(No Model.)

C. H. ROBINSON.

STEAM HEATING APPARATUS.

No. 521,440. Patented June 12, 1894.

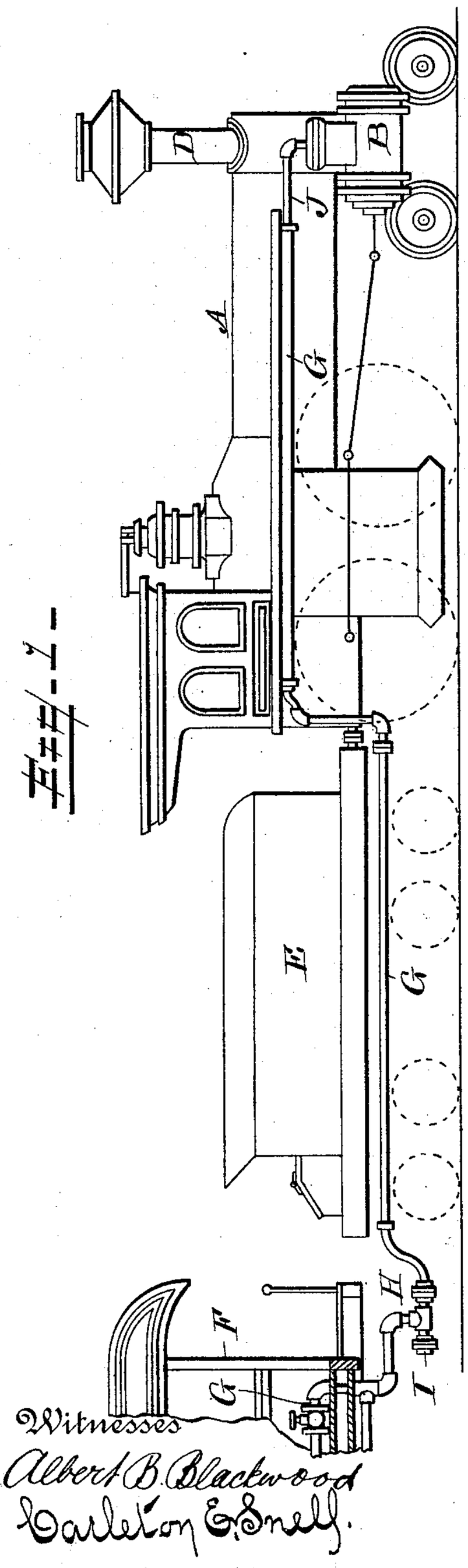

FIG. 1.

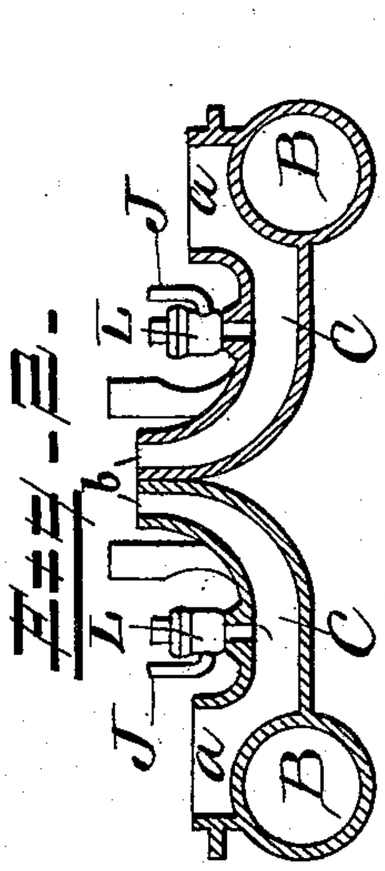

FIG. 2.

