FORESTRY COMMISSION
BOOKLET No. 19

Timber Extraction by Light Agricultural Tractor

By J. W. BARRACLOUGH

LONDON
HER MAJESTY'S STATIONERY OFFICE
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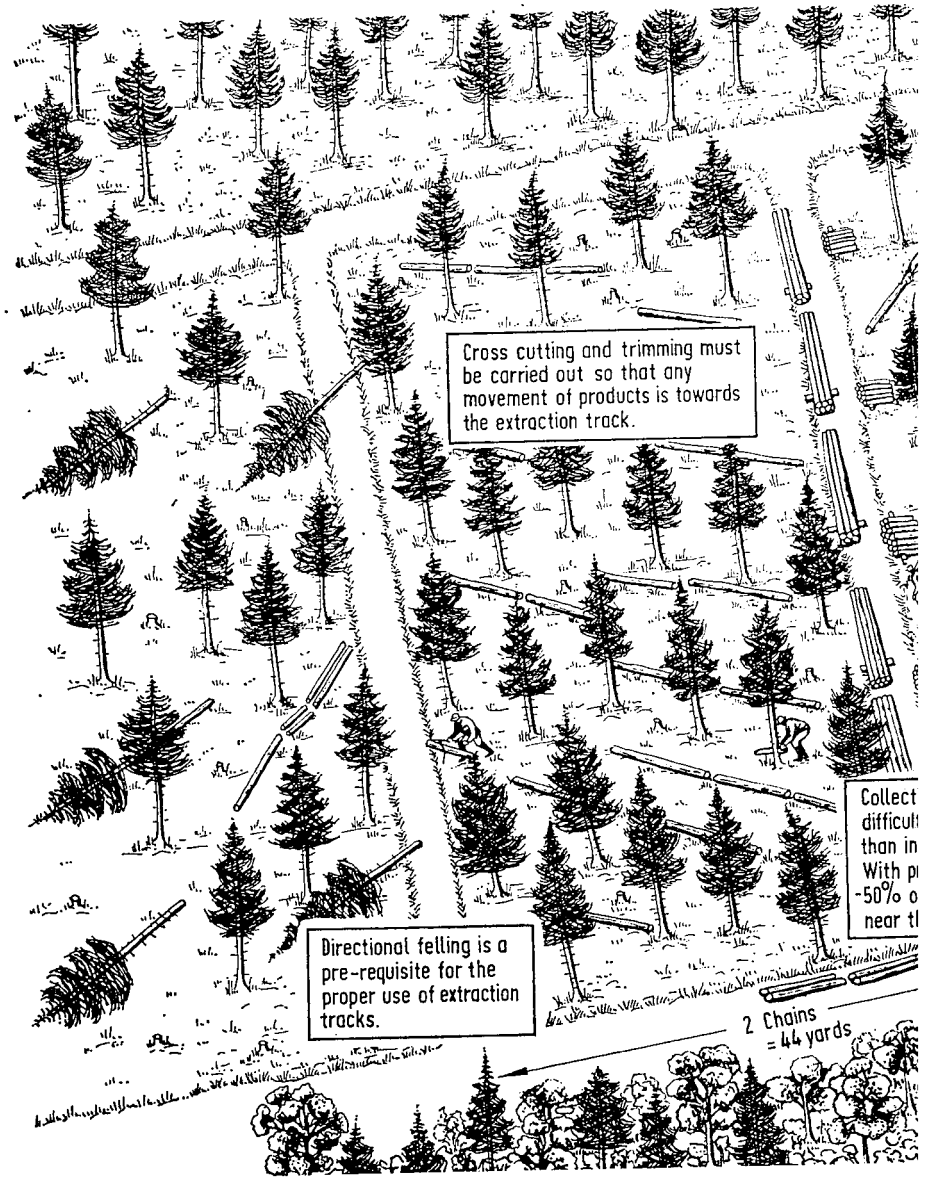
Cross cutting and trimming must be carried out so that any movement of products is towards the extraction track.
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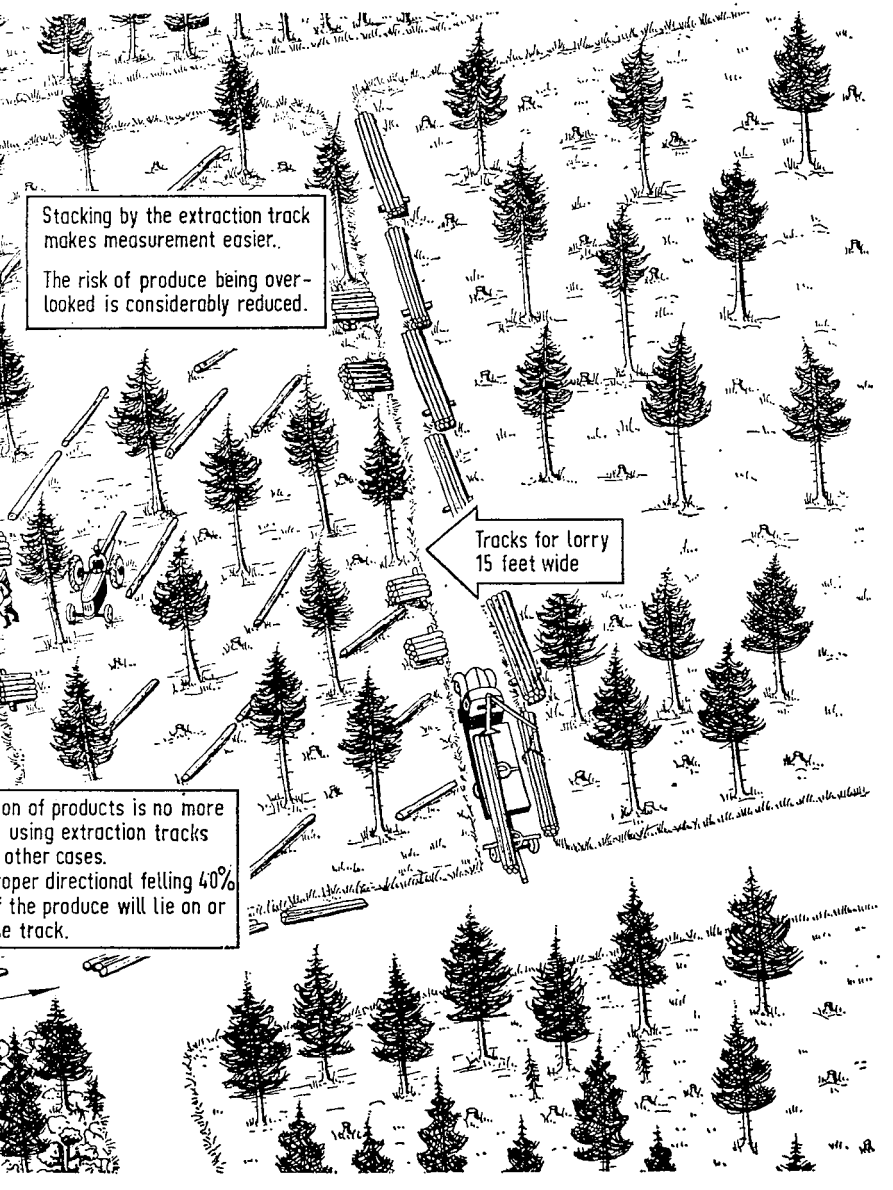
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(*a*) The hoppus foot (h. ft.) used for volumes of round timber throughout this text is equivalent to 1·27 true cubic feet, or 0·0361 cubic metre, solid measure.

(*b*) One cubic metre=27·7 hoppus feet.

(*c*) All measurements of round timber are over-bark.

(*d*) Costs represent average levels at the date the investigations were carried out, and are intended mainly for purposes of comparison. Unless stated otherwise, they are inclusive of labour, labour overheads, and machine costs.

(*e*) "Tushing" implies the dragging out of poles, logs, etc., by chains secured to a horse or a tractor, without the aid of a sledge or a wheeled carriage.

Inside front cover: Bird's-eye View of Extraction in Progress at Thetford Forest.
Inside back cover: Organization of Extraction at Thetford Forest.

CONTENTS

ACKNOWLEDGEMENTS

The data which form the basis of this booklet have been gathered from the tractor drivers and supervisory staff at the Forestry Commission's Thetford Chase Forest in Norfolk. The tools described, apart from the Alice Holt Drawbar, are their inventions, and I am extremely grateful to all who have freely given of their knowledge and experience. The Alice Holt Drawbar was developed by Col. R. G. Shaw, in his capacity as Machinery Development Officer to the Forestry Commission.

The booklet has been prepared with the help and guidance of Mr. N. Dannatt, a Forestry Commission Work Study Officer, and also Mr. J. W. L. Zehetmayr, who was the Commission's Chief Work Study Officer at the time of the investigations.

The photographs are by Mr. W. O. Wittering, and some of the sketches were supplied by Messrs. A. H. Spencer and A. M. Morris. Finished drawings were prepared by Mr. Marc Sale.

J. W. BARRACLOUGH

Part 1: Equipment and Methods

INTRODUCTION

There are real advantages in using the same tractor for nursery work, ride mowing and extraction. Full utilisation of the tractor means low machine costs, fewer stores and easier maintenance. This booklet describes how, in Thetford Forest, the same light agricultural tractors which are used for forest nursery work and forest ride mowing are used also for the extraction of produce from thinning and clear felling. The implements used with the tractor are cheap, and mostly blacksmith-made. They are good examples of the simple and efficient devices which can be evolved by the local staff concerned with the job.

OTHER FORESTS WHICH HAVE REASONABLY LEVEL AND FIRM GROUND FREE FROM ROCK OR COPPICE STOOLS COULD BENEFIT FROM THE EXPERIENCE AT THETFORD. THE TRACTORS ILLUSTRATED THROUGHOUT THIS BOOKLET ARE NOW OBSOLESCENT. THE PRINCIPLE OF THE GUARDS AND OTHER EQUIPMENT IS IMPORTANT, NOT THE DETAILED DESIGN OF THE TRACTORS. THE EXAMPLES GIVEN IN THE FOLLOWING PAGES SHOULD BE USED AS A GUIDE, AND PROVIDED THE GUARDS OR OTHER EQUIPMENT DO THE SAME JOB THEN THE DETAILS OF THEIR DESIGN IS OF NO CONSEQUENCE. The layout of the forest and the methods of working at Thetford are described in the following paragraphs, and are illustrated on the front and rear end papers of this booklet.

Thetford Forest covers an area of some 52,000 acres of level terrain in Norfolk and Suffolk. The majority of soils are derived from sands overlying chalk, which give a well-drained and firm surface. The forest consists of even-aged plantations of Scots and Corsican pines, planted in rectangular compartments which are served by a network of firm level rides normally at 200-yard spacing. Because ground conditions are so good, the produce from thinnings and fellings is loaded on to lorries as near to stump as possible. To facilitate this work, racks 15 feet wide at 2-chain (1 chain=66 feet) intervals are cut through all stands during the first thinning. This makes the direct distance from stump to rack a maximum of 1 chain and an average of $\frac{1}{2}$ chain. Plate 12 shows the general conditions.

A system of primary conversion in the wood has been evolved to assist subsequent conversion and sale. Trees are cross-cut by the feller to produce various sizes of poles, small butts and logs; these assortments are sub-divided into those of top quality which are to

be peeled and subsequently cross-cut into pit props or wood wool material, and medium grade poles which, though yielding some pit props, are mainly cut up into pulpmill or boardmill material. The primary conversion serves two other purposes: it is the basis for a simple piece-work system, and it also enables hand extraction of much of the produce to the rack, leaving only the heavier pieces in the wood for mechanised extraction from stump to rack or ride. The dimensions of these heavier pieces are: *poles*, 6 to 8 inches butt diameter under bark, and 3 inches top diameter under bark, and ranging from 15 to 30 feet long; and *logs*, minimum top diameter under bark of 6 inches, and lengths from 10 to 22 feet. As thinning proceeds, the hand-extracted products are loaded onto lorries, usually 7-ton Bedfords, which are equipped with either 1-ton or 2-ton HIAB cranes; thereafter the heavier products, large poles and logs, are extracted by tractor. The front and rear endpaper drawings illustrate these methods.

It is the extraction of the heavier poles and logs that is described in the following pages. Each piece of equipment is illustrated with photographs and drawings together with notes on how it is used.

LIST OF EQUIPMENT AND SUPPLIERS

ITEM	APPROXIMATE COST 1964	SUPPLIER
Wheel Valve Guards	£ s. d.	
Front	3 10 0	
Rear . .	1 10 0	
Radiator Guard (Massey-Ferguson Type 35) Front . Base . .	20 0 0	H. Mills, Esq. Blacksmith,
Thetford Tongs	7 10 0	25 London Road,
V Drawbar .	5 0 0	Brandon,
Stackers, Mark II	5 0 0	Suffolk.
Grab Hook	2 0 0	
12 ft Chain		
Alice Holt Drawbar with 6 chains	25 0 0	Roadless Traction Ltd,. Hounslow, Middlesex.
Hand Tongs .	1 10 0	Wm. H. Meyer, Ltd., 9/11 Gleneldon Road, London, S.W.16.
Wheel Weights. .	7 10 0	Any Ferguson Agent.

THE TRACTOR

The Massey-Ferguson FE 35 is the standard tractor currently used at Thetford Forest, but there is no reason why the equipment described cannot be adapted and used with any light wheeled tractor which has a hydraulic system and a three-point linkage. The principal criterion is size; the smaller the tractor the greater the manoeuvrability in the wood. The larger type of agricultural tractor has been used but it is both cumbersome and slow compared with the lighter models. The latest Massey-Ferguson FE 35 is better for the job than the older type of Ferguson TF 20, because the hydraulics can be raised and lowered whilst the tractor is in gear. This saves time in moving off, and also in stacking poles. Before a tractor is used in the wood, the track width of the wheels should be adjusted and guards must be fitted to protect weak points.

Track Width

The wheels of a tractor used in a forest nursery are often set wide apart in order to pass between seed beds and transplant lines, this extra track width can make a considerable difference to manoeuvrability amongst the trees. If such tractors are used for extraction, both their front and rear wheels should be re-set to the normal track width of 48 inches front and 52 inches rear. The time taken to alter the wheels to normal is approximately one hour, using a Ferguson jack, but up to two hours using one or two ordinary jacks. It is worthwhile altering the wheels for only one day's extraction, even though it will take another hour to change back again.

Wheel Valve Guards

These are shown in Plates 1 and 2, and details appear in Figure 1. They are made from 18-gauge sheet metal, and are designed to protect the valves from being damaged by brash or stumps. The front wheel valve guard shown has three holes to bolt it to the wheel. On the latest Ferguson Model 35X there are four holes in the front wheel, and the guard has four holes to correspond. A hole of 1¼ inch diameter, centred approximately 1½ inches from the edge of the disc, is cut over the valve. This hole is best made at the time of fitting so that it corresponds exactly with the valve; it is then possible to inflate the tyres without removing the guard. When working, the valve is tucked away behind the guard and is thus protected

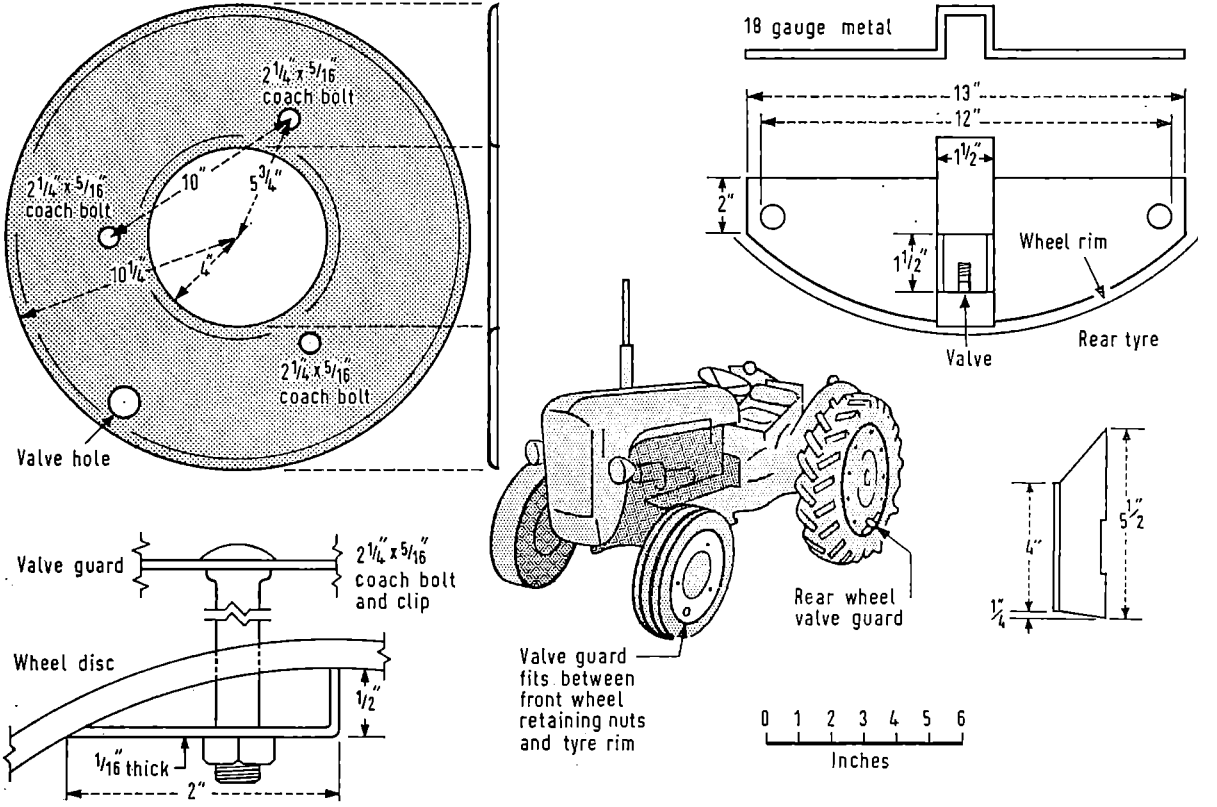

FIG. 1. Wheel valve guards.

from damage. The rear-wheel valve guard is made of similar gauge metal and fits on to two of the wheel rim nuts.

