

Nov. 4, 1969

W. J. WITWER
BACKHOE HYDRAULIC CONTROL SYSTEM

3,476,274

Filed Feb. 2, 1968

4 Sheets-Sheet 1

Fig. 1.

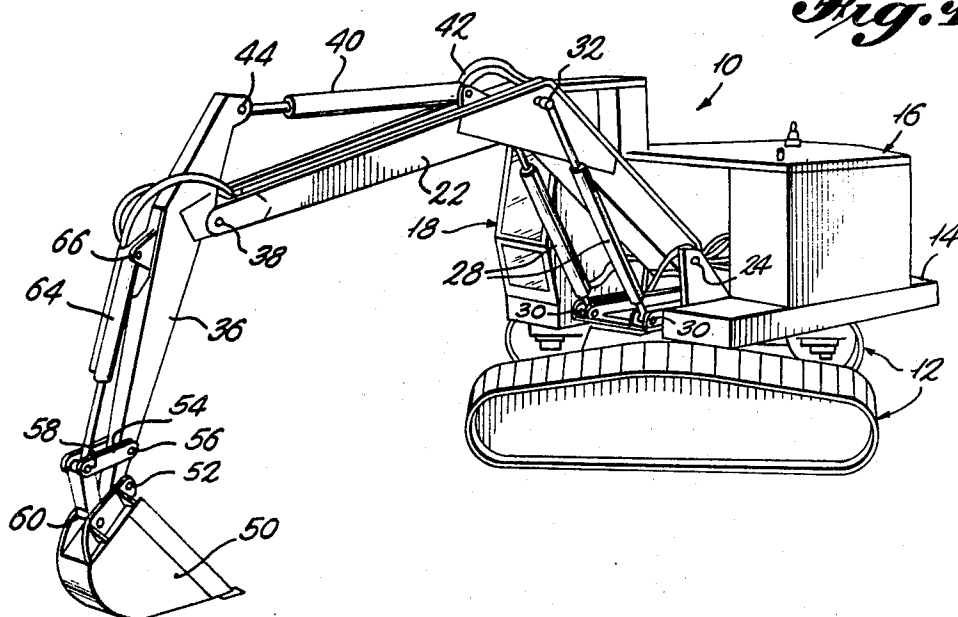
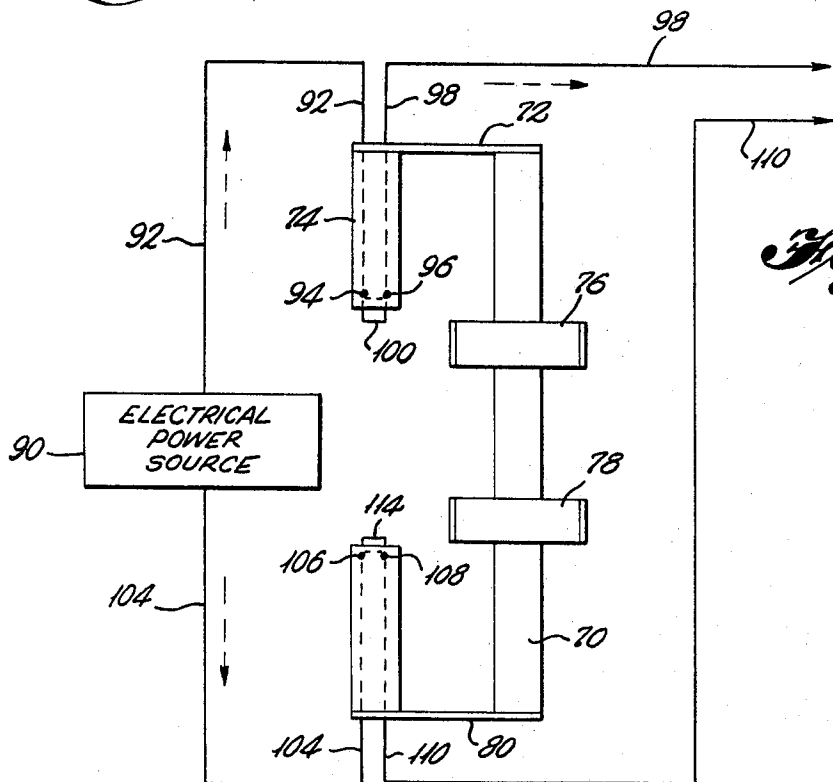


Fig. 2.

