

(No Model.)

3 Sheets—Sheet 1.

D. E. KEMPSTER.  
STEAM ACTUATED VALVE.

No. 436,830.

Patented Sept. 23, 1890.

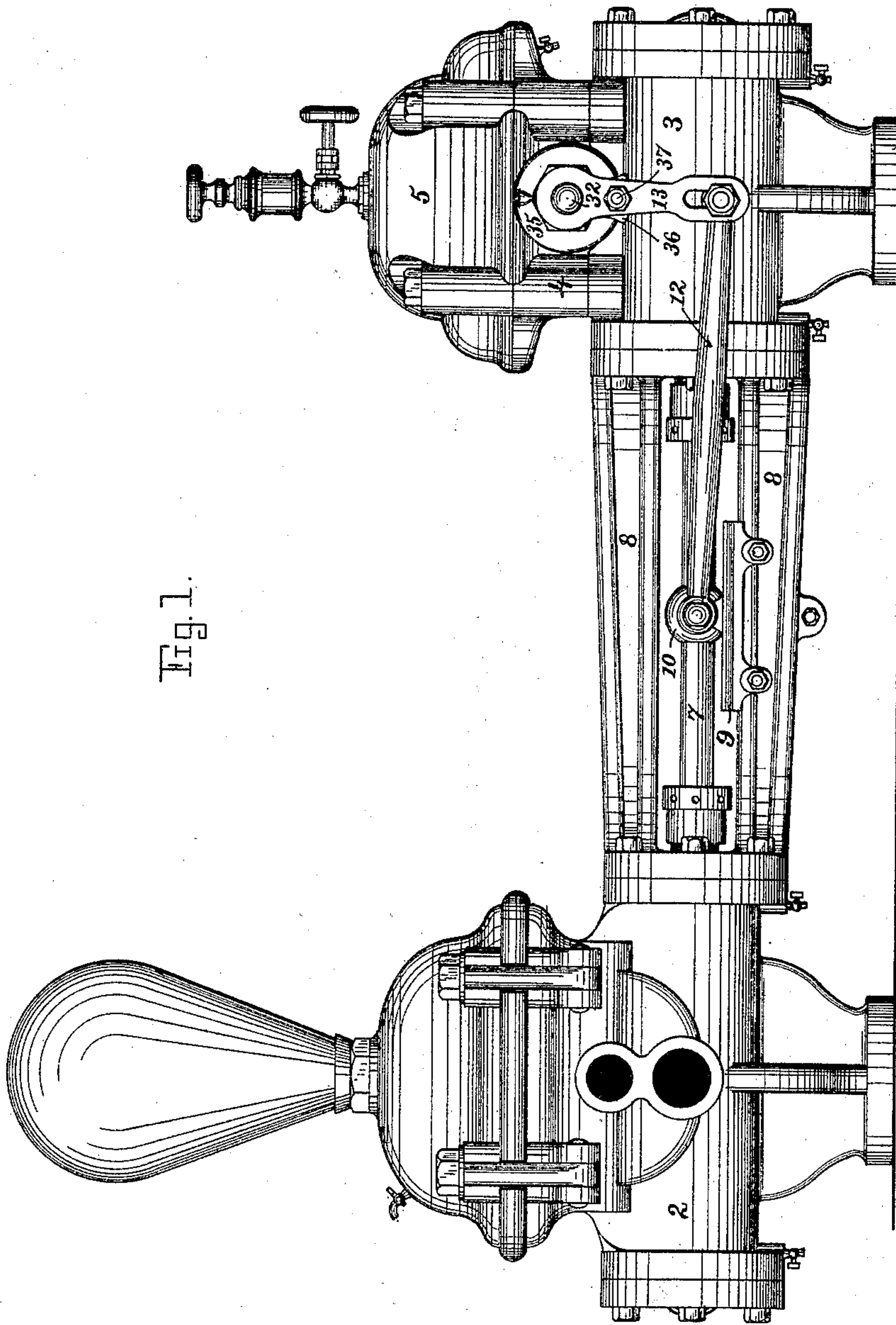


Fig. 1.

