No. 809,253. PATENTED JAN. 2, 1906.

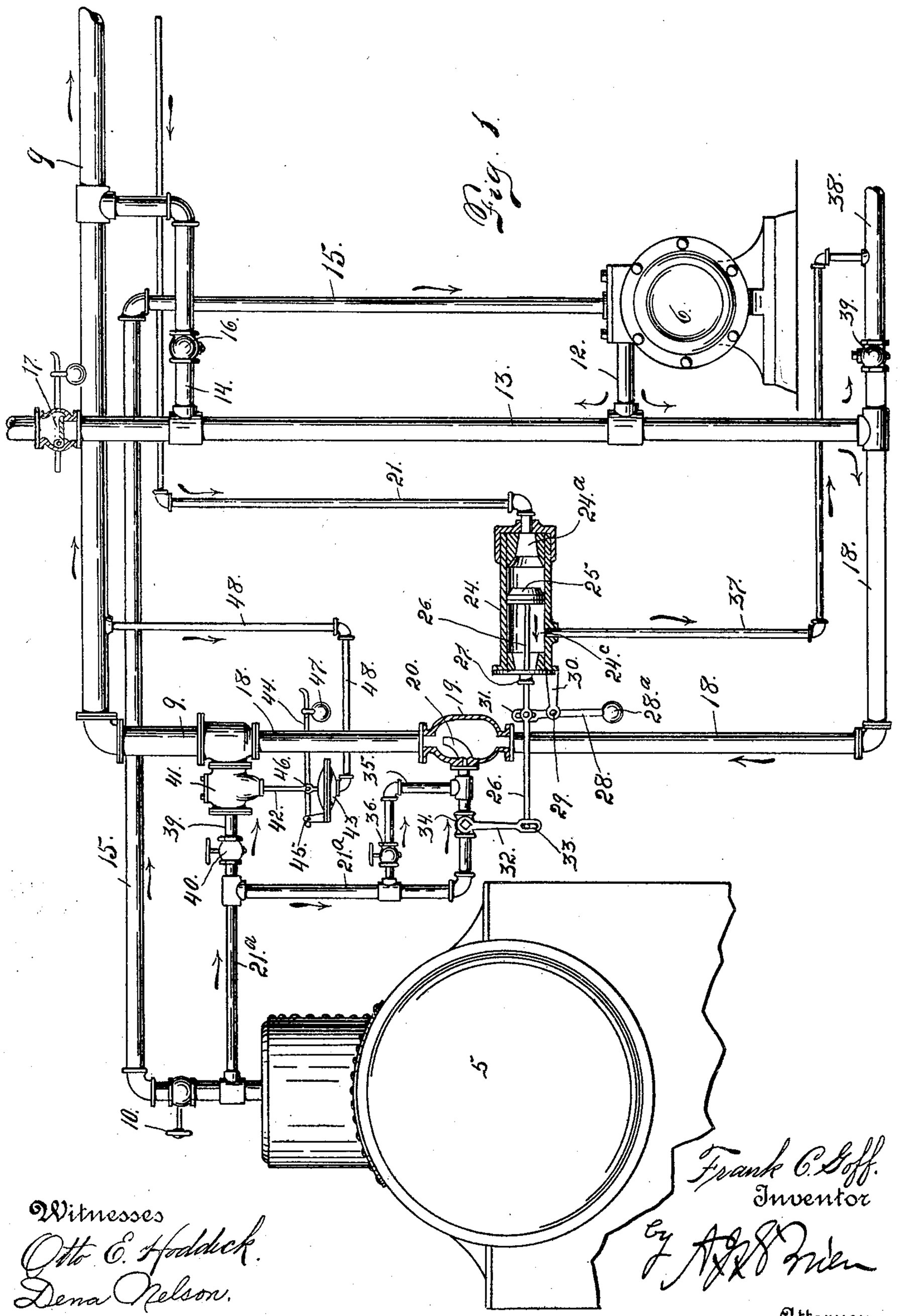
F. C. GOFF.

DEVICE FOR CIRCULATING STEAM, &c.

APPLICATION FILED NOV. 5, 1902.

4 SHEETS—SHEET 1.

Fig. 1.



