

Feb. 13, 1951

R. FERWERDA ET AL
MATERIAL MOVING APPARATUS

2,541,045

Filed May 15, 1944

5 Sheets-Sheet 3

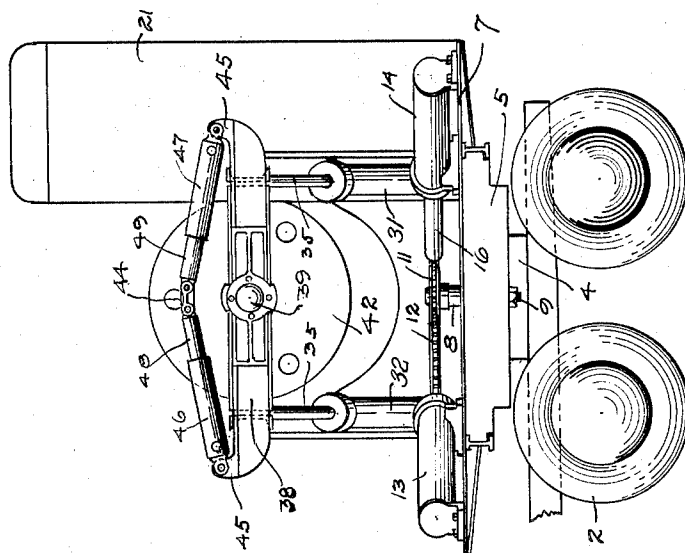


FIG. 4

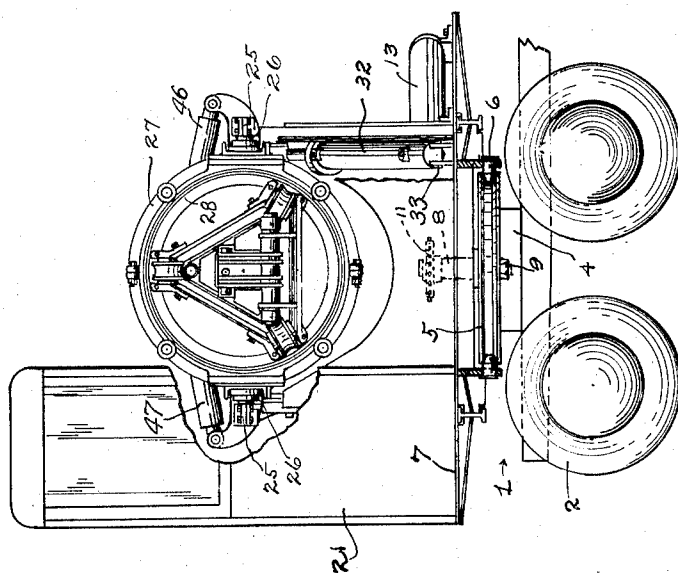


FIG. 3

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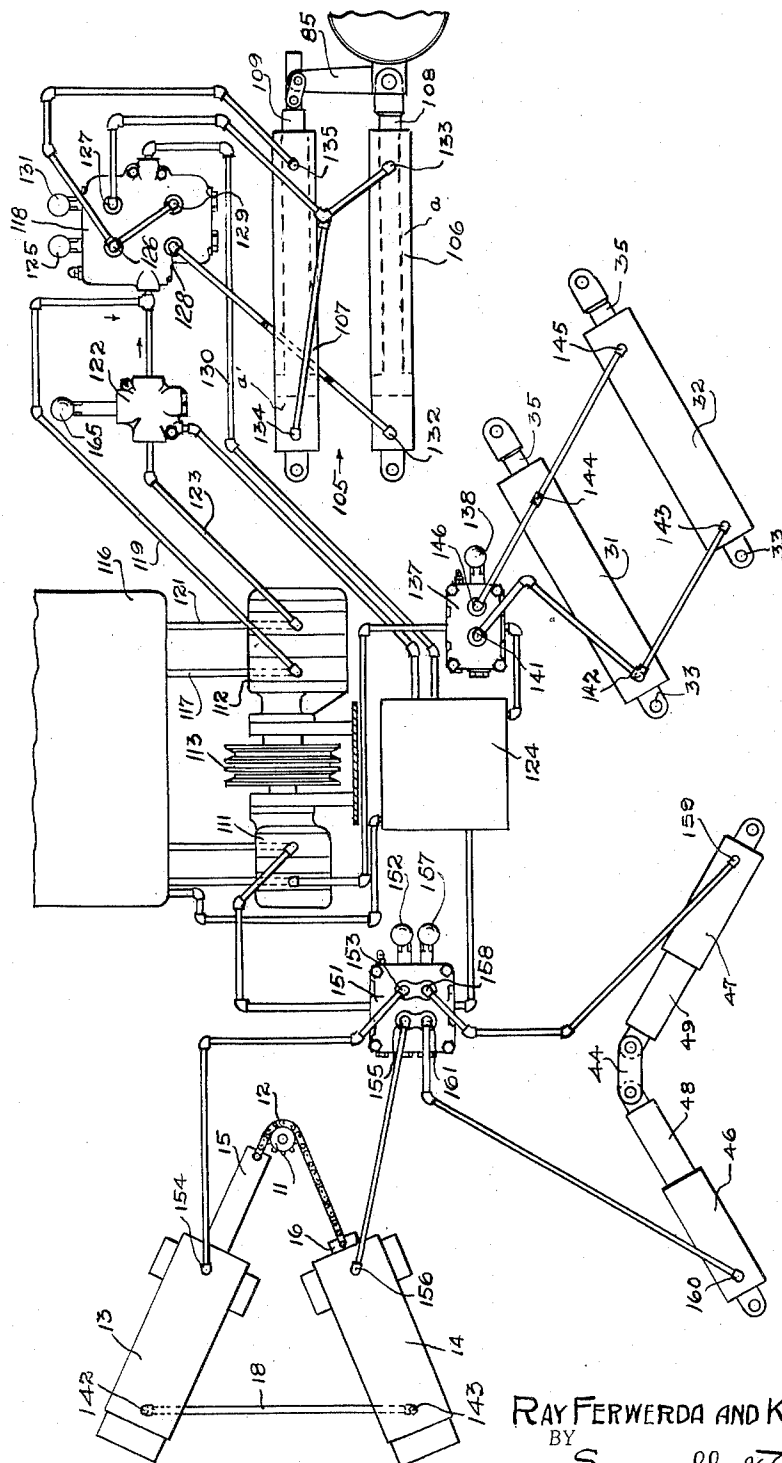