Witnesses

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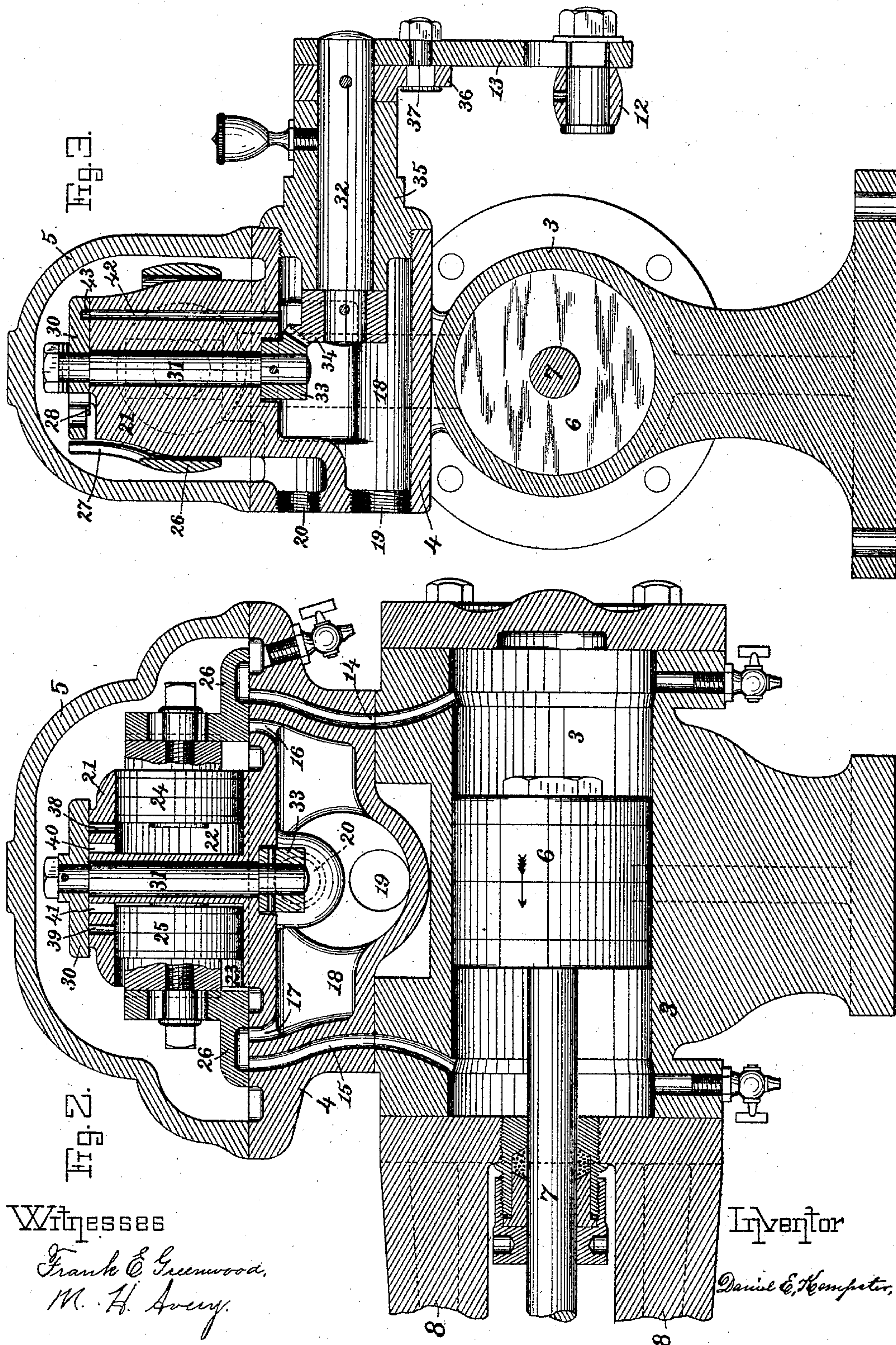
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.



