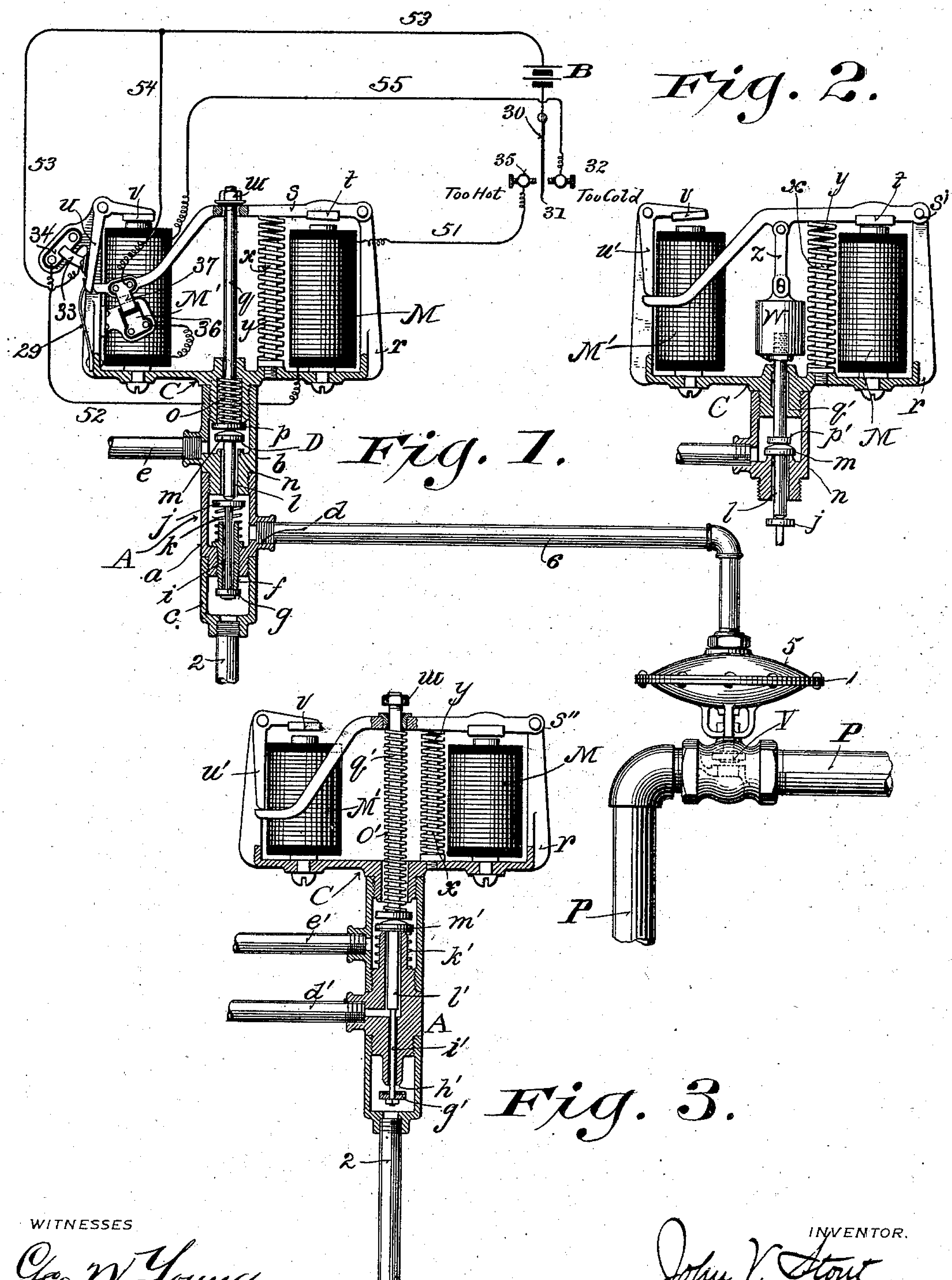
(No Model.)

3 Sheets—Sheet 1.

J. V. STOUT.

AUTOMATIC HEAT REGULATING DEVICE.

No. 560,763. Patented May 26, 1896.



WITNESSES

Geo. W. Young,
C. C. Burdine

INVENTOR.

John V. Stout,
BY Dodge & Sons,
ATTORNEYS.

ANDREW B.GRAHAM. PHOTO-LITHO. WASHINGTON D.C.

(No Model.)