FIG. 5

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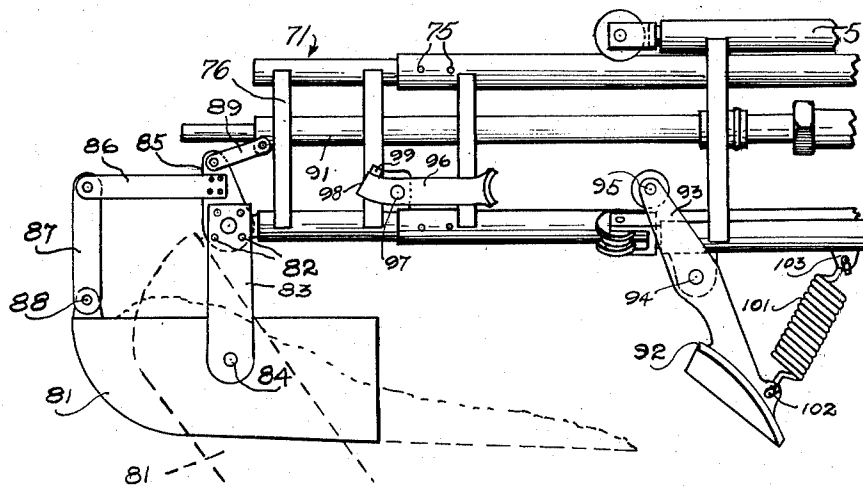


FIG. 6

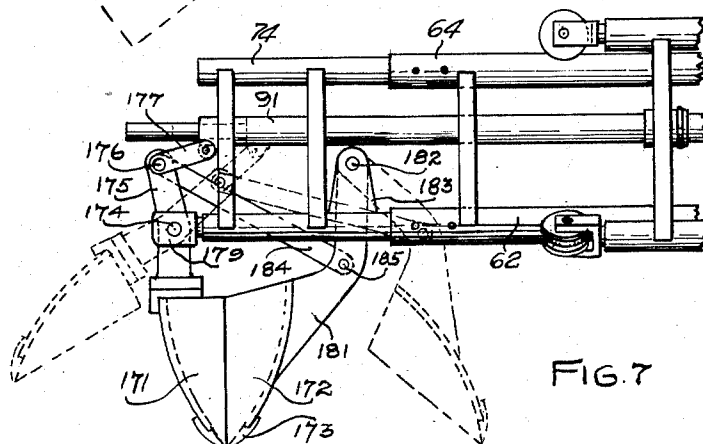


FIG. 7

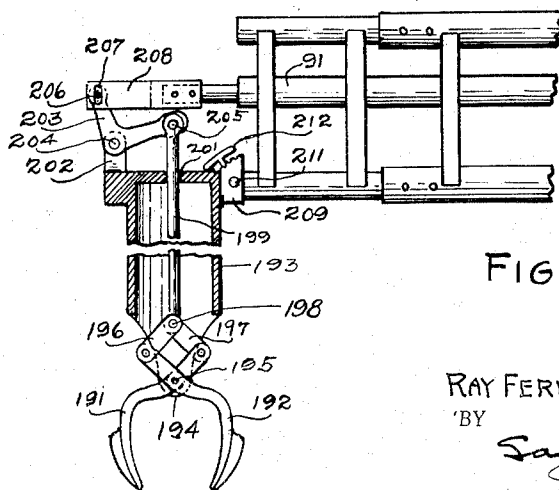


FIG. 8

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UNITED STATES PATENT OFFICE

2,541,045

MATERIAL MOVING APPARATUS

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Application May 15, 1944, Serial No. 535,706

16 Claims. (Cl. 214—132)

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This invention, as indicated, relates to a material moving apparatus. More particularly, it relates to a means of more expeditiously carrying out various operations wherein material is elevated and moved to a predetermined position or carried to a distant place of disposal. It is of particular utility for earth-working operations or for handling bulk material, such as sand, gravel, coal, snow, ashes, chemicals, minerals and other similar materials. The apparatus is in the nature of a universal earth-working machine adapted in a single unit to perform functions usually carried out by specialized types of apparatus, such as graders, bull-dozers, slopers, motor patrols, ditchers and the like. This is a continuation in part of our Patent 2,348,796, May 16, 1944.

