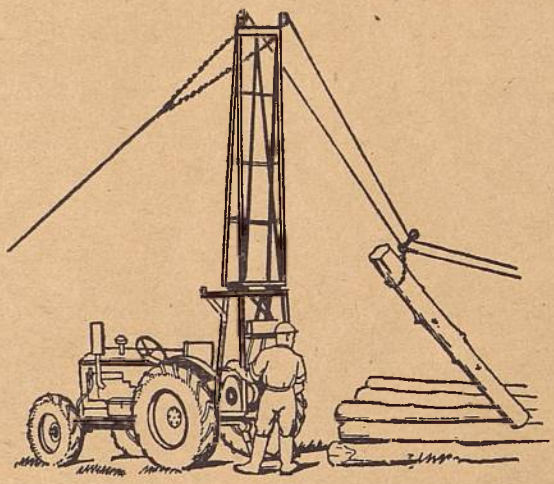
FORESTRY COMMISSION

BOOKLET No. 12

Double Drum Winch Technique

By R. E. CROWTHER and S. FORRESTER



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By R. E. Crowther, B.Sc., *and* S. Forrester, B.Sc.,
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CONTENTS

DOUBLE DRUM WINCH TECHNIQUE

I. INTRODUCTION

Trials with the Isachsen double drum winch in this country have reached a stage where it can be recommended for extraction of both thinnings and clear fellings in mountainous country. Where a horse can only work in the downhill direction the double drum winch can operate both uphill and downhill, and extraction costs are lower. On level or gentle slopes, costs by the double drum winch may not be as low as by horse; they are certainly lower than by crawler tractor, but a wheeled tractor is the cheapest method if it can operate within the stand.

Successful work with a double drum winch depends on two main factors:—

(a) The organisation of the whole logging operation to suit the winch.

(b) The skill of the operators in making the best of the equipment in varied conditions.

There are many points of organisation and technique that play a large part in achieving a high output. This booklet records those that have been found useful in this country to date, but though several pairs of operators have been employed, experience has been limited to a few machines and cannot be comprehensive. The use of the double drum winch is not familiar to many people and hence this booklet has been produced in the hope that it will be of assistance to those using the double drum winch for the first time.

The double drum winch, designed to be mounted on an agricultural wheeled tractor, has been developed in Norway by Professor Samset of the Norwegian Forest Research Institute at Vollebekk as an alternative to the horses which are traditionally owned by small farmers and used for agriculture in the summer and on forest extraction in the winter. In Norway horses are largely being replaced on the farms by wheeled tractors.

The wheeled tractor alone is not an alternative to the horse in the forest except in relatively easy country and the double drum winch aims at making it more versatile. A measure of success is that over 1,000 are in use in Norway, but it should be remembered that Norway, with older forests, has a high proportion of clear fellings and later thinnings, a rather different problem to this country with its preponderance of early thinnings.

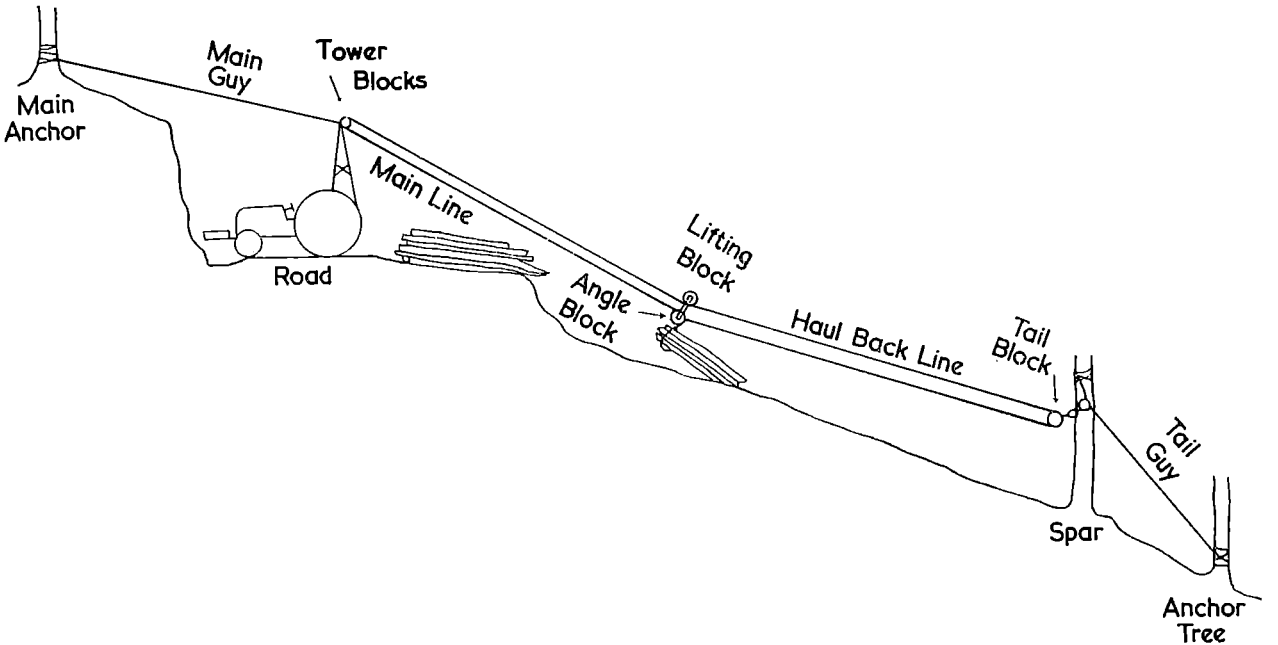


FIG 1. General view of a double drum winch lay-out. "Main Anchor", "Spar", and "Anchor Tree" are all standing trees.

The Isachsen double drum winch No. 3 (with 16-inch drums) is the one on which this booklet is based. There is another version of this winch, No. 2, which is the same but with smaller drums (11-inch). There is also a lighter model, No. 1, also with 11-inch drums which has been tried on a limited scale. While these may have value in some areas, the most generally useful one for the British hill country would appear to be the larger model. Another Norwegian make, the Vinsje, marketed by Jo-Bu, is available; and a British model with hydraulic drive is under development by Boughtons of Amersham. In addition a light portable winch developed by the Forestry Commission in Wales has been operated successfully with two drums, for early thinnings on smooth terrain. Much of the information in this booklet will be applicable whatever the type of double drum winch employed.

II. WORKING PRINCIPLES

The principle of all these winches is that one drum hauls in the "main line" with load attached and the other pulls in the "haul back line", which passes round the "tail block" and so to the end of the main line, drawing it out again. (See Figure 1). The tower on the tractor and a "spar tree" supporting the tail block raise the lines off the ground. The lifting effect is augmented by running the "lifting block" on the haul back line, this block being secured to the "angle block" from which the load is suspended. (See Figures 1 and 2 and Plates III and VII).

Each drum has both a clutch and a brake so that when hauling in a load with the main line, an application of the brake on the haul back line drum, tightens the lines and lifts the load. This balance between application of the clutch and brake requires a certain amount of skill which takes a short time to acquire; the inexperienced operator puts much more strain on the lines than is necessary. The hydraulically driven winch may make work easier in the learning stage, but this has not yet been proved.

The angle block on the end of the haul back line allows the main line to be pulled by hand to either side for a distance of 20 or 30 yards. This distance is limited by the time and effort required, and by obstructions over which the load cannot pass because of the lack of lifting effect.

The normal maximum operating distance between tractor and tail block is 150 yards. This is determined by the high lead effect, which only persists for about ten times the combined height of the blocks;

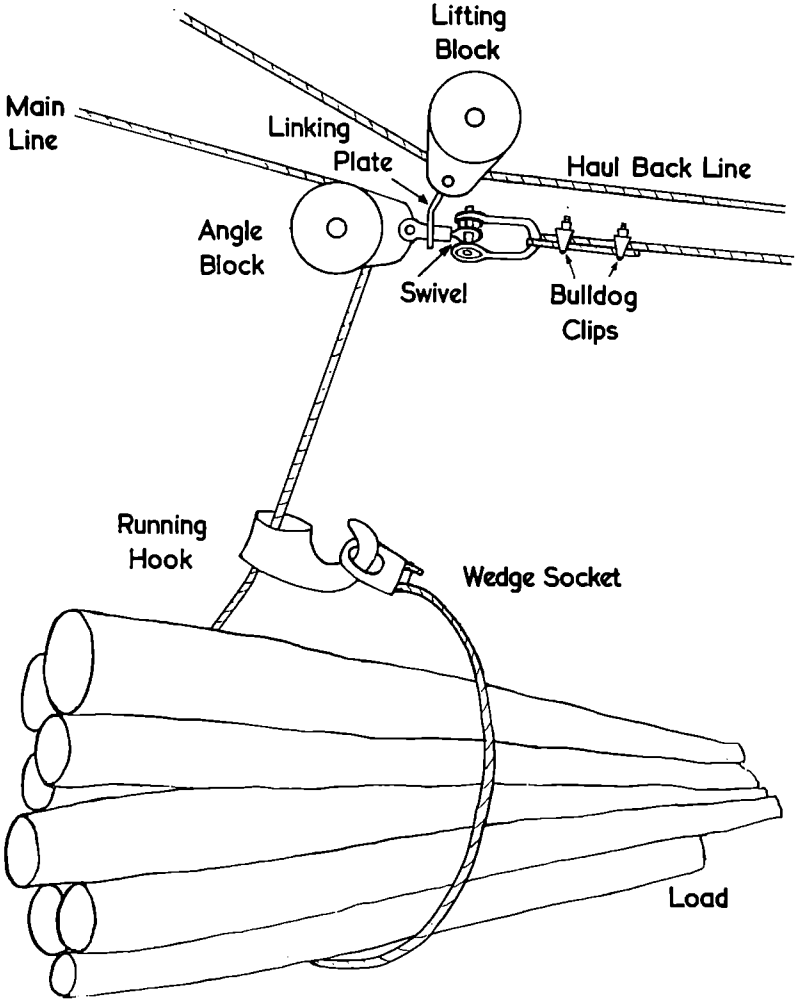


FIG. 2. View of load attachments.

even with the ends of the line raised 20 feet, little lifting effect is obtained in the middle. Where the ground is concave, however, this limit may be exceeded, and distances of a little over 200 yards have been worked. The drums of the Isachsen No. 3 winch will take 450 yards of 5/16th inch diameter wire; this length is required on the haul back line for work at this extreme range.

