

March 8, 1960

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2,927,706

HYDRAULICALLY-OPERATED DIPPER

Filed July 20, 1956

4 Sheets-Sheet 1

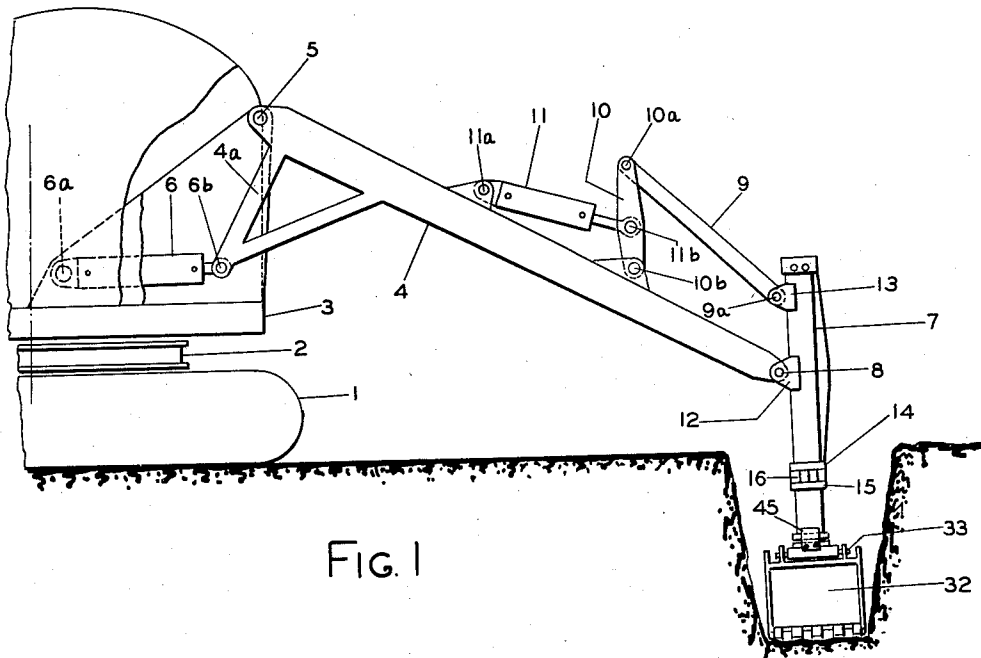


FIG. 1

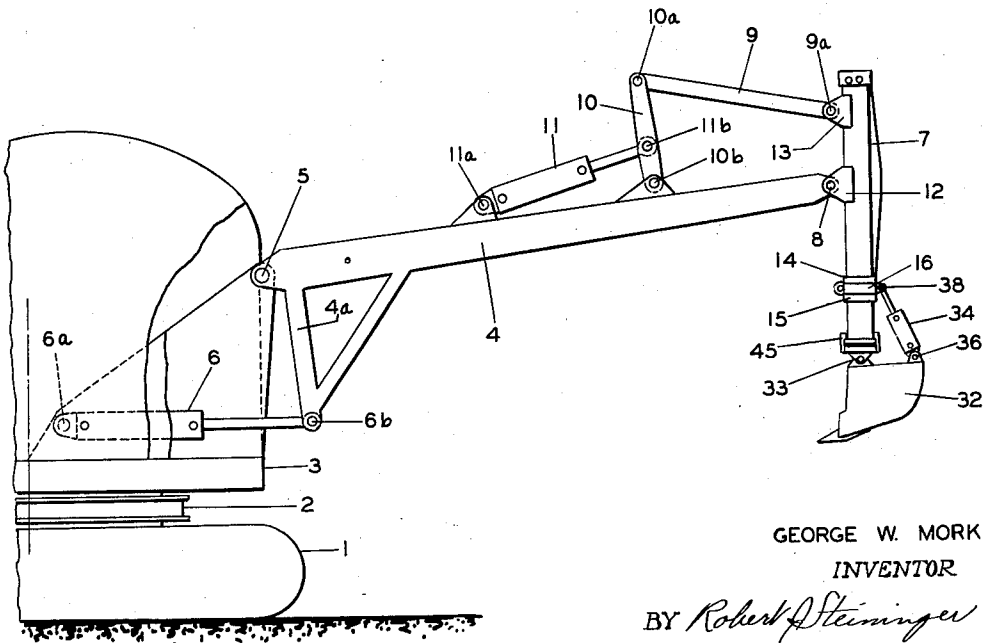


FIG. 2

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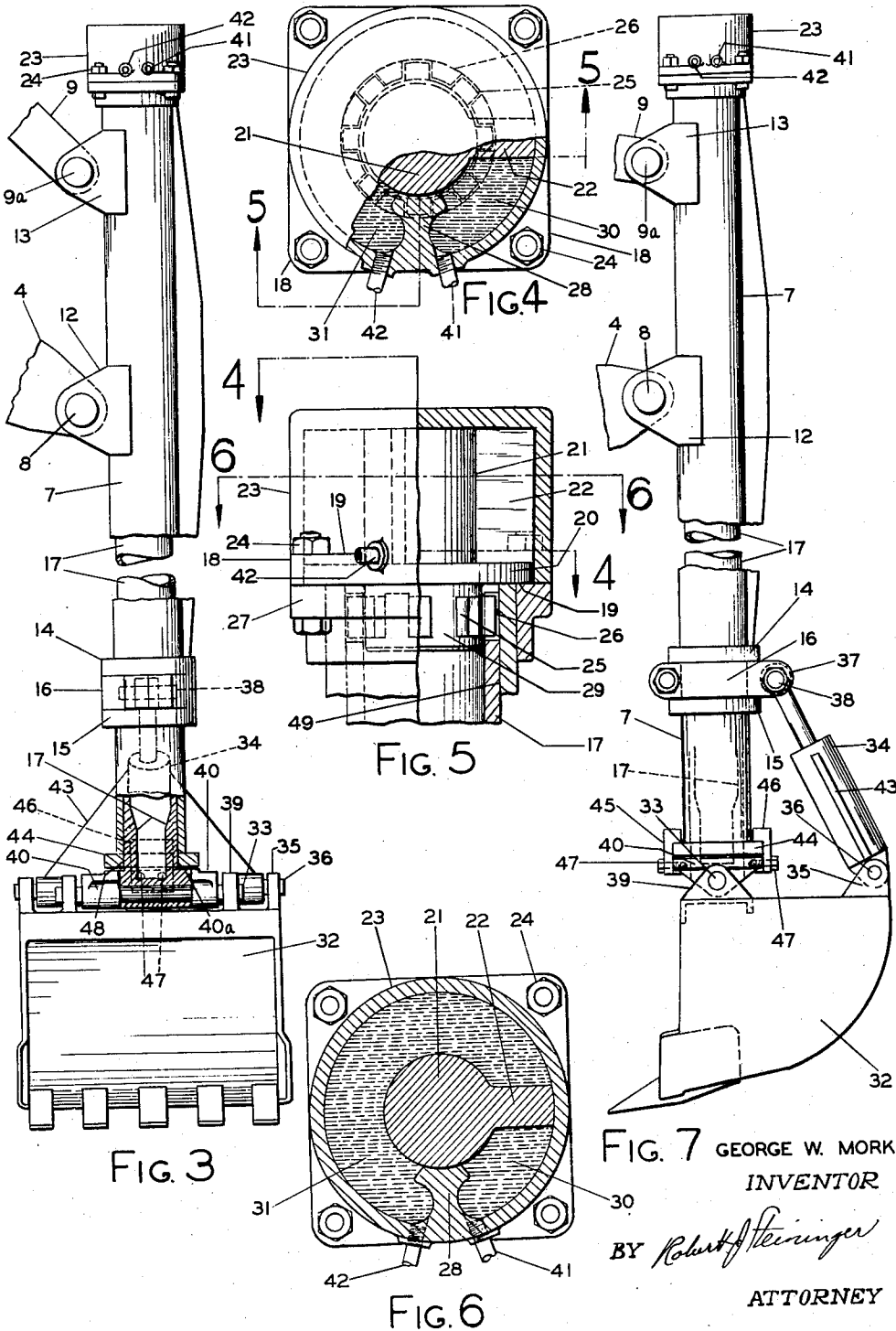
