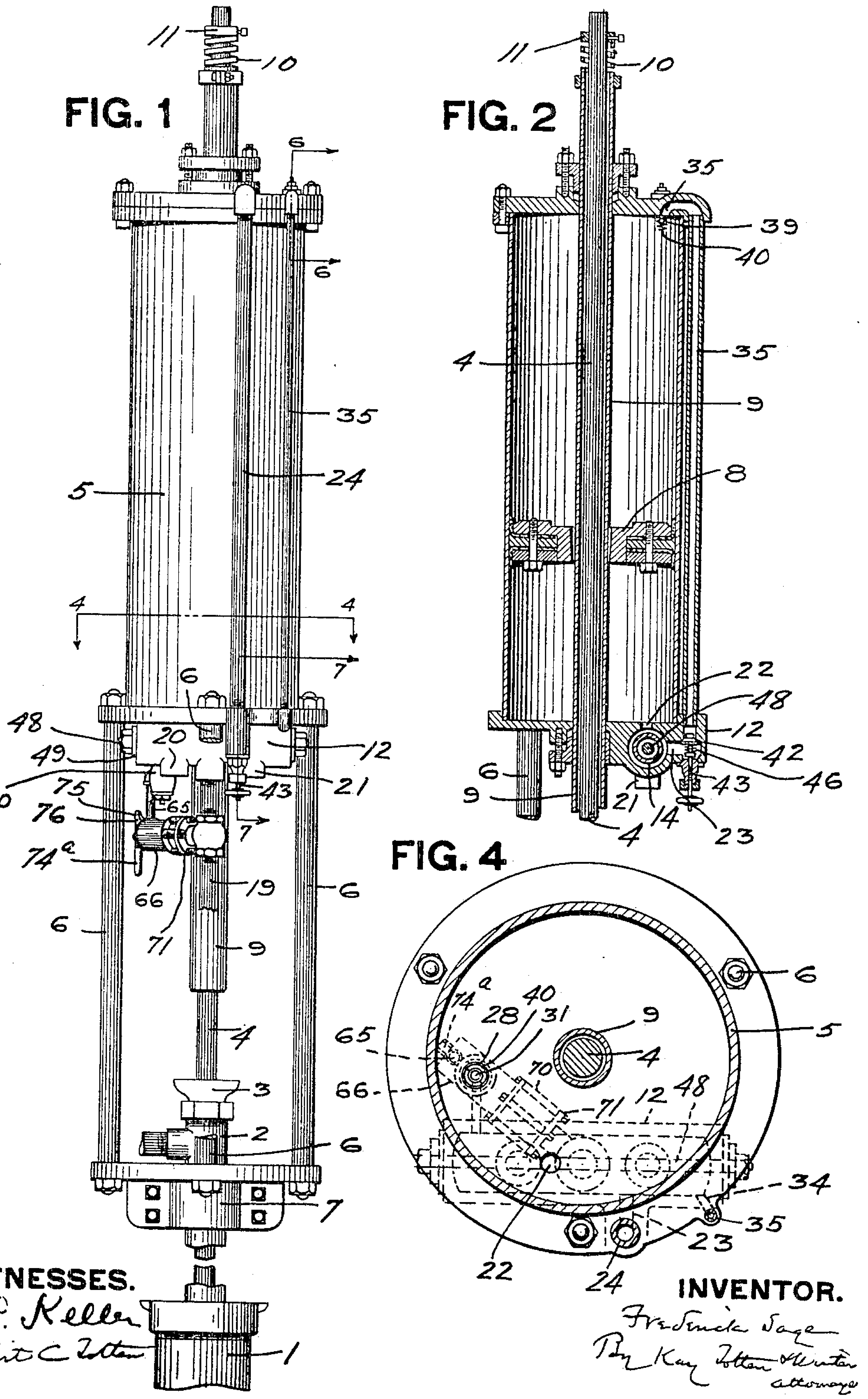
No. 799,190. PATENTED SEPT. 12, 1905.

F. SAGE.

PUMPING ENGINE.

APPLICATION FILED MAR. 31, 1905.

2 SHEETS—SHEET 1.



WITNESSES.

