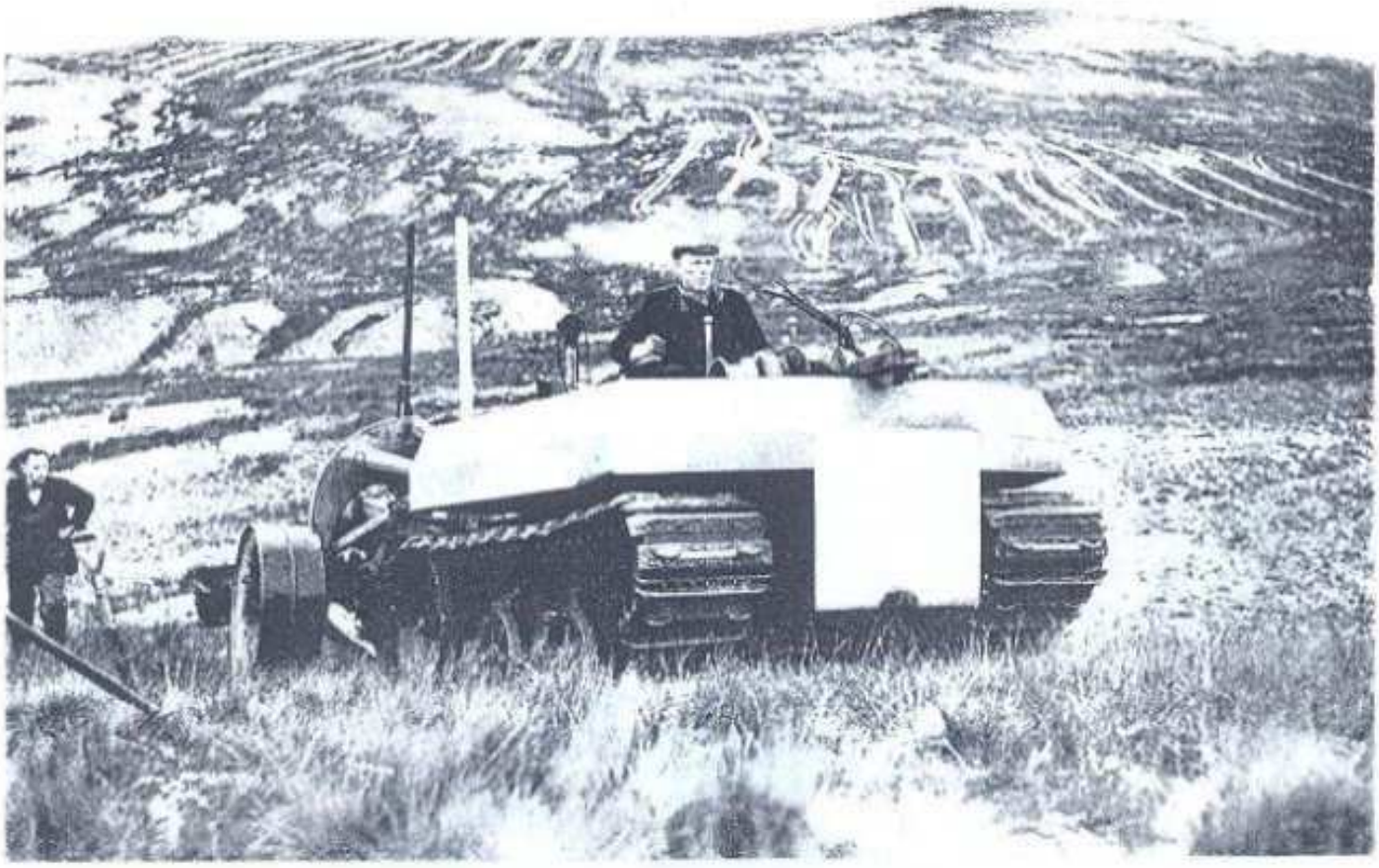
Reprinted from "Farm Mechanization," February, 1951



These rugged hills, lanced by open drains cut by the Water Buffalo, are typical of the terrain in which this machine is being developed.

The Water Buffalo

This article, by T. Hammond Crodock, tells the story of an advanced prototype tracklayer—the Cuthbertson Water Buffalo. It is a 70 b.h.p. Diesel-engined tractor weighing 13,100 lb. and giving a drawbar pull of 15,000 lb. The tractor has many unorthodox features, one of which is the Cuthbertson patented rubber track which gives a ground pressure of only 2.67-lb. per sq. in. and conforms to ground undulations with snake-like tenacity.

