Sept. 20, 1960 K. R. PARTINGTON ET AL 2,952,994

AIR CONDITIONER ELEMENT ARRANGEMENT

Filed Sept. 26, 1957 4 Sheets-Sheet 1

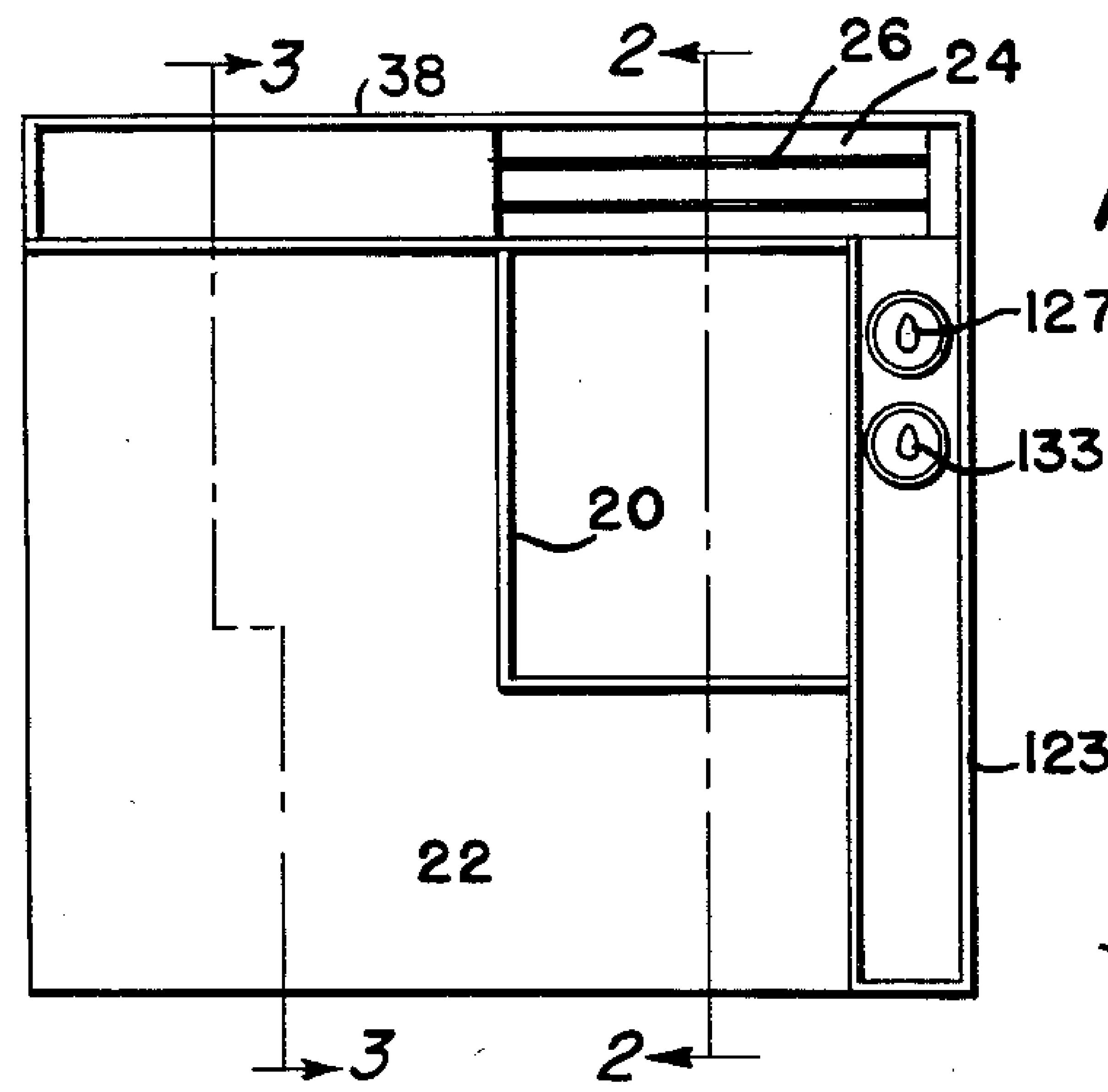

Fig. 1

