No. 646,915. Patented Apr. 3, 1900.

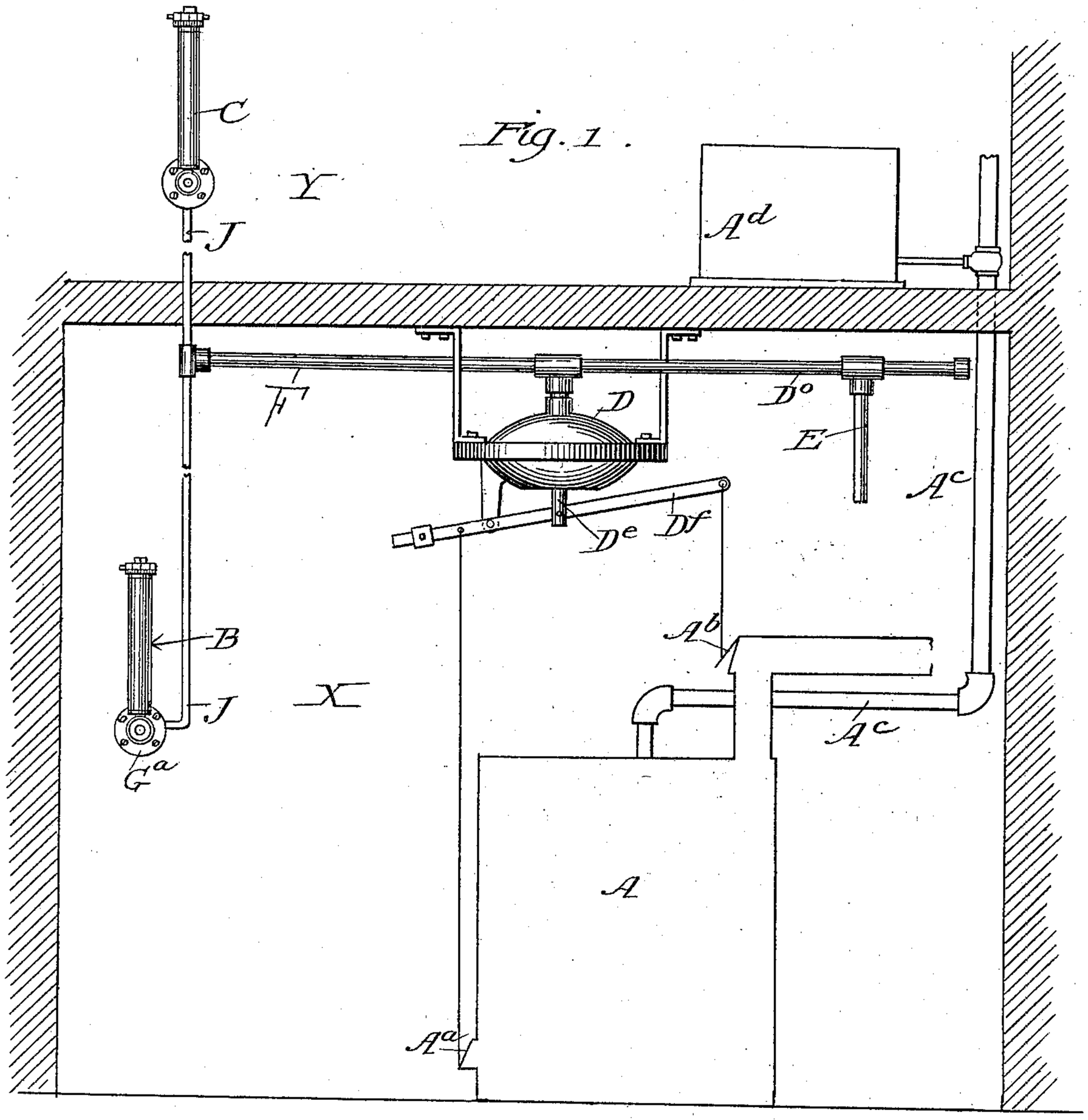
T. O. PERRY.

TEMPERATURE REGULATOR.

(Application filed Mar. 27, 1897.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



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(No Model.) (Application filed Mar. 27, 1897.) 3 Sheets—Sheet 2.

Fig. 3.

