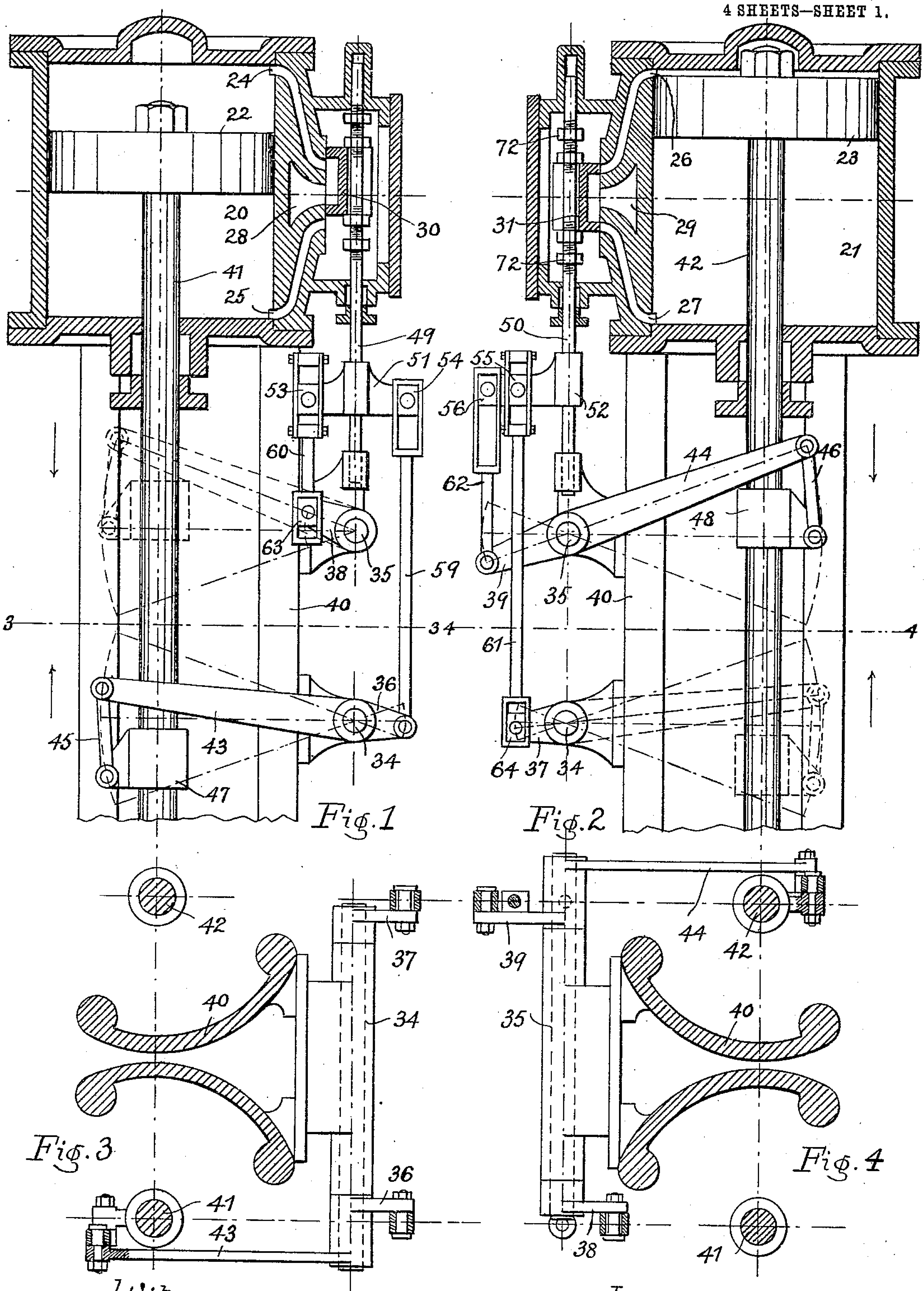
F. F. NICKEL.

STEAM PUMP.

APPLICATION FILED AUG. 7, 1907.

945,578. Patented Jan. 4, 1910.