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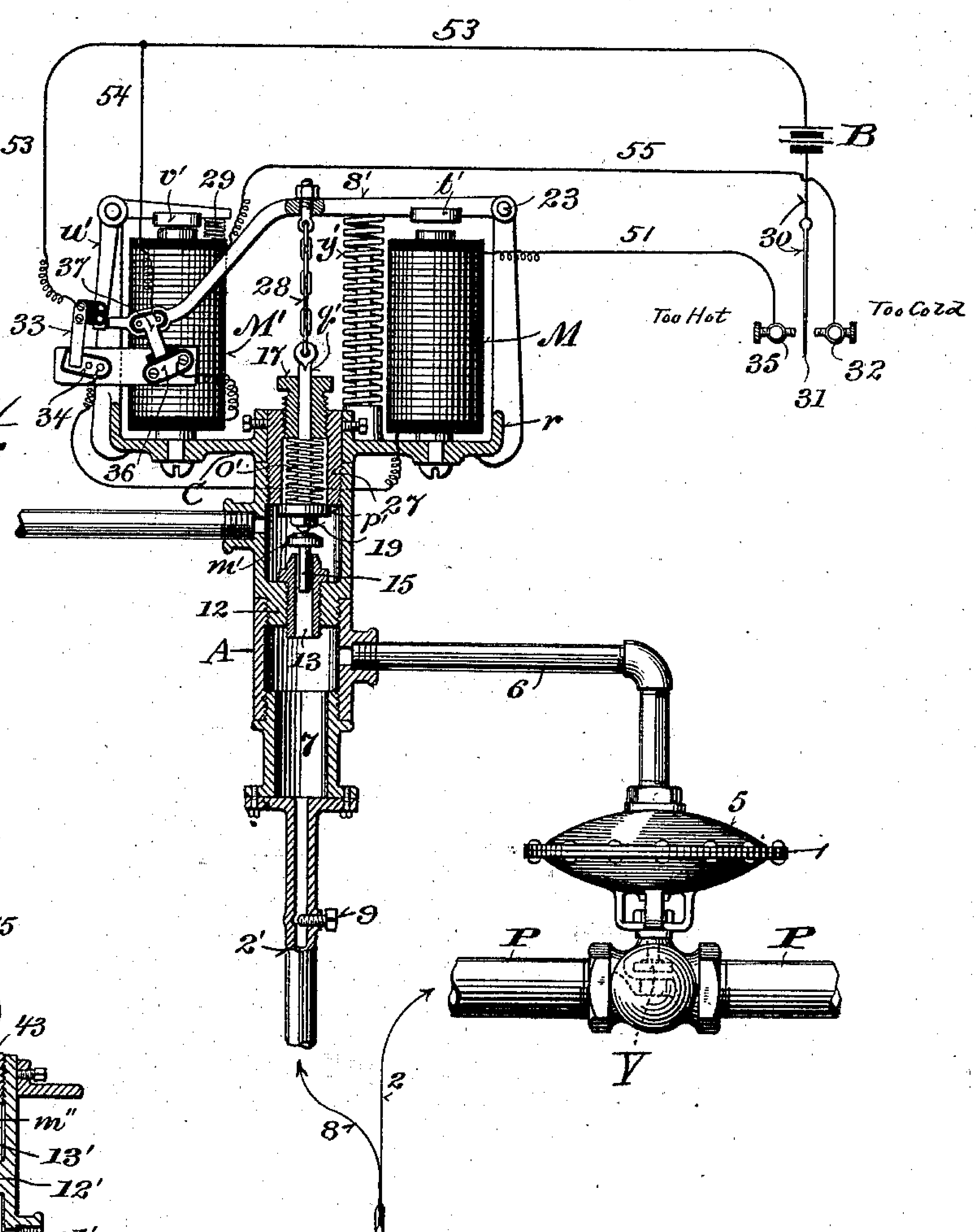

Fig. 4.

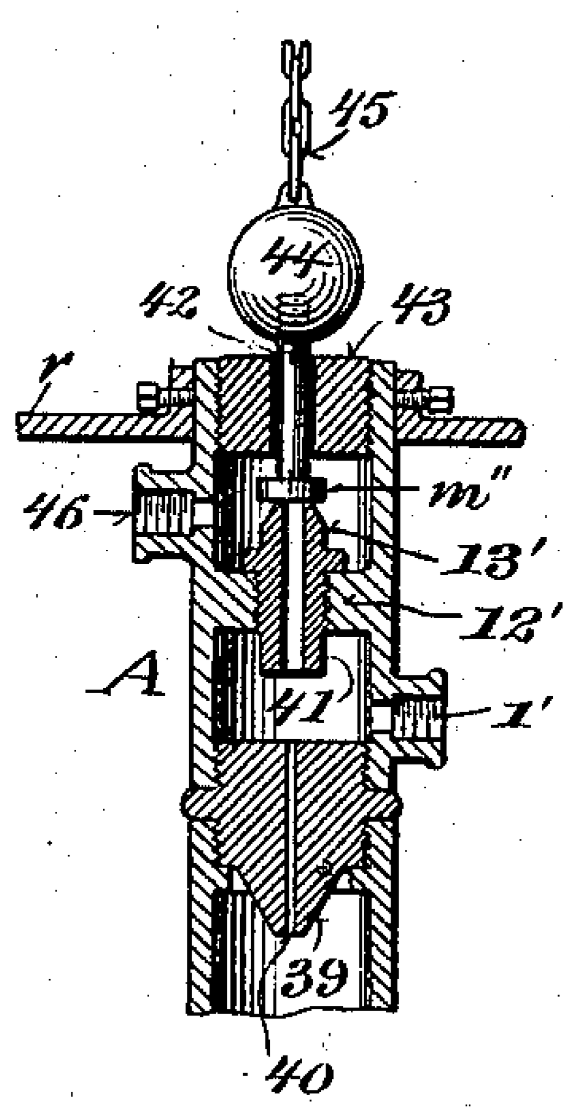

Fig. 5.

WITNESSES

Geo. W. Young.

C. C. Burdine

INVENTOR.

John V. Stout,

BY Dodge & Sons

ATTORNEYS.

(No Model.)