Radiator Guard—Ferguson Model TF 20

Plate 3 and Fig. 2 show the type of guard developed for the old-type Ferguson—a simple front plate of $\frac{1}{4}$-inch steel secured to the engine cowl, in which holes are bored.

Radiator Guards—Massey-Ferguson Type 35

See Figs. 3 and 4 and Plate 5. This tractor requires additional protection to prevent branches thrusting up between crank-case and radiator. Branches can catch in the fan-belt and break it, or strike and puncture the radiator. A base plate of $\frac{1}{2}$-inch steel is secured to the bottom of the tractor, where threaded holes will be found.

The front guard of $\frac{1}{4}$-inch steel is hinged to this plate, and struts from the top run back to the crank-case. There is a slight difference in the layout of the engine between the 3- and 4-cylinder Massey-Ferguson 35's. This can cause some variation in the bend of the struts, and how they are fixed to the tractor. Because of these variations, foresters should use the drawing as a guide and get the local blacksmith to make the guard to measure. It is essential when fitting the front radiator guard to make sure that the struts are clear of the front axle and will also be clear on rough ground. It is advisable to jack the front wheels off the ground when fitting to see if enough room has been allowed for the vertical movement of the front axle.

Sump Oil Strainer Guard

Plate 5. The three-cylinder Massey-Ferguson Type 35X should also have a guard to protect the four studs that secure the sump oil strainer to the sump. The guard should be made of 18-gauge metal and be $9\frac{1}{2}$ inches wide (the same width as the base plate to the radiator, Fig. 4) and 31 inches long. The guard is held in place by the two studs at the back of the radiator guard base plate and, toward the rear of the tractor, by the two studs at the front of the clutch housing.

Tyres

Tyres with hard walls should be fitted. It is the walls of the tyres which wear during extraction, and any soft type, whilst suitable for the forest nursery, is not recommended for timber extraction. There are two front wheel sizes, 400×19 and 600×16; the 600×16 is preferred, since it is wider, has a greater bearing surface, causes less damage to rack and ride, and has a longer life. It is important to

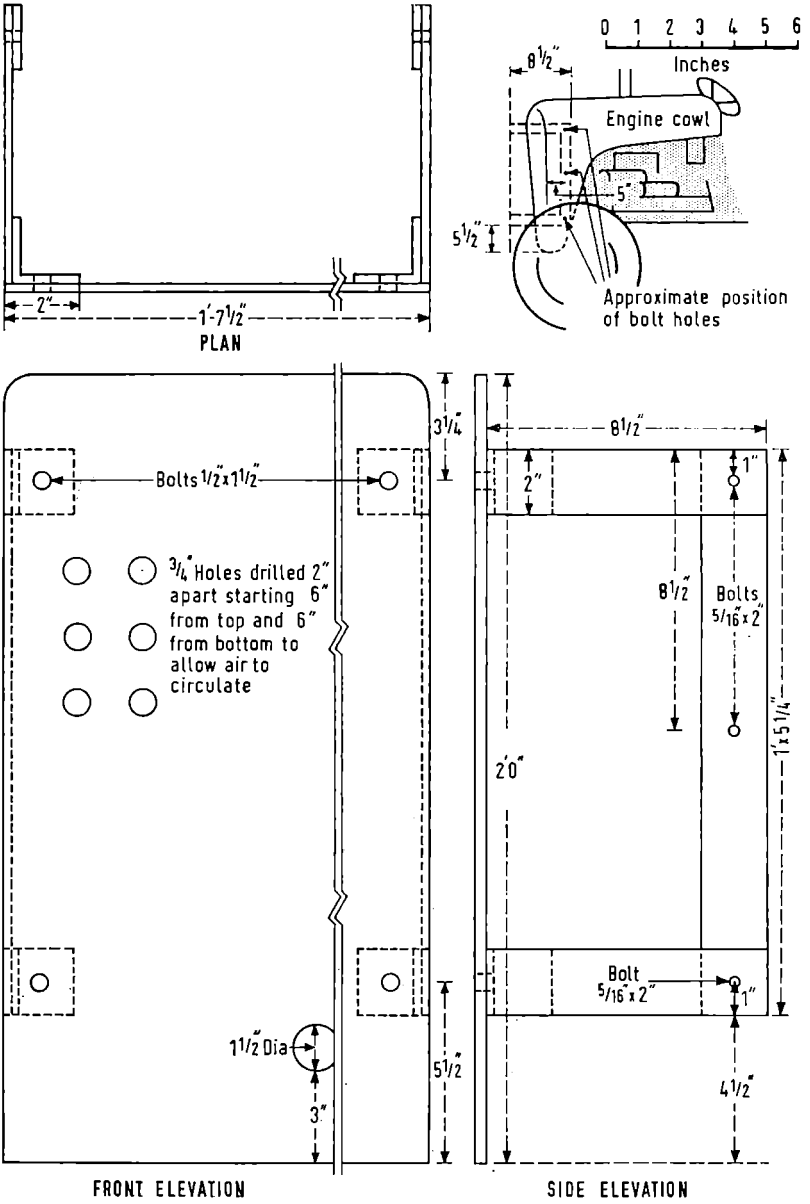

FIG. 2. Radiator guard. Ferguson Model T.F. 20.

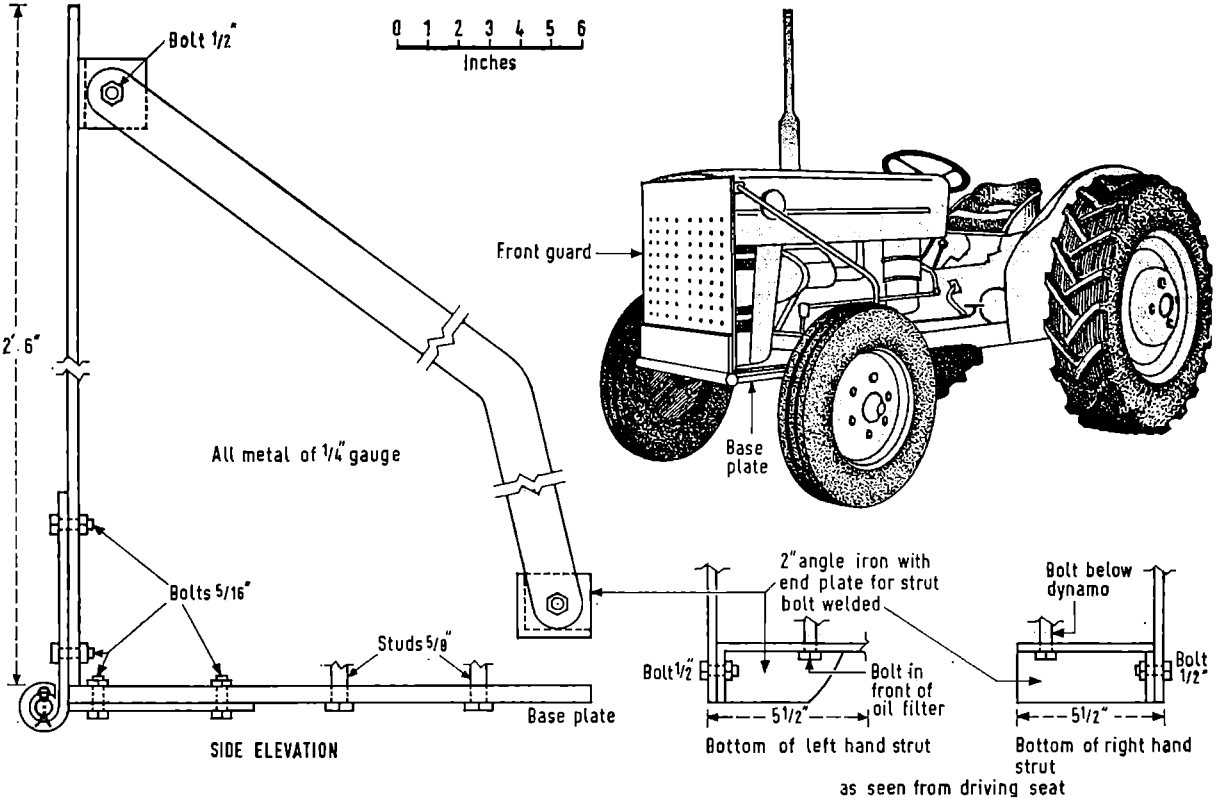

FIG. 3. Radiator guard. Massey-Ferguson Type 35.
Side elevation—sketch and details.

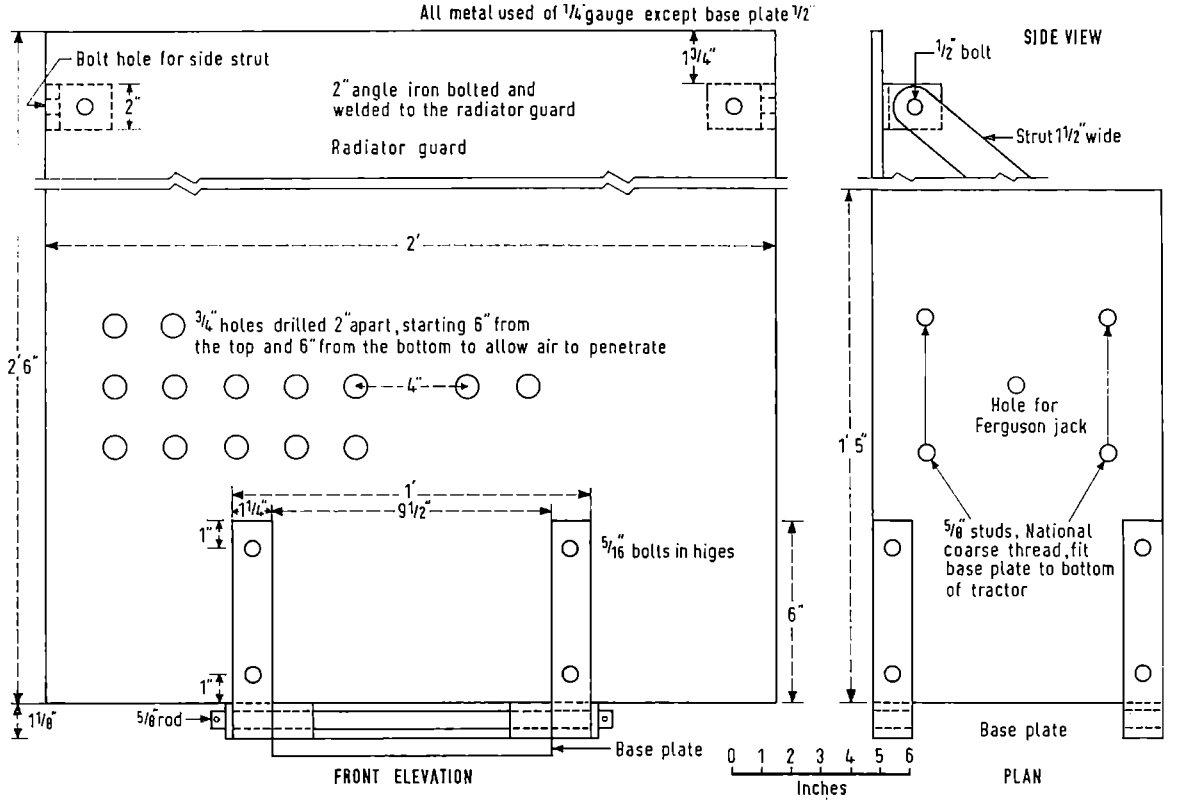

FIG. 4. Radiator guard. Massey-Ferguson Type 35. Front elevation and plan.

inflate the tyres to the correct pressures, which should be: front tyres 27 lbs. per square inch; rear tyres 12 lbs. Front tyres need to be hard to prevent damage when running on to stumps etc., rear tyres should be soft to give greater bearing surface, prevent wheel spin and thus increase traction.

Stepboards
(Plate 4). The stepboard is clipped on to the foot-rests in front of the clutch pedal on the left-hand side of the tractor, and in front of the brake pedal on the right-hand side of the tractor. Unless these stepboards are bolted down, the brash will knock them off and buckle them. To secure them, drill a hole in the stepboard immediately under the foot-rest, and put in a nut and bolt. The nut and bolt will prevent the stepboard clip from jumping off the foot-rest.

Safety Note
Drivers should drive with their thumbs on the outside of the rim of the steering wheel. If the front wheels hit a stump, the steering wheel is liable to spin violently and the spokes may cause sprained thumbs.

Fashion Note
A silk stocking over the top of the air intake will prevent a lot of dirt and dust getting into and blocking the filter.

THETFORD TONGS

Description and Fitting
The tongs consist of two "pincer-like" jaws, joined together through a parallelogram linkage. See Plate 6. One arm of this linkage is extended to form the handle. Fig. 5 gives details of the tongs used when extracting poles and small logs (up to 15-inch butt diameter); for large logs the jaws are 2 inches longer. The tongs are easily moved and grip the pole or log equally. The jaws are symmetrical from the pivoting point but one side "lifts" when in use and the other is "stiff". This difference in action results from the linkage.

The tongs are fastened to the tractor drawbar through a U-coupling attached to the handle; the nut and bolt of this coupling is loose to give free movement. The tongs can be placed on the inside or outside of the drawbar. The choice depends on the arm-length of the driver. Some operators have the handle curved toward the tractor for easy reach.

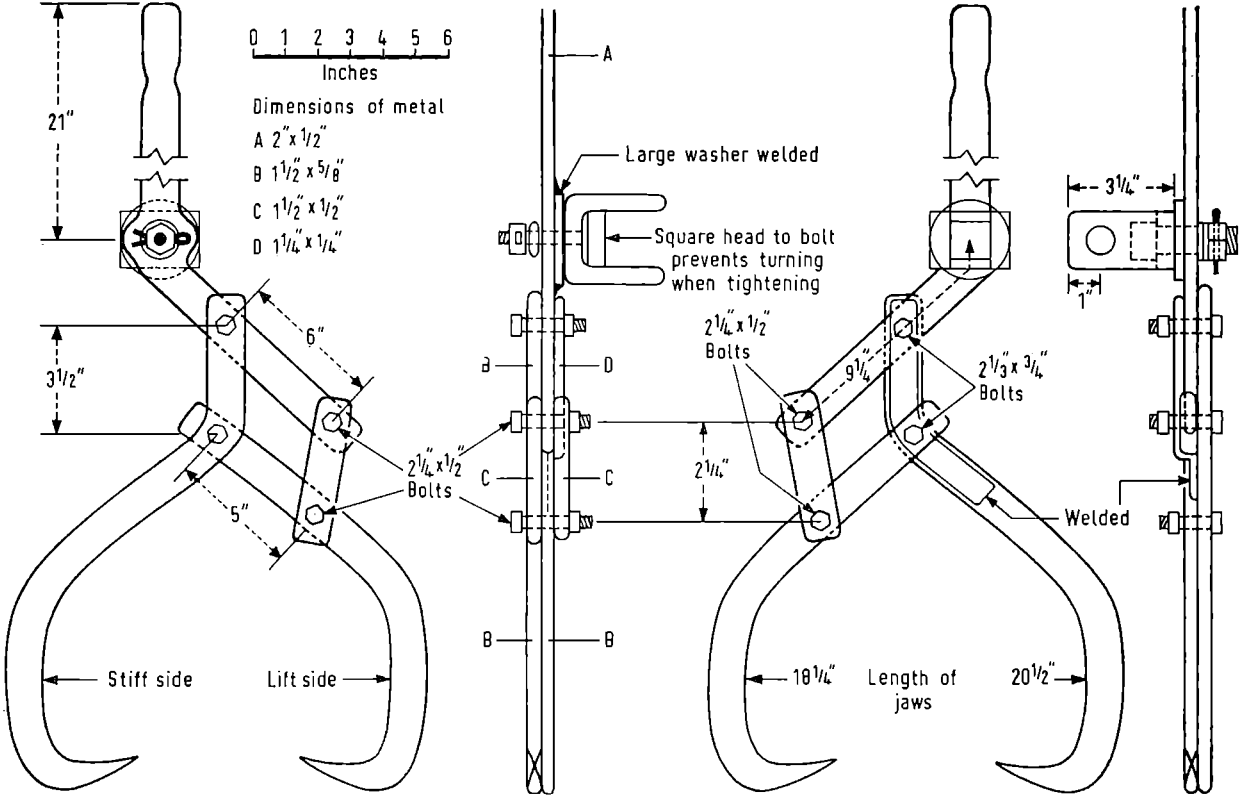

FIG. 5. Thetford Tongs.

The hydraulic control is on the right hand side of the tractor; the driver always turns to his right to work the control and tongs. On a 9-hole standard drawbar, some drivers prefer the tongs in the fourth hole from the right for easier working; others use the centre hole. Rubber tubing round the handle will prevent the paint on the mudguard being chipped by the handle and protect the driver's hands. The points of the tongs should be kept sharp to enable them to grip into the log or pole.

