(No Model.)

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T. E. BROWN.

HYDRAULIC LIFT.

No. 604,364. Patented May 24, 1898.

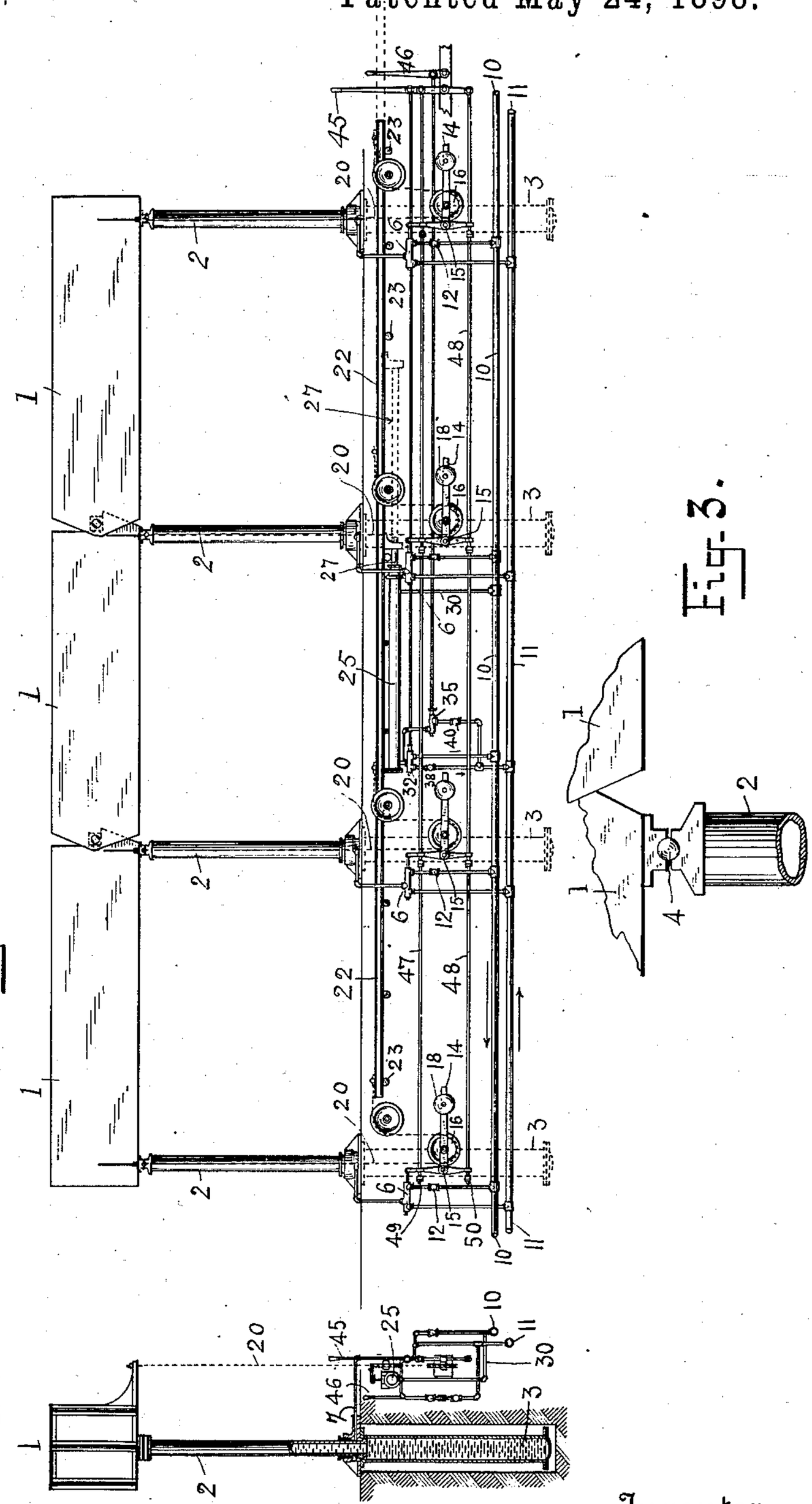

Fig. 1.

Fig. 3.

Fig. 2.

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(No Model.)