4 SHEETS—SHEET 1.



Witnesses
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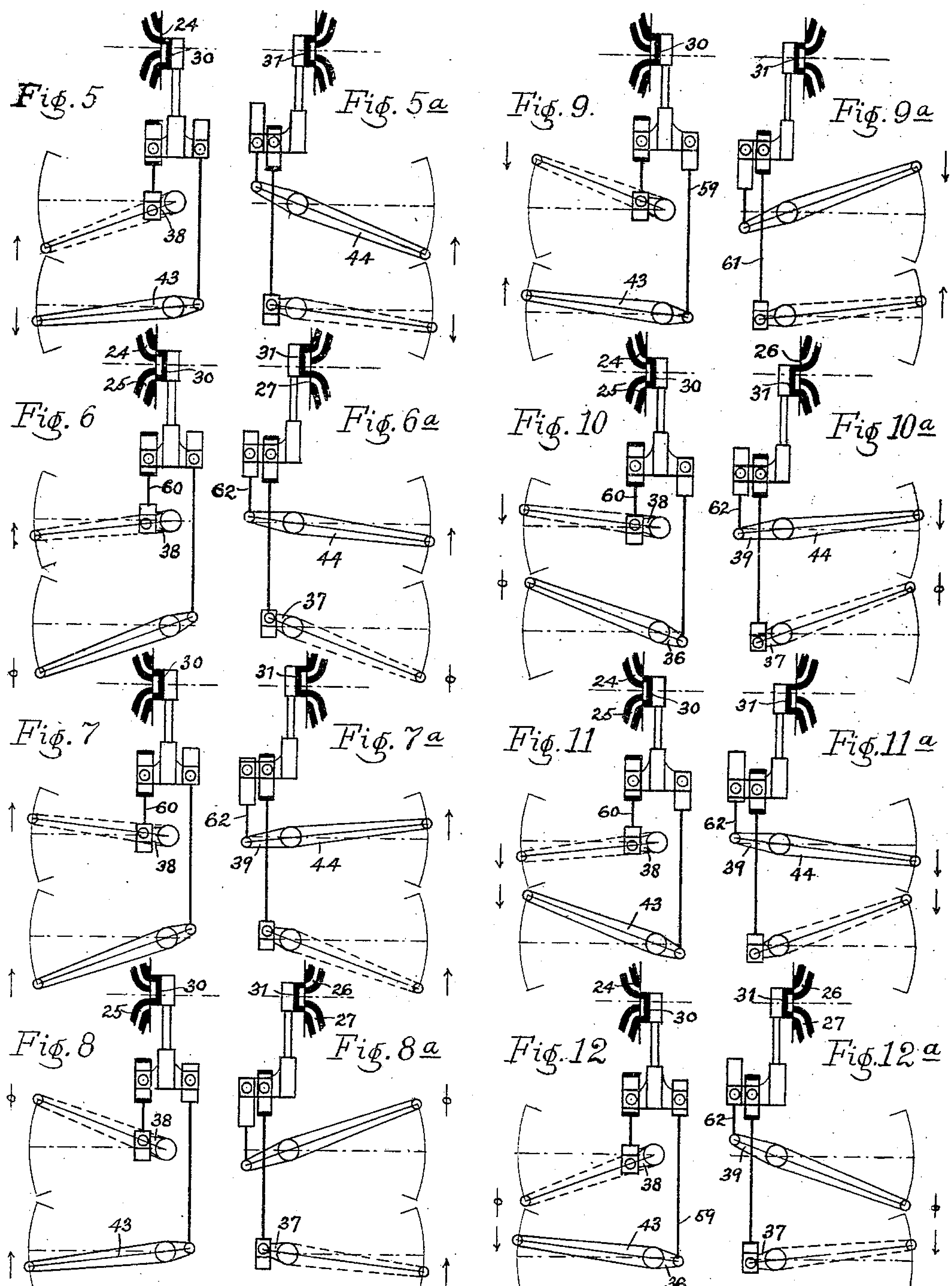

