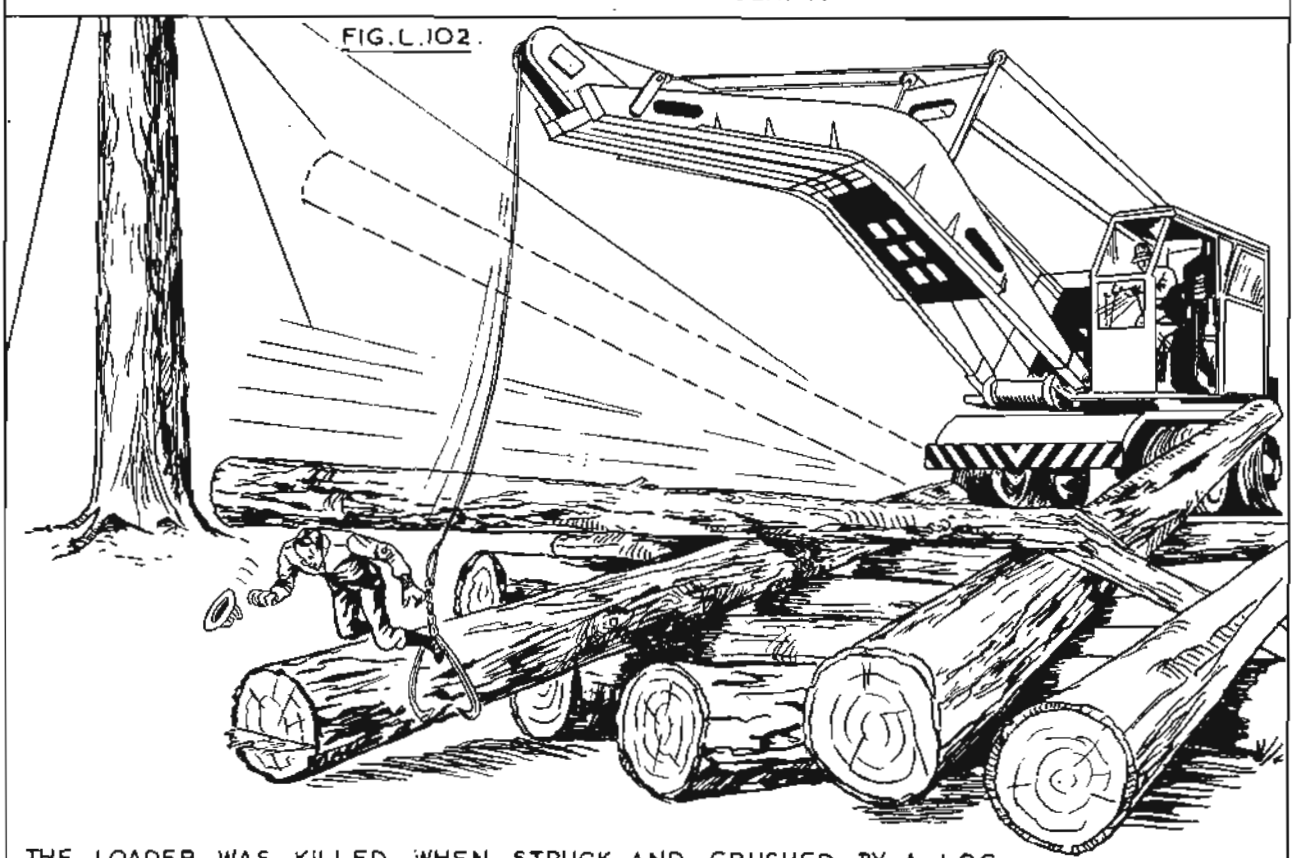
(ii) If there is a danger of a loaded log extending over the cab platform, then the loader should get into the clear.

FIG.L.101.



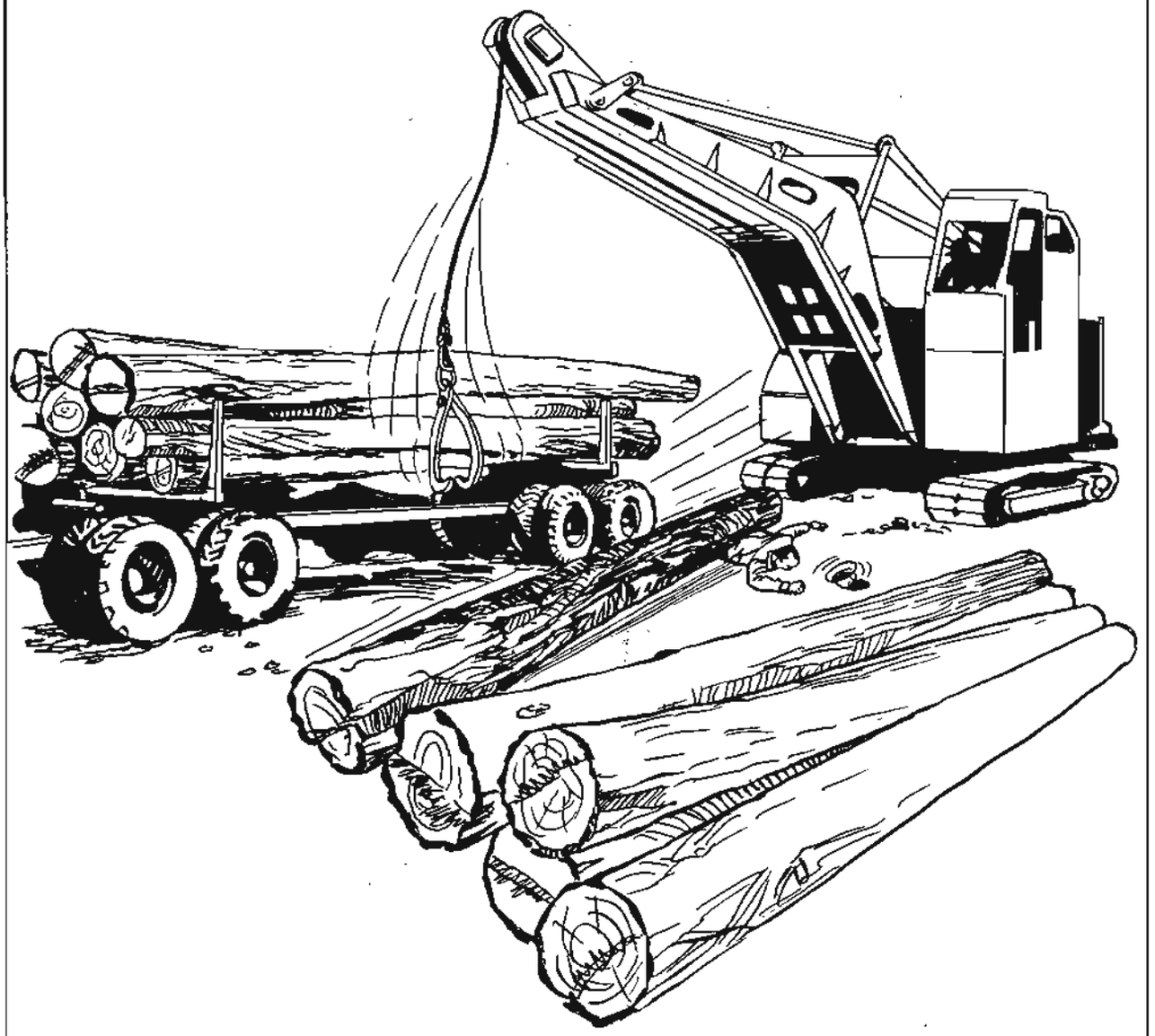
THE SECOND LOADER WAS CRUSHED AGAINST THE TRAILER OF A LOG TRUCK BY A LOG THAT SLID AS IT WAS BEING TURNED END FOR END ON THE LANDING. THE SECOND LOADER WAS TIGHTENING THE REACH CLAMP.

FIG.L.102.



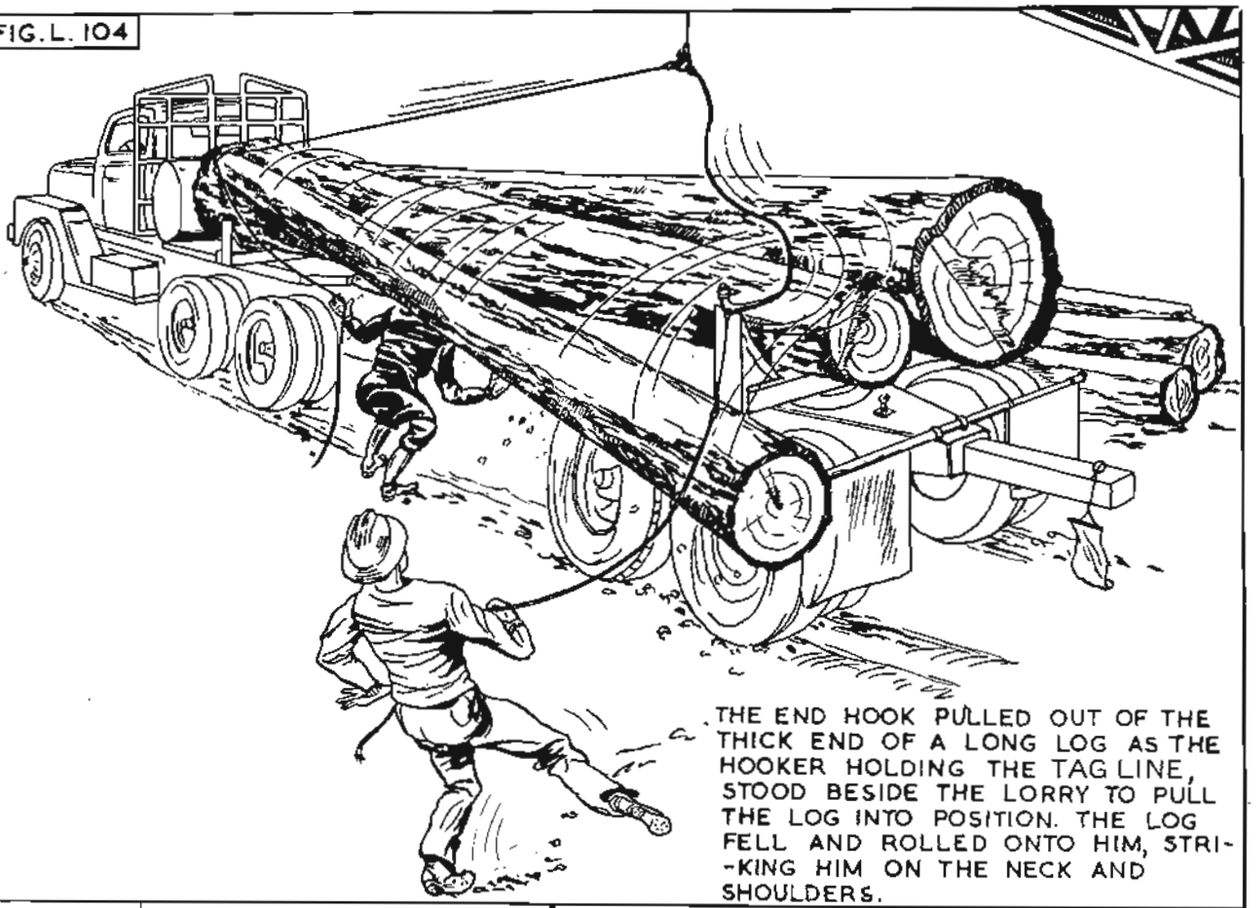
THE LOADER WAS KILLED WHEN STRUCK AND CRUSHED BY A LOG THAT BROKE AND FELL ON HIM AS HE WAS TRYING TO SORT OUT A BADLY CROSSED UP PILE OF LOGS.

FIG. L. 103



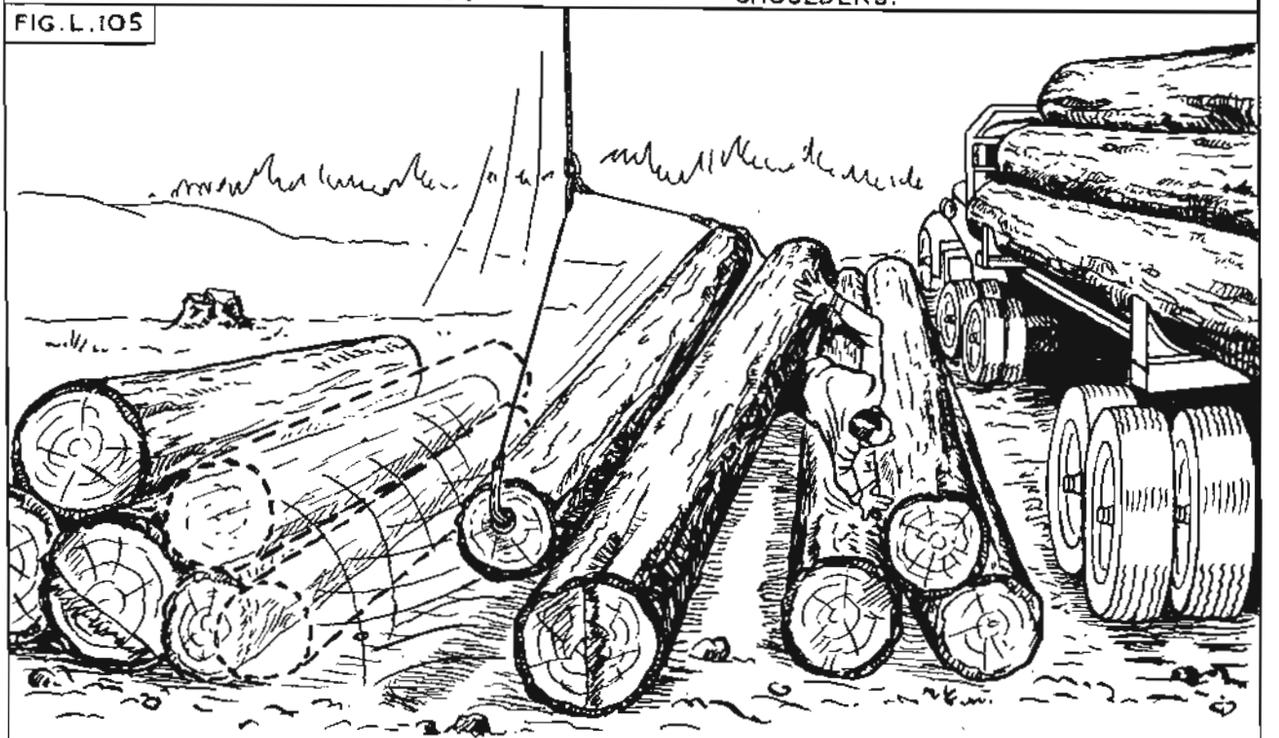
THE LOADER DIED AS A RESULT OF INJURIES RECEIVED WHEN HE WAS STRUCK BY A SMALL LOG THAT SLIPPED FROM A TONG AS HE WALKED UNDER IT.

FIG. L. 104



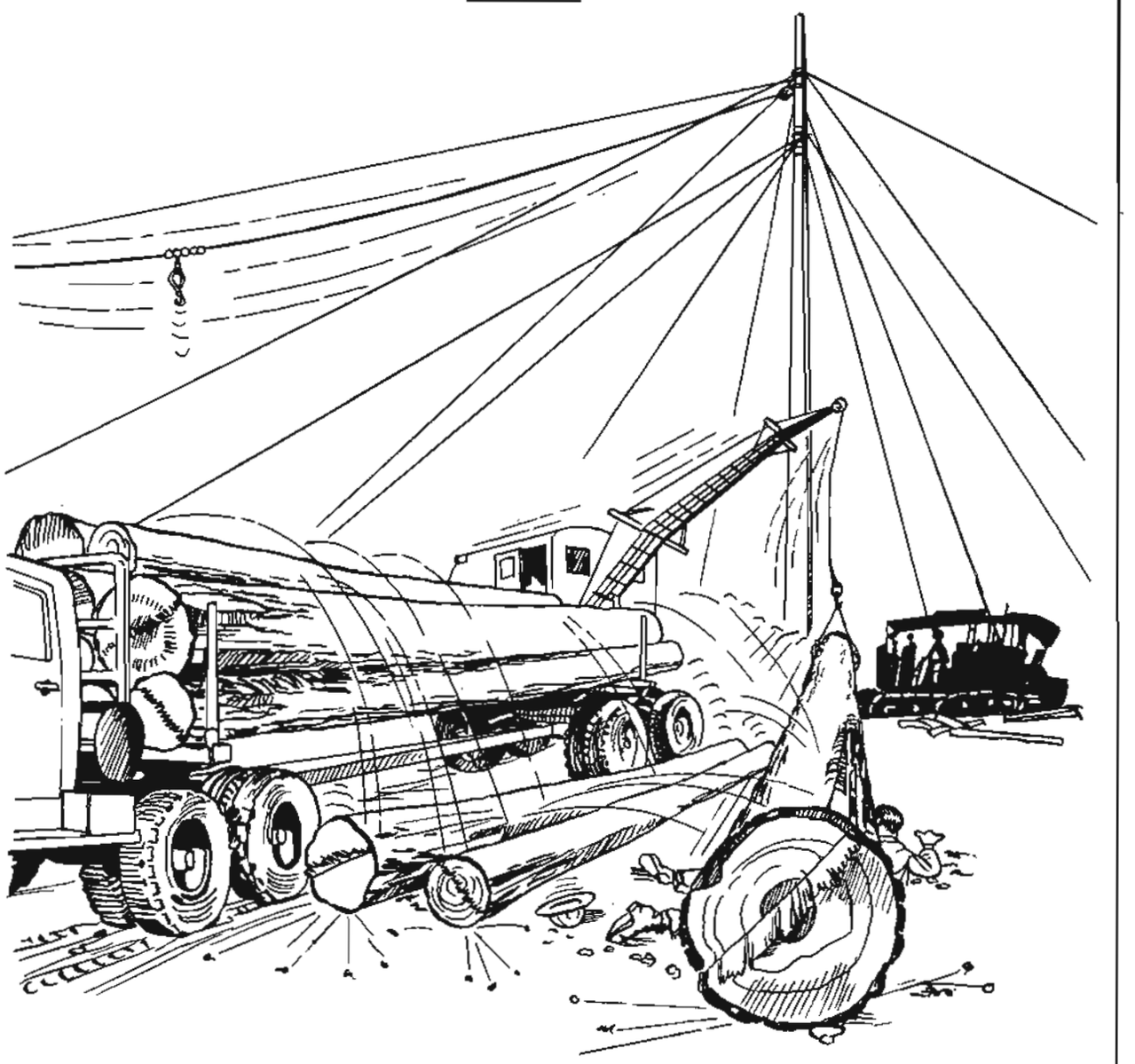
THE END HOOK PULLED OUT OF THE THICK END OF A LONG LOG AS THE HOOKER HOLDING THE TAG LINE, STOOD BESIDE THE LORRY TO PULL THE LOG INTO POSITION. THE LOG FELL AND ROLLED ONTO HIM, STRI-KING HIM ON THE NECK AND SHOULDERS.

FIG. L. 105



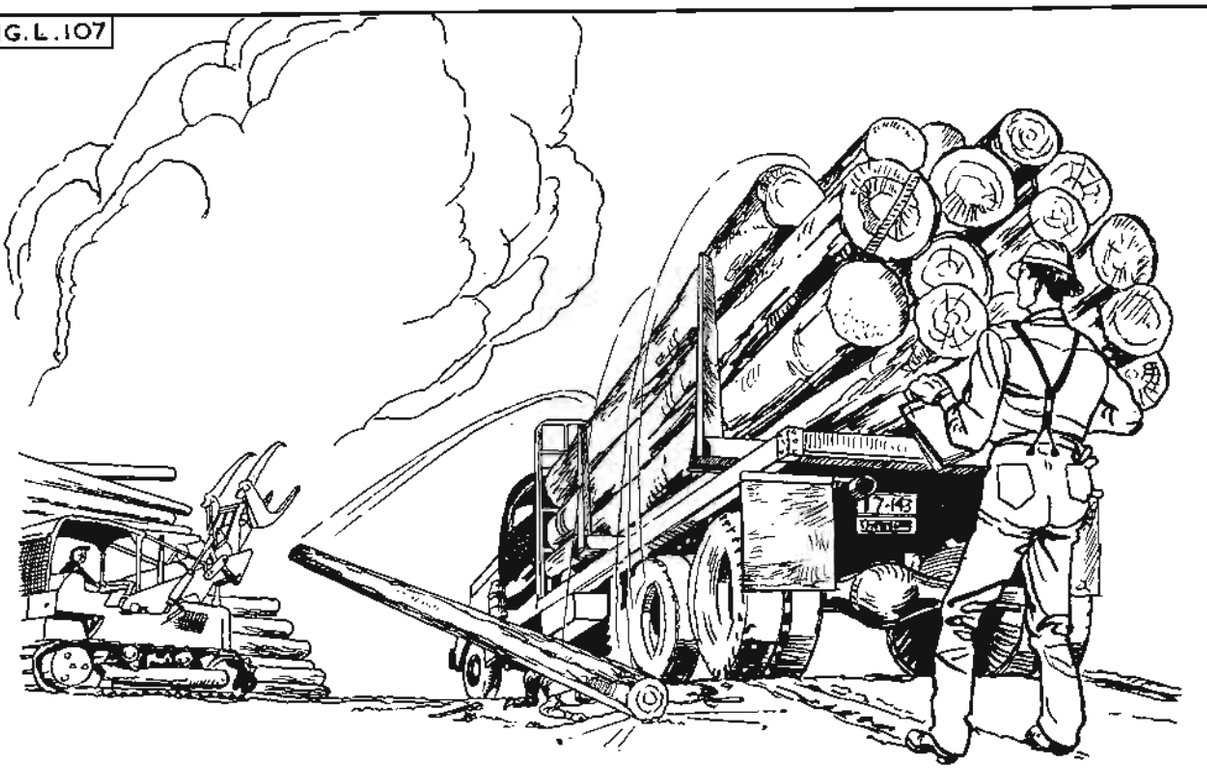
A LOADER WAS CRUSHED BY A LOG ROLLING FROM THE DECK AS HE STOOD BESIDE A LOG INTO WHICH HE HAD SET HIS END HOOK. A SLIGHT STRAIN ON THE LOAD-ING LINE MOVED THE HOOKED LOG, DISLODGING A SECOND LOG FROM THE PILE, WHICH CRUSHED HIM AGAINST THE FRONT LOGS.

FIG.L.106



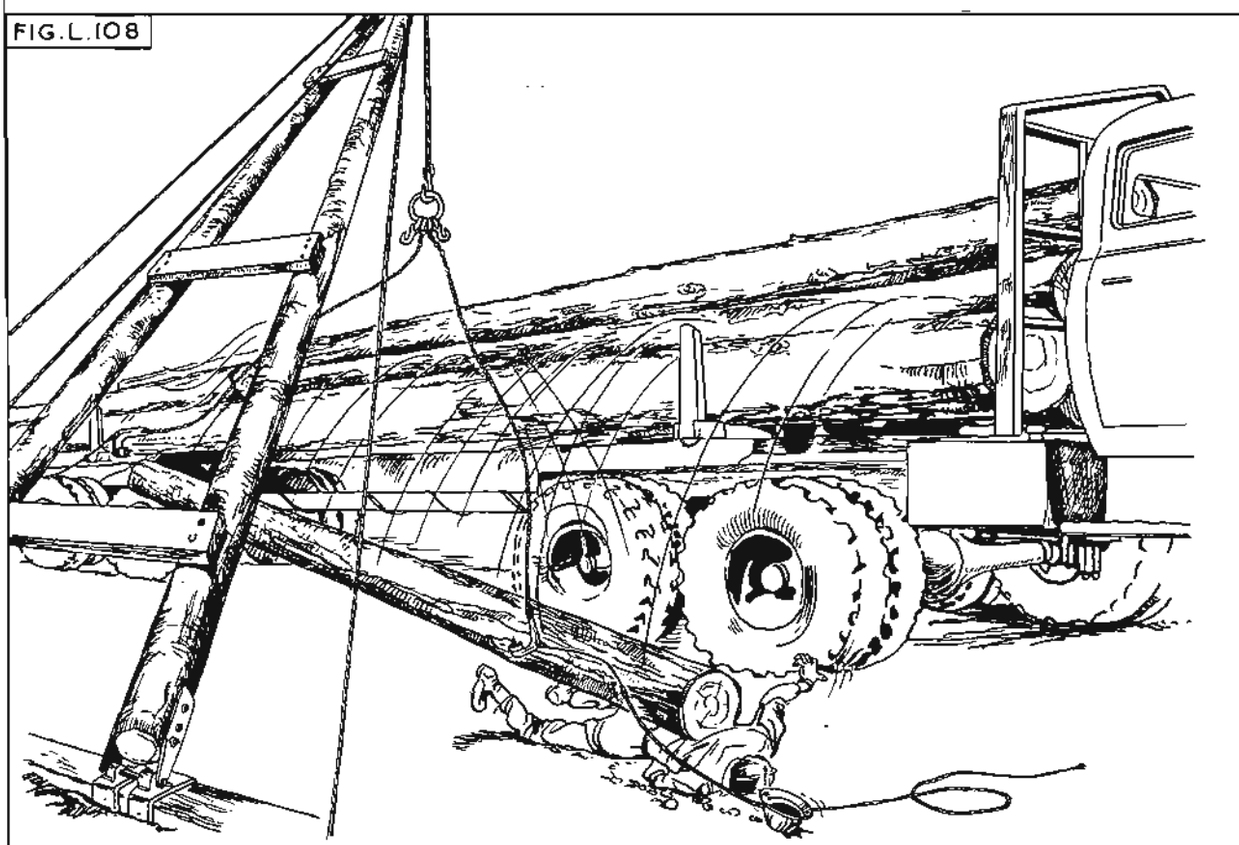
A SECOND LOADER WAS INSTANTLY KILLED WHEN THREE TOP LOGS OF AN ELEVEN-LOG LOAD ROLLED FROM THE TRUCK, CARRYING HIM TO THE GROUND AND CRUSHING HIM BENEATH ONE OF THE FALLING LOGS.

FIG.L.107



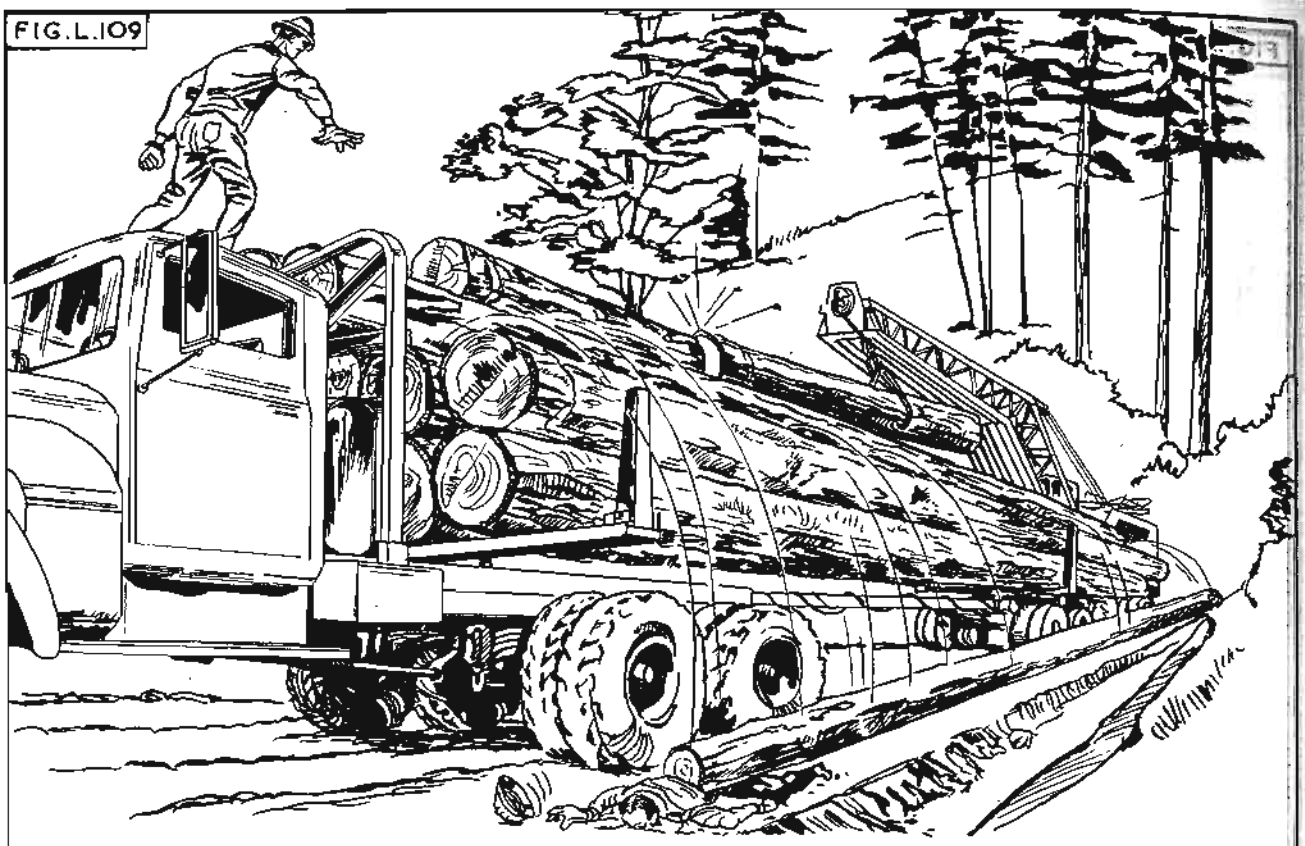
TRUCK DRIVER KILLED WHEN CRUSHED BENEATH A FOURTH TIER WING LOG THAT FELL AS HE WAS REMOVING THE FOURTH BINDER FROM AROUND THE LOAD.

FIG.L.108



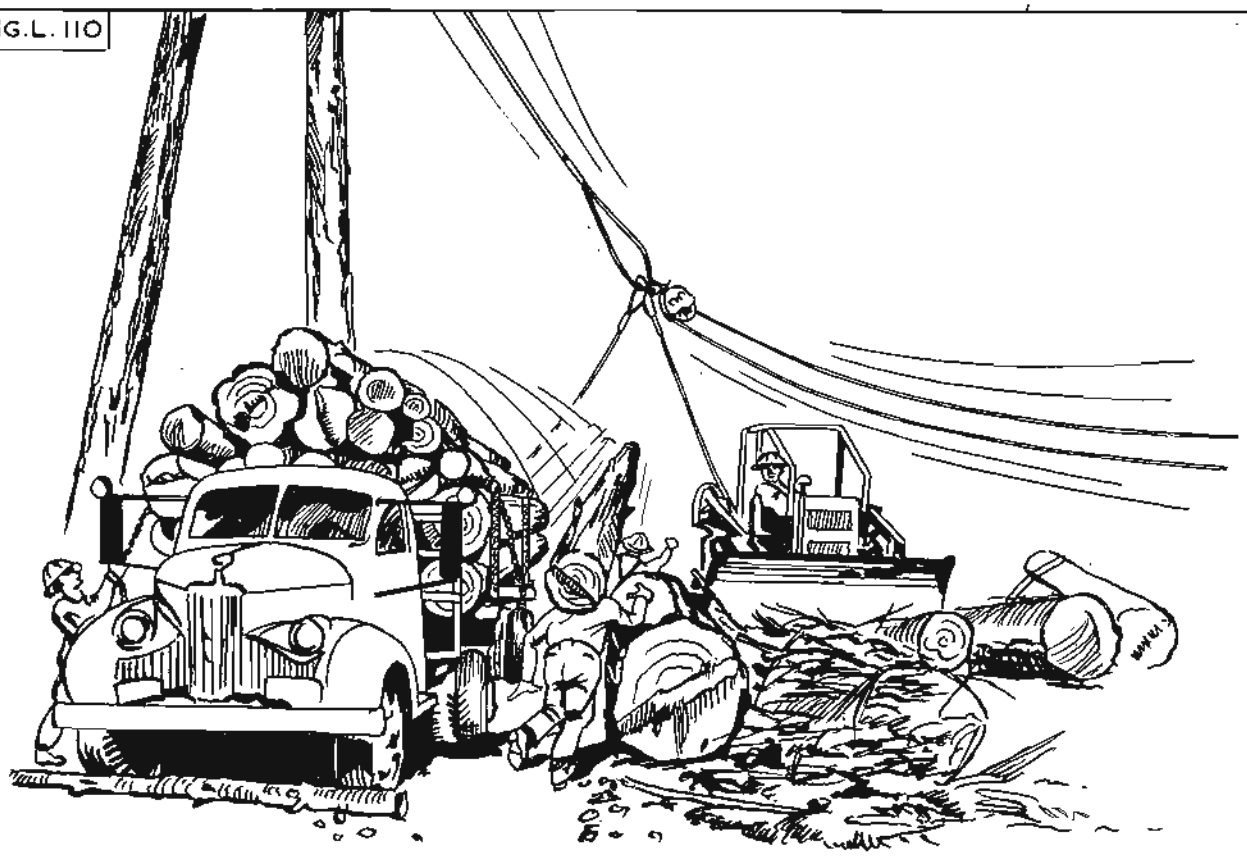
LOADER CRUSHED BY FALLING LOG AS END HOOKS PULLED OUT BEFORE THE LOG HAD BEEN SETTLED ON THE LOAD.

FIG.L.109



LOADER KILLED WHEN A POORLY SADDLED WING LOG BECAME DISLODGED, KNOCKED HIM OFF THE LOAD, THEN FELL ON HIM, CRUSHING HIS BACK.

FIG.L.110



LOADER KILLED WHEN STRUCK AND CRUSHED AGAINST THE BROW LOG BY A SMALL LOG THAT FELL FROM THE TRUCK WHILE HE WAS HELPING TO INSTALL THE BINDERS ON THE LOAD.

Fig. L. 101. - Second loader crushed by sliding log

The second loader was instantly killed when he was crushed against the trailer of a log truck by a log that slid as it was being turned end for end on the landing. The second loader was tightening the reach clamp.

Preventive measures

(i) Make certain all workmen are in the clear before moving logs on the landing.

(ii) The head loader, having the responsibility for the safety of the loading crew and the movement of logs, shall warn and make certain everyone is in the clear before giving the signal to turn a log.

Fig. L. 102. - Loader killed by falling log

The loader was killed when struck and crushed by a small log that broke and fell on him while he was trying to straighten out a badly crossed up pile of logs.

Preventive measures

(i) Make certain logs are properly landed.

(ii) Straighten the logs in a pile before letting them get crossed up in a hazardous condition.

(iii) All men must stay away from beneath loaded logs at all times.

Fig. L. 103. - Loader killed as log slips from tong

The loader died en route to the hospital as the result of injuries received when he was struck by a small log that slipped from a tong as he walked under it.

Preventive measure

Supervisor to make certain that workmen constantly stay in the clear of suspended logs.

Fig. L. 104. - Loader killed as end hook pulls out

The end hook pulled out of the thick end of a 9 metres log as the hooker, holding the tag line, stood beside the lorry to pull the log into position. The log fell and rolled onto him, striking him on the neck and shoulders.

Preventive measures

(i) Loaders should always hold onto the end of their tag lines and keep well clear of the log being loaded.

(ii) Crane operators must see that logs are securely placed on the load.

Fig. L. 105. - Head loader killed by rolling log

A head loader was fatally crushed by a log rolling from the deck as he stood at the end of a log into which he had set his end hook. A slight strain taken on the loading line, while waiting for the truck to position itself, moved the first log enough to permit a second log extending from the pile to roll down, crushing him against two other logs at the front of the landing.

Preventive measures

(i) Loads should only be hooked when everything is ready for loading.

(ii) As soon as end hooks are secured in the log, the loader should step into the clear with his tag line.

(iii) Logs should be securely stacked, and where possible the front logs of a stack should be loaded first.

Fig. L. 106. - Second loader killed by log falling from truck

A second loader was instantly killed when three top logs of an eleven log load rolled from the truck, carrying him to the ground and crushing him beneath one of the falling logs.

Preventive measures

(i) Load logs in adequate and secure saddles, and build the load in a manner to be stable without binders.

(ii) Make certain logs are securely loaded before permitting anyone to work on, or alongside, the load.

(iii) Reduce the size of loads to a height at which a secure load can be made.

Fig. L. 107. - Truck driver fatally injured by falling log

The log truck driver died about one hour later from injuries received when he was crushed beneath a fourth tier side log that fell on him as he was removing the binder from around the load. He did not wait for the dump operator to hold the logs with the unloading machine.

Preventive measures

(i) Properly saddle logs that are not secured by stakes or bunk blocks, and build the load so that it will be stable without binders.

(ii) Before releasing binders, make certain the load is securely held together.

Fig. L. 108. - Loader killed by falling log as end hook pulls out

The loader was killed when the end hooks pulled out of a log before it was properly settled on the load; the log rolled and fell on him, crushing him to the ground.

