E. H. GOLD.

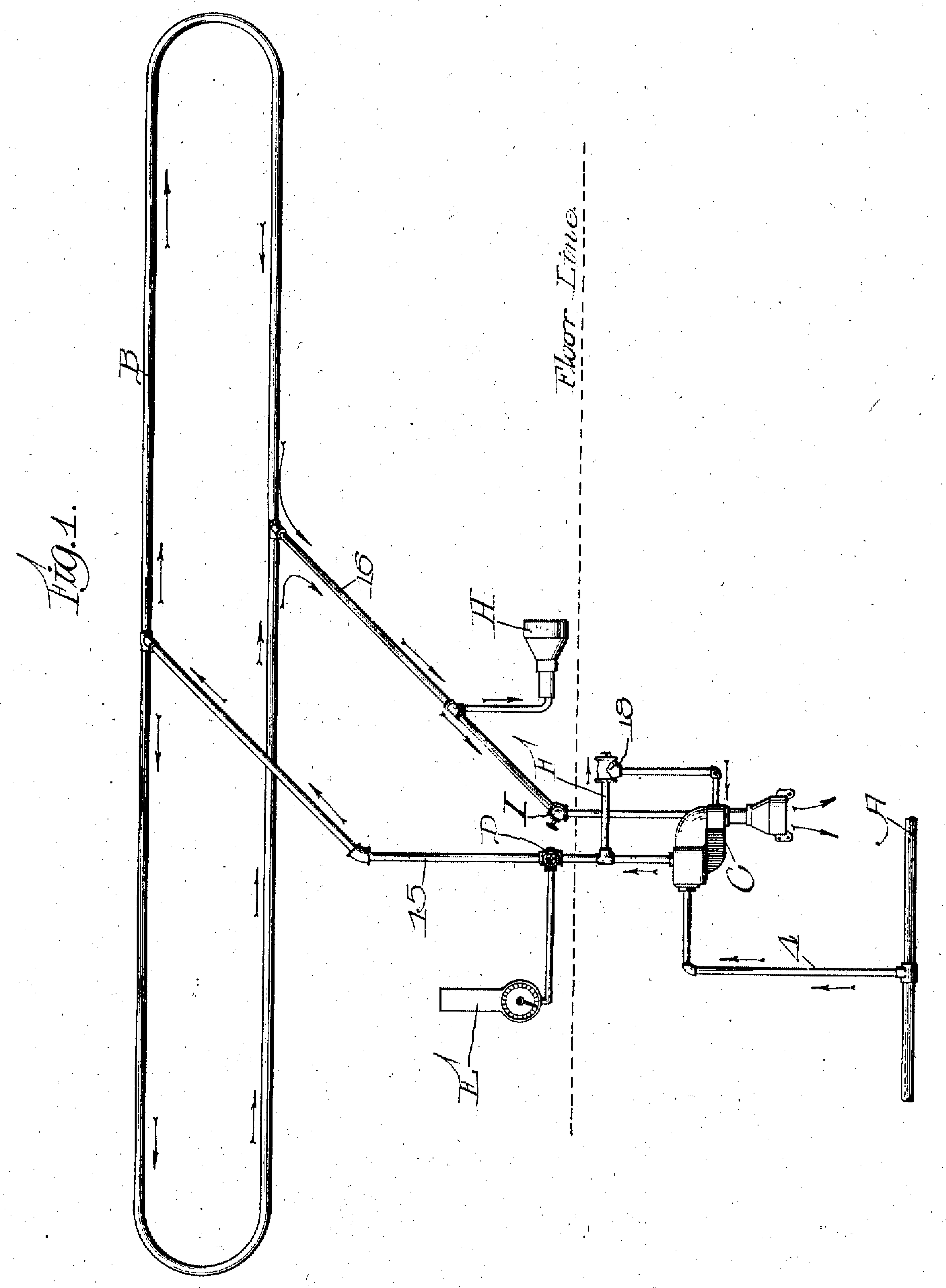
VARIABLE VOLUME HEATING SYSTEM.

APPLICATION FILED NOV. 14, 1908.

929,934.

Patented Aug. 3, 1909.