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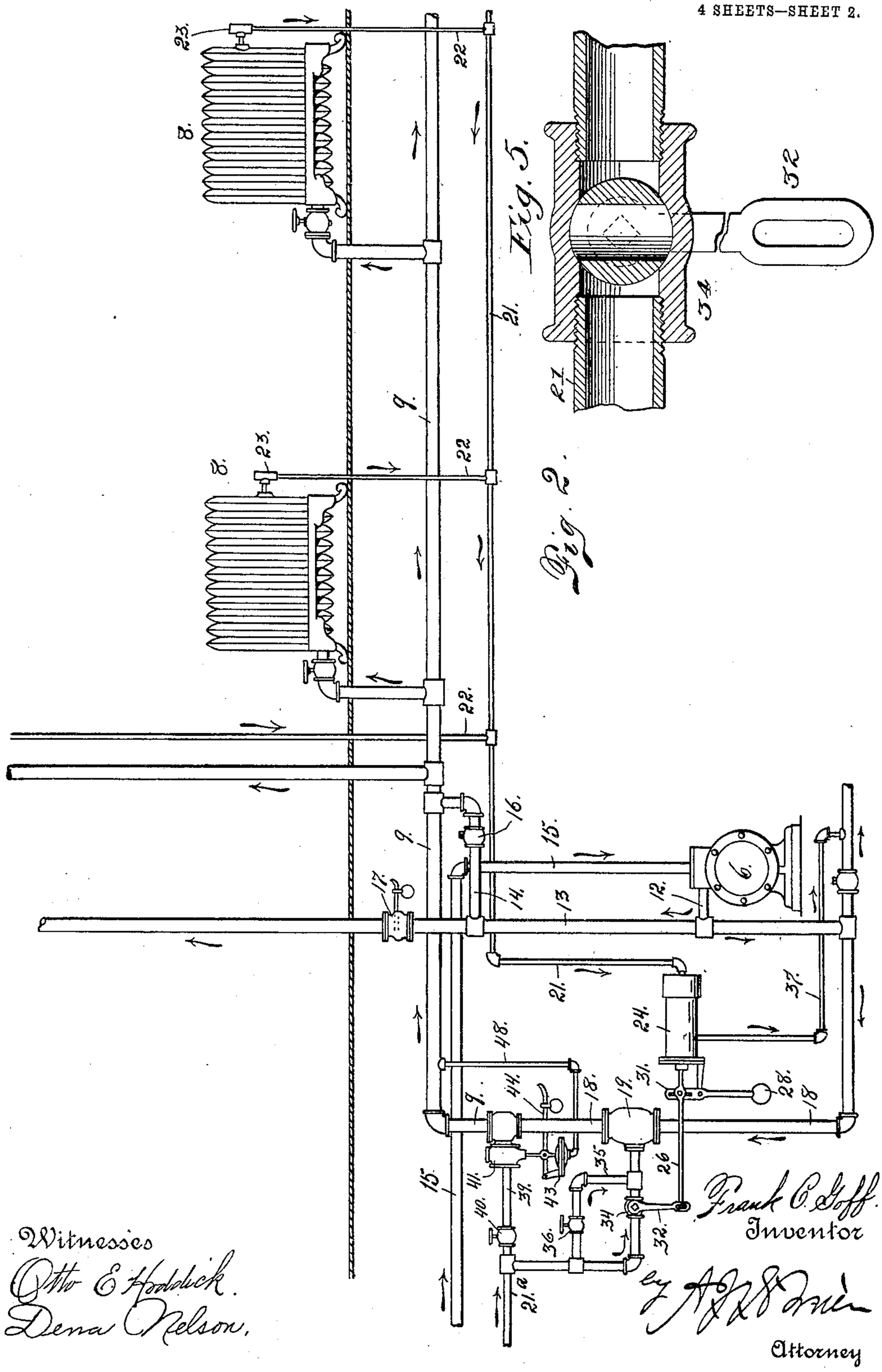

Fig. 2.

Fig. 5.

