Aug. 9, 1949. T. M. DEAL ET AL 2,478,747

FRONT END TRACTOR IMPLEMENT

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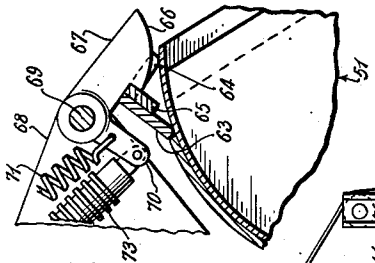

Fig. 5.

Fig. 1.

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Fig. 2.

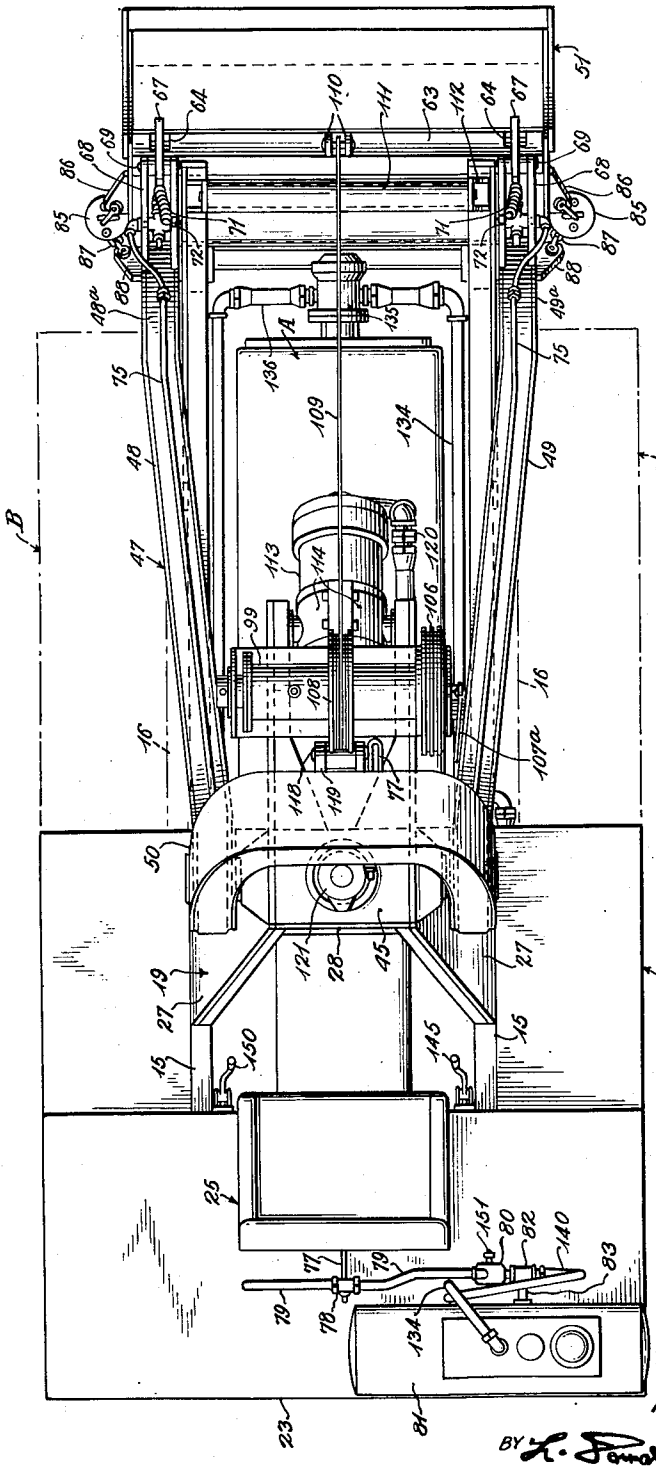

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Fig. 3.

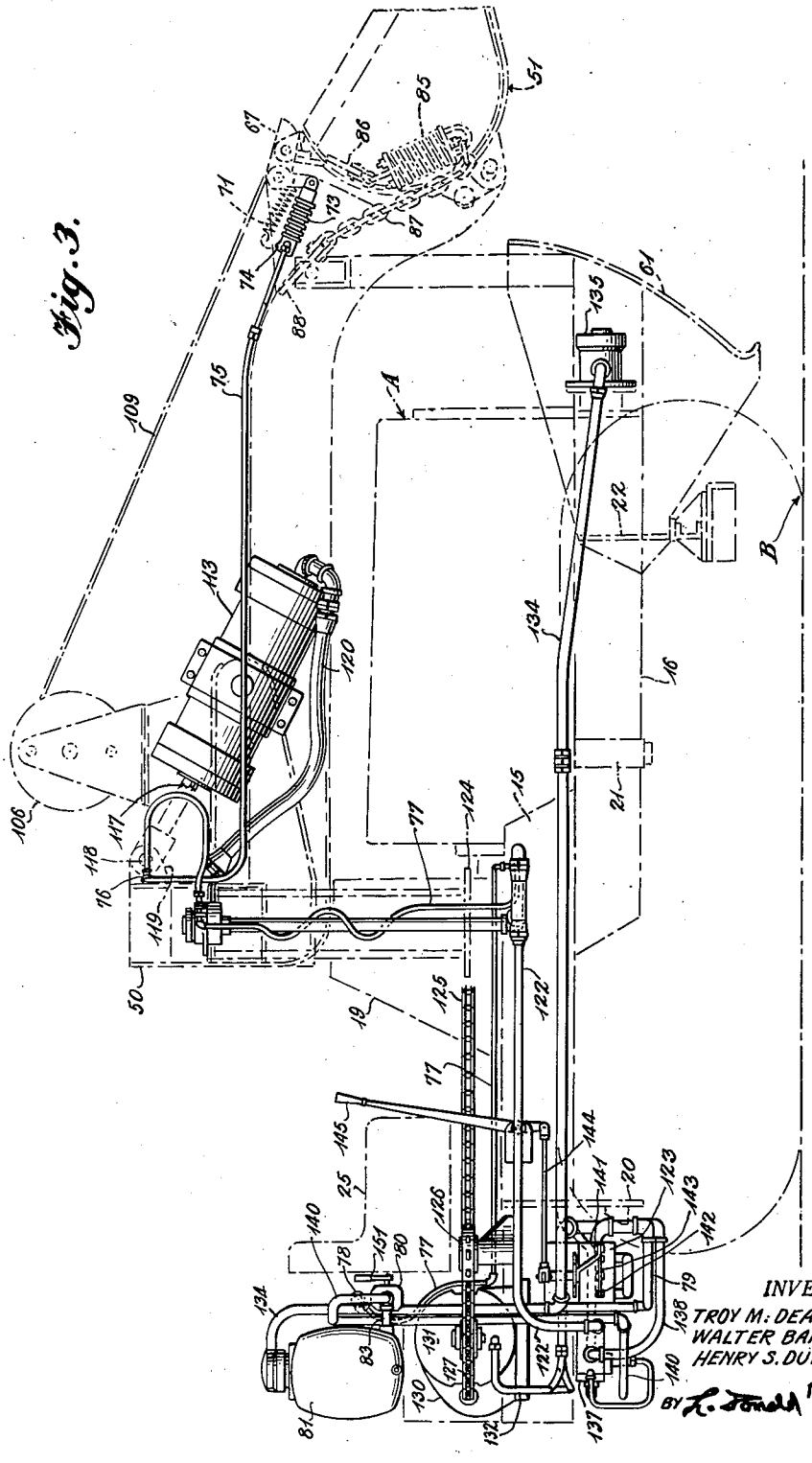

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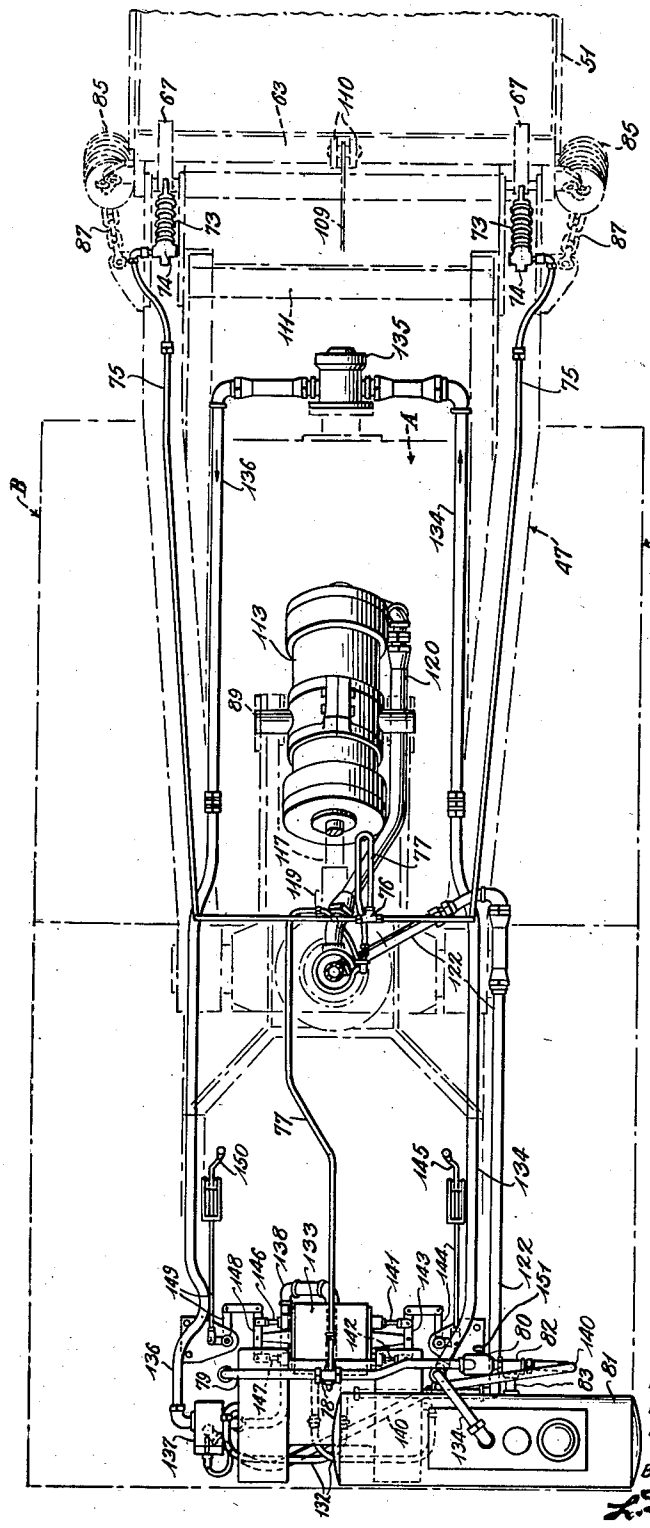
Fig. 4.



