H. W. CHENEY.

LIQUID RHEOSTAT.

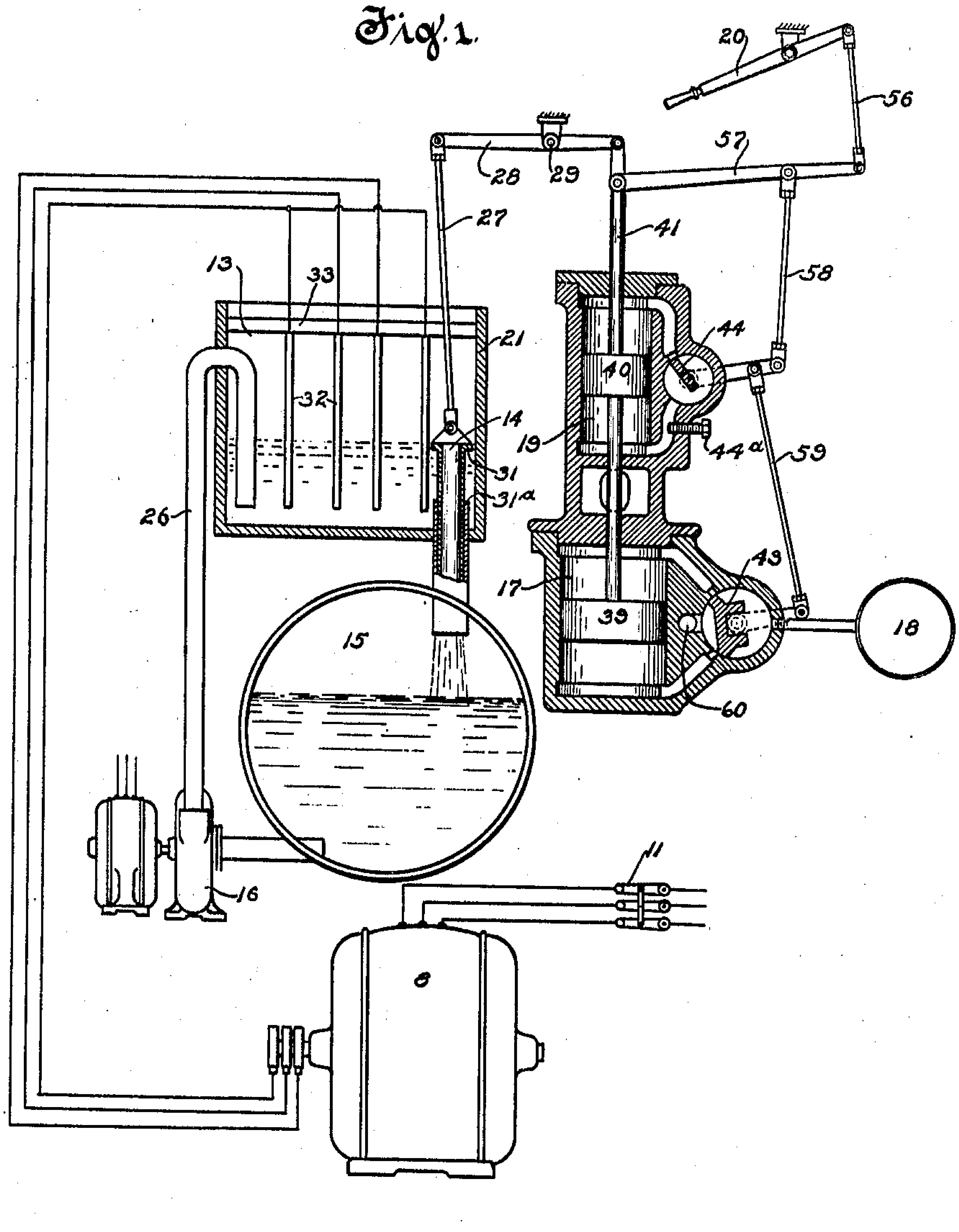
APPLICATION FILED SEPT. 6, 1910.

993,027.

Patented May 23, 1911.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses

John L. Johnson

Chas. L. Byron.

Inventor

Herbert W. Cheney

By Chas. E. Lord

Attorney

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2 SHEETS—SHEET 2.

