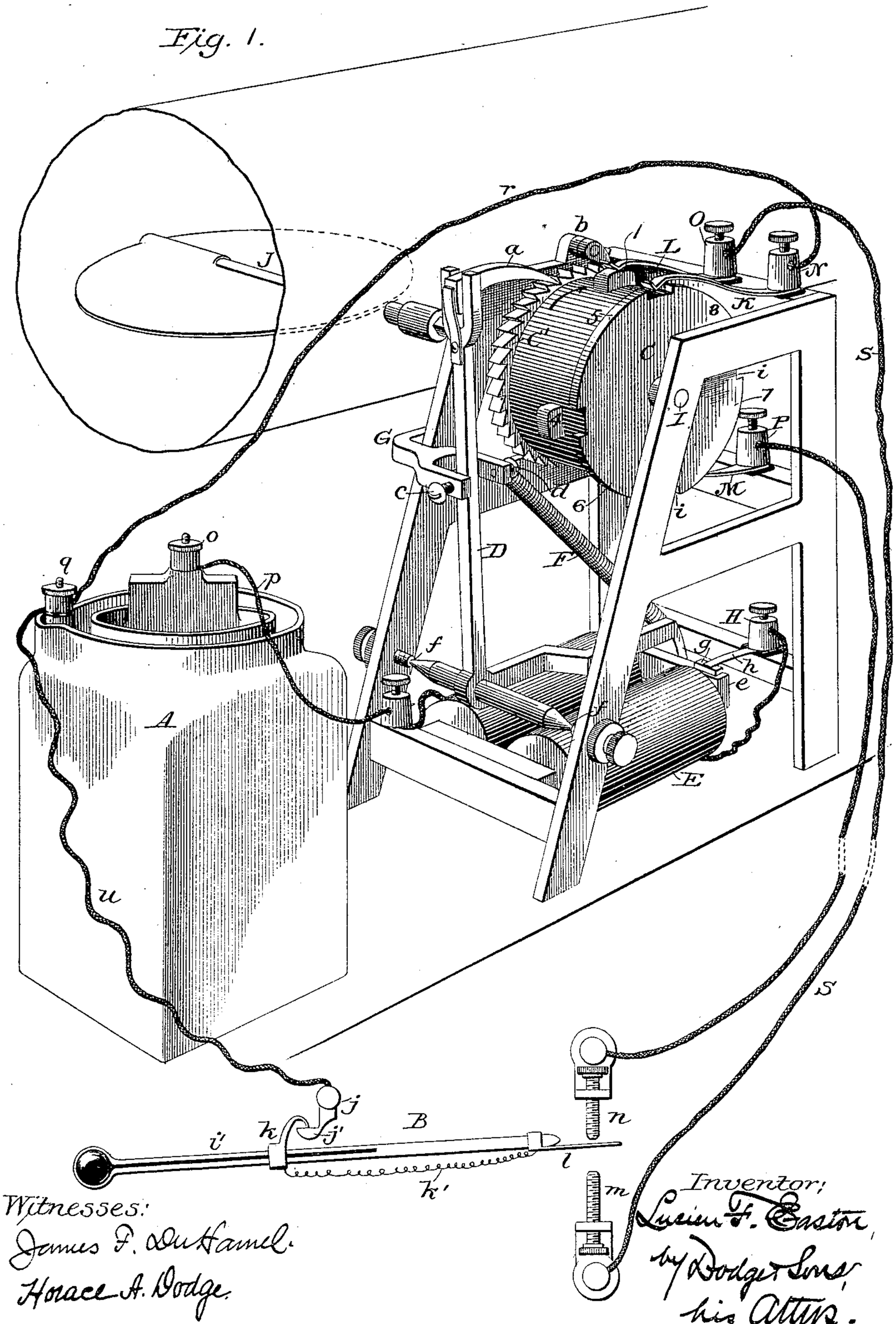
(No Model.) 2 Sheets—Sheet 1.

L. F. EASTON.

ELECTRIC TEMPERATURE REGULATOR.

No. 377,021. Patented Jan. 31, 1888.

Fig. 1.



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

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Fig. 2.