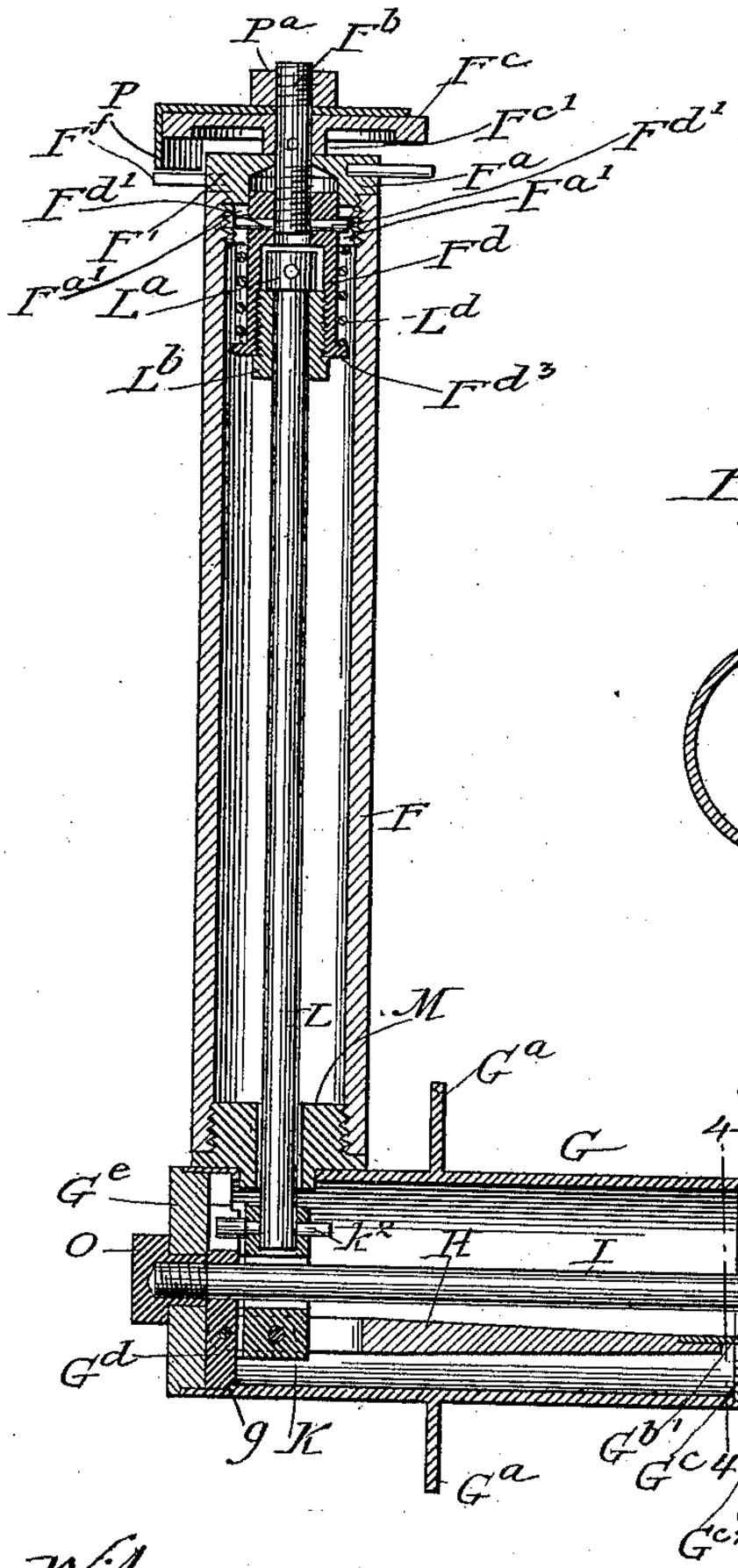


Fig. 4.

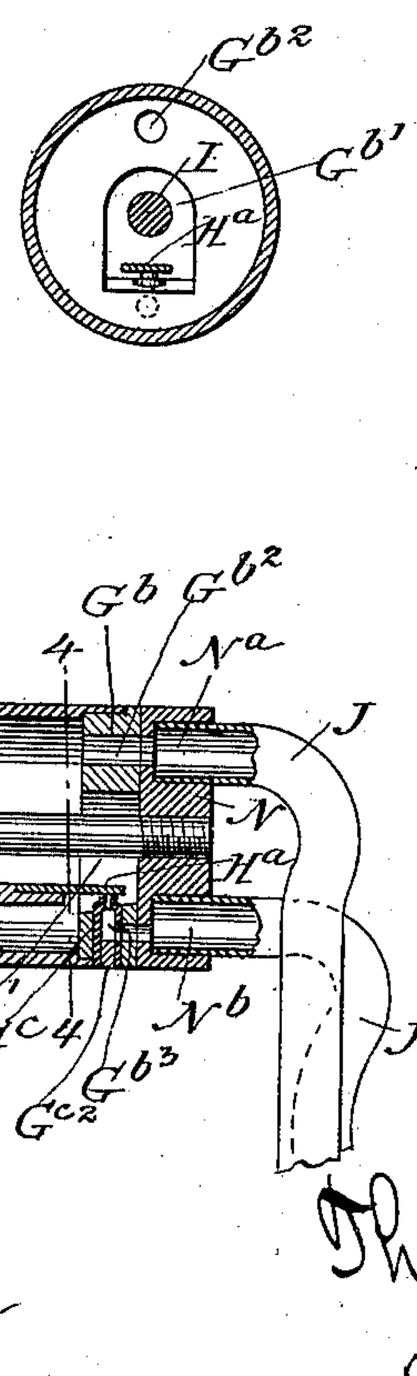
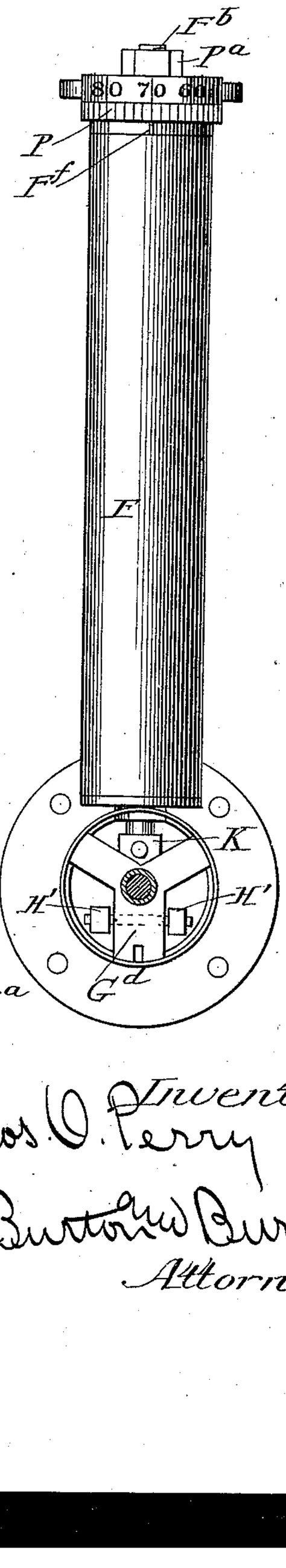


