(No Model.) 2 Sheets—Sheet 1.

E. S. MATTHEWS.

HYDRAULIC ELEVATOR.

No. 520,166. Patented May 22, 1894.

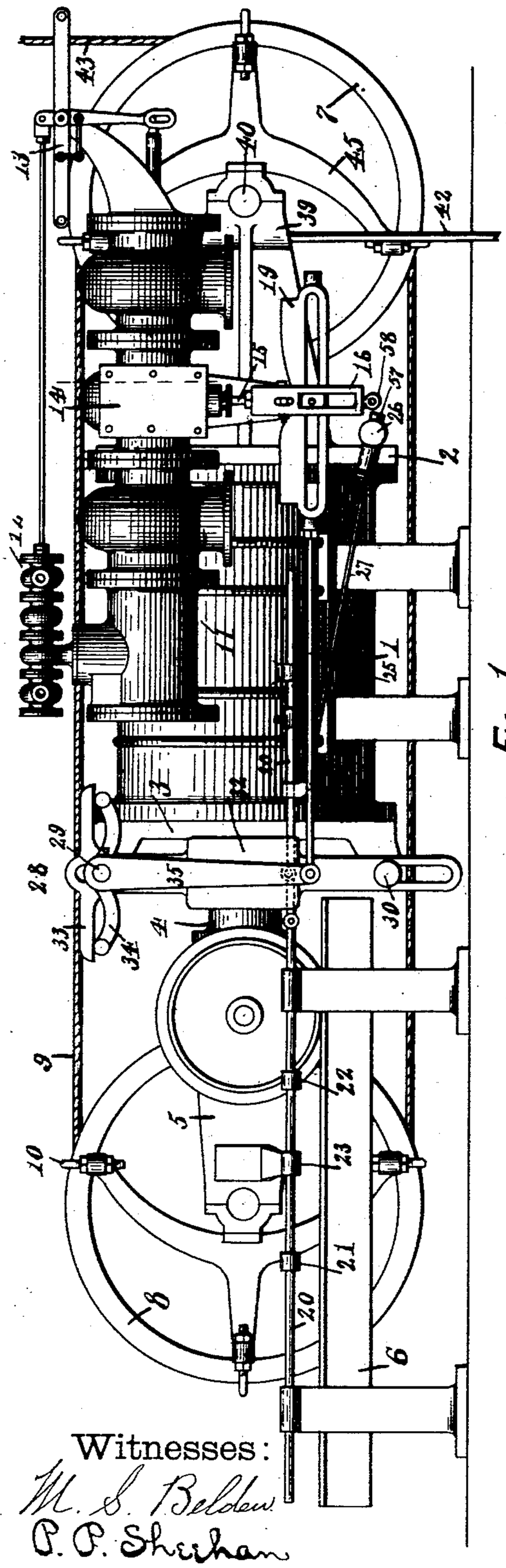

Fig. 1.

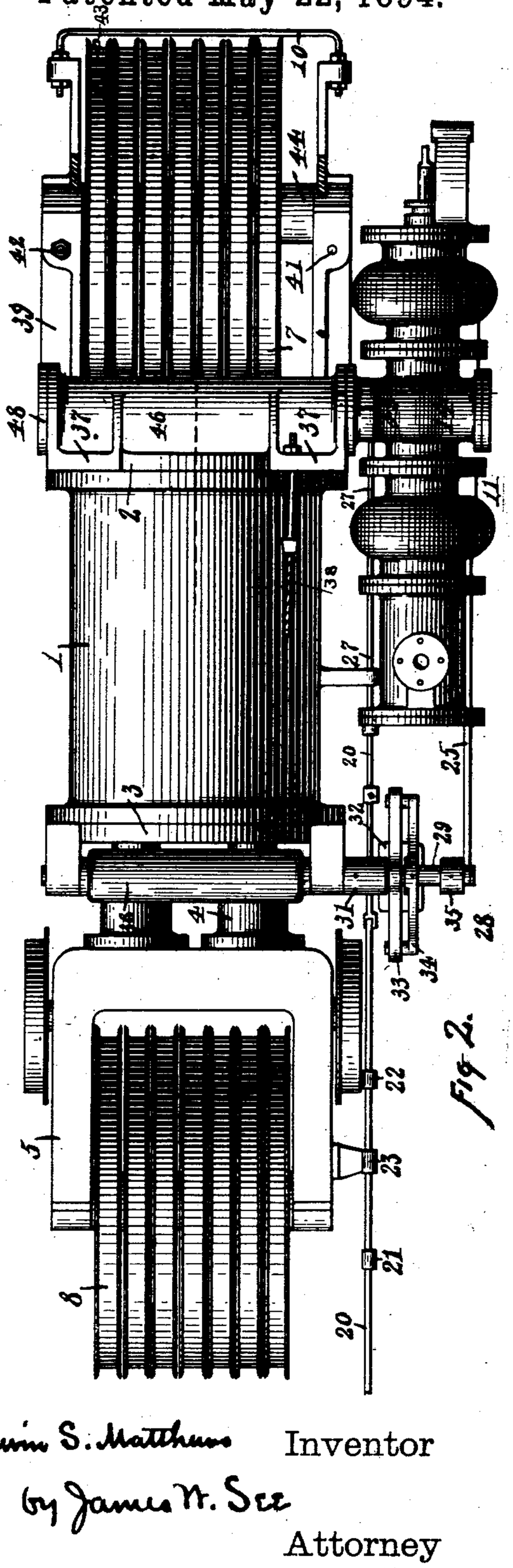

Fig. 2.