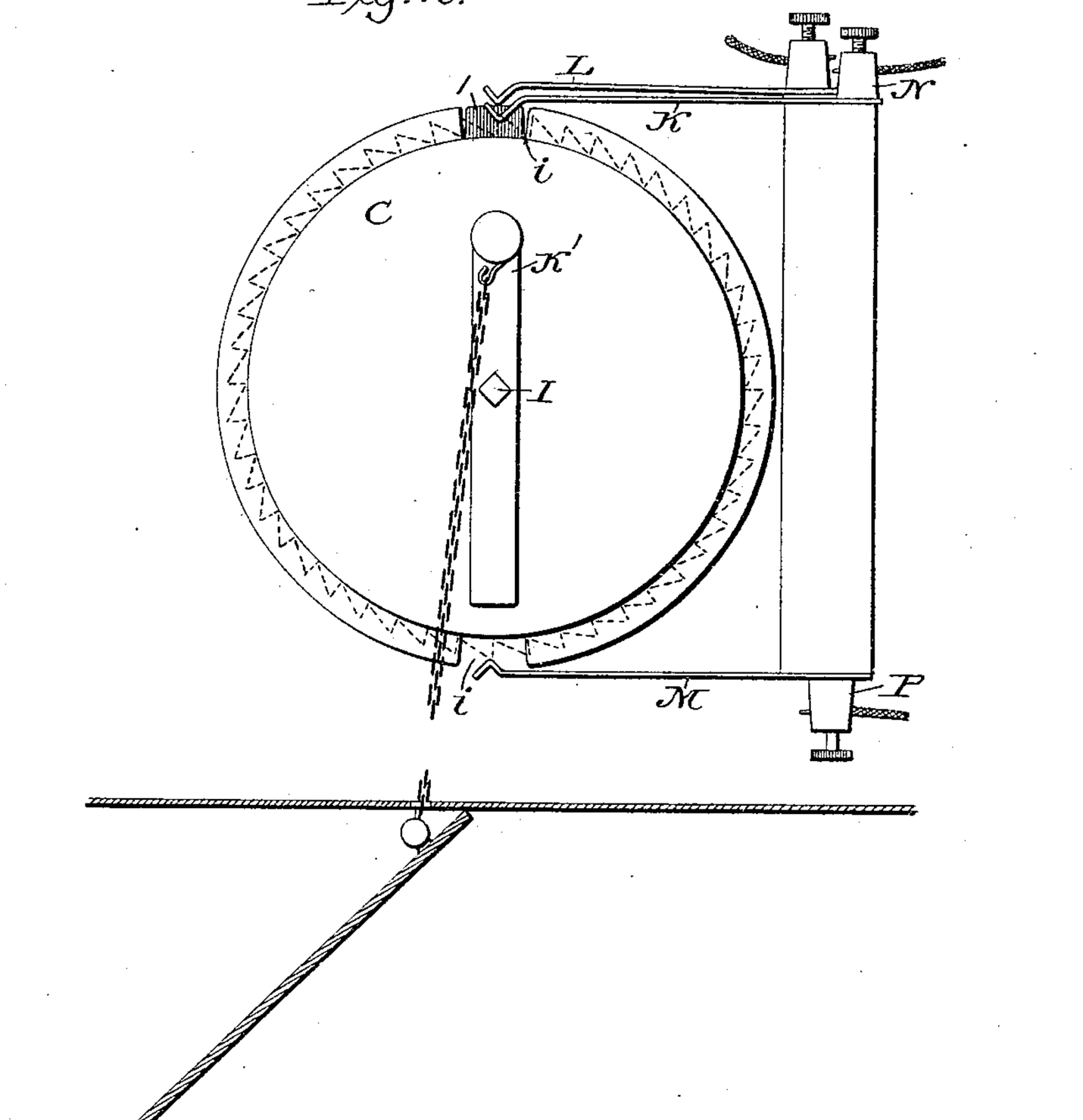


Fig. 3.

