(No Model.)

E. S. MATTHEWS.
HYDRAULIC VALVE GEAR.

No. 503,975. Patented Aug. 29, 1893.

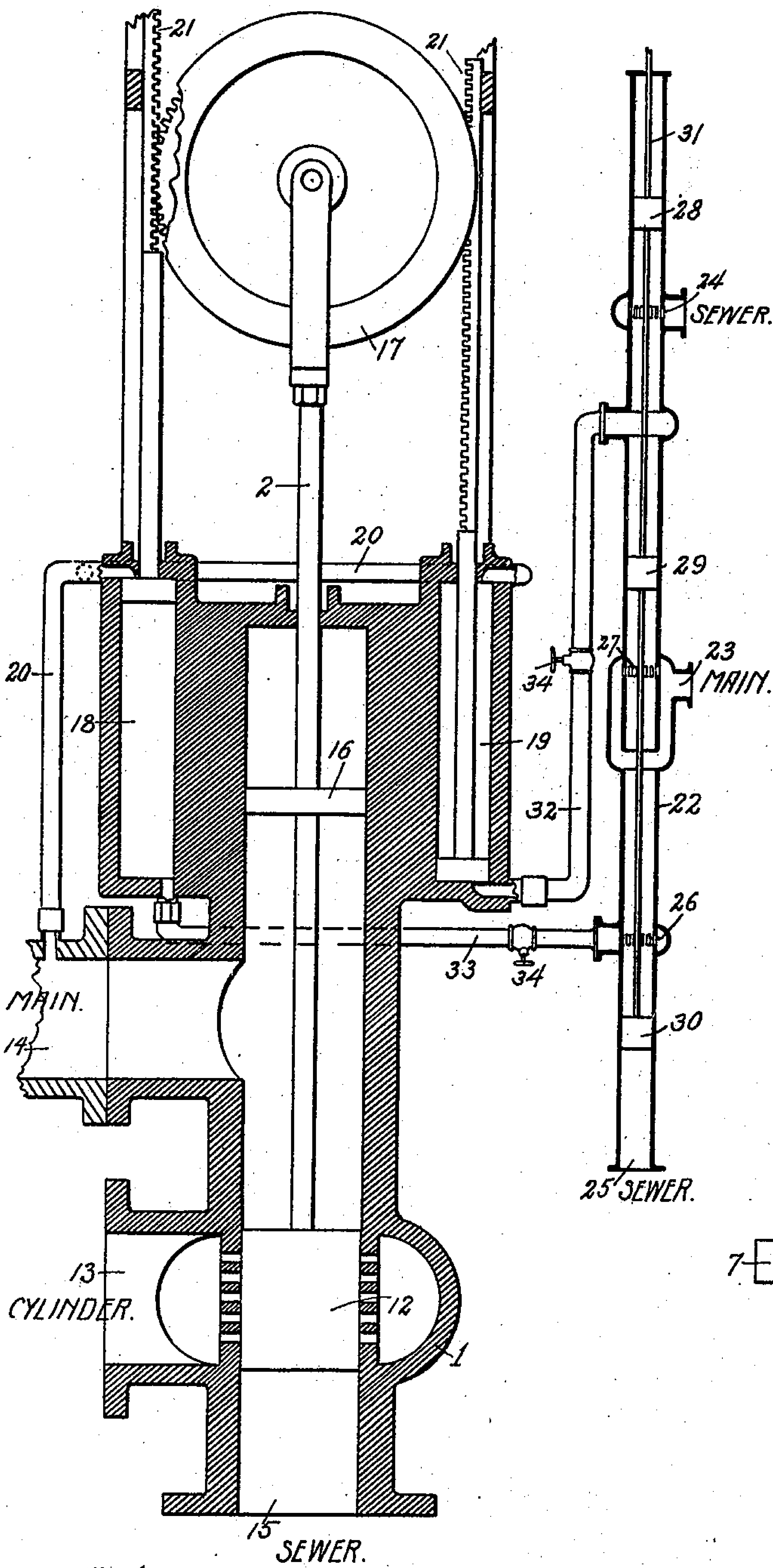

Fig. 1.