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(No Model.) 2 Sheets—Sheet 2.

E. S. MATTHEWS.

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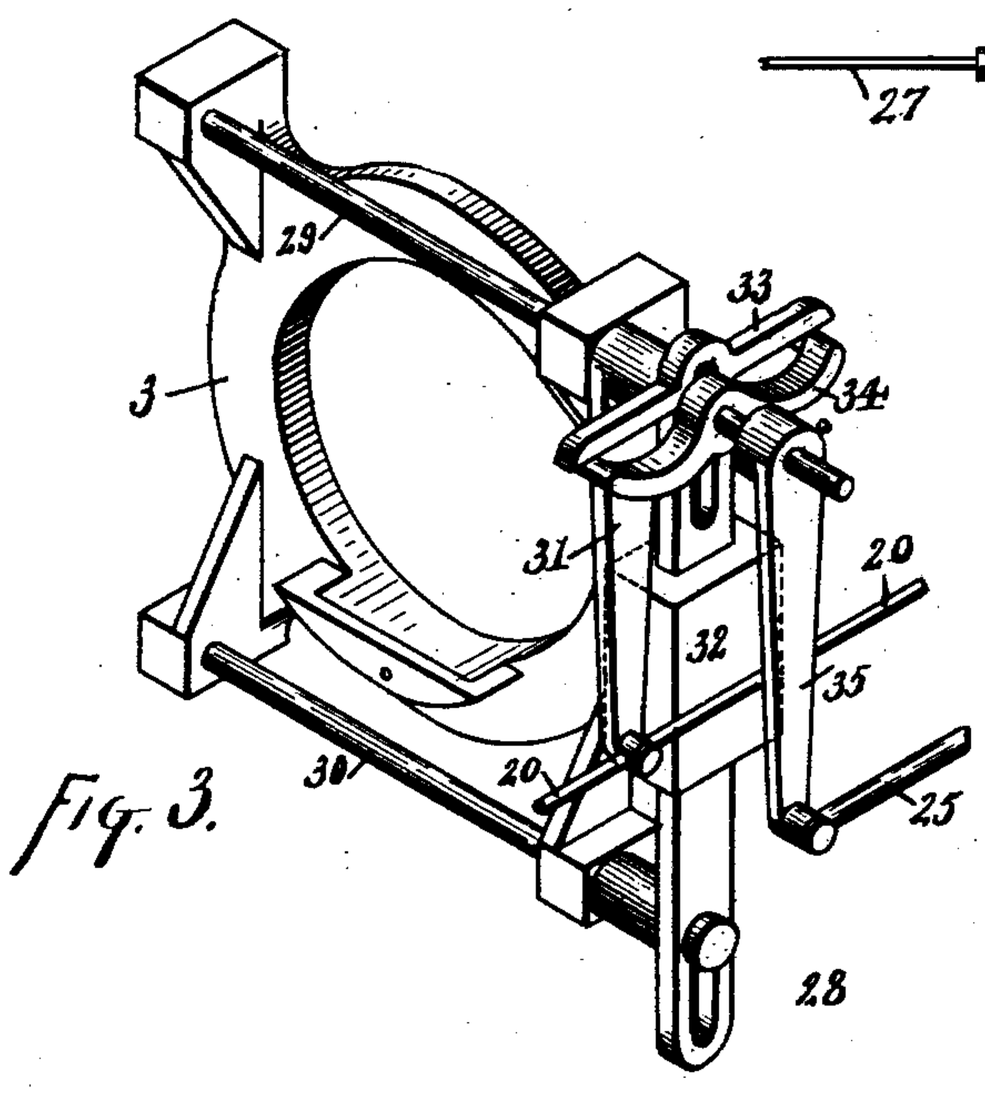

Fig. 3.

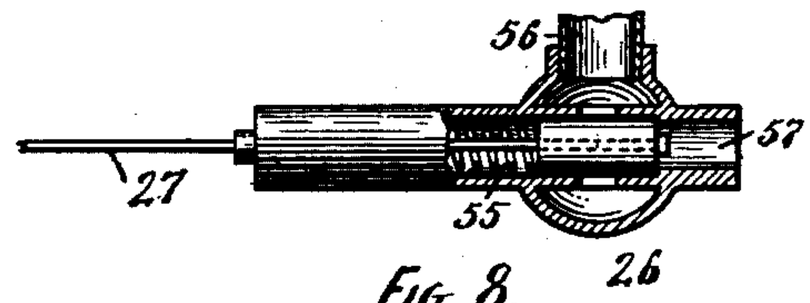

Fig. 8.