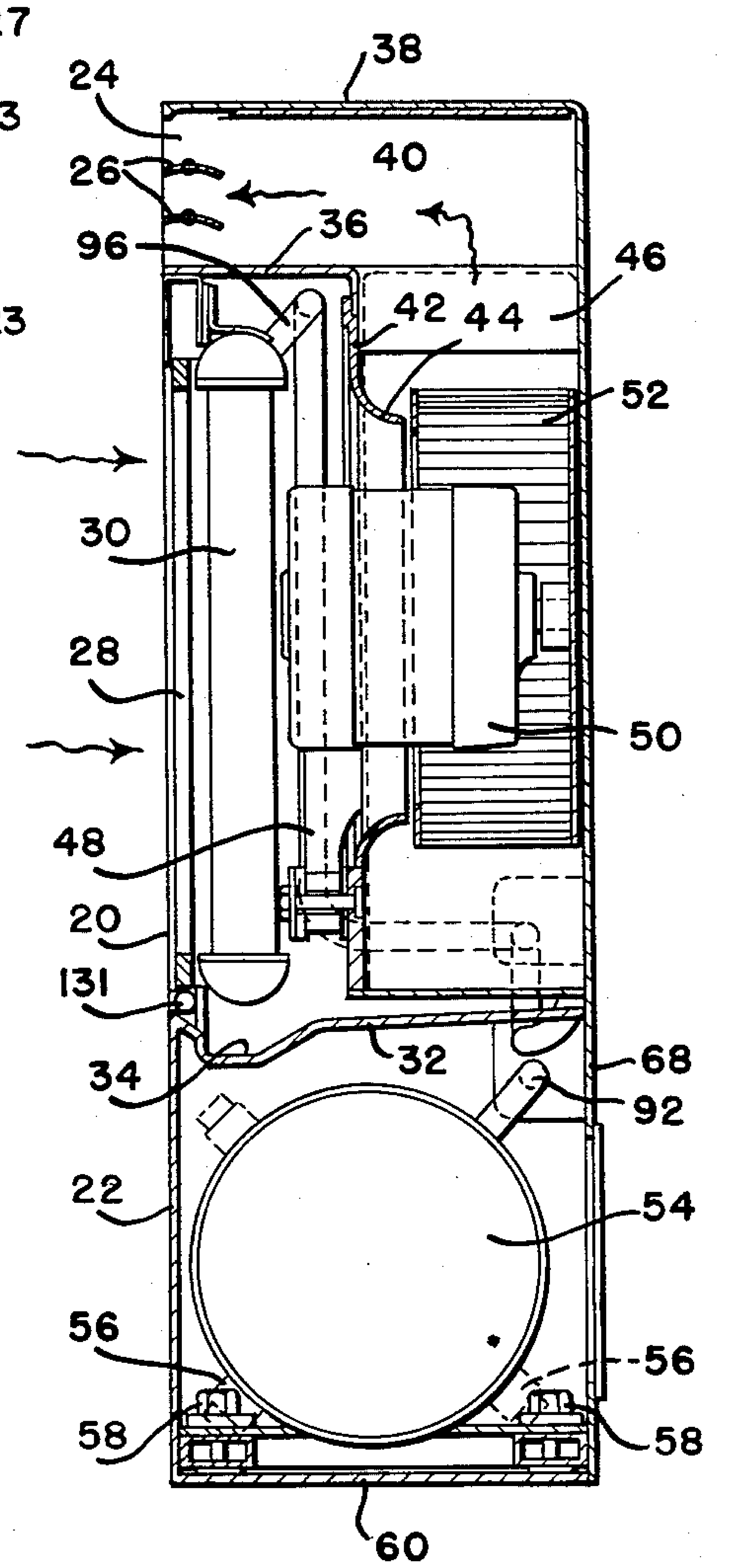

Fig. 2

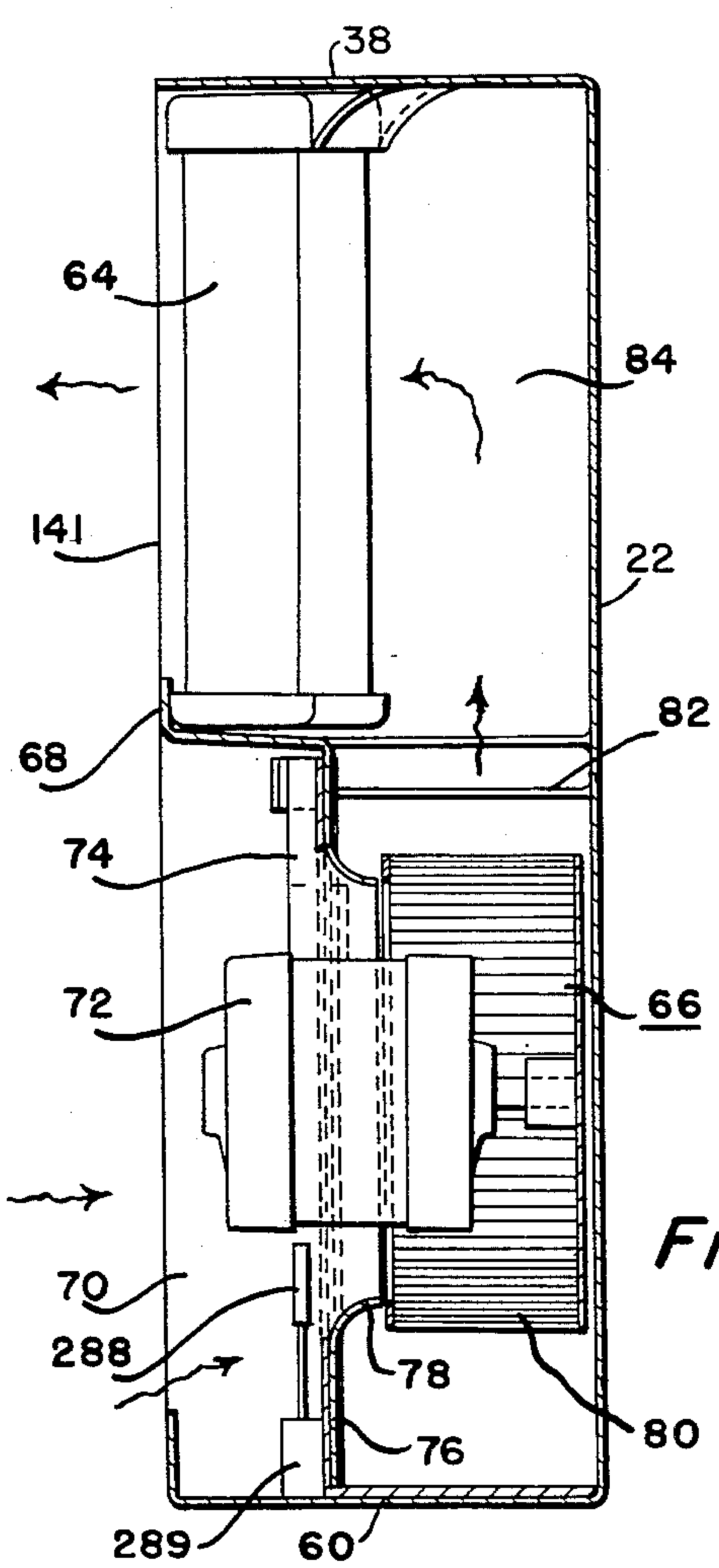

Fig. 3

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AIR CONDITIONER ELEMENT ARRANGEMENT

