E. H. GOLD.

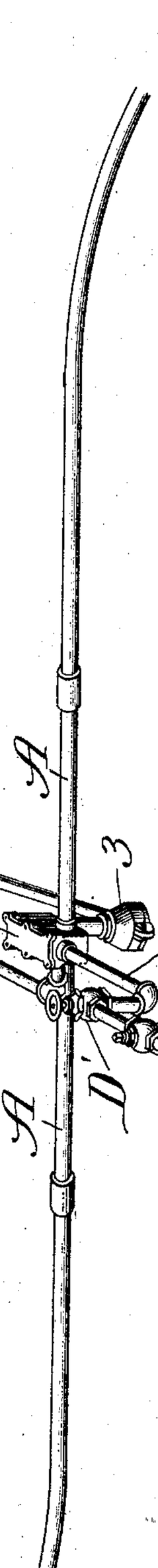
LOW PRESSURE FLUID HEATING SYSTEM.

APPLICATION FILED FEB. 5, 1906.

928,040.

Patented July 13, 1909.

4 SHEETS—SHEET 1.



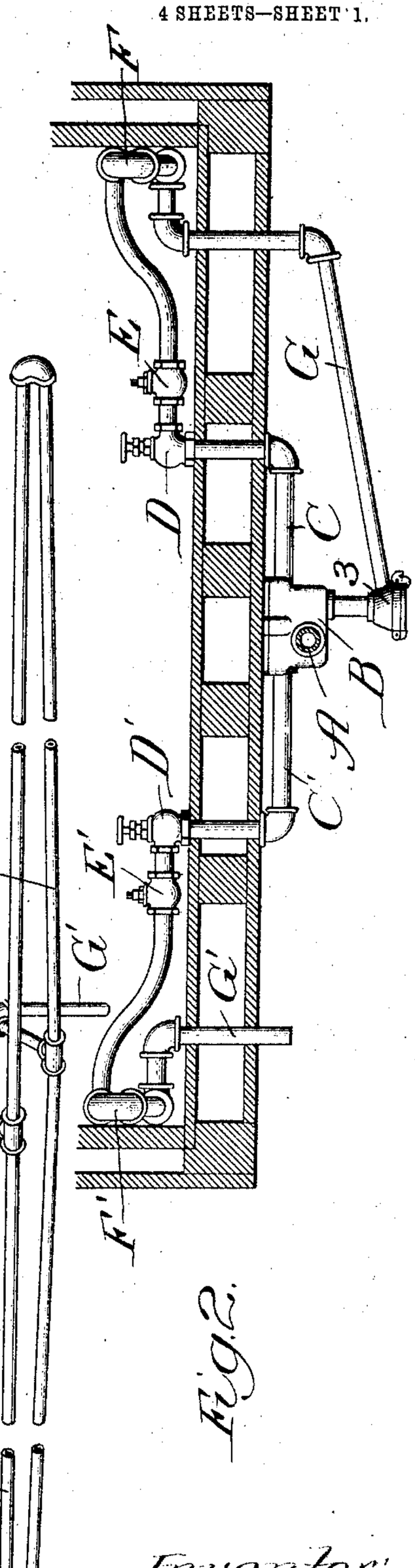


FIG. 1.

FIG. 2.

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4 SHEETS—SHEET 2.

