No. 845,618.

PATENTED FEB. 26, 1907.

C. DE KANDO.

AUTOMATICALLY OPERATED LIQUID RHEOSTAT.

APPLICATION FILED MAY 6, 1905.

3 SHEETS—SHEET 1.

Fig. 1.

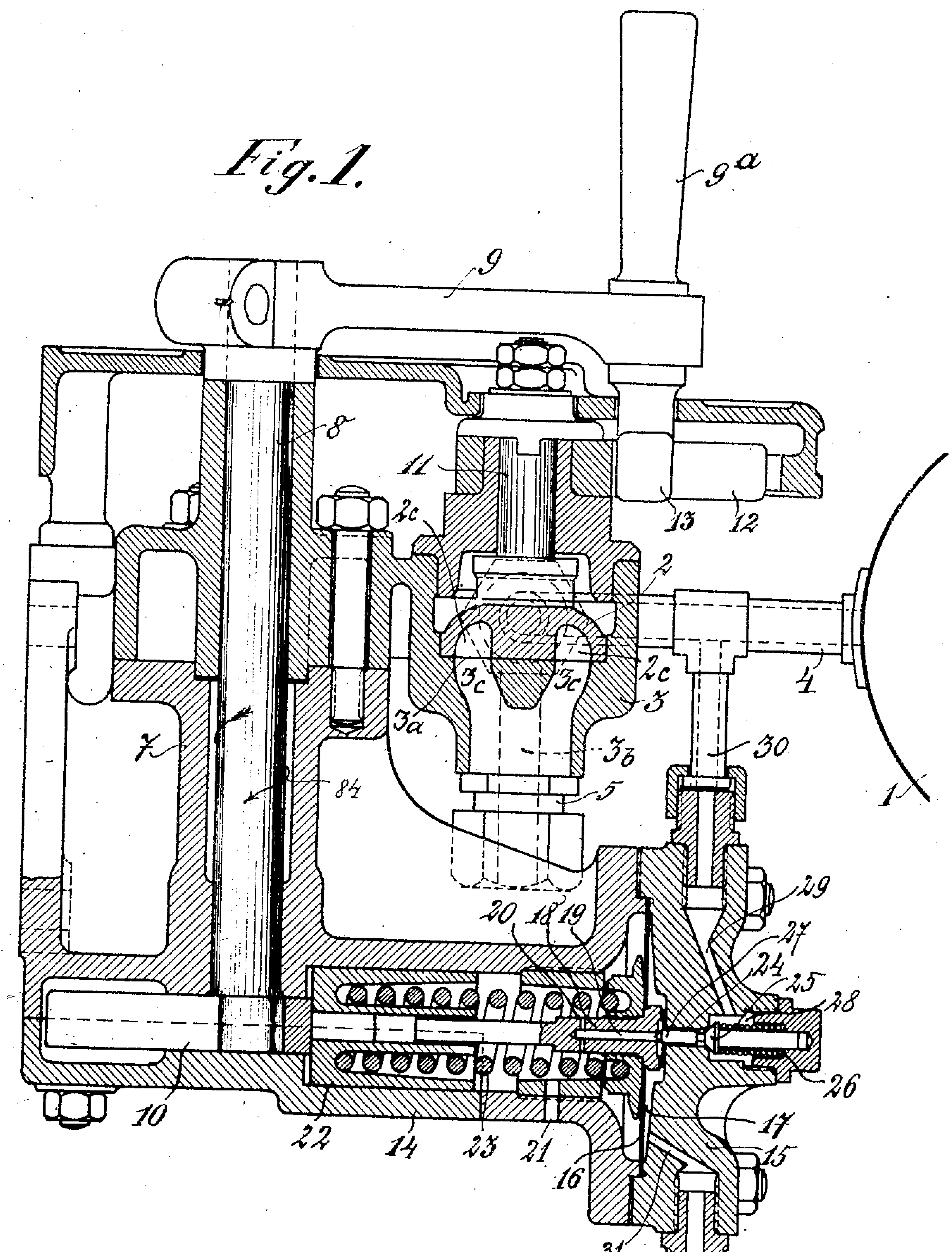

Fig. 2.

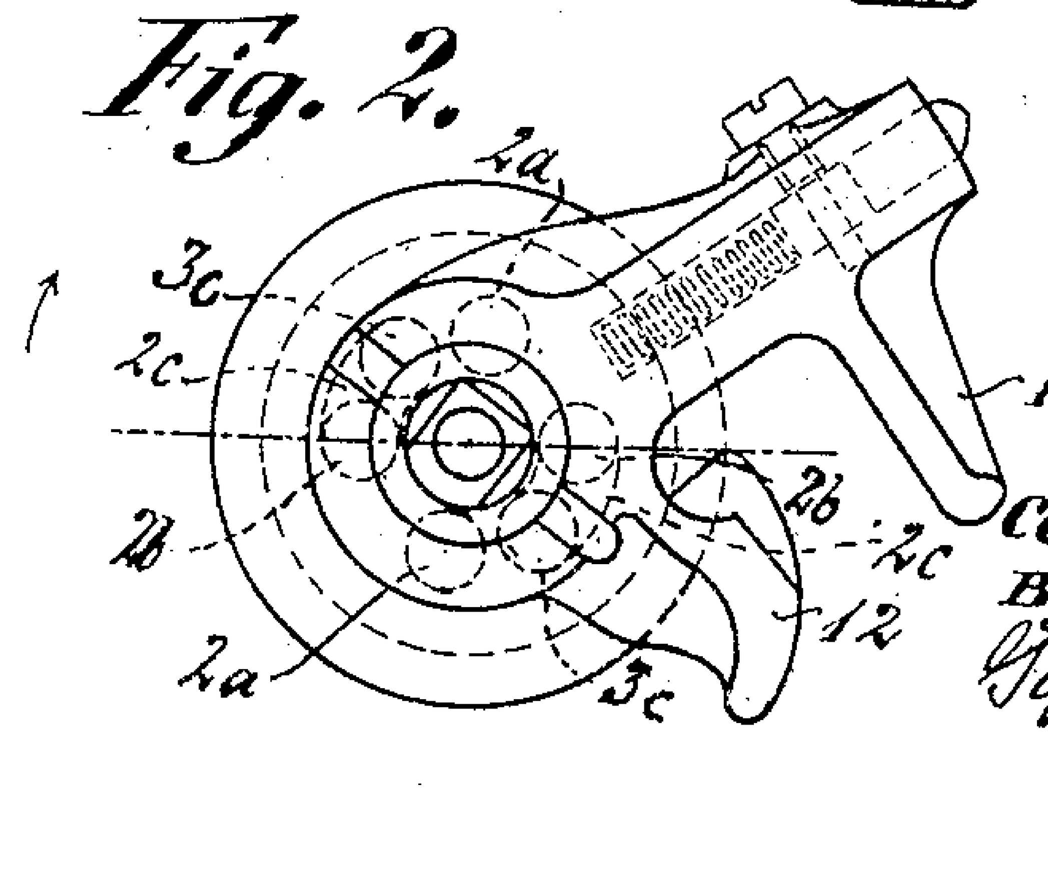

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Fig. 4.

