No. 618,921. Patented Feb. 7, 1899.

F. TUDOR.

REGULATING APPARATUS FOR STEAM HEATERS.

(Application filed Apr. 7, 1897.)

(No Model.)

Fig: 1.

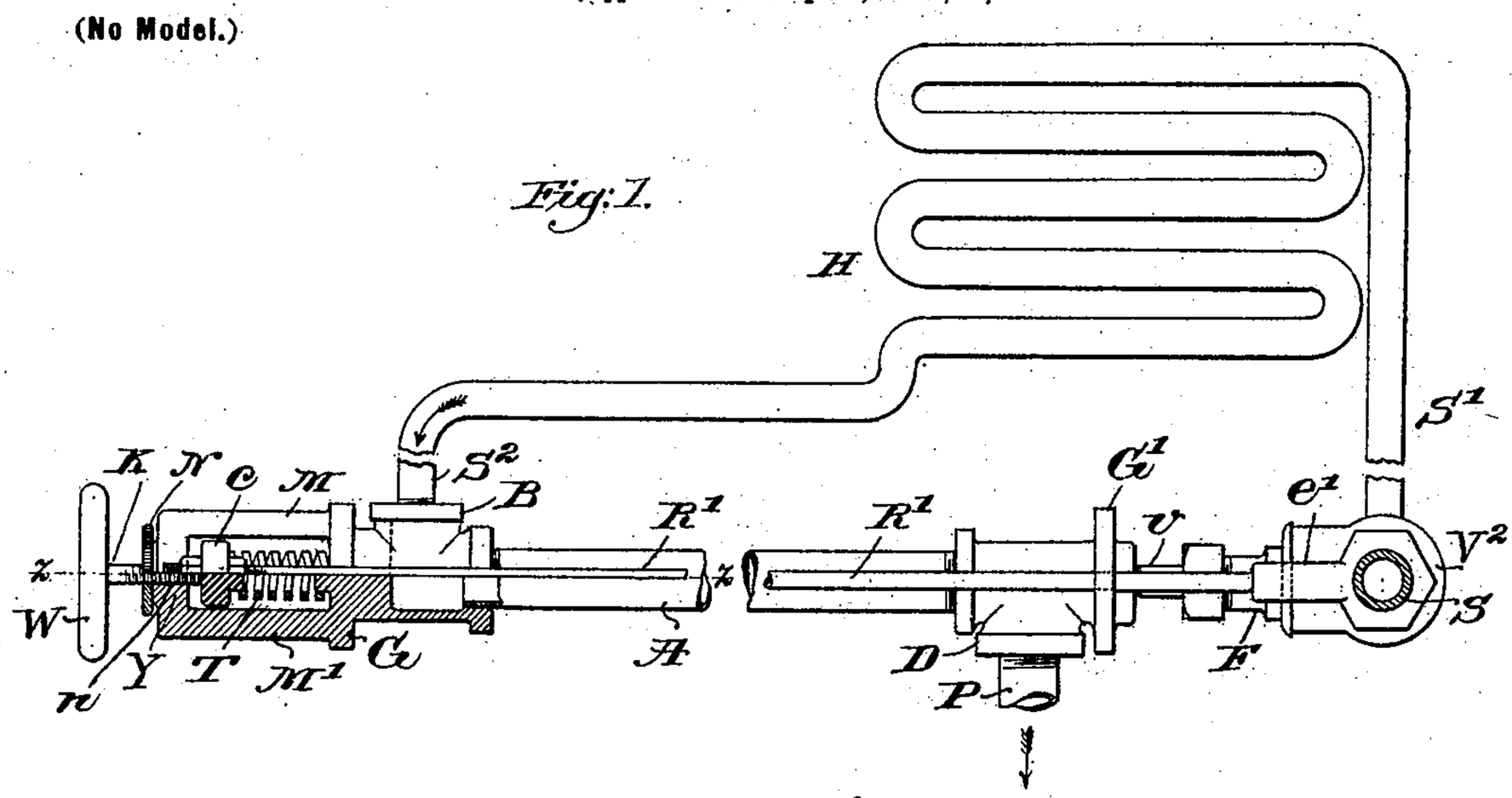


Fig: 2.

