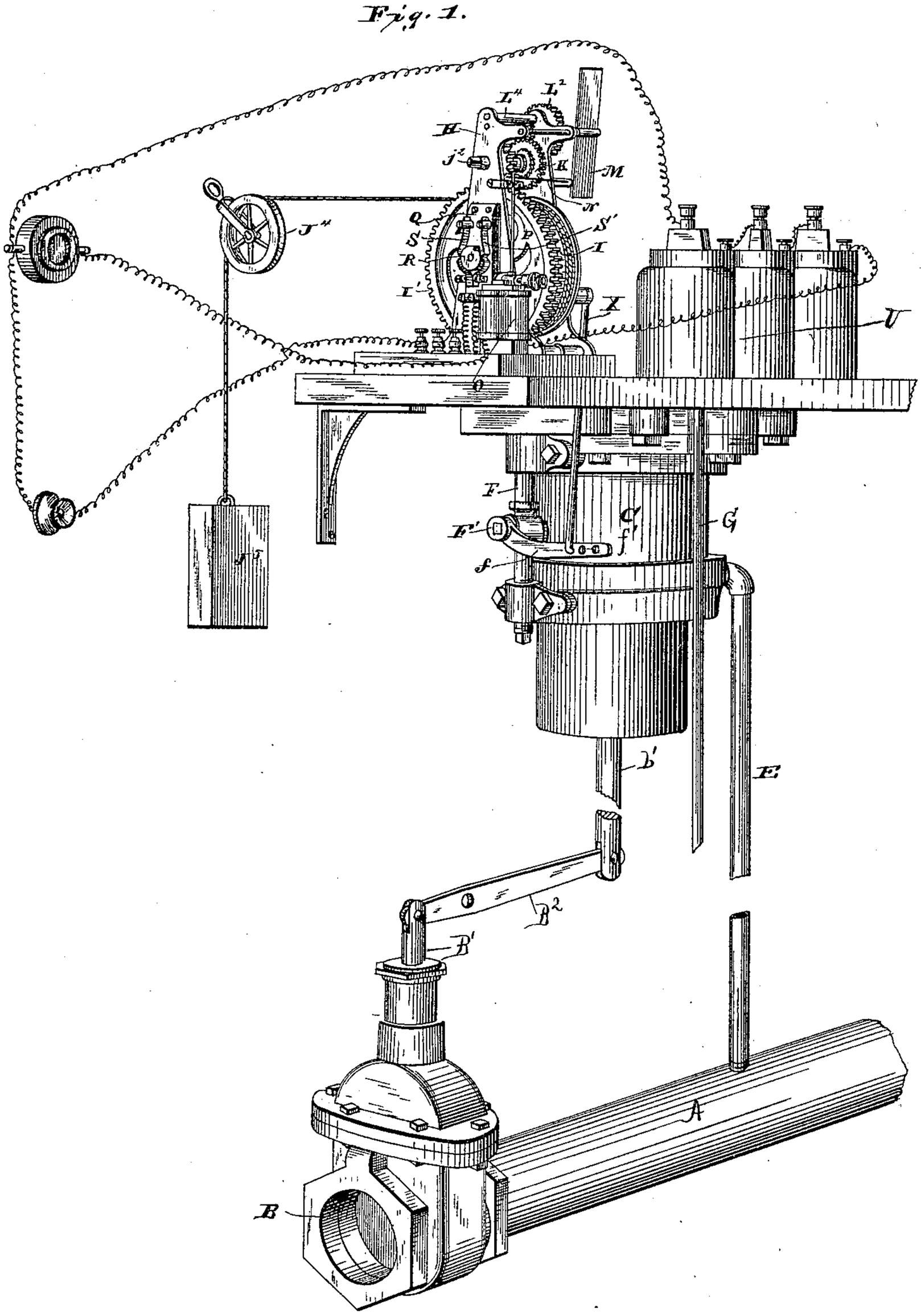
(No Model.) 3 Sheets—Sheet 1.

H. LIKLY, C. A. CARPENTER & F. B. GRAVES.

ELECTRICAL APPARATUS FOR WORKING VALVES.

No. 353,637. Patented Nov. 30, 1886.

Fig. 1.



Witnesses.
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(No Model.) 3 Sheets—Sheet 2.

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Fig. 3.