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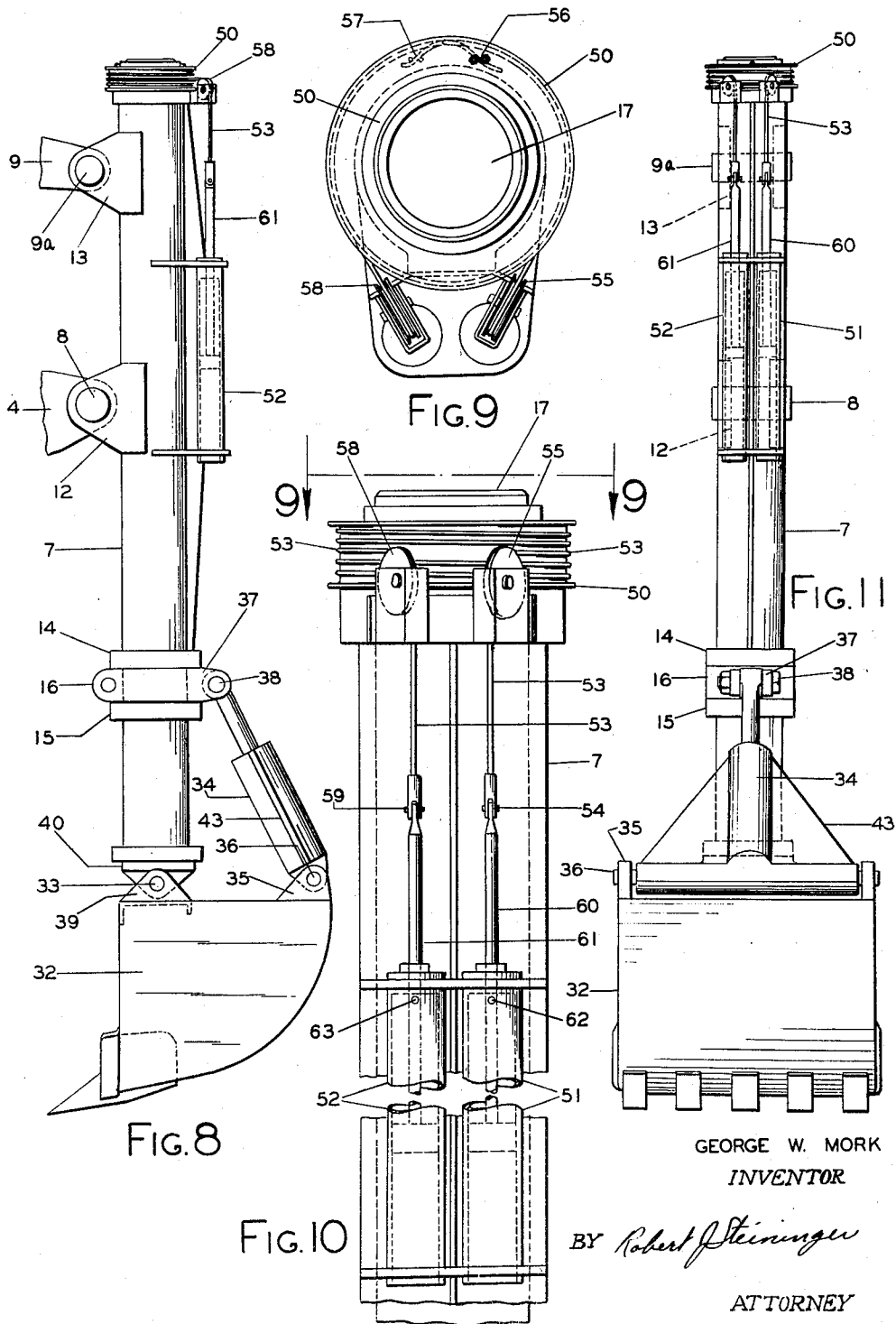
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4 Sheets-Sheet 4