Fig. 2.

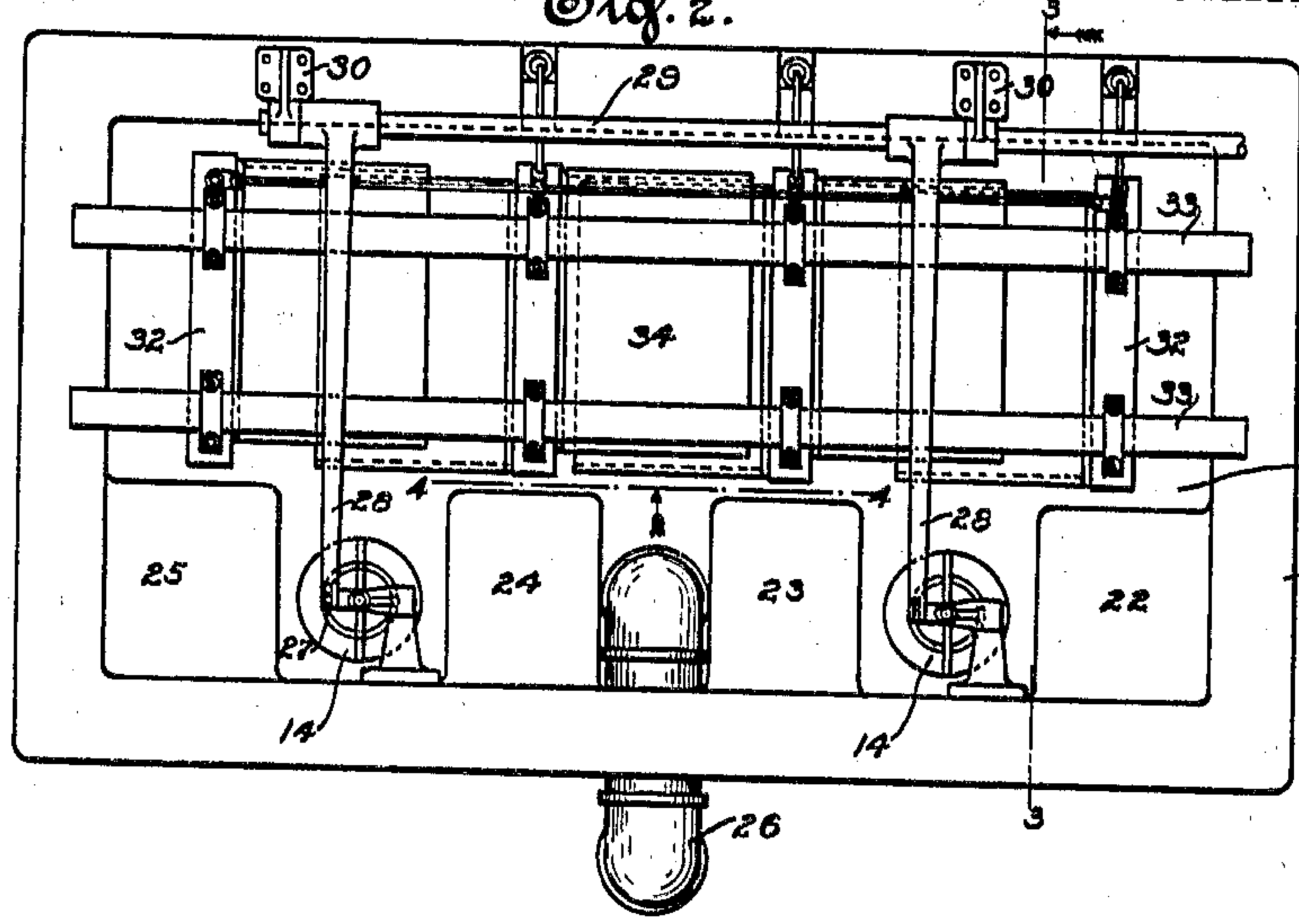


Fig. 3.