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FIG. 3

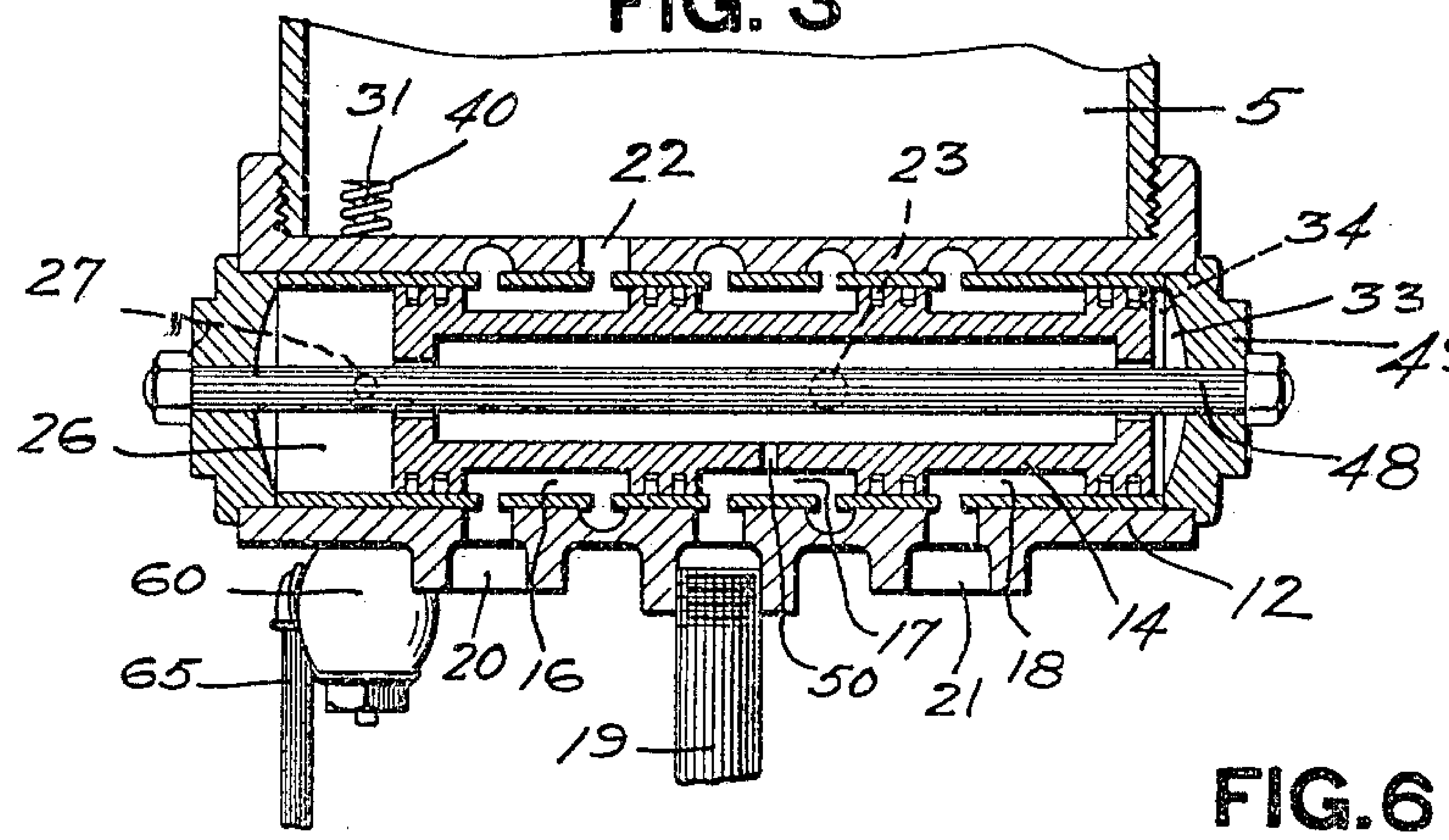


FIG. 5