The tractor is stayed by a single main guy from the top of the tower to a suitable tree, stump, or artificial holdfast, and the tail block on the spar tree is similarly anchored. No other anchorage is necessary for the normal set up, where the tractor is in line with the extraction rack. (See Figures 1 and 3 and Plate I).

III. SITE LAYOUT

Careful planning of the whole logging operation from layout of extraction racks to disposal of produce is essential for successful use of the double drum winch.

(a) **Roads**

If roads are farther apart than 300 yards in any part of the area to be worked, then this cannot be covered by normal use of the double drum winch, unless concave slopes allow longer than normal lines. Construction of additional roads may be an uneconomic proposition, and alternative methods of using the winch need to be considered; some of these are described in Section VIII.

The normal forest road of 10 feet wide and a formation of 15–20 feet may not be wide enough to operate the tractor standing across it and still give adequate stacking space. Much can be done by using existing turning and passing places, bends and corners on the road, and places where the formation is wider than usual, but where extraction has to take place on to a narrow part of the road, the tractor may have to be offset, necessitating extra guy ropes and anchorages. (See Section VIII, page 27).

(b) **Racks**

In clear falls the lines for extraction should be selected before felling, and in thinnings it is necessary to cut racks (unless suitable clear lanes already exist); these should be marked before the thinning. Data from Germany indicates that racks up to 15 feet wide do not result in any loss of increment provided they are cut early enough. Even in later thinnings it would appear that since only the occasional

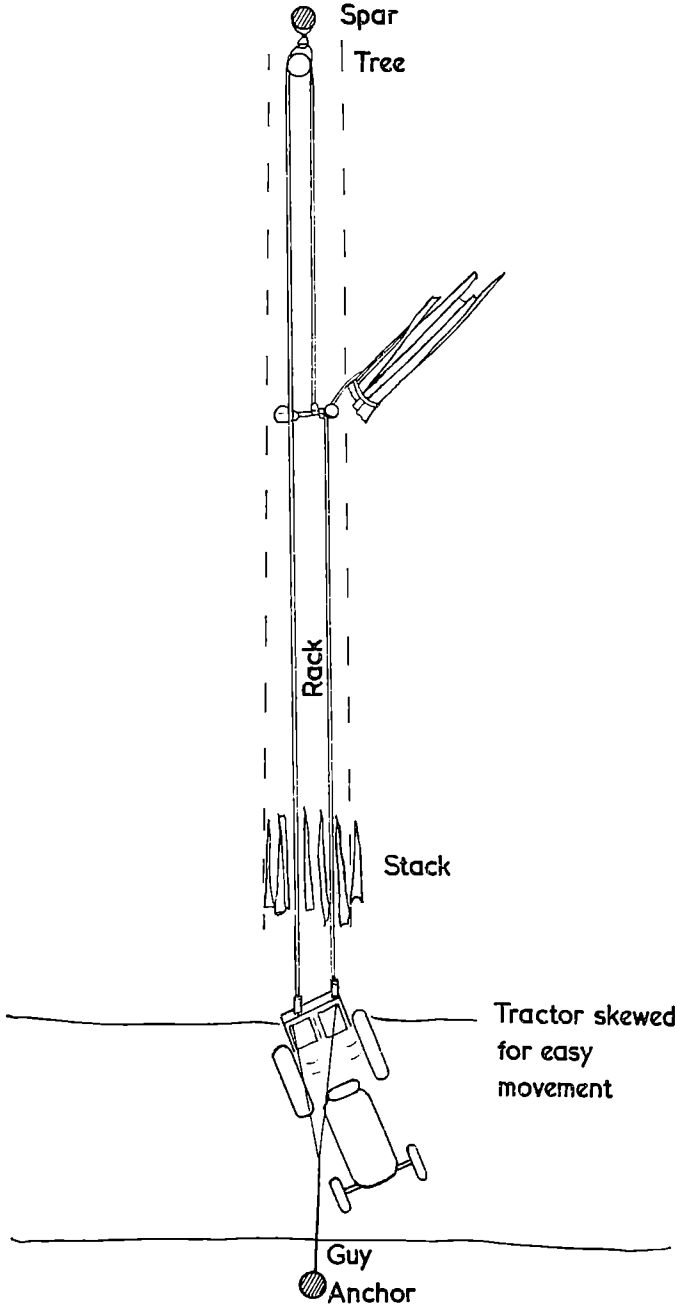


FIG. 3 Set up with ample space. The tractor can be set up in line with rack, and only two anchors and a spar are needed; the "spar" is guyed to another anchor (not shown).

crop tree is cut, losses are marginal. Racks of ten feet wide have been found convenient and adequate. They must, of course, be straight, but need not avoid crossing gullies, or low rock cliffs.

A number of factors, some of which conflict, have to be taken into account in siting racks. These are:—

(i) Racks must terminate at a stacking site on the road, and, on all but the shortest racks, there should be a suitable spar tree at the far end to which the tail block can be attached. Alternatively the tail block can be suspended from a wire between two trees a short distance apart.

(ii) Racks should be spaced about 20 yards apart, particularly in early thinnings, to avoid the need for pulling the main line too far to the side, or alternatively, excessive manual shifting of the timber nearer to the racks.

(iii) Convex slopes are much more difficult to work than concave ones, and obstructions also cause difficulties. Careful layout of racks can minimise these difficulties.

(iv) It is not essential for racks to be parallel, nor at right angles to the road, nor need they be equally spaced, but maximum efficiency on easy conditions will be obtained by having them so. In less easy conditions full use of stacking space can often be obtained by running several racks into one turning place or road end.

(c) Stacking Space

This is one of the most critical factors in using the winch. Ideally, the timber should be left in a stack in line with the rack. It can be swung at right angles as shown in Figure 11, page 32, but this takes extra time. Every site must be dealt with as circumstances dictate, the amount of room, and the subsequent disposal of the produce having to be considered. It has been found most efficient to carry out the cross-cutting at stump; this shortens the length of the poles thus usually allowing stacking at right angles to the road, and is convenient for loading straight on to lorries. Where crosscutting is carried out at roadside, the stack must be in a suitable position for subsequent handling, and this usually involves swinging the poles parallel to the road.

(d) Felling Direction and Preparation of Loads

Where thinnings are to be extracted in the pole length, careful directional felling is required. Trees should be felled herring-bone fashion in relation to the racks, but as poles can be extracted as

easily point first as butt first, the question of whether the tops or butts should be towards the rack can be left to the feller's discretion.

Though working with pole lengths is feasible, the turning and stacking of long poles at roadside is difficult and the best results have been achieved where considerable preparation has been carried out by the fellers ready for the winch. Poles have been crosscut at stump into lengths of 10–12 feet, with saw logs up to 20 feet (though, so far, only very occasional logs have been as long as this). The lighter timber has been piled, sometimes on top of a log too heavy to move by hand, to give loads of about 10 hoppus feet (See Plates V and VI). The loads should be laid with the end raised on a bearer to allow the wire to be easily passed round, and should be in such a position that they will be pulled into the rack without hitting obstructions.

IV. METHOD OF WORKING

(a) **Tractor**

Wherever possible the tractor, main guy, and the rack should be in line. (See Figure 3, page 10). The tractor may be set at an angle to the rack, with the main guy adjusted to ensure an even strain, as shown in Figure 3, to allow it to be driven clear more easily. This is particularly useful if the road is in use and the tractor has to be moved to allow traffic to pass, as it can easily be driven forward without dismantling any of the rigging.

Where space is limited or where stacking is required on the opposite side of the road, a spar tree on the roadside will have to be used and the tractor parked clear of the end of the rack. This raises considerable difficulties with visibility, and increases the amount of rigging required. (See Section VIII (a), page 27 and Figure 8, page 28).

The tractor must be set up so that it is reasonably level. It is particularly important that the axis of the winch on the Isachsen should be level because a slope will cause the drums to lean against the clutch plates with the result that the clutch will not disengage properly. This makes pulling out the rope by hand very hard work.

The Isachsen winch is supplied with two different tower extensions, giving total heights of about 10 feet and 16 feet from the ground. Normally the taller tower should be used, to give the maximum

possible lift for the extraction itself and for stacking. However there are occasions, particularly on downhill hauls, when the higher tower keeps the timber so high off the stack that careful placing is difficult. The other case for using the lower tower is on very short hauls, where height is not important, and less strain may be put on the anchor using the lower tower. In places, where only a few loads have to be taken out with one set-up, the low tower, or even the tower base only, may be used without a main guy at all; however this is a technique only for the very experienced operator.

(b) **Anchors**

A safe anchor for the tractor is essential as failure can result in a serious accident. The safest is a large tree or stump to which the half inch diameter wire of the guy rope should be fastened with bulldog clips, or some other secure device. Several types have been tried but the bulldog clip has proved most reliable. The anchor rope should be fastened as near the base of the tree as possible, tightening up as far as possible by hand with the final tension being put on by driving the tractor backwards. If the anchor is a crop tree it should be protected e.g., by old conveyor belting.