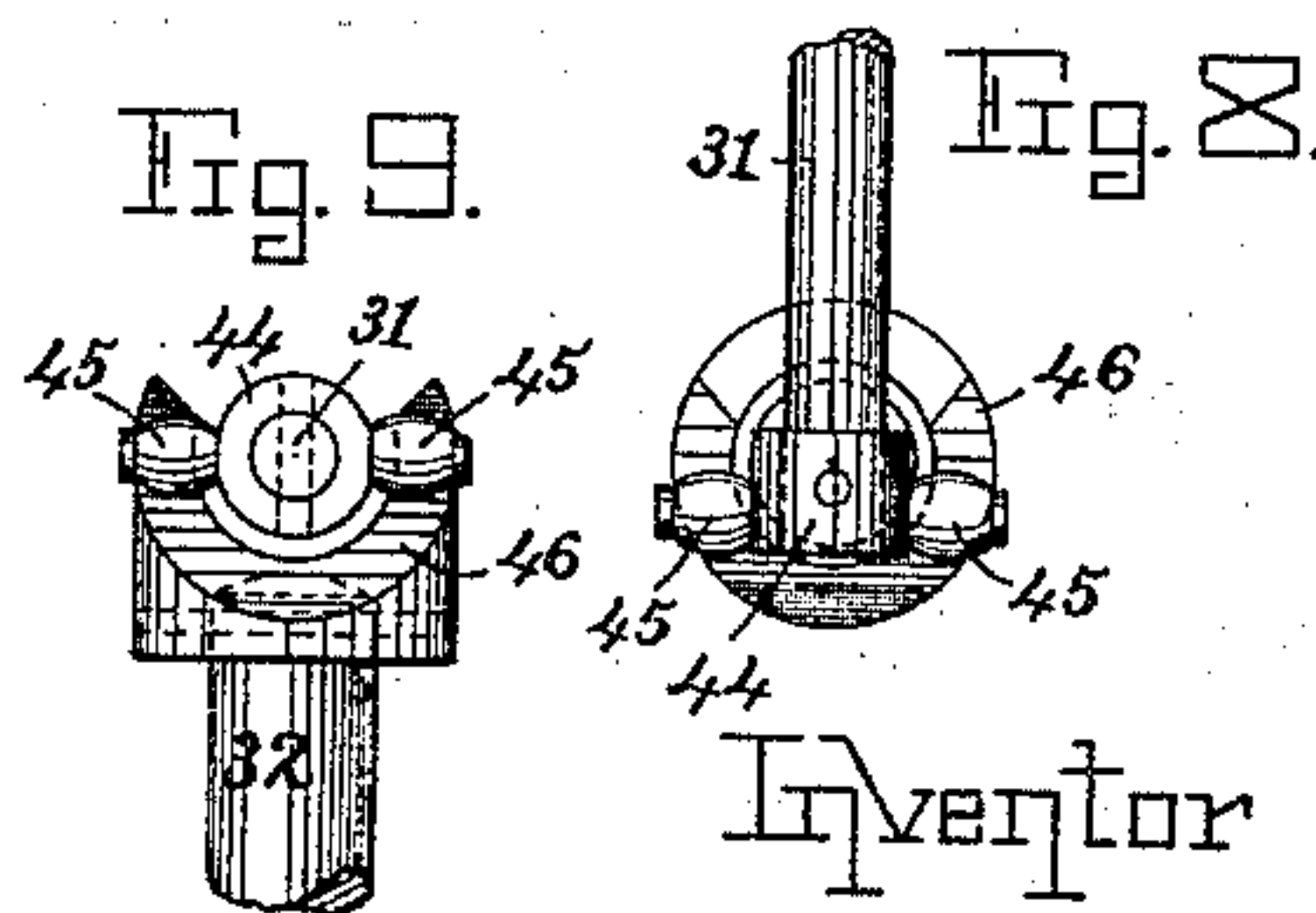
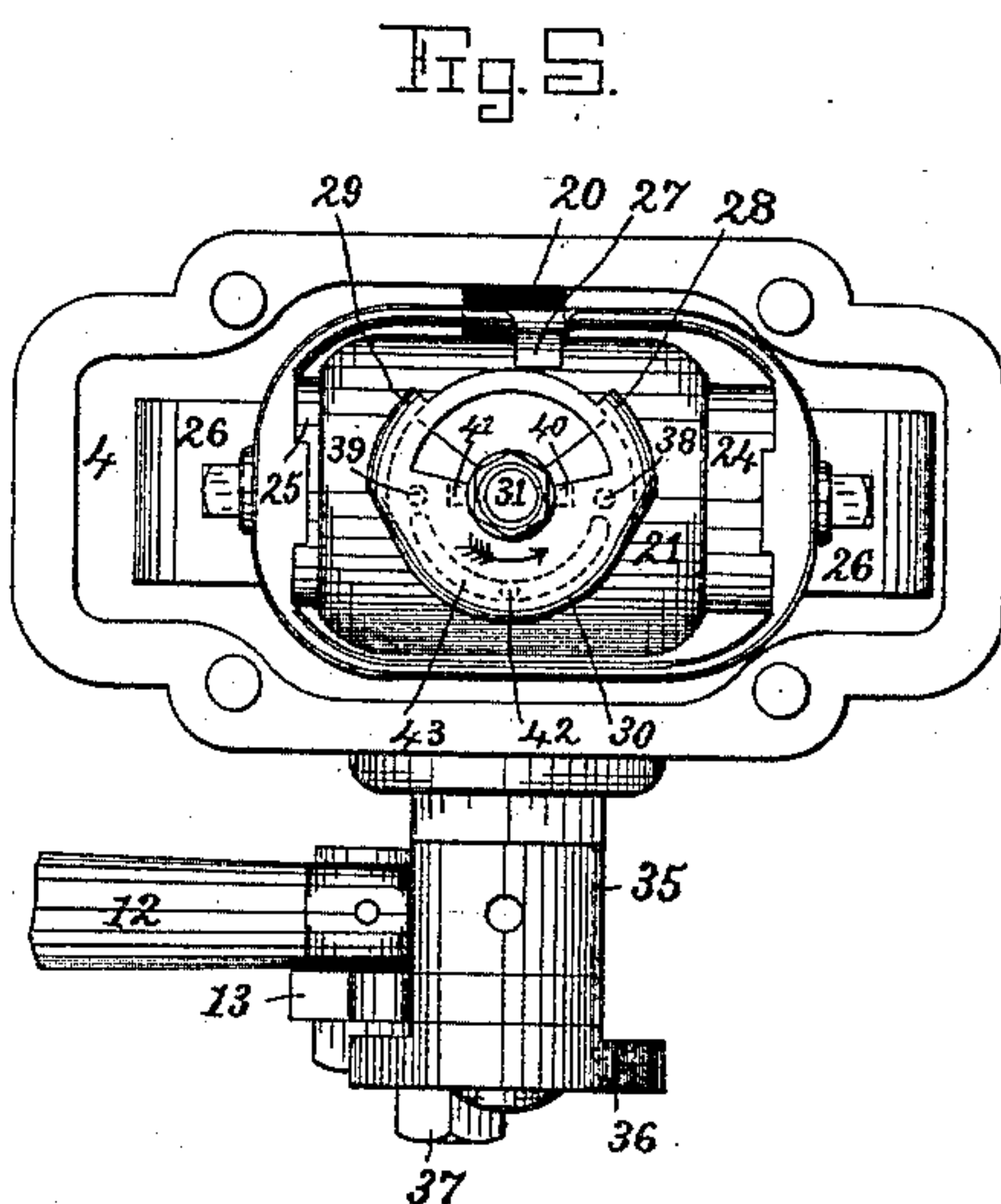
