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Hydrostatic Skidder

W O Wittering

Plate 1. (front cover). The Mark II (43 brake-horse-power) prototype tractor on trial at Alice Holt Forest, Hampshire.

Plate 2. The very first (75 brake-horse-power) hydrostatic forest tractor.

THE HYDROSTATIC SKIDDER

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SUMMARY

This leaflet traces the development of a hydrostatic drive skidder, gives an indication of its performance, and outlines the arrangements made for its manufacture on a commercial scale.

Extraction by Tractor: The Problems

The proportion of forests where tractors can be used for harvesting has increased over recent years partly due to improvements in tractor design, and partly due to increasing knowledge and experience of logging. About 75% of forests in Britain are now considered capable of being harvested by some sort of tractor. Within this area, the most difficult sites for tractor extraction are the soft peats typical of the Scottish Borders. Ploughed ground and intensive drainage systems also pose problems.

A number of commercially available skidders were tried in 1966 and 1968 for the extraction of tree lengths; with minor exceptions, they did not match up to the demands made of them by the terrain. The machines were either too big for operating in thinning stands, lacked manoeuvrability, had insufficient ground clearance, were too heavy, or were too expensive to operate.

The Type of Tractor Required

These trials confirmed experience abroad that for difficult terrain, the right sort of four-wheel-drive frame-steered skidder would outperform the more conventional machines. In the absence of such a machine suitable for extracting thinnings, it was decided in 1968, in conjunction with outside industry, to design and build a forest tractor to the following specifications:—

a Narrow enough to negotiate racks between trees.
b Able to traverse side slopes.
c High ground clearance.
d Low centre of gravity.
e Four wheel drive.
f Chassis to be articulated to assist wheels to stay in contact with the ground on rough terrain.
g Small turning circle.
h As the trees are generally on the small side, two winches and fairleads suitable for timber skidding to be fitted.
i A roll-over safety frame to British Standard 4063:1966.
j Low vehicle weight.
k Moderate capital and operating costs.
l Ergonomically well designed.
m Brakes must be unaffected by mud or water.
n A driver-selected differential or differential lock.

Hydrostatic Drive

Because of the demanding specification, hydrostatic drive was chosen as the means of propelling the tractor. In this system, the engine does not drive the wheels direct but by means of hydraulic oil piped via a variable-

flow pump to axial ball motors in each wheel hub. The system provides an infinitely variable drive between zero and maximum speed, coupled with high ground clearance and a low centre of gravity. Hydrostatic drive requires no clutches, gears or axles, gives protection against overload, and provides full dynamic braking.

Prototype Machines

Several tractors were built between 1969 and 1973 with engines varying in power from 43 to 75 brake-horse-power. Different-sized axial motors in the wheel hubs were tested and different systems of control for the operator.

Specification of Final Prototype

As a result of trials carried out on the early prototypes, a final design evolved. This machine is a frame-steered tractor, all steering and articulation taking place about a central pivot. Most of the framework is built from hollow section steel to British Standard 4360 grade C. The front chassis and safety frames are combined; the rear chassis incorporates butt plate, fairleads and mudguard brakes.

Power steering is accomplished by means of hydraulic rams. The operator is provided with a four part control system consisting of:—

(i) a pedal controlling acceleration and braking,
(ii) A lever to select reverse,
(iii) lever-operated steering, combined with
(iv) a push button differential control.

Parking braking is achieved by lowering the rear section of the tractor by means of two hydraulic rams, so that the rear mudguards sit on the rear tyre treads.

The hauling winches are driven directly by Carron NEL ball motors. They are fitted with disc brakes and controlled by radio, operated either from the cab, or from a small packset strapped to the driver's chest.

Other details are as follows:—
Maximum speed: about 15 mph (24 km/h)
Drawbar pull: over 4000 lbs (1800 kg)
Weight: approx. 6300 lbs (2850 kg)
Turning radius (inside tyres): 44 inches (112 cm)
Ground clearance: 23·5 inches (60 cm)

Performance

The various prototypes were tested at a number of forests including the Dean (Gloucestershire), the Kielder District (Northumberland), Wauchope (Roxburghshire), Glentrool (Kirkcudbrightshire), Rheola, (Glamorganshire), Dunkeld (Perthshire), and Solway (Dumfries-shire). Though the machines were tested in trial conditions, they have also done a considerable amount of work in normal forest conditions operated by tractor drivers from the Commission's industrial labour force who were given a short training course.

Detailed records were kept and the following table summarizes the performance of one prototype machine:

Period	Working Time (hrs)	Idle* Time (hrs)	Working Time as % of Total Time	Vol extracted (m^3)	Output per working hour (m^3)
July 71 – Dec 71	138·5	413·5	25	300·5	2·17
Jan – Dec 1972	863·5	1165·0	42·5	3170·3	3·67
Jan – June 1973	477·5	553·5	46·3	1605·7	3·36
July – Nov 1973	336·5	507·5	39·9	1131·1	3·36
Totals	1816·0	2639·5	40·8	6207·6	3·42

*Idle time includes time lost because of bad weather, travelling to different areas, repairs, modifications and time awaiting spares, etc.

Plate 3. A Mark III prototype fitted with a 65 brake-horse-power International D239 engine on trials at Alice Holt Forest.

Plate 4. An indication of the high ground clearance and the advantages of the articulated chassis can be gleaned from this photograph of the Mark III.

Plate 5. Full lock on the wheels during trials at Alice Holt (Mark III).

Plate 6. The Mark III on trial in thinning Sitka spruce at Greskine Forest, Dumfries-shire. Note the "tiller" steering.

Plate 7. Extracting Sitka spruce in line thinnings at Greskine Forest. The hydraulic winches are controlled from a radio packset on the operator's chest.

In line thinnings at Wauchope Forest, this tractor extracted 5346 m^3, an average of 3·71 m^3 per working hour. Its best performance in line thinnings, also at Wauchope was achieved when, during a period of 124 working hours, it extracted 500 m^3, an average of 4·03 m^3 per working hour. At this time, the average tree size was 0·08 m^3 and the estimated volume per hectare removed 54 m^3. The mean extraction distance was 170 metres with a downhill slope of 11%.

A direct comparison with other tractors used for extraction in line thinnings is difficult because the hydrostatic skidder can travel over terrain which is impassable to the others. However, as an approximate guide, in the line thinning situation as described, the hydrostatic shows an increase in output of about 22%. There is an 18½% saving on the terminal time, attributable to the use of radio control on the winches, and 29% on travelling time because of the increased ground clearance and better traction and manoeuvrability brought about by the articulation.

Arrangements for Manufacture

Roadless Traction Ltd of 717 London Road, Hounslow, Middlesex, are to manufacture the hydrostatic forest tractor. It was hoped that machines would start coming off the production line in June 1974 but because of difficulties in obtaining engines and steel, this proved optimistic. The Commission proposes to acquire twelve of these tractors in the first seven months of manufacture and to increase its fleet steadily over the next four years. As their production line permits, Roadless Traction intend to build additional tractors for sale both to the private sector and abroad, though initially their intention is to limit sales to the United Kingdom.

Costs

It is likely that the cost of the tractor including radio and Value Added Tax will be in the £8,500 to £9,000 range. Because of the nature of the construction, past experience is of little guide when arriving at an hourly charge, but an operating cost of about £3·00 per hour is indicated; this figure may prove to be on the high side. With operator and oncost, the total hourly rate will be about £4·20 giving an average cost per cubic metre of £1·20, or £1·10 in the line thinning situation described above.

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