Dec. 3, 1940. E. F. LIMBERS 2,223,492

AIR CONDITIONER

Filed Jan. 11, 1939 9 Sheets-Sheet 1

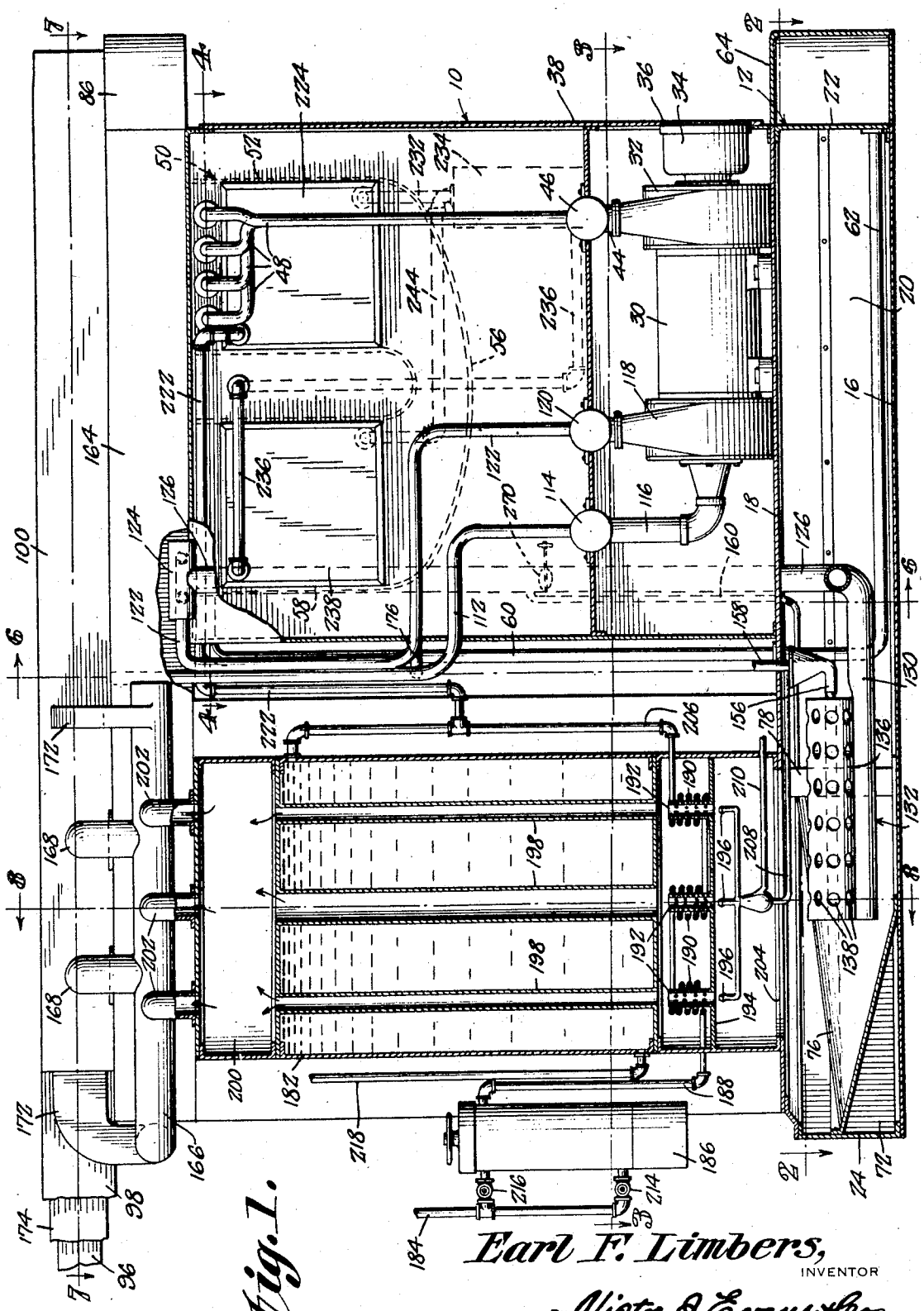


Fig. 1.