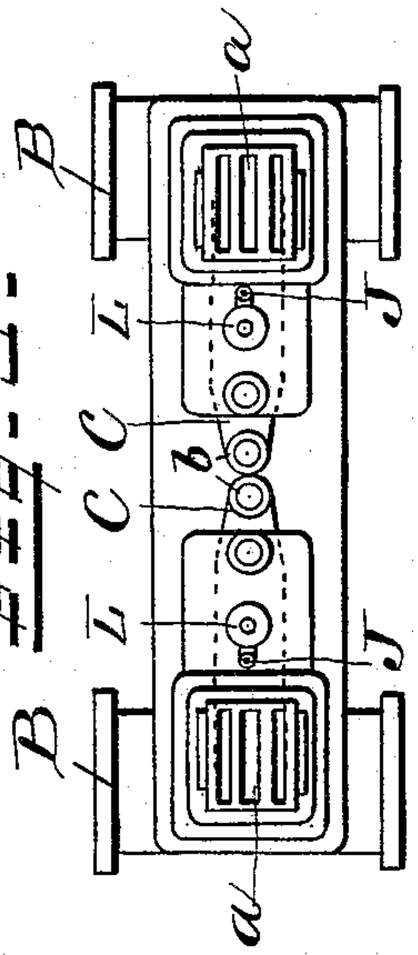

FIG. 3.

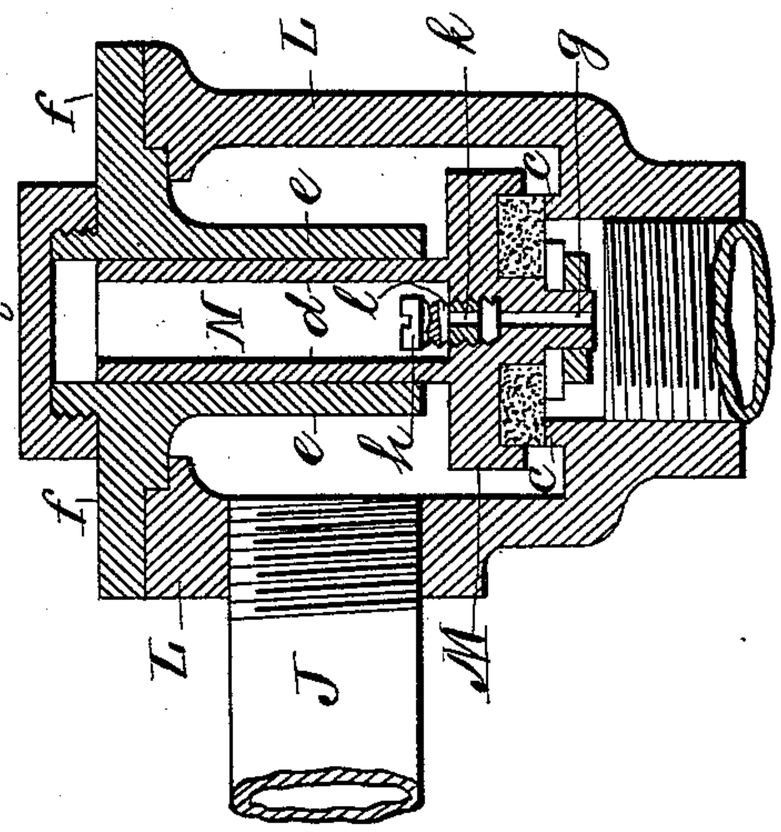

FIG. 4.

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UNITED STATES PATENT OFFICE.

CHARLES HENRY ROBINSON, OF ST. PAUL, MINNESOTA, ASSIGNOR TO ARTHUR S. BROWNE, OF WASHINGTON, DISTRICT OF COLUMBIA.

STEAM HEATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 521,440, dated June 12, 1894.

Original application filed April 5, 1887, Serial No. 233,804. Divided and this application filed November 10, 1891. Serial No. 411,480. (No model.)

To all whom it may concern:

Be it known that I, CHARLES HENRY ROBINSON, of St. Paul, in the county of Ramsey and State of Minnesota, have invented certain new and useful Improvements in Steam Heating Apparatus, of which the following is a specification.

This application is a division of application for Letters-Patent of the United States No. 233,804, filed by me April 5, 1887.

