No. 798,506. PATENTED AUG. 29, 1905.

M. W. HALL.

PUMP OR COMPRESSOR.

APPLICATION FILED MAR. 4, 1904.

2 SHEETS—SHEET 1.

Fig. 1.

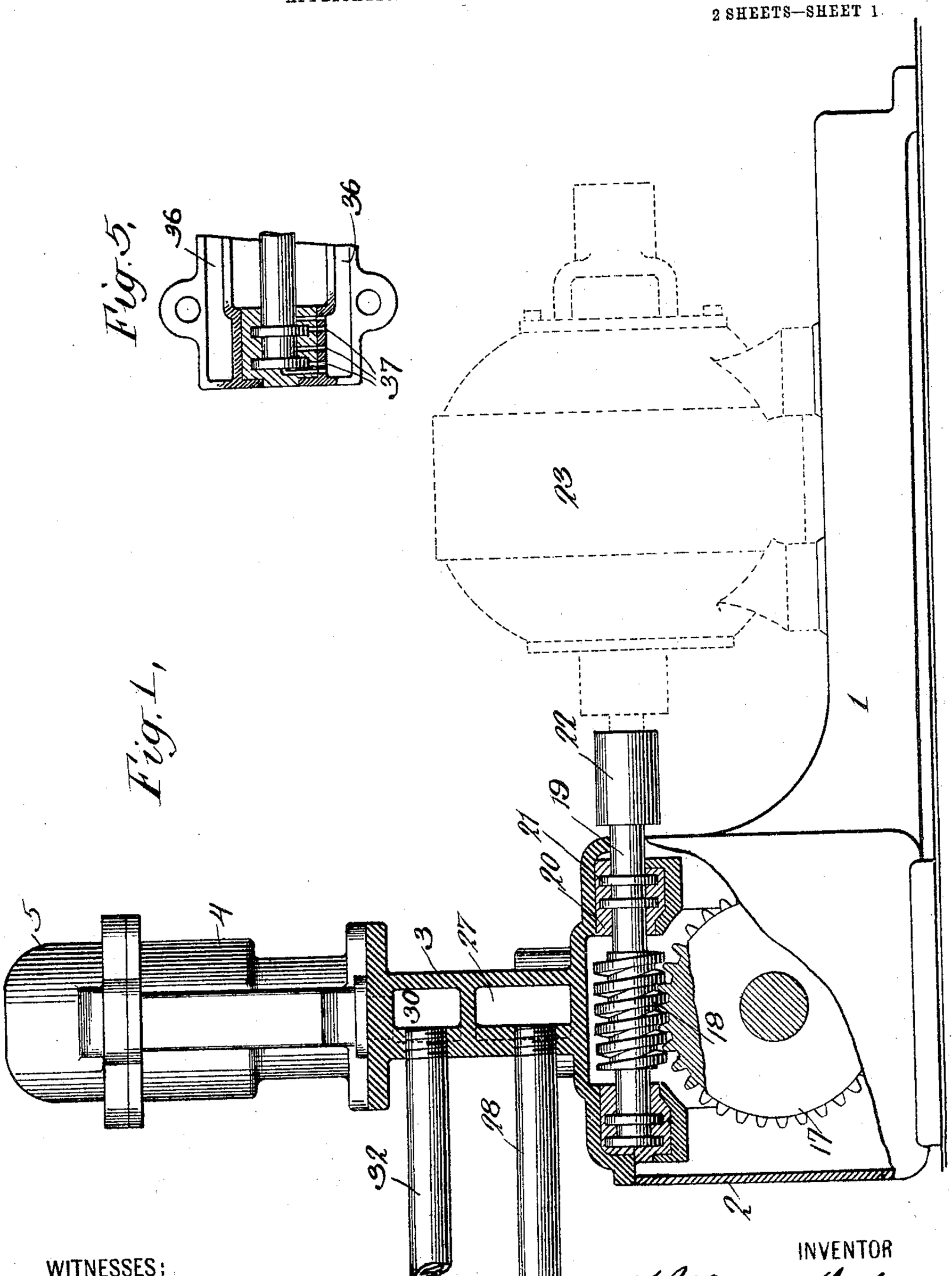

Fig. 5.