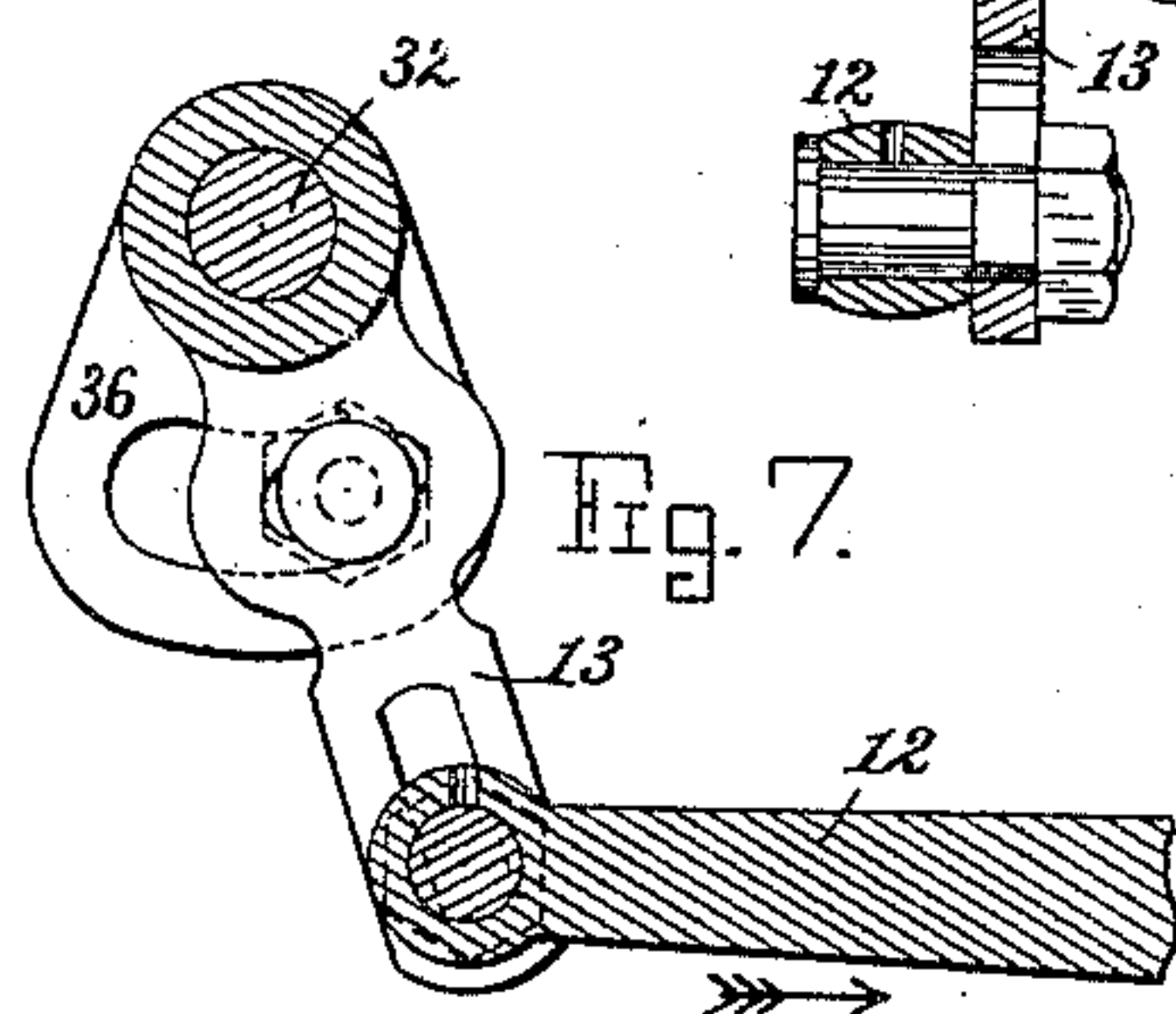
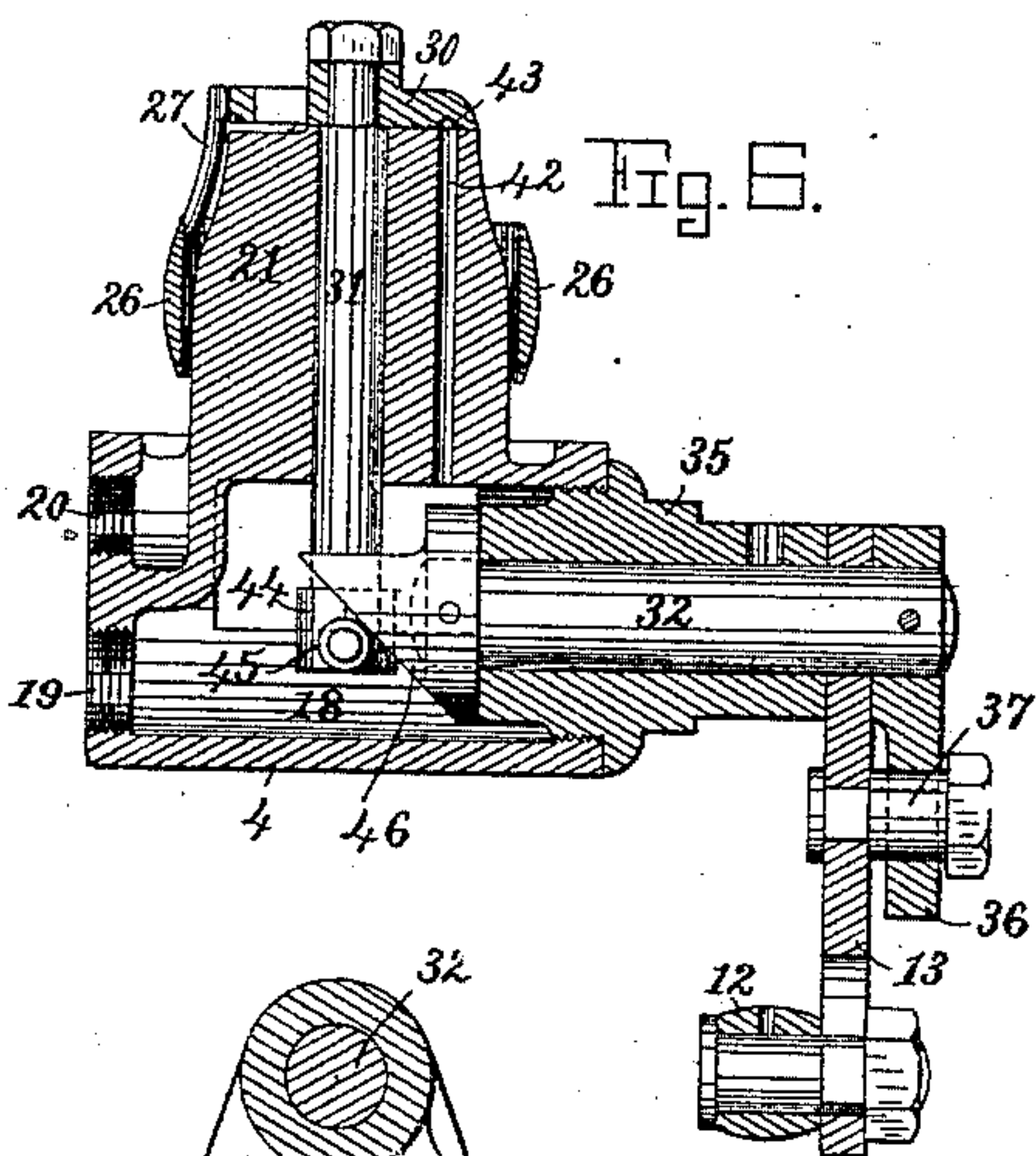
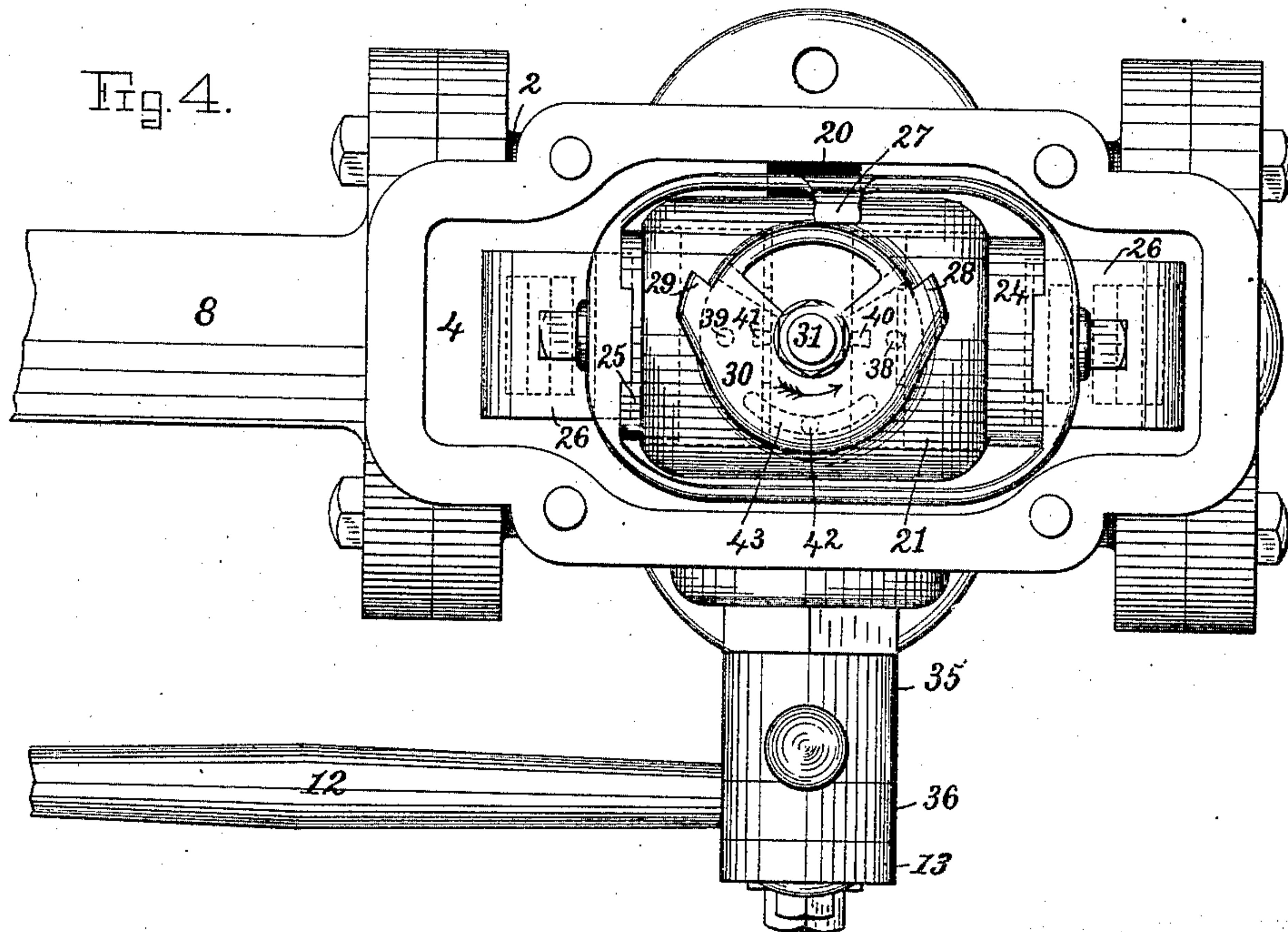
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# UNITED STATES PATENT OFFICE.