DESIGNED and manufactured by James A. Cuthbertson, Ltd., agricultural and general engineers and contractors, Biggar, Scotland, the prototype Water Buffalo constitutes one of the most interesting developments in tracklayer history. This is my opinion after spending a week observing the construction and performance of prototype Water Buffalos in Scotland.

It has a hill and bog performance which must be seen to be believed. I saw it hauling a 7,000-lb. load over quaking swamp and negotiating soft-surfaced gradients approximately 1-in-1, and am convinced that when its design has been finalized and the tractor is produced commercially, hitherto impossible hill and swamp areas throughout the world will be brought within the scope of mechanized reclamation and subsequent cultivation.

The Water Buffalo's most outstanding features are its watertight hull construction and rubber tracks, evolved to overcome conditions which had proved impracticable to orthodox tracklayers. A description of these conditions and of the efforts made to overcome them will emphasize the fact that this tractor is a product of harsh environment.

In 1938, Mr. Cuthbertson undertook to drain, mechanically, vast tracts of Scottish moor and mountain, the principal characteristics of which were bog, boulders and rushes; gradients ranged from the gentle to the precipitous, and streams varied from inches to feet in depth.

Before the turn of this century most of this land was drained and carried cattle and sheep. Then came agricultural poverty. During the past 50 years the drains were neglected, hence the thousands of acres of bog and rushes, not only in the Scottish Highlands, but also on the comparatively level Lowlands.

For most of the hill-land, surface draining by open trenches was all that was needed. Finding that existing drainage machinery did not obtain the results he required, Mr. Cuthbertson designed and constructed a drainage plough which has since proved itself in many parts of the world.

The main operation characteristics of this plough are automatic depth control, irrespective of surface undulations, and the production of a round-bottomed vee-shaped trench, which can be varied up to a maximum of 24 ins. deep, 12 ins. wide at the bottom and 34 ins. wide at the top. Drawbar pull required varies from 6,000 lb. to 10,000 lb.

Twelve orthodox tracklayers of different makes were put to work soon after 1938. These tractors had proved themselves adequate for reasonable tracklayer conditions; but, judged by normal standards, the Scottish conditions were most unreasonable, consequently tractor trouble was experienced.

Ground pressures were too high, with the result that bogging-down became frequent—so frequent, in fact, that spades and a spare tractor, complete with winch, had to be kept to salvage sunken machines.

Track-shoes widths were increased up to 24 ins., but results were unsatisfactory. Constant bogging and track slip imposed a severe strain on tracks and transmission, and repair bills mounted, until Mr. Cuthbertson realized that he was asking his tracklayers to do something for which they were not designed, and consequently the project was becoming uneconomical.

Decision on Basic Details

He decided that the conditions called for a tracklayer with the following attributes: a static ground pressure of not more than 3 lb. per sq. in., if the worst bogs were to be negotiated; a drawbar pull of not less than 10,000 lb.; watertight hull construction, to enable deep streams to be forded and to prevent mud reaching the engine and transmission; a winch to enable the machine to salvage itself from morass which could not support the tractor.

In 1949, Mr. Cuthbertson and his team of Scottish engineers produced a first

a consequence of this, a five-forward-and-reverse speed winch drive has been provided by the gearbox, with the least possible mechanism.

Two winch-drive points are at present available: the first provides an amidships drive from a chain sprocket mounted on the gearbox output shaft between the gearbox and the distribution box. The second drive is via a shaft extending from the end of the gearbox output shaft through the distribution box to the front of the tractor. A sprocket is mounted on this shaft immediately behind the nose of the hull.

So long as a gear is engaged, both winch-drive sprockets continue to turn. If the steering clutches are disengaged, one or both winches can be used when the tractor is stationary, and the speed of drive can be varied through the gearbox.

Demonstration on Saturated Peat

An impromptu demonstration of the value of this arrangement was given me as I watched a Water Buffalo operating a drainage plough on a stretch of moor above Paisley reservoir. The ground was saturated peat, in which a walking-stick could easily be pushed to about 20 ins. The plough was being pulled uphill, and was cutting a trench about 18 ins. deep, 22 ins. wide across the top and 8 ins. across the bottom. The spoil was being displaced about 30 ins. from one side and turned into an old surface drain choked with liquid mud and rushes.