Method of Using Tongs

The correct place to grip a log or pole is 9 to 12 inches from the butt. The larger log, however, should be gripped nearer the butt, about 4 inches from the end. This allows the arch of the tongs to swing forward freely as the strain is taken. If the tongs gripped logs further from the butt they would tend either to lever themselves free or to bend. See Fig. 6.

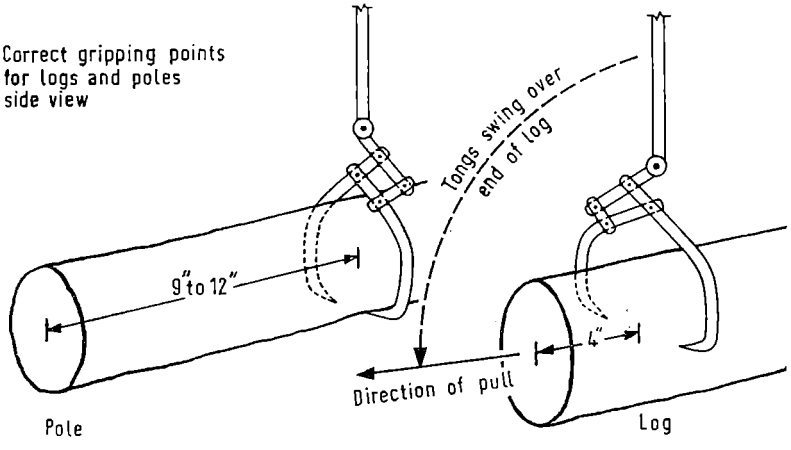

FIG. 6. Gripping points for Thetford Tongs.

The butt of a small pole is usually completely encircled by the arms of the tongs, which pinch into the sides of the pole whilst the points grip from underneath. A log or large pole, on the other hand, is gripped by the points just below the widest part. If only small poles of 4- to 6-inch diameter butt are being extracted, the grip of the tongs can be improved by altering their shape from the very full pear-shape shown in Fig. 5 to a thinner "Conference pear-shape" as in Fig. 7 overleaf.

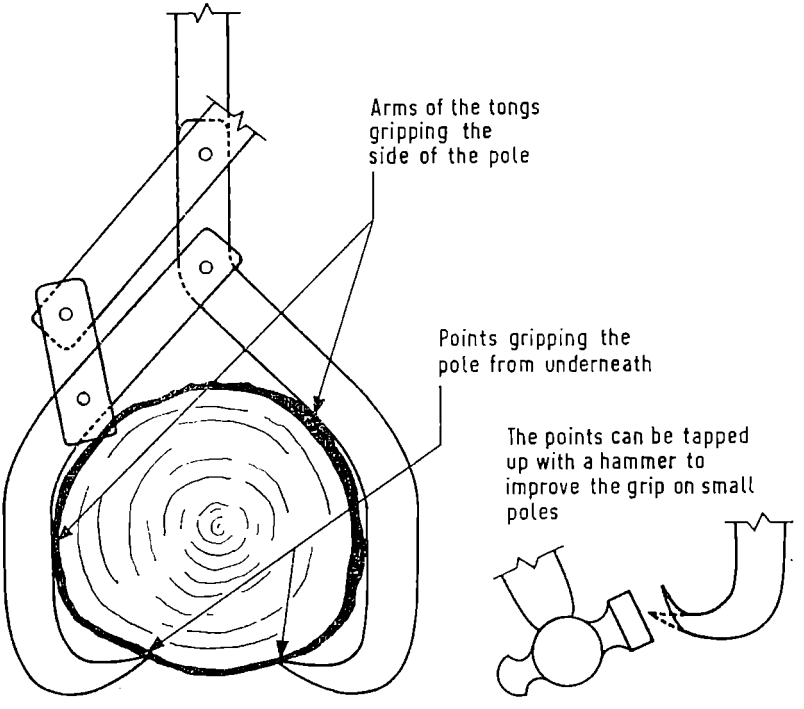

FIG. 7. Modified shape for Thetford Tongs.

It is not always possible to fell trees with butts facing the correct direction, and in some cases poles have to be brought out of the wood top-first. These poles can be gripped in the middle with the tongs; then with the butt under the tractor the whole pole can be lifted clear of the ground by the hydraulics. The pole can then be turned round in the rack. See Fig. 8

There is a tendency for poles to lever open the tongs when the tractor turns sharply into the rack. Lowering the drawbar so that the pole is just clear of the ground when taking these sharp turns helps to counteract the tendency to lever open the tongs. However, it is better to avoid too sharp turns into the rack.

One of the secrets of extraction by tongs is to allow oneself plenty of room to work. It is advisable to extract as many poles as possible into the ride at either end of the rack before filling the rack itself. *It is quicker to travel a bit further than to have excessive stacking.* The average extraction distance for poles from stump to stack in rack is 42 yards at Thetford for strips of one chain wide on either side of the rack. Another secret is whilst extracting one pole to mark

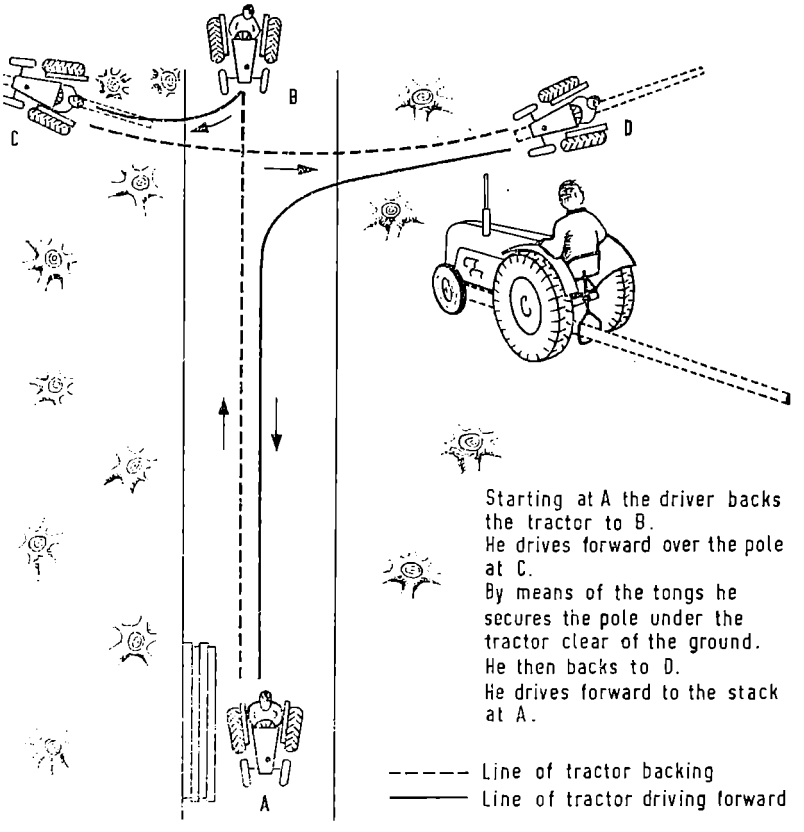

FIG. 8. Turning a pole in the rack.

the next pole that is to come. This means that the driver can back into the wood to it by the most direct route without hesitation and/or loss of time.

To release a pole or log from the tongs, the drawbar is lowered and the handle moved, either to the right or left, with a twisting movement to free the points of the jaws from the butt. The tongs are made with a "lifting side" and a "stiff side" as shown in the sketch overleaf. The way in which the tongs are hung decides whether the driver moves them to the right or left when releasing a pole or log; some drivers prefer one way, some the other. See Fig. 9.

It is important to remember not to trap the "lift side" of the tongs against another pole when stacking; e.g. when stacking poles on the right-hand side of the rack, the "stiff side" would be nearest the stack, that is on the right looking from the rear to the front of the tractor.

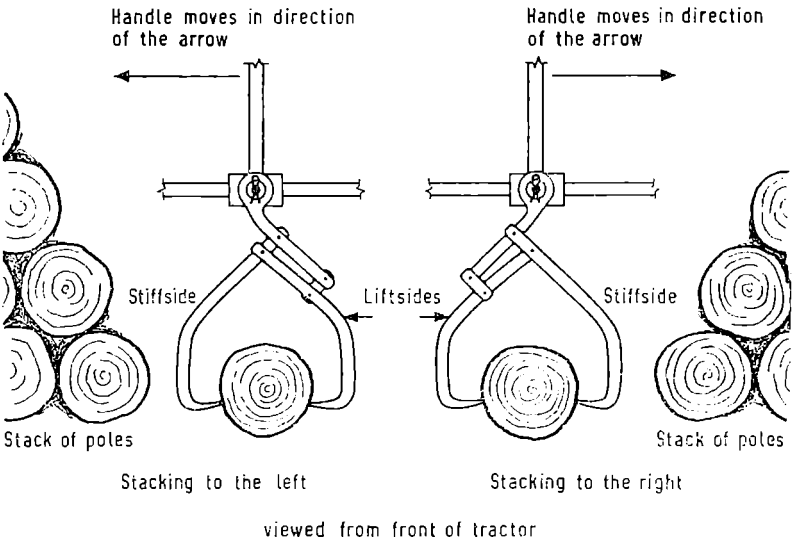

FIG. 9. Alternative fixings for Thetford Tongs.

If tongs are changed to the inside from the outside of the drawbar, it is necessary to undo the bolt on the main U-coupling and refix the tongs on the other side, to obtain the same action when moving the handle to the right or left.

System of Extraction by Tongs

(a) **General.** The trees are felled with their butts pointing towards the racks to assist extraction. Saw logs have a 6-inch minimum top diameter underbark and range from 10 to 22 feet in length, poles from 15 to 30 feet have a 3-inch minimum top diameter underbark. Produce is extracted the shortest possible distance to the nearest point where it can be loaded by HIAB crane on to lorries. Poles are extracted from stump to *rack*; logs on the other hand are less numerous and so these are concentrated on the *ride*, rather than in the racks. The number of poles extracted to the rack or logs to the ride naturally varies with the type of thinning. In third thinning of pine (average size of tree 3·5 hoppus feet), the numbers are approximately 100 poles and 30 logs per acre. This gives a stack of 10 poles every 10 to 15 yards down the rack and a stack of 30 logs on the ride at each end of a 200-yard-long rack. Poles average 2½ hoppus feet and logs range from 3 to 15 hoppus feet. 15 to 20 hoppus feet is considered a safe maximum load for logs at Thetford, but poles of up to 50 feet in length and averaging 5 or 6 hoppus feet can be extracted by this method after 3rd thinnings, when there is more

room to move. The only reason for a maximum pole of 30 feet long in Thetford, is to produce a pole that can easily be handled on to a lorry and, what is more important, subsequently handled by men using a saw bench.

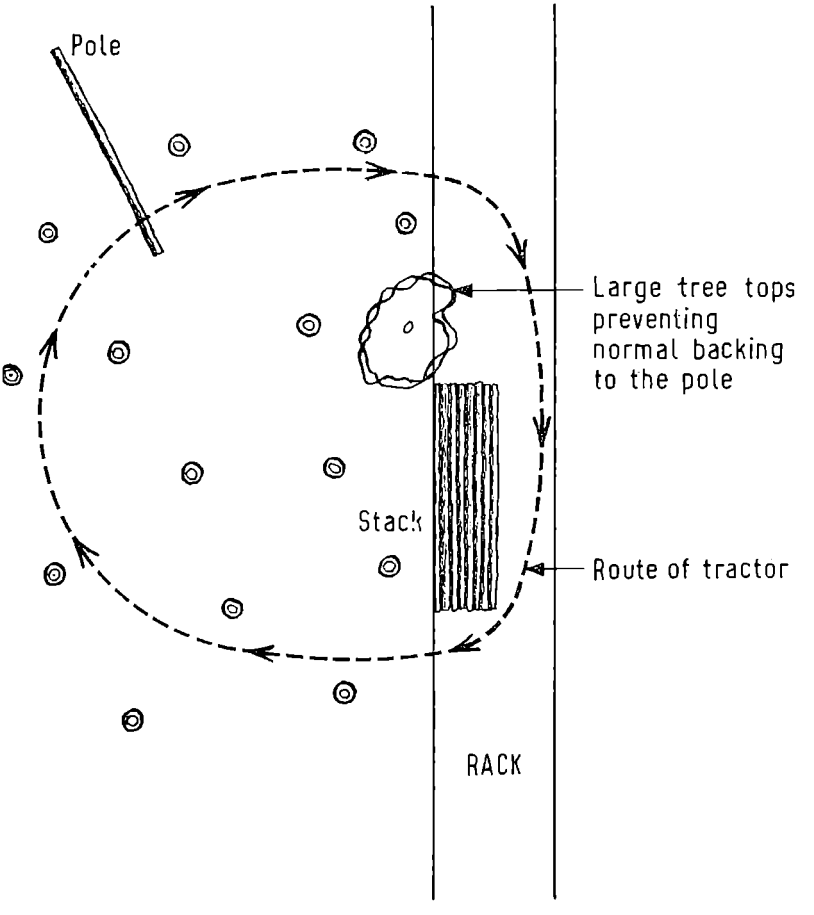

FIG. 10. Extracting a pole round an obstacle.

In Thetford conditions, the poles and logs are extracted by tractor from a one-chain-wide strip along each side of the rack. The poles are stacked with their butts facing the direction in which the lorry will travel and on the right-hand side of the rack. (This helps subsequent lorry loading as the driver's seat and controls are on the right-hand side of the lorry). For this reason it is important to begin

by extracting the produce from the right-hand strip to prevent the stacks of produce obstructing subsequent extraction. After extracting the right-hand side, the left-hand side is extracted and the produce added to the existing stacks; or new stacks are made still on the right-hand side. All products. poles or logs, are extracted as the driver comes to them; if only one type of product was extracted at a time then the ground would be covered several times and the racks would be obstructed by the first type of product extracted. See front and rear end-paper diagrams.

(b) **Method of Extraction.** The driver reverses the tractor into the wood up to the butt end of the pole or log; he stops the tractor and turns to his right, his right hand going to the tong handle, his left hand to the hydraulic control. The driver lowers the drawbar hydraulically and guides the tongs on to the butt end. As soon as the tongs grip he raises the drawbar and lifts the butt end off the ground. As the butt starts to lift, the driver turns to the front; his left hand goes to the gear lever, his right hand to the steering wheel. He drives out forward and runs to the stack in the rack or ride. As he reaches the end of the stack he drops the drawbar and releases the tongs.

This is a description of the method at its simplest. There are often complications such as manoeuvring around obstacles, bringing out a pole top-first and turning it, adjusting the tongs when a pole drops off.

When obstacles such as large stumps or big tree-tops prevent the driver backing the tractor into the wood in the normal way, he drives into the wood forwards, then travels in a circle picking up the pole or log on the way round to bring it out on the rack. See Fig. 10.

THE DRAWBAR

Two types are in use, the *Standard* and the *V* drawbars. The *Standard 9-hole drawbar* is supplied by the tractor manufacturers. The *V* drawbar is a local development used by some of the more experienced drivers at Thetford.

The V drawbar allows the coupling of the tongs to turn at right-angles to the line of the tractor. See Fig. 11 facing. Thus the tractor can make sharper turns than with a Standard drawbar, without dislodging the pole. It also prevents the handle of the tongs striking the mudguard during tight turns, and reduces the risk of bending the tongs.

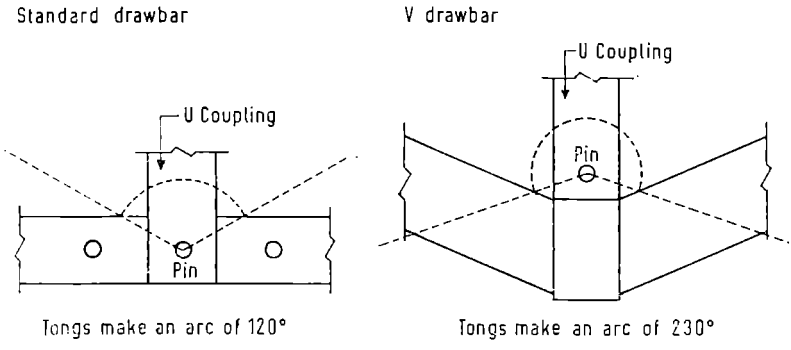

FIG. 11. The Standard drawbar and the V drawbar.

The V bar can be used with the "V" pointing inward towards the driver and the tongs on the outside, or with the "V" pointing away from the driver and the tongs on the inside. This depends on the reach and individual preference of the driver. The latter position is usually adopted by men with a shorter reach. Some training is necessary with this drawbar. When releasing a pole from the tongs, the driver has to grasp the handle of the tongs as he applies the brake to stop. If he leaves it too late the handle will tend to swing away from him. A beginner would be advised to start with the Standard drawbar before graduating to the V bar. The V bar is shown in Plate 6, the Standard in Plate 7.

STACKING AND STACKERS

Description and Fitting

Two types of stacking attachments have been designed by Thetford tractor drivers. The first type, Mark I (see Fig. 12), was designed to fit the Standard drawbar; and the Mark II (see Fig. 13), to fit the V drawbar. The Mark II stackers remain attached throughout the extraction operation; but the Mark I stackers are fitted only for the stacking operation and are then removed.

The Mk. II is considered the better type. It can be attached to the *Standard* drawbar by either lengthening the pins at each side of the bar by about ½ inch and re-drilling the hole for the retaining split-pin ⅜ inch to ½ inch nearer the outside end, or by grinding about ½ inch off the inner flanges of the drawbar. The effect in both cases is to give sufficient space to accommodate a stacker on arms at each end of the drawbar.