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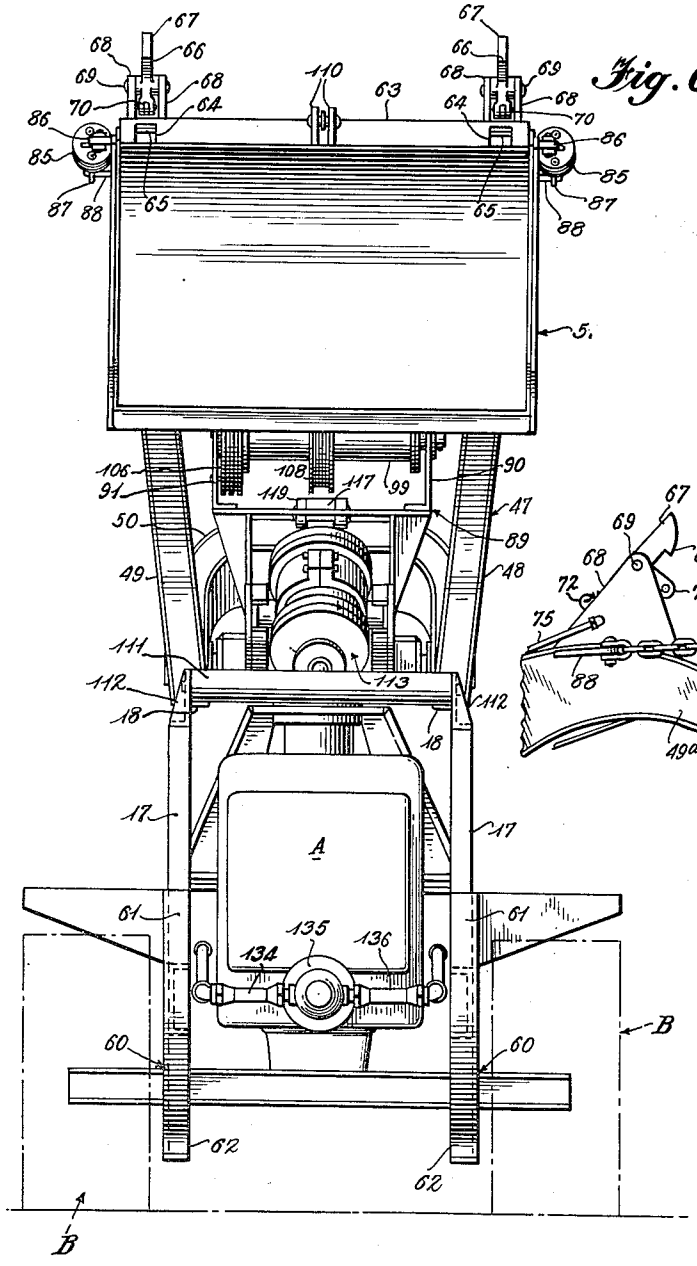

Fig. 6.

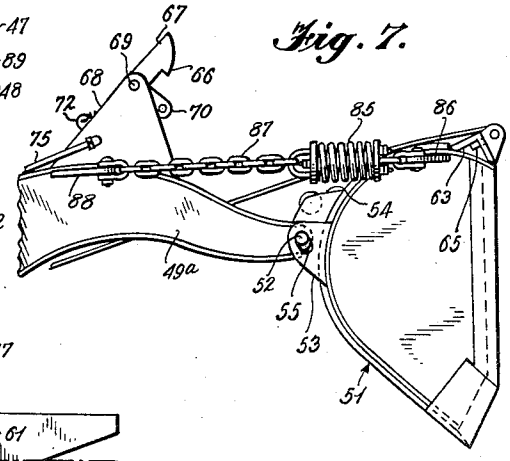

Fig. 7.

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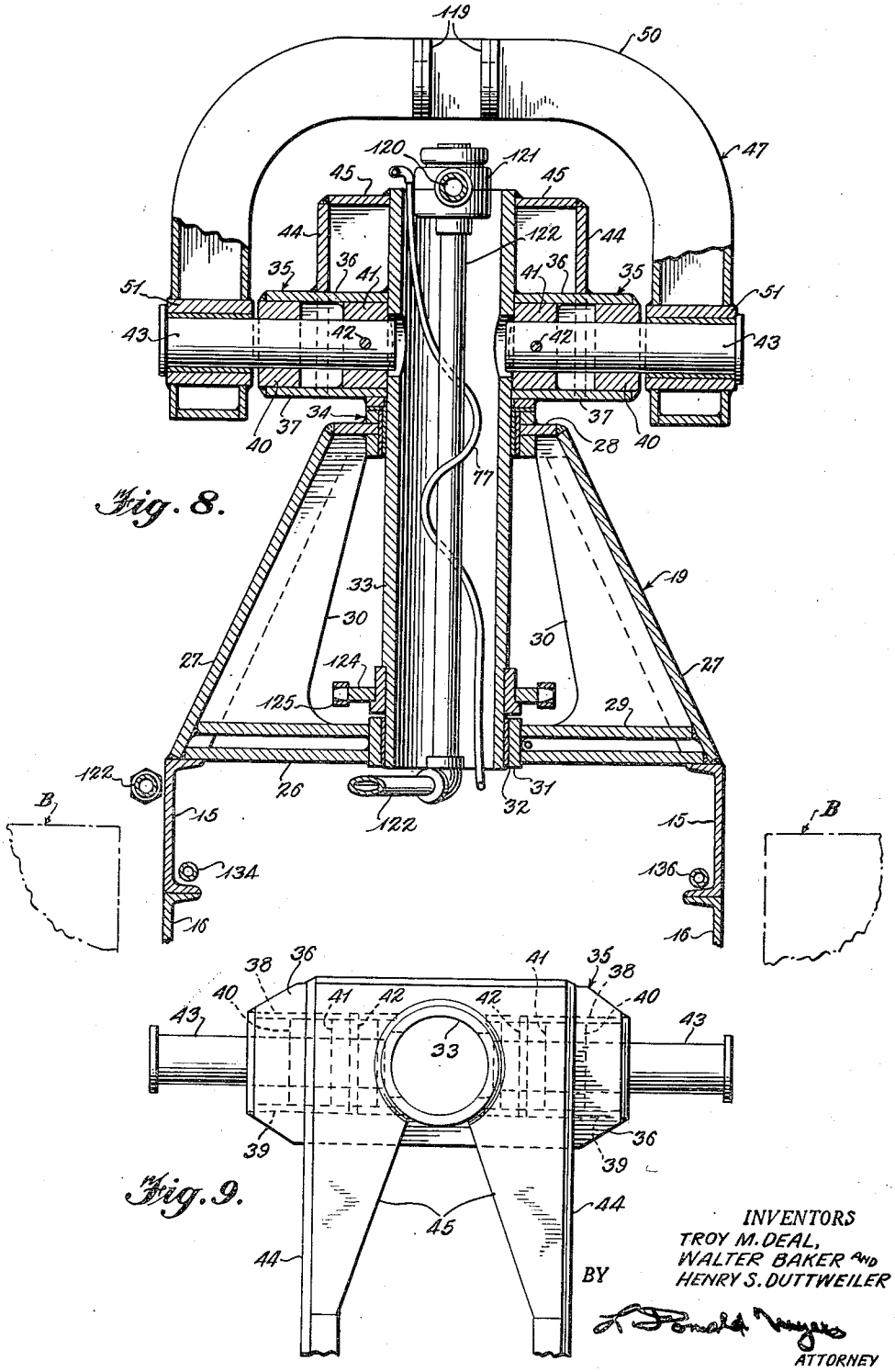

Fig. 8.

Fig. 9.

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FRONT END TRACTOR IMPLEMENT

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Fig. 10.

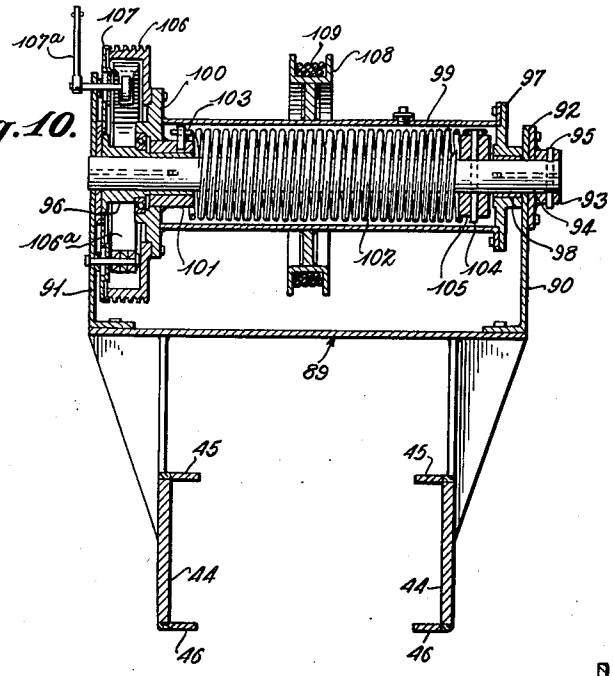


Fig. 11.