Fig. 2.



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3 Sheets—Sheet 3.

Fig. 5.

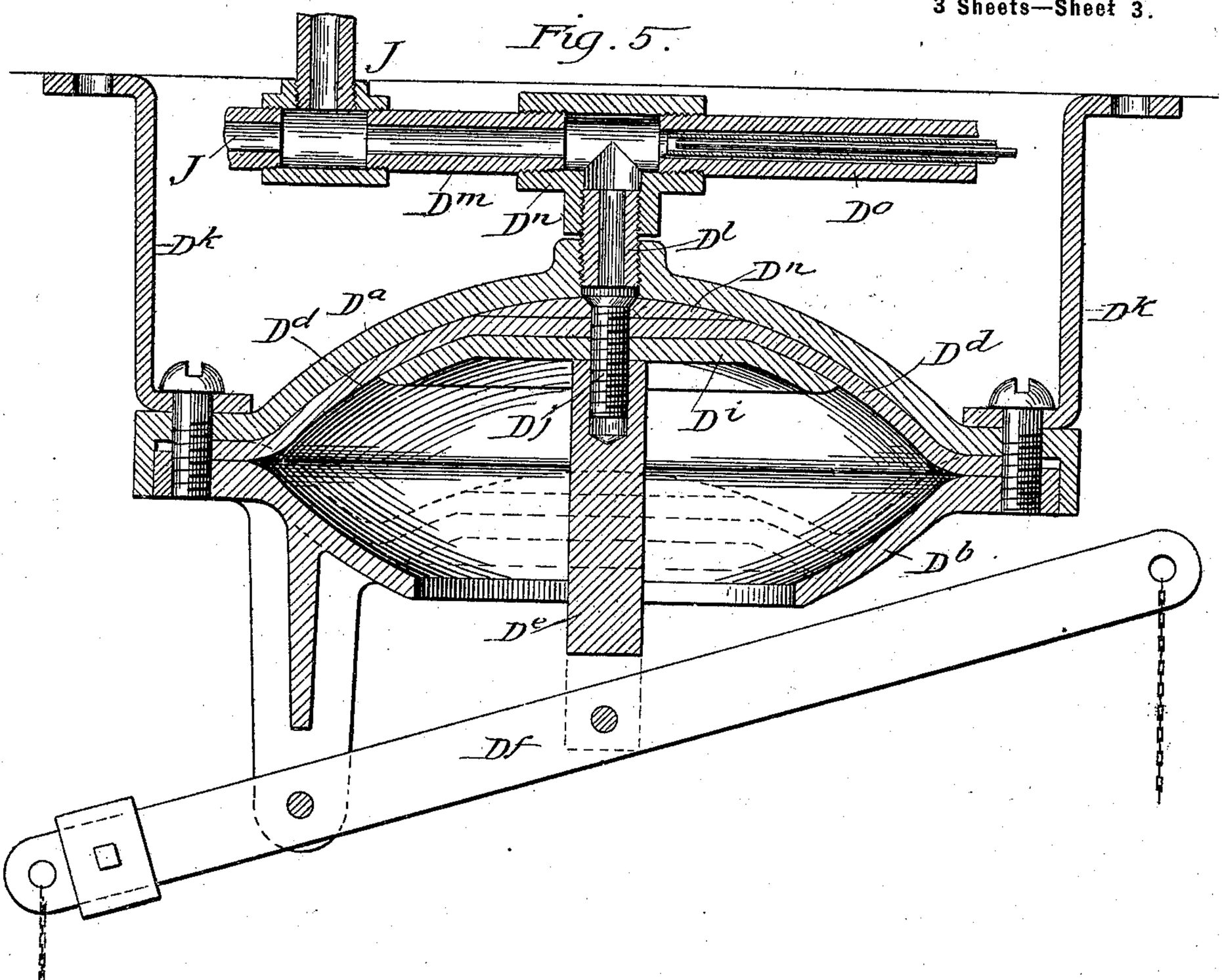
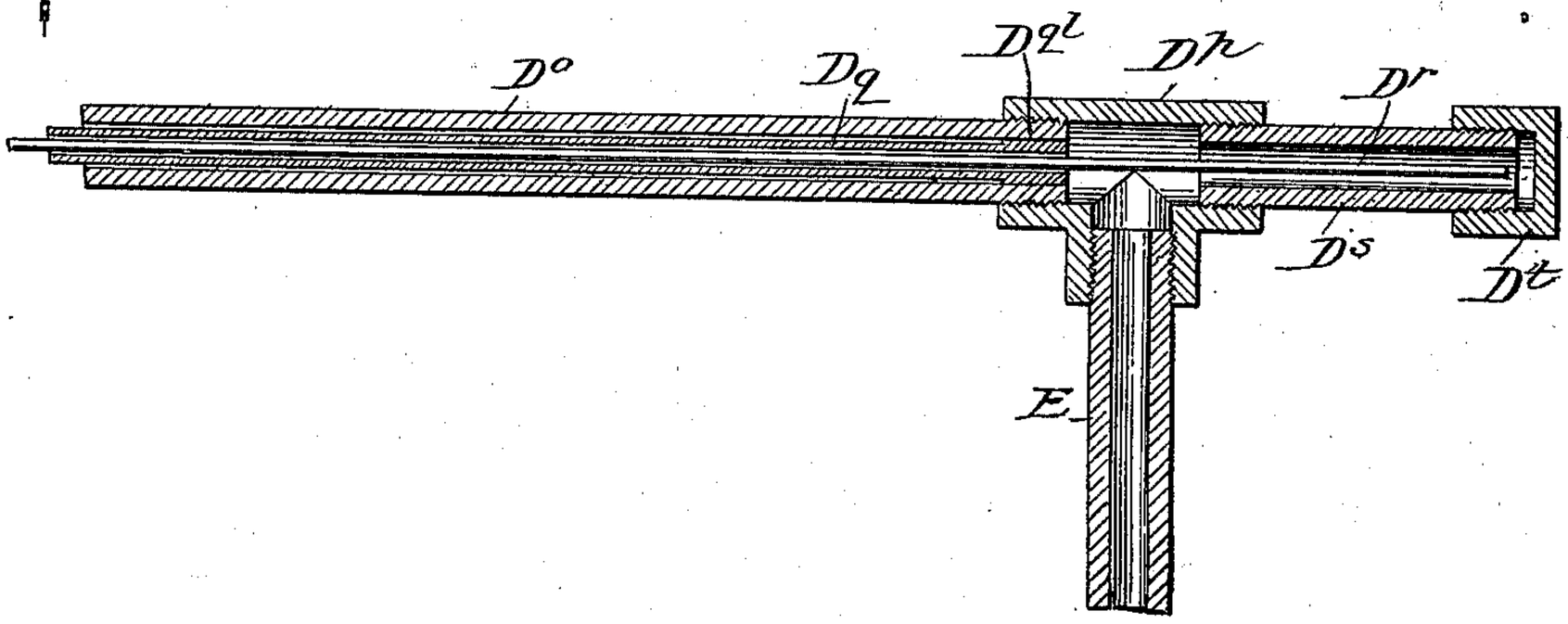