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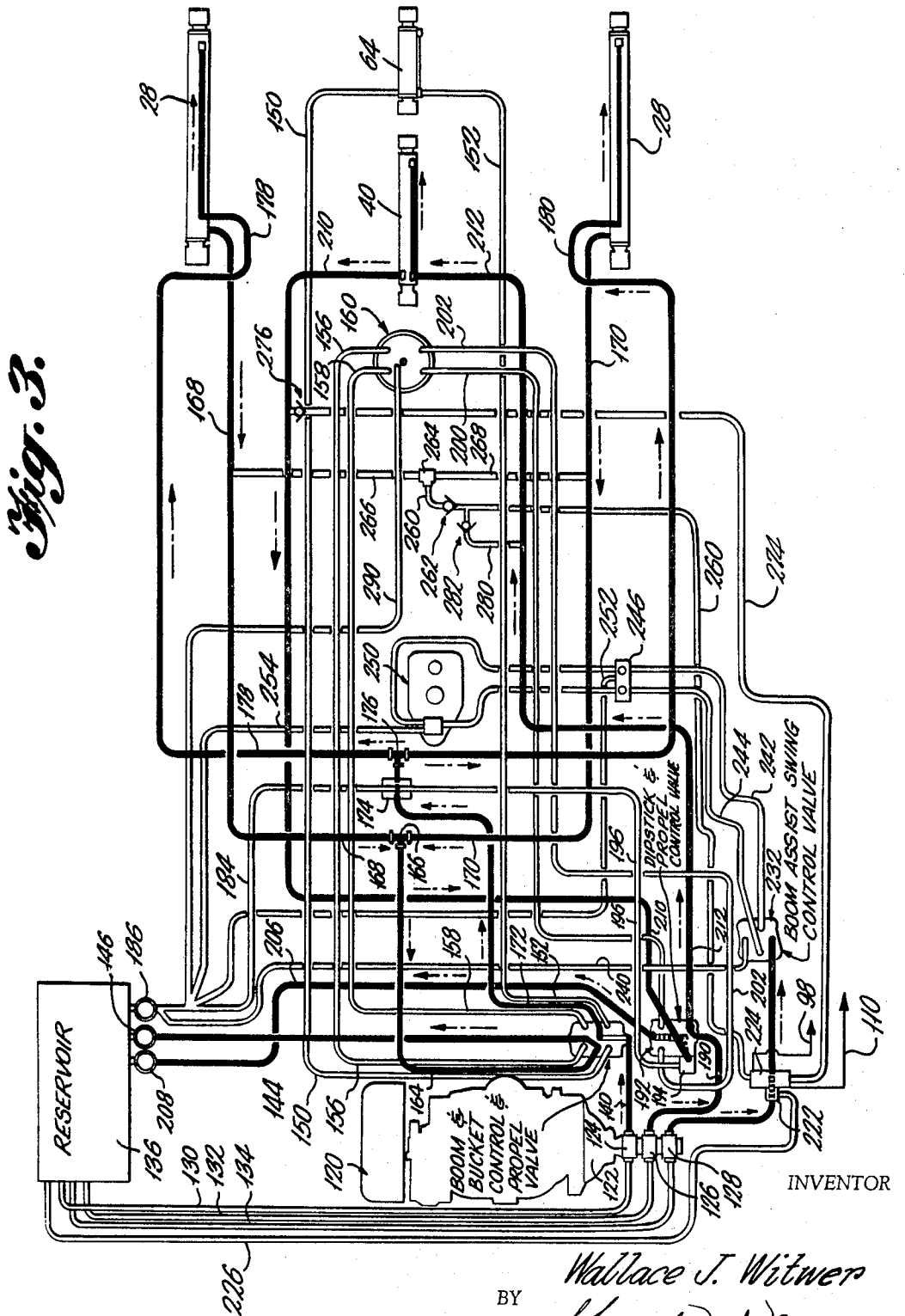
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BACKHOE HYDRAULIC CONTROL SYSTEM

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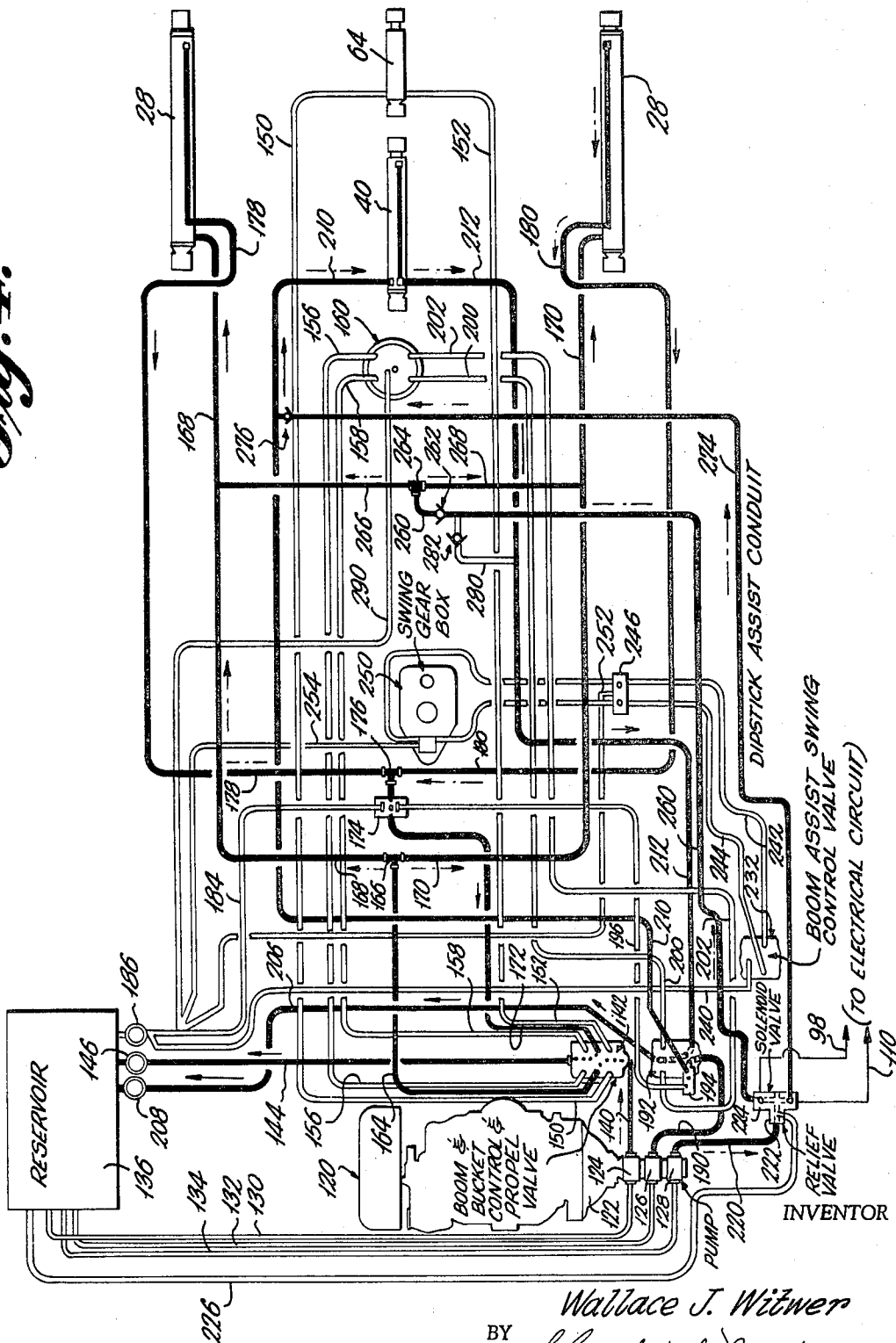
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Fig. 4.