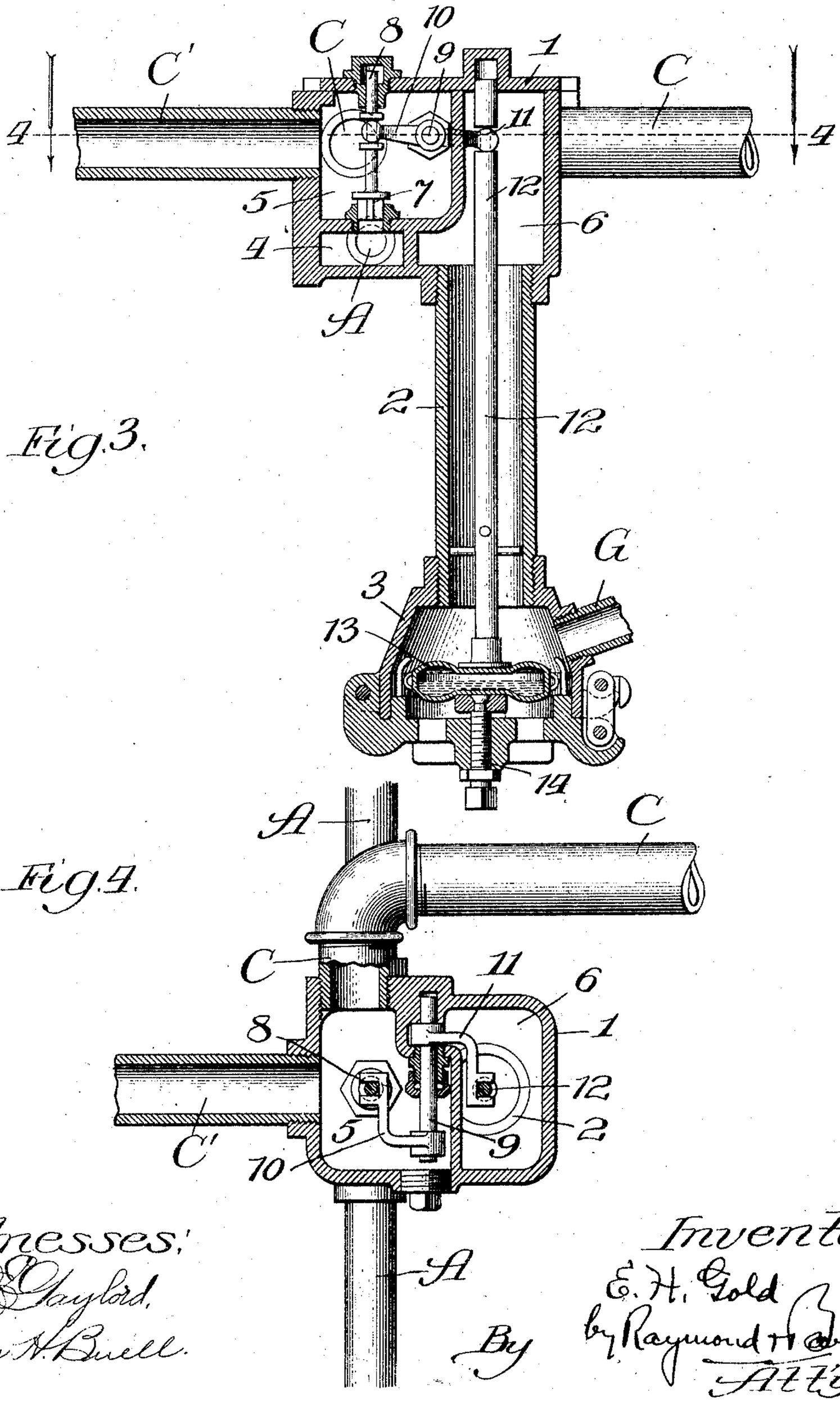

Fig. 3.

Fig. 4.

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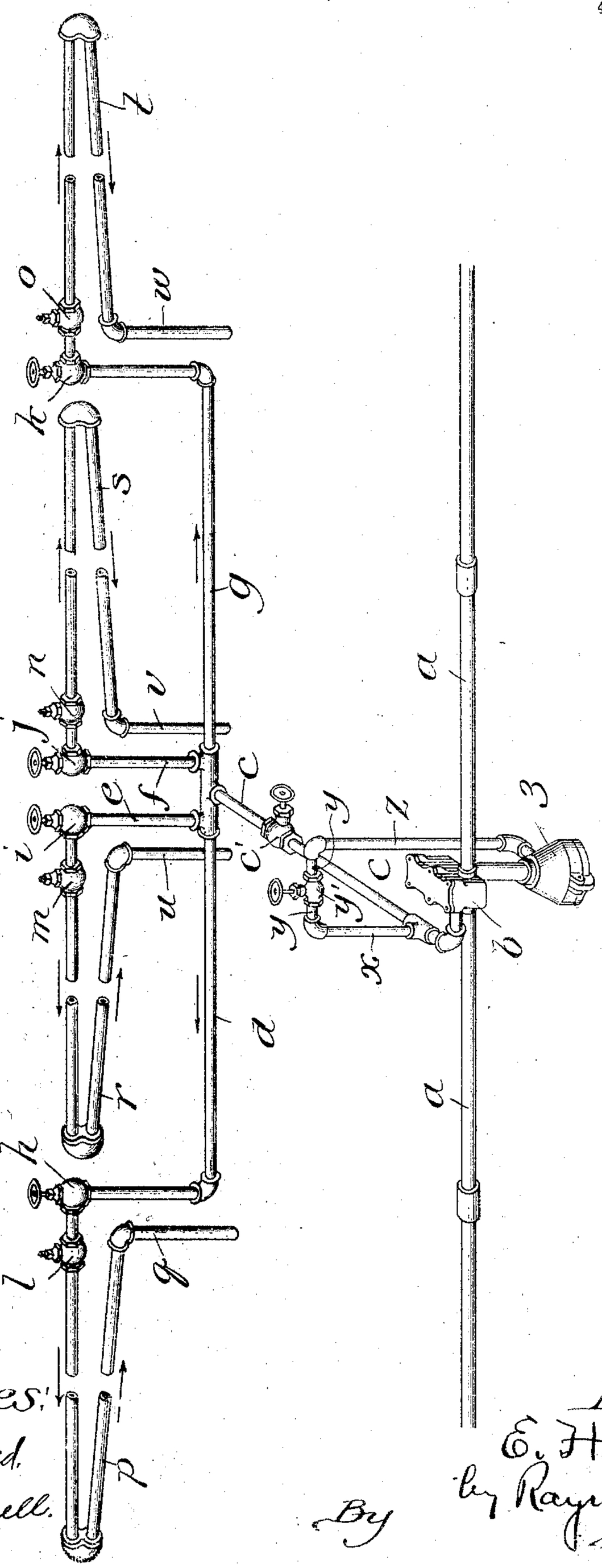
4 SHEETS—SHEET 3.