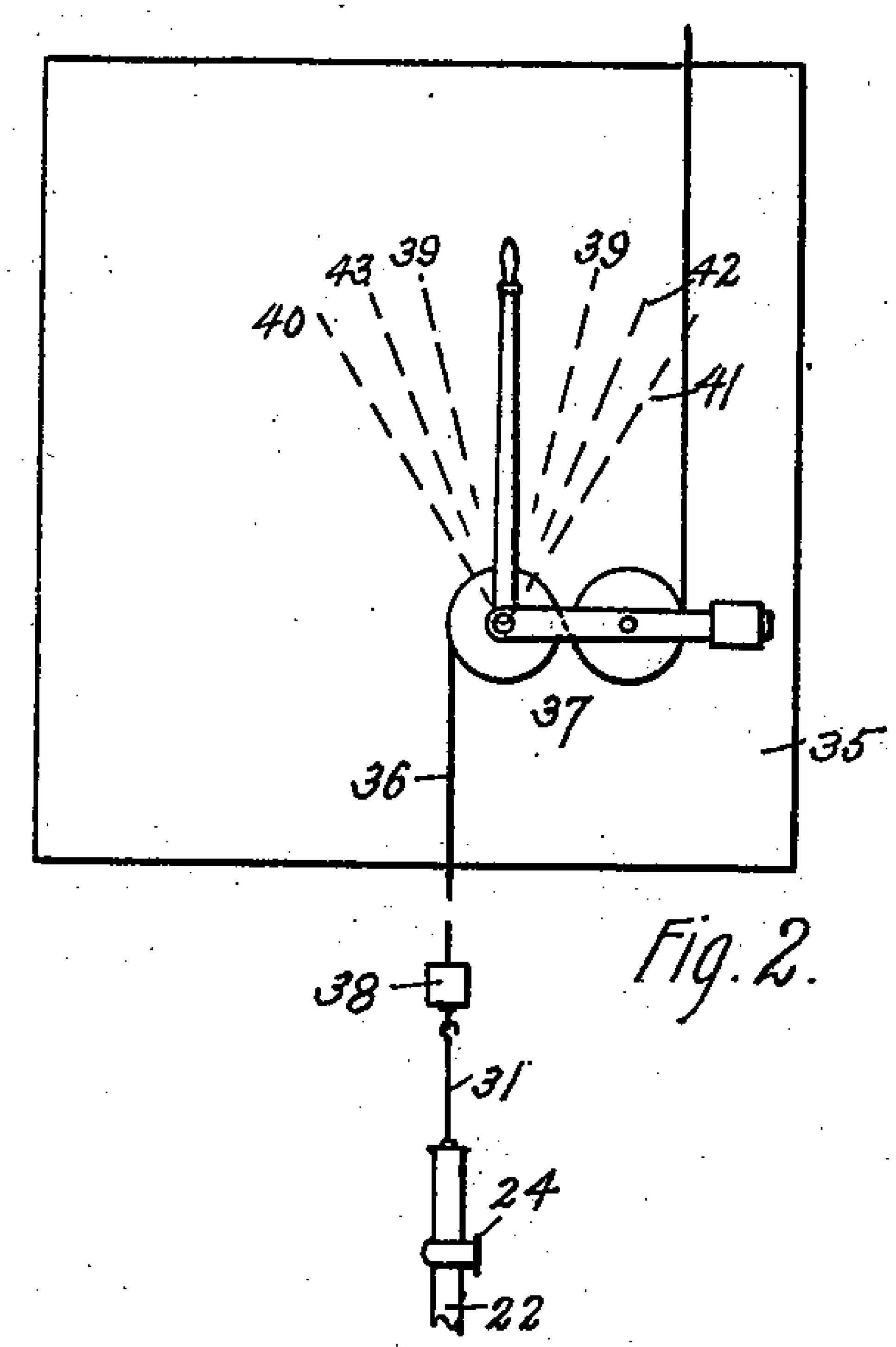

Fig. 2.