3 SHEETS—SHEET 1.



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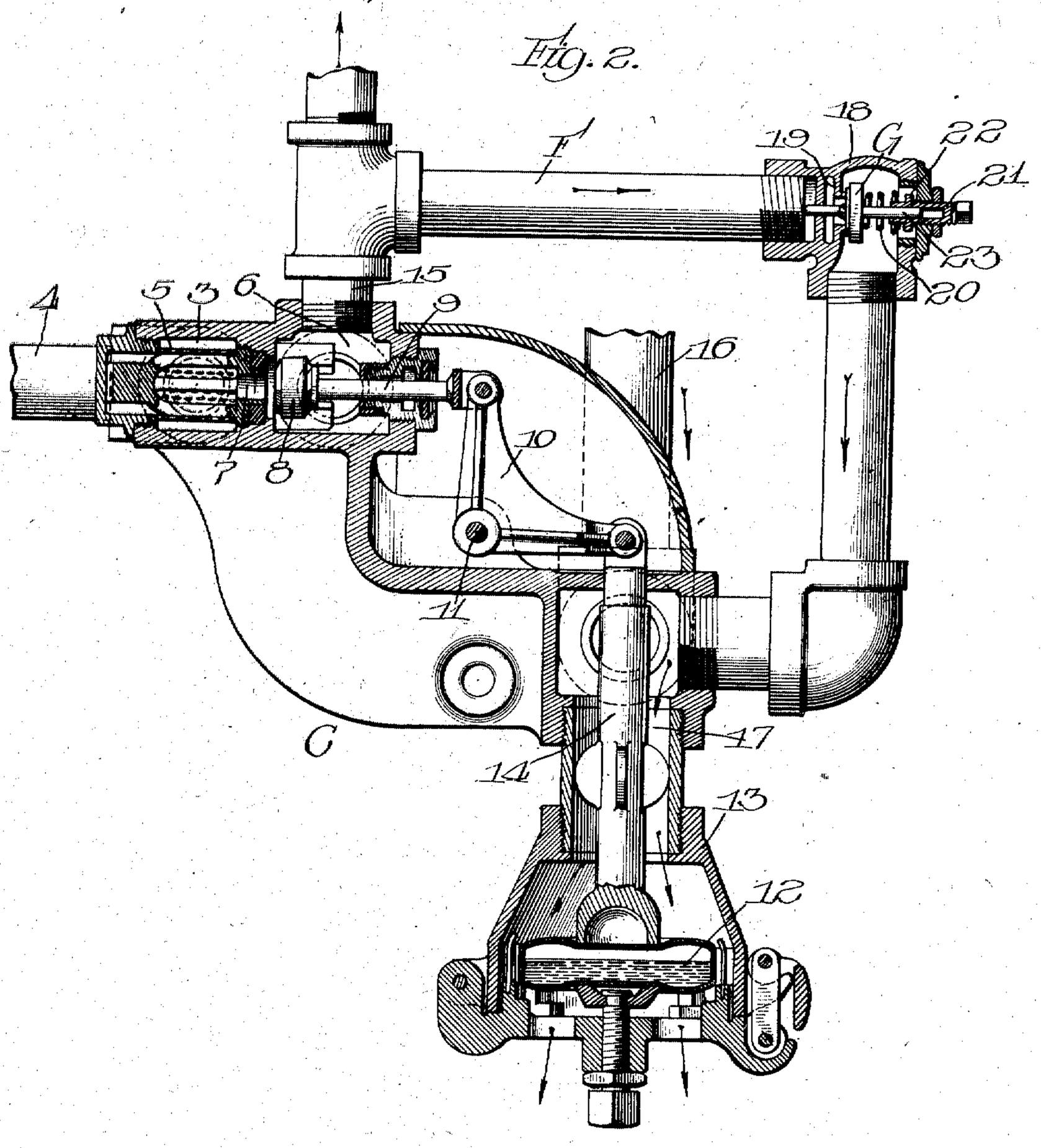
3 SHEETS—SHEET 2.

Fig. 2.