The right-hand track dropped into a morass of liquid mud, and the belly of the tractor rested on the bank, which, by comparison, was firm. The tractor canted sideways at a very awkward angle, and the fact that it was resting on its belly made track grip impossible. Water drained into the hole and submerged the right-hand track. I began to think in terms of railway sleepers and spades, when there came one of the neatest extrication processes I have ever seen.

A steel-plate anchor, approximately 90 ins. long, and resembling a vee-shaped pig-trough, each vee leg being about 12 ins. deep, was dropped into a slot dug into the peat about 50 yds. ahead and broadside to the tractor front. The drainage plough was unhitched. A cable was connected from a winch on the tractor front to a hook-up cable in the centre of the anchor.

Driven through the lowest forward ratio of the gearbox, the winch hauled on the anchor, which was so designed that it sank deeper as its load increased. When the anchor stopped sinking, the Water Buffalo slid forward on its smooth belly until the tracks nosed against the edge of the morass. Then the steering clutches were engaged, and the tracks, running at a speed synchronized with the winch speed, assisted the tractor out of the morass.

So far, excellent, I thought; but now what about drawing the 3,000-odd-lb. dead weight of drainage plough through the same morass? This proved equally simple. A cable was run from the rear of the tractor to the plough. The front winch and tracks operated simultaneously, and the plough had no option but to move forward. Work was resumed within 15 minutes of the break-through.

Details of steering-clutch designs can be seen in the illustration on the centre pages. From the clutches, the drive continues to two overdrive-worm final reduction gears, and thence by half-shafts to the track drive sprockets.

Fully Flexible Track

The revolutionary type of track on the Water Buffalo was designed and patented by Mr. Cuthbertson. It consists essentially of ¾-in.-thick rectangular rubber pads reinforced by steel cable in the manner shown in the inset to the main illustration. An interesting feature is that the cable, though anchored at each end, is free to slide over the ferrules, so that the track can flex in all directions.

The rubber pads are joined by steel grousers above and by steel plates with dog teeth below. To take advantage of the track flexibility, the intermediate track roller mountings are spring-loaded and independently articulated.

The rear roller of each track runs on a stub axle carried by a dead 5-in.-diameter steel axle, and supports the rear weight of the tractor on the track. One reason for providing such a large-diameter dead axle is to provide a basic anchorage point for bulldozer equipment at present being developed.

Two transverse springs support the tractor hull on the intermediate articulated roller mounting, and immediately behind each track-drive sprocket is a track tension roller, which bears on the track under pressure from a third transverse spring.

In operation, the top of the track is taut while the bottom tends to be slack. This condition, in conjunction with the high flexibility of the track and the independent articulated roller suspension, enables the bottom of the track to "wrap" itself round the ground, and undoubtedly accounts for excellent adhesion shown by the greater-than-deadweight drawbar pulls. A track tension adjuster is incorporated with rear roller stub axle, and is combined with a shear device which prevents track damage should large stones become trapped inside the track.

The breaking strain of the track, as tested by the Heriot-Watt College (Edinburgh) Mechanical Engineering Laboratories, is 58,240 lb. The track is also being made available as a half-track unit for Fordson, Massey-Harris, International and other well-known tractors. The first Cuthbertson half-track was shown on a Fordson 1950, since when enquiries have been received from many countries.

Commercial production of the Water Buffalo is scheduled to begin towards the end of 1951. In its final form, the superficial appearance of the Water Buffalo may differ from that of the prototype, but the basic essentials of track and hull construction and Albion Diesel engine will remain.

General Specification

Weight	13,100 lb.
Length overall	156 ins.
Width	86½ ins.
Height	60 ins.
Minimum ground clearance	12 ins.
Drawbar height	14 ins.
Drawbar lateral movement	30 ins.
Track centre	62½ ins.
Length of track on ground	102 ins.
Track shoe width	24 ins.

The Water Buffalo's rubber track has a high degree of flexibility, as shown in the left-hand photograph. On the right, the Cuthbertson drainage plough is seen leaving a clean, even trench free from spoil.