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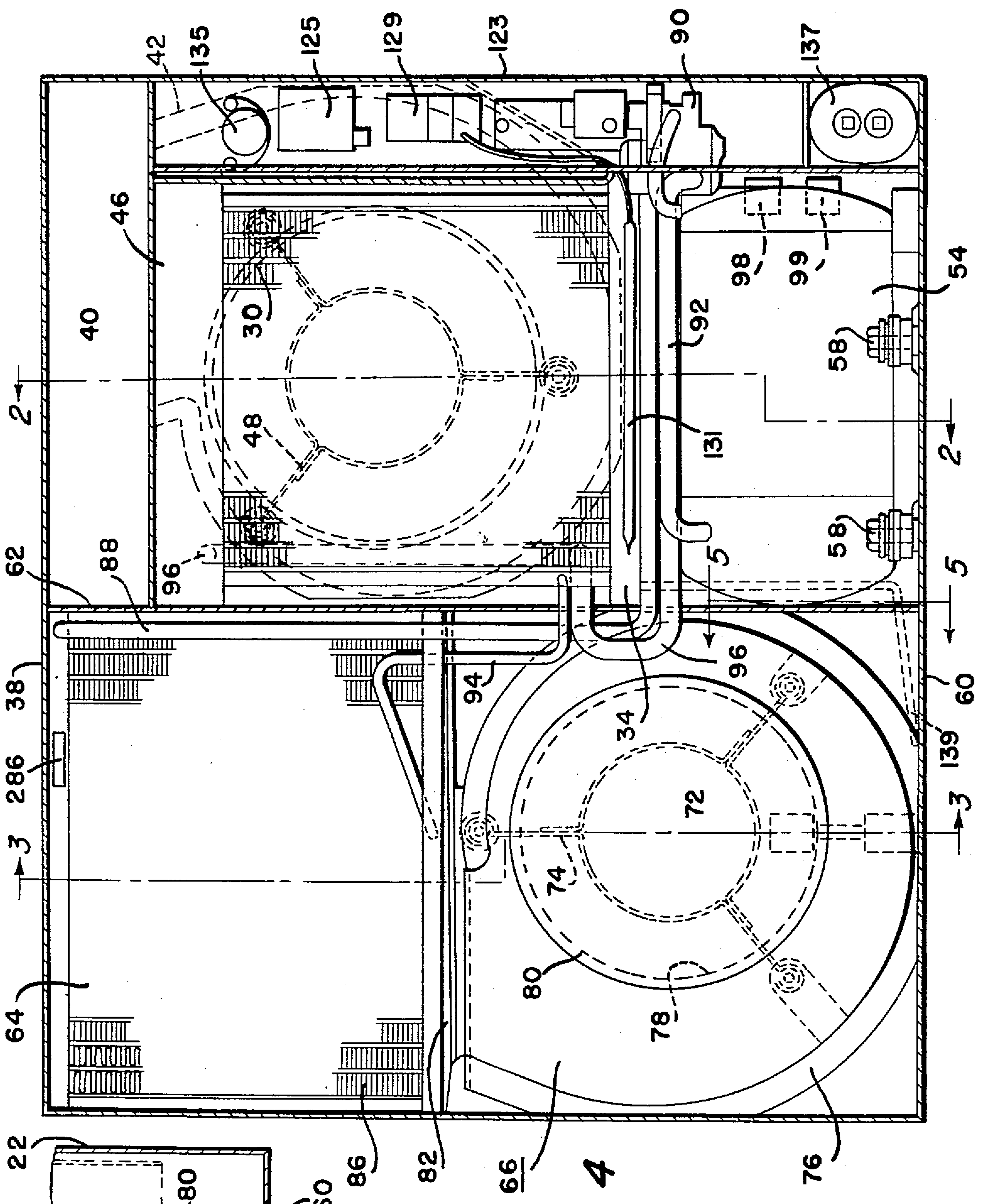

