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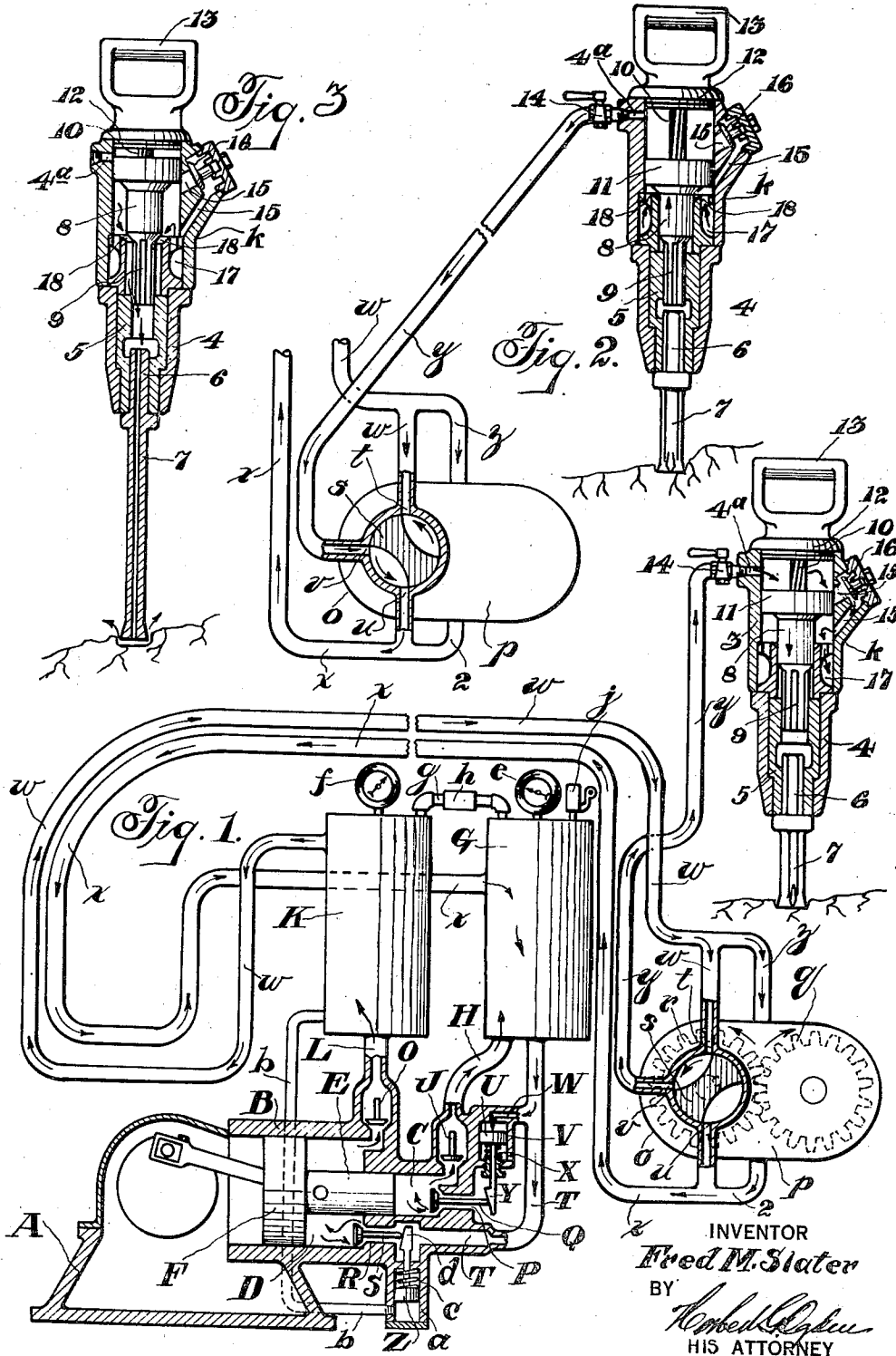
F. M. SLATER