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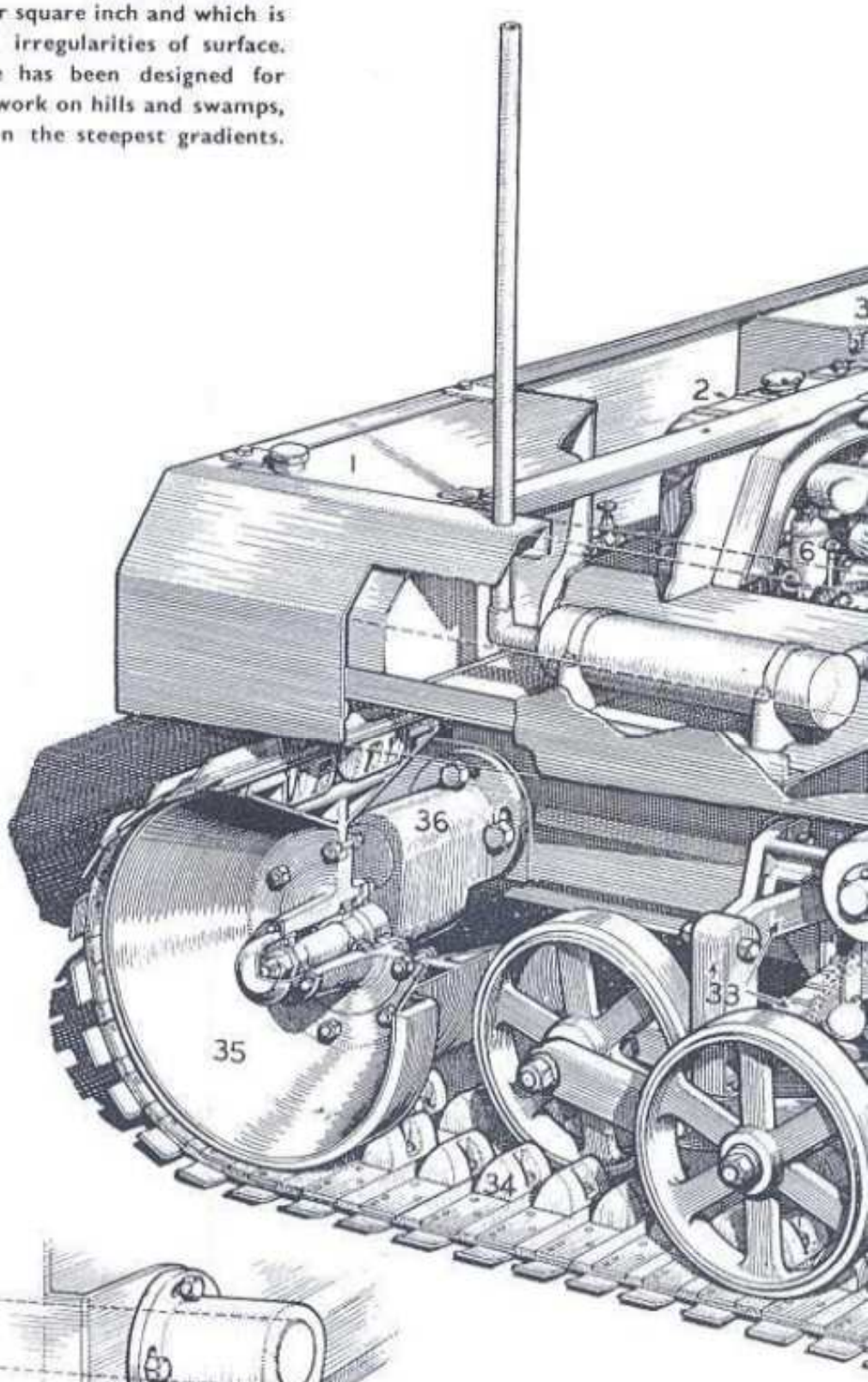
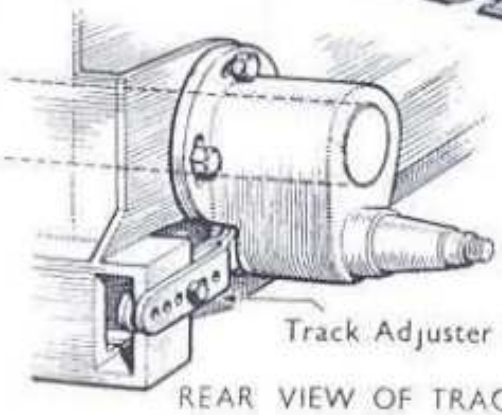
The Cuthbe

An outstanding feature of the Water Buffalo is the Cuthbertson patented rubber track giving a ground pressure of only 2.67-lb. per square inch and which is able to follow closely all irregularities of surface. This unorthodox machine has been designed for drainage and reclamation work on hills and swamps, and maintains stability on the steepest gradients.