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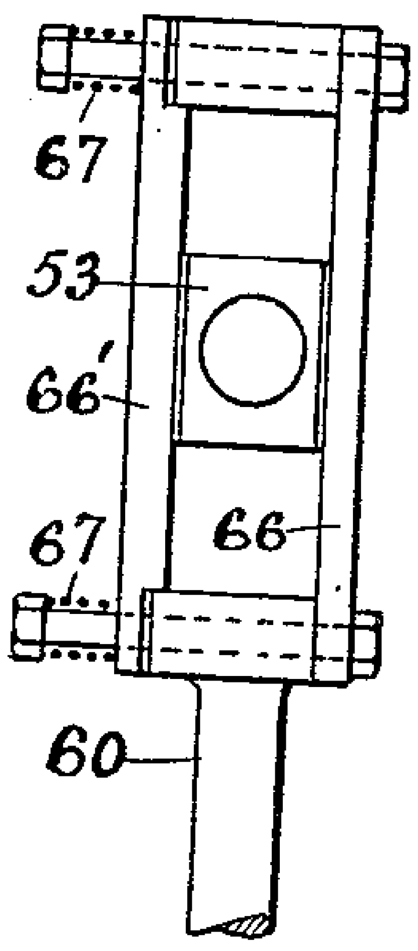

Fig. 13.

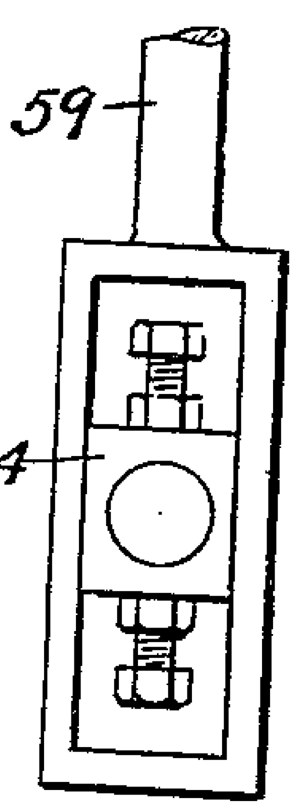

Fig. 14.

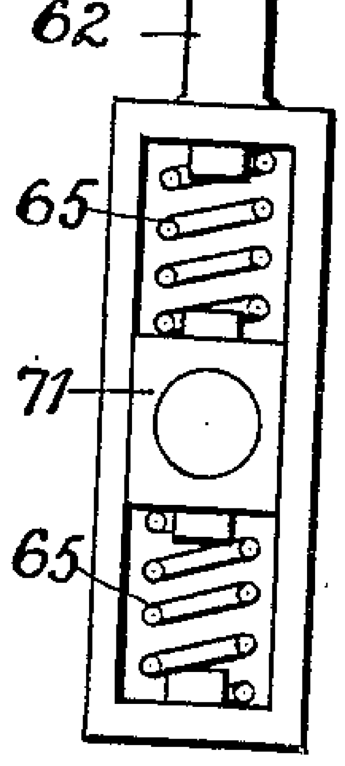

Fig. 15.

