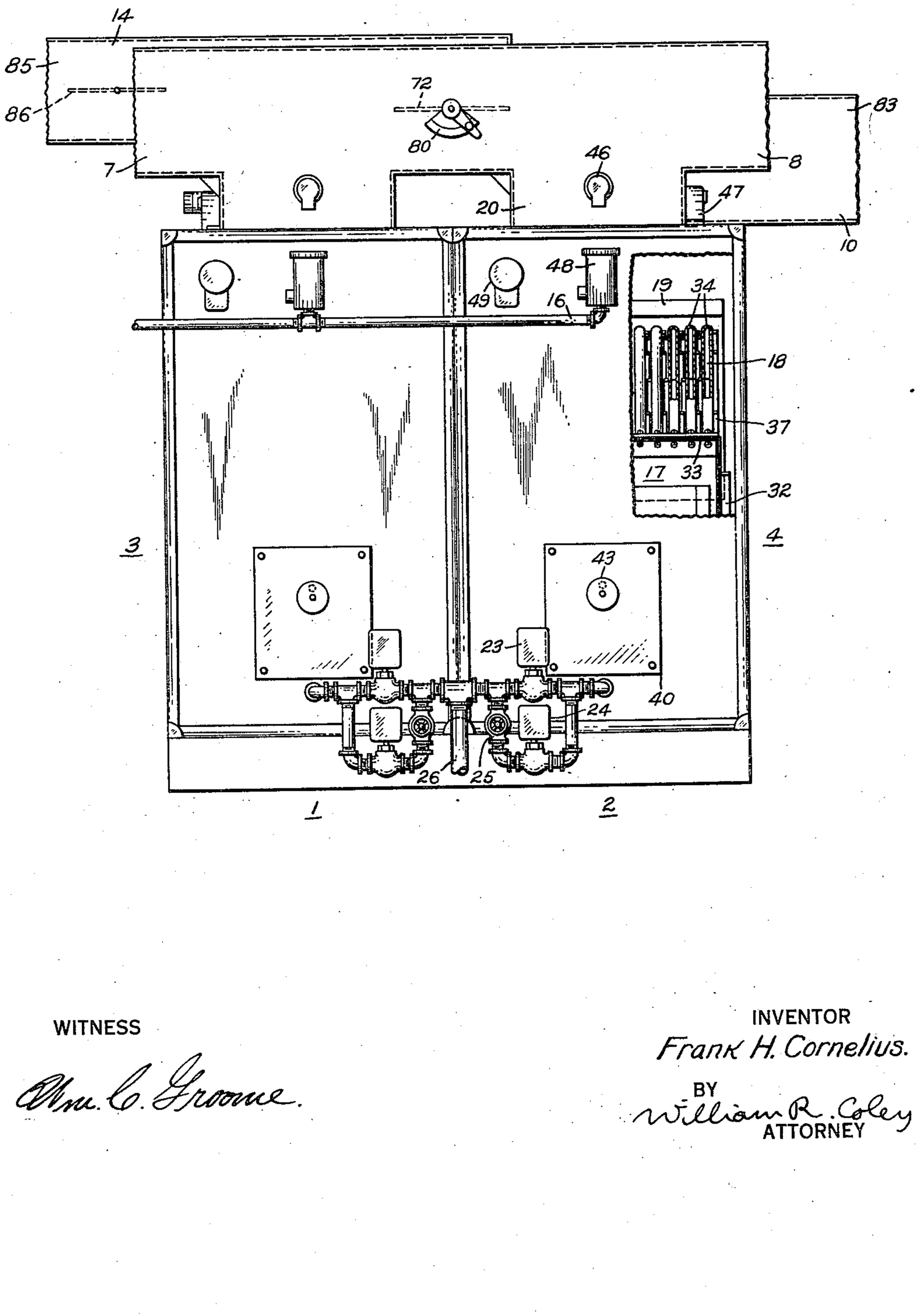
Aug. 20, 1935. F. H. CORNELIUS 2,011,753

HEAT EXCHANGER

Filed July 23, 1931 3 Sheets-Sheet 1

Fig. 1.