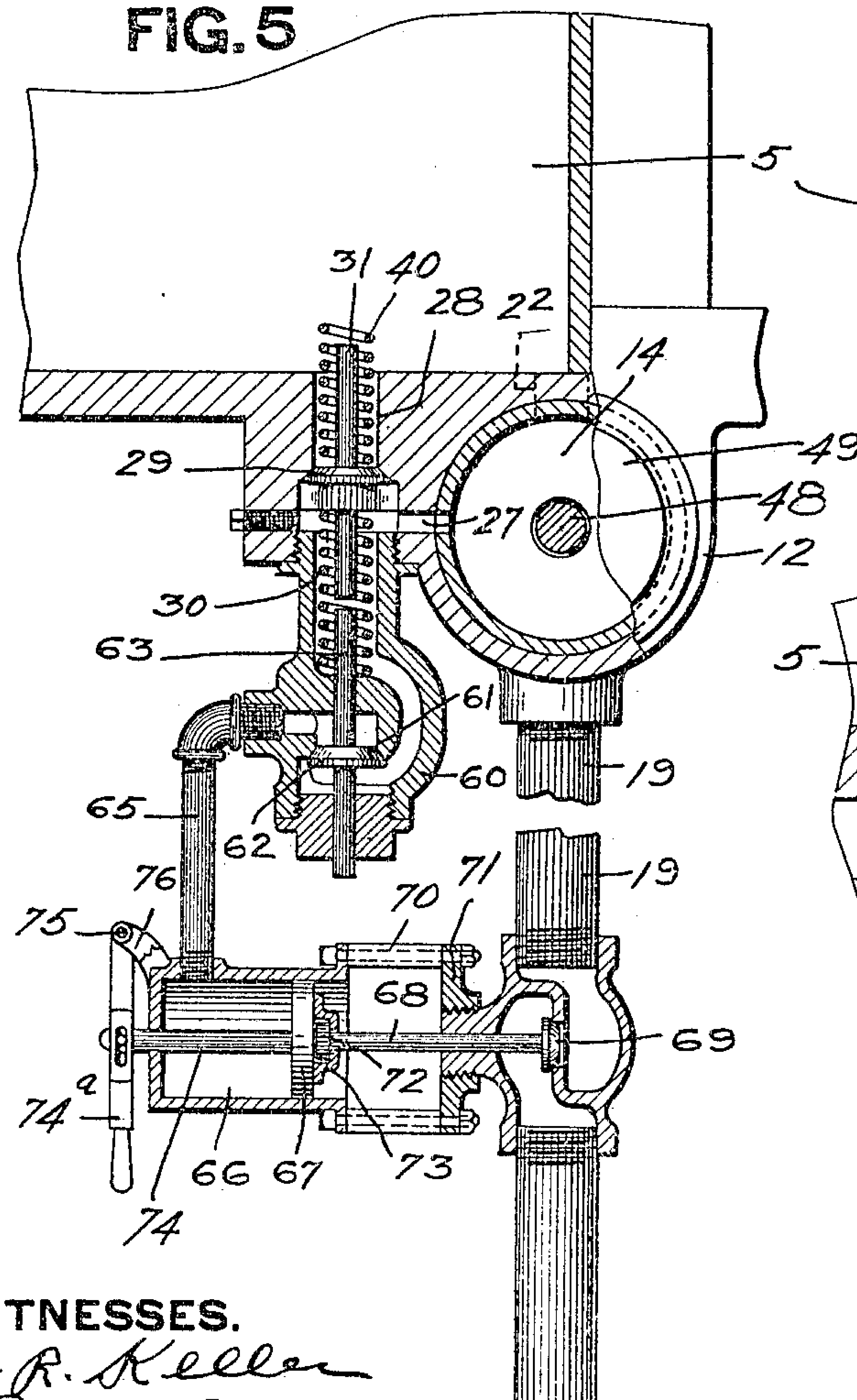


FIG. 6

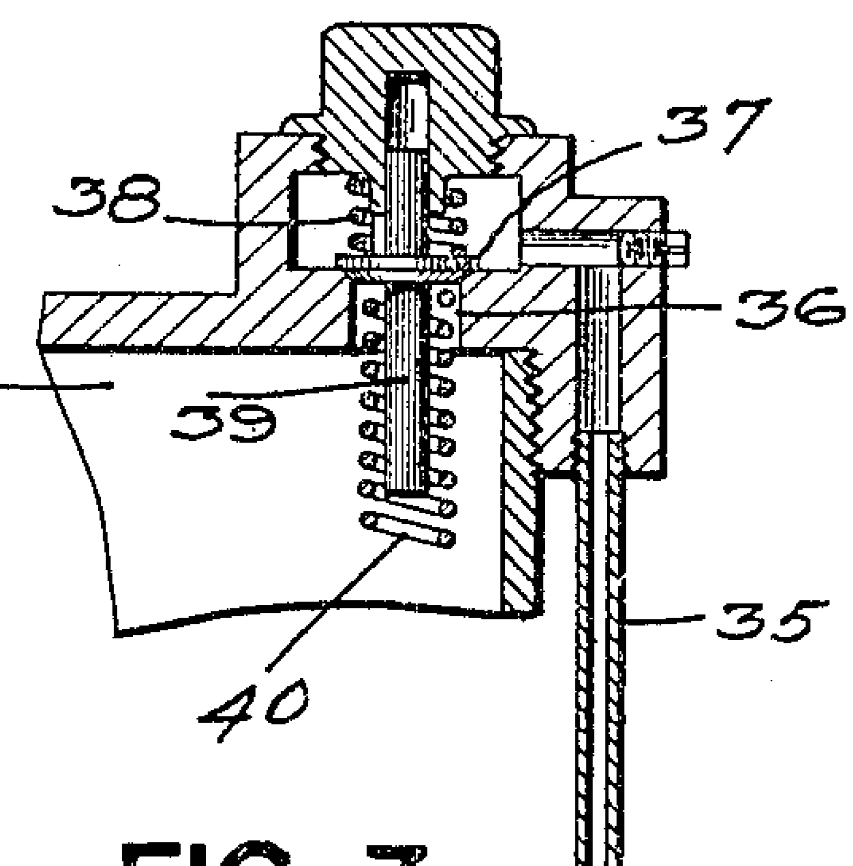
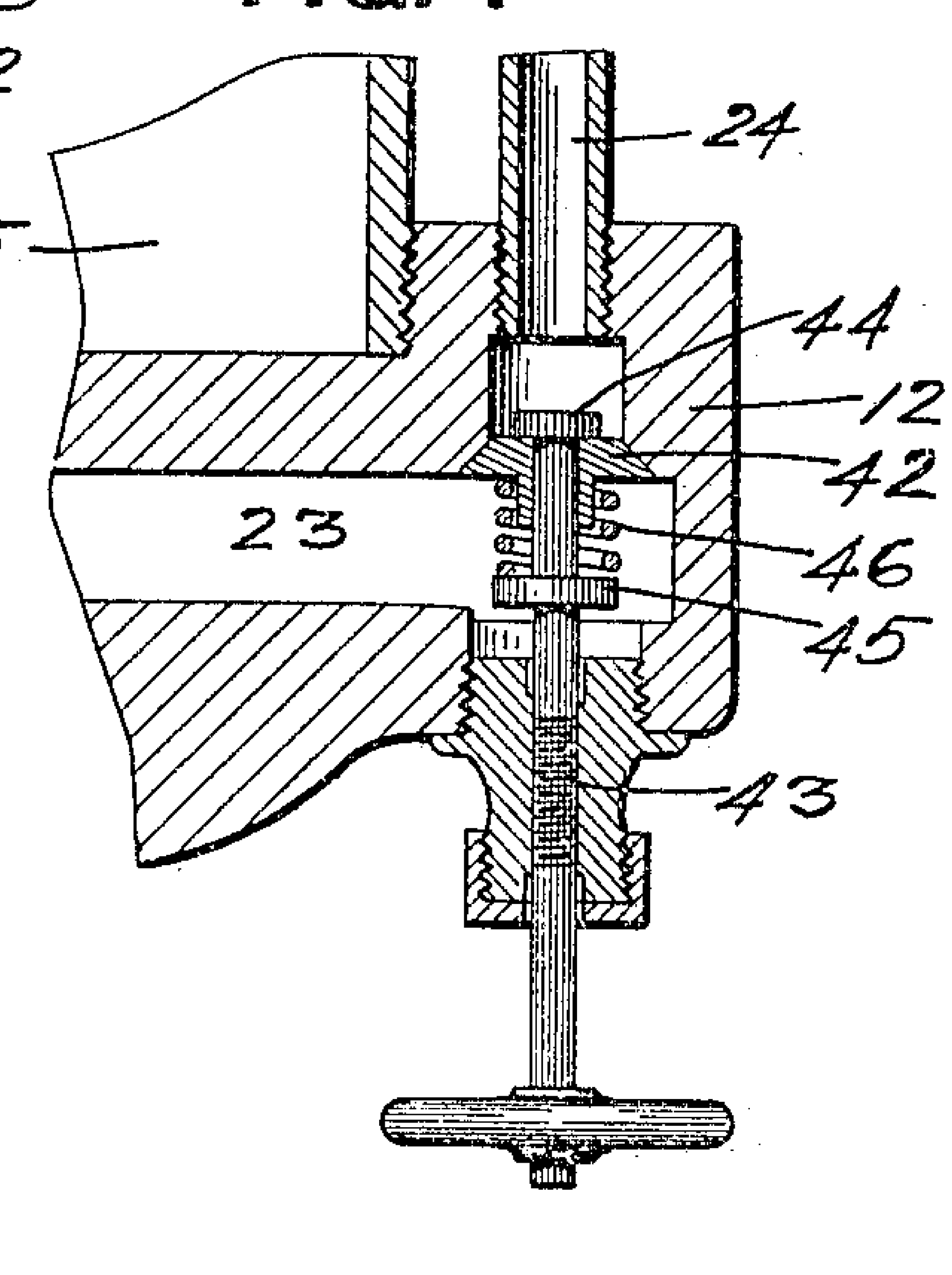


FIG. 7



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UNITED STATES PATENT OFFICE.