Earl F. Limbers,
INVENTOR

BY Victor J. Evans & Co.
ATTORNEYS

WITNESS

Dec. 3, 1940. E. F. LIMBERS 2,223,492

AIR CONDITIONER

Filed Jan. 11, 1939 9 Sheets-Sheet 2

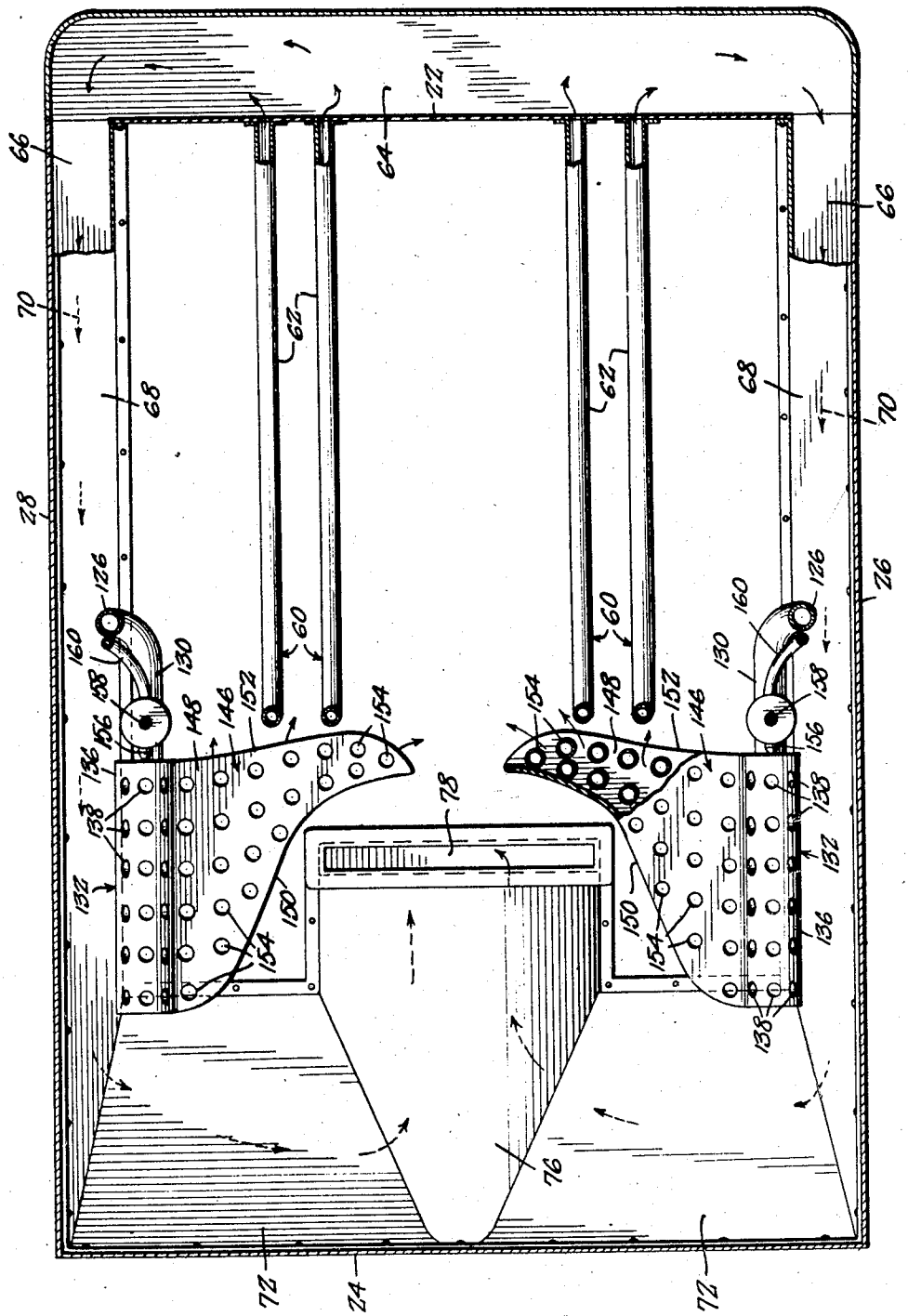


Fig. 2.

Earl F. Limbers,
INVENTOR

BY Victor J. Evans & Co.
ATTORNEYS

WITNESS

Dec. 3, 1940. E. F. LIMBERS 2,223,492

AIR CONDITIONER

Filed Jan. 11, 1939 9 Sheets-Sheet 3

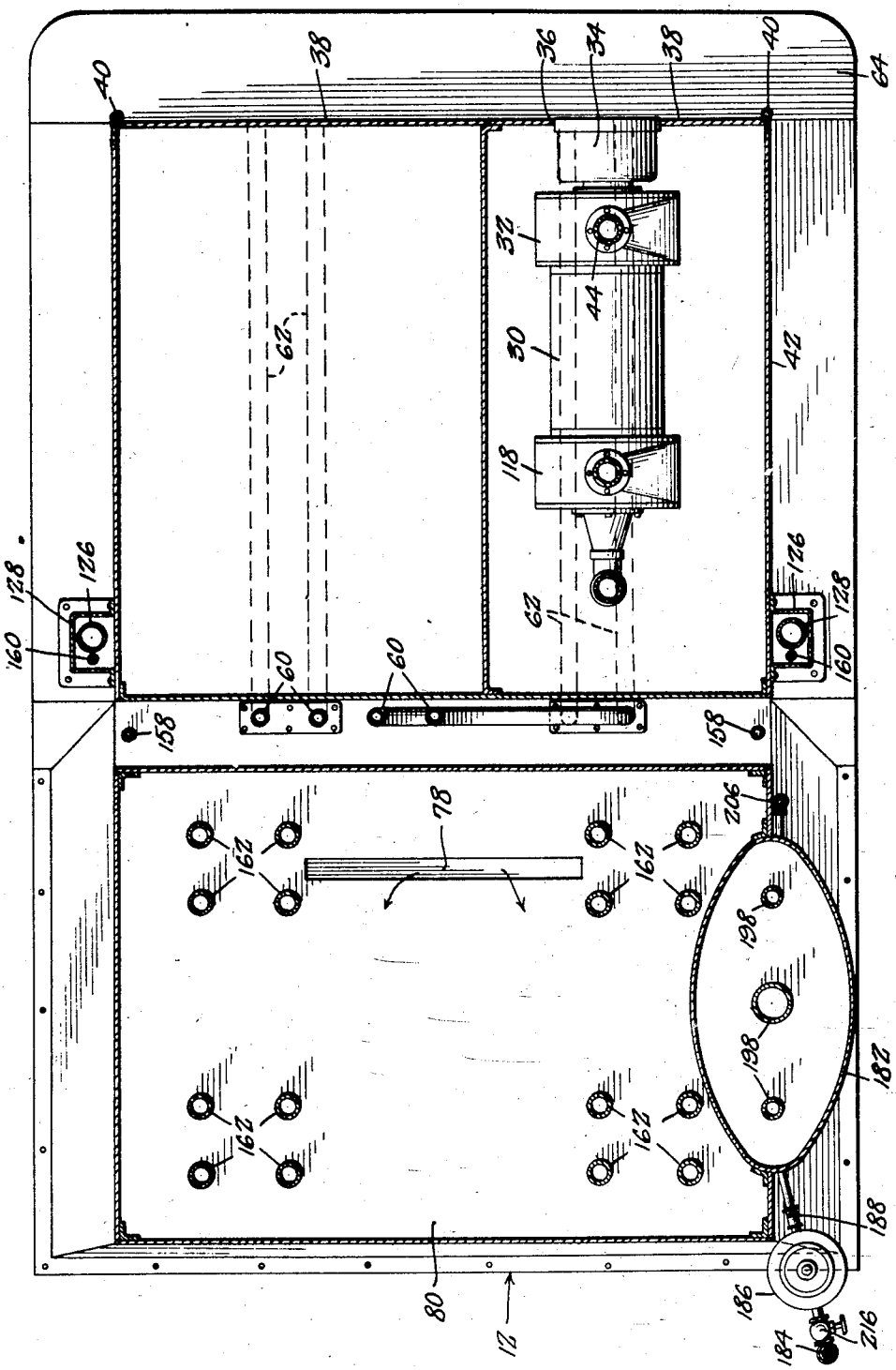


Fig. 3.

Earl F. Limbers,
INVENTOR

BY Victor J. Evans & Co.
ATTORNEYS

P. E. Hickey
WITNESS

Dec. 3, 1940. E. F. LIMBERS 2,223,492

AIR CONDITIONER

Filed Jan. 11, 1939 9 Sheets-Sheet 4

Fig. 4.