The invention includes an apparatus with an extension boom of exceptional radius of action, and with precision control, and with positive locking features which is adapted for operating in places where other apparatus could not function. It also includes material gathering and lifting operations of wide variety and at a relatively high rate of speed and with simple effective control and manipulation. The invention includes a combined boom extension and implement positioning mechanism of simple character and relatively light weight which may operate wholly different types of implements.

In the form illustrated the implement is embodied in a hoe-type scoop which may be operated alone or as a surface finishing unit, or may be moved into cooperative action with a closure member whereby the scoop will act somewhat after the manner of a bucket or shovel. It thus can shape the adjacent earth surface and scrape excess material to a loading point and then rapidly perform the loading operation. Besides the scoop a double cylinder mechanism is provided to operate the same, such mechanism elongating the boom to a degree suited to the work in hand and at the same time permitting an irreversible adjustment of the scoop or scraper angle particularly suited for such operation. In addition to utilizing a double cylinder mechanism for a scoop or scraper type implement, various other highly specialized types of implements may be used, including ditching type units, clam-shell diggers, specialized rakes and the like.

The invention includes the method of material moving whereby the operations of engaging the load and thereafter moving the load to another position is carried on by a combined unit having a differential action to permit such dual function.

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The invention also includes the method of material moving through the use of hydraulically controlled elements operating in pairs and adapted to be moved relatively to each other under various operative conditions of the apparatus.

The principal object of the present invention is to provide an improved type of material moving apparatus adapted to fulfill a wide variety of operations with high efficiency.

Another object of the invention is to provide an apparatus adapted to move material to a loading point and thereafter to load such material on vehicles for transportation to other locations.

Another object of the invention is to provide an apparatus suitable for earth-working at various operative angles in the direction of earth movement and transversely thereof.

Another object of the invention is to provide an apparatus having an extensible boom and a material handling implement at the end thereof with dual operative means serving to elongate the boom and to operate such implement at any predetermined angle and thereafter to retract the boom to any predetermined extent.

Another object of the invention is to provide a material moving apparatus operated by a hydraulic system of control and wherein a specialized implement is provided forming part of the hydraulic system and subject to harmonious control with the movement of the apparatus.

Another object of the invention is to provide a method of material moving wherein a dual system of control is employed for engaging the material and thereafter moving it to a predetermined position.

Another object of the invention is to provide a method of engaging certain material to be moved by means associated with the moving operation and operable at any range of movement of such apparatus, in conjunction with such moving mechanism.

Other and further objects of the invention will appear in the course of the following description.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims, the annexed drawing and the following description setting forth in detail certain means embodying the invention, such disclosed means constituting, however, but several of various forms in which the principle of the invention may be used.

In said annexed drawing:

Fig. 1 is a rear end view of the vehicle base sup-

porting apparatus with the material moving apparatus shown in side elevation;

Fig. 2 is a top plan view of the structure shown in Figure 1;

Fig. 3 is a view of the structure shown in Figure 1 as seen in elevation from the left-hand side of Figure 1, or front of the material moving apparatus, the implement being omitted;

Fig. 4 is a view of the structure shown in Figure 1 as seen in elevation from the right-hand side of Figure 1;

Fig. 5 is a diagrammatic view or schematic outline of the hydraulic control system;

Fig. 6 is a side elevation of the forward boom end portion showing a hoe-type scoop and closure in open position, and with a scraper angle adjustment shown in dotted lines;

Fig. 7 is a side elevation of a clam shell bucket type implement in closed position, with the open position shown in dotted lines; and

Fig. 8 is a side elevation partly in section of a deep ditching type implement.

As is clearly shown in Figures 1 to 4 of the drawing, the material moving apparatus comprises a support 1, preferably in the form of a vehicle of rigid construction with heavy wheels 2 and axles 3 and a substantial frame or body member 4, on the upper side of which a circular turntable unit 5 provided with roller bearings 6 is mounted. The upper turntable member is secured to the under side of an enlarged platform 7, which is provided at a central point with an opening through which a fixed vertical standard 8 secured at its lower end 9 to the vehicle body member 4, is engaged. The standard 8 carries at its upper end a stationary sprocket 11, over which a sprocket chain 12 is engaged. The sprocket chain 12 is preferably of a length adequate to carry the platform 7 through a rotation around the turntable of at least a complete circle.

The means for rotating the platform in the full hydraulic system illustrated provides a hydraulic cylinder unit at each end of the sprocket chain 12. These cylinder units 13, 14, are preferably anchored on the platform floor along diagonal lines at each of the rearward corners. Each cylinder should be of sufficient length to permit its piston rods 15, 16, respectively, a long range of motion. A double acting valve in the valve unit 151, presently to be described, supplies oil under pressure selectively to one or the other of these cylinders according to the direction of motion desired. An air line connection 18 between the two cylinders, transfers air from one cylinder to its companion cylinder to correspond with the direction of movement.