Fig. 4

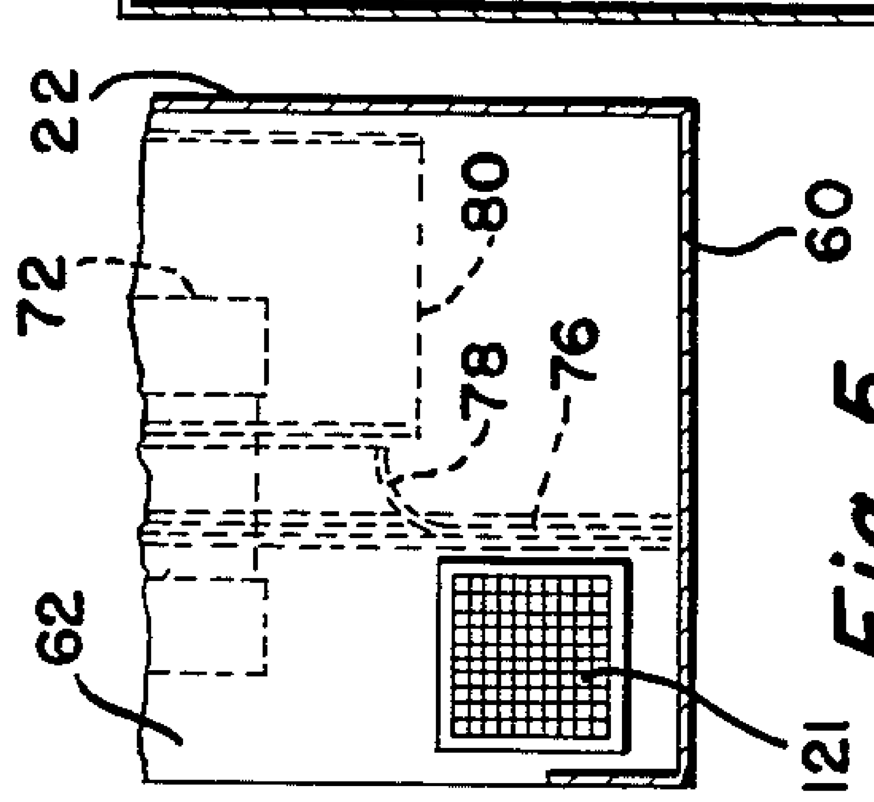

Fig. 5

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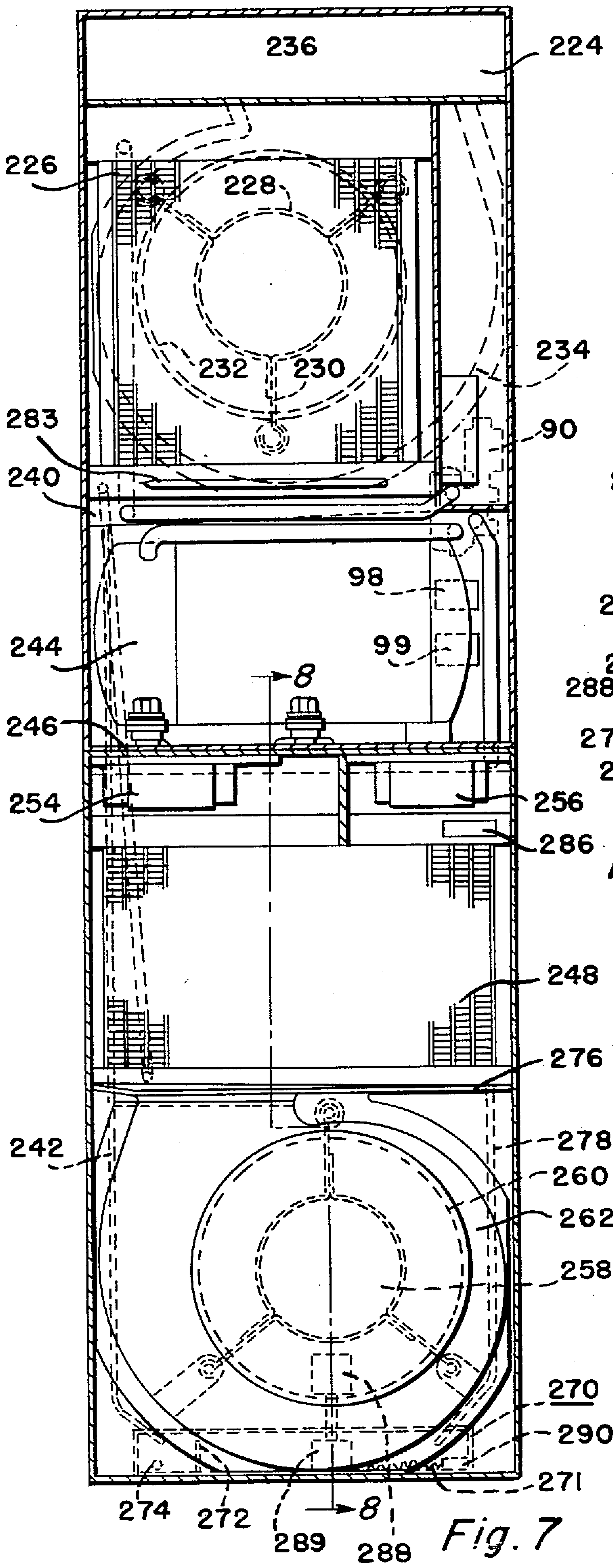