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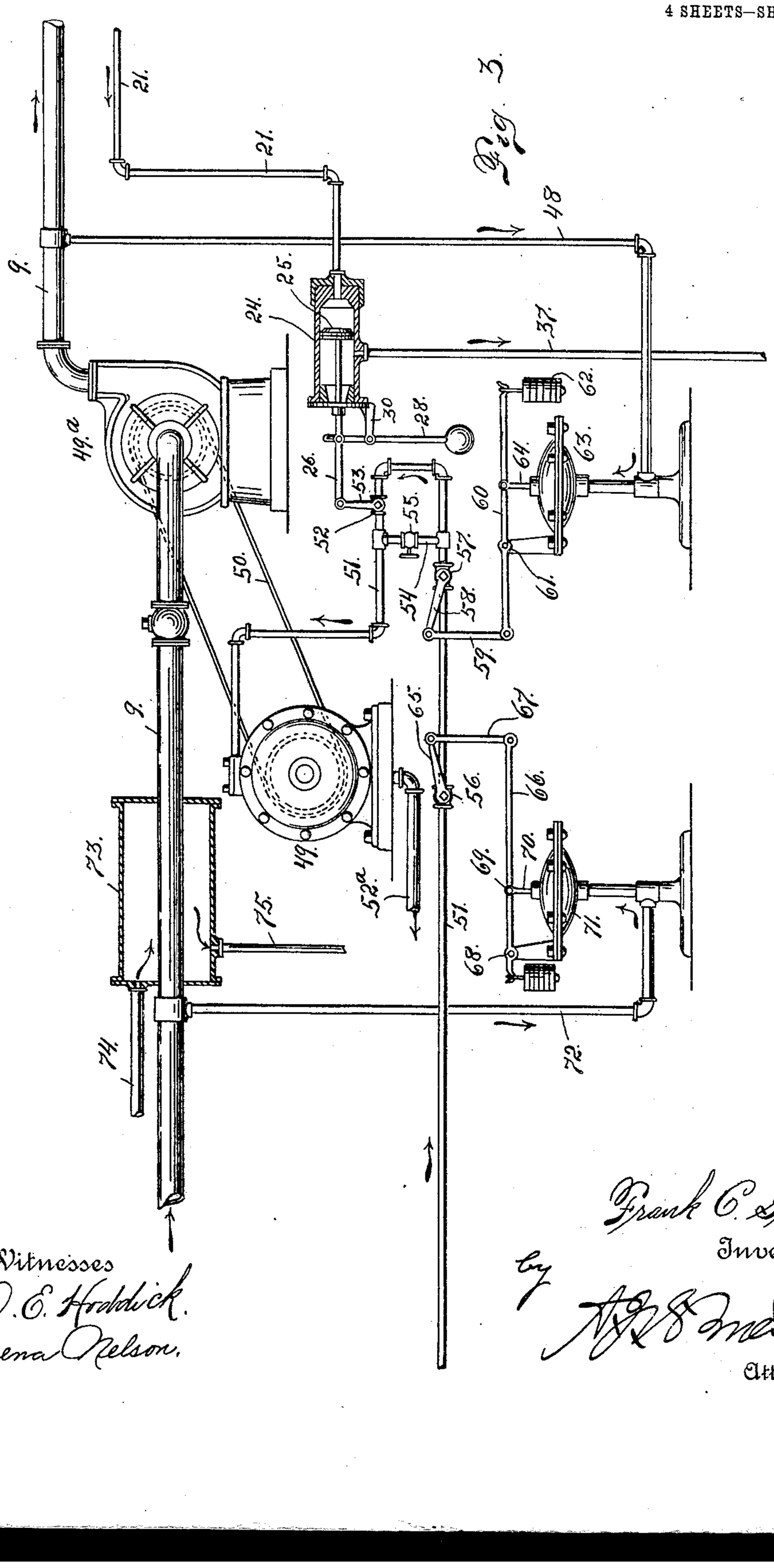
4 SHEETS—SHEET 3.