The Molex screw type of anchor, and the plate and pin type, (two plates each with eight pins), have been used on occasion, but they take extra time to fix and difficulties with both types are found in rocky soil.

The tail block should normally be secured as high as convenient, up the spar tree, a short strop passing round the tree and being shackled to the block. A guy rope of three-eighths inch diameter wire should be shackled round the tree at the same point and carried back to another tree or stump, being fastened with bulldog clips in the same way as the main guy. (See Figure 4). If there is no suitable tree for the tail block in line with the rack, a longer strop can be used between two trees; in this case the tail block itself should be anchored back to a tree or stump. The two trees will tend to pull together until the meeting of their crowns prevents further movement.

(c) **Sequence of Jobs**

(i) **Preparation**

1. Lay out racks before marking, taking into account topography, space for tractor and stacking, and availability of anchor and/or spar trees.
2. Fell trees and prepare the timber for extraction. (See Section III (d) page 11).

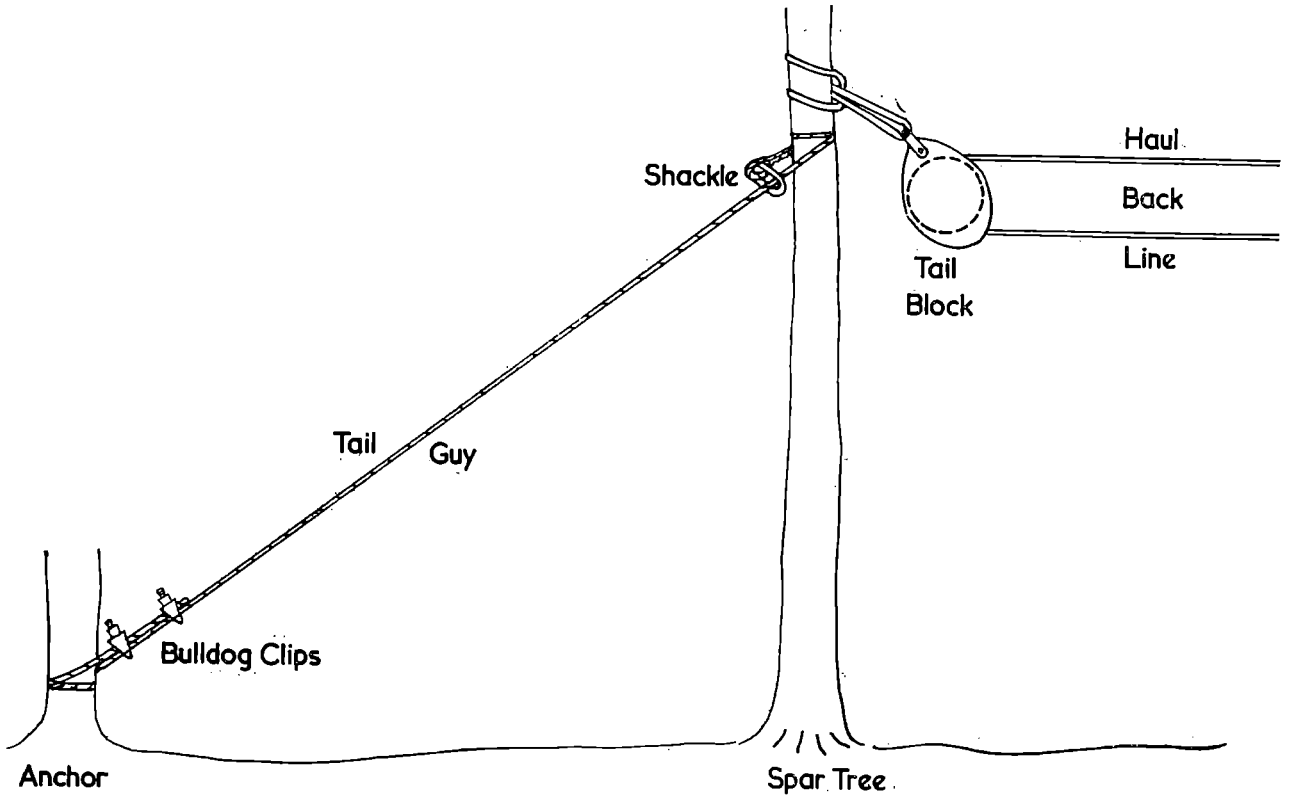


FIG. 4. Rigging tail block.

(ii) **Setting up.** (With the normal team of two men).

Winch Operator	*Choker Man*
1. Examine site, decide on best location of tractor.	
2. Place tractor in position, move it forward two or three feet to allow for tightening guy.	Consider line of rack.
3. Assist choker man by paying out haul back line. Main line brake on.	Pull out haul back line by pulling tail block rigged to line.
4. Fit guy rope to tower (if not already hooked on), and secure guy to anchor. Drive tractor back to tighten guy.	Rig tail block and guy rope. (The ladder, and possibly guy rope may be fetched from previous rack).
5. Tighten lines by operating clutches and brakes.	Check lines clear and return to start of rack.

Where the line has to be taken uphill for a downhill extraction, assistance may be needed to haul out the line. It is often worth dismantling the lifting and angle block in these circumstances and hauling out the end of the haul back line rather than a bight of it; the end of the line is then passed through the tail block and hauled downhill to the tractor. A temporary rigging of the tail block can be made, and the guy rope and any additional equipment hauled up using the winch.

(iii) **Operating**

Winch Operator	*Choker Man*
1. Haul out tackle by operating haul back clutch.	Check preparation of load. Signal "Stop" when blocks reach the required position.
2. Apply haul back brake. Free main line brake.	Haul out main line to load.
3. Adjust stacking of last load extracted as necessary.	Secure wire round load. Signal.
4. Haul in.	See load away.
5. Release load.	Check preparation of next load.

Repeat cycle.

(iv) **Dismantling.** (After hauling in last load).

Winch Operator	*Choker Man*
1. Dismantle main guy.	Dismantle tail block and guy. (If time take ladder and guy to next rack).
2. Haul in haul back line.	Keep strain on line by walking with tail block.
3. Move to next rack.	

The details of operation of the winch controls are given as an Appendix on page 35.

V. DETAILS OF TECHNIQUE

The normal team for use of the winch is two men. A great deal of the success of using the winch can depend on the felling gang. It is thus of advantage to have the fellers themselves helping with the winch. A suitable arrangement would be a winch and its operator serving two or three pairs of fellers in turn, one of the fellers acting as choker man for their part of the felling. If an extra man is required to assist in setting up (See Section IV (c) (ii) page 15), the other feller could be called for the short time required.

(a) **Attaching the Load**

Providing the loads are prepared by the fellers with the ends raised, the most convenient way of attaching the load is with a wedge socket at the end of the rope and a running hook on the rope. With well prepared loads it is a matter of seconds to slip the rope round and fasten it. If the wire has to be pushed through under a load, the eye of the wedge socket is convenient to grasp.

The hook and eye shown in Figure 2 have been found more satisfactory than any form of sliding clip.

The use of separate chokers of chain or wire would mean that the load was suspended below the angle block and some of the lift which is so valuable, would thus be lost.

Chokers have however been used for pole length extraction where the trees were too large to gather by hand. The chokers were fixed by the choker man in advance, and the wire fed through two or three of them and hooked into the last one. Several difficulties with snags and tangling were experienced.

It is strongly recommended the operations be so organised that the loads can be prepared in advance.

(b) **Dragging from the Side**

This should be kept to the minimum, particularly in thinnings, by close spacing of the racks, i.e. about 20 yards apart and by the fellers judging carefully where to place piles. Trees should always be felled towards the racks and any movement of pieces into loads made so as to reduce the distance from the racks. The choker man is responsible for stopping the angle block exactly where he wants it to minimise difficulty and damage in hauling from the side. The operator must then ensure that the haul back line brake is hard on, to keep the block in this position, until the load has moved into the rack. Even if the timber is being extracted downhill, the haul from the side should normally be in an uphill direction. If the side haul is made downhill, not only does the choker man have to pull out the main line uphill, but the load tends to run out of control and snag behind standing trees. Where there is a great deal of timber to come in on a side haul, it may be worth using a chain to prevent the wires being pulled hard against the trees on the side of the rack, but normally this is not necessary. A loop of chain is passed round a tree and round the double haul back line beyond the angle and lifting blocks.

The choker man is responsible for checking the load into the rack until the winch operator can see it. The haul should be slow at this time, and the choker man should signal "stop" if any snags occur. A snag may be cleared by hand, or by signalling to have the angle block shifted to change the direction of haul by hauling in or out with no brake on the other drum. (See Figure 5, page 18).

(c) **Clearing Snags in the Rack**

Normally snags occurring in the rack are surmounted by hauling back, and again hauling in with a heavier application of the brake. The experienced operator may give a heavier application of the brake thus lifting the load just before a snag is likely to occur. He may also, if a snag does occur, free it by applying the haul back line clutch momentarily, keeping the main line clutch engaged. This tends to lift the load up and back and usually clears the snag.