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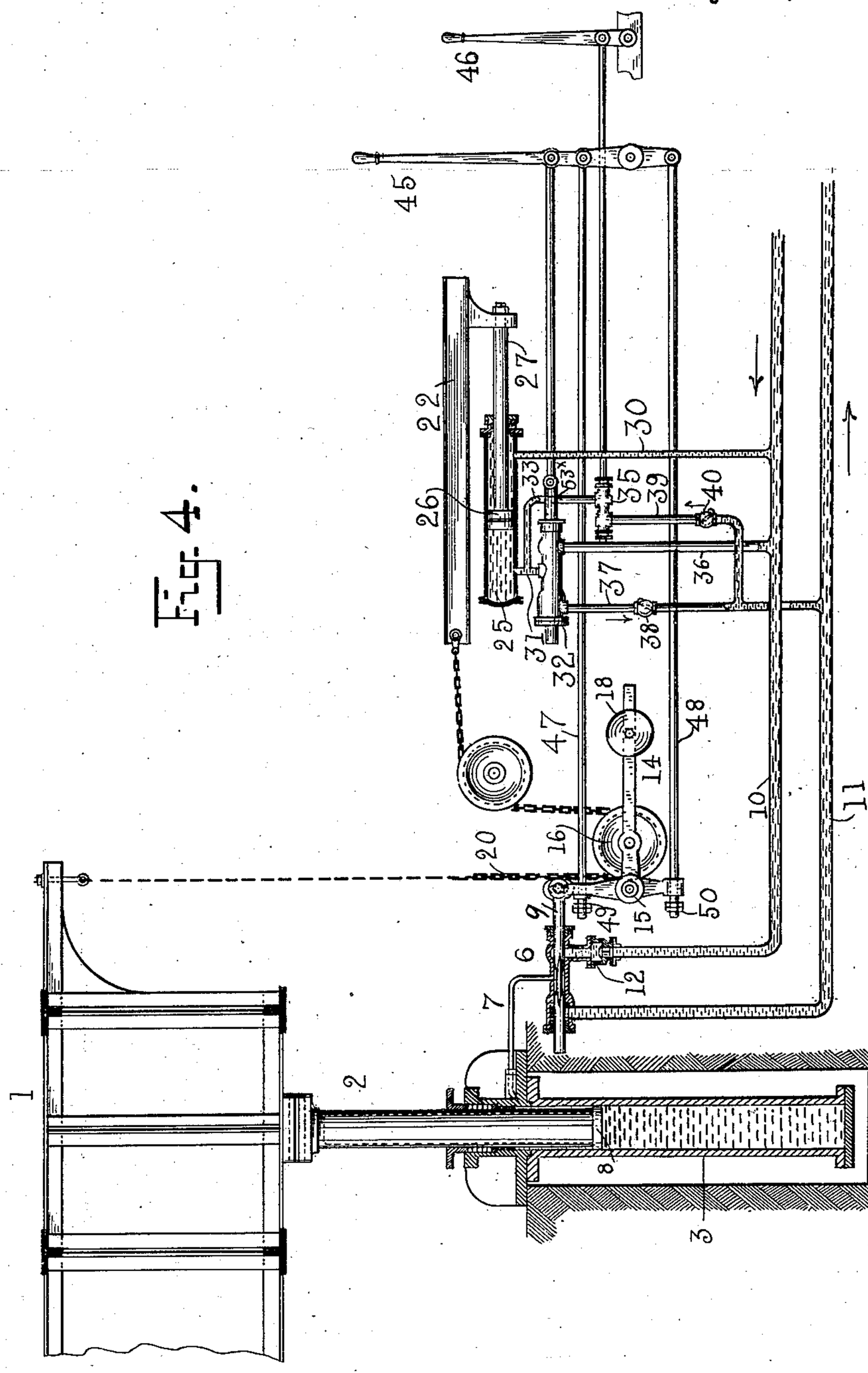
Fig. 4.



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(No Model.) 5 Sheets—Sheet 3.

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Fig. 5.