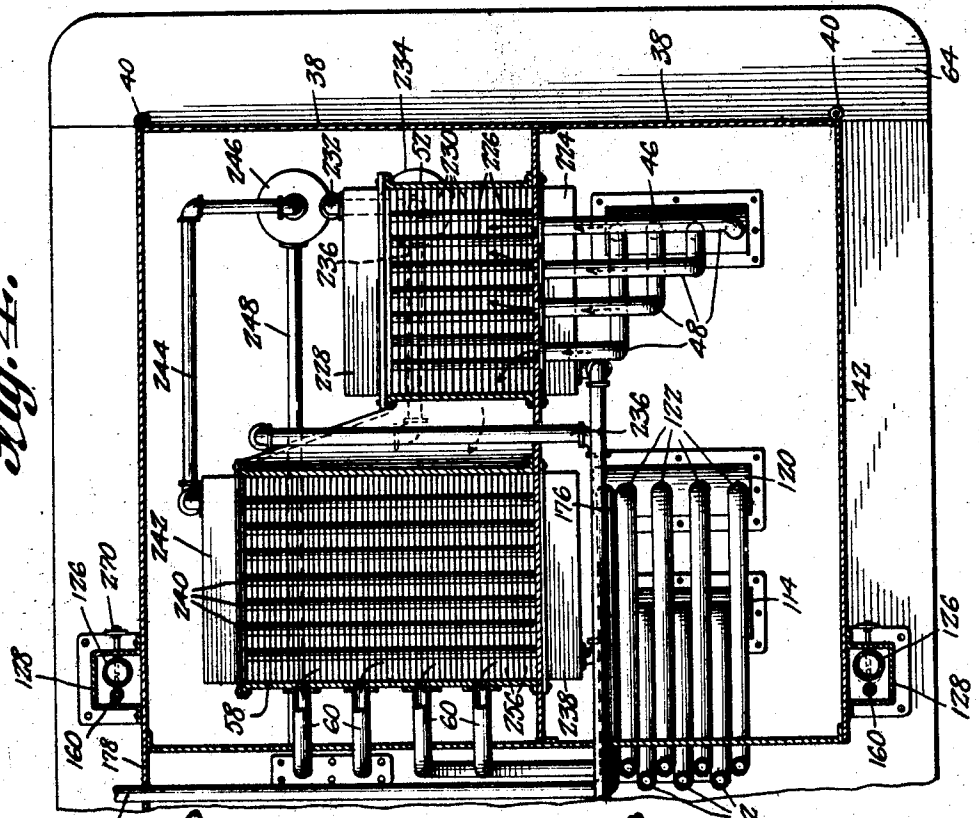
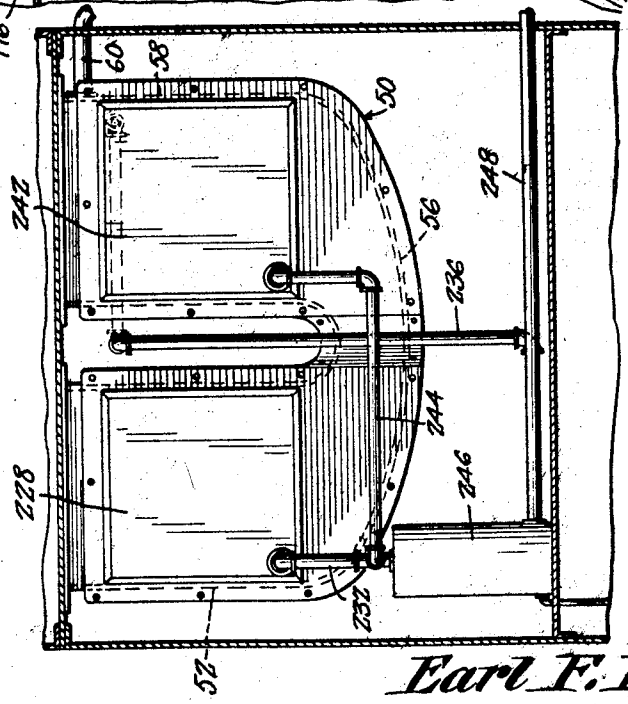


Fig. 9.



Earl F. Limbers,
INVENTOR

BY Victor J. Evans & Co.
ATTORNEYS

P. L. Hickey
WITNESS

Dec. 3, 1940. E. F. LIMBERS 2,223,492

AIR CONDITIONER

Filed Jan. 11, 1939 9 Sheets-Sheet 5

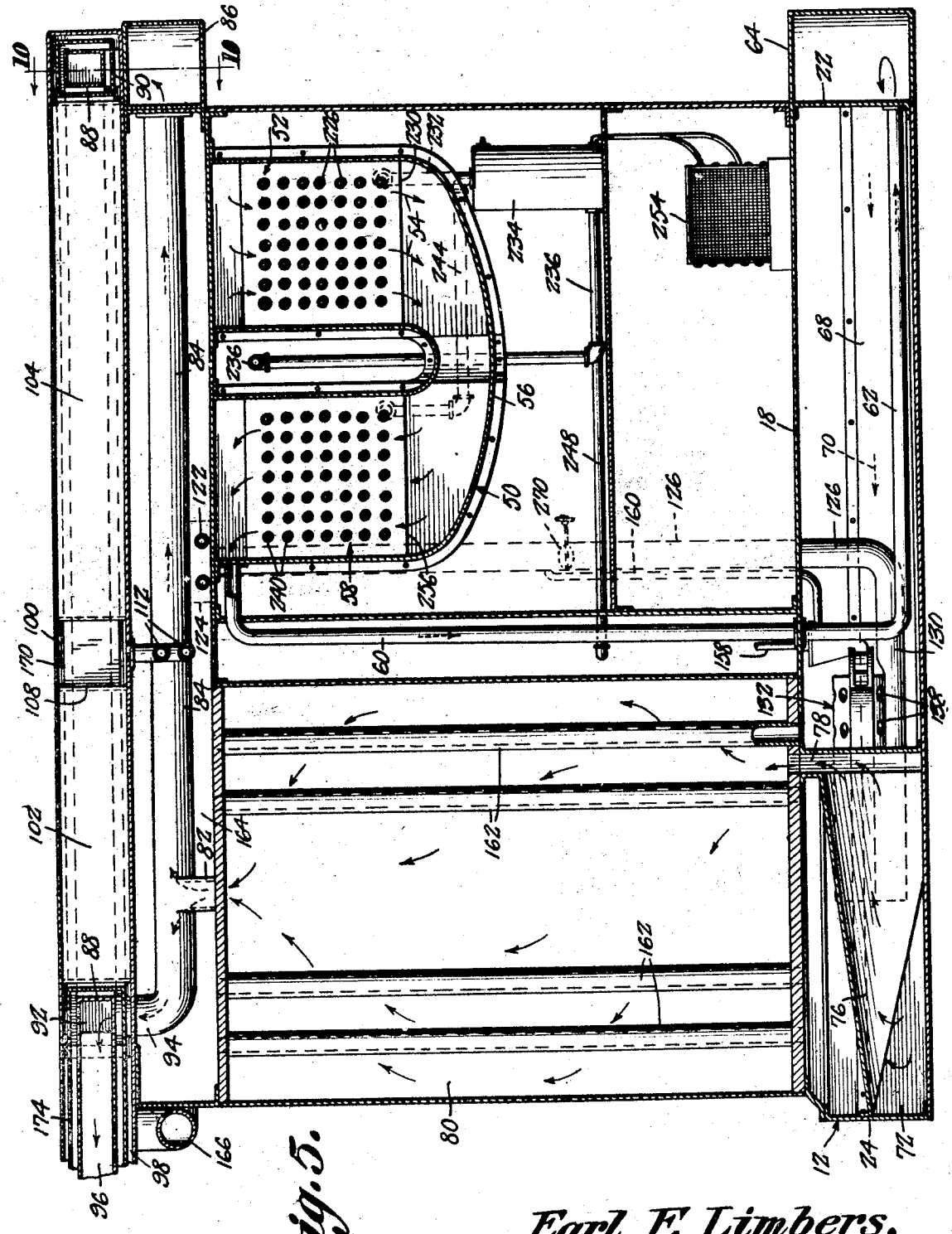


Fig. 5.

