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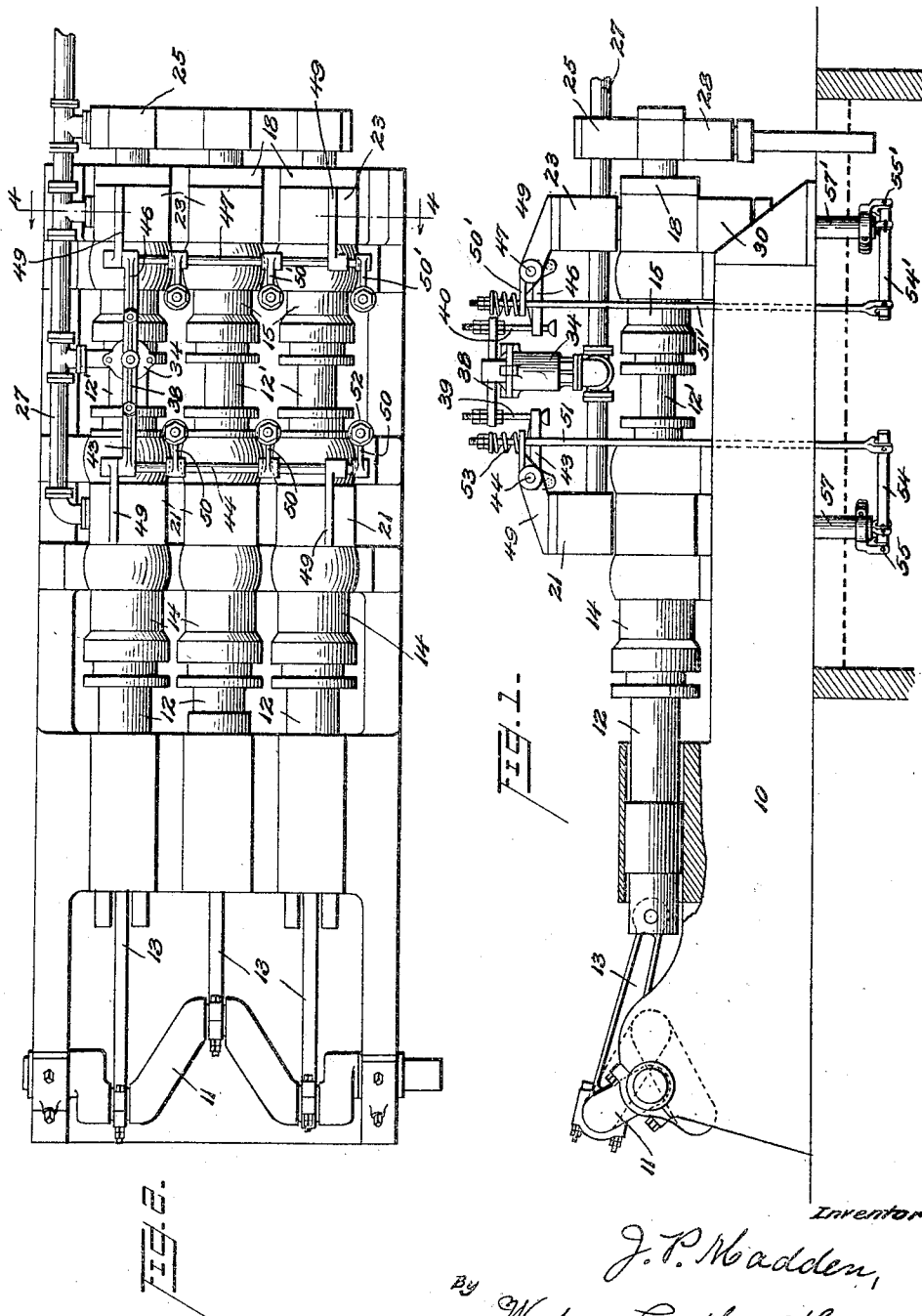
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1,521,461