Fig. 6.



Witnesses:
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UNITED STATES PATENT OFFICE.

THOMAS O. PERRY, OF CHICAGO, ILLINOIS.

TEMPERATURE-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 646,915, dated April 3, 1900.

Application filed March 27, 1897. Serial No. 629,509. (No model.)

To all whom it may concern:

Be it known that I, THOMAS O. PERRY, a citizen of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Temperature-Regulators, which are fully set forth in the following specification, reference being had to the accompanying drawings, forming a part thereof.

This invention relates to the class of temperature-regulators in which compressed air or other fluid under tension is employed to operate a motor which actuates devices for controlling the heat of a furnace or other generator—as, for example, by operating the dampers of such furnace—the access or egress, or both, of the motive fluid being controlled by a thermostat in the apartment or apartments whose temperature is to be regulated by thus controlling the heat-generator.

It consists in improvements in the form of the thermostat, in improvements in the form of the motor, in improvements in the devices for regulating the access of the compressed fluid, and in the combination, with such generator-controlling motor, of a plurality of thermostats exposed to the temperature of different apartments, one being preferably exposed to the heat of the generator or furnace directly as distinguished from the heat of the heating medium—water, steam, or air—and the other being located in an apartment which is heated indirectly by such generator or furnace by means of the heating medium conducted from the generator to said apartment.

It consists of further details of construction set forth in the claims.

In the drawings, Figure 1 is a diagrammatic view representing in elevation and outline only the arrangement of my improvements with respect to the generator or furnace and with respect to the apartments in which the thermostats are located. Fig. 2 is an elevation of my improved thermostat with the front head removed from the chamber containing the motive-fluid-controlling valve. Fig. 3 is a section axial with respect to two cylinders comprising it of my improved thermostat. Fig. 4 is a section at the line 4 4 on Fig. 3. Fig. 5 is an axial section through the motor and its connecting-tubes. Fig. 6 is a continuation of the same section as Fig. 5 through the remainder of the inlet-pipe for the motive fluid which actuates the motor, showing a restricting device therein.

I will first explain the general mode of operation and arrangement or distribution of the several elements concerned in the operation of my invention.

