

April 25, 1933.

B. S. T. BISHOP ET AL
HYDRAULIC FEED FOR MACHINERY

1,905,133

Filed April 23, 1929

5 Sheets-Sheet 1

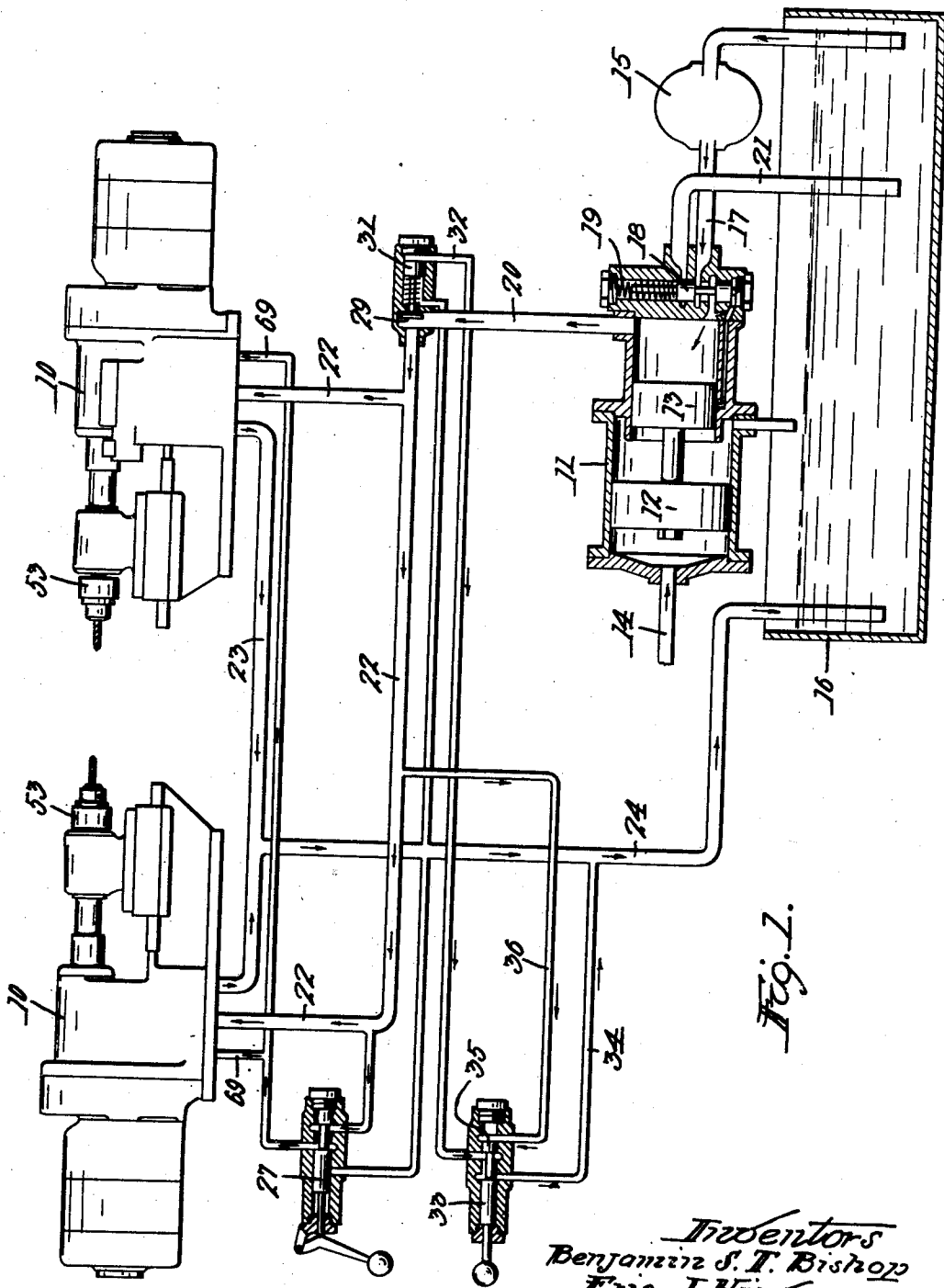


Fig. 2.