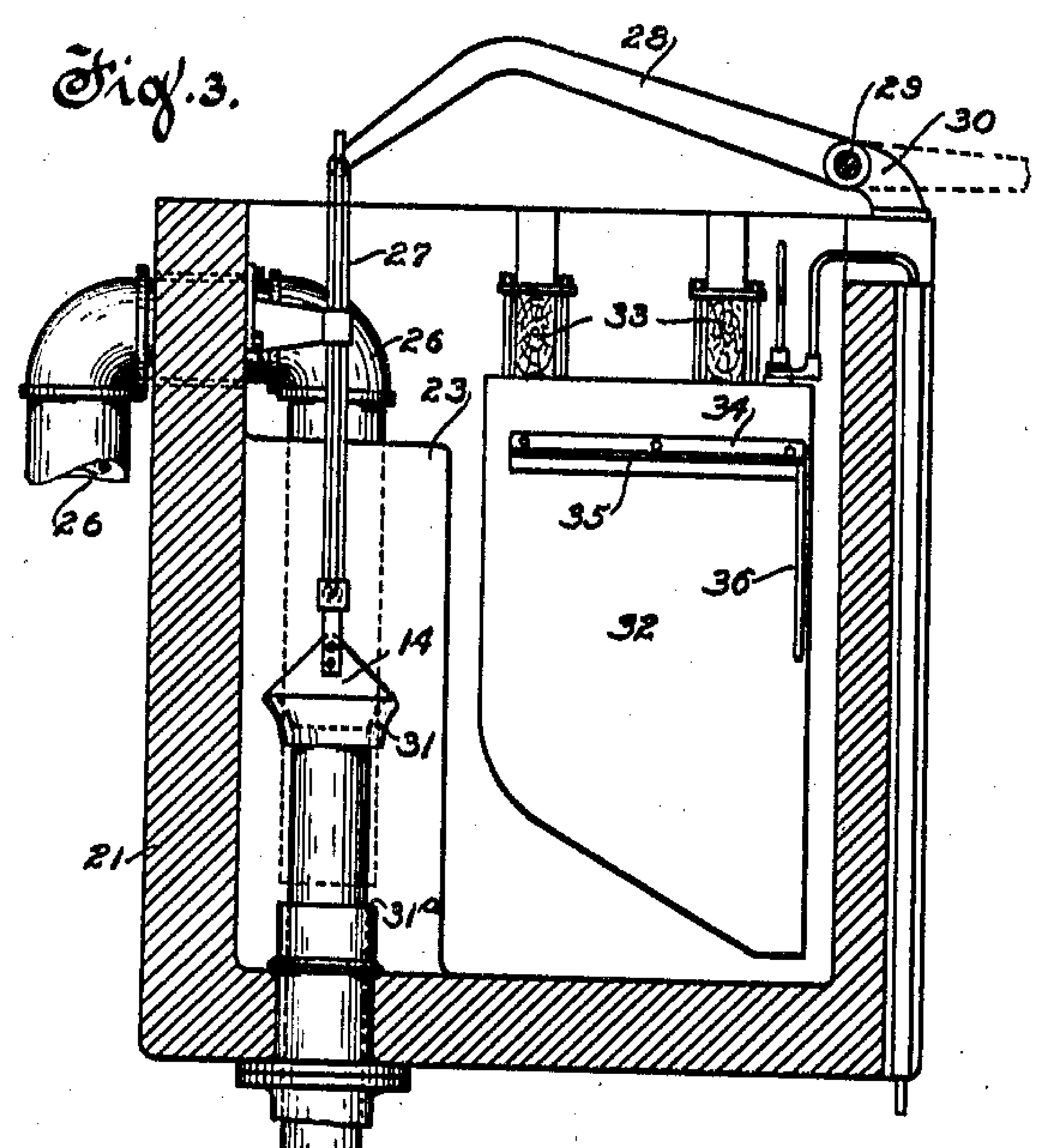
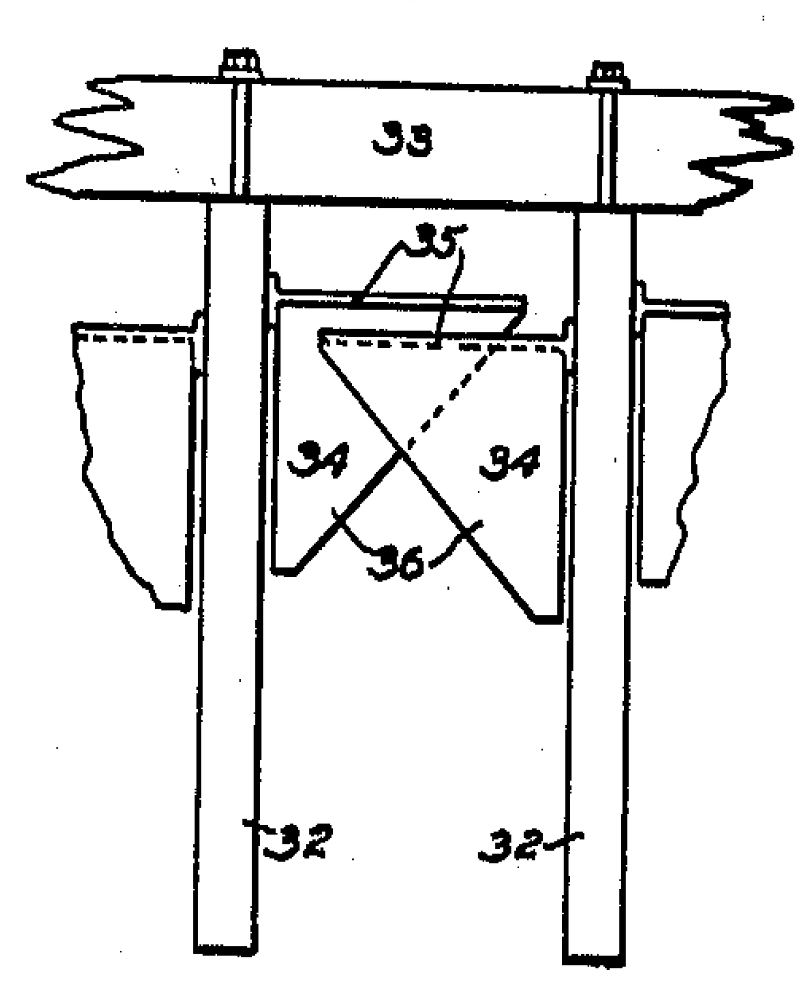