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2 SHEETS—SHEET 2.

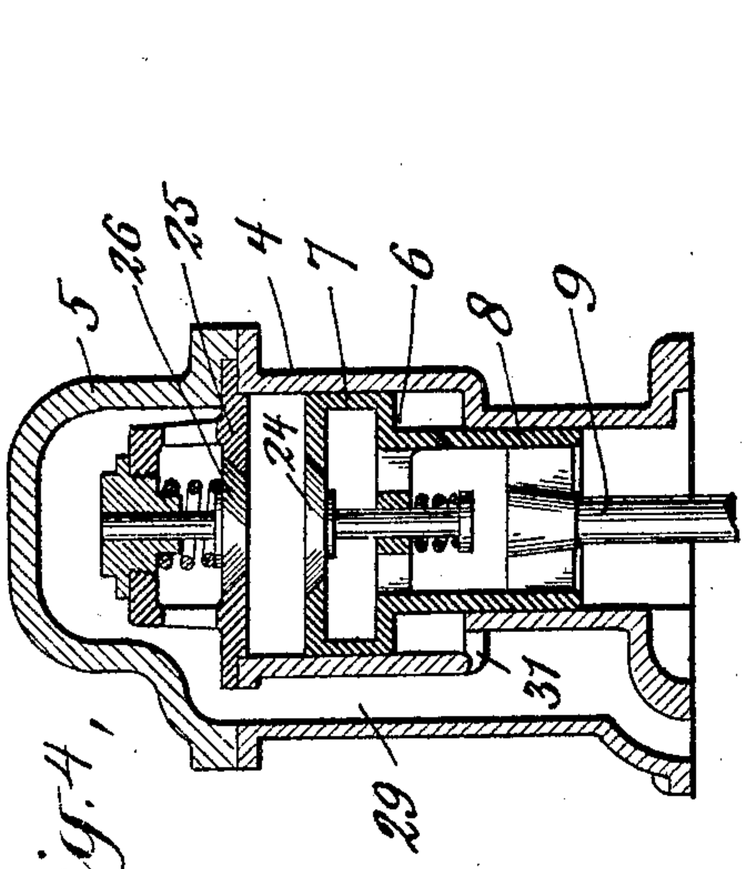

Fig. 4.