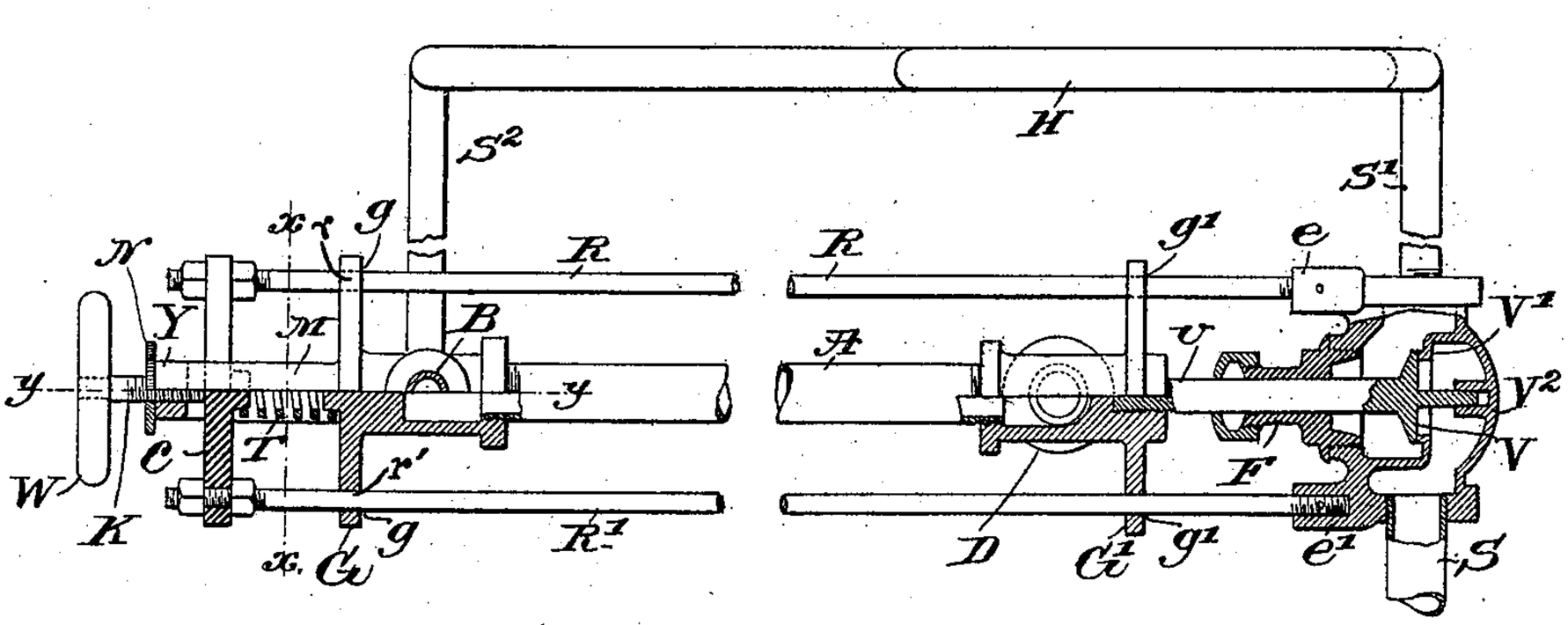
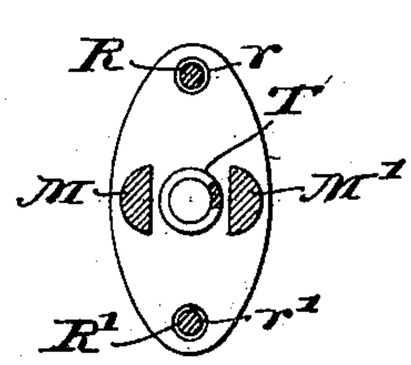


Fig: 3.



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UNITED STATES PATENT OFFICE.

FREDERIC TUDOR, OF BOSTON, MASSACHUSETTS.

REGULATING APPARATUS FOR STEAM-HEATERS.

SPECIFICATION forming part of Letters Patent No. 618,921, dated February 7, 1899.

Application filed April 7, 1897. Serial No. 631,064. (No model.)

To all whom it may concern:

Be it known that I, FREDERIC TUDOR, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented a new and useful Improvement in Regulating Apparatus for Steam-Heaters, of which the following is a specification.

By the within-described invention a regulating apparatus is provided which when used in connection with a steam heating-coil or radiator and the valve at the intake thereof, arranged to admit steam from a main pipe or branch therefrom, serves automatically to secure a constant heat delivery from the heater or radiator and to determine the degree of service to be demanded from it.