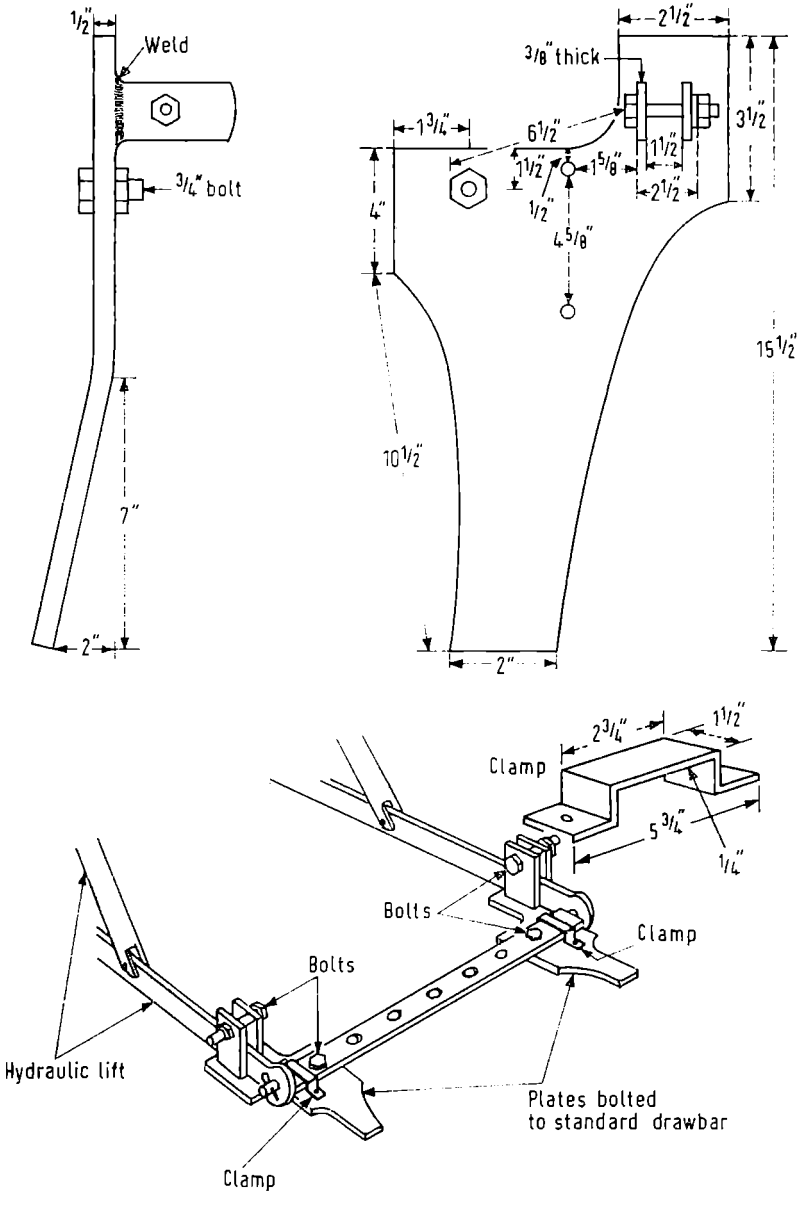

FIG. 12. Stacking attachments, Mark I, to fit Standard drawbar; details above, assembly below.

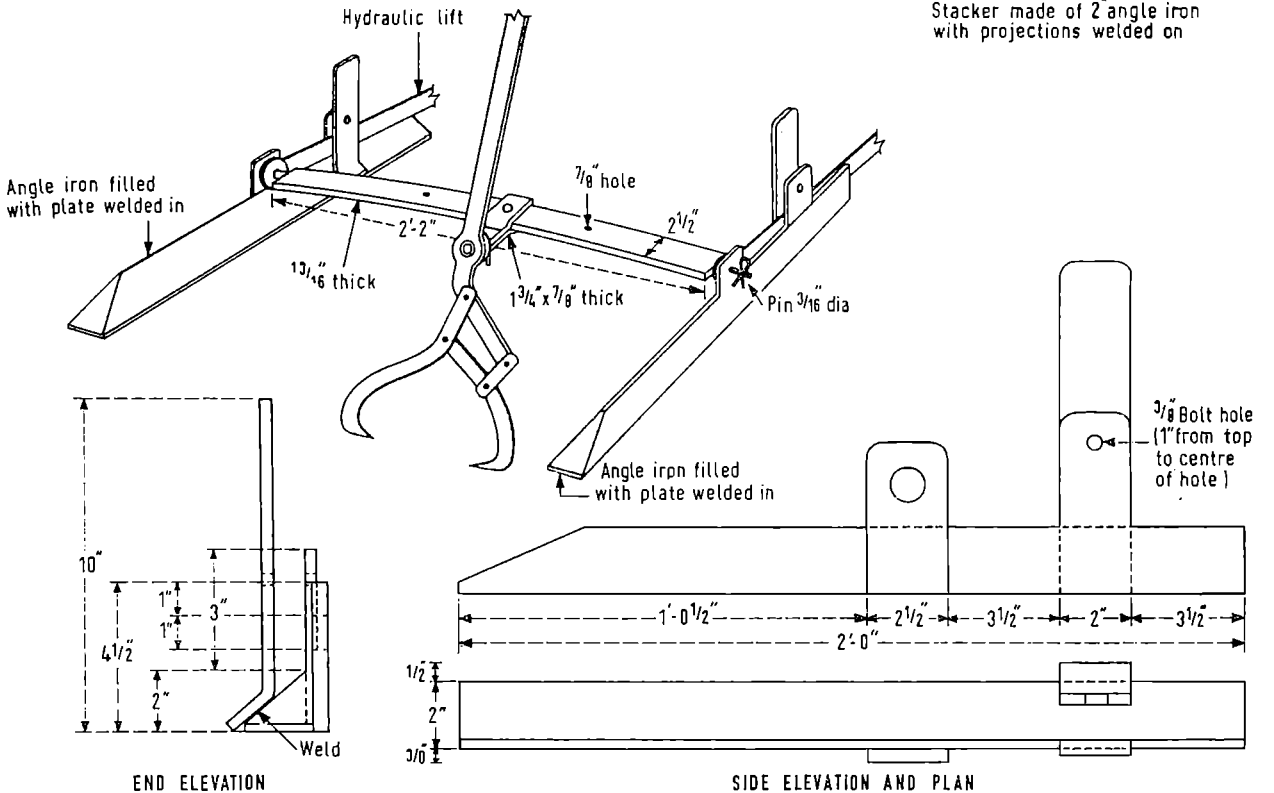

FIG. 13. Tongs, with V drawbar, and stacking attachment, Mark II, to fit V drawbar.

Note. The distance piece linking the tongs to the drawbar is seven inches long overall, giving an offset of five inches.

Methods of Use

When extracting a *pole*, the driver usually drives the tractor over the stack of poles which he is gradually assembling in the rack, and drops the pole on top of them. He does this until he can no longer drive the tractor over the stack—because it is getting too high. Thereafter he drops the poles alongside the stack, nudging the last pole into the stack with the front wheels of the tractor as the next is brought alongside.

The stackers are used to tidy up large spreading stacks of *poles* in order to give sufficient space for lorries to pass down the racks and to load. See Plate 8. To use the stackers, the driver pulls out the tong-retaining-pin and drops the tongs off in the rack away from the stack. It is possible with practice to use the Mark II stackers without taking off the tongs. He then drives into the wood and backs through the trees until the tractor is placed about one third of the length of the stack from the butts, that is at approximately the point of balance of the poles. He lowers the drawbar so that the stackers just clear the ground, and then backs the tractor into the stack. As the stackers pass under the poles the drawbar is lifted with the usual hydraulic power; this imparts a forward and upward movement to the poles and lifts them on to the stacks. It is better to lift five or six poles at a time rather than, say, nine or ten; large numbers tend to splay and take longer to stack in the end.

When extracting *logs* into the ride, the driver nudges the last log up to the stack with the front wheels as he comes alongside with the next one. The same method of using the stackers is applied to logs. After using the stackers he fastens the tongs back on to the drawbar and continues to extract materials as before.

Stacking with Chain and Wire Rope

The following paragraph describes an alternative method of stacking when the stackers are not available. This is quite a good method but not so efficient as the stackers. A 12-foot chain and a length of wire rope are used as shown in Fig. 14.

(i) Drop the poles on the stack until it is too high for the tractor to run over it.

(ii) Attach the 12-foot chain, or a wire rope, to the outside poles by its attached hook; then continue to drop poles on top of the chain.

(iii) When the chain is full, the tractor driver drives the tractor into position on the far side of the stack, and attaches a length of wire rope from the free end of the chain, over the top of the stack, to the drawbar of his tractor.

(iv) He then pulls the poles that are lying on the chain, onto the top of the stack, by moving forward with the tractor.

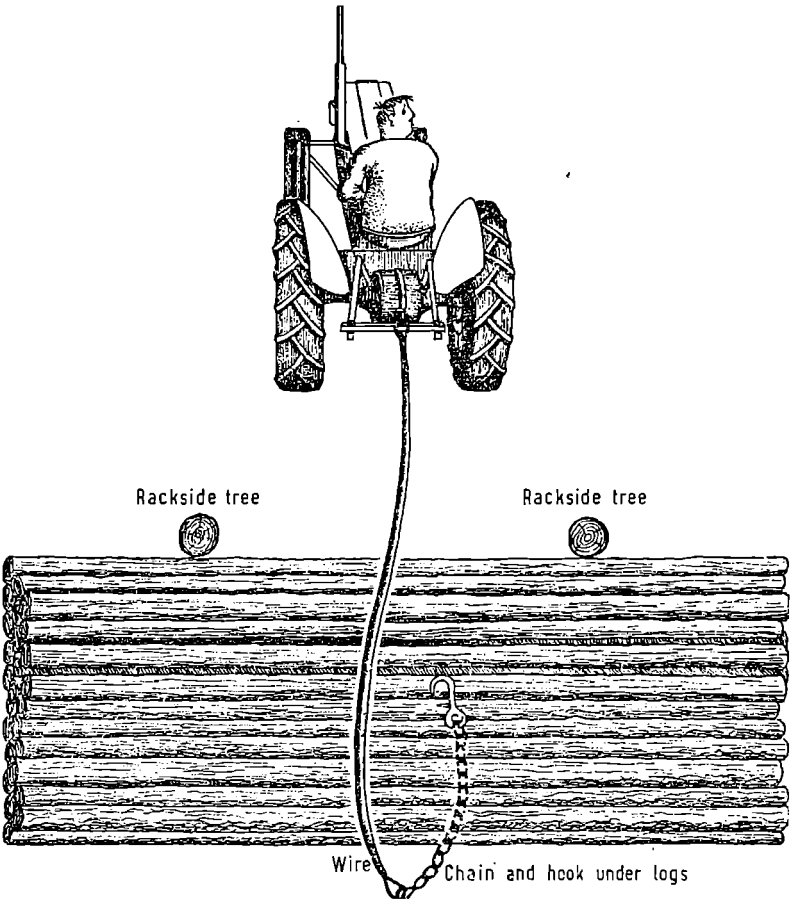

FIG. 14. Stacking with chain and wire rope.

GRAB-HOOK AND TWELVE-FOOT CHAIN

Description

A twelve-foot chain and grab-hook, Fig. 15 and Plate 9, are used together for extracting sawlogs from thinning operations. The chain is fitted with a round hook at one end and a ring at the other, links are 2-inch × $1\frac{3}{8}$ inch × $\frac{3}{8}$ inch. The grab-hook is bolted into one of the holes on the drawbar.

When not in use the chain is hung around the base of the driving seat.

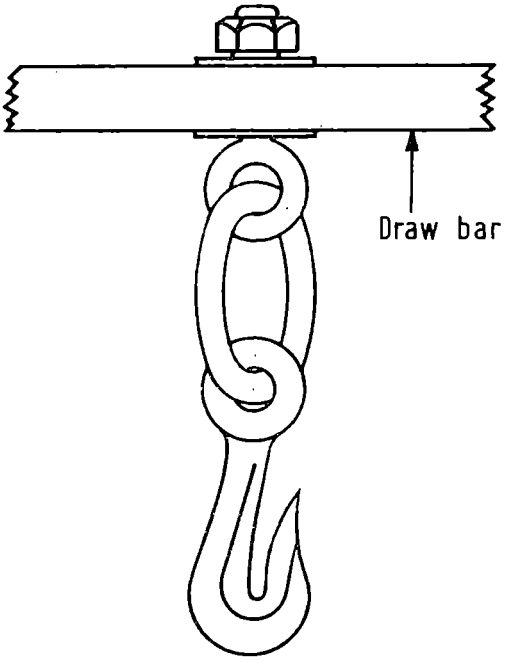

FIG. 15. Grab-hook.

Method of Use

Within a range of fifty yards from the ride, the logs are extracted singly, using the tongs. But on longer hauls, of more than fifty yards from the ride, batches of two to five logs are extracted by chain and grab-hook. The driver lays a chain across the rack near to the point where he is stacking *poles*. He continues extracting *poles*, but as he comes to a *log* he brings it out and lays it on the chain. Having placed two to five logs on the chain (a load of 15 to 20 hoppus feet), he closes the chain round them, and fastens it with the hook. Then he lowers his drawbar, slips the free end of the chain into the grab-hook on the drawbar, and raises the drawbar, thus tightening the chain round the logs and lifting their butts off the ground. He then moves down the rack to the ride, where the logs are stacked. It is emphasized that the driver does not *search* for logs but gathers them as he comes across them.

ALICE HOLT TIMBER DRAWBAR

Description

The Alice Holt Drawbar, Fig. 16 and Plate 10, was designed by the

Forestry Commission Machinery Development Officer at Alice Holt. It is a simple frame device which is mounted on the normal three-point linkage of the tractor. The drawbar can be adapted to fit any size of tractor; for example a larger model is made for the Fordson tractor. Six chains (6 feet long, with links $1\frac{3}{8}$ inch $\times \frac{7}{8}$ inch $\times \frac{1}{4}$ inch gauge for Ferguson) are provided with the drawbar; these chains hook into slots in the cross-members.

It is important to ensure that the top link of the three-point linkage is fully extended, so that the drawbar leans backwards to allow free movement when turning, and so reduces the strain on the chains. Chains should be put into the chain-box provided, between loads, and not be hung on the drawbar. Time can be lost searching for chains which have fallen from the retaining slots.

Method of Use

Sometimes the condition of the racks prevents lorries travelling along them, and all poles have to be extracted to the ride. In narrow belts and along compartment edges, those poles which are within fifty yards of the ride should always be extracted singly by Thetford tongs. For distances over fifty yards down the rack, it is worthwhile making up batches. Poles are extracted singly from stump to rack, using the tongs, and are placed in batches of 15 to 20 hoppus feet. When the driver has extracted all the poles, or has filled up the rack with produce, he takes off the drawbar and tongs, and fits the Alice Holt Drawbar to the three-point linkage of his tractor.

The tractor is driven up to a batch of poles, and is manoeuvred to get the drawbar as near as possible to the butts. The driver lowers the drawbar and gets off the tractor. Then, using hand tongs, he places one, two, or three poles on each chain, closes the chain and slips the loose ends of the chains, with all the slack taken up, into the locking slots on the drawbar. A *timber sword* is used to draw the chain under the larger poles. When the driver has made up a load, he climbs on to the tractor and raises the drawbar which lifts the butts off the ground. He then drives out to the ride.

To unload, the driver lowers the drawbar and gets off the tractor. Then he unclips and unchains the poles. If the driver has picked up two types of pole, he can stack them separately at different stacks.

