(No Model.)

W. E. EASTMAN.

THERMOSTATIC GOVERNOR AND MOTOR.

No. 476,372. Patented June 7, 1892.

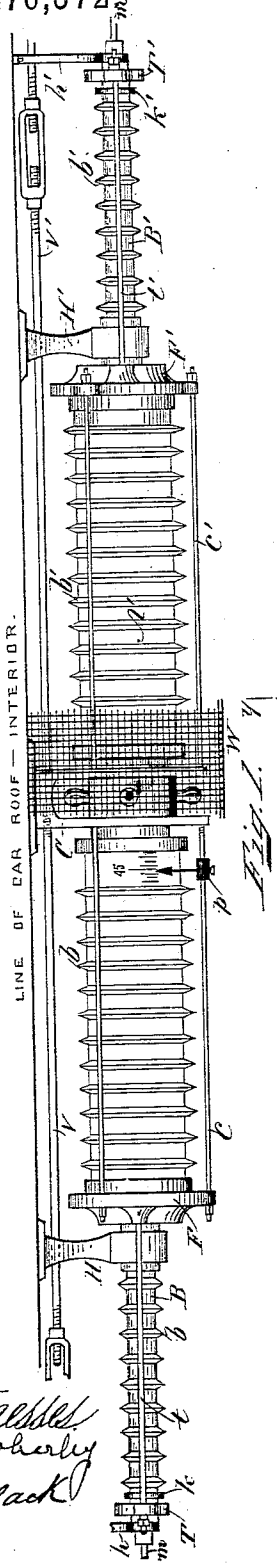

Fig. 1.

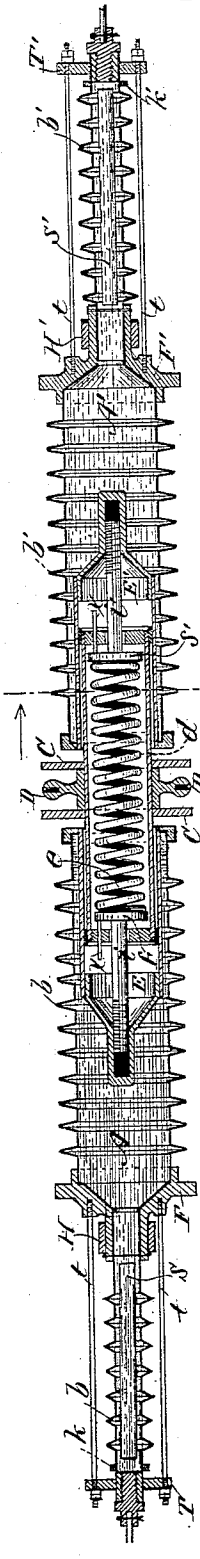

Fig. 2.

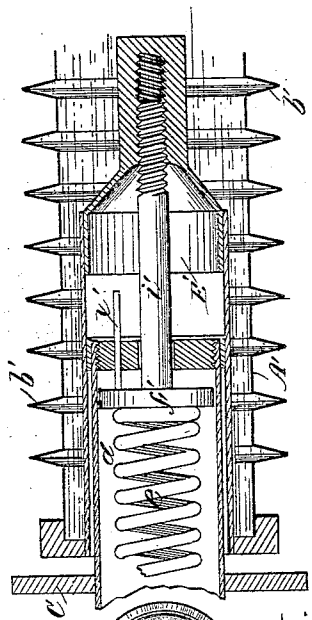

Fig. 3.

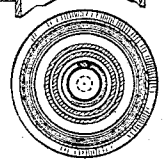

Fig. 4.

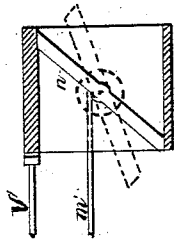

Fig. 6.

Fig. 5.

Witnesses:
W. Smoderly
J. T. Black

Inventor.
William E. Eastman
By Baxter & Vale
Attorneys.

UNITED STATES PATENT OFFICE.

WILLIAM E. EASTMAN, OF BOSTON, MASSACHUSETTS.

THERMOSTATIC GOVERNOR AND MOTOR.

SPECIFICATION forming part of Letters Patent No. 476,372, dated June 7, 1892.

Application filed September 4, 1891. Serial No. 404,720. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM E. EASTMAN, a citizen of the United States of America, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Thermostatic Governors and Motors, of which the following is a specification, reference being had therein to the accompanying drawings.

The object of my invention is to provide a reliable and positive working mechanism to be operated by change of temperature and in which movement shall be ample and powerful, with a freedom from lost motion and small liability to get out of order. I attain these ends in the following-described manner:

Figure 1 is a side elevation of my governor. Fig. 2 is a longitudinal section of the same. Fig. 3 is an enlarged detail. Fig. 4 is a transverse section through line *y y* of Fig. 2. Fig. 5 is an end elevation. Fig. 6 shows the valve, shutter, or damper operated by the governor.