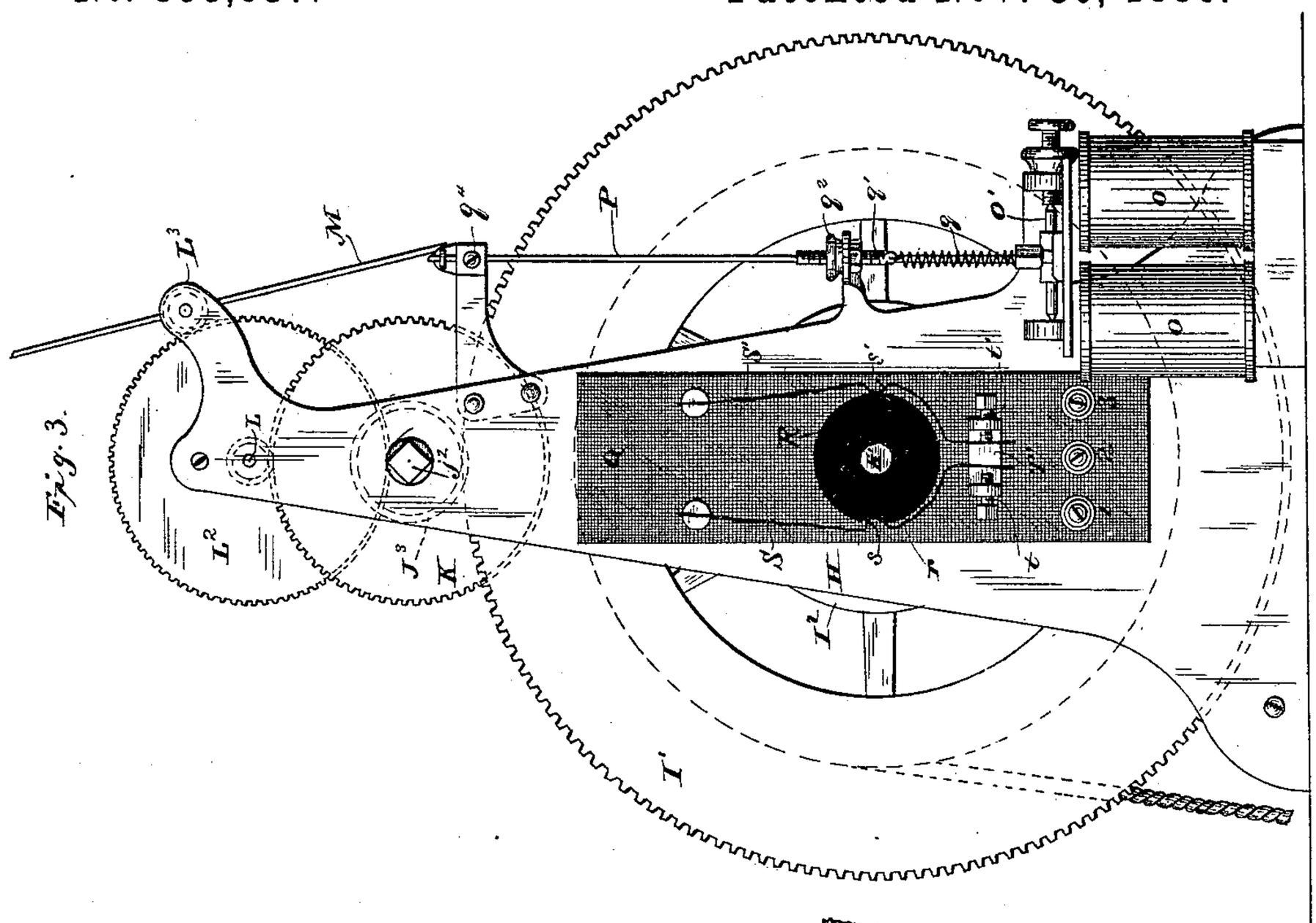
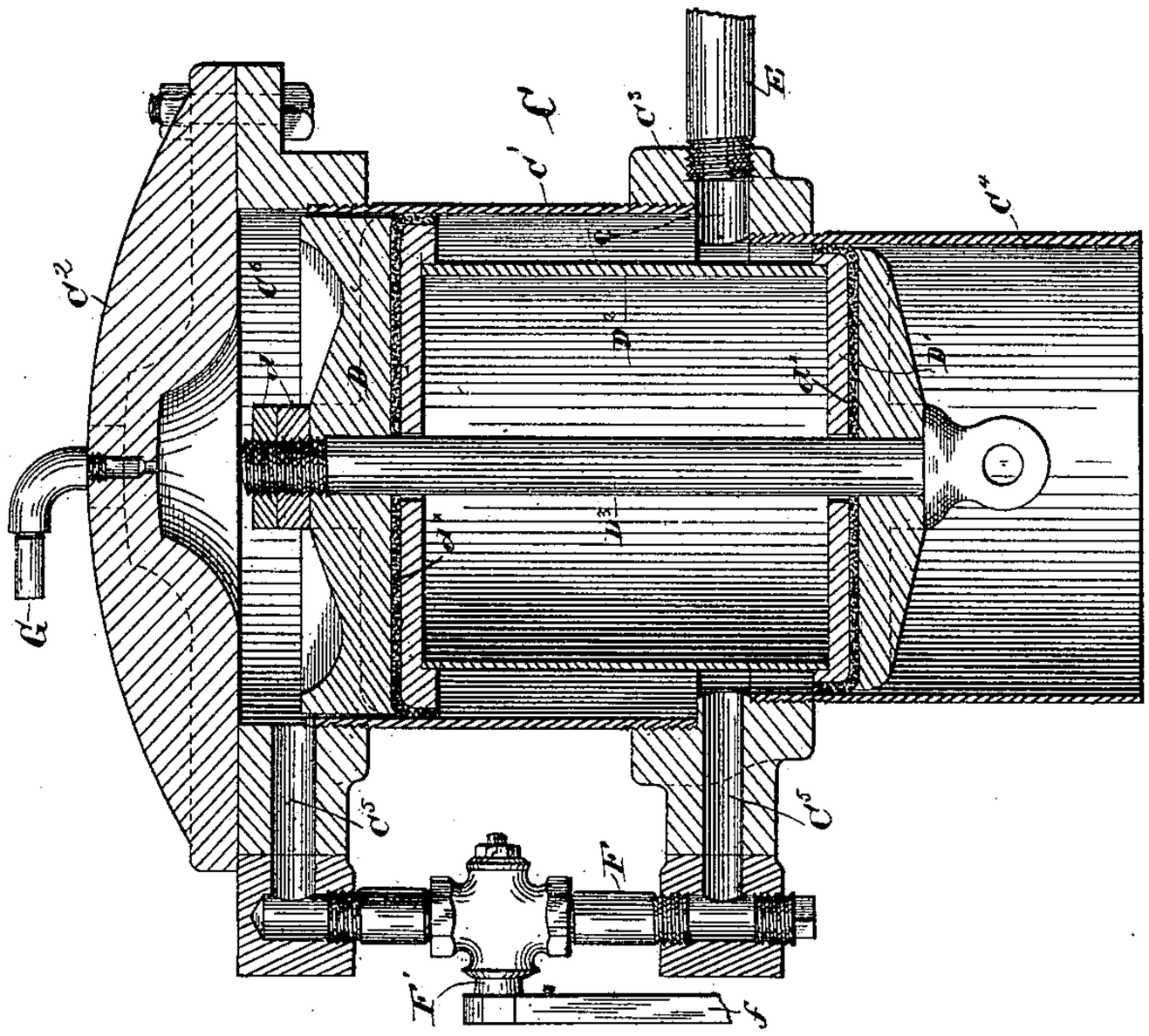