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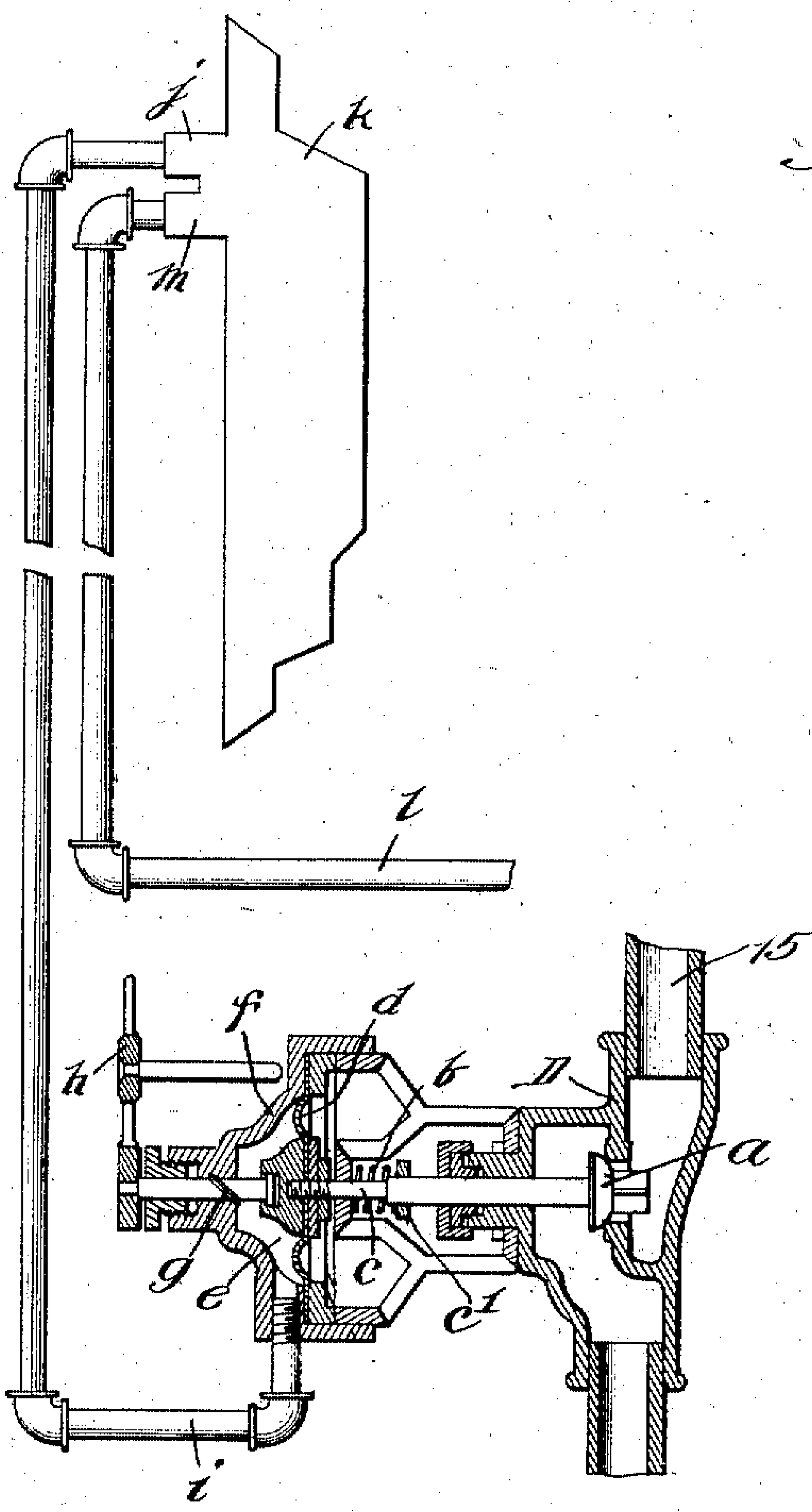
3 SHEETS—SHEET 3.

Fig. 3.



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UNITED STATES PATENT OFFICE.

EGBERT H. GOLD, OF CHICAGO, ILLINOIS.

VARIABLE-VOLUME HEATING SYSTEM.

No. 929,934. Specification of Letters Patent. Patented Aug. 3, 1909.

Application filed November 14, 1908. Serial No. 462,693.

To all whom it may concern:

Be it known that I, EGBERT H. GOLD, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Variable-Volume Heating Systems, of which the following is a specification.

My invention relates to a heating system particularly adapted for use upon railway cars, though capable of employment in other connections, of the general type of heating system in which the heating fluid is taken from a high pressure source and circulated through the radiator at a constant, lower pressure.