3 Sheets—Sheet 3.

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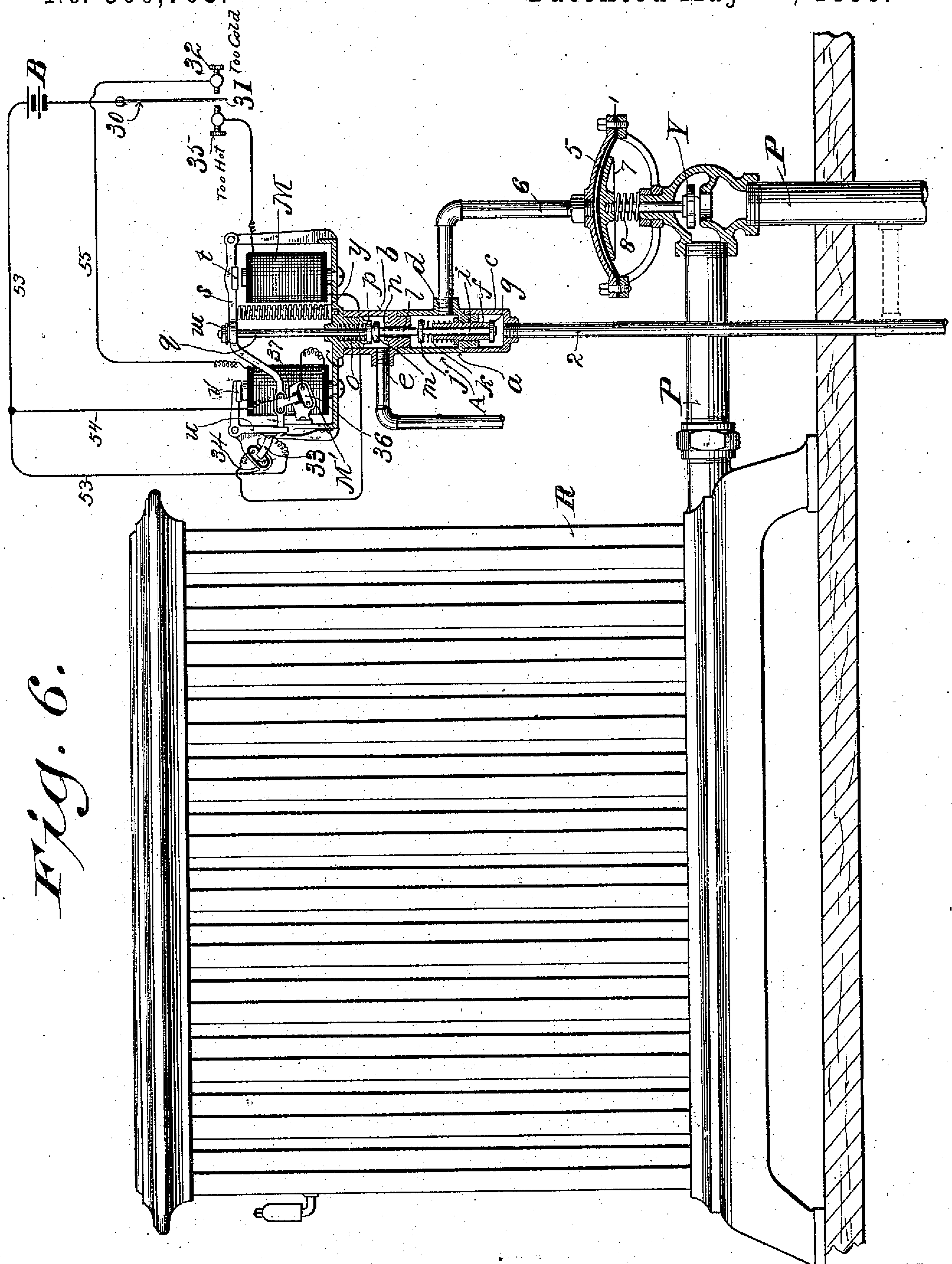

Fig. 6.

WITNESSES

Geo. W. Young.

W. C. Burdine

INVENTOR,

John V. Stout,

BY Dodge & Sons.

ATTORNEYS

UNITED STATES PATENT OFFICE.

JOHN V. STOUT, OF EASTON, PENNSYLVANIA.

AUTOMATIC HEAT-REGULATING DEVICE.

SPECIFICATION forming part of Letters Patent No. 560,763, dated May 26, 1896.

Application filed June 6, 1895. Serial No. 551,918. (No model.)

To all whom it may concern:

Be it known that I, JOHN V. STOUT, a citizen of the United States, and a resident of Easton, county of Northampton, and State of Pennsylvania, have invented certain new and useful Improvements in Automatic Heat-Regulating Devices, of which the following is a specification.

My invention relates to that class of automatic temperature-regulating apparatus in which a main heat-controlling valve, damper, draft, or ventilator is actuated by fluid-pressure, controlled by an auxiliary valve, which is in turn governed by a thermostat.

The invention consists in various novel features, details, and combinations hereinafter pointed out, whereby certainty and efficiency of action are secured, together with simplicity and durability.

In the accompanying drawings, Figure 1 is a side elevation of the working parts of my apparatus, showing the shell or casing of the auxiliary valve in section. Figs. 2, 3, 4, and 5 are views of slightly-varying forms of the auxiliary valve, the shell or casing being similarly in section. Fig. 6 represents the apparatus of Fig. 1 applied to a steam-radiator.

In order to secure a proper degree of sensitiveness in apparatus of this character, it is now the practice to employ the thermostat or the heat-measuring device merely to bring into action more powerful mechanism for actuating the main valve, damper, or other device which directly or immediately controls the temperature. In the present instance I make use of a fluid-pressure motor or device to move the main valve, damper, or heat-controller, and I regulate the pressure of fluid in said motor or device by an auxiliary valve operated by an electromagnet, the energizing-circuits of which are closed and opened as required by a thermostat or a heat-measuring instrument. So far as I am aware the most perfect or satisfactory temperature-regulating systems heretofore proposed or adopted have, for the purpose of avoiding the necessity of a stuffing-box or packing-gland, placed part or all of the electrical apparatus within the valve-casing, thus exposing the circuit-breakers to the actuating medium. Such arrangement, while obviating the objectionable friction of stuffing-glands, is nevertheles objectionable for the reason that it requires the employment of an actuating fluid which shall not affect the electrical contacts and cause the circuit to be closed or short-circuited at an improper time, air being the medium usually employed under such circumstances and the use of water and steam being precluded. When air is employed, an air-pump or compressing apparatus is necessarily included in the apparatus, and this is for many reasons undesirable.