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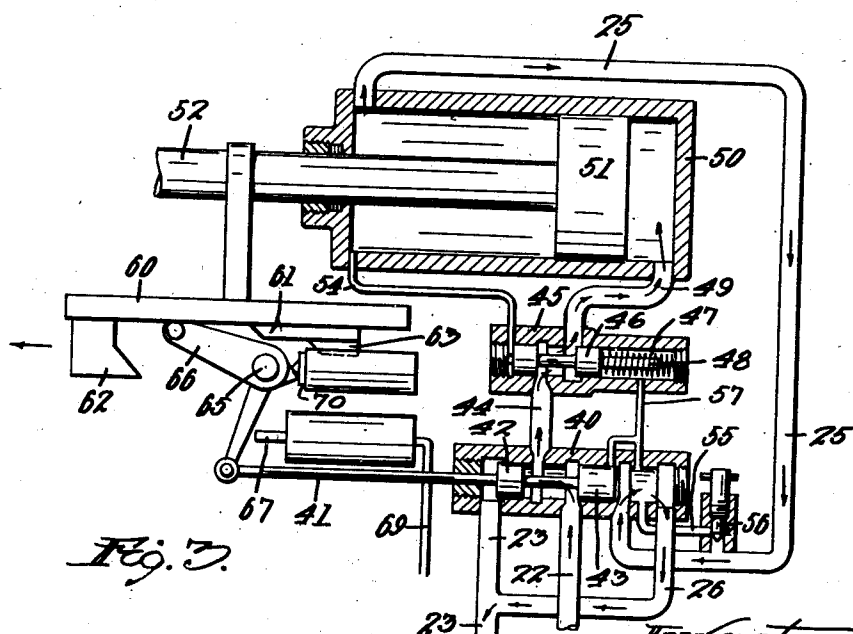
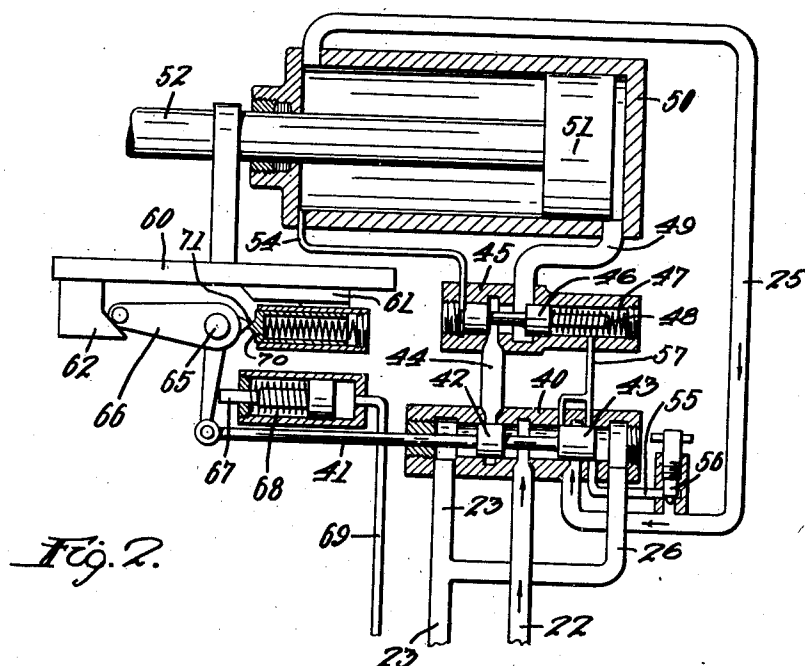
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Filed April 23, 1929

5 Sheets-Sheet 2



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Filed April 23, 1929

5 Sheets-Sheet 3

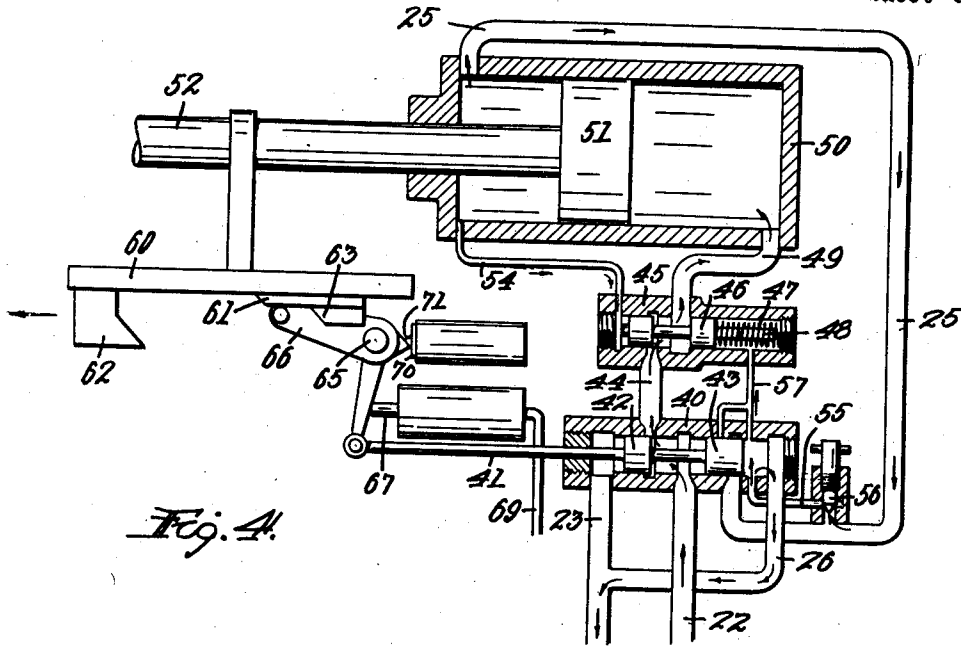


Fig. 4.