FREDERICK SAGE, OF JOHNSONBURG, PENNSYLVANIA, ASSIGNOR OF THIRTY ONE-HUNDREDTHS TO ENOS B. SAGE, OF REDROCK, AND TWENTY-FIVE ONE-HUNDREDTHS TO CYRUS H. SAGE, OF JOHNSONBURG, PENNSYLVANIA.

PUMPING-ENGINE.

No. 799,190. Specification of Letters Patent. Patented Sept. 12, 1905.

Application filed March 31, 1905. Serial No. 253,114.

To all whom it may concern:

Be it known that I, FREDERICK SAGE, a resident of Johnsonburg, in the county of Elk and State of Pennsylvania, have invented a new and useful Improvement in Pumping-Engines; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to pumping engines or heads; and the object is to provide an engine for this purpose which will automatically stop operating when the fluid in the well becomes exhausted.

In the oil regions there are many wells which produce only a small quantity of oil, but which nevertheless can be profitably worked providing the apparatus is sufficiently economical. The accumulation of oil in these wells can usually be pumped out in a short time, and it is therefore not profitable to keep the pumps in continuous operation. It is the custom for an attendant to go from well to well and start the engines and then after a time again make the rounds and stop the engines. This entails a considerable expense and correspondingly reduces the profit derived from these small producers.

My invention has for its object to provide an arrangement whereby the pumping engine or motor will be automatically stopped by means controlled by the exhaustion of the oil in the well, thus dispensing entirely with an attendant for stopping the engine.

My invention may be applied to any form of pump-motor, whether electrical, hydraulic, pneumatic, or steam. In this application I have shown and described the same in connection with a specific form of pumping engine or head which was invented by me and which forms the subject of a prior application for patent, Serial No. 230,595, filed October 29, 1904. The invention, however, is not limited to this form of pumping-engine, and I have merely chosen it for convenience of illustration, but without intending to limit my invention or the terms of the claims hereinafter made.

In the accompanying drawings, Figure 1 is a side elevation of my pumping head or engine. Fig. 2 is a vertical section through the cylinder, taken transversely of the main valve. Fig. 3 is a vertical section taken longitudinally of the main valve. Fig. 4 is a horizontal section taken on the line 4 4, Fig. 1. Fig. 5 is a vertical section taken through the valve for stopping the engine. Fig. 6 is a vertical section taken on the line 6 6, Fig. 1; and Fig. 7 is a vertical section on the line 7 7, Fig. 1.

In the drawings the well-casing is shown at 1 and the pump-tubing at 2. The latter at its upper end is provided with an outlet and with the usual stuffing box or gland 3. Passed through the latter is the rod 4, which is the pump-rod, and may be either a sucker-rod or a polish-rod, as is now used in deep-well pumping.

My improved pumping-head comprises a fluid-pressure cylinder 5, arranged vertically and directly above the pump-tubing, being supported directly from the tubing by means of vertical rods 6 and a split clamp-collar 7, which is fastened around the pump-tubing. In this manner the cylinder 5 is supported above and in axial line with the pump-tubing. The cylinder 5 is provided with a piston 8, secured to a hollow piston-rod 9, which projects through both heads of the cylinder. The pump or polish rod 4 passes up through this hollow piston-rod and is secured to the upper end thereof by means of the coil-spring 10, which is fastened to both the upper end of the hollow piston-rod 9 and to a collar 11 on the pump-rod 5, so that said spring will act both as a tension and compression spring. The object of this spring is to lessen the shock and jar which occurs when the pump-rod begins to lift and the weight of the fluid comes onto the same. The object of making the piston-rod 9 hollow is to adapt the motor-head to existing oil-well rigs. It is now the custom to connect the pump or polish rod 4 to one end of a walking-beam, and consequently said rod projects a considerable distance above the ground. In order to locate the cylinder 5 as low as possible and still not necessitate a cutting off of the rod 4 or the replacement thereof by a shorter rod, I make the piston-rod hollow, so that the full length of present pump or polish rods can be retained and passed up through the hollow piston and secured to the upper end thereof.