1,503,922

FLUID PRESSURE IMPULSE SYSTEM

Filed July 20, 1921

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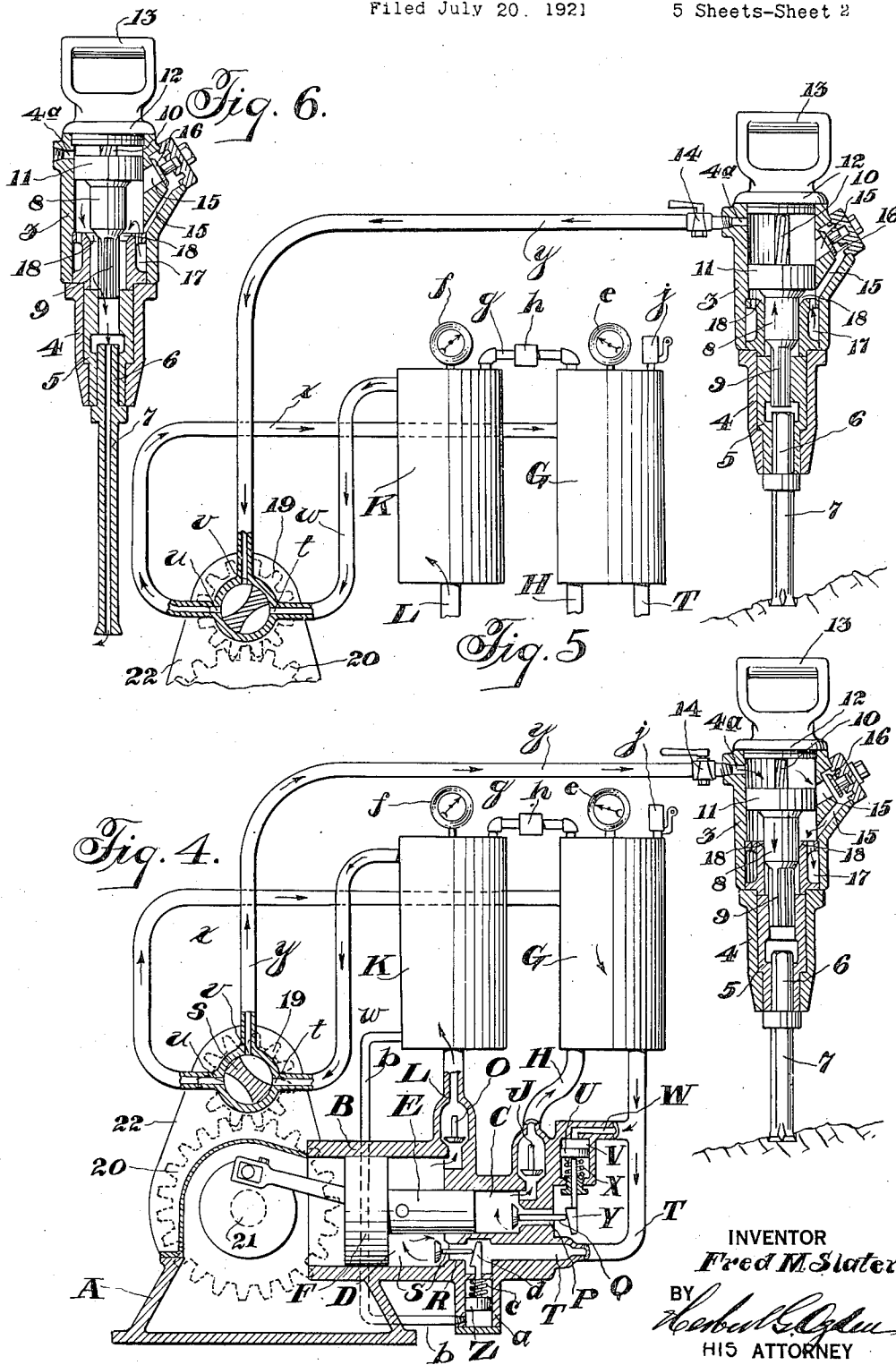
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FLUID PRESSURE IMPULSE SYSTEM