In clear fellings, where the number of saw logs is greatly increased, it is easier to collect a larger load in a shorter time than would be possible in a thinning. Therefore the Alice Holt Drawbar should be used instead of the "grab-hook and chain" method described for thinnings. For distances over fifty yards the driver extracts the logs out of the brash, from the stump to the rack, with the tongs. He is then able to run down the rack with the Alice Holt Drawbar adding

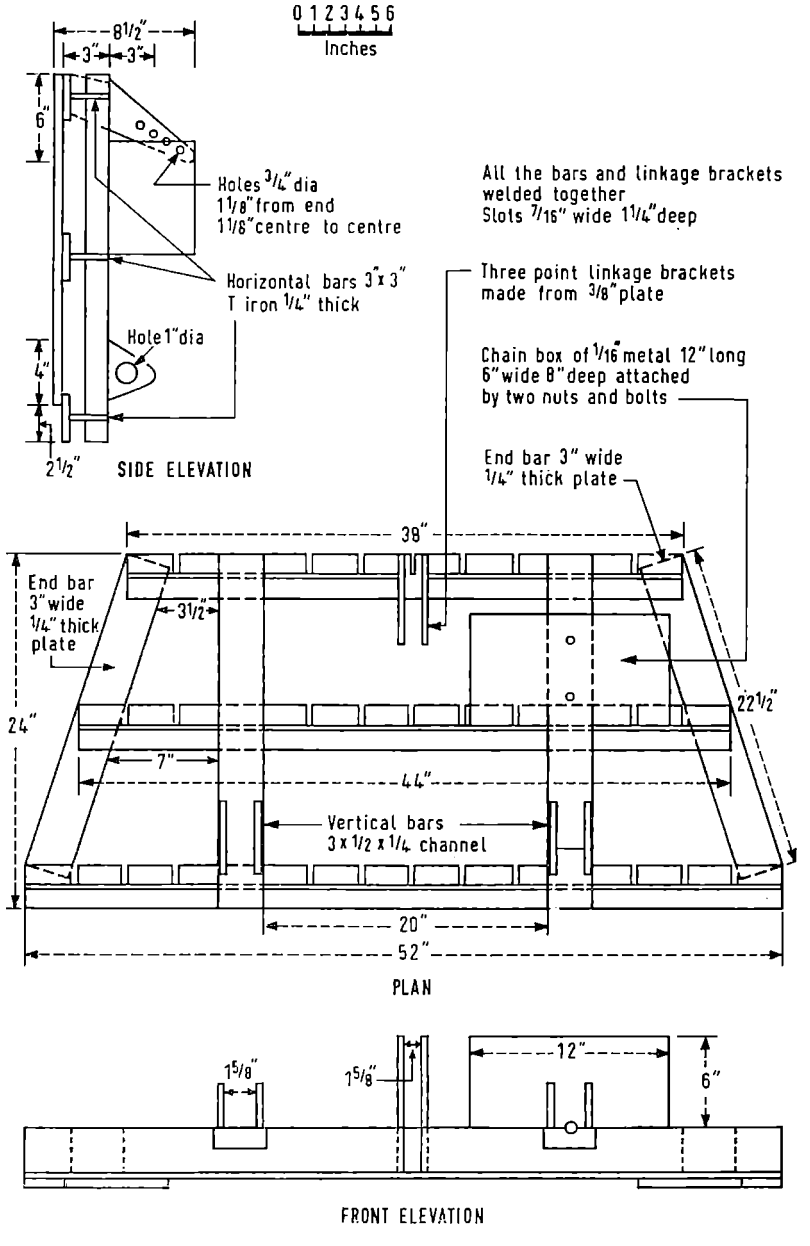

FIG. 16. Alice Holt Timber Drawbar.

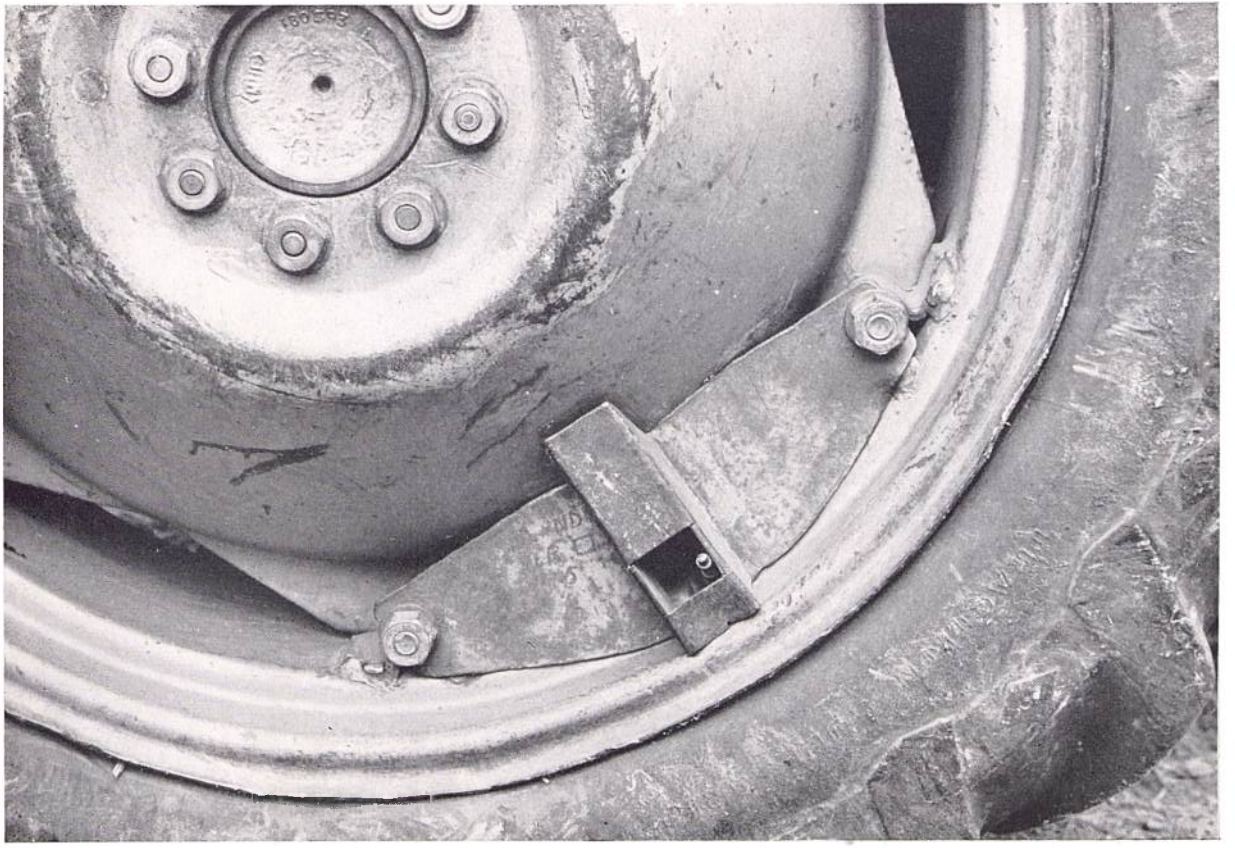

Plate 1. The Rear Wheel Valve Guard. Note how the valve guard is attached by the disc/rim nuts.

Plate 2. Showing the Front Wheel Valve Guards and the Front Radiator Guard for the Massey-Ferguson Type FE 35. Note the struts holding the front radiator guard and how the front guard is hinged to the base-plate.

Plate 3. The Radiator Guard for the Ferguson Type TF 20.

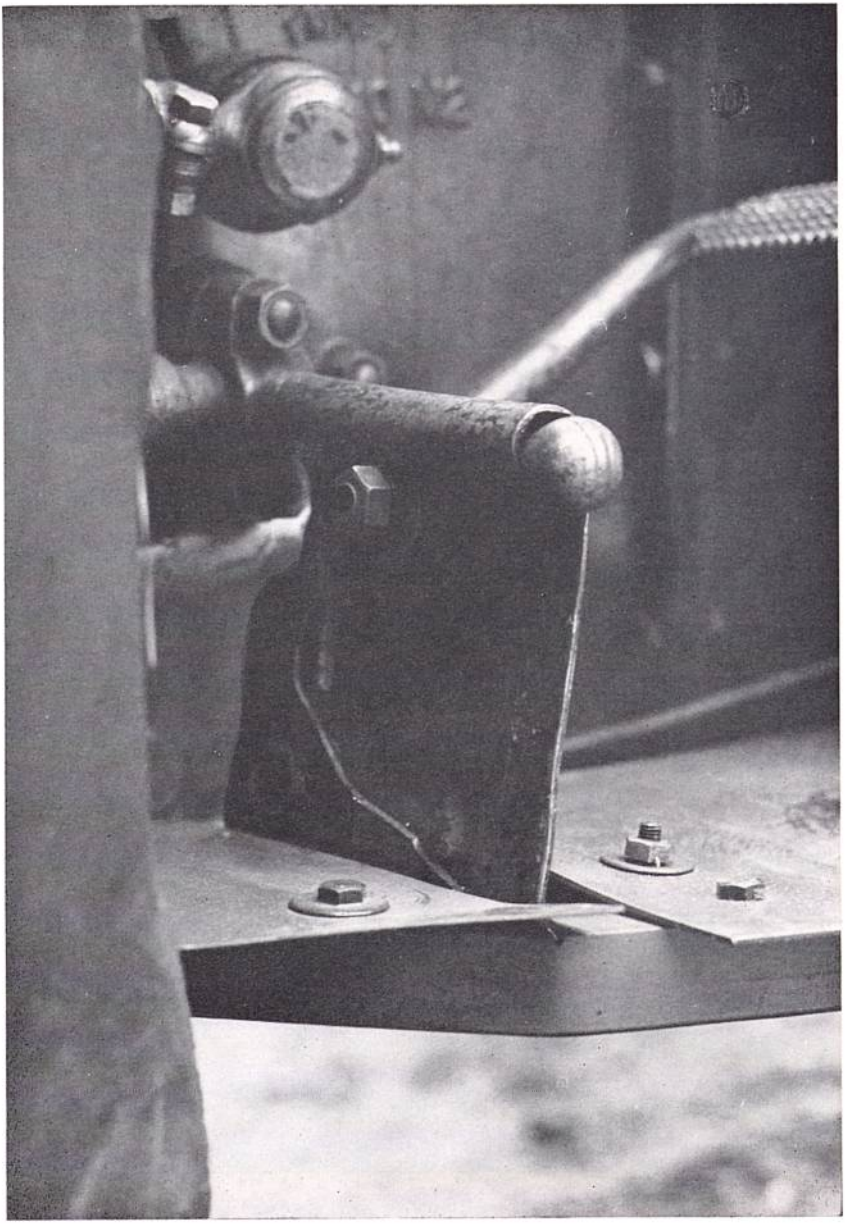

Plate 4. Shows the nut and bolt through the stepboard immediately below the Foot-rest. This prevents the clip of the stepboard being dislodged from the foot-rest.

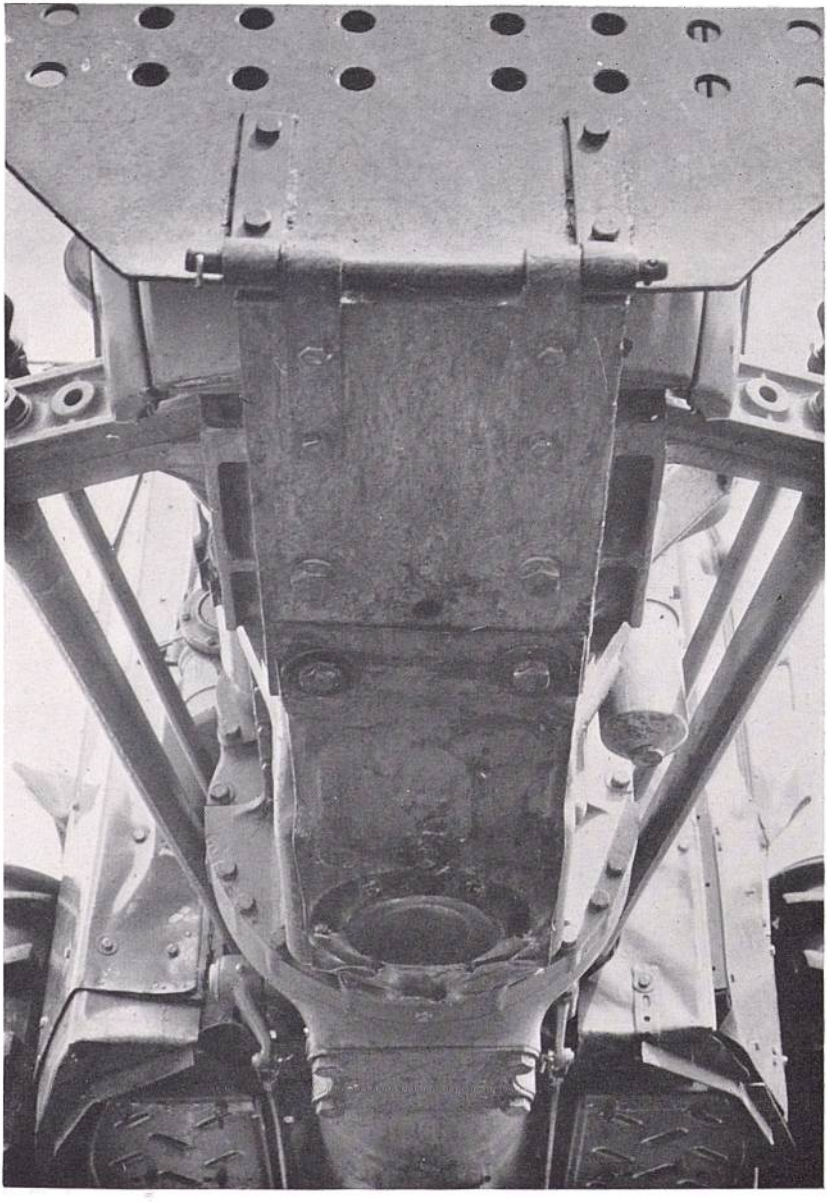

Plate 5. The Base-plate which protects the bottom of the Radiator and the Fan Belt from brush, attached to the tractor with four studs, the holes for which are already on the tractor. (Seen from the front). Also shown is the 18-gauge metal guard protecting the sump oil strainer.

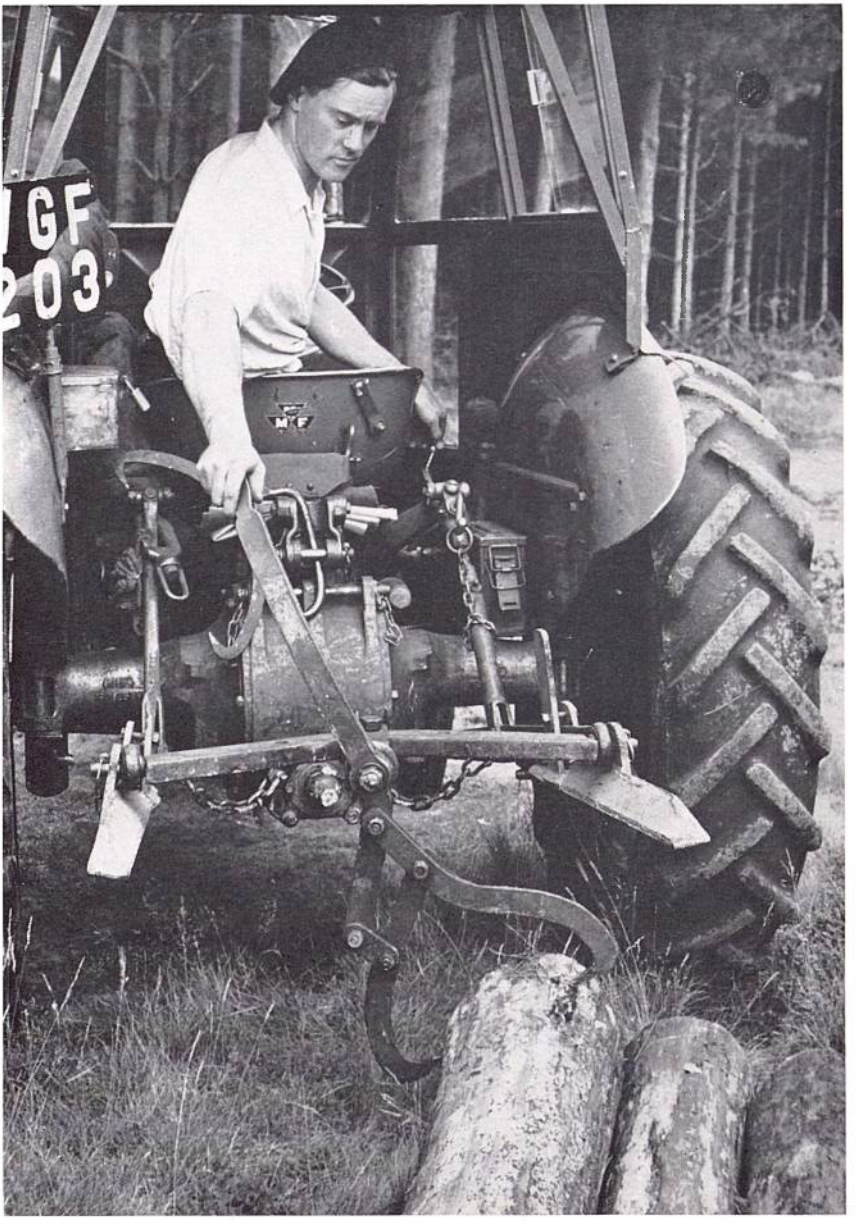

Plate 6. Shows the driver lowering the Tongs over the butt of a log. The V-drawbar and the Mark 2 Stackers can also be seen. Note the Hand Tongs placed conveniently for use behind the seat.