KEY TO NUMBERS ON DIAGRAM

1. Fuel tank
2. Radiator
3. Battery box
4. Engine oil filler
5. Air cleaner
6. Fuel oil filter
7. Exhaust pipe
8. Air cleaner to inlet manifold junction
9. Seat
10. Throttle lever
11. Steering clutch and brake levers
12. Gear lever
13. Electric junction box
14. Oil pressure gauge
15. Engine clutch pedal
16. Clutch inspection plate
17. Five speed and reverse gearbox
18. R.H. steering brake cable
19. Gearbox output shaft
20. Drive distribution box
21. Gearbox output shaft pinion
22. Independent clutch drive pinions
23. Steering clutch and brake assemblies
24. Final drive reduction worm gears
25. Fabricated steel hull, front
26. R.H. hand track drive sprocket
27. Transverse spring loaded flexible suspension of track tension roller
28. Track tension roller
29. Weight carrying transverse spring connected to flexible suspension of front triple roller group
30. Triple roller group
31. Pivot mounted triple roller carrier beam
32. Track carrier roller
33. Rear positioned counterpart of assembly 29
34. Steel track drive dog (see inset right)
35. Rear weight carrying roller
36. Adjustable rear roller stub axle (see inset below)



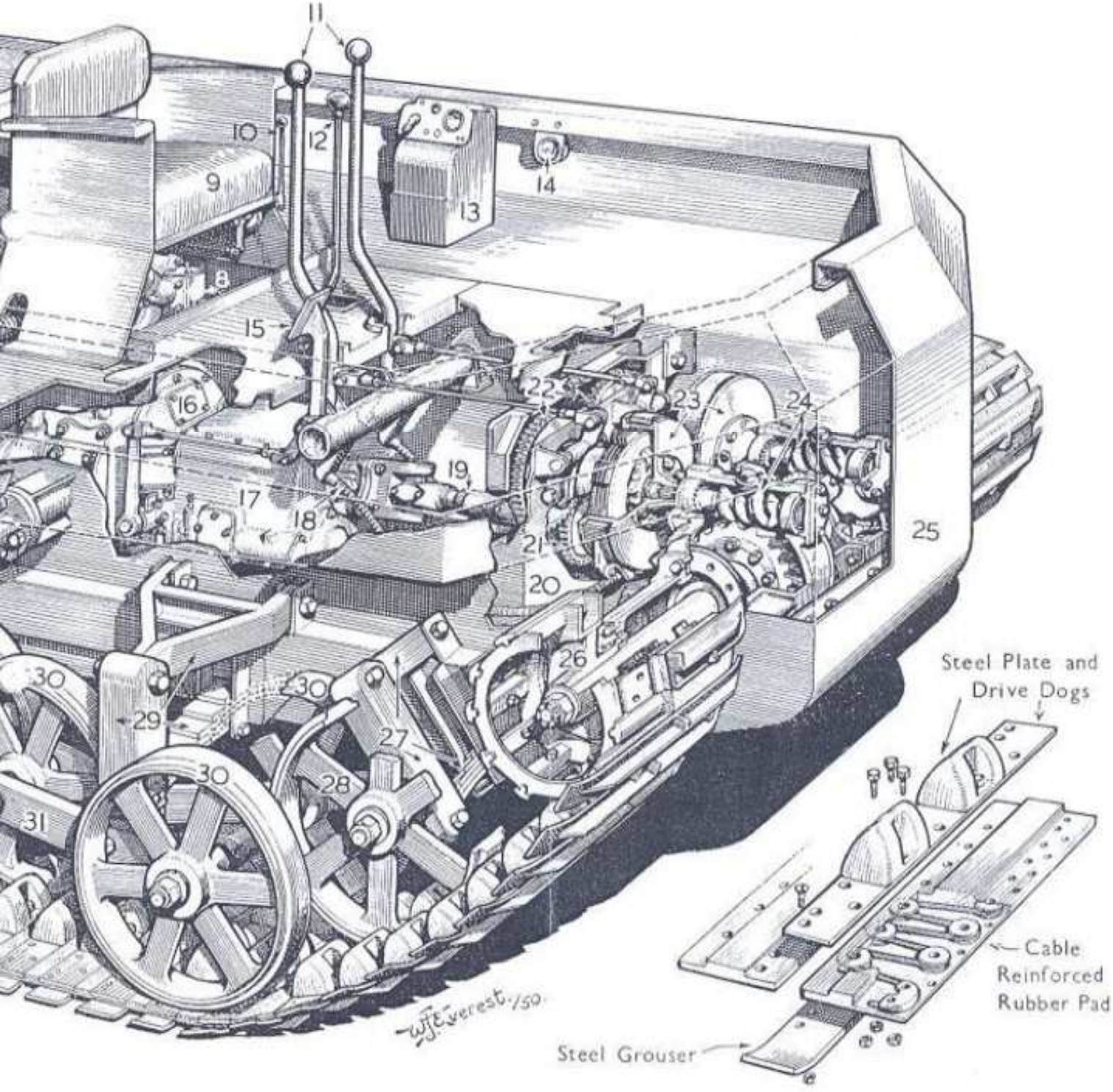


Track Adjuster Shear Bolt

REAR VIEW OF TRACK ADJUSTER (36)

on Water Buffalo

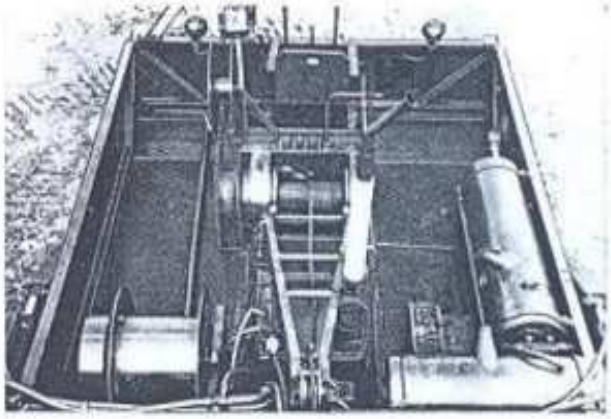
A drawing specially prepared by FARM MECHANIZATION