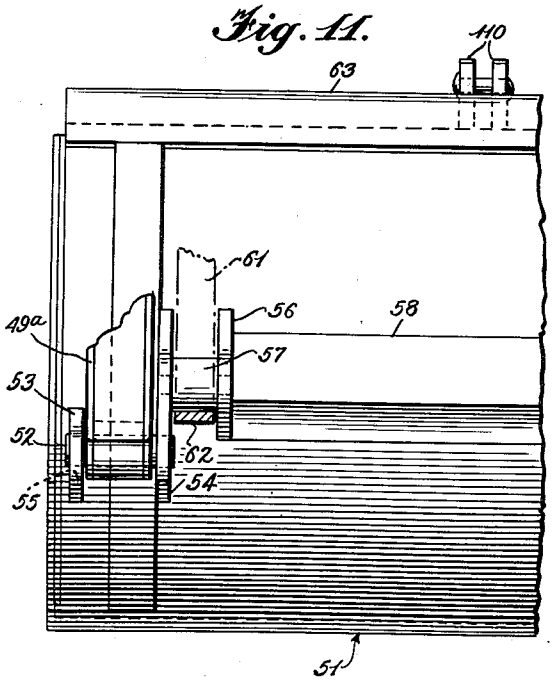
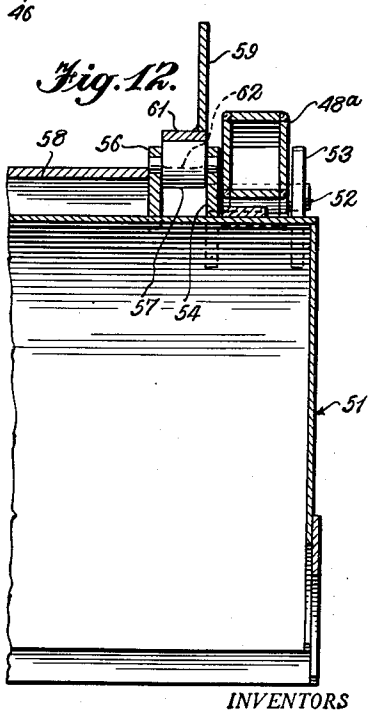


Fig. 12.



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FRONT END TRACTOR IMPLEMENT

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Fig. 13.

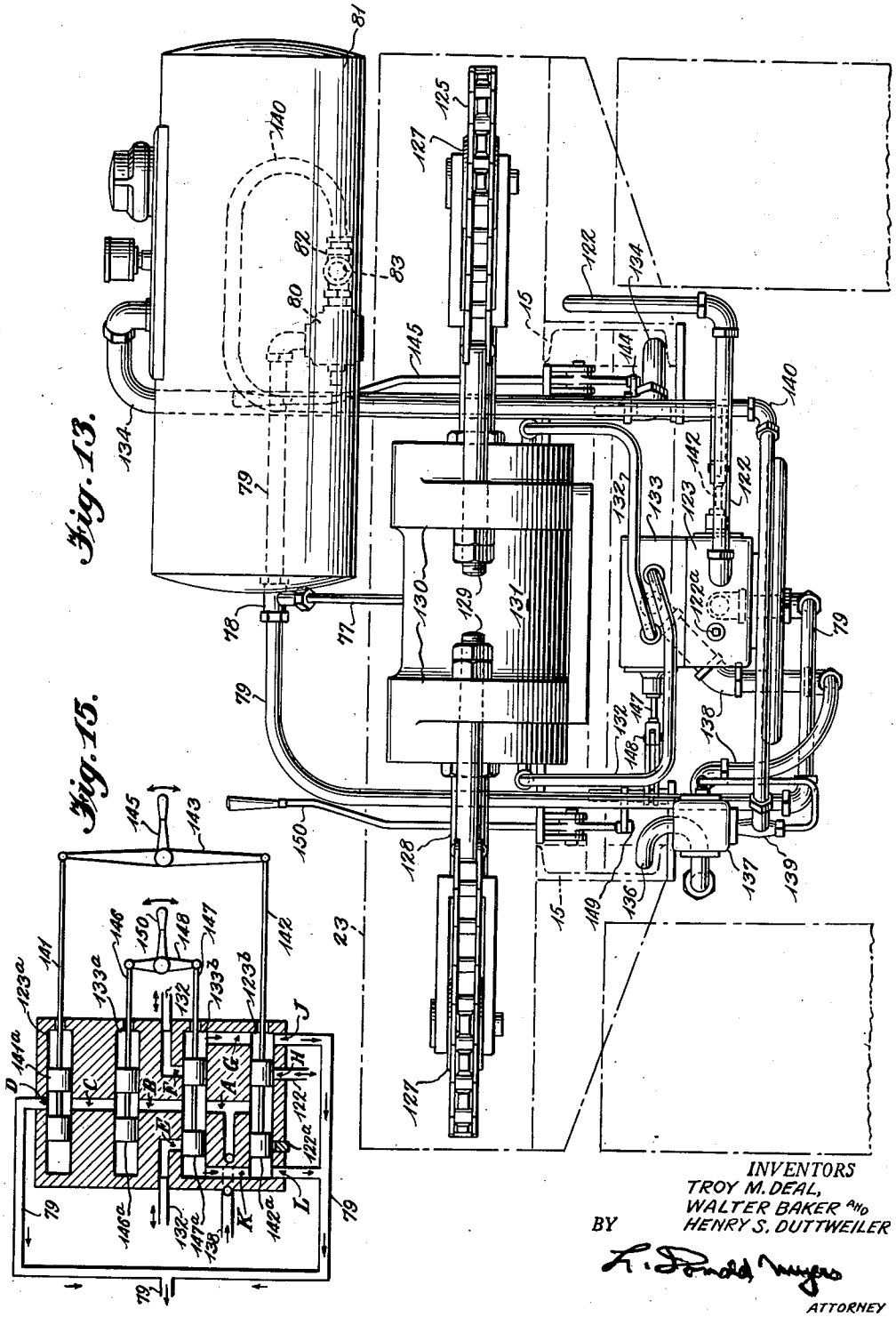

Fig. 15.

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FRONT END TRACTOR IMPLEMENT

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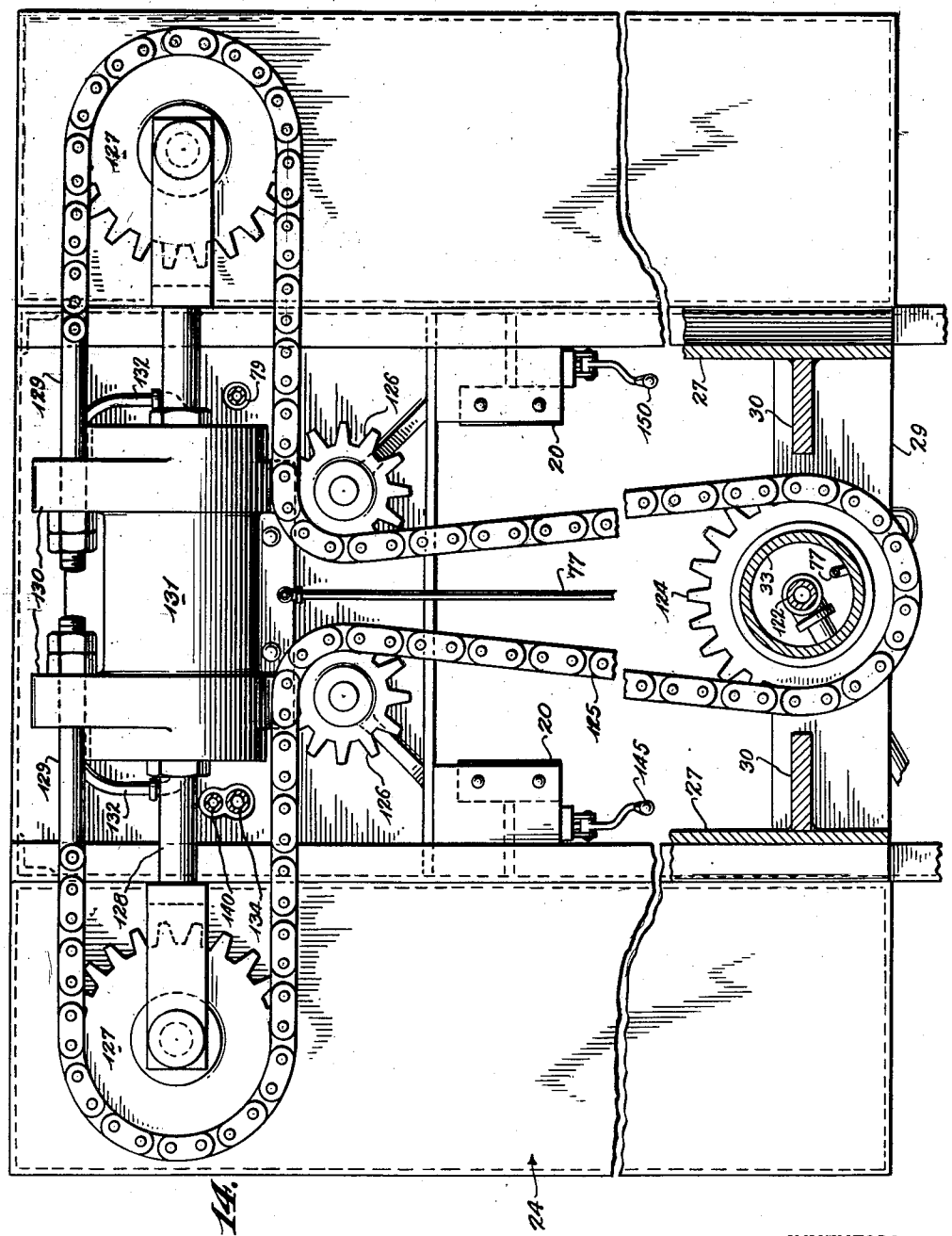

Fig. 14.

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Patented Aug. 9, 1949

2,478,747

UNITED STATES PATENT OFFICE

2,478,747

FRONT END TRACTOR IMPLEMENT

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Application August 3, 1945, Serial No. 608,624

24 Claims. (Cl. 214—132)

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This invention relates to front end implements for tractors of the crawler or wheel supported types, and deals more particularly with load handling implements, such as shovels, which are prefabricated as complete, self-contained units ready for mounting on, or to be attached to, general purpose tractors, such as the regular standard products of tractor manufacturers.

It has been the practice to mount shovels on the front ends of tractors in such a manner that the movements of the buckets or scoops, between loading and dumping positions, are limited to a vertical path that usually is defined by fixed guide rails or slides. Consequently, the entire tractor assemblies must be moved, usually by backing and turning, to properly position the buckets or scoops for dumping their loads.

With this type of shovel mechanism, the weight of the bucket, the load carried thereby, and the mounting mechanism for the bucket is applied to the front end of the tractor, with the result that the center of gravity of the entire unit is shifted forwardly a substantial distance from the location of the center of gravity of the tractor when considered by itself. This displacement of the center of gravity materially reduces the stability of the entire machine and lessens the traction that can be obtained with the traction or travel mechanism of the tractor.