In Fig. 1, X represents the furnace-room or apartment in which the generator is located, and Y represents any other apartment remote from the furnace-room which is warmed by heat conducted from the generator by a suitable fluid medium to such apartment. A represents a furnace or other heat-generator having the draft and check dampers A^a and A^b in the customary situations and for the customary purposes in such furnaces and having also the pipe A^c, which conveys the heating medium (which is for the purpose of illustration in this case assumed to be hot water) to a proper heater A^d, from which the heat may be radiated in the apartment Y remote from the furnace-room. B is a thermostat located in the furnace-room, which may be a sample of conditions or locations which may be generally described as such that the thermostat is exposed to the temperature produced by the heat of the furnace as a whole—that is, as distinguished from the temperature of the heating medium, affected or modified only by the general conditions as to temperature existing outside the house—that is to say, the location of this thermostat, here shown in the furnace-room, and which is usually preferably so located, should be such that the general condition of the furnace as to heat radiated from it and the general conditions of the weather requiring heat, and such conditions only, affect said thermostat, it being exempt from the special or local conditions affecting the several apartments which derive heat through a heating medium from the same generator, (and which may also derive heat or be subject to cooling from entirely independent sources.) C represents a thermostat in the apartment Y, which stands for an apartment not exposed to the direct heat of the generator or furnace as a whole, but which is warmed by means of the heating medium conducted to it from the furnace. D is a motor for operating the dampers A^a and A^b. The particular construction of this motor is

shown in other figures and hereinafter described. In general it consists of a chamber having a flexible diaphragm D^d and adapted to be actuated by the admission to the chamber of compressed air or other fluid under tension and having connected to it a stem D^e, which is connected in turn to a lever D^f, which is connected at opposite sides of its fulcrum with the two dampers above mentioned, so that the distension of the chamber causes the draft-damper to be opened and the check-damper to be closed, stimulating the fire, and so that its collapse reverses the operation, closing the draft-damper and opening the check, checking the fire. E is the pipe through which the motive fluid is admitted to the motor, and F the pipe leading to the thermostats B and C, where its escape is controlled by the action of the thermostats hereinafter described, the action of said thermostats, as will fully appear, being that increase of temperature opens a vent, permitting the free escape of compressed air or other fluid and the evacuation of the motor-chamber, while the cooling of the thermostat closes the valve and permits the motor-chamber to be inflated. Following this order of action, it will be understood that if the furnace-room thermostat B is adjusted for a temperature of, say, 75° Fahrenheit, that temperature in a furnace being by experiment in the particular case found necessary to yield the proper amount of heat in the house, the furnace being checked, as shown in Fig. 1, the temperature of the furnace-room may fall below 75°, and thereupon, the valve of said thermostat B being closed by the contraction of the thermostat, if the valve of the thermostat C is also closed by reason of the apartment Y being cooled below the proper point for which the thermostat C is adjusted, the compressed air constantly supplied through the pipe E, wherein its access is restricted, as hereinafter explained, will inflate the motor-chamber, depress the stem D^e, and open the damper A^a, and close the check A^b, causing the fire to be stimulated and the temperature eventually to rise first in the furnace-room, (at least if the heating medium is steam or water, and usually even if it is heated air.) Considerable time may be required for the heating medium to circulate through the apartment Y and raise the temperature there to the proper point, and if the furnace were not checked until that result were experienced the furnace would be liable to become overheated, so that the apartment Y would eventually become much overheated, even though the furnace were checked immediately as soon as the thermostat C in said apartment experienced the proper temperature. This result is prevented, however, by the action of the thermostat B, which, experiencing the temperature due to the stimulated fire in the furnace before the heat thus generated has had time to reach the apartment Y, expands and opens its valve, venting the motor-chamber and causing the dampers to be reversed to check the fire. The use of a plurality of thermostats thus arranged with respect to the furnace and to the apartments to be heated is of great importance when the heating medium is one which circulates slowly, as in the case of hot water, and in which overheating of the medium would be dangerous, since such overheating, as above explained, would make the regulation of the fire depend upon a thermostat in a remote apartment; but it is also of great importance in case of a more-rapidly-circulating medium, such as air, for if a window be opened in such remote apartment as Y, and thereby the apartment be cooled below the desired point, the thermostat in that apartment experiencing the reduced temperature would operate in a manner to stimulate the fire, if the fire could be stimulated by its action alone, and thereupon the increased heat, still wasting through the open window and failing to raise the temperature but slightly, would not be greatly noticed by the occupants; but when the special cooling cause was removed, as by the closing of the window, the apartment would be found almost instantly to be overheated, and the furnace, although instantly checked by the action of the thermostat in said apartment, would continue to overheat the room for a long time thereafter. Thus, when for any cause an apartment should become so warm as to require or seem to require special expedients for cooling, the employment of such means, affecting the thermostat directly, would tend to stimulate the fire instead of to check it, as the overheated condition of the apartment would require. These defects of operation are obviated by use of the thermostat B, exposed to the general conditions of the furnace and weather only, and not to the special conditions of particular apartments. On the other hand, if any apartment becomes too warm—that is, above the temperature for which the thermostat in that apartment is adjusted—the expansion of that thermostat opening its valve will vent the motor, even though no other thermostat in the building is similarly exposed to excessive temperature. Thus it will be understood that with a plurality of thermostats, one of which is in the furnace-room or in a situation equivalent to that, the fire will be checked whenever an excess of temperature is experienced anywhere—that is, at either one or more of the thermostats—(the effect being only slightly more prompt in case more than one of the thermostats at once should open their valves) but will not be stimulated unless both the furnace-room and the other apartments should be cooled below the proper point—that is, so long as any one apartment in the house is warm enough the fire will not be increased; but since if there is heat enough to maintain the desired temperature in any apartment the furnace-room itself will be the first to experience that heat, this last statement is equivalent to saying

that the fire will not be stimulated unless the temperature in the furnace-room indicates that it needs stimulating.