Like letters and figures of reference in the several views denote the same parts.

The device is adapted to work as a governor of valves, dampers, and the like by changes of temperature, and also as a motor to operate proper mechanism to close electric circuits or to move an index of a thermometer and for various other purposes.

It consists, essentially, of a corrugated tube of metal, the corrugations being annular. These corrugations allow a lengthening of the tube by the expansion of a liquid hermetically sealed within and completely filling it, and the shortening of the tube is caused by the resiliency of the corrugations plus atmospheric pressure when the fluid contracts.

I use the device for operating the valves or shutters in a refrigerator-car of my invention, and although I do not confine its use to this purpose I shall describe it, for the sake of clearness, in connection with a car and operating two shutters.

In Figs. 1 and 2 the device is shown in duplicate, (except the index, which is shown in only one half.)

A and A′ are the larger corrugated tubes, and B and B′ the smaller or operating tubes.

The letters *b* and *b′* indicate the annular corrugations formed by any proper mechanical means in the walls of all the tubes. The function of the larger tubes A and A′ is to prevent distortion and rupture of the tubes by excessive expansion by lengthening toward the central bracket or hanger C, which supports the central part of the governor. This movement to accommodate excessive expansion will not take place until after the tubes B and B′ have made their full stroke, because the lengthening of tubes A and A′ is hindered by the resistance of the spiral spring *e*, as well as by their own greater resistance. The bracket or hanger C carries between its leaves the hand-wheel D, which incloses the inner tube *d* and is rigidly fastened to it, so that the tube *d* revolves with the hand-wheel and revolves within circular openings in the bracket C. Within this inner tube *d* is a spiral spring *e*, bearing at its ends against the bolt-heads *f* and *f′*. Crank or dog pins *x*, passing from the bolt-heads through the closed ends of the tube *d*, give rotary motion to the bolts *i* and *i′*, which work with right and left hand threads in internally screw-threaded tubes or anchorages secured to the carriers E and E′ whenever the hand-wheel D (and the inner tube *d*) are revolved to set the governor. A revolution that throws the carriers E and E′ away from the center shortens the tubes A and A′ by carrying their inner ends away from the center as they slide freely on the inner tube *d*, their only attachment to the center bracket C being through the bolts *i i′*, the inner tube *d*, and the hand-wheel D. The tubes A and A′ are rigidly held *in situ* at their outer ends by the yoke-rods entering the yoke-plates F and F′. These yoke-rods *c* and *c′* are fastened at their inner ends to the central bracket C. Other hangers H and H′ and *h* and *h′* give support to the governor. The throw of the operative tubes B and B′ is limited in its outward excursion by the yoke-plates T and T′, which are held back to the yoke-plates F and F′ by the yoke-rods *t* and *t′*. The collars *k* and *k′*, firmly fixed to the tubes B and B′, come into contact with the yoke-plates T and T′ whenever the tubes B and B′ have made their full outward stroke, and afterward, if expansion of the contained liquid goes on, all motion will be by the larger tubes A and A′ toward the central bracket, compressing the spring *e*. This providing for excessive ex-

pansion is very essential. Alcohol or other liquid may be used in the hermetically-closed tubes, and in practice I use ordinary kerosene oil, and I provide a greater number of corrugations to take the expansion and a smaller body of liquid by allowing the carriers E and E′ to occupy space within the tubes A A′. In the tubes B and B′ are also cylinders of metal S and S′, which very nearly fill the inside diameter of the tubes. They act to change the ratio between the number of the corrugations and the volume of the contained liquid and also to give rigidity to the tubes, and thus prevent deflections from a right line when the tubes are elongating. At the outer end of the tubes B and B′ are the connecting-rods *m* and *m′*, and one of them *m′* is shown in connection with the valve or damper *n* in Fig. 6. Rods *v* and *v′* are shown above the governor. Their inner ends are screwed into the central bracket C and their outer ends into the valve-casing. Turnbuckles allow of their adjustment to preserve a fixed distance between the bracket and valve-casing.

An enveloping protector of wire-netting is shown at W.