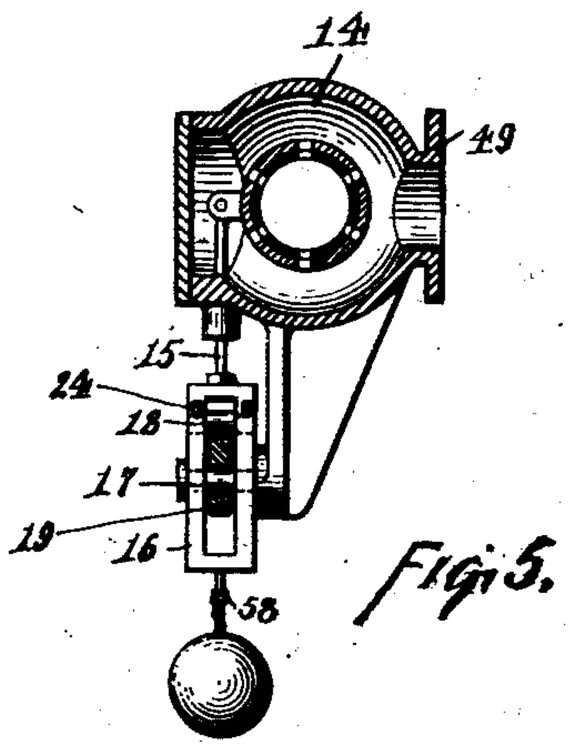

Fig. 5.

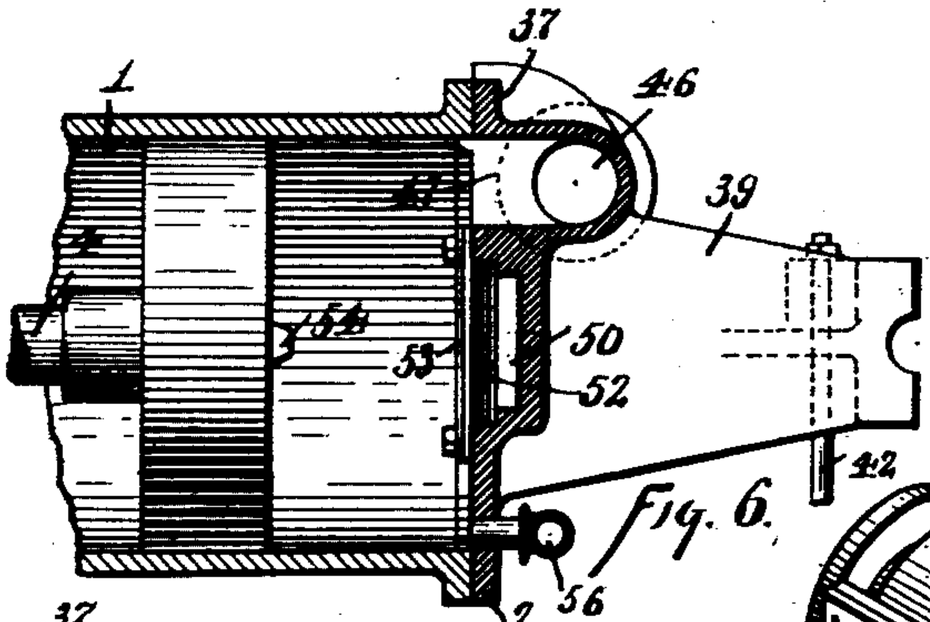

Fig. 6.

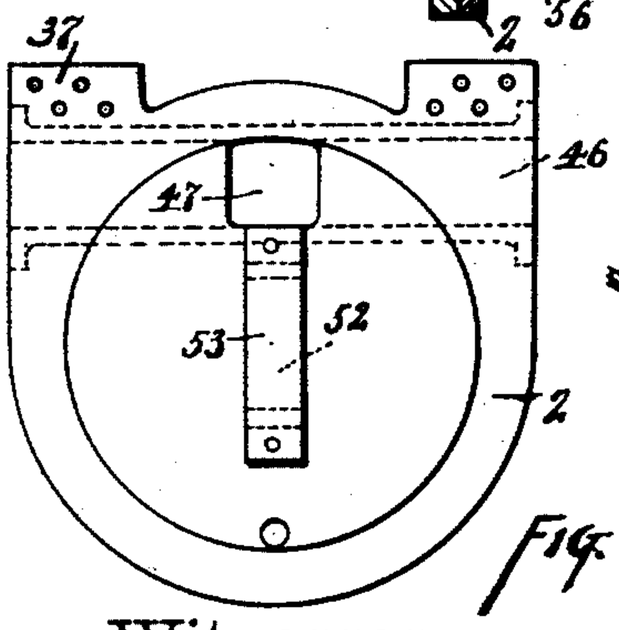

Fig. 7.