It is the primary object of this invention to provide front end shovel mechanism which is adapted to be prefabricated as a complete, unitary assembly in readiness for easy attachment to general purpose tractors of standard makes, the said shovel mechanism being so constructed that its bucket or scoop may be loaded while arranged in its digging position in front of the tractor, as a result of forward movement of the latter, and may be dumped at any desired location throughout an arc of approximately 180° without moving the tractor.

Another important object of the invention is to provide a front end shovel attachment for tractors in which the bucket is supported for horizontal swinging movements relative to the tractor about a vertical axis that is positioned so as to substantially intersect the center of gravity of the complete tractor and shovel assembly.

Still another important object of the invention is to provide a front end shovel for tractors in which the bucket is connected to the outer end of an arm that in turn is supported for universal movements by a mast assembly that projects upwardly from substantially the center of the tractor.

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A further important object of the invention is to provide a front end shovel for tractors in which the bucket is lowered into a position in advance of the tractor, so that the crowding motion required to load the bucket is accomplished by advancing the entire tractor through its travel mechanism, and so that the thrust from the digging action is applied to the under-carriage of the tractor by the base frame of the shovel mechanism; and in which the loaded bucket is hoisted to a sufficient height to clear the power plant of the tractor when it may be swung to either side of the tractor for dumping.

A still further important object of the invention is the provision of hydraulic means for effecting hoisting and swinging movements of the bucket through manipulations of a bucket supporting arm.

Another object of the invention is to provide pivotal connections between the bucket and the outer end of the bucket arm so that the bucket may assume load carrying and dumping positions relative to said arm, and employ hydraulically operated latches for releasing the bucket from its carrying position to effect dumping.

A further object of the invention is to provide means for utilizing the downward movement of the bucket arm, in returning the bucket for loading, to effect pivotal movement of the bucket relative to the outer end of said arm for returning the bucket from its dumping position to its loading position.

Still another object of the invention is to provide thrust members at the front end of the shovel base frame by means of which the thrust resulting from digging action of the bucket may be delivered to the under-carriage of the tractor through said shovel base frame, and independently of the bucket arm, the said thrust members being so shaped and arranged that they will cooperate with the bucket when positioned for digging at any desired elevation which falls within a vertical range that extends from a lower limit which is several inches below the ground level to an upper limit which may be approximately two feet above the ground level.

A still further object of the invention is to provide a front end shovel for standard tractors of the crawler or wheel supported type in which the bucket is so positioned and hydraulically actuated that the tractor equipped therewith may be used very effectively as an implement for cutting and maintaining a grade, and for other similar earth working operations.

Other objects and advantages of the invention

will be apparent during the course of the following description.

In the accompanying drawings forming a part of this specification and in which like numerals are employed to designate like parts throughout the same,

Figure 1 is a side elevational view of a tractor with a complete front end shovel assembly attached thereto,

Figure 2 is a top plan view of the combination tractor and front end shovel combination illustrated in Fig. 1,

Figure 3 is a side elevational view that is provided to better illustrate the hydraulic system employed for actuating the bucket portion of the shovel assembly, said bucket being illustrated in a partially hoisted position,

Figure 4 is a top plan view of the hydraulic system illustrated in Fig. 3,

Figure 5 is a detail, vertical sectional view provided to illustrate the latching mechanism that is employed for holding the bucket in its digging and load carrying position with respect to the bucket arm, and for releasing the bucket to effect dumping of its load,

Figure 6 is a front elevational view of the tractor with the bucket arm hoisted to approximately its upper limit of movement and with the bucket released to effect dumping. In viewing this figure, it is to be remembered that the bucket usually is swung into a position at one or the other side of the tractor for dumping the load,

Figure 7 is a detail side elevational view of the outer end portion of the bucket arm with the bucket unlatched and occupying its load dumping position,

Figure 8 is a detail vertical sectional view, taken transversely of the tractor, of the mast assembly that is employed for supporting the bucket arm for universal movements,

Figure 9 is a detail, top plan view of the mast assembly illustrated in Fig. 8,

Figure 10 is a detail, vertical sectional view of mechanism employed for returning the bucket to its loading position, relative to the bucket arm, during lowering movement of said arm,

Figure 11 is a detail elevational view of the bucket when viewed from its inner or rear face,

Figure 12 is a fragmentary horizontal sectional view of the bucket, and taken on line 12—12 of Fig. 1,

Figure 13 is a detail, rear elevational view of the hydraulic system employed for actuating the bucket and its arm,

Figure 14 is a fragmentary view, partly in top plan and partly in horizontal section, illustrating the portion of the hydraulic system that functions to effect horizontal swinging movements of the bucket and its supporting arm, and

Figure 15 is a diagrammatic view of the swing and hoist valves which are illustrated in certain of the preceding figures.

In the drawings, wherein for the purpose of illustration is shown the preferred embodiment of this invention, and first particularly referring to Figs. 1 to 4 inclusive and 6, the reference character A designates in its entirety the power plant of any general purpose, standard make of tractor. The illustrated tractor is provided with crawler traction mechanism B, but it is to be understood that the shovel mechanism that is to be described just as readily can be applied to a tractor that is equipped with traction wheels instead of the illustrated crawler mechanism.

The shovel mechanism consists of a complete, prefabricated assembly that can be handled as a unit for mounting on any general purpose, standard make of tractor. For that reason, the shovel mechanism includes a base frame that is made up of two partially overlapped, channel iron beams 15 and 16 which are adapted to be located on each side of the tractor selected for mounting the mechanism. The overlapped ends of these beams are suitably connected by welding and the beams on each side of the tractor extend longitudinally of the latter. The front ends of the beams 16 are connected to upstanding angle irons 17. Extending rearwardly from the upper ends of these angle irons 17 are longitudinal bracing irons 18. The inner or rear ends of these bracing angle irons 18 are suitably connected to a fabricated, mast mounting 19, which will be described more in detail at a later point. This mast mounting is suitably supported on the base frame beams 15.

The base frame of the shovel mechanism is best illustrated in Figs. 1 and 3 as being suitably attached to the under-carriage of the selected tractor by means of the mounting brackets 20, 21 and 22. No attempt has been made to disclose in detail the exact shapes of these brackets 20 to 22, or the exact manner in which they are fastened to specific portions of the under-carriage of the tractor because these attachment brackets, naturally, will be varied in shape, size, and location to accommodate the structural details of tractors manufactured by different companies.

Bridging the space between and supported on the rear end portions of the base frame beams 15 and extending laterally on opposite sides thereof is a housing 23 that is employed for enclosing a portion of the hydraulic system which is utilized to actuate the bucket and its arm. Forwardly of this housing is an operator's platform 24. An operator's seat 25 is positioned centrally of and supported by the housing 23. The various controls for the tractor have not been illustrated but it is to be understood that they are properly associated with the operator's seat 25 so that the person occupying this seat can control the tractor as well as the shovel mechanism.

The previously referred to fabricated mast mounting 19 is best illustrated in Figs. 1, 2, 8, 9 and 14. It includes a transverse bottom plate 26 which is suitably welded, at its opposite ends, to the top flanges of the side frame beams 15. Side plates 27 are welded at their lower edges to the top flanges of the frame beams 15, as best illustrated in Fig. 8. These side plates converge upwardly and are connected at their upper edges by the top plate 28. A second bottom plate 29 is arranged in parallelism with the bottom plate 26 and is spaced vertically thereof. The side edges of this upper plate 29 are suitably welded to the inner faces of the two side plates 27. Perpendicular web members 30 are secured in place and function to reinforce the side plates 27.

The two bottom plates 26 and 29 are cut away, or provided with openings, to receive the sleeve 31 which is welded, or otherwise suitably secured, to the margins of the openings that are formed in the plates 26 and 29. The sleeve 31 is illustrated as being provided with a bronze bushing at 32 to act as a radial bearing for the lower end of the rotatable mast post 33. It is to be understood, however, that a ball or roller anti-friction bearing may be substituted, if desired, for this lower post bearing.

The top plate 28, also, is provided with an opening that is in axial alignment with the openings formed in the bottom plates 26 and 29. Associated with the opening in the top plate 28 is a combined thrust and radial bronze bearing assembly 34. This latter bearing rotatably supports the upper portion of the mast post 33. This latter bearing, also, may take the form of a roller or ball bearing structure if desired.

By referring to Figs. 8 and 9, it will be seen that the upper end portion of the rotatable mast post 33 has suitably secured thereto the box structures 35 that project laterally in opposite directions. Each one of these box structures is made up of four plates 36, 37, 38 and 39. These plates are welded together at their adjacent, longitudinal edges. The bores of these boxes 36 are employed for housing the blocks 40 and 41. The blocks 40 are fastened in the outer end portions of the boxes 35 by welding. The blocks 41 are welded in the bores of the boxes 35. Pins 42 pass through and secure to the boxes 35 the inner end portions of the shafts 43 that project beyond the outer ends of said boxes.

Figs. 1, 2, 8 and 9 disclose parallel bracket arms or plates 44 as being connected at their inner, lower corner portions to the boxes 35 by welding. These bracket arms or plates are clearly illustrated in Figs. 1, 2 and 9 as extending laterally of the rotatable mast post at right angles to the shafts 43. Top plates 45 and bottom plates 46 are welded at their longitudinal edges to the top and bottom edges of the arms 44 to form flanges for these arms. The plates 45, additionally, are welded to the upper extremity of the rotatable mast post 33, as best illustrated in Fig. 8.

A bucket arm, designated in its entirety by the reference character 47, is illustrated in Figs. 1, 2, 6 and 8 as being journaled on the projecting end portions of the two shafts 43. This bucket arm includes the two branches 48 and 49 that are so shaped as to provide downwardly curved end portions 48*a* and 49*a*. The inner ends of these branches 48 and 49 are suitably welded to an arched branch 50 which is arranged substantially at right angles to the main body portions of the branches 48 and 49. Fig. 8 shows the two extremities of the arched branch 50 as having bronze bearings 51 for receiving the projecting end portions of the two stub shafts 43.

From the description so far presented of the mast assembly and bucket arm, it will be seen that the bucket arm may be hinged or pivoted vertically about the stub shafts 43 and the bucket arm may be swung horizontally in opposite directions as a result of rotation of the mast post 33. The horizontal swinging of the bucket arm, of course, can only occur while the branches 48 and 49 of the arm are located above, or at a higher level than, the power plant A of the tractor and the shovel frame portion that is formed by the angle iron members 17 and 18.