The present invention relates to the utilization of the exhaust steam from engines, pumps and other steam-operated motors for heating purposes. More specifically the invention relates to the heating of railway trains by means of utilizing the exhaust steam from the locomotive.

Hitherto many attempts have been made to utilize for heating purposes the exhaust steam from the locomotive, but such prior attempts have been unsatisfactory or impracticable through the adoption of defective means for the accomplishment of the desired end. The means usually adopted have been either by throttling the exhaust pipe leading to the smoke-stack of the locomotive by means of a manually-operated throttle valve, or by the use of an auxiliary motor supplied from the generator for pumping or driving the exhaust steam radiating system, or else, less frequently, by means which involve radical changes in the construction of the locomotive itself. Such means are defective in that they either require the attention and direction of the engineer whose duties are already excessive, or take steam from the generator when it cannot be spared, or else involve such additions to or modifications of the construction of the locomotive as to render their adoption practically impossible, and the chief defect common to all of such prior means or systems is that they interfere to a greater or less degree with the creation of the draft in the locomotive by the exhaust steam.

Any practical and efficient method or means for utilizing the exhaust steam from the locomotive for heating purposes must be produced in recognition of the fact that the primary use of the exhaust is and must continue to be the creation of a draft, and to be perfectly efficient the exhaust steam should be taken systematically so as to make no call upon the attention of the attendants of the locomotive; it should be taken without the intervention of an extraneous motor, and without requiring the use of steam from the generator; and the mechanism employed should be adaptable to existing locomotives without necessitating the re-organization of the same, and should be applicable thereto with the minimum labor, alteration and expense.

The primary object of this invention is to utilize the waste steam of steam-operated motors for heating purposes particularly by taking a portion of the exhaust steam of locomotives for heating the train, in such manner and by such means as will overcome the objections and secure the advantages which have been enumerated. It is a well known fact in steam engineering in the case of high pressure non-condensing steam engines such as are universally employed on railway locomotives, that the exhaust steam just as it escapes from the steam cylinder into the exhaust passage is of a relatively high pressure compared with the pressure in the exhaust passage during the continuance of the exhaust. This initial high pressure in the exhaust passage is speedily relieved by the escape of the steam through the exhaust nozzle, but for a moment of time there is an excess of steam pressure in the exhaust passage greater than the exhaust nozzle can conduct away, and which is hence not only useless for the creation of a draft, but is detrimental in that it creates a back pressure on the steam piston thus interfering with the effectiveness of the live steam, and this high exhaust pressure in the exhaust passage is greatest during its continuance next the exhaust port and is much less at the exhaust nozzle. The present invention contemplates taking advantage of these existing conditions in such manner that a portion of the high pressure exhaust steam will automatically force itself into the steam radiating system at each stroke of the piston. The means or apparatus for accomplishing this is illustrated in the accompanying drawings, in which—

Figure 1, is a side view of a railway locomotive and a portion of a railway train provided with the improved apparatus. Fig. 2 is a vertical cross-section of the steam cylinders, and exhaust ports. Fig. 3, is a plan view of the same. Fig. 4, is a vertical section in detail of a steam-balanced steam-actuated valve employed in the apparatus.

A, is a locomotive of the usual style for passenger traffic; B, B, are the steam cylinders thereof; C, C, are the exhaust passages or pipes leading therefrom, as usually constructed and arranged. D, is the smoke-stack of the locomotive. E, is the tender. F, is the front end of the first passenger car. G, G, is the system of radiating pipes which convey steam to and throughout the train. H, is a coupling; and I, a steam trap employed with the coupling; all of which parts are or may be of usual and known constructions.

The exhaust steam for heating purposes may be taken from either or both of the steam cylinders, the latter method being shown in the drawings. The description will, however, be confined to the apparatus in connection with a single one of the cylinders, it being understood, that the apparatus are the same with both cylinders.