VARIABLE PRESSURE POWER PUMP

Filed June 2, 1921

4 Sheets-Sheet 1



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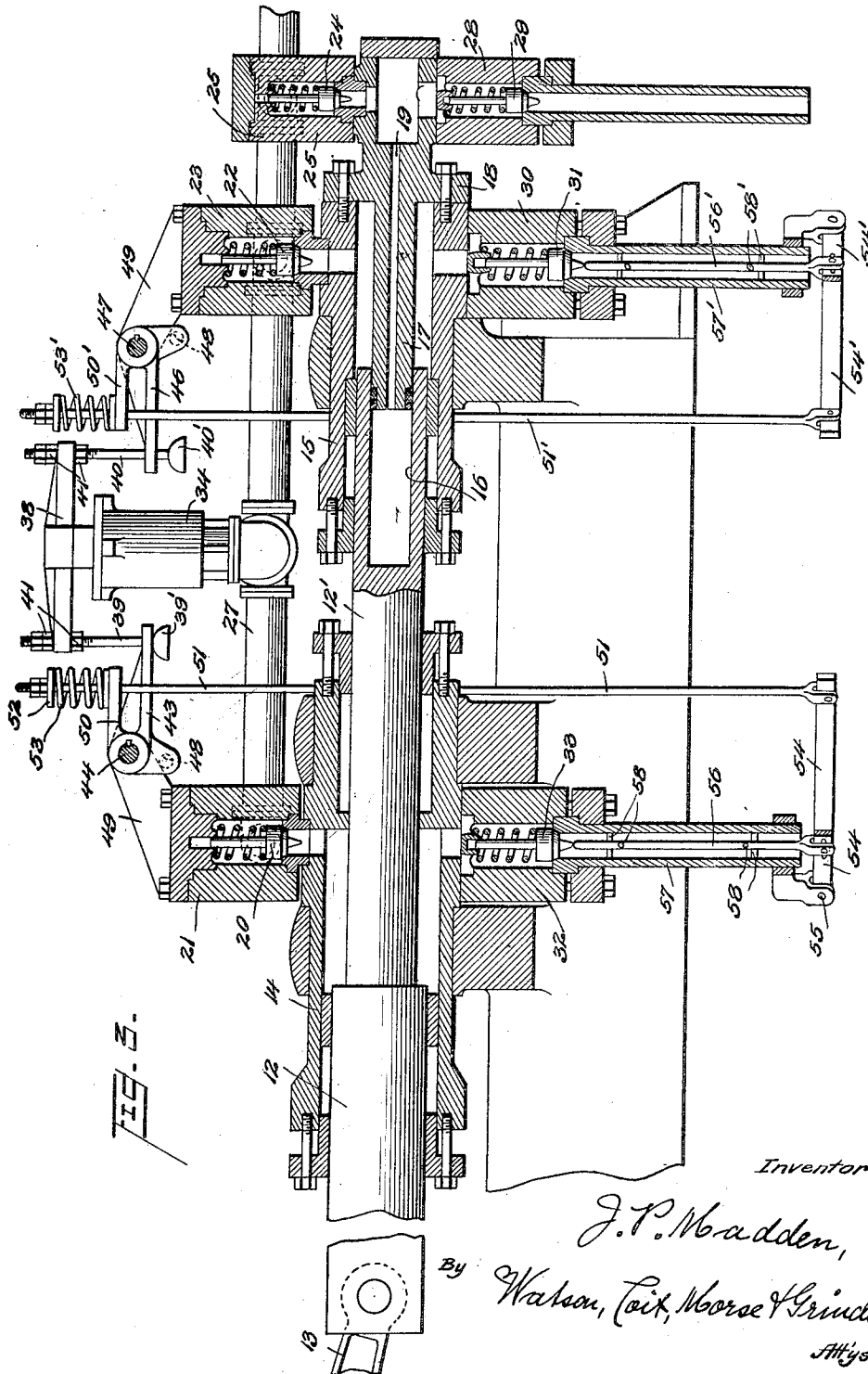
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VARIABLE PRESSURE POWER PUMP