From the considerations suggested above it will be manifest that many of the advantages set forth will be obtained from a plurality of thermostats in different apartments, all operating upon one motor which controls the heater by which all the apartments are warmed, and in the broadest phase my invention includes such plurality of thermostats independently operating the same motor.

Passing now to the description of details of the structures which are shown in diagram in Fig. 1, I will first describe the thermostat. It consists of a hard-rubber tube F, which is the expanding and contracting element and which is designed to be vertical when mounted in the position of use, and attached to the lower end of such hard-rubber tube is a horizontal tube G of any suitable material, preferably metal. The tube G is designed to be inserted into the wall of the apartment in which the thermostat is located, the flange G^a serving as a stop and means of securing the entire thermostat to the wall, the remote end of the tube G being within the wall and in position to receive the pipe connections for the compressed air. The tube G is designed to be a portion of the passage through which the compressed air is admitted or vented from the motor which actuates the dampers, and it contains also within it the valve and the mechanism for operating it which controls said passage, said mechanism being operated by the expansion and contraction of the hard-rubber tube F. The pipes constituting the compressed air or gas connections with the tube G must of necessity make air-tight junctions therewith, and since they are extended within the wall on which the thermostat is secured by the flange G^a, and it is very frequently necessary to insert such tubes in the wall and connect the thermostat thereto after the building is completed, and therefore, without marring the wall to any greater extent than can be thoroughly concealed by the thermostat itself when attached, the most feasible method of making such connection is to employ lead-pipe terminals for the air-ducts within the walls, which may be soldered and remain permanently attached to a part of the thermostat device to which all the remaining parts may be joined air-tight by other means consistent with inserting such additional parts through an opening which may be made in the wall only sufficiently large to admit them. I therefore make the tube G cylindrical, so that a round hole, easily made through the plaster and lathing of the wall, will admit the thermostat to a position where the flange G^a may be neatly and securely attached by screws reaching into the lath, and for the purpose of affording convenient means for soldering the lead-pipe terminals of the air or gas ducts I make a plate N, having two ports N^a and N^b, corresponding to the inlet and outlet ports of the thermostat-chamber, suitably enlarged at the rear to receive the ends of the lead-pipe terminals J J^a, which may be used indiscriminately as inlet and outlet tubes and which may be drawn out through the hole made in the wall, (by virtue of the flexibility of the lead-pipe,) so that the plate N may be connected and soldered fast to such terminals easily—that is, while it is fully exposed outside the wall. For convenience merely in tracing the structure through the different figures I have indicated the tube J as the "inlet," and there is a slight advantage in so connecting the thermostat, because thereby the pressure tends to resist the opening of the valve H^a, hereinafter described, and causes it to open suddenly when the expansion of the tube F has accumulated sufficient force to overcome the pressure. The tube G is provided at the rear end with a head G^b, which has a central opening $G^{b'}$ for the binding-stem I, and, in addition, ports G^{b2} and G^{b3} corresponding to and adapted to register with the ports N^a and N^b of the plate N. This head is first made with the central opening $G^{b'}$ and the port G^{b2}, and in this form it is soldered permanently into the end of the tube G. The port G^{b3} is then made by drilling from the outside of the tube G radially into the head G^b to the central opening $G^{b'}$, inserting an axially-apertured plug G^e, whose inner end forms the actual port and valve-seat, and then completing the port G^{b3} by drilling from the outer face of the head into the said axial aperture of the plug G^e. At the opposite or forward end of the tube G a radial branched spider G^d is inserted and seated at a slight shoulder formed at *g* on the tube G, and to one of the branches of said spider there is fulcrumed the lever H, forked at its forward end to embrace said branch of the spider and afford widely-spread bearings for the lever at its said fulcrum. The free end of the lever constitutes or carries the valve H^a, which closes the port G^{b3}. I have shown this valve in a separate piece from the lever, simply because in the process of manufacture, which it is not necessary to explain in detail here, an accurate seating is practically obtainable better by making the valve proper in a separate piece from the lever and joining it rigidly to the lever by soldering.

K is a link which is in the form of a yoke having a central opening for the stem I, which is pivotally attached at the lower end between the fork-arms H^1 H^1 on the lever H, and at the upper side it is connected by a pin k^2 to the rod L, which extends up centrally within the tube F, passing easily, but without leaving any more space than to avoid friction, through the coupling M, by which the tube F is attached rigidly to the tube G. The aperture in the coupling M is thus restricted to prevent the motive fluid from entering the tube F so freely as to materially influence the temperature of the tube. The rod L is connected at the upper end, in a manner which

will be hereinafter described, to the upper end of the tube F, so that the expansion of the tube tends to draw said rod upward and through the link K lift the lever H and open the port G^{b3}.