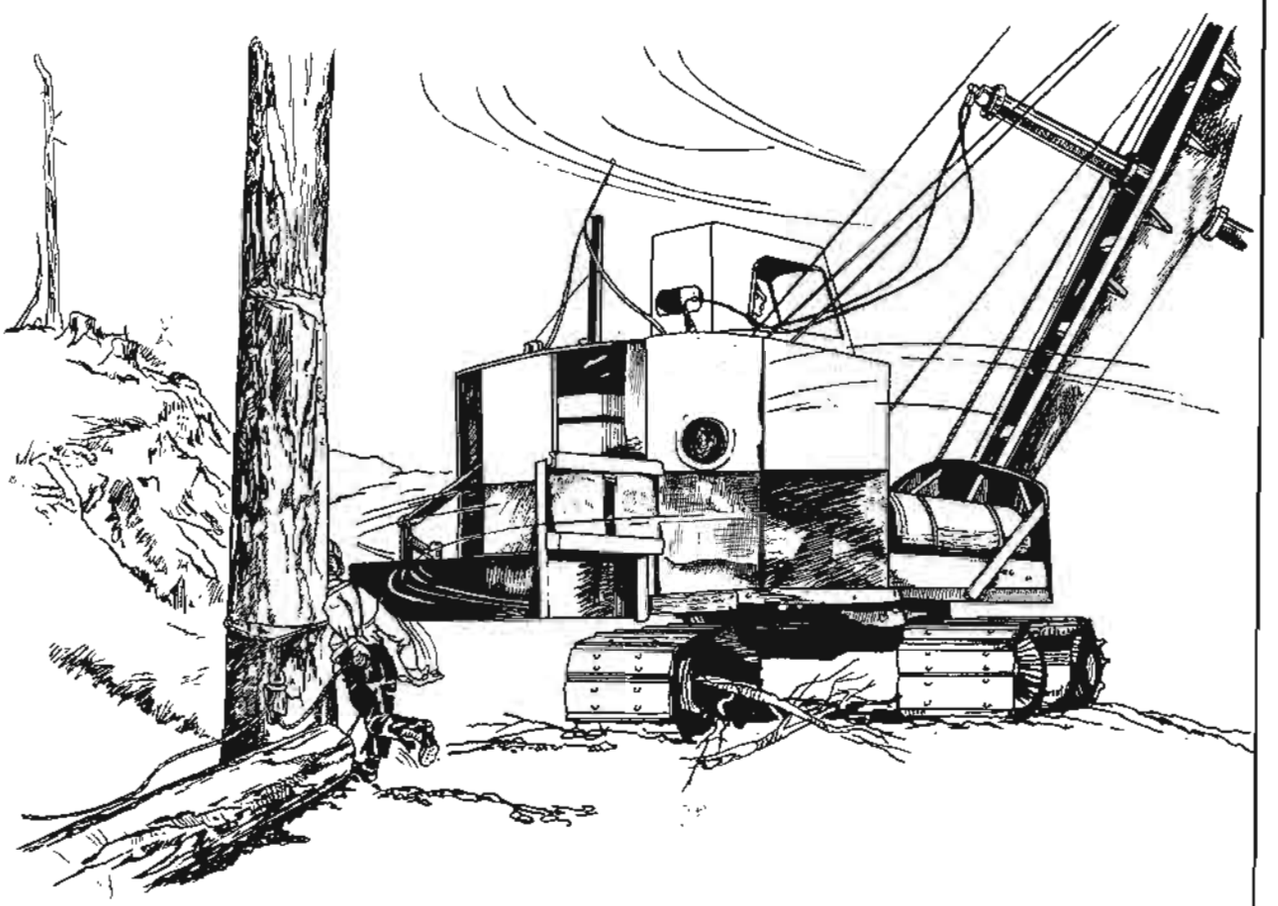
Preventive measure

Loaders must hold onto the ends of their tag lines, keeping well in the clear and preferably to the side of logs being loaded.

Fig. L. 109. - Second loader crushed by falling wing log

The second loader was fatally injured when a poorly saddled wing log became dislodged, knocking him off the load, then fell on him, crushing his back, as he was assisting in loading the truck.

FIG.L.III



THE UNHOOKER WAS KILLED WHEN HE WAS CRUSHED BETWEEN THE CRANE COUNTERWEIGHT AND SPAR TREE.

FIG. L. 112

A TRUCK DRIVER WAS ELECTRO--CUTED WHILE HE WAS HOLDING ONTO THE CRANE HOOK WHEN THE OPERATOR LIFTED THE BOOM TO ITS WORKING POSITION AND CONTACTED A HIGH VOLTAGE OVERHEAD POWER LINE.

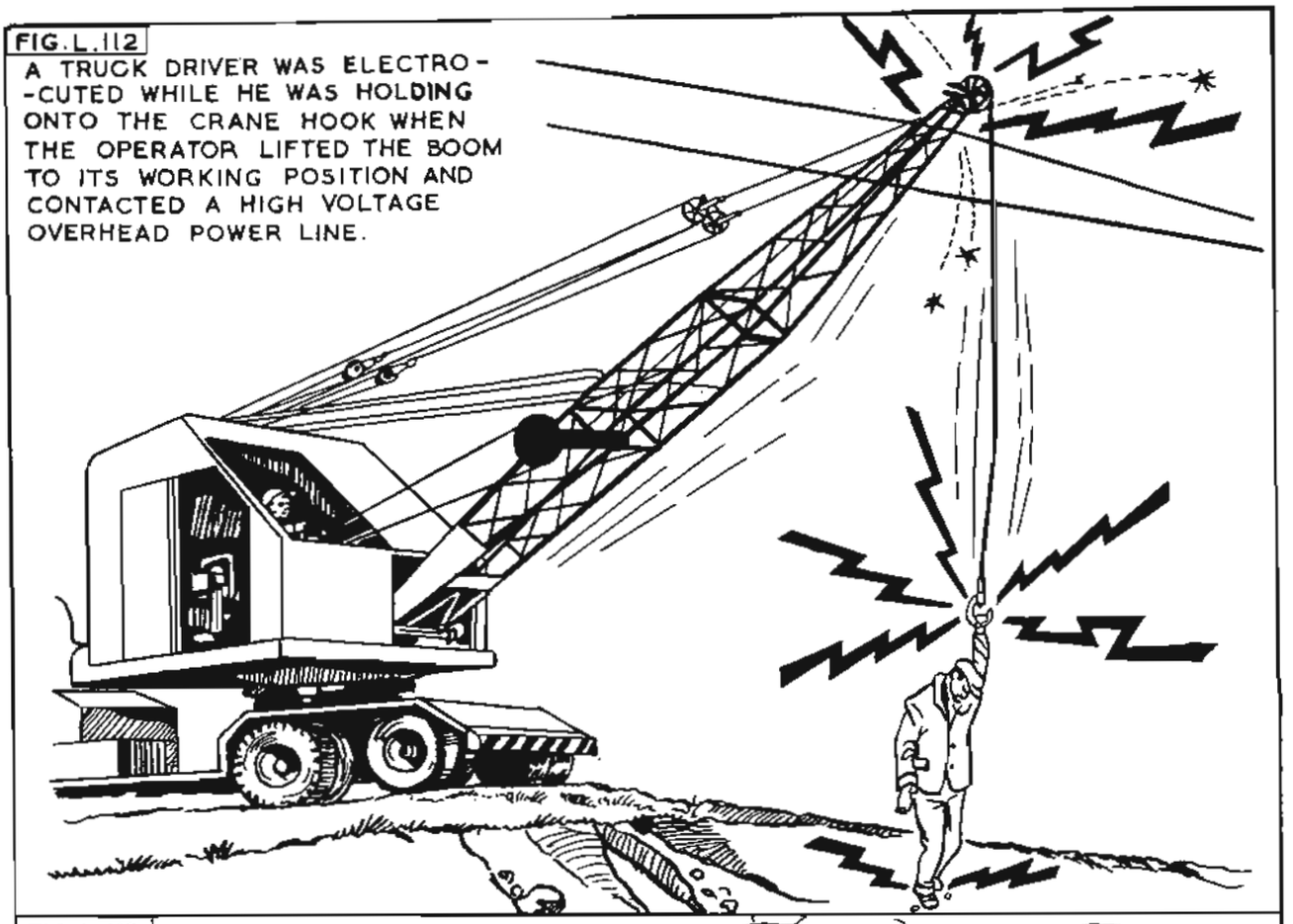
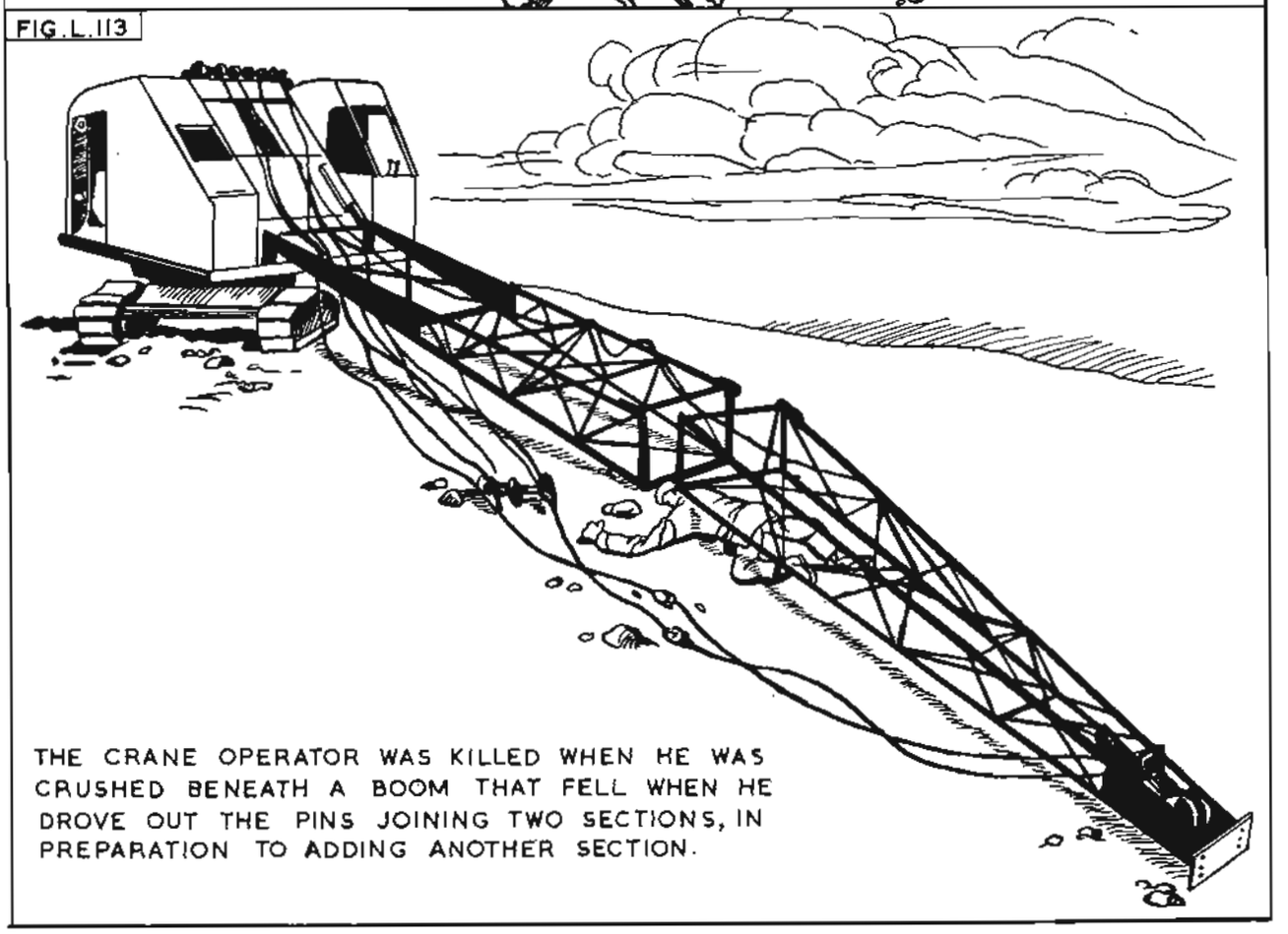


FIG. L. 113



THE CRANE OPERATOR WAS KILLED WHEN HE WAS CRUSHED BENEATH A BOOM THAT FELL WHEN HE DROVE OUT THE PINS JOINING TWO SECTIONS, IN PREPARATION TO ADDING ANOTHER SECTION.

Preventive measures

(i) Make certain logs are securely saddled, or held by stakes, before approaching them.

(ii) Supervisor to make certain loaders do not stay on or near the side of loads while logs are being moved or shifted.

Fig. L. 110. - Unhooker killed by log falling from truck

The unhooker was instantly killed when struck and crushed against the brow by a small log that fell from a fully loaded truck as he was helping to install the binders on the load.

Preventive measures

(i) Load logs in adequate and secure saddles, and build the load in a manner that will be stable without binders.

(ii) Reduce the size of loads to a height at which a secure load can be made.

Fig. L. 111. - Unhooker crushed by crane counterweight

The unhooker was killed when he was crushed between the crane counterweight and spar tree as the crane swung round to load a log.

Preventive measures

(i) Maintain a clearance of at least 1 metre between cranes and stationary objects at all times.

(ii) Cranes should not commence movement until all men are in the clear.

(iii) Crane operator's cabs should have 360° visibility.

Fig. L. 112. - Truck driver electrocuted as crane contacts power line

The truck driver was electrocuted while he was holding onto the crane hook when the crane operator lifted the boom to its working position and contacted a high voltage overhead power line.

Preventive measures

(i) Make certain that all persons working with cranes are trained and instructed to be watchful for overhead power lines.

(ii) Keep all conductive equipment at least 2,5 metres from energised power lines.

Fig. L. 113. - Crane operator crushed by falling boom

The crane operator was killed when he was crushed beneath a boom that fell when he drove out the pins joining two sections in order to add another section.

Preventive measures

(i) Always lower a boom to the ground or secure position, and use blocking before starting to remove fastening pins.

(ii) Do not work under insecurely suspended equipment.

N. EFFICIENCY REPORT FOR LOADING AND TRANSPORT

(a) INTRODUCTION

An investigation was made and proposals prepared for the transportation of sawlogs by road to State sawmills.

Studies were made to cover loading times by both mechanical and manual means, the average travelling time per kilometre for trips between loading points and sawmills, unavoidable time losses, off-loading times, and average lorry loads. Tables of allowed times and expected volumes and costs were then drawn up.

When loading is done by crane, the loading time for long and short sawlogs varies considerably and it was therefore necessary to provide separate tables for long and short logs.

The times are as shown below:

Truck capacity in tons	Normalised time + 20% C.R. and C.A.	
	Long logs. Time in minutes per load	Short logs. Time in minutes per load
7 ton lorries	20	27
10 ton lorries	32	38

Abbreviations: C.R.: Compensatory rest allowance
C.A.: Contingency allowance

(b) MANUAL LOADING

When loading is done manually, the loading time for long and short logs remains the same. The logs derived from thinnings are usually small and with a small mass and can easily be handled by seven labourers. In clearfellings, where the logs have a greater mass, a team of 10-12 labourers is necessary to do the loading.

The loading time for both seven and 10 ton lorries is 54 minutes, when 7 labourers are used for 7 ton lorries and 10-12 labourers for 10 ton lorries. (Normalised time + 20% C.R. and C.A.)

(c) TRANSPORT

The average travelling time that can be maintained is 25 km per hour or 2,5 minutes per kilometre, at an 80 rating.

The average off-loading time at a 60 rating + C.R. and C.A. is 12 minutes per load.

When more than one lorry is allocated to a team of loaders or a crane, the time lost by a particular lorry will be the loading time multiplied by the number of lorries loaded before this particular lorry at the start of the day. The time loss of the third lorry will thus be twice loading time and the time loss of the fourth lorry will be three times loading time.

LOAD DISTRIBUTION ON LOGGING TRUCKS

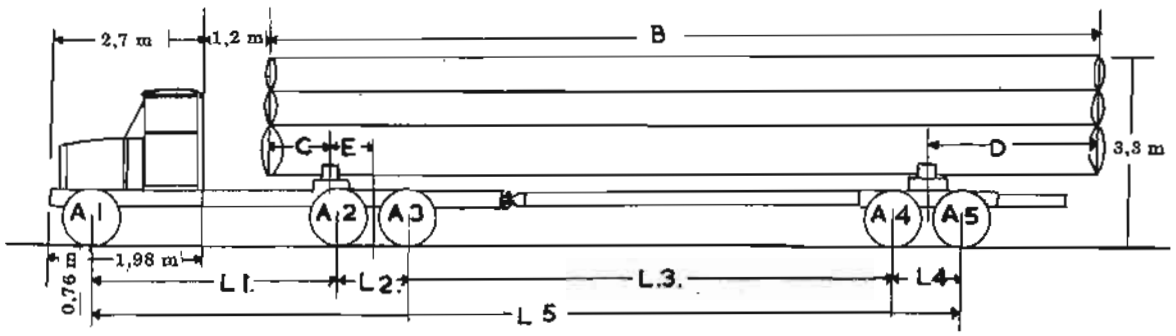
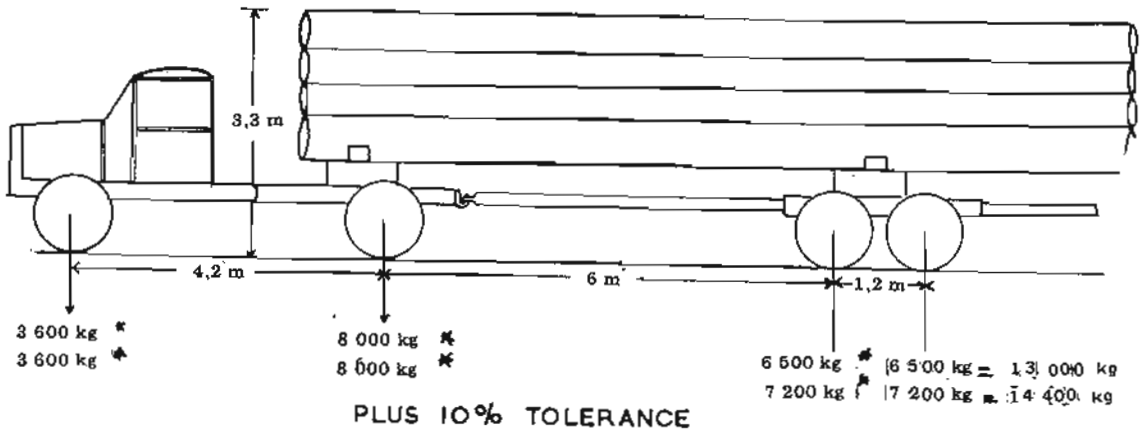


FIG.L.114 AXLES AND WHEEL BASES



PLUS 10% TOLERANCE

FIG.L.115 MASS DISTRIBUTION ON AXLES

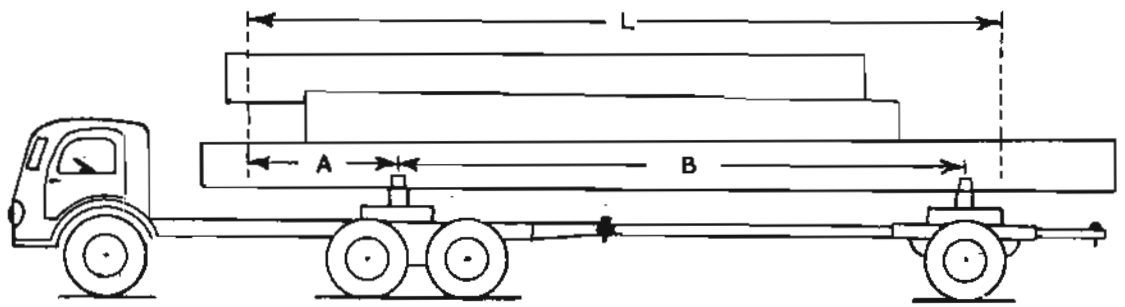


FIG.L.116

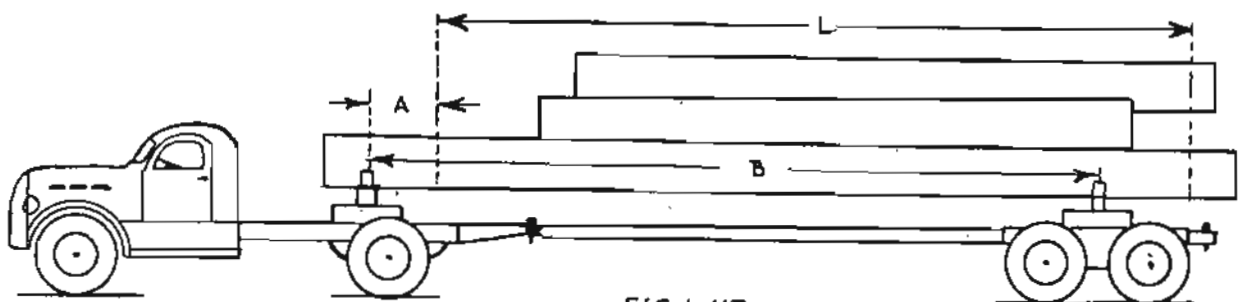


FIG.L.117

THE ABOVE TWO FIGURES SHOW THE SAME LOAD DISTRIBUTED PROPERLY ON TWO DIFFERENT TYPES OF VEHICLES

Time lost due to the allowed time for the maximum number of loads being less than day time. i.e. it may occur that day time divided by the allowed time per load is equal to 5,5 loads per day, in this case the 0,5 load cannot be transported and the time loss will be 0,5 of the allowed time per load.

(d) LOADING TEAM

The loading team or crane will loose the travelling time and off-loading time of at least one lorry load each day. This is due to the fact that the crane or loading team cannot start work before the first lorry has arrived, and that after the last load the lorry must be allowed time to travel to, and off-load at the mill and to return to the garage, unless some other arrangement is made.

Lost times can be utilised by servicing and checking the units, and not when units can be used for loading or hauling.

(e) AVERAGE LORRY LOADS

The following table shows the average and maximum volumes per load in cubic metres for 7 and 10 ton lorries respectively.

Lorry tonnage	Crane loading	Manual loading	Maximum
	m^3	m^3	m^3
7 ton	5,7	5,7	6,5
10 ton	8,5	7,7	9,5

Tables of allowed times, numbers of lorries, number of loads per day and costs were drawn up. Tables show the allowed times per load, for trip in kilometres.

The number of lorry loads per day is day time divided by the allowed time per load. Day time must, however, be reduced by subtracting time losses. The number of lorries and lorry loads is that which can be handled by one crane or team of labourers per day.

It will, however, be noted that in certain instances the lorry loads are less than that which can be handled by the crane or team of labourers. In these instances an extra lorry is needed to cart the extra load or two. The idle time costs of the driver will, however, be more than the idle time cost of the crane or team of loaders.

Lorry services, up to and including 5 000 kilometres, are carried out by the drivers, assisted by a Bantu labourer. After this kilometric distance the lorry must be examined by a mechanic, working as prescribed by the Government Garage service schedule.

The following table should serve as a guide for servicing times of lorries.

Service	Allowed time in minutes	
	5-7 ton lorries	10 ton lorries
Refueling	6,7 min + 0,1 min/litre	6,7 min + 0,1 min/litre
Daily check	12	25
Weekly or 400 km	39	75
1 500	40	91
3 000	64	91
5 000	64	91

O. LOAD DISTRIBUTION ON LOGGING TRUCKS

Load distribution is related to the overload of timber trucks and proper load balance on the truck. The term "overload" may be considered from various points of view:

(i) Maximum hauling economy.

(ii) Truck chassis and tyre recommended carrying capacity.

(iii) Mass legally permitted.

Besides the above factors to which overload applies, there may be a gross overload on the whole vehicle, or there may be a localised overload on certain axles or wheels.

Before proper judgement can be exercised a knowledge of timber mass is required, which is in turn dependent upon the structure of timber species and their moisture content, thickness of bark, and from what part of the tree the log has been derived.

If there is no intention to overload a truck, and the driver checks the volume of the load, then he is the person responsible for ensuring that the load is of the proper size and that the balance distribution is correct.

Note : If two trucks are of different sizes, but have the same gross rating, the one with the greater mass will carry the load with the smaller mass.

Different logging truck designs will require a different distribution of the load on the lorry log bunk (Fig. L. 116, 117). For example, the load distribution on a two-axle truck will be different to the load distribution on a 3-axle truck, despite their having a similar log bunk capacity.

The truck driver should be responsible for the volume loaded and the load distribution, as he has the most opportunity to acquire a practical knowledge of the facts involved by observing and supervising the loading and driving. He should be guided first, by determining the mass on each wheel of the loaded truck and explaining how the load should be distributed according to the manufacturer's instructions, based on the built-in carrying capacity of each axle. (Fig. L. 114, 115).

Manufacturers' instructions usually refer to normal conditions of gradient and road surface, but in practice conditions vary, and extremely adverse gradients or muddy roads may have to be negotiated. Under these conditions load distribution must be arranged bearing in mind that the drive wheels are subject to additional strain, apart from the load which they carry. By travelling the same route and observing truck behaviour the driver can best learn how to distribute the load by trial and error in order to obtain the best traction for the actual road condition.

TABLE L.1 - 9 000 kg lorries carting long logs. Loading by mobile crane

Trip km	Allowed time per load, min	Effective crane capacity loads	Number of loads per day with							Volume per day m^3
			1 lorry	2 lorries	3 lorries	4 lorries	5 lorries	6 lorries	7 lorries	
1	29,5	34	18	34						290
2	32,0	34	16	32						272
3	34,5	34	15	30						255
4	37,0	34	14	28						238
5	39,5	34	13	26						220
6	42,0	34	12	24						204
7	44,5	34	12	24						204
8	47,0	33	11	22	33					280
9	49,5	33	10	20	30					255
10	52,0	33	10	20	30					255
11	54,5	33	9	18	27					230
12	57,0	33	9	18	27					230
13	59,5	33	9	18	27					230
14	62,0	32	8	16	24	32				272
15	64,5	32	8	16	24	32				272
16	67,0	32	8	16	24	32				272
17	69,5	32	7	14	21	28				238
18	72,0	32	7	14	21	28				238
19	74,5	32	7	14	21	28				238
20	77,0	32	7	14	21	28				238
21	79,5	31	6	12	18	24	30			255
22	82,0	31	6	12	18	24	30			255
23	84,5	31	6	12	18	24	30			255
24	87,0	31	6	12	18	24	30			255
25	89,5	31	6	12	18	24	30			255
26	92,0	31	5	10	15	20	25	30		255
27	94,5	30	5	10	15	20	25	30		255
28	97,0	30	5	10	15	20	25	30		255
29	99,5	30	5	10	15	20	25	30		255
30	102,0	30	5	10	15	20	25	30		255
31	104,5	30	5	10	15	20	25	30		255
32	107,0	30	5	10	15	20	25	30		255
33	109,5	29	4	8	12	16	20	24	28	238
34	112,0	29	4	8	12	16	20	24	28	238
35	114,5	29	4	8	12	16	20	24	28	238
36	117,0	29	4	8	12	16	20	24	28	238
37	119,5	29	4	8	12	16	20	24	28	238
38	122,0	28	4	8	12	16	20	24	28	238
39	124,5	28	4	8	12	16	20	24	28	238
40	127,0	28	4	8	12	16	20	24	28	238
41	129,5	28	4	8	12	16	20	24	28	238
42	132,0	28	4	8	12	16	20	24	28	238
43	134,5	28	4	8	12	16	20	24	28	238
44	137,0	28	3	6	9	12	15	18	21	179
45	139,5	27	3	6	9	12	15	18	21	179
46	142,0	27	3	6	9	12	15	18	21	179
47	144,5	27	3	6	9	12	15	18	21	179
48	147,0	27	3	6	9	12	15	18	21	179

1. Volume per load: 8,5 m^3
2. Loading time = 15 min/load
3. Off-loading time = 12 min/load
4. Travelling time = 2,5 min/km.

TABLE L. 2 - 9 000 kg lorries carting short logs. Loading by mobile crane

Trip km	Allowed time min.	Effective crane capacity Loads	Number of loads per day with				Volume per day m^3
			1 lorry	2 lorries	3 lorries	4 lorries	
1	50,5	14	10	14			119,0
2	53,0	14	10	14			119,0
3	55,5	14	9	14			119,0
4	58,0	14	9	14			119,0
5	60,5	14	8	14			119,0
6	63,0	14	8	14			119,0
7	65,5	14	8	14			119,0
8	68,0	14	7	14			119,0
9	70,5	14	7	14			119,0
10	73,0	13	7	13			110,5
11	75,5	13	7	13			110,5
12	78,0	13	6	12	13		110,5
13	80,5	13	6	12	13		110,5
14	83,0	13	6	12	13		110,5
15	85,5	13	6	12	13		110,5
16	88,0	13	6	12	13		110,5
17	90,5	13	5	10	13		110,5
18	93,0	13	5	10	13		110,5
19	95,5	13	5	10	13		110,5
20	98,0	13	5	10	13		110,5
21	100,5	13	5	10	13		110,5
22	103,0	13	5	10	13		110,5
23	105,5	13	5	10	13		110,5
24	108,0	13	5	10	13		110,5
25	110,5	12	4	8	12		102,0
26	113,0	12	4	8	12		102,0
27	115,5	12	4	8	12		102,0
28	118,0	12	4	8	12		102,0
29	120,5	12	4	8	12		102,0
30	123,0	12	4	8	12		102,0
31	125,5	12	4	8	12		102,0
32	128,0	12	4	8	12		102,0
33	130,5	12	4	8	12		102,0
34	133,0	12	4	8	12		102,0
35	135,5	12	3	6	9	12	102,0
36	138,0	12	3	6	9	12	102,0
37	140,5	12	3	6	9	12	102,0
38	143,0	12	3	6	9	12	102,0
39	145,5	12	3	6	9	12	102,0
40	148,0	11	3	6	9	11	93,5
41	150,5	11	3	6	9	11	93,5
42	153,0	11	3	6	9	11	93,5
43	155,5	11	3	6	9	11	93,5
44	158,0	11	3	6	9	11	93,5
45	160,5	11	3	6	9	11	93,5
46	163,0	11	3	6	9	11	93,5
47	165,5	11	3	6	9	11	93,5
48	168,0	11	3	6	9	11	93,5

1. Volume per load = 8,5 m^3
2. Loading time = 36 min./load
3. Off-loading time = 12 min/load
4. Travelling time = 2,5 min./km

TABEL L. 3 - 6 300 kg lorries carting long logs. Loading by mobile crane

Trip km	Allowed time per load, min	Effective crane capacity Loads	Number of loads per day with 1 lorry	2 lorries	3 lorries	4 lorries	5 lorries	6 lorries	7 lorries	Volume per day m^3
1	24,5	52	22	44						248
2	27,0	52	20	40						226
3	29,5	52	18	36	52					294
4	32,0	51	16	32	48					271
5	34,5	51	15	30	45	51				288
6	37,0	51	14	28	42	51				288
7	39,5	51	13	26	39	51				288
8	42,0	50	12	24	36	48				271
9	44,5	50	12	24	36	48				271
10	47,0	50	11	22	33	44				248
11	49,5	50	10	20	30	40	50			282
12	52,0	50	10	20	30	40	50			282
13	54,5	49	10	20	30	40	49			276
14	57,0	49	9	18	27	36	45			254
15	59,5	49	9	18	27	36	45			254
16	62,0	48	8	16	24	32	40	48		271
17	64,5	48	8	16	24	32	40	48		271
18	67,0	48	8	16	24	32	40	48		271
19	69,5	48	7	14	21	28	35	42	48	271
20	72,0	48	7	14	21	28	35	42	48	271
21	74,5	47	7	14	21	28	35	42	47	265
22	77,0	47	7	14	21	28	35	42	47	265
23	79,5	47	6	12	18	24	30	36	42	237
24	82,0	46	6	12	18	24	30	36	42	237
25	84,5	46	6	12	18	24	30	36	42	237
26	87,0	46	6	12	18	24	30	36	42	237
27	89,5	46	6	12	18	24	30	36	42	237
28	92,0	46	6	12	18	24	30	36	42	237
29	94,5	45	5	10	15	20	25	30	35	197
30	97,0	45	5	10	15	20	25	30	35	197
31	99,5	45	5	10	15	20	25	30	35	197
32	102,0	44	5	10	15	20	25	30	35	197
33	104,5	44	5	10	15	20	25	30	35	197
34	107,0	44	5	10	15	20	25	30	35	197
35	109,5	44	5	10	15	20	25	30	35	197
36	112,0	44	4	8	12	16	20	24	28	158
37	114,5	43	4	8	12	16	20	24	28	158
38	117,0	43	4	8	12	16	20	24	28	158
39	119,5	43	4	8	12	16	20	24	28	158
40	122,0	42	4	8	12	16	20	24	28	158
41	124,5	42	4	8	12	16	20	24	28	158
42	127,0	42	4	8	12	16	20	24	28	158
43	129,5	42	4	8	12	16	20	24	28	158
44	132,0	42	4	8	12	16	20	24	28	158
45	134,5	41	4	8	12	16	20	24	28	158
46	137,0	41	4	8	12	16	20	24	28	158
47	139,5	41	3	6	9	12	15	18	21	119
48	142,0	40	3	6	9	12	15	18	21	119

1. Volume per load = 5,65 m^3
2. Loading time = 10 min/load
3. Off loading time = 12 min/load
4. Travelling time = 2,5 min/km

TABLE L. 4 - 6 300 kg lorries carting short logs. Loading by mobile crane

Trip km.	Allowed time/load min	Effective crane capacity Loads	Number of loads per day for 1 lorry	2 lorries	3 lorries	4 lorries	5 lorries	6 lorries	Volume per day m^3
1	39,5	21	13	21					119
2	42,0	21	13	21					119
3	44,5	20	12	20					113
4	47,0	20	11	20					113
5	49,5	20	11	20					113
6	52,0	20	10	20					113
7	54,5	20	10	20					113
8	57,0	20	9	18					102
9	59,5	20	9	18					102
10	62,0	20	8	16	20				113
11	64,5	20	8	16	20				113
12	67,0	20	8	16	20				113
13	69,5	19	7	14	19				117
14	72,0	19	7	14	19				117
15	74,5	19	7	14	19				117
16	77,0	19	7	14	19				117
17	79,5	19	6	12	18				102
18	82,0	19	6	12	18				102
19	84,5	19	6	12	18				102
20	87,0	19	6	12	18				102
21	89,5	19	6	12	18				102
22	92,0	18	5	10	15	18			102
23	94,5	18	5	10	15	18			102
24	97,0	18	5	10	15	18			102
25	99,5	18	5	10	15	18			102
26	102,0	18	5	10	15	18			102
27	104,5	18	5	10	15	18			102
28	107,0	18	5	10	15	18			102
29	109,5	18	5	10	15	18			102
30	112,0	18	4	8	12	16			90,5
31	114,5	18	4	8	12	16			90,5
32	117,0	17	4	8	12	16			90,5
33	119,5	17	4	8	12	16			90,5
34	122,0	17	4	8	12	16			90,5
35	124,5	17	4	8	12	16			90,5
36	127,0	17	4	8	12	16			90,5
37	129,5	17	4	8	12	16			90,5
38	132,0	17	4	8	12	16			90,5
39	134,5	17	4	8	12	16			90,5
40	137,0	17	4	8	12	16			90,5
41	139,5	17	3	6	9	12	15		85,0
42	142,0	17	3	6	9	12	15		85,0
43	144,5	16	3	6	9	12	15		85,0
44	147,0	16	3	6	9	12	15		85,0
45	149,5	16	3	6	9	12	14	16	90,5
46	152,0	16	3	6	9	12	14	16	90,5
47	154,5	16	3	6	9	12	14	16	90,5
48	157,0	16	3	6	9	11	13	15	85,0

1. Volume per load = 5,65 m^3
2. Loading time = 25 min/load
3. Off-loading time = 12 min/load
4. Travelling time = 2,5 min/km.

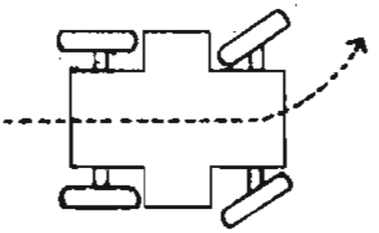
TABLE L. 5 - 9 000 kg lorries carting long and short logs: Clearfellings
6 300 kg lorries carting long and short logs: Thinnings
Manual loading

Trip km	Allowed time per load, min	Effective loading capacity for 10 Labs/ (loads)	Number of loads per day for:			Volume per day 9 000 kg lorries m^3	Volume per day 6 300 kg lorries m^3
			1 lorry	2 lorries	3 lorries		
1	68,5	9	7			55,3	39,5
2	71,0	9	7			55,3	39,5
3	73,5	9	7			55,3	39,5
4	76,0	9	7			55,3	39,5
5	78,5	9	6			47,4	33,9
6	81,0	9	6			47,4	33,9
7	83,5	9	6			47,4	33,9
8	86,0	9	6			47,4	33,9
9	88,5	9	6			47,4	33,9
10	91,0	9	5	9		71,1	50,8
11	93,5	9	5	9		71,1	50,8
12	96,0	9	5	9		71,1	50,8
13	98,5	9	5	9		71,1	50,8
14	101,0	9	5	9		71,1	50,8
15	103,5	9	5	9		71,1	50,8
16	106,0	9	5	9		71,1	50,8
17	108,5	8	5	8		63,2	45,2
18	111,0	8	4	8		63,2	45,2
19	113,5	8	4	8		63,2	45,2
20	116,0	8	4	8		63,2	45,2
21	118,5	8	4	8		63,2	45,2
22	121,0	8	4	8		63,2	45,2
23	123,5	8	4	7		55,3	39,5
24	126,0	8	4	7		55,3	39,5
25	128,5	8	4	7		55,3	39,5
26	131,0	8	4	7		55,3	39,5
27	133,5	8	4	7		55,3	39,5
28	136,0	8	4	7		55,3	39,5
29	138,5	8	3	6	8	63,2	45,2
30	141,0	8	3	6	8	63,2	45,2
31	143,5	8	3	6	8	63,2	45,2
32	146,0	8	3	6	8	63,2	45,2
33	148,5	8	3	6	8	63,2	45,2
34	151,0	8	3	6	8	63,2	45,2
35	153,5	8	3	6	8	63,2	45,2
36	156,0	8	3	6	8	63,2	45,2
37	158,5	8	3	6	8	63,2	45,2
38	161,0	8	3	6	8	63,2	45,2
39	163,5	8	3	6	8	63,2	45,2
40	166,0	7	3	5	7	63,2	39,5
41	168,5	7	3	5	7	63,2	39,5
42	171,0	7	3	5	7	63,2	39,5
43	173,5	7	3	5	7	63,2	39,5
44	176,0	7	3	5	7	63,2	39,5
45	178,5	7	3	5	7	63,2	39,5
46	181,0	7	2	4	6	47,4	33,9
47	183,5	7	2	4	6	47,4	33,9
48	186,0	7	2	4	6	47,4	33,9

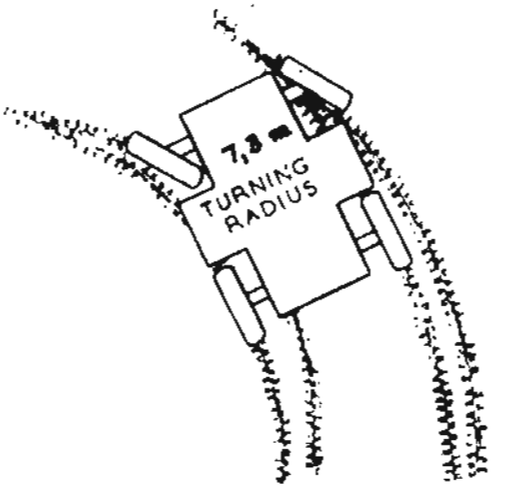
1. Volume per load = 7,9 m^3 (9 000 kg)
" " " = 5,65 m^3 (6 300 kg)
2. Loading time = 54 min/load
3. Off-loading time = 12 min/load
4. Travelling time = 2,5 min/km.