The chief object of this invention is to provide an apparatus which can be directly actuated by water or steam without liability of inopportunely closing the electrical circuits or short-circuiting the current and without danger of permitting the escape of the actuating fluid into the apartment in which the device may be located. In this way I avoid the expense of the air-pump and the trouble and annoyance incident to its use, and also dispense with stuffing boxes or glands, thereby obviating the friction which so materially interferes with the sensitiveness of regulation.

Having thus stated in general terms the nature of my invention, I will proceed to describe the same in detail, with the aid of the drawings, observing, however, that the selection of steam heating apparatus is merely for convenience of illustration, and that any form or system of heating apparatus may be employed.

Referring first to Figs. 1 and 6, which show the preferred embodiment of my invention, P indicates a pipe or conduit for conveying the heating medium or agent—steam, hot water, heated air, or other. This pipe or conduit will communicate with the heat-generator, a steam-boiler being contemplated in Figs. 1 and 6, as indicated by the character of the pipe and valve and by the connected radiator R of Fig. 6. V indicates a main valve or controlling device applied to pipe P and bearing at the outer end of its stem a convex disk 7, beneath which bears one end of a coiled spring 8, encircling the valve-stem, the other end of said spring resting upon the valve-casing. The purpose of the spring is to open the valve V when relieved of fluid-pressure. The disk 7 rests against the under or outer face of the flexible diaphragm of a fluid-pressure chamber or motor 5, of which said diaphragm constitutes the moving member, and said chamber communicates by means of a pipe 6 with a fluid-pressure-supply pipe 2, provided with an auxiliary valve hereinafter described. The fluid-pressure pipe may be placed in communication with a water main or reservoir, with an accumulator or an air-pump, or with any other convenient source of pressure supply. In Fig. 6 I have indicated by dotted lines a connection with the steam-pipe P—an arrangement that will be found convenient in many instances. A indicates the shell or casing of the auxiliary valve by which the pressure of fluid within chamber 5 is controlled. This shell is preferably formed of three parts *a*, *b*, and *c*, as a matter of convenience in fitting and assembling the parts of the valve and its actuating devices, the sections being conveniently screwed together, as indicated. In Figs. 1 and 6, *g* indicates the valve which controls delivery of fluid under pressure to chamber or motor 5. As there shown, it consists of a disk carried at the lower end of a stem *i*, passing longitudinally through a threaded nipple *f*, screwed through a central opening in the lower end of section *a* of the valve-casing and extending downward into the interior of section *c* thereof. At its upper end the stem *i* bears a head or button *j*, beneath which presses the upper end of a coiled spring *k*, the lower end of which rests upon a collar or shoulder of the nipple *f*. Under this construction the nipple *f* may be raised and lowered at will without disturbing the relation thereto of either the valve-disk *g* or the spring *k*. Directly above and axially in line with the valve *g* and its stem *i* is a second stem *l*, provided with a disk *m*, designed to seat upon and to seal the mouth or collar *n* of the passage through which stem *l* extends, said passage being here represented as formed through the otherwise closed lower end of section *b* of the auxiliary-valve casing. The upper end of said section *b* is provided with a screw-threaded cap or top C, which is extended outward to constitute a frame or support for electrical appliances hereinafter described. Passing through the cap or top C is a stem *q*, bearing at its lower end a disk *p*, adapted to seat against and seal the mouth or lower end of the opening through which the stem *q* passes. As shown in Figs. 1 and 6, this opening is enlarged in its lower part to receive a coiled spring *o*, which exerts a constant downward pressure upon disk *p*. When the disk *p* is free to descend and is thus pressed down, it depresses stem *l*, which in turn acts upon disk *j* and through stem *i* moves disk *g* away from its seat. In doing this the stem *q* forces disk *m* to its seat on the collar *n*, and thus closes communication between sections *a* and *b* of the valve shell or casing. Hence fluid entering chamber *a* through the unsealing of valve *g* is at the same time precluded from entering chamber *b*. Stem *i* must of course be of such length relatively to that of the nipple as will permit disk *g* to be unseated without sealing the upper end of the nipple by head or button *j*. The pipe 6, by which fluid under pressure is conveyed to chamber or motor 5, communicates with section *a* of the auxiliary-valve shell, being conveniently screwed into a nipple formed at the side thereof, and a similar nipple is formed at the side of chamber or section *b*, through which is formed an exhaust-passage. Said passage may open directly to the atmosphere, or a waste-pipe *e* may be screwed into said nipple, as shown. Where water, steam, or gas is employed as the source or medium of fluid-pressure, the pipe *e* will ordinarily be used, but with compressed air it will not be necessary ordinarily. It will be observed that the stem *i* is of smaller diameter than stem *l*, and that a larger space exists for the flow of fluid between stem *i* and its surrounding walls than between stem *l* and the walls of the passage in which it stands. This relatively greater capacity of passage is important for the reason that it insures automatic relief of the fluid-pressure motor from excess of pressure. In constructing and adjusting the mechanism the exhaust-valve *m* is set to withstand a predetermined pressure, but to be lifted from its seat whenever that pressure is exceeded, thus accurately determining the maximum pressure to which the diaphragm of fluid-pressure device 5 may be subjected. When the pressure falls to normal state, the exhaust-valve will close, but so long as valve *g* is open the pressure-motor 5 will receive its proper supply and no more. This provision effectually guards against rupture or injury of the fluid-pressure motor and is particularly important where a rubber diaphragm is employed.