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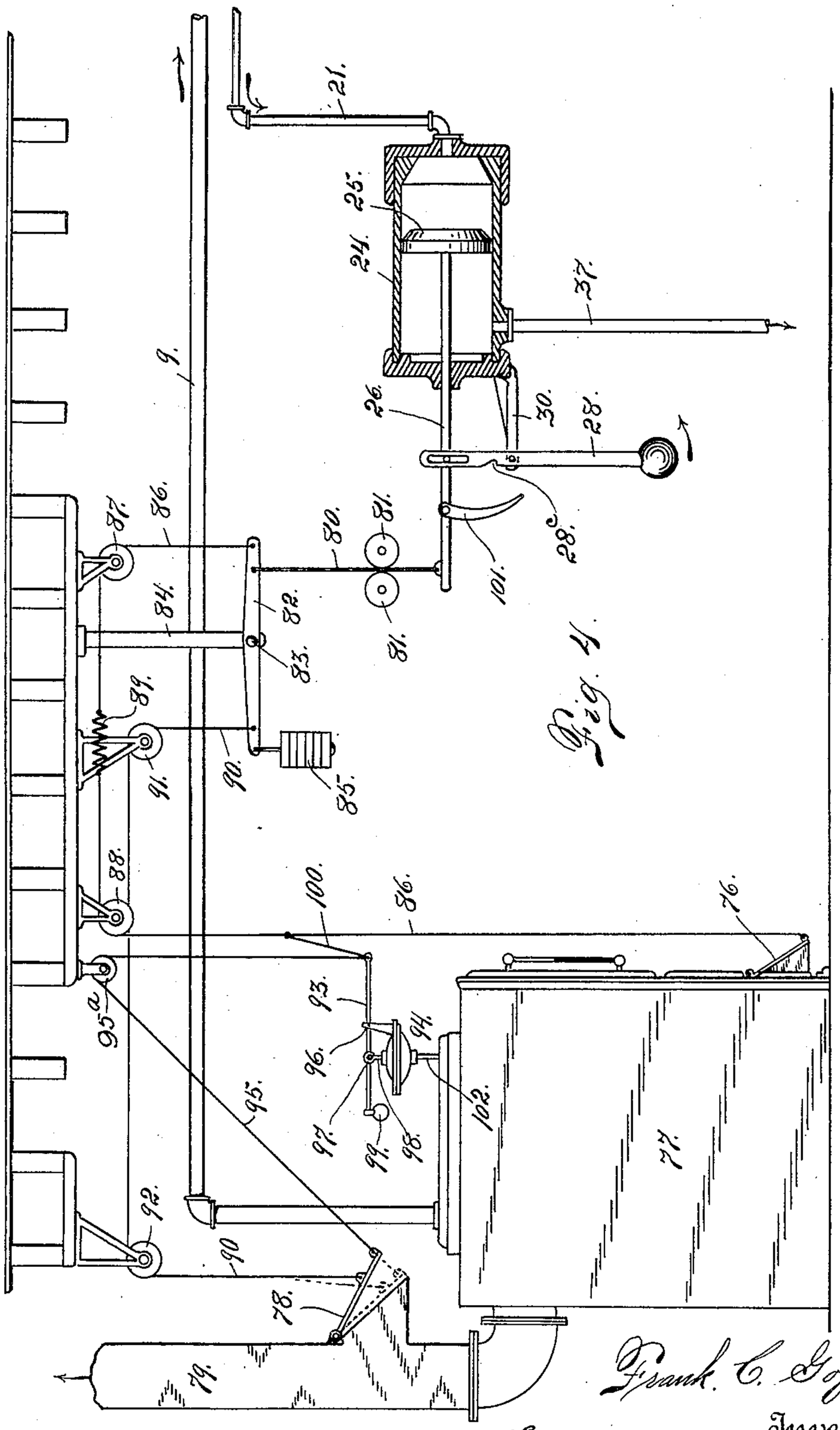
4 SHEETS—SHEET 4.



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DEVICE FOR CIRCULATING STEAM, &c.

No. 809,253. Specification of Letters Patent. Patented Jan. 2, 1906.

Application filed November 5, 1902. Serial No. 130,203.

To all whom it may concern:

Be it known that I, FRANK C. GOFF, a citizen of the United States of America, residing at Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Devices for Circulating Steam or other Vapor or Heating Agent; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in devices for circulating steam or other vapor or heating agent through any desired arrangement or system of piping, heaters, and radiators, with their various branches and connections used for heating, ventilating, drying, evaporating, and other similar purposes.

My object is to create, maintain, and control a free and perfect circulation of steam or other heating agent in heating or other systems, all of which will be fully understood by reference to the accompanying drawings, in which is illustrated an embodiment thereof.

In the drawings, Figure 1 illustrates my invention, partly in section, in connection with an engine and boiler arranged to utilize both live and exhaust steam. Fig. 2 shows the same in elevation and on a smaller scale, the boiler being omitted and radiators shown in connection with the system of piping. Fig. 3 shows a modified form of construction in which a water-motor is employed for operating a blower through which the steam passes to the system. Provision is also made in this view for superheating or increasing the temperature of the steam, whereby it will stand a gerater degree of pressure without condensation. Fig. 4 shows still another form of construction in which the front draft and smoke-flue air-check of a furnace are controlled by means of my improvements. Fig. 5 is a sectional view, in detail and on a larger scale, of certain valves employed in connection with the apparatus.