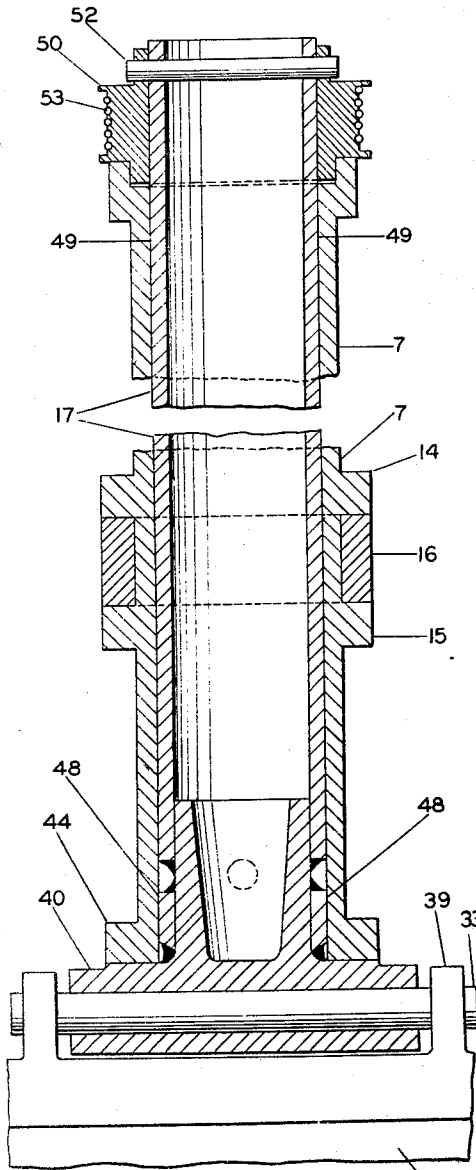


FIG. 12

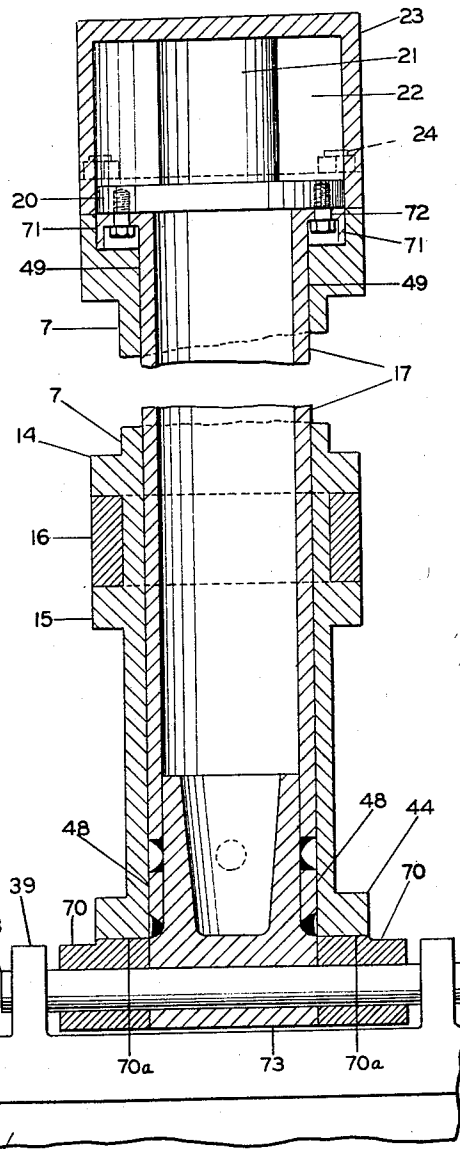


FIG. 13

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HYDRAULICALLY-OPERATED DIPPER

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7 Claims. (Cl. 214-138)

This invention relates to new and useful improvements in material-handling attachments for excavating machines, and more particularly to dippers of the hydraulically-operated type.