SECTION OF TRACK

Cuthbertson

OIL FIELD MODEL
MEDIUM MARK 1



IT CRAWLS
Ground pressure 2·8 psi

IT PULLS
24,000 lb. D.B. pull

IT CLIMBS
Slopes of 1 in 1

IT FLOATS
Using detachable floatation tanks

IT FORDS
Up to 5 ft. of water

IT LIFTS
Up to 8 tons

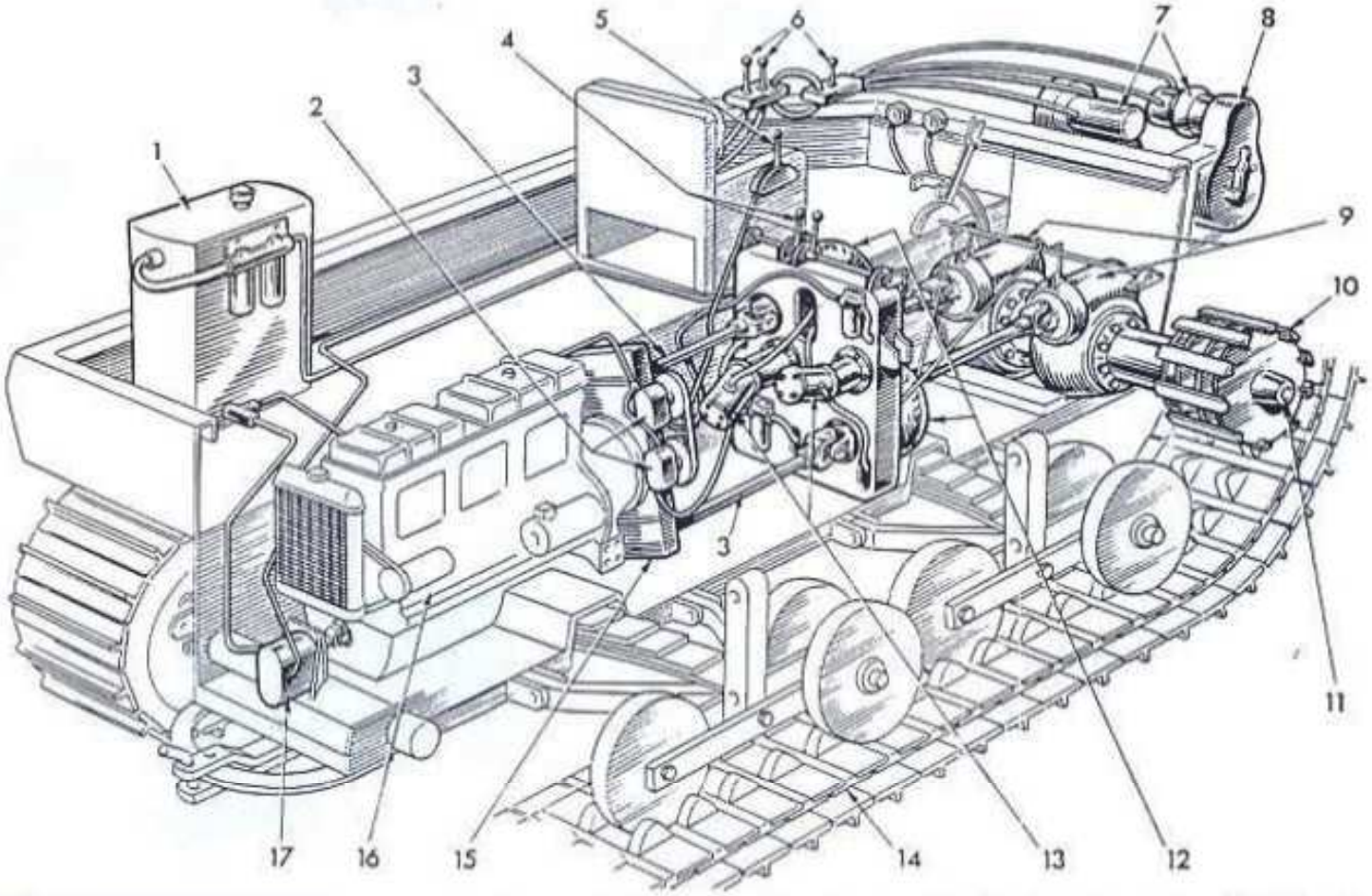
IT DIGS
Holes 13 ft. deep

IT DOZES
11'-0" wide high lift blade

THE ONLY
CRAWLER TRACTOR

ON SOFT LAND

HYDROSTATIC TRACKLAYER



1.—Oil tank. 2.—Boost pumps. 3.—Left-hand propeller shaft. 4.—Speed and direction controls. 5.—Throttle. 6.—Winch controls. 7.—Winch hydrostatic motors. 8.—Winch. 9.—Worm reduction gears. 10.—Track drive sprocket. 11.—Epicyclic hub reduction. 12.—Hydrostatic pumps. 13.—Hydrostatic motors. 14.—Flexible rubber track. 15.—Splitter gearbox. 16.—Albion 80-h.p. diesel engine. 17.—Winch drive pump.

THE CUTHBERTSON WATER BUFFALO

Now on the market with hydrostatic transmission

