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 [21] Appl. No. **761,655**
 [22] Filed **Sept. 23, 1968**
 [45] Patented **June 1, 1971**
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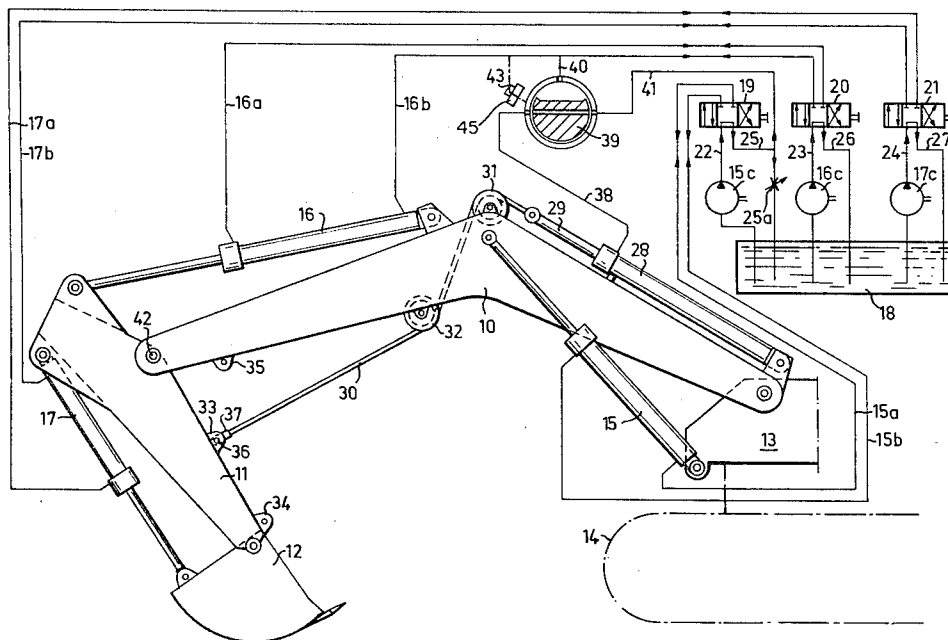
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[54] **HYDRAULIC DIGGING MACHINES**
3 Claims, 2 Drawing Figs.

[52] **U.S. Cl.**..... **214/138,**
214/762
 [51] **Int. Cl.**..... **E02f 3/62**
 [50] **Field of Search**..... **214/138,**
140, 762, 131

ABSTRACT: A hydraulic digging machine has a boom and a digging arm with a bucket. A first hydraulic power means is employed for normal operation of the digging arm. A second hydraulic power means is adapted to be connected to the digging arm when desired to assist the first hydraulic power means.