FIG L 118

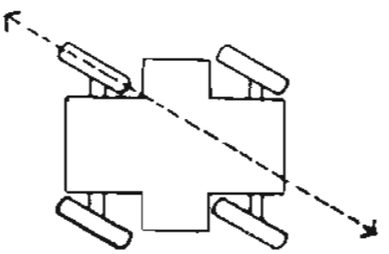
SINGLE AXLE STEERING.
(STANDARD)

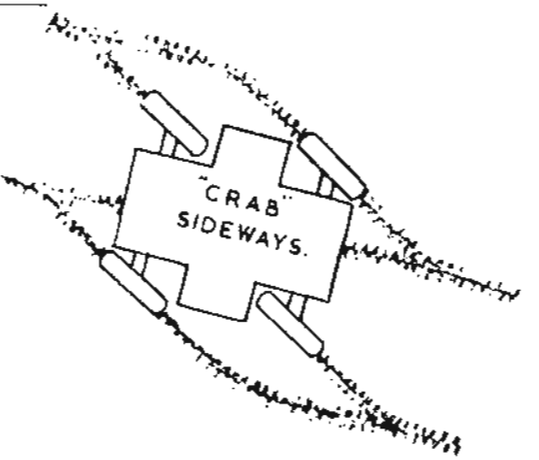


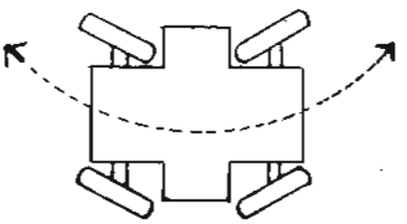
7,3 m TURNING RADIUS.



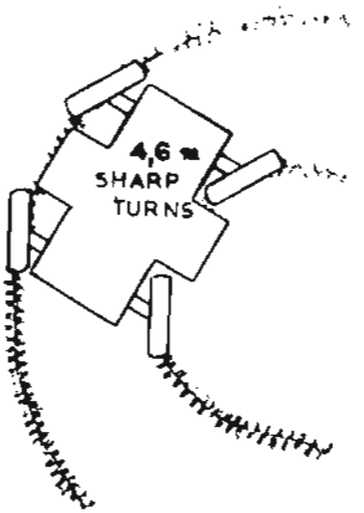
TWO AXLE STEERING.
(AVAILABLE)







4,6 m TURNING
RADIUS.



E. 677.

FIG.L.119.

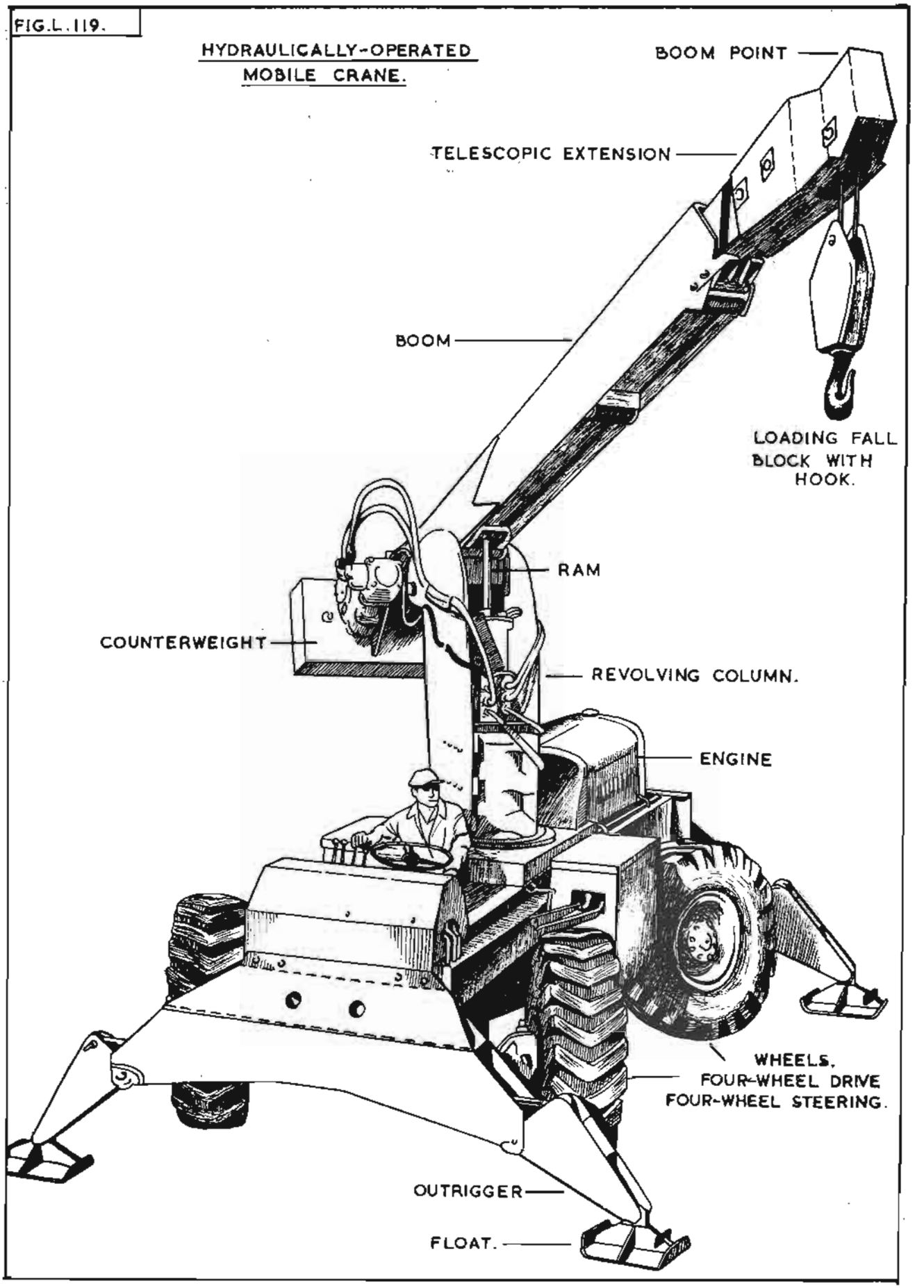
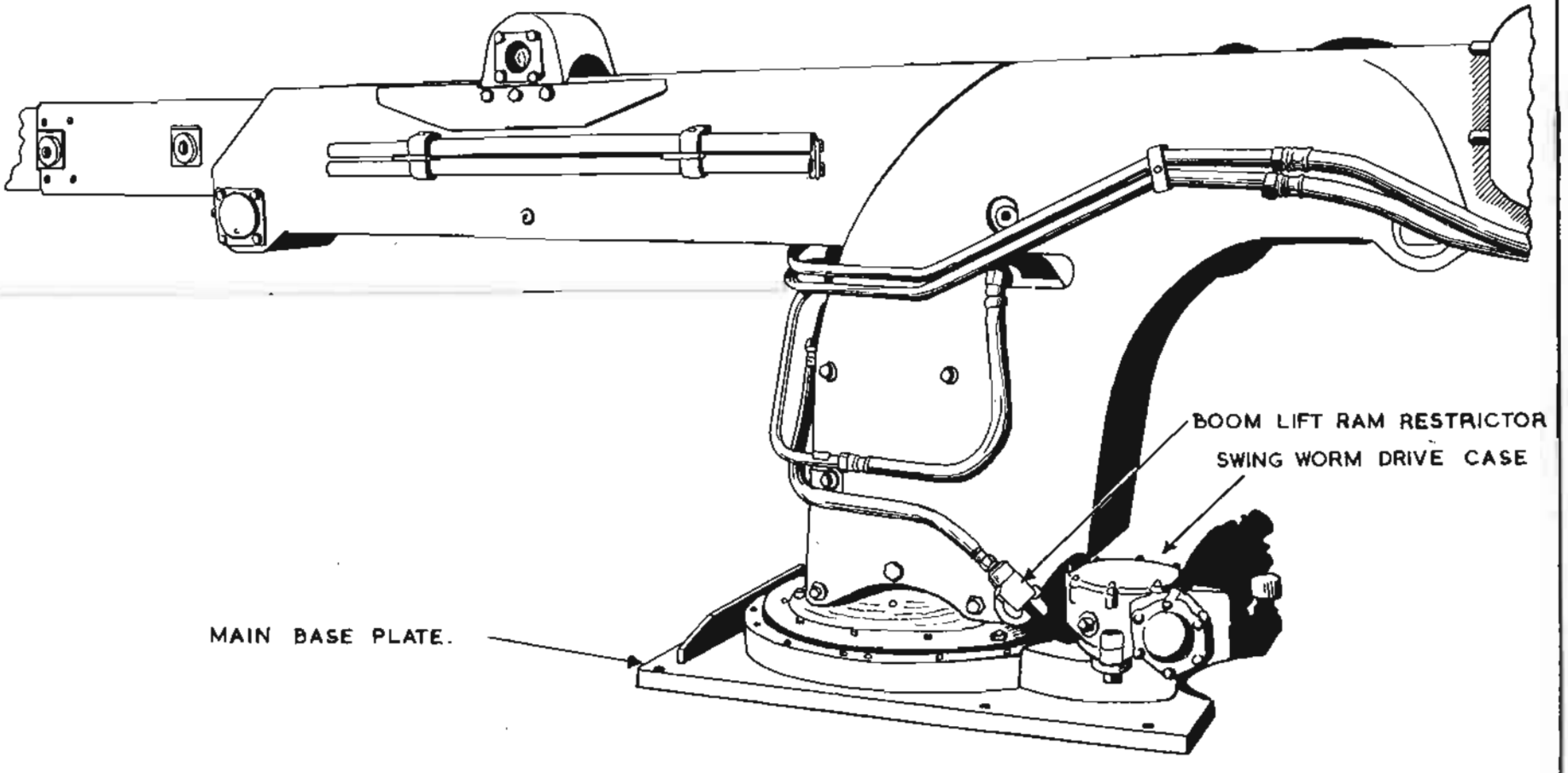

HYDRAULICALLY-OPERATED
MOBILE CRANE.
BOOM POINT
TELESCOPIC EXTENSION
BOOM
LOADING FALL
BLOCK WITH
HOOK.
RAM
COUNTERWEIGHT
REVOLVING COLUMN.
ENGINE
WHEELS,
FOUR-WHEEL DRIVE
FOUR-WHEEL STEERING.
OUTRIGGER
FLOAT.

FIG. L. 120

HYDRAULICALLY-OPERATED MOBILE CRANE.

REVOLVING SUPERSTRUCTURE WITH BASE OF BOOM.



If the combined vehicle tyre width is less than 75 cm, the allowable load is 35 kg/cm^2 of tyre width. If combined vehicle tyre width is more than 75 cm, the allowable load is 42 kg/cm^2 of tyre width. Maximum gross load on hard-surfaced or paved roads is 4 000 kg per wheel; 8 000 kg per axle maximum is the gross load permitted (Fig. L. 114, 115).

At no time shall the gross mass exceed 30 000 kg.

Note : Gross mass includes the mass of the truck.

Fig. L 114

An = number of axles
Ln = distance between axles (L5 = total distance).
B = length of logs.
C = distance from front of load to tractor bunk.
D = distance from end of load to trailer bunk.
E = distance between mean wheel base of tractor and bunk.

Fig. L 115

This figure illustrates the load distribution on the truck and trailer axles.

Fig. L 116, 117

A = distance from centre of the front bunk to the effective front end of the load in metres.

L = effective length of load in metres.

B = Bunk spacing, centre to centre, in metres.

Formula for correct load distribution:

$A = \frac{1}{2}L - (B \times f)$ metre

$B = \frac{\frac{1}{2}L - A}{f}$ metre

f = factor obtained by dividing the nett capacity of the trailer by the total payload rating in kilograms.

Load distribution on Leyland Super Hippo (used departmentally)

	Total kg	Front axle kg	Rear axle kg
Unloaded mass - chassis and cab	7 440	3 377	4 063
7 m steel body	1 449	298	1 151
Total unloaded mass	8 889	3 675	5 214
Payload, (10 ton)	10 000	1 857	8 143
	18 889	5 532	13 357

Note : Data by Department of Transport

Platform trucks working on high speed hauls are designed so that the measurement from the centre of the payload on the truck to the rear axle is 15 to 17% of the wheel base for four wheelers, and 12-14% for six wheel trucks.

With regard to the distribution of a load of short or medium length logs, it is necessary to shift the logs on a lorry platform, or place them in the necessary position when loading. A load of long logs cannot be balanced satisfactorily on the lorry platform as longitudinal shifting of the load is limited.

It is not within the scope of this manual to go into full details of load distribution for all kinds of trucks or tractors with semi-trailers, but it is important that one has some idea of the importance of proportional load distribution on timber trucks. This is particularly important where adverse road conditions may be encountered.

4. HYDRAULICALLY-OPERATED CRANE

HYDRAULICALLY-OPERATED FULL AUTOMATIVE CRANE - 6 TON LIFTING CAPACITY ON 3 METRES RADIUS

The main parts of the hydraulic crane are the same as those of the standard mobile crane, i.e. carrier, revolving superstructure and boom. The unit mounting is an all-steel chassis main frame of 45 cm rectangular box sections. The carrier has a rubber-tyred four-wheel drive and four-wheel steering (Fig. L. 118). All wheels are offset, viz. all wheels are removable and may be turned about and re-assembled on the wheel hubs. See Fig. L. 119 for general details of the crane.

The transmission is constant mesh, with three forward speeds and reverse, and includes a torque converter.

The clutch is 35 cm in diameter, of the dry, single disc type.

The engine, which may be petrol or diesel-driven, drives the hydraulic pump for the crane which is mounted directly to the engine crankshaft by means of a short propeller shaft, which means that the pump is always in operation while the engine is running. There are two hydraulic pumps, one for driving and the other for steering. The hydraulic oil tank is located on the left side of the vehicle.

The revolving superstructure consists of:

(1) The turn-table mounted on the main base plate with a swing worm drive case and swing motor (Fig. L. 120). The turn-table can rotate through 360° by means of the hydraulic motor.

(2) Column (or pivot post), which connects the base of the turn-table with the hinged base end of the boom (Fig. L. 119). This column houses the ram with hydraulic vertical cylinder for vertical lift of the main part of the boom.

FIG. L. 121. HYDRAULICALLY-OPERATED MOBILE CRANE — DETAILS OF BOOM AND WINCH.

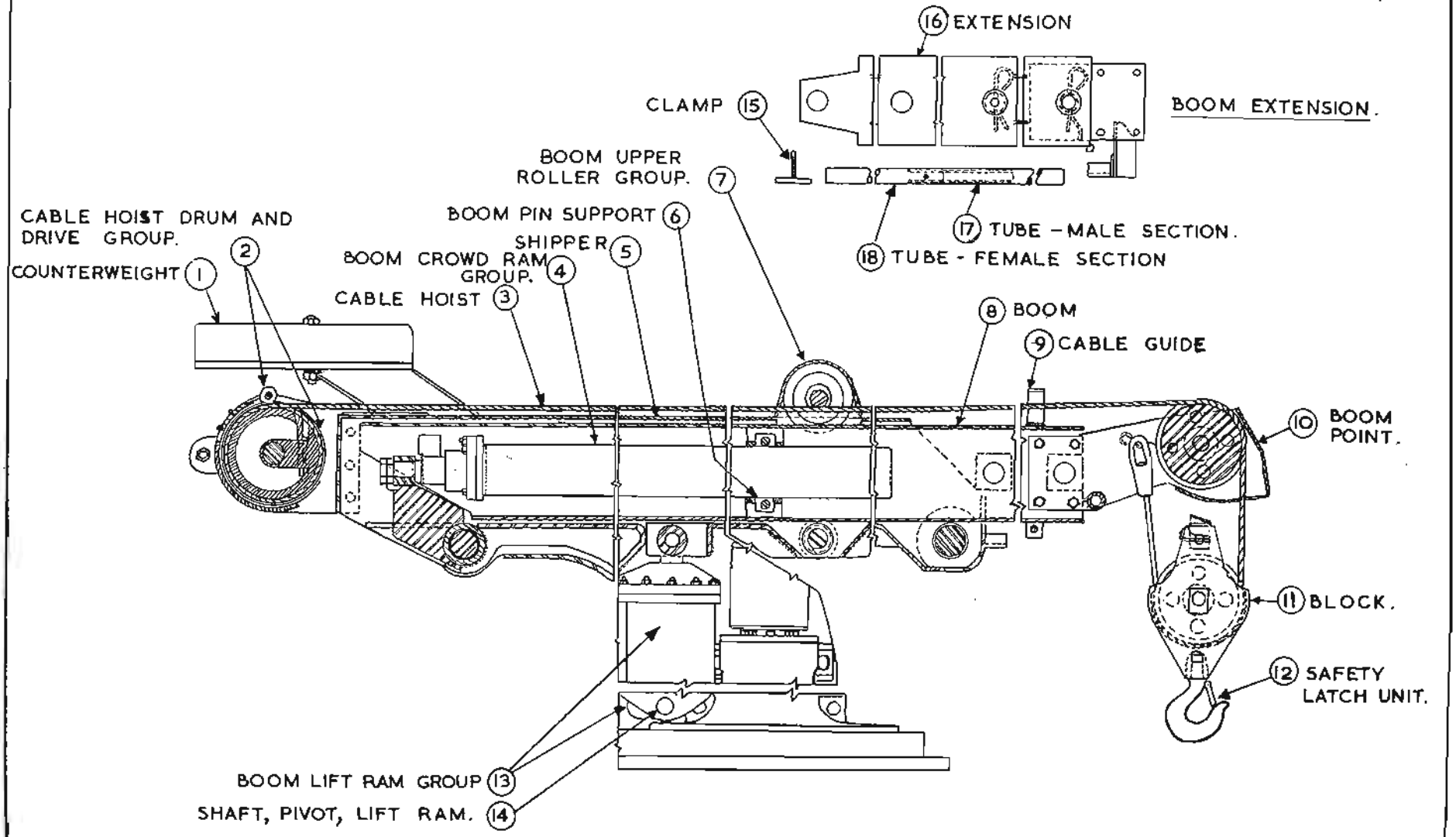


FIG L.122

HYDRAULICALLY – OPERATED CRANE
STACKING LOGS AT THE ROADSIDE

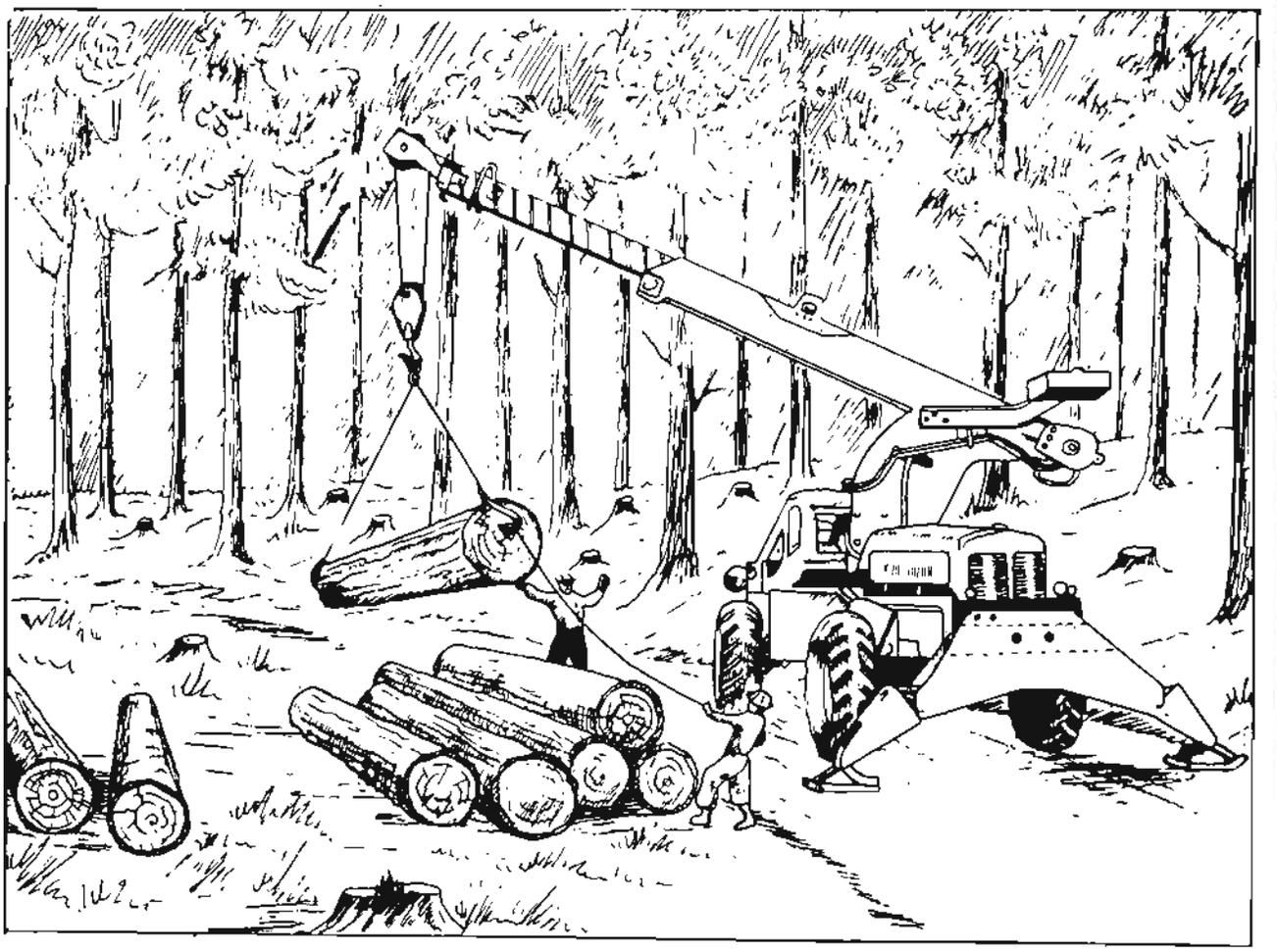


FIG. L.123 TRUCK-MOUNTED CRANE

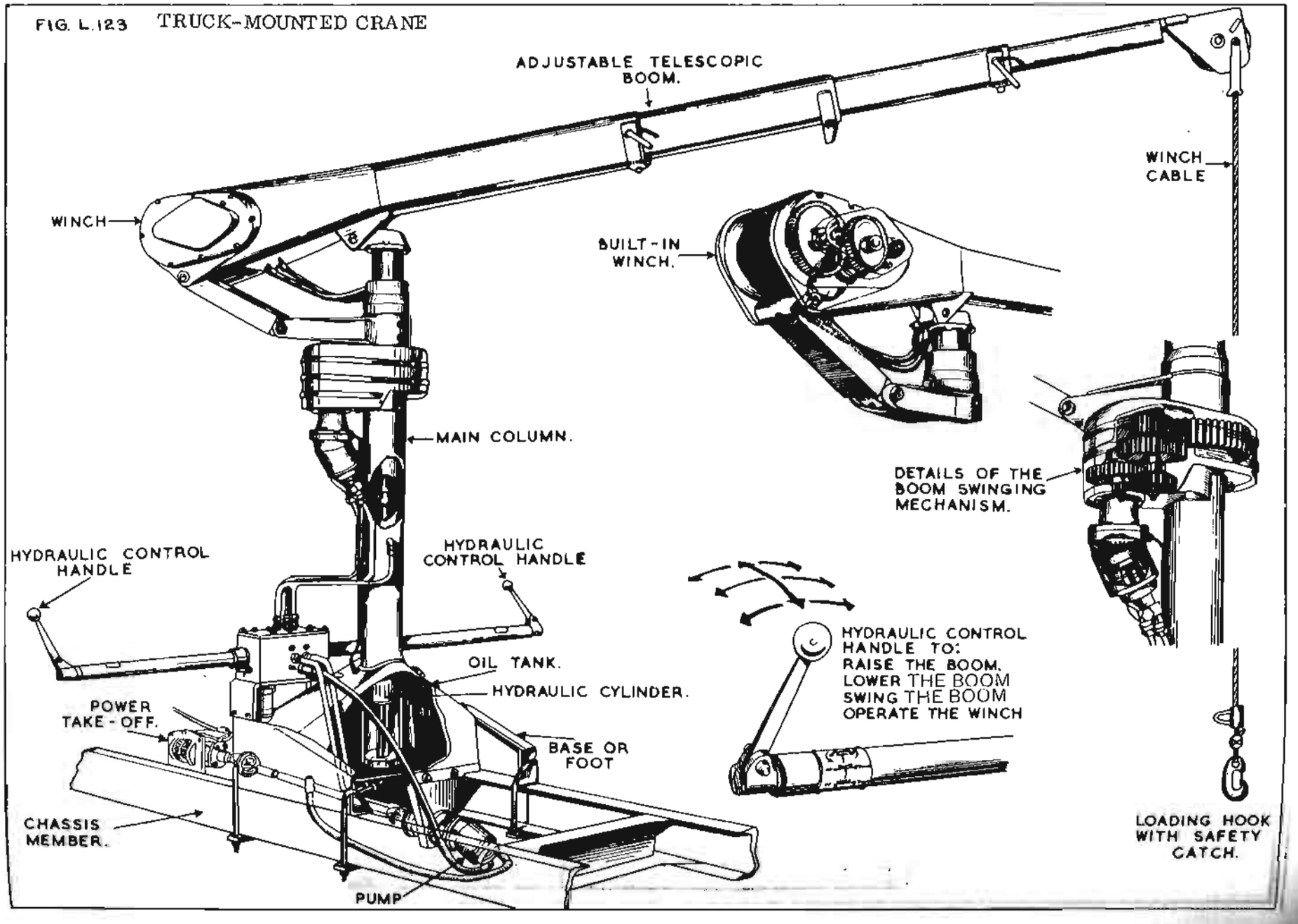
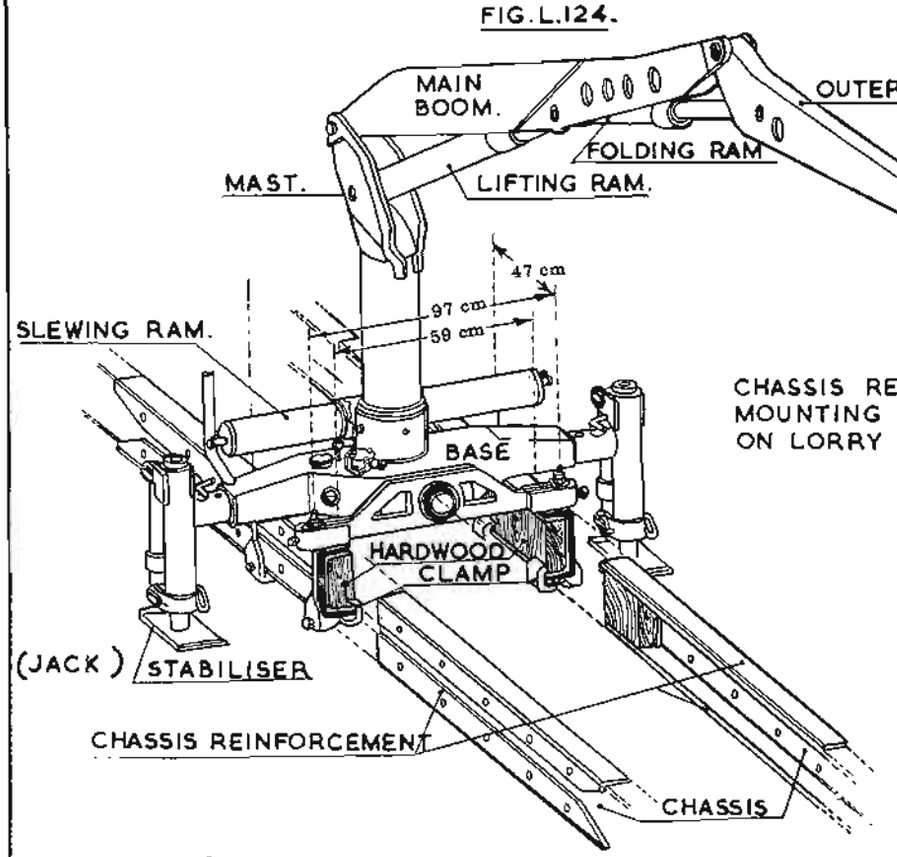
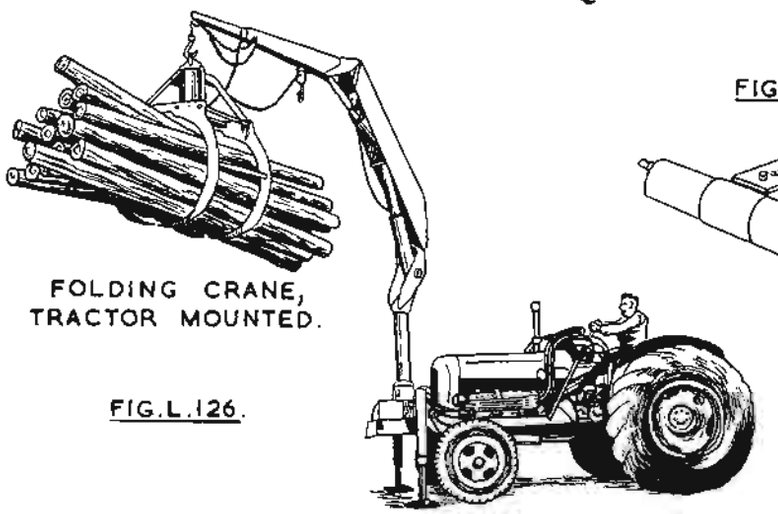


FIG.L.124.



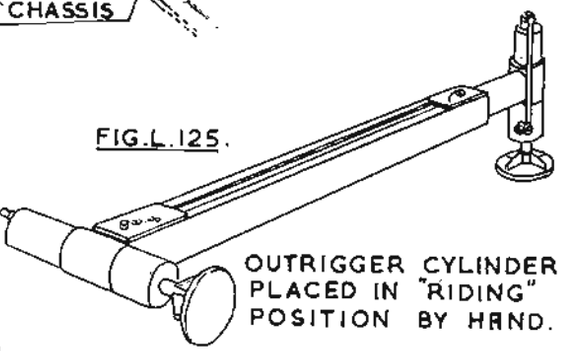
CHASSIS REINFORCING AND MOUNTING OF FOLDING CRANE ON LORRY CHASSIS.



FOLDING CRANE, TRACTOR MOUNTED.

FIG.L.126.

FIG.L.125.



OUTRIGGER CYLINDER PLACED IN "RIDING" POSITION BY HAND.

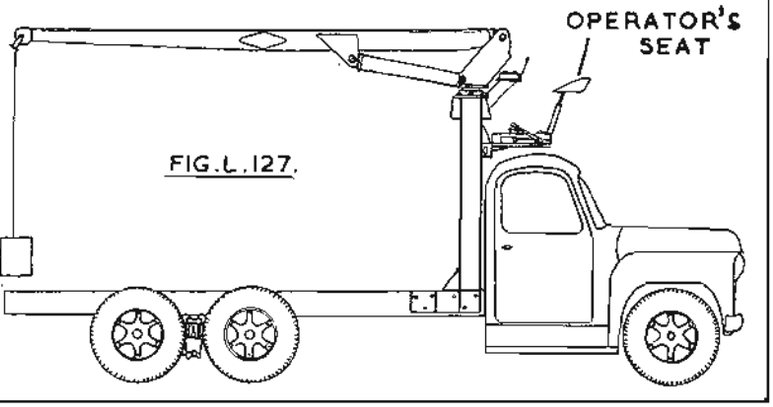


FIG.L.127.

The front end equipment, or boom (Fig. L. 121):

(1) The boom consists of the main hinged part and a telescopic extension, the latter hydraulically operated by means of the ram cylinder housed inside the boom itself. An additional telescoping extension, which is hand operated, is also available if the length of the standard boom is found to be inadequate. When the extensions are in position they are secured by retaining pins.

(2) Bolted to the end of the boom is the boom head.

(3) Raising and lowering the cable hook (via the sheave mounted on the boom head) is by means of the hydraulic motor with the winch drum, mounted on the back end of the boom.

Refer to Appendix L. 5 and L. 6 for departmental requirements and crane cost.

APPLICATION METHOD OF USE:

Because the crane has a telescoping boom operated by a hydraulic ram at the boom base, and also a winch with cable, loads may be lifted in two ways:

1. By hydraulically derricking the boom (i.e. moving it in a vertical plane) by means of the ram, in order to reach and lift the slung load with the boom hook, provided that the load is within the direct boom reach.

2. By setting and maintaining the boom at the desired vertical angle, then using the winch cable for lifting the slung load, hooked to the cable hook.

Besides the loading factors, the telescoping boom also permits the load to be placed in the correct position on the truck without having to adjust the crane or truck position.

Fig. L. 122 illustrates an hydraulic crane in action.

The four-wheel drive and steering (Fig. L. 118) of the short crane carrier is also of great advantage with regard to the movement of the crane over forestry roads, which are usually narrow, as difficulty is usually experienced when lorries have to bypass the cranes, and no turnings have been excavated in the road bank.

The hydraulically-operated crane has been tested by the efficiency section, and the following data obtained:

(a) LONG LOG LOADING

- Average volume per 10 ton lorry load 10,1 m^3 (13, 5 sling loads)
- Average number of logs per load 26, 5
- Average loading time per lorry load 827, 5 sec. (13, 7 minutes)
- Average time per single log load 31, 7 seconds

(b) SHORT LOGS

- Average volume per 10 ton lorry load 9, 5 m^3
- Average number of logs per load 107
- Average number of logs per bundle 5, 36
- Average time per single sling load 73 seconds
- Average number of bundles per load 20

Note : The data refer to the actual loading time for crane movements, and preparation for loading has not been taken into consideration. The purchase cost of the crane is approximately R20 000. The hiring cost of the crane is 444c per actual working hour.

Reliable data for loading operations over a prolonged period are not available as the crane has not been employed for a sufficiently long time.

5. TRUCK-MOUNTED HYDRAULICALLY-OPERATED CRANE FOR SELF-LOADING LORRIES

Refer to Fig. L. 123, 124

A. DESCRIPTION

(1) The design of the hydraulically-operated crane for lorry self-loading consists of a column mounted on a steel chassis, fitted between the chassis members of the lorry. The unit has hydraulically-operated main and articulating booms of folded welded steel construction, with a manually-operated boom extension, secured in place by a safety peg. Hydraulically-operated stabilisers relieve strain on the vehicle chassis while the crane is in operation, and an outrigger arm gives additional stability, particularly on uneven site conditions (Fig. L. 125).

All movements are hydraulically controlled, including slewing through 180°, and 360° for some makes, while more than one movement can sometimes be carried out simultaneously.

(2) The loader fits practically any lorry as only a 30-40 cm clearance is required between the cab and body, for mounting. Mounting the crane on a lorry of less than 5 ton capacity is both unsafe and uneconomical. Fitting is simple, and some makes do not even require drilling, bolting or welding, as they are fixed in place with tension bolts, leaving the chassis practically untouched.

(3) The pump supplying hydraulic power to the crane is usually driven from the power take-off of the gearbox.

(4) The boom may be of the telescoping or folding type. The reach of the standard folding boom is from 3,5 to 4 metres, and this length can be automatically folded behind the cab with some makes, when not in use. A special extension to the

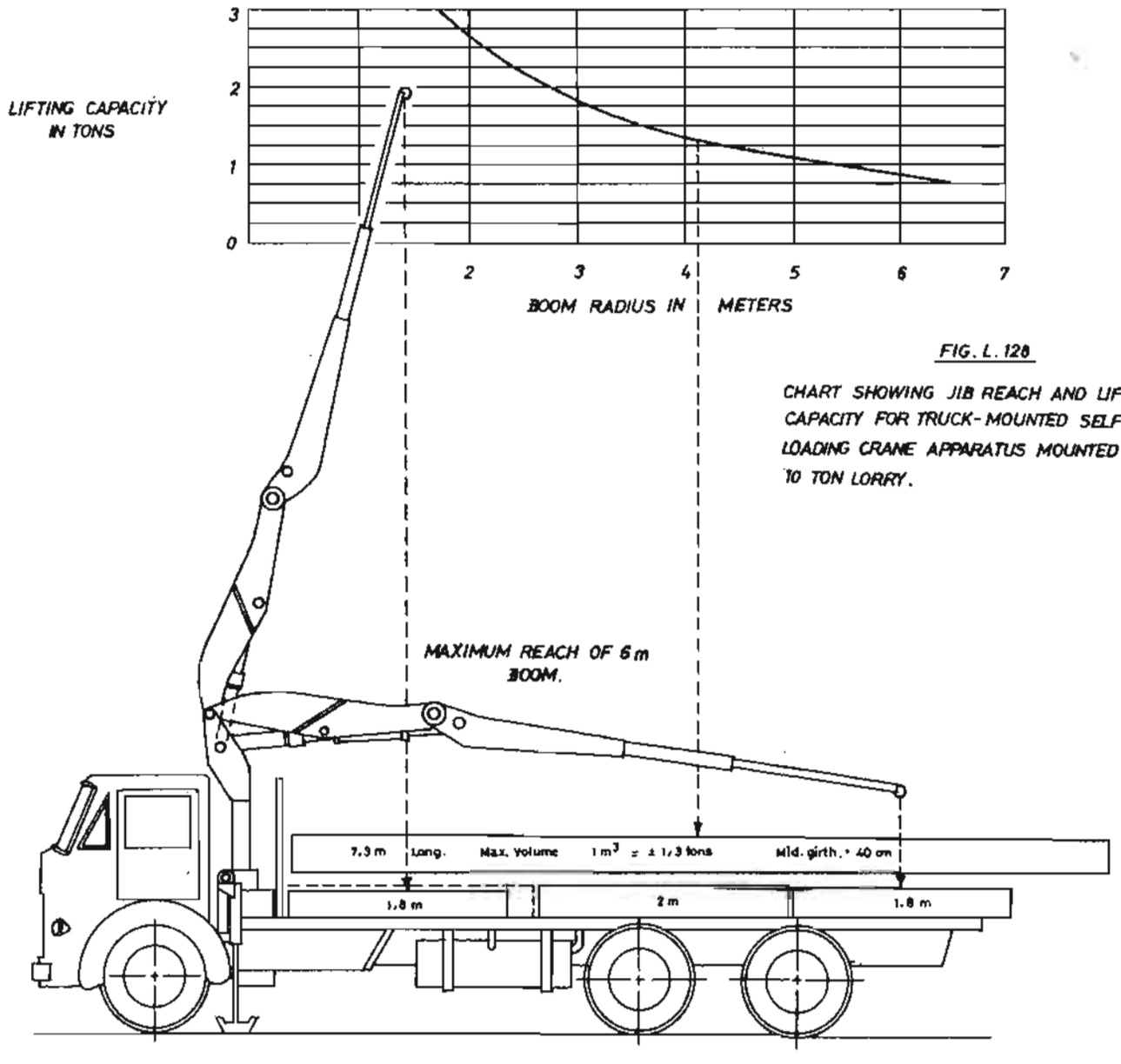
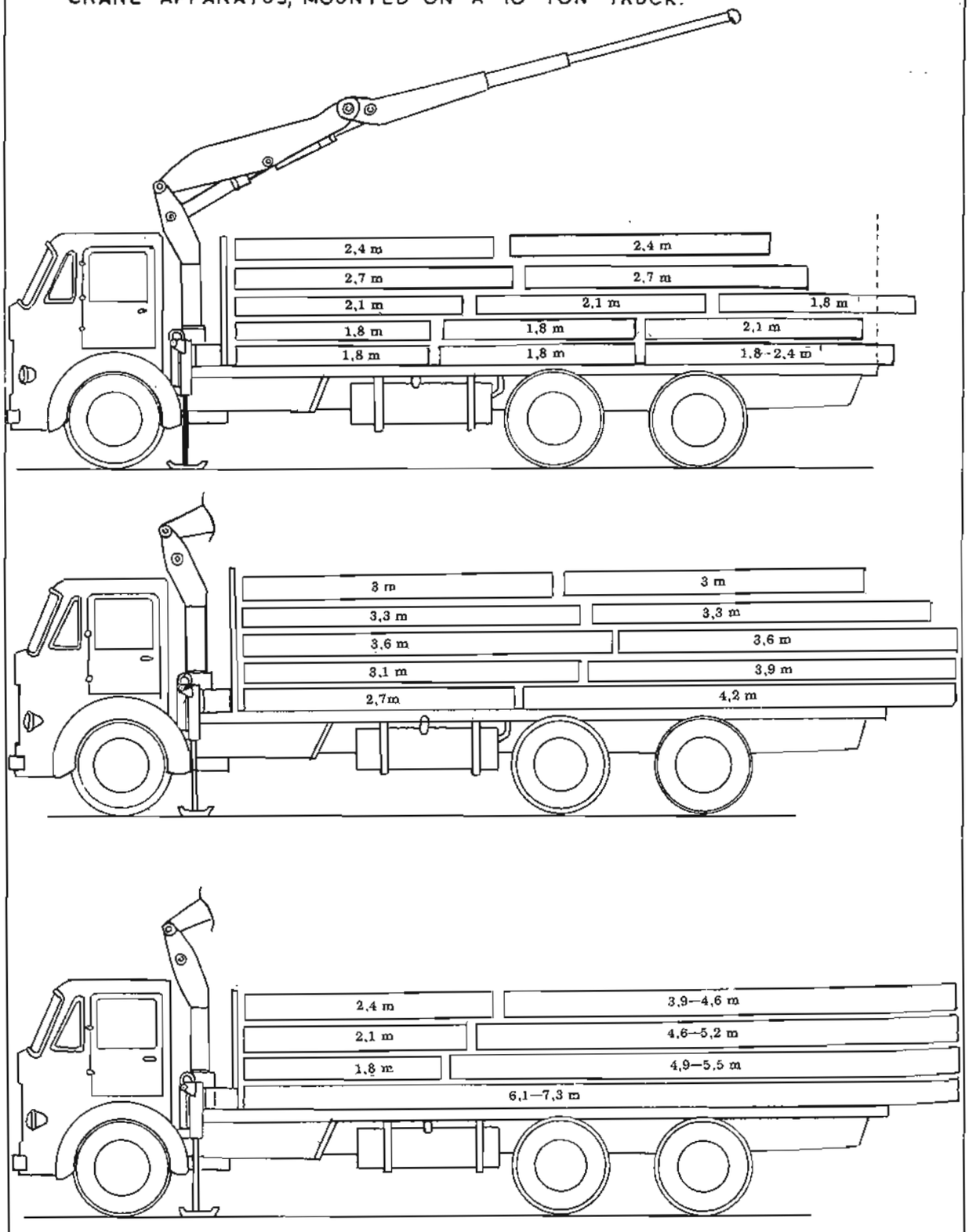


FIG. L. 128

CHART SHOWING JIB REACH AND LIFTING CAPACITY FOR TRUCK-MOUNTED SELF-LOADING CRANE APPARATUS MOUNTED ON A 10 TON LORRY.