The same reference characters indicate the same parts in all the views.

Referring first more particularly to Figs. 1 and 2 of the drawings, let the numeral 5 designate a boiler, 6 an engine, and 9 the main steam-pipe from which the radiators 8 receive their supply of steam, which may be live steam from the boiler, exhaust-steam from the engine, or both live and exhaust steam, as may be desired. A pipe 15 leads from the boiler to the engine for supplying steam to the latter and is provided with a controlling-valve 10. A branch exhaust-pipe 12 leads from the engine to a steam-pipe 13, from which leads a branch pipe 14 to the main steam-supply pipe 9. The pipe 14 has a check-valve 16, which allows steam to pass from the pipe 13 to the pipe 9, but prevents its return. Above its connection with the branch pipe 14 the pipe 13 is provided with a weighted valve 17, adapted to open under certain conditions and allow the exhaust-steam to pass to the atmosphere when it is not desired to utilize it for heating purposes. This valve may be set to open at any desired pressure. The lower extremity of the pipe 13 is connected with a pipe 18, leading to the pipe 9. This pipe 18 is provided with an enlargement or chamber 19, entered by an upwardly-turned nozzle 20, communicating with a branch pipe 21^a, leading from the steam-pipe 15 and connected therewith between the dome of the boiler and the valve 10. The nozzle 20 when utilized delivers an upwardly-directed steam-jet and produces a partial vacuum in the chamber 19 and the pipe 18 below said chamber, whereby the exhaust-steam from the pipe 13 may be delivered to the pipe 9 by way of the pipe 18. An air-conduit 21 is connected with a branch conduit 22, leading from air-valves 23 of all the radiators 8. This conduit 21 leads to one end of a cylinder 24, provided with a piston 25, whose stem 26 passes through a stuffing-box 27 and is connected outside of the cylinder with a weighted lever 28, fulcrumed at 29 on an arm 30, mounted on the cylinder. Beyond its connection with the lever 28, as shown at 31, the piston-stem 26 is connected with a lever-arm 32, as shown at 33. This lever-arm 32 is connected with a valve 34, located in the pipe 21^a, for controlling the passage of steam from the boiler to the steam-jet nozzle 20. A branch pipe 35, connected at one extremity with the pipe 21^a between the valve 34 and the boiler, is connected at its opposite extremity with the chamber 19. This pipe 35 may be utilized to deliver steam to the nozzle 20 when the valve 34 is closed. The pipe 35 contains a valve 36, which may be closed when the steam is passing to the nozzle 20 through the valve 34.

Assuming now that it is desired to utilize the exhaust-steam from the engine for heating purposes and the radiators of the system are devoid of steam, and therefore filled with air, this exhaust-steam may pass directly to the pipe 9 by way of the branch pipe 14 and through the check-valve 16 when the force of the exhaust is sufficient for the purpose. When, however, it is desired to increase the force of the exhaust and drive it into the system under pressure and at the same time relieve the engine of the pressure incident to the passage of the exhaust-steam unaided into the heating system, the valve 36 is opened, allowing the live steam from the boiler to pass to the jet-nozzle 20. This steam-jet is directed upwardly into the pipe 18 above the chamber 19, whereby a partial vacuum is produced in the chamber 19 and the pipe 18 below said chamber. The exhaust-steam in response to the suction passes downwardly in the pipe 13 from the pipe 12 and thence upwardly by way of the pipe 18 into the chamber 19, whence it passes to the pipe 9 and thence to the radiators 8 under the required pressure.