The main valve of the cylinder is located in a suitable casing 12, formed on or secured to the lower head of the cylinder. This main valve preferably will be automatically moved by the fluid-pressure itself. It is shown as a cylindrical piston-valve 14, slidably mounted in the casing 12 and provided with four pistons, so as to provide the connecting passages or spaces 16, 17, and 18, respectively. The fluid-pressure inlet is through the pipe 19, substantially midway of the length of the valve-casing. The exhaust-ports are shown at 20 and 21. The walls of the valve-casing are cored out, so as to provide passages for the fluid-pressure, one of which passages communicates, through the port 22, with the lower end of the cylinder 5, and another port 23 of which communicates, through the pipe 24, with the upper end of the cylinder 5. The end 26 of the valve-chamber communicates, through a port 27, with another port 28, leading to the lower end of the cylinder. The port 28 is controlled by a check or puppet valve 29, which normally is held closed by means of a spring 30, but is provided with a stem 31, projecting up into the cylinder, so that when the main piston 8 reaches the limit of its downward stroke it will contact with this stem and open the puppet-valve 29. In a similar manner the end 33 of the valve-casing communicates, through a port 34 and pipe 35, with a port 36, which opens into the upper end of the cylinder 5. This port 36 likewise is controlled by a puppet or check valve 37, which is kept normally seated by a spring 38 and has a stem 39 projecting down into the cylinder in position to have the main piston 8 contact therewith at the limit of its upward movement to open the puppet-valve. Both the puppet-valves 29 and 37 have spiral springs 40 surrounding their stems and projecting slightly beyond their ends, these springs serving as cushions to lessen the shock when the main piston 8 strikes the stems of said valves and also to hold the valves 29 and 37 open for a longer period of time than would otherwise be the case in order to give a more positive movement to the main valve 14.

In the port 23, communicating with the pipe 24, leading to the upper end of the cylinder, I place an automatically-operating throttle and check valve, this comprising an ordinary disk valve 42, which seats toward the upper end of the cylinder and which is carried by a manually-adjustable threaded stem 43. The valve 42, however, is not rigidly connected to the stem, but is slidable thereon between the collars 44 and 45 on said stem. A coiled spring 46 holds the valve normally against the collar or head 44. By turning the stem 43 the valve 42 can be drawn away from its seat the required distance to admit the necessary quantity of motive fluid to the upper end of the cylinder. When the exhaust occurs, this valve will slide freely down the stem against the tension of the spring 46, thus opening a free passage to the exhaust and permitting the pressure to escape from the upper end of the cylinder without resistance. As soon, however, as the fluid-pressure comes in the opposite direction the disk valve 42 will at once slide up against the head 44, and thus throttle the passage to the upper end of the cylinder and not admit any more fluid thereto than is determined by the position of the adjustable stem 43.

The main valve 14 is made hollow and is perforated from end to end. Through this projects a bolt 48, which serves not only to secure in place the ends or heads 49 of the valve-casing, but also as a guide for the main valve. This through-bolt does not completely fill the openings in the ends of the main valve, so that fluid-pressure can leak through to both ends of the valve-casing. The interior of this main valve is constantly open to the inlet 19 through a port 50 in the valve-shell.

My pumping-engine will operate with either steam, compressed air, gas, hydraulic pressure, or the like; but preferably steam or compressed air will be used. Its operation will be as follows: When the main valve is in the position shown in Fig. 3, the fluid-pressure entering at the pipe 19 will pass, by means of the passage 17 in the valve and corresponding cored-out passage in the casing, to the port 23, and thence when the throttle-valve 42 is open by means of the pipe 24 to the upper end of the cylinder. This will force the main piston downwardly, and at the limit of its downward movement said piston will contact with the stem 31 of the puppet-valve 29, thus opening the end 26 of the valve-chamber to the lower end of the cylinder 5. The lower end of this cylinder is already opened through the port 22 and passage 16 in the main valve to the exhaust-post 20. As a consequence, when the puppet valve 29 is opened the pressure in the end 26 of the valve-chamber will be exhausted, so that the fluid-pressure in the opposite end 33 of the valve-chamber will force the main valve over to the position opposite to that shown in Fig. 3. In this position the passage 17 of the main valve will connect the inlet-pipe 19 with the port 22, leading to the lower end of the cylinder, thus forcing the main piston upwardly. At the same time the passage 18 of the main valve will connect the port 23 with the exhaust-port 21, thus connecting the upper end of the cylinder with the atmosphere, so that the fluid-pressure will escape down through the pipe 24, past the throttle-valve 42 to the port 23, and thence to the atmosphere. This escaping fluid-pressure will force the throttle-valve 42 downwardly against the tension of the spring 46, thus giving a very large opening for the exhaust and preventing the retention of any resisting fluid-pressure against the free upward movement of the main piston. The upward movement of the main piston will continue until it strikes the stem of the puppet-valve 37. This will open the valve and put the upper end of the cylinder in communication with the pipe 35, which is connected to the port 34, leading to the end 33 of the valve-chamber. As the upper end of the cylinder is in free communication with the atmosphere, it follows that as soon as the puppet-valve 37 is opened the pressure in the end 33 of the valve-chamber is reduced, thus permitting the pressure in the opposite end 26 of the valve-chamber to force the main valve back to the position shown in Fig. 3, when the first-mentioned operation will be repeated.