FIG. L. 129

DESIRABLE LOADING ARRANGEMENTS WHERE ALL LOGS ARE WITHIN THE JIB REACH AND LIFTING CAPACITY FOR TRUCK-MOUNTED SELF-LOADING CRANE APPARATUS, MOUNTED ON A 10 TON TRUCK.



NOTE: EACH TIER OF LOGS REPRESENTS THE PLAN FOR A FULL LOAD.

boom may be obtained to lengthen the reach to 6 metres, but the extension must be extended or retracted by hand. A boom with attached extension cannot be folded behind the cab, but in the "travelling position" it may rest on the lorry deck, log bunk or load. Some hydraulically-operated booms are rigid when fixed in any position, so when resting on top of a load during travelling, they will be subjected to considerable shaking. In consequence wear on the crane may be greater during travelling than during the actual loading operation. The boom may be operated from both sides of the lorry, but some manufacturers provide an arrangement facilitating control from the top of the drivers cab (Fig. L. 127).

(5) A hook is fitted to the end of the standard boom, to which the loading rig is attached. The following auxiliary equipment may be used with this crane for log loading:

(a) Crotch-type two or four leg chain loading sling assemblies with end hooks, for loading heavy or medium logs respectively, heavy logs being loaded singly and medium logs two at a time.

(b) Crotch-type two leg wire rope slings with sling hooks, for loading small sized logs in bundles.

Note: It is advisable to use tag lines with both of the above assemblies for better control and load placement.

(c) Grabs, hydraulically-operated, for loading small logs in bundles.

(d) Loading tongs, for loading single logs.

Details of the above auxiliary items have been described in the section on crane auxiliary equipment.

B. PROBLEMS

The main problems with this crane are associated with its short reach, due to the standard boom length of between 3,5 - 4 metres (6 metres with additional extension). All logs must be stacked close to the road within reach of the crane boom. If specially requested, some manufacturers equip the units with a winch and cable, but as the winch is hydraulically operated, its maximum pulling speed is low (12 - 30 metres per minute) and winching outside logs to within reach of the boom is a slow and time-consuming process.

When winching logs, particularly if jerks may occur, the jib must be set exactly in line with the pull or else it may be damaged, as it is prevented from adjusting itself by the rigidity of the hydraulic system.

Paying out the rope from the drum to the logs is usually done hydraulically, and at the same slow speed as winching in logs. Some manufacturers, if requested, will install a winch with a free revolving drum, so that the hooking crew can pull out the line and hooking assembly to the outside logs of the stack at the speed of a walking man.

Taking the limited reach of the crane jib and the slow winch line pull into consideration, it is important that logs be stacked within reach of the jib and no extension of the winch cable is required. In this way auxiliary loading equipment such as loading slings, tongs, etc., can be hooked directly to the boom hook, attached to the tip of the boom. Crane efficiency can be achieved if each load is as close to crane capacity as possible. Long logs, 5 - 6 metres in length and of a volume within the crane capacity, also increase loading efficiency.

Fig. L. 128 shows the boom reach and lifting capacity for truck-mounted self-loading crane apparatus mounted on a 10 ton truck, and Fig. L. 129 shows desirable loading arrangements where all logs are within reach of the boom, and within the lifting capacity of the apparatus mounted on a 10 ton truck.

C. DEPARTMENTAL REQUIREMENTS

In general the departmental requirements are the same as for the standard truck-mounted cranes, with the following additional requirements:

(1) A 360° power traverse and an adjustable articulate boom with a maximum reach of 6 metres.

(2) A lifting capacity of 900 kg at a radius of 4,5 metres from the centre column.

(3) Loading to be done in humid areas under dusty conditions, so filters must be incorporated where required.

(4) Safety devices must be provided against overloading, hose failures, over elevation, and rapid lowering of the load.

(5) Controls must be dual operated from either side of the vehicle or from the top of the cab, where an unrestricted view of the operation is permitted.

(6) It is desirable that the crane be able to fold up completely behind the driver's cab for travelling, and should in no way encroach on the loading space.

(7) The crane must be mounted just behind the driver's cab.

(8) The maximum reach of the boom to be not less than 6 metres from the centre line of the column, and the boom shall be capable of lifting 2 metre logs from alongside the truck at ground level and stacking them on the truck in front of the column at a height of not less than 1,2 metres, but 1,8 metres is desirable. The boom must be under full control in any position of the truck and safe-guarded against uncontrolled swing. The boom must also have a lift of at least 4,8 metres above the bed of the truck to extract slings from beneath the load disposed on the lorry deck.

(9) A winch should be provided to permit logs to be skidded to within reach of the boom tip. Lifting of logs must be done through the cable by the hydraulically-operated boom, and not by the winch. The winch drum must be free spooling and it

FIG.L.130

CRANE JIB REACH OF SELF-LOADING LORRY.

FIG.L.131

FIG.L.132

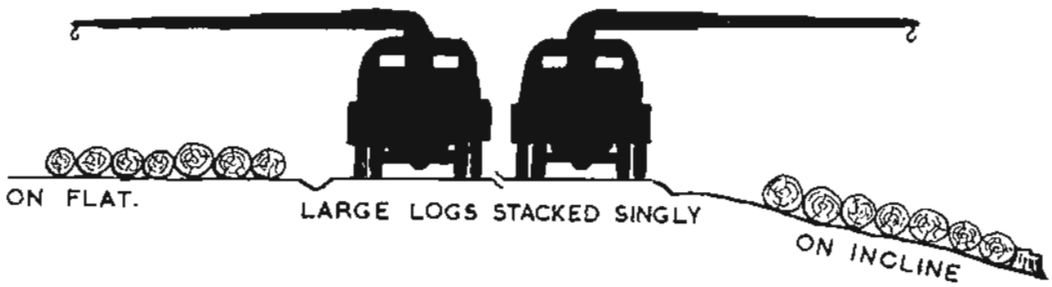


FIG.L.133

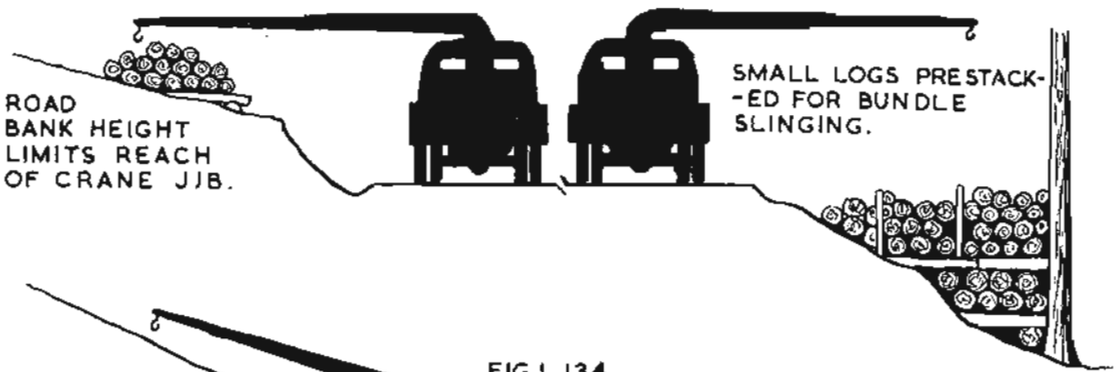
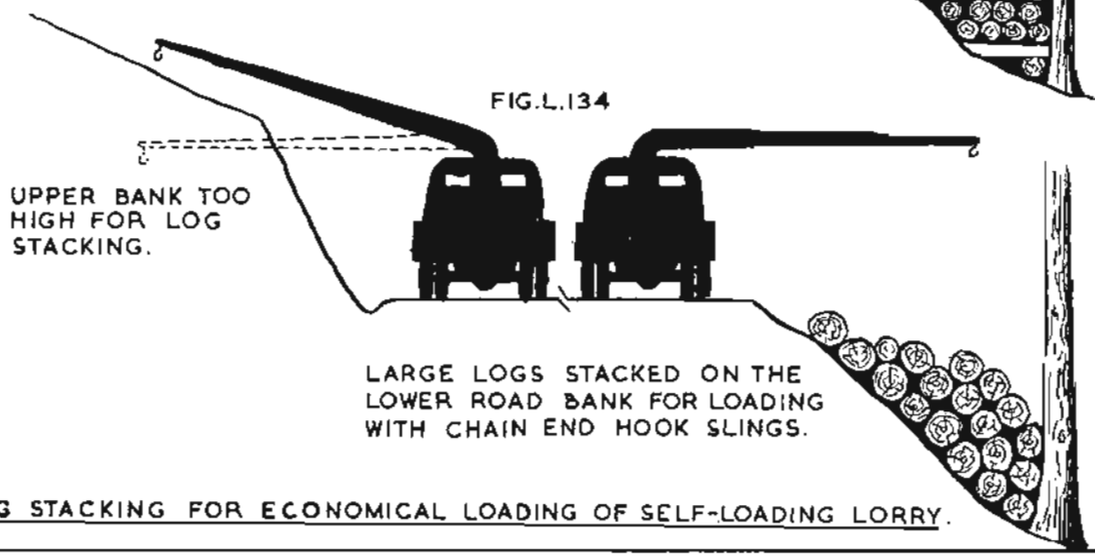


FIG.L.134



LOG STACKING FOR ECONOMICAL LOADING OF SELF-LOADING LORRY.

must be possible for the line hook and cable to be pulled out freely. The slow, power-operated return is unacceptable.

The winch must be of strong construction, fitted with ball and/or roller bearings throughout and equipped with a suitable brake. A safetydevice to guard against possible overloading shall be incorporated in the winch, which shall conform to the following requirements:

(i) Maximum lift and pull not less than 900 kg.
(ii) Maximum cable capacity: 18 metres of 13 mm cable.
(iii) Line speed: Not less than 21 metres per minute, but 54 metres is ideal.

(10) Outrigger shall be of sturdy construction, equipped with jacks and floats capable of being retracted for travelling.

(11) The paint work shall have a high quality gloss finish and be comparatively resistant to scratches and abrasions.

(12) A full set of quality tools to fit every nut and bolt of the crane shall be supplied.

D. LOADING BY SELF-LOADING LORRIES

The success of a log loading operation is dependent on the following factors:

(1) On the total volume available for loading and its distribution.

(2) Daily loading requirements.

(3) Configuration of the terrain, which influences log stacking at the roadside.

(4) Selection of the proper crane for the existing conditions, also taking into consideration the size (length and volume) of the logs to be loaded.

(a) PREPARATORY STEPS FOR LOG LOADING

Logs are skidded from the compartment to the closest point at the roadside and stacked in two ways for self-loading lorries:

(1) Logs stacked along the upper or lower road banks in narrow stacks, within direct reach of the crane boom.

(2) Where only limited stacking space is available along the roadside, logs are stacked in extended stacks, within reach of the winch cable.

The former case provides for convenient loading, while the second case is less convenient for loading by self-loading lorry. This arrangement makes for saving on reduced skidding distances, although it may not be ideal from the loading point of view, and damage to the road bank or surface is eliminated.

Some contractors, however, who use self-loading lorries, not equipped with winches, have contracted to load departmental logs, but they require that logs be stacked level with the road surface or slightly below it. Stacking on the upper road bank is accepted only if the bank height is negligible and the approach to the roadside is gentle. All logs must be within reach of the crane jib.

For comparative purposes with the self-loading lorry it is not merely sufficient to observe the loading operation itself, but consideration must also be given to the accompanying skidding conditions, log disposal and prestacking in order to obtain a clear picture of the operation. Only then can costs for the applied operation be determined.

Some methods of log prestacking for economical loading under various conditions for loading by self-loading lorries are illustrated in Fig. L. 130 to 134. Only the correct location of logs has been shown in the illustrations, and any deviation from this pattern of stacking will necessitate rolling the logs towards the crane or winching the logs in, both methods being slow and costly. There are, none the less, occasions where one is compelled to load under such adverse conditions.

The following factors have an adverse effect on the operation:

(1) If the self-loading lorry stands on a steeply inclined road.
(2) If the logs are stacked on a steep upper road bank.
(3) If the slings used are too long or too short.
(4) If stacks are deep in extent and the outside logs are beyond the reach of the crane jib and have to be rolled or winched towards the lorry.
(5) If short logs have to be loaded in short stacks, one behind the other, on the lorry deck or log bunk. In this case loading occupies almost twice as much time as would be the case for long logs.

Note: For item (4) two additional labourers are required.

(b) LOADING OPERATIONS

An attempt is made below to present some loading operations by self-loading lorries under different conditions, with outputs and costs. In some instances only isolated cases were observed, but the results are still of interest for comparative purposes.

(c) TIMING THE ELEMENTS IN ONE LOADING CYCLE, USING A CRANE WITH FOLDING BOOM

The log was positioned on the road, near the lorry, and chain slings with end hooks, adjusted to suit the length of the loaded log, were used. The cycle below is for loading a single log:

Hooking the log	18 sec.
Lifting the log	15 sec.
Slewing	8 sec.
Lowering on to lorry deck	11 sec.
Unhooking	4 sec.
Slewing and lowering the sling for the next log	14 sec.
Total cycle time	1 min. 10 sec.

Under ideal conditions the loading of a load of logs 5 metres and over in length and not less than 25 - 40 cm top diameter can be accomplished in 22 to 30 minutes, including the preparatory steps of lifting the crane boom from the folded position, lowering the jacks, hanging the loading rig on the boom hook and adjusting the length of the chain slings. Preparatory steps occupy about 6 minutes. The time of lorry movement from stack to stack is not included.

A similar observation to the above was made where a 7 ton lorry was loaded by its own self-loading crane, with a telescoping boom. Seventeen long logs having a mass of 6 ton were loaded in 30 minutes, including 8 minutes spent in preparing the crane for loading.

A similar crane, mounted on an 8 ton lorry, was observed in operation and the following observations were made:

Lowering the boom to the logs	20 sec.
Slinging and hooking prestacked bundles of logs	45 sec.
Lifting the load (logs in bundles)	33 sec.
Slewing the load	21 sec.
Unhooking slings from sling hook	15 sec.
Extracting slings from beneath load	21 sec.
Delay	35 sec.
Total time for this cycle	3 min, 10 sec.

This particular lorry load was made up as follows:

24 logs - 1,8 m x 15 - 30 cm	1,87 m^3
12 logs - 2,1 m x 15 - 30 cm	1,21 m^3
22 logs - 2,4 m - 2,7 m x 12 - 30 cm	1,51 m^3
11 logs - 2,7 m - 3 m x 15 - 30 cm	1,50 m^3

Total : 6,09 m^3 = 7 ton

E. SPECIAL CASE: FOLDING CRANE: WHEEL-TRACTOR MOUNTED (Fig. L. 126)

The above unit was privately owned, and used for loading a 10 ton lorry, using loading tongs. The following observations were made:

Clearfelled area, flat. Logs were rolled to the side of a lane and were easily accessible Brush and branches were stacked out of the way to one side.
Average log: 0,37 m^3 = 415 kg
Lorry load: 29 logs = 10,7 m^3 = 12½ ton
Loading time: 16 minutes 45 seconds
Private loading crew: 1 operator plus 3 labourers.

(a) COMMENTS

The following data relating to the clearing of lanes, stacking of brush and rolling of logs to the lanes were obtained and costs estimated:

(b) CONDITION

Average tree yields 1,7 m^3 of merchantable timber.
Number of logs per tree: 5.
Volume of average log: 0,3 m^3

(c) LOG SKIDDING BY MULES

Task given to a gang of 40 men to roll 80 trees (in logs) to the lanes.
400 logs - 136 m^3 rolled an average distance of 3 metres.
136 m^3 ÷ 40 men: 3,4 m^3 per unit.
Delivery of trees or logs to the lane by two-mule team with 2 labourers:
40 trees delivered daily by 8 mules, i.e. 5 trees per two-mule team.
5 trees @ 1,7 m^3 = 8,5 m^3 ÷ 2 mules = 4,25 m^3 per mule.

Costs:	1 mule @ 40c	40c
	1 labourer @ 67c	67c
		107c

107c ÷ 4,25 = 24,7 c/m^3 ..... (A)

(d) STACKING OBSERVED FOR 2 HOURS 30 MINUTES

9 men rolling, assisted by one man with axe - 10 men.
Volume rolled during 2½ hours, and partly stacked: 6,8 m^3
Volume rolled during 6 hour working day: 16,5 m^3
16,5 m^3 ÷ 10 men = 1,65 m^3 per man/day.
Wages per unit: 67c ÷ 1,65 m^3 = 38,8c/m^3 ... (B)
(A) + (B) 24,7c + 38,8c = 63c/m^3

(e) LOADING COST

Privately-owned folding crane, wheel-tractor mounted, loading a 10 ton lorry.

(1) Tractor hiring cost (departmental scale) per working hour:	124c.
Crane hiring cost (departmental scale) per working hour:	98c.
Total cost of the assembly per hour	222c.

222c ÷ 60 minutes = 3,7c per minute.

Loaded one lorry (10,8 m^3) - 16 minutes @ 3,7c = 59,2c per load ..... (C)

(2) Crew

(i) 1 European operator per day	500c.
3 labourers @ 70c	210c.
Total daily	710c.

(ii) Actual loading time: 16 min. per load of 10,8 m^3
Number of loads loaded per day: 118,3 m^3 ÷ 10,8 m^3 = 11 loads

710c ÷ 11 loads = 64c ..... (D)
(C) + (D) = 59,2c + 64c = 123c per load
123 ÷ 10,8 m^3 = 11,4 c/m^3 ..... Loading

(f) TOTAL COST PER CUBIC METRE FROM STUMP TO LOADED LORRY

Log slipping by mule	24,7 c/m^3
Log stacking by hand	38,8 c/m^3
Log loading by crane	11,4 c/m^3
Total	74,9 c/m^3

FIG. L.135

LORRY MOUNTED SELF LOADING
CRANE ATTACHMENT.

HAVING PLACED THE TOPS IN POSITION, THE ASSISTANT HAS RELEASED THE BUTTS WHILST THE OPERATOR RAISES AND TRAVERSES THEM OVER THE STANCHION.

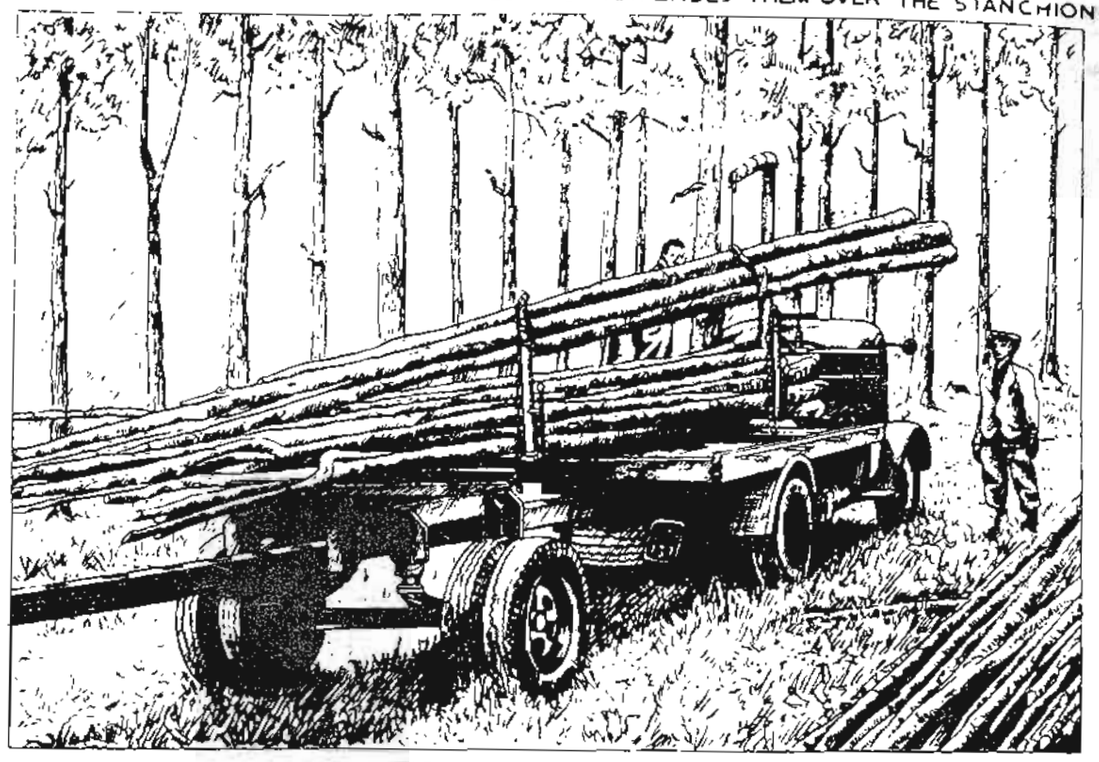
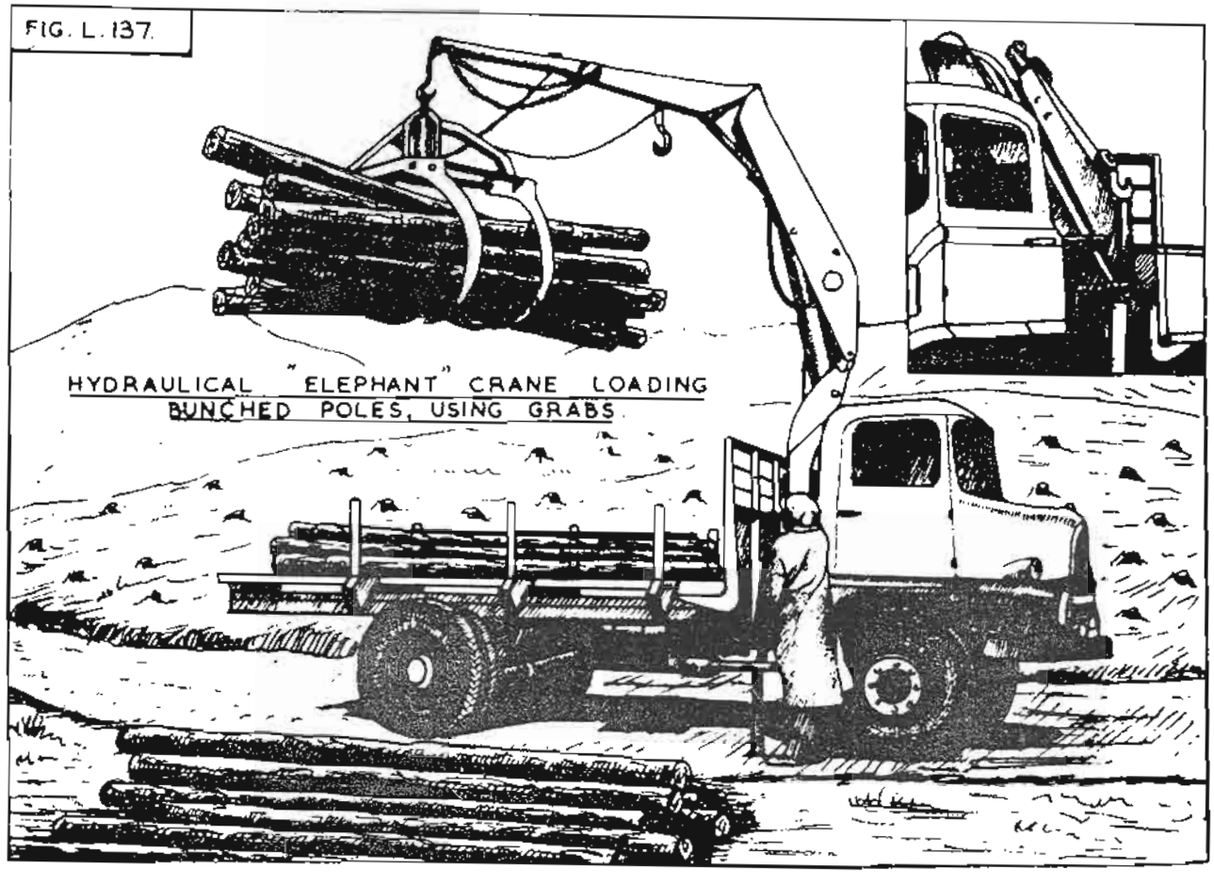


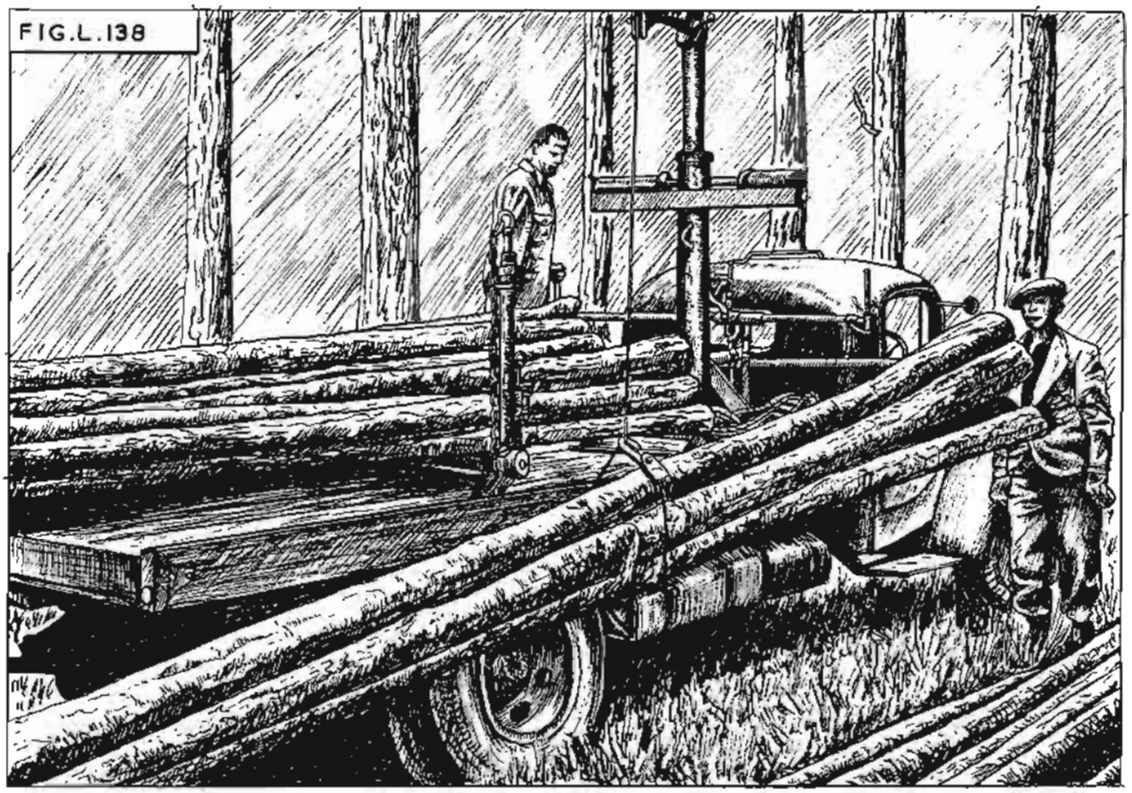
FIG. L. 136

FIG. L. 137.



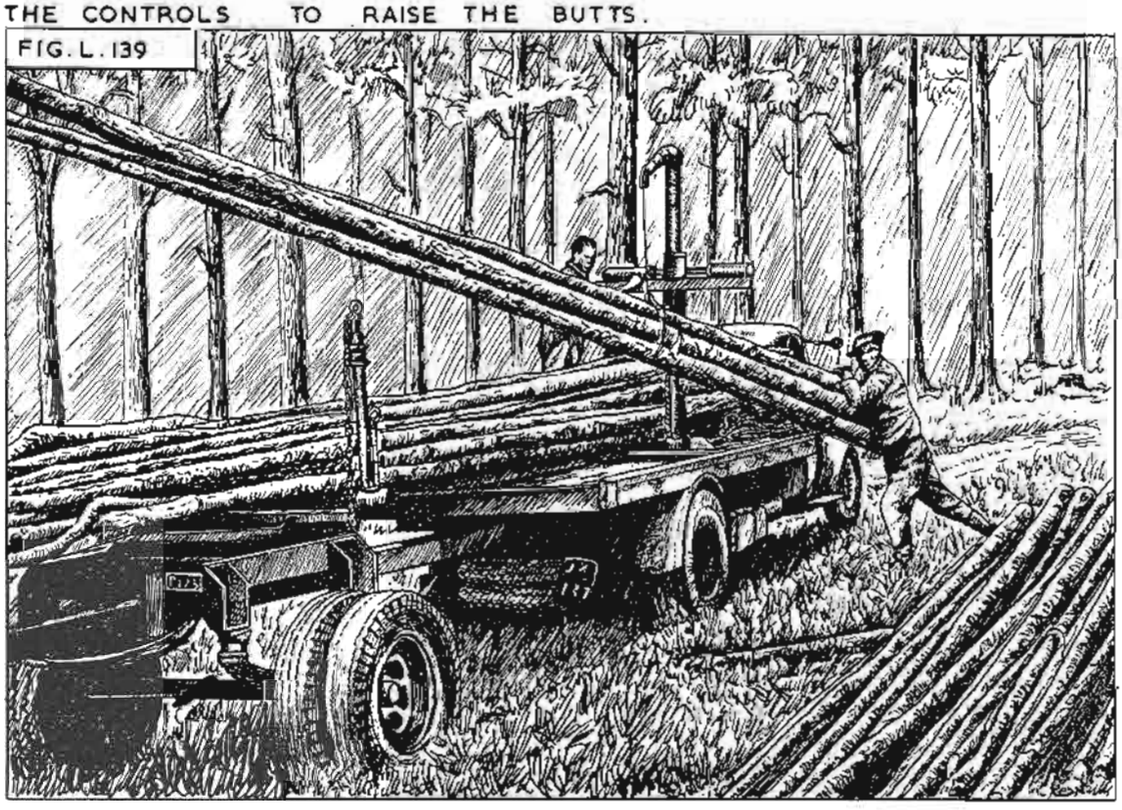
HYDRAULICAL "ELEPHANT" CRANE LOADING BUNCHED POLES, USING GRABS.

FIG.L.138



THE ASSISTANT HAS ATTACHED THE CABLE JUST TO THE BUTT-END OF THE POINT OF BALANCE. HE STANDS BY WHILE THE OPERATOR OPERATES THE CONTROLS TO RAISE THE BUTTS.

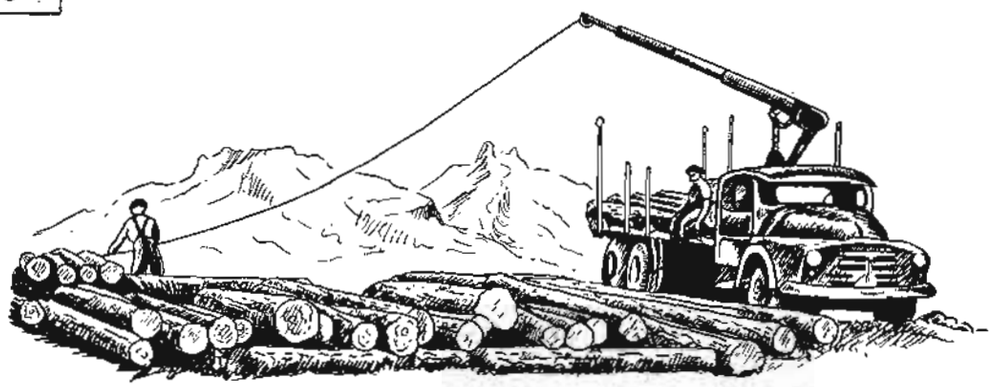
FIG.L.139



ASSISTANT IS NOW PRESSING THE BUTTS DOWN TO RAISE THE TOPS ABOVE THE HEIGHT OF THE SIDE STANCHION. THE OPERATOR IS AT THE TIME LIFTING AND TRAVERSING THE JIB.

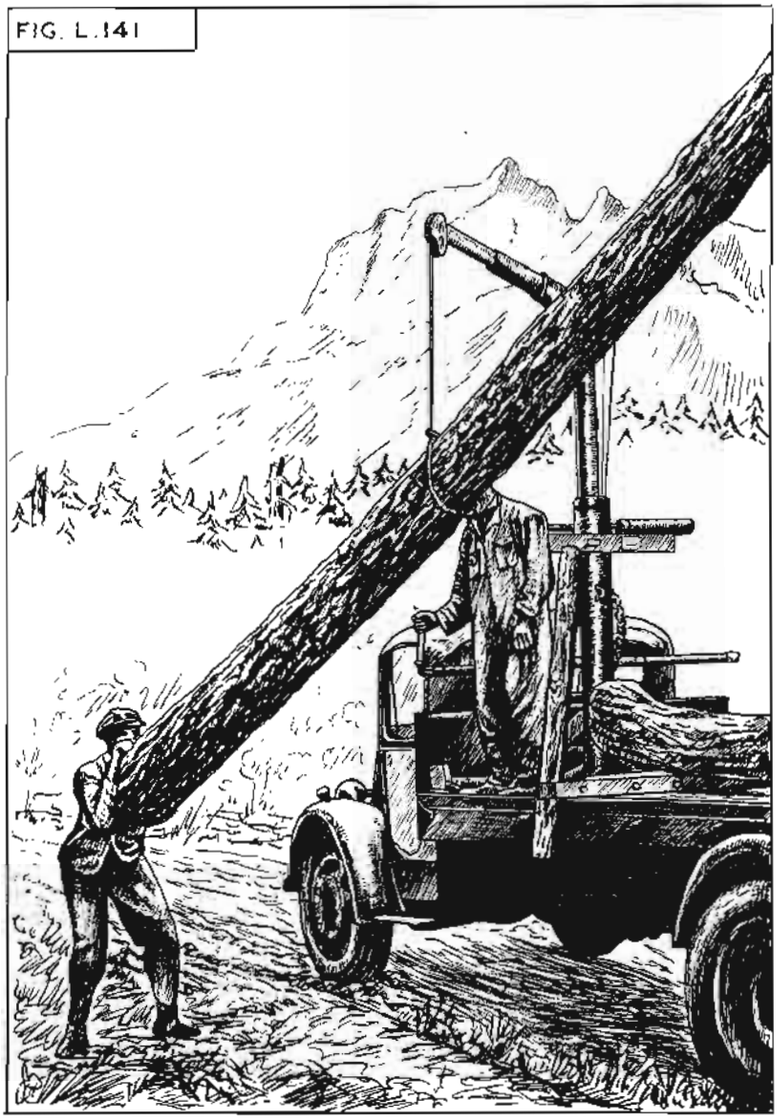
SELF-LOADING LORRY ATTACHMENT LOADING LONG POLES IN BUNCHES

FIG. L.140



SELF-LOADING LORRY ATTACHMENT WITH DRUM AND EXTENDED REACH WIRE ROPE

FIG. L.141



HEAVY, LONG LOGS UP TO 0,5 TONS CAN BE LOADED SINGLY BY SELF-LOADING LORRIES. HERE THE ASSISTANT IS PRESSING DOWN ON THE BUTT WHILST OPERATOR LIFTS AND TRAVERSES

FIG. L.142

LORRY-MOUNTED CRANE LOADING MEDIUM SIZED LOGS, END HOOK CHAIN SLINGS.