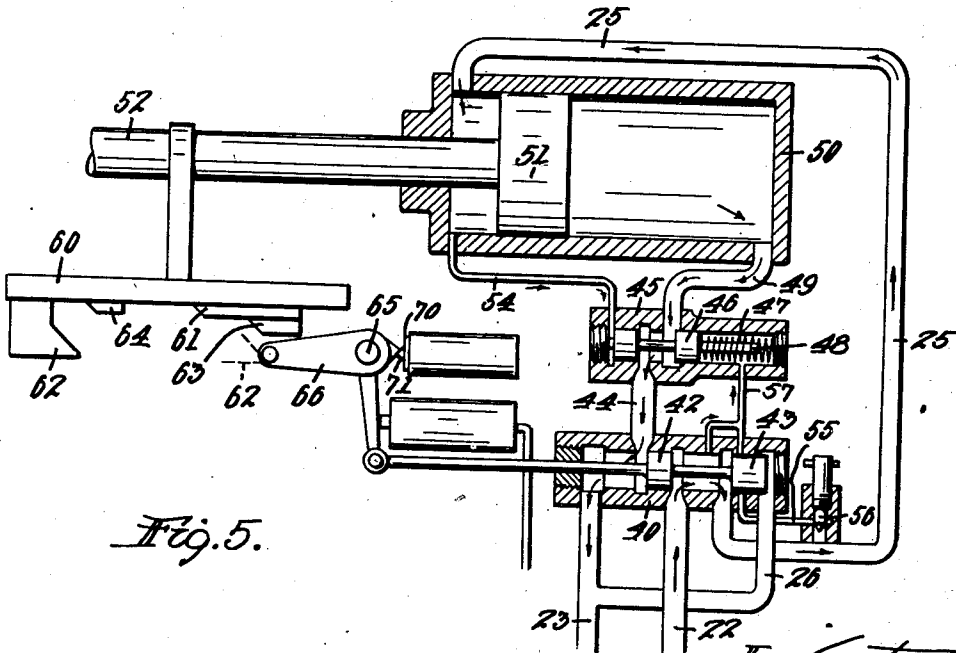


Fig. 5.

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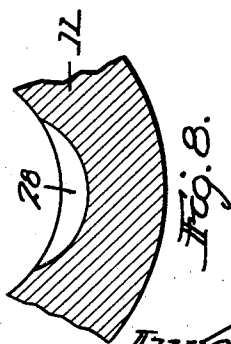
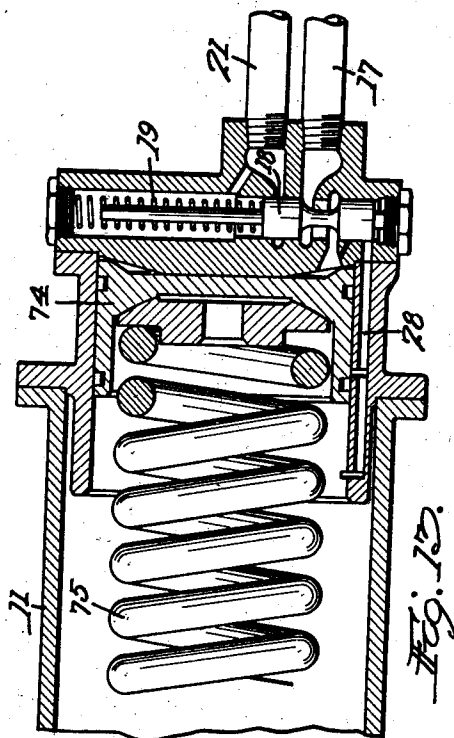
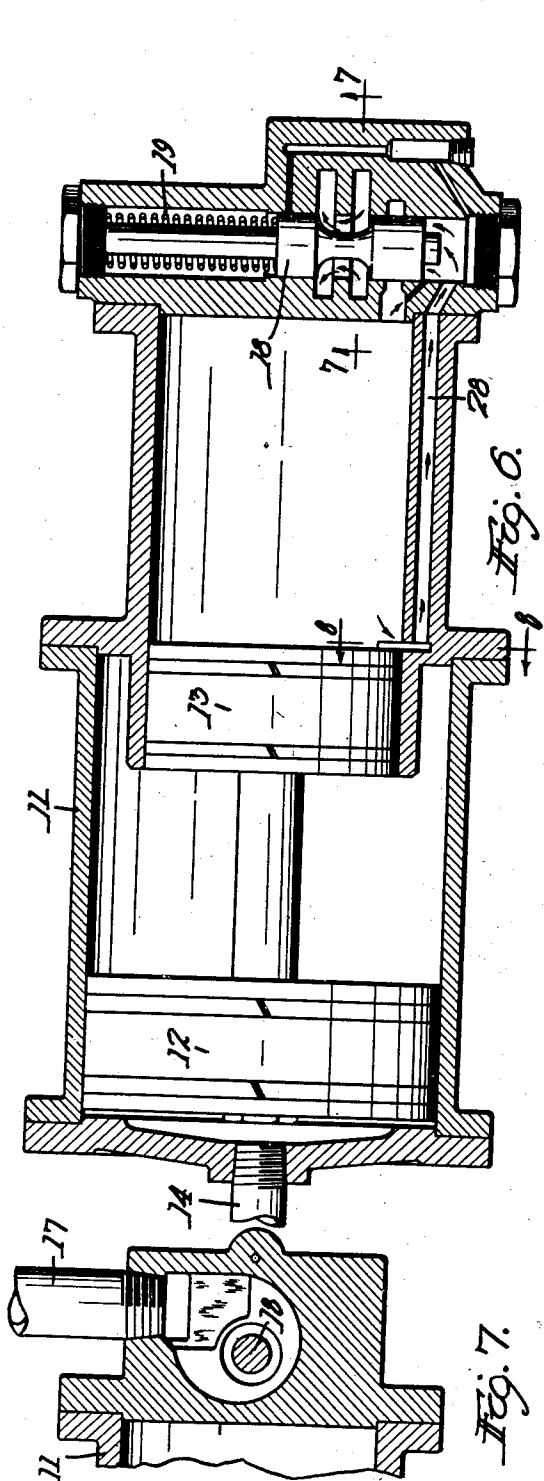
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1,905,133