Fig. 2.



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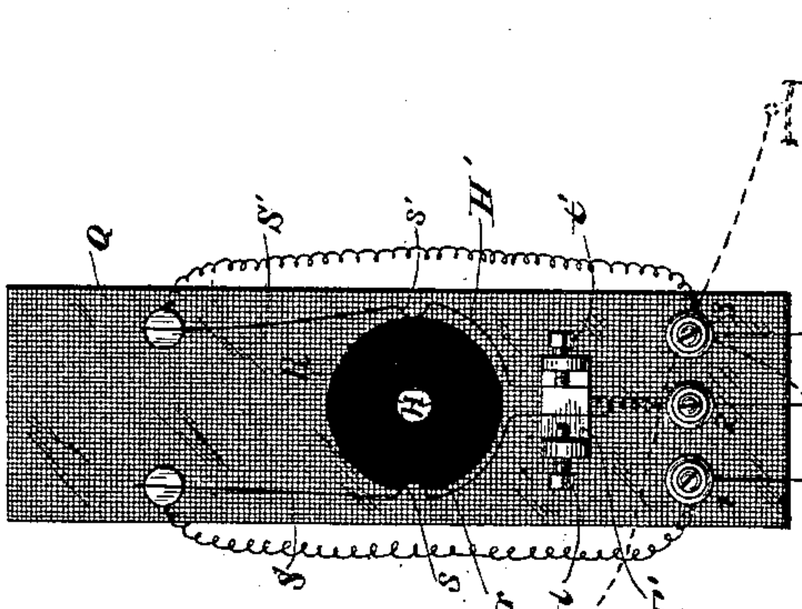

Fig. 5.

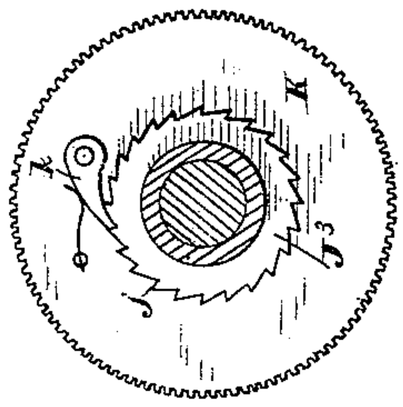

Fig. 6.