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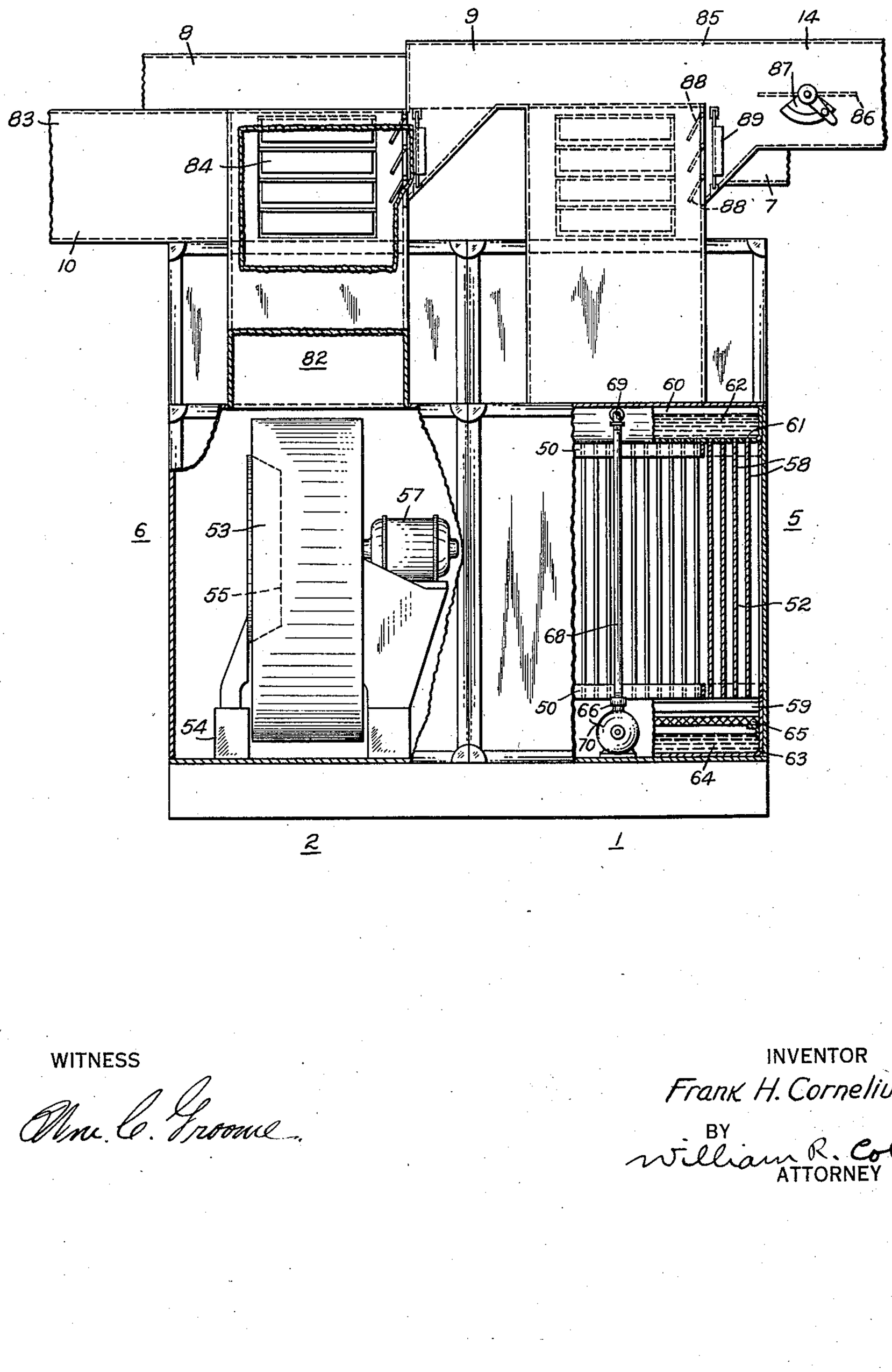
Filed July 23, 1931 3 Sheets-Sheet 2

Fig. 2.