Filed April 23, 1929

5 Sheets-Sheet 4



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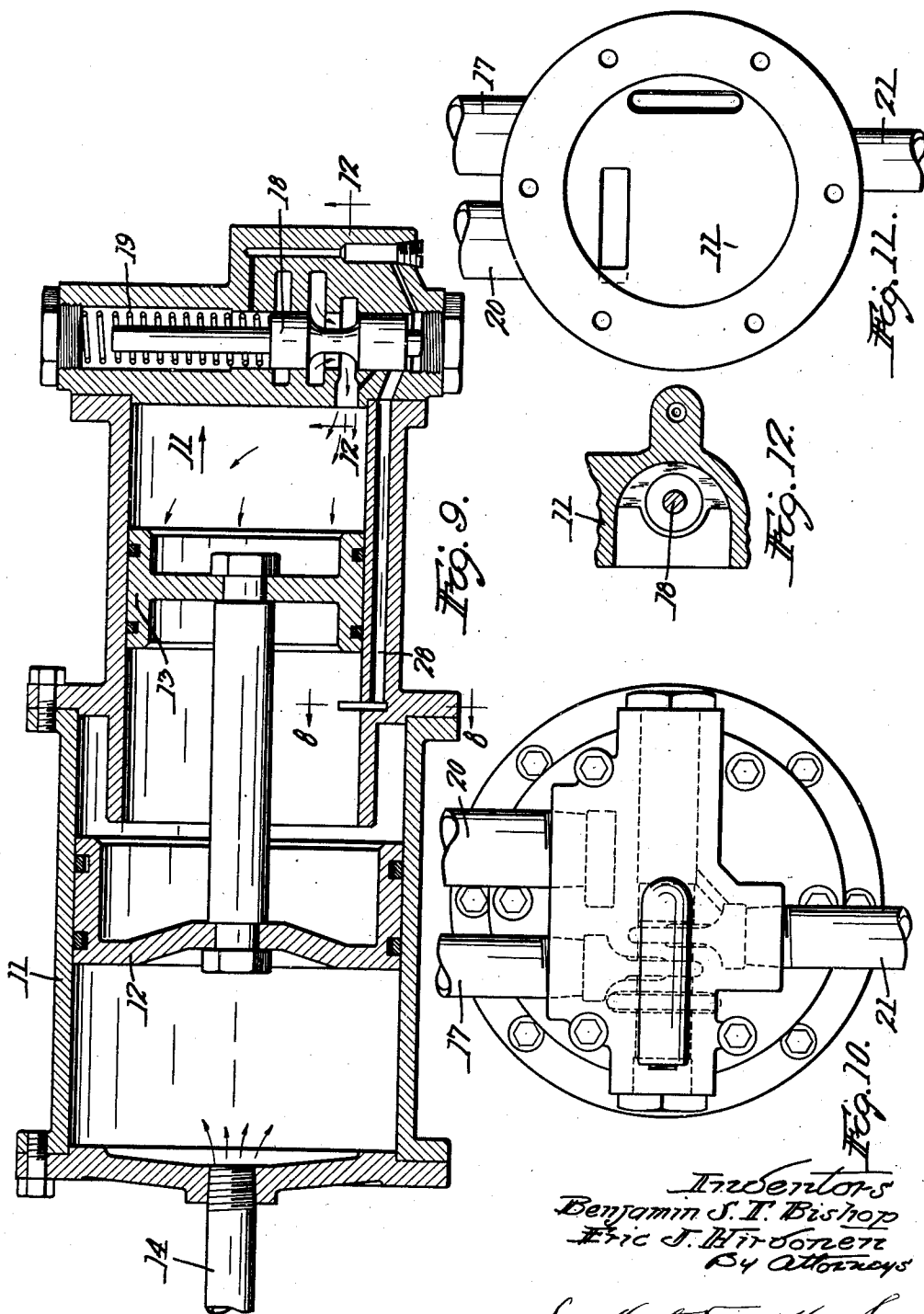
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Filed April 23, 1929

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

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HYDRAULIC FEED FOR MACHINERY

Application filed April 23, 1929. Serial No. 357,532.

This invention relates to a hydraulic feed for a battery of machines.