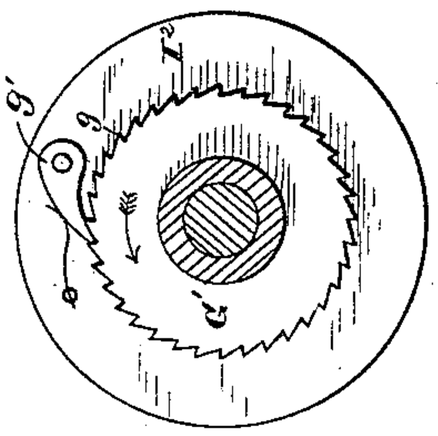

Fig. 4.

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UNITED STATES PATENT OFFICE.

HENRY LIKLY, CHARLES A. CARPENTER, AND FRED. B. GRAVES, OF ROCHESTER, NEW YORK.

ELECTRICAL APPARATUS FOR WORKING VALVES.

SPECIFICATION forming part of Letters Patent No. 353,637, dated November 30 1886.

Application filed August 2, 1886. Serial No. 209,800. (No model.)

To all whom it may concern:

Be it known that we, HENRY LIKLY, CHARLES A. CARPENTER, and FRED. B. GRAVES, all of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Apparatus for Working Valves; and we do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the figures and letters of reference marked thereon.

Our invention relates to a novel system of mechanism for automatically and at will actuating a valve located in a fluid, liquid, or gas supply pipe or main to open or close said valve, and thereby control the flow of the fluid maintained under pressure in the said supply pipe or main.

Generally stated, the said novel and improved system comprehends the use of three co-operating but independent and distinct sets or series of devices, each possessing novel features, and as combined forming a complete system. These sets or series of devices may be denominated, the first, the "valve-operating" mechanism, embracing the motor and connections for actuating the valve in a manner to close or open the passage for the fluid in the main or supply pipe; the second, the "motor-controlling" mechanism, comprehending the devices for setting in action the motor, and the third, the "trip" or "releasing" mechanism, which includes the necessary devices for releasing the motor-controlling mechanism, said trip mechanism being arranged to operate automatically or at will, whereby the opening and closing of the valves can be effected at a distance, if desired.

In the accompanying drawings, Figure 1 is a perspective view showing the whole apparatus complete. Fig. 2 is a vertical sectional view through the operating cylinder or motor. Fig. 3 is an end view of the mechanism for setting the valve-operating motor in operation. Fig. 4 is a front view of the same; Fig. 5, a sectional view on the line *x x* of Fig. 4; Fig. 6, a similar view on the line *y y* of Fig. 4. Fig. 7 is a plan view of the electrical circuits, the manipulation of which sets the motor-operating mechanism in motion.

Similar letters of reference in the several figures indicate the same parts.

A represents the water or gas main, and B the valve therein, which is to be operated by the apparatus about to be described.

B′ is the stem of the valve, connected with one end of a lever, B^2, pivoted upon a suitable support, the other or larger end being connected by a link or rod, *b′*, with the piston of the motor.

C is the cylinder of the motor, consisting of upper cylindrical portion, C′, to the upper end of which is secured a metal cap or casting, C^2, and at the lower end is a ring or casting, C^3, having the annular chamber *c* on its inside, and communicating with the interior of the cylinder. These castings are secured to the cylinder in any suitable manner, preferably by screw-threads, as shown. To the lower side of the casting C^3 is attached a cylinder, C^4, open at its lower end and of an internal diameter less than the upper cylinder.

D D′ represent two piston-heads, provided with suitable packing, *d x*, on their peripheries, the former of a size to fit tightly the upper cylinder, C′, and the latter the lower cylinder, C^4, connected by a suitable cylindrical casting, D^2, abutting against them, and the whole secured together by a headed bolt, D^3, passing through the heads and provided on its upper end with a nut, *d*, as shown. The lower end of the bolt D^3 is provided with a loop or eye, to which connects the rod *b′*, that is jointed to the lever B^2.

If desired, the lower piston may be dispensed with and only the larger piston, D, used, a suitable piston-rod being employed, passing through a stationary head at the lower side, provided with suitable stuffing-boxes, as will be readily understood; although we prefer to employ the double piston shown.

On one side of each of the castings C′ and C^3 are hollow projections C^5, communicating with the inside of the cylinder, connected by a pipe or channel, F, provided with a valve or cock, F′, therein for shutting off communication between them when desired. The valve has an extended arm or lever, *f*, for operating it, provided with a series of perforations, *f′*, therein, so that the leverage of the link from the valve-operating mechanism can be

changed and regulated so as to move faster or slower or have a greater power, as desired.