DANIEL E. KEMPSTER, OF BOSTON, MASSACHUSETTS.

## STEAM-ACTUATED VALVE.

SPECIFICATION forming part of Letters Patent No. 436,830, dated September 23, 1890.

Application filed June 23, 1890. Serial No. 356,397. (No model.)

*To all whom it may concern:*

Be it known that I, DANIEL E. KEMPSTER, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Steam-Actuated Valves; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

My invention relates to direct-acting engines of that class in which the main valve is actuated by steam or other fluid under pressure, through the medium of minor pistons working in minor cylinders which are controlled by an auxiliary valve operated by the main piston-rod of the engine.

My invention has for its object to improve and simplify this class of engines; and it consists in the hereinafter-described construction of the valve mechanism, whereby all stuffing-boxes therefor are avoided, and the said mechanism, while intact, may be entirely exposed and readily inspected without disconnecting any part of said valve mechanism or separating any steam-joints, excepting the removal of the outer independent valve casing or hood, all of which will now be fully described, and clearly pointed out in the claims.

In the accompanying drawings, similar figures of reference indicate corresponding parts wherever they occur thereon.

Figure 1 represents a side elevation of a steam-pump embodying my invention. Fig. 2 is a central longitudinal section of the steam end of said pump. Fig. 3 is a central cross-section of the same. Fig. 4 is a top or plan view of the said steam end, with the valve casing or hood removed. Fig. 5 is a similar view on a smaller scale, showing a little different arrangement of the auxiliary valve and its operating mechanism. Fig. 6 is a central cross-section of said arrangement shown in Fig. 5. Figs. 7, 8, and 9 are detail views of the aforesaid arrangement of valve mechanism.

In the drawings, 2 represents the main wa-

ter-cylinder. 3 represents the main steam-cylinder, 4 its steam-chest, and 5 its valve casing or hood portion of said steam-chest. The main steam-cylinder is provided with the piston 6 and its piston-rod 7, which rod extends through the stuffing-boxes on the steam and water cylinders, and has upon its water end the usual piston or plunger. Said water-cylinder is provided with valve and air chambers, and is constructed in the usual manner with water ends of steam-pumps.

The steam and water cylinders are separated by the intermediate frame 8, which is provided upon its side with the slide 9.

The piston-rod has fastened upon it about midway of its length the cross-head 10, which is provided with a bearing adapted to travel upon the slide 9, and to the outer end of said cross-head is pivotally attached the connecting-rod 12, which rod in a similar manner connects at its opposite end to the side lever 13, said side lever being slotted so as to vary the length of the stroke of the engine, as will be readily understood without further explanation.

The steam-chest 4 is secured to the main cylinder by suitable bolts, and its upper face is provided with the main-valve seat having steam-ports 14 15 and exhaust-ports 16 17. Said steam-ports 14 15 extend downwardly into opposite ends of the main cylinder, and the exhaust-ports 16 17 extend into an exhaust-chamber 18 within said steam-chest, said exhaust-chamber being provided with an outlet 19 for the exhaust-pipe. The steam-chest has just above said outlet for the exhaust-pipe an inlet 20 for the steam-supply pipe, said inlet running into the side of the chest and then turning upwardly, opening through the face of said chest into the valve casing or hood portion thereof.

The steam-chest is provided with a central and upwardly-extending portion 21, having therein the minor cylinders 22 23, provided with suitable pistons 24 25, said pistons being attached to the main valve 26 by suitable screws passing through slots in said valve, so as to connect the said pistons to opposite ends of the valve in such a manner as to allow the valve a certain amount of vertical movement or play, whereby as the valve and valve-seat wear away the valve may follow down and



keep tight upon its seat; also, when water from condensation in the steam-chest or otherwise is forced by the steam through the main cylinder into the exhaust-pipe the valve is  
 5 free to rise from its seat and free itself from the water, thus avoiding danger of breakage. The main valve is of a double-D pattern, and covers the ports at opposite sides of the central portions 21, and has side arms which en-  
 10 circle said central portion of the chest and connect the two ends or faces of the main valve together.

Upon one of the side arms of the valve 26 is situated an upwardly-extending projection  
 15 27. Said projection is adapted to be engaged by projections 28 and 29 on the auxiliary disk-valve 30, pivoted on the vertical shaft 31, so as to swing or oscillate on the valve-seat or face of the central portion of the steam-chest.  
 20 The auxiliary disk-valve 30 is suitably secured to the upper end of the vertical shaft 31, so that said valve may be readily adjusted thereon to compensate for any wear between said valve and its seat, and also to admit of  
 25 the easy removal of said valve when desired for any purpose. Said shaft 31 extends downwardly between the two minor cylinders 22 and 23, through the steam-chest, into its exhaust-chamber 18, where it connects with the  
 30 horizontal shaft 32 by the bevel gear-sectors 33 and 34, secured fast on the adjacent ends of said shafts.

The horizontal shaft 32 is supported by the sleeve or bearing 35 on the side of the steam-  
 35 chest, and has securely fastened upon its outer end the small arm 36, which is slotted laterally and provided with the bolt 37, which passes through said slot and a hole in the side lever 13, and thus clamps and holds fast  
 40 said side lever upon the end of the horizontal shaft. The slot in the arm 36 admits of adjusting the position of said side lever with relation to the auxiliary disk-valve, so as to regulate the movement of the main piston in  
 45 either direction, the adjustment being such that a movement of the bolt 37 out of a central position toward either end of its slot produces a corresponding shortening of the stroke of the main piston in one direction and the  
 50 lengthening of said stroke a similar amount in the opposite direction, and by raising or lowering the pivoted connection of the connecting-rod in the slot of the side lever 13 the movement of the auxiliary valve may be  
 55 changed and the stroke of the engine shortened or lengthened, as desired.

The central portion 21 of the steam-chest is provided with the auxiliary-valve seat, and  
 60 38, 39, 40, and 41 are small steam-ports extending through the same into the minor cylinders 22 and 23.

42 is an exhaust-port for said minor cylinders, and extends from the disk-valve seat through into the exhaust-chamber 18.