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HEAT EXCHANGER

Filed July 23, 1931 3 Sheets-Sheet 3

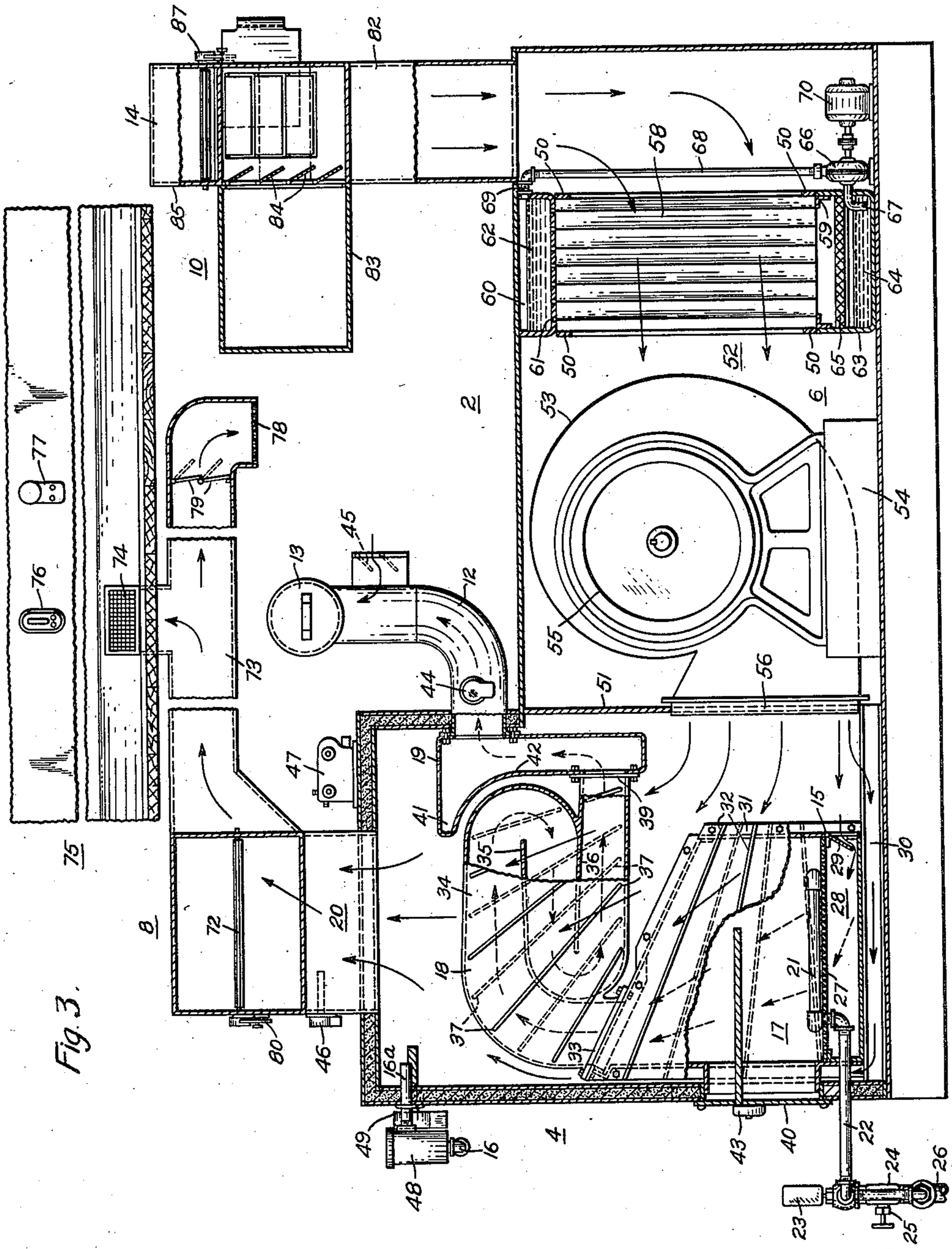

Fig. 3.

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Patented Aug. 20, 1935

2,011,753

UNITED STATES PATENT OFFICE

2,011,753

HEAT EXCHANGER

Frank H. Cornelius, Swissvale, Pa.