The conventional excavating machine is equipped with a dipper, which can be actuated either toward or away from the machine by pivoting the dipper arm about a horizontal transverse axis at the end of the boom and/or by pivoting the dipper about such an axis at the end of the dipper arm. The latter motion is known as "wrist action." A refinement has been to equip the machine with means at the lower end of the dipper arm for rotating the dipper about the longitudinal axis of the dipper arm, thereby making it possible to change the direction of digging relative to the vertical plane through the boom, without moving the entire machine. This motion of the dipper is hereinafter called "angling." However, introduction of such a means for angling the dipper weakens the dipper arm so that heavy digging is not possible.

Accordingly a principal object of this invention is to provide an excavating machine having a dipper which can be angled with a dipper arm sufficiently rigid to withstand stresses of heavy digging without greatly increasing the size and weight of the dipper arm.

A further object is to provide a means for angling the dipper about the dipper-handle axis by use of a minimum of moving parts.

A further object is to provide angling in conjunction with wrist action without weakening the dipper arm.

A further object of this invention is to provide power means for producing angling of the dipper which is arranged above the connection of the dipper arm on the boom where it will not interfere with digging nor weaken the dipper arm.

In addition to these objects, a number of novel and useful details have been worked out, which will be readily evident as the description progresses.

This invention consists in the novel parts and in the combination and arrangement thereof, which are defined in the appended claims, and of which two embodiments are exemplified in the accompanying drawings, which are hereinafter particularly described and explained. Throughout the description the same reference number is applied to the same member as to similar members.

Figure 1 is a side elevation of the first embodiment of the invention showing the dipper angled in a digging position at right angles to a vertical plane through the boom.

Figure 2 is a side elevation of the first embodiment showing the dipper in back-acting digging position.

Figure 3 is an enlarged view partly in section of the dipper and dipper handle of the first embodiment in the position shown in Figure 1.

Figure 4 is a plan view of the dipper-handle in the first embodiment, partly in section along the line 4-4 of Figure 5.

Figure 5 is a side elevation of the upper end of the

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dipper-handle in the first embodiment taken along the line 5-5 of Figure 4.

Figure 6 is a horizontal section of the hydraulic motor at the upper end of the dipper-handle taken along the line 6-6 of Figure 5.

Figure 7 is an enlarged side elevation, partly in section, of the dipper and dipper-handle of the first embodiment in the position shown in Figure 2.

Figure 8 is a side elevation of the dipper and dipper-handle of the second embodiment showing the dipper in back-acting digging position.

Figure 9 is a plan view of the dipper-handle in the second embodiment taken along the line 9-9 of Figure 10.

Figure 10 is an enlarged rear elevation of the upper end of the dipper arm in the second embodiment.

Figure 11 is a rear elevation of the dipper and dipper arm in the second embodiment.

Figure 12 is a longitudinal section of the upper and lower ends of the dipper arm in the second embodiment.

Figure 13 is a longitudinal section of the upper and lower ends of the dipper arm showing a variation of the first embodiment.

Referring to Figures 1 to 7 which show the first embodiment of this invention, an outwardly-projecting unit shown as boom 4 is mounted on a mobile unit having traction mechanism 1, revolving platform 2 and main frame 3. Horizontal pin 5 pivotally connects boom 4 to the main frame. A cylinder-piston assembly 6 is pivotally connected by means of pin 6a to main frame 3 and by pin 6b to arm 4a on boom 4 so that extension and retraction of cylinder-piston assembly 6 will raise and lower the boom about its pivot axis 5.

A support means for a material-handling unit consists of a dipper arm having an outer cylindrical element 7 and an inner cylindrical element 17 (Figures 3, 5 and 7). Outer element 7 is pivotally connected to the outer end of boom 4 by horizontal pivot pin 8 for jack-knife swinging movement relative to the boom. This movement is controlled by an actuated linkage comprising links 9 and 10 (Figures 1 and 2) pivotally connected respectively to outer element 7 at 9a to boom 4 at 10b and pivotally interconnected at 10a. This linkage is actuated by cylinder-piston assembly 11 which is pivotally attached to boom 4 at 11a and to link 10 at 11b.