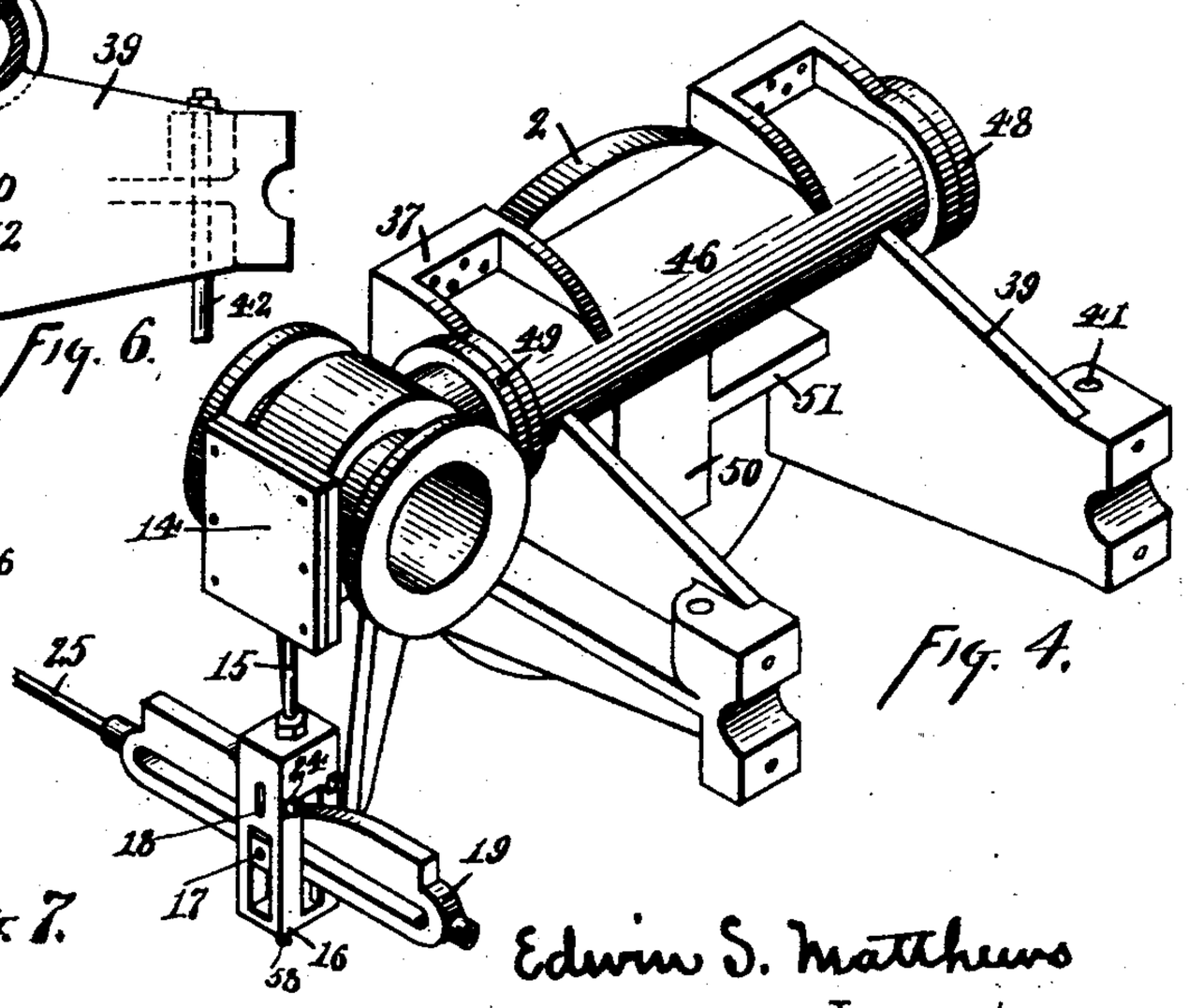

Fig. 4.

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UNITED STATES PATENT OFFICE.

EDWIN S. MATTHEWS, OF CINCINNATI, OHIO, ASSIGNOR OF ONE-HALF TO JAMES L. HAVEN, OF SAME PLACE.

HYDRAULIC ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 520,166, dated May 22, 1894.

Application filed February 12, 1892. Serial No. 421,247. (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 Elevators, of which the following is a specification.

The term "hydraulic elevator" might, in its broad sense, be held to include the car to be elevated, the hydraulic machine to do the elevating, and the necessary adjuncts for their connection, but in the present case that term is used as referring to the hydraulic machine which does the work.

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

Figure 1, is a side elevation of a hydraulic elevator exemplifying my invention; Fig. 2, a plan thereof, with the hoisting-ropes, pilot-valve, cross head track and valve gear omitted; Fig. 3, a perspective view of the back cylinder head with its attached safety-stop return devices; Fig. 4, a perspective view of the front cylinder head with safety-stop attached; Fig. 5, a vertical transverse section of the safety-stop; Fig. 6, a vertical longitudinal section of the front cylinder-head; Fig. 7, a rear elevation of the front cylinder-head; and Fig. 8, a horizontal section of the bleed-valve.

Many, in fact most of the parts of this apparatus, are or may be of the construction usual in such machines and therefore no extended description will be given of such parts further than is necessary for a comprehension of my present invention.

In the drawings:—1, indicates the usual hydraulic cylinder, strapped to the foundation shoes and capable of endwise shifting as usual: 2, the front cylinder-head, secured as usual, to the cylinder: 3, the back cylinder-head, this cylinder-head, as usual, not forming a complete closure for the back end of the cylinder, as the machine is of a single acting type: 4, the usual piston-rods, extending backward from the piston of the machine to the crosshead: 5, the crosshead, provided with the usual track-wheels: 6, the usual crosshead-track: 7, the usual head sheaves, mounted on a shaft carried in brackets formed upon the front cylinder-head, the number of sheaves depending of course upon the relation of travel desired between the piston of the machine and the elevator car: 8, the tail-sheaves, similarly mounted on a shaft carried by the crosshead: 9, the hoisting-rope, with its tail end anchored to the machine, the rope passing thence rearwardly over a tail sheave and then forwardly and around a head sheave and so back and forth over all the sheaves and finally leading up or off to the hoist way, and if a multiplicity of hoisting-ropes are employed, as is usual, they will all follow the course of the single rope just referred to: 10, cable-guards extending across the sheaves and preventing the displacement of the ropes therefrom and having their ends secured in the usual spiders secured to the brackets which carry the sheave-shafts, these cable-guards consisting of rods with their ends projecting inwardly through bosses on their supporting spiders, nuts being provided on the guards inside and outside the spiders so that the guards may be delicately adjusted to and from the sheaves and firmly secured in adjusted position: 11, the main valve structure, having no peculiarities so far as my present improvements are concerned, the construction followed being substantially such as is shown in my Patent No. 465,611 of 1891, the office of the main valve being, to control the flow of water to and from the cylinder, the main valve structure, in the present case, being disposed alongside of and parallel with the cylinder of the machine and at about the level of its top: 12, the pilot-valve, which may be as shown in my former patent referred to: 13, the valve-gear connecting the main valve with the pilot-valve and which may be as shown in my former patent: 14, the safety-stop valve, incorporated within the main valve structure, and exemplified in the present case as a ported valve surrounding and operating on ports in the main valve cylinder, as clearly shown in Fig. 5, the office of this safety-stop being to automatically cut off the flow of water to or from the cylinder of the machine when the piston of the machine shall have reached either limit of its stroke, regardless of the position at that time occupied by the main valve: 15, the stem of the safety-stop valve: 16, a yoke secured

