No. 881,328. PATENTED MAR. 10, 1908.

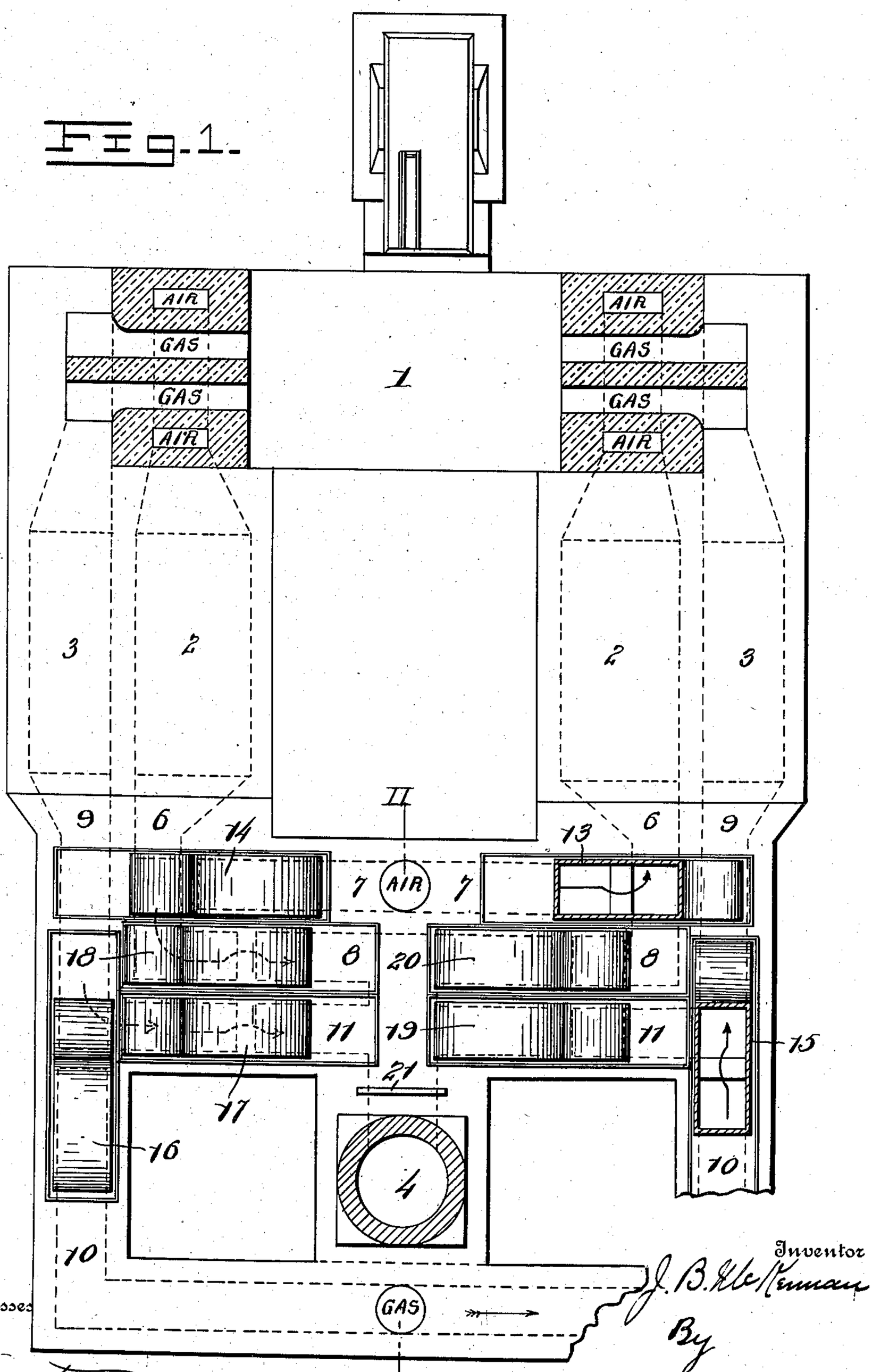
J. B. McKENNAN.

FLUE AND VALVE SYSTEM FOR FURNACES.

APPLICATION FILED MAY 14, 1906.

5 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
L. Armstrong.
H. A. Coombe.

Inventor
J. B. McKennan
By
Walter D. Cronbach, Attorney

No. 881,328. PATENTED MAR. 10, 1908.

J. B. McKENNAN.

FLUE AND VALVE SYSTEM FOR FURNACES.

APPLICATION FILED MAY 14, 1906.