Application July 23, 1931, Serial No. 552,596

8 Claims. (Cl. 257—137)

My invention relates to heat exchangers especially adapted for furnaces of the warm air type, and has particular reference to the conditioning of air circulated through rooms from the standpoint of temperature, moisture and cleanliness.

One object of my invention is to provide a heat exchanger for a warm air furnace, or the like, having a plurality of hollow members severally adapted to produce substantially horizontal paths for the heated gases in their passage from the combustion chamber to the stack.

More specifically stated, this object of my invention is to provide flat tubular members, arranged side by side, to provide a heat exchanger, and severally having substantially horizontal baffles to produce a travel of heated gases therethrough in a path of substantially reversed S-shape.

A further object of my invention is to provide members of the type set forth above for heat exchangers severally having externally located means in the form of ribs, or the like, for radially directing the flow of air to be heated by the members.

Another object of my invention is to provide articles of manufacture of the character set forth above, comprising the individual tubular members having the internal horizontal baffles and the external radiating ribs.

Other objects will appear from the following description taken in conjunction with the accompanying drawings, wherein—

Figure 1 is a view in front elevation, with certain parts broken away for clearness, of my furnace;

Figure 2 is a view in rear elevation, with several portions broken away for clearness, of the apparatus shown in the preceding figure;

Figure 3 is a view showing various longitudinal sections of the furnace illustrated in the preceding figures.

Referring to Figures 1 to 3 of the drawings, the structure here shown comprises a furnace having a plurality of complete units 1 and 2 arranged side by side, the front portions 3 and 4 housing the combustion chambers and heat exchangers and having a greater vertical dimension than the rear elongated portions 5 and 6 for housing a blower and an air filter. Suitable warm air outlets or house inlets 7 and 8 to the various rooms are provided above the front sections 3 and 4, while return air ducts 9 and 10 and a fresh air duct 14 are provided near the rear end of the furnaces, for obvious reasons.

The front sections 3 and 4 are provided at their rear sides above the corresponding rear sections 5 and 6 of the furnaces with suitable stacks or smoke boxes 11 and 12, communicating with a central vent or flue 13 for carrying off the combusted gases.

The front portions of sections 3 and 4 of the furnaces are identical, and only one, therefore, need be described in detail. A closed combustion chamber 17 is provided in the front lower portion of the section 4, for example, and communicates with a heat exchanger 18, of novel design, located above the combustion chamber, which in turn leads to a manifold 19 and thence to the stack or smoke box 12.

The central upper portion of the front section 4 comprises a warm air outlet or duct 20, which, through the duct 8 and eventually other ducts, directs the warm conditioned air into various rooms.

A source of heat, such as a gas burner 21 of any suitable type, is located near the bottom of the combustion chamber 17, communicating with a pipe 22, which is controlled by means of a solenoid-operated gas valve 23 and a by-pass structure comprising a similar solenoid-controlled gas valve 24 and a hand-operated globe valve 25. The two parallel channels, just described, for permitting gas to flow to the burner 22, in turn communicate with a fuel inlet or supply pipe 26, which is associated with a source of fuel gas in any suitable way.

Just below the burner 21 a perforated plate or grating 27 is suitably positioned for the purpose of permitting air for combustion purposes to flow from the enclosed chamber 28 below the grating through an apertured or louvered shutter 29, preferably of aluminum, which is hinged at its top edge, as indicated at 15. The shutter may have a suitable stop or damper to regulate the amount of air admitted. At the very bottom of the furnace an air passage 30 is provided for the double purpose of maintaining the outer walls of the furnace section cool and at the same time carrying the heat that would otherwise be wastefully radiated to the atmosphere up towards the warm air outlet 20.

The combustion chamber or box proper may be constructed of suitable sheet members 31, bolted or otherwise fastened together, and having an inclined upper surface, as shown. Around the outside of the combustion box a plurality of ribs or strips 32, preferably integral with the sheet material members, are provided for the double purpose of reenforcing the walls and di-

recting a flow of air thereover to produce the best possible heat-exchanging relation therewith.

The upper front portion of the top inclined wall of the combustion chamber 17 has an opening for communicating with the lower openings of the various members or units constituting my heat exchanger. The heat exchanger and the combustion box are bolted together through suitable flanges, as indicated at 33.