A principal object of the invention is to provide means for so controlling the supply of steam or other heating medium to the radiator that the volume or quantity of the heating medium in the radiator may be varied at will, so as to partially or completely fill the radiating pipes, as may be desired, and, at the same time, to obtain a perfect control of the amount of steam introduced.

The invention has for a further object to provide such means with regulating devices by which the amount of steam supplied to the radiator may be varied either arbitrarily or in accordance with the temperature outside of the heating system.

The invention has for a further object to provide a system which may be operated either to maintain the radiator full of steam at atmospheric pressure or, when desired, to maintain in the radiator an amount of steam insufficient to fill the same while, at the same time, obtaining the accurate control of the inflow which has been attained by systems which maintain the pipes full of steam at atmospheric pressure by controlling the inflow in accordance with thermostatic conditions near the outlet of the radiator. In this respect the invention is in the nature of an improvement upon or modification of the well-known vapor system shown in my Patent No. 758,436, granted April 26, 1904.

The invention has for a further object to provide means in such a heating system for keeping the controlling thermostat, or equivalent device, which is ordinarily located in a relatively exposed, cold place, in constant or frequent contact with sufficient hot fluid to keep it from freezing even when only small amounts of steam are being supplied to the radiator.

The invention has for further objects such new and improved arrangements, constructions and devices in heating systems, and particularly in car heating systems, as will be described in the following specification and particularly claimed in the claims appended thereto.

The invention, in a typical and preferred embodiment, is illustrated in the accompanying drawings, in which—

Figure 1 is a diagrammatic elevation of the heating system as a whole; and Fig. 2 is a vertical, sectional view through the controlling thermostat and associated parts. Fig. 3 is a detailed view of mechanism for thermostatically operating the valve D.

Like characters of reference indicate like parts in all the figures of the drawings.

A represents the supply or train pipe, which ordinarily runs the length of the train and is connected with the locomotive, and which carries steam at high but frequently varying pressure.

B is the radiator, which, for convenience of illustration, is shown as a simple coil of pipes. Any form of radiator or system of radiators or radiating pipes might be employed.

C is a controller which may be of any ordinary type. For purposes of illustration I have shown the form of thermostatic controller disclosed in my co-pending application Serial No. 426,718. This device is provided with a high pressure chamber 3, which is connected to train pipe A by the pipe 4 and which contains ordinarily the strainer 5, and a low pressure chamber 6, these chambers being in communication by means of the port 7, controlled by valve 8 on the stem 9, the latter being connected to the bell-crank 10, which is pivoted at 11 to the casing of the controller.

12 is a thermostat located in a casing 13 and connected with the bell-crank by a rod 14.

A pipe 15 leads from the low pressure chamber 6 to the radiator. A discharge pipe 16 leads from the radiator to the chamber 17 containing the thermostat 12 and its operating rod.

The operation of the parts, when the controller constitutes a vapor, is familiar. The steam enters chamber 3 passes by valve 8, when the latter is open, through pipe 15 into the radiator B, where it circulates, we will

suppose, in opposite directions through the radiator and discharges through pipe 16 to the thermostat chamber. When live steam reaches the thermostat, it expands the same and thereby closes valve 8, which shuts off the supply; the operation in practice, however, being ordinarily a throttling to a greater or less extent of valve 8 and the consequent admission of small amounts of steam sufficient to keep the radiator full of live steam.

G is a valve interposed at any convenient point between the effective radiating surface and the thermostatic member of the regulator C.

H indicates any desired form of thermostatic steam trap.

According to the present invention, I provide adjustable means for retarding the flow of steam into the radiator, when it is desired that a volume of steam be maintained therein insufficient to fill the same, thus obtaining an amount of heat less than can be obtained by the operation of the system as a vapor system. Preferably I provide in the pipe 15 a throttle valve of any desired type, conventionally represented in Fig. 1 by D, which may be either set by hand or may be controlled by a thermostat of any ordinary type, the latter being conventionally represented by E, or may be adjusted by hand and then thermostatically operated. Supposing the radiator to have been filled with steam and valve D operated so as to throttle the flow through pipe 15. The automatic controller C will be thrown out of operation, because no steam will pass to thermostat 12 through pipe 16. Inlet valve 8 will then stand open, allowing full train pipe pressure with its variations, or at least a very high pressure, to reach valve D. To meet this, I provide the system with means for controlling the inflow to pipe 15 in accordance with pressure conditions in the high pressure part of the same between the pressure reducing device C and valve D. This means is shown as consisting of what I term a controlling circuit F, leading from pipe 15 to the thermostat chamber 17. In order to regulate and adjust the flow to the controlling circuit, a pressure operated and preferably adjustable valve G is interposed in this circuit. This valve may be located in a valve casing 18, in which is a seat 19 against which the valve is forced by a spiral spring 20, the tension of which can be adjusted by a nut 21 having an abutment 22 for the spring and perforated to receive the end of the valve stem 23.