For convenience in assembling and mounting and dismounting and disassembling the parts the stem I is secured permanently at the center of the plate N, as by being screwed thereinto to the end of the thread cut on the stem, so that it may be set very firmly into the plate without other securing device. When the plate, therefore, is soldered to the pipes J and J^a and the plate is then pushed back through a hole in the wall through which the pipes have been drawn out for the purpose of soldering, the stem I protrudes, and the tube G, with the tube F attached and mechanism therein, may be passed over the stem, which will emerge through the center of the spider G^d, the head G^b seating on the forward face of the plate N, an air-tight packing-disk being interposed, if necessary, or, if the surfaces have been matched, such disk being dispensed with, a drop of oil applied before binding the parts together serving to make the junction air-tight. The forward head G^e being now inserted, a nut O is screwed onto the forward threaded end of the stem I and binding against the head G^e clamps the plate N against the head G^b, whereby the unitary structure, comprising the two tubes G and F, is bound firmly to the plate N, and the device is ready for attachment to the wall by means of the flange G^a and may be detached at any time by loosening the nut and withdrawing the structure from the stem I, leaving the stem and plates N, with pipe-terminals soldered thereto, undisturbed in the wall.

I will now describe the connection of the upper end of the rod L with the tube F. It is at the upper end of the tube F that the adjustments are located by use of which the thermostat may be set to operate in the opening and closing of the valve H^a upon variation either way from a predetermined temperature, and to permit such adjustment and indication thereof and at the same time prevent the escape of the motor fluid, compressed air or gas, through the joints of the devices arranged for the purpose of such adjustment and indication constitutes the purpose of the several expedients and detail devices now to be described.

F^a is a plug or cap which is screwed permanently into the upper end of the tube F. It has a central aperture through which the bolt F^b emerges. This bolt constitutes the stem of a disk F^c, which has a hub $F^{c'}$, which when held firmly seated on the top of the cap F^a makes an air-tight junction therewith and being fitted air-tight onto the stem F^b makes the tube F air-tight at the upper end. The stem F^b is connected swivelwise with the stem L, but with capacity for adjustment by which the total distance from the lower end—that is to say, from the pin k^2 at the lower end of the rod L—to the shoulder of the hub $F^{c'}$, seating on the top of the cap F^a, may be varied at will. This swivel junction consists of the sleeve F^d, into whose upper end the bolt F^b is screwed, the sleeve extending thence down outside a stop-collar L^a on the upper end of the rod L and being screwed tightly onto a sleeve L^b on the rod L below the stop-collar. The cap F^a is provided with two diametrically-opposite slots $F^{a'}$ $F^{a'}$ in its threaded portion, which is screwed into the end of the tube F, and pins $F^{d'}$ $F^{d'}$, set into the sleeve F^d, protrude into said slots, so that the sleeve is prevented from rotating when the stem F^b is rotated to screw it into or out of the sleeve. The sleeve has at the lower end the flange F^{d3}, and about the sleeve there is coiled a spring L^d, which rests on the flange and reacts between the same and the lower end of the cap F^a, tending to force the sleeve downward. The operation of this structure is that by rotating the disk F^c, which constitutes simply a handle for the threaded stem F^b, the sleeve F^d may be raised or lowered against the tension of the spring L^d or permitted to be forced downward by the spring, thus raising or lowering the rod L, and thereby determining the degree of expansion or contraction of the tube which will unseat or seat the valve H^a. The purpose of the swivel-rod L at the upper end, as described, is one of convenience merely—viz., that in assembling the parts it shall not be necessary to contrive that the cap F^a shall come tight at its thread with the tube F in any particular position, the rod L being adapted to be turned after the parts are secured together at the top to bring the hole for the pin k^2 in position to receive said pin to connect it with the lever K.

P is a graduated segment which is bound onto the disk F^c by means of a nut P^a, the upper end of the stem F^b being threaded for that purpose. This segment might be rigid with the disk F^c, except as a matter of convenience, for, the purpose of the graduated segment being to indicate how the device is set with respect to the temperature at which the thermostat is designed to hold the apartment, it is convenient that the figure on the graduated segment indicating the selected temperature should in all cases be at the front, where for convenience in accurate observation of the device an index-finger F^f is provided, and this may be done by use of the structure shown, wherein the nut P^a serves to bind the segment to the disk at any selected position. If, for example, as shown in the drawings, 70° Fahrenheit be the selected temperature, the segment will be bound to the disk with the figure "70" at the front over the index-finger F^f. When thus adjusted, if the disk F^c be rotated to carry the figure "70" to the right, for example, of the finger, the temperature of the room will continue to rise until it reaches that indicated by the point on the graduated seg

ment which is opposite the finger, and similarly, if the disk be rotated in the opposite direction, the temperature of the room should continue to fall until the lower temperature indicated by that on the graduated segment is reached.

The motor for operating the dampers has been briefly described. It consists of the upper inwardly-concave cap D^a, the lower upwardly-concave annulus D^b, the flexible diaphragm D^d, bound at its periphery between the other two parts, the lower disk D^i, and the upper disk D^n, clamped at the center of the diaphragm by means of the screw D^j taking into the stem D^e, the latter being connected to the lever D^f, which operates the dampers, as described.