From the foregoing description it will be seen that the auxiliary valve *g* and the escape-valve *m* are wholly contained within the shell or casing, and that the stem *q*, which actuates or controls them, is furnished with a sealing-disk *p*, which precludes escape of fluid when the escape-valve is opened. The valve-actuating stem is wholly above the exhaust-valve and out of contact with the fluid under pressure in all embodiments of my invention, which feature is of considerable practical importance. By making the stems of the inlet and exhaust valves and the operating-stem (or some of them) separate and independent the minimum of friction may be secured without such accurate fitting and adjustment as would be required if a single stem were used. The disk *p* and valve *g* can also be seated without the close adjustment that would be necessary were both on one stem. The valve-stems fitting loosely in their passages, the valves may be accurately seated and tightly closed with a minimum force or pressure.

Having now described the construction of the valves and their relation to each other, it remains to explain the thermostatic and electrical devices whereby their action is primarily controlled.

The cap C of the auxiliary valve shell or casing is fashioned into a frame *r*, from opposite ends of which rise two standards. Between these standards and secured in any convenient way to frame *r* are two electromagnets M and M'. Pivotally attached to one of the standards of frame *r* and extending across the top of electromagnet M is a lever *s*, the free end of which carries an insulated contact spring or plate 37, which when the magnet is deënergized rests upon an insulating-block, to which is secured a contact-plate 36. To the other standard of frame *r* is pivoted an elbow lever or latch *u*, which bears against the outer end of lever *s* when magnet M is deënergized, but which is thrown inward by a spring 29, or it may swing inward by gravity and engage over the lever *s* when magnet M is energized and caused to attract the armature *t* of said lever, thereby depressing the lever, as in Figs. 2 and 3. Lever *s* is normally urged upward by a spring *y*, encircling a stem *x*, extending upward from frame *r*, and in rising the lever elevates rod or stem *q*, thereby seating valve-disk *p*, the power of spring *y* being superior to that of spring *o* or other force tending to throw disk *p* away from its seat. Latch or lever *u* is provided with an armature *v* of soft iron, so that when magnet M' is energized it shall attract the armature, rock the lever, and carry its lower arm off from over the lever *s*, thus permitting said lever to rise under the action of spring *y*. Latch or lever *u* carries an insulated contact spring or finger 33, which rests upon an insulated contact-plate 34 when armature *v* is attracted to magnet M', but which rides off of said plate when the latch-lever swings to locking position over lever *s*.

B indicates an electric generator or source of electric-current supply, and 31 a thermostat of any suitable form, preferably a bimetallic bar, having one end electrically connected with a terminal of the generator and the other end arranged to play between two adjustable contacts 32 and 35. Contact 35 is connected by a conductor 51 with one end of the helix of electromagnet M, the other end thereof being connected by conductor 52 with contact 34. A conductor 53 extends from contact-finger 33 to the second terminal of the generator B, and a conductor 54 connects contact-finger 37 with conductor 53, and thus with the generator. Lastly, a conductor 55 connects contact 32 with one end of the helix of electromagnet M', the other end of which is electrically connected with contact-plate 36.

The direction of flow of the current will of course depend upon the order in which the connections are made with the generator; but assuming conductor 53 to be connected with the positive pole, as indicated, and that the bar 31 be arranged to contact with screw 35 when the temperature rises and with screw 32 when it falls from the normal, the action will be as follows: The heat-supply valve being open, as indicated in Figs. 1 and 6, the temperature will rise in the apartment in which thermostat 31 is located and its bar will swing to contact-screw 35, thus causing a circuit to be established from generator B by conductor 53 and contacts 33 and 34 to helix of magnet M, and thence by conductor 51, contact 35, and bar 31 back to generator B. This will cause magnet M to be energized and to attract armature *t*, thereby drawing down lever *s* against the pressure of spring *y* and permitting spring *o* to carry down the rod *q*, which, acting upon disk *m*, will seat it upon collar *n* and cause its stem to carry down the stem *i* and thus unseat valve *g*. In this way fluid under pressure will be permitted to enter by pipe 6 into fluid-pressure chamber or motor 5, where it will act upon the flexible diaphragm or other movable member and cause it to press down the stem of valve V, closing said valve and shutting off the heat-supply. As the end of lever *s* is carried below the depending arm of latch or lever *u* said arm swings in above lever *s* and locks it against rising, thereby insuring the continued opening of the auxiliary valve *g* until the temperature falls to a predetermined limit. In thus swinging to locking position the latch-lever *u* carries the contact-finger 33 off of plate 34 and thus opens or breaks the circuit in which magnet M was included, thereby avoiding waste of current. At the same time lever *s* in descending carries contact-finger 37 into position to bear upon contact-plate 36, thus connecting the helix of magnet M' with conductor 54 and thus with conductor 53 and the generator. If now the temperature fall so low as to cause the thermostat-bar 31 to make contact with screw 32, a circuit will be established from generator B by conductor 53, branch 54, contacts 37 and 36, the helix of magnet M', and conductor 55 to contact-screw 32, and thence by thermostat-bar 31 to generator B. This circuit including, as it does, the magnet M', said magnet will be energized and will attract its armature *v*, thereby rocking latch-lever *u* and causing its end to swing off from and to release lever *s*, which will at once rise under the force of spring *y*. In thus rising lever *s* will elevate rod or stem *q*, leaving spring *k* free to lift stem *i* and thereby to close valve *g*, which will be further held to its seat by the fluid-pressure beneath it. As valve *g* rises its stem lifts stem *l* and unseats valve-disk *m*, thus venting fluid-pressure chamber 5 and leaving valve V free to open. As the lever *s* rises it carries apart the contacts 36 and 37 and thus breaks the circuit of magnet M', but not until the end of said lever passes in front of the latch-lever and prevents it from resuming its locking position. The rise of lever *s* also causes latch-lever *u* to swing about its pivot and to reëstablish connection between contacts 33 and 34. It will thus be seen that the action of the battery is but momentary, whether opening or closing the heat supply. Mention has already been made of the fact that valve *m* acts as a safety-valve or relief for the fluid-pressure chamber or motor 5. In order that this action may take place in connection with the electrical mechanism described and shown, it is necessary that the rod or stem *q* be free to rise independently of lever *s*, as otherwise it could not rise when the lever is depressed and locked, as it is when valve *g* is open, and the dangerous pressure is liable to occur. A convenient connection is illustrated in Figs. 1 and 6, where the stem *q* is represented as passing freely through an opening in lever *s* and carrying above said lever a washer and an adjusting-nut *w*. Obviously a weight may be substituted for spring *o*, and any convenient form of loose or sliding connection adopted in lieu of that just described. Thus I have shown in Fig. 2 a weight W, applied to stem *q'* and having a slotted connection with link *z*, by which it is suspended from lever *s'*. So, too, without departing at all from the spirit of my invention, a spring *o'* may be arranged to extend all the way from disk *p* to the under side of lever *s*, as shown in Fig. 3, rod *q'* of said figure being the same as rod *q* of Figs. 1 and 6. Again, the valve-disks *g* and *m* of Figs. 1 and 6 may be carried by a continuous stem, or, in other words, the stems *i* and *l* of said figures may be united, as in Fig. 3, in which the parts mentioned are designated by the letters *g'*, *m'*, *i'*, and *l'*, the seat for valve *g'* being lettered *h'*, and the lifting-spring of valve *m'* being lettered *k'*. Under this modified construction a like difference between the capacities of the inlet and exhaust passages will be observed. The inlet and outlet connections are designated by the letters *d'* and *e'* in said figure.