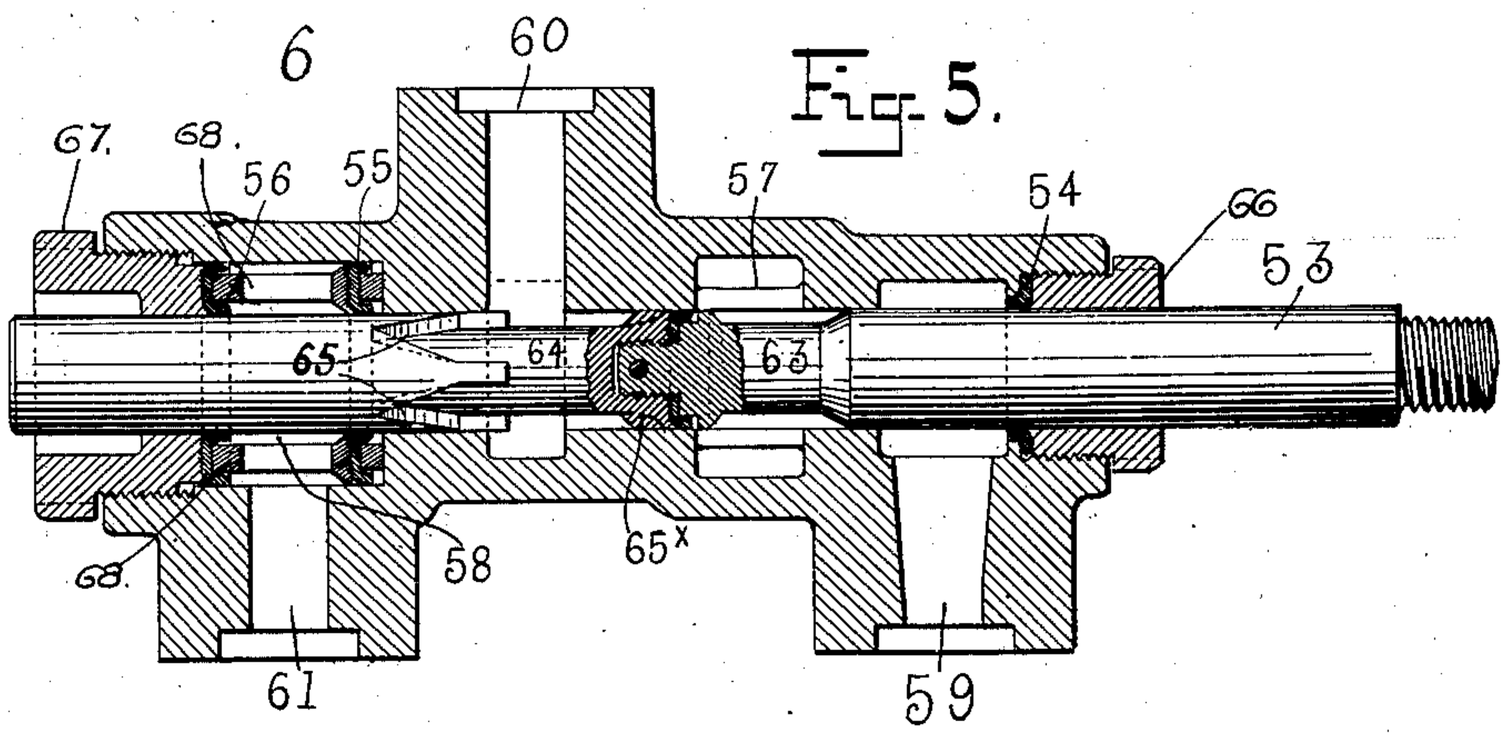


Fig. 6.