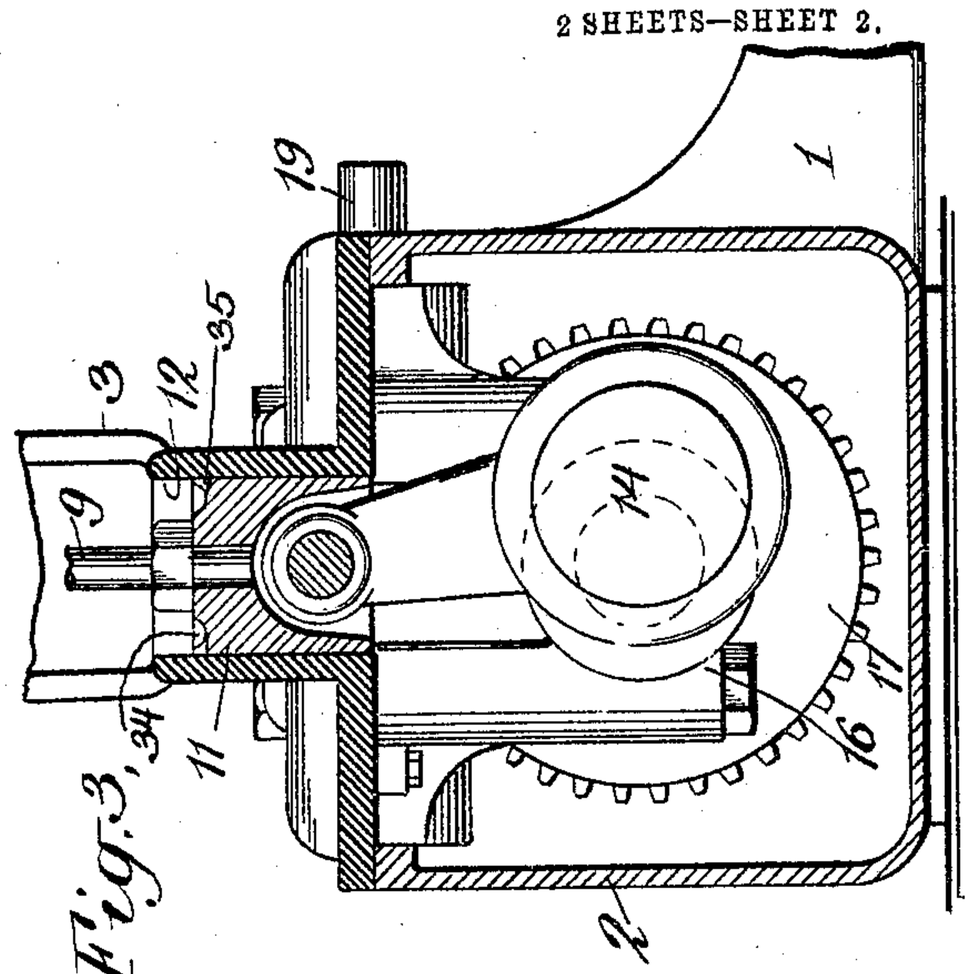

Fig. 3.

Fig. 2.

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UNITED STATES PATENT OFFICE.

MILAN W. HALL, OF BROOKLYN, NEW YORK.

PUMP OR COMPRESSOR.

No. 793,506. Specification of Letters Patent. Patented Aug. 29, 1905.

Application filed March 4, 1904. Serial No. 196,522.

To all whom it may concern:

Be it known that I, MILAN W. HALL, a citizen of the United States of America, and a resident of Brooklyn, county of Kings, State of New York, have invented certain new and useful Improvements in Pumps or Compressors, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

My invention relates to improvements in pumps or compressors, and particularly to pumps or compressors of the reciprocating type designed to be operated by rotary motors. In pumps or compressors of this type so operated it is desirable to balance the pump or compressor as much as possible as to resistance during all parts of the stroke; otherwise the efficiency of the pump is impaired and undue wear results. A double-acting pump has the advantage over a single-acting pump in this respect, and a duplex double-acting pump in which the operating cranks or eccentrics are set at right angles to each other approaches very nearly the ideal conditions, as in such form of pump the resistance is very nearly balanced through all parts of a revolution thereof. A duplex double-acting pump of the reciprocating type, however, is usually quite complicated and employs a number of inlet and discharge valves. It is the main object of my present invention to simplify pumps of this type and to reduce and simplify the valve system.

My invention also consists in certain novel details of construction and combination of parts, including certain novel features in the driving mechanism and connections, as will be more fully pointed out hereinafter.

I will now proceed to describe a pump or compressor embodying my invention and will then point out the novel features in claims.

In the drawings, Figure 1 is a view, partially in side elevation and partially in central vertical section, of a pump or compressor embodying my invention, showing in dotted outline an electric motor in driving relation therewith. Fig. 2 is a view in central vertical section of the same, the point of view being at right angles to the point of view of Fig. 1. Fig. 3 is a detail view, in vertical section, of certain parts, the plane of section being taken substantially upon the line 3 3 of Fig. 2. Fig. 4 is a detail view, in vertical section, showing the somewhat different form of valve employed when the device is used as a compressor instead of a pump. Fig. 5 is a detail view illustrating certain means employed for lubricating the driving-shaft bearings.

In the form of my invention illustrated herein a bed 1 is provided, one portion of which comprises a hollow box-like casing 2, which serves as a support for the pump proper and as an oil-reservoir and the other portion of which constitutes a bed-plate for an electric or other motor.