The rotatable platform 7, at its forward portion at one side is provided with an operator's cam 21, and the valve controls are centered at such point, as will later be described in detail.

Centrally of the platform 7, an extensible boom 22 is provided, the forward portion of the main body of the boom projecting beyond the front edge of the platform, in the apparatus illustrated, approximately half its length. In order to obtain longer range of action and balanced operation the boom is pivoted on the platform at an intermediate point, in the apparatus illustrated, at a point approximately one-third the distance from its rearward end. The horizontal pivot for the boom is somewhat in advance of the turntable center and is part of a broad rigid structure supporting the boom horizontally in a plane

some distance above the floor of the platform 7.

The supporting structure for the boom 22 comprises a pair of heavy plates 23, 24, securely mounted centrally of the platform 7 and spaced apart a distance somewhat greater than the turntable width. At the forward upper edges of the plates trunnion bearings 25, are mounted, within which the stub axles 26 are engaged, the stub axles being secured to the opposite sides of an annular roller bearing track 27 within which an annular roller bearing shell 28 is rotatably engaged. The plates 23, 24, are cut away on an angle at their rearward portion 29 to a point adjacent the floor of the platform and immediately inside the walls thus provided, boom raising and lowering cylinders 31, 32, are pivotally mounted on pivot bearings 33 mounted on the platform immediately below the trunnion bearings 25 of the boom. The piston rods 35 of the boom raising and lowering cylinders are pivotally engaged with pivot pins 35' mounted in brackets 36 at the lower rearward ends of a rearwardly extending frame 37 securely mounted on the rearward face of the annular roller bearing track 27 heretofore described.

The rearward portion of the frame 37 is formed of a built-up cross-member 38 having a large central bearing 39 for the main rotatable boom body 51 which terminates in a large circular end plate 42, carrying centrally a stub shaft (not shown) engaged in the bearing 39. The end plate 42 also has securely mounted thereon a bracket 44 providing two pivot pins adjacent its upper margin above the central bearing 39.

The cross-member 38 has upturned end members providing spaced brackets 45 within which are mounted the axially rotating, tilting, cylinders 46, 47. The pistons 48, 49, of said cylinders are connected to the respective pivot pins of the bracket 44, and oil pressure selectively directed into one of these cylinders produces axial rotation of the entire boom structure, as will be explained in detail hereinafter.

The extensible axially rotatable boom structure comprises the rearward section 51, preferably formed of a skeletonized frame of three tubular members 52, 53, 54, of extended length secured in the rearward end plate 42, preferably arranged in triangular relation to provide two lower parallel track-ways 52, 53, and a central upper trackway 54.

The rearward boom section 51 is securely engaged within the annular roller bearing shell 28 which, as stated, rotates within the annular roller bearing trackway heretofore described. Adjacent its forward end the boom section 51 is provided with a triangular bracing member 55, and it may also have one or more similar intermediate bracing members, such as shown at 56.

At the extreme forward ends of the tubular members 52, 53, 54, brackets 57 carrying grooved rollers 58 are provided for cooperation with the extensible or telescopic inner boom section 61. The boom section 51 is preferably made very rigid and its central portion may be provided with reinforcing webs or gusset plates of sheet metal 59 welded to the tubular members 52, 53, 54 on their outer surfaces or to the brace bars secured thereto.

The inner boom section 61 is very similar in construction to the outer boom section 51 having three triangularly related tubular members 62, 63, 64, with bracing members 65 at intervals of their length. At their rearward ends the

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tubular members 62, 63, and 64 each carry a bracket 65 carrying a grooved roller 67 similar to the rollers 58 on the boom section 51. It will be noted that the tubular members of the inner boom section bear against the rollers 58 at the forward end of the boom section 51, and that the rollers 67 on the rearward end of the section 61 bear against the tubular members of the boom section 51. The structure thus has very little friction to overcome when the boom extension moves outwardly or in the reverse direction.

The two boom sections 51 and 61 just described provide all the range of action usually required by the work in hand, but occasionally a somewhat greater extension is necessary where otherwise inaccessible areas are to be covered. Such additional range is provided by a manually adjustable telescopic section mounted on the forward end of the inner boom section 61.

This auxiliary boom section 71 is provided with tubular members 72, 73, 74, formed of tubes of a diameter to slidingly engage within the tubular members 62, 63, 64. The auxiliary boom section 71 may be adjusted to several different lengths of extension, being held by locking pins 75 engaged in aligned apertures through the tubular members. The forward portions of such tubular members have bracing members 76.