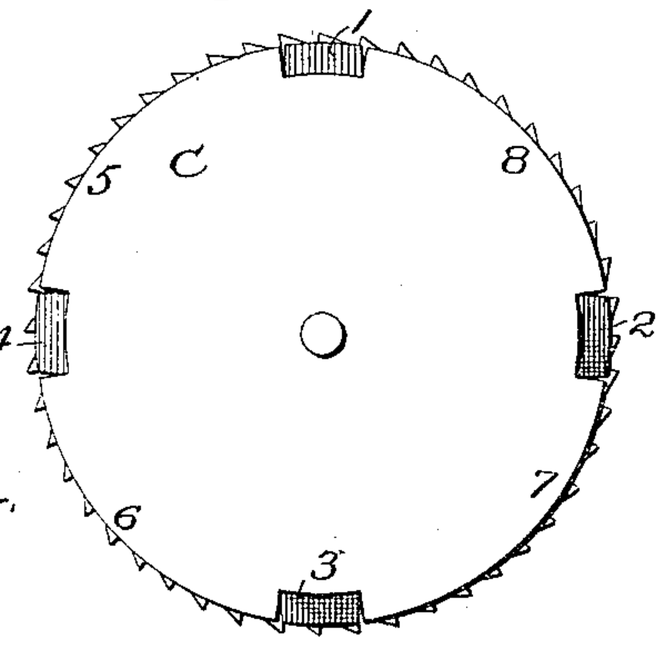
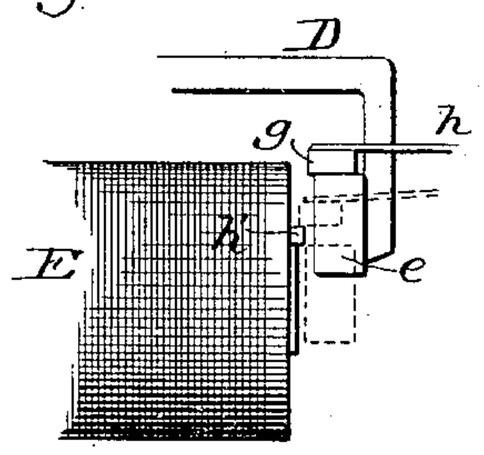


Fig. 4.



Witnesses:

James F. DeHamel

Horace A. Dodge.

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UNITED STATES PATENT OFFICE.

LUCIEN F. EASTON, OF LA CROSSE, WISCONSIN.

ELECTRIC TEMPERATURE-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 377,021, dated January 31, 1888.

Application filed October 17, 1887. Serial No. 252,605. (No model.)

To all whom it may concern:

Be it known that I, LUCIEN F. EASTON, of La Crosse, in the county of La Crosse and State of Wisconsin, have invented certain new and useful Improvements in Temperature-Regulators, of which the following is a specification.

My invention relates to apparatus for regulating valves, dampers, or other temperature-controlling devices for the purpose of maintaining an even or uniform temperature; and the improvements consist in various novel combinations and arrangements of parts (most of them well known in themselves) whereby I am enabled to actuate the valves, dampers, &c., with certainty and promptness.

In the drawings annexed, Figure 1 is a perspective view of my improved apparatus. Fig. 2 is a view showing the form of a circuit-wheel as used where a half-revolution is required at each operation, and Figs. 3 and 4 views of certain details.

The objects sought to be attained by this invention are adequate power to actuate the valve-damper or other part and the full movement or adjustment thereof, even though the thermostat remain only for an instant at the point or in the position it assumes when the temperature reaches the predetermined limit. In other words, the thermostat merely sets the apparatus for operation and leaves it to perform its work without further assistance from the thermostat.

The apparatus which I employ consists of a battery, a thermostatic circuit-closer of any convenient form, a circuit-closing wheel which is so constructed and arranged that whenever the thermostat closes the battery-circuit a short circuit is at once established through the circuit-wheel independently of the thermostat, and the short circuit is maintained until the valve, damper, or other device is moved to a predetermined extent.

Referring again to the drawings, A indicates a battery, (or it may be any other source of electric energy;) B, a thermostat, (represented in the drawings in the form of the well-known balanced thermometer;) C, the short-circuiting wheel or cylinder; D, a vibrating lever provided with a pawl or dog, *a*, for rotating said wheel; and E, an electro-magnet by which the lever is moved in one direction, its reverse movement being effected by a spring, F.

As shown in Fig. 1, the cylinder C is formed with a toothed rim or ratchet, C′, and the vibrating lever D is furnished with a pawl or dog, *a*, which engages with the teeth of said rim successively and causes a step-by-step rotation of the cylinder, a backward movement thereof being prevented by a click or dog, *b*.