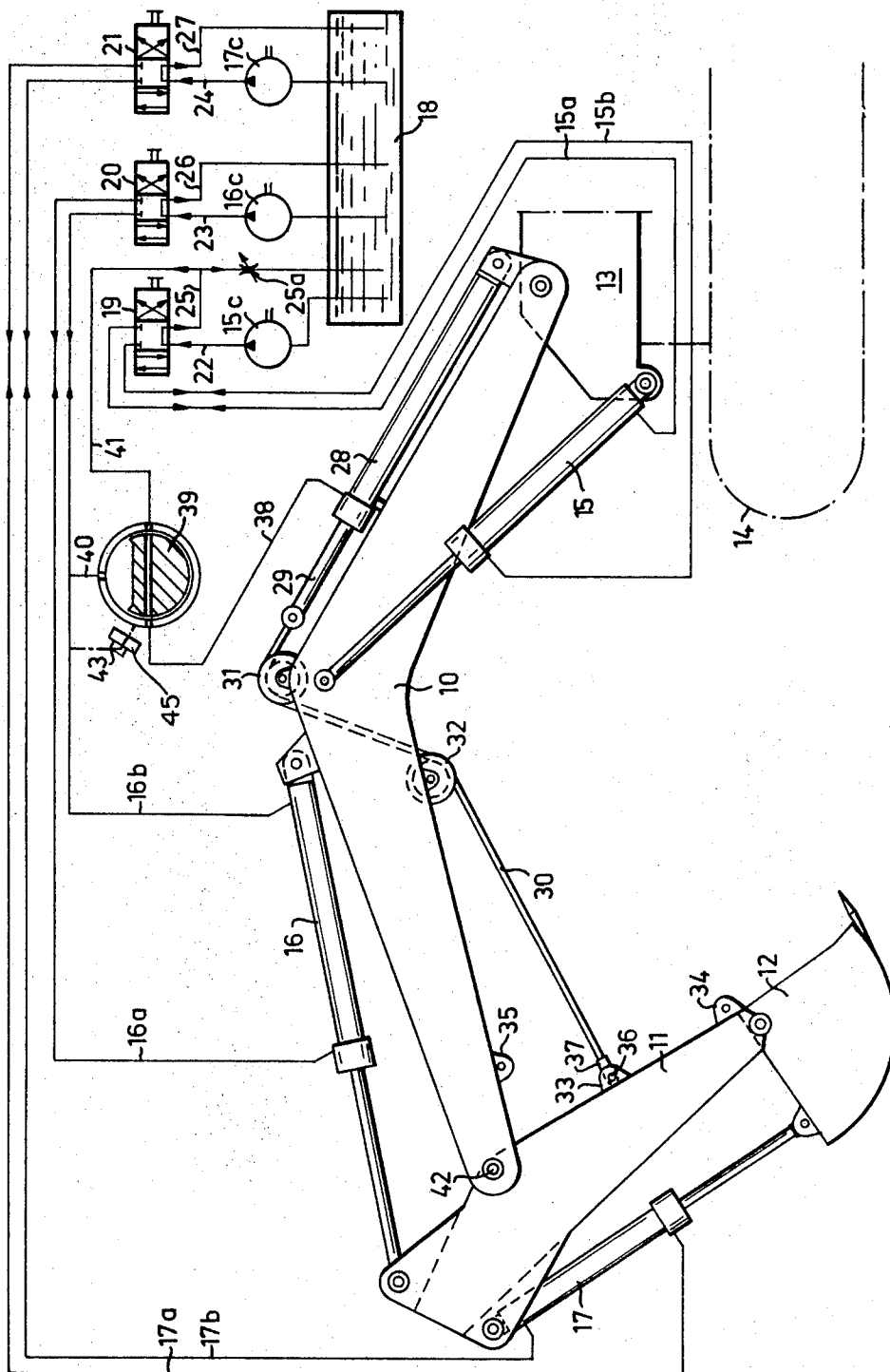
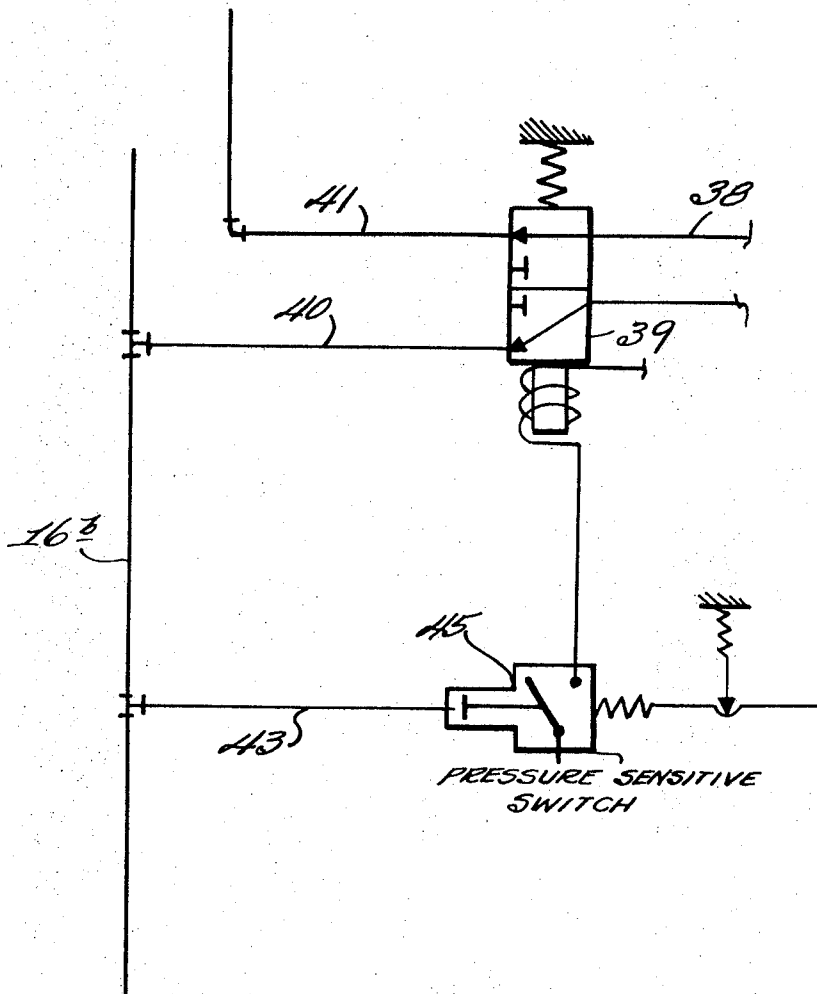


FIG. 1

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HYDRAULIC DIGGING MACHINES

The present invention relates to hydraulic digging machines having a boom, a digging arm pivotally at the outer end of the boom and supporting a bucket for digging when the digging arm is swung by means of a hydraulic power means.