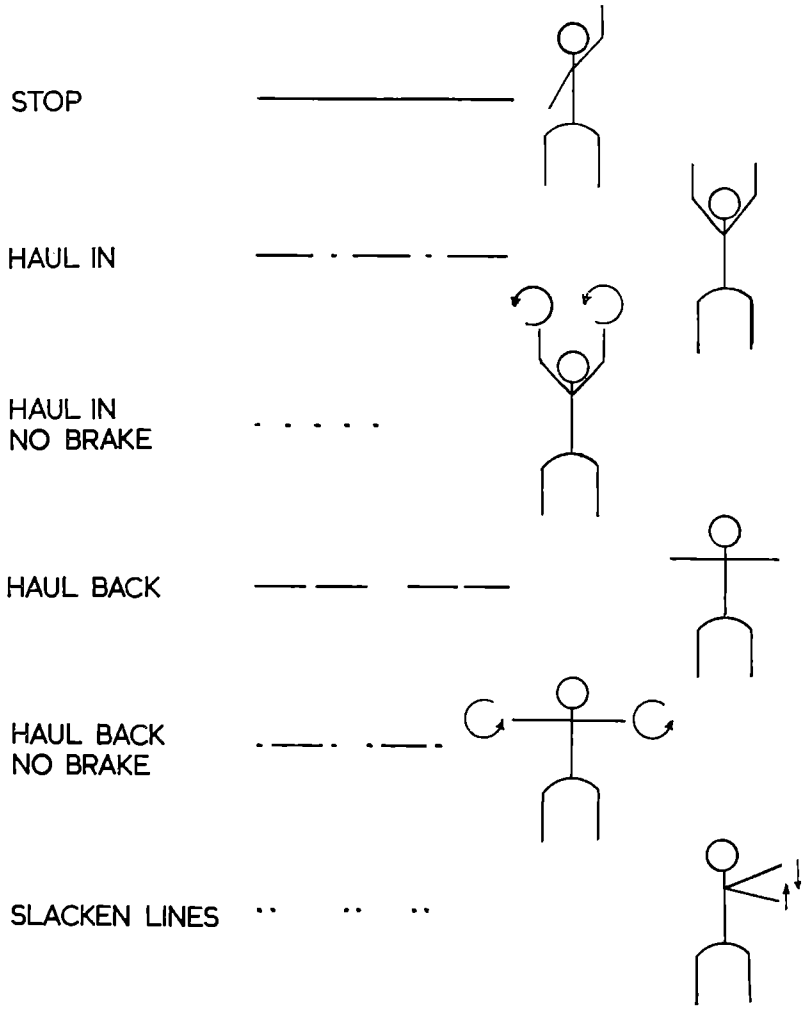
(d) **Signals and Signalling**

Clear unambiguous signalling is essential to efficient and safe working. Hand signals which are illustrated in Figure 5 are satisfactory when visibility is good and have the advantage that the winch man has the choker man in sight when he is pulling in, thus reducing the likelihood of accidents. A pair of yellow painted bats, the size of table tennis bats, are useful over long distances in poor visibility.

If visibility is obscured either by topography or the crop the most satisfactory alternative is a pair of field telephones. Speech is not

essential (though useful in cases of difficulty), and the required signals can be given by a code of rings on the telephone bell. (See Figure 5).

A useful compromise between signals and speech when using a telephone is to have one ring meaning stop if the winch is running or start if the winch is already stopped, while two rings means "I want to speak".



(after I. Samset)

FIG. 5. Double drum winch signals. Sound or light signals are shown on left, manual signals on right.

With bell, or light signals, a safety precaution is that one ring or flash should always be the stop signal, the more complicated signals being the movement signs. Similarly with the hand signals, one hand held up means stop.

Signalling devices tried but found unsatisfactory are:—

(i) Whistle—not loud enough to hear above the tractor noise.

(ii) Loud hailer—not loud enough to hear above the tractor noise.

(iii) Radio equipment—standard packsets are not satisfactory for continuous listening by the winch operator.

(e) **Safety**

SAFETY HELMETS OF FIBREGLASS ARE A NECESSARY PROTECTION FROM BLOCKS AND WIRES WHICH ARE IN MOTION ABOVE THE WORKERS' HEADS.

THE CHOKER MAN MUST NOT SIGNAL A START UNTIL HE IS STANDING CLEAR OF THE WIRES AND LOAD.

THE OPERATOR MUST OPERATE SLOWLY UNTIL HE CAN SEE THE LOAD ITSELF.

VI. OUTPUT AND COSTS

The data from time studies is not fully comprehensive. Recent studies on thinnings with crosscutting at stump indicate the following tentative standard times.

(Standard time, expressed in standard minutes, is the time taken to complete a specified task by the average worker, skilled and accustomed to the job, working with incentive and taking the necessary rest. Basic time is the time for carrying out the actual work in the task, not including rest or incidental work, e.g. maintenance).

High output will not be obtained until the team has become fully proficient, but it is important that a target should be kept in view from the outset by both operators and supervisors, as it is easy to accept low standards initially which become very difficult to alter.

Apart from the skill of the operators the most important factors influencing output are:—

(a) The adequacy of preparation, both in general organisation, and in the work of the felling squad. Well laid out racks with good stacking space greatly facilitate the work.

(b) The adequacy of stacking sites. If timber has to be swung at right angles to the rack, i.e. in line with the road, the extra

time involved is likely to add about half a minute per load to a time for the load of 3 or 4 minutes.

(c) The effectiveness of the layout and set up in overcoming obstacles such as ridges or humps in the ground.

(d) The general conditions, e.g. heavy brash, or undergrowth, rocks or broken ground, or dense stocking of the remaining trees.

(e) The volume per acre. This is not as serious as might be supposed, a reduction of volume from 500 hoppus feet per acre, to 200 hoppus feet increases the standard time by 0·24 minute

TABLE 1

OPERATING DATA

Line 1.	Length of rack—yards . .	50	100	150
Line 2.	Volume per rack—H.ft. .	100	200	300
	Set up and dismantle			
Line 3.	Basic time per set up—mins.	25	30	35
Line 4.	Standard minutes per set up	34	40	47
Line 5.	Standard minutes per H.ft..	0·34	0·20	0·16
	Extraction			
Line 6.	Basic time per load—mins.	2·7	3·3	4·0
Line 7.	Standard minutes per load	3·3	4·1	4·9
Line 8.	Standard minutes per H.ft.	0·47	0·59	0·70
	Total: Set up, Dismantle, Extract			
Line 9.	Standard minutes per H.ft.	0·81	0·79	0·86
Line 10.	Output H.ft./day . .	640	650	600
Line 11.	Cost pence/H.ft. . .	3·8	3·7	4·0

See Figure 6 for graph of costs.

Notes—Line 2. Assuming 200 H.ft. per 100 yards of rack, for example from a thinning of 500 hoppus feet per acre with racks at 20 yards apart or 330 hoppus feet/acre with racks at 30 yards.

Line 3. These times are for gentle or moderate slopes. They would be somewhat higher for downhill hauls on steep slopes where the wire is taken out uphill.

Line 10. Assuming an average working day derived from:—

$$\frac{43 \text{ hours per week} \times 60}{5} = 516 \text{ minutes} = \text{say } 8\tfrac{1}{2} \text{ hours/day}$$

Line 11. The operating cost of an Isachsen double drum winch complete with a team of two men was, in 1963, about £10 per day made up as follows:—

Tractor and winch. 7 hours at 7/6d. =	52/6
Two men, piece work at 55/- =	110/-
Overheads at 20/- per man day =	40/-
	202/6

or say £10 per day

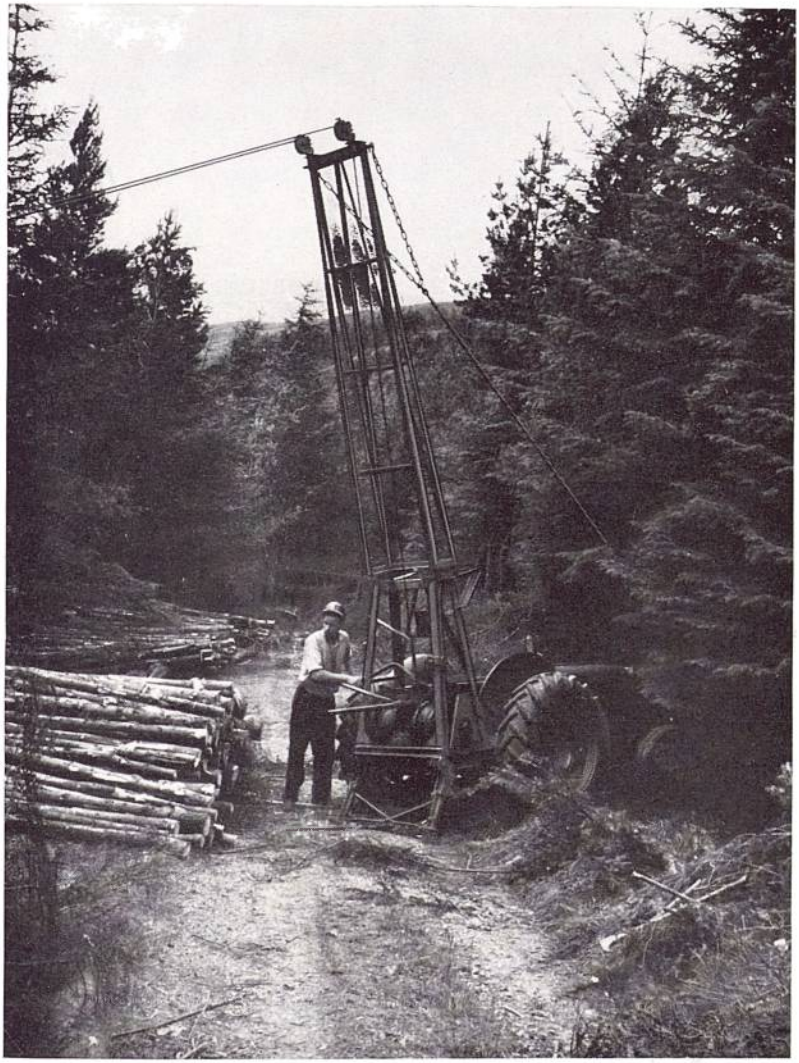


PLATE I The Isachsen double drum winch on a Ferguson 35 tractor. Note the operator's hard hat.

