(No Model.) 2 Sheets—Sheet 1.

A. F. NAGLE.

TEMPERATURE REGULATOR.

No. 509,625. Patented Nov. 28, 1893.

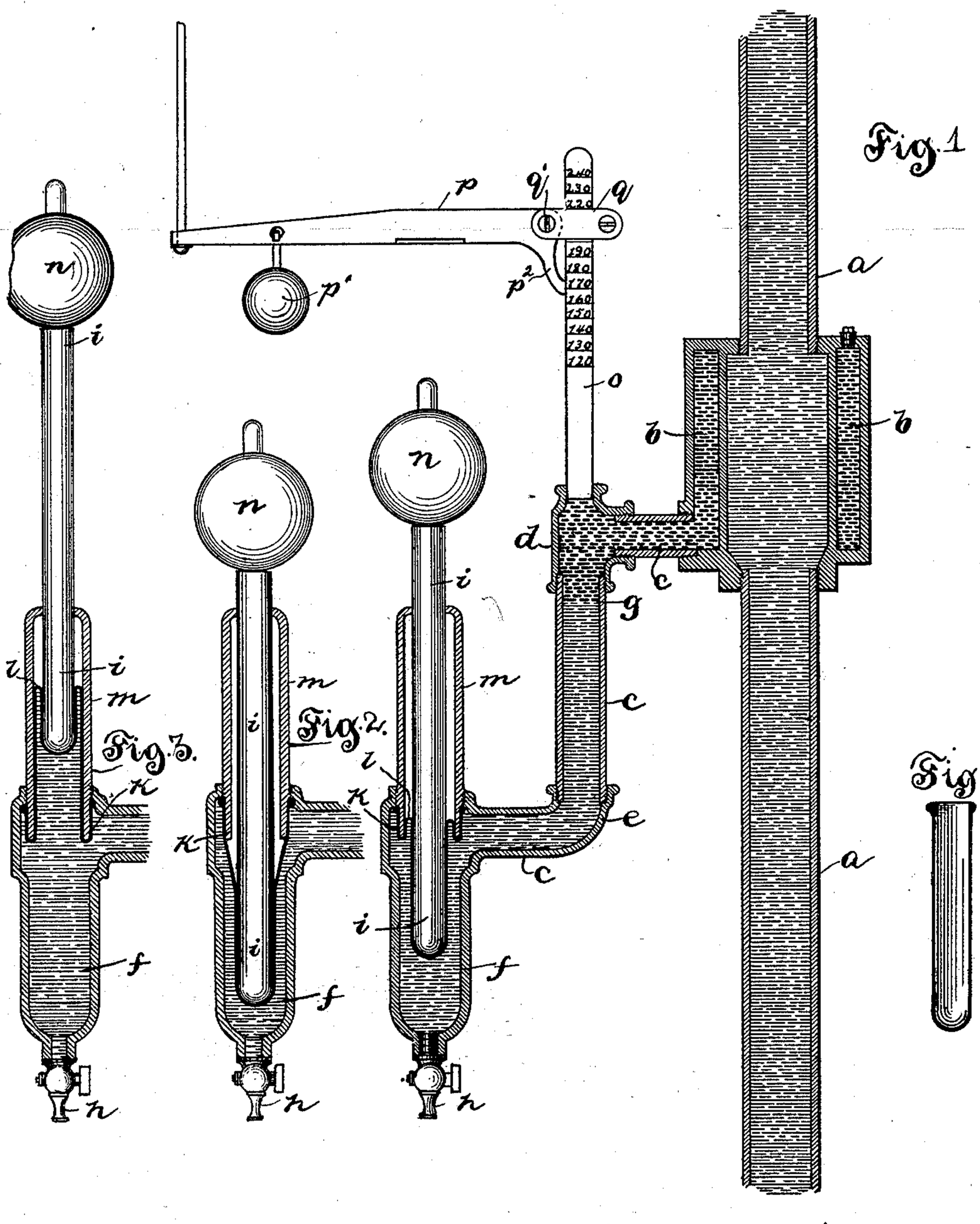

Fig. 1

Fig. 3.

Fig. 2.

Fig. 4.

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(No Model.) 2 Sheets—Sheet 2.