5 SHEETS—SHEET 2.

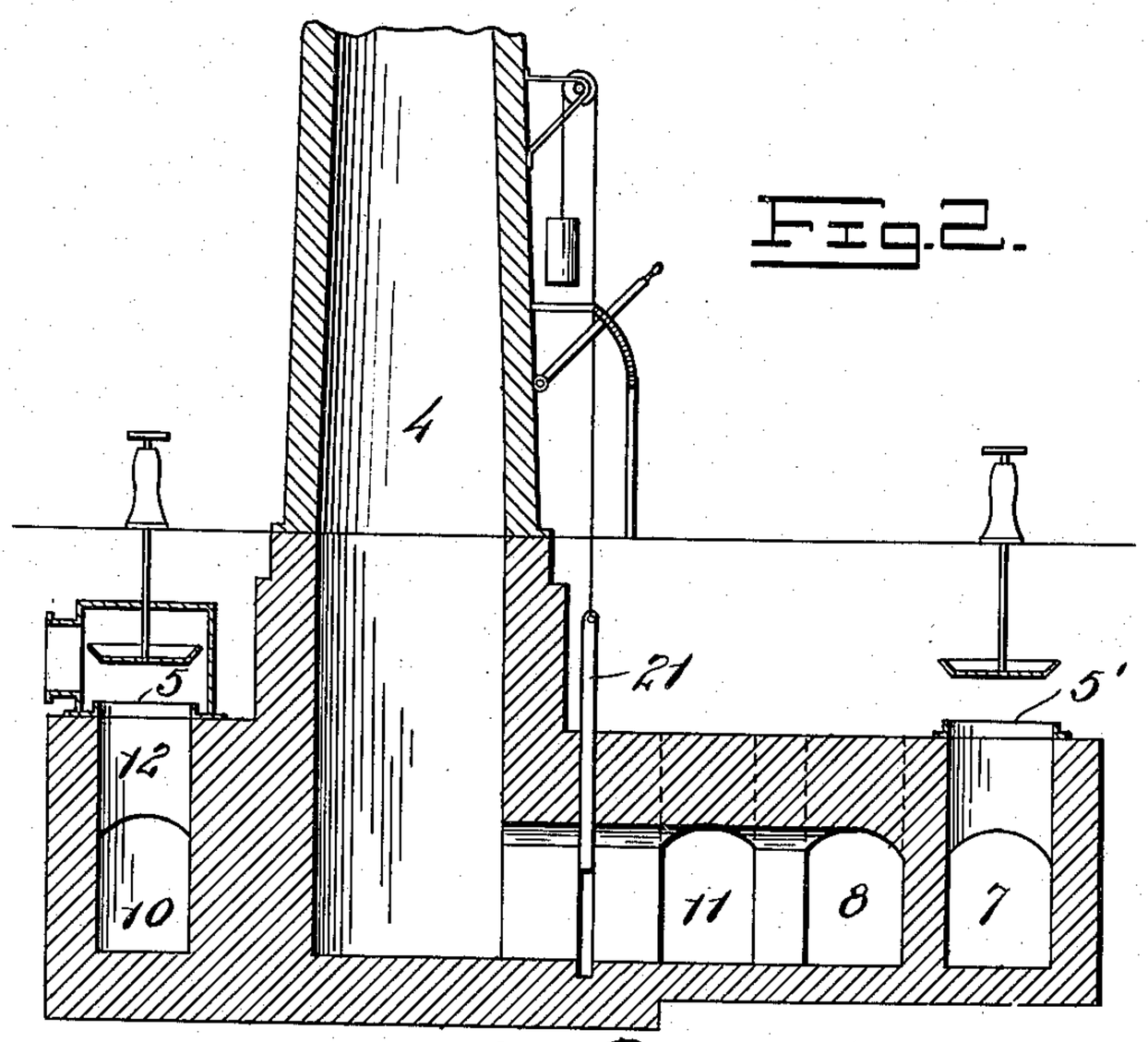


Fig. 2.