Earl F. Limbers,
INVENTOR

By Victor J. Evans & Co.
ATTORNEYS

WITNESS

Dec. 3, 1940. E. F. LIMBERS 2,223,492

AIR CONDITIONER

Filed Jan. 11, 1939 9 Sheets-Sheet 6

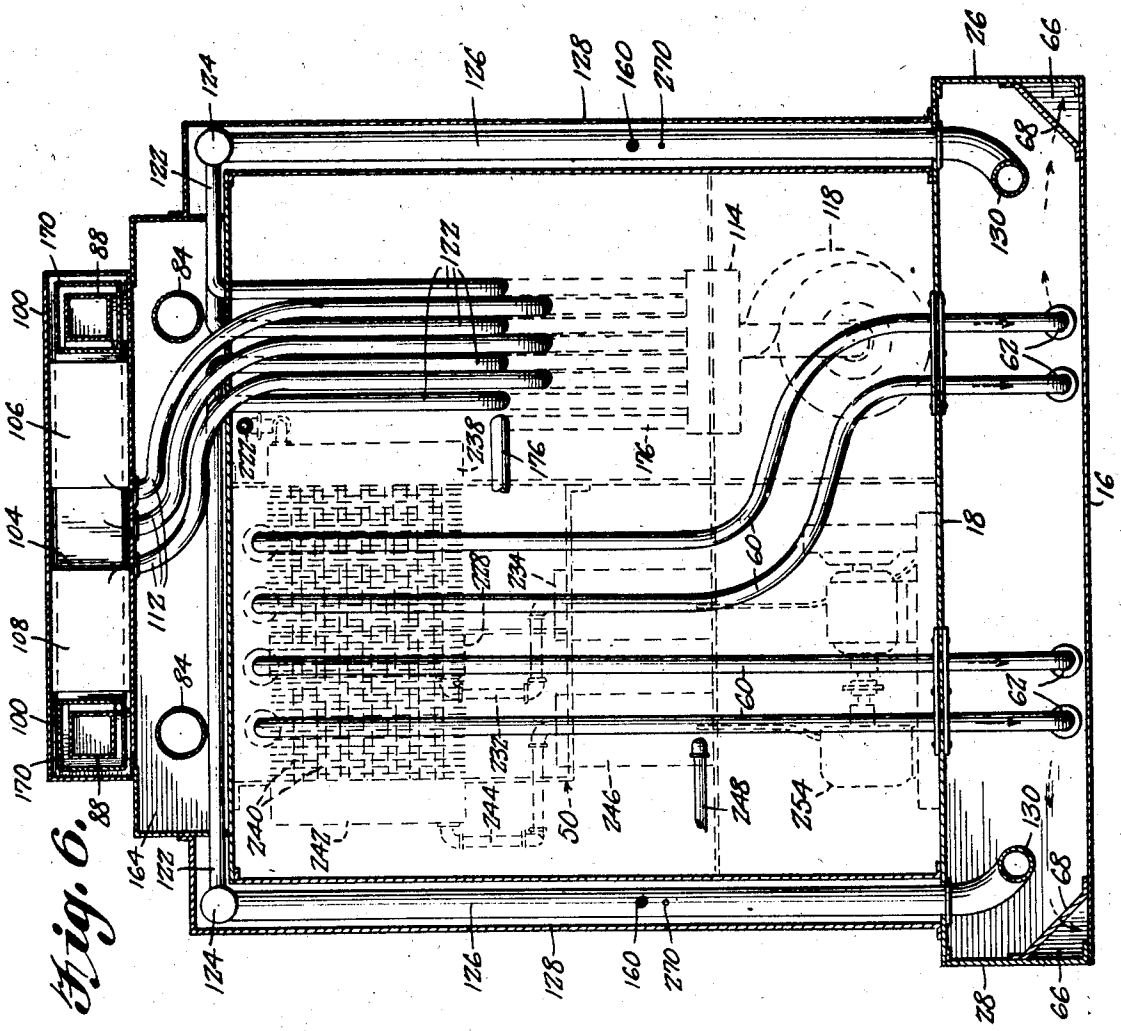


Fig. 6.