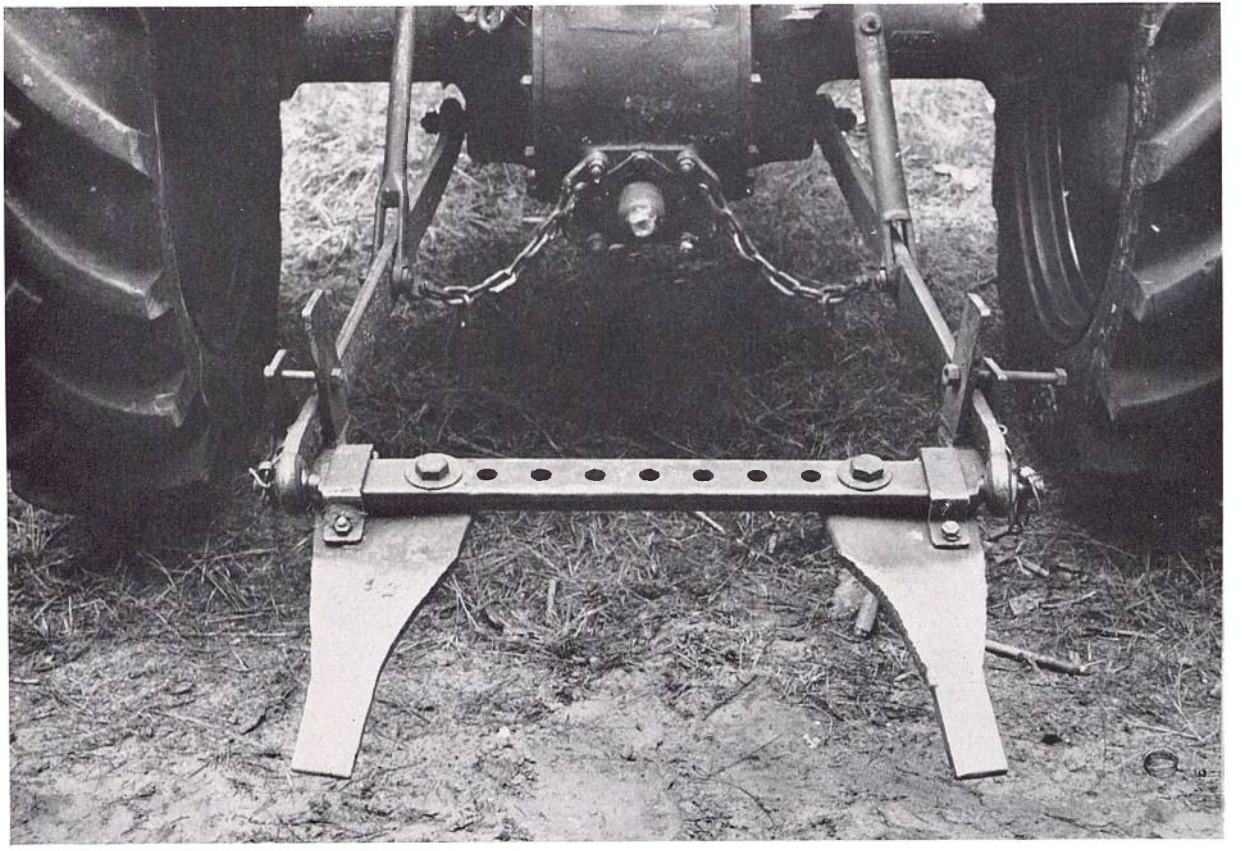

Plate 7. The Mark I Stackers fitted to a Standard Drawbar.

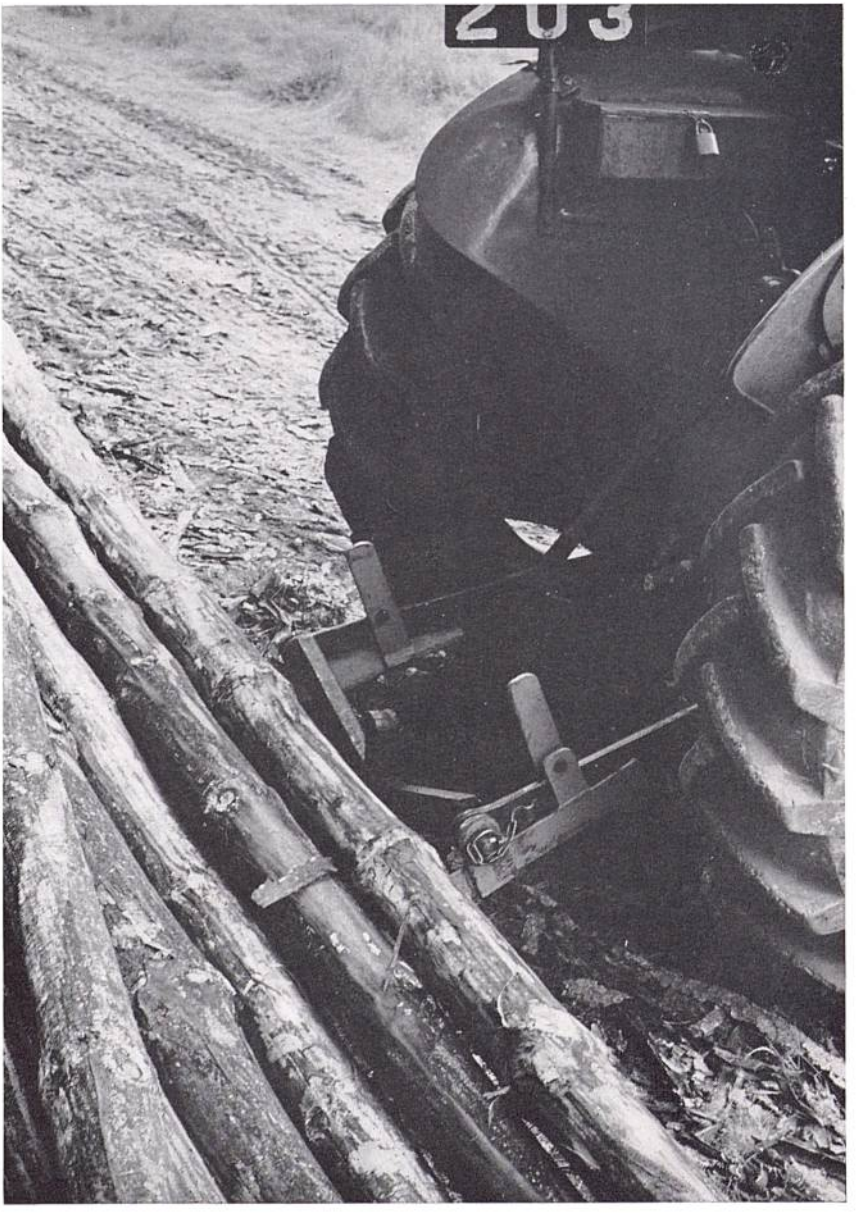

Plate 8. The Mark 2 Stackers "in action" lifting poles onto a stack.

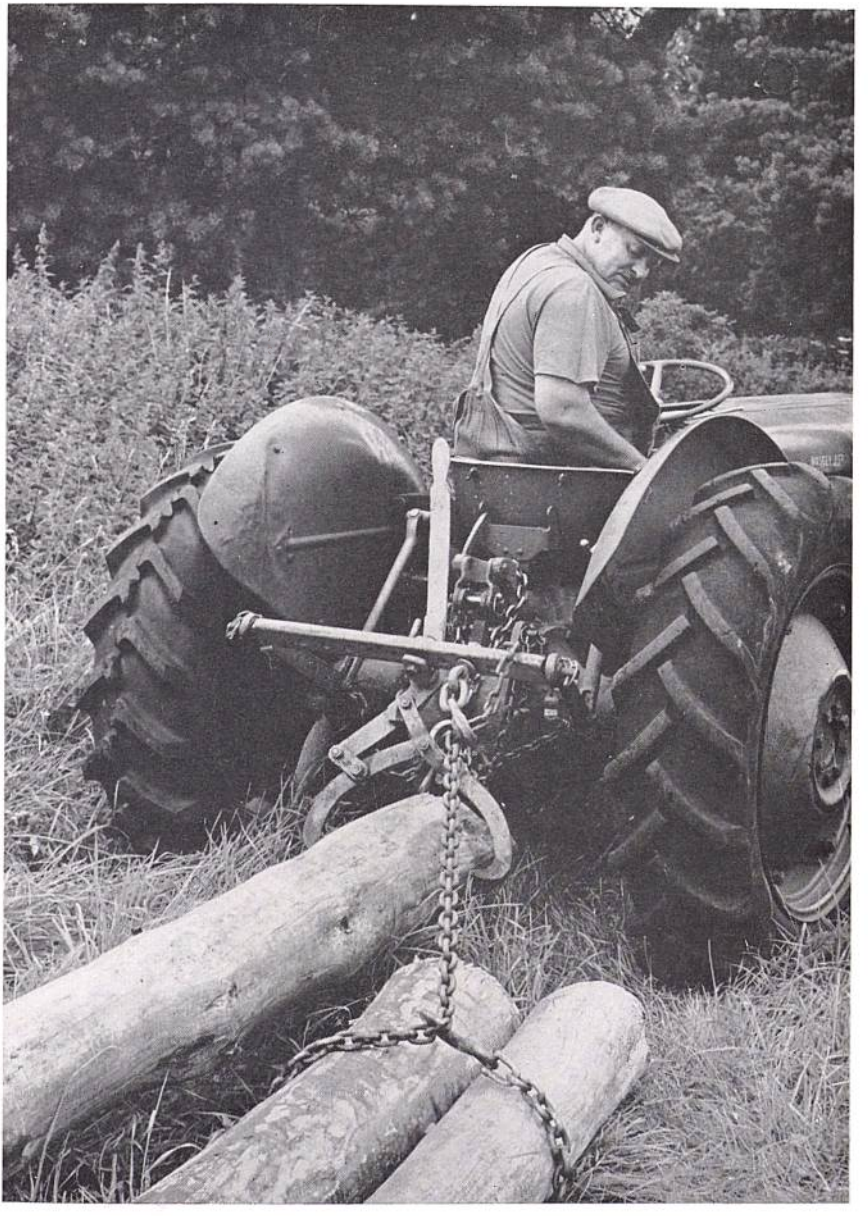

Plate 9. Using the Chain and Grab-hook. One log can be kept in the tongs whilst the remainder of the 15 to 20 hoppus foot batch is in the chain.

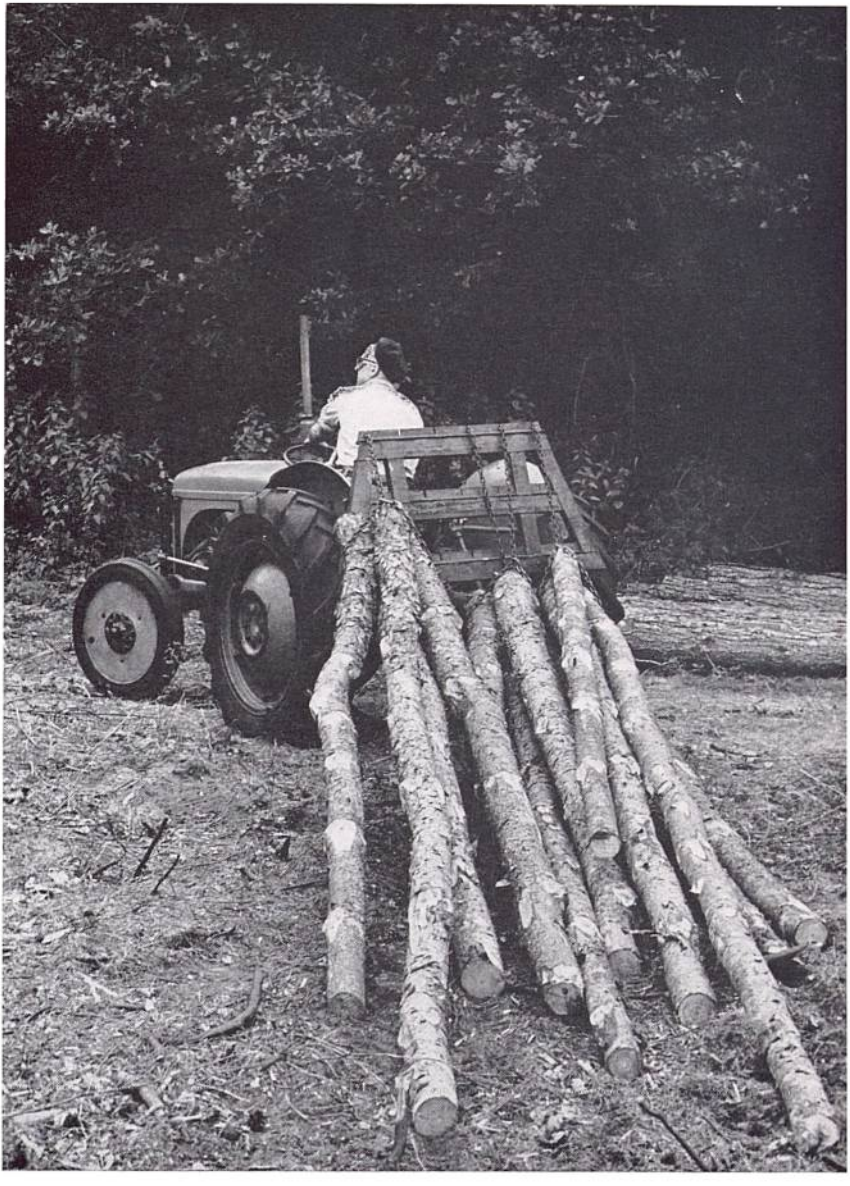

Plate 10. The Alice Holt Timber Drawbar extracting poles.

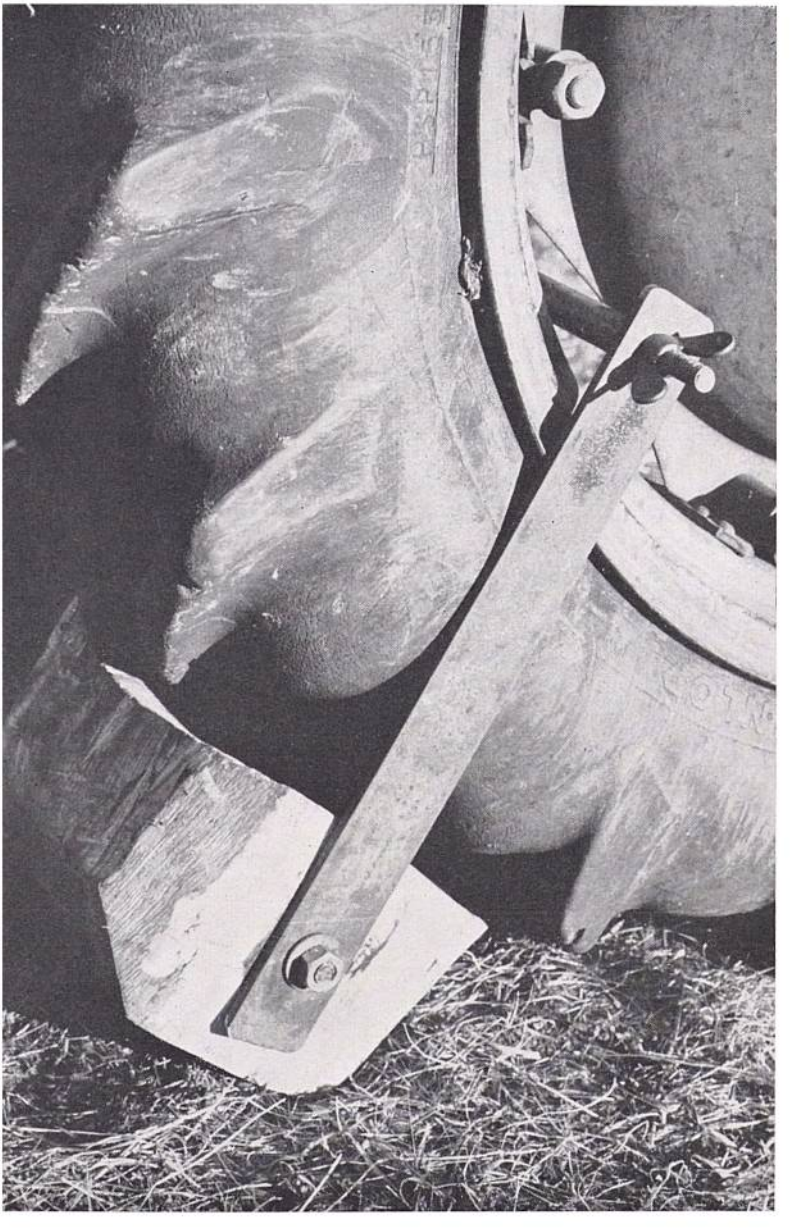

Plate 11. The Stump-stepper. Note the bolt securing the stepper to the wheel.

Plate 12. The equipment at work in a pine plantation at Thetford Chase.

logs as he comes to them, to make up a full load of 15 to 20 hoppus feet, before driving out to the ride to stack the logs. He can, using this method, extract various categories of log, and stack each separately on the ride. The driver can use the drawbar to tidy the stack of produce by using it like a bulldozer.

In normal conditions, where the Alice Holt Drawbar is used in conjunction with the Thetford tongs, the average load will be between 15 and 20 hoppus feet. If the drawbar is to be used continuously, front wheel weights should be fitted so that loads can be increased up to 30 hoppus feet.

Safety Note

Overloading the drawbar is dangerous, especially in extraction work on slopes. "Snatch pulls" to free trapped poles are an unsafe practice.

HAND TONGS

Description

The hand tongs used are known as E.1.A.451 10-inch, and are supplied by Wm. H. Meyer Ltd., 9/11 Gleneldon Road, London, S.W.16. These tongs are carried on the tractor at all times. They are used for manhandling the occasional pole in the wood, hand-stacking poles, and for loading of the chains of the Alice Holt Drawbar. The driver should never need to manhandle poles by hand; gripping poles with the hands, instead of a straight clean lift with the tongs, saves neither time, clothing nor temper.

STUMP-STEPPER

Description

The stump-stepper (Fig. 17 and Plate 11), is made from a block of wood 10½ inches long × 9 inches wide × 6 inches deep. A hollow, 1 inch deep, is chipped out at the top of the block to allow it to fit round the tyre of the tractor. A strip of ¼-inch steel plate is attached to each end of the block by a long bolt, which passes through the centre of the block. The other ends of the two strips of plate are held together by a bolt on which a piece of ½-inch pipe acts as a spacer. The longitudinal edges at the base of the block are bevelled.