As has been stated, various types of material moving implements may be used with the apparatus, but the particular implement shown in Figures 1 and 6 is the preferred type inasmuch as it lends itself to a wide degree of operative adjustments and includes the material loading elements along with the scraping and shaping adjustments of the device. The implement as illustrated comprises a hoe-type scoop member 81 connected with the forward end of the inner boom member 61 by means of rivets 82 engaged through depending arms 83 secured to the respective sides of the scoop by means of trunnions 84. Operating arms 85 are pivoted above the arms 83, and such operating arms have forward extension members 86 connected by means of links 87 with pivots 88 on the closed end of the hoe-type scoop. A link 89 pivotally connected with a sleeve 91 adapted to be secured to the piston rod of the control cylinder 107 will be presently described. The hoe-type bucket may thus be turned to any desired angle of contact with the surface operated on, and is adapted to be drawn against a load of material, thus filling the scoop and thereafter will be closed upon reaching a position of contact with a closure 92 mounted on the non-sliding telescopic section 51 of the boom. The closure 92 comprises a suitably shaped plate or gate and conforming to the general configuration of the scoop when in closed position. The closure is carried on arms 93 at each side of the frame 51, such arms having central pivots 94. Said arms are provided with cross-pins 95 adapted to be engaged by closure operating arms 96 supported on pivot pins 97 adjacent the end of the inner boom section. Said closure operating arms have short extensions 98 engaging against stop lugs 99 mounted on adjacent bracing elements. The closure is normally held in open position by means of a spring 101 engaged with an apertured lug 102 centrally of the closure member with the opposite end of the spring engaged with an apertured lug 103 mounted on the under side of the frame section 51.

The hoe-type scoop structure just described is shown in closed position in Figure 1 and in open position in Figure 6. In the last-mentioned posi-

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tion, the scoop body may be turned to a number of angular positions, one of which is indicated in Figure 6, in which position it may act as a scraper blade. This angular adjustment of the blade is preferably brought about by means of a dual cylinder operating unit, positioned within the skeletonized boom structure.

As is shown in Figures 1 and 5 the boom extension and blade or implement control cylinders are an operative unit 105 comprising the main cylinder 106 and the positioning cylinder 107, which provide equal areas a and a' within the respective cylinders causing pistons 108 and 109 to move in unison when the boom is to be elongated. When the blade 81 or other implement is to be turned to a different angle to the line of operation, the differential action of the valves is made use of and the desired angular adjustment brought about. When so adjusted the angular relation set up is maintained due to certain of the valve passageways being closed and a fluid lock thus established.

The fluid pressure is provided by a closed hydraulic system wherein two oil pumps are driven by a gas engine which may be mounted on the platform 7 as shown in dotted lines in Figure 1.

The operation of the various elements embodied in the apparatus will best be understood by reference to Figure 5 which shows diagrammatically the complete hydraulic system with the actuating cylinders and pistons and their associated mechanism. In the closed hydraulic system just referred to two oil pumps 111, 112 are provided with an intermediate pulley drive 113 which, as indicated in Figure 1, is connected by means of suitable belts with a gas engine. The mechanism for operating the boom extension and blade or scoop position will next be described.

One pump member of the dual pump 112 draws oil from the reservoir 116 through the pipe 117 and supplies it to the valve 118 through the pipe 119. The companion pump member of the dual pump 112, supplies oil from the reservoir 116 through the pipe 121 to the valve 122 through the pipe 123. The valve 122 is a single acting valve that diverts the flow from the pump to either the valve 118 or to the manifold tank 124.

When oil is diverted through the valve 122 into the valve 118 it will double the volume and thereby double the speed of the boom movement. When the plunger 125 of the valve 118 is in neutral position the ports 126 and 128 are blocked off and the oil passes freely through the valve 118 and through the pipe 130 to the manifold 124. When the plunger 131 is in neutral position the ports 127 and 129 are also blocked off. When the plunger 125 for operating the boom extension is pulled out the oil flows from the valve port 128 to the cylinder port 122. As the boom is extended the oil flows from the cylinder port 133 to the cylinder port 134 of the cylinder 107. At such time the oil cannot flow to the valve port 127 because this port is blocked off by the plunger 131 when the handle is in neutral position. The oil flows from the cylinder port 135 into the valve port 126 and through to the manifold tank 124. When the plunger 125 is pushed in the oil flow is reversed. The oil leaves the valve port 126 and flows into the cylinder port 135 and out of the cylinder port 134 into the cylinder port 133, out of the cylinder port 132 into the valve port 128, and back into the manifold tank 124.

The displacement of the cylinder 107 is less than the displacement of the cylinder 106 to compensate for the differential caused by the

piston rod displacement. This allows the piston rod of the cylinder 107 to extend at the same rate as the piston rod in the cylinder 106.

While combined extension of the boom and operation of the implement may be carried on under certain conditions, the operation of the apparatus has in view the use of one valve at a time. However, where bulk material is to be moved as the apparatus traverses an area on its own power or with a tractor, for example, in pushing back high snow drifts by stages in successive levels from the top of the snowbank with the boom held stationary at the selected working height and angle, the blade may be continuously adjusted as to the contact angle to spill or roll the snow into the proper line of discharge while the work is in progress.