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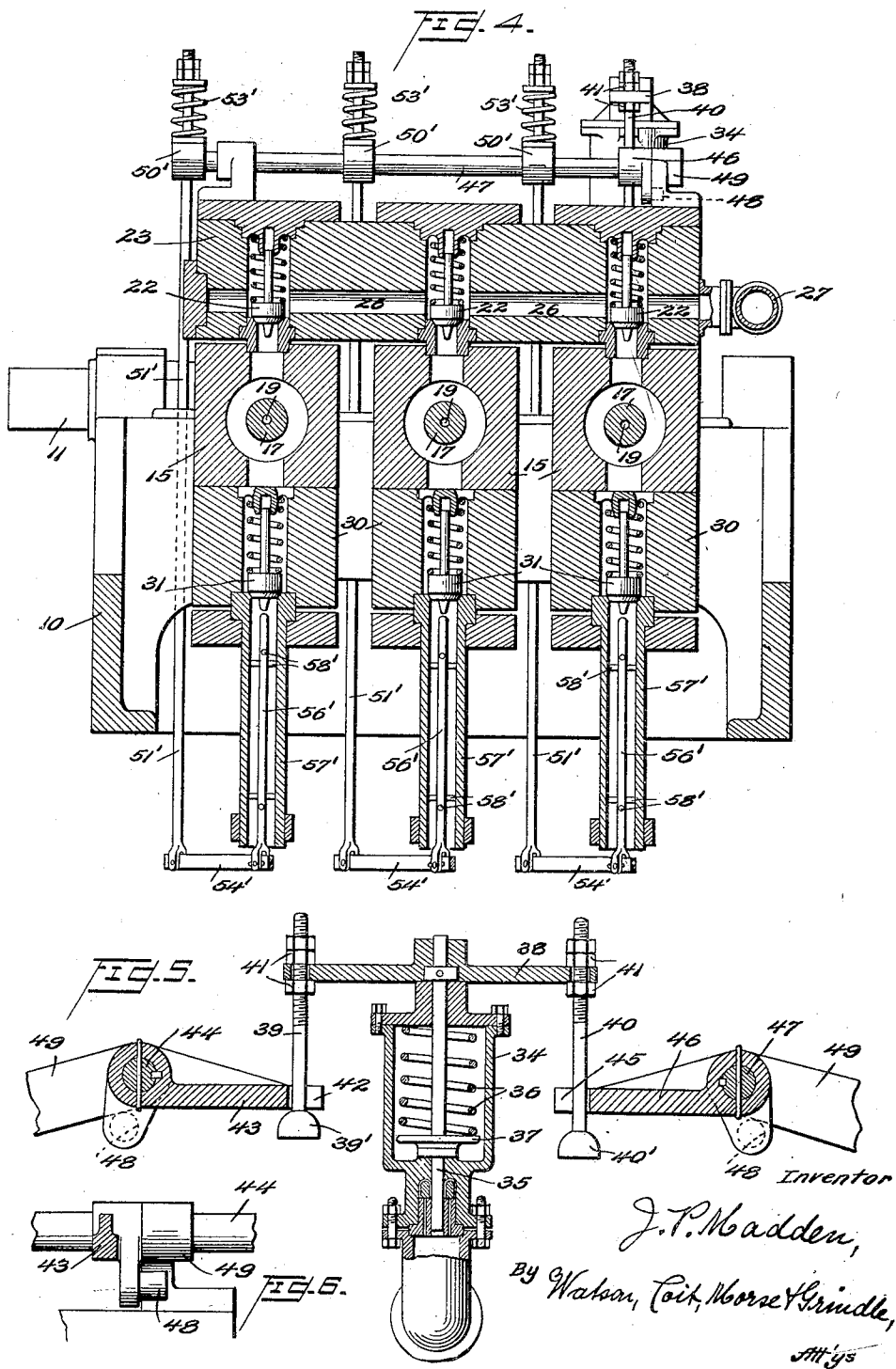
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VARIABLE PRESSURE POWER PUMP.