65 The auxiliary disk-valve 30 is provided with an exhaust-cavity 43 on its under or face side. Said cavity is formed concentric

with the central pivot or valve shaft 31 and is of a proper length and location therein to permanently register with the exhaust-port 70 42, and intermittently and alternately register with the steam-ports 38 and 39 as the disk-valve is oscillated upon its seat.

The operation of my invention is as follows: Referring to Figs. 1, 2, 3, and 4, steam enters 75 the inlet 20 and fills the valve casing or hood 5, passing in under the end of the main valve 26 (see Fig. 2) and down through the main port 14 into the cylinder 3, where it forces the piston 6, together with its rod 7, to the left, 80 as indicated by the arrow thereon, the steam or other vapor on the opposite side of the main piston passing up through the main port 15, and turning in the exhaust-cavity of the main valve passes down through the exhaust-port 85 17 into the exhaust-chamber 18, and thence through the outlet 19 into the exhaust-pipe. As shown in Figs. 2 and 4, the main valve and its actuating minor pistons 24 and 25 stand to the right of their stroke, and as the main 90 piston and rod travel to the left the auxiliary disk-valve 30, through the medium of the connecting mechanism between said auxiliary valve and the piston-rod, is caused to swing on its seat in the direction indicated by the 95 arrow in Fig. 4, and as the main piston approaches the end of its stroke to the left the auxiliary steam-ports 39 and 41 are uncovered by said auxiliary disk-valve, thus admitting steam through said ports into the minor cyl- 100 inder 23, first by entering behind the minor piston 25 through the port 41, and moving said minor piston, together with its connected main valve 30, toward the left, steam also entering said minor cylinder 23 through port 105 39, as said piston 25 passes and uncovers the inner end of said port. As the auxiliary disk-valve uncovers the ports 39 and 41 the exhaust-cavity 43 of said valve is swung into position to register with the auxiliary port 38, 110 and thus establish communication between the minor cylinder 22 and the auxiliary exhaust-port 42, allowing the steam in said cylinder to be freely exhausted therefrom. As the main valve and its minor pistons travel 115 to the left, the minor piston 24 passes and covers the inner end of port 38, and then cushions on the vapor shut up within its cylinder 22, as the auxiliary port 40 is closed by the face of the auxiliary disk-valve 30, and 120 the main valve is thus quickly actuated and properly cushioned at the end of its stroke.

The above-described movement of the main valve to the left establishes communication between the main ports 14 and 16, and thus 125 opens the exhaust to the right-hand end of the cylinder, and at the same time steam or other motive fluid is admitted through the main port 15 into the left-hand end of said cylinder, thereby reversing the movement of 130 the main piston, and as said piston travels to the right the movement of the main valve to the right into its original position (shown in Fig. 2) to reverse the stroke of said piston is



accomplished by a precisely identical operation of the auxiliary-valve mechanism as just described with relation to the movement of the main piston to the left. Therefore a redescription of the movement of the parts in the opposite stroke of the engine would seem superfluous.

It will be observed in the foregoing description that the auxiliary disk-valve has a continuously oscillating movement imparted by the continuously reciprocating movement of the piston-rod of the engine, but under some circumstances I may prefer to give said auxiliary disk-valve an intermittently oscillating movement, whereby the auxiliary steam-ports are uncovered by said valve and remain open during the greater part of the stroke of the engine, as will be seen in the case illustrated by Figs. 5, 6, and 7, in which the small arm 36 is secured fast upon the extreme end of the shaft 32, and between it and the shaft-bearing is loosely hung the side lever 13, having the bolt 37, laterally adjustable within a slot crosswise of said lever, said bolt being held fast therein and passing loosely through a laterally-curved slot in the arm 36, the slot of said arm being the proper length to permit the side lever to oscillate without the bolt 37 engaging and moving the said arm and its connected auxiliary disk-valve, only at or near the ends of the stroke of said side lever in either direction, the adjustment laterally of the bolt 37 within its slot in the side lever, together with the vertical adjustment of the pivoted connection between the connecting-rod and said side lever, insuring regulating the length and position of the stroke of the engine, as must be readily understood.

In the case of an intermittent circular movement of the disk-valve, as last described, the projections 28 and 29 on said valve, and also the exhaust-cavity 43 therein, are somewhat changed or modified, as shown in Fig. 5, to conform to the lesser movement or oscillation of said auxiliary valve.

The object of the projection 27 on the side arm of the main valve 26 and the projections 28 and 29 on the auxiliary disk-valve 30 is for the purpose of establishing a positive mechanical connection between the main and auxiliary valves, whereby if at any time, by reason of the small auxiliary ports becoming clogged up, or by reason of a very great speed of the engine occasioned by suddenly relieving it of the load against which it was working—as, for instance, when a pump loses its water, and the steam did not act upon the minor pistons to reverse the main valve quick enough to prevent the main piston from striking the cylinder-heads—one or the other of said projections 28 or 29 would engage the projection 27 and move the main valve mechanically in the proper time to absolutely prevent the piston from ever striking the cylinder-heads at any speed of the engine, the projections on the two valves being so located relative to each other as to positively engage

after the auxiliary ports have opened to admit steam to the minor pistons and the main valve has not been moved in a proper time thereby and both valves are then moved by the main piston. The steam acting on said minor pistons will ordinarily operate the main valve, as required, in which case the projections on the two valves will never come in contact with each other, their office being simply a positive safeguard against accidents, which might occur under some such circumstances as are above mentioned.