When the blade or scoop operating plunger 131 is pushed in, oil flows from the valve port 127 to the cylinder ports 134 and 133. But oil will not flow through the cylinder 106 because the piston is locked due to the valve port 128 being blocked. As oil enters the cylinder port 134, oil leaves the cylinder port 135 and the piston operates the lever or operating arm 85 on the blade or scoop adjusting it to the required angle. Oil enters the valve at the port 129 since the port 126 is blocked off. When the plunger 131 is pulled out oil flows out of the valve port 129 into the cylinder port 135 retracting the piston. Oil leaves the cylinder port 134 and enters the valve port 127 returning to the manifold tank 124.

The hydraulic system for raising and lowering the boom comprises a simple double acting valve associated with two double acting hoists connected in parallel.

Oil is supplied from one pump of the dual pump unit 111 to the valve 137. When the valve plunger 138 is in its neutral position oil by-passes through the valve into the manifold tank 124. When the valve plunger 138 is pulled out in boom raising position, oil flows out of the valve port 141 and into the cylinder ports 142, 143 raising the boom. Oil leaves the cylinder ports 144 and 145 and returns to the valve port 146. When the valve plunger 138 is pushed in to lower the boom, oil leaves the valve port 146 and enters the cylinder ports 144 and 145. Return oil passes through the cylinder ports 143 and 142 into the valve port 141 and thence into the manifold tank 124.

The axially rotating, the tilting operation and the turntable rotation or sluing operation are each carried out by means of two double acting valves each of which is connected to single acting cylinders which oppose each other. The valve 151 is supplied from one of the pumps 111 of the dual pump assembly. When the valve plunger 152 is pushed in, oil flows from the valve port 153 into the port 154 of the cylinder 13. Since the cylinder 13 is fastened to the rotatable platform 7 and the sprocket wheel 11 is stationary the movement of the chain will turn the cylinders and platform pivoted on the turntable 5 in a clockwise direction. This movement will extend the companion plunger or piston rods 16 in cylinder 14 and the oil will flow from the cylinder port 156 into the valve port 155 and thence to the manifold tank 124. The pipe line 18 between the two cylinders transfers air from one cylinder to the other. When the valve plunger 152 is pulled out, oil flows from the valve port 155 into the cylinder port 156 and causes a counter-clockwise rotation of the rotatable platform 7. Oil flows from the cylinder port 154 into the valve port 153

and into the manifold tank 124. When the valve plunger 157 is pulled out, oil flows from the valve port 158 into the cylinder port 159 forcing the piston 49 from the cylinder 47 causing the companion piston 48 to be forced into the cylinder 46 and its oil to flow from the cylinder port 160 into the valve port 161 and thence to the manifold tank 124.

When the valve plunger 157 is pushed in its operation is reversed. Oil flows from the valve port 161 into the cylinder port 160 which will cause oil to flow from the cylinder port 159 into the valve port 158 and thence to the manifold tank 124.

All oil from the manifold tank 124 flows into the reservoir supply tank 116 which in turn feeds the two dual pumps 111, 112, as heretofore described.

It is to be understood that the main oil supply tank 116 and the manifold tank 124 may be arranged on the apparatus at any convenient position, such as beneath the internal combustion engine shown in Figure 1. The several control valves with the valve plungers are positioned within a valve housing 100, mounted within the cab, and connected beneath the floor by suitable pipe lines with the oil supply tanks and cylinders as clearly shown in the diagrammatic view or schematic outline comprised in Figure 5.

The various valves used to effect the operations just described co-operate with each other as follows:

Valve 122 controls by means of the plunger 165 the flow through the pipe 123 shown in Figure 5 to divert the oil into valve 118 controlling the boom extension and blade, angle, position, or to by-pass such oil to the manifold 124.

The valve 118 just referred to controls by means of the plungers 125 and 131, the extension of the boom with the pistons 108 and 109 (shown in Figure 5) moving in unison and by differential action of said valve as heretofore described in connection with Figure 5 controlling the operative angle, or operation, as the case may be, of the implement mounted on the free end of the boom.

The valve 137, by means of the plunger 138, controls the vertical angle of the boom and holds it locked in adjusted position, as above described.

The valve structure 151 provides two double acting valves, each connecting with a separate hydraulic operating unit. The valve plunger 152 controls the horizontal angle of the platform and locks the same in adjusted position as above described in connection with Figure 5 and the valve plunger 157 controls the axial rotation of the boom as set forth above.

As has been stated, the structure shown in Figure 7 is substantially identical with the hoe-type scoop 81 heretofore described and illustrated in Figure 1. Two different types of implements to be actuated through the differential action of the dual hydraulic cylinder units are illustrated in Figures 7 and 8.

In Figure 7 a clam shell bucket-type of implement is illustrated, the open position being shown in dotted lines. The clam shell implement comprises two complementary shells, 171, 172, having reinforced marginal edges 173. The member 171 is provided with a pivot 174, centrally of an extension arm 175, mounted on the upper edge of said member. The extension arm is provided with a pivot 176 at its upper end, connected by a link, 177, with the sleeve, 91, secured to the piston rod of the control cylinder, 107. The pivot 174 is

supported on a bracket, 179, connected with the auxiliary section of the boom. The shell member 172 carries an extension arm, 181, having a pivot 182 at its extreme upper end, engaged with a bracket, 183, removably mounted on the auxiliary frame. A cross link, 184, is connected with an intermediate portion of the arm, 181, by means of a pivot pin, 185, and at its opposite end is engaged on the pivot pin 176, heretofore described. It is believed the operation of the device will be obvious from the description of its construction, and the showing in dotted lines in Figure 7, wherein the retraction of the operating piston 91 serves the purpose of swinging the shells widely apart.