It is assumed that the valve 34 is closed when the operation begins. In this case the steam entering the radiators or heating apparatus of the system drives out the air through the valves 23 into the pipes 22 and thence into the pipe 21, whence it is delivered to the cylinder 24. Connected with this cylinder is an outlet-pipe 37, which leads to a discharge or waste pipe 38. This waste-pipe is connected with the exhaust-pipe 13; but a valve 39, located in the pipe 38, is closed when the exhaust-steam is utilized for heating purposes. When the valve 34 is closed, the piston 25 is located between the air-inlet end 24^a and the air-outlet 24^c. When the piston is in this position, the valve may be opened by the movement of the piston in either direction in the cylinder. Hence the air which enters the cylinder through the pipe 21 acts on the piston 25 and drives the latter forwardly or in the direction of the arrow (see Fig. 1) until the stem 26 is actuated sufficiently to open the valve 34 and the piston has moved to a position forward of the outlet 24^c, after which the air passes through the pipe 37 to the waste-pipe 38. As soon as the valve 34 is opened the valve 36 may be closed, and subsequently the operation of the system is automatic. After the air has been forced out of the radiators by the entrance of the steam the air-valves (which it is assumed are of any suitable or ordinary automatic type) are of course closed. As soon as this occurs the weight 28^a of the lever 28 will act to return the lever to its normal or vertical position, and this action will close the valve 34 and return the piston 25 to its normal position between the cylinder-outlet 24^c and the inlet end 24^a. As soon as the radiators begin to cool and condensation takes place therein the resulting partial vacuum produces a suction or pull in the air-pipe 21 toward the radiators. This suction or pull extends to the cylinder 24 in the rear of the piston and acts on the latter to move it rearwardly sufficiently to again open the valve 34. In this case the arm 32 is moved to the right of its vertical position and steam is again driven into the radiators in the same manner as before. The air which has entered the radiators (the air-valves or their equivalent being of that type which allows air to enter the radiators on a sufficient reduction of pressure therein) to fill the vacuum produced by the condensation is again driven out into the pipe 21 and thence into the cylinder 24 in the rear of the piston, which is again driven forward to the normal position and the valve closed. If at this time the air-valves are still open and air continues to pass into the cylinder, the piston will be again driven forward from its normal position and the valve 34 again opened in the manner heretofore described. It will thus be seen that the supply of steam to the system is automatically controlled under the circumstances.

Live steam from the boiler may be delivered to the pipe 9 by a pipe 39, connected with the pipe 21^a and provided with a valve 40. When this valve is opened, the live steam may pass toward the pipe 9. Between the valve 40 and the pipe 9 is a valve 41, which is normally open. This valve, however, is connected with a stem 42, attached to a diaphragm 43. A lever 44, fulcrumed at 45 and connected with the stem 42 at 46, is provided with a weight 47, which is set by the arrangement of the weight to hold the valve 41 normally open. Connected with the diaphragm from below is a pipe 48, which leads to the steam-pipe 9. If the pressure in the pipe 9 becomes too great or greater than is necessary, as determined by the weighted lever 44, the diaphragm 43 will be raised by the action of the steam-pressure and actuate the stem 42 sufficiently to close the valve 41 and shut off the live steam from passing to the pipe 9. If it is not desired to utilize exhaust-steam and the live steam is from a high-pressure boiler, the jet-nozzle 20 and its coöperating features may be entirely eliminated, in which event the live steam in its passage to the system will be automatically controlled by the operation of the valve 34 through the instrumentality of the piston 25 in precisely the manner just described.

In the construction shown in Fig. 3 a water-motor 49 is employed to operate a blower 49^a, connected with the steam-pipe 9. As shown in the drawings, a belt 50 connects the motor with the blower. The latter is employed to produce the pressure necessary