Figs. 1, 2, 5, 6, 7, 11 and 12 illustrate the bucket 51 that is pivotally connected to the outer extremities of the branches 48 and 49 of the bucket arm 47. Each one of the bucket arm branches carries a transverse pin 52 at its other extremity. At each side of the back of the bucket 51 there are provided two lugs 53 and 54. These lugs are formed with elongated openings 55 that receive the projecting ends of the pins 52. These elongated openings 55 and the pins 52 cooperate to provide a pivotal connection between the bucket 51 and the bucket arm branches 48 and 49 and, also, provide for a relative shifting movement, or

displacement, of the bucket relative to the said arm branches. The reason for providing this shiftable or relative movement connection will be explained at a later point.

Additional lugs 56 are fastened to the back wall of the bucket 51 and are arranged in parallelism with and inwardly of the lugs 54. Rollers 57 are rotatably supported by the lugs 54 and 56. A suitable length of angle iron 58 is illustrated in Figs. 11 and 12 as being fastened to the back of the bucket 51 to lie between the innermost lugs 56.

Figs. 1, 2, 6, 11 and 12 illustrate thrust plates 59 that are located on opposite sides of the front end of the tractor. These thrust plates are suitably fastened to the under-carriage of the tractor, as at 60 in Fig. 1, and to the front end portions of the base frame beams 16. These thrust plates are provided with front edge flanges 61 which are slightly hooked or curved at their lower ends 62.

Thrust plates 59 are longitudinally in alignment with the rollers 57 carried by the back of the bucket and the flanges 61 of the thrust plates are intended to be engaged by the rollers 57 when the bucket is caused to shift rearwardly or inwardly as a result of digging action to load the bucket. It will be seen, therefore, that the thrust developed during digging of the bucket into a bank or pile of material, or while performing other material moving operations, will be applied to the front edges of the thrust plates 59. Any vertical movement of the bucket 51, while it is displaced inwardly to place the rollers 57 into engagement with the thrust plate flanges 61, will cause the rollers 57 to roll over these flanges.

By considering the disclosures of Figs. 1 and 6, it will be seen that the rollers 57 will engage the thrust plate flanges 61 when the bucket is positioned for digging at any desired elevation falling within a vertical range that will have as its bottom limit the bucket position illustrated in Fig. 1 and will have as its top limit a bucket position in which the rollers engage the upper end portions of the thrust plate flanges 61. In the bottom limit position illustrated in Fig. 1, the forward or cutting edge of the bucket is located several inches below the ground level. In the upper limit position, the cutting edge of the bucket will be located approximately two feet above the ground level. It will be appreciated that this range of bucket digging positions can be varied, as desired, by employing thrust plates with different length front flanges 61.

The front edge of the bucket 51 is caused to dig into the material that is to be loaded into the bucket by advancing the entire tractor by means of its travel mechanism. By taking the thrust, that is developed by the digging action, on the thrust plates 59, and through these thrust plates on the base frame of the shovel mechanism and the under-carriage of the tractor, no digging thrust is applied to the bucket arm 57 and the rotatable mast post 33.

Figs. 1, 2, 5, 6 and 7 disclose the mechanism for holding the bucket 51 in its digging and load carrying position relative to the bucket arm 47.

Extending across the upper, rear edge portion of the bucket is an angle iron 63 which is provided in its upper flange with the two latch receiving openings 64 which are lined up longitudinally of the tractor with the bucket arm branches 48 and 49. A wear plate 65 is associated with one margin of each one of these openings 64 and is adapted to be engaged by the hooked end 66 of a pivoted latch 67.

Each bucket arm branch 48 and 49 has suitably attached thereto a pair of spaced, triangularly shaped bracket plates 68. The latches 67 are pivotally connected to these plates 68 by the pins 69 so that the latches lie between the plates 68. Each one of these latch members 67 is provided with an operating arm 70. A spring 71 is attached at one of its ends to each one of these latch operating arms 70 and at its other end to a lug 72 carried by one of the plates 68. These springs 71 load the latch members 67 in the proper direction to cause them to engage and hold the bucket 51 in its digging and load carrying position.

The latch operating arms 70, also, have connected thereto the hydraulically operated, expansible, trip cylinders 73.

These trip cylinders 73 are best illustrated in Figs. 1, 3, 4 and 5. Their inner ends 74 are suitably connected to the associated plates 68 to permit the cylinders to operate the latches 67, to trip the bucket 51 for dumping its load, whenever sufficient fluid pressure is applied to the expansible trip cylinders 73 to cause these cylinders to pivot the latches 67. Fluid supplying tubes 75 are connected to the inner ends 74 of the trip cylinders 73 and extend longitudinally of the respective bucket arm branches 48 and 49 and then laterally inwardly to be connected to the T-coupling 76, see Figs. 1, 3 and 4. From this coupling 76 flexible tubing 77 extends downwardly through the hollow bore of the rotatable mast post 33 to the level of the base frame of the shovel mechanism. The tube 77 then extends horizontally beneath the platform 24 and upwardly through the casing 23 for connection with the T-coupling 78 that is connected in a fluid return line 79. This fluid return line is illustrated in Figs. 1, 2, 3, 4, and 13 as being connected to the trip cylinder controlling valve 80 that has its second opening connected to the fluid supply tank 81 by the coupling 82 and the nipple 83. The operation of this latch tripping control valve 80 in connection with the remainder of the hydraulic system will be described more in detail at a later point.

Figs. 1 to 4 inclusive, 6 and 7 disclose spring means for limiting the movement of the bucket 51 into its dumping position and for absorbing the shock resulting from the stopping of the pivotal movement of the bucket. This mechanism consists of a spring 85, on each side of the bucket, which is connected at one end to the lug 86 attached to the adjacent bucket side. The remaining end of each one of these springs 85 is connected by a short length of chain 87 to a laterally projecting lug 88 that is attached to the outer side of the associated bucket arm branch 48 or 49.

The mechanism so far described in connection with the operation of the bucket 51 provides for the holding of the bucket in its digging and load carrying position, the tripping of the bucket to effect dumping of the load, and the stopping of the bucket at the proper load dumping position. The mechanism next to be described performs the operation of returning the bucket from its dumping position to its latched digging and load carrying position as a result of downward movement of the bucket arm 47.

By referring to Figs. 1, 2, 6 and 10, it will be seen that the bracket arms 44 have mounted thereon a fabricated platform 89 that straddles the space between the said bracket arms. Supported on this platform 89 are the brackets 90 and 91. The upper end portion of the bracket 90 has suitably fastened thereto a plate 92 which acts as a mount for the collar 93. Supported in this collar is one end of the shaft 94. The pin 95 is employed for fastening the shaft 94 to the collar to prevent either angular or axial movements of the shaft. The remaining end of the shaft is supported by the collar 96 that is suitably fastened to the second upstanding bracket 91.

An end plate or disc 97 is journaled on one end portion of the shaft 94 by the bronze bearing 98. A tubular sleeve or housing 99 has one of its ends suitably flanged and fastened to the disc or end plate 97. The remaining end of this tubular housing or sleeve 99 is welded to a second end plate or disc 100. This end plate or disc 100 is suitably welded to the bearing sleeve 101 that is provided with a bronze bearing and is journaled on the adjacent portion of the stationary shaft 94.

A coil spring 102 is enclosed within the housing or sleeve 99 and has its end 103 fastened to the bearing sleeve 101 that rotates with the housing or sleeve 99. The remaining end of this spring is fastened by the pin 104 to the supporting block 105 and the associated portion of the stationary shaft 94.

The disc or end plate 100 has suitably fastened thereto a brake drum 106. The open side of this drum is closed by the stationary cover 107. A conventional brake shoe mechanism 106a will be positioned within the brake drum 106. It is intended that the brake shoes of the mechanism 106a be actuated for engaging the inner peripheral surface of the brake drum 106 by any suitable pull-cable or rod actuating mechanism 107a, or by any desired form of hydraulic mechanism, not shown.

A cable sheave 108 is attached to and mounted on the exterior of the sleeve or casing 99 so as to rotate with the latter. An appropriate length of cable 109 is suitably anchored at one end to the sheave 108 and wound a desired number of times therearound.

This cable 109 extends longitudinally of the bucket arm 47 and is attached at its outer end to the pair of lugs 110 fastened to the angle iron 63 that has been previously referred to as being attached to the upper edge portion of the rear wall of the bucket 51.

Whenever the bucket 51 is located in front of the tractor and at an elevation that positions the cable attaching brackets 110 below the level of the shovel frame that is formed by the angle members 17 and 18, the cable 109 will engage the roller 111 that is rotatably supported by a rod mounted at its ends in the brackets 112. These brackets are supported by the shovel attachment frame that is formed by the angle members 17 and 18.

The operation of this bucket returning mechanism will be described as follows.

The spring 102 should always be tensioned, or wound up, so as to take up any slack that occurs in the cable 109 as a result of the bucket 51 being moved upwardly from the position it occupies in Figs. 1 and 2. Consequently, the cable 109 will always be maintained taut by the spring 102.

When the bucket 51 is hoisted and tripped to effect dumping, the bucket will occupy the position illustrated in Figs. 6 and 7 with reference to the bucket arm 47. The cable 109 is pulled off of or unwound from the sheave 108, to the desired extent, by this dumping movement of the bucket 51. If the bucket has been dumped while the bucket arm 47 is positioned at either side of the tractor, the bucket arm is swung around until

it is properly positioned over the tractor so that it can be lowered with the bucket arm branches 48 and 49 lying on opposite sides of the tractor power plant A and the front portion of the shovel attachment frame. With the bucket arm properly positioned for lowering, the arm is allowed to move downwardly. The brake shoes of the mechanism 106a are applied to the brake drum 106, at the proper time during the downward movement of the arm 47 and its bucket 51. This braking of the sleeve 99 and its attached cable sheave 108 against angular movement causes the cable 109 to exert a pull on the upper back portion of the bucket. This pull causes the bucket to swing upwardly and inwardly, from the position illustrated in Figs. 6 and 7, until the latches 67 will be permitted to engage the bucket for fastening the latter in its digging and load carrying position. After the bucket is thus latched, the brake shoes are released from engagement with the brake drum 106 so that further downward movement of the bucket, and the bucket arm 47, will be accompanied by unwinding of the cable 109 from its sheave 108.