Communicating with the annular space *c* in the lower casting, C^3, is a pipe, E, leading to the main on the side of the valve toward the supply, and as this pipe is always open the water, gas, or other fluid will fill the chamber C′, and the under surface of the piston D being of greater area than that of the piston D′ exposed to the action of the fluid, the piston will move to the upper portion of the cylinder, its normal position, and, in the arrangement shown, through the lever B^2 and the links the valve B will be closed. As soon, however, as the valve F′ is operated by any suitable mechanism, the fluid will pass through the pipe F, enter the chamber C^6 above the piston D, and, by reason of the greater area of surface on the top of the latter exposed to pressure, will press said piston D downward, and operating again through the links and lever will open the valve B and permit the fluid to fill the system of pipes in the house, if the device is used in connection with a fire-extinguishing apparatus. When, now, it is desired to again close the main valve, the valve F′ is closed by any suitable mechanism, cutting off communication with the upper side of the piston D. As soon as this is done the water from the main will exert all its pressure on the under side of the piston D, and cause the latter to move upward again forcing the water above it out through the waste-pipe G, communicating therewith, and closing the main valve B. This waste-pipe is of small bore and the valve will consequently close slowly; but the pipe can be made larger, if desired, and the piston caused to move faster; but we prefer to make it small, as the water will run out of it continuously while the pressure is upon the upper side of the piston-head and the quantity lost will be small. A cock may be provided in the pipe G, to regulate the discharge as desired, and consequently the rapidity with which the valve closes.

In order to have the apparatus operate automatically, it is of course necessary to have some mechanism for operating the valve F′, and this we provide in the shape of the arrangement shown in Fig. 4, constituting a supplemental motor mechanism. In said figure, H represents a suitable frame supported, preferably, above the motor mechanism, in which is mounted a suitable shaft, H′, having upon one end a crank-arm, $G^\times$. Near the other end of this shaft is a wheel, G′, provided with a series of ratchet-teeth, *g*. Mounted loosely upon the shaft H′, and adapted to rotate independently thereof, when desired, is a drum, I, having at one side a large gear-wheel, I′, secured rigidly to and preferably formed with it, and upon the side of a disk or collar, I^2, secured to the hub of the drum, is a spring-pawl, *g′*, adapted to engage the teeth *g* of the ratchet-wheel G′ when rotated in the direction indicated by the arrow in Fig. 6. Above the shaft H′, parallel therewith, is a shaft, J, having a small gear or pinion, J^2, meshing with the gear-wheel I′ and adapted to be rotated thereby, and having also a ratchet-wheel, J^3, provided with teeth *j*, corresponding to the one on the wheel G′ of the shaft H′. Also mounted loosely upon this shaft J is a larger gear, K, provided with a spring-pawl, *k*, cooperating with the teeth *j* on the wheel J^3, so as to permit of the independent rotation of the wheel J^3 in one direction, but carrying the wheel K with it when rotated in the opposite direction.

L represents still another shaft, parallel with the former ones, and carrying a gear, L′, meshing with the wheel K. Shaft L on its end has a large gear-wheel, L^2, which meshes with a small gear, L^3, on a fan-shaft, L^4, which carries a fan or regulator, M. Now, it will be seen that when the drum I is rotated in the direction of the arrow in Fig. 6 by any suitable mechanism, the motion will be transmitted through the gear I′, pinion J^2, shaft J, ratchet-wheel J^3, pawl *k*, gears K, gear L′, shaft L, gear L^2, shaft L^4 to fan M, which latter, by reason of its large surface and the resistance which it encounters in rotation, will cause an even and regular motion of the mechanism. The drum, when rotated also through pawl *g′* and ratchet-wheel G′, rotates the shaft H′ in the direction indicated by the arrow, Fig. 6. The crank $G^\times$ upon the end of the shaft H′ is connected with the handle or operating-lever *f* of the valve F′ of the motor by a pitman or connecting-rod, X, the lower end of said pitman being adapted to engage with one or the other of the perforations *f′* of said lever *f*. The crank and valve-lever are so positioned relatively that when the crank is in one position—say elevated—the valve F′ will be closed, and the fluid, operating upon the lower side of the piston D only, will keep the piston raised and the main valve closed; but when the shaft has made a half-revolution and the crank is at its lowest position the lever-arm *f* will be depressed and the valve F′ opened, permitting the fluid to pass to the upper side of the piston D, depress it, and open the main valve, as will be readily understood.

As before stated, any suitable means may be provided for rotating the drum I; but we prefer to employ a cord connected at one end to the drum and wrapped around it several times, passing over a pulley, J^4, and provided at the other end with a weight, I^5. The cord is so wound upon the drum as to cause the latter to be rotated in the direction of the arrow, Fig. 6, as the weight falls, at the same time rotating the shaft H′ and the escapement mechanism.