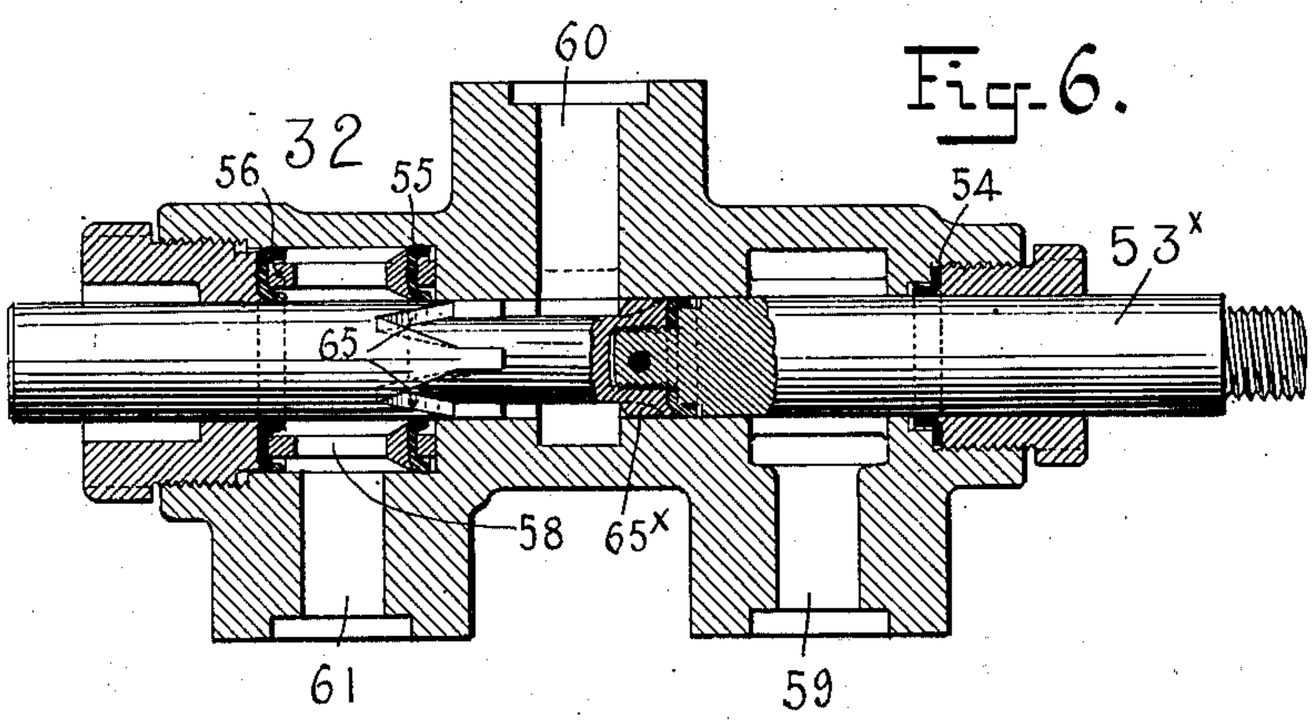
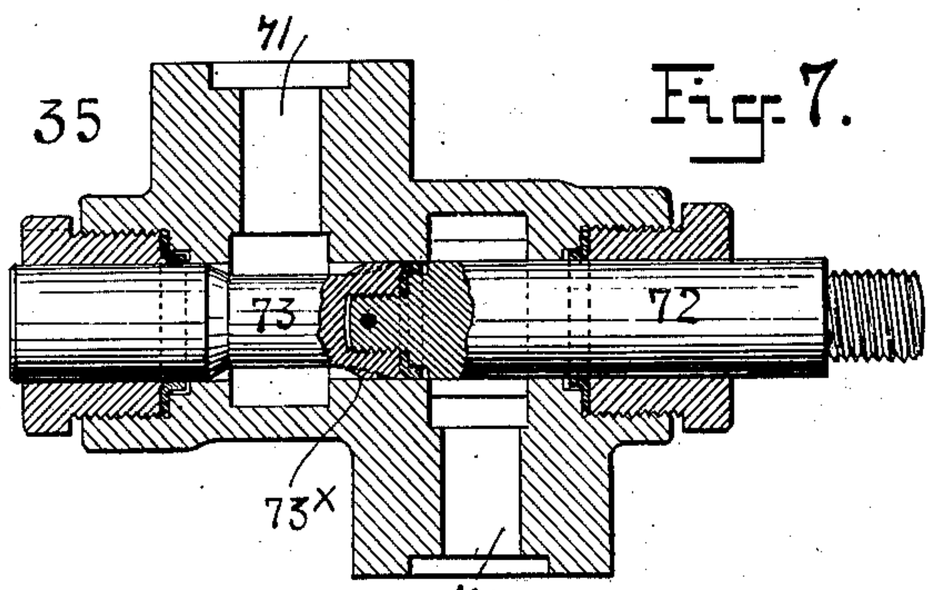