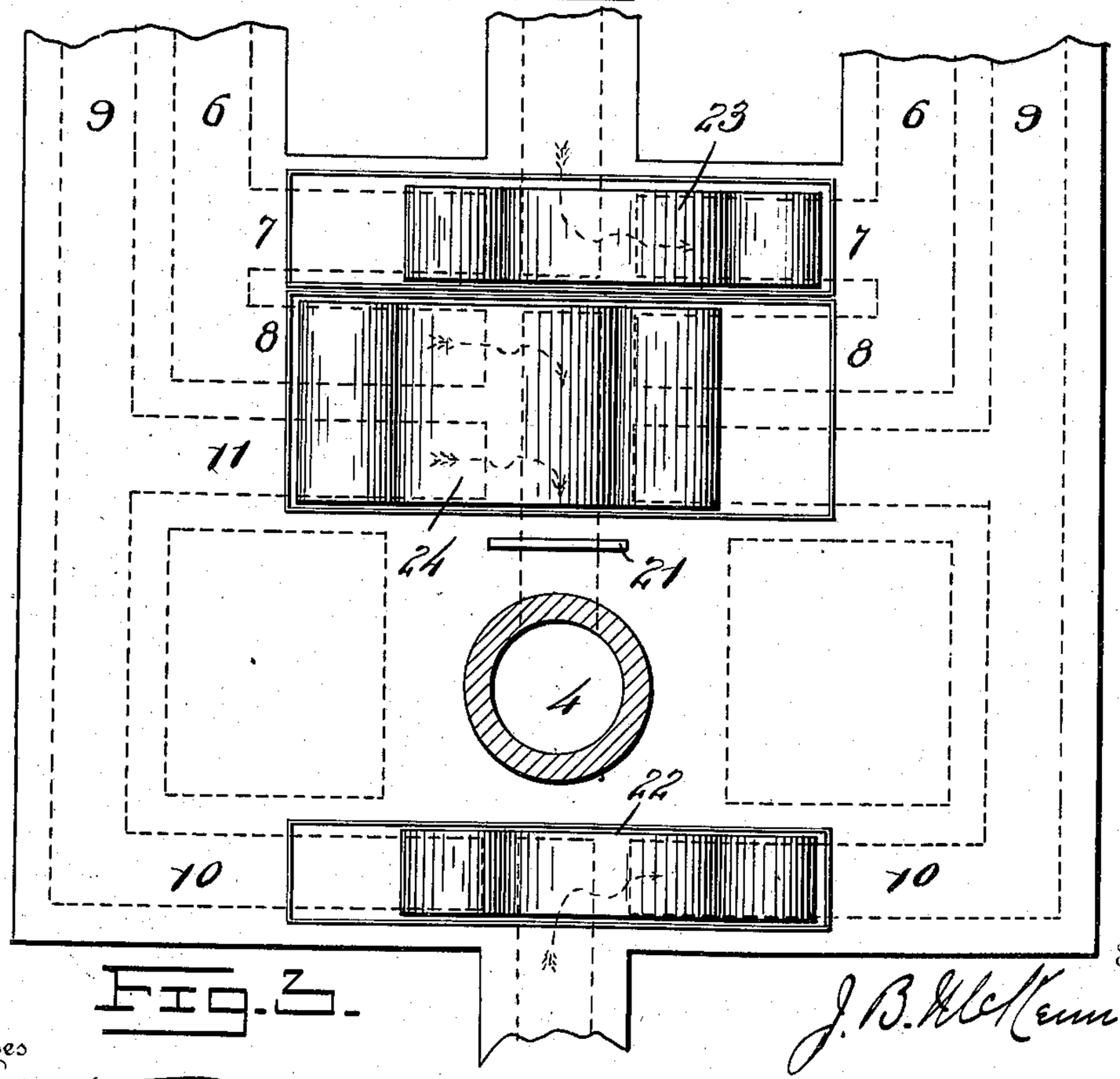


Fig. 3.

Witnesses
L. Armstrong;
H. A. Coombs

Inventor
J. B. McKennan,

By
Walter D. Overbeck, Attorney

No. 881,328. PATENTED MAR. 10, 1908.

J. B. McKENNAN.

FLUE AND VALVE SYSTEM FOR FURNACES.

APPLICATION FILED MAY 14, 1906.