The brake shoe mechanism 106a, also, can be employed for controlling the dumping action of the bucket. By properly applying the brake mechanism during the dumping movement of the bucket, the rate of discharge of the material can be controlled. The operator thus can better distribute the spilled material into trucks and can lessen the impact load on the truck and the shovel mechanism.

The bucket arm 47 is actuated to effect hoisting and lowering of the bucket 51 by a hydraulic motor which now will be described in connection with Figs. 1 to 4 inclusive, 6 and 8.

The hydraulic cylinder 113 is pivotally attached to the outer end portions of the bracket arms 44 by means of the split clamping collar 114 and the stub shafts 115 which are carried by the opposite halves of the collar. These stub shafts are journaled in openings 116 formed in the extremities of the bracket arms 44.

The hydraulic cylinder 113 is provided with an appropriate piston, not shown, and the rod 117 projects from the inner end of the cylinder and is pivotally connected to the yoke-shaped branch 50 of the bucket arm 47 by means of the pin 118 and the lugs 119.

The outer end of the hydraulic cylinder 113 has connected thereto a fluid pressure supply line 120 that is connected at its remaining end to the swivel coupling 121 positioned at the open upper end of the rotatable mast post 33. This coupling is mounted on the non-rotatable fluid supply pipe 122 that extends axially of the bore of the rotatable mast post 33 to emerge from the lower end of the latter. The supply pipe 122 is illustrated in Figs. 1, 3, 4 and 13 as extending laterally of the bottom of the mast post 33 and then rearwardly along one of the shovel base frame beams 15 for connection at its inlet end with a fluid flow control valve 123. The manner in which this valve 123 controls the flow of pressure fluid to the outer end of the cylinder 113 will be described more in detail at a later point in referring to the entire hydraulic system.

It will be appreciated that when pressure fluid is admitted to the pipes 122 and 120, pressure is built up in the outer end portion of the cylinder 113 and this pressure will effect movement of the piston, not shown, of the cylinder to cause the piston rod 117 to move outwardly of the inner end of the cylinder. This outward movement of the piston rod applies force to the bucket arm branch 50. This pressure, or force, will cause the bucket arm to be pivoted relative to its supporting shafts 43, that are carried by the upper end portion of the rotatable mast post 33. Fluid pressure is applied to the cylinder 113 until the bucket arm 47 has been raised to the desired elevation. The pressure fluid then is locked in the cylinder 113, by proper operation of the control valve 123, and the bucket arm 47, with its bucket 51, then may be swung in either direction by rotation of the mast post 33. When the bucket 51 and its arm 47 again are to be lowered, the pressure fluid is withdrawn from the cylinder 113 and the weight of the bucket and its arm will cause the piston to be moved inwardly of the cylinder 113.

From the above description of the operation of the hydraulic motor for raising and lowering the bucket arm 47, it will be appreciated that fluid pressure is applied only to one end of the cylinder 113. The remaining end of this cylinder will be provided with a suitable vent or breather opening, not shown, to prevent the building up of either positive or negative pressure on the inner side of the piston.

It will be appreciated that pressure fluid could be applied to the upper end of cylinder 113 if such a procedure is desired. Application of pressure fluid to the upper side of the piston in cylinder 113 would cause the bucket 51 and its arm 47 to be moved downwardly and would overcome the need for relying on the weight of the bucket and its arm to effect this movement. The application of pressure fluid to move the bucket downwardly, also, could be employed for forcing the bucket downwardly into the material being handled to assist the digging action that is otherwise dependent on the forward movement of the tractor. Plug 122a in Fig. 15 closes a port in valve 123 that can be used when fluid is to be delivered to the upper end of cylinder 113.

The mechanism employed for effecting swinging movement of the bucket 51 and its arm 47, by means of the rotatable mast post 33, is best illustrated in Figs. 3, 8, 13 and 14. This mechanism will be described by referring to these figures.

The rotatable mast post 33 has suitably fastened to its lower end portion a sprocket wheel 124 over which is trained a suitable length of roller chain 125. This chain is further trained over the two idler sprockets 126 and then over the two drive sprockets 127 that are rotatably carried by the opposite ends of the hydraulic motor operated piston rod 128. The opposite ends of the length of roller chain 125 are anchored by the adjustable bolts 129 to the portions 130 of the hydraulic cylinder 131. The piston rod 128 that extends axially through the cylinder 131 has mounted thereon a double acting piston, not shown. It will be appreciated that reciprocation of this piston within the cylinder 131 in opposite directions will cause the mast post 33 to be rotated in opposite directions through the medium of the roller chain 125.

Pressure fluid is selectively fed to the opposite ends of the cylinder 131 through the two supply pipes 132 that extend to and are connected with the control valve 133. The operation of this control valve 133, for effecting rotation of the mast post 33, will be described more in detail when the complete hydraulic system is referred to.

The complete hydraulic system will be described in connection with the disclosures provided by Figs. 1 to 4, inclusive, 13, 14, and 15. The oil re-

quired for the hydraulic system is obtained from the supply tank 81 that is mounted on the top of the casing or housing 23. The oil is withdrawn from this tank, by means of a dip tube that is not disclosed, through the pipe line 134. This pipe line extends downwardly through the casing or housing 23, as is best illustrated in Fig. 13, to the level of the base frame beam 15 and then extends horizontally and longitudinally of the tractor to be connected to the pump 135 that is located at the front end of the tractor power plant A. This pump is driven by the crank shaft, not shown, of the power plant. From the discharge side of the pump 135, the fluid flows through the pipe line 136 which extends longitudinally of the shovel base frame member 15 and is connected at its rear end to the relief valve 137. This relief valve normally is conditioned so that the oil flows therethrough and leaves the same by means of the pipe line 138. This latter pipe line directs the flow of oil into the previously referred to control valve 133 for the mast swinging hydraulic cylinder 131. If the valve 133 is not conditioned to feed oil to either end of the cylinder 131, the oil flows through the valve 133 to the valve 123. This valve 123 controls the operation of the shovel arm hoist cylinder 113 and if this valve is not conditioned to deliver oil to this cylinder, the oil flows through the valve 123 and discharges therefrom through the return pipe line 79, which has been previously referred to. This pipe line 79 carries the oil back to the supply tank 81 by way of the bucket latch trip control valve 80, the coupling 82 and the nipple 83.

The relief valve 137 is set to relieve the system when the maximum operating pressure prevails therein. A pressure of 1000 pounds per square inch has been established as this maximum operating pressure. This pressure is reached when either the piston for the hoist cylinder 113 or the piston for the swing cylinder 131 is prevented from partaking of further movement, such as when it reaches its limit of travel in an operative direction. When this maximum pressure is reached, the relief valve 137 is actuated and functions to cause the oil to flow through its bottom coupling member 139 and from this member through the pipe line 140 which extends to the remaining branch of the previously referred to coupling 82. This coupling is connected to the supply tank 81 by the nipple 83 and the by-passed oil is thus returned to the supply tank.

It previously has been stated that the valve 123 controls the flow of pressure fluid to the hoist cylinder 113. This valve 123 is illustrated in Figs. 3, 4, 13 and 15 as being provided with two operating stems 141 and 142. The several figures show these two stems in neutral positions. By referring to the diagrammatic disclosure of Fig. 15, it will be seen that valve stem 141 extends into what will be termed a cut-off valve chamber 123*a* for operative connection with the double-piston cut-off valve member 141*a*. This same figure shows the valve stem 142 extending into the control valve chamber 123*b* for operative connection with the double-piston control valve member 142*a*.

The two valve stems 141 and 142 are pivotally connected to the ends of the centrally pivoted lever 143 so that movement of this lever will cause the valve members 141*a* and 142*a* to be moved in opposite directions. In Figs. 3, 4 and 13, the lever 143 is illustrated as being operatively connected by the train of link and lever elements 144 to the hoist control lever 145 that is conveniently located to an operator occupying the seat 25. The condensed disclosure provided by Fig. 15 shows the hoist control lever 145 as being directly connected to lever 143.

The valve 133 has been described as controlling the flow of the pressure fluid into the pipe lines 132 that lead to the opposite ends of the swing cylinder 131. This valve 133 is provided with the two operating stems 146 and 147. The several figures show these two stems in their neutral positions. By referring to Fig. 15 it will be seen that valve stem 146 extends into cut-off valve chamber 133*a* for operative connection with the double-piston cut-off valve member 146*a*. This same figure shows the valve stem 147 extending into the control valve chamber 133*b* for operative connection with the double-piston control valve member 147*a*.

The two valve stems 146 and 147 are pivotally connected to the ends of the centrally pivoted lever 148 so that movement of this lever will cause the valve members 146*a* and 147*a* to be moved in opposite directions. In Figs. 4 and 13, the lever 148 is illustrated as being operatively connected by the train of link and lever elements 149 to the swing control lever 150 that is conveniently located to an operator in seat 25. The disclosure provided by Fig. 15 shows the swing control lever 150 as being directly connected to lever 148.

It will be understood that the casings of valves 123 and 133 are provided with a proper number and arrangement of ports and ducts for properly connecting the various valve chambers 123*a*, 123*b*, 133*a*, and 133*b* with each other and with the supply pipe line 138, the return pipe line 79, the hoist fluid supply pipe line 122, and the swing fluid supply pipe lines 132. For the purpose of simplification, these ports and ducts are illustrated in Fig. 15 in a diagrammatic manner and are identified by the reference characters A to L. These reference characters will be employed in describing the operations of the valves 123 and 133.

The operation of valves 123 and 133, in effecting hoist and swing movements of the bucket arm 47 and the bucket 51, now will be described by referring principally to the disclosure of Fig. 15.

When the hoist control lever 145 and the swing control lever 150 are in their neutral positions, as illustrated in Figs. 1 to 4 inclusive, 13 and 14 as well as Fig. 15, the various valves 141*a*, 142*a*, 146*a* and 147*a* are so arranged that the pressure fluid will flow from the supply pipe line 138 through the ducts A, B, and C and through the valve chambers 133*b*, 133*a*, and 123*a* to the port D and through this port to the return pipe line 79.