Fig. 5.



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4 SHEETS—SHEET 4.

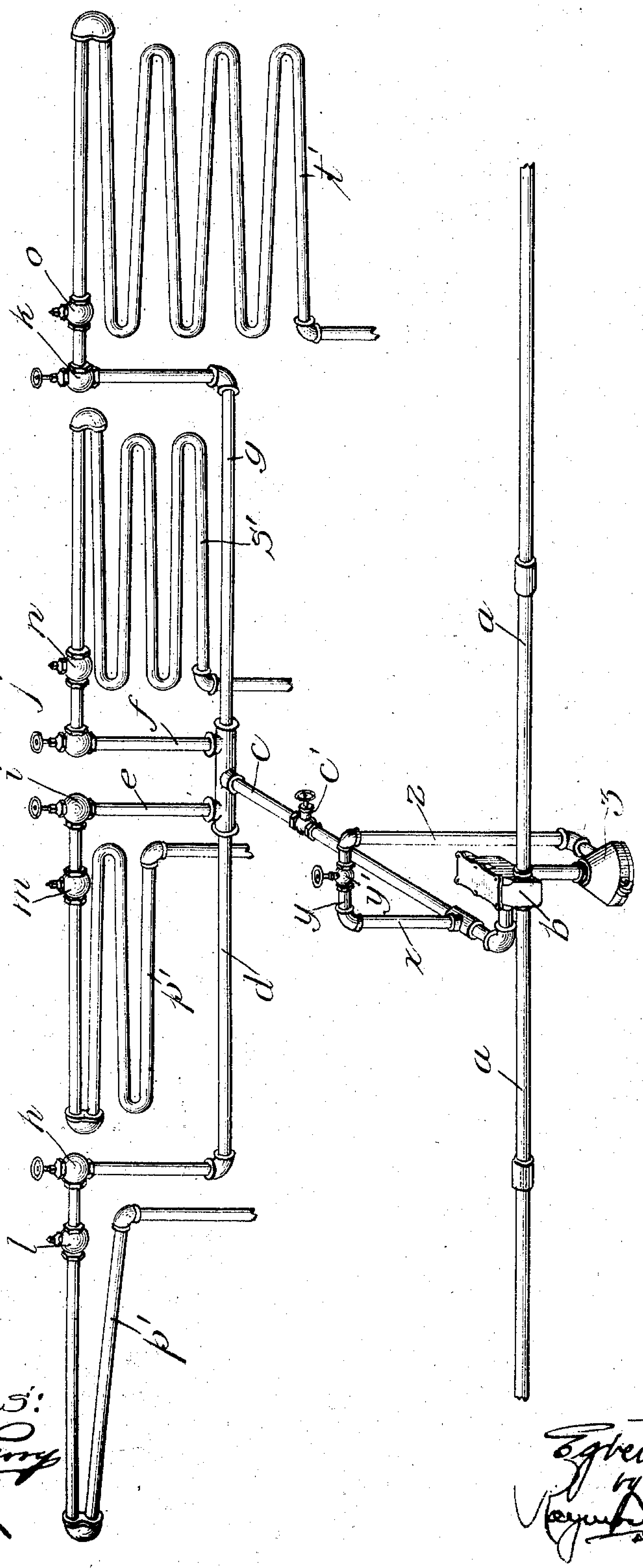

Fig. 6.