Earl F. Limbers,
INVENTOR

BY Victor J. Evans & Co.
ATTORNEYS

WITNESS

Dec. 3, 1940. E. F. LIMBERS 2,223,492

AIR CONDITIONER

Filed Jan. 11, 1939 9 Sheets-Sheet 7

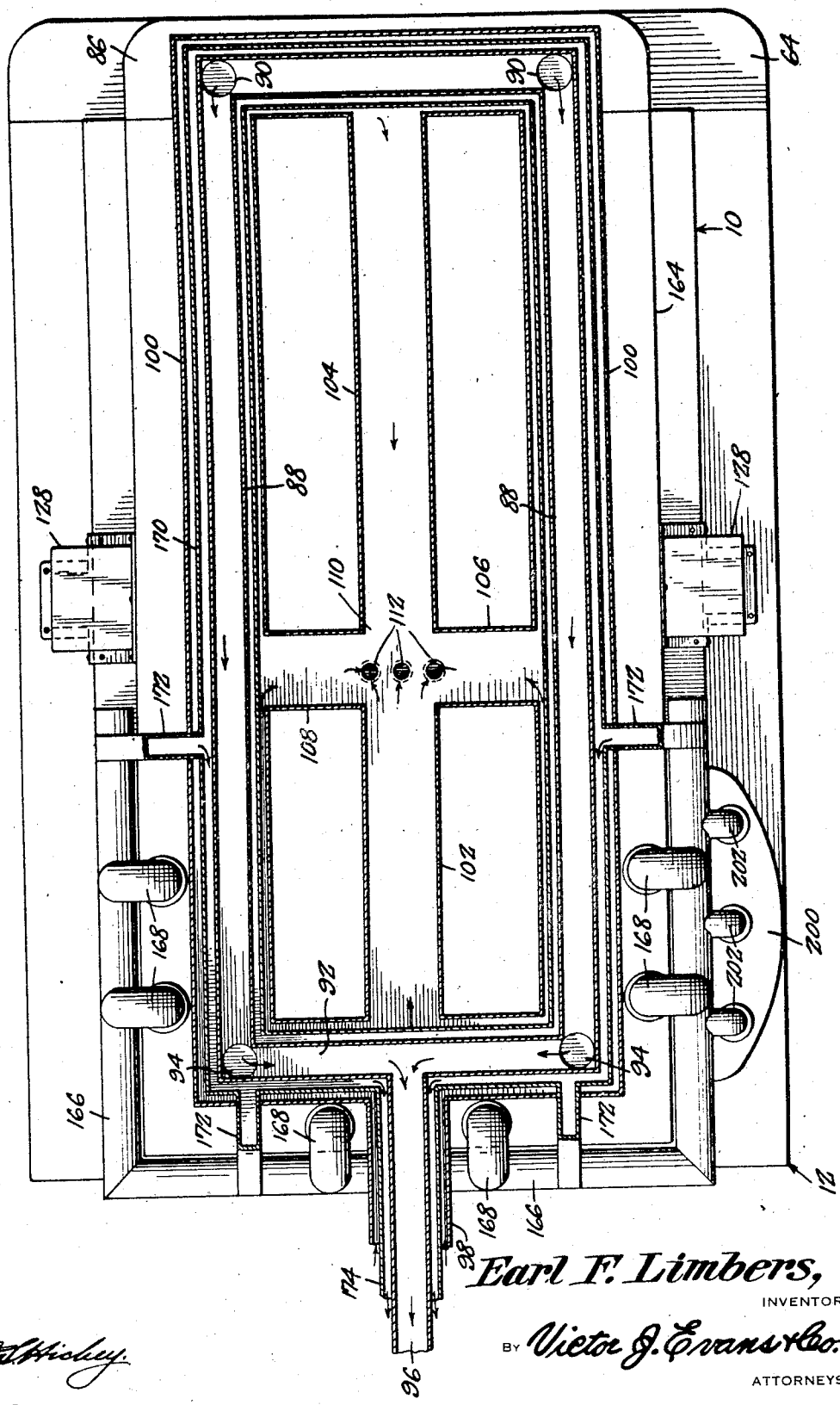


Fig. 7.

Earl F. Limbers,
INVENTOR

BY Victor J. Evans & Co.
ATTORNEYS

WITNESS

Dec. 3, 1940. E. F. LIMBERS 2,223,492

AIR CONDITIONER

Filed Jan. 11, 1939 9 Sheets-Sheet 8

Fig. 10.

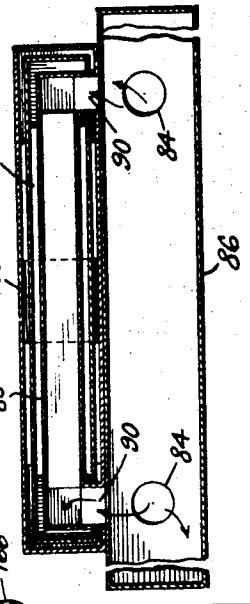


Fig. 12.

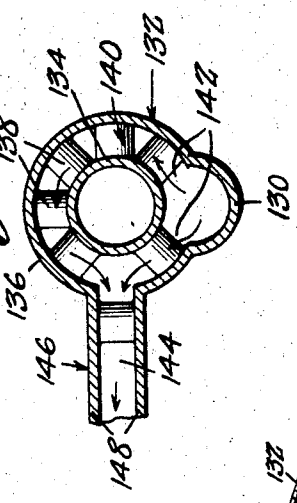
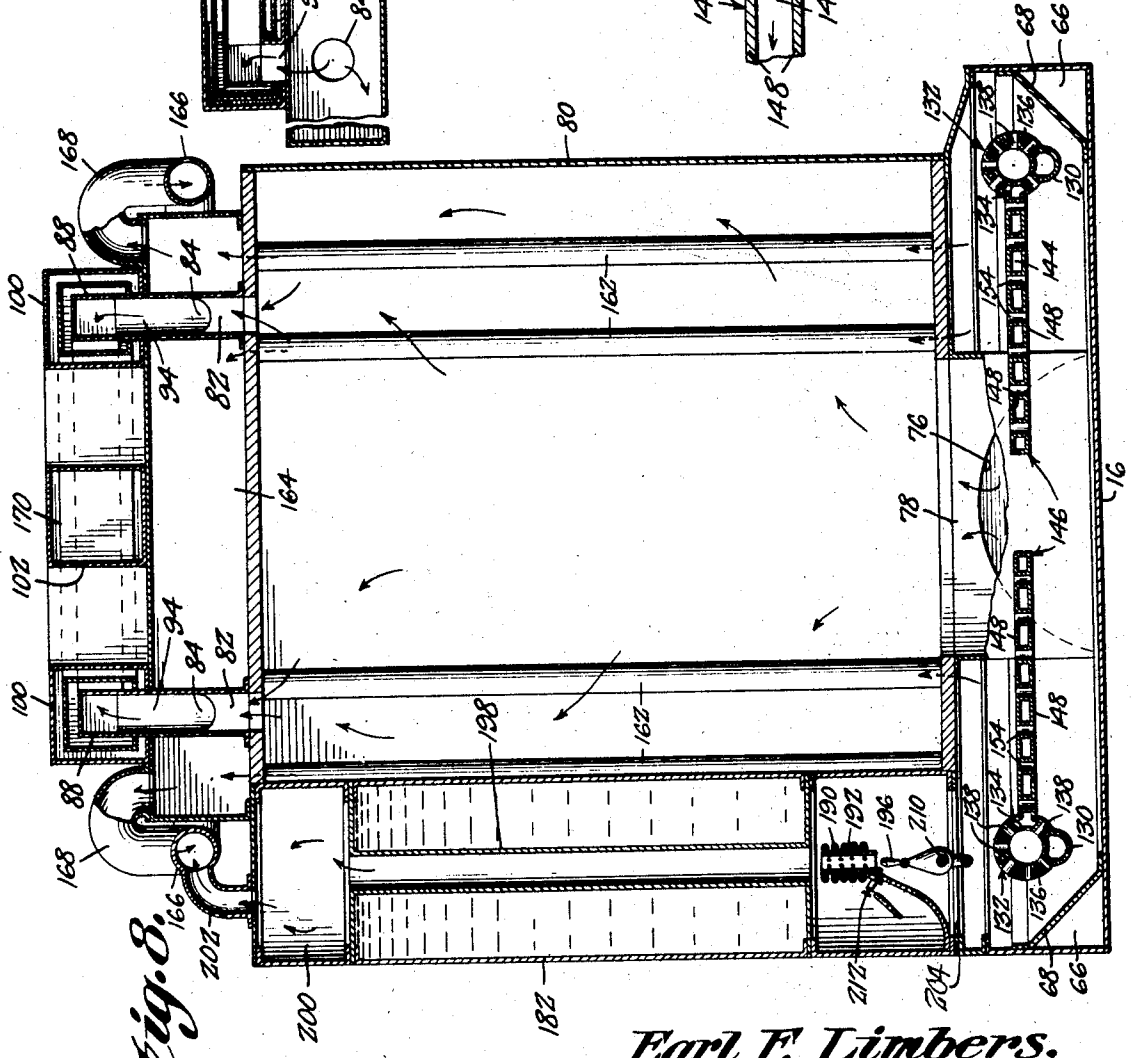


Fig. 8.