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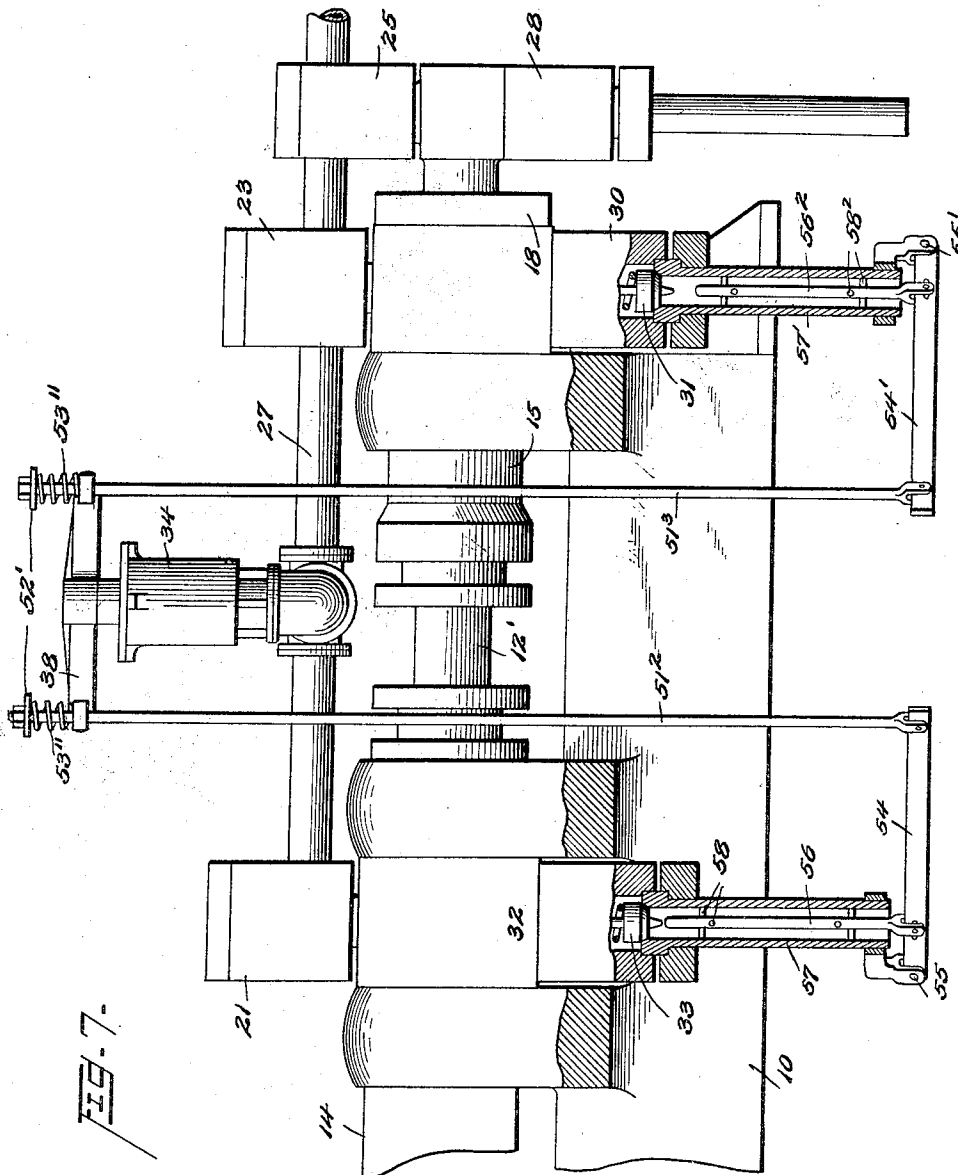
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VARIABLE PRESSURE POWER PUMP

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4 Sheets-Sheet 4



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7/11/45

UNITED STATES PATENT OFFICE.

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VARIABLE-PRESSURE POWER PUMP.

Application filed June 2, 1921. Serial No. 474,332.

To all whom it may concern:

Be it known that I, JAMES P. MADDEN, a citizen of the United States, and residing at Bethlehem, county of Lehigh, State of Pennsylvania, have invented certain new and useful Improvements in Variable-Pressure Power Pumps, of which the following is a specification.