The movement of lever D is controlled by means of set-screws *c* and *d* in front and in rear thereof, which screws pass through the branches of a forked arm, G, or other fixed portion of the frame of the apparatus.

The vibrating lever D consists of three arms or members, an upright branch of considerable length carrying the pawl or dog *a*, a second branch or member projecting from the upright arm at or substantially at a right angle, and a short arm projecting downward from the outer end of the second member at a right angle or practically so. The lower arm carries a soft-iron armature, *e*, which faces the core or cores of electro-magnet E, and which, owing to the fact that lever D is pivoted at the point *f* near the rear end of the electro-magnet E, has a considerable range of movement within the field of attraction of said magnet, the movement being up and down as well as to and from the core of the magnet. This long movement is quite important, as it insures an ample movement of pawl or dog *a* at each stroke with adequate power throughout such movement.

Resting upon the armature *e* is a small soft-iron armature, *g*, carried by a light spring, *h*, strong enough to quickly lift the small armature when the latter is not held down, yet light enough to offer little resistance to the descent of said small armature. The spring *h* extends from a binding-post, H, secured to, but insulated from, the frame-work of the machine, and its office will be presently explained. As the armature *e* is within the attractive field of electro-magnet E, it follows that so long as the electro-magnet is energized or active the armature *e* will be polarized and will magnetically attract the small armature *g*, which rests upon it. The spring *h*, which carries the small armature *g*, being very light, its resistance is readily overcome by the attractive force of the polarized armature *e*, and hence the small armature *g* will move with the larger armature, *e*, as the latter approaches the core or cores of the

electro-magnet. This joint movement continues until the small armature *g* comes in contact with a non-magnetic stop, *h*, as in Fig. 4, which arrests its movement, and, as the armature *e* continues to move, destroys the contact between them, the spring *h* at once carrying the armature *g* up to its normal position.

As the small armature and its spring serve to complete the electric circuit of the magnet E, it follows that whenever the contact between armatures *e* and *g* is thus broken the magnet E will become inert and cease to attract armature *e*, thus leaving the spring F free to draw back the lever D and to carry the armature E away from the cores of the electro-magnet, in doing which said armature is again carried up to and into contact with the small armature *g*, thereby again completing or perfecting the circuit at that point.

The wheel or cylinder C is carried by a shaft, I, suitably mounted in boxes or bearings, and may be either extended outward to connect with a damper-spindle, J, as in Fig. 1, or provided with a crank-arm, K′, as shown in Fig. 2.

Where the device is used to operate or control a butterfly valve or damper by continuous rotation in one direction, as in Fig. 1, it is necessary to give a quarter-turn each time to change it from an open to a closed position, or vice versa; but when employed to raise and lower a draft-door, or to move a draft, damper, valve, or other device alternately in reverse directions, by a rotation of the shaft I always in the same direction, a half-turn of the shaft is required.

To effect the quarter-turn, the cylinder C is furnished with four contact points or lugs, 1 2 3 4, and with four intermediate or alternate contact rims or segments, 5, 6, 7, and 8, a path for the current being at all times furnished by either one of the lugs or one of the segments.

K indicates a spring-finger having a curved end which rests upon one or another of the segments 5, 6, 7, or 8 at all times, except when one of the notches or openings *i* separating said segments falls beneath the bearing-point of said finger, as indicated in Fig. 1.

L indicates a similar spring-finger, which makes contact alternately with contact lugs or points 1 and 3 as the cylinder C rotates, and M indicates a third spring-finger, which makes contact alternately with the contact points or lugs 2 and 4, the lugs 1 and 3 being in line with each other and with finger L, but out of line with lugs 2 and 4, and lugs 2 and 4 and their finger M being in line with each other, but in a different plane from either the lugs 1 and 3 and their finger L or the segments 5 6 7 8 and their finger K.

As the cylinder rotates contacts will be made as follows: Beginning with a contact between finger L and lug or point 1, as indicated in Fig. 1, the cylinder rotating in the direction indicated by arrow, the lug 1 will pass out of contact with finger L, and segment 5 will pass into contact with finger K. Next this contact will be destroyed and lug or point 2 will pass into contact with finger M. Next segment 6 and finger K make contact, then lug 3 and finger L, then segment 7 and finger K, then lug 4 and finger M, then segment 8 and finger K, and, finally, as one revolution is completed, lug 1 and finger L again make contact, this movement restoring the parts to the position which they occupied at the commencement of the revolution.