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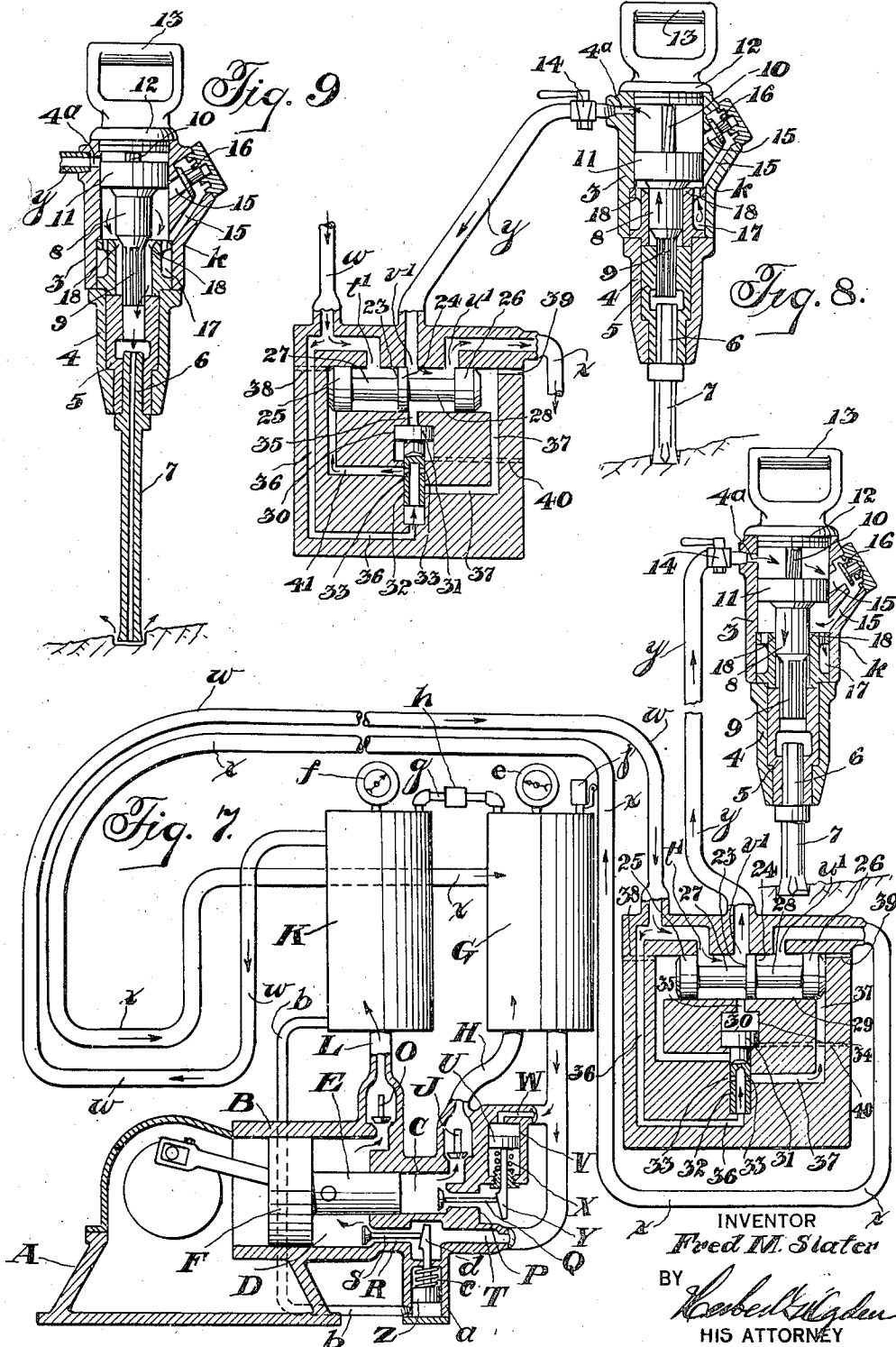
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FLUID PRESSURE IMPULSE SYSTEM

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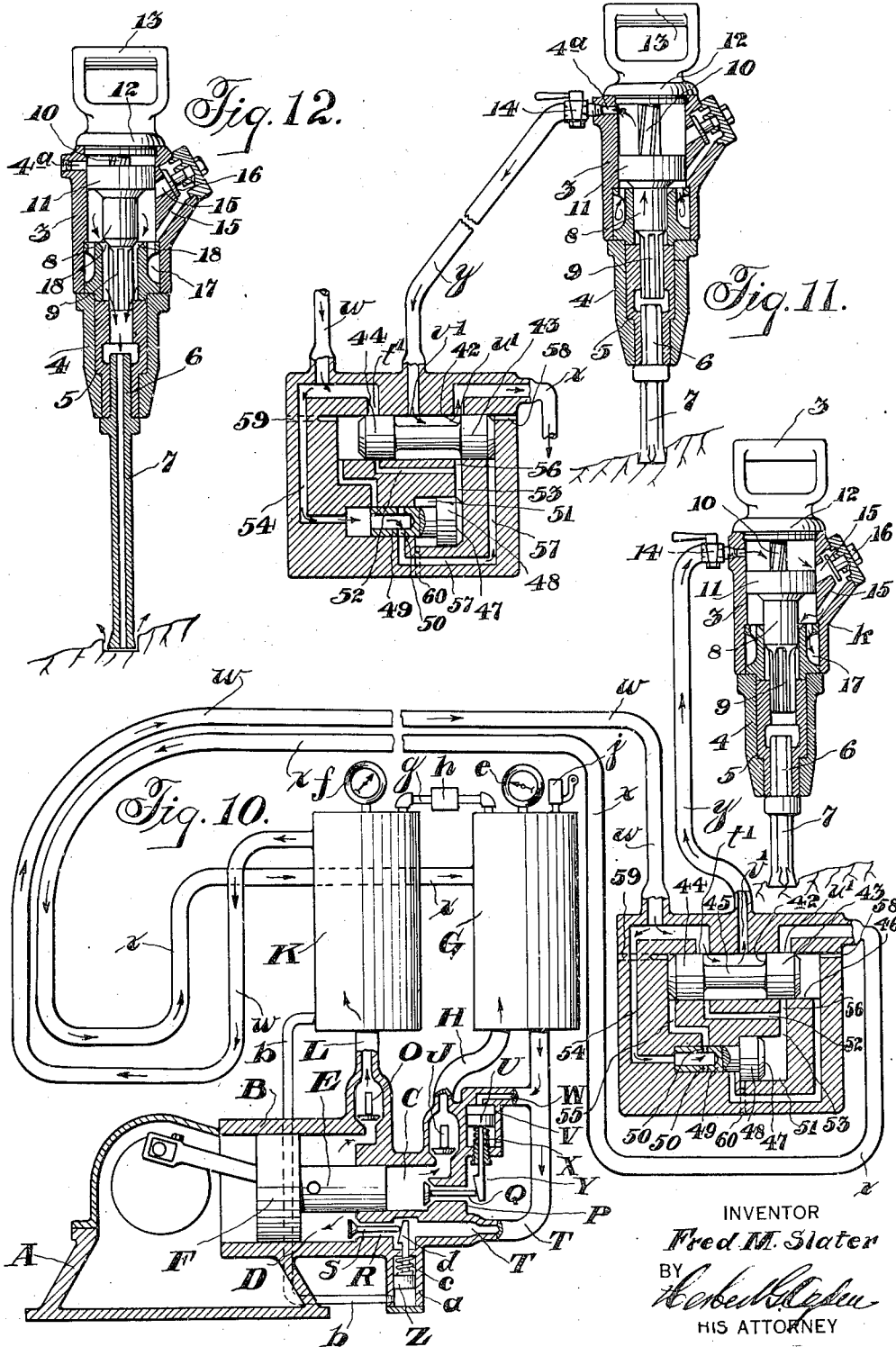
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FLUID PRESSURE IMPULSE SYSTEM