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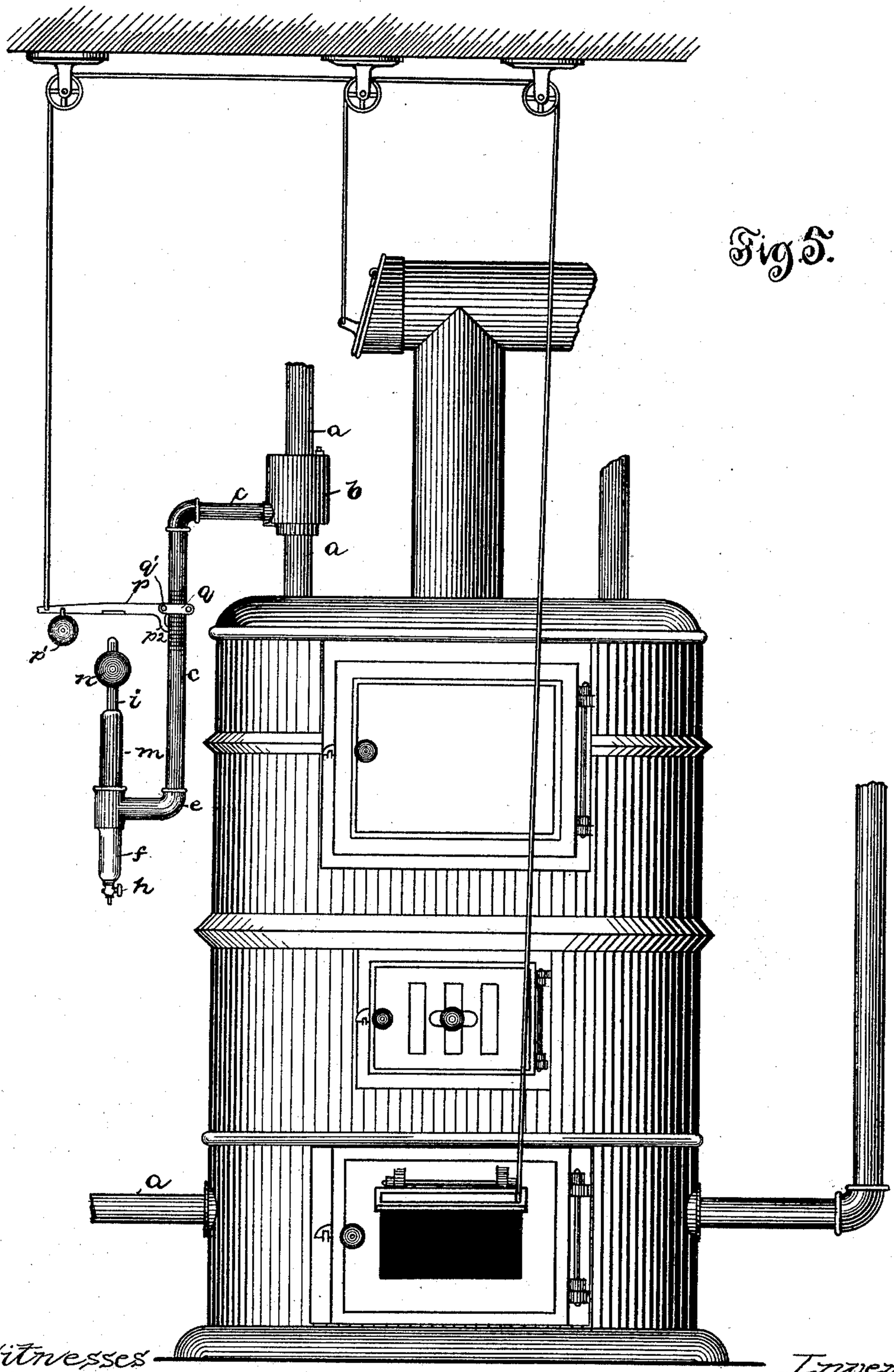
Fig 5.



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UNITED STATES PATENT OFFICE.

AUGUSTUS F. NAGLE, OF CHICAGO, ILLINOIS.

TEMPERATURE-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 509,625, dated November 28, 1893.

Application filed April 2, 1892. Serial No. 427,535. (No model.)

To all whom it may concern:

Be it known that I, AUGUSTUS F. NAGLE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Temperature-Regulators, (Case No. 1,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to regulating devices for hot water heaters and its object is to secure in such a regulator a wide range of primary motion of apparatus under the influence of varying temperature, and also to provide a device sensitive to slight variations of temperature both of the hot water and of the surrounding atmosphere which will respond quickly and positively to any such variation.

In the devices which have hitherto been made utilizing the molecular expansion of liquids under the influence of heat, it is possible to secure only a small amount of primary motion, and it is the object of this invention to secure a greater amount of primary motion than has heretofore been possible by the molecular expansion of liquids under the influence of heat, as distinguished from the vaporization of such liquids.

When liquids have been used heretofore the closed vessels filled with the liquid, the expansion of which operates a damper has been surrounded in whole or in part by the water of the heater. This arrangement is open to the objection that the promptness and sensitiveness of the response to temperature variations is impaired, as the expansive liquid contained in the vessel is always protected from cooling by the hot water surrounding it.