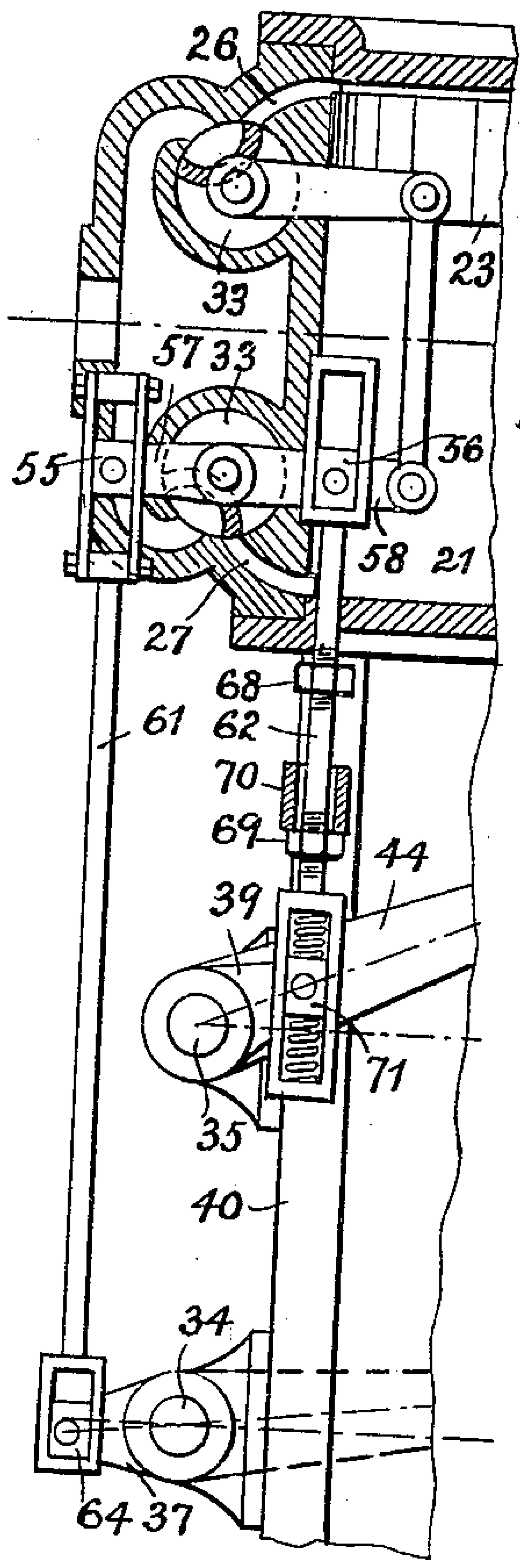

Fig. 17.

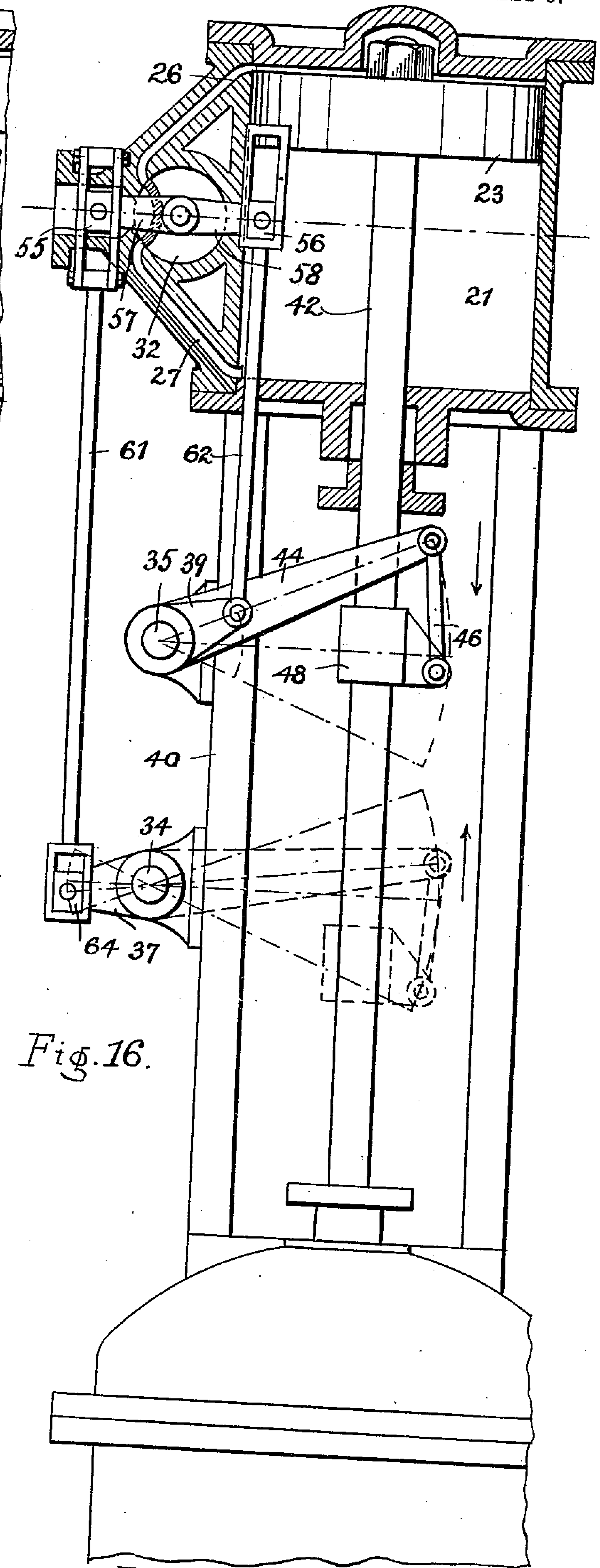

Fig. 16.