PLATE II General view as a load reaches the stack.

PLATE III A load attached to the wire showing the lifting and angle blocks.

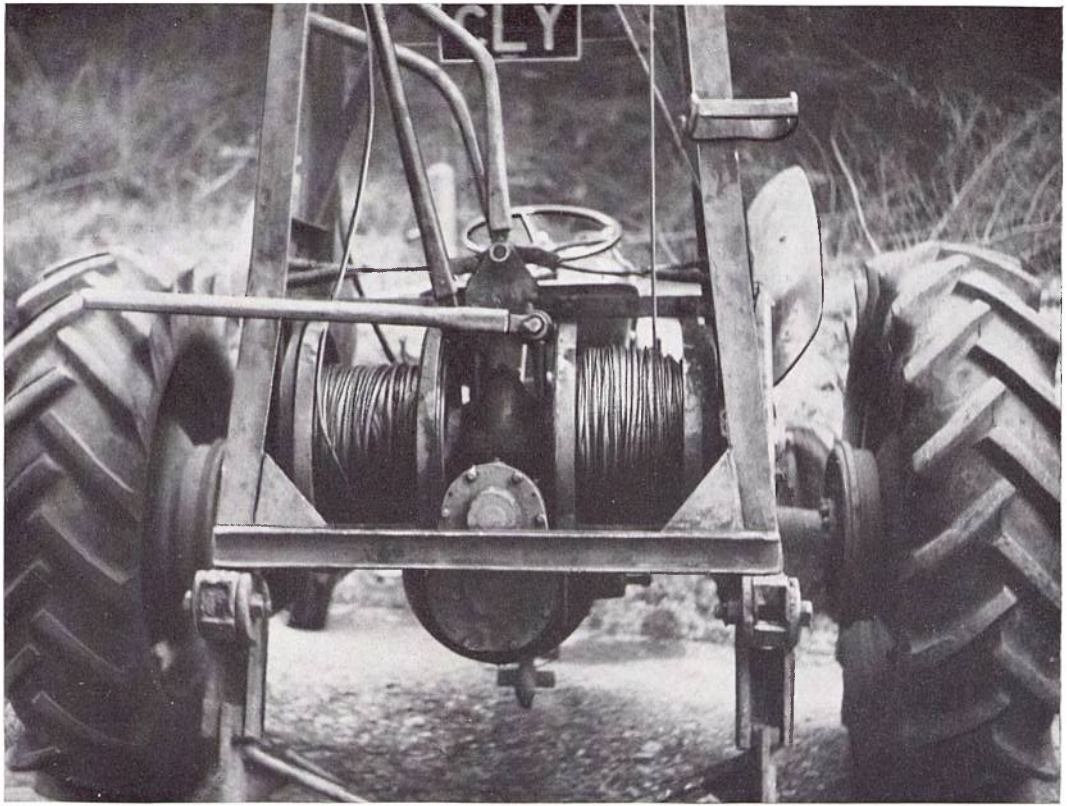


PLATE IV The two drums of the winch. The main line brake is off to allow the choker man to pull out the wire.

PLATE V*a* Timber prepared for extraction by winch. 'A' is the spar tree.

PLATE VI A load laid ready on a large log.

PLATE VII A load starts its journey out.

PLATE VIII The choker man stands clear as a load starts. Note his hard hat.

per load. (Compare this with an increase of over half a minute through bad stacking conditions).

(f) Within the limits of the range of the winch, there is very little difference in output for various distances as is seen from line 11 in the table.

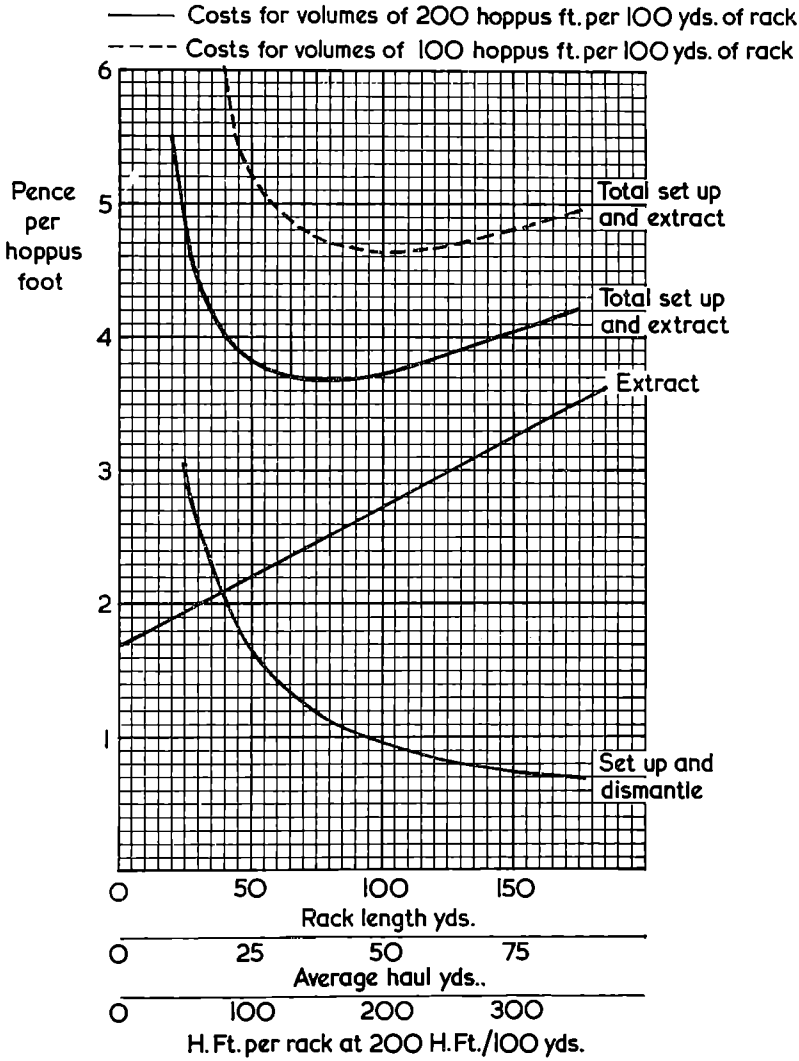


FIG. 6. Effect of length of rack on costs.

VII. DETAILS OF EQUIPMENT AND MAINTENANCE

(a) Wire Rope

Main line—250 yards 1 inch circumference ($\frac{5}{16}$ inch diameter) 6/24

Haul back line—450 yards 1 inch circumference ($\frac{5}{16}$ inch diameter) 6/24

Guy Ropes; Main—25 yards $1\frac{1}{2}$ inch circumference ($\frac{1}{2}$ inch diameter) 6/19

Tail—25 yards $1\frac{1}{4}$ inch circumference ($\frac{3}{8}$ inch diameter) 6/19

The detailed specification of the winch rope is as follows:—

"Ungalvanised best plough, extra flexible, steel wire rope, 100/110 tons per square inch; basic grade, ordinary lay, fibre main core, 6/24. Nominal breaking load 3 tons".

(i) **Length:** This is governed by size of the winch drums and the maximum length of $\frac{5}{16}$ inch diameter rope that can be wound on one drum. The 16 inches diameter drums of the Isachsen take 450 yards of $\frac{5}{16}$ inch diameter rope.

When fitting new rope it may be found that the limit of capacity on the drum is about 400 yards. As the rope is worked it will be found to pack better and the additional length can be spliced on if desired.

(ii) **Diameter:** The size of rope, with other factors, governs its strength and the $\frac{5}{16}$ inch diameter is adequate for this purpose.

The main line takes a greater strain than the haul back line. One suggestion is that it should be of $\frac{3}{8}$ diameter wire; with the shorter length required in the main line, the drum will still be of adequate capacity. On the other hand, if the two lines are the same diameter, partly used main lines can be spliced to make a haul back line, or spliced into the haul back line to replace a well worn part.

(iii) **Construction:** For long life with continual passage over pulley blocks a flexible rope is essential and this is achieved by making the rope of numerous small strands. In this case it is made up of 6 strands, each of which contains 24 wires. The centre of the rope is a hemp core which also aids flexibility and retains oil which lubricates and preserves the rope.

(iv) **Lay:** This refers to the direction in which the wires are twisted in the strands and the strands twisted together. In ordinary lay the wires are twisted together clockwise and the

strands anti-clockwise. In Lang's lay both directions are the same; it has the advantage that it is more flexible than ordinary rope but has a greater tendency to kink and untwist, hence ordinary lay is more satisfactory for forest winch work.

(v) **Galvanising:** This is not necessary on a working rope provided it is oiled frequently, and galvanising may affect its strength.

(vi) **Care of Wire Rope:** Wire rope is an expensive item as a set of ropes 700 yards long costs about £40 and it can quickly wear out through careless use.

Damage can easily occur at the winch drums if slack turns are allowed; these are caused by not braking the drums quickly enough, particularly when hauling out the main line. The remedy is to apply slight braking to the drums so that this over-run does not occur.

Snagging of the wire at the lifting and angle blocks can occur and may damage the rope. On any sign of this, when weight is first taken on a load, the choker man should signal to stop and free the tangle. Both men need to keep an eye open for the rope catching on parts of the equipment or not running correctly in the pulleys; stopping quickly will save damage to ropes and other tackle.

Ropes should be oiled frequently by pouring oil on to the rope on the drums and when rope is stored it should be passed through a container of oil before putting away. There is a danger with fibre core ropes that the core may absorb moisture in which case internal rusting of the rope will occur in storage unless it is well soaked with oil.