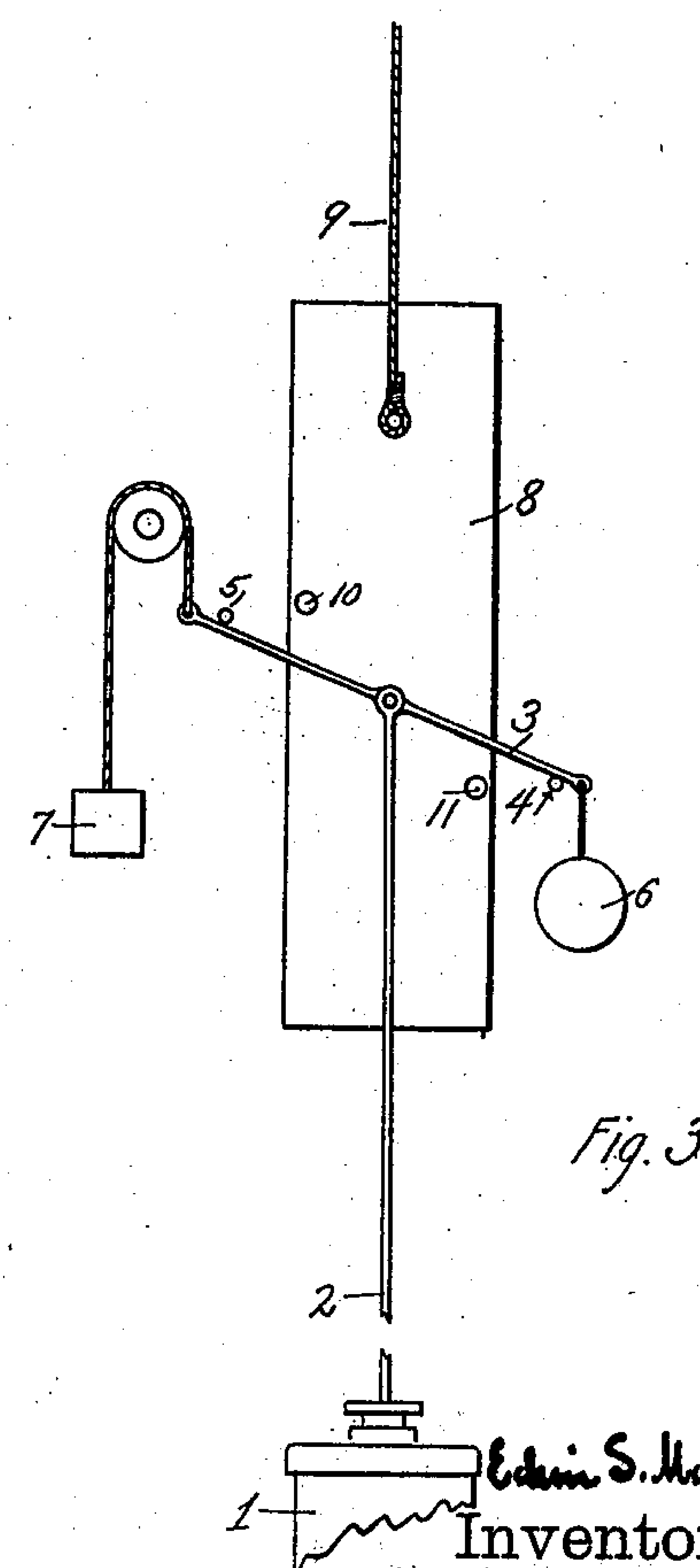

Fig. 3.

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HYDRAULIC-VALVE GEAR.

SPECIFICATION forming part of Letters Patent No. 503,975, dated August 29, 1893.

Application filed July 18, 1892. Serial No. 440,315. (No model.)

To all whom it may concern:

Be it known that I, EDWIN S. MATTHEWS, of Cincinnati, Hamilton county, Ohio, have invented certain new and useful Improvements in Hydraulic-Valve Gears, of which the following is a specification.