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UNITED STATES PATENT OFFICE.

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LOW-PRESSURE FLUID-HEATING SYSTEM.

No. 928,040. Specification of Letters Patent. Patented July 13, 1909.

Application filed February 5, 1906. Serial No. 299,529.

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 Low-Pressure Fluid-Heating Systems, of which the following is a specification.

This invention relates to improvements in low-pressure fluid-heating systems, and has special reference to a heating system wherein fluid is received at a high pressure and maintained by suitable automatically-operating means at a predetermined lower pressure after being admitted to the radiating pipes. Such a fluid-heating system is particularly adapted to car-heating, wherein the heating fluid is steam supplied at a variable high pressure from the locomotive boiler and distributed to the various cars along the train at such high pressure.

A principal object of the present invention is to provide means whereby the radiating pipes of a car may be divided into two or more heating systems, one or more of which may be shut off without affecting the other systems. Heretofore this result has been accomplished by duplicating the automatically-operating supply controlling means so as to have one such controlling device for each section or system of the radiating pipes.

By the use of the invention hereinafter disclosed and pointed out in the claims, I am enabled to divide the radiating pipes of a car into independent sections or systems, each of which may be shut off or turned on independently of the others, and to have the pressure in the pipes of these various systems, and the amount of steam passing into and through each of said systems, governed by one and the same controlling device for the whole car. Several advantages accrue from a system in which this is possible, among which may be mentioned the obviating of the necessity of multiplying certain parts of the device which are automatic. Another advantage that may be mentioned is decreased cost of installation.

Broadly considered, the present invention contemplates the provision of a thermostatically operated controlling device adapted to receive steam at a high pressure from the train pipe and to deliver the same at a reduced pressure, and a plurality of sets of steam conduits some or all of which constitute radiators and which receive steam from the controlling device, one of these conduits leading back into proximity to the thermostatic member of the controlling device so that the latter may be influenced by the thermostatic condition in said conduit. This conduit may constitute of itself a radiator, or it may be simply a controlling circuit or loop without possessing any effective heating function. In the latter case, its office will be to provide means independent of the radiating coils, which latter may discharge to the atmosphere at a point remote from the controlling thermostat, for conducting steam from the low pressure side of the inlet valve to the thermostat; and in such case a valve will be provided in said loop for regulating the flow through the same.

Obviously although the free outlet from the apparatus will ordinarily discharge directly to the atmosphere, the only important point is that it shall discharge to a zone in which the pressure is lower than the pressure in the radiator. For convenience, I have in the claims referred to such zone as the atmosphere, and it should be understood that any zone in which the pressure is not higher than the pressure in the radiator is considered as equivalent to the atmosphere within the meaning of the claims.

In the accompanying drawings: Figure 1 shows diagrammatically the arrangement of the parts of my improved fluid-heating system as installed in a passenger car. As here shown the radiating pipes of the car are divided into two substantially similar sections, each arranged along one side of the car. Fig. 2 is an elevational-view of the same looking toward the end of the car. Fig. 3 is a vertical, longitudinal, sectional view of the controlling device used in this system. Fig. 4 is a cross-sectional view of the same on the line 4—4 of Fig. 3 looking downward. Fig. 5 shows how the invention may be applied to compartment cars. The drawing shows the radiating pipes arranged for four compartments. Fig. 6 shows my invention applied to a heating system in which the radiators are shown to be of unequal radiating surfaces.

In these figures, and referring particularly to Fig. 1, A is the train-pipe filled with steam at high pressure. B is the thermostatically-actuated controlling device adapted to receive the high-pressure steam from the

train-pipe A. C and C′ are pipes leading from the controlling device B and conducting low-pressure steam, one of said pipes leading to each side of the car. D and D′ are manually-operated valves for shutting off or admitting steam to the radiating pipes F and F′. E and E′ are valves for regulating the relative amounts of steam which may pass to the radiating pipes F and F′, as will be more specifically explained below. After passing through the radiating pipe F′ the steam is permitted to pass to the atmosphere through the pipe G′ this pipe opening below the floor of the car. The steam from the radiating pipe F is conducted through the pipe G to the controlling device B which contains thermostatically-operating means adapted to be influenced by the heat contained in the exhaust steam conducted thereto by the pipe G.