As best shown in Figure 3, each of the heat exchanger units or members comprises a flattened tubular member 34 having preferably integral baffles 35 and 36 extending between the walls of each unit. It will be noted that the baffle 35 starts at a point near the joint 33, and extends vertically for a short distance and then curves over and for the most part extends horizontally towards the right, leaving a suitable stream passage between its end and the adjacent wall of tubular members 34. The other baffle 36 extends from a point adjacent the manifold 19 horizontally towards the left, likewise leaving a suitable stream passage between its end and the curved portion of the other baffle 35. It will be noted from the dotted arrows, indicating the passage of heated gases that, after leaving the burner 21, the gases flow into the mouths of the various heat exchanger units and then follow for the most part successive horizontal paths, as determined by the tortuous passages formed by the substantially horizontal baffles 35 and 36. In the heat exchanger proper, therefore, the heated gases for the most part follow a path of substantially reversed S-shape before entering the manifold 19, and then passing through the smoke box 12 to the vent 13.

The outer flat side surfaces of the units 34 are provided with preferably integral strips or ribs 37 which extend radially across these surfaces between the respective units, as shown in Fig. 2, for directing the passage of air to be heated in a uniform fan-shaped stream around and between the individual units of the heat exchanger. The ribs 37 on both the heat exchanger and the combustion box radiate toward a central point located substantially within the mouth or outlet 56 of the illustrated blower 53.

It will be noted that the stream of air from the blower 53, as indicated by the solid arrows, flows in part through the outer channel or passage 30, for the purpose previously mentioned, partly into the closed chamber 28, past the hinged shutter 29, as hereinbefore discussed, and mainly across the combustion box and heat exchanger, following for the most part substantially radial paths, as directed by the external ribs 32 on the combustion box and ribs 37 on the heat exchanger. It will also be noted that it is the lowermost section of the heat exchanger 18, containing the coolest gases, that the coolest air from the blower encounters first, and, as the air proceeds over the heat exchanger, it successively encounters more highly heated zones or regions.

By reason of this counterflow relation of the heated gases and air to be heated in combination with the peculiar construction of the heat exchanger units, a very high degree of gas velocity and turbulence, resulting in a high heat transfer is continuously effected, so that the air entering the house inlet 20 reaches a suitably high degree of temperature, whereas the gases entering the manifold 19 are relatively low in temperature and very little heat is lost up the flue, while the water vapor in the gases passes up the flue without condensation.

The manifold 19 has a plurality of openings near its lower left-hand corner for communicating with the ends of the various tubular units 34 of the heat exchanger, suitable bolted flanges 39 being provided in each case for this purpose. In order to still further remove heat from the outgoing gases, the upper end of the manifold 19 has a narrowing projection 41 extending over a portion of the tubular units of the heat exchanger and providing a curved internal space 42 for again heating air which flows through this space toward the house inlet 20.

The rear furnace portion 6 contains an air filter structure 52 and a centrifugal blower 53, the latter being suitably mounted upon a base 54 and having a central intake 55 and an outlet or delivery mouth 56 located in the partition 51 between the front and rear portions of the furnace, whereby air is delivered, as previously described, over and through the heat exchanger and other surfaces. A suitable electric motor 57 is mounted to drive the centrifugal blower 53.

The air filter structure 52 comprises a plurality of zigzag sheet metal members 58 placed in a row to act as baffles with respect to the return air being delivered to the blower 53. These baffles extend parallel to the long dimension of the furnace, thereby forming zigzag or tortuous passages between them for the air streams. These metal baffles may be supported in any suitable way, as by angle irons 59, at either side of the air filter structure upon which the lower ends of the baffles rest or to which they are welded or otherwise secured. Above the nest of baffles 58 a closed chamber or compartment 60 is provided, having a plurality of perforations 61 in its bottom surface, and which contains a body 62 of circulating oil when a pump 66, to be described, is in operation. Below the nest of baffles a larger chamber or container 63 is provided, which may also conveniently constitute upper apertured frame members 50 for the air filter structure, and to which the supporting angle irons 59 may be suitably secured. The vessel 63 contains a body of oil 64, and a screen 65 extends across the vessel for the purpose of filtering the oil during the pumping operation to be described.