The thermostat B, which, as already intimated, may be of any preferred form, is represented as consisting of a tube, *i′*, containing any suitable expansible fluid, preferably mercury, which tube is suspended from a bracket, *j*, by a hook or hanger, *k*, having a fine point, which rests in a cup, *j′*, advisably containing mercury, to insure a good electrical connection between the bracket and the hanger.

From the hanger *k* a wire or other electric conductor, *k′*, extends to a metallic plate or tip, *l*, which projects beyond the tube and plays between two metallic plates, *m* and *n*, which should be made adjustable, so that the degree of temperature at which contact shall be made with each by the tip *l* may be varied at will.

If the tip *l* be at the small or bulbless end of the tube, as shown in the drawings, the plate *m*, with which contact is made when the temperature rises, will be placed below the tip *l*; but by placing the tip at the bulb end the plate *m* may be located above and plate *n* below the tip, the movement of which latter will then be up and down, in correspondence with rise and fall of the temperature. The location is, however, a matter of no importance.

The apparatus being thus constructed, the circuit-connections are made as follows: From pole *o* of battery A a wire or conductor, *p*, passes to the helix of electro-magnet E, and thence to binding-post H, the current passing thence through spring-arm *h*, armatures *g* and *e*, lever D, and pawl or dog *a* to cylinder C, which has the lugs 1 2 3 4 and segments 5 6 7 8 made integral or electrically connected therewith, so that the circuit may be completed through any one thereof upon establishing proper contact and connections therewith. From pole *q* of battery A a wire or conductor, *r*, passes to binding-post N, which carries or is electrically connected with spring-finger K. From plate or contact *m* of thermostat B a wire or conductor, S, passes to binding-post O, which carries or is electrically connected with spring-finger L, and from contact-plate *n* of thermostat B a wire or conductor, *t*, extends to binding-post P, which carries or is electrically connected with spring-finger M. Bracket *j* of the thermostat B is connected by a wire or conductor, *u*, with pole *q* of battery A.

Assuming the cylinder C to be in the position indicated in Fig. 1, and supposing that the valve, damper, or other contrivance has been actuated to cause a rise of temperature in the apartment in which the thermostat is located, the operation will be as follows: The

temperature rising causes the fluid of tube *i* to expand and to move outward toward the tip *l*, thereby destroying the equilibrium of the tube and causing the tip to descend, this action continuing and taking place gradually until the tip makes contact with the plate *m*. When this occurs, an electric circuit is established from pole *o* of battery A, through wire *p*, the helix of electro-magnet E, the wire *p* continued, to binding-post H, through spring *h*, armatures *g* and *e*, lever D, pawl or dog *a*, cylinder C, lug 1, spring-finger L, post O, conductor *s*, plate *m*, tip *l*, conductor *k'*, hook *k*, hanger *j*, and conductor *u* to pole *q* of battery A. The electro-magnet E is thus energized, and consequently armature *e* is attracted, and also polarized, and in consequence of such polarization attracts and carries with it the small armature *g*, thus preserving the continuity of the circuit until the movement of armature *g* is arrested by stop *h'*, at which moment the armature *g* is carried upward by spring *h*. The circuit being thus destroyed or broken, the magnet E ceases to attract armature *e*, and consequently spring F draws back the lever D, carrying armature E away from the pole or poles of the magnet and into contact with armature *g*, but not out of the field of force of the electro-magnet. Contact being thus again established between the armatures *e* and *g*, the circuit is completed, as before, and the action above described is repeated. As the lever D vibrates or oscillates, its dog or pawl *a* alternately pushes against and rides back over the teeth of the cylinder C and causes said cylinder to rotate in the direction indicated by arrow.