The particular controlling device B, shown in detail in the sectional views Figs. 3 and 4, comprises an outer casing 1, a pipe 2, leading downwardly therefrom, and a thermostat casing 3 at the lower end of the pipe 2. The casing 1 contains a high-pressure chamber 4, a low-pressure chamber 5, and an outlet chamber 6. Steam at high-pressure from the train-pipe is admitted to the high-pressure chamber 4 from the train-pipe A. The valve 7 is adapted to regulate the flow of steam from the high-pressure chamber 4 to the low-pressure chamber 5. This valve 7 is carried at the lower end of the plunger 8. Within the low-pressure chamber 5, and extending into the outlet chamber 6, is a rocking-shaft 9. This rocking-shaft 9 carries upon one of its ends an arm 10 working in the low-pressure chamber 5 and engaging the plunger 8, and upon its opposite end an arm 11 working in the outlet chamber 6. Extending vertically through the pipe 2 is a rod 12, the upper end of which engages the arm 11, its lower end engaging a thermostat 13. This thermostat may conveniently consist of an expansible box containing a volatile liquid such as alcohol. The screw 14 serves as means for raising and lowering the thermostat 13 and rod 12, whereby the device is adjusted. Of course other controlling devices may be used.

The operation of a fluid-heating system when constructed and installed as shown in Figs. 1, 2, 3 and 4, will be as follows: Steam at high-pressure from the train-pipe A is admitted to the high-pressure chamber 4 of the controlling device B. Suppose, now, the valves D and D′ be open. The valve 7 will be forced open or will be open by reason of the weight of the rod 12, and steam will flow into the low-pressure chamber 5, thence through the pipes C and C′, and valves D, D′, E and E′ to the radiating pipes F and F′. Steam from the radiating pipe F will flow back through the pipe G to the controlling device B and will enter the thermostat casing 3, finding its way to the atmosphere through the bottom of this casing. The thermostat 13 will be expanded by the heat carried by this steam, the rod 12 and arm 11 will be raised, the rocking-shaft 9 will be rotated, causing the arm 10 to thrust the spindle 8 and valve 7 down, throttling the steam and shutting off the flow of the same. When the temperature of the vapor surrounding the thermostat 13 has fallen sufficiently to cause the thermostat 13 to contract, the valve 7 will open and permit steam to flow into the low-pressure chamber 5. In practice the device will shortly adjust itself so as to permit the constant flow of a small amount of steam into the chamber 5. This steam will circulate throughout the pipe C, the valves D and E, radiating pipes F and outlet-pipe G back to the controlling device and will keep the thermostat sufficiently expanded to so throttle the valve 7 that the inflowing steam will just compensate for the condensation which takes place between the valve 7 and the thermostat 13. The steam which is admitted to the radiating pipes F′ will find its way through the pipe G′ directly to the atmosphere.

In practice the valves E and E′ will be adjusted so as to permit such relative amounts of steam to pass through each of these valves that the two sides or halves of the system will balance each other. After the proper adjustment has been found it will not be necessary to change their adjustment. By reason of the fact that the radiating pipe F′ has a more direct connection with the atmosphere through the pipe G′ than has the radiating pipe F through the pipe G and thermostat chamber 3, it will be found that the valve E′ should be set so as to give a more restricted passage therethrough for the steam.

Suppose, now, the valve D′ be closed. Steam will be shut off, the radiating pipe F′ will cool and the water of condensation from this radiating pipe will find its way by gravity out through the pipe G′ and will drip from the end of the latter below the floor of the car. The valve D being still open, steam will pass therethrough to the radiating pipe F and will find its way through the same and the pipe G to the thermostat casing 3 of the controlling device B, and condensed water will issue from the bottom of the same as hereinbefore pointed out. If, now, the valve D be also closed, steam will be shut off from the radiating pipe F, this pipe will cool, the steam will condense therein, and the water of condensation resulting therefrom will drip from the bottom of the thermostat casing 3. It will be seen that whether one or both sides of the system are shut off, the system will be kept drained and the accumulation and con-

sequent danger of freezing of water therein will be prevented.