The principal objects of the invention are to provide a single feeding device for supplying oil, water or other fluid for actuating a number of machine units, as for example, drills, which will be capable of supplying sufficient motor fluid, when all the machines are running, and will not supply any excessive amount if only one or a small number of machines have to be running at any particular time; to provide improved means for storing pressure, so to speak, in a single cylinder for supplying it to a battery of machines in such a way as to accomplish the above mentioned result; to provide such a system with means for taking care of the exhaust pressure fluid from the high pressure sides of the operating cylinders; to provide an accumulator for storing up oil or other liquid under pressure for running the machines with means for constantly applying pressure to that fluid and means whereby, when a quantity of liquid is collected, the liquid will be circulated back without pressure into the supply with no necessity for stopping the pump which supplies it so that a single pump can be used for a number of machines and will take care of all their needs under all circumstances, and will not require constant attention; to provide connections of such a nature that in emergency all the machines can be stopped simultaneously at whatever point they may be at that time and can start up again from those points without involving any complications or any uncertainty of each of the machines completing its stroke and to provide a mechanism for controlling the admission and exhaust for the several individual machines with means whereby the control of the power fluid is performed by the position of the piston of each machine and whereby each piston will automatically move forward rapidly at first and then slowly for cutting, reverse, and then stop at the end of the back stroke or by which any other suitable change in feed can be secured so that in some cases two holes might be bored at a distance from

each other with a fast feed between them, or the like.

The invention also involves improvements in the accumulator itself and its connections with the several machines and operating valves and improvements in the valve mechanism and operating connections therefor for each of the machines.

Other objects and advantages of the invention will appear hereinafter.

Reference is to be had to the accompanying drawings in which

Fig. 1 is a diagrammatic view of the piping and the accumulator connected up with a plurality of machines in accordance with this invention;

Fig. 2 is a view of one of the machines showing the pipe and valves somewhat diagrammatically in neutral position;

Fig. 3 is a similar view showing the position of parts for fast approach;

Fig. 4 is a similar view showing slow feed for the cutting stroke;

Fig. 5 is a similar view showing the parts in reversed position and illustrating another way in which the controlling dogs or cams can be set;

Fig. 6 is a sectional view of the accumulator, shown in Fig. 1, on enlarged scale;

Fig. 7 is a transverse sectional view on the line 7—7 of Fig. 6;

Fig. 8 is a sectional view on the line 8—8 of Fig. 6;

Fig. 9 is a view similar to Fig. 6 showing the pistons in section also;

Fig. 10 is an outside end view of the same;

Fig. 11 is an inside end view of the same, as indicated by the arrow 11 of Fig. 9;

Fig. 12 is a sectional view on the line 12—12 of Fig. 9, and

Fig. 13 is a view similar to Fig. 9 showing a modification.

This invention is designed to operate a plurality of machines as for example, drills. These drills are constructed in such a way that the tools are rotated by means, not constituting a part of this invention, and this invention is designed to move the drill heads inwardly to perform drilling opera-

tions. This has been done hydraulically before but for a set of machines it has been necessary to provide separate means for supplying the oil or water for operating each machine.

It will be understood that these drills usually go in together so that a maximum supply of the fluid is required on the working strokes, ordinarily, and yet it is not essential that they keep together and it is one purpose of this invention to provide a construction whereby the drills can advance at different times if desired or some of them can be moving in one direction and others in the opposite direction. A special feature of this invention is the provision of an accumulator for the oil or other liquid for operating the several machines which will be capable of supplying all the fluid under pressure necessary and will accommodate itself to differences in the amount of fluid used by the different units and will be universal in operation, that is, capable of operating the machines in any desired way and of supplying sufficient fluid for them if they all do their cutting at the same time and yet will be sufficiently flexible so that it will operate a single unit by itself if desired and everything will be taken care of. It is intended that the pump for supplying the accumulator with the pressure fluids shall operate all the time and by this condition this pump can be made much smaller than would be necessary to operate the same number of machines if the accumulator feature were not used. If any machine is stopped, or any number of machines, anywhere in the stroke, it or they can be started again from that point and the stroke completed, without any attention being paid to the single pump or to any regulating means for the pressure. The pressure on the motive fluid in the accumulator is constant as the pressure in the pipe 14 is constant.

The units which are shown in the form of horizontal drills are illustrated in Figs. 2 to 5 as comprising certain elements which will be described later but involving the use of fluid pressure for actuating a piston and moving the drill heads forward or back. They are all connected with a single accumulator 11 which includes a main cylinder having two diameters and two pistons 12 and 13 therein rigidly connected together. Constant pressure of compressed air, steam or other elastic fluid is introduced through a pipe 14 so that the pistons will move in the cylinders in accordance with the volume of oil in the small cylinder, the pressure on the piston 12 being constant. The pressure in the small cylinder is provided by a rotary pump 15 taking oil, water, or other liquid out of the tank 16 and constantly operating.

The ports by which the oil is introduced into the small cylinder through a pipe 17 are

controlled by a valve 18 constantly pressed forward by a spring 19. As the pump 15 operates constantly, it supplies the small cylinder with the liquid, which, as will appear, is fed to the various cylinders of the machine units and supplies all of them through a pipe 20. Whenever the amount of oil in the small cylinder increases too much on account of the constant operation of the pump, or the shutting down of some of the machines, the piston 13 will be forced back in the accumulator. Finally this will expose the end of a by-pass 28 and the oil will act against the end of the piston valve 18 and force it back against the spring and allow the oil to flow back into the tank through a pipe 21 thus providing constant circulation without stopping or slowing down the pump, the pump idling or circulating oil under no pressure, so that there is no working load on the pump motor. Oil can be withdrawn at any time from the small cylinder under the constant pressure given by the large piston 12. When a sufficient amount of oil has been withdrawn so that the back side of the small piston 13 passes beyond and uncovers the by-pass 28, the pressure on the end of the piston valve is relieved and the spring 19 moves the valve down, thereby admitting oil from the pump to the small cylinder, to refill it.