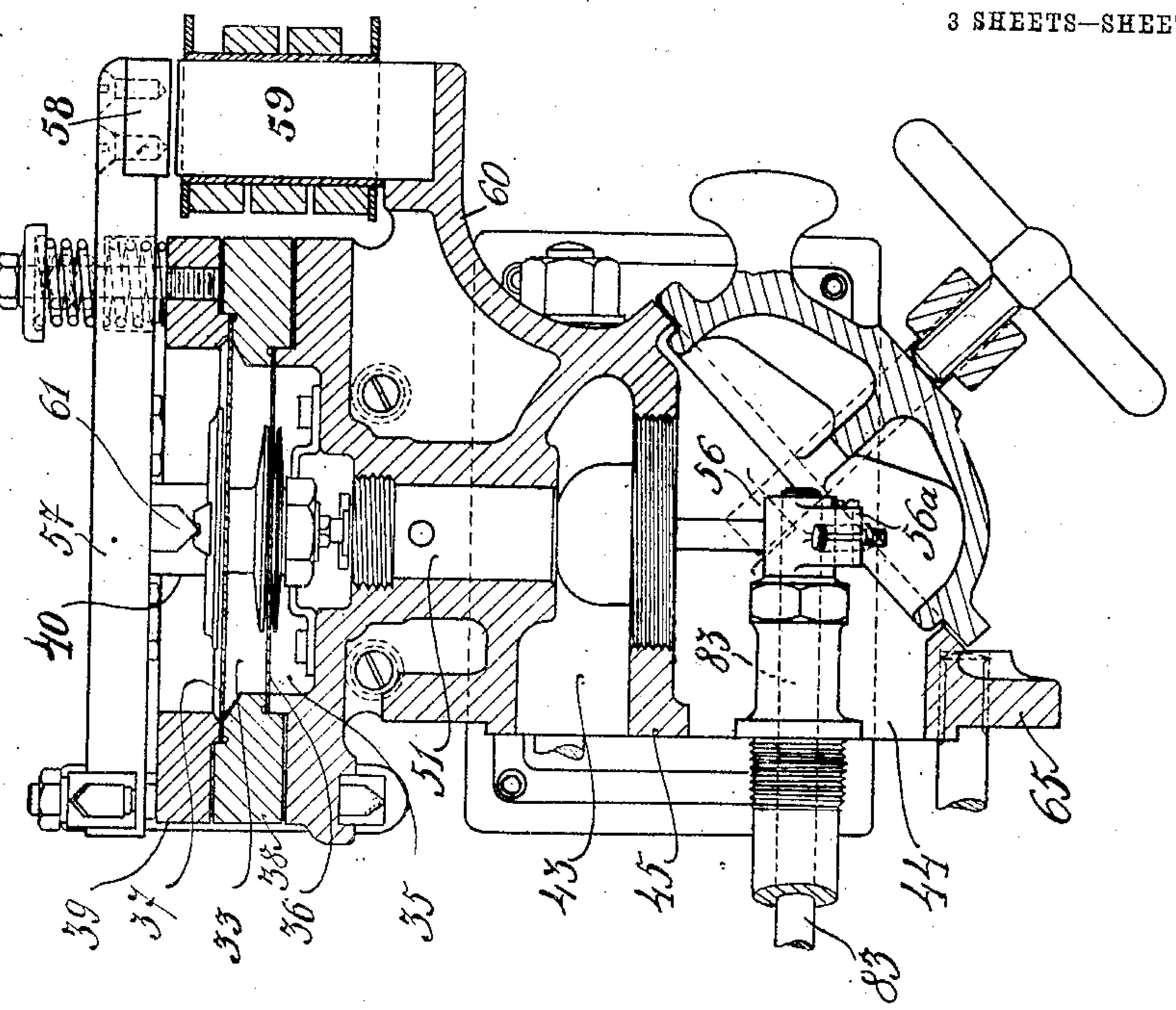
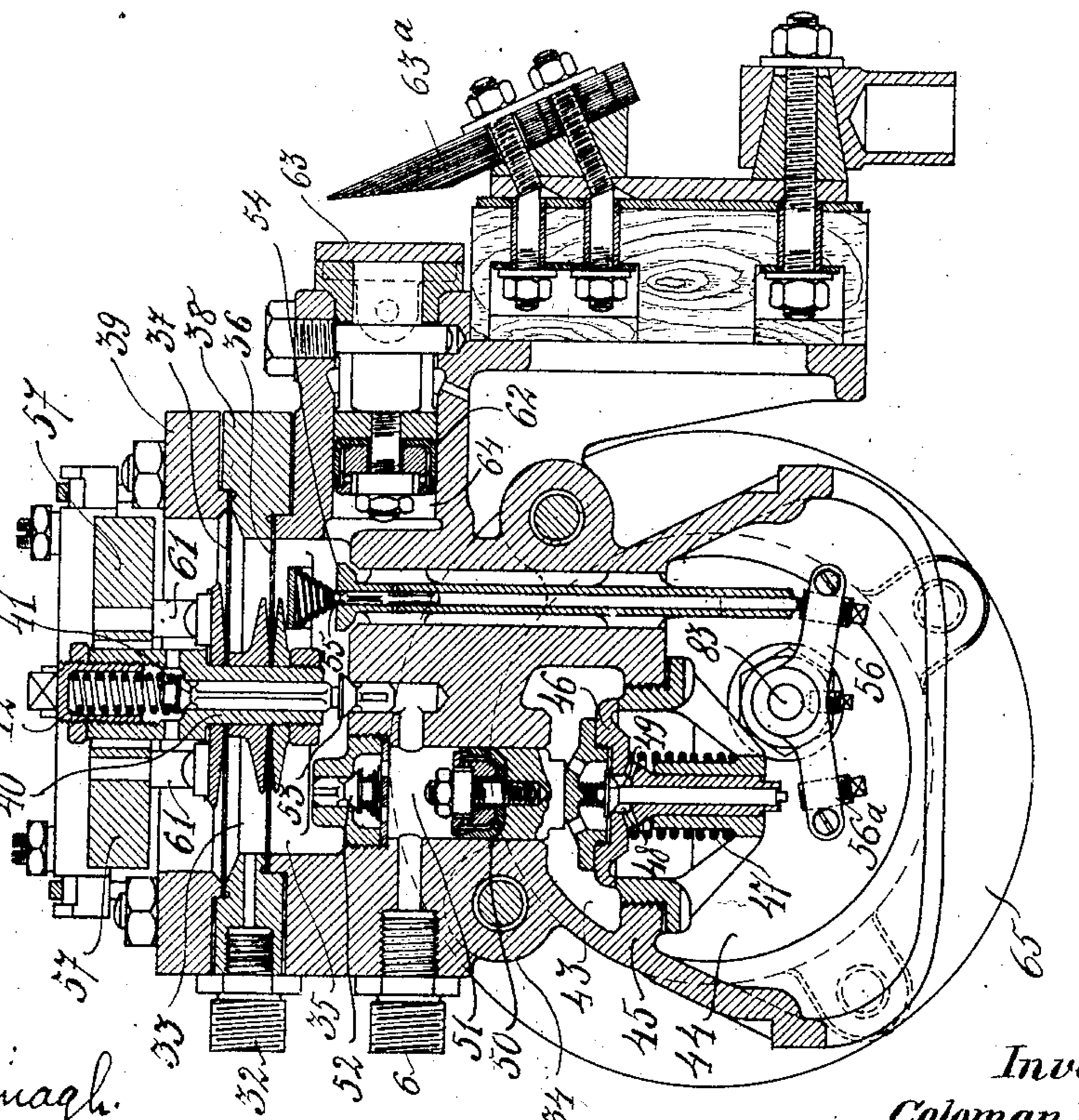