Fig. 7

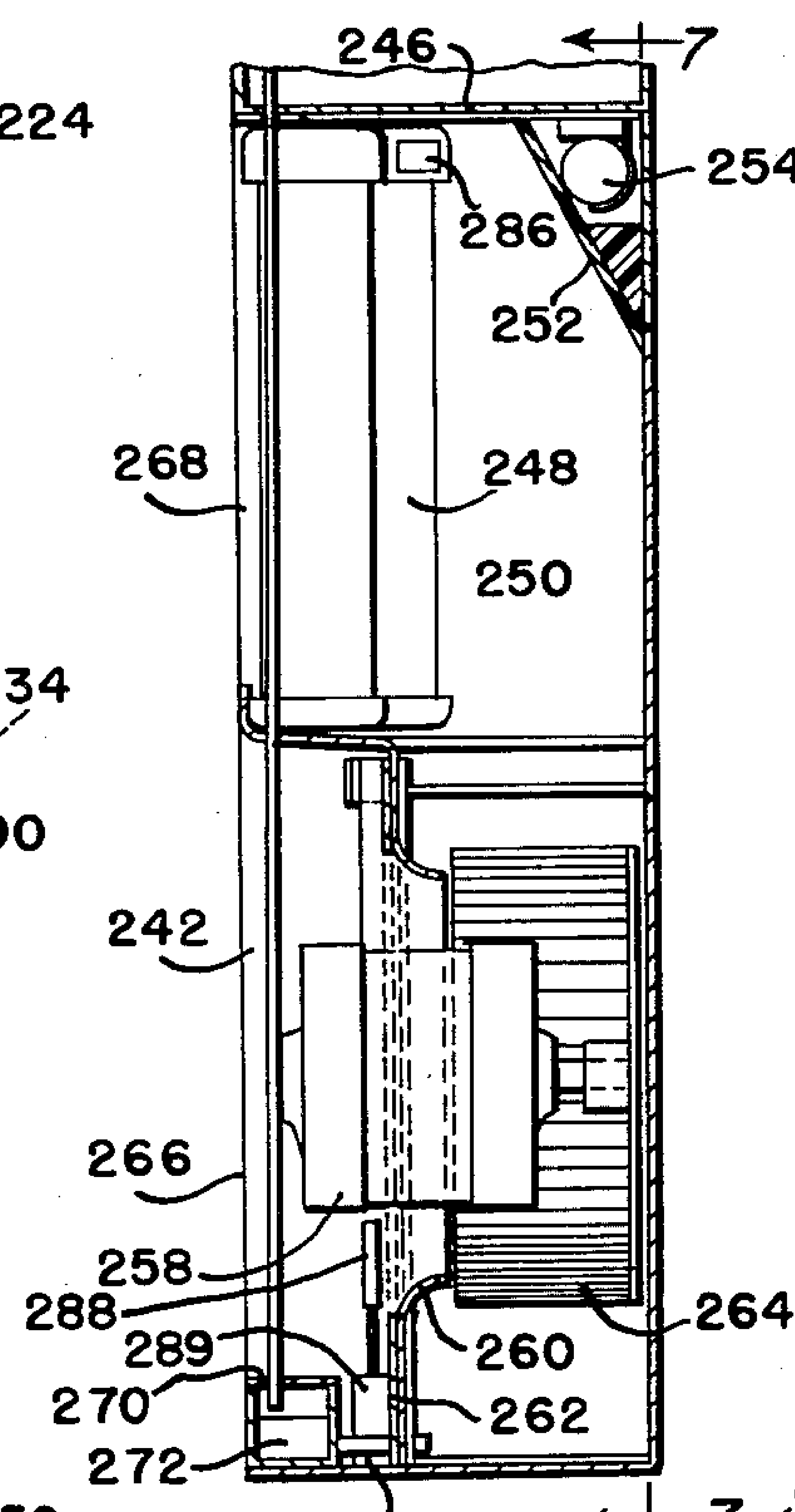

Fig. 8

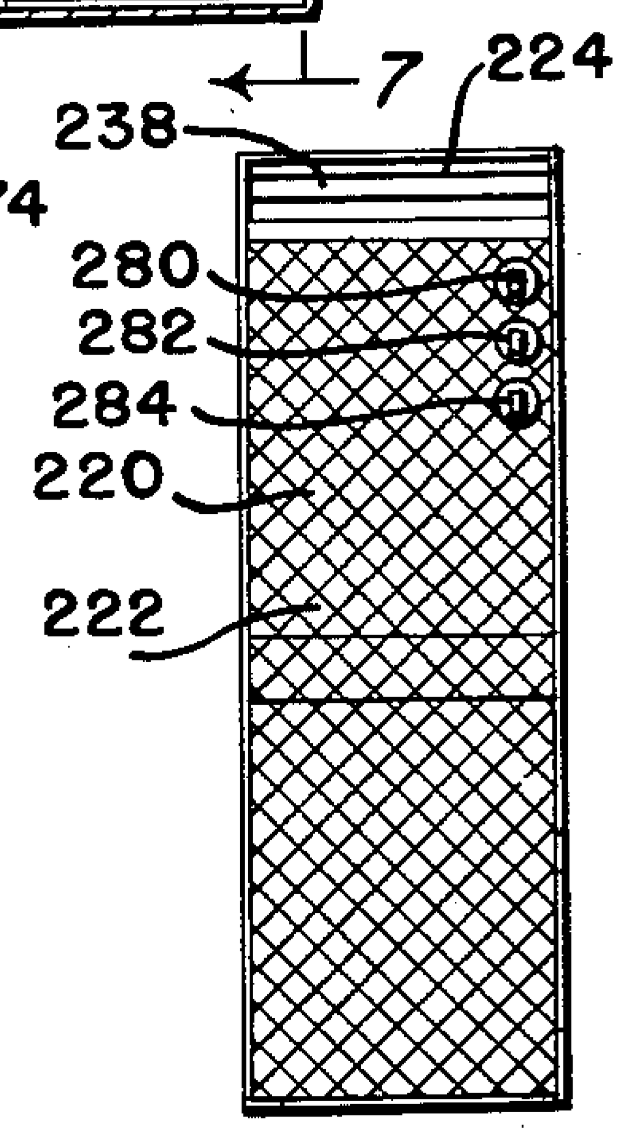

Fig. 6

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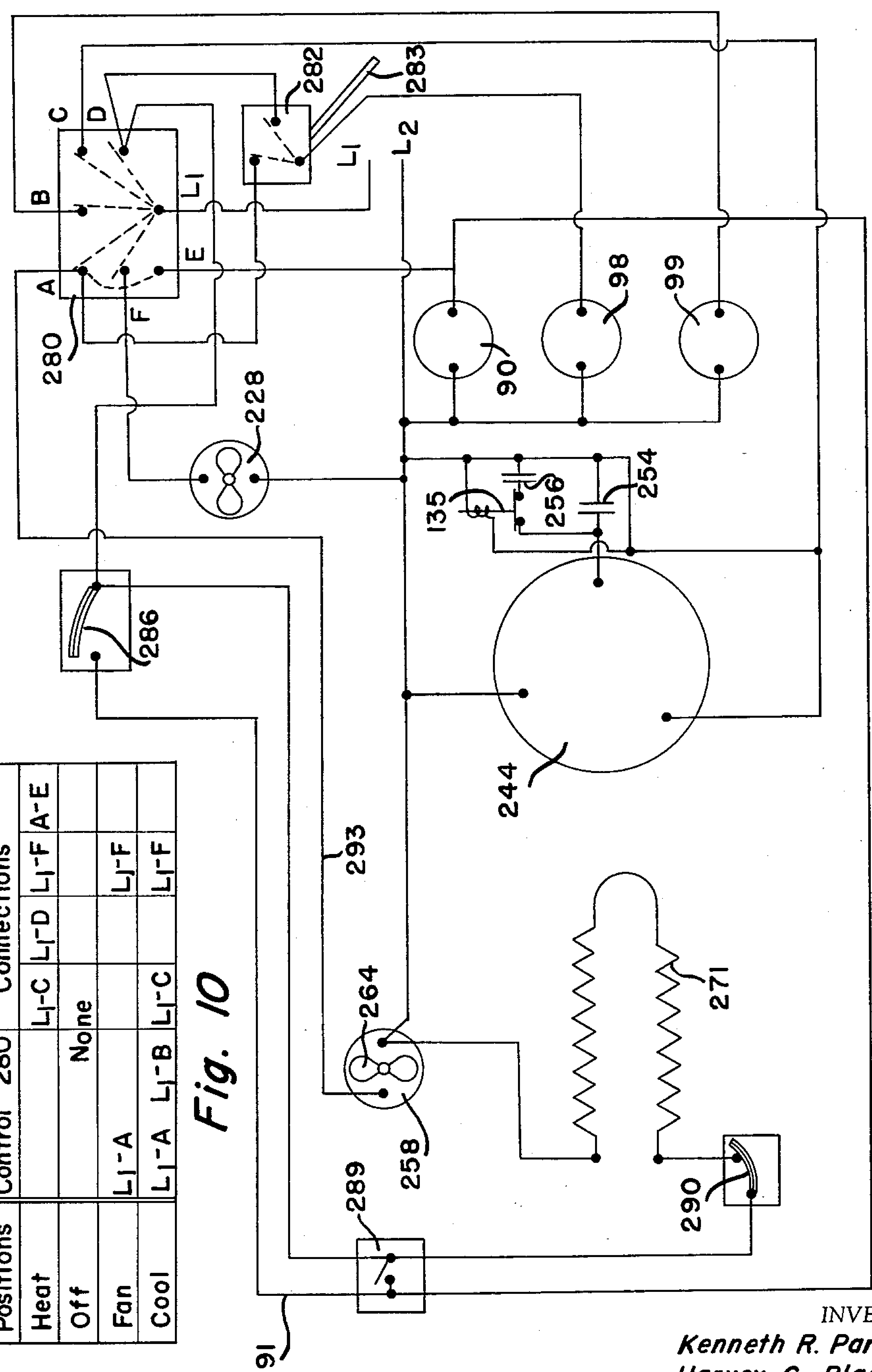

Fig. 9

Positions	Control 280 Connections
Heat	L1-C, L1-D, L1-F, A-E
Off	None
Fan	L1-A, L1-F
Cool	L1-A, L1-B, L1-C, L1-F

Fig. 10

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United States Patent Office 2,952,994
Patented Sept. 20, 1960

2,952,994

AIR CONDITIONER ELEMENT ARRANGEMENT

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Filed Sept. 26, 1957, Ser. No. 686,436

5 Claims. (Cl. 62—285)

This invention relates to refrigerating apparatus and more particularly to ultra-thin room conditioners which may be located entirely within the room or sunk partially between the two normally spaced and sized studs.

It is an object of this invention to so construct the indoor coil, the outdoor coil and motor-compressor unit and to so arrange the blowers and controls that a one-ton room air conditioner may be made less than 8" thick.

It is another object of this invention to so construct a room air conditioner that a substantial portion may be located between two normally spaced and sized studs with only a minor portion projecting out into the room.