This invention pertains to improvements in gears for operating the hydraulic valves of elevators, &c.

My improvements will be readily understood from the following description taken in connection with the accompanying drawings in which:—

Figure 1, is a vertical central section of a hydraulic valve operated by hydraulic pressure controlled by a pilot valve and embodying an exemplification of my invention, this valve being assumed as for use in connection with a hydraulic elevator; Fig. 2, a side elevation of an elevator car showing the controlling rope and mechanism for actuating the valve gear; and Fig. 3, an elemental diagram illustrating the prime factors of my invention.

Before proceeding with a description of the more refined construction shown in Fig. 1, it is deemed best to describe Fig. 3 in order that a general understanding of the subject may be had. Let it first be assumed that we have a hydraulic elevator whose cylinder is piped to a source of water supply and to a source of discharge, the pipe being provided with a controlling valve, which valve, when in mid-position, cuts the elevator cylinder off from communication with either the supply or discharge and therefore holds the elevator in position of rest: and that the movement of this valve in one direction puts supply water to the cylinder, thus moving the elevator car upwardly, and that moving the valve in the other direction, from the mid-position, puts the elevator to discharge and permits the car to descend, all as in ordinary arrangements. The central position of the valve corresponds with the condition of rest of the elevator. Where the valve is controlled by a single cable from the elevator car the varying in length of this rope is liable to seriously disturb the position of the valve and to render it extremely difficult to promptly bring the valve to its mid-position, and numerous compensating devices, in the way of double ropes, &c., have been devised to overcome this difficulty. My improved gear gives perfect and safe control of the valve whether the control be through the medium of a single rope or through compensating ropes.

Referring to Fig. 3:—1, indicates a hydraulic valve to control the flow of water to and from the cylinder of the elevator: 2, the valve-stem, the valve to be assumed of such construction that a downward movement of the stem, from mid-position, means the opening of the supply and the rise of the car, and that the upward movement of the stem means the opening of the discharge and the consequent descent of the car, the stem in Fig. 3 being assumed as in mid-position with both supply and discharge cut off from the cylinder and the car at rest: 3, a lever pivoted at its center to the valve-stem 2, and pivoted to nothing else: 4, a stop under one end of this lever to limit the descent of that end of the lever: 5, a stop over the other end of the lever, to limit the ascent of that end of the lever: 6, a weight attached to one end of the lever and tending to tip that end as far downward as stop 4 will permit: 7, a weight connected with the other end of the lever and tending to raise that end as far as stop 5 will permit: 8, a heavy plate disposed for vertical movement alongside the lever: 9, a control-rope by which plate 8 is suspended: 10, a pin projecting from plate 8 over the left hand portion of the lever, but some distance above it: and 11, a similar pin projecting from the plate some distance below the right hand portion of the lever.

Assume that rope 9 is attached at its upper end at the head of an elevator shaft and that it is traversed by the elevator car which is provided with some suitable means for lengthening and shortening the rope, as usual, such a device for instance as is seen on elevator car 35 in Fig. 2. Plate 8 may therefore be raised or lowered. The valve being in its central position, which is the position in Fig. 3, if we lift the plate gradually no effect will be had while pin 11 is rising until that pin engages under the lever. Again, if we lower the plate no effect on the valve will be had until pin 10 engages over the lever. The sum of these two amounts of lost motion represents the amount of travel which the plate may have without moving the valve from its mid-position and anything within the range of this lost motion of the plate may therefore be called mid-position of the plate, and within this range contraction or expansion of the rope will not effect to disturb the valve. But if we lift the plate sufficiently pin 11 will lift the right hand end of the lever, stop 5 acting as the fulcrum of the lever, and the valve will therefore be raised and opened to discharge and the car will descend. The degree of valve opening will depend of course upon the degree of motion given to the plate after the pin engages under the lever. Upon again lowering the plate the valve again comes to mid-position, weight 6 bringing the lever down upon stop 4. If the plate be sufficiently lowered, pin 10 tips the left hand end of the lever down, stop 4 now acting as the fulcrum, and the valve becomes lowered and opened to supply when the car goes up, and when the plate is again raised weight 7 brings the valve again to mid-position. It will thus be seen that stops 4 and 5 act as fulcrums alternatively. It is the duty of weights 6 and 7 to draw the lever to the fulcrum stops and tend to hold the lever in normal position. It will be readily understood that the offices of these weights could be performed by springs or by hydraulic engines. It will be observed that plate 8 is merely a means for rocking the lever one way or the other on its alternative fulcrums and that its movements are under the control of the control-rope. The office of this plate could also obviovsly be performed by a motor under the control of the control-rope, a hydraulic motor for instance. It will be obvious that in the arrangement shown in Fig. 3 the entire work of moving the valve must be done by the operator through the medium of the control-rope. There would be no objection to this in the case of very small valves, but with large valves the work would be too great to impose upon an elevator attendant and it therefore becomes desirable, as it is quite customary, to arrange that the valve operating work be done by a motor, the attendant's work being limited to the control of the motions of the motor.