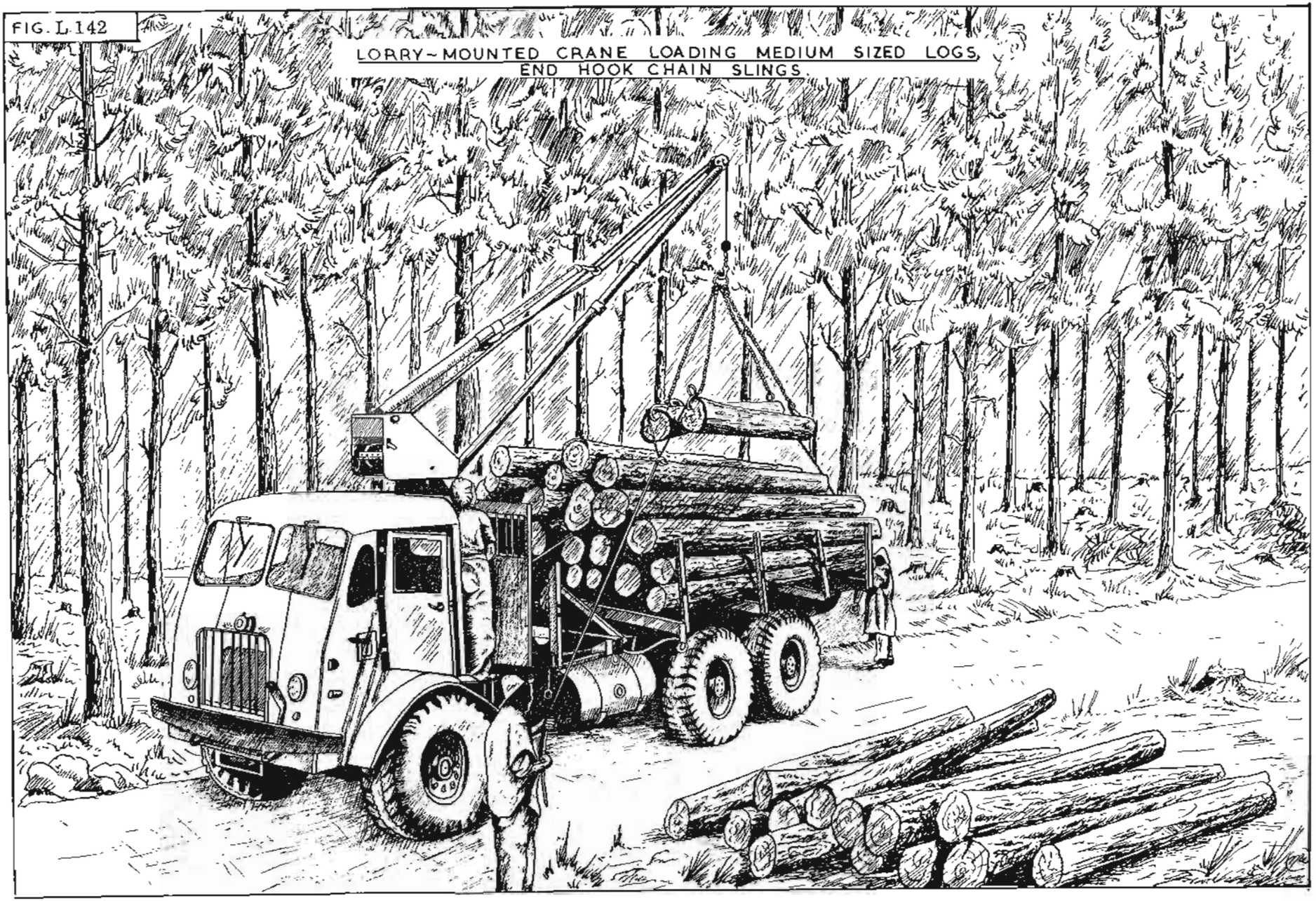
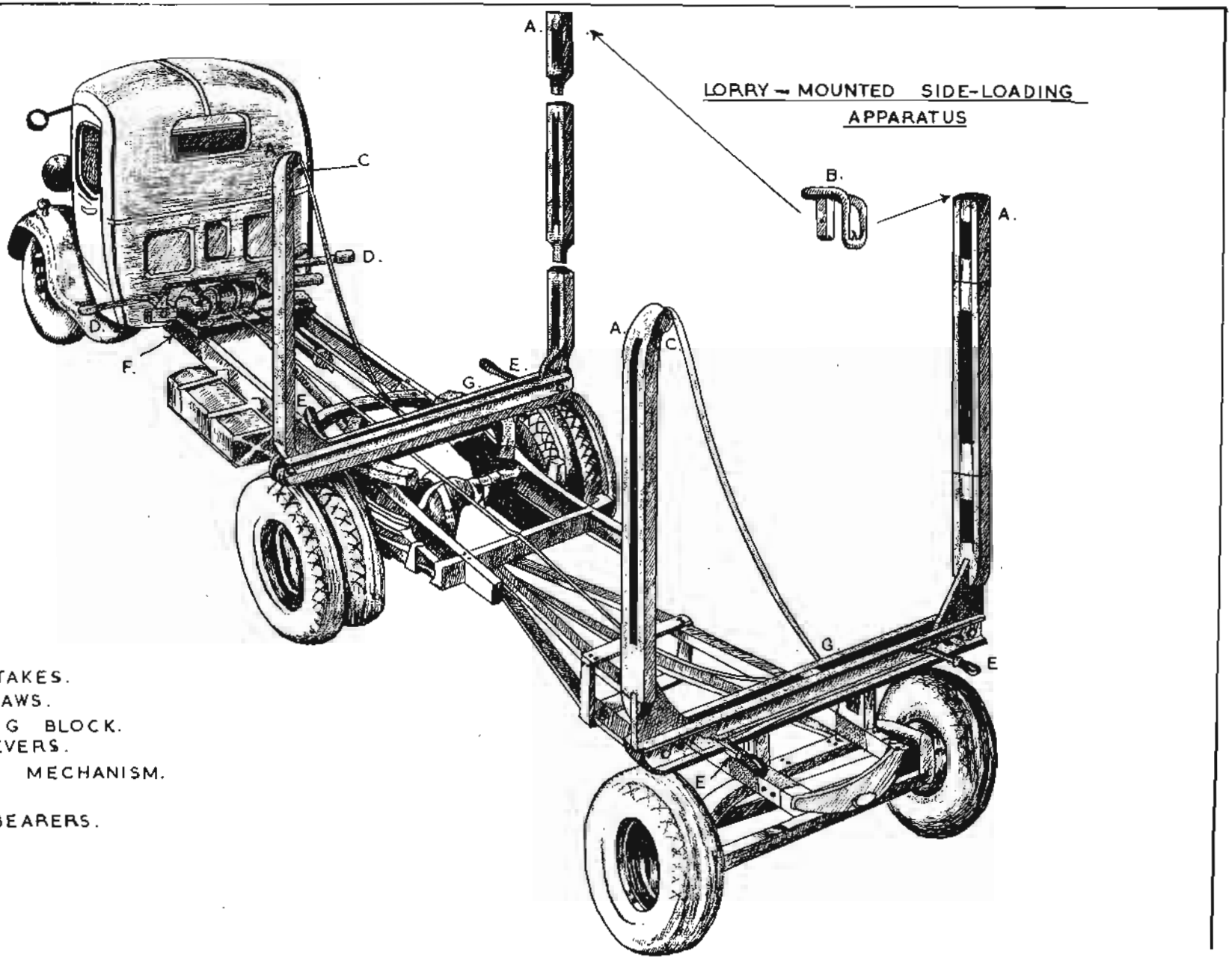


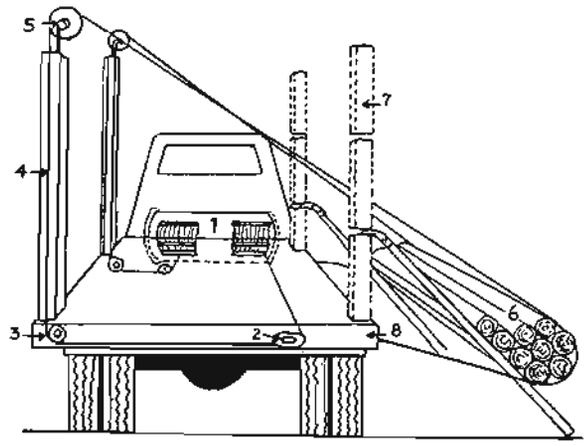
FIG. L.143



A. CRANE STAKES.
B. SHARK JAWS.
C. REVOLVING BLOCK.
D. DRUM LEVERS.
E. TRIPPING MECHANISM.
F. WINCH.
G. CROSS BEARERS.

FIG.L.144

DETAILS OF LORRY SIDE-LOADING APPARATUS.



(1) P.T.O. DRIVEN VIA A DUPLEX CHAIN. THIS WINCH HAS ELECTROMAGNETICALLY-CONTROLLED DUAL DRUMS.

(2) HORIZONTAL GUIDE SHEAVES.

(3) VERTICAL GUIDE SHEAVES.

(4) INTERCHANGEABLE STANCHION ALLOWING LOADING FROM EITHER SIDE.

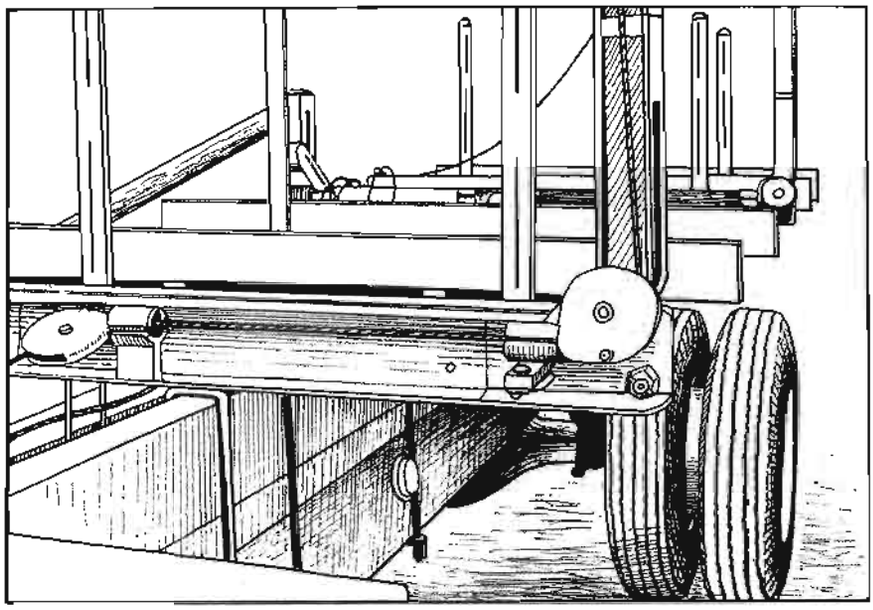
(5) ARTICULATED TOP SHEAVE.

(6) 9 mm STEEL WIRE ROPE LOOP.

(7) SECTIONAL STANCHION FOR ADJUSTABLE LOADING HEIGHT.

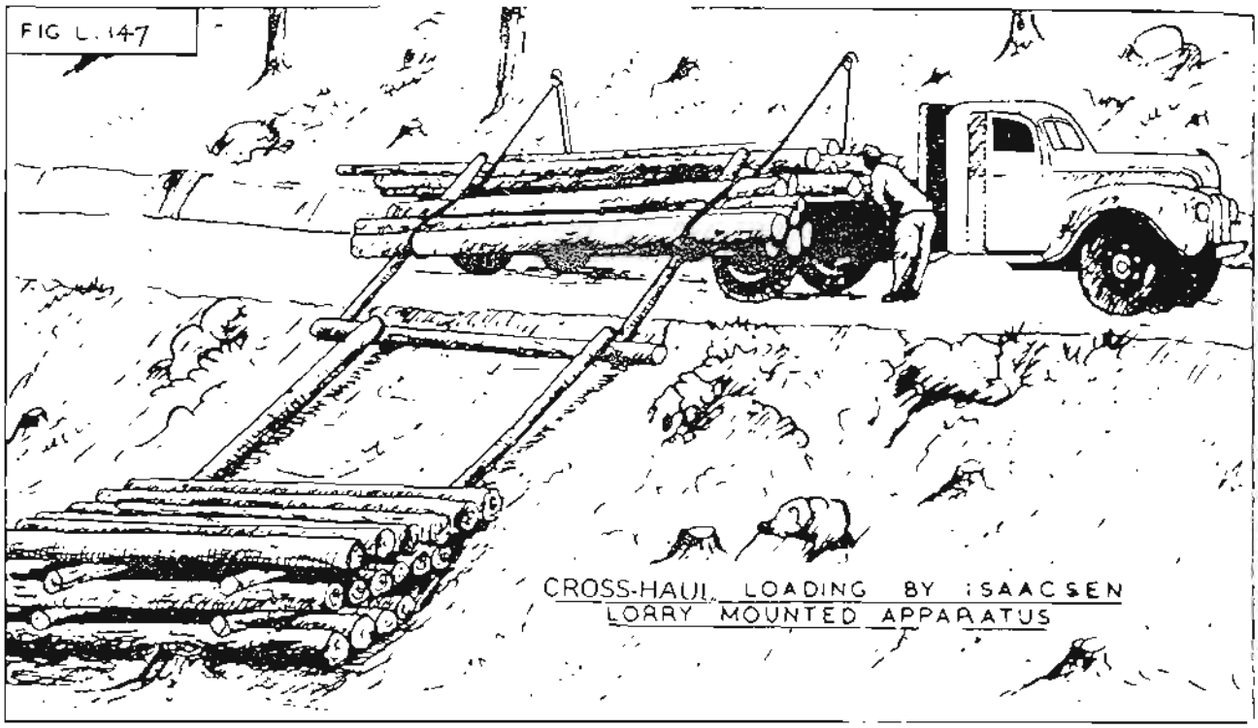
(8) SWIVEL DROP ACTION STANCHION MOUNTING FOR FAST UNLOADING.

FIG.L.145



SOME DETAILS OF FAIRLEADER POSITIONS ON LOG BUNK MEMBERS FOR DEVIATION OF CABLE FROM THE WINCH DRUM TO THE UPPER STANCHION FAIRLEADER.

FIG L.147



CROSS-HAUL LOADING BY ISAACSEN
LORRY MOUNTED APPARATUS

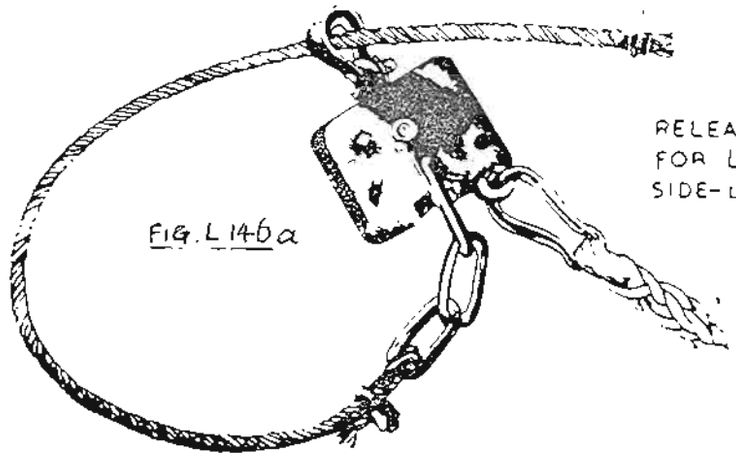
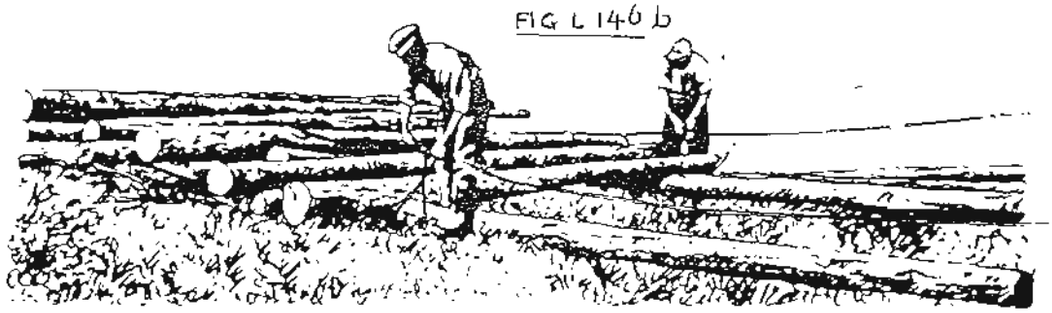


FIG. L 146 a

RELEASER MECHANISM
FOR LORRY-MOUNTED
SIDE-LOADING APPARATUS :

FIG L 146 b



SLINGING A BUNCH OF POLES USING THE RELEASER MECHANISM

F. SOME REMARKS RELEVANT TO LOG LOADING METHODS USING TRUCK-MOUNTED LOADING APPARATUS WITH HYDRAULICALLY-OPERATED BOOM

(a) SHORT LOG LOADING (Fig. L. 135)

(1) Logs loaded in bundles with two-leg wire rope slings

It is advisable that logs be prestacked in sling-size bundles. The stacks may be located a short distance from the roadside if the crane has a winch and cable, otherwise stacks must be close to the roadside and within direct reach of the crane boom. Logs are slung, lifted and transferred to the lorry deck without difficulty, control being done by hand, but preferably by means of tag lines, for safety reasons.

(2) Logs loaded with hydraulically-operated grabs (Fig. L. 137)

Grabs are apt to take a capacity load of logs from a large stack; so small logs have to be prestacked for faster loading and logs to be loaded to be within reach of the crane boom with grabs. Although the grabs may be attached to the winch cable line hook, if used, they cannot be carried any great distance to the logs by hand due to their mass, and if they are dragged along the ground with a load they may be damaged. Apart from this, with hydraulically-operated grabs the hydraulic control tubes attached to the grabs do not permit them to be taken beyond the direct reach of the crane boom.

(b) LONG LOG LOADING

(1) Long log loading in bundles (Fig. L. 138, 139, 136)

The above illustrations show two stages of loading bundles of long poles. Fig. L. 138 shows the load after it has left the ground, while Fig. L. 139 shows the load being balanced by an assistant loader so that one end of the load can pass over the rear lorry stanchions. Fig. L. 136 shows how the other end of the bundled load is passed over the front lorry stanchion, near the driver's cab.

Note:

(i) This method of controlling the position of long poles while loading is only possible when a single sling is used, and it is placed in the correct position, slightly off the point of balance of the load, so that the rear end of the load has a slightly greater mass than the front end.

(ii) Due to the short crane boom the cable and line hook are used to sling the load. Under this condition the cable is subject to wear and tear at the point where the hook is placed, and breakages often occur.

(2) Single log loading

Fig. L. 140 shows log slinging with the extended winch cable in order to drag the load towards the lorry before it is lifted. This is a slow process with this type of loading apparatus as the winch is operated hydraulically and its speed of pull only ranges from 12 to 30 m per minute.

Fig. L. 141 illustrates only one stage of a single log loading operation, i.e. balancing the log over the rear lorry stanchion. In all other respects the operation is similar to that described for long poles loaded in bundles.

Fig. L. 142 shows two single logs being loaded by four-leg loading slings, controlled by means of tag lines.

6. SIDE-LOADING LORRY-MOUNTED APPARATUS FOR LONG POLE CROSS-HAUL LOADING

The side-loading lorry-mounted apparatus may be mounted on a long deck lorry, trailer or semi-trailer. It consists of a winch, 4 crane stakes (stanchions), a number of revolving blocks (fairleaders) and a wire rope with releaser attachments. (Fig. L. 143, 144, 145).

(a) THE WINCH

The winch is of the double-drum one axle type, mounted behind the driver's cab and connected to the gearbox by the power take-off. The winch drums can be operated by two levers, on either side of the truck.

The action of the levers is transferred to the accelerator so that the speed of the motor is regulated automatically according to the mass and number of poles. The pulling capacity of the winch is a quarter of a ton. Each drum accommodates 25 m of 9 mm diameter wire rope. The same wire is used for load slinging.

(b) THE RELEASER (Fig. L. 146a)

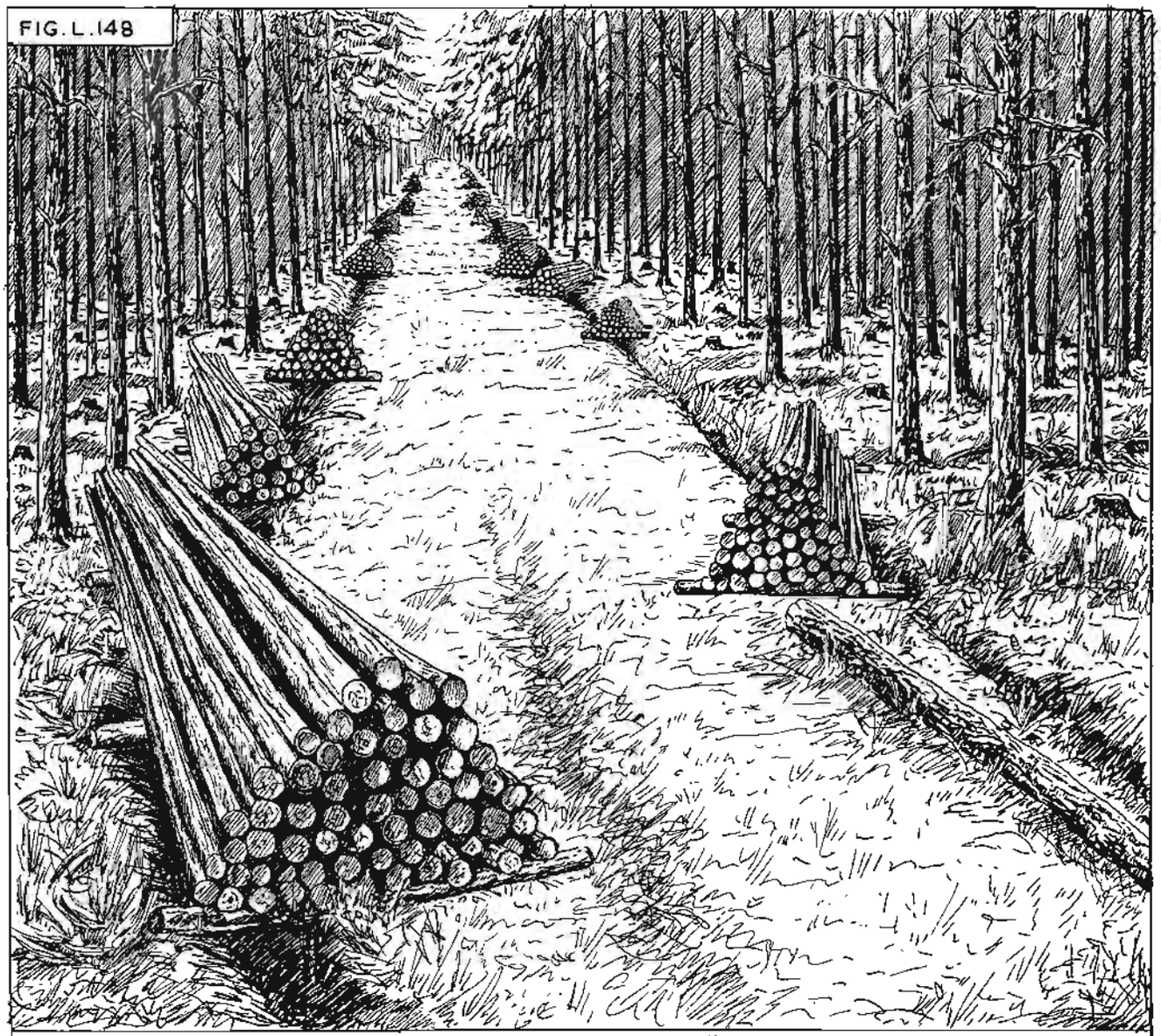
On the end of the wire a "releaser" is threaded on to the rope through its sleeve shackle. Three chain links (9 mm material diameter) are attached to the free end of the cable by means of two 9 mm Crosby clips. When slinging the load the end link is locked by the "releaser" lock. When the load is landed on the lorry deck, the spring loaded lock of the "releaser" can be unlocked by pulling the fibre rope (tag line) attached to the lock arm.

(c) CRANE STAKES (STANCHIONS OR UPRIGHTS)

Two drop-hinged stakes are fitted to the ends of each of the 2 cross-bearers resting on the lorry chassis members. The stakes consist of three parts (the lower member and two extensions) mounted on top of each other and kept in vertical position by their telescoping bases.

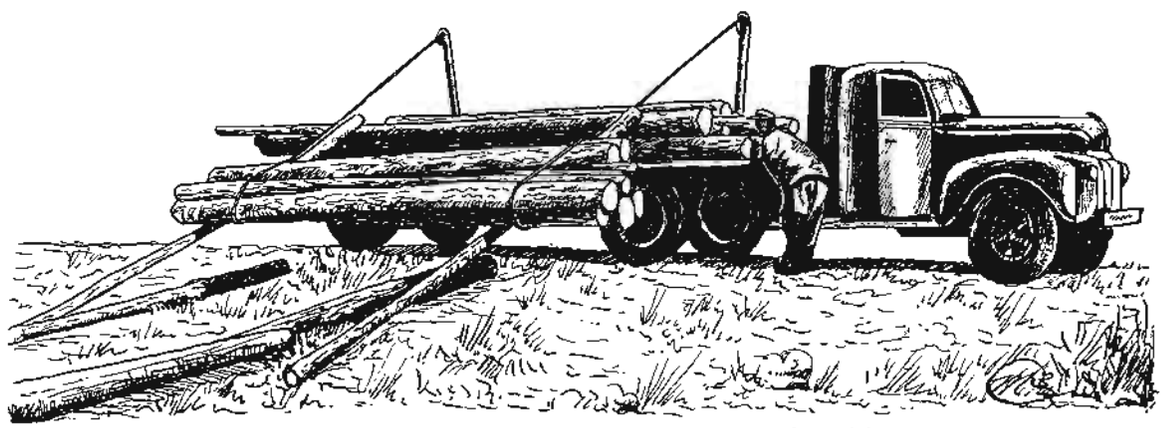
The two stakes on one side of the lorry have revolving blocks (fairleaders) fitted to their tops. The stakes on the opposite (loading) side are fitted with two "shark jaws" (toothed, bowed-shaped holder fittings), which serve to hold the top end of the skid spar, thus facilitating cross-haul loading.

FIG. L. 148



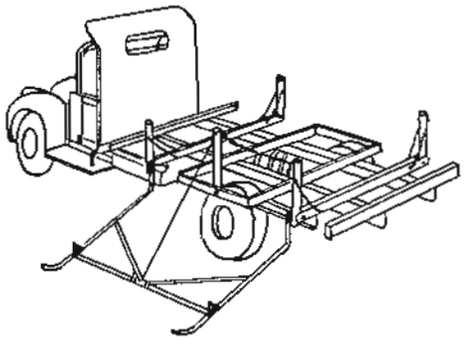
STACKING OF POLES FOR HAND OR CROSS-HAUL LOADING, FROM THINNINGS ON FLATS.

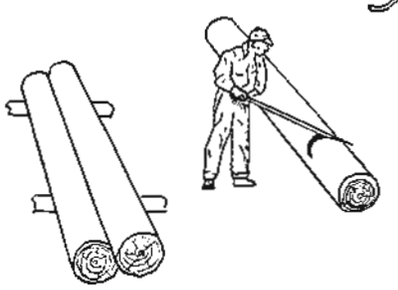
FIG. L. 149



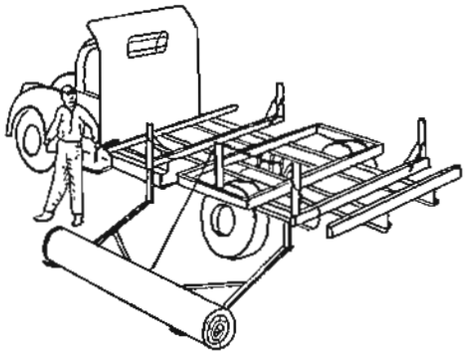
LOADING BY LORRY-MOUNTED CROSS-HAUL.

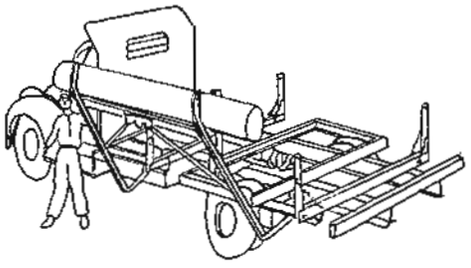
FIG. L. 150

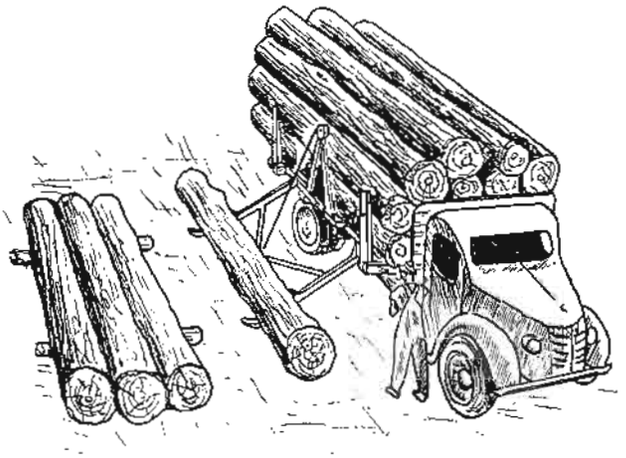




LOG-LOADING WITH LOG-TOSSER ATTACHMENT.







This stake design permits loading from both sides of the lorry, besides having the additional advantage that the crane stake height may be adjusted according to the increasing height of the load on the lorry being loaded.

Locking of the stakes in a vertical position or when dropped down is controlled by a tripping mechanism operated by levers with the extensions.

(d) REVOLVING BLOCKS (FAIRLEADERS) (Fig. L. 145)

There are three blocks on each stake assembly. They are located in their fittings as follows:

(1) To the side of the channel iron of each of the two cross-bearers, directly facing the winch drum.

(2) On the end of each of the two cross-bearers.

(3) On top of each of the two crane stakes.

The loading rope is passed through the revolving blocks across the lorry to the load.

Note: As additional fittings are available, the fairleaders are transferable, thus permitting loading from both sides of the lorry. The "shark jaws" can likewise be fitted on to the crane stakes, on both sides of the lorry.

(e) LOADING

The poles to be loaded have to be stacked lengthwise along the roadside on cross-sticks to permit the wire to pass beneath them. The log stacks should not be too far from the ends of the skids (in loading position) or else rolling of the logs to the loading ropes, which are of limited length, will take too much time and labour.

Two men prepare a load of suitable size by rolling the poles from the stack on to cross-sticks and into a slinging position, while two others sling the load and control with tag lines its slide on to the lorry, then release it and pull the rope back for the next load (Fig. L. 146, 147).

Considering that the load is dragged along the skid-spars and not rolled, considerable friction is developed, which forces the skids forward if they are too short, consequently skid-spars should be of suitable length, which is at least twice as long as the height of the lorry bank plus the height of the crane stakes.

Note:

(1) Enough room should be reserved at the loading site to accommodate the positioned skid-spars between the pole stack and the lorry to be loaded.

(2) If well-organized, a 10 ton lorry can be loaded in 25 to 30 minutes.

(3) See Fig. L. 149 for application.

(4) Additional control to even the load being dragged up the skids can be obtained by acting on the levers of the independent winch drum.

(5) Loads with a much greater mass of single poles or long logs can be loaded by this apparatus when the rolling system of round timber is applied instead of dragging. In this case the speed of loading is reduced by as much as 50%, and control to dispose the load in the desired position on the lorry deck is more difficult. The attachment of the end of the cable has also to be re-arranged, which is not shown in the illustrations.

(6) The same type of loader as the one described above, mounted on a private 10 ton Leyland lorry was observed loading medium-heavy logs from a convenient upper road bank. The loading crew of four men was engaged as follows:

- Driver - controlling the clutch and accelerator.
- Loading operator - operating the winch controls.
- Labourers - log slinging and sorting on the lorry log bunk when required. The quick releasers were not used.

(f) CONCLUSION

Generally speaking the equipment is slow and should be considered rather as a labour saving device than a time saving device.

7. SIDE LOADER - TOSSER TYPE (Fig. L. 150)

The tosser type of side loader is truck mounted and serves only to load the truck upon which it is mounted. The more advance type of tosser can be accommodated on either side of the truck, truck and semi-trailer, or semi-trailer attached, without any major alterations, simply by re-arranging the arms and their suspended hydraulic piping, and adding an extra shaft if necessary. The apparatus consists of a rear-mounted basic plate with side fitting, by means of which the whole assembly is attached to the truck. A shaft with two hinged hydraulically-operated arms is attached to the basic plate. The side loader works via the power take-off and is fully hydraulically-operated.

The lifting arms automatically adopt the correct position, and they therefore work effectively despite differences in level encountered from loading site to loading site. The length of the arms can also be adjusted, as well as the distance between the arms. The complete side loader has a mass of 240 kg.

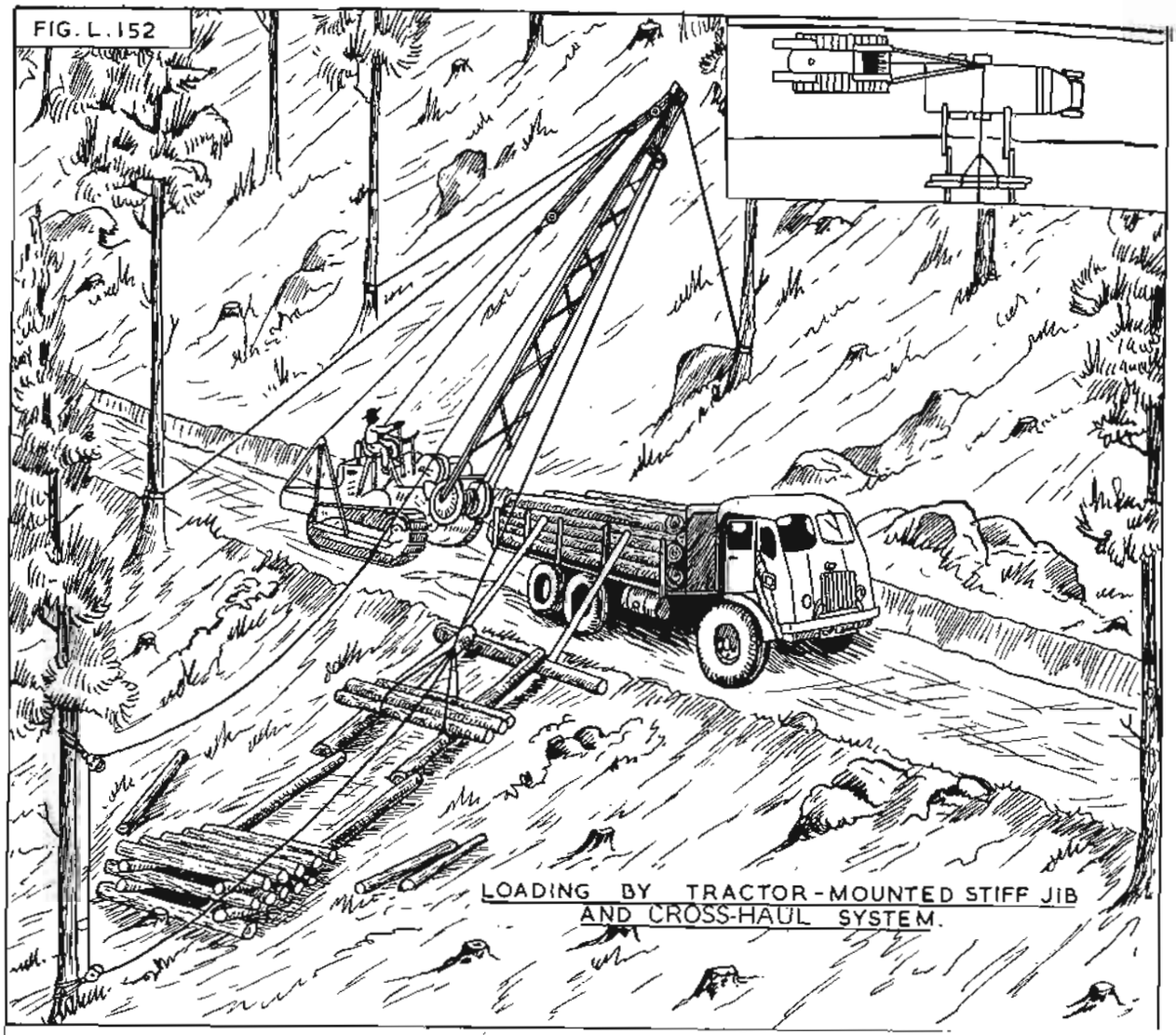
OPERATION

Logs must be manually rolled on to the arms, which lift them and toss them on to the log bunk, where they are positioned by hand. To simplify rolling logs on to the arms they are best stacked on flat ground on cross-sticks, level with the road, where the tosser arms are positioned to receive the logs. When logs are stacked on the slope above the upper road bank, the bank may not be too high, as log loading will then be inconvenient.

FIG L. 151.

TRACTOR LOADING WITH STIFF JIB

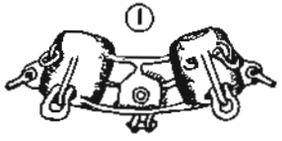
FIG. L. 152



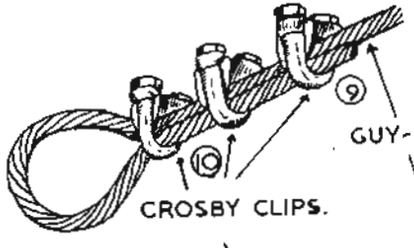
LOADING BY TRACTOR-MOUNTED STIFF JIB AND CROSS-HAUL SYSTEM.