The structure shown in Figure 8 is intended for use in deep-ditching operations, and the like. It is somewhat in the nature of a post-hole digger in its structural features, but the jaws of the implement 191, 192 are appropriately in shape for the work in hand. The jaws are supported on a tubular member, 193 of extended length, the lower end of which is cut away to provide a narrow terminal portion, 194, provided with a pivot pin, 195. Toggle links 196, 197 are provided at the upper ends of the arms supporting the jaws above the pivot, 195, and the toggle links are connected to a pivot pin 198 on the end of an operating rod, 199, extending through a central aperture 201 at the upper end of the tubular member, 193. An upstanding lug, 202, is provided on the forward edge of the upper portion of the tubular member, 193, and a bell-crank lever is pivotally mounted on a pivot pin, 204, on said lug. One end of the bell-crank lever is provided with a slot which engages over a pivot pin, 205, in the upper end of the operating bar, 199. The opposite end of the bell-crank lever carries a pin, 206, engaged in a slot, 207, in an extension plate, 208, secured by suitable fastening devices to the end of the operating piston, 91. Various means of fastening the tubular member to the auxiliary section of the boom may be used, but an adjustable device is desirable in order to have the ditching operation take place on approximately a vertical line, with the operating apparatus at various angles to the work at hand. A plate, 209, is provided secured to the forward end of the auxiliary section of the boom, having a curved front edge, provided with notches permitting various angles of adjustment. The tubular member is pivotally secured centrally of the plate by means of a heavy pin, 211, and a latch member, 212, engaging in the notches serves to hold the tubular member at various angles of adjustment.

Other modes of applying the principle of our invention may be employed instead of those explained, change being made as regards the means herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

We therefore particularly point out and distinctly claim as our invention:

1. An apparatus of the character described having in combination a vertical support, a platform rotatable on said support, standards on said platform, a telescopic boom pivotally supported on said standards, hydraulically operated means for moving said boom on its pivot, hydraulic means for operating the telescopic elements of said boom, a scoop member on said boom end and a closure member for said scoop movably supported inwardly thereof on the guide portion of said boom, and means automatically bringing said closure member into closing action through

the inward movement of said scoop toward said closure member.

2. An apparatus of the character described having in combination a support, a rotatable platform on said support, a pair of standards on said platform, a vertically adjustable frame pivotally mounted on said standards, an axially rotatable main boom section supported on said frame, means acting between said frame and said boom section for axially rotating the same, at least one extension boom section slidably mounted within said main boom section, a material moving implement carried at the free end of an extension boom section, and means acting between said main boom section and an extension boom section for projecting and retracting the same, and associated means for changing the angle of said implement with reference to its supporting boom extension section.

3. Apparatus comprising, a vehicular base, a boom on the base mounted for sluing and comprising a free end, the boom comprising a main member attached to the base and extending outwardly therefrom, a working member movable longitudinally of the main member to extend and retract the free end of the boom and operable to perform a working stroke by retracting the free end of the boom, a scooping implement attached to the working member at the free end and operated by the working member performing a working stroke, a closure member for the scooping implement attached to the main member at its free end and being positionable to automatically close the implement when the working member of the boom is retracted, and a power system operable to slue the boom and to actuate the working member.

4. Apparatus comprising, a vehicular base, a boom on the base mounted for sluing and comprising a free end, the boom comprising a main member attached to the base and extending outwardly therefrom, a working member movable longitudinally of the main member to extend and retract the free end of the boom, a scooping implement attached to the working member at the free end, a closure member for the scooping implement movably attached to the main member at its outward end and being positionable to automatically close the implement when the working member of the boom is retracted, means operable by the retracting movement of the working member to actuate the closure member into position to close the implement, and a power system operable to slue the boom and to actuate the working member.

5. Apparatus comprising, a vehicular base, a boom on the base mounted for sluing and comprising a free end, the boom comprising a main member attached to the base and extending outwardly therefrom, a working member movable longitudinally of the main member to extend and retract the free end of the boom, a scooping implement attached to the working member at the free end, a closure member for the scooping implement movably attached to the main member at its free end and being positionable to automatically close the implement when the working member of the boom is retracted, means operable by the retracting movement of the working member to actuate the closure member to push material into the scooping implement and to close the implement, and a power system operable to slue the boom and to actuate the working member.

6. Apparatus comprising a base, a boom

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mounted on said base for sluing, mechanism for sluing said boom, said boom having a base section and an extensible section telescopically mounted on said base section, mechanism to extend and retract said extensible section, an implement attached to the free end of said extensible section and having a working edge, said base section having a transverse pivotal mounting, mechanism for tilting said base section about said pivotal mounting, one of said boom sections having a fixed orientation relative to said implement working edge, said one boom section being mounted for oscillation about an axis extending longitudinally of said boom, and mechanism for oscillating said one boom section.