The mechanism so far described is all a part of my prior invention, as hereinbefore stated.

My present invention provides for automatically stopping the engine when the well is exhausted. This may be accomplished in many ways, and in the drawings only one arrangement for this purpose is shown, and this becomes operative only upon an abnormal downward stroke of the main piston, which abnormal stroke will occur only when the fluid in the well is exhausted. The operation depends on the fact that the pump at the bottom of the well is a lifting-pump. When the lifting-valve is forced downwardly by the sucker or pump rods, the fluid in the pump-barrel is supported by the valve at the bottom of the pump-barrel, and the weight of the column of fluid that is above the lifting-valve is also supported by the bottom valve when the lifting-valve is on its downward stroke. When the fluid in the pump-barrel becomes all or partially exhausted, there will be a separation of the column of fluid in the pump-barrel, which upon the next downward stroke of the pump will throw all the weight of the fluid that is above the lifting-valve onto the pump-rods. This will cause an abnormal speed on the downward stroke until the upper column of fluid comes in contact with the fluid that is supported by the valve at the bottom of pump-barrel. This abnormal speed on the downstroke is increased as the fluid becomes more exhausted, from the fact that the fluid becomes separated farther at each stroke of the pump until no more fluid comes into the pump-barrel. When this occurs, a full column of fluid will be on top of the lifting-valve, which added to the pressure exerted by the motor in forcing the rods downwardly will cause the piston to drop very rapidly. As long as the well is not exhausted the engine-piston in its downward stroke will not come into contact with the lower head of the cylinder. In actual practice there is a certain amount of clearance between the head and the piston when the latter is in its lowermost position; but when the well is exhausted the engine-piston 8 will make a slightly-longer stroke, coming into or very nearly into contact with the lower head of the cylinder. I utilize this extended amplitude of stroke of the engine-piston when the well is empty to stop the operation of the engine. Various arrangements of mechanism for stopping the engine may be arranged to be actuated by this extended amplitude of stroke of the engine-piston. In the drawings I have shown a valve-casing 60 screwed into the opening in the lower head of the cylinder directly underneath the puppet-valve 31. The spring 30 for holding up this puppet-valve rests upon a shoulder formed in said valve-casing. The passage through this valve-casing is provided with a seat 61, with which coöperates a downwardly-opening valve 62. The latter has its stem 63 projecting upwardly into fairly-close proximity to the lower end of the stem of the puppet-valve 31, but so that when the valve 31 opens in the normal operation of the engine it will not quite contact with the stem 63 of the valve 62. When, however, the engine-piston 8 makes a full downstroke, as it does when the well is exhausted, the puppet-valve 31 will be driven downwardly far enough to contact with the stem 63 and force the valve 62 downwardly, thus permitting fluid-pressure to escape through the passage in said valve-casing. Normally the valve 62 is held close, because of the fluid-pressure acting against the larger lower face of said valve, thus holding it up independently of any springs for this purpose; but when unseated the pressure on the two sides of the valve is equalized and said valve will remain open. The fluid-pressure escaping past the valve 62 upon the abnormal stroke of the engine-piston passes by means of a pipe 65 into a cylinder-chamber 66, which will be provided either with a diaphragm or the equivalent piston 67. This piston 67 has suitably connected thereto the stem 68 of a cut-off valve 69, located in the main supply-pipe 19. The valve 69 will be normally open, but with the escape of fluid-pressure through the auxiliary valve 62 into the outer end of the cylinder or chamber 66 the piston 67 will be driven outwardly and will force the valve 69 to its seat, thus shutting off the supply of fluid-pressure for the engine and stopping the same. In this manner the engine will be automatically stopped when the fluid in the well becomes exhausted.