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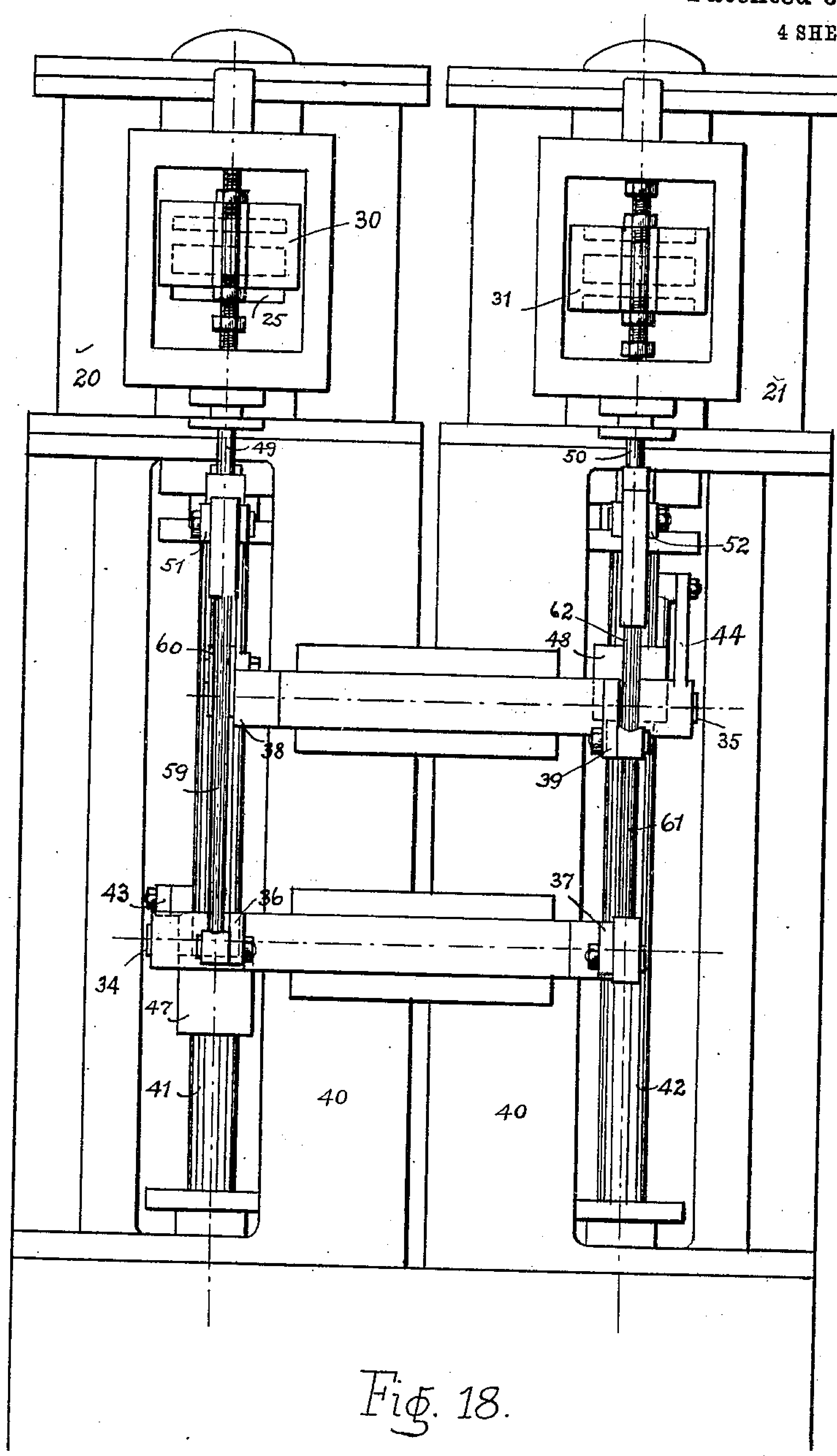

Fig. 18.