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 5.

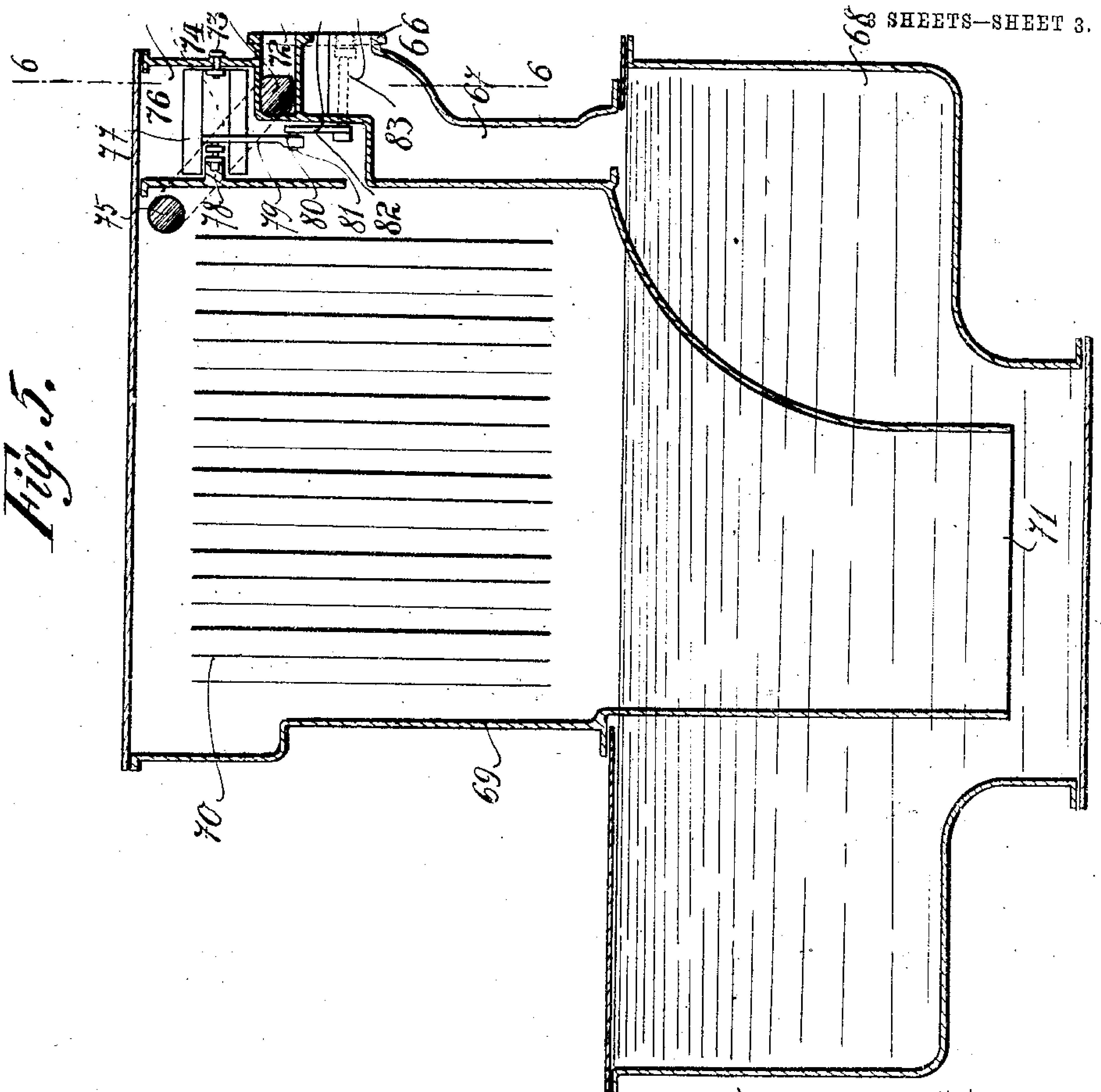


Fig. 6.