In Fig. 5 I have shown my improved fluid-heating system forming the subject of the present invention as applied to a car wherein it is necessary or convenient to divide the radiating pipes into more numerous parts or systems. Such an arrangement is especially desirable in a car containing compartments. In such a car it is often desired to shut off steam from one or more of the compartments without shutting it off from the pipes of the other compartments. In this view *a* is the train-pipe. *b* is the controlling device which receives the steam at high pressure from the train-pipe *a*. *c* is a pipe leading from the low-pressure chamber of the controlling device *b* to one side of the car. In this pipe is a valve *c'* for shutting off or admitting steam to all of the radiating pipes at the same time. This pipe *c* branches into the pipes *d*, *e*, *f*, and *g*, each of these pipes leading to a manually-operated valve, *h*, *i*, *j*, and *k* respectively. A short pipe connects each of these valves with a regulating valve, these regulating valves being designated *l*, *m*, *n* and *o* respectively. The radiating pipe *p* is open to the atmosphere through the pipe *q*, which opens below the floor of the car. The radiating pipes *r*, *s*, and *t* are likewise open to the atmosphere through the pipes *u*, *v* and *w*. Extending upwardly from the regulating device *b* is a short loop consisting of the pipes *x*, *y*, and *z*. The pipe *x* takes steam from the low-pressure side of the controlling device *b*, the pipe *z* leading back to the controlling device and entering the thermostat casing 3. In the pipe *y*, is a regulating valve *y'*, similar to the valves, *m*, *n*, and *o*, for reducing and regulating the flow of steam through the loop.

In practice the valve *y'* will be set to give a very restricted opening for the passage of steam therethrough, while the valves *l*, *m*, *n*, and *o*, will be set to permit the flow of relatively large amounts of steam, each of said valves being preferably set to provide different sized inlet passages in accordance with the length of the respective radiating pipes to be supplied therethrough or in accordance with the other requirements peculiar to the respective radiating pipes. With the valves *c'*, *h*, *i*, *j*, and *k*, open, and the valves *y'*, *l*, *m*, *n*, and *o* properly adjusted, there will be a constant slight flow of steam into each of the radiating pipes *p*, *r*, *s* and *t*, and the condensation from all of these pipes will find its way directly to the atmosphere below the floor of the car. The steam from the loop consisting of the pipes *x*, *y*, and *z*, will, however, be conducted back to the controlling device *b*, and will enter the thermostat chamber 3. As the valve *y'* is set to provide a greatly restricted passage for the steam, a very small amount of steam will find its way through the loop, but as this loop is very short and consequently there is but little cooling of the steam passing therethrough, this small amount of steam is sufficient to actuate the controlling device. When the temperature in the loop approaches the temperature at which the device is designed to operate, the thermostat 13 in the thermostat casing 3 will expand, and the valve 7 will begin to close, throttling the steam and preventing the further passage of steam to the radiating pipes. When the temperature in the loop begins to fall, the thermostat 13 will begin to contract, the valve 7 will begin to open and steam will be admitted to all of the radiating pipes.

It will be seen that a fluid-heating system constructed to embody the present invention permits of admitting fluid through a controlling device to a plurality of pipe systems, some of which are radiating pipes and at least one of which forms a loop or "master circuit" having both of its ends in communication with the controlling device, utilizing the thermostatic condition of the loop to control the admission of steam to all of the systems, and adjusting the size of the inlet ports to each of the circuits with such relation to the master circuit that the heating medium will substantially fill each of the secondary circuits before it operates the automatic controlling device through the master circuit. In the arrangement shown in Figs. 1 to 4 this loop or master circuit is itself utilized as a heating coil or system. In the arrangement of Fig. 5 it does not have that for its purpose primarily.

In Fig. 6 the radiators *p'*, *r'*, *s'* and *t'* are shown to have different radiating surfaces proportioned to the particular surface which may be required of them and to any other exigencies of practical service which may require radiators of different capacities in different parts of the car.

I do not claim in the present application, specifically, the particular arrangements shown in Figs. 5 and 6, as these arrangements in the features by which they are distinguished from the arrangements of the first four figures are made the subject of a divisional application, Serial No. 488,801 filed November 14, 1908. In the present application I lay claim to the invention common to all of the figures and the inventions specific to the first four figures.