The mechanical details of the parts described may be varied within wide limits. The cut-off valve may be of any suitable form, that shown in the drawings being an ordinary globe-valve. The cylinder 66 may be supported in any suitable manner, the drawings showing the same connected by means of rods or bolts 70 to a collar 71, secured to the bonnet of the valve.

When the valve 69 is closed, it will remain in that position, due to the fact that the fluid-pressure acts on its upper surface and holds it to its seat. As a convenient means for opening the same I connect the valve-stem to the piston 67, as by providing the valve-stem with a head or button 72, engaged by fingers or socket 73 on the piston. The piston-stem 74 projects out through the head of the cylinder and has pivoted thereto a lever or handle 74, fulcrumed at 75 to a projecting bracket 76 or other convenient support. By merely drawing outwardly on the handle 74 the piston 67 and valve 69 will be drawn downwardly, thus again admitting fluid-pressure to the main cylinder and starting the engine.

In the normal operation of the pump the auxiliary valve 62 will remain closed, the amount of clearance between the main piston 8 and the cylinder-head being such that the puppet-valve 31 will not be forced into contact with the stem 63 of said auxiliary valve. When, however, the well becomes exhausted, there will no longer be a back pressure in the pump-barrel, and consequently the main piston 8 will come down more rapidly and forcibly and will travel farther than during the normal operation of the pump. When this occurs, the puppet-valve 31 will be forced downwardly far enough to unseat the auxiliary valve 62, thus permitting the pressure from the end 26 of the main-valve chamber to rush into the cylinder 66, force the piston 67 outwardly, and close the cut-off valve. Various other arrangements might be used. If desired, the auxiliary valve 62 may merely vent the fluid-pressure from the end of the main-valve chamber to the atmosphere, and in this case the main valve will stay in one position and the main piston 8 will travel to the upper end of the cylinder and will then stay there. This is due to the fact that the valve 62 when unseated will remain open, so as to maintain a constant exhaust from the end 26 of the main-valve chamber. It is preferred, however, to positively cut off the supply of motive fluid. In either event, however, the pump is automatically stopped when the well is exhausted, thus making it unnecessary to supply an attendant for this purpose.

What I claim is—

1. The combination of a pump-rod, a motor connected thereto, and means controlled from the pump-rod for automatically stopping said motor when the well is exhausted.

2. The combination with a pump-rod, of a motor connected thereto, and means controlled by the back pressure on the pump-rod for automatically stopping the motor when the well is exhausted.

3. The combination with a pump-rod, of a fluid-pressure motor connected thereto, and valve mechanism controlled from the pump-rod and arranged to stop said motor when the well is exhausted.

4. A pumping-motor provided with an element adapted for connection to a pump-rod and with mechanism controlled by the back pressure on said pump-rod for automatically stopping the motor when the fluid in the well is exhausted.

5. A pumping-motor comprising a stationary element and a reciprocating element adapted for connection to the pump-rod, and means for stopping the flow of motive fluid to said motor upon an abnormal travel of said reciprocating element, due to fluid being exhausted from pump-barrel.

6. A fluid-pressure pumping-motor comprising a stationary cylinder and a reciprocating piston, and means for stopping the flow of motive fluid to said motor upon an abnormal travel of said piston.

7. A fluid-pressure pumping-motor comprising a stationary cylinder and a reciprocating piston, valve mechanism for cutting off the supply of motive fluid to said motor, and means operated upon an abnormal travel of said piston for actuating said valve mechanism.

8. A pumping-engine comprising a main cylinder, a piston therein, a cut-off valve, actuating means for said valve, and a valve arranged upon an abnormal travel of the piston to admit pressure to the cut-off-valve-actuating mechanism.

9. In a pumping-engine, the combination of a main cylinder, a piston therein, a cut-off valve, fluid-pressure-actuating means therefor, an auxiliary valve for admitting motive fluid to said cut-off-valve-actuating means, and operating means for said auxiliary valve arranged to be actuated upon an abnormal travel of said main piston.

10. In a pumping-engine, the combination of a main cylinder, a piston therein, a fluid-pressure-actuated valve therefor, and means arranged to maintain a constant exhaust from one end of the main cylinder upon an abnormal travel of the main piston.

11. In a pumping-engine, the combination of the main cylinder, a piston therein, a fluid-pressure-actuated valve for said engine, an auxiliary valve connected to one end of said main-valve chamber, and actuating means for said auxiliary valve arranged to be actuated upon an abnormal travel of the main piston.

In testimony whereof I, the said Frederick Sage, have hereunto set my hand.

FREDERICK SAGE.

Witnesses:
James M. Read,
John J. Murray.