Outer element 7 in its preferred form is a hollow cylinder having intermediate its ends a pair of lugs 12 with horizontally-aligned holes for receiving pivot pin 8 and adjacent its upper end a second pair of lugs 13 with horizontally-aligned holes for receiving pivot pin 9a.

Inner element 17, shown in its preferred form as a hollow cylinder (Figures 3, 5 and 7), is concentrically mounted within outer element 7 for movement relative thereto about a common longitudinal axis, and has points of lateral bearing contact with outer element 7 at 48 and 49. Attached to the lower end of inner element 17, as by welding, is a lug 40 with its pin-receiving opening lying transversely of the dipper arm and having a shoulder 40a for engaging the lower end of outer element 7. Clamps 45 and 46 (Figure 7) are connected at their lower ends to lug 40 by bolts 47 and their upper ends engage flange 44 on the lower end of outer element 7 thereby slidably supporting inner element 17 for swiveling within outer element 7.

A material-handling unit shown as dipper 32 is pivotally attached to the lower end of inner element 17 by pivot pin 33 inserted through lugs 39 on the dipper and through lug 40 on inner element 17, and is held against upward movement relative to the dipper arm during digging by engagement of shoulder 40a with the lower end of outer element 7.

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Hydraulic cylinder-piston assembly 34 and its brace 43 are pivotally connected at their lower ends to lugs 35 on dipper 32 by pin 36 and at their upper ends to lugs 37 on collar 16 by pin 38. Collar 16 is rotatable about the longitudinal axis of the dipper arm on an annular track intermediate the ends of the dipper arm and formed by concentric rings 14 and 15 on outer element 7.

Mounted on the upper end of the dipper arm is a dipper-angling hydraulic motor having an impeller 22 attached to inner element 17 and a casing 23 attached to outer element 7 on which are ports 41 and 42 opening into chambers 30 and 31, respectively (Figures 4, 5 and 6). Impeller 22 is integral with a rotor 21 and a bottom wall 20 and these elements make a fluid tight sliding contact with casing 23. Abutment 28 extends inwardly from casing 23 and makes a similar contact with bottom wall 20 and rotor 21. Bolts 24 through lugs 18 and 27 connect casing 23 to outer element 7.

Integral with the lower surface of bottom wall 20 is a concentric downwardly extending cylinder 29 having a diameter substantially equal to the inside diameter of inner element 17 and receivable therein, and having a plurality of radial teeth 25 circumferentially arranged for engagement with notches 26 on the upper end of inner element 17 (Figures 4 and 5).

In the operation of that form of this invention shown in Figures 1-7, rotation of inner element 17 within outer element 7 is produced by operating an hydraulic-control valve (not shown) so that pressure from a fluid-pressure source (not shown), introduces fluid into one of chambers 30 and 31 through ports 41 or 42 respectively, as the case may be, and simultaneously ejects fluid from the opposite chamber into the tank (not shown) thus causing rotation of impeller 22, rotor 21, bottom wall 20, cylinder 29, teeth 25 and inner element 17 and angling of dipper 32. Angling of dipper 32 swivels cylinder-piston assembly 34 and collar 16 about the longitudinal axis of the dipper arm.

When dipper 32 is in the position shown in Figures 2 and 7, impeller 22 is in position shown in Figure 6 and if the control valve is then closed the impeller 22 will be held against rotation and the conventional dragshovel-digging motion can be produced by extension of cylinder-piston assemblies 11 and 34. When it is desired to dig in a direction at right angles to the boom, impeller 22 is rotated until the dipper makes the desired angle with the boom and digging is accomplished by extension of cylinder-piston assembly 34. This is illustrated in Figures 1 and 3. In like manner, impeller 22 can be rotated to any position within the limits of the opposite sides of abutment 28 thereby angling dipper 32 for digging at a plurality of desired angles.