As stated above, the end is wrapped several times around the drum and will consequently cause as many revolutions of the latter as there are convolutions before running down. In order to provide for rewinding the cord upon the drum and elevating the weight, we have provided the arrangement of ratchet-wheels and pawls described. The end of the shaft J

is squared at j^2, for the application of a crank or handle, so that it may be rotated in a direction opposite to its normal movement, to wind up the weight when desired, the pinion J^2, which meshes with the large gear I', transmitting motion to the drum, and the pawl g' slipping over the teeth g and permitting the movement independent of the shaft H'. The pawl on the wheel K also slips by the teeth on the gear J^3, and does not transmit the motion to the escapement mechanism and fan when the winding operation takes place.

It is necessary to prevent the continuous operation of the escapement mechanism and shaft H', and this we accomplish by a longitudinal rod, N, sliding in suitable ways in the frame and adapted to project into the path traversed by the wings of the fan, and to be withdrawn either by hand or automatically by means of mechanism which we will now proceed to describe.

At one side of the frame H is secured an electro-magnet, O, having an armature, O', secured to one arm of a bell-crank lever, P, pivoted to the frame, the other arm of which is connected with the rod N. The armature is held elevated away from the magnet by means of an adjustable tension device, as shown, consisting of a spring, q, secured at one end to the armature-lever, and at the other to a threaded rod, q', passing through a bracket, and provided with an adjustable set-nut, q^2, by screwing which up and down the desired tension can be secured. The upper end of the bell-crank lever moves in suitable guides, and at its outer side abuts against a screw, q^4, adapted to be adjusted in or out so as to regulate the throw of the arm and the distance the armature is held from the magnet when the latter is energized and the armature drawn down. The spring, it will be seen, keeps the rod N projected and in engagement with the fan M and the mechanism from operation. Upon the side of the frame H is mounted a plate, Q, of insulating material, preferably hard rubber, and through it one end of the shaft H' projects, and has a disk, R, of insulating material, preferably hard rubber, mounted thereon, and this disk has a notch, r, in its periphery.

S S' represent two springs, of metal, secured upon the plate Q, one on each side of the disk R, and having projections $s\,s'$, substantially in line with the center of the disk and in contact with the periphery thereof. The tendency of the springs is to approach each other, and they are held separated only by the disk R, with their projections $s\,s'$ in contact therewith, while their lower ends project between the arms of a yoke, T', in which are secured screws $t\ t'$, the yoke being also fastened to the plate Q. When the projection of either of the springs is in the notch of the disk, the end of that particular spring does not touch the screws t or t'; but at all other times both said springs abut against the said screws $t\ t'$ and maintain electrical contact therewith.

Mounted upon the plate Q are three binding-posts, 1, 2, and 3, with which the necessary electrical connections are made with the battery and circuit manipulating devices. The posts 1 and 3 are connected by suitable wires on the under side of the plate with the springs S S', respectively, while the central post, 2, is connected to the yoke T, as shown. From the binding-post 2 a wire, u, runs to one of the coils of the magnet O, and from the other coil a wire, u', runs to one terminal of a battery, U, located at any suitable distance from the device. From the other terminal of the battery a wire, u^2, runs to the binding-post 3, but between them is located a suitable circuit making or breaking device, preferably a thermostat, V, adapted in the apparatus, as shown, to complete the circuit upon the application of heat. The binding-post 1 is connected by a wire, v, to the side of the battery, from which the wire u^2 extends, and interposed in this circuit is a circuit making and breaking key, W, which is normally open, but is adapted to be closed by hand when desired.

The battery employed is some open-circuit battery—such as Leclanché or similar makes—and may consist of any desired number of cells, preferably two or more, so that there will be no failure to work by reason of insufficient battery power to operate the electro-magnet.

The lower ends of the springs S should be faced with platinum or similar metal, so as to insure a good contact with the screws or points $t\ t'$, and the latter may be similarly provided, if desired.

The thermostat is to be located at the point where the danger from fire is greatest, and, if desired, several of them may be employed placed in parallel circuits, as shown in dotted lines in Fig. 7; or a key may be used operated by hand to close this circuit when desired.

The wheel or disk R on the shaft H' is so positioned relative to the crank and supplemental motor-valve F' as that when the crank is elevated and the valve closed projections s on the spring connected with the circuit v, containing the key w, will rest within the notch r in the disk R, breaking the connection between the lower end of the spring and the screw t on the yoke. The projection s' on the spring S', however, will be in contact with the periphery of the disk, closing the contact between the end of the spring and the pin t' on the yoke, the circuit containing the yoke, magnet, battery, and thermostat being open only at the latter point.