I will now proceed to a description of an exemplification of my invention in which a hydraulic motor fulfills the offices of weights 7 and 8 and of stops 4 and 5 and of plate 8, the attendant controlling the motions of the motor through the medium of a pilot valve operated by the control-rope. This arrangement is illustrated in Fig. 1 in which, as before, 1 indicates the main valve and 2 the valve stem. Proceeding now with Fig. 1:—12, indicates the valve piston of the main valve, shown in mid-position; 13, connection to elevator cylinder, communicating with the valve by ports covered when the valve is in mid-position, thus preventing water moving either to or from the cylinder, the elevator being therefore at rest; 14, connection from source of water supply, say a street main; 15, connection to discharge, say a sewer; 16, an ordinary counterbalancing piston on the valve stem; 17, a floating gear mounted in the upper end of the valve-stem, and corresponding with lever 3 of Fig. 3, the gear constituting virtually an infinite number of levers having a common axis; 18, a cylinder with its axis arranged tangentially below the left hand side of gear 17; 19, a similar cylinder at the right, both these cylinders having pistons with large piston rods so that the lower sides of the pistons have areas in excess of the upper sides; 20, connection of water supply to the upper ends of these cylinders, whereby water under pressure is always acting above the pistons and tending to press them to the bottom of the cylinders; 21, upward continuations of the piston-rods suitably guided, and provided with rack teeth engaging gear 17; 22, the pilot-valve; 23, connection of pilot-valve with the source of water supply; 24, a connection of the pilot-valve with the sewer, this connection being through ports in the valve, above connection 23; 25, another connection from the pilot-valve to the sewer, below connection 23; 26, ports in the pilot-valve between supply connection 23 and sewer connection 25; 27, ports in the valve between supply connection 23 and sewer connection 24; 28, a piston in the pilot-valve adapted to travel over ports 24; 29, a piston in the pilot-valve adapted to travel over ports 27; 30, a piston in the pilot-valve adapted to travel over ports 26; 31, valve-stem of the pilot-valve attached to and unifying motions of all of the pistons; 32, a connection from the lower end of cylinder 19 to the pilot-valve between ports 24 and 27; 33, a connection from the lower end of cylinder 18 to ports 26 of the pilot-valve; 34, valves in connections 32 and 33 to serve in regulating the velocity with which water may move through those connections; 35, an elevator car; 36, the control-rope, to be anchored at the upper end of the elevator-shaft and attached at its lower end to pilot-valve stem 31; 37, a rocking-sheave control-lever mounted on the car to serve in lengthening and shortening the control-rope; 38, a weight to push the stem of the pilot-valve down as the control-rope is lengthened; and 39, 40, 41, 42, and 43 lines indicating angular positions of the control lever on the car.