In Fig. 4 I have shown the auxiliary valve arranged merely to control the exhaust, and have represented a chain connection 28 between stem *q'* and lever *s'*. Provision for adjustment is made by arranging a plug or nut 17 to screw more or less into and out of the top of the auxiliary valve shell or casing, and by like construction of the nipple 13, in which is guided stem 15, carrying the valve *m'*. In order that the proper relation between the inlet and exhaust passages may be secured, a reducing plug or screw 9 may be carried through the side of pipe 2' to restrict the passage through it.

Fig. 5 shows a chain 45 and a weight 44, from which depends a stem 42, carrying a disk *m''*, which constitutes the exhaust-valve and corresponds to disks *m* and *m'* of other figures. In this case the connection between the actuating-stem and the valve-disk is direct instead of being made through an intermediate. So, too, the difference in area of inlet and exhaust passages is here secured through the use of a nipple 39, having a passage 40, smaller than the passage of nipple 41 above it, and adjustment of the valve *m''* and its seat is secured by screwing the nipple 13' up or down through collar or diaphragm 12'. The lateral necks 1' and 46 represent the connections for the pipes 6 and *e*, respectively.

It will be noted that in all the forms of apparatus represented the exhaust-valve is adapted to act as a relief or safety valve to protect the fluid-pressure motor 5 against injury, and that the relatively small inlet and large outlet are common to all the forms shown and essential where such protection is to be secured. If, however, this feature be deemed unimportant in any particular instance, it may be omitted, though in its most perfect embodiment the invention includes such protection. The top is shown closed by a screw-plug 43. The interior of section *b* of the auxiliary-valve casing, or the space in which valve *m* is located, constitutes an expansion-chamber in which the fluid-pressure is dissipated, so that there is no liability of back pressure upon and interference with valve *m*. This is of considerable importance when elastic fluids are employed.

Various other minor changes may be made in the structure without departing from the limits of my invention.

Springs and weights being recognized as equivalents for most purposes in mechanical structures, it is to be understood that either may be employed where springs are shown in the drawings, and for this reason I shall use in the claims the term "yielding pressure device," meaning thereby to include either springs or their equivalents—weights. While the form of springs is not essential, I prefer to employ compression-springs, as shown.

As above indicated, the connection between the valves themselves and between the electrical mechanism and the valves may be rigid stems or any other operative connections, as chains or the like.

In speaking of the auxiliary-valve apparatus as being in a pipe or conduit between the motor and the fluid-pressure source it is of course to be understood that the term "pipe" includes any chamber or space between said parts.

While I have, for convenience of description, spoken of the valve-casing as comprising three parts *a*, *b*, and *c*, it will be observed that the part *c* is not a necessary part of the casing, and may, in fact, be merely a coupling, T, or other connection. The three-part construction is a mere matter of convenience.

Fig. 5 shows the expansion-chamber in the form of a T or coupling, or a single body or casting comprising the parts represented as separate sections *a* and *b* in Fig. 1.

Having thus described my invention, what I claim is—

1. In a heat-regulating apparatus, the combination of a main valve to control the flow of heating fluid; a motor for moving said valve; a source of fluid-pressure; a pipe connecting said motor with the source of pressure; an auxiliary-valve apparatus in said pipe, comprising an inlet-valve for admitting pressure

to, and an exhaust-valve for relieving the pressure in the motor; an electrical device for moving said valves in one direction; mechanical means for holding the valves in the position to which they are thus moved; means for moving the valves in the opposite direction; a non-packed operative connection between said valves and said electrical device located exteriorly to the valve-casing, and entirely above the exhaust-passage of said valve; and a thermostat for controlling said electrical device.

2. In a heat-regulating apparatus, the combination of a main valve to control the flow of heating fluid; a motor for moving said valve; a source of fluid-pressure; a conduit connecting the motor and the source of pressure; an auxiliary-valve apparatus in said conduit, comprising an inlet-valve for admitting the fluid under pressure to, and an exhaust-valve for relieving or venting the motor; an expansion-chamber on the delivery side of said exhaust-valve; a waste-passage for said expansion-chamber, said expansion-chamber and waste-passage being of larger capacity than the exhaust-passage; an electric motor; a non-packed guide or passage way between said electric motor and the exhaust-valve; an operative connection between said valves and said electric motor, said connection extending through said non-packed guide or passage; and a thermostat for controlling the electrical apparatus and through it the valves.