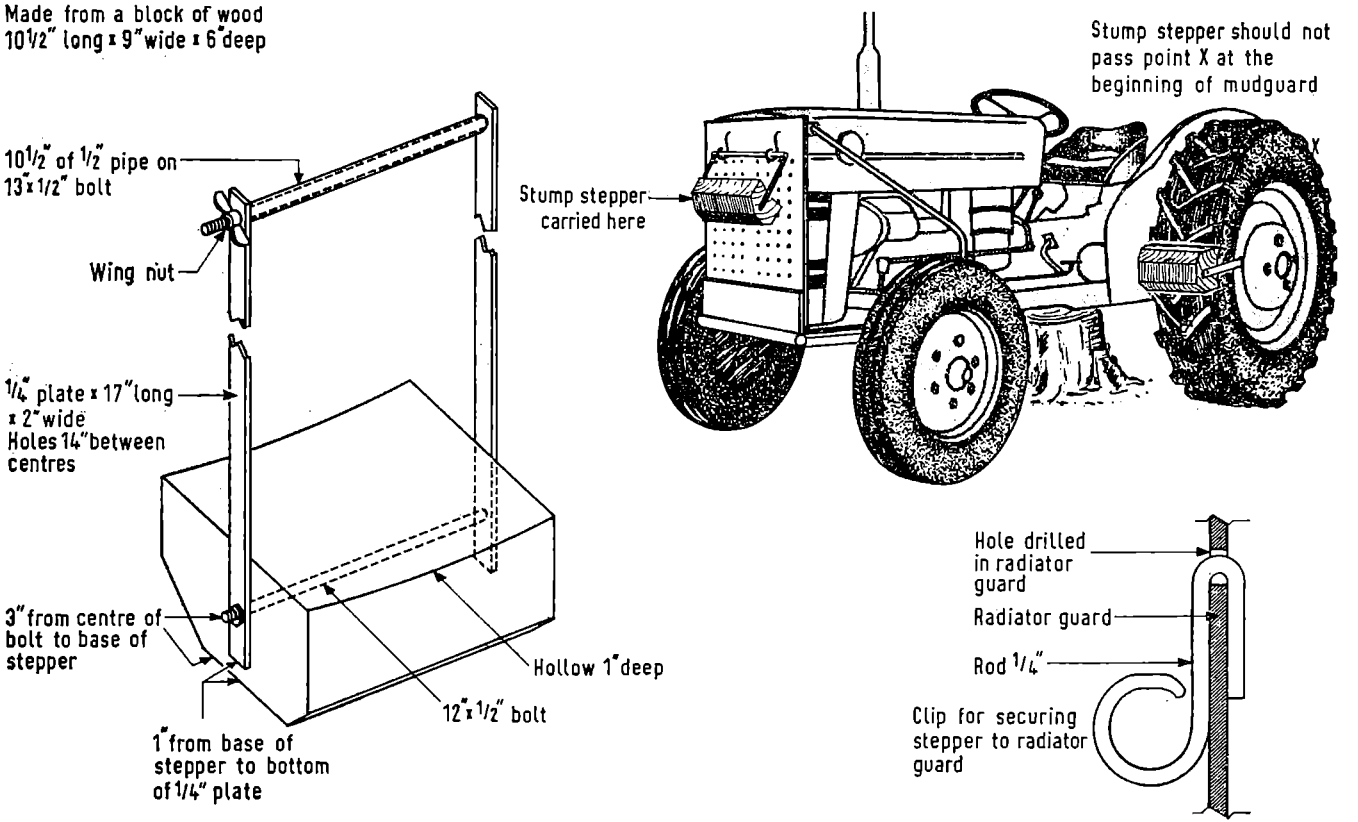

FIG. 17. Stump-stepper.

Method of Use

Sometimes the sump of the tractor slides on to a stump or sticks on a pile of logs, and the wheels are unable to get enough traction to move the tractor. The drawing of the tractor in Fig. 17 illustrates the use of the stump-stepper. The stepper is held in position on the wheel by the bolt and pipe spacer, which are passed through one of the rear wheel slots.

Do not fix the stepper into the wheel slot containing the valve, for the valve will be ripped off.

When the stepper is in position, engage forward gear and allow the wheel to turn slowly so that the stepper will provide lift and traction. If the wing-nut on the bolt which passes through the wheel slot is kept to the outside of the wheel, the wheel can be fully turned without any part of the stepper touching the mudguard. But mudguards become bent and drivers should keep their eye on the stepper when it reaches the point "X" on the diagram. The tractor can equally well be reversed *off* a stump if this is more convenient.

When not in use, the stepper can be hung either behind the seat of the tractor, bolted through the top-link connection, or be fixed to the radiator guard with a couple of hooks as shown in the diagram.

This stepper is designed to fit a 10×28 Ferguson tractor tyre, but the same principle can be applied to other sizes of tyre or wheel by increasing or decreasing the length of the block and the metal strips.

Tractors fitted with a differential lock are unlikely to need a stump-stepper.

Safety Note

It is emphasized that the wheel *must* always be rotated *slowly* when using the stepper. Sudden jerks or violent spinning of the wheel could cause damage to the stepper, the tractor, or even the driver. When the block of wood becomes worn or cracked it must be replaced.

Part II: Time Study Results

Some fifty time studies have been made on the extraction of poles and timber lengths by Massey-Ferguson 35 tractor. Studies have covered a wide variety of thinnings and clear fellings of Scots and Corsican pine. They range over most parts of Thetford Forest and include varying conditions of stand and ground.

For the purpose of time studies, the cycle of extracting poles or logs was broken down into the following elements:

Travelling:	In Ride In Rack In Wood
Loading:	(fixing tongs or chains on to pole or log)
Travelling:	Out of Wood Out of Rack Out of Ride
Unloading:	(off tongs or chains)
Stacking:	Poles or logs
Adjust:	Poles or logs (refix on tongs or chain, turn round pole etc.)

STANDARD TIMES

The following is a detailed list of the conditions for the job as seen in Thetford, with tables which show the best combinations of tools and equipment, and standard times to cover these conditions. All rates relate to the year 1964, and no allowance is made for any later increases.

Piecework Rates and Costs

PIECEWORK RATES can be calculated from the Standard Time Tables as shown in paragraph 5(f) on page 00. These rates depend upon the "price per standard minute", which is negotiated between management and men. This price is, in time, influenced by the prevailing conditions of employment, amongst which wages and hours are the most important.

COSTS can be calculated by adding two factors to the piecework rates. These are the *hourly cost of the tractor*, and the *operator overheads*. The hourly cost of the tractor, in these investigations, was found to be approximately 5/–, and the daily overhead charge per man was between 12/– and 15/–. Thus the *additional* price per standard minute for the tractor is $\frac{5/- \times 12}{60} = 1{\cdot}00\text{d}$, and for the operator overheads $\frac{12/- \times 12}{8\frac{1}{2} \times 60}$ or $\frac{15/- \times 12}{8\frac{1}{2} \times 60} = 0{\cdot}28\text{d}$ or $0{\cdot}35\text{d}$.

Thus the total cost per standard minute for an $8\frac{1}{2}$-hour day is:

$$1.40 + 1{\cdot}00 + 0{\cdot}28\text{d or } 0{\cdot}35\text{d} = 2.68\text{d to } 2{\cdot}75\text{d}.$$

Some idea of the overall cost of extracting various sizes of logs from stump to the ride is shown in Fig. 18. The accompanying Fig. 19 shows the daily output that can be expected for logs of different sizes.

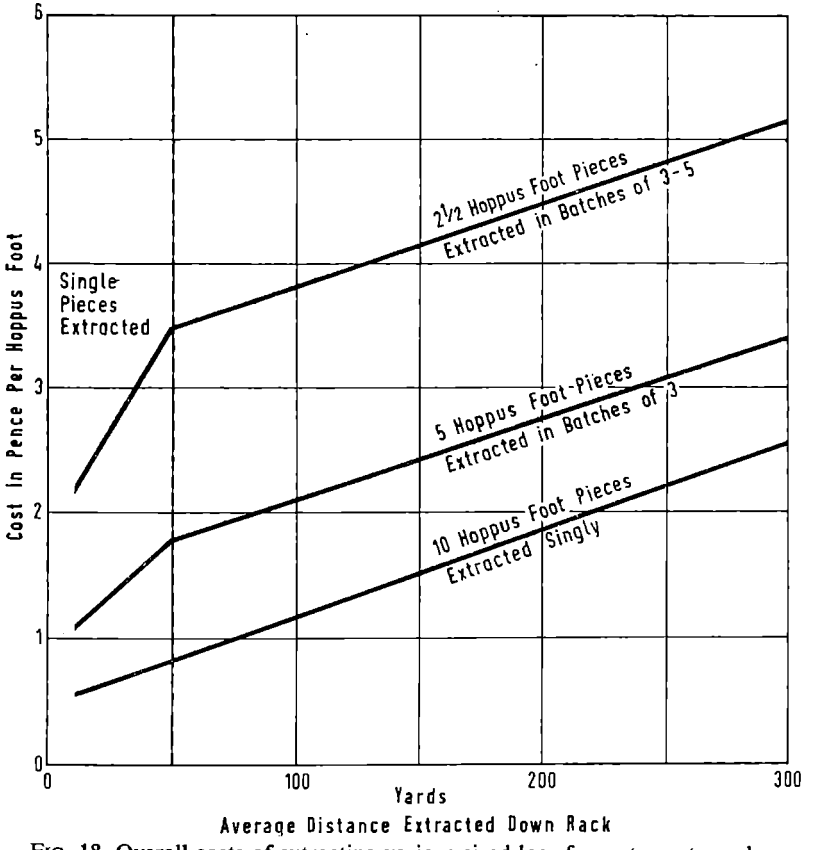

FIG. 18. Overall costs of extracting various sized logs from stump to rack.

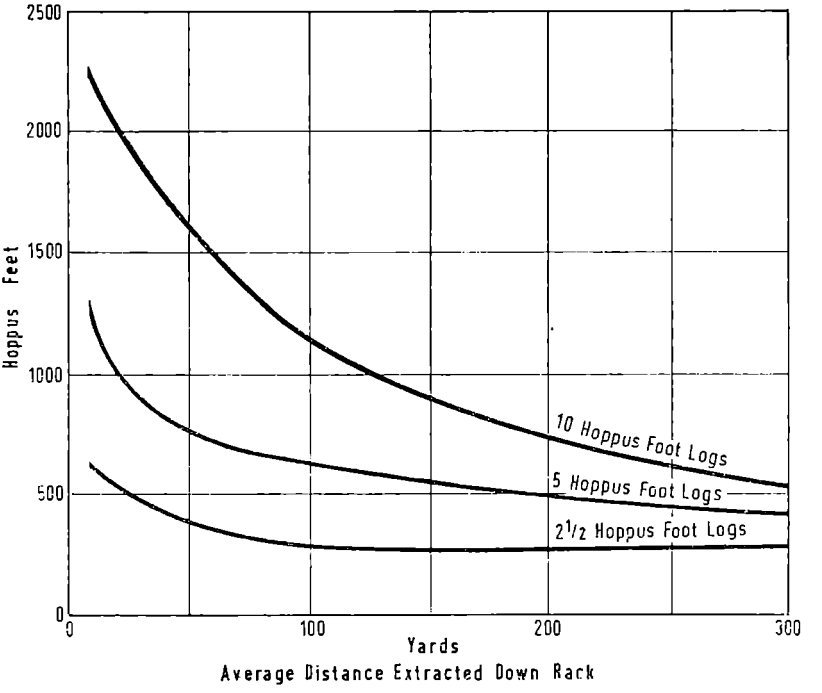

FIG. 19. Daily output for logs of different sizes.

A forester wishing to adopt the Thetford system should pay due regard to the conditions and specifications stated in the following section, before adopting the Thetford "standard minutes". He should also remember that it may take some months to train a tractor driver to the high degree of efficiency that is enjoyed by the Thetford tractor drivers.

The time for each of the elements involved was observed, and the distance travelled into the wood, and out to the stack, was measured and recorded.

From this data the standard times for poles and logs were plotted against the distance travelled in and out, and graphs were produced showing times for different lengths of haul and types of conditions. Comparison of the graphs (Figs. 18 to 21) revealed seven main facts:

(i) Logs or poles between 2 and 15 hoppus feet, travelling over a given distance, take exactly the same time irrespective of size. This meant that the standard times should be based on the piece and not on the volume. Small pieces under 2 hoppus feet take slightly less time per piece, because they are shorter and easier to handle.

(ii) For hauls up to 100 yards, it is quicker to extract poles singly; but for greater distances it is quicker to make up batches and to extract 3 or 4 pieces at a time. See Fig. 20.

(iii) The number of standing trees per acre affects the cycle times. At 450 trees or less per acre, the tractor works freely without obstruction from the trees; from 450 to 800 trees the standard time becomes progressively greater, until at 800 standing trees per acre it becomes almost impossible to work the tractor economically in the wood. See Fig. 21.

(iv) The distribution of poles per acre in normal thinnings has little effect on the average time or distance hauled. In the lighter thinnings, there are the same number of stacks in the rack, but with fewer poles per stack. Thus it is possible to give one standard time per piece, stump to rack.

(v) Heavy bramble, or working in the heavy brash in clear-fell areas where the brash was left for a mechanical chopper, show an increase of 15 per cent on the standard minutes for normal working.

(vi) The variable element for poles or logs extracted to the ride is the TRAVELLING TIME in the rack. All other elements—travel in ride, in wood, load, unload, travel out of wood, out of ride—are constant, and can collectively be called the TERMINAL TIME.

(vii) Tools like the Alice Holt Drawbar are a better means of extracting logs in some conditions, such as clear-fell areas, than is the grab-hook and chain. Comparisons are seen in the summary below.

	Type of Operation or Extraction Job		Best Method and Best Tool
(a)	Thinnings	*Poles*, stump to rack.	Single *Poles* by Thetford Tongs.
(b)	Thinning and clear-fell	*Logs* less than 50 yds from ride. Stump to ride.	Single *Log* by Thetford Tongs.
(c)	Thinning	*Logs* more than 50 yds from ride. Stump to ride.	Single *log* to rack with Thetford Tongs. Then batches 3 to 5 logs, or 15 to 20 hoppus feet with grab-hook and chain.
(d)	Clear-fell	*Logs* more than 50 yds from ride. Stump to ride.	Single *log* to rack by Thetford Tongs. Batches 15 to 20 hoppus feet, rack to ride, with Alice Holt Drawbar.

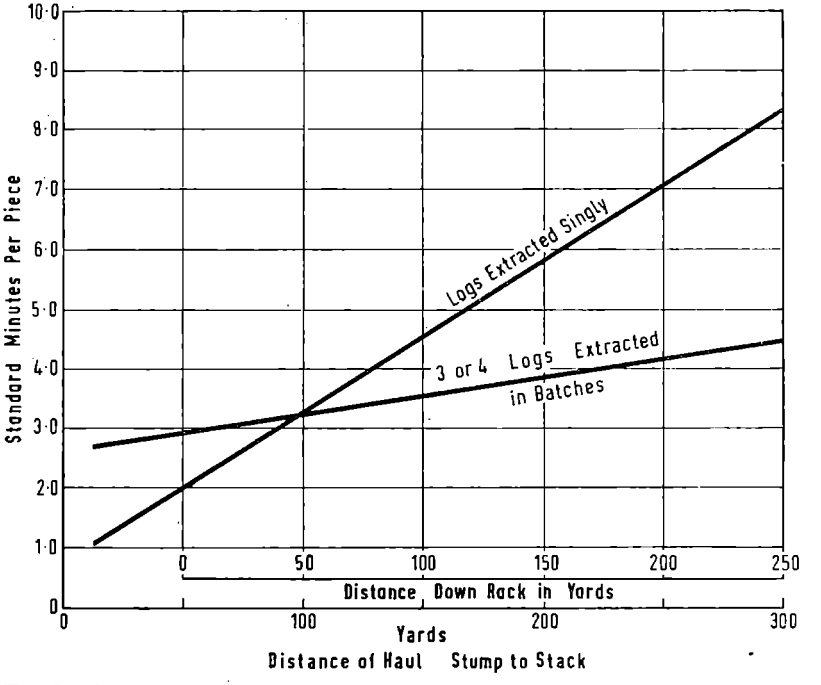

FIG. 20. Comparison between logs extracted singly and logs extracted in batches.

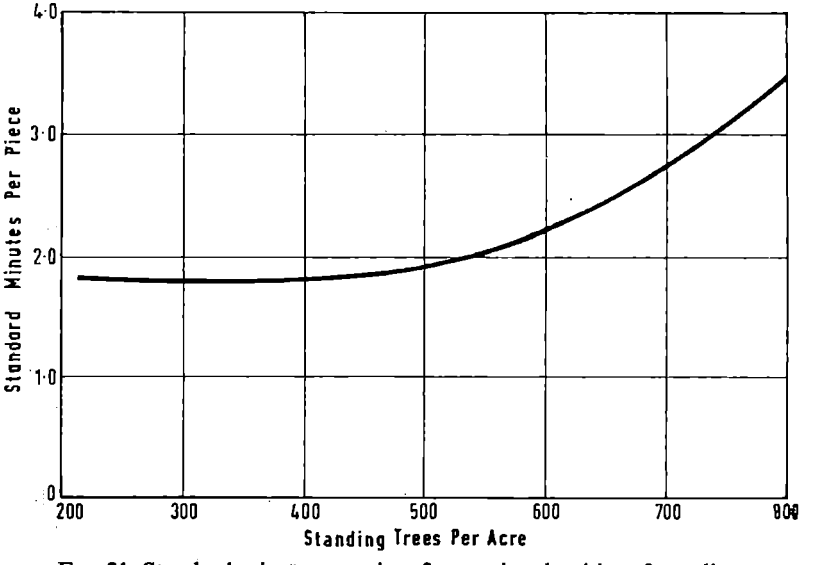

FIG. 21. Standard minutes per piece for varying densities of standing trees per acre.