This device is called an accumulator because, with a constantly operating pump, the pressure of the oil in it is kept at a substantially predetermined mark and it will supply oil for operating the various tools, no matter how many of them are at work or how many of them are stopped, and it contains means within it for keeping the pressure substantially constant under the influence of the constantly acting pump. This pump, on account of the above mentioned conditions can be made much smaller than has been possible with this system. The pump requires no special attention because it is run constantly as long as the machines are being used. The pump is never slowed down and never stopped and even if the machines should all be stopped it would not be necessary to go to the trouble of stopping the pump.

The oil is delivered from the small cylinder through the pipe 20 past a valve 29 and into a plurality of supply pipes 22 which feed the machines. The exhaust motive fluid oil from the pressure sides of the machines is delivered through pipes 23 into a main 24 which delivers the oil to the tank 16. The low pressure sides of the cylinders operating the several machines are connected with the pipe 25 through which the oil passes first in one direction and then in the other and these outlets are connected with the pipes 23 through branches 26.

For the purpose of stopping the machine

in case of emergency, an emergency stop valve 33 is provided. Normally a pipe 32 is connected with a pipe 34 through this valve which drains the space back of a piston 31 and leaves a spring operated valve 29 open so that the machine can operate. When the valve 33 is pushed in and this connection is closed, a second piston 35 on the valve 33 will open communication between a pipe 36 and the pipe 32. The pipe 36 is connected with the high pressure when the machine is operating and consequently this full pressure will be introduced through the pipe 32 behind the piston 31 and close the valve 29. This can be done because the pressure on the other side of the valve 31 is merely that of the spring, this side being open to the drain pipe 24.

It will be seen therefore that at any time, no matter what the position of the parts, the emergency stop valve can be operated to stop the entire machine. But even then the pump 15 can be left running and by-pass the accumulator and the accumulator will be ready to start into operation as soon as the valve 29 is opened.

The pipes 22 and 23 enter a valve casing 40. Into this casing extends a valve stem 41 having two valves 42 and 43 thereon located at all times on opposite sides of the port in the valve casing which communicates with the inlet pipe 22. On one side of this port and spaced from it a distance equal to the length of the piston valve 42 is a port communicating with a pipe or passage 44 which extends to a second valve casing 45. This valve casing has in it a double piston valve 46 pressed by a spring 47 and its motion backward limited by a pin 48 as usual. This piston valve controls the pipe or passage 44 and the main inlet pipe or passage 49 to the high pressure side of a cylinder 50. In this cylinder is a piston 51 operating a piston rod 52 on which, or connected with which, is the drill head 53. All these machines, of course, are constructed alike.

From the other or low pressure side of the cylinder 50 a pipe 54 communicates with the valve casing 45 at one extreme end. Also from the extreme end of the low pressure side of the cylinder 50 extends a pipe 25 which has been mentioned and through which the oil passes first in one direction and then the other constituting the exhaust. This pipe enters the casing 40 at a point to be controlled by the piston valve 43 and will allow the exhaust low pressure oil to flow into the pipe 26 when the parts are in the position shown in Figs. 3 and 4. There is a by-pass 55 controlled by an adjustable needle valve 56 which is closed and opened by the valve 43. There is also a pipe or passage 57 entering the spring chamber behind the valve 46 and having two entrances to the valve casing 40 spaced apart as shown. The pipe 23 is con-

nected with the casing 40 at the extreme left end so as to communicate with the passage 44 only in the reverse position shown in Fig. 5.

Connected with the piston rod 52 is a cam plate 60 reciprocating with it. This cam plate in the form shown in Figs. 2, 3 and 4 has a simple set of cams thereon comprising a slow feed or cutting stroke cam 61, a stopping cam 62 and a reverse cam 63. Fig. 5 shows a slight modification in which a second slow feed cutting cam 64 is employed where there are two holes to be bored at one stroke located at a distance apart.

Mounted on a stationary shaft 65 is a bell crank 66 having a roll for engaging said cams. The other end of the bell crank is connected with the valve rod 41 pivotally. The motion of the bell crank in a certain direction is resisted by a plunger 67 which is moved inwardly by a spring 68 and is supplied with pressure fluid through a pipe 69 to move it out against the arm of the bell crank 66 for starting from neutral. There is also a spring pressed plunger 70 having a V-point 71 for engaging a similar point on the bell crank, forcing the bell crank out of neutral position so that it will always be moved toward one of the cams 61 or 62.

It is to be noted that a battery of machines is intended to be employed, all these machines being connected with the accumulator 11 in a manner that has been described. The valve 29 is closed if the emergency stop valve 33 is pushed in, because the pressure from the pipes 22, through the pipes 36 and 32, will operate on the piston 31 to keep it closed. If the stop valve 33 is pulled out as shown, the pipe 32 will be drained into the pipe 24 and the valve 29 will open.