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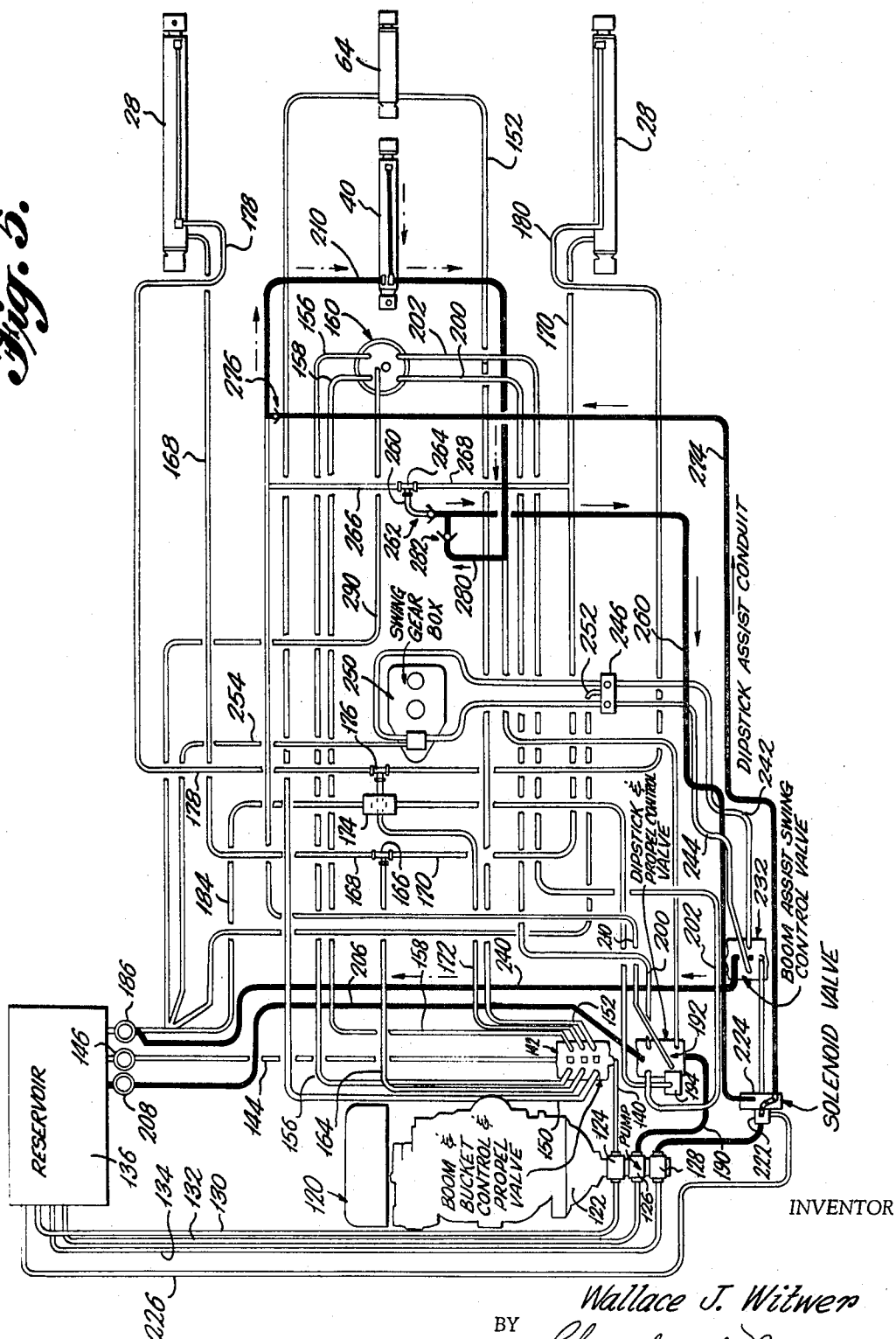
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BACKHOE HYDRAULIC CONTROL SYSTEM

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Fig. 5.