It is evident I may oscillate the auxiliary disk-valve by other mechanism than that described; and, if preferred, the geared sectors 33 and 34 may be dispensed with and an equivalent cam motion—such as illustrated in Figs. 6, 8, and 9—used in place thereof, in which case the vertical shaft 31 has fast upon its lower end a cross bar or collar 44, having two anti-frictional rolls 45, which are adapted to run upon two inclined surfaces on a cam 46, fast on the inner end of the horizontal shaft 32, as plainly shown in Fig. 6. As the shaft 32 and its cam 46 are rocked, one of the anti-frictional rolls is forced outwardly and the opposite roll inwardly by the inclines on said cam, thereby giving the vertical shaft 31 an oscillating movement similar to that imparted by the bevel gear-sectors before described, and this arrangement, as well as the arrangement described for imparting an intermittently oscillating movement to the auxiliary disk-valve, may be preferred in place of the mechanism first described for oscillating or swinging said valve upon its seat.

By my invention the auxiliary valve is positively operated by the movement of the main piston without any connections entering through from the outside into that part of the steam-chest having steam-pressure, thereby avoiding the disadvantage of stuffing-boxes for the valve mechanism, and also by my construction and arrangement thereof I am able to inclose said valve mechanism within a removable casing or hood entirely independent from said mechanism, whereby said casing or hood may be removed from its steam-chest without disconnecting or disturbing said valve mechanism in any way, but leaving it intact in all parts, so as to be operated by hand and readily inspected. This is a very great advantage over similar valve mechanism wherein when the said mechanism has to be inspected it is necessary to disconnect and separate said mechanism before it can be exposed for inspection, as will readily be understood and appreciated by engineers and others familiar with this class of engines.

It is evident that the part 4 of the steam-chest may be cast integral with the main cylinder, if so preferred, and the hood part 5 of said steam-chest may be of different shape from that shown, providing, always, that said hood part is entirely independent and free from the outside connections or valve-stem, and enveloping the main and auxiliary valves,



together with the valve-pistons, joins with the steam-chest proper at or near the line of its main-valve seat, as shown plainly in the drawings.

5 It will be observed that as the exhaust-steam from the minor cylinders passes from the port or passage 42 it effectually lubricates the sector-gears in its passage through and around them toward the outlet or exhaust  
10 pipe.

The invention is of course applicable to any fluid-pressure engine, and is susceptible of minor modifications within the scope of mechanical skill without departing from the  
15 spirit of my invention.

Having thus fully described the nature and construction of my invention, I wish to secure by Letters Patent, and claim—

1. The combination, with the main cylinder  
20 having suitable main induction and eduction ports, the main piston and piston-rod, the steam-chest having minor pistons and cylinders having suitable ports, and the main valve operated by said minor pistons, of the pivoted  
25 oscillating auxiliary disk-valve controlling the supply and exhaust of said minor cylinders, having its connected operating mechanism passing between said minor cylinders out through said steam-chest and connected to  
30 the main piston-rod of the engine, substantially as described.

2. In a direct-acting engine, the main cylinder having suitable supply and exhaust ports, and the steam-actuated main valve therefor  
35 having the side projection 27, in combination with the pivoted auxiliary disk-valve having the side projections 28 and 29, and the auxiliary-valve-operating mechanism, substantially as and for the purpose described.

40 3. In a direct-acting engine, the main cylinder, the main piston therein, the steam-chest on said cylinder, the two minor cylinders and their pistons therein, the main-valve seat having induction and eduction ports, the main  
45 valve controlling said ports, suitable connecting devices between said main valve and the minor pistons, the auxiliary-valve seat having suitable ports for said minor cylinders, the flat auxiliary disk-valve pivoted on said  
50 seat and controlling said ports, the vertical shaft for oscillating said auxiliary valve passing between said minor cylinders into the exhaust-chamber, the horizontal shaft passing from said exhaust-chamber through the side of

the steam-chest, the sector-gears or mechanism for connecting the vertical and horizontal  
55 shafts, the side lever and its small connected arm on said horizontal shaft, the connecting-rod pivoted to said side lever, the cross-head fast on the piston-rod, and the other end of said  
60 connecting-rod pivoted thereto, and the piston-rod passing through its stuffing-box and attached to the main piston, all constructed, combined, and arranged to operate substantially as herein described.

4. In a direct-acting engine, the combination, with the main cylinder, of the steam-chest, substantially as herein shown and described, comprising the parts 4 and 5, the  
70 part 4 having the main and auxiliary valves, the minor cylinders and pistons for operating said main valve, and the auxiliary-valve-operating mechanism, and the part 5 constructed in one piece, secured to and forming an independent covering or hood for said  
75 part 4 and its connected mechanism, for the purpose set forth.

5. In a steam-engine, the combination of the main valve 26, having the side projection 27, and the pivoted auxiliary disk-valve 30,  
80 having the side projections 28 and 29, said valves being arranged for conjoint operation, substantially as described.

6. In a steam-engine having a steam-chest provided with a main valve and two auxiliary  
85 minor cylinders and pistons for steam-actuating said valve, the combination of an auxiliary valve above said minor cylinders, and its connected actuating mechanism passing downwardly through a central head between  
90 said cylinders and outwardly into connection with the main piston-rod of the engine, substantially as described.

7. The combination of the steam-chest, the oscillating auxiliary valve therein, the shaft  
95 31, sector-gears 33 34, shaft 32, slotted arm 36, bolt 37, side lever 13, piston-rod 7, cross-head 10, and connecting-rod 12, pivoted to said side lever and cross-head, all constructed and arranged to operate substantially as described,  
100 and for the purpose set forth.

In testimony whereof I affix my signature in presence of two witnesses.

DANIEL E. KEMPSTER.

Witnesses:

HENRY CHADBURN,  
FRANK E. GREENWOOD.