The initial radiating or connecting pipe J, of the radiating system is located on the locomotive and it enters and communicates with the exhaust pipe in as close proximity to the exhaust port *a*, as is practicable. The connecting pipe is so attached to the exhaust pipe that it does not enter the same, or in any manner obstruct the exhaust passage, so that a free and unobstructed passage is presented in the exhaust pipe for the exhaust steam to the exhaust draft nozzle *b*. When, now, there is an excess of pressure above the normal exhaust pressure in the exhaust pipe, it will be relieved by a portion of the high-pressure exhaust steam forcing or pumping itself into the connecting pipe J. The main volume of the exhaust will continue to pass unobstructedly through the exhaust pipe and out through the exhaust nozzle so that the draft is not interfered with, and since the area of opening into the connecting pipe is much smaller than that of the exhaust nozzle it is only the excess of exhaust steam at relatively high pressure which forces itself into the radiating system. This forcing of a small portion or fraction of the exhaust steam by its own pressure into the radiating system is effected intermittently at each successive exhaust, so that there is a constantly recurring pumping action which forces the steam throughout the radiating system. In case, however, the pressure in the radiating system exceeds the normal exhaust pressure in the exhaust pipe, there would be a reverse current of steam from the radiating system into the exhaust pipe. It is hence essential that the steam forced into the radiating system should be retained therein. Accordingly it is necessary that there should be provided means for preventing back-flow of the steam, and the back-flow preventer should be located as close as practicable to the exhaust passage C. The back-flow preventer may be a simple check valve located at the mouth of the pipe J, but preferably there is employed a partly steam-balanced automatically-acting steam-actuated valve mechanism, which is located in the connecting pipe J, between the source of steam supply and the radiating system, and as close as practicable to the exhaust pipe. This valve mechanism, which is shown in detail in Fig. 4, consists of a casing L, communicating with the source of steam supply (which is the exhaust pipe), and with the radiating system, provided with an annular valve seat *c*, which is preferably in a horizontal plane. Seating on this seat is a rising and falling valve M, which moves to and from the seat by the variations of steam pressure. On the sides of the valve opposite the source of steam supply is an expansible balancing chamber N. This chamber is formed by a movable part by which the valve is carried consisting of a chambered stem *d*, formed on the valve, and by a stationary part consisting of a chambered projection *e*, formed on the cover *f*, of the casing, said chambered stem and chambered projection sliding the one within the other. This expansible balancing chamber has an effective area less than the effective area of the valve, and it communicates at all times with the source of steam supply by means of an orifice *g*, extending through the valve, so that the steam pressure within the balancing chamber is proportioned to the steam pressure on the under side of the valve, but is always less than the latter, whereby the valve always tends to seat itself. The valve is thus only a partly balanced valve, and in addition it is normally pressed to its seat by the pressure in the steam radiating system acting on its unbalanced area. The orifice *g*, has a small area compared with the area of the valve seat *c*, so that the pressure in the expansible balancing chamber is less subject to variations in steam pressure than the exhaust pipe with which the under side of the valve is in constant communication. In fact when the locomotive is running regularly the pressure in the expansible balancing chamber will remain substantially constant at a pressure above the normal exhaust pressure in the exhaust pipe, but below the high initial exhaust pressure. When, then, the exhaust-port is opened and the pressure rises suddenly in the exhaust pipe and beneath the valve the valve will be lifted from its seat, and the high pressure exhaust steam will force itself with a sudden impulse into the steam radiating system; but as soon as the exhaust pressure in the exhaust pipe reaches its normal pressure, the pressure in the balancing chamber causes the valve to instantly seat itself, thus preventing the back flow of steam from the radiating system into the exhaust pipe. The

valve, it will be seen, is automatic in its operation, being actuated by the exhaust steam, in both directions.