This tracklayer is designed primarily for reclamation work on hills, bogs and swamps. It is made by James A. Cuthbertson Ltd., Biggar, Scotland, and is powered by an 80-h.p. Albion diesel engine mounted at the rear as shown in the cutaway drawing above. This drawing also shows how the final drive and track sprockets are arranged at the front.

The price of the hydrostatic Buffalo, at £8,404 ex works, is the same as that of the well-established mechanical-drive versions. The price has not altered because standard production hydraulic units have been used.

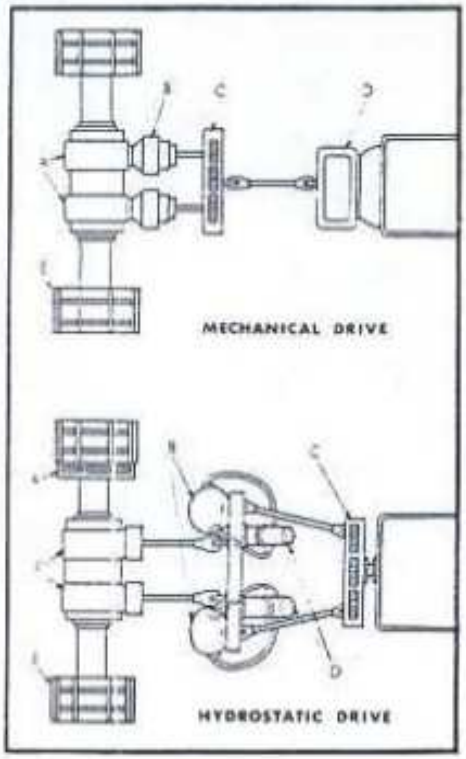
The Buffalo was introduced with mechanical drive in 1951 and a special *Farm Mechanization* drawing was published in February of that year. The arrangement of the mechanical drive is shown in the upper of the two diagrams on the right. It will be seen that the drive from the engine to the track sprockets (E) was through a gearbox (D), splitter box (C), two clutch and brake steering assemblies (B) and two worm reduction units (A).