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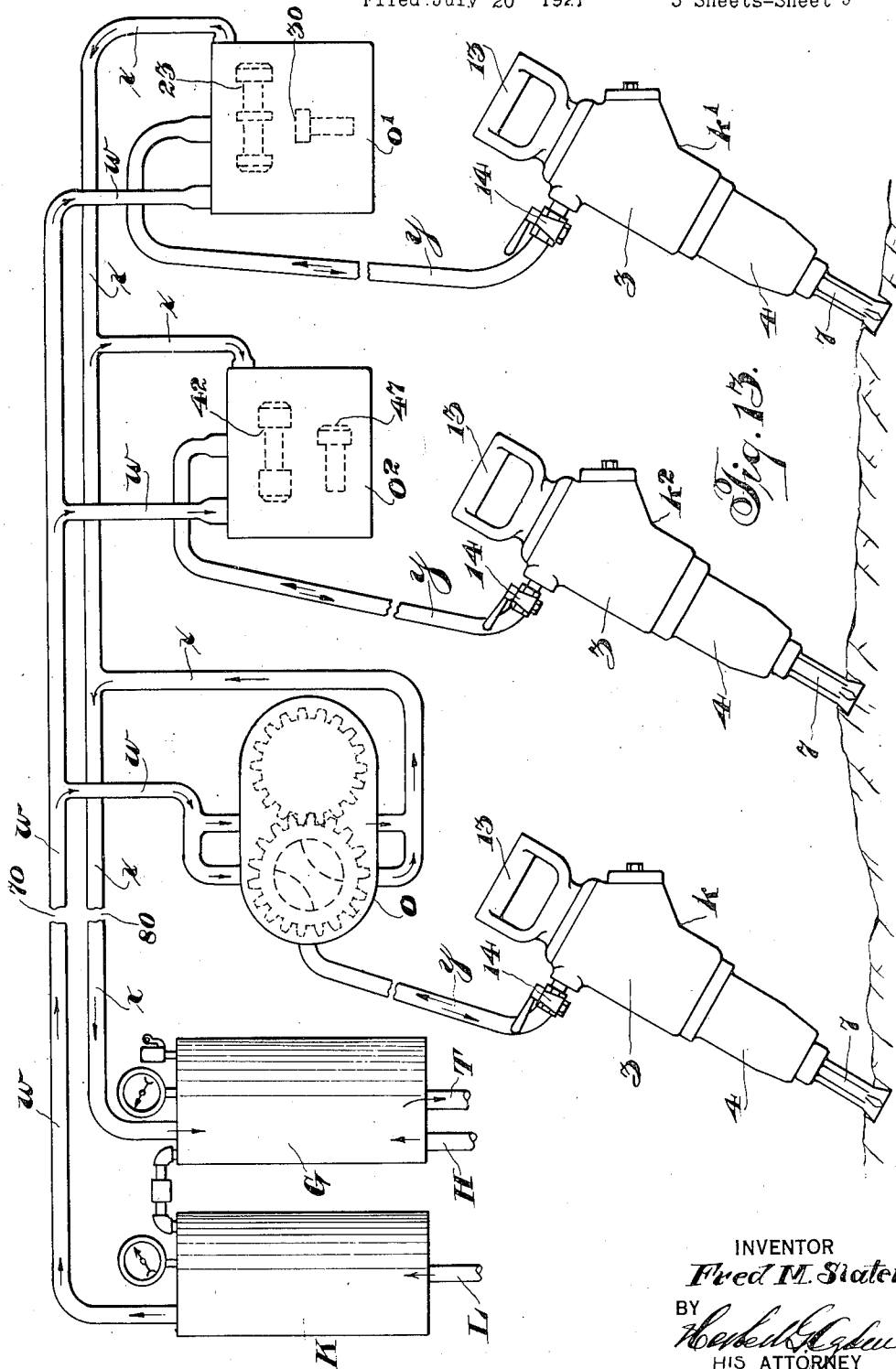
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FLUID PRESSURE IMPULSE SYSTEM

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5 Sheets-Sheet 5



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FLUID-PRESSURE IMPULSE SYSTEM.