Since the duration of the high exhaust pressure in the exhaust pipe is short compared with the duration of a low pressure and no pressure at all, the larger the orifice through the valve is, which establishes communication between the exhaust pipe and the expansible balancing chamber, the lower the pressure will be within the balancing chamber; and as a result the valve will remain open a comparatively long time, opening the more quickly and closing the more slowly. By adjusting the size of this orifice, the duration of the opening of the valve can be regulated, so that in comparatively warm weather by making the orifice smaller a less quantity of steam will enter the radiating system; and in colder weather by making the orifice larger more steam will be admitted. To accomplish this an auxiliary valve for the orifice *g*, is employed. This auxiliary valve consists of a screw plug *h*, tapped into the valve M, within the balancing chamber above the orifice *g*, the cover *f*, of the valve-casing having a removable cap *i*, for permitting access to the auxiliary valve for adjusting the same. Said auxiliary valve is provided with a longitudinal steam passage *k* communicating with the orifice *g*, and with a lateral steam passage *l*, communicating with the passage *k*, and opening at both ends into the expansible balancing chamber. By raising and lowering the auxiliary valve the extent of the openings of the passage *l* into the balancing chamber can be adjusted, and hence the duration of the opening of the main valve can be regulated.

I am aware that it has heretofore been proposed to utilize the exhaust steam from the locomotive for heating purposes, and to that end a pipe has been tapped into the exhaust pipe of the locomotive, said pipe being provided with a check valve to prevent back flow of the steam. Such a construction and arrangement is shown, for example, in the United States patent to Andrew S. Brownell, No. 207,588, dated September 3, 1878. The arrangement, however, shown in said patent is impracticable and would, if used, fail of its intended purpose. The patent does not state at what point of the exhaust pipe the steam radiating pipe should be connected, and the check valve for preventing back-flow of the steam is located near the cab-box several feet away from the exhaust pipe. As the result of this construction and arrangement, any of the exhaust steam entering the pipe connecting with the exhaust would so far lose its pressure before reaching the check valve that it would fail to counterbalance the working pressure on the other side of the check valve in the radiating system, and consequently none of the exhaust steam would enter the radiating system. The present invention overcomes the defects of this patented construction, first, by recognizing the conditions of steam pressure in the exhaust pipe and tapping the exhaust pipe close to the exhaust port; secondly, by providing a connecting pipe between the exhaust pipe and the radiating system which does not obstruct the exhaust pipe, and, thirdly, by providing a back-flow preventer which is located immediately adjacent to the exhaust pipe so that it is acted upon immediately by the high initial exhaust steam pressure, is therefore opened, and consequently enables the steam radiating system to catch and retain a supply of exhaust steam at each stroke of the piston.

I claim as my invention—

1. In a steam-heating apparatus for utilizing a portion of the exhaust steam from engines, pumps, and other steam-operated motors, the steam radiating system, the motor, and the exhaust pipe thereof, said exhaust pipe being constructed as usual so as to freely discharge the steam without obstruction, in combination with a connecting pipe connecting the steam radiating system to said exhaust pipe, said connecting pipe opening into the exhaust pipe close to the place where the steam escapes from the cylinder and where the escaping steam is still under pressure, and a back-flow preventer operating in conjunction with said connecting pipe, said back-flow preventer being located immediately adjacent to said exhaust pipe, substantially as set forth, whereby the free exhaust of the steam is permitted, and a small portion of the exhaust steam is forced by its own pressure intermittently into the radiating system at each successive exhaust.

2. In a steam-heating apparatus for utilizing a portion of the waste steam from engines, pumps, and other steam-operated motors after said steam has ceased to be operative in the motor but while it is still under pressure, the steam radiating system, and the motor, in combination with a connecting pipe connecting said radiating system and said motor so as to receive the waste steam while it is still under pressure, and a back-flow preventer consisting of a check valve in said connecting pipe, said valve being located in close proximity to the motor, substantially as set forth, whereby said valve opens under the direct influence of and responsively to the high exhaust pressure in said exhaust pipe.