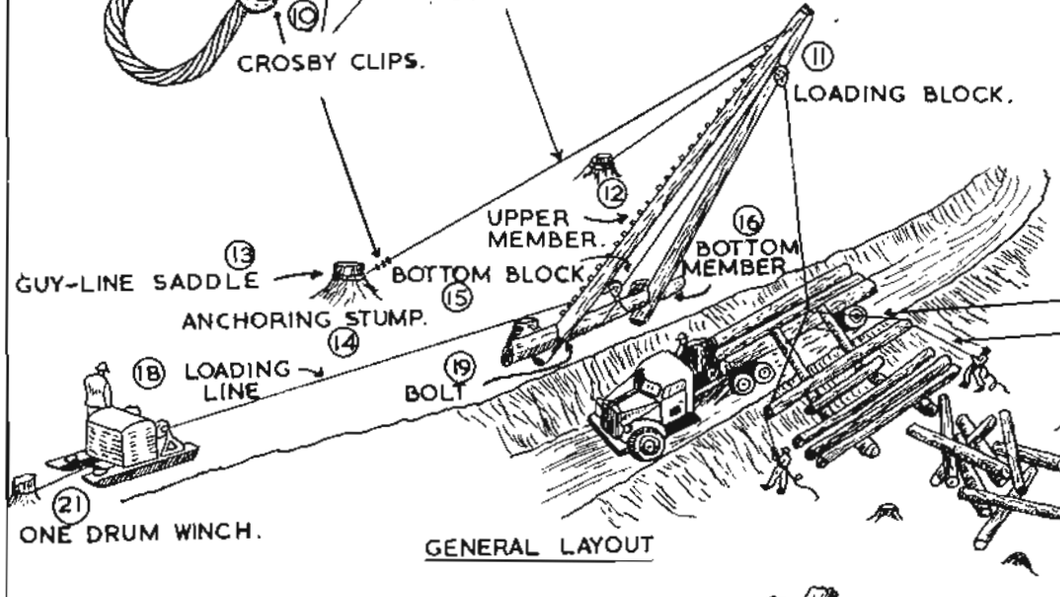
FIG.153

"A"-FRAME LOADING.



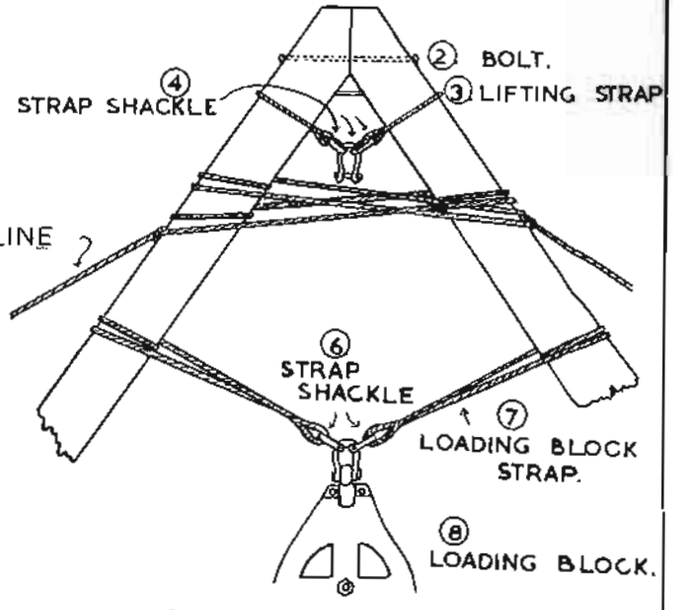
"A" FRAME CAP



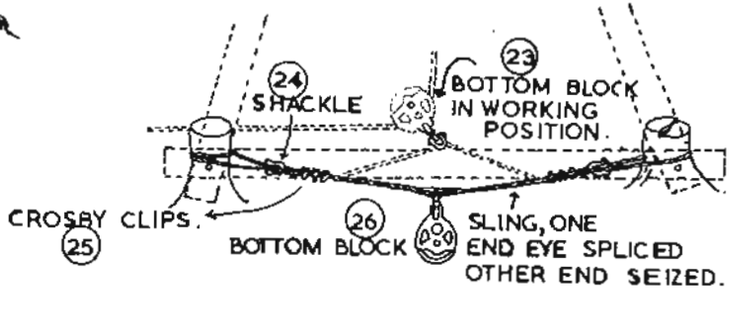


GENERAL LAYOUT

METHOD OF JOINING UPPER AND LOWER MEMBER.



DETAILS OF TOP PART.



DETAILS OF BOTTOM PART.

Should logs have to be loaded from the lower road bank they must be stacked level with the road, which will necessitate the construction of "crib work" to raise the stacked logs to road level, for easy rolling on to the tosser arms.

The tosser loader is primarily a labour saving device and its loading speed depends to a large extent on the size of the logs. If logs are not of too large a diameter, two logs may be loaded at a time. The tosser is, however, not very suitable for loading small, short logs.

The lifting capacity is as follows:

Approximately 0,65 m^3 or 688 kg at an arm length of 1,8 m
Approximately 0,51 m^3 or 550 kg at an arm length of 2,1 m
Approximately 0.37 m^3 or 490 kg at an arm length of 2,7 m.

The only tosser purchased was used with the truck for loading timber in plantations yielding a very limited volume of timber.

From the above it is obvious that correct log prestacking will contribute much to accelerating loading with the tosser.

The equipment is comparatively cheap, and so fairly suitable for a small contractor carting logs of medium size.

8. LOG LOADING BY D.4 CATERPILLAR TRACTOR WITH DOUBLE-DRUM LOGGING WINCH AND FOLDING CRANE

The above rig with the D.4 Cat. tractor has been used for log loading in emergencies due to a lack of any other mechanical equipment at the time. The rig is the same as that used for high-lead operations, already described in the chapter "Highlead Log Skidding". The cables are set out as described, except on a much smaller scale, but instead of choker assemblies, wire rope slings with sling hooks were used for slinging the logs. The only advantage of the tractor with this equipment is that it can reach loads located quite a distance away without the assistance of men needed to take the slings to the logs. The operation is very similar to cross-haul loading with the A-frame and skid-spars, but instead of the winch with a single drum, a double drum winch is used. The haulback line, when tightened, helps a great deal to locate the load in the right position on the lorry (by tightening or loosening). The sheave of the loading line should be positioned exactly above the side of the lorry closest to the tractor.

Fig. L. 151 clearly illustrates the operation of the unit. While a bundle of logs is being dragged on to the truck, the next bundle is being slung with spare slings. When the empty slings return to the stacks, they are unhooked and the slung bundle then hooked on to the main line of the tractor and hauled on to the lorry. Fig. L. 152 shows a similar operation under unfavourable conditions.

Logs or pole stacks may be arranged on level ground or on a slope for uphill dragging and loading. Hauling the load downhill is not recommended.

The process of loading is rather slow, and the operation was discontinued when a mobile crane became available. None the less, the tractor-mounted double-drum winch with folding crane can be used for log loading in a small scale operation, if it is conveniently located nearby where it is being used as a log yarding unit, as the unit is fully mobile.

The lifting and skidding capacity over an adverse gradient of pull is up to 0,57 m^3, where a well-worn tractor is employed.

Loading time varies considerably, dependent upon the size of the logs and whether one long stack or two or three short log stacks are to be loaded on to the truck deck.

9. LOADING BY SEMI-PORTABLE "A"-FRAME - Fig. L. 153

The semi-portable "A"-frame, which is a progressive step after hand loading, was originally introduced into departmental loading operations as an emergency measure for salvaging damaged timber after a severe fire.

The A-frame assembly consists of:

(1) The A-frame structure, consisting of two upright members and a horizontal cross-member at the bottom of the uprights.

(2) A 21 kW petrol engine with a free-revolving single drum winch.

(3) Auxiliary equipment such as wire ropes for loading and guy-lines, blocks, straps, slings, hooks, shackles, crotch-type chain loading slings, and wire ropes with specially designed hooks, tag lines, etc

Note : For details and function of the rig see Appendix L 9.

Construction of the A-frame is a simple affair. The two upright members consist of two poles of 15-20 cm top diameter, 10 metres long, and splay cut at the top. The lower horizontal cross-member is rebated to the bottom ends of the uprights. The joints of all wooden members were bolted with 16 mm bolts with washers and nuts. Rungs were fitted to one of the uprights for convenience sake so that the top block was accessible for lubricating.

Guy-lines were attached just below the top of the frame in such a way that the upright members were pulled together under guy-line stress. This was achieved by anchoring the guy-lines to stumps on the opposite side of the upright to which the guy-lines were attached.

The A-frame is raised into the upright working position by applying the conventional method of using an auxiliary pole. The pole, which is approximately 1/3 of the length of the A-frame uprights, is placed vertically between the uprights lying on the ground, and 1/3 of the length of the uprights from the top end of the uprights. Fibre ropes are fastened from the top of the pole

LORRY POSITION IN RELATION TO STACKS OF DIFFERENT LENGTH LOGS FOR "A" FRAME LOADING IN FLAT COUNTRY.

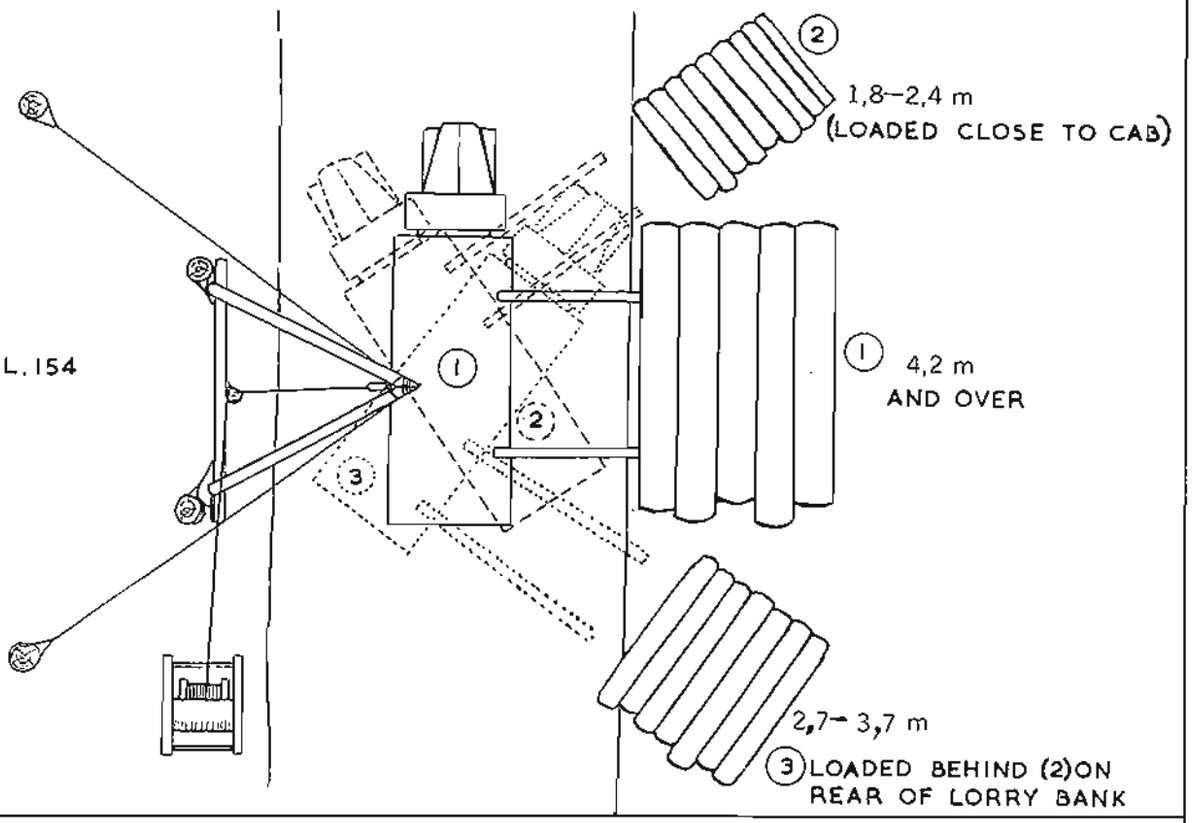
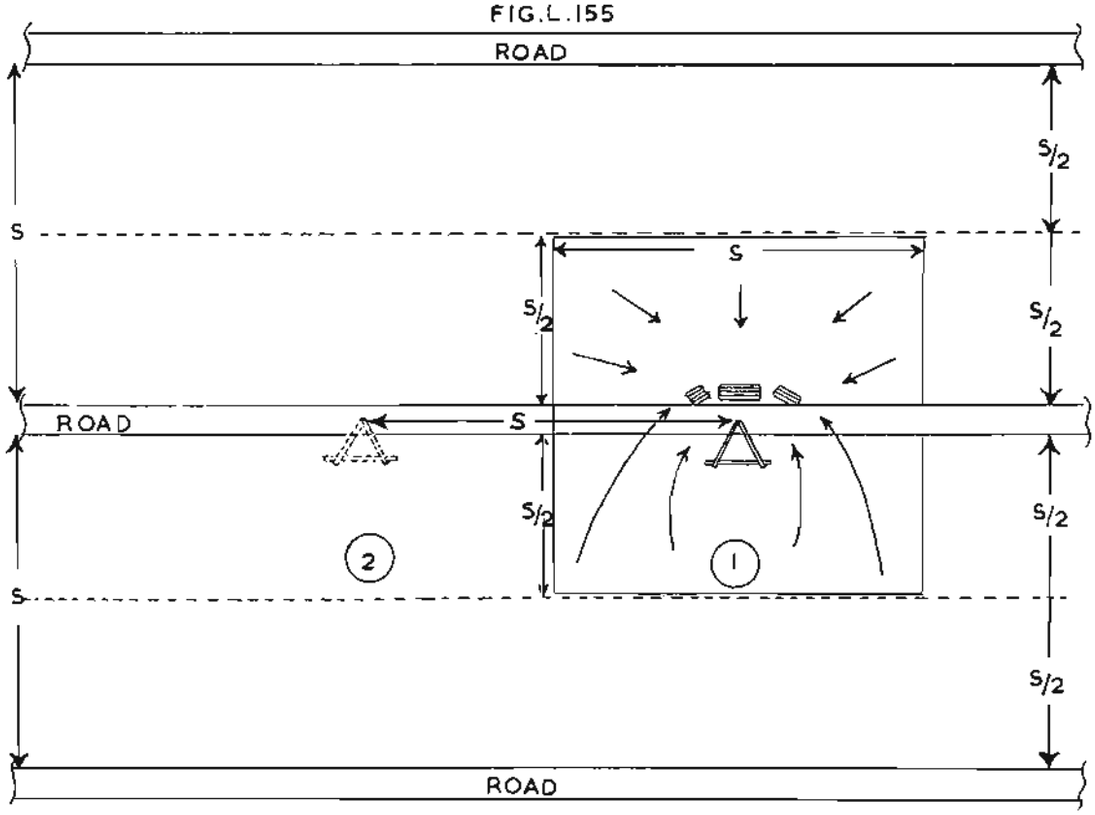


FIG.L.154

FIG.L.155



"A" FRAME INTERVAL IN SQUARE SETTING WITH EQUAL ESPACEMENTS BETWEEN ROADS IN FLAT COUNTRY

FIG. L.156

LOADING BY SLED – MOUNTED "A"–FRAME, USING ANIMALS.

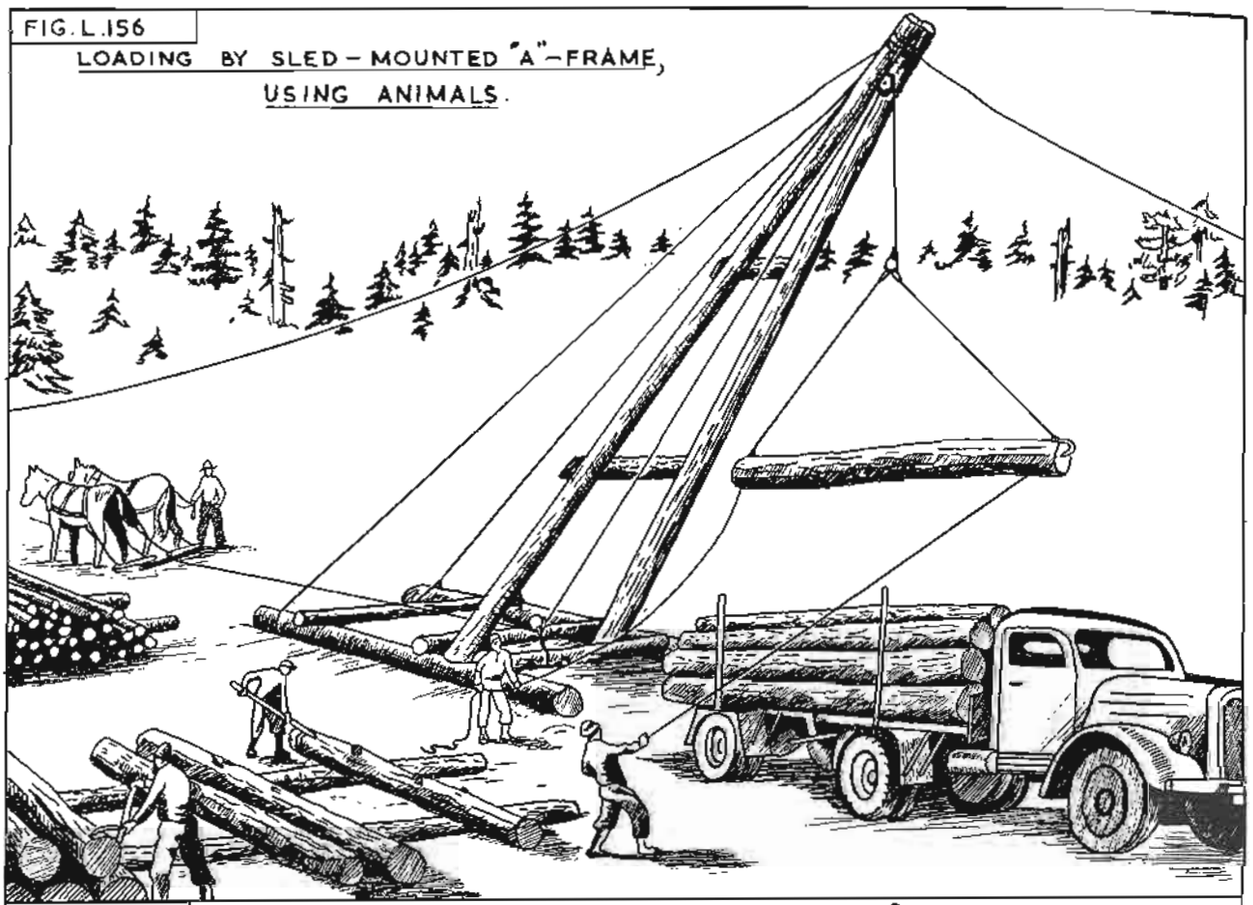
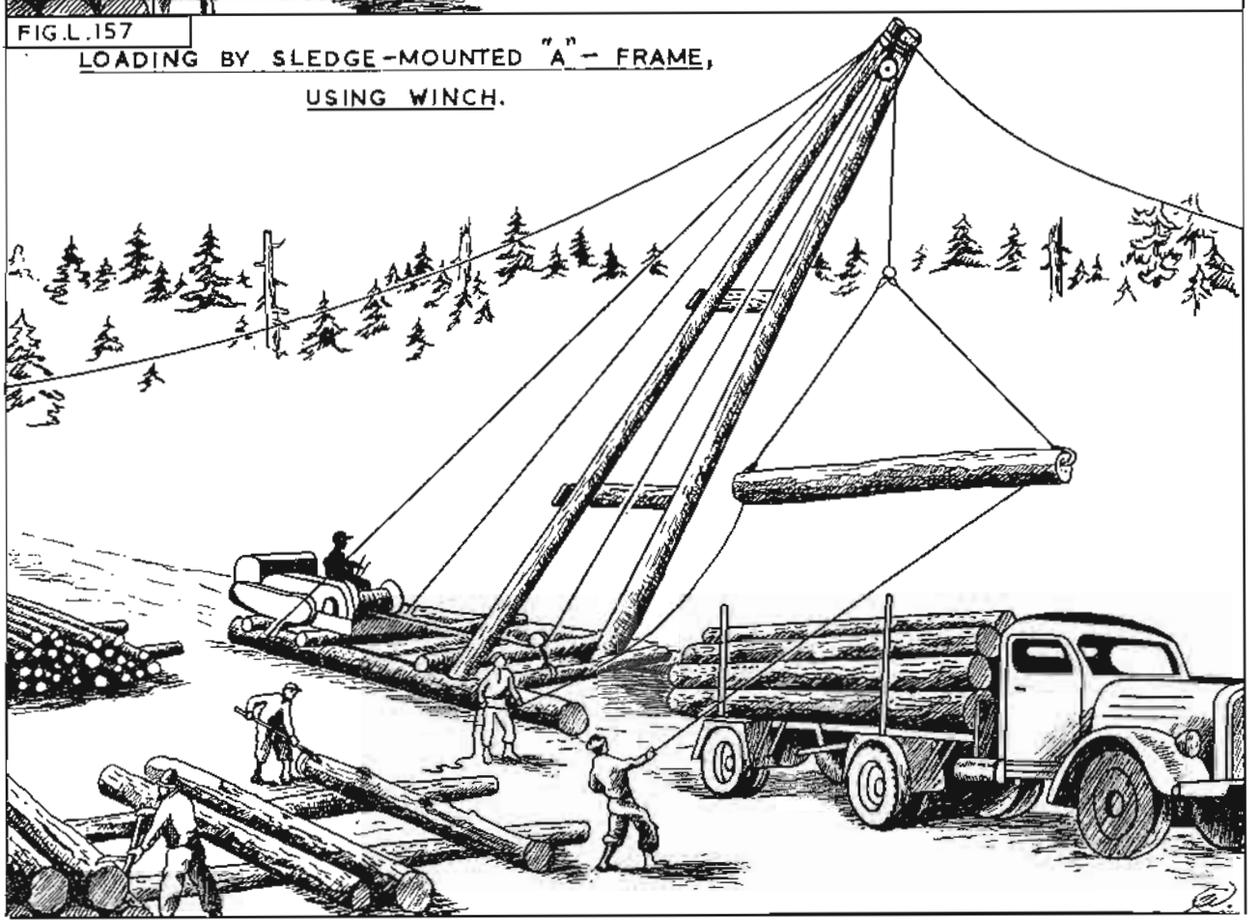


FIG. L.157

LOADING BY SLEDGE–MOUNTED "A" – FRAME, USING WINCH.



to the uprights, lying on the ground. One end of a lifting sling is secured to the lifting shackle on top of the frame, the other end of the sling is wound round the top of the lifting pole and secured with a Crosby clip, the eye of the sling still being free. This eye is then secured to the puller cable by means of a shackle. By engaging the puller, the cable is pulled in and the A-frame raised into position. The lifting pole ensures that there is sufficient initial lift to raise the frame off the ground. If the puller is located on a higher elevation than the top of the frame, the lifting pole may not be necessary. Dependent on the size of the frame, a Tirfor puller, monkey winch or mechanical winch may be used for raising the frame into the upright position.

The frame with its lower members propped against two stumps, is located on one side of and close to the road, while the stacks of logs to be loaded are located on the opposite side of the road. The top and bottom blocks of the A-frame are secured with slings illustrated in Fig. L. 153. The slings of the top block are unable to slip down due to the splayed position of the frame uprights. The bottom block is secured with slings (straps) attached to stumps at each end of the frame cross-member, and the slings are passed beneath this member to ensure that the block is kept in the correct position while loading, i.e. with the sheave up and the shackle down.

(a) OPERATION

Logs are skidded to the roadside and stacked in front of the A-frame, but on the opposite side of the road. Logs may be stacked in three stacks, and grouped in the following length classes: 2-2,5m; 3-4m; 5-7m. The longest logs should be in the centre, facing the A-frame squarely (Fig. L. 154) with the other two groups on the left and right, positioned at a slight angle so that they also face the loading block with their full length.

The lorry to be loaded is parked on the road between the stacks and the A-frame, parallel to the stacked logs to be loaded, and in such a position that the top loading block of the A-frame hangs directly above the side of the lorry closest to the frame. This position ensures the best control of the logs being loaded. If logs are to be loaded on different parts of the length of the lorry bunk, the lorry must be adjusted accordingly. If logs are to fill the length of the lorry, the line block and middle of the stack should coincide with the midpoint of the lorry bunk.

The two skid-spars are positioned on the stack side of the lorry.

The loading crew should consist of only two labourers if they are skilled, plus the winch operator. The two-leg chain loading sling assembly with end hooks is used for loading large logs, and two-leg wire rope slings with sliding hooks are used for loading bundles of smaller logs. In the latter case spare slings should be used for preslinging the next load while the first is being loaded. When smaller logs are loaded in bundles a crew of 4 or 5 men is usually needed, two preparing loads, two loading and controlling the loads with tag lines, and one for releasing slings when the load has been securely positioned on the lorry log bunk.

(b) REMARKS

The logs are stacked in advance for A-frame loading, and it is important that log stacks are not too deep, i.e. extend too far from the road, otherwise dragging the furthest logs to the lorry will consume too much time and keep the lorry standing longer than necessary. "Hot decking" is preferred when loading by A-frame.

Apart from the semi-portable A-frame described above, the frame may be sledge-mounted, as in Fig. L. 156, 157, but this method has not been used in the Department. The sledge-mounted frame may be pulled from site to site by animals or tractors, or may even propel itself by winch. Loading may be done by animals or winch as illustrated. This type of A-frame is cumbersome to move and occupies considerable space on the road, so it is more suitable for flat country with wide roads.

A-frame loading was discontinued in the Department with the introduction of self-propelled cranes and lorry-mounted loading apparatus. The A-frame could none the less be usefully employed for loading small quantities of logs with a great mass without having to employ an expensive self-propelled crane.

10. LOGGING SAFETY: CROSS-HAUL AND A-FRAME LOADING

(a) CROSS-HAUL

(1) When using a cross-haul loading system, the skid timbers (spars) shall be of sufficient strength to support the logs being loaded. These timbers shall be of sufficient length to remain in place while the log is being loaded. The skids shall be increased in size in accordance with the strain imposed.

(2) Cross-haul hooks shall be maintained in a condition that will ensure secure holds.

(3) Loaders on this system shall work at the ends of logs being loaded.

(b) A-FRAMES

(1) A-frames shall have at least two guy-lines attached to substantial anchors and spread to form between a 70 and 90 degree angle with the point of attachment.

(2) Provision shall be made to prevent the frame from tipping back.

(3) A-frame and/or main members shall be of sufficient strength and height to provide the safe and adequate control of loads.

(4) The stiff-leg hold-up line shall be at least of the same diameter as the loading line, and shall be anchored to the frame by means of a strap, a shackle, or an eye bolt of equal or greater strength.

FIG. L 158

HIGHLEAD AND McLEAN BOOM LOADING

FIG.L.159

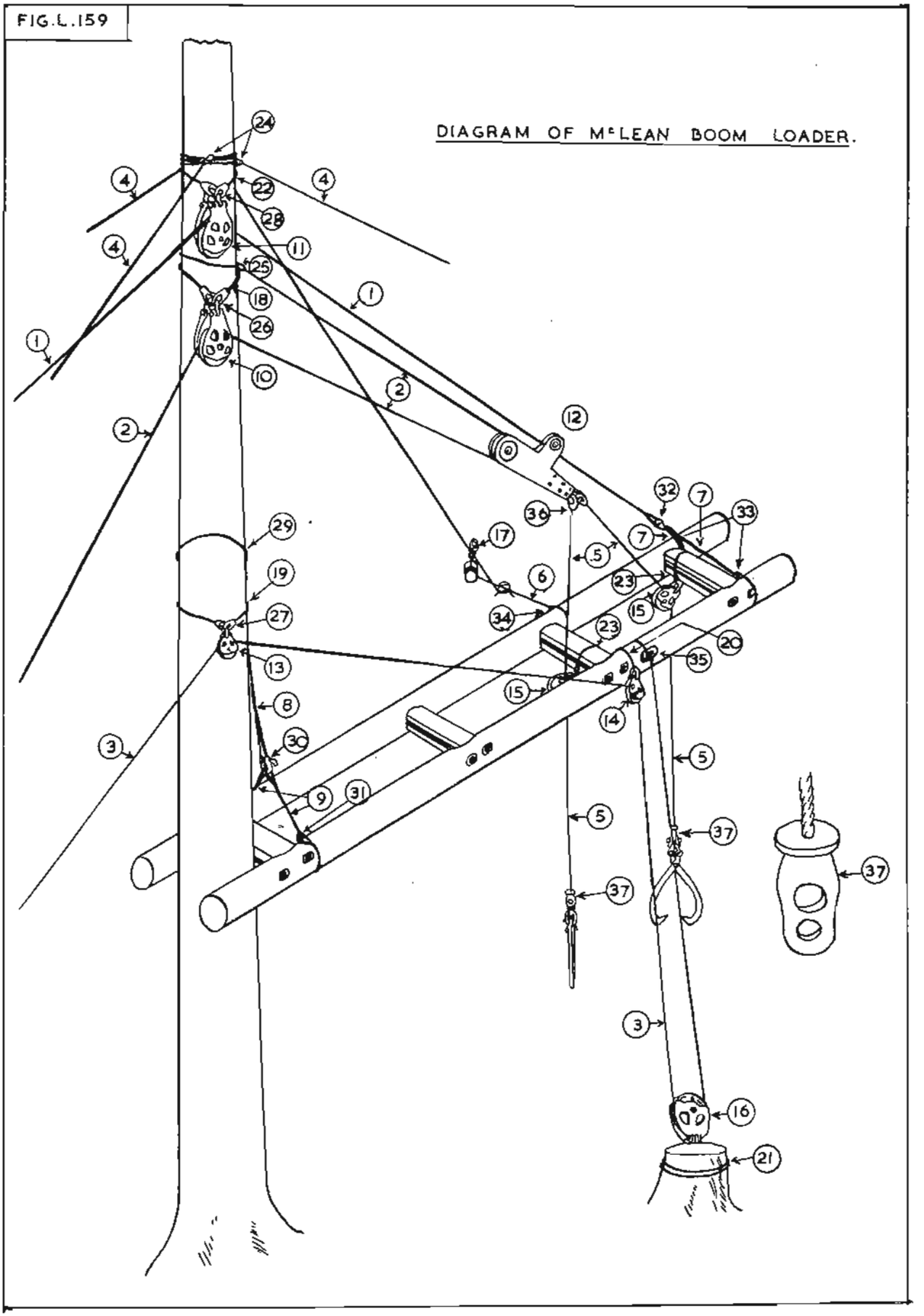


DIAGRAM OF McLEAN BOOM LOADER.
24
4
22
28
11
25
18
26
10
1
2
12
32
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17
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FIG.L.160

HIGHLEAD AND McLEAN BOOM LOADING OPERATION

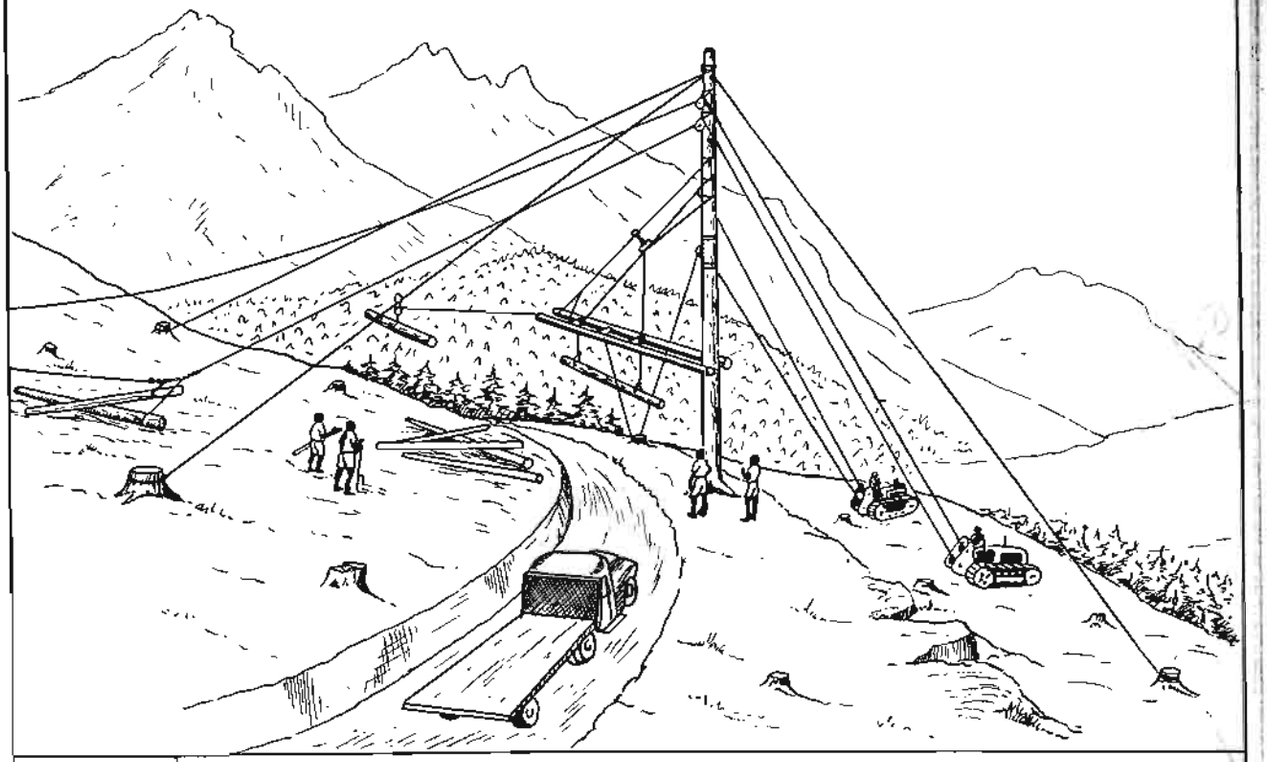
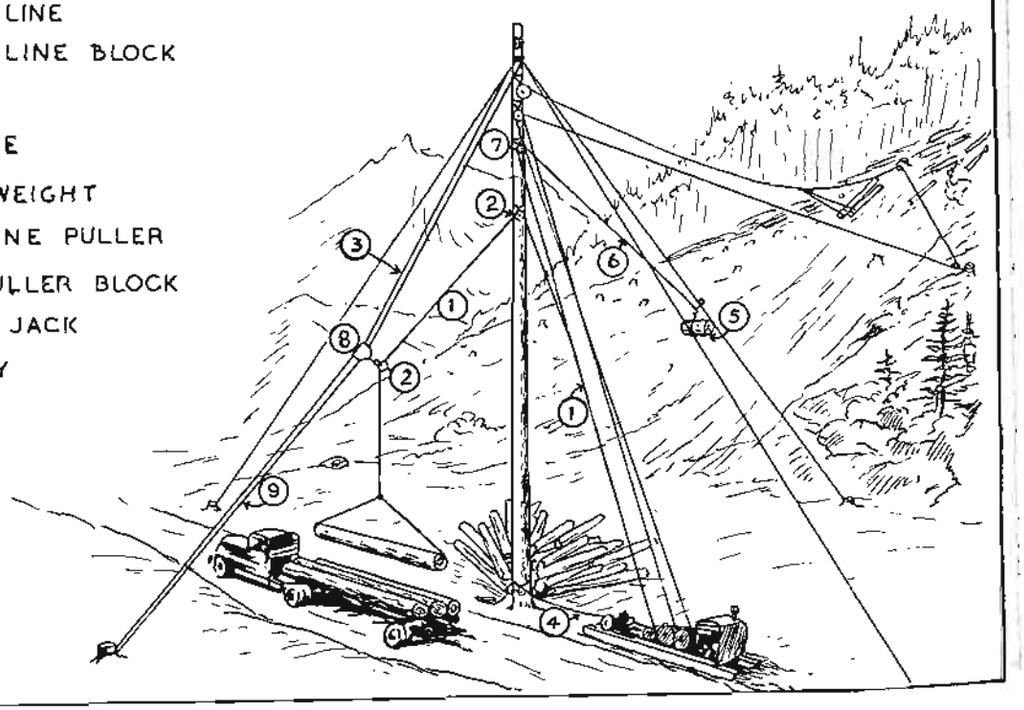


FIG.L.161

HIGHLEAD AND GUY-LINE LOADING, USING FIXED LOADING JACK AND BLOCK WITH SINGLE LINE

1. LOADING LINE
2. LOADING LINE BLOCK
3. GUY-LINE
4. STRAWLINE
5. COUNTERWEIGHT
6. SLACK LINE PULLER
7. SLACK PULLER BLOCK
8. LOADING JACK
9. JACK GUY



(5) Uprights or legs of A-frames shall be of good, sound, straightgrained stock and not less than 17 cm in diameter (top). They shall be increased in size in accordance with the strain imposed.

(6) The base of A-frames shall be secured against possible displacement and the top shall be securely bolted or lashed to prevent displacement.

(7) If a machine is moved with A-frame raised, sufficient guys and sled or truck width shall be provided to prevent its tipping. Workmen shall not ride or walk beside a machine being moved.

(8) All blocks, lines and straps shall be arranged to prevent sawing or chafing.

11. SOME NORTH-WEST AMERICAN LOADING METHODS

In the foregoing chapters of this volume, mention has been made of the log loading methods which have evolved and been used in the Department over a considerable period of years, ranging from the most primitive methods and simple equipment to modern equipment. It should be emphasised, however, that modern loaders are mounted on their own carriers, generally truck type carriers, and are fully mobile. These loaders usually work in departmental plantations in combined operations with log towing tractors or highlead log skidding yarders, the latter being mobile units mounted either on tractors or trucks.

Regardless of the availability of modern mobile loading equipment, cases sometimes occur where log skidding and loading have to be done in rugged, rocky terrain with narrow roads and limited space to accommodate log landings and machine sites for truck-mounted skidding or loading units. In this case semi-portable equipment has to be put into use. Double-drum tractor-mounted yarders and spar trees are used for highlead log skidding. With the spar tree being available, the McLean boom or guy-line rigs may be added to facilitate a combined skidding and loading operation.

The conditions mentioned above may still occur in the future, and as tractor-mounted yarders with their rigs are available and may be transported by 10 ton lorries, it will be possible to organise skidding and loading operations with semi-portable equipment, particularly where medium or large scale operations are being conducted.

The rig and operation of semi-portable highlead log skidding units has been dealt with in the previous volume. Once the spar tree has been erected, there is an opportunity to attach a McLean boom, heel boom or guy-line loading rig to the same spar tree.

(a) McLEAN LOADING BOOM RIG - Refer to Fig. L. 158, 159, 160.

This loading rig has already been used departmentally, so some experience as to its use has already been gained. A D.6 Caterpillar tractor with Hyster double-drum winch was used for highlead log skidding, and a D.4 tractor with double-drum winch was used to operate the McLean boom loader. Erection of the rig occupied two days with two European and four Bantu labourers. The spar tree was about 13 metres high with a top diameter of 25 cm. The rig may be divided into three groups:

(1) The frame
(2) The hoisting group
(3) The swinging group

The function of each group of the rig will be described below, but detailed mention will only be made of the main parts of the rig.