I do not limit myself to the particular forms, constructions and arrangements above described, as modifications might be devised which would come within the scope of my invention as defined by the claims.

The operation of the system is as follows: Supposing that it is desired to operate the system so as to keep the radiator full of steam at atmospheric pressure, valve D will be set to remain wide open and the controller C will operate, as first above described, by the outflow of steam through pipe 16, to automatically throttle the inflow through valve 8 of device C. If the system is to be operated to maintain a lesser volume of steam in the radiator, valve D will be set so as to throttle the flow of steam through pipe 15, it being possible to automatically effect this regulation in accordance with temperature conditions outside of the system by means of the thermostat E, if desired. In such case, the steam pressure in the controlling circuit F will rise until sufficient pressure, for example, two pounds to the square inch, has been obtained to open valve G, whereupon steam will pass to the thermostat 12 and expand the same, so as to close, or partially close, valve 8. The pressure sufficient to open valve G may be fixed by a proper adjustment of the tension of its spring, this valve being ordinarily kept adjusted so that pressure sufficient to open it will supply only enough steam past partially closed valve D to keep the radiator only partly filled. A closer adjustment can be more conveniently made by manipulation of valve D either arbitrarily or thermostatically. This arrangement secures a perfect control of the inflowing steam, regardless of variations of pressure in the train pipe. It also provides a system which, at will, can be operated either to keep the radiator full of steam at atmospheric pressure or to maintain in the radiator variable volumes of steam. It also provides means for keeping the inlet controlling thermostat for valve 8, which may be, and ordinarily is, located outside of the car, in constant or frequent contact with steam, so that it cannot easily freeze up. This is important because, when but small volumes of steam are being maintained in the radiator, the condensation will be necessarily slow and at a low temperature, so that the likelihood of a freeze-up is increased. If a thermostat, as at E, be used, any change in the temperature of the apartment to be heated, after the initial adjustment of valve D, will result in an automatic change of adjustment of valve D. When valve D is closed, the circulation will be only through circuit F. When valve D is wide open, there will not ordinarily be any substantial pressure in circuit F, and consequently valve 18 will remain closed.

It will be noted that in my heating system this not necessary to retain the water of condensation in the radiator when the system is to be operated with a volume of steam less than the volumetric contents of the radiator. The radiator may, as shown, be open to the atmosphere and may be constructed so that the water of condensation will drain off as fast as it forms. This eliminates the possi-

bility of the water of condensation collecting and freezing up at cold places in the radiating pipes or drip pipe. It also allows a more even distribution of steam throughout the entire system of radiating pipes, which results in a more equable and even radiation of heat into the car than is possible in those systems which control the inlet valve by the temperature of the water of condensation.

If it be desired to operate the system whereby the radiating pipes will be filled with steam at any desired pressure from atmospheric pressure to supply pipe pressure, both inclusive, this result can be attained by manipulation of the valve I and the valve G.

When the system is operating at atmospheric pressure or less, it is a matter of no consequence whether or not the trap H operates, but, when the radiating pipes are to be filled with the heating medium at any pressure above atmospheric pressure, obviously there can be no constantly open outlet to the atmosphere and the function of the trap H comes into play, in the manner usual in pressure systems, to permit the discharge of water of condensation, while preventing an undesirable loss of steam. Consequently the closing of the valve I shuts off the thermostatic member of the controller C, thereby permitting the inlet valve 8 of the controller C to remain wide open until steam from the circuit F obtains access to the thermostatic member 12 of the controller C. If the valve G be held unyieldingly to its seat, of course there will be no possibility of steam reaching the thermostat 12, consequently the inlet valve 8 will remain constantly open and the radiating pipes will be supplied with heating medium at substantially supply pipe pressure. If, however, the valve G be adjusted so as to yield and open under any pressure in the circuit F less than supply pipe pressure, then the pressure and temperature in the radiating system and in the circuit F will rise until such pressure is sufficient to open the valve G, whereupon steam will pass entirely through the circuit F, to the thermostatic member of the controller C, and the inflow of steam will be throttled.