5 SHEETS—SHEET 3.

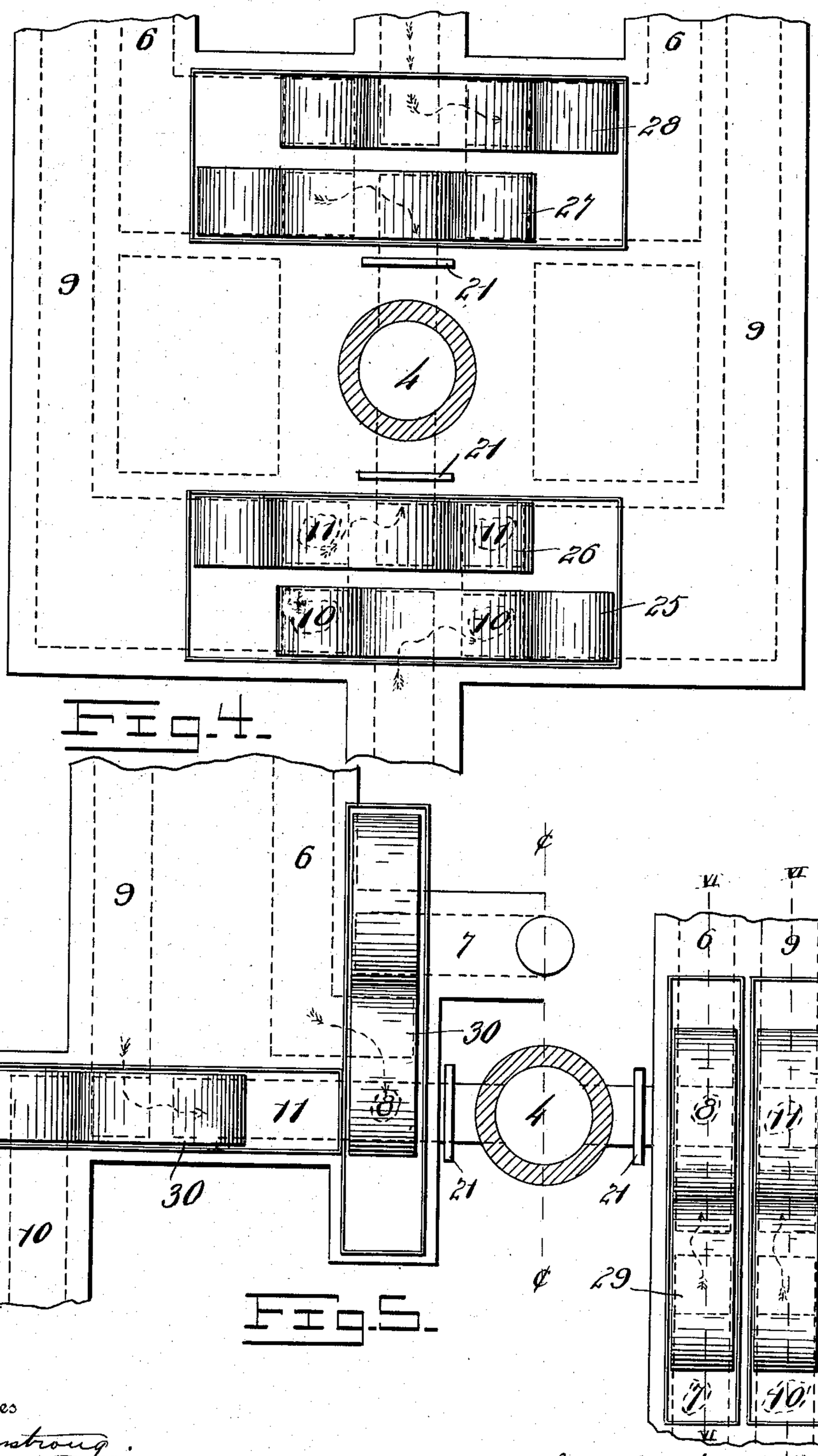


Fig. 4.

Fig. 5.

Witnesses
H. Armstrong.
H. L. Coombs.

Inventor
J. B. McKennan,
By Walter D. Goodrich, Attorney

No. 881,328. PATENTED MAR. 10, 1908.

J. B. McKENNAN.

FLUE AND VALVE SYSTEM FOR FURNACES.

APPLICATION FILED MAY 14, 1906.

5 SHEETS—SHEET 4.

FIG. 6.