Application filed July 20, 1921. Serial No. 486,227.

To all whom it may concern:

Be it known that I, FRED M. SLATER, a citizen of the United States, and a resident of Easton, Northampton County, State of Pennsylvania, have invented a certain Fluid-Pressure Impulse System, of which the following is a specification, accompanied by drawings.

This invention relates to a fluid pressure impulse system for operating fluid actuated machines, as for instance rock drills of the hammer type, although the principles of the system may be utilized in any connection in which they are found applicable.

An ordinary pulsator system, in which the motive fluid, as compressed air, is actually pulsated back and forth without interruption, is wasteful and moreover is limited to a comparatively short length of hose from the pulsator to the rock drill or other machine, because of the elasticity of the air and also due to the fact that a pulsation in one direction must have time to travel its full course, before the reverse pulsation sets in.

One of the objects of the present invention is to economize air by repumping at least some of the same air at all times and using more or less of it over again through the system, only a part of the air being utilized for blowing the drill hole through the drill steel in the preferred form of the invention. Large receivers are not necessary in my system, which also reduces the cost of installation.

Another object is to generate impulses in the supply lines, as by means of an interrupter, for operating the fluid actuated machine which may be a rock drill. Such an impulse system has the advantage that the flow of fluid medium through the respective supply lines leading from the source or sources of pressure to the interrupter may be in the same direction in a given pipe line at all times, and these supply lines can be relatively long so that the interrupter, which is a small device, may be conveniently located remote from the source, while the length only of the line from the interrupter to the rock drill is limited.

Furthermore, with a pulsator system a cumbersome pulsator forming the source of supply is required for each and every tool, while with my impulse system, a plurality

of tools may be operated from one source, and a small interrupter provided for each tool.

The invention is illustrated in some of its preferred forms in the accompanying drawings, in which—

Figure 1 is a diagrammatic view partly in vertical section of a fluid pressure impulse system in accordance with the invention, shown connected to operate a fluid actuated rock drill of the hammer type for illustrative purposes.

Figure 2 is a detail diagrammatic view of a portion of Figure 1 showing the interrupter and the hammer piston of the rock drill in a different position.

Figure 3 is a detail longitudinal sectional elevation of the rock drill showing the hammer piston at the rearward end of its stroke.

Figure 4 is a diagrammatic view similar to Figure 1 showing the interrupter in a different location.

Figure 5 is a diagrammatic view of a portion of Figure 4 showing the interrupter and the hammer piston of a rock drill in a different position.

Figure 6 is a detail longitudinal sectional elevation of the rock drill showing the piston hammer at the rearward end of its stroke.

Figure 7 is a diagrammatic view partly in sectional elevation of an impulse system showing a modified form of interrupter.

Figure 8 is a detail diagrammatic view of a portion of Figure 7 showing the interrupter and the hammer piston of a rock drill in a different position.

Figure 9 is a detail sectional elevation of a rock drill showing the hammer piston at the rearward end of its stroke.

Figures 10, 11 and 12 are views similar to Figures 7, 8 and 9, showing a modified form of interrupter, and

Figure 13, is a diagrammatic view illustrating a plurality of rock drills operated from a common source of supply by means of my impulse system.

Referring to the drawings, A represents a suitable source of motive fluid pressure, which may be a compressor of any desired type, in this instance a two stage machine being illustrated, having a cylinder B formed with the chambers C and D, in which the piston E, having the head F reciprocates.

A low pressure receiver G, is connected by the discharge pipe H, having the valve J, to the first stage or low pressure end of the compressor represented by the cylinder chamber C. A high pressure receiver K, is connected by the discharge pipe L, having the valve O, to the second stage or high pressure end of the compressor represented by the cylinder chamber D.

The inlet P of the low pressure end of the compressor, communicating with the atmosphere, is controlled by the inlet valve Q, so that the low pressure receiver G forms a "make up" tank, which is pumped up from the atmosphere. The inlet R of the high pressure end of the compressor is controlled by the inlet valve S and communicates by means of the pipe T with the low pressure receiver G so that the fluid under low pressure from the receiver G is pumped to high pressure in the receiver K.

Means are provided for unloading the compressor when the pressure in the low pressure receiver G reaches a predetermined point, and for this purpose, the piston U in the small cylinder V is subjected to receiver pressure through the passage W, and opposed by the spring X. A wedge Y on the stem of the piston cooperates with the stem of the valve Q so that as the controlling piston U is forced outwardly in the small cylinder V, the inlet valve Q of the low pressure stage of the compressor will be forced and maintained open to unload the compressor.