Now the starting valve 27 is pushed in, as shown, and the oil under pressure in the pipes 22 is allowed to flow through the pipe 69 to push out the rods 67 of the entire battery of machines. This moves the bell cranks 66 from the neutral position shown in Fig. 2 to that shown in Fig. 3. Now the pressure enters various casings 40 through the several pipes 22 and each machine thereafter is self-controlled, that is, independently of the other machines. Now, under neutral conditions, the two valves 42 and 43 are in the position shown in Fig. 2 closing the ports which lead to the pipes or the passages 44 and 57 and also closing the pipe 25, excepting through the by-pass 55. The oil pressure within the casing 40 from the pipe 22 exerts equal pressure on the two pistons 42 and 43 in opposite directions. Therefore the rod 41 can be moved easily so the bell cranks can be moved over by operation of the starting valve 27 to the position shown in Fig. 3. This is sufficient to pull the piston valve 42 to the left enough to uncover the pipe 44 and the oil will flow into the cylinder 50 through the valve casing 45 in the direction

of the arrows in Fig. 3. This forces the piston 51 forward and the oil on the low pressure side of this piston is forced through the pipe 25 in the direction of the arrows.

5 The piston valve 43 uncovers the ports so that this oil can flow into the pipe 26 and from there into the pipe 23 freely as indicated in Fig. 3.

The piston 51 now moves forward in the
10 direction of the arrow in Fig. 3 at its highest rate of speed for enabling the tool to approach the work. The dog or cam 61 is so placed that at the proper time it will force out the bell crank to the position shown in
15 Fig. 4. In this position the tool is to be fed forward into the work but at low or cutting speed. That is, the piston valve 42 has moved back so as to restrict the opening into the pipe 44 and the piston valve 43 is moved
20 back so as to cut off the pipe 25 entirely at this point. The result is that there will be less oil supplied to the high pressure side of the piston and it will flow forward more slowly and also the pressure from the low
25 pressure side will be restricted by the valve 56 as it has to go through that to get into the pipe 26 as shown in Fig. 4. So in both ways the speed is cut down.

In the slow feed position shown in Fig.
30 4 it will be noticed that the oil in the left hand end of the cylinder 50 is under substantial pressure due to the restriction to its free escape provided by the needle valve 56. This pressure is transmitted, through the
35 pipe 54, to the left hand end of the valve cylinder 45, thereby forcing the valve 46 therein to the right and partially closing the outlet of the pressure pipe 44, thereby to obtain the desired slow forward feed. The
40 position assumed by the valve 46 is determined by the resistance to forward movement of the tool-moving piston 51. If there is little opposition to its movement, the pressure of the oil on the exhaust side of the piston tends to be high, so that the valve 46
45 partially closes, thereby tending to reduce the rate of inflow of pressure oil to the cylinder 50. If the resistance is high, there is less pressure on the oil on the exhaust side, so
50 that the valve 46 opens more, thereby tending to admit pressure oil at a more rapid rate to the working side of the piston. This arrangement, combined with the needle valve 56, thus tends to maintain a constant
55 rate of feed of the piston 51 regardless of variations of load thereon. During this slow forward feed, the right hand branch of the pipe 57 is under no pressure so that the pressure in the pipe 54 is effective in displacing
60 the valve 46 in the aforesaid manner. When, however, the piston valve 42-43 is moved to the right to obtain reverse feed the part 43 of the valve uncovers the left hand branch of the pipe 57 and places it in communication
65 tion with the high pressure oil inlet pipe 22,

thereby causing the valve 46 to be moved to its extreme left hand position, where it does not throttle the outflow of oil from the right hand side of the cylinder 50.

The dog 63 is so located that it will come
70 into position to operate the bell crank 66 and force it over the point 71 as shown in Fig. 5 and swing it as far back as possible, thus moving the piston valves 42 and 43 to the positions shown in Fig. 5 which brings the pressure supply pipe 22 into communication with
75 the pipe 25 and introduces the power fluid behind the piston to force it back. The exhaust comes through the pipes 49, 44 and 23. There is nothing to move the parts out of this position until the entire reverse stroke has been accomplished, which is done at high speed because none of the ports through which the oil has to pass from the low pressure side of the piston are restricted.

When the machine has traveled clear back, the cam 62 will operate the roller on the bell crank and move it from the position shown in Fig. 5 to that shown in Fig. 2 and the machine will stop. All the machines will go
90 through this cycle, perhaps not simultaneously, and stop in neutral. They are started again by the starting valve 27 when the work has been placed in position.

The object of this invention can be carried
95 out in other ways one of which is shown in Fig. 13. Here the same principle is maintained, the elastic pressure being provided for the piston 74 by a spring 75 which will tend to produce the same effects as in the other case illustrated. No further description of this figure is thought to be necessary because the parts common to both forms are designated by the same reference numbers as in the other figures. Of course, in this case there
100 would be no pipe 14. The pump regulator shown herein is not claimed by itself as it forms the subject matter of our divisional application, Serial No. 565,472, filed September 15, 1931. Furthermore this case contains matter shown and described in our prior application for Patent, Serial No. 241,694, filed December 21, 1927 and claimed therein.