The use of this invention will enable the user of a steam-heater to run it at high or low service, according to his changing needs, the automatic regulation of steam-supply securing constant service for any given adjustment without being disturbed by changes in the pressure at which the steam is delivered by the boiler and main pipes. A heating-coil may be used at a uniform rate of service either as a steam-heater or by adjustment of the regulator be reduced practically to the conditions of a hot-water heater for low service, although steam only is admitted to the heater feed-pipe at the valve.

The general arrangement and operation of the regulating apparatus are as follows: From the steam-valve, which may be of any desired construction, leads the pipe to the heating-coil. A discharge-pipe from the heating-coil is open and free to deliver to a hot-well or return-pipe the condensed or cooled contents of the heating-coil. Part of this discharge-pipe between the heating-coil and the final outlet passes in contact with or proximity to the mechanism which controls the action of the supply-valve, so that the heat emitted by the matter discharged from the heater is communicated to the valve mechanism. As this mechanism is warmed or cooled it expands or contracts, closing or opening the steam-valve, according to expansion or contraction.

In the drawings, wherein like letters are uniformly used to designate like parts, Figures 1 and 2 show the regulating apparatus in elevation and plan, respectively, with partial sections as follows: In Fig. 1, section at *y y* of Fig. 2; in Fig. 2, section at *z z* of Fig. 1 and section of the admission-valve. Fig. 3 is a detail of Figs. 1 and 2.

In Figs. 1 and 2 the heating apparatus is represented by a valve of the usual globe-valve construction, from which leads the steam-pipe S′ to the heating-coil, which is shown merely in conventional form at H. The return or exhaust pipe S^2 of the heater H leads to the regulating apparatus, which operates on the valve V.

The waste-pipe S^2 delivers its contents into the pipe A, which through the union D and pipe P communicates with the hot-well or final receptacle of the condensed contents of the heater. At one end the pipe A is inserted in an elbow or union B. The other end of the pipe A carries the union D. Into the union D is screwed or otherwise firmly and tightly attached the stem *v* of the valve V, so that the latter will be withdrawn from its seat V′ as pipe A contracts and will be pressed toward its seat as pipe A expands. The valve V, with its seat V′ and casing V^2, is shown in cross-section in Fig. 2. The pipe S leads to the valve from the boiler and the pipe S′ leads from the other side of the valve to the heater H.

A frame is attached to the valve-casting and consists of two stiff rods R R′, which are secured to the valve-casting by being screwed into ears *e e′*. At the further ends of the rods R R′ those rods are joined by a cross-head *c*, which is secured to the rods by nuts, for which the rods R R′ are suitably threaded. This frame constitutes the supporting device to which the regulating apparatus is attached and from which as a base it exercises its control over the valve V.

The unions B and D have cast upon them oval flanges G G′. Onto the flange end of union D the valve-stem *v* is securely screwed. The casting of the union B has in addition to its flange G a bridge portion which consists of side pieces M M′ and a yoke Y, joining the two. Pipe S^2 leads into union B, pipe P connects with union D, and the pipe A joins the unions B and D, Figs. 1 and 2.

The ends *g g g′ g′* of flanges G G′, respec-

tively, are pierced with holes *r r*, Fig. 3, through which pass the rods R R′, which thus support the regulating apparatus.

Between the cross-head *c* and flange G there is placed under compression a powerful spring T, which tends constantly to keep the valve-regulating apparatus, with valve-stem and valve connected, in proper position for valve closure. The spring T constitutes an elastic reaction member or abutment from which the valve-regulator makes its operative movement. Through the yoke Y passes a tapped hole *n*, which receives the threaded shaft K of the hand-wheel W. A set-nut N on shaft K serves to set the wheel W in any desired position. The end of the screw-shaft K bears upon the middle of the yoke *c*, which constitutes the fixed point from which the valve-regulating apparatus acts on the valve. As hand-wheel W is turned and shaft K bears upon cross-head *c* the effort of spring T is passively expended between the thrust-seats on cross-head *c* and union-casting B.