Fig. 4.



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By Chas. E. Lord
Attorney

UNITED STATES PATENT OFFICE.

HERBERT W. CHENEY, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO ALLIS-CHALMERS COMPANY, A CORPORATION OF NEW JERSEY.

LIQUID RHEOSTAT.

993,027. Specification of Letters Patent. Patented May 23, 1911.

Original application filed April 15, 1910, Serial No. 555,624. Divided and this application filed September 6, 1910. Serial No. 580,544.

To all whom it may concern:

Be it known that I, HERBERT W. CHENEY, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Liquid Rheostats, of which the following is a full, clear, and exact specification.

My invention relates to liquid rheostats.

The present application is a division of my co-pending application Serial No. 555,624, filed April 15, 1910.

Liquid rheostats of large size require considerable power for their operation. I therefore propose to provide power-operated means for operating the liquid rheostat, there being a number of novel features both in the rheostat proper and its operating means. By reason of these new features, the operator has his physical labor materially lightened and the size of the liquid rheostat proper is much reduced. Moreover, in case the rheostat is used for polyphase systems, its structure provides for preventing or counter-acting any tendency toward unbalancing.

The various novel features of my invention will be apparent from the description and drawings, and will be particularly pointed out in the claims.

Figure 1 is a diagrammatic view showing my improved liquid rheostat connected for controlling the resistance of the secondary circuit of an induction motor; Fig. 2 is a plan view of a liquid rheostat constructed in accordance with my invention; Fig. 3 is a section on the line 3—3 of Fig. 2; and Fig. 4 is a detail view taken substantially on the line 4—4 of Fig. 2.

The device to be controlled is here illustrated as a three-phase motor 8 having its primary supplied from a suitable source of alternating current, and its wound secondary connected to the plates of a liquid rheostat 13 constructed in accordance with my invention. The resistance of the rheostat is varied by adjusting the level of the liquid therein by varying the height of one or more overflow pipes or weirs 14, the liquid overflowing into a tank 15; from which it is pumped, as by a motor-driven centrifugal pump 16, into the rheostat 13. This continuous circulation of the liquid, which is preferably acidulated water, reduces the temperature of the rheostat and enables a much smaller rheostat to be used for the work than could otherwise be used. The weirs 14 are operated by an air engine 17, air under pressure being supplied from any suitable source 18. The engine is provided with an oil lock 19, which prevents its accidental movement. If desired, the oil lock may be omitted, or a suitable dashpot or cataract may be substituted for it. The direction and extent of the movement of the air engine are controlled by the master control lever 20.