Fig. 7.



70

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5 Sheets—Sheet 4.

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Fig. 8.

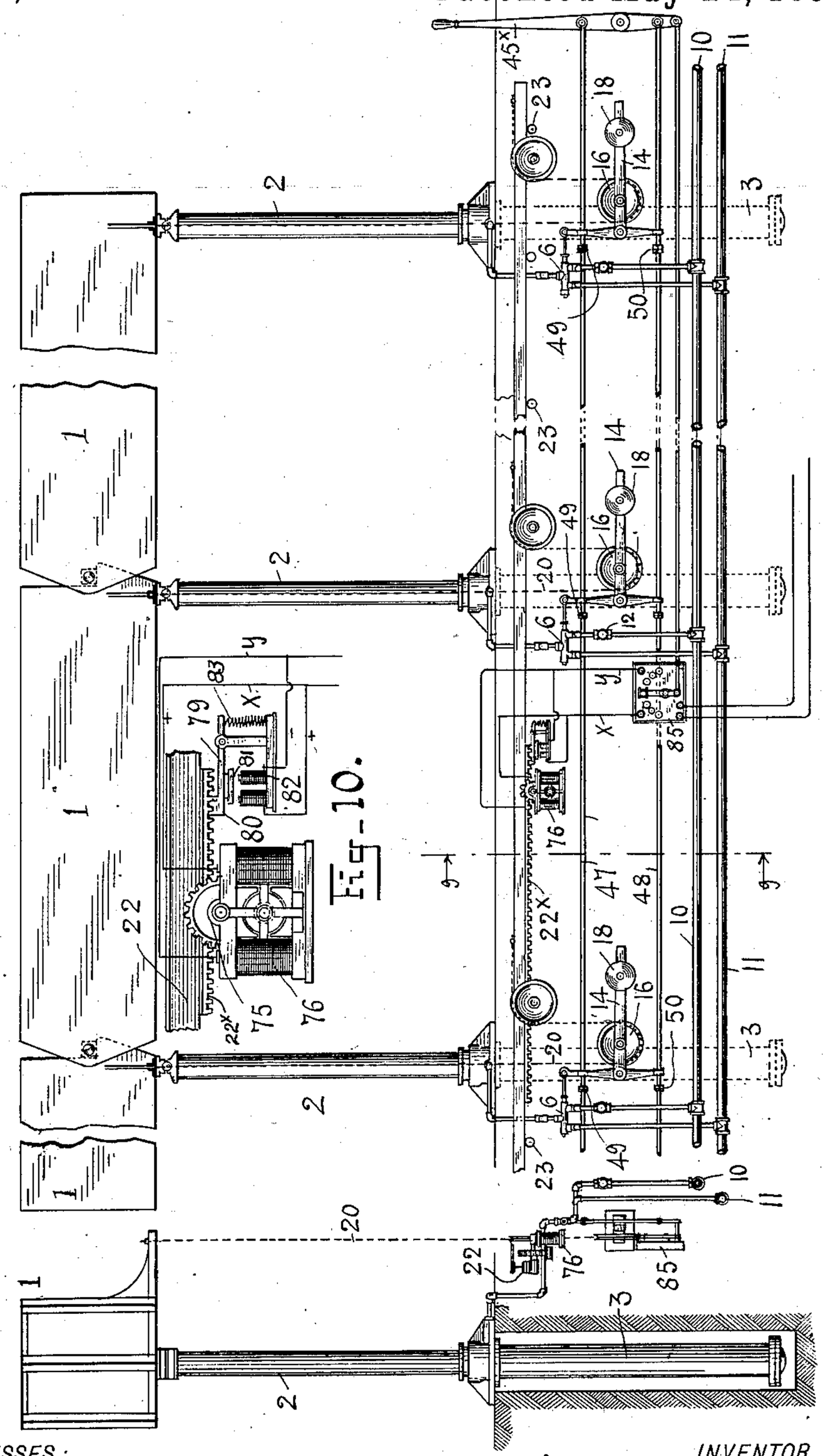

Fig. 10.

Fig. 9.

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(No Model.) 5 Sheets—Sheet 5.

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HYDRAULIC LIFT.

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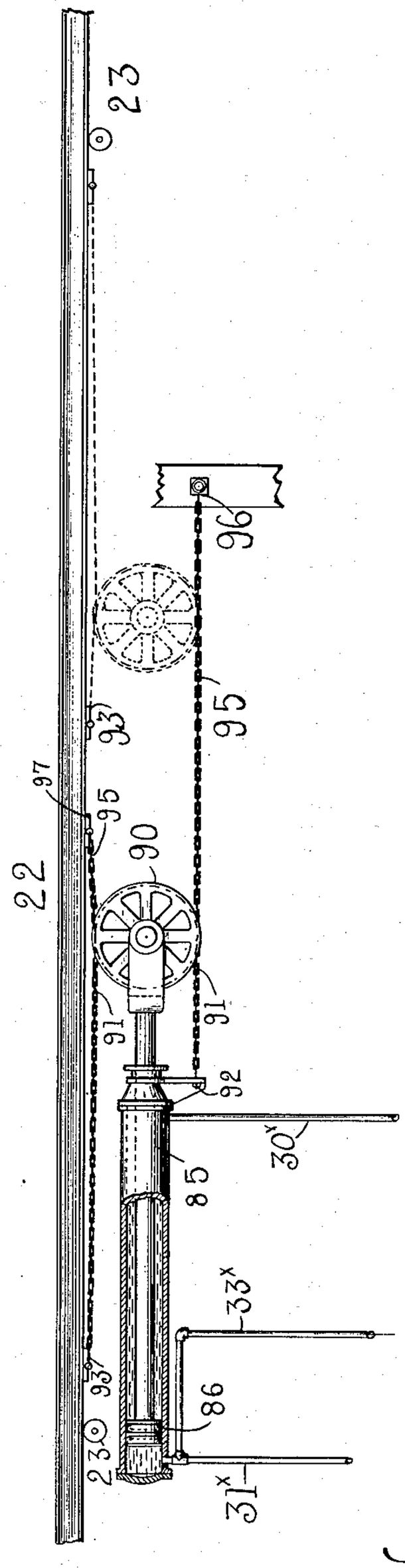
Fig. 11.



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UNITED STATES PATENT OFFICE.

THOMAS E. BROWN, OF NEW YORK, N. Y.

HYDRAULIC LIFT.

SPECIFICATION forming part of Letters Patent No. 604,364, dated May 24, 1898.

Application filed June 14, 1897. Serial No. 640,791. (No model.)

To all whom it may concern:

Be it known that I, THOMAS E. BROWN, a citizen of the United States, and a resident of the city of New York, in the county and State of New York, have invented certain new and useful Improvements in Hydraulic Lifts, of which the following is a specification.

This invention relates to improvements in hydraulic lifts, especially such as are designed for raising long structures like platforms for railway-trains and cradles of ships.

When hydraulic power is applied to lifting structures of the great length of railway-platforms and the like, it is of course necessary to use a plurality of hydraulic lifting-rams. Therefore in the varying conditions of use it will happen that some rams will be doing more and some less than their proper share of the work. In such circumstances, if we suppose all the operating-valves to be equally open, the rams doing the least work will rise with the greatest rapidity, and the result of the unequal motion of the rams will be very injurious strains on the structures which are being raised.

It is the especial purpose of this invention to provide means for controlling the operation of the rams in such a manner as to compel each ram to move at practically the same speed.