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BACKHOE HYDRAULIC CONTROL SYSTEM

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U.S. Cl. 214—138

18 Claims

ABSTRACT OF THE DISCLOSURE

A hydraulic control system is provided for a backhoe having a swingably mounted platform upon which a boom is pivotally mounted and including a dipstick pivotally supported on the boom for curling movement inwardly and outwardly of the backhoe. The hydraulic control system includes means for increasing the speed of movement of the boom upwardly and also includes means for increasing the speed and power of the dipstick as it curls in. The hydraulic control system also includes means for increasing the power and decreasing the speed of the dipstick as it curls in.

BACKGROUND OF THE INVENTION

The present invention relates to a backhoe used for high speed excavating and comprises a control system for the backhoe wherein hydraulically operated means are provided for swinging the machinery platform of the backhoe and for operating the boom and dipstick during excavating operations. The hydraulic control system is interconnected with the hydraulically operated means and includes remotely operated valve means for diverting the flow of hydraulic fluid within the hydraulic system to provide speed and power assist to certain of the hydraulically operated means as required.

The present invention represents an improvement over the construction as shown for example in the service and parts manual for Series 10, 10HD and 12HD HYDRAULIC BACKHOES, CED-47, published by Hein-Werner Construction Equipment Division, Waukesha, Wis. 53187.

In conventional backhoes of this type, the hydraulic system does not include means incorporated in the hydraulic control system thereof for increasing the speed or power of movement of the boom or dipstick. It is possible by moving the hydraulic cylinder mounting points to increase power, but this mechanical re-location of lift points is time consuming and requires a relatively expensive design of the structure.

Accordingly, such conventional backhoes have a limited digging power and there is no practical way to shorten the cycle time involved in excavating operations.

Summary of the invention

In the backhoe of the present invention, the hydraulic control system includes remotely controlled valve means and suitable conduit means and check valves connected therein to provide speed assist to the hydraulically operated ram means connected with the boom and the dipstick, and furthermore the power to the dipstick ram means may be increased while decreasing the speed of movement thereof. This is accomplished by diverting flow of hydraulic fluid from the portion of the hydraulic system employed for swinging the machinery platform to the hydraulic ram means which operates either the boom or the dipstick. Such diversion is feasible since it is not necessary to swing the machinery platform while lifting the boom or curling in the dipstick.

The desired speed/power assist to the hydraulic ram

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means for operating the boom or dipstick is obtained in the present invention without the necessity of providing additional sources of hydraulic pressure, and flow is simply diverted from one portion of the system to another at a propitious time in order to accomplish the purposes of the present invention without adversely affecting the over-all functioning of the apparatus.

An object of the present invention is to provide a new and novel backhoe including a hydraulic control system having means for increasing the speed of movement of the boom and to increase the speed and power of movement of the dipstick, or increasing the power of movement of the dipstick while reducing the speed of movement thereof.

Brief description of the drawings

FIG. 1 is a top perspective view of a backhoe according to the present invention;

FIG. 2 is a top somewhat schematic view of a portion of the operating controls provided in the operator's cab; and

FIGS. 3, 4 and 5 each illustrate the hydraulic control system in a somewhat schematic manner and indicate different conditions of operation of the apparatus.

Description of the preferred embodiment

Referring firstly to FIG. 1 of the drawings, the backhoe is indicated generally by reference numeral 10 and includes a pair of crawler assemblies 12 disposed at opposite sides thereof. It is apparent that the backhoe can also be mounted upon a wheeled vehicle if desired.

A machinery platform 14 is swingably supported by the undercarriage of the backhoe which in turn is supported by the crawler assemblies. A machinery housing 16 is supported on platform 14 as is the operator's cab 18.

A boom 22 is pivotally supported at the inner end thereof about a boom pivot pin which is suitably mounted on the support structure secured to the machinery platform. The boom is raised and lowered by means of double-acting hydraulic rams 28 pivotally connected at the lower ends thereof about pins 30, the outer ends of the rams being pivotally interconnected with the boom lift pins 32 disposed at opposite sides of the boom.

A dipstick 36 is pivotally connected with the boom by the dipstick pivot pin 38. The dipstick is operated by the hydraulic ram 40 having the inner end pivotally connected to a dipstick ram means base pin 42, the outer end of the ram 40 being pivotally interconnected with the dipstick ram means rod pin 44.

A bucket 50 is pivotally connected to the bucket pivot pin 52 mounted at the outer end of dipstick 36. A bell crank 54 is pivotally secured to the dipstick by a bell crank pivot pin 56. A bucket link and bucket cylinder rod end 58 are provided, and the bucket link is indicated by the reference numeral 60, this arrangement being of conventional construction.