to that stem and having vertical longitudinal slots extending through it from front to rear and from side to side: 17, a guide-pin rigidly supported in a bracket projecting from the safety-stop structure, this pin projecting horizontally through the side slots in the yoke 16 so as to form a guide for the vertical movements of the yoke: 18, a pin or roller mounted in the yoke, over and parallel with the guide-pin 17, the end journals of this roller being carried in vertical slots in the yoke so that the roller is capable of vertical adjustment in the yoke: 19, a cam-plate arranged for reciprocation in the fore and aft slots of the yoke, the plate being provided with a horizontal slot which engages the guide-pin 17, the upper edge of the plate being formed into two horizontal curved cams meeting at the center and engaging under the roller 18, whereby when the cam-plate is moved in either direction from the normal central position, the yoke will be raised and the stop-valve closed, the curve of the front cam being gentle so as to effect a gradual closure of the stop-valve, while the curve of the rear cam is comparatively abrupt so as to effect a quicker closure of the stop-valve: 20, a sliding-rod mounted in suitable guides and extending along parallel to the path of movement of the cross-head of the machine: 21, a collar on this rod to be engaged by a tappet on the crosshead when or just before the crosshead reaches its rear limit of motion: 22, a similar collar to be engaged when the crosshead reaches its forward limit of motion: 23, a tappet secured to the crosshead, to operate on these collars: 24, (Fig. 5) adjusting wedges arranged in the yoke 16 over the journals of the roller 18 and serving as means for the vertical adjustment of the roller in the yoke: 25, a rod extending forward from cam-plate 19 into connection with the rod 20, the connection between the two rods, while not direct, as hereinafter specified, being positive so that movement of rod 20, as effected by the crosshead tappet, results in positive endwise movement of the cam-plate: 26, a bleed-valve or cock arranged in the lower portion of the front end of the cylinder of the machine, this valve or cock being of any ordinary or suitable construction, as exemplified in Fig. 8, and as will be later explained, the office of this bleed-valve being to remain normally closed but to automatically open at proper times and permit a leakage to take place from the cylinder of the machine: 27, the valve-rod of the bleed-valve, adjustably connected with rod 20 so that when rod 20 is moved by the crosshead at the back limit of the stroke of the machine, the bleed-valve will be opened at proper time and held open so long as the crosshead occupies its position of back limit of stroke: 28, mechanism for automatically returning the safety-stop valve to its normal open position when the crosshead shall have moved in either direction from its position of limit of stroke, this mechanism being hereinafter termed the "return device:" 29, a shaft journaled in brackets formed with or mounted upon the upper portion of the back cylinder-head, one box at each side of the machine, this shaft forming the top shaft of the return device and extending endwise beyond that side of the machine on which the valve apparatus is mounted: 30, a similar shaft similarly mounted on the lower portion of the back cylinder-head and forming the lower shaft of the return device: 31, a lever fixed to shaft 29, just outside the box which supports the shaft, the lower end of this lever having connected to it the rod 20 so that any endwise movement of that rod, as effected by the crosshead tappet, results in a rocking of the shaft: 32, a weight, shown partially in dotted lines in Fig. 3 so as not to obscure the parts behind it, this weight having vertically slotted tails engaging the two shafts of the return device, so that the weight may move vertically and be guided in such movement by the shafts: 33, arms projecting horizontally from the upper tail of the weight: 34, a lever fast on shaft 29 and engaging its ends under the arms 33 so that the tendency of the gravity of the weight is to hold the lever 33 in a normal horizontal position, and so that if shaft 29 and lever 34 be rocked, in either direction, the weight will be lifted and form a resistance to such rocking and an agent tending to return the shaft to normal position: 35, a lever fixed upon shaft 29, outwardly beyond the other parts secured to that shaft, the lever being adjustable in and out upon the projecting shaft, the lower end of this lever having connected to it the rod 25 of the cam-plate, the structure being therefore such that rods 20, and 25 and levers 31, 34 and 35 all move together: 36, (Fig. 2) a roller on the top shaft of the return device, to support the hoisting-ropes passing endwise over the machine: 37, upward projections from the sides of the front cylinder-head, pierced for the reception of the tails of the hoisting-ropes which are there anchored upon the appropriate side of the machine: 38, (Fig. 2) the tail of the hoisting-rope thus anchored to one of these projections, it being understood of course that if a multiplicity of hoisting-ropes are employed, their tails will be similarly anchored in this projection, the drawings showing the projections as pierced to receive the tails of four hoisting-ropes, the anchoring being effected by a threaded shank on the hoisting-rope engaged by a nut on the front face of the projection of the cylinder-head: 39, the brackets projecting forwardly at each side of the front cylinder-head, to receive the shaft of the head-sheaves of the machine, the distance between these brackets being greater than that called for by the number of head-sheaves employed by a degree represented by the thickness of one sheave, whereby the group of sheaves may be shifted to one side or the other a distance corresponding to the width of a sheave: 40, the shaft of the head-sheaves, carried by the