It will be observed in Fig. 1 that valve 12 is in central position, the elevator being therefore at rest. The pilot-valve is at mid-position. Water pressure is acting on top of the pistons in cylinders 18 and 19. This pressure holds the right hand piston clear down against the bottom of the cylinder, the lower face of the piston being open to the sewer. But it will be observed that the lower face of the left hand piston is, through the pilot-valve, open to the pressure of the main, therefore this pressure, acting on the preponderating area of the piston holds that left hand piston at the upper end of its cylinder. Very little analysis will show that with the parts in the position shown in Fig. 1, gear 17 corresponds with lever 3, of Fig. 3, and that the top of cylinder 18 corresponds with stop 5 and the lower end of cylinder 19 corresponds with stop 4 of Fig. 3. If, now, the pilot-valve stem be raised, piston 30 will be raised and ports 26 may be uncovered to any extent desired, pistons 28 and 29 effecting no change. The uncovering of ports 26 opens the lower end of cylinder 18 to the sewer, consequently the pressure acting over the piston of that cylinder will carry its rack downwardly and turn the gear and push main valve 12 down and permit water to flow from the main to the cylinder of the elevator, precisely as equivalent parts operated in Fig. 3. Thus it will be seen that the main valve can be opened to the supply to any degree desired by raising the stem of the pilot-valve. The pilot valve pistons are in mid-position, and they should correspond with the mid-position of the control-lever on the car. While piston 30 is traveling upward no effect results until the lower face of that piston has traveled up beyond the lower ends of ports 26. Therefore the control-rope may, by shrinkage, shorten that much without disturbing the main valve and this much range is therefore given at one side of the mid-position of the control-lever. If, now, we lower the stem of the pilot-valve, from the position shown in Fig. 1, no effect will result until the top of piston 29 comes below the top of ports 27, piston 28 having meantime closed ports 24. This gives a range for the stretching of the control-rope, and permits a range of variation of the control-lever to the other side of its central position.

In Fig. 2, the angular distance between lines 39 may represent the range of movement of the control-lever corresponding to the condition of rest of the elevator. Anywhere within this angle the elevator will be held at rest, and this range may be sufficient to compensate for all ordinary variations in the length of the control-rope. It gives an extended range within which safety may be found, an elevator car at rest being assumed as safe as distinguished from danger due to car motion. When piston 29 continues its motion farther downwardly, uncovering ports 27 to any desired degree, pressure from the main comes under the right hand piston, and this pressure acting on the preponderating area of that piston raises the piston and lifts main valve 12 and opens the elevator cylinder to discharge, precisely as equivalent parts operated in Fig. 3. When the pilot-valve is again moved within the range of mid-position, supply pressure is cut off from connection 32 and that connection is put to the sewer and the right hand piston goes back to normal position by reason of pressure above the piston, precisely as weight 6 brought the right hand end of the lever to stop 4 in Fig. 3.

It will be observed, in Fig. 1, that main piston 12 is held positively to mid-position, or closed position, it not being a question of pressure on two sides of a piston to do the work. The holding is as positive as with stops 4 and 5 in Fig. 3. It may very properly be said that in this gear there are motion terminals represented by the contact of iron with iron and that either of these positive terminals represents the closed condition of the main valve, and that positive arresting contact at these terminals is insured by full water pressure acting on pistons. By examining the right hand cylinder of Fig. 1 it will be observed that no practical leakage at the piston of that cylinder can have any damaging effect, the leakage simply going through to the sewer without tending in any way to modify the position of the piston or disturbing the main valve. It will also be observed that full water pressure is acting on both sides of the piston in cylinder 18 and that no practical leakage can have any disturbing effect on that piston. Again, examining closely the pilot-valve, it will be observed that no leakage of piston 30 can have any effect whatever in disturbing the main valve, that leakage simply going to the sewer. It will also be noticed that leakage of piston 29 can have no effect on the main valve, as leakage of pressure water by that piston can never result in pressure under the piston of cylinder 19, because that leakage finds free escape to sewer through ports 24. Leakage of piston 28 can have no effect on anything. It will be further observed, in connection with the pilot-valve, that the affair is thoroughly counterbalanced at all times. Pistons 28 and 29 are oppositely acted upon either by supply pressure or sewer pressure between them, and pistons 29 and 30 are acted upon by supply pressure between them through port 27, or by no pressure. It will therefore be understood that when the car is at rest no practical leakage about the pilot-valve or about the actuating cylinders will tend to disturb the position of the main valve and cause creeping of the car.