The bucket is operated by the hydraulic ram means 64, the inner end of which is pivotally connected with a bucket cylinder base pin 66, the outer end of the ram means 64 being pivotally interconnected with mechanism 58 previously described.

Referring now to FIG. 2, the operating controls incorporated in the cab of the backhoe are somewhat schematically illustrated. These controls are mounted for swinging movement about a tubular support means 70 and include a conventional swing control lever 72 having a handle 74 extending laterally therefrom at the upper end thereof. Movement of the lever in opposite directions from a neutral position causes the machinery platform to swing either counter clockwise or clockwise as the case may be.

A bucket control pedal 76 is provided. To place the bucket in closed position, the operator pushes down with

the heel of the left foot. When the operator wishes to place the bucket in open position, he pushes down with the toe of the left foot on this pedal.

A dipstick control pedal 78 is provided, and when the operator pushes down with the toe of the right foot on this pedal, the dipstick curls out. When the operator pushes downwardly with the heel of the right foot on pedal 78, the dipstick curls inwardly.

A boom cylinder control lever 80 is provided and includes a laterally extending handle 82 at the upper end thereof. When lever 80 is pulled backwards toward the operator, the boom will rise, and when the lever is pushed forwardly, the boom will fall.

These controls as described up to this point are of conventional construction and well known in the art.

An electrical control circuit is incorporated in combination with the handle portions 74 and 82 to enable the operator to control the operation of a remotely controlled valve in the hydraulic control system. A suitable source of electrical power 90 is provided which for example may be a battery. One side of the electrical power source is connected by lead 92 to a contact 94 disposed within handle 74. A spaced contact 96 is connected to a lead 98 which in turn is connected with the remotely controlled valve hereinafter described.

A circuit is closed through contacts 94 and 96 by a push button 100 which is normally resiliently urged outwardly of the handle so as to disconnect contact 94 from contact 96. When the operator pushes the button inwardly, the circuit is closed through these contacts to operate the remotely operated valve means.

The opposite side of the electrical power source is connected through lead 104 to a contact 106 disposed within handle 82. A spaced contact 108 is provided within handle 82 and is connected to a lead 110 which in turn is also connected with said remotely operated valve means.

A push button 114 similar to push button 100 is provided, push button 114 normally being urged outwardly of the handle to open the circuit through the contacts 106 and 108. When the operator depresses push button 114, the circuit is closed through these contacts in the handle to cause operation of the remotely operated valve means as hereinafter described.

Referring now to FIGS. 3-5 inclusive, each of these figures illustrates somewhat schematically the over-all hydraulic control system of the present invention. A motor assembly is indicated generally by reference numeral 120 and is operatively connected through a clutch mechanism 122 with three separate gear type pumps 124, 126 and 128 connected in tandem. The three pump sections enable simultaneous use of all three hydraulic circuits operatively connected therewith. Supply conduits 130, 132 and 134 are operatively connected between the pumps 124, 126 and 128 respectively and a fluid reservoir 136.

The outlet of pump 124 is connected through conduit 140 with a four-way, three-position boom, bucket and propel valve indicated generally by reference numeral 142. A conduit 144 is connected between an outlet of the valve and a filter 146 which is in turn connected with the reservoir 136.

A pair of conduits 150 and 152 are connected between valve 142 and the hydraulic ram means 64 which operates the bucket of the backhoe. The operation of this portion of the hydraulic control system does not form a portion of the present invention.

A pair of conduits 156 and 158 are connected between valve 142 and a Hydra-Swivel mechanism 160. Hydra-Swivel is a trademark of the Hein-Werner Corporation, Waukesha, Wis., and provides a construction which enables hydraulic connections to be made through relatively rotating parts, which in this case are mounted on the swingable platform in the underlying supporting structure respectively. The fluid flowing through conduits 156 and 158 is employed for propelling the backhoe and forms no part of the present invention.

A conduit 164 is connected between valve 142 and a

T-connection 166 which in turn is connected with conduits 168 and 170. Conduit 168 is connected with hydraulic ram means 28 and is connected with the inner end thereof so that fluid flowing through conduit 168 will cause the piston within the ram means to be moved outwardly thereby raising the boom. Conduit 170 is similarly connected with the inner end of the other of the boom cylinders 28 so that fluid flowing therethrough will cause the boom to rise.

A conduit 172 is connected with an in-line relief valve means 174 which is set to relieve at a pressure of about 2000 p.s.i. This relief valve is in turn connected with a T-member 176 which is connected with conduits 178 and 180. Conduit 178 is connected with the outer end of the ram means 28 at one side of the boom, and conduit 180 is connected with the outer end of the ram means 28 at the other side of the boom. Fluid flowing outwardly through conduits 178 and 180 will cause the boom to lower.

It will of course be understood that the operation of valve means 142 so as to control movement of the boom is in turn controlled by the boom cylinder control lever 80 previously described which is suitably connected through conventional linkage with the valve means 142.

The in-line relief valve 174 is connected through a conduit 184 to a filter 186 which in turn is connected with the reservoir previously described.

A conduit 190 is connected between pump 126 and dipstick and propel control valve 192 and an in-line relief valve 194 is operatively connected with the valve 192. The relief valve 194 is connected by conduit 196 with the in-line relief valve 174 previously described.