Hydraulic digging machines are becoming more used than digging machines controlled by means of a wire system. The reason for this is mainly that the boom, digging arm and bucket of the hydraulic digging machines may be operated at a higher speed by means of hydraulic piston and cylinder assemblies. This is particularly true for digging machines of the smaller sizes. However, when the volume of the bucket is increased to greater values, certain difficulties may arise when the resistance in the ground or soil is high. To overcome this resistance it would be possible to increase the size of the hydraulic cylinder actuating the digging arm. However, such an increased size would require a correspondingly stronger boom and a greater pump capacity, that is a greater power output from the engine of the machine. Therefore, a disadvantage of the hydraulic digging machines is that they are hitherto not quite as efficient for digging in hard soil and the like with buckets having a relatively great volume, as so-called wire machines.

The general object of the invention is therefore to provide a hydraulic digging machine which in a simple manner overcomes the above-mentioned disadvantage.

To this end the hydraulic digging machine according to the invention is characterized by a second hydraulic power means provided to alternatively actuate the digging arm when an additional force is desired to assist the first hydraulic power means connected to the digging arm. In a preferred embodiment of the invention the two hydraulic power means are controlled by a valve which in a first or neutral position admits pressure fluid merely to the first power means and in a second or effective position admits pressure fluid to both power means. It is preferred that the second hydraulic power means is connected to the digging arm through a wire which may easily be disconnected from the digging arm when not in use. The first hydraulic power means is a hydraulic piston and cylinder assembly, and the second hydraulic power means may be a hydraulic piston and cylinder assembly or alternatively a pressure fluid rotary motor driving a winch for pulling the wire.

Further details and advantages of the invention will be disclosed more in detail with reference to the accompanying drawing wherein,

FIG. 1 illustrates a diagrammatic view showing the present invention and its associative hydraulic circuitry,

FIG. 2, illustrates a detail schematic view of a portion of the hydraulic circuitry of the present invention.

In FIG. 1 there is diagrammatically shown a digging assembly comprising a boom 10, a digging arm 11, a bucket 12 and a pressure fluid system for controlling the hydraulic power means in the form of hydraulic piston and cylinder assemblies, hereinafter referred to as cylinders.

The frame structure 13 supporting the boom 10 may be carried on endless belts 14 or wheels in a conventional manner.

The boom, digging arm and bucket are in a known manner pivotally mounted and actuated by cylinders 15, 16 and 17 which are double acting as indicated by a pair of pressure fluid conduits 15a, 15b, 16a, 16b and 17a, 17b to the respective cylinder.

From an oil reservoir 18 three pumps 15c, 16c and 17c feed pressure oil through valves 19, 20 and 21 to the cylinders 15, 16 and 17, respectively. Each pump has a pressure conduit 22, 23 and 24, respectively, to its valve, and an oil return conduit 25, 26 and 27, respectively, from the valve to the reservoir 18. Between the valve 19 and the reservoir 18 is an adjustable restriction or nozzle 25a to adjustably increase the flow resistance in conduit 25 for reasons given hereinafter.

All valves 19, 20 and 21 may be moved from an intermediate neutral position shown to either of two end positions. For example, when valve 20 is shifted to its right-hand end

position, pressure oil is admitted to conduit 16b, whereas oil leaves through conduit 16a and conduit 26 to the reservoir 18. The digging arm is then swung inwards. Vice versa, when the valve 20 is in its left-hand end position, pressure oil is admitted to conduit 16a, whereas conduit 16b is connected to the return conduit 26. In the neutral position of valve 20, oil in conduit 26 is recirculated directly through conduit 26.

The aforementioned parts of the machine are known per se and, therefore, have not been described in detail.

In accordance with the invention, the digging arm 11 may be alternatively actuated by a second hydraulic power means to assist the cylinder 16 when desired. To this end an additional cylinder 28 is mounted on the boom close to its inner end and has its piston rod 29 connected to one end of a wire 30 running over two pulleys 31 and 32 rotatably mounted on the boom. The other end of the wire is detachably secured to an attachment 33 on the digging arm. A similar attachment 34 is provided at the lower end of the digging arm 11, and further, there is a similar attachment 35 on the boom near its outer end. The attachments 33, 34, 35 are in the form of a pair of lugs with coaxial holes for a pin 36 which when inserted through the lugs and a hole in the end piece 37 of the wire will secure the wire. Accordingly, the wire may be rapidly shifted to any of the attachments 33, 34 and 35.

The cylinder 28 receives oil through a single conduit 38 because the cylinder is used merely for effecting a pull of the wire 30 when desired. The supply or return of oil from the cylinder 28 through conduit 38 is controlled by a valve 39 which may take two positions.