brackets 39: 41, vertical holes in each of the brackets 39 and near the sheave-shaft: 42, a bolt, properly anchored in the foundation, and extending up through the appropriate one of the holes 41 and having a nut over the bracket, this bolt being disposed in that bracket which is subjected to the upward strain of the hoisting rope as it finally leaves the head-sheaves, the drawings assuming the hoisting-rope as starting, at 38, on the front side of the machine and passing in its several turns over the sheaves rearwardly until it finally passes up from the rear one of the head-sheaves: 43, the hoisting-rope thus finally leaving the head-sheaves: 44, a loose collar on the head-sheave shaft, between the front bracket and the front one of the head-sheaves, this collar serving to hold the group of sheaves to the rear, and permitting the group to be similarly held against the front bracket by moving the collar to a position between the group of sheaves and the rear bracket, such change of position of collar and sheaves being effected when the situation of the machine is such as to call for a hoisting-rope finally leaving the head-sheaves at the front of the machine instead of at the rear, in which case the tail 38 of the hoisting-rope would be anchored in the rear one of the projections 37 and, correspondingly, anchor bolt 42 would engage the front bracket instead of the rear one: 45, the spiders, previously referred to, secured to the brackets and crosshead and serving for the support of the cable-guards 10: 46, a horizontal tube cast upon the forward upper portion of the front cylinder-head, the opening in this tube extending entirely through it: 47, a port in the cylinder-head, placing this tube in communication with the upper front portion of the cylinder of the machine; 48, a blind flange closing the rear end of the tube, that end of the tube opposite the valve apparatus: 49, a flange on the main valve structure, specifically in the present case on the body of the stop-valve, uniting the valve structure to the tube and furnishing the support for the valve structure, this connection therefore forming the sole support for the valve structure and the means of communication between the valve structure and the cylinder of the machine: 50, an inwardly open rectangular pocket formed at the center of the front cylinder-head, the body of this pocket projecting outwardly from the front face of the head: 51, (Fig. 4) horizontal ribs on the front face of the front cylinder-head, extending from the body of the pocket 50 to the brackets 39, and serving to brace the brackets and pocket and cylinder-head and transmit strains between them: 52, rectangular spring-plates disposed within the pocket, with their ends resting against shoulders in the upper and lower walls of the pocket: 53, a spring plate disposed against the inner face of the pile of plates within the pocket and extending endwise beyond those plates and having its extended ends secured to the inner face of the cylinder-head, there being one or more of these plates 53, which thus form additional spring plates for the series, and also a keeper for the pile of plates within the pocket: 54, a central projection on the front face of the piston of the machine, adapted to make contact with the spring plates when the piston reaches its front limit of stroke: 55, (Fig. 8) a spring to hold the bleed-valve normally closed and permit that valve to be pulled open when the crosshead-tappet moves rod 20 rearwardly, the bleed-valve, in the exemplification, being merely a piston working in a ported cylinder: 56, connection placing the bleed-valve in communication with the lower front portion of the cylinder of the machine: 57, outlet from the bleed-valve, to be properly connected with a discharge-pipe to carry off the water: and 58, an eye upon the yoke of the stop-valve to receive attachment from a weight or spring to serve in drawing the yoke down and opening the stop-valve.

In the illustrations the hoisting-rope finally leaves the head-sheaves at the rear, and all the valve apparatus is disposed at the front of the machine. The arrangement of the hoisting-rope may be reversed, as before explained, by shifting the tail anchor to the rear projection and by shifting the collar 44 to the rear head-bracket, and anchor bolt 42 would then be located in the front head bracket where the upward strain of the hoisting-rope is imposed. The valve apparatus may also be located at the rear of the machine by transposing the valve structure and blind-flange 48, and by reversing the projections of the shafts of the return device. Normally, the safety-stop valve is open, and the flow of water controlled entirely by the position of the main valve. When the machine reaches the back limit of its stroke, corresponding to the top limit of the elevator car, the attendant may have failed to have secured proper control of the elevator by means of the valves, in which case a shock would take place at the top of the lift. But in the present case, when this limit of stroke is approached, the crosshead-tappet will push rod 20 rearwardly and the right hand portion of the cam-plate will cause the safety-stop valve to close, thus practically severing the main cylinder from the main valve and bringing the machine to rest. With a completely closed safety-stop valve in this condition, the main valve could not permit discharge from the cylinder of the machine in order to start the car away from its top limit of stroke. I therefore do not entirely close the safety-stop valve, thus insuring that a proper start can be made from the top position at which it has arrested the car. But this non-closure of the stop-valve might permit inflow to the cylinder of the machine and thereby cause the limit of travel to be exceeded even with the stop-valve thus closed. Compensation for such inflow is therefore made by causing the bleed-valve to open and permit the inflow due to incomplete closure