Earl F. Limbers,
INVENTOR

BY Victor J. Evans & Co.
ATTORNEYS

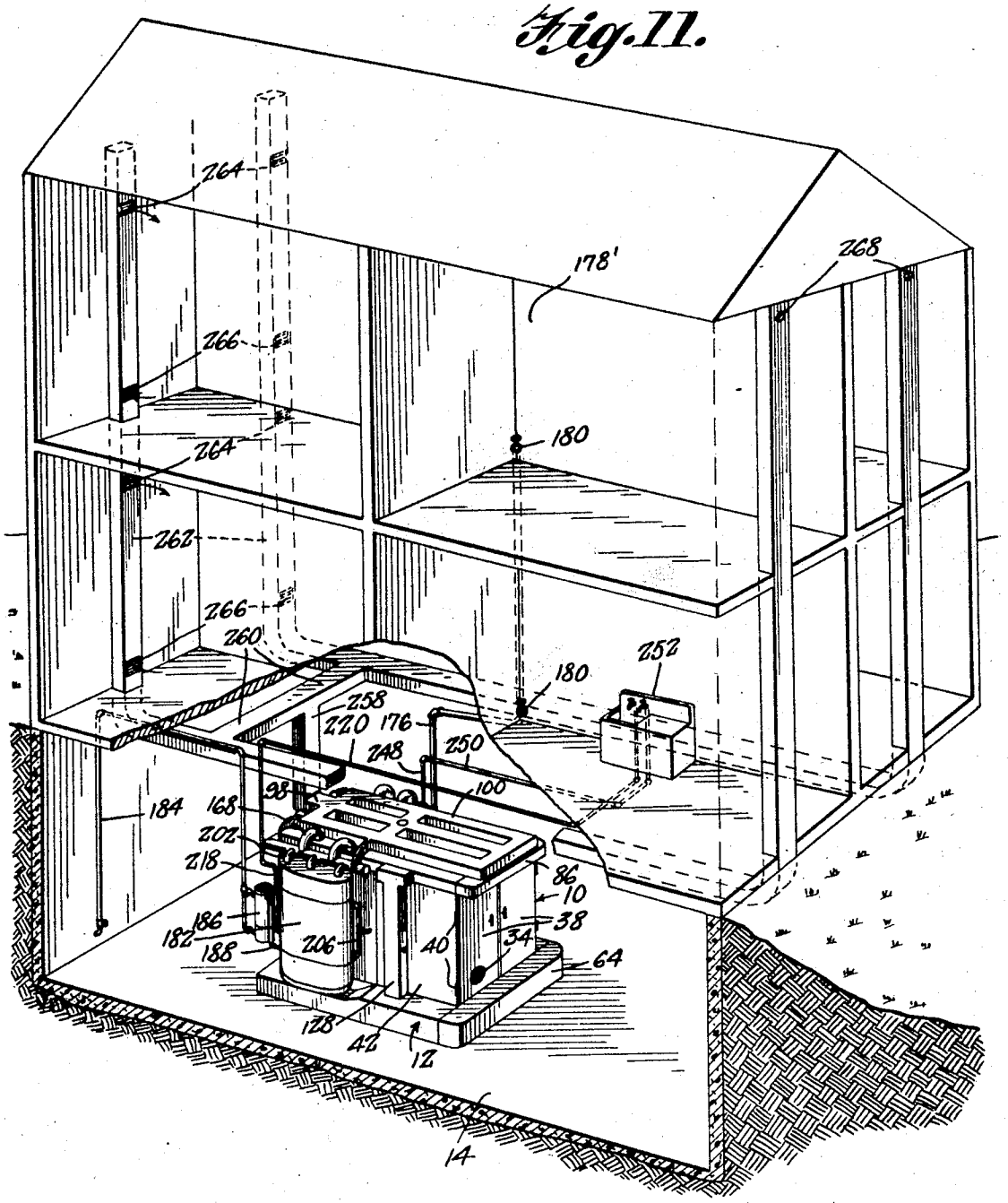
P. L. Hickey
WITNESS

Dec. 3, 1940. E. F. LIMBERS 2,223,492

AIR CONDITIONER

Filed Jan. 11, 1939 9 Sheets-Sheet 9

Fig. 11.



Earl F. Limbers,

INVENTOR

BY Victor J. Evans & Co.

ATTORNEYS

P. J. Hickey.

WITNESS

Patented Dec. 3, 1940 2,223,492

UNITED STATES PATENT OFFICE

2,223,492

AIR CONDITIONER

Earl F. Limbers, Castle Shannon, Pa.

Application January 11, 1939, Serial No. 250,434

4 Claims. (Cl. 237—48)

My invention relates to buildings, and has among its objects and advantages the provision of an improved air conditioning system, which system includes novel means for heating and cooling water.

In the accompanying drawings:

Figure 1 is a sectional view of the air and water conditioning unit;

Figure 2 is a sectional view along the line 2—2 of Figure 1;

Figure 3 is a sectional view along the line 3—3 of Figure 1;

Figure 4 is a sectional view along the line 4—4 of Figure 1;

Figure 5 is a view similar to Figure 1 but sectioned in a different plane;

Figure 6 is a sectional view along the line 6—6 of Figure 1;

Figure 7 is a sectional view along the line 7—7 of Figure 1;

Figure 8 is a sectional view along the line 8—8 of Figure 1;

Figure 9 is a fragmentary detail view of a portion of the structure illustrated in Figure 1;

Figure 10 is a sectional view along the line 10—10 of Figure 5;

Figure 11 is a diagrammatic view in perspective illustrating the manner in which the invention may be incorporated in a building; and

Figure 12 is a sectional detail view of a burner unit.

In the embodiment selected to illustrate my invention, I make use of an air conditioner 10 which includes a base 12 to be mounted on the floor 14, preferably in the basement of the building. Base 12 includes a floor 16 and a top plate 18 spaced therefrom to provide a chamber 20. Floor 16 and the top plate 18 are interconnected into a unitary structure through the medium of end walls 22 and 24 and side walls 26 and 28. These parts may be welded into connected relation. Upon the top plate 18 I mount a motor 30, which motor operates a blower 32, which may be of conventional design, operatively connected with a filter 34 for the inlet of basement air. Filter 34 extends through an opening 36 in a door 38 hinged at 40 to the side wall 42 of the conditioner 10.

Blower 32 includes an air discharge neck 44 which communicates with a header 46, see Figures 1 and 4. A plurality of pipes 48 has communication with the header 46 and communicates with the interior of a shell 50, see Figures 4 and 1. Shell 50 is of substantially U-shaped configuration, and the pipes 48 deliver fresh air to the shell at the upper end of its branch 52, see Figures 1, 4 and 5. Air delivered to the shell passes downwardly of the branch 52, as indicated by the arrows 54 and passes through the curved run 56 which interconnects the branch 52 with a larger branch 58. Air moves upwardly through the branch 58 and is delivered to a plurality of pipes 60 which extend downwardly and pass through the top plate 18. Shell 50 constitutes a heat exchanger which functions to partly heat the air passing therethrough.