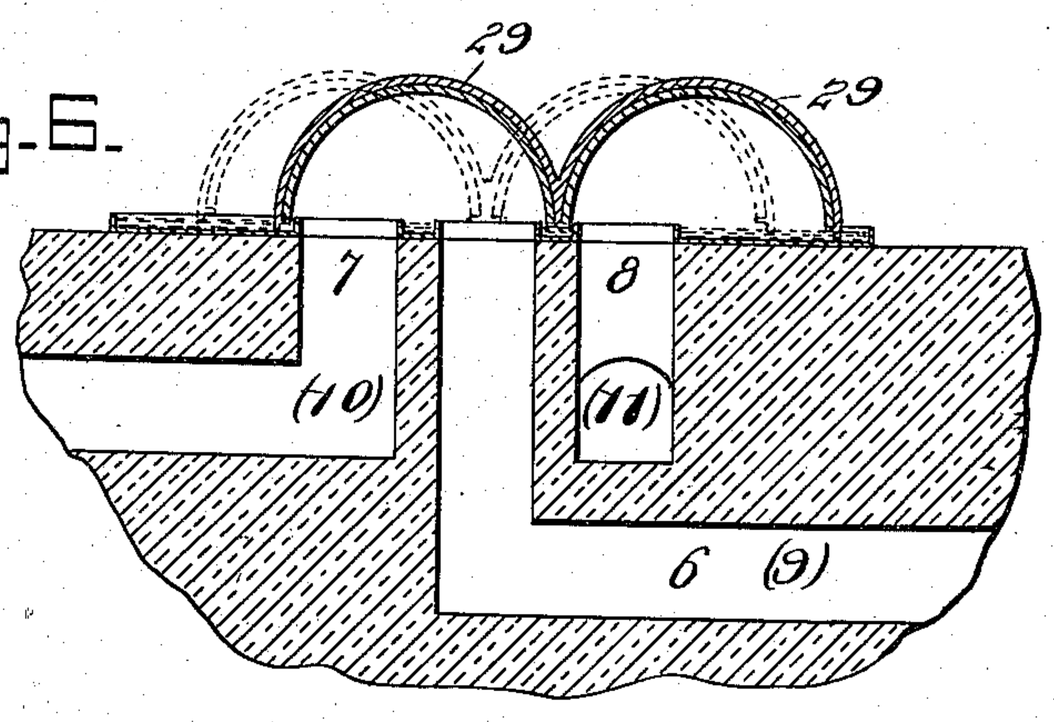
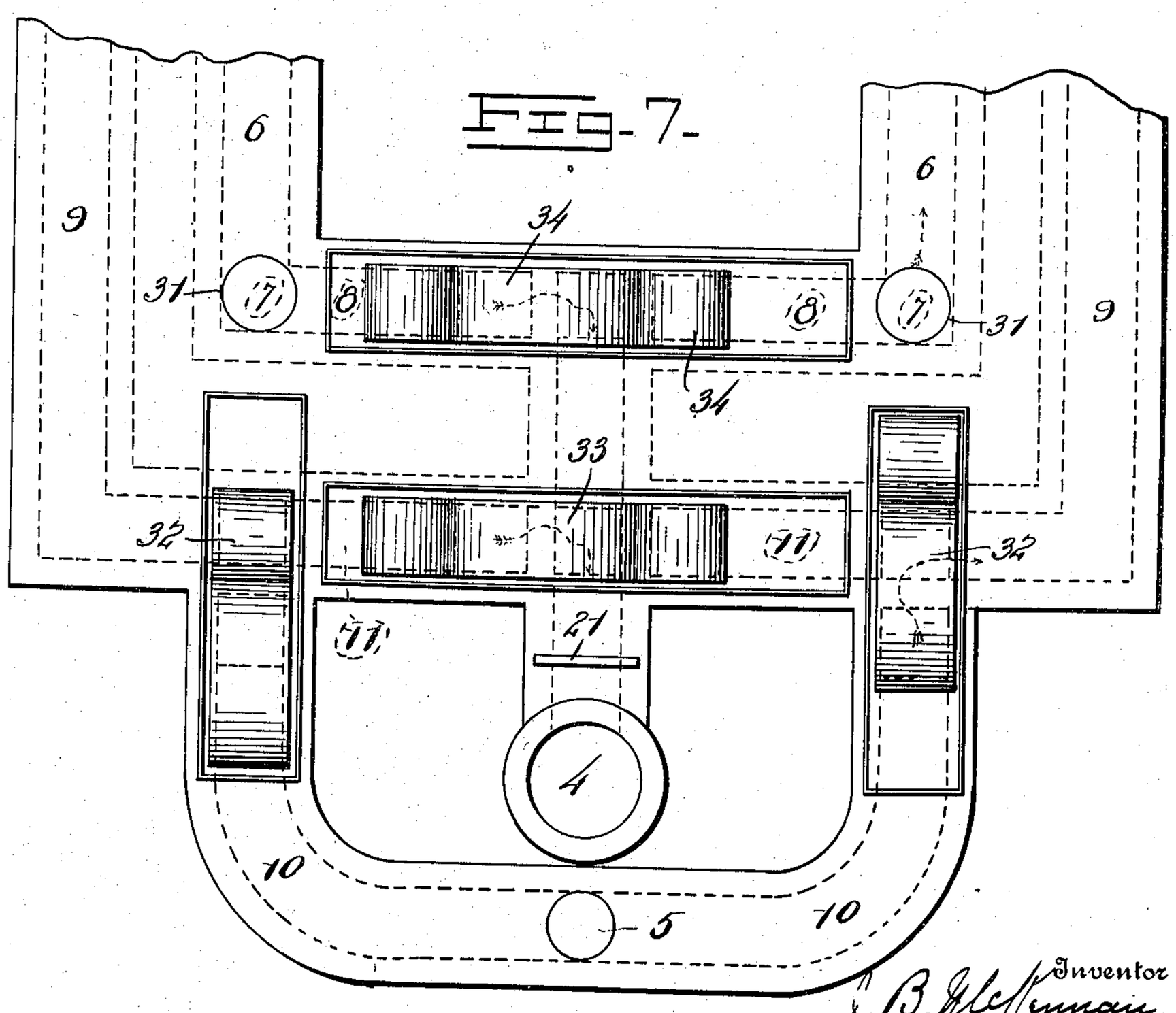


FIG. 7.



Witnesses
L. Armstrong.
H. D. Coombs.

Inventor
J. B. McKennan,

By
Walter D. Groesbeck,
Attorney

No. 881,328. PATENTED MAR. 10, 1908.