to drive the steam through the heating system. A water-supply pipe 51 and a discharge or exhaust pipe 52ª are connected with the motor. Located in the supply-pipe 51 is a valve 52, connected with a lever-arm 53, whose extremity remote from the valve is connected with the piston-stem 26 of the piston 25 belonging to the cylinder 24. The valve 52 is held normally closed by the weighted lever-arm 28. Between two parallel arms of the supply-pipe 51 is located a branch pipe 54 between the valve 52 and the motor. This pipe 54 is provided with a valve 55, which may be opened by hand to start the motor. The pipe 9 is connected with any suitable source of steam-supply. In the pipe 51 are located two valves 56 and 57. The valve 57 is provided with an arm 58, which is connected by a link 59 with a lever 60, fulcrumed at 61, provided with a weight 62 and connected with a diaphragm-motor 63 by a stem 64. The pressure-pipe 48 is connected with the diaphragm-chamber of motor 63 from below. The valve 57 is held normally open by the weight 62, which is constructed and arranged to resist a certain number of pounds pressure in the pipe 48 before the lever 60 will be actuated sufficiently to close the valve. The valve 56 is provided with an arm 65, which is connected with a lever 66 by a link 67. The lever 66 is fulcrumed at 68 and connected at 69 with a stem 70 of a diaphragm-motor 71, whose diaphragm-chamber is connected from below with a pipe 72, leading from the steam-pipe in the rear of the blower. The pipe 9 is surrounded in the rear of the blower with a jacket 73, connected with a pipe 74 for supplying superheated steam to the jacket for the purpose of raising the temperature of the steam in the pipe 9, whereby its capacity to undergo pressure from the blower without condensation is increased. The water of condensation escapes from the jacket 73 by way of a pipe 75. In describing the operation of this form of device it must be assumed that the valves 56 and 57 are open and the valve 52 closed. The apparatus is started by opening the valve 55, whereby the water from the pipe 51 is allowed to pass to the motor 49, which being started operates the blower 49ª and forces the steam through the system. The steam drives the air out of the radiators or other devices of the system, and this air passes through the pipe 21, which is connected with the air-valves, as aforesaid, enters the cylinder 24, and acts on the piston 25, which is thereby actuated sufficiently to open the valve 52 for the passage of water to the motor. The valve 55 may then be closed, and subsequently the operation of the system will be automatic. After the radiators are filled with steam and the air all driven out of the system the weighted lever 28 will return to its normal position, closing the valve 52, whereby the water-supply is cut off and the motor stopped. It must be understood that the valve 52 is controlled by the escape of air from the system. The water will be partly or completely cut off, as circumstances may require. The valve 52 will be automatically actuated by the piston 25 and its connections in precisely the same manner as the valve 34, as heretofore explained in detail. If the steam-pressure in the pipe 9 becomes greater than is necessary, this pressure acting on the diaphragm 63 will actuate the lever 60 and close or partly close the valve 57, thus automatically regulating the motor. If the steam-supply connected with the pipe 9 fails for any reason, the suction produced by the blower in the pipe 9 in the rear of the blower will act on the diaphragm 71 to close the valve 56 and stop the motor by cutting off the water-supply. It is evident that this feature may also be employed in connection with the system shown in Figs. 1 and 2.

My improved means for automatically controlling the steam-supply to a heating system by the action of the air forced out of the system by the steam will now be described in connection with the apparatus for regulating the draft of the furnace employed in generating steam for the system. In Fig. 4 a system suitable for an ordinary dwelling-house is illustrated. Referring to this figure, let the numeral 76 designate the front damper of the steam-generating furnace 77, and 78 the air-check or damper in the rear connected with the smoke flue or stack 79. The pipe 9 for supplying steam to the system is suitably connected with this plant. To the outer extremity of the piston-stem 26 is connected a flexible device 80, as a chain, which passes between two guide-pulleys 81 and is connected at its upper extremity with a lever 82, fulcrumed at 83 on a hanger 84. To the lever 82 remote from this connection with the chain 80 is attached a weight 85. To the extremity of this lever, near the chain 80, is attached a chain 86, which passes over guide-pulleys 87 and 88 and extends thence downwardly to the damper 76. The chain 86 is provided with a compensating spring 89. To the extremity of the lever 82 remote from its connection with the chain 86 is attached a chain 90, which passes over guide-pulleys 91 and 92 and extends thence downwardly, being connected at its lower extremity with the air-check or damper 78. This air-check or damper is also connected with a lever 93 of a diaphragm 94 by a chain 95, which passes over a guide-pulley 95ª. The lever 93 is fulcrumed at 96 and connected at 97 with a stem 98, attached to the diaphragm from above. The lever 93 is provided with a weight 99. The chain 86 is connected with the lever 93 by a short chain 100. The piston-stem 26 is provided with a pivoted dog

101, and the lever 28 is provided with a notch 28c adapted to receive the said dog.