A pair of conduits 200 and 202 are connected between the valve 192 and the Hydra-Swivel mechanism 160 previously described. These conduits are adapted to be connected with suitable mechanism for propelling the backhoe, and form no part of the present invention.

A conduit 206 is connected between the valve 192 and a filter 208 which in turn is connected with the reservoir previously described.

A conduit 210 is connected between relief valve 194 and the inner end of the hydraulic ram means 40 for operating the dipstick. Accordingly, when fluid flows outwardly through this conduit to the inner end of the dipstick ram means, the dipstick is caused to curl inwardly. A further conduit 212 is connected between valve 192 and the outer end of the dipstick ram means whereby fluid flowing outwardly through conduit 212 will cause the dipstick to curl outwardly.

A conduit 220 is connected between pump 128 and a relief valve 222 which is in turn connected with a remotely controlled valve means in the form of a solenoid valve 224. This solenoid valve 224 is remotely controlled by the electrical system previously described and is operatively connected with the electrical leads 98 and 110 as described in connection with FIG. 2 of the drawings.

A conduit 226 connects the relief valve 222 with the reservoir 136. This relief valve is set to open at a pressure of approximately 2500 p.s.i., whereas the remaining relief valves of the hydraulic system are adapted to relieve at a pressure of approximately 2000 p.s.i.

A conduit 230 connects solenoid valve 224 with the swing control valve 232 which is adapted to control the swinging movement of the machinery platform. It will of course be understood that the swing control valve 232 is controlled by operation of the swing lever 72 through suitable linkage, and the operation of the dipstick control valve 192 is controlled by movement of the dipstick control pedal 78 which is suitably connected therewith through conventional linkage.

A conduit 230 connects solenoid valve 224 with the reservoir through filter 186 previously described.

A pair of conduits 242 and 244 are connected through a pressure compensating unit with the swing control gearbox 250 so that flow or fluid through these conduits 242

and 244 in particular directions will control the direction of swinging of the machinery platform, it being understood that the swing control gearbox is connected with the machinery platform through suitable gearing to cause swinging movement thereof.

The pressure compensating unit 246 is connected through conduit 252 to the reservoir through the intermediary of filter 186, and the swing control gearbox is also connected through conduit 254 with the reservoir through the intermediary of filter 186.

A boom assist conduit 260 is connected with the remotely operated valve 224 and has a one-way check valve 262 connected therein which permits fluid flow away from the solenoid valve but not in a reverse direction. This boom assist conduit 260 is connected with a T-member 264 which in turn is connected with conduits 266 and 268. Conduit 266 is connected with the conduit 168 previously described, and conduit 268 is connected with the conduit 170 previously described.

A dipstick assist conduit 274 is connected with the remotely operated valve means 224 and has a one-way check valve 276 connected therein, the conduit 274 being connected with the conduit 210 previously described. The one-way check valve 276 will permit fluid flow from the valve 224 to the conduit 210 and will prevent reverse flow.

A further conduit 280 is connected between the boom assist conduit 260 and the conduit 212. A one-way check valve 282 is connected in conduit 280 and will permit fluid flow from conduit 212 to conduit 260 but will prevent flow in a reverse direction.

A conduit 290 is connected to Hydra-Swivel mechanism 160 and the reservoir through filler 186 and forms no part of the present invention.

Operation

Referring now to FIG. 3 of the drawings, a first condition of operation of the apparatus is illustrated. In this figure, the solenoid valve is illustrated in its neutral position wherein neither of the push buttons 100 or 114 are depressed. Fluid flows through conduit 220 and conduit 230 to the swing control valve, and operation of the swing control lever 72 is effective to cause the machinery platform to swing in either desired direction. The relief valve 222 is ineffective in this condition of operation, and relief is controlled by the components in the swing circuit.

It should be understood that in the neutral position of the boom control valve 142, fluid will flow through conduit 140 and thence through conduit 144 to the reservoir. In the neutral position of the dipstick control valve 192, fluid will flow through conduit 190 and thence through conduit 206 to the reservoir.

As shown in FIG. 3, the boom control valve 142 is in operative position to lower the boom. In this position, fluid flows through conduit 140 and thence through conduit 172 and conduits 178 and 180 to the outer ends of the hydraulically operated ram means 28 so as to cause the boom to be lowered. Fluid will be forced from the inner ends of the hydraulic ram means through the conduits 168 and 170 to the conduit 164, and thence through conduit 144 to the reservoir.

FIGURE 3 also illustrates the dipstick control valve 192 in position to cause the dipstick to curl out. In this position, fluid flows through conduit 190 and thence through conduit 212 to the outer end of the hydraulic ram means 40 to cause the dipstick to curl outwardly. Fluid from the inner end of the hydraulic ram means 40 will flow through conduit 210 and thence through conduit 206 to the reservoir as illustrated.

Referring now to FIG. 4 of the drawings, this drawing shows the system in operative position for raising the boom plus providing a speed assist in raising the boom. This figure of drawing also illustrates the operative position of the system for causing the dipstick to curl in plus providing a speed and power assist for the dipstick curl in. It should be clearly understood that only one of these

assist circuits can be connected at a time. In other words, the solenoid valve can either be operated so as to provide a boom assist or to provide a dipstick assist. The two circuits have been incorporated on this sheet of drawing for the sake of illustration, although it is clear that only one assist circuit can exist at a particular time during operation of the apparatus.