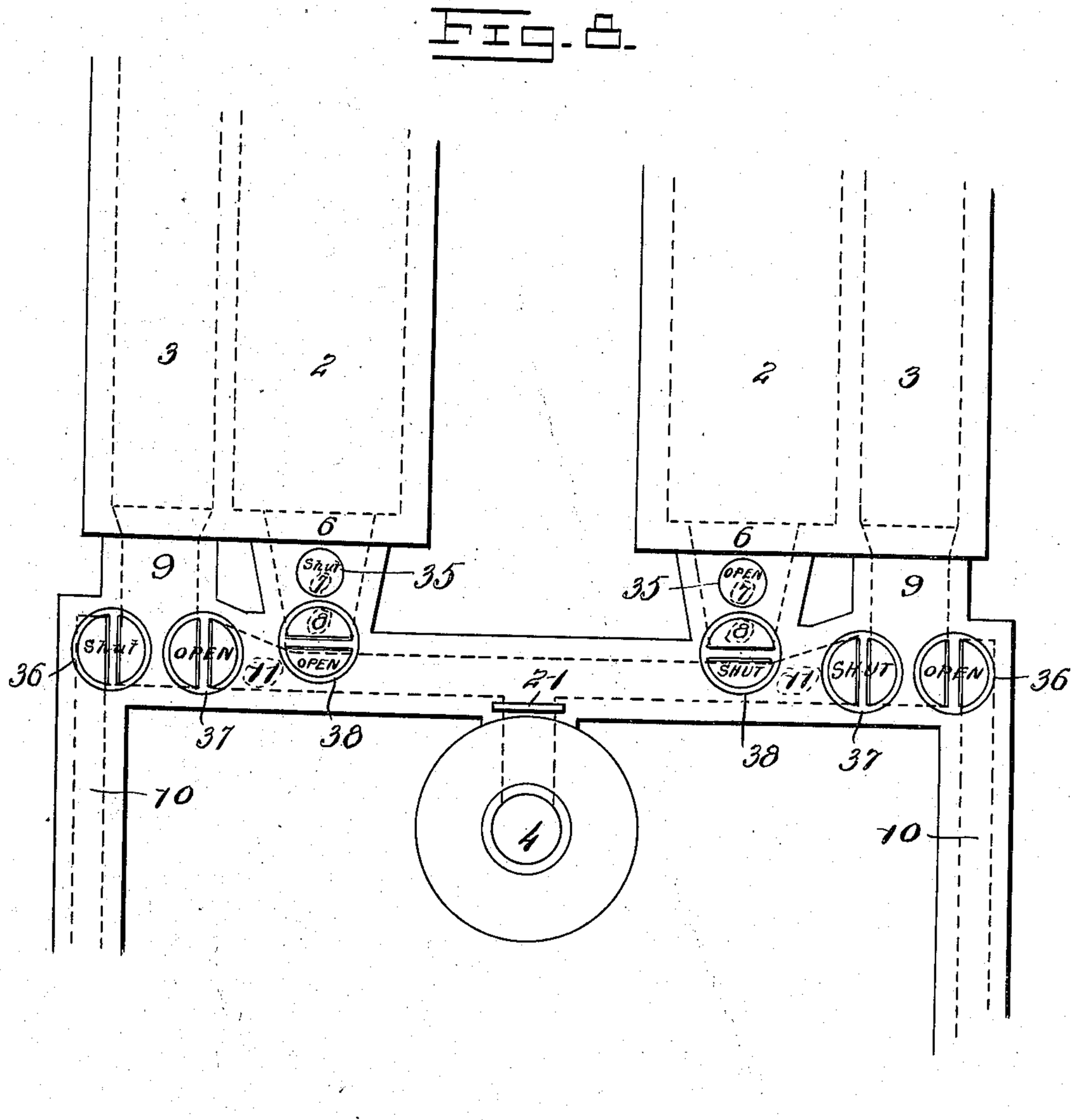
J. B. McKENNAN.

FLUE AND VALVE SYSTEM FOR FURNACES.

APPLICATION FILED MAY 14, 1906.

5 SHEETS—SHEET 5.

FIG. 5.



Witnesses
L. Armstrong.
H. A. Coombs.

J. B. McKennan, Inventor

By Walter D. Cronbach, Attorney

UNITED STATES PATENT OFFICE.

JACOB BOWMAN McKENNAN, OF PUEBLO, COLORADO.

FLUE AND VALVE SYSTEM FOR FURNACES.

No. 881,328. Specification of Letters Patent. Patented March 10, 1908.

Application filed May 14, 1906. Serial No. 316,773.

To all whom it may concern:

Be it known that I, JACOB BOWMAN McKENNAN, a citizen of the United States, residing at Pueblo, in the county of Pueblo and State of Colorado, have invented certain new and useful Improvements in Flue and Valve Systems for Furnaces, of which the following is a specification.

The object of my invention is to provide a circulating system, or system of flues and valves for regenerative furnaces, by means of which the furnace can be reversed without loss of gas except such as fills the cooled gas regenerator at the moment of reversing; without danger of injury to the furnace or employees from explosions at the time of reversing; and by means of which the producer flues can be periodically burned out without providing a special stack-connection for that purpose, the furnace and all the regenerative chambers be rapidly and simultaneously cooled for repairs, and the heat in the furnace and regenerators effectively retained when the furnace is temporarily shut down.