7. Apparatus comprising a base, a boom mounted on said base for sluing, mechanism for sluing said boom, said boom having a base section and an extensible section telescopically mounted on said base section, mechanism to extend and retract said extensible section, an implement attached to the free end of said extensible section and having a working edge, said implement having a fixed orientation relative to the longitudinal axis of said extension section, said base section having a transverse pivotal mounting, mechanism for tilting said base section about said pivotal mounting, means mounting said base section for oscillation about an axis extending longitudinally on said boom, said extensible section being mounted non-oscillatably about said axis relative to said base section, and mechanism for oscillating said base section about said axis.

8. Apparatus comprising a base, a boom mounted on said base for sluing, mechanism for sluing said boom, said boom having a base section and an extensible section telescopically mounted on said base section, mechanism to extend and retract said extensible section, an implement attached to the free end of said extensible section and having a working edge, said implement having a mounting on said extensible section including a linear pivot extending crosswise of said boom, means for holding said implement in various positions about said pivot, said base section having a transverse pivotal mounting, mechanism for tilting said base section about said pivotal mounting, means mounting said base section for oscillation about an axis extending longitudinally of said boom, said extensible section being mounted non-oscillatably about said axis relative to said base section, and mechanism for oscillating said base section about said axis.

9. Apparatus comprising a base, an annular track having a horizontal pivotal mounting on said base, a telescoping boom having a base section and an extensible section slidable longitudinally of said base section, said base section having an annular bearing in said track so arranged that said base section of said boom is held against longitudinal movement relative to said annular track, power means operatively connected between said base and said base section of said boom for tilting said boom about said horizontal pivotal mounting, power means operatively connected between said base section and said annular track for oscillating said boom in said bearing about an axis longitudinal of said boom, mechanism operatively connected between said base section and said extensible section for extending and retracting said extensible section of said boom, and an implement attached to the free end of said extensible section

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in fixed orientation about the longitudinal axis of said extensible section.

10. Apparatus comprising a vehicular base, a rotatable platform on said base, an annular track having a horizontal pivotal mounting on said platform, a telescoping boom having a base section and an extensible section slidable longitudinally of said base section, said base section having an annular bearing in said track so arranged that said base section of said boom is held against longitudinal movement relative to said annular track, said base section on the side of said bearing opposite said extensible section lying wholly within the dimensions of said base, power means operatively connected between said base and said base section of said boom for tilting said boom about said horizontal pivotal mounting, power means operatively connected between said base section and said annular track for oscillating said boom in said bearing about an axis longitudinal of said boom, mechanism operatively connected between said base section and said extensible section for extending and retracting said extensible section of said boom, and an implement attached to the free end of said extensible section in fixed orientation about the longitudinal axis of said extensible section.

11. In material handling apparatus of the character described, a telescopic boom comprising a base section and an extensible section movable longitudinally relative to said base section, a scooping implement attached to said extensible section and having an open side toward said base section, a closure member for said implement open side positioned on said base section to register with and close said open side when said extensible section and implement are retracted toward said base section, and means for extending and retracting said extensible member.

12. The combination of claim 11 including a pivotal mounting for said closure member permitting oscillation of said closure member toward and away from said open side, and mechanism for so oscillating said closure member.

13. The combination of claim 11 including a pivotal mounting for said closure member permitting oscillation of said closure member toward and away from said open side, and means operable by retracting movement of said extensible section for oscillating said closure member toward said implement open side.

14. In material handling apparatus of the character described, a telescopic boom comprising a base section and an extensible section movable longitudinally relative to said base section, a scooping implement attached to said extensible section in fixed orientation relative thereto, said base section comprising a plurality of spaced parallel beam members, a fixed annular track, a bearing secured to the base section of said boom and engaging in said track for mounting said base section of said boom for oscillation about its own longitudinal axis, mechanism operatively connected between said track and said base section for so oscillating said boom, and mechanism operatively connected between said base section and said extensible section for extending and retracting said extensible section.

15. In material handling apparatus of the character described, a telescopic boom comprising a base section and an extensible section movable longitudinally relative to said base section, a scooping implement attached to said extensible section in fixed orientation relative thereto,

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said base section comprising a plurality of spaced parallel beam members, a bearing mounting said base section for oscillation about its own longitudinal axis, a horizontal pivotal mounting for said bearing mechanism for oscillating said base section in said bearing, mechanism for tilting said bearing and base section about said horizontal pivotal mounting, and mechanism for extending and retracting said extensible section.

16. An apparatus of the character described having in combination a support, a platform pivotally mounted on said support, hydraulic means for rotating said platform acting between said platform and said support and operative through an angle of not less than 180 degrees of circular movement around its pivot, a telescoping boom comprising a base section and an extensible section, means mounting said base section on said platform for boom oscillation about an axis longitudinal of the boom, a horizontal pivot for said base section mounted on said platform, hydraulic means for tilting said base section about said horizontal pivot, hydraulic means for rotating said boom base section axially, hydraulic means for extending said extensible boom section, a material moving implement pivotally mounted on said extensible section, and means for moving said implement about its pivotal mounting.

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