The rheostat 13 has a casing 21, which is preferably provided with four interiorly projecting abutments 22, 23, 24, and 25. This casing may be made of any desired material, concrete being especially suitable. Water is supplied to the casing through the inlet pipe 26, which extends from the pump 16, enters the rheostat near the top, and passes downward almost to the bottom between the abutments 23 and 24. By this means much obnoxious splashing is avoided. In the arrangement shown there are two overflow pipes or weirs 14, these being located respectively between the abutments 22 and 23, and 24 and 25. The abutments prevent the passage of the liquid directly from the inlet pipe to the overflow weirs. The weirs 14 are swung by links 27 from arms 28 fixed on a shaft 29, the latter being preferably supported in bearings 30 on the casing 21. The shaft 29 is rotatable by the air engine 17, through suitable connecting mechanism. The downward movement of the weirs 14 is limited by coöperating shoulders 31 and 31ª, so located that the level of the water in the casing 21 is always sufficiently high to cover the lower ends of the rheostat plates 32. These rheostat plates 32 are suspended from two bars 33 which extend lengthwise across the casing 21 near its top. The bars 33 are preferably of wood or other insulating material, though they may be of conducting material if other suitable provision is made for insulating the plates 32 from one another. There are four plates 32, the two outer plates being connected together and to one lead from the secondary of the motor 8, and the two inner plates being connected to the other two leads respectively. The distance between the various plates 32 is adjustable so that the resistances of the several phases of the secondary circuit of the motor may be made equal. It is evident, and is found to be the case in practice, that this equality is obtained by making the distance between the two inner plates less than that between either inner plate and the adjacent outer plate. Thus unbalancing of the system is avoided. Near the top on both sides of the inner plates 32 and on the inner sides of the outer plates 32 there are mounted auxiliary plates 34 which have horizontal portions 35 and vertical portions 36. The vertical portions 36 increase extra proportionately the effective superficial conducting area of the plates 32 to which they are attached as the water level in the water rheostat approaches its upper limit, and the horizontal portions 35 which project from the adjacent sides of adjacent plates 32 overlap each other quite closely, as indicated in Fig. 4, so that when the water level in the rheostat reaches its upper limit the main part of the rheostat is in effect short-circuited.

When the handle of the master control lever 20 is in the off or uppermost position and the motor 8 is at rest, the pistons 39 and 40 of the air engine 17 and its oil lock 19 respectively are in their uppermost position, the valves 43 and 44 of the air engine and its lock respectively are in their middle or closed position, and the weirs 14 are in their lowermost or maximum resistance positions. The pump 16 may be either in motion or at rest, but should be set in motion before starting the motor 8. To start the motor, its primary circuit is closed, as by the switch 11. Then the master control lever 20 is moved downward. This movement is communicated, through the link 56, the floating lever 57, and the links 58 and 59, to the valves 43 and 44, moving said valves in a counter-clockwise direction to admit air pressure from the source 18 to the space above the piston 39 of the air engine and to connect the space below such piston to the atmosphere through the exhaust 60, and to open the valve 44 to allow oil to pass from the space below the piston 40 to the space above such piston. The rate at which it may pass is determined by the extent of the opening of the valve 44; and also, if desired, by a screw 44[a] by which the maximum rate may be set. The pressure above the piston 39 now moves such piston and the parts connected therewith in a downward direction, this movement being transmitted from the piston rod 41 through the arm 28, shaft 29, and links 27 to raise the weirs 14. This raises the level of the water in the rheostat and decreases the resistance in the secondary circuit of the motor 8, thereby increasing the speed of the motor. The piston rod 41 in its downward movement also moves downward the left hand end of the floating lever 57, thus gradually closing the valves 43 and 44. The distance which the piston rod 41 must move in order to close the valves 43 and 44 and stop the movement of the rod, depends upon how far the master control lever 20 has been moved from its off position; for, for each position of the control lever 20, there is a corresponding ultimate position for the piston rod 41 and the parts operated thereby. Thus the level of the water in the rheostat 13 will rise to a height determined by the position of the lever 20.