The range of motion comprehended by mid-position of the control lever may be ample for all reasonable conditions but it might properly be assumed that stretching, for instance, of the control-rope would continue on indefinitely until the increase in length has absorbed the range of permissible departure. In this case no harm would flow, for the pilot-valve would simply go down and the main valve would be opened to discharge and the elevator would descend and there it would stay, for the pilot-valve could not be moved, with the stretched rope, sufficiently to open the valve for ascent. This would mean simply that fair and safe notice is given that the control-rope has stretched past the proper limit and that the elevator cannot be operated until the evil is corrected.

Consider, again, all of the parts shown in the position indicated in Figs. 1 and 2, we have already seen that if we raise the pilot-valve stem no movement of the valve can take place until the lower face of piston 30 gets above the lower ends of ports 26. Then, and then only, can water flow to sewer through connection 33. Assume, now, that piston 30 has uncovered ports 26 a trifle, thus allowing the left hand rack 21 to descend, thereby opening the main valve a certain degree to the supply. This having been done, and the opening of the main valve being in proper degree, the pilot-valve stem may be lowered so that piston 30 covers ports 26, thus preventing any further movement of the left hand piston or of the main valve. And the length of piston 30, traveling over ports 26, represents a range of movement of the control-lever on the car within which the main valve will have been hydraulically locked to any position in which it may have been put. And the same considerations hold good with regard to the action of piston 29 on ports 27. The sweep of the control-lever to each side of the exact central position therefore divides itself into three portions. For instance, in Fig. 2, analyzing the motion to the left of the central position of the control-lever, the angle between the vertical central line and line 39 represents sweep of the lever within which the main valve is closed: the angle between lines 39 and 43 a range within which a pilot valve system is traveling over its ports and no flow can take place in either direction, which range may be called the range of inactivity: and the angle between lines 43 and 40 a range resulting in the loss of greater opening of pilot valve ports which bring about motion of the main valve. Therefore, the attendant may hold the elevator at rest by putting the levers anywhere between lines 39: he may move the elevator down at various degrees of speed by adjusting his lever between lines 43 and 40 or between lines 42 and 41: or, having by the last mentioned action secured the desired degree of main valve opening, he may lock the main valve in that position of opening by putting the lever anywhere in the range between lines 43 and 39 on one side and lines 39 and 42 on the other side.

I claim as my invention—

1. In a hydraulic valve gear, the combination, substantially as set forth, with a valve to have movement both ways from a neutral position, of a lever pivoted to the stem of such valve, a stop over one end of said lever, a stop under the other end of said lever, power agents holding the ends of the lever against said stops, a power agent for moving the lever from either stop while the other stop acts as a fulcrum, and a movable part, substantially as set forth, for controlling the motion of said last mentioned power agent.

2. The combination, substantially as set forth, of a main valve, a lever centrally pivoted to the stem thereof, a pair of cylinders arranged parallel with each other, a piston in one of said cylinders connected with one end of said lever, a piston in the other of said cylinders connected with the other end of said lever, and a valve to control the motions of said pistons, said pistons being so connected to said valve-stem that when said main-valve is in its neutral position one of said pistons is at one end of its cylinder and the other of said pistons is at the opposite end of its cylinder.

3. In a hydraulic valve gear, the combination, substantially as set forth, of two cylinders, a rack carried by the piston of each cylinder, a floating gear engaging said racks and connected with a main valve, and water-connections and a controlling-valve for moving said pistons independently.

4. In a hydraulic valve gear, the combination, substantially as set forth, of two cylinders, a rack carried by the piston of each cylinder, a floating gear engaging said racks and connected with a main valve, a power agent constantly urging the pistons to an extremity of stroke, and water-connections and a controlling valve for moving said pistons independently away from such extremity of stroke.

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