These and other objects are attained in the forms shown in the drawings in which the blower motors are placed partially within the blowers or fans for both the outdoor coil and the indoor coil. The outdoor coil and the indoor coil are each of the ultra-thin wire fin type. The sealed motor-compressor unit is made long, thin and compact so as to fit the space immediately beneath the indoor coil and its blower. The blower for the indoor coil is located immediately behind it and discharges through a duct extending over the indoor coil. The outdoor coil blower is located beneath and discharges through a vertical duct behind the outdoor coil, forcing the air to flow out through the outdoor coil. The outdoor coil and its blower may be located at the side of the indoor coil and blower and motor-compressor unit or the indoor coil and blower and motor-compressor unit may be arranged above the outdoor coil and its blower so that the unit is narrow enough to be sunk in between standard studding.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein preferred forms of the present invention are clearly shown.

In the drawings:

Figure 1 is a front view of a room air conditioner embodying one form of our invention;

Figure 2 is an enlarged vertical sectional view taken along the line 2—2 of Figures 1 and 4;

Figure 3 is an enlarged vertical sectional view taken along the line 3—3 of Figures 1 and 4;

Figure 4 is an enlarged front view of the conditioner with the front wall removed;

Figure 5 is a fragmentary vertical sectional view taken along the line 5—5 of Figure 4;

Figure 6 is a front view of the second narrow form of room conditioner;

Figure 7 is an enlarged front view, with the front wall removed, of the conditioner shown in Figure 6 taken along the line 7—7 of Figure 8;

Figure 8 is a fragmentary vertical sectional view taken along the line 8—8 of Figure 7;

Figure 9 is a wiring diagram of the control system for the second narrow form which is also applicable in greater part to the first form; and

Figure 10 is a connection chart for Figure 9.

Referring now more particularly to Figs. 1–4, there is shown a room air conditioner having the dimensions 28 x 24 x 7½". It includes a room air inlet **20** on the front wall **22** and a room air discharge **24** over the inlet **20** provided with adjustable horizontal louvers or deflectors **26**. The room air inlet is provided with a thin air filter **28** behind which is located a thin rectangular indoor coil **30** of the wire fin type mounted between a lower wall **32** provided with a trough **34** beneath the indoor coil and an upper wall **36** spaced below the top wall **38** of the cabinet to form the discharge duct **40**. Behind the indoor coil **30** is a scroll **42** having a front inlet opening **44** directly behind the indoor coil **30** and having an upper discharge outlet **46** discharging into the rear of the duct **40**, which extends forwardly to the discharge **24**. Connected to the scroll **42** is a three-armed support **48** which includes a band extending around the front of the fan motor **50**. The rear of the fan motor **50** is provided with a squirrel-cage type of blower wheel or fan **52** which may have either forward curved, straight or rearward curved blades. The air from the room is drawn through the filter **28**, and the indoor coil **30** through the opening **44** around the motor **50** into the interior of the blower wheel **52** from which it is discharged through the scroll **42** and the discharge opening **46** and the duct **40** forwardly through the opening **24** guided by the vanes or louvers **26**.

Beneath the wall **32** is a compact sealed motor-compressor unit **54** which is comparatively of small diameter and long along its cylindrical axis which is positioned horizontally. This sealed motor-compressor unit is provided with four legs **56** which are supported on vibration absorbing supports **58** fastened to the bottom wall **60** of the conditioner. A vertical wall **62** divides the indoor coil and blower compartment as well as the motor-compressor compartment beneath the wall **32** from the compartment containing the outdoor coil **64** and its blower **66**. The rear wall **68** of the conditioner has an outdoor air inlet opening **70** within which is located the fan motor **72** supported by the three-armed support **74** mounted upon the rear side of the blower scroll **76**. The blower scroll has an inlet opening **78** within which is located the fan motor **72**. The fan motor **72** also extends within the blower wheel **80** which may have either forwardly or rearwardly directed or straight blades. The blower scroll **76** is provided with an upward discharge opening **82** through which the air centrifuged by the fan **80** is discharged into the duct **84** providing space at the rear of the thin wire fin outdoor coil **64** which is positioned substantally parallel to and adjacent the rear wall **68**.

However, this outdoor coil is turned slightly from a true parallel position, as evident in Fig. 3, to provide room for the compressor discharge conduit **88** which extends from the reversing valve **90** adjacent the three-cylinder motor-compressor unit **54** alongside one vertical edge of the outdoor coil **64**. The reversing valve **90** is connected by the compressor discharge conduit to the outlet of the motor-compressor unit **54**. The bottom of the outdoor coil **64** is connected by a capillary refrigerant expansion tube **94** to the bottom of the indoor coil **30**. The top of the indoor coil **30** is connected by the suction conduit **96** to the reversing valve **90** and then to the compressor inlet by the suction conduit **92**. The motor-compressor unit **54** may be provided with solenoids **98** and **99** each of which removes different cylinders from operation. To provide increased ventilation for the sealed motor-compressor unit **54**, the lower rear portion of the wall **62** may be provided with a small grille **121** as shown in Fig. 5 located behind the blower scroll **76**.

At the right side of the cabinet 123 there is provided an off-on, heat and fan control 125 for providing either refrigeration operation or reverse cycle heating through the reversing action of the reversing valve 90 or for operation of the indoor fan 52 and its motor without refrigeration. This control 125 is controlled by the knob 127, as shown in Fig. 1. There is also provided beneath the control 125 a thermostatic switch 129 connected by a capillary tube to the thermostat bulb 131 located in the room air inlet 20 directly below the filter 28 so as to be directly responsive to the temperature of the air being drawn from the room. The thermostat 129 cycles the refrigerating system according to the room air temperature. The thermostatic control 129 is provided with an adjusting knob 133 immediately below the knob 127. There is also provided a starting relay 135 for the sealed motor-compressor unit 54 located above the control 125 and a running capacitor 137 located below the reversing valve 90 for the sealed motor-compressor unit 54.

The indoor coil 30, during normal refrigeration, condenses moisture from the air flowing through it from the room and this moisture is collected in the trough 34 formed in the wall 32. This moisture is drained from the trough 34 by conduit 139 which extends into the scroll 76 of the outdoor blower 66. The air flowing through the scroll picks up this moisture and carries it to the warm outdoor coil 64 where it evaporates into the air which is discharged outside the room through the opening 141 in the rear wall.