3. In a steam heating apparatus for utilizing a portion of the exhaust steam from engines, pumps, and other steam operated motors, the steam radiating system, the motor, and the exhaust pipe thereof, in combination with a pipe connecting said exhaust pipe with said radiating system, said connecting pipe opening into the side of but without obstructing the passage within said exhaust pipe at a point close to the exhaust port where the steam is of sufficient pressure to force itself by its own pressure into said connecting pipe, and a check valve in said connecting pipe which opens intermittently at each stroke of

the piston to admit steam into said radiating system, said check valve being located in close proximity to the exhaust pipe substantially as set forth.

4. In a steam heating apparatus for utilizing a portion of the exhaust steam from engines, pumps, and other steam-operated motors, the steam radiating system, the motor, and the exhaust pipe thereof, said exhaust pipe being constructed as usual so as to freely discharge the steam without obstruction, in combination with a pipe connecting said steam radiating system and said exhaust pipe, said connecting pipe opening into the side of but without obstructing the passage within the exhaust pipe close to the place where the steam escapes from the cylinder and where it is still under pressure, and a partly steam-balanced steam-actuated valve in said connecting pipe close to said exhaust pipe, said valve being constructed to be normally closed and to be automatically opened to admit steam to the radiating system, when the exhaust steam is above a certain pressure at each successive exhaust, substantially as set forth.

5. In a steam heating apparatus, a valve mechanism located between the steam radiating system and the source of steam supply, said mechanism consisting of a casing, formed with a valve seat, in combination with a valve which moves to and from said seat by the variations of steam pressure, an expansible balancing chamber on the opposite side of the valve from the source of steam, the valve being carried by the movable part of said chamber, and said valve having an orifice extending therethrough for establishing communication at all times between said steam supply and said balancing chamber, substantially as set forth.

6. In a steam heating apparatus, a valve mechanism located between the steam radiating system and the source of steam supply, said mechanism consisting of a casing formed with a valve seat, in combination with a valve which moves to and from said seat by the variations of steam pressure, an expansible steam balancing chamber on the opposite side of said valve from the source of steam, said chamber having an area less than the area of the valve, said valve being carried by the movable part of said chamber, and said valve having an orifice through it which establishes communication at all times between said balancing chamber and the steam supply, substantially as set forth, whereby the steam pressure in said balancing chamber is proportioned to that in the source of supply.

7. In a steam heating apparatus, a valve casing having a seat for the valve, a steam supply pipe entering said casing, and a steam discharge pipe leading therefrom, in combination with a steam actuated valve located in said casing and movable to and from said seat, an expansible balancing chamber above said valve having an area less than the area of the seat, said valve being carried by the movable part of said chamber, and said valve having an orifice therethrough which establishes communication at all times between said chamber and the steam supply pipe, substantially as set forth.

8. In a steam heating apparatus, a valve casing having a seat for the valve, and a tubular projection within said valve casing in line with said seat, in combination with a steam actuated valve which moves to and from said seat, said valve having a chambered stem which co-operates with said tubular projection to constitute an expansible balancing chamber, the area of which is less than the area of said valve seat, and said valve having an orifice therethrough which establishes communication at all times between said chamber and the steam supply, substantially as set forth.

9. In a steam heating apparatus, a valve mechanism located between the steam radiating system and the source of steam supply, said mechanism consisting of a casing formed with a valve seat, a valve which moves to and from said seat by the variations of steam pressure, an expansible balancing chamber on the opposite side of the valve from the source of steam, said valve being carried by the movable part of said chamber, and said valve having an orifice extending therethrough which establishes communication between the source of steam and said balancing chamber, in combination with an auxiliary valve for controlling the size of said orifice, substantially as set forth.

10. In a steam-heating apparatus, the steam supply pipe, the valve-casing located therein, said casing having a valve seat, and the cover of the casing having an inwardly-extending chambered projection, in combination with a rising and falling valve within said casing, said valve having a chambered stem co-operating with said chambered projection to constitute an expansible balancing chamber between said valve and casing cover, said valve having also an orifice extending therethrough, and an auxiliary valve having steam passages therethrough, said auxiliary valve controlling said orifice in the main valve, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

CHARLES HENRY ROBINSON.

Witnesses:
JOHN D. GRUBER,
O. R. MANNERS.