1. The loading frame group

(i) The frame

- 2 poles, 10 metres long, 17-20 cm top diameter kept approximately 1 metre apart and parallel to each other by means of
- 4 cross-members (spacers), 20-25 cm diameter x 1 metre long, and
- 8 contracting bolts (buckle braces) 19 mm diameter, with washers and nuts on both ends.

Note : The figures in brackets below refer to parts of the rig shown in Fig. L. 159.

(ii) The frame was suspended - 4-5 m above the ground as follows:

- The rear end, against the tree, was secured by the "heel strap" (8) with spreader lines (9) attached to the spar tree.
- The front end was secured with the sail guy (1) with spreader lines (7)

2. The hoisting group consists of:

(i) The sail guy carriage (12) riding on the sail line

(ii) Main loading line (2) which controls the movement of the carriage, and is operated by the yarder winch

(iii) Two loading tongs (37) are shackled to the sail carriage by means of the tong lines, each being guided by the loading blocks (15)

Note : One of the loading blocks is suspended on the pole member, close to the front cross-member, of the frame; the other is suspended on the opposite pole member of the frame close to the second cross-member from the rear, or the second from the front, depending on the length of the logs being loaded. This arrangement places the blocks in an offset position, which facilitates positioning the truck to be loaded closer to the spar tree for better control of the log being loaded.

3. Method of use

(i) The frame suspension as decribed is flexible enough to permit movement in the horizontal plane.

FIG. L. 162

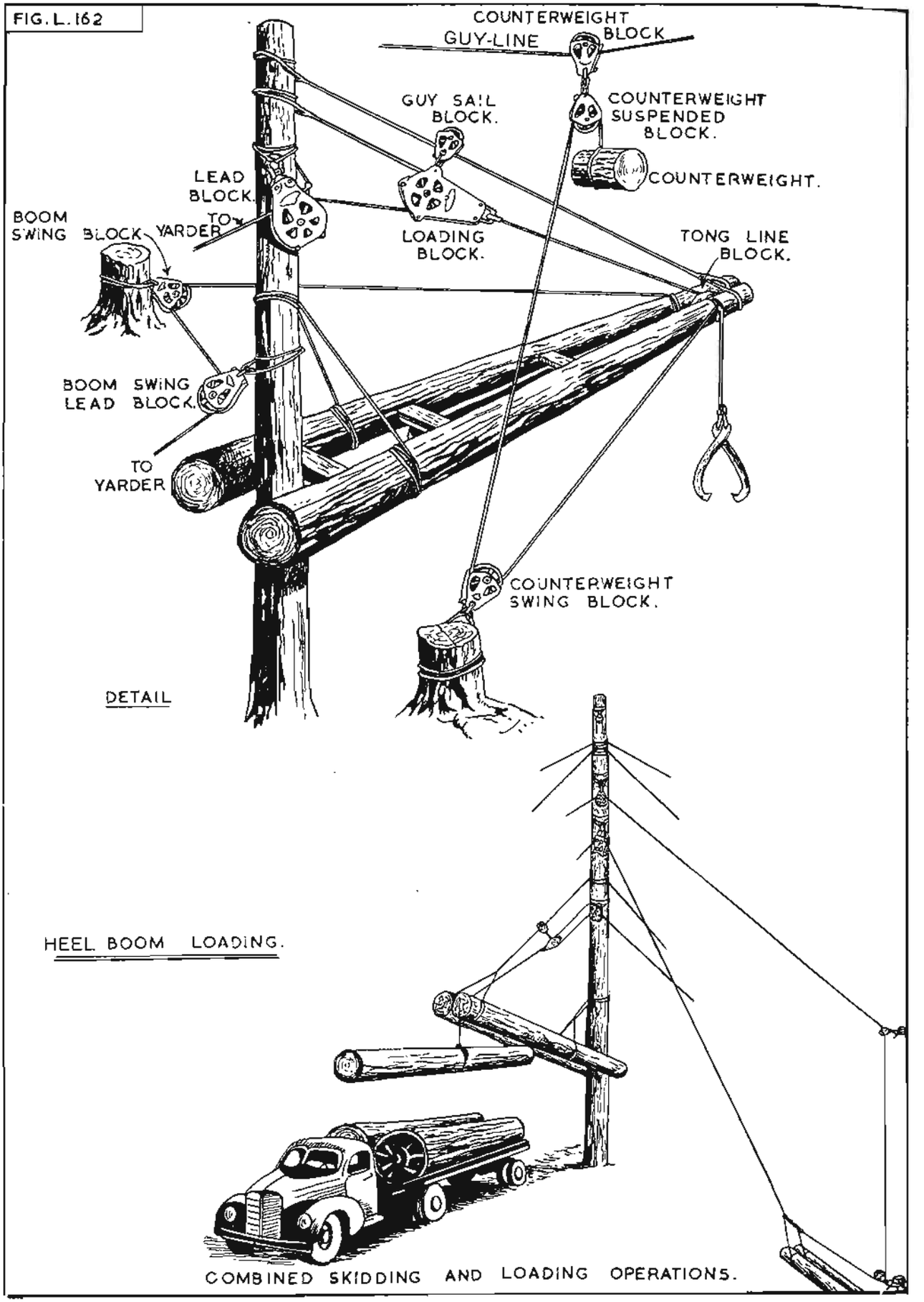

COUNTERWEIGHT
GUY-LINE
BLOCK
GUY SAIL
BLOCK.
COUNTERWEIGHT
SUSPENDED
BLOCK.
COUNTERWEIGHT.
LEAD
BLOCK.
TO
YARDER
BOOM
SWING BLOCK
LOADING
BLOCK.
TONG LINE
BLOCK.
BOOM SWING
LEAD BLOCK.
TO
YARDER
COUNTERWEIGHT
SWING BLOCK.
DETAIL
HEEL BOOM LOADING.
COMBINED SKIDDING AND LOADING OPERATIONS.

FIG. L. 163

HEEL-BOOM CRANE ON TRACKS, LOADING WITH MECHANICALLY-OPERATED GRABS.

FIG. L.164

CRANE – HEEL BOOM LOADER

CRANE MOUNTED ON WHEEL CARRIER

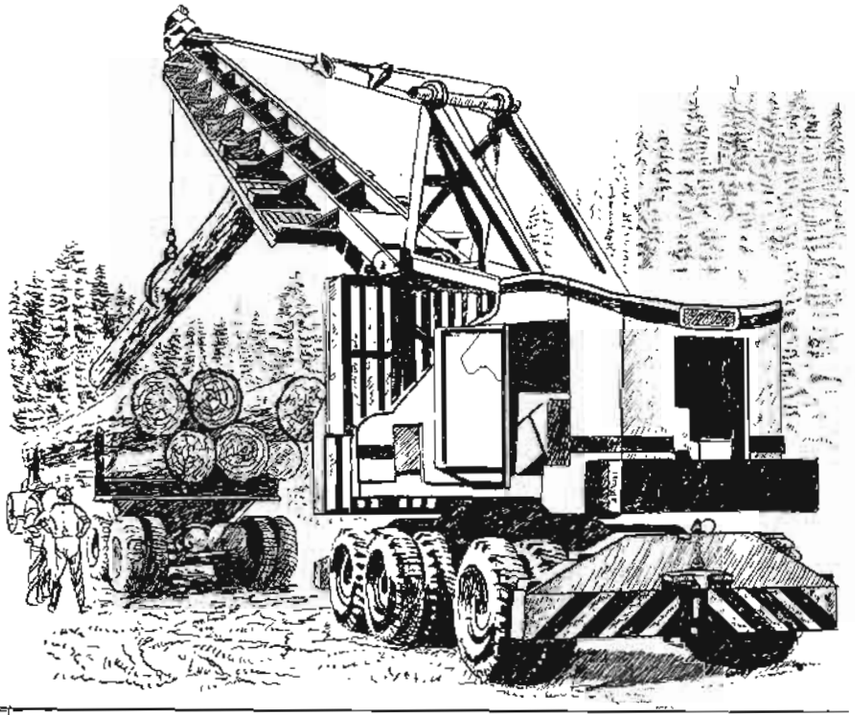
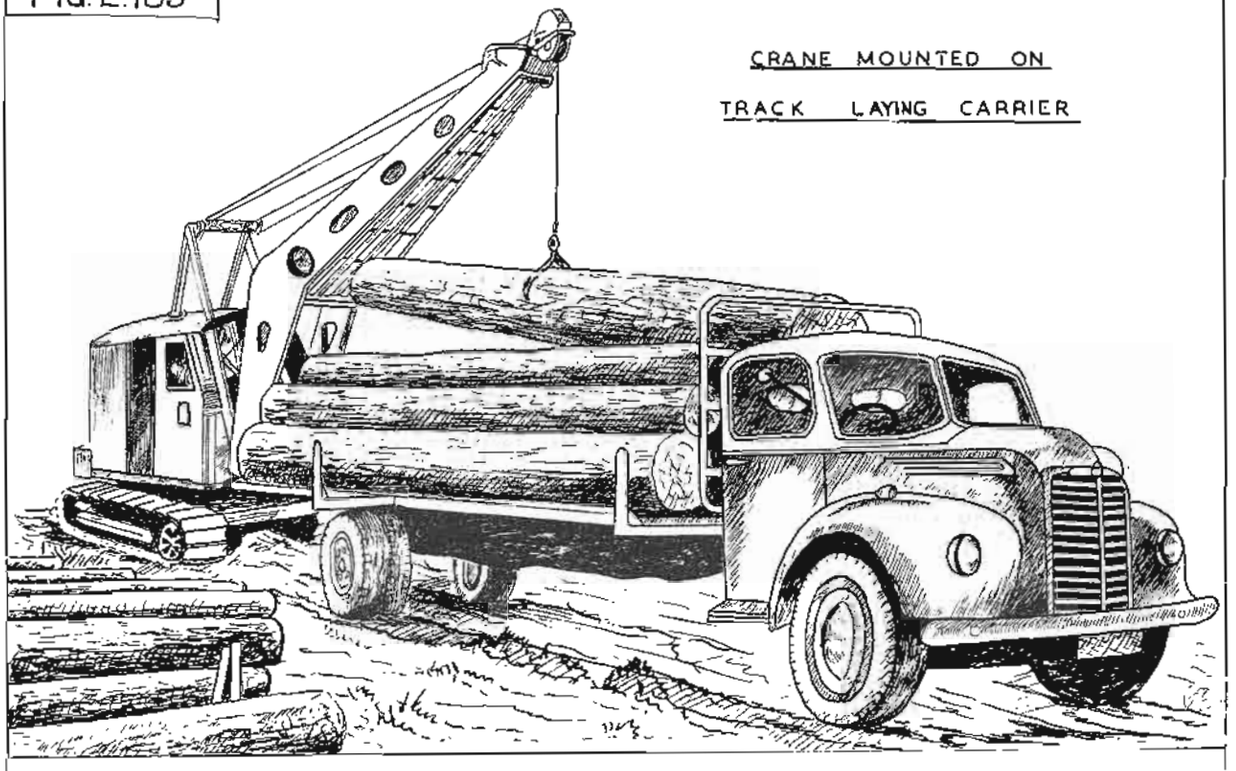


FIG. L.165

CRANE MOUNTED ON TRACK LAYING CARRIER



(ii) The loading line is spooled on the main drum of the hoist. It is threaded over the sheave of the loading lead block (10), suspended high on the spar tree, thence over the sheave of the sail block (12) and fastened back to the tree just above the loading block. The sail block should have sufficient mass to overcome the mass of the loading line in order to obtain slack on the tongs when the brakes of the main drum are released so that the logs piled near the spar tree can be hooked.

(iii) The haulback line or swinging line is spooled on the haulback drum of the hoist.

(iv) This line is threaded over the sheave of the swinging line lead block (13), suspended on the spar tree below (or above) the heel strap sleeve (29)

(v) From there it passes over the sheave of the swinging line boom block (14), attached to the pole member of the frame close to the second cross-member of the frame, then

(vi) Over the sheave of the swing block (16)

(vii) Finally towards the frame again, where it is attached with the top tong line socket, or directly to the pole of the frame.

(b) APPLICATION

When the operator winches in the swing line on its drum the frame will move in the direction of the swing block (16), which causes the swinging movement of the frame to one side.

In order to swing the frame in the opposite direction the "squirrel line" (6) is fitted to the "squirrel line sheave" (34) (or directly to the frame pole) and is attached to its stump. This enables horizontal movement of the suspended frame for as much as 90° in both directions.

The loading tongs can move between the frame and the ground. Having the two essential basic movements, the rig can load logs onto a truck positioned correctly with regard to the spar tree and loading frame (Fig. L. 158).

Fig. L. 159 shows in detail the complete rig of the McLean boom loader. Details of the items numbered in the illustration are given in the attached specification list, in Appendix L. 11. A full list of the McLean boom rig as used by the Department is included in Appendix L. 12. The rig given is much lighter than that recommended by the Skagit Co., but the rig was used at a time when the more modern equipment was not available.

Fig. L. 158 shows the standard highlead and McLean boom loading rigs on the same spar tree for normal conditions, and Fig. L. 160 shows a similar operation under more difficult conditions.

(c) HEEL BOOM LOG-LOADING SYSTEM (Fig. L. 162)

This system has not yet been used in the Department, but is, none the less, worth mentioning.

The pole members of the heel boom loading rig are not parallel to each other but are secured together in the form of a narrow "A"-frame. Apart from the cross-members, railings are also fitted to the underside of the frame to sustain the force exerted by a log when it is lifted with one end pressed against the frame, which serves to take the main force of the log. A tong is set at the A-frame end at a distance from the centre which ensures that the short end of the log being lifted butts against the boom when the tong line is tightened. When the log has been lifted a swing line attached to the winch is then used to pull the boom over the truck being loaded. The tong line is then slacked until the log end furthest from the spar tree is placed in position on the truck load, then the line is further slackened until the log rests fully on the load. When the tongs have been unhooked the swing line is slackened and a counterweight riding on the guy-line pulls the boom back over the logs to be loaded.

There is very little difference between the rigs of the two loading frame systems. Besides the frame shape, the McLean boom has two loading tongs, while the heel boom has only one tong.

1. Advantages of the heel boom system

(i) Only one tong is required on the log

(ii) Longer logs can be loaded

(iii) The tong line can be pulled out to the logs.

2. Disadvantages

(i) A much heavier rig is required i.e. to the frame, loading block and sail block, spar tree with all its lines, and the loading tongs.

(ii) If the logs are not in the correct position in relation to the frame they must first be moved in order to be conveniently positioned with the shorter end against the frame. The same thing occurs when the truck is at an inconvenient angle to the log held by the A-frame, and several movements may be required before the log is placed correctly.

(iii) Loading onto trucks with the heel boom loader is more dangerous.

3. Modern advances

Fig. L. 163, 164 and 165 illustrate modern mobile mechanical heel boom loaders operating with grabs. Fig. L. 163 shows a truck-mounted heel boom crane loading by means of mechanically-operated grabs, although hydraulically-operated grabs may also be used. Fig. L. 164 shows a heel boom crane mounted on a wheel carrier, while Fig. L. 165 shows the crane mounted on tracks.

(d) GUY-LINE LOADING

Guy-line loading is usually used in conjunction with the spar tree and highlead log skidding. This is one of the simplest and most inexpensive methods of loading from the point of view of machine and rigging requirements. The system utilises a single loading line and a single drum winch (Sullivan winch).

FIG. L.166
SAIL BLOCK LOADER.

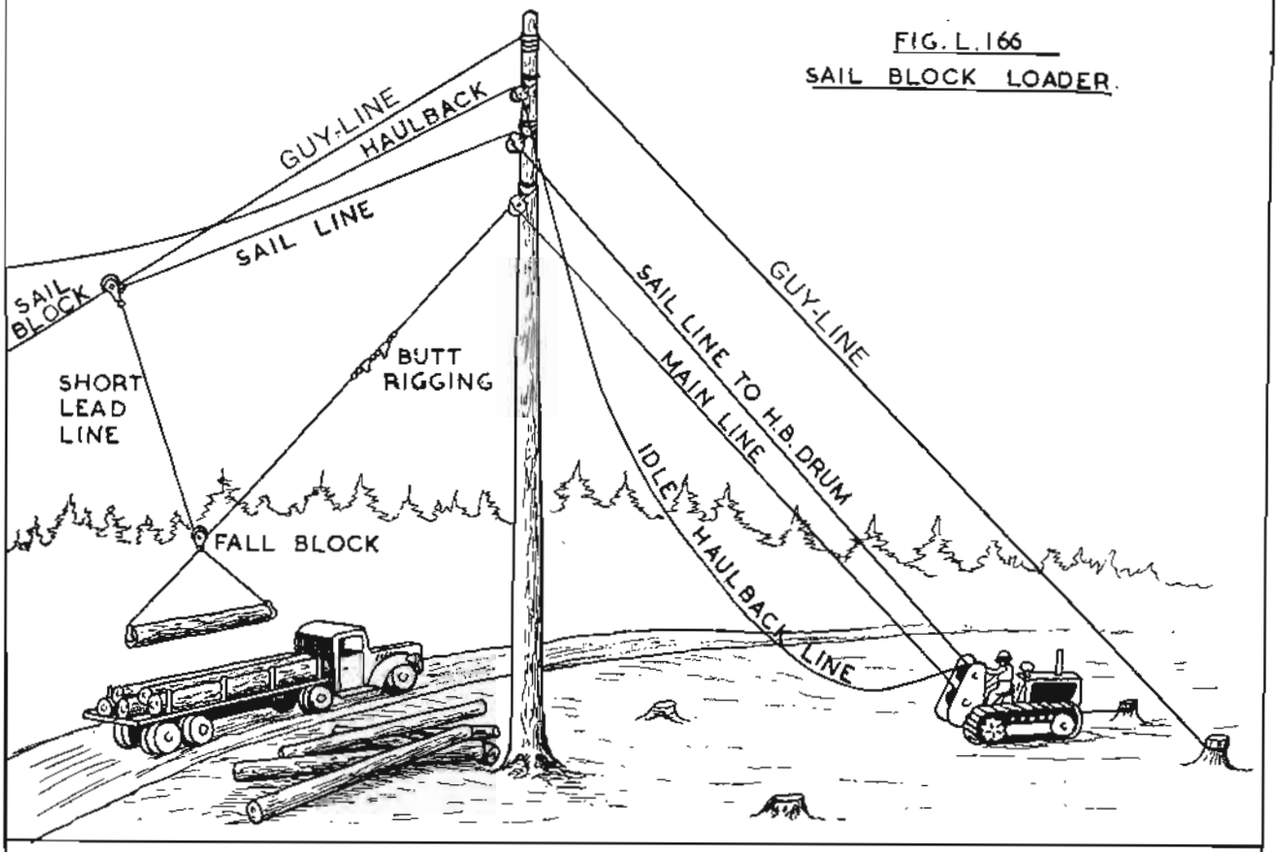
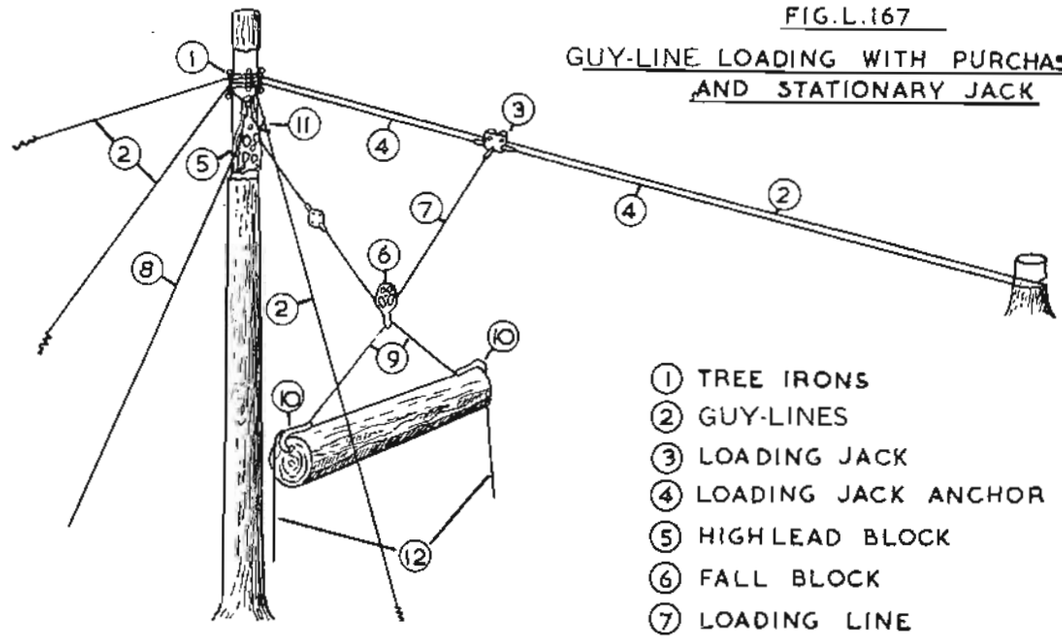


FIG. L.167
GUY-LINE LOADING WITH PURCHASE BLOCK AND STATIONARY JACK



(1) TREE IRONS
(2) GUY-LINES
(3) LOADING JACK
(4) LOADING JACK ANCHOR STRAP
(5) HIGH LEAD BLOCK
(6) FALL BLOCK
(7) LOADING LINE
(8) MAIN LINE
(9) CROTCH LINE
(10) LOADING HOOKS
(11) SAFETY STRAP
(12) TAG LINES
(T) TAIL HOLD TO STUMPS

With the guy-line loading system a loading jack is attached to a guy-line in a position where a lead loading block fastened to the jack is approximately over the centre of the truck positioned in the road for loading. The jack in departmental cases, was fastened to the guy-line in both directions, with the upper and lower ends secured by the jack guy-line (Fig. L. 161). The lower end of the guy-line was fastened to a stump, while the upper end was threaded over the sheave of a block suspended on the spar tree, then brought down to the bottom of the spar tree. This arrangement keeps the jack from sliding down the guy-line. The loading line is threaded through a lead loading block on the spar tree and through a block on the jack. The chain loading slings with end hooks and tag lines are shackled to the lower end of the loading line (Fig. L. 161).

Located at a predetermined point on the loading line, between the loading drum and the load block on the spar tree, is a slack puller line. This line is threaded through a block located above the lead loading block on the spar tree, thence to a travelling (squirrel) block on a guy-line. A counterweight is attached to the travelling block, and this rolls off the slack on the loading line when friction and the brakes are released on the loading drum.

In order to prevent the log being loaded from hitting the truck as it swings, a large log is placed alongside the road next to the truck. It is sometimes advisable to place two loading spars with one end propped against the truck deck, or in the case of trailers, against the nearest log or on the first layer of loaded logs. The other ends of the spars are rigidly supported on the ground to prevent slipping.

Note : The slack puller line is attached to the loading line, and should be of such a length that the junction of both lines will not interfere with the loading block or logging winch drum. The latter case can be avoided by placing the winch at a sufficient distance from the spar tree.

(e) GUY-LINE AND FALL BLOCK LOADING (Fig. L. 167)

The arrangement of the guy-line and fall block loading system is as follows:

The main loading line (8) from a single winch drum is threaded through the highlead loading block (5), strapped near the top of the spar tree, then through the fall block (6) and is finally strapped to the jack (3). The jack is rigidly positioned by means of the anchor straps, (4).

By paying out or spooling in the loading line the operator causes the fall block to ride over the loading line. In this way the fall block with its crotch line loading slings (9) can be lowered to the logs and then hoisted and at the same time moved with the log over the lorry and lowered onto the lorry deck. Final minor adjustments positioning the log above the lorry is done manually by means of tag lines (12) fastened to the sling hooks (10).

This method has not been used departmentally.

(f) IMPROVED METHOD OF GUY-LINE AND FALL BLOCK LOADING

The same double-drum yarder with spar tree rigging is used in this operation as for highlead log yarding. Log skidding may be temporarily suspended, after a slight re-arrangement described below.

The methods previously described with the jack rigidly fixed on the guy-line have a number of drawbacks. The truck being loaded is sometimes battered by the log being loaded. In order to avoid this the following improvement in the arrangement of the loading rig has been suggested (Fig. L. 166).

The main alteration to the rig is to run a sail block on the guy-line instead of having a rigidly positioned jack on the guy-line. To operate the rig the chokers are removed from the butt rigging, together with the haulback line, and a short extension to the main line is fitted to the butt rigging. The other end of the extension is fastened to the sail block riding on the guy-line. A fall block with end loading slings attached is saddled on the extention. Finally a light sail line is fastened to the tail hold of the sail block, then threaded through a block strapped to the spar tree and down to the haulback drum, on which it is given a few turns. Prior to this the haulback drum is rotated in order to slacken the haulback cable, as it is not used in loading, but is left in the field so that skidding can continue immediately after loading has been completed.

End hooks, suspended from the fall block, are used for loading. When the log is hooked, lifting is done by the main line, while the sail block line allows the log to travel down the guy-line and squarely out over the truck by easing off on the haulback drum brake. Logs to be loaded must be placed between the base of the spar tree and the truck road, or truck, a distance of about 9 metres sufficing, thus simplifying piling and loading.

This rig has not been used by the Department, but is well worth testing out.

Note : When highlead skidding has been completed and loading is to be done, the main line and haulback line can be spooled in from the field. In this case the haulback line can be used instead of the sail line to control the sail block on the guy-line, and the main line can be used directly as a loading line, without an extension, the end simply being fixed to the sail block. The fall block is then saddled on the main line.

The loading methods described above using guy-line and McLean boom rigs are interesting since they eliminate log swinging to the roadside from the highlead log landings. These loading methods would be justified if logs are sufficiently large (about 1 ton) in medium scale logging operation where continuous yarding by highlead is not required.

FIG. L.168

TRUCK MOUNTING, THREE AXLES.

DIMENSIONS AND SPECIFICATIONS.

FIG. L.169

WHEEL-MOUNTED CRANE, TWO AXLES - DIMENSIONS.

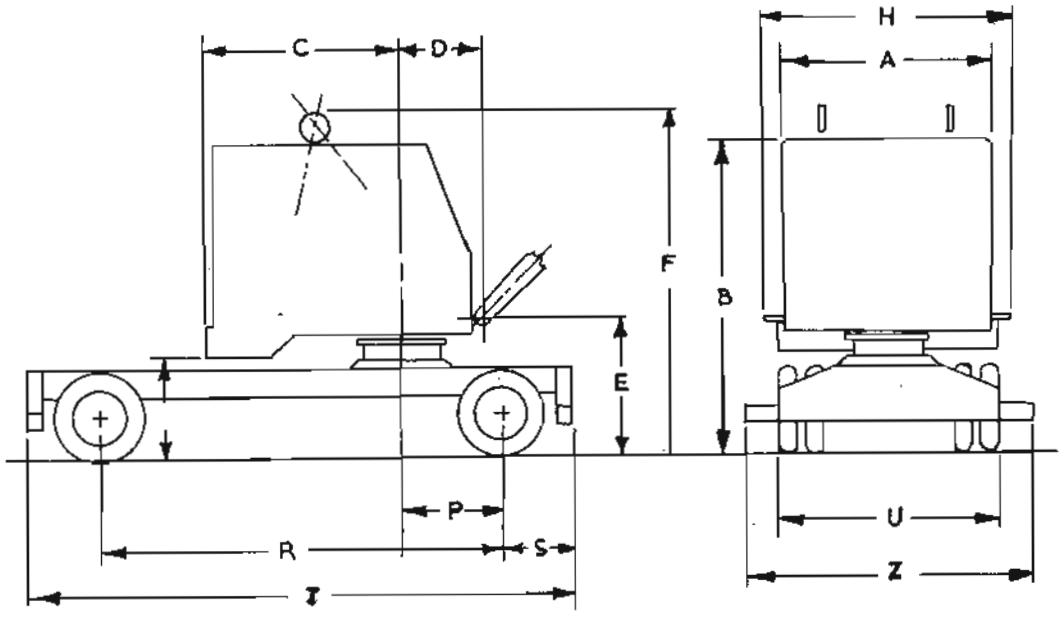
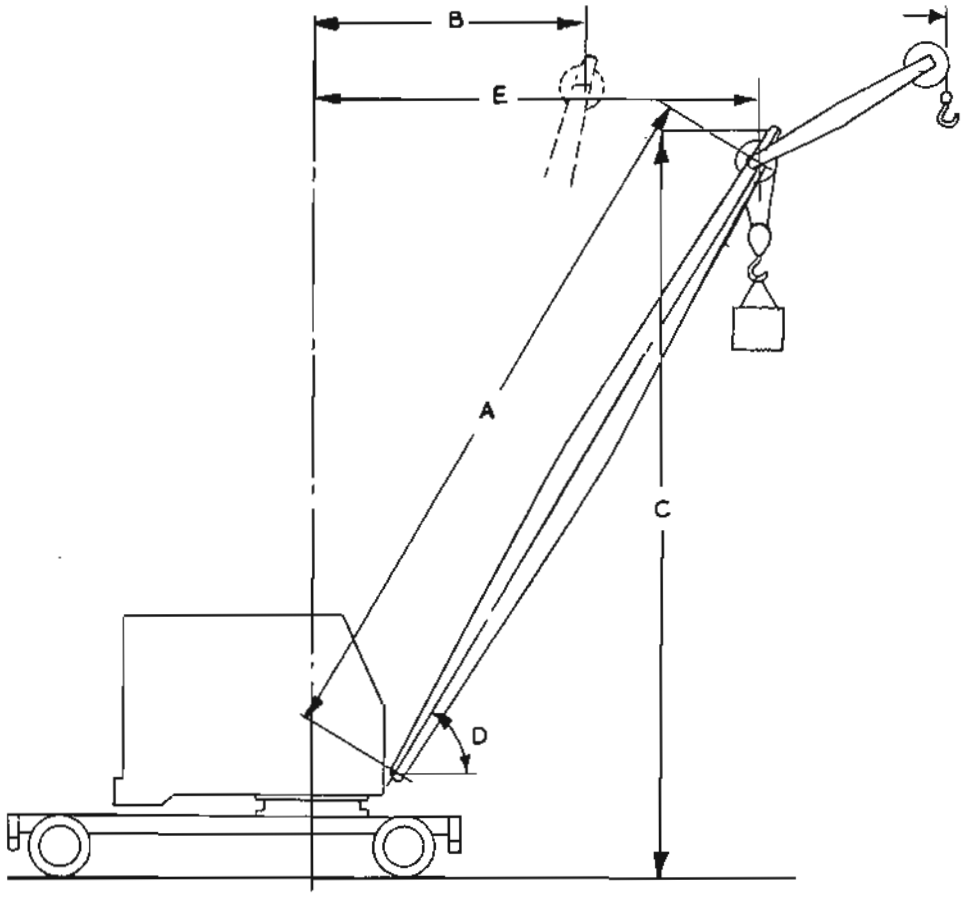


FIG. L.170

COMMON CRANE BOOM EQUIPMENT - DIMENSIONS.



APPENDIX L. 1

LOADING CRANE

REVOLVING SUPERSTRUCTURE AND CAB DIMENSIONS (Fig. L. 169)

A. Width of cab

B. Clearance height of cab

C. Clearance radius of rear end

D. Location of boom hinge pin ahead of centre of rotation

E. Height of boom hinge pin above ground

F. Gantry heights above ground when in operation and when folded

G. Counterweight clearance from grade

H. Overall width when running boards are used

TRUCK MOUNTING AND WHEEL MOUNTING (Dimensions and specifications - Fig. L.168,169)

P. Distance from the centre of rear axle or bogie to centre of rotation

Q. Distance between centres of axles of tandem axle bogie

R. Distance from centre of rear axle or bogie to rear end of frame

T. Overall length

U. Overall width, greatest dimensions over tyres, fenders or retracted outriggers

V. Minimum diameter of clearance circle, neglecting overhang of front end equipment, in which the machine can be turned completely

W. Distance from back of carrier cab to centre of rear axle or bogie

X. Size and ply of tyres

Y. Size and type of service brakes and parking brakes

Z. Overall width of extended outriggers

CRANE RATING DATA (Fig. L. 170)

The manufacturer shall furnish the data listed below:

A. Length of boom

B. Minimum practical operating radius

C. Boom head clearance data

D. Boom angle

E. Radius

DEPARTMENTAL TENDER REQUIREMENTS CARRIER-MOUNTED, SELF-PROPELLED, FULL-SLEWING CRANE

In general the departmental tenders are based on British Standard 1757 of 1951, and also follow the manufacturer's specification of the selected crane type for purchase. Some additional requirements have, however, also to be met.

The departmental requirements with regard to the crane and its performance for log loading can be briefly summarised as follows:

1. DUTY

(a) The crane boom to be of the strut type, 7,5 metres long, with an additional 1,5 metre extension piece specially supplied to lengthen the boom to 9 metres when required

(b) The crane should be capable of lifting 1700 kg on 1,5 metres radius without outriggers and with a crane stability as set by British Standard

(c) The travelling speed in unloaded condition to be not less than 30 km/h

(d) Lifting and lowering speed to be not less than 45 metres per minute. The empty line hook to be dropped at the same speed of 45 metres per minute

2. WORKING CONDITIONS

(a) The crane must be able to move over temporary forest roads

(b) The climatic conditions will be humid, of 80% relative humidity, and temperatures of up to 35° C will be encountered

(c) The crane must be able to operate efficiently at an altitude of 1800 metres

(d) In general unlimited headroom will be available under working conditions

(e) The maximum height of the crane in the travelling position will be 4 metres

(f) It should be capable of turning from a 7 metres wide road into a 4,5 metres wide branch road at right angles

(g) The crane will have to negotiate roads with gradients of up to 8°, and even short stretches about 200 metres in length with gradients up to 15°.

3. ENGINES

(a) In the event of separate carrier and crane engines, the carrier engine should be petrol driven and the crane engine diesel driven. If one engine is utilised it should be diesel driven

(b) Cooling: - Engines should be cooled efficiently by means of air or water under tropical conditions

(c) Liners: - Renewable loose liners must be fitted in diesel engines and preferably also in petrol engines

(d) Fuel: - Clean fuel shall be ensured by means of a strainer in the fuel tank, provision for removing dirt which accumulates in the fuel tank, a glass sediment bowl to remove water, and replaceable full flow filter element

(e) Lubrication: - All bearings should be pressure lubricated and the lubricating oil should preferably be kept cool by means of an oil cooler. It should be kept clean by at least one full flow filter. The engine must operate on oil obtainable throughout the country, and of a grade and type according to the U.T.B. specification

(f) Air-cleaner:- A dry type air-cleaner should be fitted. It should be constructed with a precleaner and replaceable paper element. The paper element should not be affected by moisture or oil. The air-cleaner should preferably be fitted with a service gauge to indicate when the element should be cleaned or replaced

(g) Instruments: - The following instruments should be provided for each engine:

(i) Mechanical hour-meter driven from the engine. Electrically-operated hour-meter may be considered, provided that it is operated by means of an oil pressure switch

(ii) Engine-cooling water temperature gauge, or cylinder head temperature gauge

(iii) Lubricating oil pressure gauge

(iv) Fuel gauge

(v) Ammeter

(h) Starting: - Direct electric starting, or starter engines with electric starters will be acceptable

(i) Electrical system: - 12/24 volt system will be preferred. Generators should be fitted with efficient voltage regulators to ensure long battary life

(f) Governor: - The engine should preferably be fitted with a governor which automatically adjusts the engine speed to the load required

4. RANGE OF LIFT TO HOOK REQUIRED

(a) Below ground level: Not less than 9 metres

(b) Above ground level: Not less than 6 metres

5. CAB

A fully enclosed lock-up metal cab should be provided. Two cabs required if the transport and crane operating positions are different. The crane operating cab should have a 360° view. The cabs should provide adequate protection for the driver and should be provided with comfortable seats.

6. CHASSIS

The crane should be mounted on a truck-type chassis specially designed for crane service, with three axles, all driven. Pneumatic tyres should be fitted of a size manufactured in the country. They should not be smaller than 9,00 x 20 x 12 ply. The chassis should be constructed to travel over rough, temporary forest roads. Rocker suspension should be fitted to the rear axles. Two hooks should be supplied both at the front and rear. A spare wheel with tyre and tube should be mounted on the chassis. Two axle chassis may be considered provided the tyre sizes are at least 1300 x 24. All chassis should be complete with mudguards and protecting plates.

7. LIGHTS

The crane should be fitted with lights for travelling purposes only. At least two headlights should be fitted with yellow lenses or bulbs for good fog penetration.

OPERATING COSTS FOR LIFTING CRANES

The operating cost information given below should only be regarded as the theoretical approach to the problem. The data were determined for cranes of 5 ton lifting capacity on a 2,5 m boom radius.

Investment costs of the crane comprise the following:

(a) The price f.o.b. factory, including all accessories for work performance

(b) Freight - calculated on the mass and volume shipped

(c) Unloading and erection costs: - 3 men require approximately 20 minutes moving to the job

(d) Depreciation - calculated for 5 years - 10 000 hours

(e) Interest

(f) Taxes

Note : All figures given relate to the accepted data for an intensive operation of the crane, i.e. 40 working hours per week or 2 000 working hours per year, or 10 000 working hours in five years

For departmental conditions the crane occupation is actually much lower than that mentioned above.

Although the average figure for crane occupation has been accepted, most units will in practice work more or less than the estimated time.

No salvage value is expected when this type of equipment is scrapped.

Depreciation percentage of the total investment per year or per hour may be calculated as follows:

$$\frac{100\%}{5 \text{ years or } 10000 \text{ hours}} = \begin{matrix} 20\% \text{ per year,} \\ \text{or } 0,01\% \text{ per hour.} \end{matrix}$$

In general costs may be divided into two groups: fixed or direct costs and variable (or operating) costs.

Fixed costs consist of:

(a) Interest, taxes, insurance, storage and investment

(b) Repairs, maintenance, supplies, including labour associated with them, and delivery of spare parts.

Operating costs are:

(a) Engine fuel and lubricating oil

(b) Labour - operating crew

Other costs

Supervision, local office overheads or indirect costs, insurance, moving from job to job, and weather.

The above costs are not included in the foregoing calculation as they vary from place to place, but may be accepted as being from 20% to 30% of the fixed and variable or operating costs.