It will be seen, therefore, that, by the arrangement shown in my present application, I provide means whereby the widest range of heating efficiency may be attained from the slightest heat above the temperature of the apartment when unheated, to the highest temperature afforded by supplying the radiating pipes with heating medium at supply pipe pressure.

In order to distinguish the parts in claiming them, the terms radiator inlet valve or inlet valve for the radiator are used to designate valve D, or such other means as may be employed for retarding the flow of steam to the radiator after it has passed through valve 8, which I term the supply valve. It will be seen that controller C, including valve 8, affords means for automatically controlling the supply of steam taken from the train pipe in response to thermostatic conditions near the outlet of the radiator, when the system is running at atmospheric pressure with a full volume of steam and that controller C, valves G and I, trap H and their connections, constitute together controlling means for automatically maintaining in the pipes, determinable volumes of steam, less than enough to fill the same, or an amount of steam sufficient to fill the same at any desired pressure from atmospheric pressure to a pressure approximating train pipe pressure.

Any well known thermostatic device may be used for operating the valve D, such, for example, as the apparatus shown in Fig. 3, in which *a* is the valve-piece normally held to its seat by a spring *b* surrounding the valve spindle *c* and abutting at one end against a part of the casing and at the other against a collar on the spindle *c*. The spindle *c* is attached to a flexible diaphragm *d*, which is open to the atmosphere on its under side, while its upper side is under the influence of the pressure existing in the chamber *e* in the casing *f*. Thus, according to the variations of pressure in this chamber, the valve piece *a* will be moved to or away from its seat. It may also be operated by a threaded spindle *g* operated by a handle *h*. The chamber *e* above the diaphragm is connected by a pipe *i* to a connection *j* on a thermostat *k*. A supply of compressed air from any source is led by a pipe *l* to a connection *m* on the thermostat *k*. The thermostat may be of any usual type whereby the operations of the thermostat will control the compressed air in the pipe *l*.

The foregoing arrangement is no part of my invention, but is merely conventional so far as my invention is concerned and is the same thermostatic valve operating mechanism as is shown in Patent No. 869,612. Any well known device in common use whereby a valve is actuated by a thermostat exposed outside of the radiator may be used.

I claim:

1. In a heating system, the combination of a source of supply of heating fluid at high pressure, a radiator, a supply valve, means for retarding the inflow to the radiator, and automatic controlling means which controls the supply valve, either in accordance with thermostatic conditions in proximity to the discharge end of said radiator or in accordance with thermostatic conditions in the system between said supply valve and said retarding means, according to the adjusted position of the retarding means.

2. In a heating system, the combination of a source of supply of heating fluid at high pressure, a radiator, a supply valve, means for retarding the inflow to the radiator, and

automatic controlling means for controlling the supply valve, either in accordance with thermostatic conditions in proximity to the discharge end of said radiator or in accordance with thermostatic conditions in the system between the supply valve and the retarding means, according to the adjusted position of the retarding means.

3. In a heating system, the combination of a source of supply of heating fluid at high pressure, a radiator, a supply valve, means for retarding the inflow to the radiator, a thermostat to control the supply valve in accordance with thermostatic conditions near the outlet of the radiator, and a controlling circuit receiving fluid from between the supply valve and the retarding means and conducting the same into contact with the thermostat.

4. In a heating system, the combination of a source of supply of heating fluid at high pressure, a radiator, a supply valve, means for retarding the inflow to the radiator, a thermostat to control the supply valve in accordance with thermostatic conditions near the outlet of the radiator, a controlling circuit receiving fluid from between the supply valve and the retarding means and conducting the same into contact with the thermostat, and a pressure operated valve in said circuit.

5. The combination with a source of steam supply, of a radiator, an inlet pipe from said source of supply to the radiator, means for retarding the inflow of steam to the radiator, and means for automatically controlling the inflow of steam to said radiator so as to maintain the same therein in determinably variable volume according to the adjusted position of said retarding means.