(vii) **Re-winding Ropes:** Despite careful working, there is a tendency for a few coils of wire on the drum to work loose, just beyond the length which is being used. If these are not tightened up damage to the rope will result. Provided the tail block is at least half the length of the rope from the winch, (i.e. 125 yards with the lengths suggested above), the full length of the wires can be run out and rewound under strain as shown in Figure 7.

(viii) **Splicing:** The various blocks on the Isachsen double drum winch are designed to take splices so breakages can be repaired by splicing and short lengths of unworn rope can be used up.

Most wear occurs at the end of the main line where rope is chafed between the load and the ground, rocks and stumps. Breakage of individual wires does not seriously affect the

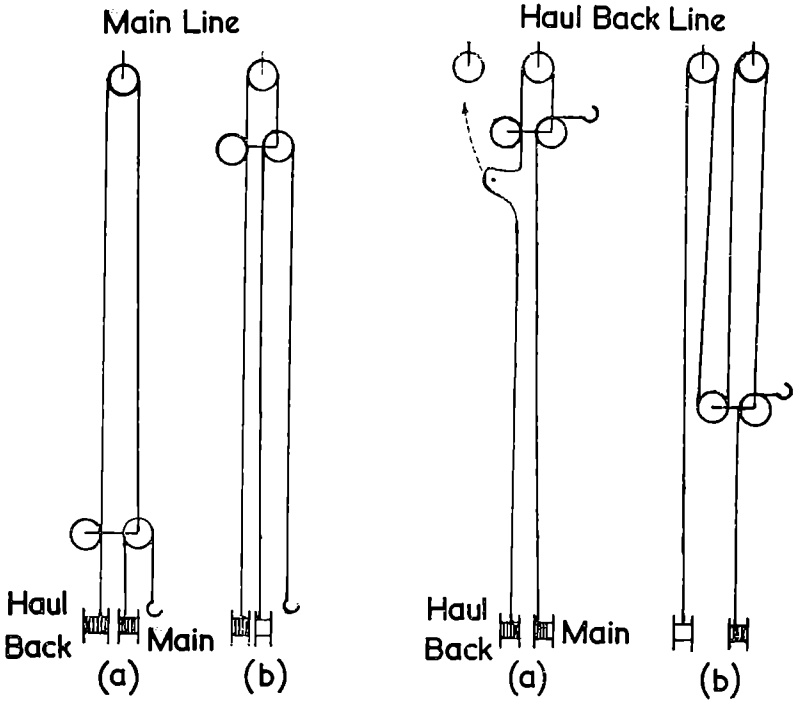


FIG. 7 Re-winding wires.

Main Line

(a) Hook end of main line to winch.
(b) Wind in haul back line until main line is right out.
Wind in main line with brake on haul back line.
Unhook end of main line from winch.

Haul Back Line

(a) Wind in haul back line until lifting and angle blocks are at tail block. Slacken wires. Hitch a spare block to anchor tree and pass haul back line (between lifting block and winch) round pulley.
(b) Wind in main line until haul back line is right out.
Wind in haul back line with brake on main line.
Unhitch spare block.

Completion

To complete wind in both lines with a log attached.

strength of the rope though it makes handling difficult and leather gloves should be worn. Once a strand is broken then that part of the rope should be repaired at once because a complete breakage will ensue when next a maximum strain is put on. Repairs at the end of the main line are simple as the damaged section is cut out and the end re-fitted with bulldog clips or the wedge socket replaced.

A breakage in the middle of one of the ropes, usually caused by damage, will have to be spliced. For a rope that has to work over pulley blocks a long splice is advisable and it is a big advantage if the operators can make this themselves. The technique of making a long splice is well described in various text books on seamanship but a small booklet entitled "Wire splicing" by R. Scot Skirving published by Brown, Son & Ferguson, Ltd., 52–58 Darnley Street, Glasgow, S.1, at four shillings and sixpence post free, gives a particularly good description.

One operator has used the short splice satisfactorily but a long splice is a more workmanlike join.

Splicing in the small size rope, $\frac{5}{16}$ inch diameter, is not the formidable task that splicing large steel wire ropes is, but the technique is easiest learned by watching someone who is proficient.

(b) **Pulley Blocks**

The correct design of pulley blocks is most important, blocks not designed for the purpose cause heavy wear-and-tear on wire ropes and may be time-consuming to rig. Unfortunately standard blocks made for engineering purposes such as lifting tackle are designed for heavy loads and usually the minimum sizes are for ropes of $\frac{1}{2}$ inch diameter; these are unnecessarily heavy for $\frac{5}{16}$ inch diameter rope. Yacht tackle on the other hand is too light and the majority of it is intended for cordage.

The blocks for the Isachsen winch are designed for the job, they are reasonably light yet robust. They are mounted on ball bearings and can be dismantled easily for rigging.

(c) **Bulldog Clips**

These are used on the ends of the main line and the haul back line to attach the angle and travelling blocks and also for the anchors. They should be the correct size for the rope being fastened, i.e. $\frac{1}{4}$ inch for $\frac{5}{16}$ inch diameter rope, $\frac{5}{16}$ inch for $\frac{3}{8}$ inch diameter rope, $\frac{3}{8}$ inch for $\frac{1}{2}$ inch diameter rope, and each joint should normally have three. Fitted correctly the closed end of the U bolt should go over the short

end of the wire rope. A thimble should be fitted inside the loop of wire rope to avoid damage by kinking.

(d) **Shackles**

These are U-shaped fittings with a screw pin across the opening used for joining the end of wire rope to pulley blocks. Shackles with a pin diameter of $\frac{1}{2}$ inch should be used.

(e) **Strops**

These are short loops (3 to 5 feet) of wire rope used for attaching blocks to trees. They can be made up from spare lengths of rope by joining with bulldog clips but a neater and more easily handled strop is one in which the rope is joined by "Telurit" fastenings. These have to be put on by the rope manufacturer. Shackles are used to attach the strop to the block. (See Figure 4, page 14).

(f) **Ladder**

A ten foot ladder should form part of the equipment to facilitate fixing of the tail block at a reasonable height above ground. If spar trees on the roadside are in regular use a longer ladder will be an advantage.

(g) **Choker Hooks**

The most satisfactory choker hooks found so far are those described in Section V (a) (page 16) and illustrated in Figure 2 (page 8). They are used with a wedge socket having an eye. Obtainable from:—

$2\frac{1}{2}$ *ton Choker Hook:*—Mark Priest & Sons, Ltd., Bristol Proving House, Franklyn St., Bristol 2.

Wedge Socket:—Wm. Clark & Son, Parkgate, Dumfries.

(h) **Oil and Grease**

The following greasing prescriptions have been found satisfactory for the winch and ancillary equipment:—

Component	*Oil or grease*	*Frequency*
Hardy Spicer joints on shaft	Retinax A grease	Weekly
Gear Box	Hypoid 90	Top up, change yearly if necessary.
Final drive	Hypoid 90	Change twice yearly
Winch		
Inner thrust bearing	Retinax A	Grease weekly
Outer thrust bearing	,,	Grease monthly

Clutch	Retinax A	Grease annually or if it sticks
Brakes	Old engine oil on brake drum	When brakes run unevenly
Pulleys and Swivel	Marfak O	Daily
Ropes	Engine oil—pour on to drum	Weekly
Tyre pressures	Higher than recommended in tractor manufacturers' handbook.	

VIII. ALTERNATIVE WORKING METHODS

The equipment is versatile and the purpose of this section is to record several working methods most of which have not yet been fully tried in this country but they should be worth while for particular conditions.

(a) **Use of Spar Tree**

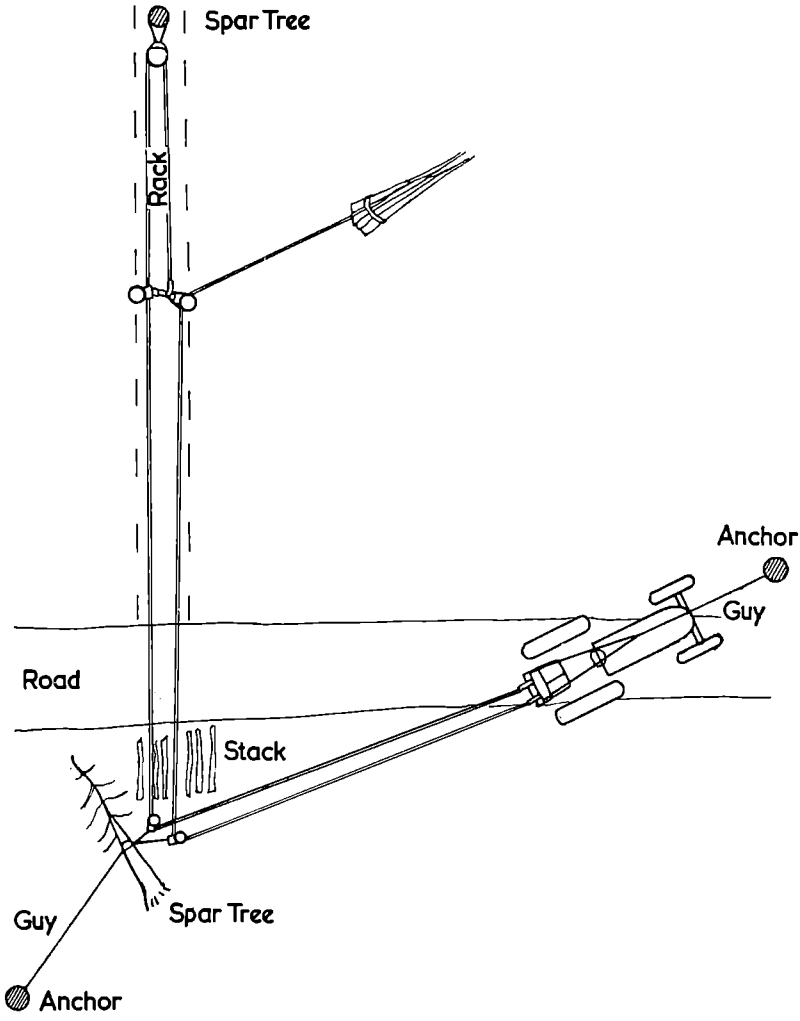
When hauling uphill on to a narrow road on a steep slope there is often not enough room for the tractor to stand on the road at the rack end and leave enough space to stack poles. In this case the tractor can be offset from the rack end and the two ropes taken through two pulley blocks mounted 20 to 30 feet up a tree on the high side of the road. (See Figure 8). If the spar tree is selected far enough back it is possible to lay poles on the high side of the road, but because the tractor is 20 or 30 yards from the stack a third man is required to release loads and relay signals.