First, let us assume that it is desired to raise the boom. The boom control valve 142 is operated to the position shown so that fluid will flow through conduit 140 and thence through conduit 164 and conduits 168 and 170 to the inner end of the hydraulic ram means 28 so as to urge the boom upwardly. Fluid will flow from the outer ends of these hydraulic ram means through the conduits 178 and 180 and thence through conduit 172 and conduit 144 back to the reservoir.

If it is desired to further provide a speed assist to the movement of the boom, the push button 100 is depressed thereby energizing the circuit through the solenoid valve so as to move it to a position so that fluid will flow through conduit 220, thence through the solenoid valve to the boom assist conduit 260. This fluid will then flow through the check valve 262 and thence through conduits 266 and 268 and conduits 168 and 170 respectively so as to add the flow of fluid from the pump 128 to that of pump 124 to thereby substantially increase the amount of fluid reaching the hydraulic ram means 28 to thereby speed up movement of the boom. Normally, 59 gallons per minute is the rate of flow employed from pump 124 to give a maximum lift and speed of movement. The pump 128 has an output of approximately 35 gallons per minute; and accordingly, when the solenoid valve is operated as aforescribed, the total amount of fluid in the hydraulic system for moving the boom upwardly provides a total of about 94 gallons per minute thereby considerably increasing the speed of movement of the boom. The machinery platform cannot of course swing while this assist operation is in process since the flow of fluid to the swing control valve has been cut off. When the pressure on the switch 100 is removed, the solenoid valve will return to its neutral position and the flow of fluid will again be provided to the swing control valve. The speed increase of the boom is directly proportional to the increase in the flow of fluid to the boom during the assist operation.

An experienced operator can benefit from the mode of operation of the present invention. By pulling or pushing the swing control lever depending on the desired direction of swinging movement, nothing will happen as long as the solenoid valve is operated. However, when the boom comes out of the associated trench, the switch 100 can be released to cause the fluid to again flow through the swing control valve and to the swing gearbox whereby the machinery platform will immediately swing and be under complete operator control through the intermediary of the swing control lever. This can greatly increase the amount of work that can be done. It is apparent that in the process of digging the trench, it is necessary to raise the boom above the trench before the bucketload of material can be dumped. The faster the boom can be raised, the greater the number of digging cycles that can be made, and the more efficient the machine becomes.

Let us now assume that it is also desired to have the dipstick curl in. The dipstick control valve 192 is moved to the position shown in FIG. 4. Fluid flows through conduit 190 and thence through conduit 210 to the inner end of the hydraulic ram means 40 for operating the dipstick, thereby causing the dipstick to curl in. Fluid from the outer end of hydraulic ram means 40 will flow through conduit 212 and thence through conduit 206 to the reservoir.

If it is now desired to provide a power and speed assist to the dipstick ram means, button 114 is depressed, operating the solenoid valve so as to move it to a position so that fluid will flow from conduit 220 through the solenoid valve to the dipstick assist conduit 274. Fluid will flow

through conduit 274 and the one-way check valve 276 into the conduit 210 and the fluid which normally flows to the swing circuit is diverted into the dipstick circuit so as to provide a speed and power assist to movement of the dipstick.

If the pressure in the system should exceed the setting of relief valve 194 during operation of the system to cause the dipstick ram means to curl in, fluid will be by-passed from conduit 190 into the conduit 196 and will return to the reservoir.

Referring now to FIG. 5, let us assume that it is desired to provide a power assist to the dipstick ram means to cause the dipstick to curl inwardly, and at a reduced speed than normal movement of the dipstick.

The dipstick control valve is in neutral position in this condition of operation, and fluid will flow through conduit 190 and thence through conduit 206 back to the reservoir.

The switch 114 is then depressed to cause the solenoid valve to move into position so that fluid will flow from conduit 220 through the solenoid valve into the dipstick assist conduit 274. The fluid will then flow through check valve 276 and into conduit 210. The fluid cannot flow backwardly through the dipstick control valve, and accordingly, the fluid flows outwardly to the inner end of the hydraulic ram means for operating the dipstick thereby causing the dipstick to curl in.

Fluid from the outer end of the hydraulic ram means 40 will flow from the ram means through conduit 212. However, the fluid cannot flow backwardly through the dipstick control valve 192. Accordingly, the fluid flows through conduit 280 and one-way check valve 282 into the boom assist conduit 260. The fluid will then flow through this conduit 260 and the solenoid valve to the conduit 234. The fluid will then flow through the swing control valve and conduit 240 back to the reservoir.

When the switch 114 is depressed, the solenoid valve will cause the normal flow of fluid to the swing control valve of 35 gallons per minute to be diverted into the dipstick control circuit. When this flow is added to the flow passing through the dipstick control valve as shown in FIG. 4, the speed and power of movement of the dipstick will be increased.

On the other hand, when the switch 114 is depressed and the dipstick control valve remains in neutral position as shown in FIG. 5, the flow from pump 128 is diverted to the dipstick hydraulic ram means at 2500 p.s.i., this pressure being controlled by relief valve 222. Since the remainder of this system is operated at a pressure of about 2000 p.s.i., the working power is increased by 25 percent, but the speed of movement of the dipstick is decreased since the rate of flow of 35 gallons per minute is substantially less than the normal flow to the dipstick of 59 gallons per minute. This power increase is particularly helpful in pulling through hard material and breaking loose an embedded rock or the like wherein a greater force is demanded on the dipstick.