3. The combination in a heat-regulating apparatus, of a main valve to control the flow of heating fluid; a motor for moving said valve; a source of fluid-pressure; a pipe or conduit connecting the motor and the source of fluid pressure; an auxiliary-valve apparatus in said pipe, comprising an inlet-valve, and an outlet-valve, for venting or relieving the motor; an electrical device for moving said valve in one direction; means for moving said valves in the opposite direction; an expansion-chamber and a waste-passage between said electrical device and said exhaust-valve, said chamber and waste-passage being of larger capacity than the said exhaust-valve; a non-packed passage between said electrical device and said expansion-chamber; an operative connection between said electrical apparatus and said exhaust-valve, extending through said non-packed passage; and a disk or valve for excluding fluid from said passage when said exhaust-valve is opened.

4. In combination with a main heat-controlling valve or device; a fluid-pressure motor for actuating the same; a source of fluid-pressure; a valve shell or casing provided with an exhaust-passage for escape of fluid from the motor; a valve to close said passage; an unpacked stem bearing upon the exhaust-valve; and a disk carried by said stem and serving to seal the opening through which the stem passes, when said exhaust-valve is open.

5. The combination in an automatic heat-regulating apparatus, of a main valve for controlling the heat supply; a motor for actuating said valve; a source of fluid-pressure; a pipe or conduit connecting the motor with the source of fluid-pressure; an auxiliary-valve apparatus in said pipe or conduit, comprising a casing having an inlet port and valve, a discharge-port leading to the motor, an exhaust port or valve, and means for holding said exhaust-valve yieldingly against its seat when pressure is on the motor; an electric motor for controlling and actuating the auxiliary valve, and a thermostat serving to control the action of the electric motor.

6. In an automatic heat-regulating apparatus, the combination of a main valve for controlling the heat supply; a motor for actuating said valve; a source of fluid-pressure; a pipe connecting the motor with the source of fluid-pressure; an auxiliary-valve apparatus in said pipe, comprising a casing having an inlet-port and a valve for the same, a discharge-port leading to the motor, an exhaust port and valve, said exhaust-valve being operatively connected with said inlet-valve and adapted to move therewith, and means for holding said exhaust-valve yieldingly against its seat when pressure is on the motor, whereby said valve is enabled to operate as a safety-valve to prevent undue pressure upon the motor.

7. In a heat-regulating apparatus, the combination of a main valve; a motor for actuating the same to control the heat supply; a source of fluid-pressure; a pipe or conduit connecting the motor with the source of fluid-pressure; an auxiliary-valve apparatus in said pipe, comprising a casing having an inlet passage or port leading to the motor, an inlet-valve controlling said port, an exhaust passage or port, and a valve of larger capacity than the inlet passage or port, whereby a predetermined yielding pressure against said exhaust-valve will enable it to discharge any excess of pressure on the motor, but said predetermined pressure will open said inlet-valve against a greater pressure than that at which said exhaust-valve is adjusted to open, thereby relieving the pressure on said motor; an electric motor for actuating said auxiliary-valve apparatus; and a thermostat controlling the action of the electrical device.

8. In an automatic temperature-regulating apparatus, the combination of a main heat-controlling valve; a motor for actuating said valve; a source of fluid-pressure; a pipe or conduit connecting said motor with the source of fluid-pressure; an auxiliary-valve apparatus in said pipe, comprising a casing having an inlet port and valve, a port leading to the motor, an exhaust port and valve, said exhaust-valve being operatively engaged with said inlet-valve, and means for holding said exhaust-valve yieldingly against its seat when pressure is on the motor, whereby said valve is enabled to discharge any excess of pressure on the motor; and a non-packed stem arranged

to act upon the exhaust-valve, and adapted to exert a predetermined yielding pressure upon the exhaust-valve when the latter is closed.

9. In a heat-regulating system, the combination of a main heat-controlling valve; a motor for actuating said valve; a source of fluid-pressure; a pipe or conduit connecting the motor with said source of fluid-pressure; an auxiliary-valve apparatus in said pipe, comprising a valve-body having a restricted inlet, a valve for controlling the inlet, a discharge-passage leading to the motor, an exhaust-port of greater capacity than the inlet, an exhaust-valve for controlling the same, and an actuating-stem separate from the valve-stem engaging said valve to hold it against its seat with a predetermined yielding pressure when said exhaust-valve is closed; and a thermostatically-controlled electric motor for actuating said stem.

10. In an automatic heat-controlling apparatus of the character described, the combination of a main heat-controlling valve; a motor for actuating said valve; a source of fluid-pressure; a pipe or conduit connecting the motor with the source of fluid-pressure; an auxiliary-valve apparatus in said pipe, comprising a valve-body having a restricted inlet, an inlet-valve, a discharge-passage leading to the motor, an exhaust-port, an exhaust-valve for controlling the same, a stem engaging said valve and serving to hold it to its seat with a predetermined yielding pressure; and means for varying or adjusting said pressure, substantially as described.

11. The combination in a heat-regulating apparatus, of a main heat-controlling valve; a motor for actuating said valve; a source of fluid-pressure; a pipe or conduit connecting the motor with the source of fluid-pressure; an auxiliary-valve apparatus having an inlet, an outlet, and an exhaust-port, a valve between the inlet and outlet ports, an exhaust-valve for controlling the exhaust-port, a stem for said exhaust-valve separate from the inlet-valve but arranged to move both valves; and thermostatically-controlled electrical devices for actuating said stem.