(b) **Sky Line**

On uphill hauls over 150 yards and up to a maximum of 300 yards a sky line can be used. In this case a static line is erected of 6 × 19 $1\frac{1}{2}$ inch circumference rope ($\frac{1}{2}$ inch diameter). The travelling tackle runs on this and return depends on gravity; the haul back line is not used. A stop at the lower end automatically lowers the end of the rope to the choker man. Intermediate supports are possible with this system. (See Figure 9).

(c) **Trailer**

Much of the extraction in Norway involves a journey from stump to road or river of 2 to 3 miles and wheeled tractors drawing sledges



With restricted space a spar tree has to be used at both ends and the tractor offset from the end of the rack

FIG. 8. Set-up with restricted space.

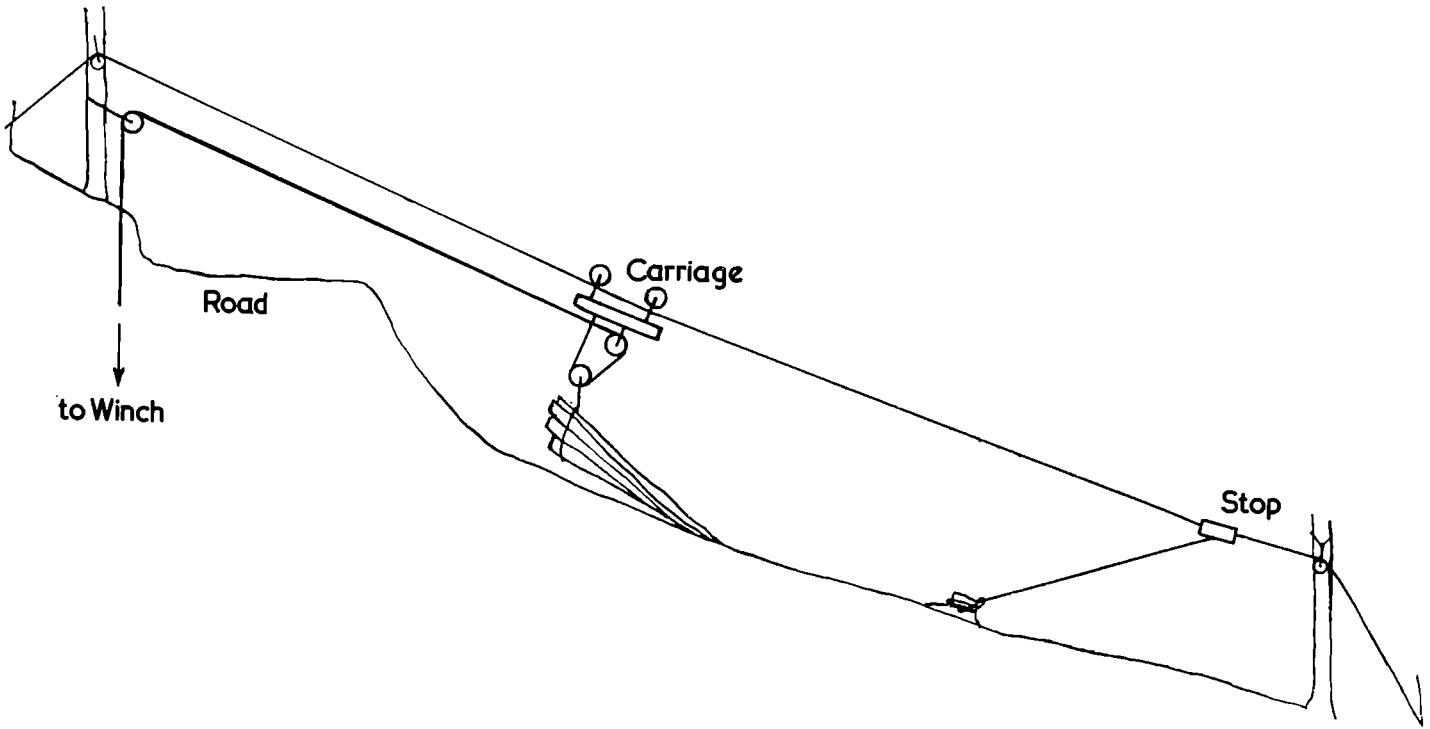


FIG. 9. Sky line.

or trailers are used. The double drum winch extracts and loads; the haul back line is left lying, the main line is wound in, and the journey is completed by drawing the trailer. (See Figure 10a).

Alternatively a second tractor and trailer is employed for the longer hauls, the winch tractor being solely employed in extracting and loading.

A special boom attached to the tower can be employed to assist in loading trailers. (See Figure 10b).

(d) **Use of Winch to Move Tractor**

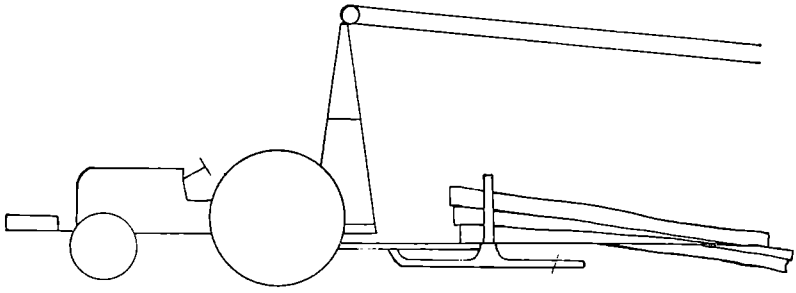
On occasions it may be an advantage to use the winch to assist the tractor over difficult ground. For example a level spot may exist on the side of the road but the tractor cannot reach it because of the bank and roadside drain. In such cases the main line should be taken forward over the bonnet of the tractor and round a block attached to the base of a convenient tree and back to the front axle of the tractor. (See Figure 10c). The tractor can then be drawn over the obstruction by the winch.

(e) **Stacking Parallel to the Road**

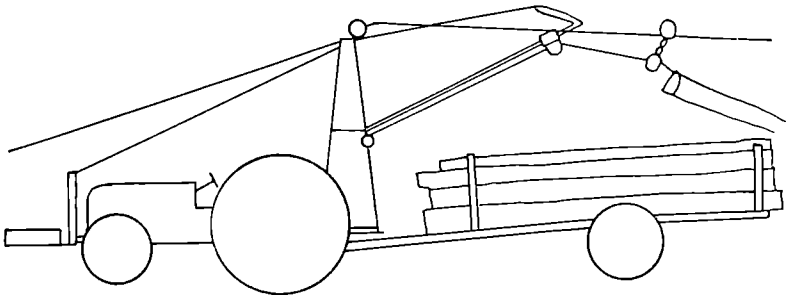
Poles may need to be stacked parallel to the road to facilitate lorry loading or crosscutting. A pole placed at an angle across the rack, with one end raised by resting it in a tree, can help to turn loads if they are dropped on to it beyond the point of balance of the load so that the free end of load is raised off the ground. As the lines are momentarily slackened the load moves a few feet sideways on the pole so that hauling on the haul back line pulls the butts to one side and turns the load through 90° on to the stack. (See Figure 11).

(f) **Concave Ground**

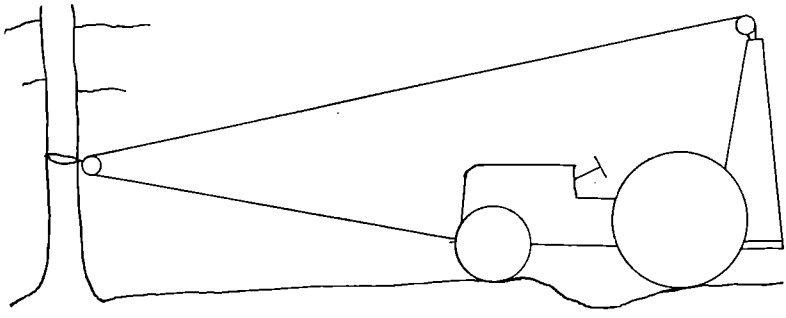
On concave ground it is possible to exceed 150 yards hauling distance by adding an extra length of cable and using two angle blocks. This set up is shown in Figure 12. Where this method is used the extra wire must be the correct length, i.e., from stacking site to tail block, plus a few feet. A shuttle system can be worked by this means: whilst one rope is hauling in a load the other is being hauled back. As much of the lifting effect is lost by not being able to use the lifting block this must be compensated by the shape of the ground which must be concave and reasonably free from obstructions.



a) — With sledge



b) — With loading boom and wheeled trailer



c) — Winching the tractor over difficult ground

FIG. 10. Other methods.