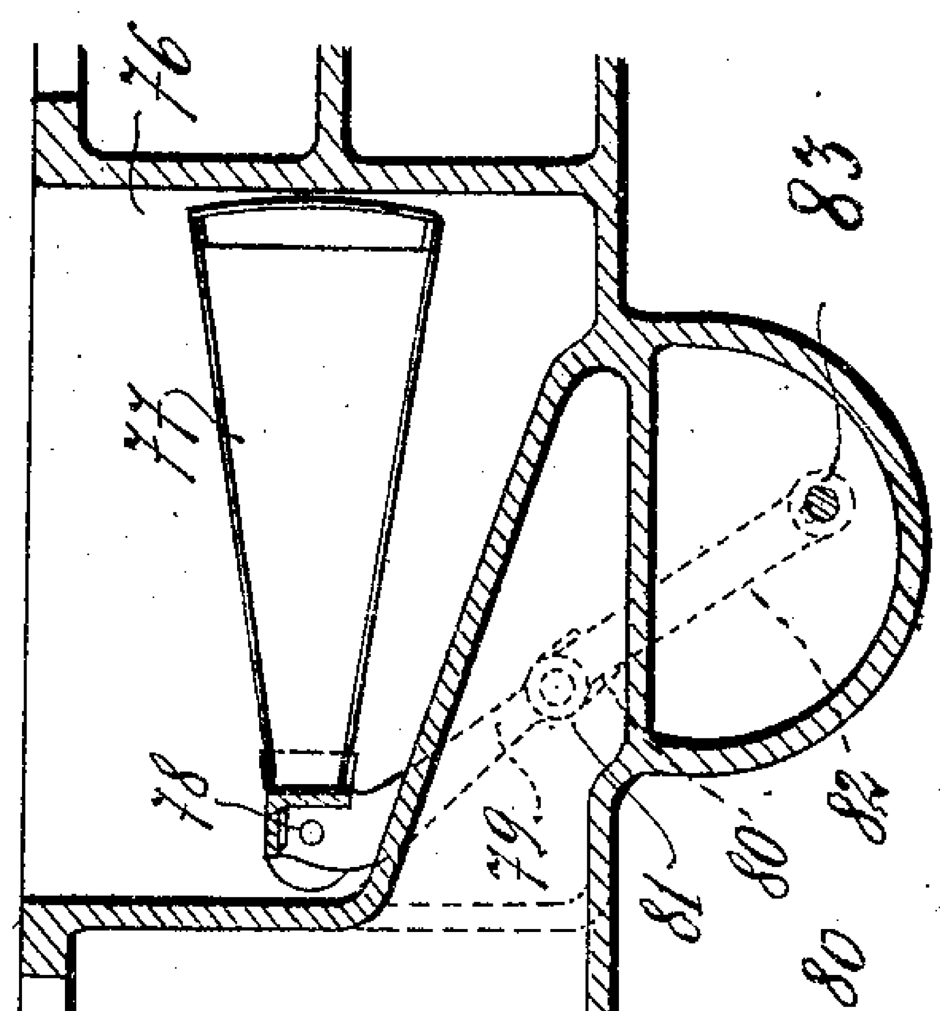


Fig. 7.

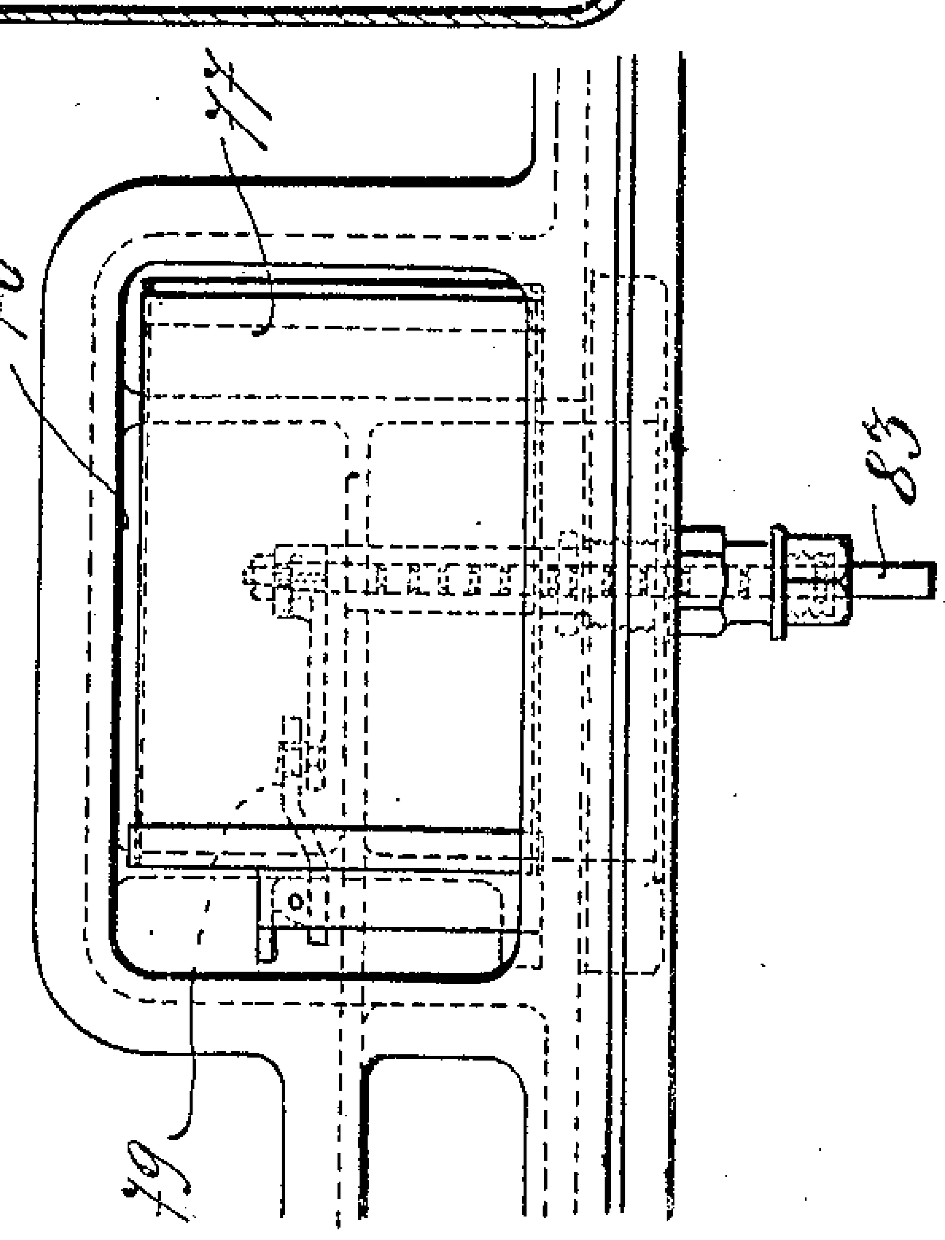
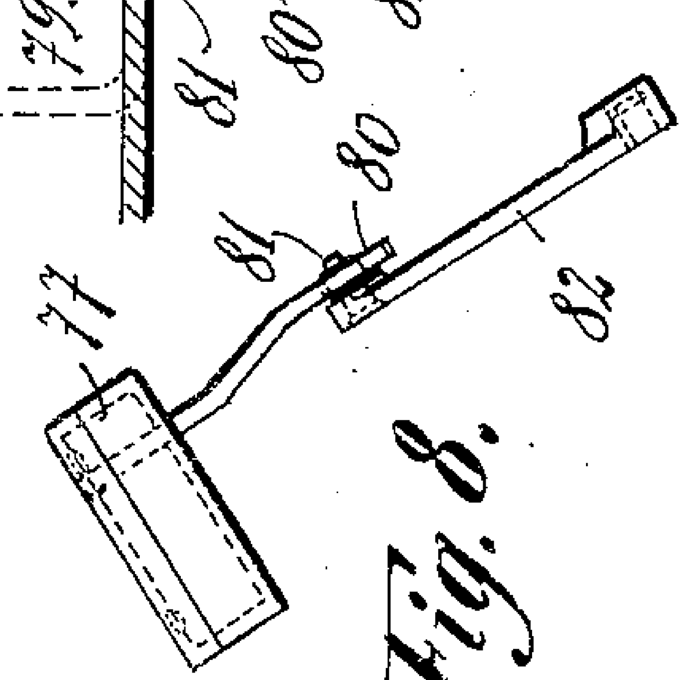