From conduit 16b there is a branch conduit 40 to the valve 39, but in the shown position of valve 39 the conduit 40 is closed from conduit 38. Instead, conduit 38 is through the valve 39 connected to a return conduit 41 which in turn is connected to the return conduit 25 at a point between the valve 19 and the restriction 25a which provides a predetermined, raised oil pressure in the conduits 41 and 38 when the cylinder 28 is idling, that is not used for effecting additional power. Alternatively, the restriction may be obtained by selecting a dimension of the conduit 25 which will result in the same or desired resistance to flow as the restriction 25a.

Due to the somewhat raised pressure in the conduit 41 as described above, this pressure will act on the piston in the cylinder 28 in order to prevent slackening of the wire when the digging arm is swung under normal operation, that is when no additional force is needed.

When additional force on the digging arm 11 is needed, the valve 39 is shifted to its second position in which conduits 38 and 40 are connected and conduit 41 is closed from conduit 38. Accordingly, the pressure oil in conduit 16b will also be led to the cylinder 28. If the resistance to digging is extremely high in the ground, the wire 30 is attached to the lowermost attachment 34, which will result in the greatest lever arm to the pivot 42 of the digging arm 11.

No extra pump is needed since the pump 16c for the operation of the normal cylinder 16 is also employed to feed the cylinder 28. Of course, this means that the piston in the cylinder 16 will receive a less oil volume per minute so that its speed is decreased. However, this is no disadvantage under the circumstances when the bucket 12 is meeting a high resistance to digging in the ground, particularly when this is frozen.

The valve 39 may be shifted manually but it is preferably automatically shifted in response to the pressure in the conduit 16b. This may be obtained by means of any well known device for such purpose such as that shown in FIG. 2. In this figure there is shown a separate branch conduit 43 from conduit 16b to an oil pressure responsive device 45. This device may comprise a microswitch operated by a spring biased pressure member connected to conduit 43 and closing the contacts of the switch when the pressure in conduits 16b, 43 exceeds a predetermined value which corresponds to a relatively high load on the bucket and digging arm. When the microswitch closes, electrical current will be admitted to an electromagnetic device which actuates the valve to shift it to its second

position in which pressure oil is admitted to conduit 38. When the pressure is again decreased below said predetermined value and a second lower value in a known manner, the microswitch is disengaged and the valve 39 returns to its neutral position. Thus, the additional cylinder 28 will be used only when needed, and the digging arm will be swung at its normal speed to and from the position where the digging resistance is high.

If the digging conditions are such that no additional force will be required, the wire 30 is attached to the attachment 35 on the boom.

I claim:

1. In a hydraulic digging machine for loading, carrying and unloading soil and other materials having a boom, a digging arm pivotally mounted at the outer end of said boom and supporting a bucket for loading, carrying and unloading said soil, a first hydraulic power means for providing a first actuation force on said digging arm to swing said digging arm against the resistance of said soil during loading, said first hydraulic power means including a hydraulic piston and cylinder assembly, the improvement comprising:

a second hydraulic power means for selectively providing a second force to assist said first hydraulic power in swinging said digging arm to overcome the resistance of said soil during loading, said second hydraulic power means including a rotary hydraulic motor for driving a winch, said winch having a wire attached thereto and detachably connected to said digging arm for assisting said first hydraulic power means.

2. A machine according to claim 1, in which said first hydraulic power means is connected via a conduit connected

to a pressure fluid pump, said conduit having a branch conduit connected to said second hydraulic power means through a valve, which in a first and effective position admits pressure fluid to said second hydraulic power means, and in a second and neutral position closes the supply of pressure fluid to said second hydraulic power means and connects the same to a return conduit leading to an oil reservoir for said pump, said pump being connectable with the first hydraulic power means through a control valve which permits fluid to return to said reservoir through said return conduit which includes an adjustable restriction to provide a desired raised pressure in the return conduit, and said return conduit from said second hydraulic power means is connected to said return conduit which includes the restriction and has said raised pressure, said valve in said branch conduit leading to said second hydraulic power means being automatically controlled by a fluid pressure responsive device adapted to shift said valve to its effective position when a predetermined fluid pressure is exceeded in the pressure fluid conduit to said first hydraulic power means and to shift said valve back to its neutral position when said fluid pressure is thereafter decreased below a predetermined value.

3. A machine according to claim 2, in which said fluid pressure responsive device includes an electromagnetic power device adapted to move said valve between its neutral and effective positions, and the electric current to the electromagnetic device is controlled by a microswitch adapted to be closed by a pressure responsive device influenced by the pressure fluid in said conduit to said first hydraulic power means.

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