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UNITED STATES PATENT OFFICE.

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STEAM-PUMP.

945,578. Specification of Letters Patent. **Patented Jan. 4, 1910.**

Application filed August 7, 1907. Serial No. 387,419.

To all whom it may concern:

Be it known that I, FRANZ F. NICKEL, a citizen of the United States, and a resident of East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Steam-Pumps, of which the following is a specification.

My invention relates to pumps, and particularly to that class of steam pumping engines known as "direct acting duplex"; and it has for its object to simplify the same and to insure the more perfect control of steam admission to and exhaust from the steam cylinders of such pumps, and to avoid the use of double ports and cushion relief valves. I attain these objects by the mechanism illustrated in the accompanying drawings in which—

Figures 1 and 2 are longitudinal sections respectively of the right and left hand steam cylinders of a steam pump, and elevations of the valve gear. Figs. 3 and 4 are sections on lines 3—3 and 4—4, Figs. 1 and 2 respectively, looking in the former figure toward the water end, and the latter toward the steam end. Figs. 5 to 12 are diagrammatic views illustrating the valve motion on the right hand side of the pump; and Figs. 5ᵃ to 12ᵃ are similar views illustrating the corresponding valve motion on the left hand side. Fig. 13 is a detail view illustrating one way of effecting a constant friction between link and sliding block. Fig. 14 is a view illustrating the lost motion link ends. Fig. 15 is a similar view showing the elastic link end. Fig. 16 is a longitudinal section of one cylinder provided with an oscillating valve, and an elevation of the valve gear. Fig. 17 is a modification of same showing two oscillating valves, and also the application of the elastic link end. Fig. 18 is a plan view of the two cylinders and valve gear.

It is well known to those familiar with the design of direct acting steam pumps, that in the absence of a crank shaft or other device giving to the pistons a positive stroke, some other means must be provided to stop the motion of the piston at the end of the stroke. Since the two pistons are entirely independent of each other it is impossible to adjust the valve motion to cut off the steam at exactly the time when its piston has reached the end of the stroke. But, even should it be possible to do so, the valve would be in this position only for an instant and would slide over this point at high speed, thereby reversing the piston before the water valves had time to seat.

In order to impart to the valve a motion which will close it exactly at the time when its piston has reached the end of the stroke and then allow it to remain closed a certain time to give the piston an opportunity to come to a stand still and the water valves time to seat before the said piston reverses, I provide the mechanism hereinafter set forth.

In low service pumps where the weight of the reciprocating parts is heavy, it is often desirable to cut the steam off before the piston has reached the end of the stroke. As the valves of a duplex pump are made without outside or inside lap to prevent stoppinig, it follows that the valve when closed must remain in this central position until the piston has completed its stroke. This I accomplish by the mechanism set forth in the specification and shown in the drawings.

As shown in the drawings, 20 indicates the right hand cylinder and 21 the left hand cylinder of a steam pump in which reciprocate respectively the pistons 22 and 23. Each cylinder is further provided with the respective admission ports 24, 25 and 26, 27, as well as the exhaust ports, 28 and 29. These admission ports are controlled by means such as slide valves 30 and 31 Figs. 1 and 2, or oscillating valves 32 or 33 Figs. 16 and 17. These steam controlling means are governed by a valve gear acting to close said admission ports through the action of the piston of their own cylinder and to open the same through the action of the piston of the opposite cylinder. The mechanism through which this valve motion is effected comprises two controlling rock shafts 34 and 35 actuating respectively the cranks 36, 37 and 38, 39 arranged in reverse position with respect to the two cylinders. The rock shafts 34 and 35 are mounted in suitable bearings of the frame 40 of the pump, and derive their movement from piston rods 41 and 42 respectively through the arms 43, 44, links 45, 46, and piston-rod cross-heads 47, 48.