Fixed cost analysis

(a) Interest, Taxes and Insurance. - The costs of interest on investment, taxes and insurance may be expressed as a percentage of the average annual investment. The average annual investment is that amount which equals the average book value during the depreciation period. If the depreciation period is 5 years, then the average annual investment, expressed as a percentage of the original investment, will be as follows:

Year	Book Value
1	100% of original investment
2	80% of original investment
3	60% of original investment
4	40% of original investment
5	20% of original investment
Total investment	300% of original investment
Average Annual Investment	$\frac{300\%}{5 \text{ yrs.}}$ = 60% original investment

The average annual investment may also be calculated according to the following formula:

$$\text{Average Annual Investment (A. A. I.)} = \frac{1}{2} \times \frac{n+1}{n} \times \frac{100}{1}$$

where n = number of years in depreciation period. Applying this formula to the above example, the average annual investment is:

$$\frac{1}{2} \times \frac{5+1}{5} \times \frac{100}{1} = 60\% \text{ of original investment}$$

If it is assumed that the cost of interest equals 6% of the investment and the costs of taxes and insurance are 4%, then the cost per year in respect of interest, taxes and insurance is 10% of the A.A.I. Applied to the above example, the costs of interest on investment, taxes and insurance would be $60\% \times \frac{10}{100} = 6\%$ of the original investment. The costs per hour would then be $\frac{6\%}{h}$, where h = number of working hours per year.

In the case of a 5 ton crane with an economic lifetime of 10 000 hours over a period of 5 years, the costs of interest on investment, taxes and insurance, expressed as a percentage of the original investment, would be as follows:

A. A. I.	Depreciation Period	No. of working hours	Cost of interest on investment, taxes and insurance	
			Per year	Per hour
60%	5 years	10 000 or 2 000 p.a	6%	0,003%

The reason for calculating the A.A.I. is that depreciation is written off annually against income, and can therefore be deducted from the previous year's book value or original purchase price. The book value is therefore meant to indicate a realistic market value for the specific item or that value at which an item of equipment, having had the same number of working hours, could reasonably be purchased. The book value therefore indicates the nett investment, for the specific year, in that specific item.

(b) Repairs, maintenance and supplies. - The percentage of the repair and maintenance cost is extremely difficult to estimate. The severity of the work done will make a large difference in the amount of maintenance and repair required, and these expenses will not be uniform each year.

Assuming that the cost of repairs, maintenance and supplies is 100% of the total investment spread over the economic life of the machinery, the percentage of these items will be the same for the crane as the percentage for depreciation. Half of this charge is estimated to be for labour and half for material.

Not included in this cost are:

Cost of the operating crew, engine fuel and lubricating oil.

The cost percentage for the above group, including labour, will be:

Crane lifting capacity	years	hours	% of total investment per year	per hour
5 ton	5	10 000	12%	0,006%

Example: Assuming that a 5 ton crane cost a total of R10,000.

Repairs, maintenance and supplies = $\frac{\text{R10 000}}{\text{10 000 hrs.}}$ = R1,00 per hour

Assuming that the crane can load 30m³ per hour.

So repairs, maintenance and supplies = $\frac{100c}{30m^3}$ = 3,3c/m³

VARIABLE OR OPERATING COSTS

Fuel: - Below is the formula for the approximate estimation of the petrol or diesel fuel consumption for crane types:

$$\frac{\text{kW x factor x kg. fuel per kW.h}}{\text{Wt of fuel per litre}} = \text{litre per hour}$$

Where:

kW = Brake kW of engine, or rated kW
Factor = Factor used is 50 to 60%
Petrol = 0,36 kg per brake kW.h
Diesel = 0,23 kg per brake kW.h
Petrol = 0,5 kg per litre
Diesel = 0,7 kg per litre

From the above formula one can obtain a petrol consumption of approximately 0,35 l per kW.h, and a diesel fuel consumption of 0,24 l per kW.h.

Note : The machine used for lifting crane service only operates intermittently and fuel consumption is difficult to estimate.

Example: For 75 kW engine. 75 kW x 0,36 l = 27 litres per hour of petrol.
75 kW x 0,24 l = 18 litres per hour of diesel fuel.

Auxiliary fuel cost for petrol engine starters for diesel engines is estimated at 1 cent per hour of machine operation.

Lubricating oil

The use of oil depends on the size and type of the engine, but it usually includes a complete change every 100 hours, plus topping up oil between changes.

The formula used to estimate oil consumption for cranes is as follows:

$$\text{l.p.h.} = \frac{\text{kW x 0,6 x 0,0031 p.kW.h}}{\text{0,7 kW per litre}} + \frac{\text{litres capacity of crane case}}{\text{100 h between complete change}}$$

An engine factor of 60% is used. The figure 0,0031 is used for engines under 75 kW and 0,0032 for engines over 75 kW.

Note: Nowadays the period between complete changes of crankcase oil is considerably increased and the common practice is to change oil every 150 hours.

Example: Lubricating oil consumption for 112 kW engine with 22 litre crankcase capacity would be:

$$\text{l. p. h.} = \frac{112 \times 0,6 \times 0,0031 \times 1}{0,7} + \frac{5}{100}$$

$$= 0,085 + 0,05 = 0,135 \text{ gallons}$$

$$\text{l. p. h.} = \frac{112 \times 0,6 \times 0,0031 \times 1}{0,7} + \frac{22}{100}$$

$$= 0,3 + 0,14 = 0,44 \text{ l/h}$$

Operating costs - continuation

Labour - operating crew.

The wage per labour unit as well as the number of labourers employed with the crane unit varies

in different parts of the country, so reliable estimates can only be made by local managements.

Besides rates of pay, one must consider insurance, workmen's compensation, overtime, paid leave, etc., if applicable.

Other costs are:

Supervision, overhead or indirect cost, moving from job to job or about the job, weather, local office, and taxes, all costs which must be considered locally and added to the operating cost.

Note: In the Department the above cost are approximately 30% of the total costs.

SUMMARY OF FIXED COSTS IN PERCENTAGES

Crane of 5 ton lifting capacity at 2,5 metres radius

Economic life - 5 years of 10 000 hours

Total cost on total investment 100%

Average investment 60% per annum

	Cost in % of total cost	
	Per year	Per hour
1. Depreciation	20%	0,01%
2. Interest, taxes, insurance	6%	0,003%
Total (1) and (2) (10% of average investment)	26%	0,013%
3. Repairs, maintenance, supplies	12%	0,006%
Fixed costs (1), (2), (3) for crane	38%	0,019%

Add engine fuel and lubricating oil costs and labour (operating crew only).

Example: Estimating form complete with data

Machine 5 ton crane with diesel engine 52kW
Crankcase: 18 litres, single shift, 2 000 hours per year

Price and mass f.o.b.	18 160 kg	R20 000
Blocking	454 kg	
Additional equipment (Ropes, wire rope, slings)	272 kg	600
Freight	18 886 kg	520
Unloading and moving to the job		75

Item No. 1. Total cost of investment: 100% - R21 195, say R21 200. Economic life: 5 years or 10 000 hours.

Item No. 2. Average annual investment: 60% of item No. 1 = R12 720.

TABLE L.7: SUMMARY OF COSTS

		Costs	
		Per year	Per hour
Item No. 3	Depreciation. 20% of item No. 1 per yr.	R4 240	R2,12
Item No. 4	Interest, taxes, insurance 10% of item (2) per yr.	R1 272	R0,636
Item No. 5	Repairs, maintenance, supplies. Crane. 100% of item No. 1 over machine life.	R4 240	R2,12
Item No. 6	Total fixed costs (items 3,4,5)	R9 752	R4,876
Item No. 7	Engine fuel and lubricating oil. Fuel per hour: 13,6 l. @ 3,3c R0,45; Auxiliary fuel/hour. R0,05; Lubricant oil/hour 0,4 l. @ 22c R0,09; Per hour. R0,59	R1 180	R0,59
Item No. 8	Direct labour - operating crew. 1 operator. R1,50 per hour; 2 loading men R1,25 per hour; Total R2,75 per hour. Add for overtime, insurance, etc.	R5 500	R2,75
Item No. 9	Total direct costs (Item 6, 7, 8).	R16 432	R8,216
Item No. 10	Indirect cost Supervision, overheads, etc.	R	R
Item No. 11	Total costs. (Item 9 and 10)	R	R

Output 28 m^3 per hour loaded
R8 216 ÷ 28 m^3 = 29 c/m^3

Note: The example is given from the "Operating Cost Guide for Shovels and Cranes," by the Power Crane and Shovel Association, U.S.A.

APPENDIX L. 4

NOMENCLATURE

Glossary and index. - The following is a glossary of technical terms and definitions peculiar to the power crane industry. No terms of general mechanical engineering or design are listed.

Accessory. - Any device, mechanical or otherwise, that assists or increases the usefulness of the machine.

A - Frame (or Gantry). - A gantry or A-frame is defined as superstructure of the machine to which the boom supporting cables are attached.

Air brake. - Brake operated by compressed air developed from air compressor. Most important use is for service brakes on truck-mounted or wheel-mounted machines.

Assembly. - Any minor or major group of mechanical parts designed to perform a given function.

Attachment. - An alternative designation for a front end component. Also any other device that may be added to a complete unit or assembly.

Axle. - The shaft or spindle on which a wheel or gear revolves. On truck-mounted and wheel-mounted machines, it refers to the automative type of axle assembly, including gearing and differential.

Axle (bogie). - Two automative-type axles mounted in tandem in a frame so as to permit oscillation in vertical direction.

Axle (truck). - Wheel and axle arrangements are designated by standard automative practice, and refer to both truck and wheel mountings. Any one axle may have two or more wheels.

Backward stability. - Mass distribution to be such as to avoid excessive or unsafe counterweighting of the machine on pneumatic tyres, and to ensure proper backward stability when the machine is used as a lifting crane.

Ballast. - See counterweight.

Band brake. - Circular type of brake either of external contracting type or internal expanding type, having a steel strap lined with heat resistant and wear resistant friction material.

Band clutch. - Circular type of clutch either of external contracting type or internal expanding type, having a steel strap lined with heat resistant and wear resistant friction material.

Bank (lever). - Group of operating levers used for controlling the machine.

Base (rotating). - Cast or structural member on which all revolving superstructure mechanism is mounted.

Base (travel). - Sometimes used to describe complete mounting, truck or wheel.

Base (turntable). - See base (rotating).

Block. - Sheaves or grooved pulleys in a frame provided with hook, eye and strap.

Block (hook). - Block with hook attached used in lifting service. It may have a single sheave for double or triple line or multiple sheave for four or more parts of line.

Bogie axle. - See Axle, bogie.

Boom. - Structural member attached to a revolving superstructure used for guiding and acting as support for front end operating mechanism.

Boom angle. - The angle from horizontal at which the boom is inclined. This angle is measured between the horizontal and a straight line drawn between the boom foot pin and boom point sheave pin. Boom angle is adjustable by means of the boom hoist (also called derricking) device.

Boom chord. - The corner member of a structural boom.

Boom head fairlead. - A swivelling sheave or sheaves at head of boom used to reduce hoist cable wear by compensating for operation not in line with the boom.

Boom hoist. - The hoist drum for controlling the angle of the boom.

Boom lacing. - Structural truss members at angles to and supporting the corner members of the boom.

Boom length. - The boom length is the straight line distance from the centre line of boom foot pins to centre line of boom head main sheave pin.

Boom sections. - Crane booms are usually in two sections, upper and lower. Such booms may be lengthened by insertion of one or more intermediate sections.

Boom splices. - Splicing connections for sections of basic crane boom and intermediate sections may be of the splice plate type, pin type or butt type.

Booster. - An auxiliary device attached to main functional clutch or brake to activate it for greater ease of operation. Also separate auxiliary device used to assist in other functions such as steering.

Brake (air). - See air brake.

Brake (band) - See band brake.

Brake shoe. - That part of a shoe-type brake or clutch which makes contact with brake wheel, brake drum or clutch drum.

Bridle. - Another term for guy rope and pendant.

Bull gear. - See swing gear.

Cab. - Housing that covers revolving superstructure, usually of sheet metal, on structural frame. Also, on truck carriers, the drivers enclosure.

Cable. - Steel wire cables or ropes used in various front end equipment operating functions.

Car body. - Wheel-mounted chassis.

Centre gudgeon. - See gudgeon.

Centre pin. - Large pin or vertical shaft which acts as rotation centring device and connects revolving superstructure and travel base.

Centre post. - See centre pin.

Clutch (band). - See band clutch.

Common crane boom. - It is a boom structure having head shafts, sheaves and other functional parts as required.

Component. - An assembly or group of mechanisms which, when attached to or installed on a machine, permits the performance of distinct functions.

Continuous boom hoist cables. - Are those cables which lead without interruption from the gantry to the boom head.

Counterweight. - Weight used for balancing operating loads and usually attached to rear of revolving superstructure. Also called ballast.

Deck. - Revolving superstructure turntable bed.

Derricking. - Operation of changing boom angle or of hoisting or lowering boom.

Derricking cables. - May be continuous boom hoist cables or floating boom harness.

Double reduction. - Automative term applying to type of drive from drive shaft to differential in driving axles.

Fairlead. - See boom head fairlead and dragline fairlead.

Floating harness (sometimes called bridle). - A floating frame or spreader equipped with sheaves and connected to the boom head by stationary cables called pendants.

Fuel pump (diesel). - Pump on diesel engine which takes fuel from supply line and distributes it to nozzles on injectors.

Fuel pump (petrol). - Pump on petrol engine which forces fuel in supply line to carburettor.

Fuel pump (hand). - Hand-operated pump may be used for filling fuel tank by pumping fuel from another receptacle.

Full-load speed. - The highest speed, under load, at which governor has fully opened the throttle or fuel pump.

Gantry. - See A-frame.

Goose-neck boom. - A boom which has a rigid upper section projecting at an angle from longitudinal axis of boom, usually a curved section.

Governed speed. - Is the top speed at which the engin will run, with or without a load, governor controlled.

Gudgeon. - A centring housing between revolving superstructure and travel base or centre pin.

Guy-rope. - Cables with both ends dead-ended. Usually used in connection with boom hoist system when floating harness is installed. Also called bridle or pendants.

Head, high altitude. - High compression cylinder heads installed on petrol or gas engines to partially compensate for low air pressure at high altitude.

Hoist. - Is defined as the function of lifting or lowering loads (see boom hoist).

Hook block. - See block (hook).

Hook rollers. - Rollers which prevent the lifting of the turntable from the base.

Idler rollers. - Rollers of tread belt mechanism which are not power driven.

Independent boom hoist. - When a boom hoist is completely independent of all other functions, it is usually designated as the independent type.

Jack shaft. - Term applied to any intermediate shaft.

Jib. - Jib, or boom tip extensions are attached to the boom head for further lengthening the boom beyond the boom head main sheaves. The jib may be straight or offset.

King pin. - See centre pin.

Laggings. - Removable and interchangeable drum spool shells for changing hoist drum diameter to provide variation in rope speeds and line pulls. This construction is optional with manufacturers.

Latticed boom. - Boom of open construction with angular lacing between main corner members in form of truss.

Lifting capacity. - Rated loads at specified radii shall be the maximum loads covered by the manufacturer's warranty, with the crane in working order standing on a firm, level and uniform supporting surface.

Line pull. - Is defined as the maximum pull in kg at the drum, at full-load governed speed, with the specified pitch diameter of drum or laggings, for the first layer of rope or cable.

Line speed. - Is defined as the speed in metres per minute at the drum, at full load governed speed, with the specified pitch diameter of drum or lagging, for the first layer of rope or cable.

Live roller circle. - An assembly of multiple swing rollers free to roll between revolving superstructure and mounting.

Load line. - Another term for hoist line. In lifting crane service, it refers to the main hoist. The secondary hoist is referred to as a whip line.

Luffing. - See derricking.

Main hoist. - See hoist.

Mast. - An adjustable frame hinged to the turntable at or near the boom hinge and extending above the cab for use in connection with supporting the boom. Head for mast is usually supported and raised or lowered by the boom hoist cables. When used with crane type boom, it serves the purpose of a high A-frame or gantry.

Mats. - Supports or floats used for supporting machine on extremely soft ground, usually of timber construction.

Monkey line. - Another term for tag line. Used for controlling swing of load.

Outriggers. - Are members attached to the carrier frame which may be blocked up to increase stability. When extendable they can further increase stability by increasing the size of the supporting base.

Overhaul. - Ability of a weight on end of hoist line to unwind cable from drum when brake is released.

Pay load. - The nett load or volume handled exclusive of mass of handling mechanism.

Pendant. - Another term for bridle or guy rope.

Pitch diameter. - Diameter of drum, lagging or sheave plus the diameter of the cable.

Power equipment. - May be powered by internal combustion engines of various types.

Power lowering. - Hoist mechanism with reversing drive that permits lowering the load under power, for more precise control, rather than by gravity with brake control.

Power lowering boom. - Boom hoist which has reversible mechanism permitting lowering under power rather than by gravity with brake control.

Power take-off. - Is defined as the method of transmitting power from the engine to the operating mechanism of the revolving superstructure.

Radius (of load). - Is defined as the horizontal distance from the axis of rotation of the machine to a vertical line through the centre of gravity of the suspended load.

Rated load. - See lifting capacity.

Rear end radius. - Clearance distance from centre of rotation to maximum rear extension of revolving superstructure. Also called tail swing radius.

Reeving. - The passing of cables or ropes over drums, sheaves or pulleys.

Revolving superstructure. - Includes the rotating frame, gantry and machinery common to all functional operations.

Ring gear. - See swing gear.

Roller (idler). - See idler roller.

Roller path. - The surface upon which run the rollers that support revolving superstructure. It may accommodate either cone rollers or cylindrical rollers or live roller circle.

Rope. - See cable.

Rotating base. - See base (rotating).

Slewing. - Another term for the swinging function.

Swing. - Is defined as the function of revolving the superstructure of the machine, usually through reversing clutches.

Stability. - The ability of machine to resist tipping.

Swing gear. - External or internal gear attached to the lower base with which swing pinion on revolving superstructure meshes to provide swinging motion.

Tail swing. - See rear end radius.

Tipping load condiion. - With or without outriggers - with machine on firm, level and uniform supporting surface, a tipping condition shall be considered to exist when all tyres on one or more wheels leave the supporting surface.

Tyre sizes. - These are specified by diameter of casing, diameter of wheel and ply rating, i.e. 9,00 x 20 - 10 ply is 23,5 cm casing on a 50,5 cm diameter wheel or rim, and is of 10-ply construction.

Torque convertor. - Auxiliary hydraulic device usually direct-connected to main engine or prime mover which multiplies engine torque as load increases with corresponding decrease in speed.

Trailer. - Rubber-tyred vehicle on which machine is loaded for long moves; also one pulled by machine, particularly a truck-mounted machine, when hauling auxiliary equipment.

Truck crane. - Crane mounted on independent engine-driven rubber-mounted carrier.

Turning circle. - Minimum diameter of circle in which machine can turn completely.

Turntable. - Another term for revolving superstructure of machine.

Wagon - (Wheel mounting). - A heavy-framed, rubber-tyred carrier supported by two or more axles, upon which is mounted a revolving superstructure with appropriate front end operation equipment, and which is controlled for travel from the cab of the revolving superstructure.

Wheel base. - Distance to centre of front and rear axles. On three axle trucks rear centre is centre of bogie axle.

APPENDIX L. 5

HYDRAULICALLY-OPERATED MOBILE CRANE

Departmental requirements

The following are some of the more important departmental requirements relating to the specification of hydraulic cranes:

Austin Western Crane, Model 220 - 6 ton capacity diesel automative crane.

The crane shall have the following capacities, dimensional limitations and special features:

1. Capacity. - 6 ton at 3 m radius.

2. Boom. - The boom shall be hydraulically-operated and capable of hydraulic telescoping to a minimum of 5,5 metres. From 2 to 4,5 metres manual extensions shall be provided. The total length of the boom, fully extended, shall not exceed 10 metres. The total angle of the boom shall be a minimum of 60°. The crane shall be designed to revolve through a full 360°.

3. Crane operation. - The crane shall be power operated in both directions for hoisting, topping and slewing, with a full load on the hook, independently or simultaneously in the same or opposite directions.

4. Sheave block and swivel. - Weighted sheave block and swivel hook shall be provided, and shall be of the heavy duty type.

5. Braking. - There shall be automatic braking on all three driving units for hoisting, boom topping and boom swinging.

6. Controls. - All controls for travel and crane operation shall be within easy reach of the operator in the normal driving position.

7. Visibility. - The operator must have a clear view of the hook, load and roadway.

8. Gears. - All gears, shaft journals, bearings and wearing surfaces shall be totally enclosed, running in lubricant and with dust-tight seals.

9. Drive. - Torque convertor travel drive shall be provided with 4-wheel drive and 6 travel speeds forward and 6 travel speeds in reverse.

10. Engine. - A heavy duty diesel engine or petrol engine complete with electric starter, battery, oil filter, oil pressure gauge, motor temperature gauge and battery charge indicator shall be provided.

11. Steering. - Power steering shall be provided on all four wheels.

12. Service brakes. - Brakes shall be of the hydraulic type. Parking brakes shall be provided.

13. Outriggers. - Hydraulically-operated outriggers shall be provided. They shall be of a type that can be used individually or in combination, and be controlled from within easy reach of the operator from his operating position. Outriggers to be situated at all four corners.

14. Tyres. - Tyres not less than the following sizes to be provided on all 4 wheels. Model "220": 20 - 12 ply.

15. Engine size. - Petrol: kW not less than 67 at 2 000 r.p.m.
Diesel: kW not less than 60 at 2 000 r.p.m.

APPENDIX L. 6

HYDRAULICALLY-OPERATED MOBILE CRANE

Austin Western Hydraulic crane - costs

							R
Engine	I. H. C.	-	U. B.	-	264 Petrol engine	- 8 000 kg	14 460
	Ford				332 Petrol enigine	- 8 000 kg	14 736
	I. H. C.	-	U. D.	-	282 Diesel engine	- 8 150 kg	15 276
Manual boom extensions			2m		135 kg		204
			3m		200 kg		264
			4,5m		300 kg		360
Boom point, heavy duty					22 kg		46
Brakes, four wheel							378
Cab, complete enclosed					180 kg		426
Fuel gauge - electric					2 kg		78
Fuel gauge - sight					2 kg		34
Generator, heavy duty, 50 Amp.							94
Hoodsides					13 kg		48
Governor, hi-speed travel (for Ford 322 engine only)							356
Hour meter							30
Hoist, double drum					450 kg		1 440
Lights: Electric, includes 2 head, 2 tail, 1 dash						11 kg	38
Flood, electric on crane. One light only						7 kg	66
					Two lights only	13 kg	126
Directional 4 kg							72
Maintenance platform 380 kg							283
Outriggers, on four corners. Hydraulic 1 100 kg							1 206
Pintle hook - front and rear 9 kg							60
Pump, special 330 l.							204
Tyres: (The prices quoted below are in lieu of the standard 25 cm x 50 cm - 14ply rating)							
30,5 cm x 50 cm - 14 ply rating). Mass 90 kg							276
35,5 cm x 61 cm - 12 ply (sure grip) 226 kg							476
40,5 cm x 50 cm - 14 ply (all weather) 360 kg							1 194
40,5 cm x 50 cm - 14 ply (sure grip) 360 kg							1 330
Winch: Front mounted, less cable:							
1. Mechanical with power take-off from crane with outriggers:						340 kg	916
2. Hydraulic - for crane with outriggers.						400 kg	1 374
rear mounted						380 kg	1 142
Power take-off, only						30 kg	226

Total cost of the crane - Approximately R20 000 delivered at the plantation.

APPENDIX L. 7.

ADDITIONAL DETAILS OF OPERATION

LOADING BY "A"-FRAME WITH SULLIVAN WINCH

1. Fuel and lubricant used:

	R	
Fuel (petrol) - 1 245 l x 4,6 c	57,54	aprox.
Engine oil - 35 l x 24 c	8,48	"
Grease 0,9 kg x 0,35 c	0,32	"
Total during observed time	R66,34	"

2. Spares, and repairs; during observed period 13,80
   Note: Hiring cost per hour, including use of machine 124c ..... (A)

3. Cost of auxiliary equipment

	R
Loading cable. 13 mm x 60 metres	14,62
2 guy-lines. 13 mm x 60 metres	14,62
2 slings, 16 mm x 3 m one end eye spliced	4,00
2 slings,13 mm x 5 m endless	2,80
1 sling, 13 mm x 2,5 m both ends eye spliced	2,00
1 set chain loading slings plus hooks	26,00
1 set wire rope loading slings plus hooks	6,00
2 tag lines, 16 mm x 9 m hemp rope	2,00
Sister hooks, 2 only	1,50
Crosby wire rope clips 13 mm - 12 @ 15 c.	1,80
16 mm - 12 @ 17 c.	2,00
Peavy hooks, 3 only	7,50
Peavy spare handles, 9 only	4,50
Hookaroons, 4 only	10,40
Hookaroons, spare handles	4,80
Total value of auxiliary equipment	R104,54

Depreciation of auxiliary equipment: R104,54 ÷ 1 000 hours 10-4c,
say 11c/h ..... (B)

Loading blocks.	No. 3122 (S) =	R70,00
	No. 7010 (S) =	R50,00
Total cost of blocks		R120,00

Depreciation of blocks: R120,00 ÷ 5 000 hrs = 2,4c per hour ..... (C)
Total cost per working hour: A + B + C = 124c + 11c + 2,4c = 137,4c say 138 cent.

Note: The value of the 3 timber A-frame members is not included.
Their dimensions were as follows:

(a) Vertical (Upright): 15 - 17 cm top diameter x 9 m long.
(b) Horizontal (cross): 25 cm top diameter x 4 metres long.

Dismantling and moving

Dismantling, moving the frame and equipment to the next operating site, and re-erecting took 4 men about 2 hours. The engine and dismembered A-frame were towed by a D.2 tractor. A monkey winch or Tirfor puller (3 ton capacity) could be used to raise the frame into the working position.

APPENDIX L. 8

OPERATION DATA FOR A-FRAME LOADING

The following data refer to a particular operation observed, where loading was done by A-frame and Sullivan-type single-drum winch.

1. Cost of equipment

   Hire of A-frame, engine and auxiliary equipment. 138 c. per hour (A)

2. Occupation and output

   Days worked: 65 days
   Hours worked: 239 hours 15 minutes
   Average hours worked per day: 3 hours 36 minutes.
   Timber volume loaded. Total: 2 625 m^3
   Average timber volume loaded per hour: 10,8 m^3
   Daily capacity. (7 hours working): 79 m^3

3. Labour costs

1 Operator	R276,00
Bantu labour	52,00
Total labour cost	R278,00

   Cost per working hour: R278,00 ÷ 239 hours = 116c per hour (B)

4. Loading cost per m^3

   A + B = 138c + 116c = 254c per hour.
   254 ÷ 10,8 m^3 = 23,5 per m^3
   The above data refer to a 65 day period of work.

   Loading time for a 7-8 ton lorry, with a single load of from 17 to 18 logs, occupied an average time of 25 to 30 minutes.

   In practice difficulty will be experienced to keep the A-frame continually occupied, as lorries do not always arrive on schedule, or there may not be sufficient lorries to keep the A-frame occupied throughout the working day.

"A"-FRAME RIG AND ITS APPLICATION

Fig. L. 153.

Item No's.	Name	Quantity	Application
1	A-frame cap.	1 only	Used for heavy structures only
2	16 mm bolts, 45 cm long	1 only	To hold the tops of the upright members of the structure together.
3	Strap (sling) 13 mm diam. x 2,4 m long	1 only	For lifting frame to the upright
4	Bow shackle, 16 mm	2 only	To fit the eye splice ends of the lifting strap.
	Bow shackle, 19 mm	1 only	To link the shackled ends of the lifting strap.
5, 9	Guy-lines, 16 mm x 30 m	2 only	To hold the frame in the working position.
6	Shackle, bow, 19 mm	2 only	To attach suspended block to its strap(sling).
7	Straps, (slings) 16 mm x 4 m Both ends eye spliced.	2 only	To suspend the loading block.
8, 11	Block (main) 3 ton safe load capacity with sheave for 13 mm wire rope.	1 only	To load the logs.
10	Clips, Crosby, 16 mm	12 only	To attach 16 mm guy-lines to anchor stumps
	Crosby clips, 13 mm	12 only	To use with 13 mm wire rope.
12	Poles, 17 cm top x 9 m	2 only	Structure upright members.
13	Sling saddle	2 only	The notch on the anchor stump to firmly hold the guy-line in position.
14	Anchoring stumps	2 only	To attach the guy-lines on the structure to keep it upright.
15	Blocks, 3 ton safe lifting capacity	1 only	To deviate the loading cable.
16	Log (pole) 25 cm x 4 m	1 only	Lower cross-member, to rigidly support uprights at the bottom and keep them together.
17	Loading chains 9 mm link diameter	1 set.	Crotch type two-leg adjustable chain loading slings with end hooks.
18	Wire rope cable, 13 mm x 60 m	1 only	To lift the loaded logs.
19	Bolts, 16 mm x 45 cm	2 only	To secure uprights to cross-member.
20.	Fibre rope 16 mm x 9 m long, one end thimbled.	2 only	To control the loaded logs.
21	Single drum, one speed winch (winch sledgemounted with drum in front of winch)	1 only	To winch loading cable with load.
22	Rebate joint	2 only	For joining the bottoms of the uprights to the cross-member to hold the structure together.
23	Bottom block. Loading position		Sheave upwards while loading.
24	Shackles, 19 mm	2 only	For linking the 13 mm endless slings attached to the stumps with 16 mm slings holding the bottom blocks. They facilitate adjustment of the sling length.
25	Crosby clips, 16 mm		For attaching 16 mm slings holding the block, seized end to the shackle.
26	Bottom block position		The same as in item 23, except that the block is shown in the idle position.

APPENDIX L.10

TOOLS USED WITH A-FRAME LOADING RIG

PEAVY HOOKS, with sockets and handles (63 mm x 101 mm)	8 only
HOOKAROONS - medium pick with 91 cm handle	4 only
PICKAROONS - hook and pipe, with 91 cm handle	2 only
LUG (CLASP) HOOKS - with handle	2 only
BOW-SAW - 1,4 m	1 only
AXE	2 only
SPIKES	24 only
NAILS - 13 cm	120 only
LIFTING APPARATUS - Power grip, or equivalent	1 only
LOADING WINCH, OR TRACTOR. 3 ton capacity, single drum Note: With 13 mm cable	1 only
HOISTING BLOCKS: Double sheaves, both ends shackled for 19 mm wire rope, sheave 35 cm x 3,7 cm x 3,5 cm	2 only
APRONS	3 only
GLOVES - safety palm stapled and wire stitched	3 only
SAFETY HATS	4 only
FIRST AID KIT	1 only

APPENDIX L.11

McLEAN BOOM LOADER

SPECIFICATIONS ACCORDING TO FIG. L.159

1.	Sail guy-line	32 mm
2.	Loading main line	19 mm
3.	Loading haulback or swing line	13 mm
4.	Guy-lines	25 mm
5.	Tong lines	19 mm
6.	Squirrel line	13 mm
7.	Sail guy spreader lines	25 mm
8.	Heel strap	28 mm
9.	Heel strap spreader lines	22 mm
10.	Loading lead block	412
11.	Sail guy block	No. 21
12.	Sail guy carriage	No. 118
13.	Swing line lead block	T-6
14.	Swing line boom block	T-6
15.	Loading block	1010
16.	Swing block	T-6
17.	Squirrel travelling block	No. 21
18.	Loading lead block strap	25 mm
19.	Swing line lead block strap	19 mm
20.	Swing boom block strap	16 mm
21.	Swing block strap	22 mm
22.	Sail guy block strap	32 mm
23.	Loading block strap	22 mm
24.	"Screwy" guy-line hooks and ferrules	Jr.
25.	Loading line tail bold sheave	19 mm
26.	Loading line block strap sockets	No. 41. 22 mm
27.	Swing line lead block strap sockets	No. 41. 19 mm
28.	Sail guy block strap sockets	No. 99. 32 mm
29.	Heel strap sleeve	29 mm
30.	Heel strap shackle	No. 320. 37 mm
31.	Heel strap spreader line sleeves	29 mm
32.	Sail guy shackle	No. 320. 37 mm
33.	Sail guy spreader line sleeves	25 mm
34.	Squirrel line sleeves	25 mm
35.	Swing line sleeves	25 mm
36.	Top tong line socket	No. 41. 22 mm
37.	Bottom tong line bumper socket	No. 41. 22 mm

APPENDIX L. 12

SUMMARY OF McLEAN LOADING BOOM EQUIPMENT

A. QUANTITY OF ROPES REQUIRED

1. Sail guy - 19 mm diam. x 30 m - 1
2. Guy-line - 16 mm diam. x 60 m - 5
3. Guy-line - 19 mm diam. x 60 m - 5
4. Squirrel line - 9 mm diam. x 60 m - 2

Note: The construction of the cables:

(a) 19 mm and 16 mm diameter
6 x 25, Seale, fibre core, best plough steel or better, ordinary lay, both ends eye spliced (20 cm x 10 cm)

(b) 9 mm diameter
6 x 19 Seale, independent wire rope core, best plough or better, ordinary lay, both ends eye spliced (15 cm x 8 cm)

B. WIRE ROPE ON MACHINE HYSTER DRUMS

(i) With D. 6 Caterpillar tractor or similar.
Main drum - 19 mm diam. x 230 m.
Haulback - 13 mm diam. x 750 m

(ii) With D. 4 Caterpillar tractor or similar
Main drum - 16 mm diam. x 200 m
Haulback - 9 mm diam. x 500 m

Note: 1. Rope construction: 6 x 19 Seale, independent wire rope centre.
Best plough or better, ordinary lay
2. One end of the rope to be spliced and thimbled, other end ferruled

C. CROSBY CLIPS (WIRE CLAMPS) - GENUINE

For 19 mm rope	-	60 only
For 16 mm rope	-	60 only
For 13 mm rope	-	36 only
For 9 mm rope	-	36 only
For 8 mm rope	-	36 only

D. QUANTITY OF SLINGS REQUIRED

Total length m	13 mm wire diameter. Quantity		16 mm wire diameter. Quantity		19 mm wire diameter. Quantity	
	Originally required	with spares	Originally required	with spares	Originally required	with spares
3	2	2	2	2	2	2
4	2	2	2	2	2	2
6	2	2	2	2	2	2
8	2	4	3	6	2	2
10	3	6	4	8	1	2
12	2	4	5	10	2	4
14	2	4	2	2	2	4
16	2	2	2	2	2	2
18	-	-	-	-	2	4
	17	26	22	34	17	24

E. QUANTITY OF BLOCKS REQUIRED

1. Loading block - 19 mm sheave - 1 only
2. Loading block - 16 mm sheave - 1 only
3. Sail guy carriage (block) - 19 mm sheave - 1 only
4. Skookum 206 (block) - 16 mm sheave - 2 only
5. Skookum T. 6 (block) - 16 mm sheave - 4 only
6. Skookum 66 (block) - 9 mm sheave - 2 only
7. Skookum 64 (block) - 9 mm sheave - 2 only

Note: When blocks are used for guy-lines at the anchors, the following are required:

(i) Sullivan 20 cm diam. sheave - 5
(ii) Slings 22 mm x 3, 5 m - 5

F. QUANTITY OF SHACKLES (OR CLEVISES) REQUIRED

(1) Shackles or clevises, bow or bell, with eye screw pin. 25 mm material diameter - 10 only
(2) Shackles or clevises, bow or bell, with drop pin and split pin. 25 mm material diameter - 6 only.
(3) Shackles or clevises, bow or bell, with eye screw pin. 19 mm - 6 only
(4) Shackles or clevises, bow or bell, with eye screw pin - 16 mm - 6 only.

G. OTHERS

(1) Wire-rope shortener for 19 mm diameter - 2 only (monkey winch type)
(2) Wire-rope shortener for 16 mm diameter - 2 only (monkey winch type)
(3) Spikes - 17 cm long (railway type) - 60 only.

McLean Boom log loader - tools

(a)	Auger	16 mm with handle	2 only
	do	19 mm with handle	2 only
	do	22 mm with handle	2 only
(b)	Axe	2 kg	2 only
	Hatchet	1 kg - T. 341/D. 73 No. 3 (Tarry's)	2 only
(c)	Hammer	Sledge or club - T. 1706/D. 58 Mass 1 kg (Tarry s)	1 only
	do	Carpenter's - T.2/D. 53. No. 3 Mass 1 kg (Tarry's)	1 only
(d)	Saw.	Bow - 91 cm	1 only
	Saw.	Cross-cut - 1, 22 m	1 only
	Saw.	Power driven, 3-5 kW	1 only

(e)	Wedge	Wooden 10 cm x 4 cm x 25 cm	10 only
(f)	Chisel	Double hooped T. 601/D. 54 (Tarry's)	
		Size 25 mm	2 only
		Size 51 mm	2 only
(g)	Screw-driver	Size 7 cm blade, 5 mm diam. 15 cm overall - T. 20/D. 53. (Tarry's)	2 only
(h)	Pliers	Combination "elect" T. 216/D. 33, Size 20 cm (Tarry's)	2 only
(i)	Spanners	- ring. Both ends offset - set	1 only
		Double hexagon openings Long type to suit S. A. E. and U.S.S. sizes. Chrome vanadium T. 2804/4/D. 31 (Tarry's) Sizes from 6-37 mm nuts.	
	do	Adjustable. Crescent:	
		20 cm	2 only
		30 cm	2 only
		38 cm	2 only
(j)	Cotter pin mild steel. Size 3 mm, 5 mm, 6 mm; each size		24 only
(k)	Jacks for wire drum lifting, hand operated		2 only
(l)	Wire rope climbing ladders, 6-9 metres		1 only
(m)	Climbing irons, full set with rope; set		1 only
(n)	Safety hook, ¼ ton capacity		1 only
(o)	Spreader bar, 5 ton capacity		1 only
(p)	Loading tongs - size 46 cm span		2 only
		size 66 cm span	2 only
(q)	Wire rope cutters (hammerblow) 19 mm capacity		1 only

APPENDIX L.13

ROUND STRAND FLEXIBLE ROPES FOR MECHANICAL LOGGING

Construction: 6 x 19 (9 x 9 x 1) "Seale". Main core - fibre

mm		Approximate mass per kg/m	Approx. actual breaking load in kilograms
Circ.	Approx. diam.		Special improved plough
19	6	0,15	2 129
25	8	0,28	3 750
28	9	0,33	4 466
35	11	0,47	6 668
41	13	0,68	10 004
44	15	0,79	11 161
51	16	1,04	15 220
60	19	1,45	21 617
70	22	1,96	28 140
76	24	2,45	35 415
79	25	2,67	37 744

Construction: 6 x 19 (9 x 9 x 1) "Seale". Independent wire rope core.

mm		Approximate mass per m/kg	Approx. actual breaking load in kilograms
Circ.	Approx. diam.		Special improved plough
41	13	0,71	11 174
44	14	0,83	13 206
51	16	1,08	17 269
60	19	1,51	24 688
70	22	2,02	33 015
76	24	2,54	39 618*
79	25	2,75	43 173

* Lang lay rope. All other ropes specified are ordinary lay.

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