Fig. 8.



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UNITED STATES PATENT OFFICE.

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AUTOMATICALLY-OPERATED LIQUID-RHEOSTAT.

No. 845,618. Specification of Letters Patent. Patented Feb. 26, 1907.

Application filed May 6, 1905. Serial No. 259,245.

To all whom it may concern:

Be it known that I, COLOMAN DE KANDO, a subject of the King of Hungary, and a resident of Budapest, in the Kingdom of Austria-Hungary, have invented certain new and useful Improvements in Automatically-Operated Liquid-Rheostats, of which the following is a specification.

My present invention relates to liquid-rheostats; and it consists of certain novel parts and combinations of parts particularly pointed out in the claims concluding these specifications.

In the accompanying drawings I have shown my invention embodied in the form at present preferred by me; but it will be understood that various modifications and changes may be made without departing from the spirit of my invention and without exceeding the scope of my claims.

In the accompanying drawings, Figure 1 is a sectional elevation of the controlling device. Fig. 2 is a detail of the same. Fig. 3 is a sectional elevation of the rheostat-controlling valve; Fig. 4, a sectional elevation on a plane perpendicular to Fig. 3, the valves being omitted. Fig. 5 is a diagrammatical sectional elevation of the liquid-rheostat. Fig. 6 is a section on the line 6 6 of Fig. 7. Fig. 7 is a plan view of Fig. 6. Fig. 8 is a front elevation of the float shown in Fig. 6.

Referring to Fig. 1, 1 is the reservoir containing compressed air, only a part of which is shown in the drawings. 2 is a sliding valve controlling the passage of compressed air from the reservoir 1 toward the rheostat. 3 is the casing of the valve 2, said casing being connected above the valve by means of the pipe 4 to the reservoir 1. 7 is a support in which the spindle 8 is journaled. The upper end of said spindle bears the controlling-lever 9 with a handle 9^a, and on the lower end of the spindle is secured a cam 10. The spindle 11 of the sliding valve 2 is provided with a double cam 12 12^a, (see Fig. 2,) engaged by a stud 13, extending downward from the handle 9^a. The valve 2 is provided with two openings 2^a, Fig. 2, corresponding to the two openings 2^b of the sliding face 3^a of the valve-casing. The openings 2^b are connected by means of a channel 3^b and a pipe-joint 5 to a pipe (not shown) leading to a pipe-joint 6 of the rheostat-valve, Fig. 3. The sliding face of the valve-casing has further openings 3^c communicating with the atmosphere. When the slide-valve is in the position shown in Figs. 1 and 2, the cavities 2^c of the valve establish communication between the openings 3^b and 3^c of the sliding face, thus connecting the pipe leading to the rheostat or rheostats with the atmosphere. By turning the valve to the position in which the openings 2^a of the valve correspond with the openings 3^a of the sliding face compressed air is admitted through the valve from the pipe 4 to the rheostat.

The lower part of the support 7 is provided with a bracket, on which is formed a hollow cylinder 14, closed by a cover 15. Between the flanges of the cylinder and the cover is fitted a membrane 16, forming, with the cover, a chamber 17. In the center of the membrane is fixed a plug 18 with a central boring 19 and with radial borings 20, establishing communication between the boring of the plug and the cylinder 14, which latter communicates with the atmosphere through the opening 21. A piston 22 is arranged to slide in the cylinder 14, and a spring 23 is located between the plug 18 and piston 22. The cover 15 is provided with a central boring 24, controlled by a valve 25, subjected to the pressure of a spring 26. The stud 27 of the valve 25 projects with its tapered end into the opening of the boring 19 and acts as a valve shutting said boring toward the chamber 17. A channel 29 and a pipe 30 connect the valve-chamber 28 of the cover 15 with the compressed-air conduit 4. The chamber 17 communicates, through the channel 31, by means of a pipe (not shown) connected to the pipe-joint 32, Fig. 3, with the chamber 33.