My invention consists in a construction by which the chamber containing the expanding fluid is external to the hot water of the heater.

It also consists in the use of the combination of oil and water or of oil alone as the expanding fluid and in a new and original construction of responsive device for transforming the molecular expansion of the expanding fluid into motion adapted to operate the damper of the heater.

My invention is illustrated in the accompanying drawings in which—

Figure 1 is a sectional view of the entire apparatus shown in connection with the main pipe of the hot water heater and with the lever which transmits the motion to the damper and the standard which supports said lever in elevation. Fig. 2 shows the responsive device as it appears when the rubber tube is expanded to its full length downward. Fig. 3 shows the responsive device with the weighted plunger withdrawn and the rubber tube pressed upward and outward. Fig. 4 shows the rubber tube in which the plunger is inserted. Fig. 5 shows the device in place attached to the hot water heater.

Similar letters of reference refer to similar parts throughout the views.

The feed pipe of the hot water heater *a* is surrounded by the chamber *b* and connected by the nipples *c*, *c*, *c*, the T *d* and the elbow *e* with the cylindrical vessel *f*. The nipple *c* is attached and connects with chamber *b*, at or near the bottom thereof so that the conduit leading to the cylinder *f* will be below the lowest point of said chamber. The object of this is that the water with which the vessel *f* and the conduit leading thereto shall be partially filled may not rise above any part of the chamber containing the oil, my object being to confine the oil to the chamber *b* and to the nipple *c* and the T *d* immediately adjoining said chamber where it will be subjected to the influence of the heat of the water in the pipe *a*, but to fill the rest of the space in the conduit with water. I have shown a water line at *g*. It is obvious that this line between the water and the oil will rise and fall with the expansion of the oil in the chamber *b*, and that by proper proportioning of the chamber *b* the vessel *f* and the conduit connecting the two, this line will at no time rise above the bottom of the chamber *b*. The lower specific gravity of the oil and the fact that the two liquids are mutually repellant will keep the oil always above the water in the construction shown.

The chamber *f* is provided at its lowest portion with a dripcock *h* for convenience in case it is desired to draw the fluid out of the chamber or to renew it. Into the chamber *f* the plunger *i*, preferably of cylindrical form, projects, and the lower end of this plunger is enveloped with a rubber tube, the top of which is drawn over the end *k* of tube *m*. The tube *m* and its lower extension *k* upon which the

rubber tube is fastened serve to prevent a too great expansion of the rubber as it is forced up under the influence of the fluid pressure against the inside of the tube *m*.

I preferably construct the plunger and the tube *m* of such size relatively that there shall be between the interior surface of said tube *m* and the plunger a space about equal to three thicknesses of the rubber tube when it is not stretched, thus permitting the rubber tube to fold upon itself as the plunger rises. The rubber tube is closed at its lower end and is of a size to approximately fit the plunger *i*. This rubber tube turns upon itself as shown at *l l* as the plunger *i* rises. The pressure of the fluid tending to drive the plunger *i* out of the chamber *f*, also serves to keep the two surfaces of the rubber tube, where it is folded, separated, so that they will not come in contact and stick together. The tube *m* extending upward from chamber *f* has at its upper end an opening adapted to fit the plunger *i* and serves as a guide to said plunger. Upon the top of this plunger is fastened a weight *n*, this weight being sufficient in amount to cause the necessary fluid pressure upward to keep the surfaces of the tube enveloping the lower end of the plunger from contact and sticking as it folds upon itself.

The standard *o* I preferably fasten to the T as shown above, although it is obvious that it can be fastened in any suitable manner so as to support the lever *p* which is pivoted to the clamp *q* at *q'* in a position to be operated by the plunger, the top of which comes in contact with the lower surface of said lever *p*. The standard *o* may be graduated as shown and the clamp *q* carrying the lever *p* may be readily moved up or down through any desired range of adjustment. It is obvious that the higher the lever *p* is placed the higher the temperature will necessarily be in order to cause the mechanism to operate.

To balance the weight of the damper I suspend the weight *p'* from the lever *p*. The arm p^2 rests against the standard *o* and serves to keep the lever *p* in a horizontal position. The lever *p* is connected in any suitable way with the damper to be operated by the regulator. As this intermediate mechanism is not an essential feature of my invention, I do not deem it necessary to further describe it. I prefer in order to open and close the damper within a few degrees change of temperature to give the plunger a large idle motion before lifting the lever connected to the damper.