In its essential elements the invention consists in combining with the plurality of hydraulic rams and their main operating-valves means controlled by the operator and connected with each of the main operating-valves by a tension connection in such manner that the movement of the valves is controlled so as to force all the main lifting-rams to move at the same rate of speed.

In the following specification and the accompanying drawings I describe several modifications in the apparatus for effecting this result, but all of them applying the principle and essential elements of construction just above mentioned.

Referring to the drawings which accompany the specification to aid the description, Figure 1 is a side elevation of one arrangement of my invention, wherein the movement of the main hydraulic valves is controlled by a pilot-beam operated by a pilot-ram. Fig. 2 is an end elevation of the same. Fig. 3 is an enlarged detail of the top of one of the lifting-rams, showing its preferred rocker-bearing connection with the platform. Fig. 4 is an explanatory diagram, on an intermediate scale, of the device shown in Fig. 1 and illustrating the manner in which the pilot-beam is operated and how it controls the main valves. Fig. 5 is an enlarged section of one of the main valves. Fig. 6 is a section on the same scale of the valve of the pilot-ram, the exhaust being partially opened for raising the platform. Fig. 7 is a section on the same scale of the auxiliary valve for establishing communication directly between the pilot-ram and the exhaust-main in certain cases. Fig. 8 is a broken side elevation of a form of the invention wherein some other motor than the pilot-ram is employed to shift the pilot-beam. In the figure this motor is electric. Fig. 9 is an elevation of the left end of Fig. 8, and Fig. 10 is an enlarged detail of the motor. Fig. 11 is a side elevation of a pilot-beam and a double-acting hydraulic ram for shifting the same.

Referring to Figs. 1 to 7, inclusive, 1 is the platform, preferably but not necessarily made in sections hinged together, as indicated in Fig. 4. 2 2 are rams, of which there will be several, according to the length of the platform, one for each section, for lifting the platform, and 3 3 the hydraulic cylinders thereof. At the top said rams are preferably connected with the platforms by rocker-bearings 4. Each hydraulic cylinder 3 is connected with a suitable main valve, as 6, the connection 7 being made, preferably, at the upper part of said cylinder and with a downward inclination, Fig. 4, there being a sufficient waterway around the stops 8 on the bottoms of the rams 2. Said valves 6 may be of any suitable construction (the preferred form being hereinafter described) and are connected with the usual pressure-main 10 and exhaust-main 11, 12 being a check-valve opening inward. Each valve is operated by bent lever 14, connected with the valve-stem 9 and pivoted at 15 on any suitable framing. (Not shown as being no part of this invention.) The free arm of said lever 14 carries a sheave 16 and a sliding weight 18, said arm being weighted sufficiently to throw the valve 6 open—*i. e.*, to the right of Fig. 4—when not

prevented by the chain 20. At one end each of said chains 20 is connected to its proper section of platform and at the other end to a device for exerting a variable tension on said chains, so as to control said valves 6 according to the load on the rams, and any device which exerts such tension is within the scope of my invention. In Figs. 1, 2, and 4 said device is represented as a beam 22, termed the "pilot-beam," which may be formed of an iron or steel I-beam, preferably nearly as long as the platform 1 and supported in any suitable manner, as on rollers 23, carried by the framing. In place of said beam 22 any other suitable device might be substituted—as, for example, a chain kept taut by weights or otherwise and connected with each of the valve-chains 20. In the form of the apparatus shown in Figs. 1, 2, and 4 said pilot-beam 22 is reciprocated by the pilot-ram, which consists of a hydraulic cylinder 25, within which works a piston 26 on the end of a plunger 27 of half the cross-area of the piston and connected in any suitable manner with the beam 22.

30 is a connection from the front of piston 26 directly to pressure-main 10.

31 is a connection from behind piston 26 to the pilot-valve 32, and 33 a by-pass to a special or auxiliary valve 35.

The preferred construction of valves 32 and 35 will be hereinafter described. Valve 32 is connected by pipes 36 and 37 with the pressure and exhaust mains, respectively, 38 being a check-valve on pipe 37, opening toward the exhaust. Valve 35 is connected with the exhaust by pipe 39, 40 being a check-valve opening toward valve 35. Valves 32 and 35 are operatively connected, respectively, with hand-levers 45 and 46, as shown in Fig. 4, and 47 48 are rods connected with hand-lever 45, carried adjacent to or through an arm of lever 14, as shown, and provided with stops 49 50, respectively, so that the motion of lever 14 will in certain circumstances throw lever 45 and pilot-valve 32.