Means are also provided for unloading the compressor when the pressure in the high pressure receiver K reaches a predetermined point, and for this purpose a piston Z in the small cylinder a is subject to receiver pressure through the pipe b, opposed by the spring c, and a wedge d on the stem of the piston Z cooperates with the stem of the inlet valve S and forces and maintains said valve open to unload the compressor at a predetermined point.

The receivers G and K may be provided with the gauges e and f and a connection g is preferably provided between the tanks, having a safety valve h of any suitable type adapted to be set at a pressure slightly above the maximum pressure of the high pressure receiver K in order to open communication between the tanks at a predetermined point. A blow-off valve j may also be provided on the low pressure receiver G. The automatic unloading devices, and safety valve h, which is preferably a reducing valve, and the blow-off valve j, protect the apparatus and insure continuous and steady operation.

In order to generate impulses of motive fluid under high pressure for operating a suitable machine or tool as for instance, a rock drill k, located at a distance, I connect

an automatic interrupter o in the supply line between the receivers G and K and the rock drill k. A suitable form of interrupter o comprises a fluid actuated motor casing p containing rotary gears q and r, one of which is connected to drive a two-way valve s controlling the ports t, u and v, in such manner that as the valve s rotates continuously in one direction, the port v is alternately and intermittently placed in communication with the ports t and u. A supply pipe w leads from the high pressure receiver K to the port t, through which motive fluid under high pressure is supplied, and a return pipe x leads from the port u back to the low pressure receiver G, through which fluid under reduced pressure is returned to the low pressure receiver. A combined supply and return pipe y connects the rock drill k with the port v of the interrupter, through which motive fluid under high pressure is supplied to the rock drill, while fluid under reduced pressure flows back from the rock drill through the pipe y in the other direction. A branch pipe z from the supply pipe w supplies motive fluid to the inlet of the motor casing p for operating the rotary gears q and r and the exhaust from the motor is connected to the return pipe x by the short pipe 2.

The rock drill selected for purposes of illustration, comprises a cylinder casing 3 having a front head 4 and a rotating chuck 5 into which the shank 6 of the drill steel 7 extends in position to receive the blows of impact of the reciprocating hammer piston 8. The piston is provided with a forwardly extending fluted shank 9, as in the usual construction, which is slidable within but non-rotatable relatively to the chuck 5. A rotation rifle bar 10 extends rearwardly from the piston head 11 and any suitable means within the back head 12 of the machine are provided cooperating with the rotation rifle bar 10 for causing rotation and imparting rotation to the drill steel. The back head is provided with the usual handle 13, and the pipe y has a controlling valve 14.

The drill cylinder 3 has a rearwardly located cylinder port 4^a to which the pipe y is connected, and a passage 15, controlled by the valve 16, connects the rearward portion of the cylinder 3 with the forward portion and also communicates with a volume chamber 17 in the forward end of the cylinder. The valve 16 may have any suitable spring (not shown) for assisting it to close.

In the operation of the apparatus so far described, let it be assumed that the compressor A is operating, that the low pressure receiver G and high pressure receiver K are under operating pressure, neither too high nor too low, and that the interrupter valve s is rotating at the required speed,

which is a high speed corresponding to one-half the number of blows required to be struck per unit of time by the hammer piston 8. In each revolution of the interrupter valve *s*, when the valve is in the position indicated in Figure 1, motive fluid under high pressure passes from the high pressure receiver K through the supply pipe *w*, through the interrupter valve casing and out through the pipe *y*, to the rock drill, actuating the hammer piston 8 on its forward stroke to the position indicated in Figure 2. As the piston head 11 uncovers passage 15, as indicated in Figure 1, a portion of the motive fluid flows through the passage 15 to the forward end of the cylinder into the volume chamber 17, in which the fluid is trapped as the valve 16 closes, due to the pressure behind the valve.

With the parts in the position indicated in Figure 2, the interrupter valve *s* in its revolution has interrupted the flow from the high pressure tank K through the supply pipe *w* and has placed the pipe *y* from the rock drill in communication with the return pipe *x* leading to the low pressure receiver G, so that the motive fluid under reduced pressure behind the rock drill piston head 11 flows back to the low pressure receiver and the trapped and expanded air in the volume chamber 17 of the rock drill actuates the hammer piston 8 on its return stroke to the position indicated in Figure 3, at which point the cycle is repeated in the rotation of the interrupter valve *s*. With the piston 8 at the end of its rearward travel, as in Figure 3, motive fluid in the volume chamber 17 and in front of the piston passes through the space 18 and through the flutes of the fluted piston extension 9 to the hollow drill steel 7 for blowing out the hole. This portion of the air used for blowing is lost, but that portion of the air which passes back through the pipe *y* and pipe *x* to the low pressure receiver G, is saved and repumped by the compressor to higher pressure in the high pressure receiver K, and used over again.