The entire device is designed to be supported from the ceiling by the hangers D^k. At the center of the cap D^a the chamber of the motor above the diaphragm is connected by the nipple D^l with the pipe D^m by means of the T D^n, into one end of whose cross-arm said pipe D^m is connected, said pipe D^m leading to the several thermostats which are connected with the motor, one being in the vicinity of the furnace, as in the furnace-room, and others being in apartments, as Y, which are heated by means of the heat-conveying medium conducted to such apartments from the furnace. Into the other branch of the cross of the T the pipe D^o is connected, which leads from the source of motor fluid, compressed air, or gas. In this pipe I provide a means of restricting the supply of the motive fluid, so that it shall not equal the capacity of the port G^{b3}, by way of which, past the valve H^a, such motive fluid escapes when the valve is opened. Since the port controlled by the valve H^a is itself quite small, a passage much more restricted than the port, if the restriction were effected by reducing the aperture correspondingly below that of the valved port, would involve too small an aperture to be reliable, since it would be liable to become filled with fine dust or rust. In order, therefore, to retain a suitably-large passage and yet restrict the passage of air therethrough, so that it shall be less free and shall permit much less rapid movement of air through it than can be obtained past the valve H^a, I locate the T D^p in the pipe D^o merely for convenience of access to the horizontal portion of said pipe. In said horizontal portion I insert a tube D^q, having at the end a boss $D^{q'}$, adapting it to fit air-tight within the pipe D^o, and within this tube D^q, I insert a wire D^r, which, being made of suitable size merely to slip easily within the tube D^q, would leave, if it were centered in the tube, a very thin annular space around it. In practice a very slight bending or irregularity in the wire makes it stick in the tube and retain its place therein without any securing device. Into the opposite end of the cross of the T D^p another piece of pipe D^s may be secured and closed by a cap D^t, which, being disconnected from the T, will afford easy access to the end of the wire. I find by experience that having in the first place supplied an ample length of tube D^q—as, for example, two feet—the length of the wire D^r may be made to produce the desired degree of restriction to the passage of the motor fluid. If upon the first experiment it should be found that the tension with which the motive fluid is actually supplied the restriction is insufficient, a longer wire being inserted may then be reduced little by little until just the desired restriction is obtained. It becomes an easy matter thus to adjust the device to the particular situation to which it is placed, accommodating it to the tension of the motive fluid, the actual friction which the pipes conducting the motive fluid and other causes, which will vary according to the distance of the motor from the source of motive fluid. This species of restricting device is therefore much more easily and accurately made to suit each particular situation than a restriction consisting of a very-fine aperture in which the variations necessary to accommodate different situations would be almost infinitesimal.

I claim—

1. In combination with a fluid-pressure motor, a thermostat which controls the same comprising two tubes, one of which is the expanding and contracting element, and the other of which constitutes a part of a motive-fluid conduit; a valve in said latter tube, which controls the flow of the motive fluid and operating connections from said valve to the remote end of the expanding and contracting element; a cap closing said end of said element, said operating connections comprising a link which extends longitudinally within said element, and longitudinally-adjustable connections for suspending the link from the cap, said adjustable connections comprising a stem which protrudes through the cap; a stop which bears on the cap, and a spring within the tube which reacts in one direction on the cap and in the other direction on the link-suspending connections, tending to hold the stop against the cap.

2. In combination with a fluid-pressure motor, a thermostat which controls the same comprising two tubes, one of which is the expanding-rod and contracting element, and the other of which constitutes a part of a motive-fluid conduit; a valve in said latter tube, which controls the flow of the motive fluid and operating connections from said valve to the remote end of the expanding and contracting element; a cap closing said end of said element, said operating connections comprising a link which extends longitudinally within said element, and longitudinally-adjustable connections extending through the cap; a stop above the cap by which the longitudinally-extending link is suspended from the top of the expanding and contracting element, and a spring within the latter reacting upward or outward on the cap and downward

or inward on the link-suspending connections, tending to seat the stop on the upper or outer side of the cap.

3. In combination with a valve-motor adapted to be operated by fluid under tension, a thermostat and a valve operated thereby which controls the flow of the motive fluid from the motor; a pipe through which such motive fluid is admitted to the motor, and a restriction in said pipe consisting of rod or wire therein whose length determines the amount of restriction which it causes of the flow of the motive fluid.

4. In combination with a motor for regulating a heater; a thermostat and the valve operated thereby which controls the escape of motive fluid from the motor; the pipe which conducts the motive fluid to the motor, comprising the T D^n, from one branch of which the pipe leads to the motor, and the pipe D^s closed at the end and connected to the other branch of the T, and the restricting device comprising the rod or wire D^r inserted through the T and accessible by detaching the pipe D^s.

5. In combination with a valve-motor adapted to be operated by a fluid under tension, a thermostat and a valve operated thereby which controls the flow of the motor fluid; a pipe communicating with the motor-chamber, and a restriction in such pipe consisting of a rod or wire whose length determines the amount of restriction which it causes to the flow of the motor fluid.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, at Chicago, Illinois, this 24th day of March, 1897.

THOMAS O. PERRY.

Witnesses:
JEAN ELLIOTT,
E. T. WRAY.