Referring to Fig. 5, the main hydraulic valves are preferably three-way spindle-valves, as shown. The spindle 53, preferably in two parts, as shown, works with water-tight fit through the packings 54 55 56, the valve-body being chambered at 57 58, as shown, 59 being the pressure-inlet, 60 the connection to the hydraulic cylinder, and 61 the connection to the exhaust. Said spindle 53 is diminished in diameter at 63 on the pressure side and at 64 on the exhaust side. At the latter point are provided V-notches 65, as shown, to produce a gradual opening and closing of the exhaust, and $65^{\times}$ are similar V-notches to produce a gradual opening and closing of the communication from pressure 57 to the outlet 60 to effect a gradual opening and closing of the supply. The stuffing-box glands 66 67 and the rings 68 68 in chamber 58 are all as well known in the art, and in general said valve is of a type well known in hydraulics and no part *per se* of my invention. Also many other types of three-way valves might be used without affecting the operation. Said spindle 53 being represented in Fig. 5 in the middle position, wherein it closes both pressure and exhaust connections and holds the rams 2 at rest, it is to be understood that when it moves to the right it opens communication from the pressure-main to the corresponding hydraulic cylinder 3, and the proper ram 2 rises; but when it moves to the left it opens communication from the corresponding cylinder 3 to the exhaust, and the ram 2 falls because of the weight of the platform.

The pilot-valve, Fig. 6, is in essential respects the same as the main hydraulic valves, except that its spindle does not require to be diminished in diameter at a point corresponding to part 63 of the spindles of said main hydraulic valves, because said pilot-valve does not require to have a chamber 57. Similar parts in Figs. 5 and 6 are represented by the same reference-numerals, and the pilot-valve requires no further description. The special or auxiliary valve, Fig. 7, is also in general similar to the main hydraulic valve, but has only two ports 70 and 71, respectively connecting with pipe 39 from the exhaust-main 11 and by-pass pipe 33 to the pilot-ram. Its spindle 72 also requires only one reduction in diameter, 73 corresponding to the part 63 of the spindle of the main hydraulic valve.

The operation is as follows: To raise the platforms, the operator throws lever 45, so as to move spindle $53^{\times}$ of pilot-valve 32 to the left and open the left end of the pilot-ram cylinder to the exhaust. Then the pressure in the right end of said pilot-ram cylinder moves the ram and the pilot-beam 22 to the left. As the main rams 2 2 are yet motionless, the chains 20 slacken, lowering the weighted levers 14 until the valves 6 open sufficiently to allow the rams 2 2 to start up. As soon as any valve 6 has opened sufficiently to enable its ram to move as fast as the pilot-beam 22 the ram will take up its chain 20 as fast as the said pilot-beam pays it out, and therefore its corresponding sheave 16, lever 14, and valve will now remain stationary. Since a lightly-loaded ram will rise more rapidly, pressures being equal, than a heavily-loaded one, it follows that a lightly-loaded ram will open its valve slightly, while a heavily-loaded ram will open its valve to a greater degree, and this invention will compel all the rams to move at the same speed. When the operator throws lever 45 so as to bring spindle $53^{\times}$ to center, the pilot ram and beam 22 stop, the rams 2 continuing to raise the platform and tighten the chains 20 until the valves 6 close and all rams come to rest. Should the rams 2 come to the top of their stroke and butt against cylinder-heads, the pilot-ram, being a little longer, can continue moving, so as to open said valves 6 wide, leaving all rams under pressure, so that no movement or settlement

can take place during loading or unloading at the upper landing. In lowering the platform the operation is the reverse, the pilot-beam 22 moving ahead, lifting the sheaves 16 and levers 14, and opening valves 6 to the exhaust until each ram 2 receives an outlet sufficient to enable it to descend as fast as the pilot-beam moves.

Should a ram leak in rising, it will lag until its valve 6 opens its supply-port sufficiently to balance the leak.

Should a cylinder 3 leak while its ram 2 is descending, the ram will tend to run ahead and close the outlet-port of the valve until the discharge is diminished by the amount of the leak, and if the leak is sufficient the ram will continue moving the valve and will open the pressure-main to the leaking ram. Hence a leaking ram can be controlled up to the limit of a leak equal to the full power-supply.

If, when lifting, a pipe clogs or a sufficient leak exists to prevent a ram moving, weight 18 on lever 14 of this ram will descend as the pilot-beam moves and will continue descending until lever 14 comes in contact with stop 50 of rod 48 and moves this rod, which in turn pulls lever 45 to the central position, and thereby stops the pilot-ram and in consequence the whole machine. Similarly in descending should a ram 2 fail to respond the similar rod 47 would be pulled and valve 32 brought to center and the machine be stopped.