(e)	Thinning. Clear-fell or windblow.	Batches of *poles* or other produce stacked in the rack on the ground, or on bearers at the side of the rack, extracted to the ride. Also very scattered *poles* and *logs*.	Batches of 15 to 20 hoppus feet with Alice Holt Drawbar.

SCHEDULE

STANDARD TIMES FOR TIMBER EXTRACTION BY LIGHT AGRICULTURAL TRACTOR (MASSEY-FERGUSON 35)

1. CONDITIONS

The Standard Times apply to:

(a) Poles, peeled or unpeeled, cut to Thetford local volume tables. Saw logs, peeled or unpeeled, 10 to 22 inches long, minimum top diameter under bark 6 inches.
South Wales pitprops, unpeeled 9-foot lengths with top diameters of 5 to 7 inches under bark.

(b) Pieces lying, with the majority of the butts facing the direction of extraction.

(c) 100% brashing.

(d) Normal floor conditions, i.e. flat or gently sloping ground, a fair amount of brash and vegetation; few, if any, high stumps or coppice stools; no deep ditches or drains; trees planted either direct or in shallow furrows.

(e) 450 or less standing trees per acre after thinning.

(f) Racks two chains apart and reasonably free of other produce.

(g) The methods and tools described in para. 2 and 3, noting that the times apply to the Alice Holt Drawbar *without* wheel weights.

(h) More standing trees per acre, or heavy brash and bramble represent more difficult conditions. Such conditions justify higher standard times and examples are given on page 39.

2. JOB SPECIFICATION

The Standard Times are for the following work:

(a) Method of working under various conditions:

Job: Extraction of:	Thinnings	Method	Clear-fell Windblow
Produce at stump to rack or to ride under 50 yards	Move single logs or poles by Thetford Tongs		
Logs at stump to ride if over 50 yards	Single logs to rack by Thetford Tongs, then to ride by: Batches 3 to 5 logs with chain and grab-hook		Batches of 20 hoppus feet with Alice Holt Drawbar
Produce stacked on ground/bearers on/at side, rack to ride.	Batches of 20 hoppus feet with Alice Holt Drawbar		

(b) All produce should be extracted and stacked so that it does not obstruct the passage of vehicles, and to facilitate loading by lorry-mounted HIAB crane. Each category, colour or specification of produce should be stacked separately (unless otherwise instructed), in a tidy manner, on the right-hand side of the rack or ride, with butts level and facing the direction of lorry movement. In racks the lorry will normally travel up one and down the next except where compartments slope; here all pieces should be stacked with their butts facing downhill. Stacks of each product should be of reasonable size to reduce lorry movement to a minimum, e.g.:—South Wales 9-foot props should be in stacks of 5 or 6, preferably two or three stacks adjacent, and logs should be stacked by category in ¼ to ½ loads, i.e. 50 to 100 hoppus feet.

3. TOOLS AND EQUIPMENT

Each Massey-Ferguson 35 tractor should be fitted with:

Valve and Radiator Guards,

and equipped with:

Thetford Tongs mounted on Standard or "V" drawbar.
12-foot chain for grab hook mounted on drawbar.
Set of stackers mounted on drawbar.
Stump-stepper and pair of hand tongs.

Each pair of tractors should share:

Alice Holt Drawbar with set of 6 chains.

4. ALLOWANCES

Included in the Standard Times:

(a) Personal needs and rest, 20% of total working time.

(b) For contingencies and work other than extracting poles and logs, e.g. re-fuelling, daily maintenance, to and from depots,

counting and checking, moving obstructions etc. 15% of the time extracting logs and poles.

To be included in the price per Standard Minute:

(c) Incentive allowance if any.

5. METHOD OF SELECTING STANDARD TIMES

(a) Table (i) gives the Standard Time for extracting single poles and South Wales 9-foot props from the stump to the *rack*.

Table (ii) gives the Standard Time for extracting logs or poles singly from stump to ride. This table only applies to the complete extraction of narrow belts where all the produce lies within 50 yards of the rides (average distance 25 yards or less).

Table (iii) gives the Standard Time for extracting logs or poles from stump to ride, over 25 yards average distance down rack. The table allows for single-piece extraction up to 50 yards in from the rides, and thereafter batch extraction.

Note. A Standard Time per piece for batch extraction of poles or South Wales props from *rack* to *ride* can be found by subtracting the time for single-pieces stump to rack (Table (i)) from time for the complete job stump to ride (Table (iii)).

(b) To select the Standard Time for poles and logs in a compartment, five facts may be needed.

(i) The average log size.

(ii) The average extraction distance down rack, where produce is going to ride.

(iii) The number of standing trees per acre if it exceeds 450.

(iv) The width between racks if other than 2 chains.

(v) Any other condition such as heavy brash.

(c) To find the average extraction distance down rack:— Measure from the map, or pace on the ground, the length of the average rack in the compartment. If extraction is to rides at either end of the rack, then the formula for the average extraction distance $= \frac{\textit{Total length of average rack}}{4}$

(d) If the extraction is to a ride at one end of the rack, then the formula for the average extraction distance $= \frac{\text{Total length of average rack}}{2}$

(e) The number of standing trees can be obtained by counting trees in a sample plot of 1 square chain; no racks or rides should be included in the plot.

(f) Examples of selecting a Standard Time and calculating a piecework rate:

(i) Brash normal.
(ii) Average distance down rack 150 yards.
(iii) 400 standing trees per acre.
(iv) Racks 2 chains apart.
(v) Log average 3·5 hoppus feet.

Poles—Single pieces stump to rack	1·8 Standard minutes
× price per standard minute, i.e.	1·4d
	=2·5d per piece
Logs— Terminal Times: Log of 3·5 hoppus feet	2·9 Standard minutes
Travelling Time: Average distance down rack 150 yds. at 0·6 per 100 yds.	0·9 Standard minutes
Total	=3·8 Standard minutes
× price per Standard Minute	1·4d
	=5·3d per piece

TABLES OF STANDARD TIMES FOR TRACTOR EXTRACTION

6. STANDARD TIMES FOR STANDS WITH LESS THAN 450 TREES PER ACRE

(i) Stump to Rack—Single pieces

	Poles	Logs			9-foot Props
Size of piece, hoppus feet	1.0–3.0	2.0–4.9	5.0–9.9	10.0 Plus	1.5–2.0
Standard Minutes per piece	1.8	All extracted to ride			1.5

(ii) **Stump to Ride—Single pieces within 50 yds of the ride**

	Poles	Logs			9-foot Props
Size of piece, hoppus feet	1.0–3.0	2.0–4.9	5.0–9.9	10.0 Plus	1.5–2.0
Terminal Time per piece Standard Minutes	1.8	2.0	2.0	2.0	1.5
Travelling Time per Piece for each 5 yards (average) down rack from 10 to 25 yards add: Standard Minutes	0.2	0.2	0.2	0.2	0.2

N.B. Under 10 yards is covered by the terminal time. If the average distance down the rack is over 25 yards, use Table (iii).

(iii) **Stump to Ride—Single pieces within 50 yds of the ride, 15 to 20 hoppus-foot batches thereafter**

	Poles	Logs			6½-foot Butts 9-foot Props
Size of piece, hoppus feet	1.0–3.0	2.0–4.9	5.0–9.9	10.0 Plus	1.5–2.0
Number of pieces in 15 to 20 hoppus-foot batch	6-7	3-5	2-3	1	7–10
Terminal Time per piece Standard Minutes	2.6	2.9	2.5	2.0	2.3
Travelling Time per piece for each 100 yards (average) down rack Standard Minutes	0.4	0.6	1.3	2.5	0.4

N.B. Terminal times include load, unload, travel from stump to rack and travelling time in the *ride*, and an allowance for single poles near the ride so that travelling time becomes directly proportional to "down the rack" distance.

MODIFICATIONS AND VARIATIONS

N.B. These modifications should be applied at the forester's discretion using his own judgment as to the appropriateness of the conditions.

(a) **More than 450 trees per acre:** add the following Standard Minutes per piece:

Trees per acre	451–500	501–550	551–600	601–650	651–700	701–750	751–800
Add to the Total Standard Times per piece for Poles and Logs	0.1	0.2	0.3	0.5	0.7	0.9	1.0

Tractor extraction becomes impracticable when there are more than 800 standing trees per acre.

(b) **Racks not 2 chains apart:** Per chain more or less between racks:

Single pieces — *Add or subtract* 0·1 *Standard Minute per piece*

Batches of logs or poles — *Add or subtract* 0·2 *Standard Minute per piece*

(c) **Heavy brash and bramble** and Clear-fell areas (where brash is left for the chopper). Along with heavy brash can be included the conditions when large stag-headed tops are produced in some Scots pine thinnings.

Single pieces stump to rack — *Add up to* 0·3 *Standard Minutes per piece in steps of* 0·1 *Standard Minutes.*

Pieces stump to ride — *Add up to* 0·3 *Standard Minutes per piece in steps of* 0·1 *Standard Minutes to the terminal time.*

N.B. Brash and bramble are considered heavy when 3 to 4 feet high and in a dense mass; between this and normal conditions add in steps of 5%.

(d) **Rough and crooked poles** which cause extra adjustments to the stack and extra hand stacking (i.e. where there are more than 50% rough and crooked poles)

Add 0·1 *Standard Minutes per piece.*

(e) **Widely scattered poles or logs,** e.g. from windblow, should be extracted from stump to ride using the Alice Holt Drawbar. Conditions may vary widely, but Table (iii) should be used as a guide to the Standard Time for the job.

(f) **Logs only.** Where *logs* are *not* extracted in conjunction with *poles*. Thinnings, e.g. pulpwood thinnings:

Up to 10 logs per acre	Add 15% to the terminal time.
10 to 20 logs per acre	Add 10% to the terminal time.
20 to 30 logs per acre	Add 5% to the terminal time.
Clear-fell areas	Add 15% to the terminal time.

(g) **Extra stacking.** *Clear-fell* areas, where two or more species are being extracted from a compartment, needing six or more grades of logs, or where the logs coming into the rides need extra stacking in order to provide room. — Add up to 10% to terminal time.

Thinnings, where logs or poles are required to be stacked on bearers, e.g. telegraph poles; or where extra stacking is required to provide room. — Add up to 10% to terminal time.

(h) **Extraction of long poles** from thinnings where *saw logs* but no 6½-foot butts are cut from the tree, and *poles* exceed 30 feet in length. — Add 0·1 standard minutes per piece.

(i) **Extraction of whole trees** in clear-fell areas, from stump to ride. — Treat as *logs* and apply the appropriate column in Table (iii) adding on allowances for heavy brash, "logs only", etc., where applicable.

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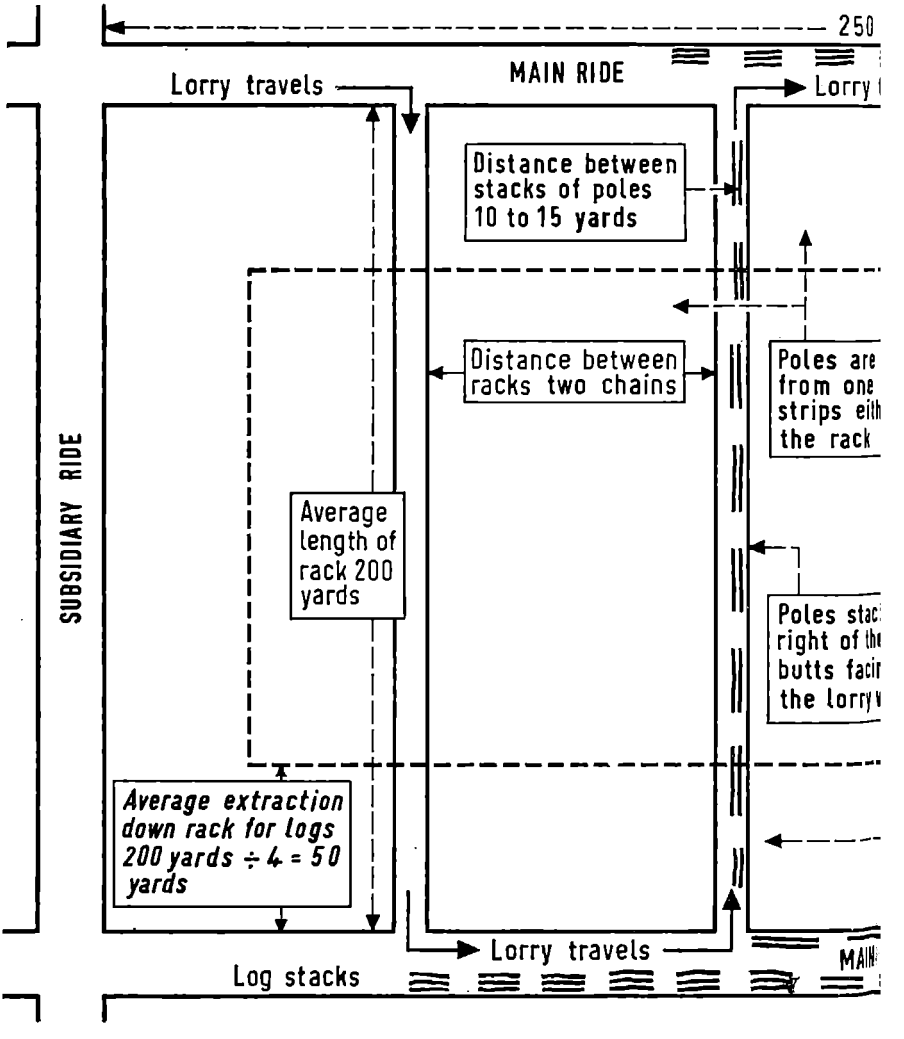
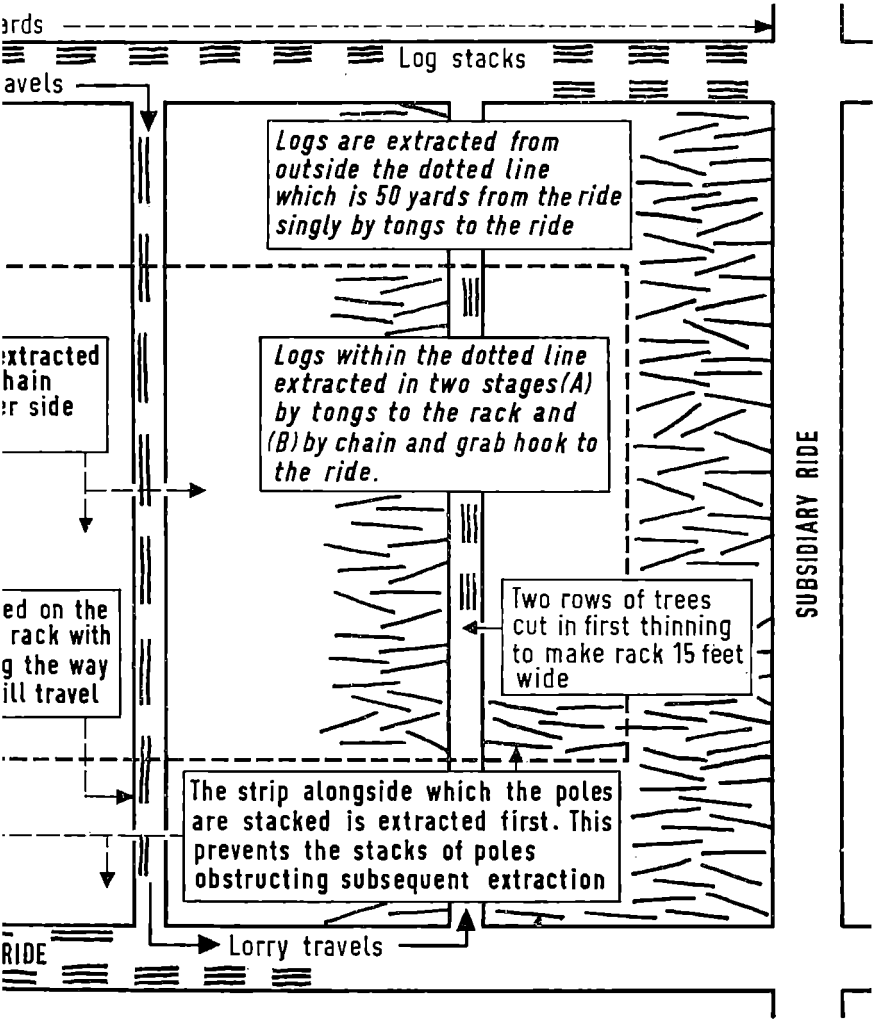

250
MAIN RIDE
Lorry travels
Lorry
Distance between stacks of poles 10 to 15 yards
Distance between racks two chains
Poles are from one strips eith the rack
Poles stac right of th butts facir the lorry
SUBSIDIARY RIDE
Average length of rack 200 yards
Average extraction down rack for logs 200 yards ÷ 4 = 50 yards
Lorry travels
Log stacks
MAIN


ards
Log stacks
avels
Logs are extracted from outside the dotted line which is 50 yards from the ride singly by tongs to the ride
xtracted
hain
r side
Logs within the dotted line extracted in two stages (A) by tongs to the rack and (B) by chain and grab hook to the ride.
SUBSIDIARY RIDE
ed on the
rack with
g the way
ill travel
Two rows of trees cut in first thinning to make rack 15 feet wide
The strip alongside which the poles are stacked is extracted first. This prevents the stacks of poles obstructing subsequent extraction
RIDE
Lorry travels

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