Starting with the idea that the devices are in their normal position, as indicated—that is to say, the main valve closed, the piston elevated, the valve F' closed, the crank G elevated, the stop-rod N in engagement with the fan, and the armature of the magnet retracted—the operation of the device will be readily understood.

When by means of the application of heat to the thermostat V, or the manipulation of the suitable key in its place, the circuit u is

closed through the magnets, the latter will be energized, will draw down the armature, withdraw the stop-rod N, and permit the escapement mechanism to be operated by the cord to which the weight is attached unwinding from the drum I. As this drum rotates, its motion being governed and regulated by the escapement mechanism and fan, the crank will move slowly down, opening the valve F′ through the connecting-rod and permitting the liquid to pass from the main and under side of the piston to the upper side, causing the piston to descend and open the main valve, and, if the device is used to turn in the water in a fire-extinguishing system, permitting it to flow to the place where the fire is located. Meanwhile the disk R is rotating and the projection *s* on the spring S has moved out of the notch on its periphery and makes contact with the screw or stop *t*, thus leaving the circuit containing this spring S, yoke, electro-magnet, and battery broken only at the contact-key or push-button W. When the crank has made just a half-revolution and is at its lowest point with the valve F′ fully open, the notch *r* is in line with the projection *s′*, which then drops in and breaks the connection between spring S and the contact *t′*, opening the circuit containing the magnets, releasing the armature of the latter, and allowing the stop-rod N to re-engage the fan, bringing the entire mechanism to a stand still, with the pressure of the fluid on the top of the piston and the main valve open. If, now, it is desired to close the main valve, it is only necessary to press the key or button W and hold it down for a few moments, closing the circuit through the magnets and battery, energizing the latter, drawing down the armature, and withdrawing the stop-rod from engagement with the fan. The mechanism will continue to rotate while the circuit is closed until the crank G× has made a half-revolution and is again in elevated position, with the valve F′ closed, the pressure from the main shut off from the upper side of the piston, and the piston raised, shutting the main valve. As soon as this position is reached, the notch in the disk is in line with the projection *s*, which drops into it, and the lower end of the spring breaks contact with the stop *t*, opening the circuit and allowing the spring *q* to retract the armature and throw the rod into engagement with the fan, stopping the mechanism and leaving it in normal position to be again operated in the same manner as before.

The advantages of the invention described above will be obvious, as a ready means is provided for operating valves in remote or inaccessible places simply by the pressure of an electric push-button; or, if desired, suitable mechanical devices can be employed in their stead for releasing the supplemental valve-operating devices; but we prefer to employ the electrical devices, because the valves may be operated from a greater distance, and the mechanism employed is simpler and not so liable to get out of order.

By the employment of a thermostatic device for opening the main valve we are enabled to place a number of them in parallel circuits in different parts of a building, each connected to a local branch of a main, and adapted when operated by fire to open the valve and permit the water to flow to the place of conflagration and extinguish the fire; and the particular advantage that our apparatus possesses over others of its class is that it provides for the turning off of the water by a means as simple, and at the same time as reliable, as the turning-on mechanism, merely by the pressure of a contact-key.

The electrical circuits can be of any number and of any length, and instead of open circuits, closed circuits may be used, the necessary obvious alterations being made.

We claim as our invention—

1. The combination, with a pipe or main and a cut-off valve arranged therein, of a cylinder having a piston operated by a difference in pressure on opposite sides and controlling by its position the valve in the main, the side to which the lesser pressure is applied being acted upon normally by a fluid, a passage through which fluid is admitted connecting with the side of the piston to which the greater pressure is applied, a valve located in said passage, devices for controlling the operation of said valve, and a device for starting or stopping the operation of said valve-operating mechanism.

2. The combination, with a pipe or main and a cut-off valve arranged therein, of a cylinder having a piston operated by a difference in pressure on opposite sides and controlling by its position the valve in the main, the side to which the lesser pressure is applied being normally acted upon by a fluid, a passage through which fluid is admitted, connecting with the side of the piston to which the greater pressure is applied, a valve in said passage, a device for controlling said valve, and an electric circuit and connections for starting or stopping the controlling device, substantially as described.

3. The combination, with a pipe or main and a cut-off valve arranged therein, of a cylinder having a piston operated by a difference in pressure on its opposite sides and controlling by its position the valve in the main, the side to which the lesser pressure is applied being normally acted upon by a fluid, a passage through which fluid is admitted, connected with the side of the piston to which the greater pressure is applied, a valve located in said passage, and automatically-operating mechanism for opening and closing said last-mentioned valve, and devices for throwing the operating mechanism into and out of operation, substantially as described.