Suppose that the pressure-main 10 bursts. If the platform 1 is descending, the pilot-ram ceases to move for lack of pressure and the apparatus comes to rest. The conductor may also, by means of lever 46 and valve 35, open the cylinder of the pilot-ram to the exhaust-main, in which there is sufficient pressure to drive the pilot-ram and so allow the platform to come to the bottom. If the platform is ascending, the pilot ram and beam 22 stop, the exhaust-pressure being prevented by the check-valve 38 from moving the pilot-ram in the reverse direction. The conductor, as before, may lower the platform by means of lever 46. Thus, it will be seen, the tensional connection which controls the main valves compels the movement of all rams 2 at practically the same speed—*i. e.*, at the same speed proportionally to the speed of the pilot-beam 22—and prevents any ram from moving the part of the platform to which it is applied more rapidly than other parts of the platform are moved, and thus prevents any undue strains on the platform or apparatus. The particular means for operating the tensional connection thus far described may of course be modified without affecting the essential invention, and I will now describe certain of those modifications.

Since the pilot-ram is essentially a motor for moving the pilot-beam 22, various other motors can be substituted, and in Figs. 8, 9, and 10 I illustrate the application of an electric motor for the purpose.

The pilot-beam 22 is furnished with a rack $22^{\times}$, in which meshes a gear 75, driven by a motor 76. A brake-lever 79, provided with a head 80, is equipped with an armature 81, which is attracted to the magnets 82, which are connected with the circuit $x\ y$ when current is flowing through said motor. $x\ y$ are the circuit-wires and 85 the switch, which may be operated by a lever $45^{\times}$ at some convenient position. By throwing lever $45^{\times}$ to the left the operator causes a current to energize the motor and magnets 82, and thereby first draw down lever 79 to free head 80 from rack $22^{\times}$ and then move the pilot-beam 22 to the left and raise the rams 2 2, as hereinbefore described. When he throws the lever to the central position to stop beam 22, the switch breaks the circuit, lever 79 rises, by reason of spring 83, and locks into the rack $22^{\times}$, and the beam and apparatus stop. Should the circuit break accidentally, the lever 79 similarly locks into the rack. To start the beam again in this case, the lever 79 can be forced down by hand and gear 75 be turned by hand to move the beam 22 by a crank placed on its axle.

Fig. 11 shows one form of arrangement of a motor connected with the pilot-beam by multiple gearing, in this the gearing being two to one, so that the pilot-beam travels twice the distance of the plunger. A double-acting hydraulic motor, Fig. 11, consisting of the usual cylinder 85 and plunger 86, can also be applied to move the pilot-beam 22. Sheave 90 on plunger 86 will be double, and one chain 91 will extend from a becket 92 on some fixed part, as the head of cylinder 85, around or partly around one sheave 90 and to a becket 93 on the beam 22. Another chain 95 leads in the opposite direction from a becket 96 on some fixed part of the framing around or partly around the other sheave 90 and to a becket 97 on the beam 22. Said cylinder is connected by pipes $30^{\times}$ $31^{\times}$ $33^{\times}$ with a pilot-valve similar to valve 32, Figs. 4 and 6, but not shown, and said valve will be controlled by a lever 45, as described, so that the operator can move beam 22 in either direction, as desired. A special valve 35, Fig. 4, may also be provided to operate as described.

Now, having described my improvements, I claim as my invention—

1. The combination with a platform, a hydraulic motor for lifting the same, and a valve for controlling the motor, of a tensional connection operatively connected with said platform and adapted to throw said valve to various degrees of opening, and an auxiliary motor for actuating said connection, substantially as described.

2. The combination with a platform, a hydraulic motor for lifting the same, and a valve for controlling the motor, of a reciprocating tensional connection operatively connected with said platform and adapted to actuate said valve, and an auxiliary motor for actuating said tensional connection, substantially as described.

3. The combination of a platform, a plurality of lifting hydraulic motors and valves therefor, a plurality of tensional connections each operatively connected with said platform and adapted to independently actuate each valve, and an auxiliary motor adapted to actuate said tensional connection, substantially as described.

4. The combination in hydraulic lifting apparatus, of a platform, a plurality of hydraulic lifting-rams operatively connected therewith, a main operating-valve for each ram, a pilot-ram and tensional connections operatively connecting the pilot-ram with said platform and each of said main operating-valves, whereby each of said lifting-rams is required to move the same distance proportionally to the movement of the pilot-ram, substantially as described.

5. The combination in hydraulic lifting apparatus, of a platform, a plurality of hydraulic lifting-rams operatively connected therewith, a main operating-valve for each ram, a lever for throwing said valves, a pilot-ram and tensional devices from said pilot-ram to each of said levers and said platform, whereby each of said lifting-rams is required to move the same distance proportionally to the movement of said pilot-ram, substantially as described.

6. The combination in hydraulic lifting apparatus of a plurality of hydraulic lifting-rams, a main operating-valve for each ram, a pilot-ram controlled by the operator, a tensional connection from said pilot-ram to each main operating-valve and an auxiliary valve in the exhaust connection from said pilot-ram, also controlled by the operator and adapted to establish communication between the said last-mentioned valve and the exhaust when desired, substantially as described.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 4th day of May, 1897.

THOMAS E. BROWN.

Witnesses:
HENRY L. BRANT,
CHARLES L. DUARKEL.