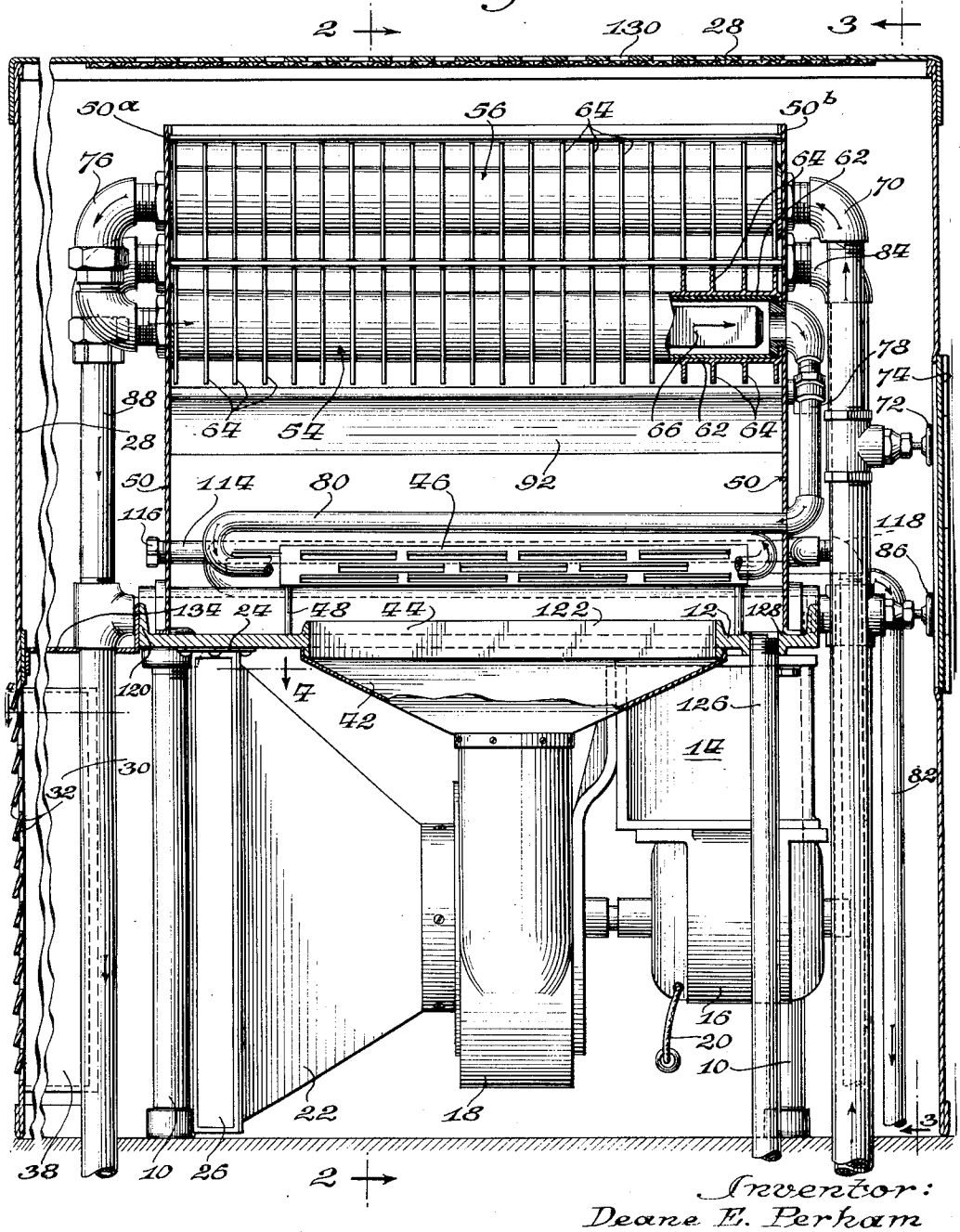
Jan. 9, 1940. D. E. PERHAM 2,186,145

AIR CONDITIONING APPARATUS

Filed July 6, 1936 4 Sheets-Sheet 1

Fig. 1



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AIR CONDITIONING APPARATUS

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Fig. 2