6. In combination, a radiator, an inlet pipe leading thereto, a thermostatic valve adapted to be actuated by steam from the radiator to control the flow of steam to the inlet pipe, a retarding device located between the thermostatic valve and the radiator, a shunt circuit leading from a point between said thermostatic device and said retarding device to the actuating member of said thermostatic valve, means for closing said shunt circuit, said means adapted to be opened by the influence of steam entering said shunt circuit from said inlet pipe, all so arranged that steam from the inlet pipe will flow through the radiator to the actuating member of said thermostatic valve or through said shunt circuit to the actuating member of said thermostatic valve, according to the adjusted position of said retarding device.

7. The combination with a radiator, of a supply pipe arranged to furnish heating medium thereto, and adjustable means for controlling the flow of the heating medium to the radiator so that, at will, the heating medium so supplied will be sufficient, either to only partially fill said radiator at not higher than atmospheric pressure, or to completely fill the radiator at any desired pressure, ranging from atmospheric pressure to supply pipe pressure, and for automatically maintaining such predetermined conditions of volume and pressure in said radiator.

8. In a heating system, the combination of a source of supply of heating fluid at a high pressure, a radiator, a supply valve, a throttle valve for the radiator, means for automatically actuating the supply valve either in accordance with thermostatic conditions in proximity to the discharge end of said radiator or in accordance with thermostatic conditions in the system between the inlet valve and the throttle valve, according to the adjusted position of said throttle valve, and a thermostat, external to the system, for controlling the position of said throttle valve.

9. The combination of a source of supply of heating fluid at high pressure, a radiator, an inlet pipe from the source of supply to the radiator, a supply valve to control the flow from the source of supply to the radiator, a throttle valve between the radiator and the supply valve, a thermostat arranged to actuate the supply valve, a pipe arranged to conduct steam from the radiator to the thermostat, a pipe leading from the inlet valve between the supply valve and throttle valve to said thermostat, and an adjustable pressure-operated valve in said pipe capable of adjustment to close said pipe and adapted to be opened under the influence of the heating fluid entering said pipe from said inlet pipe.

10. The combination of a source of supply of heating fluid at high pressure, a radiator, an inlet pipe from the source of supply to the radiator, a supply valve to control the flow from the source of supply to the radiator, a throttle valve between the radiator and the supply valve, a thermostat arranged to actuate the supply valve, a pipe arranged to conduct steam from the radiator to the thermostat, a pipe leading from the inlet valve between the supply valve and throttle valve to said thermostat, an adjustable pressure-operated valve in said pipe capable of adjustment to close said pipe and adapted to be opened under the influence of the heating fluid entering said pipe from said inlet pipe, a steam trap interposed in the pipe for conducting steam from the radiator to said thermostat, and a shut-off valve in said last named pipe between the steam trap and thermostat.

11. The combination of a source of supply of heating fluid at high pressure, a radiator, an inlet pipe from the source of supply to the radiator, a supply valve to control the flow from the source of supply to the radiator, a throttle valve between the radiator and the supply valve, a thermostat arranged to ac-

tuate the supply valve, a pipe arranged to conduct steam from the radiator to the thermostat, a pipe leading from the inlet valve between the supply valve and throttle valve to said thermostat, an adjustable pressure-operated valve in said pipe capable of adjustment to close said pipe and adapted to be opened under the influence of the heating fluid entering said pipe from said inlet pipe, a steam trap interposed in the pipe for conducting steam from the radiator to said thermostat, a shut-off valve in said last-named pipe between the steam trap and thermostat, a thermostat external to the heating system, and connections between said last-named thermostat and said throttle valve, whereby said throttle valve may be actuated by said last named thermostat.

EGBERT H. GOLD.

Witnesses:
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Corrections in Letters Patent No. 929,934.

It is hereby certified that in Letters Patent No. 929,934, granted August 3, 1909, upon the application of Egbert H. Gold, of Chicago, Illinois, for an improvement in "Variable-Volume Heating Systems," errors appear in the printed specification requiring correction, as follows: In line 107, page 1, after the word "vapor" the word *regulator* should be inserted, and page 2, line 123, the word "this" should read *it is;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 24th day of August, A. D., 1909.

[SEAL.]

F. A. TENNANT,

Acting Commissioner of Patents.