The conversion of this drive to hydrostatic layout is shown in the lower of the two diagrams. Note how the splitter box (C) in the lower diagram occupies the position of the gearbox shown in the upper diagram. The steering clutch and brakes have been replaced by two hydraulic pumps (B) and motors (D), through which the tractor is steered as well as driven.

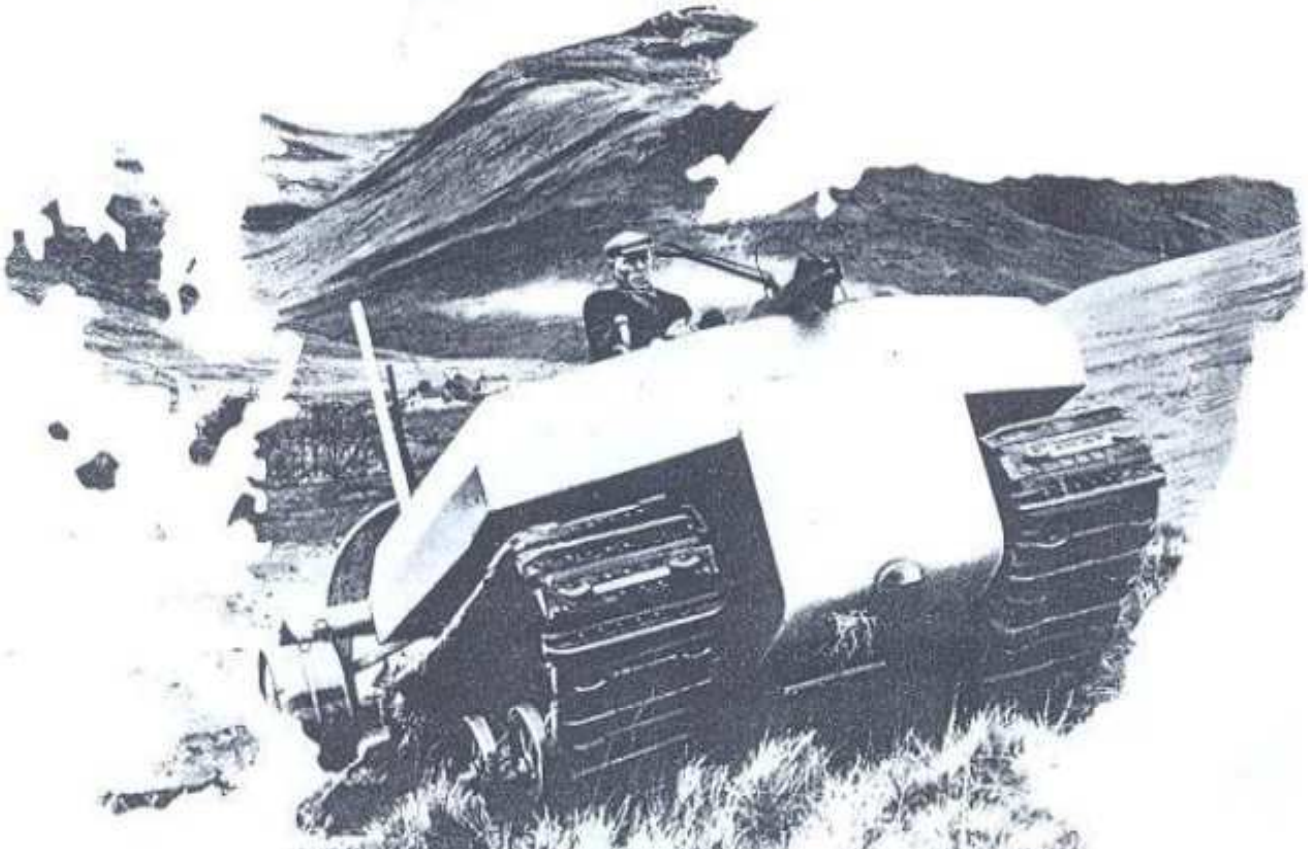
The worm drive (F) reduction ratio has been changed from 11·33:1 to 4·25:1 and each of the drive sprockets (E) has been given an epicyclic hub (A) with a reduction of 4·25:1. This hub is made by Kirstall Forge Engineering Ltd. for use with large industrial tractor shovels.

The arrangement of the hydraulic components relative to the complete tractor is shown in the main drawing, which also

(continued overleaf)



"Clyde Built"



The "Albion-Cuthbertson" Soft-land Crawler Tractor

Incorporating the "CUTHBERTSON" patented design of tracks

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