The setting device shown at 45 and *p* will be readily understood from the foregoing description. As tube A has its motion at its inner end and as motion is imparted by revolving the hand-wheel D, the setting of the tube end so that the pointer *p* will indicate the degree of temperature at which tubes B and B′ shall act upon the valve will insure a certain temperature within the car by the opening or closing of the valves. If the temperature in the car is 50° Fahrenheit and it is desired that it shall fall to 45° and maintain that temperature, the pointer is made to indicate 45°. As the cold air enters the freight-compartment from the ice-tanks the temperature will fall to or a little below 45°, when the governor will operate to close the valves, and should the temperature again rise the valves will be opened. I have found in practice that the rise or fall of a single degree will cause the governor to operate the valves. It will be understood that there is no partition between tubes A and B and the liquid in both tubes is continuous, that the spiral spring *e*, acting upon the bolt-heads *f f′*, tends always to keep the tubes A and A′ away from the central bracket C, and that there will be no retraction of the outer ends of tubes B and B′ until the bolt-heads are seated against the end plates of the inner tube *d*. Excessive expansion moves the bolt-heads from their seats and compresses the spiral spring *e*. The bolt-heads must be seated before the index can be set.

It has not been considered of importance to provide against excessive contraction of the contained liquid, as the force acting is only that of atmospheric pressure, while the expansive force of the liquid is of course immense and must be provided against.

It will be understood that the yoke-plates F and F′ by reason of the yoke-rods *c* and *c′* are held immovable by the bracket C and that said yoke-plates hold the portion of tube A B which they embrace immovable.

Having thus described my invention, I claim as new—

1. In combination, a corrugated hermetically-sealed tube filled with expansible fluid and connected with a damper at one end, a yielding detent for the tube at the other end, and a fixed detent to limit the motion of the first-mentioned end of the tube, as and for the purposes set forth.

2. A hermetically-sealed metal tube completely filled with a liquid and having annular corrugations to allow of lengthening and shortening the tube by expansion and contraction of the said inclosed liquid, the said tube being formed in two portions, which lengthen at different times, one part of the tube being prevented by the resistance of a spring from lengthening until the other portion has made its full excursion to operate the valve, substantially as described.

3. In combination, a corrugated hermetically-sealed tube filled with expansible fluid and connected with a damper at one end, a yielding detent for the tube at the other end, a fixed detent to limit the motion of the first-mentioned end of the tube, and a rigid bar or cylinder within the bore of the sealed tube to prevent deflection from a right line when lengthening against resistance, substantially as set forth.

4. A hermetically-sealed metal tube completely filled with a liquid and having annular corrugations to allow of lengthening and shortening the tube by expansion and contraction of the said inclosed liquid, the said tube being formed in two portions, which lengthen at different times, one part of the tube being prevented by the resistance of a spring from lengthening until the other portion has made its full excursion to operate the valve, one portion of the said tube being held rigidly at one end to lengthen only in one direction and the other portion of said tube held rigidly at the same point to lengthen only in the other direction, substantially as described.

5. A hermetically-sealed metal tube completely filled with a liquid and having annular corrugations to allow of lengthening and shortening the tube by expansion and contraction of the said inclosed liquid, in combination with a rigid bar or cylinder within its bore to prevent deflection from a right line when lengthening against resistance, as specified.

6. In combination, a damper, valve, or other mechanism to be operated, a corrugated hermetically-sealed tube filled with an expansible fluid and connected with the mechanism to be operated at one end, a yielding detent for the tube at the other end, a fixed detent to limit the motion of the first-mentioned end of the tube, and a rigid bar or cylinder within

the bore of the said tube to prevent deflection from a right line when lengthening against resistance, substantially as described.

7. In combination, a corrugated hermetically-sealed tube formed in two parts, one of which is of greater diameter than the other, filled with expansible fluid and connected with a damper at one end, a yielding detent for the tube at the other end, and a fixed detent to limit the motion of the first-mentioned end of the tube, as and for the purposes set forth.

8. The combination of an expansible tube having an internally-screw-threaded anchorage secured thereto, a bolt screwed into said anchorage, means for turning said bolt, and a spring bearing against said bolt at one end and having at the other end means for resisting its action, as and for the purposes specified.

9. The combination of an expansible tube having within it an internally-screw-threaded anchorage secured thereto, a bolt screwed into said anchorage, a spring bearing against said bolt, a tube surrounding said spring, the tube and bolt being secured together by an extensible connection, substantially as set forth.

10. The combination of an expansible tube having within it an internally-screw-threaded anchorage secured thereto, a bolt screwed into said anchorage, a spring bearing against said bolt, a tube surrounding said spring, the tube and bolt being secured together by a suitable connection consisting of a projection rigidly connected with the bolt, and a disk secured to the tube and having a suitable recess or perforation for receiving said projection, substantially as described.

11. A hermetically-sealed metal tube completely filled with a liquid and having annular corrugations to allow of lengthening and shortening the tube by expansion and contraction of the said inclosed liquid, the said tube operating by the motion of one end a mechanism and held at the other end by a spring having more resistance than the mechanism operated for the purpose of preventing rupture or distortion of the said tube by excessive expansion of the inclosed fluid.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM E. EASTMAN.

Witnesses:

H. D. CHAPIN,

L. T. HOWARD.