As it often happens that the contact established by the thermostat is only momentary, and as a very slight change of temperature, due to a passing current of cold air, will sometimes destroy such contact at almost the instant it is made, it is important that means be provided for maintaining a working-circuit until the operation of the apparatus is completed, and this is done in the following manner: As the cylinder C rotates, and as soon as one, two, or three strokes of the lever D have been made, (the number varying with the relative length of the teeth, the stroke, and the extent of contact-surface,) the lug 1 will pass out of contact with spring-finger L, and in this way the circuit by way of plate *m* of the thermostat will be destroyed; but at the same instant that this occurs the segment 5 of cylinder C passes beneath and makes contact with spring-finger K, and hence the circuit from wheel C back to pole *v* of battery A is established through said finger K, binding-post *n*, and conductor *r* wholly independent of the thermostat. The new path thus offered for the current will remain unbroken, except through the intermittent action of armatures *e* and *g*, until, by the rotation of the cylinder C, the segment 5 passes from beneath and out of contact with spring-arm K, by which time the position of the valve or damper is fully changed, so as to cause a lowering of temperature, at which instant lug 2 rides against and makes contact with spring-finger M.

As finger M is electrically connected with contact-plate *n* of the thermostat, it will be seen that the apparatus is thus made ready for the establishment of a circuit through the spring-finger M and said plate *n*, when the lip *l* of the thermostat makes contact with the latter, which will of course be the contact next made by the thermostat, owing to the fact that the valve or damper was last set to lower the temperature.

When the apparatus again begins to operate, the lug 2 will ride out of contact with spring arm M, and a path will be provided for the current through segment 6 and finger K, in the manner above explained. In like manner the third action will be the same as the first, except that the current will start through spring-finger L and lug 3 and change to finger K and segment 7, and the fourth operation will be the same as the second, except that the current will first pass by way of finger M and lug 4 and change to finger K and segment 8.

If it be desired to impart motion to the valve or damper alternately in reverse directions, instead of continuously in one direction, the cylinder C need have but one lug and two segments, as in Fig. 2, the action being, however, the same to all intents and purposes as that above set forth, the two fingers L and M being in such case placed in position to make contact alternately with the same lug. When such arrangement is adopted, a crank-arm, Q, may be secured to the shaft I of cylinder C, and a rod or chain, R, extended to the door, valve, or damper, as shown in Fig. 2.

Having thus described my invention, what I claim is—

1. The herein-described apparatus for controlling valves, dampers, and like devices, consisting of a battery or other source of electric energy, a thermostatic circuit-closer, an electro-magnet included in the battery-circuit, a lever provided with a pawl or dog and with a soft-iron armature, the latter within the attractive field of said magnet, a second armature arranged to bear upon the first when said first armature is moved away from the electro-magnet, a spring serving to move the second armature away from the electro-magnet, a wheel or cylinder actuated by the lever and its dog and provided with contact points or surfaces, a valve, damper, or like device connected with the cylinder and movable thereby, and spring-fingers arranged in the paths of the contact-points and surfaces of the cylinder and adapted to change the path of the current as the cylinder is rotated.

2. The actuating mechanism for a temperature-regulator, consisting of a circuit-changing wheel provided with teeth, a lever provided with an armature and with a pawl to engage with the teeth of said wheel, an electro-magnet placed within the attracting distance of said armature, a second armature carried by a

spring-arm and placed in position to be touched by the first armature as the latter moves away from the magnet, and a stop to limit the movement of the second armature toward the magnet, the electro-magnet and the second armature being included in one and the same electric circuit, and the parts being constructed and arranged to operate substantially as set forth.

3. The herein-described apparatus for regulating temperature, consisting of a battery or source of electricity, as A, a thermostat, as B, a toothed circuit-changing wheel or cylinder, as C, provided with a lug or contact-point, 1, and segments 5 and 6, electro-magnet E, lever D, provided with pawl *a* and armature *e*, armature *g*, spring-arm *h*, supporting said armature *g*, electric conductor *p*, connecting one pole of battery A, magnet E, and spring-arm *h*, conductor *r*, connecting the other pole of the battery and spring-finger K, conductor *f*, connecting contact *m* of the thermostat and spring-finger L, conductor *t*, connecting contact *n* of the thermostat and spring-finger M, and conductor *u*, connecting the thermostat with the second pole of the battery or other source of electric energy.

4. In combination with wheel or cylinder C, having teeth on its periphery, vibratory lever D, provided with a pawl to engage with said teeth, armature *e*, carried by said lever, electro-magnet E, having its pole or poles placed opposite and within attractive distance of armature *e*, a second armature, *g*, located in the path of movement of armature *e*, a spring-arm, *h*, carrying the armature *g*, and a battery or other source of electric energy including in its circuit the electro-magnet and the armature *g*.

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