In the drawings, Figure 1 is a diagrammatic plan of one form of an open hearth furnace provided with my flue and valve system, showing the use of simple opening and closing valves; Fig. 2 is a vertical section on the line II—II of Fig. 1; Fig. 3 is a plan of a modification of the flue system only, showing the system adapted for reversing valves on both inlet- and outlet-flues; Fig. 4 is a plan of a system adapted to the use of duplex reversing valves of the type shown in my copending application, Ser. No. 313,911. Fig. 5 is a plan of two further modifications adapted to the use of reversing valves, one modification being shown on either side of the center line ϕ, ϕ, of the stack and furnace; Fig. 6 is a section on either of the lines VI—VI, of Fig. 5; Fig. 7 is a plan of a further modification adapted to the use of simple opening and closing valves of either the horizontally-reciprocating or the lift-type on the supply flues and reversing valves on the draft flues; Fig. 8 is a plan of a further modification adapted to the use of lift valves of the type shown in my copending application Ser. No. 316,772.

In the various figures, 1 represents the furnace, 2, 2, the air regenerators, 3, 3, the gas regenerators and 4 the stack, Each air regenerator is provided with a flue 6 having two branches, or outlets 7, 8; the former of these branches being the intake or supply flue and the latter, the stack or draft flue. In like manner, each gas regenerator is provided with a flue 9 having two branches 10, 11; the former being the gas-main connection, and the latter the stack or draft flue.

Each flue outlet has a short vertical section 12, as clearly shown in Figs. 2 and 6, which sections extend through the water-pans of the controlling valves as is usual with water-sealed valves.

In Fig. 1, the air-valve 13 is represented as open, air-valve 14, closed; gas-valve 15, open; gas valve 16, closed; draft valves 17, 18, open and draft-valves 19, 20, closed. With this arrangement, it will be apparent that the right-hand regenerators are heating the air- and fuel-supply for the furnace; while the checkers of the left-hand regenerators are being heated by the products of combustion. To reverse the furnace, valves 13, 15, 17 and 18, are reciprocated to closed position and valves 14, 16, 19 and 20 then opened. When the valves are operated in this manner, it will be noted that there is no possibility of escape of gas direct to the stack, as with a butterfly reverse valve; besides which, the gas-regenerator and flues just closed will have been partially emptied to the furnace by expansion and the pull of the stack; so that a considerable saving of gas is effected. Neither is there liability of explosion in the furnace-hearth, due to the meeting of the unconsumed mixture of gas and air with a counter-current of products of combustion; as frequently happens in other types of reversing furnaces.

When it is desired to burn out the soot and other forms of carbon which accumulate in the gas-main (which burning out is usually done at the close of the week's run when the furnaces and gas-producers are not in operation), valves 15, 16, 17 and 19, are each opened, air is admitted to the gas-main near the producers, a fire is started in the soot-encumbered passages and, with the strong, direct draft thus established, the carbon deposits are rapidly burned out and the fine ashes carried up the stack.

To rapidly cool the furnace and regenerators for repairs, supply-valves 13, 14, 15 and 16 are each closed and draft-valves 17, 18, 19 and 20 each opened, the furnace-doors opened and the stack-damper 21 opened full.

This gives the stack a free pull on the furnace and all the regenerators simultaneously; whereas, in the systems commonly used, it is necessary to remove parts of the valves or to block them in a central position, or to reverse the valves frequently, in order to cool all the chambers equally.

When the furnace is temporarily shut down at the end of the run, or for any other reason, and no repairs are necessary, the heat in the furnace and regenerators can be effectively retained by closing all the draft-valves. Since all these valves are water-sealed, the stack is thus prevented from drawing air into the furnace and regenerators through or around the furnace doors or through leaks in the brickwork. In ordinary reversing furnaces, the only manner of cutting off draft from all the regenerators simultaneously is by closing the stack-damper; and, as such dampers cannot be made absolutely air-tight, the circulation carries off the heat more rapidly than in my construction.

In the modification shown in Fig. 3; the eight simple opening and closing valves are replaced by two single reversing valves 22, 23, and the double draft-valve 24 of the types shown in Figs. 5 and 6 of my Patent No. 853,722, May 14, 1907. The modification of this figure has the advantage of a smaller number of valves which may be simultaneously shifted to reverse the furnace, and the gas-and-draft-valves are readily set to form a burn-out connection, but it has not the advantage shown in Fig. 1 as to cooling the plant for repairs or retaining the heat during temporary suspensions of operation.