The automatic controlling device (shown in Figs. 3 and 4) comprises a casing 34 with an upper valve-chamber 35, closed by a membrane 36 and the membrane-chamber 33, formed between the membrane 36, the ring 38, secured to the upper flange of the casing 34, and the membrane 37, of somewhat larger diameter than the membrane 36 and held in place by a ring 39. The membranes 36 and 37 are connected to each other by a hollow plug 40, passing air-tight through said membranes and containing a valve 41, controlled by the spring 42, interrupting communication between the valve-chamber 35 and the atmosphere. The lower valve-chamber is divided by the division-wall 45 in two parts 43 44, and communication between the two parts is controlled by a valve 46, lifted by a spring 47. The valve 46 is provided with a central boring 48, shut by a small spring-controlled valve 49, the stem of which is guided in an axial boring of the stud of the valve 46 and projects out of the same. Between the upper and lower valve-chambers a piston 50 is fitted in a cylindrical chamber 51 and bears on the valve 46. This latter chamber communicates, through two valves 52 and 53, with the upper valve-chamber, the former valve shutting and the latter valve opening toward the valve-chamber 35. A valve 54 controls the communication between chamber 35 and chamber 44. In an axial boring of the stem of the valve 54 is fitted a small valve 55, the stem of which projects from the lower end of the stem of the valve 54 and bears on the two-armed lever 56.

On the casing 34 is pivoted a lever 57, with an armature 58 on its free end, (see Fig. 4,) controlled by an electromagnet 59, mounted on a bracket 60 of the casing 34. On the lever 57 projections 51 are provided, which bear against the plug 40 of the membranes 36 37. A piston 62, Fig. 3, actuating a switch-plate 63, is fitted in a cylinder 64, communicating with the upper valve-chamber 35. 33^a is one of the contact-brushes, connected with the secondary windings of the induction-motor to be controlled, short-circuiting the secondary windings when the switch-plate 63 is in contact therewith.

The flange 65 of the valve-casing, Fig. 3, is secured to the flange 66 of the rheostat-chamber, Fig. 5. The rheostat comprises an air-chamber 67, forming the upper part of the water-tank 68 and the rheostat-room 69, containing the well-known rheostat-plates 70, (shown only schematically,) connected in the usual manner with the secondary winding of the induction-motor to be controlled. The lower part of the rheostat-room communicates through an opening 71 with the lowest part of the water-tank. When the valve-casing 34 is mounted on the rheostat, the lower valve-chamber 44, Fig. 3, connects with the air-chamber 67, Fig. 5, of the rheostat, while the chamber 43, Fig. 3, connects with the chamber 72, Fig. 5, of the rheostat. This latter chamber 72 communicates through the opening 73, channel 74, and opening 75 with the rheostat-room 69.

The rheostat comprises, further, a float-chamber 76, (shown in detail in Figs. 6 and 7,) which chamber is arranged on the upper end of the rheostat and communicates with the bottom with the rheostat-room 69. The float 77 is journaled by pivots 78 in the float-chamber 76. A downwardly-projecting arm 79 engages with its bifurcated end 80 a pin 81 of a lever 82, pivoted on a shaft 83, projecting into the chamber 44 of the valve-casing and bearing on this end the two-armed lever 56, Figs. 3 and 4.

Fig. 4 shows, on an enlarged scale, the rheostat-head, adapted for attachment at the upper right-hand side to the rheostat shown in Fig. 5. When attached, the chamber 43, Fig. 4, of the rheostat-head is directly in communication with the chamber 72, Fig. 5, of the rheostat, and the chamber 44, Fig. 4, of the rheostat-head is directly in communication with the chamber 83, Fig. 5, of the rheostat. Hence the diaphragm 45, Fig. 4, of the rheostat-head abuts against the diaphragm between the chambers 72 and 83 of Fig. 5 of the rheostat.