The valve stems 49 and 50 in the case of slide valves being used are connected to cross-heads 51 and 52, said cross-heads being respectively provided with sliding blocks, 53, 54 and 55, 56. In the case of an oscillating valve Figs. 16 and 17 these blocks are at the end of arms 57 and 58 projecting from the valve. The cranks 36 and 38 are connected to the cross-head 51 through links 59 and 60, and the cranks 37 and 39 to the cross-head 52 through links 61 and 62.

The cut-off links 59 and 62 are slotted at the cross-head end and fit over the sliding blocks 54 and 56 respectively. The main links 60 and 61 are likewise slotted at the crank end fitting over the sliding blocks 63 and 64, and at the cross-head end are designed as a friction drive in conjunction with the blocks 53 and 55. Detail views of the cut-off link ends are shown in Figs. 14 and 15, the former representing the usual and well known form of lost motion link end and the latter a modification showing an elastic link end provided with springs 65 arranged to act against the block 71 as shown. Fig. 13 shows the friction drive of main link. The block 53 is held between the fixed bar 66 and the bar 66′ made yielding by means of adjustable springs 67, thus insuring a constant and adjustable friction irrespective of wear.

Referring to Fig. 17 I have shown a modified form of the mechanism by means of which it is possible to cut off the steam before the piston has reached the end of the stroke, the valve remaining in its central position while the said piston completes its stroke by virtue of its momentum. For this purpose adjustable collars 68 and 69 are provided on the cut-off link 62 acting in conjunction with a stop 70 secured to frame 40, which stop limits the travel of the link. In this connection it becomes necessary to employ some means to allow the crank 39 its full travel. For this purpose the elastic link end already explained and sliding block 71 are provided at the end of link 62.

The operation of my valve gear is as follows—reference being had to Figs. 5 to 12, and 5ª to 12ª which illustrate one complete cycle, the arrows indicating the direction of motion and the character Θ the absence of motion. Assuming the relative positions of valves, links and cranks of the right and left hand valve gears as shown in Figs. 5 and 5ª respectively, it will be seen that both ports of the left hand cylinder are closed and that the admission port 24 of the right hand cylinder is open. The piston 22 is therefore traveling and with it the arm 43 in the direction indicated by the arrow. The piston 23 of the left hand cylinder has completed its stroke and is about to move together with the arm 44 in the direction indicated by the upper arrow Fig. 5ª. The movement of the arm 44 as indicated in Fig. 6ª causes the valve 30 in Fig. 6 to close both ports through the action of crank 38. At the same time the port 27 of the left hand cylinder in Fig. 6ª has been uncovered by its valve 31 through the crank 37. The return movement of piston 23 has had no effect on the valve 31 because of the lost motion of link 62; nor has any effect been produced upon the valve 30 due to the movement of crank 38, as the lost motion was taken up in the link end of link 60. As the valve 30 now closes both ports 24 and 25 of the right hand cylinder the movement of the piston 22 is temporarily arrested as shown in Fig. 7, the piston 23 and arm 44, however, continuing in the direction indicated by the upper arrow Fig. 7ª. The movement of the cranks 38 and 39 is lost in the link ends of links 60 and 62. The further movement of piston 23 to the end of its stroke as shown in Fig. 8ª causes the valve 30 in Fig. 8 to open the port 25 through the action of crank 38. This causes the piston 22 and arm 43 to return as indicated by the arrow Fig. 8. The return movement of arm 43 and with it the crank 37 causes the valve 31 to close the ports 26 and 27 as shown in Fig. 8ª. As the valve 31 now closes both ports the movement of piston 23 is temporarily arrested as shown in Fig. 9ª, the piston 22 and arm 42, however, continuing in the direction of the lower arrow Fig. 9. The movement of piston 22 and the corresponding arm 43 has no effect upon the valve 30 and 31 since the motion is taken up by the link ends of links 59 and 61. As the piston 22 completes its stroke as shown in Fig. 10 the movement of crank 36 causes the valve 30 to close the ports 24 and 25. At the same time, however, the movement of the said piston 22 causes the crank 37 to move valve 31 and uncover the port 26, thereby causing the piston 23 and the arm 44 to advance as indicated by the arrow in Fig. 10ª. The advance movement of the piston 23 moves the cranks 39 and 38, but does not affect the corresponding valves 31 and 30 as the motion is taken up in the link ends of the corresponding links 62 and 60. As the piston 23 and arm 44 continue in the direction of the arrow Fig. 11ª no effect is produced upon the valves 31 and 30 as the motion of the cranks 39 and 38 is taken up by the link ends of links 62 and 60. Both ports 24 and 25 being covered by the valve 30, the movement of piston 22 and arm 43 is temporarily arrested as shown in Fig. 11. As the piston 23 completes its stroke as shown in Fig. 12ª no effect is produced upon the valve 31 by the crank 39 as the motion is taken up by the link end of link 62. The movement of crank 38, however, causes the valve 30 to uncover the port 24 and thereby cause the piston 22 and arm 43 to advance in the direction indicated by the arrow Fig. 12. The advance of piston 22 and consequent movement of crank 36 has no effect upon valve 30 as the motion is taken up by the link end of link 59. The movement of crank 37 causes valve 31 to close the ports 26 and 27 and completes the cycle.