12. In a temperature-regulating apparatus, the combination of a main heat-controlling valve; a motor for actuating said valve; a source of fluid-pressure; a pipe or conduit connecting the motor with the source of fluid-pressure; auxiliary-valve apparatus for governing the flow of fluid under pressure to and from the motor, comprising a valve-body provided with inlet, outlet, and exhaust passages, a valve between the inlet and outlet passages for regulating the admission of fluid under pressure, a stem for said valve, an exhaust-valve having an operative connection therewith, and a separate actuating-stem operatively engaged with the exhaust-valve; and thermostatically-controlled electric mechanism for actuating said stem.

13. In a temperature-regulating apparatus, the combination of a main heat-controlling valve; a motor for actuating said valve; a source of fluid-pressure; a pipe or conduit connecting the motor with the source of fluid-pressure; a three-way auxiliary-valve apparatus in said pipe, comprising a tube or nipple having a longitudinal bore through which fluid can pass and provided at its ends with valve-seats, valves for said seats, means for connecting said valves extending through the tube or nipple, a pressure device for moving said valves in one direction, and a second pressure device acting in opposition to the first; and a thermostatically-controlled electric apparatus for controlling the action of the pressure devices and through them the movements of said valves.

14. In a heat-regulating apparatus, the combination of a main heat-controlling valve; a motor for actuating the same; a source of fluid-pressure; a pipe or conduit connecting the motor with the source of fluid-pressure; an auxiliary-valve apparatus in said pipe comprising an inlet-valve, a spring or yielding pressure device tending to close said valve, an exhaust-valve operatively connected with the inlet-valve, and a spring or yielding pressure device acting against the exhaust-valve in opposition to the first-mentioned spring; and thermostatically-controlled electrical mechanism for controlling said springs and through them actuating said valves.

15. In a temperature-regulating apparatus, the combination of a main heat-controlling valve; a motor for actuating the same; a source of fluid-pressure; a pipe or conduit connecting the motor with the source of fluid-pressure; an electrically-controlled auxiliary valve comprising a valve-body provided with an inlet passage and port, an inlet-valve having a stem, an exhaust-port, and an exhaust-valve having a stem operatively connected with the inlet-valve stem, said exhaust-port and valve being of greater capacity than the inlet-port and valve; and thermostatic devices for controlling said electrical apparatus and through it the movements of said valves.

16. The combination in a heat-regulating apparatus, of a main heat-controlling valve; a motor for actuating the same; a source of fluid-pressure; a pipe or conduit connecting the motor with the source of fluid-pressure; an auxiliary-valve body in said pipe having inlet, outlet, and exhaust passages, a tube having a longitudinal bore through which fluid will pass and one end of which forms a valve-seat, a valve therefor having a stem passing through said bore, a spring or its equivalent tending to close the valve, an exhaust-valve operatively connected with the first-mentioned valve, an actuating-stem operatively connected with the exhaust-valve, and a spring or its equivalent acting thereon in opposition to the first-mentioned spring; and a thermostatically-controlled electrical apparatus for actuating said valves.

17. In a temperature-regulating apparatus,

the combination of a main heat-controlling valve, a motor for actuating the same; a source of fluid-pressure; a pipe or conduit connecting the motor with the source of fluid-pressure; an auxiliary-valve body in said pipe having inlet, outlet, and exhaust passages, inlet and exhaust valves connected by a stem or stems, one part of which extends through the inlet-passage and is smaller than said passage, and the other part of which extends through the exhaust-passage to the exhaust-valve and is larger than the first-mentioned part of said stem or stems but smaller than said exhaust-passage, and means for holding the exhaust-valve to its seat with a yielding pressure when pressure is on the motor; and a thermostatically-controlled electrical device for governing the movements of said valves.

18. In combination with a main heat-controlling valve or device; a fluid-pressure motor for actuating the same; a source of fluid-pressure; a shell or casing to contain auxiliary valves; a pipe connecting said casing and the fluid-pressure motor; an inlet-valve controlling the passage of fluid to the motor; an exhaust-valve controlling escape of fluid from the motor, the opening controlled by the exhaust-valve being of greater area than that controlled by the inlet-valve; and a pressure device acting upon the exhaust-valve and serving to hold it to its seat with a predetermined force; whereby said valve is adapted to relieve the motor from excessive pressure.

19. In combination with a main heat-controlling valve, damper, or device, and with a source of fluid-pressure; a fluid-pressure motor; a pipe connecting the source of pressure and the motor; a shell or casing interposed between the source of pressure and the motor; an inlet-valve *g* having stem *i*, head *j* and spring *k;* an exhaust-valve *m* having stem *l* arranged to bear upon head *j;* and an unpacked stem *q* extending through the valve shell or casing, provided with a disk to seal the opening through which it passes, and arranged to bear upon and to close the exhaust-valve, substantially as set forth.

20. In a temperature-regulating apparatus in which an auxiliary valve is employed to control the delivery and exhaust of fluid to and from a fluid-pressure motor which actuates the main valve, an auxiliary-valve shell or casing provided with a longitudinally-adjustable thimble *f;* a valve *g* applied to the mouth of said thimble and provided with stem *i;* and an exhaust-valve *l* in alinement with valve *g*, the adjustment of the thimble serving to determine the relative positions and consequent movements of the two valves.

21. In a temperature-regulating apparatus of the character described, the combination with the exhaust-valve thereof; of an unpacked stem adapted to act thereon; a lever for moving said stem outward; a locking device for holding said lever in a depressed position, and a yielding connection between the lever and the stem whereby the stem is enabled to move independently of the lever, and thus to free or open the exhaust-valve without affecting the lever.

Signed this 31st day of May, 1895.

JOHN V. STOUT.

Witnesses:
ED. Q. SMITH,
ABRAHAM WARD, Jr.