The present invention relates to power pumps and more particularly to improvements in the type of pumps adapted to supply fluid under pressure for operations in which a large volume of fluid at low pressure is required during the first stages of the operation and a smaller volume at higher pressure is required for the completion of the operation. This type of pump usually consists of a plurality of cylinders of different bores which are successively rendered inoperative, the largest being thrown out first whereby only the smallest cylinder is employed for producing the highest pressures.

The principal object of the present invention is to provide a novel means for rendering the cylinders of the pump successively inoperative. To this end, according to the present invention the inlet valves of the cylinders are successively held open as the pressure of the fluid discharged from the pump increases.

Other objects and features of novelty will be apparent from the description taken in connection with the drawings in which:

Figure 1 is a side elevation of a pump constructed in accordance with the present invention, certain parts being shown in section;

Figure 2 is a top plan view of the pump; Figure 3 is a longitudinal sectional elevation taken through a set of cylinders of the pump;

Figure 4 is a sectional elevation taken substantially on the line 4-4 of Fig. 1;

Figure 5 is a sectional elevation of a portion of the governing mechanism;

Figure 6 is an elevation of a detail, and Figure 7 illustrates a modification of the valve controlling mechanism.

Referring to the drawings and more particularly the plan view of Figure 2, it will be seen that the invention is illustrated in

connection with a pump comprising three groups of cylinders, each consisting of three cylinders disposed in tandem or in alignment. The cylinders of each group are of different sizes and mechanism is provided whereby the cylinders beginning with the largest are successively rendered inoperative. This mechanism, according to the present invention, consists of devices active on the inlet valves of the cylinders to hold them open thereby rendering the cylinders inoperative to discharge fluid.

Referring to the drawings the numeral 10 indicates the base of a pump embodying the invention. This base at one end carries a crank shaft 11 having three throws for actuating the groups of cylinders. As shown, there are three groups of cylinders spaced transversely of the base. Each group, in the form of the invention shown, consists of three pumps. Referring more particularly to Fig. 3 the largest pump comprises a plunger 12 reciprocated by the connecting rod 13 actuated by the crank shaft 11. The plunger 12 is reciprocated in the large cylinder 14. The plunger 12 has its forward portion 12' of reduced diameter and reciprocating in a cylinder 15. The third cylinder of the group is provided by forming a cylindrical recess 16 in the end of the plunger 12' which receives the stationary plunger or piston 17 carried by the head 18 of cylinder 15. The stationary plunger 17 is formed with an axial duct 19 to convey fluid to and from the cylinder 16.

As stated, there are a plurality of these groups of cylinders or pumps, three being shown. Each of the pumps is provided with an inlet and discharge valve. Thus the discharge valves 20 for the large cylinders or pumps 12 are disposed in a discharge manifold 21 extending transversely of the pump. Likewise the discharge valves 22 for the middle size pumps are carried by a discharge manifold 23. Finally the discharge valve 24 for the small or high pressure pumps are carried by the discharge manifold 25. The valves in each manifold are connected by suitable passages. Thus as shown in Fig. 4 the discharge valves 22 are connected by the transverse passages 26. Furthermore each of the manifolds 21, 23

and 25 are in communication with a discharge main 27.

Each of the pumps or cylinders is provided with a suction valve box carrying the inlet or suction valve. As shown in Fig. 3 the high pressure or small bore pumps have the suction valve boxes 28 carrying suction valves 29. Similarly the intermediate pumps or cylinders have the suction valve boxes 30 carrying suction valves 31 and the large or low pressure pumps have the suction boxes 32 provided with suction valves 33.