In the modification shown in Figures 4, 5 and 6, the operation of the system is precisely the same as that indicated in Figures 1, 2 and 3, except that the interrupter valve *s* is connected to be driven by means of the pinion 19 directly from the compressor A as by means of the gear 20 operatively connected to the driving shaft 21 of the compressor. A gear casing 22 covers and protects the gear 20 and pinion 19, but in other respects the piping and connections are the same as those indicated in the previous figures. In some instances, it may be preferred to drive the interrupter directly from the compressor instead of by means of a separate motor.

In Figures 7, 8 and 9, the same system is

illustrated with a modified form of automatic interrupter, comprising a main fluid actuated valve 23 having the central head 24 connected to the heads 25 and 26 by the stems or reduced portions 27 and 28. The main valve 23 reciprocates in the valve chamber 29 and is controlled by an auxiliary valve 30 having the head 31 and hollow stem 32 provided with the ports 33. The valve 30 reciprocates in the valve chamber 34.

In the operation of the apparatus shown in Figures 7, 8 and 9, fluid under high pressure from the high pressure receiver K, passes through the supply pipe *w* to the port *t'*, controlled by the main valve 23, and thence through the port *v'* to the pipe *y*, and to the rock drill *h*, when the main valve 23 is in the position indicated in Figure 7. In the reverse position of the valve, indicated in Figure 8, the motive fluid flows from the pipe *y* through the ports *v'* and *u'* which are in communication, and thence through the return pipe *x* back to the low pressure receiver G.

In the position of the parts indicated in Figure 7, high pressure fluid admitted to the auxiliary valve chamber 34 through the port 35 against the valve head 31, has actuated the auxiliary valve backwardly, thus admitting high pressure fluid through the passage 36 and through the auxiliary valve stem 32 and port 33, to the passage 37 leading to the end face of the main valve head 26, which moves the main valve 23 to the position indicated in Figure 8. A leak port 38 prevents pressure from building up against the end face of the main valve head 25. A similar leak port 39, produces a similar function for the valve head 26, and a leak port 40 affords communication with the atmosphere beneath the head 31 of the auxiliary valve 30. With the main valve 23 in the position indicated in Figure 8, the port 35 over the auxiliary valve 30 is opened to the lower pressure side of the system and the high pressure fluid beneath the valve through passage 36 moves the auxiliary valve to the position shown in Figure 8, so that the pressure fluid from the passage 36 is admitted through the auxiliary valve stem 32 and port 33 to the passage 41 leading to the end face of the main valve head 25 which throws the valve in the opposite direction to the position indicated in Figure 7. The cycle of operations is repeated continuously and motive fluid under high pressure is supplied to the rock drill for operating purposes, while a portion of the operating fluid under reduced pressure is intermittently returned to the low pressure receiver G and used over again.

The system illustrated in Figures 10, 11 and 12, is similar to that heretofore illustrated, but with another modified form of

interrupter valve 42, having the heads 43 and 44 connected by the stem 45, and reciprocating within the main chamber 46. The main valve 42 is controlled by the auxiliary valve 47, having the head 48, and a hollow stem 49 provided with the ports 50. The auxiliary valve reciprocates in the auxiliary valve chamber 51. The main valve 42 controls the ports t' , v' and u' .

With the valve 42 in the position indicated in Figure 10, high pressure motive fluid passes from the high pressure receiver K through the supply pipe w and the ports t' and v' , which are in communication, to the pipe y , and thence to the rock drill k . With the main valve 42 in the position indicated in Figure 11, the motive fluid under reduced pressure returns from the pipe y through the ports v' and u' and the return pipe x , to the low pressure receiver G.

Motive fluid supplied through the passage 52 and port 53, with the parts in the position indicated in Figure 10, forces the auxiliary valve 47 in a direction to admit motive fluid through the passage 54, and through the stem 49 of the auxiliary valve, and a port 50 to the passage 55 leading to the end surface of the valve head 44, which causes the valve to move over to the position indicated in Figure 11. The port 56 communicating with the port 53 is then opened to the lower pressure side of the system and the high pressure from the passage 54 has thrown the auxiliary valve 47 into a position to admit motive fluid through the hollow valve stem 49 and a port 50 into the passage 57, leading to the end face of the main valve head 43, so that the main valve is thrown to the position indicated in Figure 10 and the cycle repeated because live pressure through passage 52 and port 53 causes return movement of the auxiliary valve 47 to the position indicated in Figure 10. Leak ports 58, 59 and 60 are provided for the respective pressure surfaces of the main and auxiliary valves as indicated.

In Figure 13, the system is diagrammatically illustrated in connection with a plurality of rock drill k , k' and k^2 , all operated from a common source of supply, indicated by the low and high pressure receivers G and K.