to pass away. By the present arrangement each time the safety-stop is closed with the machine at its back limit of stroke, the bleed-valve opens the discharge from the extreme lower portion of the cylinder, thus permitting grit, dirt, &c., to discharge from the cylinder, the inlet of water to the cylinder being at its top and its bleed-valve discharging from the bottom, whereby an efficient washing action is produced. When the machine reaches its forward limit of stroke, corresponding with the lower limit of car travel, the stop-valve again closes automatically, but the bleed-valve does not open, the buffer arrangement of the spring plates preventing any further movement of the piston and this action of the limitation stop-valve may be made much sharper by making the appropriate cam-curve steeper. The wedges 24 serve in vertically adjusting the yoke with reference to the cam whereby the closed position of the stop-valve may be graduated to give the desired degree of inflow. After the stop-valve has been closed automatically, at either limit of stroke, the weight of the return device will restore the valve to normal open position when the machine starts on its return from its position of limit of travel.

The inner plates 53 of the series of spring plates may be employed as a means for adjusting the forward limit of piston travel, by employing a greater or less number of the keeper plates, thus providing for an accurate limit of stroke adjusted to suit the level of a lower car landing.

When the piston makes contact with the buffer-springs 53, the strain is brought centrally upon the piston, thus avoiding bending strains upon the piston-rods, and the forward strains of this contact on the front cylinder-head are met by the rearward strains of the hoisting-ropes on the head-sheaves, there being therefore no tendency to open the joint of the cylinder-head. The tube 46 of the front cylinder-head braces that head and all the strain parts connected with it. With a given size of main cylinder, the situation may call for a choice among several sizes of main valve structures, the result of which will be a possible variation in the horizontal distance between cam-plate 19 and the center of the machine, while the return device would remain constant in size regardless of change in size of main valve. The adjustment of lever 35 of the return device, in and out on its shaft, provides compensation for difference in main valve structures.

By inspecting Fig. 3 it will be seen that, when a given situation restricts side-room, weight 32 and lever 34 may be put at the other end of the shafts of the return-device, or lever 35 or 31 or both may be placed there either with them or alone, the system being quite elastic as to arrangement of parts.

It will be noticed, from an inspection of Fig. 1, that rearward movement of the cross-head when near back stroke limit, results in movement of the cam-plate and proper closure of the stop-valve, the opening of the bleed-valve taking place only when tappet 59 engages collar 60, and that collar 60, being adjustable along its rod, permits of the adjustment of the time of bleed-valve opening with reference to stop-valve closure.

As the car approaches its lower limit of travel it may be arrested with comparative suddenness by the action of the cam-plate upon the safety-stop, this water arrest, it being understood, taking place independent of any arrest by the buffer, which acts later if at all. Comparatively sharp arrests may thus be made accurately at the lower landing. But when the car is approaching the upper limit of its travel the conditions are much different. If the piston be as suddenly arrested as in the case at the lower landing, the momentum of the upwardly moving car, moving at modern high speeds, may refuse to recognize the arrest and its continued motion would slacken the cables and cause serious trouble at the head of the shaft. Therefore, the two operative inclines upon the cam-plate are different, each being as abrupt as is practicable, but that corresponding with the lower landing being much the more abrupt of the two. And in arriving at the proper degrees of abruptness for the cams regard must be had for the individual conditions under which the elevator is operating, speeds, distance between lower landing and absolute lower limit or buffer point of arrest, &c. It is therefore almost impossible to plan the cams in advance, and it becomes desirable to properly shape them after the elevator is put into operation. And this is readily done in the construction set forth, by simply dressing the operative cam surfaces to produce the best practicable results. This cannot be done where a slotted cam is employed engaging above as well as below its roller or pin.

The cylinder is strapped to the foundation shoes in an ordinary manner and is capable of the usual endwise adjustment with reference to the foundation so as to secure the proper lead to the hoisting-ropes as they leave the sheaves. If anchor-bolt 42 were rigid or restrained below bracket 39, it would interfere with this endwise adjustment of the cylinder, but in the construction set forth, there is no interference the one with the other. Heretofore anchor-bolts have, in cases, been extended from the brackets diagonally downward and anchored to some parts moving with the cylinder as it was adjusted with reference to the foundation. Such anchor-bolts would, of course, become merely the tension diagonals of the out-reaching brackets and would not at all properly meet the strains as in the present case.

The cable-guards 10 are adjustable radially by means of the nuts upon their shanks and they can therefore be adjusted with nicety

down to the cables or sheaves. Heretofore cable-guards have been fixed in radial position.

By inspecting Fig. 1, it will be observed that cam-plate 19 is virtually a lever fulcrumed on pin 17 which supports it and that rod 25 is a prolongation of this lever attached to the lower end of rocking-arm 35. It will be obvious that as arm 35 swings in its arc of motion the pivot which unites it to rod 25 will rise and fall to a degree corresponding with the versed sine of the arc. The result is that cam-plate 19 becomes rocked upon the pin which supports it, and the effect of this rocking is to raise and lower the portion acting upon the valve-stem. Indeed, if the cam-plate 19 were straight upon its upper surface instead of having the form of a cam, a certain degree of rising and falling motion would still be given to the valve-stem. And a further analysis of the movement will show that as arm 35 rocks to the left the distance becomes greater between the arm and the valve-stem, and of course, also between the arm and the pin 17 on which the cam-plate rocks. Therefore, while the valve-stem will be given vertical motion as arm 35 rocks each side of the vertical, the vertical motion given to the valve stem will be greater when arm 35 rocks to the right of the vertical than when it rocks to the left, and it will be observed that greater motion to the valve stem is given in correspondence with the lower landing, where quicker motion is wanted, this being the very reason for quickening the incline at the left of the cam.