It is apparent from the foregoing that there is provided according to the present invention a new and novel hydraulic control circuit for a backhoe including means to increase the speed of the movement of the boom thereof and further to increase the speed and power of movement of the dipstick or to increase the power of movement of the dipstick while reducing the speed of movement thereof.

I claim:

1. In a backhoe, a swingably mounted platform, a boom movably supported by said platform, a dipstick movably supported by said boom, a hydraulic system for operating said platform, said boom and said dipstick, and comprising hydraulic means for controlling the movement of each of said platform, boom and dipstick and control means for diverting the flow of fluid of the hydraulic means within the hydraulic system for selectively

varying the speed of movement of said boom or said dipstick.

2. Apparatus as defined in claim 1 wherein said control means selectively increases the speed of movement of either said boom or said dipstick.

3. Apparatus as defined in claim 1 wherein said control means selectively increases the speed of movement of said dipstick as well as the power applied thereto.

4. Apparatus as defined in claim 1 wherein said control means selectively reduces the speed of movement of said dipstick and increases the power applied thereto.

5. Apparatus as defined in claim 1 wherein said hydraulic system includes a source of hydraulic pressure, first hydraulically operated means for actuating said boom, second hydraulically operated means for actuating said dipstick, third hydraulically operated means for swinging said platform, conduit means connecting said source of hydraulic pressure and each of said hydraulically operated means, a boom control valve connected in said conduit means for controlling the operation of said first hydraulically operated means, a dipstick control valve connected in said conduit means for controlling the operation of said second hydraulically operated means, and a swing control valve connected in said conduit means for controlling the operation of said third hydraulically operated means.

6. Apparatus as defined in claim 5 including remotely operated valve means connected in said conduit means between said source of hydraulic pressure and said swing control valve.

7. Apparatus as defined in claim 6 including a relief valve operatively associated with said remotely operated valve means, a reservoir, said relief valve being connected with said reservoir, said reservoir being connected with said source of hydraulic pressure.

8. Apparatus as defined in claim 6 including a boom assist conduit means connected with said remotely operated valve means, said boom assist conduit means being connected with the said conduit means operatively connected between said source of hydraulic pressure and said first hydraulically operated means for actuating the boom so that hydraulic pressure passing through the boom assist conduit means is adapted to speed up the movement of the boom.

9. Apparatus as defined in claim 8 including a one-way check valve connected in said boom assist conduit means for permitting fluid flow from said remotely operated valve means to said first hydraulically operated means and preventing fluid flow in the reverse direction.

10. Apparatus as defined in claim 6 including a dipstick assist conduit means connected between said remotely operated valve means and said conduit means connected between the source of hydraulic pressure and said second hydraulically operated means.

11. Apparatus as defined in claim 10 including a one-way check valve connected in said dipstick assist conduit means to permit fluid flow from said remotely operated valve means toward said second hydraulically operated means and preventing flow in the reverse direction whereby fluid flowing through the dipstick assist conduit means is adapted to vary the movement of the dipstick.

12. Apparatus as defined in claim 10 including further conduit means connected between said first-mentioned conduit means and said boom assist conduit means to provide a return path of fluid from said second hydraulically operated means when the return path is otherwise blocked by said dipstick control valve.

13. Apparatus as defined in claim 12 including a one-way check valve connected in said further conduit means to permit fluid flow from the return path from said second hydraulically operated means as incorporated in said first-mentioned conduit means to said boom assist conduit means and preventing reverse flow therebetween.

14. Apparatus as defined in claim 5 including a re-

motely operated valve means connected between said source of hydraulic pressure and said swing control valve, a boom assist conduit means connected between said remotely operated valve means and a portion of said first-mentioned conduit means for providing fluid to said first hydraulically operated means for speeding up movement of said boom, and dipstick assist conduit means connected between said remotely operated valve means and a portion of said first-mentioned conduit means for providing fluid flow to said second hydraulically operated means to vary the movement of said dipstick.

15 15. Apparatus as defined in claim 14 including a one-way check valve connected in said boom assist conduit means for permitting fluid flow from said remotely operated valve means toward said first hydraulically operated means, and preventing reverse flow therebetween.

16. Apparatus as defined in claim 14 including a one-way check valve connected in said dipstick assist conduit means for permitting fluid flow from said remotely operated valve means toward said second hydraulically operated means, and preventing reverse flow therebetween.

17. Apparatus as defined in claim 16 including a further conduit connected between a portion of said first-mentioned conduit means providing a return path from said second hydraulically operated means and said boom assist conduit means to provide a return flow path from said second hydraulically operated means when said dipstick control valve prevents fluid flow through the normal return path.

18. Apparatus as defined in claim 17 including a one-way check valve connected in said further conduit means and permitting fluid flow from the portion of said first-mentioned conduit means providing a return path from said second hydraulically operated means toward said boom assist conduit means and preventing reverse flow therebetween.

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HUGO O. SCHULZ, Primary Examiner