I claim:

1. A heating system comprising a plurality of radiating systems, a common supply pipe leading to said radiating systems, thermostatically-operated means for controlling the inflow of a heating medium to said supply pipe, the return end of one of said radiating systems communicating with the thermostatic member of said thermostatically

operated means, and means for adjusting the flow of the heating medium to each of said radiating systems respectively whereby each of said systems may be continuously and automatically supplied with the required volume of the heating medium.

2. The combination with a plurality of systems of pipes, of a valve for controlling the flow of fluid to said systems, a thermostat adapted to operate said valve, one of said systems having means for conducting steam therefrom to the thermostat, and one or more of said systems having outlets directly to the atmosphere.

3. The combination with a system of radiating pipes, of a thermostatically controlled device which receives and regulates the flow of fluid to said system, and a conduit having one end in communication with said device so as to receive fluid therefrom and the other end communicating with the thermostatic elements of said device and being provided with an outlet, said conduit affording a circuit for the fluid other than that given by the aforesaid system of radiating pipes, said controlling device being adapted to be influenced by the thermostatic condition of said conduit, whereby the flow of fluid to said system is controlled by thermostatic conditions in said conduit.

4. The combination with a system of radiating pipes, of a valve for regulating the flow of fluid into said system, a valve chamber in which said valve is located, a thermostat adapted to operate said valve, and a fluid conduit independent of said system of radiating pipes leading from said valve chamber into proximity to said thermostat, whereby the inflow of steam to said system of radiating pipes is influenced by the thermostatic condition of fluid within said conduit, said conduit being provided with an outlet separate from the inlet to said conduit.

5. The combination with a plurality of radiating systems, of a source of high-pressure steam supply, a thermostatically-actuated controlling device adapted to regulate the passage of steam to said radiating systems, means for conducting steam from one of said systems back to the thermostatic element of said controlling device, the others of said systems being directly open to the atmosphere.

6. The combination with a source of high-pressure steam supply, of a plurality of radiating systems, a controlling device comprising a thermostatic member adapted to regulate the flow of steam to said radiating systems, one or more of said radiating systems having a constantly open outlet to the atmosphere, one of said radiating systems having an outlet which discharges into proximity with the thermostatic member of the controlling device, said controlling device being actuated by the thermostatic condition of the steam from said radiating system.

7. The combination with a source of steam supply, of a thermostatically-actuated controlling device, a plurality of systems of pipes, some of which are radiating pipes, a plurality of pipes each adapted to conduct steam from the controlling device to one of the systems of pipes, and means associated with one of said pipes whereby the flow of fluid to its system of pipes may be adjusted, one of said systems of pipes having an outlet communicating with the thermostatic member of the controlling device and one or more of said systems of pipes opening directly to the atmosphere.

8. The combination with a source of high pressure steam supply, of a plurality of radiators constantly open to the atmosphere, an automatically operating pressure-reducing device interposed between said source of supply and said radiators which is actuated in accordance with thermostatic conditions at the discharge end of one of said radiators, each of said radiators being provided near its inlet end with an adjustable controlling valve which may be set in accordance with the amount of steam required in said radiator, whereby the flow of the heating medium to said radiators may be so equalized that each of said radiators may be filled with the heating medium at the reduced pressure.

9. In a heating system the combination with a source of supply of heating fluid at high pressure, of a plurality of radiators, a single controlling device to control the flow of fluid to said radiators comprising a thermostatic member, and a discharge pipe from one of said radiators to the thermostatic member of said controlling device, another of said radiators having a discharge remote from said thermostatic member.

10. In a heating system the combination with a source of supply of heating fluid at high pressure, of a radiator, a valve to control the flow from the source of supply to the radiator, a thermostatic member to operate said valve, and a conduit which leads from the low pressure side of said inlet valve into proximity with said thermostatic member, said conduit being provided with an outlet separate from the inlet to said conduit.

11. In a heating system the combination with a source of supply of heating fluid at high pressure, of a radiator, a valve to control the flow from the source of supply to the radiator, a thermostatic member to operate said valve, a conduit which leads from the supply pipe to the radiator on the low pressure side of said inlet valve into proximity with said thermostatic member, and a valve in said conduit.

12. In a heating system the combination with a source of supply of heating fluid at

high pressure, of a radiator, a valve to control the flow from the source of supply to the radiator, a thermostatic member to operate said valve, a conduit which leads from the low pressure side of said inlet valve into proximity with said thermostatic member, and a valve in said conduit, the aforesaid mentioned radiator discharging to the atmosphere at a point remote from said thermostatic member.

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