Although we have illustrated and described only two forms of the invention we are aware of the fact that other modifications can be made therein by any person skilled in the art without departing from the scope of the invention as expressed in the claims. Therefore, we do not wish to be limited in this respect but what we do claim is:

1. The combination with a machine comprising a reciprocable piston and a cylinder therefor, of a valve for admitting fluid under pressure to the high pressure side of the piston, means for automatically thereafter moving said valve by said piston into a position for restricting the flow of the pressure fluid to the cylinder to cause the piston to move more slowly, means for then moving said

valve by said piston into a position for automatically cutting off the supply of fluid to the high pressure side of the cylinder and introducing it under pressure into the low pressure side to move the piston back and means for then moving said valve by said piston into a position for cutting off the supply of fluid to both sides of the piston for stopping the piston.

2. The combination with a machine including a reciprocable piston and a cylinder therefor, of a valve for admitting fluid under constant pressure to the high pressure side of the piston, means for automatically thereafter restricting the flow of the pressure fluid to the cylinder to cause the piston to move more slowly, automatic means controlled by the motion of the piston for then cutting off the supply of fluid to the high pressure side of the cylinder and introducing it into the low pressure side to move the piston back and means for then cutting off that supply for stopping the piston, the supply restricting means comprising a by-pass having an adjustable valve through which the pressure fluid escapes from behind the low pressure side of the cylinder and means for simultaneously restricting the introduction of the pressure fluid on the high pressure side of the piston.

3. The combination with a battery of machines, each involving a reciprocating part, a cylinder and piston for each machine for operating the reciprocating part, means for supplying motive fluid under pressure to the cylinders for operating the pistons, means movable with each piston for controlling the flow of motive fluid to its cylinder so as to start the piston forward at a high speed, then move it forward at a low speed, reverse it and then stop it in neutral position, said means comprising dogs movable together, a valve for controlling the flow of the fluid, and means for starting the machines from neutral position comprising plungers for operating said valves into a position to admit the pressure fluid to the cylinders so as to start the pistons forward at high speed and a starting valve for admitting the pressure fluid to the plungers to operate them when it is desired to start all the machines at once from neutral position.

4. The combination with a plurality of machines, each having a reciprocable part and a cylinder and piston for operating the reciprocable part, of means for introducing motive fluid into the cylinder for reciprocating the pistons, cams movable with each piston, means operated by said cams for controlling the connection of the cylinders with a source of supply of fluid under pressure to operate the pistons forward and back and at different speeds, a starting valve, plungers for moving each cam operated means and means so constructed and arranged that the

starting valve will act to introduce the motive fluid behind each of said plungers to start several machines when in neutral position.

5. The combination of a machine having a cylinder and piston, hydraulic means for advancing said piston at a predetermined rate that is constant for any selected rate and is independent of load variations on said piston, and means controlled by the position of said piston for changing the rate of admission of pressure fluid to alter the rate of advance of said piston.

6. The combination of a machine having a cylinder and piston, means for admitting pressure fluid behind said piston for advancing it at a predetermined rate, means for entrapping a fluid body on the other side of said piston, and means controlled by the position of said piston and also by the pressure of said entrapped fluid body for governing the rate of admission of pressure fluid for controlling the rate of advance of said piston.

7. The combination of a machine having a cylinder and piston, means including a valve for admitting pressure fluid behind said piston for advancing it at a predetermined rate, means controlled by the position of said piston for altering the setting of said valve for changing the rate of advance of said piston, and means responsive to the loading on said piston for also controlling the admission of fluid behind said piston for holding constant the rate of advance determined by said piston controlled means.

8. The combination of a machine having a piston and a cylinder therefor adapted to contain fluid on both sides of said piston, means for admitting pressure fluid into said cylinder on one side of said piston for advancing it and creating a back pressure of fluid on the other side of said piston, means controlled by said piston in a predetermined position thereof for changing the rate of admission of fluid into said cylinder to change the rate of advance of said piston, and means responsive to variations of back pressure to vary the rate of admission of pressure fluid in such manner as to maintain a uniform movement of said piston at any selected rate of movement thereof.

9. The combination of a machine having a piston and a cylinder therefor adapted to contain fluid on both sides of said piston, means including a pipe in communication with one end of said cylinder and a valve in said pipe for admitting pressure fluid into said cylinder on one side of said piston for advancing it and creating a back pressure of fluid on the other side of said piston, a regulating valve in said pipe between said cylinder and said first valve, and means responsive to variations in back pressure to vary the setting of said regulating valve.

10. The combination of a machine having
a piston and a cylinder therefor adapted to
contain fluid on both sides of said piston,
means including a pipe in communication
5 with one end of said cylinder and a valve
on said pipe for admitting pressure fluid
into said cylinder on one side of said piston
for advancing it and creating a back pressure
of fluid on the other side of said piston, a
10 regulating valve in said pipe between said
cylinder and said first valve, means controlled by the position of said piston for altering the setting of said first valve, and
means responsive to variations in back pressure to vary the setting of said regulating
15 valve.

In testimony whereof we have hereunto
affixed our signatures.

BENJAMIN S. T. BISHOP.
ERIC J. HIRVONEN.

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