Assuming that the piston 25 of the cylinder 24 is in the position shown in the drawings, in order to start the furnace the weighted end of the lever 28 is moved in the direction of the arrow sufficiently to open the damper 76 and close the damper 78. This movement of the lever 28 is sufficient to allow the dog 101 to be thrown into the notch 28a, whereby the lever and its connections are normally held in the position stated. When the parts are in these positions, the piston has not passed the port of the cylinder connected with the pipe 37. Then as steam is generated and forced into the radiators or other devices of the heatng system the air is driven out through the pipe 21 into the cylinder 24 and acting on the piston 25 moves the latter forwardly sufficiently to release the dog 101 from the lever 28, the spring 89 yielding sufficiently to permit this movement of the stem 26 after the damper 76 is wide open. After the dog is released from the lever 28 the operation of the system is automatic. After the piston 25 passes the pipe extremity 37, moving in the forward direction, the air escapes by way of the waste-pipe 37. When the steam-pressure in the boiler becomes greater than is necessary, it acts on the diaphragm from below through a pipe 102 and actuates the lever 93 sufficiently to close the damper 76 and open the damper 78. The movement of these dampers will of course depend upon the movement of the lever 93, and the fire will be automatically controlled to correspond with the pressure in the boiler. The operation of the piston 25 in response to the air-pressure from the pipe 21 and in response to the suction in said pipe produced by condensation in the radiators is exactly the same as heretofore described when referring to the construction shown in Figs. 1, 2, and 3. The rearward movement of the piston from its normal position shown in the drawings has exactly the same effect on the dampers as the forward movement, one movement being produced by the air-pressure and the other by the suction in the pipe 21.

In addition to the function of the spring 89, heretofore explained, this spring will enable the lever 93 when acted on by the steam in the boiler to pull downwardly on the chains 95 and 86 sufficiently to close the damper 76 and open the damper 78 when these dampers would otherwise be held in the opposite position by the piston-rod 26, acting through the lever 82 and its attachments.

In Fig. 5 I have illustrated a specific construction for the valve 34. It is evident, however, that while this valve is designated 34 on Fig. 5 the construction of the valve 52 is the same. It is therefore not thought necessary to show the valve 52 in detail, since the last-named valve may be assumed to be of the same construction as the valve 34 illustrated in Fig. 5.

Having thus described my invention, what I claim is—

1. The combination with a heating system, of means connected with the air-outlet of the system for automatically controlling the supply of the heating agent, by the force of the air driven out of the system by said agent.

2. The combination with a steam-heating system, of means connected with the air-outlet of the system for automatically controlling the supply of the heating agent, by the suction produced in the system incident to steam condensation.

3. The combination with a steam-heating system, of means connected with the air-outlet of the system for automatically controlling the supply of the heating agent, by the action of the air driven out of the system by the heating agent, and the suction incident to steam condensation in the system.

4. The combination with a heating system, of a cylinder in communication with the air-valves to allow the air driven out of the system, to enter the cylinder, a piston in the cylinder, and means connected with the piston and actuated thereby for controlling the supply of the heating agent.

5. The combination with a heating system, of a cylinder in communication with the air-valves of the system to allow the air driven out of the system to enter the cylinder, a piston in the cylinder, and a valve located in the system and connected with the cylinder-piston, whereby the valve is actuated to regulate the supply of the heating agent.

6. The combination with a heating system, of a cylinder in communication with the air-valves of the system, a piston in the cylinder, a lever connected with the piston-stem, a valve for controlling the heating agent, and connected with the piston-stem, the lever normally holding the valve closed, the piston-stem, however, being actuated by the movement of the piston as the latter is operated in response to the air-pressure or suction, substantially as described.

7. The combination with a heating system, of a cylinder in communication with the air-valves of the system, a piston in the cylinder, a valve located in the system for controlling the heating agent, and connected with the piston-stem, whereby the valve is automatically actuated by said stem, and a valve located in a by-pass of the system.

8. The combination with a heating system, of means in communication with the air-valves of the system for automatically controlling the supply of the heating agent to the system, by the normal action of the air driven out of the system by the heating agent, and the suction incident to condensation, and means interposed in the system for

automatically controlling the supply of the heating agent to the system.

9. The combination with a heating system, of means in communication with the air-valves of the system for automatically controlling the supply of the heating agent to the system by the normal action of the air driven out of the system by the heating agent and the suction incident to condensation, and means interposed in the system for automatically controlling the supply of the heating agent to the system by the force of said agent in the system, said last-named means consisting of a valve and a weighted diaphragm, the latter being connected with the valve on one side and in communication with the heating agent on the opposite side.

10. The combination with a radiator, of means communicating with the air-outlet of the radiator for automatically controlling the supply of the heating agent thereto, by the force of the air driven out of the radiator by said agent.

11. The combination with a steam-radiator, of means communicating with the air-outlet of the radiator for automatically controlling the supply of the heating agent thereto by the suction produced in the radiator incident to steam condensation.

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

FRANK C. GOFF.

Witnesses:
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A. J. O'BRIEN.