In the modification shown in Fig. 4, the flue-outlets are united until they reach the water-pan parts of the duplex valves; the gas-valve being located preferably in rear of the stack and the air valve between the stack and regenerators, each stack-flue being controlled by a damper. This modification has the advantages of great simplicity in flue arrangement and construction and a very short and direct burn-out connection. The manner of reversing the duplex valves 25, 26, 27, 28, will be readily understood, while the burn-out is opened by shifting both hoods 25, 26, of the duplex gas-valve to the same side of the center line of the furnace. In like manner, if desired, the air-intake may be connected direct to stack, to cool the latter.

The two modifications shown in Figs. 5 and 6 will be readily understood from the modifications already described. These flue arrangements are well adapted to the use of reversing valves 29 of the type shown in Fig. 12 of my copending application above mentioned. When this form of valve is used, the burn-out connection may be opened by setting the valve in mid-position, as shown dotted in Fig. 6, and this may be accomplished without breaking the water-seal, because of the deeper marginal flanges of the valve, which flange will maintain the seal while the shorter intermediate rib rests upon the flange of the central flue; thus connecting the vertical sections 10, 11 of the outside flues in Fig. 6. In the modification shown at the left of the center line of Fig. 5, the reversing valves 30 move in paths at right angles to each other; thus necessitating but a single air-intake for both air-regenerators. It is evident that the gas-supply flues 10 may also be joined on the center line of the furnace, so as to be connected to the gas-main through a single opening and closing valve of any desired type.

In the modification shown in Fig. 7, the supply-branches of the flues are controlled by simple opening and closing valves 31, 32 of either the horizontally-reciprocating or the lift type, while the draft-branches or flues are each controlled by a reversing valve as 33, 34. In reversing, in this modification, the supply-flues may remain closed for any desired length of time before shifting the draft-valves, and the same care is not necessary in reversing as when both sets of branches are equipped with reverse valves.

In the modification shown in Fig. 8 all flues are provided with lift-valves; the air-inlet valves 35 being preferably ordinary mushroom valves and the gas-supply valves 36 and draft valves 37, 38, water-sealed lift-valves of the type shown in my copending application Ser. No. 316,772. With this arrangement of flues and valves, all the advantages of the construction shown in Fig. 1 are secured with shorter and more direct flues, and with cheaper and more readily operated valves which may be fully opened by a comparatively short lift. The method of reversing, of opening the burn-out and of sealing all draft-flues will be readily apparent by comparison with Fig. 1 and without further description.

Many further modifications may be made in my system, by those skilled in the art, without departing from my invention; since

What I claim is—

1. In a circulating system for furnaces, in combination, conduits comprising a flue having a plurality of branches, and a plurality of reciprocating valves constructed and arranged to permit the connection of any two of said conduits; substantially as described.

2. In a circulating system for furnaces, in combination, a regenerator, conduits, each comprising a flue having a plurality of branches, with vertical sections, and reciprocating valves controlling said vertical sections and adapted to permit the connection of any two of said conduits; substantially as described.

3. In a circulating system for furnaces, in combination, a regenerator flue having a

plurality of branches, and a reciprocating valve for controlling each branch, said valves being adapted to connect their respective branches to supply and stack connections or to coöperate to directly connect the supply with the stack connection; substantially as described.

4. In a circulating system for furnaces, in combination, a regenerator-flue having supply and stack branches, and independent valves for each of said branches; said valves being adapted to coöperate to connect the supply branch directly to the stack branch; substantially as described.

5. In a circulating system for furnaces, in combination, a regenerator, a flue therefor, said flue having two branches, a supply main, a stack and independent reciprocating valve adapted to connect the supply main to one flue-branch and the other flue-branch to stack, respectively; said valves being adapted to coöperate to connect the supply main to the stack flue through the regenerator-flue branches, substantially as described.

6. In a circulating system for furnaces, in combination, a furnace chamber, regenerative chambers, supply and draft-flues, a stack, and valves for controlling the direction of flow of gases in said chambers; said valves being constructed and arranged to close the supply flues and to permit the simultaneous connection of all of said chambers to the stack; substantially as described.

7. A circulating system for furnaces comprising a gas main, a regenerator, a stack, a regenerator-flue having branches adapted to be connected with the gas-main and stack respectively and independent water-sealed valves for controlling said regenerator-flue-branches; said valves being adapted to connect the gas main and stack without the interposition of the regenerator; substantially as described.

8. A circulating system for furnaces comprising regenerators, supply-flues, stack-flues, regenerator-flues having each a plurality of branches, inlet valves for said supply-flues, and independent water-sealed valves for each of said regenerator-flue-branches; said system being constructed and arranged to connect the supply-flues to stack without the interposition of the regenerators, to simultaneously water-seal all the generators from the stack, or to simultaneously open all regenerators to the stack, as desired; substantially as described.

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

JACOB BOWMAN McKENNAN.

Witnesses:

JAS. H. ROBINSON,

A. L. BENZ.