Figure 13 shows a variation of the first embodiment. Clamps 45 and 46 and bolts 47 are eliminated. Flange 71 on the upper end of inner element 17 supports the inner element for swiveling about the longitudinal axis of the dipper arm and bolts inserted through flange 71 and bottom wall 20 connect rotor 21 to inner element 17 to produce this swiveling. A longitudinal extension 73 attached to the lower end of inner element 17, as by welding, projects into a hole in lug 70. Pin 33 is inserted through horizontal holes in lugs 39 and 70 and in extension 73 of the inner element, and, because inner element 17 is prevented from downward movement by flange 71, the lower end of inner element 17 is held adjacent shoulder 70a. This variation represents a simplified means of accomplishing the function of the first embodiment.

The second embodiment of this invention is shown in Figures 8 to 11. All of the elements are identical with those in the first embodiment except that casing 23, bottom wall 20, rotor 21, impeller 22, abutment 28, ports 41 and 42, clamps 45 and 46 and bolts 24 have been removed and there has been substituted therefor a cable-winding drum 50 connected to the upper end of inner element 17 for rotation therewith.

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Preferably single-acting hydraulic cylinder-piston assemblies 51 and 52 are mounted on outer element 7.

Cable 53 is attached to piston 60 of cylinder-piston assembly 51 by pin 54, thence is reeved over sheave 55, wound on drum 50 and anchored on said drum at points 56 and 57, thence is wound an equal number of turns on drum 50, reeved over sheave 58 and attached to piston 61 of cylinder-piston assembly 52 by pin 59.

Operation of an hydraulic control valve (not shown) to introduce fluid under pressure into cylinder 51 through port 62, causes piston 60 to retract and at the same time causes fluid the flow from cylinder 52 into the tank (not shown), extending piston 61. Retraction of piston 60 winds a length of cable 53 off drum 50 over sheave 55 and winds an equal length of cable on drum 50 over sheave 58. This unwinding of cable causes rotation of drum 50 and inner element 17, swiveling the dipper 32 in a clockwise direction.

Alternatively, introduction of fluid under pressure into cylinder 52 through port 63 causes piston 61 to retract and fluid to flow from cylinder 51 into the tank thereby angling dipper 42 counterclockwise. The degree of angling of dipper 32 which is possible in this embodiment is limited only by the distance to which pistons 60 and 61 can be extended and by the length of cable 53.

Positioning dipper 32 for digging at a desired angle relative to a vertical plane through the boom is accomplished by closing the control valve and allowing no fluid to enter or be expelled from either cylinder-piston assembly 51 or 52.

Having now described and illustrated three forms of this invention, it is to be understood that the invention is not to be limited to the specific form or arrangement of parts shown and described herein.

What is claim is:

1. An apparatus of the character described having in combination: a main frame; an outwardly-projecting unit pivotally connected to said main frame for movement about a first normally-horizontal axis; power means for pivoting the unit on said first axis; support means, comprising approximately coterminous outer and inner elements concentrically arranged for relative movement about a longitudinal axis, and pivotally supported by the outwardly-projecting unit for jack-knife swinging movement about a second normally-horizontal axis intermediate the upper and lower ends of the support means; second power means for swinging the support means on said second axis; a material-handling unit pivotally connected to one element of the support means for movement about a third normally-horizontal axis adjacent the lower end of the support means; third power means connected to the material-handling unit and to the other element of the support means intermediate the upper and lower ends thereof for pivoting the material-handling unit about said third axis; the connection between the third power means and said other element of the support means comprising a double-pivot connection to permit pivoting of said third power means about an axis parallel to said third axis and about said longitudinal axis of the support means; and fourth power means connected to the outer and inner elements adjacent the upper end of the support means for angling the material-handling unit and the third power means about the longitudinal axis of the support means.

2. An apparatus of the character described according to claim 1, further characterized by the fact that the fourth power means includes fluid pressure actuated cable means drivably connected to the inner element to swivel same relative to the outer element.