In accordance with the present invention it is desired to open the inlet valves of the pumps or cylinders as the pressure in the discharge main increases thus successively rendering the pumps, from the largest to the smallest, inoperative. For this purpose, in the form of apparatus shown the exhaust main carries a bonnet 34. A piston or spindle 35 is slidable in the bonnet and has its lower end exposed to the fluid under pressure in the discharge main. This tends to move the piston or spindle 35 upwardly as viewed in Fig. 5 but this movement is resisted by a spring 36, one end of which acts on a collar 37 carried by the spindle and the other end of which bears on the top of the bonnet 34. The spindle or piston 35 projects above the top of the bonnet and carries a transverse bar 38 at the opposite ends of which are the depending rods 39 and 40. These rods are threaded at their upper ends and clamped to the bar 38 by nuts 41 on the opposite sides of the bar. The rods at their lower ends have semi-spherical heads 39' and 40' respectively. The rod 39 is disposed in a notch 42 in the end of a crank arm 43 secured to a shaft 44 extending transversely of the entire pump. In a similar manner the rod 40 extends through a notch 45 in a crank arm 46 secured to a shaft 47 parallel to the said shaft 44. When the transverse bar 38 moves upwardly the head 39' will engage crank 43 and thereby turn the shaft 44. In a similar manner after the bar 38 has moved to a greater extent the head 40' will engage crank arm 46 and turn shaft 47. The crank arms 43 and 46 are held in substantially horizontal or normal positions by pins 48 which engage bearing brackets 49 and prevent downward movement of the crank arms.

Referring to Figs. 2 and 3 it will be seen that the shaft 44 carries three arms 50, one for each of the large cylinders or pumps. A reach rod 51 depends from each of the arms 50, the upper end of the rod having an adjustable washer or collar 52 between which and the arm is a spring 53. The lower ends of the rods 51 are secured to levers 54 pivoted at 55 to suitable supports and intermediate the ends thereof carrying push rods 56 extending up through the inlet pipes 57 and adapted to engage the lower ends of the

inlet valves 33 and open the same when the levers 54 are moved upwardly. The push rods 56 may be guided in the pipes 57 in any suitable manner. As shown transverse pins or studs 58 are employed for this purpose. If necessary the connection between the lower ends of the push rods 56 and the levers 54 may be of the pin and slot type in order to permit the slight swinging of lever 54 without causing binding of the push rods 56.

In a similar manner the inlet valves 31 of the intermediate pumps or cylinders are adapted to be operated by upward movement of the transverse bar 38. Thus the shaft 47 carries three arms 50' at the free ends of which are supported the reach rods 51' through the medium of the springs 53'. At their lower ends these reach rods 51' are connected to levers 54' which in turn are pivoted at 55' and intermediate their ends operate the push rods 56' which are adapted to open the inlet valves 31 by upward movement. These push rods are disposed in the inlet pipes 57' and guided therein by any suitable means such as the transverse studs 58'.

In operation, a spring 36 of proper strength being disposed in the bonnet, when the pressure in the discharge main reaches a value sufficient to move the transverse bar 38 upwardly, the inlet valves 33 of the large cylinders or pumps will be gradually opened. The upward movement of the bar 38 carries head 39' upwardly also which turns crank arm 43 and shaft 44 thereby raising all of the arms 50 and through springs 53, reach rods 51, levers 54 and push rods 56 opening the inlet valves 33. These valves will be held open as long as the pressure is maintained in the discharge main. In case the upward movement of transverse bar 38 occurs when the pistons or plungers 12 are on a compression stroke, the pressure within the cylinders 14 will be of such value that the inlet valves 33 will not open against the same. The movement of bar 38, however, will compress springs 53 so that on the return or suction stroke of the pistons, the energy stored in said springs will open the valves 33.

After the largest cylinders have been rendered inoperative, the pump will continue to operate with the remaining cylinders gradually building up a greater pressure in the discharge main, but delivering a smaller quantity of fluid. This increase of pressure in the discharge main will continue to move the bar or cross-head 38 upwardly and after a certain amount of movement the head 40' on the rod 40 will engage crank arm 46 and turn shaft 47 thereby through the springs 53', reach rods 51', &c., opening the inlet valves 31 of the intermediate cylinders. This will leave

only the high pressure cylinders operative for completing the operation sought to be accomplished.

Hence if the regulator spring 36 offers an initial resistance equivalent to 300 lbs. per square inch in the discharge main, the large cylinders or pumps 14 will be rendered inoperative after the pressure in the discharge main reaches 300 lbs. per square inch. Then, the length of rod 40 being greater than that of rod 39, the pressure in the discharge main builds up and when it reaches a value say of 600 lbs. per square inch the head 40' engages arm 46 and opens the inlet valves of the intermediate cylinders.