To increase the resistance of the rheostat, the lever 20 is moved upward. This movement is transmitted to the valves 43 and 44 to admit air pressure below the piston 39 and to connect the spaces on the two sides of the piston 40. The air pressure beneath the piston 39 raises such piston and the piston rod 41 to lower the weirs 14, thus lowering the level of the water in the rheostat and increasing the resistance of the secondary circuit of the motor 8. The downward movement of the weirs continues until either the floating lever 57 is moved to close the valves 43 and 44 or the shoulders 31 and 31[a] engage.

Many modifications may be made in the precise arrangement shown and described, and all such which do not involve a departure from the spirit and scope of my invention I aim to cover in the following claims.

What I claim as new is:

1. A liquid rheostat for polyphase circuits, comprising a casing containing liquid, a plurality of plates immersed in such liquid and substantially in line with one another, there being one more plate than there are number of phases and the two outside plates being connected.

2. A liquid rheostat for three phase circuits, comprising a casing containing liquid, four plates dipping into such liquid and arranged substantially in line, the two outer plates being connected together and arranged for connection to one lead of the three phase circuit, while the other plates are arranged for connection respectively to the other two leads of the circuit.

3. A liquid rheostat comprising a casing containing liquid, a plurality of electrically disconnected plates dipping into the liquid in said casing and arranged substantially in line, and means above the level of the liquid for supporting said plates so that the distance between adjacent plates is adjustable while the angle between the plates is maintained constant.

4. A liquid rheostat for three phase circuits, comprising a casing containing liquid, four plates dipping into said liquid and arranged substantially in line, the two outer plates being connected together and ar-

ranged for connection to one lead of the circuit and the other two plates being arranged to be connected respectively to the other two leads of the circuit, the distance between the two inner plates being less than that between either inner plate and the adjacent outer plate.

5. In a liquid rheostat, a casing containing liquid, a plurality of substantially parallel plates arranged substantially in line and dipping into said liquid, said plates being provided with projections toward their upper ends to increase the effective contacting surface of the plates, the projections extending from adjacent sides of adjacent plates overlapping, and means for varying the distance which said plates dip in the liquid of the rheostat.

6. In a liquid rheostat, a casing containing liquid, a plurality of plates dipping into said liquid, said plates being provided with projections toward their upper ends to increase the effective contacting surface of the plates, and means for varying the distance which said plates dip in the liquid of the rheostat.

7. In a liquid rheostat, a casing containing liquid, a plurality of plates dipping into said liquid, said plates being provided near their upper ends with horizontal flat projecting portions which extend toward the adjacent plates and overlap similar projecting portions from such adjacent plates, and means for varying the height of said plates relatively to the level of the liquid in the rheostat.

8. In combination, a casing for a liquid rheostat, a plurality of electrodes within the casing, a plurality of overflow weirs, means for adjusting the vertical height of said weirs, and means for supplying liquid to the casing.

9. In combination, a casing for a liquid rheostat, a plurality of electrodes within the casing, an inlet pipe through which liquid may be supplied to the casing, a discharge conduit, and an abutment projecting between the inlet pipe and the discharge conduit.

10. In combination, a casing for a liquid rheostat, a plurality of electrodes within the casing, an inlet pipe through which liquid may be supplied to the casing, two discharge conduits located respectively on opposite sides of the inlet pipe, and an abutment from the casing between the inlet pipe and each discharge conduit.

11. In a liquid rheostat, a casing containing liquid, a plurality of electrically disconnected plates arranged substantially in line, said plates being provided toward their upper ends with projections which extend toward adjacent plates to decrease the effective distance between adjacent plates as the plates dip farther into the liquid of the rheostat, and means for varying the distance which said plates dip in the liquid in the rheostat.

Milwaukee, Wis., Aug. 17, 1910.

In testimony whereof I affix my signature, in the presence of two witnesses.

HERBERT W. CHENEY.

Witnesses:
CHAS. L. BYRON,
JOHN L. JOHNSON.