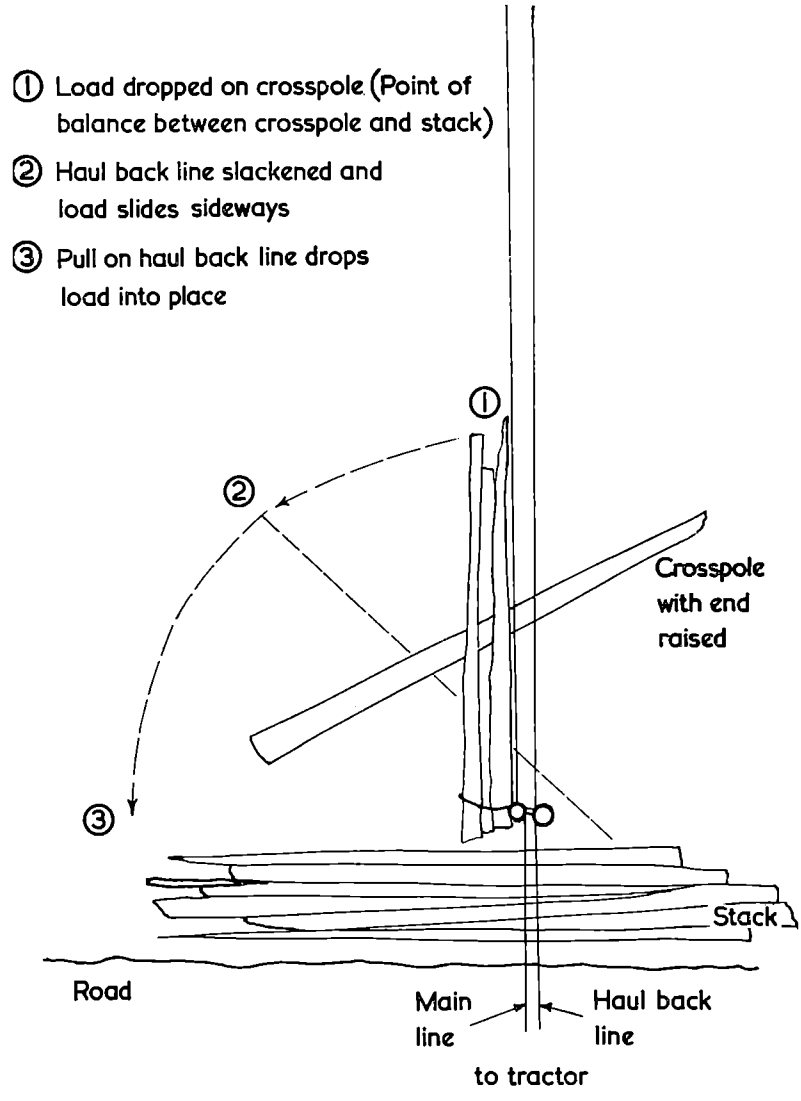
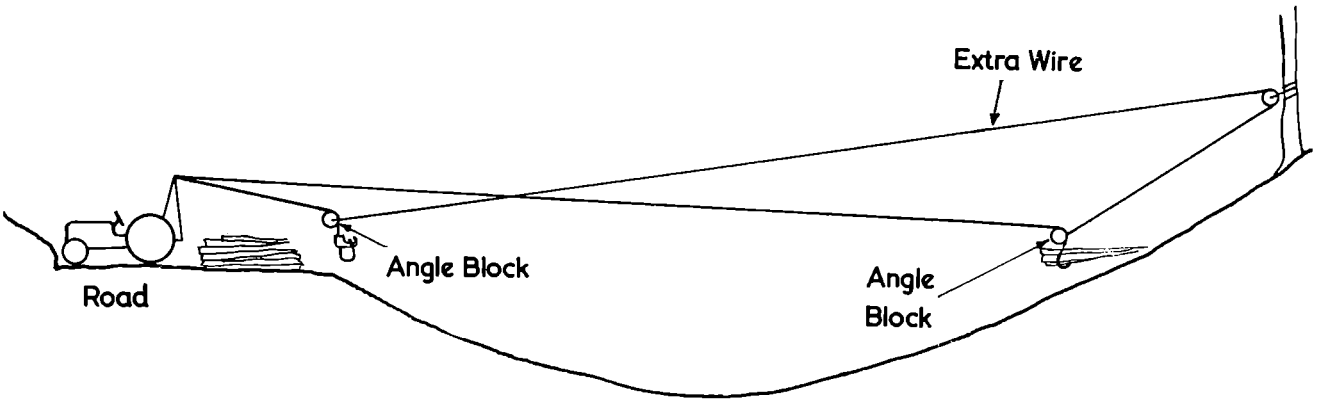


FIG. 11. Turning and stacking poles at roadside.



Alternative method for distances over 150 yards where ground is concave — an extra length of wire is added and two blocks can be used

FIG. 12. Alternative method for long distances

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APPENDIX I

OPERATING THE WINCH CONTROLS

The various controls are:—

1. The power take-off lever.
2. Winch gear lever.
3. Tractor throttle.
4. Clutch levers, one for each drum.
5. Brake levers, one for each drum.

The tractor throttle is operated in conjunction with the clutch and brake levers, and should be extended so that the operator standing beside the winch can reach it. The simplest way is to tie a stick to the throttle lever of the tractor; insulating tape on the lever itself will prevent the string slipping along it. The stick is pushed and pulled to move the throttle. This is a cheaper and more effective method than a Bowden cable.

The operator stands at the side of the winch that gives him the best view; the control levers and the throttle extension stick are moved so that they are operated from the appropriate side.

After setting up the tractor, fixing the anchors, and pulling out the cables, start the engine, engage the power take-off and the winch gear. (Top gear normally; bottom gear for exceptionally heavy loads). The machine is now ready for hauling loads and the following control movements are made.

1. Throttle to medium.
2. Engage haul back clutch; brake slightly on main line.
3. Throttle to full; reduce to medium as blocks near choker man.
4. On stop signal, release haul back clutch, brake both lines.
5. Throttle to tick over.
6. Release main brake and assist choker man if necessary by pulling main cable off drum.
7. On signal to haul in, open throttle to slow.
8. Brake hard on haul back line, operate main line clutch.
9. On load reaching angle block, ease haul back brake, throttle to full.
10. Throttle to slow as load nears stack.
11. Load reaches stack, release main line clutch and apply both brakes hard.

12. Release haul back or main line brake as necessary to lower load to stack.
13. Unhitch rope from load.
14. Brake haul back, operate main line clutch to pull rope from load and to tighten ropes to undo twists.

Repeat sequence for successive loads.

APPENDIX II

CHECKING OVER A NEW WINCH

The following notes have been prepared as a result of experience with receiving new winches. Certain initial troubles can be avoided by using these notes as a check list. They may also be useful for those concerned with fitting winches on tractors to avoid defects at the source.

A. **Pre-Rigging Checks**

1. Check that rear universal flange is fully home on the winch input shaft and secured with a grub bolt.
2. Check that wedges for fixing ropes to the drums are present. If missing make a wooden pattern and have new wedges made locally. Wedge width should be such that it will firmly secure one thickness of rope only.
3. Clean paint from sockets of tower blocks on tall tower, skidding tower and tower base.
4. Clean tower block bases of paint and check for casting or welding lips. If these are present, file smooth or else they will register with the slots in the sockets and the blocks will refuse to swivel freely.
5. Check all pulleys for free running.
6. Attach main guy rope to the chain provided.

B. **Rigging of Winch**

1. Assemble lifting block to angle block (See Figure 2).
2. Fit high tower to tower base.
3. Fit tower blocks in position on high tower.
4. Start tractor, engage power drive and high ratio on the winch.
5. Engage each clutch in turn and apply brake to the same drum. Check effective position of each brake lever and adjust brake bands, as necessary, so that they both lie in the same plane, approximately horizontal.
6. Mount the drum of cable on an axle and fix on a stand some 20 feet behind, and in line with the winch.
   Bind the end of the cable with cellotape, thread over the right hand tower block, down to the right hand drum and wedge in position. Make sure that there is no rope or part of the wedge standing proud of the socket or else uneven winding will result with eventual damage to the cable.
   Engage low ratio on the winch and with low throttle setting start winding on the cable. Make sure that the turns of wire go on evenly and as tightly as possible.

To keep the wire tight when winding apply a brake to the reel of cable.

Wind on cable on this drum until there is approximately $\frac{1}{4}$ inch clearance between the wire and the winch frame. When this is achieved there will then be some 380 yards of cable on the drum and this then becomes the haul back line.

7. Wind on 250 yards of cable on to the left hand drum in similar fashion. This is the main line drum.
8. Take the end of the haul back line through the lifting block and tail block and then secure, by means of bulldog clips, at the appropriate attachment point between the lifting block and angle block.

   Thread the main line through the angle block, then the quick release mechanism and finally bulldog clip two links of chain to the end. The link size should be such that it is an easy fit in the quick release mechanism slot.

   If the sliding hook and wedge socket eye are used make sure that the hook is pointing up the cable.
9. Fit a piece of thick hosepipe over the spar tree strop.

C. Running in Procedure

1. Set up the winch, either in a rack or the open, and with at least half throttle start running the blocks out and in for some ten minutes. Apply sufficient brake to keep the lines tight and so burn off high spots both on the brake and clutch linings.
2. Attach a load and winch normally for another hour or so, using full throttle except when pulling in from the side.

   Winching action during this break in period will be rough and jerky with blue smoke issuing from the brake linings.
3. After the hour or so of break in, squirt oil between the drums and the brake linings, repeating the process until brake action becomes smooth and progressive. After that oil once or twice per day to the haul back brake as necessary and less often, again as necessary, to the main line brake.
4. Check effective position of the brake levers and adjust as necessary.
5. Keep a close watch on the ropes and rewind as often as is necessary. Never tolerate loose or cross wound ropes.
6. After three days' work the haul back line will have stretched and should now be tightly settled on the drum with plenty of clearance between itself and the winch frame.
7. Keep ropes well oiled.

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