When the bucket 51 and its arm 47 are to be hoisted into a position where they can be swung to either side of the tractor for dumping the bucket, the hoist control lever 145 is moved counterclockwise, as viewed in Fig. 15. This movement of the hoist control lever 145 causes the port H, of valve chamber 123*b*, to be uncovered by the associated valve piston of member 142*a*. Pressure fluid then will flow from the supply line 138 through the duct A and the valve chamber 123*b* to the port H and through this port to the hoist fluid supply pipe line 122. This movement of the hoist control lever 145 has caused one of the pistons of valve 141*a* to close the port D so that the pressure fluid cannot be delivered to the return pipe line 79.

After the bucket 51 and its arm 47 have been hoisted to the desired elevation for swinging, the control lever 145 is returned to its neutral position. This movement of the control lever causes

the right hand piston of valve member 142a to close the port H for locking the pressure fluid in the hoist cylinder 113.

When the bucket 51 and its arm 47 are to be returned to the desired digging position, the hoist control lever 145 is moved clockwise, as viewed in Fig. 15. This movement of the hoist control lever causes the right hand piston of valve member 142a to be moved to uncover port H. This port H then is placed in communication with port J by the valve chamber 123b. The pressure fluid then will be exhausted from the hoist cylinder 113, by the weight of the bucket 51 and its arm 47, and the exhausted pressure fluid will flow from the pipe line 122 to the return pipe line 79.

When the bucket 51 and its arm 47 are to be swung in one direction or the other, the swing control lever 150 is moved either counterclockwise or clockwise, as viewed in Fig. 15. If this lever 150 is moved counterclockwise, the right hand piston of valve member 147a will be moved to the right to uncover port F while the left hand piston of valve member 147a will be moved to the right to uncover port E. Pressure fluid then will flow from pipe line 138 into the duct A and from this duct through the valve chamber 133b to the port F and through this port to the communicating pipe line 132 that leads to one end of the swing cylinder 131. The pipe line 132 that connects with the opposite end of the swing cylinder 131 is placed in communication with the valve chamber 133b through the port E. The duct K then functions to establish a flow path from the port E, and the associated end portion of the valve chamber 133b, to the left hand end of the valve chamber 123b. This end of valve chamber 123b is provided with port L which communicates with the return pipe line 79. Consequently, fluid in the end of swing cylinder 131 that is connected with the left hand pipe line 132 will be exhausted through the port E, the valve chamber 133b, the duct K, the valve chamber 123b, and the port L.

When the bucket 51 and its arm 47 are to be swung in the opposite direction, the swing control lever 150 is moved clockwise, as viewed in Fig. 15. This movement of the control lever 150 causes the two pistons of valve 147a to be moved to the left. This movement of the pistons of the valve member 147a causes port E to be uncovered so that pressure fluid can flow from pipe line 138 through duct A into the valve chamber 133b and through this chamber into port E for flow through the left hand pipe line 132. The right hand pipe line 132 has been placed in communication with the return pipe line 79 by the uncovering of port F. This returning or exhausting fluid will flow from the port F through the right hand end portion of valve chamber 133b into the duct G and from this duct through the right hand end portion of valve chamber 123b into port J.

Movements of the swing control lever 150 in these opposite directions will cause the pistons of valve member 146a to be moved successively into the position that will close the adjacent ends of ducts B and C. Consequently, the pressure fluid that is admitted to valve chamber 133b will not be permitted to flow to the port D that communicates with the return pipe line 79.

After the bucket 51 and its arm 47 have been hoisted to the desired elevation and swung to the proper dumping position, on either side of the tractor, the trip cylinders 73 for the latches 67 are energized to trip the bucket. These trip cylinders are energized by actuating the control lever 151 for the trip control valve 80. This actuation of the control lever 151 closes the valve 80 and causes fluid pressure to be built up in the return line 79, and from this return line in the tube 77, the T-coupling 76, and the branch tubes 75. After the latches 67 are tripped, the control valve 80 is opened again so that the springs 71 can function to return the latches 67 to their bucket engaging positions.

Where it is used in the claims, the expression "standard tractor" is to be understood and construed as referring to and covering any complete motor propelled wheel or crawler supported tractor unit that is obtainable on the open market; i. e., any general purpose standard product of recognized tractor manufacturers, and is not to be understood and construed as referring to and covering any motor propelled wheel or crawler supported unit that is designed and constructed especially for use with and as a non-detachable or non-separable part of shovel mechanism.

It is to be understood that the form of this invention herewith shown and described is to be taken as the preferred example of the same, and that various changes in the shape, size, and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described the invention, we claim:

1. In a front end tractor implement, the combination with a standard tractor having its power plant positioned at the front end thereof, of a complete shovel mechanism assembly detachably mounted as a self-contained attachment unit on said tractor, said shovel mechanism comprising a bucket, means for supporting the bucket for hoisting and lowering movements in front of the tractor power plant and for lateral swinging movement in either direction when raised above the level of the tractor power plant, and a hydraulic system for effecting such movements of the bucket and including a pump, driven by the power plant of the tractor, for developing the fluid pressure in the hydraulic system.

2. In a front end tractor implement, the combination with a standard tractor having its power plant positioned at the front end thereof, of a complete shovel mechanism assembly mounted as a self-contained attachment unit on said tractor, said shovel mechanism comprising a base frame including side beams positioned on opposite sides of said tractor, tractor mounting means carried by the side beams of said base frame, a bucket, means mounted on the base frame and straddling the power plant of the tractor for supporting the bucket for hoisting and lowering movements when the bucket is positioned in front of the tractor power plant and for lateral swinging movement in either direction relative to the tractor when the bucket is positioned at a higher level than the top of the power plant, and a hydraulic system for effecting such movements of the bucket and including a pump, driven by the power plant of the tractor, for developing the fluid pressure in the hydraulic system.

3. In a front end tractor implement, the combination with a standard tractor, of a complete shovel mechanism assembly mounted as an attachment unit on said tractor, said shovel mechanism comprising a base frame, tractor mounting means carried by the base frame, a mast assembly mounted on and projecting above the base frame and including a vertical mast post rotatable relative to the remainder of the mast assem-

bly, an arm pivoted to and entirely supported by the upper end portion of the mast post, a bucket pivotally mounted on the outer end of said arm, and a hydraulic system carried by the base frame and the rotatable mast post and including a motor for hoisting and lowering the bucket at the front end of the tractor by pivoting the arm, a motor for swinging the bucket in either direction relative to the tractor by rotating the mast post, and a pump, driven by the power plant of the tractor, for developing the fluid pressure in the hydraulic system.

4. In a front end tractor implement, the combination with a tractor having a power plant, and ground engaging traction means driven by said power plant, of a frame structure attached to the tractor, a mast assembly supported on the frame structure and including a rotatable mast post, an arm pivoted to the mast post for vertical movements, a bucket pivotally connected to the outer end of the arm, means for holding the bucket in digging and load carrying position with respect to said arm and for releasing the bucket from said position so that it will pivot into its load dumping position, means carried by the mast post for effecting pivoting of the arm, and means mounting on the frame structure for effecting rotation of the mast post.

5. In a front end tractor implement, the combination with a tractor having a power plant and ground engaging traction means driven by said power plant, of a frame structure attached to the tractor, a mast assembly supported on the frame structure and including a rotatable mast post, an arm pivoted to the mast post for vertical movements, a bucket pivotally connected to the outer end of the arm, means for holding the bucket in digging and load carrying position with respect to said arm and for releasing the bucket from said position so that it will pivot into its load dumping position, means for utilizing the downward pivotal movement of the arm for effecting pivotal movement of the bucket from its load dumping position into its digging and load carrying position, and means carried by the frame structure for effecting rotation of the mast post and pivoting of the arm.

6. In a front end tractor implement, the combination with a tractor having a power plant, and ground engaging traction means driven by said power plant, of a frame structure attached to the tractor, a mast assembly supported on the frame structure and including a rotatable mast post, an arm pivoted to the mast post for vertical movements, a bucket pivotally connected to the outer end of the arm, means for holding the bucket in digging and load carrying position with respect to said arm and for releasing the bucket from said position so that it will pivot into its load dumping position, means associated with the mast assembly and the bucket for utilizing the downward pivotal movement of the arm for effecting pivotal movement of the bucket from its load dumping position into its digging and load carrying position, means carried by the mast post for effecting pivoting of the arm, and means mounted on the frame structure for effecting rotation of the mast post.

7. In a front end tractor implement, the combination with a tractor of the crawler or wheeled type and having a power plant on its front end portion, of a bucket, means mounted on the tractor rearwardly of its power plant for supporting the bucket for hoisting and lowering movements at the front end of the tractor forwardly of its power plant and for lateral swinging movements in either direction when elevated above the said power plant, and a hydraulic system carried by the tractor for effecting such movements of the bucket.

8. In a front end tractor implement, the combination with a standard tractor having a power plant, and ground engaging traction means driven by said power plant, of a frame structure attached to the tractor, a mast assembly supported on the frame structure and including a rotatable mast post, an arm pivoted at its inner end and supported solely by the mast post for vertical movements, a bucket pivotally supported by the arm, and a hydraulic system for actuating the mast post and arm including a motor supported on the frame structure for rotating the mast post, and a motor supported on the mast post for pivoting the arm relative to the post.

9. In a front end tractor implement, the combination with a standard tractor having a power plant, and ground engaging traction means driven by said power plant, of a frame structure attached to the tractor, a mast assembly supported on the frame structure and including a rotatable mast post, an arm pivoted to the mast post for vertical movements, a bucket pivotally connected to the outer end of the arm, means for holding the bucket in digging and load carrying position with respect to said arm and for releasing the bucket from said position so that it will pivot into its load dumping position, and a hydraulic system carried by the frame structure for effecting rotation of the mast post and pivoting of the arm.

10. In a front end tractor implement the combination with a standard tractor having a power plant, and ground engaging traction means driven by said power plant, of a frame structure attached to the tractor, a mast assembly supported on the frame structure and including a rotatable mast post, an arm pivoted to the mast post for vertical movements, a bucket pivotally connected to the outer end of the arm, means for holding the bucket in digging and load carrying position with respect to said arm and for releasing the bucket from said position so that it will pivot into its load dumping position, means associated with the mast assembly and the bucket for utilizing the downward pivotal movement of the arm for effecting pivotal movement of the bucket from its load dumping position into its digging and load carrying position, and a hydraulic system carried by the frame structure for effecting rotation of the mast post and pivoting of the arm.