One rock drill k is connected to a rotary interrupter o , another rock drill k' is connected to an interrupter o' having a main valve 23 and an auxiliary valve 30 of the type illustrated in Figure 7, while another rock drill k^2 is connected to an interrupter o^2 having a main valve 42 and an auxiliary valve 47 of the type illustrated in Figure 10. The main supply pipe w and the main return pipe x of the system are connected to the various interrupters which are connected to the rock drills k , k' and k^2 . It is to be understood that a compressor is con-

nected to the receivers G and K and the main supply and return pipes w and x are shown broken at the points 70 and 80 to indicate that the interrupters may be located at any desired practical distance remote from the source of supply.

I claim:

1. In a fluid pressure impulse system for operating a fluid actuated machine, the combination of a high pressure source of supply of motive fluid pressure, and a low pressure receiver, a fluid actuated machine adapted to be actuated by motive fluid from the high pressure source, an interrupter having separate supply and return connections with said high pressure source of supply and the low pressure receiver respectively, a single connection from said interrupter to the said machine, through which high pressure motive fluid passes to the machine in one direction, and automatic means for causing the motive fluid under reduced pressure from said machine to pass in the opposite direction through said single connection back to the interrupter and thence back to the said low pressure receiver.

2. In a fluid pressure impulse system for operating a fluid actuated machine, the combination of a high pressure source of supply of motive fluid pressure and a low pressure receiver, a fluid actuated machine adapted to be actuated by motive fluid from the high pressure source, a fluid actuated interrupter having separate supply and return connections with said high pressure source of supply and the low pressure receiver respectively, a single connection from said interrupter to the said machine, through which high pressure motive fluid passes to the machine in one direction, and through which the motive fluid from the said machine under reduced pressure passes under control of the interrupter in the opposite direction back to the interrupter and thence back to the said low pressure receiver.

3. In a fluid pressure impulse system for operating a fluid actuated machine, the combination of a high pressure source of supply of motive fluid pressure and a low pressure receiver, a fluid actuated machine adapted to be actuated by motive fluid from the high pressure source, an interrupter, a high pressure supply line connecting the high pressure source to the interrupter, a low pressure return line connecting the interrupter to the said low pressure receiver, and a common supply and return line connecting the interrupter to the said fluid actuated machine, and ports and passages whereby the interrupter alternately connects the common supply and return line with the high pressure source and the said low pressure receiver respectively.

4. In a fluid pressure impulse system for operating a fluid actuated machine, the com-

5 combination of high and low pressure receivers of motive fluid pressure, an interrupter located at a point remote from the said receivers, separate connections between said receivers and the interrupter, a fluid actuated machine adapted to be actuated by motive fluid from the high pressure receiver, a single connection between the interrupter and the said machine, and ports and passages whereby the interrupter alternately connects the said single connection with the high and low pressure receivers respectively.

5. In a fluid pressure impulse system for operating a fluid actuated machine, the combination of high and low pressure receivers for motive fluid pressure, a fluid actuated rock drill of the hammer type adapted to be actuated by motive fluid from the high pressure receiver, an interrupter having separate supply and return connections with said high and low pressure receivers respectively, and a single connection from said interrupter to the said rock drill, through which high pressure motive fluid passes to the rock drill for operating the hammer piston forwardly, and through which single connection the motive fluid under reduced pressure from behind the hammer piston is caused by the interrupter to pass back in the opposite direction to the interrupter and thence to the low pressure receiver.

6. In a fluid pressure impulse system for operating a fluid actuated machine, the combination of high and low pressure receivers for motive fluid pressure, a fluid actuated rock drill of the hammer type adapted to be actuated by motive fluid from the high pressure receiver and having a cylinder and reciprocating hammer piston, a cylinder port at the rear end of the cylinder, a valve controlled passage leading from the rear to the front end of the cylinder, and communicating with a reservoir chamber at the front end of the cylinder, an interrupter having separate supply and return connections with said high and low pressure receivers respectively, a connection from said interrupter to the said rear cylinder port of the rock drill, through which high pressure motive fluid passes to the rock drill for operating the hammer piston forwardly, and through which single connection the motive fluid under reduced pressure from behind the hammer piston is caused by the interrupter to pass back in the opposite direction to the interrupter and thence to the low pressure receiver.

7. In a fluid pressure impulse system for operating a fluid actuated machine, the combination of high and low pressure receivers of motive fluid pressure, an interrupter located at a point remote from the said receivers and adapted to be automatically actuated by fluid pressure from the said high pressure receiver, separate connections between said receivers and the interrupter, a fluid actuated machine adapted to be supplied with motive fluid from the high pressure receiver, and a single connection between the interrupter and the said machine, through which high pressure motive fluid passes to the machine in one direction, and through which motive fluid from said machine under reduced pressure passes under control of the interrupter in the opposite direction back to the interrupter and thence back to said low pressure receiver.

In testimony whereof I have signed this specification.

FRED M. SLATER.