3. In a device of the character described, a support, a pivotable support connected to said support for pivotal movement about a vertical axis, a boom pivotally connected about a horizontal axis to said pivotable support, hydraulic means for raising and lowering said boom relative to said support, a dipper stick pivotally con-

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ected to said boom about an axis perpendicular to the longitudinal axis of said boom, hydraulic means connected to said boom and to said dipper stick for pivoting said dipper stick relative to said boom and a bucket pivotally carried by said dipper stick on an axis parallel to the digging edge of said bucket, said bucket having its digging edge lying in a plane parallel to the longitudinal axis of said boom, and being rotatable about the longitudinal axis of said dipper stick; and hydraulic means for rotating said bucket about said last-mentioned longitudinal axis; said dipper stick comprising approximately coterminous outer and inner cylinders concentrically arranged for relative movement about their longitudinal axis, the outer cylinder being pivotally connected to the boom for swinging about said perpendicular axis and the inner cylinder being pivotally connected to the bucket on said axis parallel to the digging edge of the bucket; and the last said hydraulic means being connected to the inner and the outer cylinders comprising the dipper stick.

4. A device according to claim 3, further characterized by having hydraulic means, for rotating said bucket about said axis parallel to its digging edge, pivotally connected to the bucket and to said outer cylinder on axes parallel to the digging edge of the bucket and pivotally connected to said outer cylinder to rotate with said bucket relative to the outer cylinder about the longitudinal axis of the outer cylinder.

5. An apparatus according to claim 1, further characterized by the fact that the third power means comprises a cylinder-piston assembly pivotally connected to the material-handling unit to pivot relative thereto about a fourth normally-horizontal axis and pivotally connected to the outer element to pivot relative thereto about a fifth normally-horizontal axis and about the longitudinal axis of said outer and inner elements.

6. An apparatus of the character described having in combination: a main frame; an outwardly-projecting unit pivotally connected to said main frame for movement about a first normally-horizontal axis; power means for pivoting the unit on said first axis; support means, comprising approximately coterminous outer and inner elements concentrically arranged for relative movement about a longitudinal axis, and pivotally supported by the outwardly-projecting unit for jack-knife swinging movement about a second normally-horizontal axis intermediate the upper and lower ends of the support means; second power means for swinging the support means on said second axis; a material-handling unit pivotally connected to one element of the support means for movement about a third normally-horizontal axis adjacent the lower end of the support means; third power means connected to the material-handling unit and to the other element of the support means intermediate the upper and lower ends thereof for pivoting the material-handling unit about said third axis; the connection between the third power means and said other element of the support

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means comprising a double-pivot connection to permit pivoting of said third power means about an axis parallel to said third axis and about said longitudinal axis of the support means; and fourth power means connected to the outer and inner elements adjacent the upper end of the support means for angling the material-handling unit and the third power means about the longitudinal axis of the support means; said fourth power means comprising an hydraulically-actuated motor having a rotor connected to the upper end of the inner element and having a casing for said rotor connected to said outer element.

7. In a device of the character described, a support, a pivotable support connected to said support for pivotal movement about a vertical axis, a boom pivotally connected about a horizontal axis to said pivotable support, hydraulic means for raising and lowering said boom relative to said support, a dipper stick pivotally connected to said boom about an axis perpendicular to the longitudinal axis of said boom, hydraulic means connected to said boom and to said dipper stick for pivoting said dipper stick relative to said boom, a bucket pivotally carried by said dipper stick on an axis parallel to the digging edge of said bucket, said bucket having its digging edge lying in a plane parallel to the longitudinal axis of said boom, and being rotatable about the longitudinal axis of said dipper stick; hydraulic means for rotating said bucket about said last-mentioned longitudinal axis; said dipper stick comprising approximately coterminous outer and inner cylinders concentrically arranged for relative movement about their longitudinal axis, the outer cylinder being pivotally connected to the boom for swinging about said perpendicular axis and the inner cylinder being pivotally connected to the bucket on said axis parallel to the digging edge of the bucket; hydraulic means, for rotating said bucket about said axis parallel to its digging edge, pivotally connected to the bucket and to said outer cylinder on axes parallel to the digging edge of the bucket and pivotally connected to said outer cylinder to rotate with said bucket relative to the outer cylinder about the longitudinal axis of the outer cylinder, said hydraulic means for rotating the bucket about the longitudinal axis of the dipper stick comprising an hydraulic motor having a rotor connected to the upper end of the inner cylinder and having a casing for said rotor connected to the upper end of the outer cylinder.

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