I claim as my invention—

1. In a hydraulic elevator, the combination, substantially as set forth, of a safety-stop valve-stem, a fulcrum pin thereunder, a bar arranged to slide upon said fulcrum pin and engage upwardly upon said valve-stem, a swinging arm normally at right angles to said bar, a prolongation from said bar to a pivot carried by said swinging arm, and means for swinging said arm.

2. In a hydraulic elevator, the combination, substantially as set forth, of a safety-stop valve-stem, a roller or pin carried thereby, a cam-plate having two dissimilarly-inclined gradually curved cams joining at a central depression and dissimilarly inclined immediately from said depression and engaged by said roller or pin, and connections between the cam-plate and piston-moved parts of the machine to move said cam-plate when those parts reach the limit of stroke the steeper incline of the cam-plate operating upon the stop valve at that end of the piston-stroke corresponding with the lower end of car-travel.

3. In a hydraulic elevator, the combination, substantially as set forth, of a safety-stop valve, connections from the piston-moved parts of the machine to properly close said valve when those parts reach a limit of stroke, a bleed-valve, connections from said piston-moved parts to open said bleed-valve, and devices for adjusting the time of bleed-valve opening with reference to the time of safety-stop valve-closure.

4. In a hydraulic elevator, the combination, substantially as set forth, of a safety-stop valve-stem, a slotted yoke thereon, a rigidly-supported guide-pin engaging said slot, a pin or roller carried by the yoke, a cam-plate engaging said pin or roller, and connections between the cam-plate and piston-moved parts of the machine to move said cam-plate when those parts reach the limits of stroke.

5. In a hydraulic elevator, the combination, substantially as set forth, of a safety-stop valve-stem, a slotted guide-yoke thereon, a rigidly supported guide-pin engaging the guide slot of the yoke, a longitudinally slotted cam-plate engaging said guide-pin, a pin or roller carried by the yoke and engaging the cam, and connections between the cam-plate and piston-moved parts of the machine to move said cam-plate when those parts reach the limits of stroke.

6. In a hydraulic elevator, the combination, substantially as set forth, of a safety-stop valve-stem, a slotted yoke thereon, a rigidly-supported guide-pin engaging said slot, a pin or roller carried by the yoke, a cam-plate engaging said pin or roller, wedges in the yoke for adjusting the position of the pin or roller, and connections between the cam-plate and piston-moved parts of the machine to move said cam-plate when those parts reach the limits of stroke.

7. In a hydraulic elevator, the combination, substantially as set forth, of a safety-stop valve-structure, a bracket and stem projecting therefrom, a guide-pin supported by said bracket, a yoke and operating cam mounted on said guide-pin, and connections between the cam-plate and piston-moved parts of the machine to move said cam-plate when those parts reach the limits of stroke.

8. In a hydraulic elevator, the combination, substantially as set forth, of a cylinder-head having projections disposed at its front and rear upper edge and fitted to receive the tail of the hoisting-rope, a group of head-sheaves for the hoisting-rope, two brackets arranged to support the shaft of said sheaves and disposed a distance apart a sheave-width in excess of the width of the group of sheaves, and a collar on the sheave-shaft at one side of the group of sheaves.

9. In a hydraulic elevator, the combination, substantially as set forth, with a cylinder having a valve communicating with its lower front part to provide for cleaning the cylinder, of connections between said valve and the piston-moved parts of the machine to automatically open said cleaning valve when the piston reaches one of the limits of its stroke.

10. In a hydraulic elevator, the combination, substantially as set forth, of a main piston, a buffer within the cylinder on the front cylinder-head to be engaged thereby, and sheave-

supporting brackets on said cylinder-head on the side opposite said buffer.

11. In a hydraulic elevator, the combination, substantially as set forth, of a main piston having a central striking-point, a front cylinder-head having a central pocket open to the cylinder, spring-plates in said pocket, and one or more keeper-plates secured to the cylinder-head behind said spring-plates.

12. In a hydraulic elevator, the combination, substantially as set forth, of a main piston having a central striking-point, a front cylinder-head having a central pocket-body and side-brackets and ribs connecting the pocket-body and brackets, and a buffer-spring arranged in the pocket to be engaged by said striking-point.

13. In a hydraulic elevator, the combination, substantially as set forth, of a safety-stop valve, an upper and lower shaft, a weight guided by said shafts and having arms, levers on one of said shafts and held in normal central position by said arms and weight, connections between said levers and safety-stop valve, and connections between said levers and the piston-moved parts of the machine to move said levers when said parts reach the limits of stroke.

14. In a hydraulic elevator, the combination, substantially as set forth, with a hydraulic cylinder, a safety-stop, and a safety-stop closing device, of a pair of shaft-boxes carried by said cylinder at its top, a pair of shaft-boxes carried by the cylinder at its bottom, the axes of said boxes being at right angles to the axis of the cylinder, and shafts carried in said boxes and having their ends projecting for the support of said closing-device.

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