Supported upon the casing 2 is an intermediate section 3, which intermediate section serves in turn to support pump or compressor cylinders 4 4. The upper ends of the cylinders 4 are closed by caps or covers 5.

Mounted in the cylinders 4 4 are differential pistons 6, the said pistons each comprising two heads, an upper head 7 and a lower head 8, the upper head 7 being of larger diameter than the lower head 8. The two piston-heads 7 and 8 are mounted in and fitted to corresponding portions of the cylinders 4, as will be seen by reference to the drawings. Each piston has secured thereto a piston-rod 9, which piston-rod passes through a stuffing-box 10, supported at and closing the lower end of the cylinders 4, and is connected at its lower end to a cross-head 11, mounted to reciprocate in suitable slide-bearings 12 in the intermediate casing-sections 3. The lower ends of the cross-heads 11 are arranged to enter the oil-reservoir at the lowermost point of their strokes, so as to receive oil for lubricating purposes, and the upper ends of the cross-heads are provided with circular grooves 34, having discharge-gullies 35, whereby any water which leaks past the stuffing-boxes 10 may be caught and discharged by the cross-heads toward the uppermost ends of their strokes. Connecting-rods 13 connect the cross-heads with crank-pins or eccentrics 14, rigidly secured to the pump-shaft 15. The pump-shaft 15 is journaled in suitable bearings 16, dependent from the lower face of the intermediate casing-section 3 and inclosed within the box-like casing portion 2 of the bed 1. The pump-shaft 15 carries a worm-wheel 17, which is rigidly secured thereto, said worm-wheel engaged by a worm 18, carried by a shaft 19, journaled in suitable bearings 20, carried by the intermediate casing-section 3. The worm-shaft 18 and bearings 20 are provided with thrust-collars 21, by which longitudinal thrust of the worm-shaft 18 is resisted. One end of the shaft 18 projects through the box-like casing 2 of the bed 1 and is arranged to be connected by a suitable shaft connection 22 or

other device, as may be desired, with the driving-shaft of an electric or other motor 23. This electric motor, being supported upon the bed-plate portion of the bed 1, will readily be maintained in proper driving relation with the worm-shaft 18. The bearings 16 are provided with open recesses 36, arranged to receive and hold oil, and channels 37 act as feeders between said recesses and the bearing-faces of the thrust-bearings, as clearly shown in Fig. 5.

The worm, worm-wheel, crank-shaft, and lower ends of the connecting-rods being contained in the box-like casing 2, may be immersed wholly or in part in oil contained within the box-like casing 2, said casing being of such form as to act as a reservoir or holder for the oil and to prevent its escape.

The differential pistons 6 are each formed with passages running longitudinally therethrough and are each provided with a valve 24, arranged to control said passage. The upper ends of the cylinders 4 are each provided with heads 25, which heads have passages therethrough, and valves 26, carried by said heads for controlling such passage. The valves 24, carried by the pistons, act as inlet-valves, while the valves 26, carried by the heads 25, act as discharge or check valves. The inlet-chamber for the pump is arranged in the intermediate casing-section 3 at 27, an inlet-pipe 28 being arranged to connect with said inlet-chamber. The discharge for the pump comprises a chamber including passages 29 in the cylinder-castings 4 and a space 30, contained within the intermediate casing-section 3. The upper ends of the cylinders 4 discharge through their heads 25 past the valves 26 into the passages 29 of the discharge-chamber, and ports 31, arranged in the walls which divide the upper and lower portions of the cylinders 4, and hence lead from the lower end of the larger portions of the said cylinders, also discharge into the discharge-passages 29. A pipe 32, connecting with the space 30, carries away the liquid discharged.