Figures 2, 5 and 6 illustrate the runs of the pipes 60 extending into the chamber 20 as being horizontally arranged at 62 and passed through the end wall 22 for delivering air into the conduit 64 extending across that end of the conditioner. Walls 26 and 28, see Figures 2 and 6, cooperate with the bottom 16 to provide conduits 66 through the medium of angular plates 68. Conduits 66 communicate with the conduit 64, as illustrated in Figure 2. Air delivered to the conduit 64 is delivered to both conduits 66 and flows therein in the direction of the arrows 70 into conduits 72 extending along the end wall 24 and communicating with a central conduit 76 provided with a throat 78 for delivering the air to a heating chamber 80, see Figures 2, 5 and 8. Chamber 80 brings the air to the proper temperature for delivery to the rooms to be heated.

Air from the chamber 80 flows through two necks 82 for delivery into horizontal conduits 84, see Figures 5 and 8. One end of each of the horizontal conduits 84 delivers air to a larger conduit 86 which has communication with a rectangularly fashioned conduit 88 through the medium of necks 90, see Figures 10, 5 and 7. The opposite ends of the conduits 84 have communication with the run 92 of the rectangular conduit 88 through the medium of necks 94, see Figures 5, 6 and 7. Run 92 of the conduit 88 connects with a main conduit 96 which connects with the conduits for delivering air to the rooms to be heated.

Room air is circulated back through the conditioner 10 through a conduit 98 which is located outside the conduit 96, but is spaced therefrom sufficiently far to provide the necessary accommodation for air circulation. Conduit 98 communicates with a rectangularly shaped conduit 100 which also encloses the rectangular conduit 88. While the four runs of the rectangular conduit 100 have intercommunication at their ends, the runs have additional intercommunication through the medium of conduits 102, 104, 106 and 108, best illustrated in Figure 7. Conduits 102,

104, 106 and 108 are joined at 110 and communicate with a plurality of downwardly extending pipes 112, see Figures 7, 4 and 6. The lower ends of the pipes 112 are connected with a header 114 which communicates with a neck 116 having communication with the suction side of a blower 118 operated by the motor 30, see Figure 1. Blower 118 delivers air to a header 120 having communication with a plurality of pipes 122. Headers 124 have communication with the pipes 122, half the pipes leading to one header and the other half leading to the other header, as shown in Fig. 6. Each header is connected with a larger downwardly extending pipe 126, each of which is enclosed in a housing 128 and passes through the top wall 18. Each horizontal run 130 of the pipes 126 is connected with one burner unit 132 located inside the chamber 20, see Figures 1, 2 and 8.

Burner units 132 are located in close relation with the side walls 26 and 28. The units are identical in construction and operation so that the description of one will apply to both. Referring to Figures 1, 2, 8 and 12, each unit comprises concentrically related tubular walls 134 and 136, which walls are connected into spaced, unitary structure through the medium of radial tubes 138, see Figure 12. The run 130 of the associated pipe 126 has communication with the space 140 between the walls 134 and 136 through the medium of a plurality of ports 142. Space 140 has communication with the space 144 in a heat exchanger wing 146. Figure 2 illustrates the wing as being made up of spaced walls 148 closed along the side 150 but open along the side 152. Walls 148 are separated to provide the space 144, and flues 154 extend through the walls 148.

Air entering the space 140 passes into the exchanger 146 and circulates about the flues 154 and flows from the exchanger through the open side 152. Such air is heated to a high temperature through the medium of the burner unit 132. Figures 1 and 2 illustrate the burner unit as including a conventional fuel nozzle 156 operatively connected with a fuel line 158. Nozzle 156 is supplied with air under pressure through the medium of the conduit 160 which connects with one of the pipes 126, see Figure 1. Nozzle 156 is axially aligned with the cylindrical wall 134. The wall assembly of Figure 12 is closed at its end opposite the nozzle 156. Thus the cylindrical wall 134 constitutes a combustion chamber associated with its respective nozzle 156, and the burnt products of combustion pass from the combustion chamber through the medium of the tubes 138. It will thus be seen that air flowing through the run 130 of the associated pipe 126 flows about the wall 134 and is confined thereabout through the medium of the wall 136. Thus the air passing through the space 140 will be effectively heated before it is delivered to the exchanger wing 146. Much of the burnt products of combustion from the burner passes upwardly through the flues 154 and additionally heat the air before it exits from the exchanger through the medium of the open side 152.

Air which exits from the exchanger wings 146 flows upwardly through tubes 162 extending vertically through the heating chamber 80, see Figures 3, 5 and 8 for heating the fresh air flowing therethrough for delivery to the main conduit 96. From the tubes 162 the burnt air is delivered to a chamber 164, see Figures 5 and 8, which chamber has communication with three communicating conduits 166, see Figures 7 and 8, through the medium of elbows 168. Conduits 166 communicate with a conduit 170 of rectangular configuration which lies between the conduits 88 and 100, see Figure 7, through the medium of tubes 172. Conduit 170 communicates with the exhaust conduit 174 which is positioned between the main conduit 96 and the return conduit 98, see Figures 5 and 7.

To the header 120 I connect a pipe 176, see Figures 1, 4 and 6, which pipe extends through the side wall 178 of the conditioner 10, see Figure 4. Figure 11 illustrates the pipe 176 as extending upwardly of the wall structure 178 of the building and provided with valved connections 180 for connection with appliances to be operated by compressed air.

In Figures 1, 3 and 8, I illustrate a hot water storage tank 182 which is supplied with water from the city pressure line 184 through the medium of a water filter 186 having a pipe 188 connected with coils 190 wrapped about heating tubes 192 mounted on a plate 194. Burner nozzles 196 are located beneath the heating tubes 192, the latter being perforated and arranged in axial alignment with flues 198 extending vertically of the hot water storage tank 182 and communicating with a chamber 200. The burnt products of combustion from the burner nozzles 196 are delivered to the chamber 200 and the latter communicates with one of the conduits 166 through the medium of elbows 202, see Figures 1, 7 and 8. Some of the burnt products of combustion from the burner units 132 exit by way of the flues 198 through the opening 204, see Figures 1 and 8. Coils 190 are interconnected and deliver water to the storage tank 182 through the medium of a pipe 206, see Figure 1.

The burner nozzles 196 are supplied with fuel through the medium of a pipe 208 which connects with the fuel line 158 and mixing air is supplied by a pipe 210 which is hooked into one of the pipes 160 which supplies air under pressure to its respective burner unit 132. Burner nozzles 196 may be of any suitable conventional type and may be associated with conventional igniting means indicated generally at 212 in Figure 8.

Water from the main line 184 is preferably delivered to the filter 186 at its bottom to avoid packing of the filter. The delivery of the water is controlled through valved connections 214 and 216. Near the bottom of the tank 182 I connect a pipe 218 which may be connected with branch lines for distribution throughout the building, as illustrated at 220 in Figure 11.