Now assume this apparatus to be manipulated by means of the wheel W. The valve V leaves its seat V′. Interference by the hand of the operator having ceased, the behavior of the apparatus is as follows: Condense-water and steam after being delivered from the heater pass through the pipe A, causing it to expand and close the valve. If the expansion of the regulator is more than sufficient to close the valve V and continues after the valve is firmly seated, further compression of the spring T relieves the regulator from any strain which would be due to the expansion of rigidly-confined members. By adjusting the valve V to a smaller opening all the steam which passes out is condensed and emerges from pipe P in the form of water, and under these conditions the operation of the heater is in effect the same as that of a hot-water heater, although the supply at the valve V is a steam-supply.

In the above-described apparatus the expansible valve-regulator constitutes a part of the return or waste passage which leads from the heater H to the hot-well, stack, or drain, as the case may be. By adopting such a construction as this the valve-regulating apparatus is made to serve several convenient functions and is adapted to receive in the best possible manner the heat of the waste products of the heater H. It is believed, therefore, that this construction is as convenient and compact as any which may be contrived, although numerous modifications to suit peculiar conditions may suggest themselves to a mechanic. In practice the valve V will be by the operation of the valve-regulator held in one position, the regulator correcting the fluctuations of service in the heater itself and automatically throttling the admission-valve V to meet changes of requirement.

The spring T constitutes an emergency relief, which in most cases will probably be necessary. It does not come into active service until the expansible regulator has completed the performance of its function by closing the valve. The combination of parts reduced to simplest form would omit this yielding member and act positively at all times. For instance, if the flange G were firmly fixed to the rods R R′ instead of being free to slide thereon, the parts M, M′, Y, W, K, N, *c*, *n*, and T being removed, the apparatus would then contain the active elementary components and would under fairly-constant conditions and with skilled handling operate properly to secure constant service from the heater. The usual conditions are such, however, that provision for relief in case of overheating or poor adjustment is believed to be desirable.

A nice adjustment of this self-regulating apparatus will enable the operator to extract the maximum duty from the steam entering the heating-coil, withdrawing from the waste-pipe P nothing except condense-water. In cases where it is desired to keep a water-tank full of water at 180° Fahrenheit, or thereabout, as for hotel water-supply purposes, &c., this self-regulating apparatus can be used to advantage, the condensation of steam in the coil being so adjusted that at no time is it possible to maintain a temperature in the tank even as high as that of steam at atmospheric pressure. This is obvious from the fact that a circuit from the valve V to the waste-pipe P is entirely open. The maximum temperature, therefore, of 212° Fahrenheit cannot in practice be reached.

By the use of the above-described appliance the amount of heat delivered from the heater or steam-coil may be made entirely independent of the pressure from the main steam-pipe. The heat delivered by the heating-coil determines the temperature and quantity of the heat of waste delivered as condense-water, and therefore controls the expansion of the governing member of the steam-throttling device. Since the heat delivered by the coil or heater governs the rate of admission of live steam, the user of the heater is not affected by the increase or decrease of the pressure of steam in the main pipes.

To illustrate the adaptability of this regulating device to situations where it is desired to maintain constant and uniform heat-delivery from heaters independently of variations in pressure in the steam-supply pipe, suppose a train of railway-cars supplied in the usual manner with heating-pipes within the cars and a continuous main or train pipe extending from the locomotive-engine. With the heaters in operation, each drawing steam from the train-pipe, the pressure of the train-pipe diminishes constantly as the rear of the train is approached, and with the ordinary hand-valves now in use constant regulation of the heat throughout the train is difficult and under many conditions impossible. Now if in each car a regulating device such as described above be attached to a valve which

draws steam from the train-pipe for the car these regulators may be adjusted for the delivery of the desired quantity of heat from the heaters and after such preliminary adjustment will take care of themselves. The regulator in the car nearest the engine, where the train-pipe pressure is greatest, will throttle its valve so as to admit a very small quantity of steam to the car-pipes, which, in the manner above described, deliver their waste water through the expansible valve-regulator. From this first car to the end of the train the regulators will hold the valves wider and wider open as the train-pipe pressure diminishes, each regulator automatically caring for the uniformity of heat delivered in its car. Obviously besides comfort much economy will result from the use of such an arrangement, the waste-pipe of each car delivering nothing but warm condense-water which has delivered a practical maximum of the heat which it originally contained when in the form of steam.