The operation of the device may be thus described. In the position shown in the drawings the motor is at rest. Communication between the compressed-air reservoir and the rheostat is then closed by the valve 2, and the rheostat is connected, through the valve 2, with the atmosphere. The spring 23 is loose. The valve 25 is closed, and the stem of said valve leaves free the opening of the boring 19, so that the chamber 17, and thus the membrane-chamber 33, Fig. 3, are at atmospheric pressure. At this time the spring 47 holds the valve 46 open, thereby putting the rheostat-chambers 67 and 69 in communication, so that the water will be on the same level in the chamber 69 and the tank 68 and will not touch the rheostat-plates 70. The float-chamber 76 is empty and the float 77 is in its lowest position, and hence the lever-arm 56 is in its highest position, lifting the valve 54 from its seat. The short-circuiting switch 63 63^a is open, the piston 62 being held in the position illustrated by a spring. (Not shown.) For starting the motor the lever 9 is turned in the direction of the arrow 84, (on the shaft 8, Fig. 1,) whereby the pin 13 acts on the cam 12 and turns the sliding valve 2 in the position establishing communication between the compressed-air reservoir 1 through the channel 3^b with the chamber 51 of the rheostat-valve, Fig. 3. The compressed air arriving in the chamber 51 exerts a pressure on the piston 50, which presses the valve 46 on its seat, thus interrupting the communication between the rheostat-chambers 67 and 69, Fig. 5. The compressed air is then lifting the throttle-valve 53 and is passing through it and through the valve 54, which is held open by the float in the chamber 76, Fig. 6. The compressed air therefore enters chamber 67, Fig. 5, exerting a pressure on the liquid in the tank 68 and causing it to flow into the rheostat-room 69. The air, throttled by the valve 53, which valve has only a slight play, is finding free passage through the valve 54, so that while full pressure will be in the chamber 51, yet in the chamber 35 the pressure of the air will be nearly atmospheric, exceeding this only by an amount equal to the difference of the liquid-levels in the chambers 69 and 68 of the rheostat. As soon as the liquid rises in the room 69 sufficiently to reach the rheostat-plates 70 current begins to flow through the rheostat, and therefore through the windings of the electromagnet or solenoid 59, arranged in the rheostat-circuit. The electromagnet excited by this current begins to attract its armature 58, and thus to exert a certain pressure, depending on the current strength, on the plug 40, transmitted by the valve 41, standing under the pressure of the spring 42, to the throttle-valve 53. The strength of the current will thus balance the admission of the compressed air through the throttle-valve to the rheostat, admitting a certain constant starting-current intensity—that is, a constant starting effort. However, it may be required to vary this constant starting-current intensity or starting effort. For this purpose the controlling-lever 9 is turned further in the direction of the arrow 84, Fig. 1, when the pin 13 will come out of engagement with the cam 12. The valve 2 will then keep the position to which it was set and may be fixed in that position in any suitable manner. Hereafter the cam 10, turning with the spindle 8 of the controlling-lever, begins to engage with the piston 22 and to push it forward, compressing the spring 23 and pushing the plug 18 against the stem 27 of the valve 25, the effect of which is to close boring 19 and to open valve 25. The compressed air now passes from pipe 30 through channel 29 and chamber 28 into the chamber 17 and thence through the channel 31 and a connecting-pipe leading to the pipe-joint 32, Fig. 3, into the membrane-chamber 33. The pressure in chamber 17 exerted on the membrane 16 is equal to the pressure of the spring 23. Hence the pressure on the opposite sides of the membrane is balanced, and the membrane tends to return to its initial position, while the stem 27 holds the boring 19 still closed. At this moment the valve 25 closes, interrupting communication between the chamber 17 and the compressed-air supply. The pressure in the membrane-chamber 33 corresponds to the pressure in the chamber 17, because they are in free communication, and therefore to the tension of the spring 23. If the pressure in the chambers 33 and 17 is decreased owing to escape of air, the pressure of the spring 23 overcomes that of the compressed air and opens again the valve 25 until the pressure in chambers 33 and 17 corresponds to the tension of spring 23. Owing to the fact that the upper membrane 37 is of larger diameter than the lower membrane 36, the pressure in the chamber 33 will produce an inflation of the whole chamber toward the larger membrane, thereby lifting the plug 40 against the pressure produced by the electromagnet 59, and hence allow the throttle-valve a larger lift and permit a more ample admission of compressed air to the rheostat. If the starting-current is too great and should be decreased, the lever 9 will be turned in the reverse direction and the pressure of the spring 23 diminished. The pressure of the compressed air acting on the membrane 16 then removes the stud 18 from the stem 27, so that compressed air can escape through the borings 19, 20, and 21 until the pressure in the membrane-chamber 33 corresponds to the diminished pressure of the spring 23. When the starting-current increases, the pressure exerted by the electromagnet on the plug 40 is transmitted by the stem of the valve 41 on the throttle-valve 53, so that this latter diminishes or interrupts totally the admission of compressed air to the rheostat until the speed of the motor increases and the starting-current decreases correspondingly. If the current rise is very considerable, as when the resistance of the rheostat liquid is decreased by reason of heating, the plug 40 will be pressed so far down by the action of the electromagnet that the stem of the valve 41 abuts on the valve 53, whereupon the plug 40 leaves the valve 41, and compressed air will escape from the rheostat through this valve until the lever of the rheostat liquid has dropped in the chamber 69, Fig. 5, far enough to increase the resistance to the required degree. The liquid rising in the rheostat-room 69 enters the float-chamber 76 and lifts the float. The movement of the float is transmitted by the bifurcated arm 79, pin 81, and arm 82 to the spindle 83, carrying on its end (projecting into the valve-chamber 44) the lever 56 56^a. This latter is thereby rotated in such a sense that the arm 56 descends and closes the valve 54 when the liquid in the rheostat-room 69 reaches its normal maximum height. When the valve 54 is closed, further admission of compressed air to reservoir 68 is prevented and the liquid will remain at rest. Up to this time the air in chamber 35 is only slightly above atmospheric pressure; but now the air having no more escape from said chamber the pressure will increase to the full value of the reservoir-pressure, which pressure is sufficient to put the piston 62 outwardly, actuating the switch 63 63^a and short-circuiting the rheostat. The starting of the motor is now completed. When the pressure in the chamber 35 has reached its full value, the pressure acting on the membrane 36 against the attractive force of the electromagnet is so strong that the electromagnet is no longer able to close the throttle-valve, which thereafter remains open.

The means which insure a constant level of liquid in the rheostat-room 69, notwithstanding leakage of air from the chamber 67 or notwithstanding the increasing pressure in this chamber due to incomplete closure of the valve 54, are operating in the following manner: If the level of the liquid drops owing to escape of air or evaporation of liquid or cooling of the air in the air-chamber, the float 77 will sink and the arm 56 of the lever 56 56ª will accordingly rise, thus lifting the valve 55. This valve must be of sufficiently small cross-section to be readily lifted by the float and sufficiently large to allow the passage of compressed air in quantities large enough to compensate for the leakage, &c. If, on the other hand, the level of the liquid rises in the rheostat-room and in consequence in the float-chamber, the float will rise and the lever 56 56ª will be turned in such a way as to lift the valve 49. This valve has to be of sufficiently small cross-section to be lifted readily by the float. Through the opened valve 49 air will enter the room 69 from the chamber 67 until the level of liquid falls to its normal height.

For stopping the motor the lever 9 is turned back in its initial position, whereby the tension of the spring 23 is released and the membrane-chamber 33 put in communication with the atmosphere. The valve 2 is then returned by the pin 13 engaging with the cam 12ª of the valve to the position shown in the drawing, connecting the chamber 51, Fig. 3, of the rheostat-valve through the pipe, joint 5, channel 3ᵇ, boring 3ᶜ, cavities 2ᶜ, and channel 3ᶜ with the atmosphere. The compressed air escapes through the valve 52 from the upper valve-chamber 35 and the cylinder 64 and the switch members 63 63ª will be separated. The pressure ceases to act on the piston 50, permitting the spring 47 to open valve 46, and thus reëstablishes communication between the chambers 67 and 69 of the rheostat, whereupon the liquid-level will fall in room 69 to the level of the liquid in room 65, and the whole apparatus returns to its initial position. (Shown in the drawings.)

Having thus described a structure embodying my invention in the form at present preferred by me, what I claim, and desire to secure by Letters Patent, is—

1. A liquid-rheostat having a plurality of liquid-containing chambers, a connection between the air-spaces of said chambers above the maximum liquid-level therein, a valve controlling said connection, and means for actuating said valve to open and close the communication between the air-spaces of said chambers.