From the construction of the apparatus described and shown, its operation will be readily understood. The operating lever *p* being set for any desired temperature, the apparatus will not operate to change the damper until there is a variation in the temperature, either of the outside atmosphere or of the hot water in the pipe *a* sufficient to cause the expansion or contraction of the oil within the chamber *b*, which being communciated through the column of water in the passages connecting the said chamber *b* with the chamber *f* into which the plunger enveloped in a rubber tube projects, causes the rise or fall of the plunger and consequently the closing or opening of the damper.

An advantage which arises from the construction of the oil chamber outside the hot water pipe in addition to the increased sensitiveness caused by the exterior radiating surface of this chamber, which permits the prompt cooling of the oil, is that this construction also results in making the apparatus of my invention responsive to changes in the temperature of the atmosphere surrounding the same. By varying the superficial area of the exterior of this chamber *b*, I am able to vary this sensitiveness to the influence of the surrounding atmosphere.

My invention is therefore peculiarly adapted to such locations, for instance, as conservatories, where it is desirable to have a temperature regulator which responds not only to the varying temperature of the water in the heater but to the varying temperature of the outside atmosphere.

By the use of oil for the expanding fluid, I am able to secure the advantage of the great coefficient of molecular expansion which oil possesses, and I am also able to get a regulation over a wider range of temperature, as olive oil, for instance, boils at about 600° Fahrenheit. The use of water limits the maximum temperature to about 212° Fahrenheit, at which temperature the water boils. Oil, however, cannot be used in contact with rubber on account of its deleterious action upon the rubber. But water being interposed between the oil, which acts as an expanding fluid, and the rubber tube, I avoid this difficulty, and at the same time secure the advantages which arise from the use of the oil and the use of the rubber.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a temperature regulator, the combiation with a closed chamber containing oil, adapted to be subjected to the varying temperature of the hot water of the heater, of a device constructed in whole or in part of rubber, said device adapted to be actuated by the expansion and contraction of said oil under the influence of varying temperatures, and a body of water interposed between said device and the oil contained in said chamber; substantially as described.

2. In a temperature regulator, the combination with a responsive device adapted to be actuated by the expansion and contraction of a liquid, of a chamber encircling the heating fluid, oil filling said chamber and communicating through a column of water with said responsive device, substantially as described.

3. In a temperature regulator, the combination with a body of oil adapted to expand and contract under the influence of the rise and fall of temperature, of a column of water

contained within a chamber in communication with the chamber containing said oil, a weighted plunger adapted to rise and fall as said oil expands and contracts, said expansion and contraction being communicated to the plunger through the column of water, said plunger being partially surrounded by a rubber tube which is attached to the end of a solid tube in which the said plunger is adapted to rise and fall, substantially as described.

4. A temperature regulator consisting of the chamber *b* exterior to the heating fluid, a conduit leading from said chamber to a chamber *f*, into which a weighted plunger projects, said plunger partially enveloped in a rubber tube, a metallic tube *m* to which said rubber tube is attached, oil within said chamber *b* and communicating pressure to said plunger through a column of water contained in said conduit and chamber *f*, said plunger being adapted to operate mechanism whereby the expansion and contraction of the fluid in said chamber *b* is adapted to open and close the damper of the heater, substantially as described.

5. The combination with a chamber having an expansive portion consisting of a flexible tube, a rigid tube leading from said chamber, but not communicating therewith, said flexible tube being attached to said rigid tube, a weighted plunger adapted to press said flexible tube into said chamber, said weighted plunger being of a size which permits the flexible tube to fold upon itself between said plunger and said rigid tube, and a liquid adapted to separate the folds of the flexible tube at all times and to press said folds respectively against the rigid tube and the plunger, whereby the said flexible tube is pressed into said rigid tube, substantially as described.

6. A responsive device adapted to be actuated by liquid pressure consisting of a rubber tube closed at one end, with a solid weighted shaft or plunger filling said tube, said tube sprung over a metal tube adapted to envelop and support said rubber tube, but with only sufficient space between the plunger and the metal tube to admit of the rubber being turned over on itself within said space when the liquid pressure is sufficient to overcome the weight of the plunger and to permit the access of the liquid between the folds of said rubber tube at all times, substantially as described.

7. In a temperature regulator, the combination with a shaft adapted to be acted upon directly and moved vertically by liquid pressure, of a pivoted lever connected with the damper and having no connection with the moving shaft, but lying in the path thereof, whereby the moving shaft may engage said lever to move the damper, and means for varying the point of the travel of the shaft at which it acts upon said lever, substantially as described.

In witness whereof I hereunto subscribe my name this 9th day of March, A. D. 1892.

AUGUSTUS F. NAGLE.

Witnesses:

N. JEANE TALLETT,

GEORGE MCMAHON.