Referring now more particularly to Figs. 6–8, there is shown an air conditioner having the dimensions of 48 x 14 x 7½". This size enables it to be recessed in the wall between two standard studs spaced 16" apart. In effect, the general arrangement is that the right side of the conditioner shown in Figs. 1–5, specifically that part to the right of the wall 62, is placed above the part on the left side of the wall 62. The room air inlet 220 is located behind the upper portion of a grillework 222 which extends from the room air discharge opening 224 at the top to the bottom of the cabinet. The room air inlet opening leads directly to a thin rectangular wire finned indoor coil 226 behind which is the indoor blower motor 228 supported by the three-armed support 230 in the opening 232 of the indoor blower scroll 234 which contains a blower wheel driven by the motor 228. The scroll 234 discharges into the duct 236 above, which connects directly with the room air discharge opening 224. This discharge opening 224 is provided with adjustable louvers 238 similar to the louvers 26.

Beneath the indoor coil 226 is a moisture collecting trough 240 provided with a drain 242 extending downward to the outdoor fan compartment. Directly beneath the indoor coil and fan is the sealed motor-compressor unit 244 arranged with its axis horizontally. It is supported upon rubber mountings fastened to the horizontal wall 246. The rear wall of the cabinet may have grillework at the rear of the sealed motor-compressor unit 244. The entire portion of the cabinet above the wall 246 may be substantially the same as shown in Fig. 2.

Beneath the wall 246 is the outdoor coil 248 having behind it a duct 250. The duct 250 has a beveled upper wall portion 252 providing space for the starting capacitor 254 and the running capacitor 256 as well as the starting control 135 (Fig. 9). Beneath the outdoor coil 248 is the outdoor fan motor 258 located in the opening 260 in the fan scroll 262. The motor is connected to the squirrel-cage type centrifugal fan 264 which draws the air from outside the room through the rear inlet opening 266 around the motor 258 in through the opening 260 into its interior and discharges the air through the scroll 262 and the duct 250 to force the air through the outdoor coil 248 and the rear outlet 268 outside the room to keep the outdoor coil cool.

The condensate from the indoor coil 226 during room cooling drains into the box-shaped container 270 shown in Figs. 7 and 8 provided with a low dividing wall 272 adjacent one end. A discharge pipe 274 extends from the chamber at this end of the container 270 into the interior of the scroll 262 where the moisture will be carried by the air flowing therein to the outdoor coil 248. The low dividing wall 272 prevents the condensate from flowing into the remaining portion of the container 270. There is also provided a collecting trough 276 beneath the outdoor coil 248 from which the excess is drained through the conduit 278 into the large chamber of the container 270. This large chamber 270 is provided with an electric heater 271 for evaporating any defrost water collecting therein from the outdoor coil 248 whenever defrosting is necessary during reversed cycle heating. This evaporated moisture travels up through the drain tube 242 to the room air circuit adjacent the indoor coil 226 to humidify the room air.

The conditioner is provided with a control 280 providing cooling or heating or fan operation. It is also provided with a combined heating and cooling thermostat 282 operated in accordance with the temperatures of the bulb 283 responsive to the temperature of the air drawn from the room into the indoor coil 226. There is also a third control 284 for operating the fresh air door (not shown) to admit a supply of fresh air from the outdoor air circuit into the indoor air circuit. The heating and cooling thermostat 282 controls the energization of the modulating valve 98 to modulate the capacity of the compressor 244. The modulating valve 99 is only actuated during the cooling period to reduce the compressor capacity. The modulating valves 98 and 99 each disable one of the cylinders of the three-cylinder compressor.

The defrosting of the outdoor coil 248 during room heating is controlled by the paddle-shaped air drag member 288 located adjacent the inlet opening 260 to the fan 264 and is lightly spring biased to the left to close the switch 289 by means of 288. This paddle-shaped member 288 is normally drawn to the right, as viewed in Fig. 8, by the air drawn into the fan 264 to hold the air drag switch means 289 closed to energize the reversing valve 90 to reversed cycle position during the operation of the fan 264 under normal conditions when the control 280 is in the heating position. However, when the outdoor coil 248 becomes clogged with frost, the air flow to the fan 264 will diminish and the paddle-shaped air drag member 288 will move to the left to open the switch 289 to simultaneously deenergize the outdoor fan motor 258 and the valve 90 to initiate a defrosting cycle by restoring the refrigerating system to normal operation.

This switch 289 is connected in parallel with an outdoor coil thermostatic switch 286 which is mounted upon the outdoor coil 248 and calibrated to be closed above 100° F. and to reopen at 60° F.

The control 280 is provided with the connections shown in Fig. 10 for the four positions, "heat," "off," "fan" and "cool." At the start of the room heating operation, both the coil thermostat 286 and the air drag switch 289 will be open, so that the reversing valve 90 and the outdoor fan motor 258 will be deenergize. The motor compressor unit 244 will be energized through the connection L_1—C for normal room cooling. The indoor fan motor 228 is energized through the connection L_1—F. The defrost heater 271 is energized through the connection L_1—D. In the "heat" position the outdoor fan 258 and the reversing valve 90 are not energized until the outdoor coil 248 reaches 100° F. to close the coil thermostatic switch 286. This closing energizes the conductor 291 and the reversing valve 90 and through the connection E—A and the conductor 295, the outdoor fan motor 258. Under frost-free conditions, the operation of the outdoor fan 264 will cause sufficient air drag upon the member 288 to close the switch 289.

The operation of the refrigerating system as a reverse cycle heating system will continue until the condenser coil 248 becomes frosted sufficiently that the air drag upon the paddle member 288 will diminish sufficiently that the switch 289 will open. This deenergizes the reversing valve 90, causing the system to operate as a normal refrigerating system for cooling purposes, in which the outdoor coil 248 again becomes a condenser and the indoor coil 226 operated as an evaporator. The outdoor coil 248 will then heat rapidly and as it is heated, frost will melt therefrom and when substantially defrosted, will allow the outdoor coil to become heated. The coil thermostat 286 will remain open until the condenser temperature reaches 100° F. The closing of the coil thermostat 286 will terminate the defrosting period and reenergize the reversing valve 90 to resume the reversed cycle heating and start the outdoor fan. The defrost water will be collected in the container 276 and flow down through the tube 278 into the container 270 where the defrost water will be heated and evaporated by the heater 271. This defrost water evaporating heater 271 will be cycled by the thermostatic switch 290 which is set to open at 220° F. and to reclose at 150° F. The vapor will ascend through the drain tube 242 into the evaporator compartment for delivery into the room air circuit to humidify the room.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. An ultra thin compact rectangular air conditioner positioned between two extensive closely spaced upright planes including an upright partition wall extending between said spaced planes, a thin evaporator positioned generally parallel to said planes between said planes on the first side of said partition wall, a first centrifugal motor blower located on the first side of said partition wall between one of said planes and said evaporator and having its axis of rotation substantially perpendicular to said planes and having its impeller partially surrounding its motor, duct means extending on the first side of said partition wall between said planes connecting said blower with the adjacent face of said thin evaporator, a thin condenser operably connected to said evaporator located on the second side of said partition wall between said planes and substantially parallel to said planes, a second centrifugal blower located on the second side of said partition wall between said planes in vertical alignment with said condenser, duct means extending on the second side of said partition wall between said planes connecting said second blower and one face of said condenser, and a compressor located on the first side of said partition wall operably connected to said condenser and evaporators and located in vertical alignment with said evaporator and said first blower between said planes.