From the above it will be seen that the main links 60 and 61 through the friction drives serve to open the valves 30 and 31, and the lost motion links 59 and 62 to close the same. The lost motion links 59 and 62 are adjusted to bring the valves 30 and 31 to a central position when the pistons 22 and 23 have reached either end of the stroke. It is therefore obvious that the lost motion must be equal to the travel of the respective cranks. Conditions may arise, however, which make it desirable to vary this amount of lost motion which is accomplished by employing collars 68 and 69 in conjunction with stop 70 and elastic link end Fig. 17, as previously explained.

Referring to Fig. 2 it will be seen that the piston 23 has reached the end of its stroke, the link 62 has through the arm 44, rock-shafts 35 and crank 39 closed its own valve 31 thereby shutting off the steam and preventing the piston from going farther. If its momentum should carry it farther, the valve will uncover the opposite port 26 and the inrushing steam will form an effective steam cushion.

In starting the pump it may happen that at one time both pistons may stand at one of the terminal points of the stroke. In this case it will be possible for the valve to occupy a position such as to not give the proper port openings for starting. To avoid this I provide two adjustable collars 72 on each valve rod in any convenient location either inside or outside of the steam chests. If now a valve should overtravel, the corresponding collar would hit against a stop such as the walls of the steam chest and the corresponding block of the friction drive would slide therein until it had reached its proper position.

By means of the above described valve gear I am enabled to obtain any desired cut off, and avoid the use of cushion relief valve and double ports.

I claim:—

1. In a direct acting duplex steam pump: the combination with a duplex pump body and a set of steam cylinders each having a single steam port at each end and an intermediate exhaust port, of means controlling said ports, and means governing the said controlling means and comprising two main links and two cut-off links, each of said main links being driven by the piston of the opposite cylinder through intermediate mechanism including a frictional drive, and each of the said cut-off links being driven by the piston of its own cylinder through intermediate mechanism.

2. In a direct acting duplex steam pump: the combination with a duplex pump body and a set of steam cylinders each having a single port at each end and an intermediate exhaust port, of valves controlling said ports, valve stems in connection therewith, adjustable collars thereon, stops for said collars, and means governing said valves acting to close said ports through the piston of their own cylinder and to open the same through the piston of the opposite cylinder, the said means including a friction drive.

3. In a direct acting duplex steam pump: the combination with a duplex pump body and a set of steam cylinders each having a single port at each end and an intermediate exhaust port, of valves controlling said ports, valve stems or the like in connection therewith, cross-heads connected to said valve stems, adjustable collars on said valve stems, stops for said collars, cut-off links connecting a cross-head with the piston of its own cylinder through intermediate mechanism, and main links connecting a cross-head to the piston of the opposite cylinder through intermediate mechanism including a friction drive.

Signed at New York in the county of New York and State of New York this 5th day of August A. D. 1907.

FRANZ F. NICKEL.

Witnesses:
FREDK. F. SCHUETZ,
SALLY O. YUDIZKY.