11. In a front end tractor implement, the combination with a tractor having a power plant, and ground engaging traction means driven by said power plant, of a base frame including side beams arranged longitudinally of the tractor on opposite sides of said power plant and attached to the tractor under-carriage, a mast assembly supported on the base frame rearwardly of the power plant of the tractor, said mast assembly comprising an upstanding stationary mounting, a vertical mast post rotatably supported by and projecting above the mounting, and a head structure attached to the projecting end portion of the mast post to rotate therewith; a bucket arm pivotally supported by said head structure to partake of vertical movements, a bucket pivotally attached to the outer end of said arm, means carried by the mast post head structure for effecting pivotal movements of the bucket arm.

and means mounted on the base frame for effecting rotation of the mast post relative to its stationary mounting.

12. In a front end tractor implement, the combination with a tractor having a power plant, and ground engaging traction means driven by said power plant, of a base frame arranged longitudinally of the tractor and attached to its under-carriage, a mast assembly supported on the base frame rearwardly of the power plant of the tractor, said mast assembly comprising a mounting, a vertical mast post rotatably supported by the mounting, and a head structure attached to the upper end portion of the mast post to rotate therewith; a bucket arm pivotally supported by said head structure to partake of vertical movements, a bucket, a loose pivotal connection between the bucket and the outer end of said arm to permit the bucket to move between a digging and load carrying position and a dumping position and to permit the bucket to be displaced relative to the end of the arm as a result of thrust developed during digging action, a pair of thrust plates attached to the front end portion of the base frame and engaged by the bucket when displaced to apply the digging thrust directly to the base frame, means carried by the mast post head structure for effecting pivotal movements of the bucket arm, and means mounted on the base frame for effecting rotation of the mast post.

13. In a front end tractor implement, the combination with a tractor having a power plant, and ground engaging traction means driven by said power plant, of a frame structure attached to the tractor, a mast assembly supported on the frame structure and including a rotatable mast post, an arm pivoted to the mast post for vertical movements, a bucket, a loose pivotal connection between the bucket and the outer end of said arm to permit the bucket to move between a digging and load carrying position and a dumping position and to permit the bucket to be displaced relative to the end of the arm as a result of thrust developed during digging action, a pair of thrust plates attached to the front end portion of te base structure and engaged by the bucket when displaced to apply the digging thrust directly to the base structure, and means for effecting rotation of the mast post and pivoting of the arm.

14. In a front end tractor implement, the combination with a tractor having a power plant, and ground engaging traction means driven by said power plant, of a frame structure attached to the tractor, a mast assembly supported on the frame structure and including a rotatable mast post, an arm pivoted to the mast post for vertical movements, a bucket, a loose pivotal connection between the bucket and the outer end of said arm to permit the bucket to move between a digging and load carrying position and a dumping position and to permit the bucket to be displaced relative to the end of the arm as a result of thrust developed during digging action, a pair of thrust plates attached to the front end portion of the base structure and engaged by the bucket when displaced to apply the digging thrust directly to the base structure, means carried by the mast post for effecting pivoting of the arm, and means mounted on the base frame for effecting rotation of the mast post.

15. In a front end tractor implement, the combination with a tractor having a power plant, and ground engaging traction means driven by

said power plant, of a base frame arranged longitudinally of the tractor and attached to its under-carriage, a mast assembly supported on the base frame rearwardly of the power plant of the tractor, said mast assembly comprising a mounting, a vertical mast post rotatably supported by the mounting, and a head structure attached to the upper end portion of the mast post to rotate therewith and including a pair of parallel, horizontally extending bracket arms, and a pair of horizontally aligned stub shafts arranged at right angles to the bracket arms; a bucket arm pivotally supported by said stub shafts, a bucket attached to the outer end of said arm, means mounted on the bracket arms for effecting pivotal movement of the bucket arm, and means mounted on the base frame for effecting rotation of the mast post.

16. In a front end tractor implement, the combination with a tractor having a power plant, and ground engaging traction means driven by said power plant, of a base frame arranged longitudinally of the tractor and attached to its under-carriage, a mast assembly supported on the base frame rearwardly of the power plant of the tractor, said mast assembly comprising a mounting, a vertical mast post rotatably supported by the mounting, and a head structure attached to the upper end portion of the mast post to rotate therewith and including a pair of parallel, horizontally extending bracket arms, and a pair of horizontally aligned stub shafts arranged at right angles to the bracket arms; a bucket arm pivotally supported by said stub shafts, a bucket attached to the outer end of said bucket arm, and a hydraulic system for actuating the mast post and bucket arm including a motor supported by the base frame for rotating the mast post, and a motor supported by the bracket arms for effecting pivotal movement of the bucket arm.

17. In a front end tractor implement, the combination with a tractor having a power plant and ground engaging traction means driven by the power plant, of a frame structure attached to the tractor, a mast assembly supported on the frame structure and including a rotatable mast post, an arm pivoted to the mast post for vertical movements, a bucket pivotably connected to the outer end of the arm, means for holding the bucket in digging and load carrying position with respect to said arm and for releasing the bucket from said position so that it will pivot downwardly into its load dumping position under its own weight, means for controlling the rate of downward pivotal movement of the bucket during dumping to control the rate of spillage of material from the bucket, and means carried by the frame structure for effecting rotation of the mast post and pivoting of the arm.

18. In a front end tractor implement, the combination with a tractor, of a mast assembly supported on the tractor and including a rotatable mast post, an arm pivoted to the mast post for vertical movements relative to said post and for horizontal swinging movements with the post when the later is rotated, a bucket pivotally connected to the outer end of the arm, means for holding the bucket in digging and load carrying position with respect to said arm and for releasing the bucket from said position so that it will pivot downwardly into its load dumping position under its own weight, means carried by the rotatable mast post and operatively connected to the bucket for controlling the rate of downward pivotal movement of the bucket during dumping to

control the rate of spillage of material from the bucket and also operable to utilize the downward pivotal movement of the arm for effecting pivotal movement of the bucket relative to the arm from its load dumping position into its digging and load carrying position, and a hydraulic system carried by the tractor for effecting rotation of the mast post and vertical movement of the arm.

19. In a front end tractor implement, the combination with a tractor having a power plant, of a mast assembly mounted on the tractor and including a rotatable mast post, an arm pivoted to the mast post; a hydraulic system for actuating the mast post and arm including a fluid motor for rotating the mast post, a fluid motor for pivoting the arm, a pump driven by the power plant of the tractor, piping through which fluid is continuously circulated under pressure by the pump, and valve means for selectively applying the fluid under pressure to the aforesaid fluid motors; a bucket pivoted to said arm, a spring-loaded latch for releasably holding the bucket in its digging and load carrying position with respect to the arm, an expansible cylinder connected to the said latch and adapted to be expanded by fluid pressure to trip the latch for releasing the bucket so that the latter will pivot into its load dumping position, a pipe line connecting the expansible cylinder to the piping of the hydraulic system at a point where the fluid is returning for recirculation by the pump, and a valve in said system piping down-stream of the point of connection of the said expansible cylinder pipe line thereto and operable to cause fluid pressure for expanding said cylinder to be built up in the pipe line leading to said cylinder.

20. In a front end tractor implement, a base frame, a bucket arm, means for supporting the bucket arm on the base frame for vertical pivotal movements, a bucket, a loose pivotal connection between the bucket and the outer end portion of said arm to permit the bucket to move between a digging and load carrying position and a dumping position and to permit the bucket to be displaced relative to the end of the arm as a result of thrust developed during digging action, and a pair of thrust plates attached to the front end portion of the base frame and engaged by the bucket when displaced to apply the digging thrust directly to the base frame.

21. In a tractor implement, a mast assembly comprising a mounting, a vertical mast post rotatably supported by the mounting, and a head structure attached to the upper end portion of the mast post to rotate therewith and including a pair of parallel bracket arms, and a pair of aligned stub shafts aranged at right angles to the bracket arms; a work arm pivotally supported by said stub shafts, load carrying means associated with the outer end of the work arm, and means mounted on the bracket arms for effecting pivotal movement of the work arm.

22. In a tractor implement, a mast assembly comprising a mounting, a vertical mast post rotatably supported by the mounting, and a head structure attached to the upper end portion of the mast post to rotate therewith and including a pair of parallel bracket arms, and a pair of aligned stub shafts arranged at right angles to the bracket arms; a work arm pivotally supported by said stub shafts, said work arm comprising an arched branch that straddles the head structure of the mast post and a pair of branches extending at right angles to the arched branch; load carrying means associated with the outer ends of the pair of branches of said work arm; a hydraulic motor including a cylinder pivotally supported by the bracket arms and a piston in the cylinder having its rod projecting from the latter; and means for operatively connecting the piston rod to the arched branch of said work arm for causing movements of the piston in the cylinder to effect pivotal movements of the work arm.

23. In a tractor implement, a mast assembly comprising a mounting, a vertical mast post rotatably supported by the mounting, a head structure attached to the upper end portion of the mast post to rotate therewith and including a pair of parallel bracket arms, and a pair of aligned stub shafts arranged at right angles to the bracket arms; a work arm pivotally supported by said stub shafts, said work arm comprising an arched branch that straddles the head structure of the mast post, and a pair of branches extending at right angles to said arched branch; load carrying means associated with the outer end of the work arm, and means mounted on the bracket arm for effecting pivotal movement of the work arm.

24. In a tractor implement, a mast assembly comprising a mounting, a vertical mast post rotatably supported by the mounting, a head structure attached to the upper end portion of the mast post to rotate therewith and including a pair of parallel branch arms, and a pair of aligned stub shafts arranged at right angles to the bracket arms; a work arm pivotally supported by said stub shafts, load carrying means associated with the outer end of the work arm; a hydraulic motor including a cylinder pivotally supported by the bracket arms and a piston in the cylinder having its rod projecting from the latter; and means for operatively connecting the piston rod to the said work arm for causing movements of the piston in the cylinder to effect pivotal movements of the work arm.

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2,190,346	Austin	Feb. 13, 1940
2,242,511	Cook	May 20, 1941
2,260,539	Ruddock	Oct. 28, 1941
2,304,443	Butler	Dec. 8, 1942
2,387,764	Maxwell	Oct. 30, 1945
2,391,857	Arps et al.	Jan. 1, 1946
2,412,412	Meili	Dec. 10, 1946
2,413,095	Barker	Dec. 24, 1946
2,413,096	Barker	Dec. 24, 1946
2,413,097	Barker	Dec. 24, 1946
2,416,893	Barker	Mar. 4, 1947