Figure 7 illustrates a modified form of valve actuating mechanism. In this arrangement the lift rods 51² associated with the large cylinders extend directly from the levers 54 to the cross head 38 so that the inlet valves of the large cylinders will be opened upon movement of the piston or spindle 35. The lift rods 51² pass through the crossheads 38 and are dependingly supported therefrom by means of the springs 53'' retained in place by the adjustable collars 52', threaded to the rods 51². The springs 53'' function in a manner similar to that described above for the springs 53. Preferably the bonnet 34 is disposed centrally with respect to the width of the pump, so that the pull on the outside rods 51² will balance each other and not bind the piston 35. In a similar manner the other end of the cross head 38 is connected to the levers 54' by the rods 51². The push rods 56² associated with the inlet valves of the intermediate cylinders however have their upper ends spaced from the inlet valves so that said inlet valves will not be opened until after the cross-head 38 has moved upwardly a sufficient amount to bring the upper ends of said push rods in contact with the inlet valves. In other words, in both forms of the invention there is a lost motion connection between the cross-head 38 and the inlet valves of the intermediate cylinders.

What is claimed is:

1. In a pump of the character described, in combination, a pair of cylinders adapted to discharge fluid at different pressures, each cylinder having individual inlet and outlet valves, a common discharge pipe, and means to hold open the inlet valve of the low pressure cylinder when the pressure in the discharge pipe reaches a predetermined amount including a movable member subjected to the pressure in the discharge pipe, yieldable means associated with said member to resist movement thereof due to said pressure, and means operatively connecting said member and the inlet valve of the low pressure cylinder.

2. In a pump of the character described, in combination, at least three cylinders of different displacements, each cylinder having individual inlet and outlet valves, a common discharge pipe, means to successively hold open the inlet valves of the largest and intermediate cylinders as the pressure in said pipe increases including a lost motion connection operative on the inlet valve of the intermediate cylinder.

3. In a pump of the character described, in combination, at least three cylinders of different displacements, each cylinder having individual inlet and outlet valves, a common discharge pipe, means to successively hold open the inlet valves of the largest and intermediate cylinders as the pressure in said pipe increases including a pressure responsive device connected to actuate the inlet valve of the largest cylinder, and a similar connection to actuate the inlet valve of the intermediate cylinder there being lost motion in the last mentioned connection.

4. In a continuously running pump, in combination, an outlet duct, a valve controlling the discharge of fluid through said duct, an inlet valve, a device for terminating the discharge into said duct when the pressure therein has reached a predetermined value comprising a reciprocable member actuated by the pressure in the duct to move in one direction, yieldable means on said member for resisting such movement and means connecting said member with said inlet valve to hold it open when said predetermined pressure has been reached.

5. In a continuously running pump, in combination, an outlet duct, a valve controlling the discharge of fluid through said duct, an inlet valve, a regulator controlling the discharge into said duct comprising a piston, a casing therefor opening into said discharge duct to permit pressure therein to act on the piston, yieldable means co-operating with said piston to resist said pressure, a lifting member for said inlet valve and adjustable connections between said piston and lifting member, whereby the inlet valve will be opened when the pressure in the duct overcomes said yieldable means.

6. A continuously running pump including in combination, a pair of tandem cylinders of different diameters, each cylinder having individual inlet and outlet valves, the outlet valves controlling the discharge into a common discharge pipe; a regulator having a housing opening into said discharge pipe, said regulator comprising a weighted piston in said housing adjusted to withstand a predetermined pressure in said discharge pipe, a lifting rod for the inlet valve of the larger pump cylinder, a

lever fulcrumed to a stationary bearing and connected to actuate said lifting rod, an adjustable connection between said lever and said weighted piston; whereby, upon
5 said predetermined pressure having been reached in the discharge pipe, said piston will actuate the other regulator parts to lift the inlet valve thus permitting said large cylinder to discharge through its inlet instead of through its discharge, while 10 the smaller cylinder continues to discharge into said pipe.

In testimony whereof I hereunto affix my signature.

JAMES P. MADDEN.