A suitable centrifugal pump 66 is located on the floor of the furnace section 6 adjacent to the tank 63, and is provided with a curved inlet pipe 67 that dips into the body of oil 64. The pump 66 is adapted to deliver oil upwardly through pipes 68 and 69 to the upper portion of the tank 60, which is located on top of the baffles 58. A suitable electric motor 70 is provided for driving the pump 66 when energy is supplied to the motor, as subsequently described.

From a study of Fig. 1, in this connection, it will be noted that the holes or perforations 61 are located substantially directly above and symmetrical with respect to the angles formed in the metal baffles 58. As a result, when the pump 66 is operating to force oil to the upper tank 60, the oil pours out of the perforations 61 over the inclined faces of the baffles 58, and thus cleans or flushes the baffles of all foreign matter which has accumulated during the previous operation of the return air stream. As hereinafter pointed out in detail, this flushing operation occurs only when the blower 53 is not operating, that is to say, only when no air is being drawn through the filter by the blower, thus preventing the drawing of small particles of oil into the ventilating air stream. The dirt or other foreign matter in the oil is either caught by the screen 65 near the bot-

tom of the air filter structure or at the bottom of the tank 63. The screen and the tank are adapted in any convenient way for permitting cleaning out at desired intervals.

At the rear end of each furnace is provided a vertical conduit 82 for returning the air from the rooms above to the rear end of the furnace portion 6, whence it flows through the filter 52 to the blower 53 and is then recirculated. Another conduit 83 leads from the rooms above and into the return conduit 82, a plurality of hinged shutters or louvers 84, preferably of aluminum, being provided to permit this direction of flow of the air stream. However, should any reversed flow be attempted, the shutters 84 close the opening between the conduits 82 and 83, by reason of gravity and air pressure, and prevent this undesired flow of the air stream.

I claim as my invention:

1. In a warm air furnace, a heat exchanger having a plurality of alined hollow members severally having means for producing for the most part substantially horizontal paths for heated gases through the respective hollow members in directions substantially at right angles to the direction of alinement of said hollow members.

2. In a warm air furnace, a heat exchanger having a plurality of alined flat hollow members severally provided with substantially horizontal baffles to produce a tortuous path therethrough.

3. In a warm air furnace, a heat exchanger having a plurality of flat tubular members arranged side by side and severally having substantially horizontal baffles to produce travel of heated gases therethrough in a path of substantially reversed S-shape.

4. As an article of manufacture, a unit flattened tubular member for a heat-exchanger of a furnace having a plurality of spaced integral substantially horizontal thin and flat internal baffles disposed between the closely-adjacent flattened sides of the member.

5. In a warm air furnace, a heat exchanger having a plurality of hollow members severally having means for producing for the most part substantially horizontal paths for heated gases, said members severally having externally located means for radialy directing the flow of air to be heated in non-parallel paths over the outer surfaces of said members.

6. In a warm air furnace, a heat exchanger having a plurality of external air-directing strips and a blower for directing air against said heat-exchanger, said strips being located along radial lines substantially centering within the mouth of said blower.

7. In a warm air furnace, a heat-exchanger having a plurality of flat-sided hollow members severally having internal baffles for producing for the most part substantially horizontal paths for heated gases, said members severally having external strips on at least one of its flat sides.

8. As an article of manufacture, a flat-sided tubular member for a heat-exchanger having a plurality of integral air-directing ribs each extending substantially radially over at least one of the flat sides of said member.

FRANK H. CORNELIUS.

CERTIFICATE OF CORRECTION.

Patent No. 2,011,753. August 20, 1935.

FRANK H. CORNELIUS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, after line 18, insert the following paragraph: I do not wish to be restricted to the specific structural details, arrangement of parts, and circuit connections herein set forth, as various other modifications thereof may be effected without departing from the spirit and scope of my invention. I desire, therefore, that only such limitations shall be imposed as are indicated in the appended claims.; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 24th day of September, A. D. 1935.

Leslie Frazer

Acting Commissioner of Patents.

(Seal)