In practice the valve-regulating wheel may be so adjusted that the heat of the condense-water, even when cooled considerably below the temperature of condensation by loss of heat in the coil or heater at the end of the circuit which is not filled by steam, may serve to expand the regulating-tube sufficiently to keep the supply of steam below the maximum requirements of full heating. Thus the coil or heater will be only partly filled with steam and the heating effect be correspondingly reduced. Since the waste-pipe is wholly free and open, the condense-water will drain away and there never can be any jarring or trouble from the presence of water or air in the pipes.

The facility by which steam-supply may be reduced is highly desirable in steam-heating, for in such a system the return or waste pipes may be made to run nearly cold, and thus there will be secured a great gain in comfort in mild weather, as well as economy of fuel, and if the waste-pipes are open only such quantities of heat are lost as remain in or are carried off by cooled condense-water.

What I claim, and desire to secure by Letters Patent, is as follows:

1. The combination, with the admission-valve and waste-pipe pertaining to a heating-coil or equivalent apparatus, of a heat-expansible valve-regulator so located and connected as to receive heat from the waste as it passes from the heating-coil and by its expansion under heat to move the admission-valve toward a position of closure, and a direct connection between the valve and the regulator, and a yielding member so located and adapted as to absorb expansion of the valve-regulator when the valve is seated, substantially as described.

2. The combination, with the admission-valve and waste-pipe pertaining to a heating-coil or equivalent apparatus, of a heat-expansible valve-regulator so located and connected as to receive heat from the waste as it passes from the heating-coil and by its expansion under heat to move the admission-valve toward a position of closure, and a reaction member adapted to sustain the steam-pressure on the valve, and to yield to expansion of the valve-regulator when the valve is seated, substantially as described.

3. The combination, with the admission-valve and waste-pipe pertaining to a heating-coil or equivalent apparatus, of a heat-expansible valve-regulator so located and connected as to receive heat from the waste as it passes from the heating-coil and by its expansion under heat to move the admission-valve toward a position of closure, and a reaction member adapted to sustain the steam-pressure on the valve, and to yield to expansion of the valve-regulator when the valve is seated, and means whereby the position of the valve with relation to its seat may be varied at will, independently of the automatic action of the valve-regulator, substantially as described.

4. The combination with the admission-valve and waste-pipe pertaining to a heating-coil or equivalent apparatus of a heat-expansible valve-regulator, of which the expansible element is a portion or connection of the said waste-pipe, the said regulator being directly attached to the valve at one end and abutting against an elastic reaction-piece at the other, the said reaction-piece in turn having its support on a frame substantially rigid with relation to the valve-casing, and being adapted to sustain the thrust of steam-pressure from the valve and to yield when the regulator expands after the valve is seated, substantially as described.

5. In a heater, the combination with a heating-coil or equivalent apparatus, its admission-valve, and waste-pipe, of a rigid frame secured to the admission-valve chamber, a heat-expansible valve-regulator attached to the valve-stem and mounted to slide on said frame, the expansible portion of said regulator consisting of a part or connection of the waste-pipe from the heater, an adjustable connection between the valve-regulator and the rigid frame whereby the position of the valve may be operated at will, and a spring located between the supporting-frame and the valve-stem, and adjusted so as to exert its effect to keep the valve thrust toward its seat, and to take up any expansion of the valve-controller which may take place when the valve is seated.

6. In a heater, the combination with a heating-coil or radiating apparatus, its admission-valve and a waste-pipe, of a heat-expansible valve-regulator, so located and connected as to receive heat from the waste as it passes from the heating-coil and by its expansion under heat to move the admission-valve toward a position of closure, and an elastic reaction member so located and adjusted with

reference to the valve-regulator as by its yielding to absorb expansion of the regulator when the admission-valve is closed.

7. In a heater, the combination with a heating-coil or equivalent apparatus, its admission-valve and waste-pipe, of a frame, rigid with relation to the admission-valve chamber, a heat-expansible valve-regulator attached to the valve-stem and mounted to move on said frame, the expansible portion of said regulator consisting of a part or connection of the waste-pipe from the heater, an adjustable connection between the valve-regulator and the said frame whereby the position of the valve may be operated at will, and a spring located between the supporting-frame and the valve-stem and adjusted so as to exert its effect to keep the valve thrust toward its seat, and to take up any expansion of the valve-regulator which may take place when the valve is seated, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FREDERIC TUDOR.

Witnesses:
ELEANOR F. GROLL,
GRACE M. SHAY.