The operation of the device is as follows: Upon an upward stroke of either of the pistons 6 water or other fluid is drawn from the inlet-chamber 27 through one of the ports or passages 33 into the lower end of the cylinder 4, or that portion thereof which has the smaller diameter. At the same time water contained in the larger bore of the cylinder 4 above the larger piston-head is forced up through the cylinder-head 25 and past the valve 26 (which is at such time opened by the pressure of water) into the discharge-passage 29. While substantially the entire quantity of water contained in the cylinder 4 above the piston-head 7 will be discharged past the valve 26, a certain percentage thereof will be carried up through the passage 31 into the lower end of the larger portion of the cylinder 4 beneath the larger piston-head 5. The amount of fluid actually delivered, therefore, during an upward stroke of the piston will be an amount proportional only to the area of the smaller piston-head—that is, equal to its area multiplied by the length of its stroke. These piston-heads may conveniently have an area one about twice as large as the other. Hence one half only of the volume discharged during an upward stroke of the piston will be actually delivered to receiver, the other half being received back into that portion of the upper section of the cylinder beneath the lower side of the upper piston-head 7. This portion will be returned again through the port or passage 31 into the passage 29 to delivery during the return or downward movement of the piston, and thus finally discharged. In its downward stroke the piston will permit the passage therethrough and past its valve 24 of water to the upper end of the larger portion of the cylinder 4 sufficient to replace the water discharged from said upper end in the previous upward stroke of the piston, the lowering of pressure below atmospheric pressure in the upper end of the cylinder 4 above the piston-head 7, which takes place immediately the piston begins to descend, closing the discharge-valve 26, opening the valve 24, and drawing water therethrough.

The amount of water lifted from the inlet-chamber 27 through the passage 33 will be about equal (in a pump proportioned as above stated) for each movement of the piston in either one direction or the other, this because in its upward movement water is drawn up to fill the area of the smaller portion of the cylinder, while in its downward movement additional water must be drawn up so that the amount will fill the area of the larger portion of the cylinder.

By reason of the foregoing it will be seen that while each cylinder has but a single discharge and a single inlet-valve each cylinder is double-acting—that is to say, it delivers fluid during movements of the pistons in both directions. The cranks or eccentrics 14 being set at right angles to each other upon the operating-shaft 15, the device will be substantially uniformly balanced as to resistance throughout every part of its cycle of operation.

It will further be seen that the driving connections are exceedingly simple, and the reduction of speed from the high-speed motor to comparatively low speed required for the pump is effected by the simple use of a worm and wheel, the thrust upon the worm being taken up by suitable thrust-bearings. It will be understood, of course, that any form of motor may be employed for running the pump, such as an electric motor, turbine, or other rotary engine, &c. The pump casing or bed being provided with a portion adapted to support the motor for driving the pump, enables the motor and pump to be maintained in proper driving relation without any trouble,

while the form of casing employed enables the driving parts to be thoroughly lubricated and protected from injury and wear.

When the device is to be used as a compressor, the construction of the valves will be changed to such a form, for instance, as is shown in Fig. 4, the object in such instance being to reduce clearance-spaces to a minimum. When pumping liquids, the form of valve shown in Fig. 2 is more desirable, being simpler in construction and cheaper to manufacture.

What I claim is—

1. In a double-acting pump or compressor, the combination with a differential cylinder and a reciprocating piston having differential heads fitted thereto, and having a passage therethrough from one end to the other, of a suction-valve carried by the piston and controlling said passage, and a discharge-valve fitted to the cylinder, the cylinder at the rear of the larger piston-head being open freely to discharge.

2. In a pump or compressor, the combination with a cylinder having differential bores, of a differential piston fitted to said bores, said piston having a passage therethrough, a valve carried by said piston controlling said passage, a discharge-valve controlling discharge from the forward end of the larger cylinder-bore, said cylinder provided with an inlet-passage leading to the rear end of the smaller bore thereof at the rear of the smaller head of said differential piston, and a passage through the wall of the cylinder separating the differential bores, connecting the rear end of the larger cylinder-bore at the rear of the larger piston-head, with discharge.