Referring to Figure 1, I connect a pipe 222 with the hot water pipe 206, which pipe leads to the upper part of a header 224 associated with the branch 52, see Figure 4. Header 224 has communication with a plurality of pipes 226, which pipes communicate with a header 228 located on the opposite side of the branch. The pipes 226 are provided with spaced heat transfer fins 230 between which the incoming fresh air passes. To the lower part of the header 228 I connect a pipe 232, see Figures 5 and 6, which leads to a cooling coil unit 234. A pipe 236 leads from the bottom of the cooling coil unit 234 up to the upper part of a header 238 associated with the branch 58. Header 238 has communication with a plurality of pipes 240 in the branch 58 communicating with a header 242 on the opposite side of the branch. To the lower part of the header 242 I connect a pipe 244 which leads to a second cooling coil unit 246. A pipe 248 connects

with the lower part of the cooling coil unit 246 for delivery with branch pipes throughout the building. Figure 11 illustrates pipe 248 as being connected with a branch pipe 250 leading to the sink 252. Cooling coil unit 246 supplies ice water to the pipe 248. The cooling coil units 234 and 246 are operatively connected with a conventional refrigeration unit 254, see Figures 5 and 6.

Pipes 240 in the branch 58, see Figure 4, are associated with a plurality of spaced fins 256 between which air from the branch 52 is circulated. Thus the air circulating through the branches 52 and 58 absorbs heat from the hot water passing through the two branches. Refrigeration units 234 and 246 cool the water in stages, with the water delivered to the pipe 248 effectively cooled for drinking purposes.

From the foregoing description of the various parts of the device, the operation thereof will be readily understood. Blower 32 of Figure 1 delivers air to the pipes 48, which air circulates through the branches 52 and 58 to absorb heat from the water passing through the pipes 226 and 240, see Figure 4. From the branch 53, air is delivered to the pipes 60 which pass downwardly and enter the chamber 20 for delivery to the conduit 64 which communicates with the conduits 66. From the conduits 66 the air passes through the conduits 72 and 76 and through the throat 78, see Figure 2. Air moving through the throat 78 is delivered to the heating chamber 80 and into the conduit 88 through the passages 90. Such air is then delivered to the main conduit 96 which is enclosed by the conduit 174, the latter being enclosed within the conduit 98, see Figure 7.

Referring to Figure 11, conduits 98, 96 and 174 are assembled in a unit conduit 258 which may be branched at 260 for connection with vertical conduits 262 leading to the rooms of the building. Conduits 262 are provided with outlets 264 near the ceilings of the different rooms for delivering warm air thereto. Similarly, the branches 262 are provided with inlets 266 which take air from the rooms for delivery into the conduit 98 leading back to the conditioner. At the same time, the branches 264 are provided with outlets 268 which deliver burnt air to the atmosphere. Main conduit 96 and all the branch conduits which deliver warm air to the rooms are well insulated by being enclosed within the conduits returning air to the conditioner and are effectively heated by the surrounding air passed to the atmosphere.

Air from the rooms returning to the conditioner 10 is delivered to the conduit 100, see Figure 7, which conduit communicates with the pipes 112 leading to the suction side of the blower 118, which blower moves the air through the pipes 122 which are connected with the larger pipes 126 leading to the burner units 132. The burner units burn the air effectively so as to destroy germs and the like, which burnt air and the burnt products of combustion are delivered through the tubes or flues 162 passing upwardly of the hot air chamber 80 for heating the fresh air passing therethrough. Burnt air from the flues 162 is delivered to the chamber 164 which communicates with the conduit 174 through the medium of the conduits 166 and elbows 168. Burnt air delivered to the conduit 174 is exhausted through the ports 268 of Figure 11.

Burner units 192 in combination with the coils 190 effectively heat water from the main 184 which water moves upwardly for delivery into the storage tank 182 and to the pipe 222 for delivery to the pipes 226 and 240 of the branches 52 and 58. Cooling coil units 234 and 246 as well as the refrigeration unit may be of any suitable conventional construction. In Figures 1, 4 and 5, I illustrate the pipes 126 as being provided with dampers 270 which may be manipulated for controlling the flow of air to the burner units 132.

My system operates to effectively heat air for room heating purposes which air is effectively insulated. Room air is returned to the conditioner to be burned and such burnt air is utilized for heating purposes and finally exhausted to the atmosphere. At the same time, water is effectively heated, and the water heating system is arranged in heat transfer relation with the burner units 132. Some of the heated water is delivered to the branches 52 and 58 for transferring some heat to the incoming fresh air before it is delivered to the heating chamber 80. The conditioner constitutes a compact unit of cabinet configuration so as to displace a relatively small amount of space in the basement. Pipes 60 and the conduits 64 and 66 derive considerable heat from the chamber 20 in which the burner units 132 are located.

Without further elaboration, the foregoing will so fully illustrate my invention that others may, by applying current knowledge, readily adapt the same for use under various conditions of service.

I claim:

1. A conditioner of the type described comprising a first air circulating circuit for delivering warm air to rooms to be heated, means for heating the air in the circuit, a second air circulating circuit for removing air from the rooms including means for heating the air to a high temperature and bringing the same into heat transfer relation with said first means, a third air circulating circuit for receiving air from said second circuit and delivering the same to the atmosphere, said third circuit having runs surrounding runs of said first circuit for heating the air flowing therethrough, and said second circuit having runs surrounding runs of said third circuit to constitute insulation therefor.

2. A conditioner of the type described comprising a first air circulating circuit for delivering warm air to rooms to be heated, means for heating the air in the circuit, a second air circulating circuit for removing air from the rooms including means for heating the air to a high temperature and bringing the same into heat transfer relation with said first means, a third air circulating circuit for receiving air from said second circuit and delivering the same to the atmosphere, said third circuit having runs surrounding runs of said first circuit for heating the air flowing therethrough, said second circuit having runs surrounding runs of said third circuit to constitute insulation therefor, and means for forcibly circulating air in said circuits.

3. A conditioner of the type described comprising a first air circulating circuit for delivering warm air to rooms to be heated, means for heating the air in the circuit, a second air circulating circuit for removing air from the rooms including means for heating the air to a high temperature and bringing the same into heat transfer relation with said first means, a third air circulating circuit for receiving air from said second circuit and delivering the same to the atmosphere, said third circuit having runs surrounding runs of said first circuit for heating

the air flowing therethrough, said second circuit having runs surrounding runs of said third circuit to constitute insulation therefor, means for forcibly circulating air through said circuits, a hot water storage tank including a heater therefor, and means associated with the heater for directing burned products of combustion from the heater into said third circuit.

4. A conditioner of the type described comprising a first air circulating circuit for delivering warm air to rooms to be heated, means for heating the air in the circuit, a second air circulating circuit for removing air from the rooms including means for heating the air to a high temperature and bringing the same into heat transfer relation with said first means, a third air circulating circuit for receiving air from said second circuit and delivering the same to the atmosphere, said third circuit having runs surrounding runs of said first circuit for heating the air flowing therethrough, said second circuit having runs surrounding runs of said third circuit to constitute insulation therefor, means for forcibly circulating air through said circuits, a hot water storage tank including a heater therefor, means associated with the heater for directing burned products of combustion from the heater into said third circuit, and means for circulating hot water into heat transfer relation with the first circuit.

EARL F. LIMBERS.