2. A rheostat having a plurality of liquid-containing chambers, a connection between said chambers, a valve for said connection, and fluid-pressure means adapted to operate said valve to close the connection between said chambers.

3. A rheostat comprising a plurality of liquid-containing chambers, a connection between said chambers, the liquid of said chambers being normally at the same level, means for cutting off the communication between said chambers, and means for varying the height of the liquid within said chambers.

4. The combination of a liquid-rheostat having a plurality of connected chambers, a reservoir containing a supply of compressed air, a connection between said reservoir and rheostat, a valve for controlling the connection between the chambers, a valve for controlling the admission of air to the rheostat from the reservoir, and a float device operated by the rise and fall of the liquid in the rheostat adapted to actuate said controlling-valve and said air-admitting valve.

5. The combination of a liquid-rheostat having a plurality of chambers, a valve controlling the connection between said chambers, a starting device admitting the compressed air to the rheostat, a throttle-valve controlling the admission of said compressed air, and an electromagnetic device, regulated by said rheostat adapted to close the throttle-valve against the pressure of the admitted compressed air.

6. In combination with a liquid-rheostat, a reservoir of compressed air, means for admitting compressed air to said rheostat when the pressure therein falls below a stated pressure, and for permitting the escape of compressed air therefrom when the pressure rises above a stated pressure.

7. In combination with a liquid-rheostat having a plurality of chambers and a reservoir of compressed air, means for admitting air to said rheostat and closing communication between said chambers when the pressure therein is below a stated pressure, and for permitting the escape of compressed air therefrom when the pressure rises above a stated pressure.

8. In combination with a liquid-rheostat and a reservoir of compressed air, of a float and mechanism operated by the float for admitting compressed air to said rheostat when the pressure therein is below a stated pressure and for permitting the escape of compressed air therefrom when the pressure is above a stated pressure.

9. In combination with a liquid-rheostat and a reservoir of compressed air, a float, a rocker-arm operated by said float, a plurality of valves operated by said rocker-arm to admit compressed air to said rheostat when the pressure therein is below a stated pressure, and to permit the escape of air from said rheostat when the pressure is above a stated pressure.

10. In combination with a liquid-rheostat, a reservoir of compressed air, a slide-valve alternately connecting said rheostat with the air and with said reservoir, a cam mechanism

attached thereto, mechanism for variably throttling the admission of compressed air to said rheostat, a controller-handle and mechanism operated by said handle whereby, on the movement thereof, said cam mechanism is operated to control the position of said slide-valve and on further movement thereof said mechanism variably throttling the supply of compressed air, is operated.

11. In combination with a liquid-rheostat, a reservoir of compressed air, a slide-valve alternately connecting said rheostat with the air and with said reservoir, a cam mechanism connected with said valve, a cam for operating mechanism for variably throttling the admission of compressed air to said rheostat, and a controller-handle actuating both of said cam mechanisms.

12. In combination with a liquid-rheostat and a reservoir of compressed air, a controller-handle provided with a projection engaging with mechanism for operating the valve controlling communication between said reservoir and said rheostat, said controller being provided with a cam mechanism controlling the operation of mechanism for variably throttling the admission of compressed air to said rheostat.

13. In combination with a liquid-rheostat containing a plurality of chambers and a reservoir of compressed air, of a valve automatically closing communication between said chambers when compressed air is admitted to the rheostat, a float and mechanism operated by the float to establish communication between said chambers when the float assumes a given position.

14. In combination with a liquid-rheostat having a plurality of chambers, a float, mechanism operated by said float for automatically admitting compressed air to the rheostat when the float is in one position, the communication between said chambers being at that time interrupted, and permitting the escape of air from said chamber when the float is in another position.

15. In combination with a liquid-rheostat having a plurality of chambers and a reservoir of compressed air, a float, a rocker-arm connected with said float, which arm in one position opens communication between the reservoir and the rheostat while interrupting communication between the said chambers, and in another position establishes communication between said chambers.

16. In combination with a liquid-rheostat a reservoir of compressed air, means for admitting air to said rheostat when the level of liquid therein falls below a stated level and for permitting the escape of compressed air therefrom when the level of liquid rises above a stated level.

17. In combination with a liquid-rheostat having a plurality of chambers and a reservoir of compressed air, means for admitting air to said rheostat and closing communication between said chambers when the level of liquid therein is below a stated level, and for permitting the escape of compressed air therefrom when the level of liquid rises above a stated level.

18. The combination with a liquid-rheostat and a reservoir of compressed air, of a float and mechanism operated by the float for admitting compressed air to said rheostat when the level of liquid therein is below a stated level and for permitting the escape of compressed air therefrom when the level of liquid is above a stated level.

19. In combination with a liquid-rheostat and a reservoir of compressed air, a float, a rocker-arm operated by said float, a plurality of valves operated by said rocker-arm to admit compressed air to said rheostat when the level of liquid therein is below a stated level, and to permit the escape of air from said rheostat when the level of liquid is above a stated level.

20. A liquid-rheostat having a plurality of liquid-containing chambers, a connection between said chambers, a main valve and a supplemental valve controlling said connection, and means for actuating both said valves to open and close said communication.

21. A liquid-rheostat having a plurality of liquid-containing chambers, a connection between said chambers, a main valve and a supplemental valve controlling said connection, said main valve being controlled by air-pressure and said supplemental valve being controlled by the level of the liquid within said chamber.

22. A liquid-rheostat, a reservoir containing a supply of compressed air, a connection between said reservoir and said rheostat, a main valve and a supplemental valve controlling said connection, and means for operating both said valves to open and close said connection.

23. A liquid-rheostat, a reservoir containing a supply of compressed air, a connection between said reservoir and said rheostat, a main valve and a supplemental valve, means operated by the level of liquid in the rheostat for controlling both said valves.

24. A liquid-rheostat, a reservoir containing a supply of compressed air, an exit for the compressed air from said rheostat, main valves controlling the entrance and exit of compressed air to and from the rheostat, and supplemental valves controlled by the level of the fluid in the rheostat for automatically maintaining said level substantially constant.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

COLOMAN DE KANDO.

Witnesses:

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