3. In a pump or compressor, the combination with a cylinder having two bores, one of larger diameter than the other, of a differential piston having two heads fitted to the said bores, said cylinder provided with an inlet-passage at the rear end of the smaller bore, a discharge-passage at the forward end of said larger bore, and a port or passage leading from discharge to the rear end of said larger bore, a discharge-valve controlling the discharge-passage through the forward end of the larger cylindrical bore, and a valve carried by said piston, said piston provided with a passage therethrough controlled by said valve.

4. In a pump or compressor, the combination with a frame or bed comprising a box-like casing inclosing a chamber adapted to receive and retain lubricating-oil, and a casing-section supported by said box-like casing, of a pump-shaft arranged within said box-like casing but journaled in bearings dependent from said casing-section, said casing-section also provided with cross-head bearings, and pump-cylinders supported by said casing-section.

5. In a pump or compressor, the combination with a frame or bed comprising a box-like casing inclosing a chamber adapted to receive and retain lubricating-oil, and a casing-section supported by said box-like casing, of a pump-shaft arranged within said box-like casing, but journaled in bearings dependent from said casing-section, a worm-wheel mounted upon said pump-shaft, a worm engaging said worm-wheel, a drive-shaft carrying said worm and mounted in bearings transverse of the pump-shaft bearings, thrust-bearings therefor, including a plurality of annular recesses and flanges upon the drive-shaft, fitted thereto, pump-cylinders supported by said casing-section, and pistons in said cylinders, connected to, and operated by, said pump-shaft.

6. In a duplex double-acting pump or compressor, the combination with a frame or bed comprising a hollow box-like casing 2 and a bed-plate extension for supporting a motor, and an intermediate casing-section supported by said box-like casing, said intermdiate casing-section having inlet and exhaust chambers 27 and 30, and provided with cross-head bearings 12, of two separate cylinders 4, 4, secured to and supported by said intermediate casing-section, said cylinders each containing differential cylindrical bores and passages connecting with said inlet and discharge chambers, differential pistons 6 fitted to said cylinders, piston-rods 9 secured to said pistons, cross-heads 11 secured to the opposite ends of said piston-rods and mounted in the cross-head bearings 12, a pump-shaft 15 arranged in the box-like casing 2, bearings 16 therefor secured to and dependent from the intermediate casing-section 3, crank-pins or eccentrics 14 carried by said shaft 15, said crank-pins or eccentrics arranged at right angles to each other, connecting-rods 13 connecting said crank-pins or eccentrics with said cross-heads 11, a worm-wheel 17 mounted upon said pump-shaft 15, a drive-shaft 19, a worm 18 thereon engaging said worm-wheel 17, bearings 20 for said drive-shaft, and thrust-collars 21 between said bearings and said drive-shaft, the end of said drive-shaft projecting laterally from said box-like casing in the direction of the bed-plate extension.

7. In a pump or compressor, the combination with a vertically-arranged pump-cylinder, a piston, a piston-rod, a cross-head, and vertically-arranged slide-bearings for the said cross-head, said cross-head provided with an open-sided circular recess and a gully leading from said recess to the exterior face thereof, of means connected with said cross-head for reciprocating same.

8. In a pump or compressor, the combination with a frame or bed comprising a box-like casing inclosing a chamber adapted to receive and retain lubricating-oil, and a casing-section supported by said box-like casing, of a pump-shaft arranged within said box-like casing, but journaled in bearings dependent

from said intermediate casing-section, a worm-wheel mounted upon said pump-shaft, a worm engaging said worm-wheel, a drive-shaft carrying said worm and mounted in bearings transverse of the pump-shaft, thrust-bearings therefor, comprising a plurality of coengaging shoulders, said bearings provided with recesses open to the interior of said box-like casing, and hollow feed-channels leading from said recesses to various points in said thrust-bearings at different distances from the axis thereof, pump-cylinders supported by said casing-section, and pistons in said cylinders connected to and operated by said pump-shaft.

In witness whereof I have hereunto set my hand this 2d day of March, 1904.

MILAN W. HALL.

Witnesses:
C. F. CARINGTON,
C. L. HALL.