2. An ultra thin compact rectangular air conditioner including a thin rectangular box shaped cabinet having top and bottom walls and an upright partition wall extending from the top to the bottom wall and two extensive closely spaced parallel upright walls each having an air inlet opening and an air outlet opening, one of said parallel walls having its openings on a first side of said partition wall and the other having its openings on the second side of said partition wall, a thin upright evaporator located between said walls substantially in alignment with the opening on the first side of said partition wall in one of said parallel walls, duct means extending between said walls on the first side of said partition wall connecting said evaporator and the other opening on the first side of said partition wall in said one wall, evaporator fan means on the first side of said partition wall between said walls for circulating air through said evaporator and duct means and said openings in said one wall, the openings in the other wall being located on the second side of said partition wall, a thin upright condenser operably connected to said evaporator located on the second side of said partition wall between said walls substantially in alignment with one of said openings in said other wall, a centrifugal blower having its axis of rotation perpendicular to said other wall and being located on the second side of said partition wall between said walls substantially in alignment with the other of said openings, and a motor-compressor unit located on the first side of said partition wall between said walls operably connected to said evaporator and condenser.

3. An ultra thin air conditioner positioned between two extensive closely spaced upright planes including an upright partition wall between said planes, a thin evaporator positioned generally parallel to said planes between said planes on the first side of said partition wall, a centrifugal motor blower located on the first side of said partition wall between one of said planes and said evaporator and having its axis of rotation substantially perpendicular to said planes and having its impeller partially surrounding its motor, duct means extending on the first side of said partition wall between said planes connecting said blower with the adjacent face of said thin evaporator, a thin condenser operably connected to said evaporator located on the second side of said partition wall between said planes and substantially parallel to said planes, a second centrifugal motor blower having its impeller partially surrounding its motor located on the second side of said partition wall between said planes beneath said condenser, duct means extending on the second side of said partition wall between said planes connecting said second blower and one face of said condenser, and a motor-compressor unit located between said spaced planes on the first side of said partition wall beneath said evaporator and said first mentioned blower and being operably connected to said condenser and evaporator, a lateral partition wall above said motor-compressor unit separating said unit from said evaporator and its blower and duct means, said upright partition wall having an opening beneath said lateral partition wall for cooling said motor-compressor unit.

4. An ultra thin compact rectangular air conditioner including a thin rectangular box shaped cabinet having top and bottom walls and an upright partition wall extending from the top to the bottom wall and two extensive closely spaced parallel upright walls each having an air inlet opening and an air outlet opening, one of said parallel walls having its openings on a first side of said partition wall and the other having its openings on the second side of said partition wall, a thin upright evaporator located between said walls substantially in alignment with the opening on the first side of said partition wall in one of said parallel walls, duct means extending between said walls on the first side of said partition wall connecting said evaporator and the other opening on the first side of said partition wall in said one wall, evaporator fan means on the first side of said partition wall between said walls for circulating air through said evaporator and duct means and said openings in said one wall, the openings in the other wall being located on the second side of said partition wall, a thin upright condenser operably connected to said evaporator located on the second side of said partition wall between said walls substantially in alignment with one of said openings in said other wall, a centrifugal blower having its axis of rotation perpendicular to said other wall and being located on the second side of said partition wall between said walls substantially in alignment with the other of said openings, a motor-compressor unit located on the first side of said partition wall between said walls operably connected to said evaporator and condenser, a laterally extending partition wall located above said motor-compressor unit having a trough beneath the evaporator for collecting condensed moisture dripping from the evaporator, and conduit means extending from said trough

to the interior of said centrifugal blower to dissipate the moisture into the air circulated by the blower.

5. An ultra thin compact rectangular air conditioner including a thin rectangular box shaped cabinet having top and bottom walls and an upright partition wall extending from the top to the bottom wall and two extensive closely spaced parallel upright walls each having an air inlet opening and an air outlet opening, one of said parallel walls having its openings on a first side of said partition wall and the other having its openings on the second side of said partition wall, a thin upright evaporator located between said walls substantially in alignment with the opening on the first side of said partition wall in one of said parallel walls, duct means extending between said walls on the first side of said partition wall connecting said evaporator and the other opening on the first side of said partition wall in said one wall, evaporator fan means on the first side of said partition wall between said walls for circulating air through said evaporator and duct means and said openings in said one wall, the openings in the other wall being located on the second side of said partition wall, a thin upright condenser operably connected to said evaporator located on the second side of said partition wall between said walls substantially in alignment with one of said openings in said other wall, a centrifugal blower having its axis of rotation perpendicular to said other wall and being located on the second side of said partition wall between said walls substantially in alignment with the other of said

openings, a motor-compressor unit located on the first side of said partition wall between said walls operably connected to said evaporator and condenser, said cabinet having upright side walls, said evaporator being spaced from the adjacent side wall to provide a space for controls, control means for said motor-compressor unit and said evaporator fan means and said blower located in said space between said evaporator and said adjacent side wall, said evaporator fan means including a blower scroll located behind the evaporator and control means and an impeller within the scroll and a motor located partially in and connected to the impeller.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 21,298	Nelson	Dec. 12, 1939
1,961,597	Roland	June 5, 1934
1,984,054	Carraway	Dec. 11, 1934
2,324,313	Meyerhans	July 13, 1943
2,726,518	Brugler	Dec. 13, 1955
2,728,197	Ellenberger	Dec. 27, 1955
2,730,873	Hardin	Jan. 17, 1956
2,736,176	Carlton	Feb. 28, 1956
2,737,787	Kritzer	Mar. 13, 1956
2,739,451	Breck	Mar. 27, 1956
2,744,389	Raney	May 8, 1956
2,810,273	Bilgrei	Oct. 22, 1957