4. The combination, with the supply-pipe or main and a cut-off valve arranged therein, of a

cylinder having a piston presenting unequal areas to pressure on opposite sides and connected to the cut-off valve, a passage for establishing communication between the main and the cylinder on one side of the piston, a valve and connections for establishing communication between the opposite ends of the cylinder, a supplemental motor device for controlling said last-mentioned valve, and means, substantially as described, for starting and stopping said motor, as set forth.

5. The combination, with the supply-pipe and a main cut-off valve arranged therein, of a cylinder having a piston presenting unequal areas to pressure on opposite sides connected to the cut-off valve, a passage connecting the smaller side of the piston with the main, a passage connecting the two sides of the piston, a valve therein, and means for operating said valve, substantially as described.

6. The combination, with the supply-pipe and a main cut-off valve arranged therein, of a cylinder having a piston presenting unequal areas to pressure on opposite sides connected to the cut-off valve, a passage connecting the smaller side of the piston with the main, a passage connecting the two sides of the piston, a valve therein, and means for operating said valve, and a discharge-opening on the larger side of the piston, substantially as described.

7. The combination, with the two heads and the intermediate tubular portion constituting the piston, of the two-part cylinder in which said two heads work, the passage leading from the cylinder to the main or other source of pressure, the valve and connections for establishing communication with the cylinder on opposite sides of the piston, and the overflow or discharge pipe, substantially as described.

8. The combination, with the main valve and motor for operating it, of the valve controlling the motor, the shaft and its crank to which the valve is connected, mechanism for rotating said shaft, and devices controlled by an electric circuit for keeping said mechanism in check, substantially as described.

9. The combination, with the valve which controls communication between the opposite sides of the valve-operating piston, of the supplemental motor-shaft and its crank, mechanism for rotating said shaft, and devices controlled by an electric circuit for keeping said mechanism in check, substantially as described.

10. The combination, with the main cut-off valve, a motor for operating it, a valve by the manipulation of which said motor is operated, and a supplemental motor mechanism for operating said valve, of an electro-magnet for starting and stopping said motor, an electric circuit including the magnet, devices for making or breaking said circuit, and suitable switch devices operating to keep the circuit in a condition to permit the motor to fully open or close the valve, and switch devices for returning the circuit to normal condition when the operation is accomplished, substantially as described.

11. The combination, with the motor mechanism and the electro-magnet for controlling it, of the electric circuit containing the magnet, a circuit-closing device, and a switch connected to the motor and included in said circuit, operating upon the closing of the circuit and the starting of the motor to keep the circuit closed until a full movement is made and then to automatically break said circuit, substantially as described.

12. The combination, with the motor-valve, the supplemental motor for operating it, and the electro-magnet for controlling the motor, of an electric circuit including said magnet, a circuit-closer, a second electrical circuit including said electro-magnet and another circuit-closer, and a switch connected to the motor and included in both circuits, whereby upon closing either of the circuits the supplemental motor will be started and the circuit kept closed until the motor-valve is operated and then broken and the supplemental motor stopped, substantially as described.

13. The combination, with the valve, the motor for operating it, and the electro-magnet for controlling the motor, of an electric circuit including said magnet and a thermostatic circuit-closing device, and another circuit including a circuit-closer and the magnet, and the switch operated by the supplemental motor and arranged in both circuits, whereby upon the closing of one of the circuits the motor will be operated and the circuit kept closed until the motor-valve has been operated and then is broken and the motor stopped, substantially as described.

14. The combination, with a valve and a motor for operating it, of an electro-magnet for controlling said motor, two electrical circuits including said magnet, a switch included in both said circuits for alternately changing their condition and operated by a movement of the motor, and devices for manipulating said circuits, whereby when one circuit is manipulated the motor is started, the valve moved to one position, and the condition of the circuit changed, and when the other circuit is operated the motor is again started, the valve returned to first position, the first circuit restored to normal condition, and the last-operated circuit changed, substantially as described.

15. The combination, with the supplemental motor-shaft, of the means for rotating and governing the same, the insulating notched disk on the shaft, the spring contact-fingers, each in a separate circuit, the yoke with which they are adapted to make contact, the electro-magnet connected thereto and controlling the supplemental motor, and two electric circuits, each including one of the spring contact-fingers, the yoke, and electro-magnet, and means for varying said circuits, substantially as described.

16. The combination, with the supplemental motor-shaft, of the means for rotating and governing the same, the notched disk on the

end of the said shaft, the spring contact-fingers, the yoke, electro-magnet, armature, bell-crank, the stop-rod, and the electric-circuit connections, substantially as described.

17. The combination of the motor-shaft, the means for rotating and governing the same, the notched disk, the spring contact-fingers, the yoke and its contacts, the electro-magnet, armature, bell-crank, and governor-stop with the electric-circuit connections, including a thermostat or thermostats or other circuit-manipulating devices, substantially as described.

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