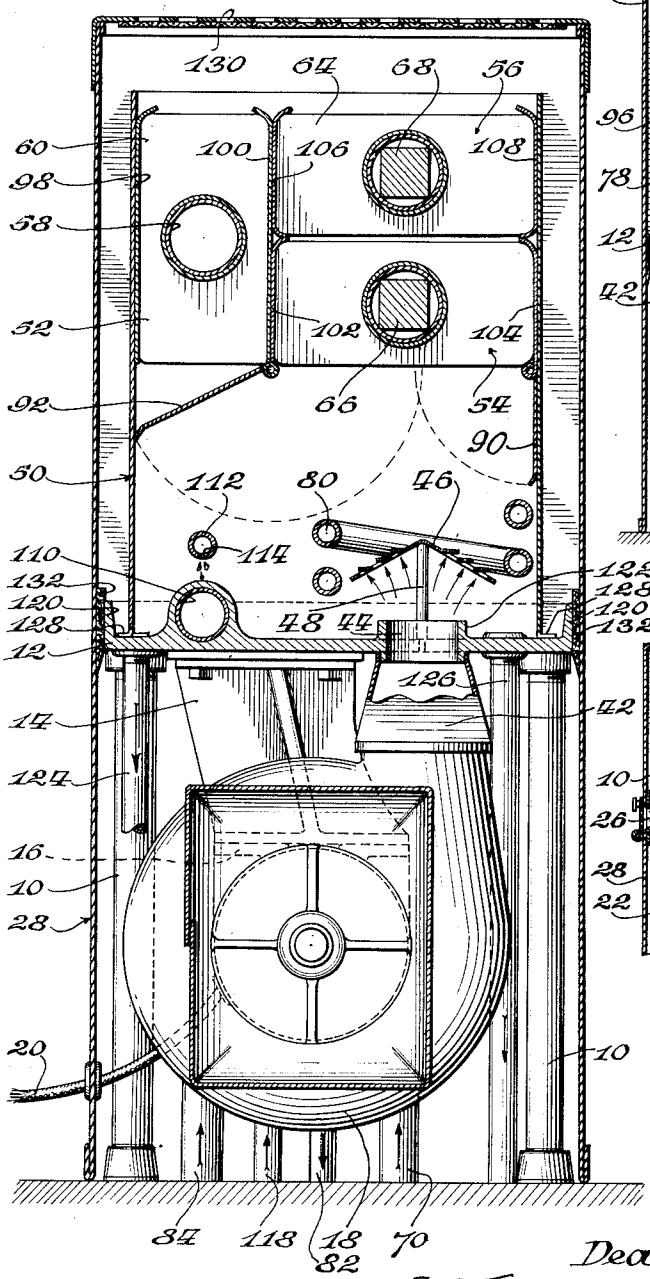


Fig. 3

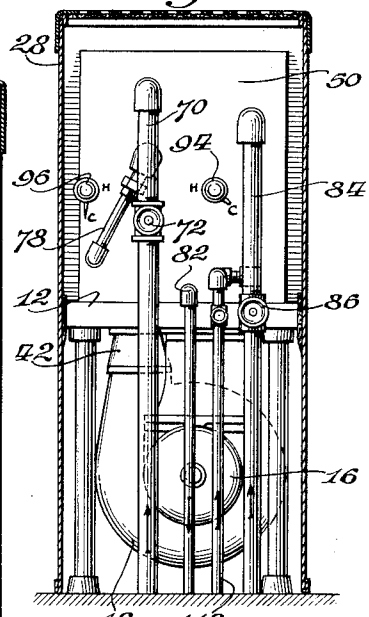
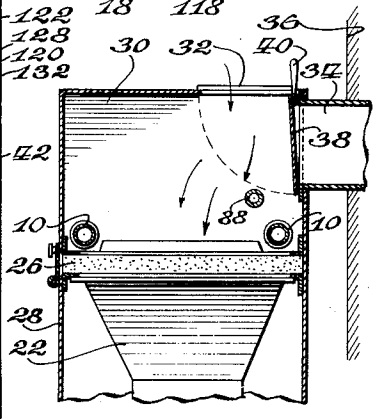


Fig. 4



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Jan. 9, 1940. D. E. PERHAM 2,186,145

AIR CONDITIONING APPARATUS

Filed July 6, 1936 4 Sheets-Sheet 3

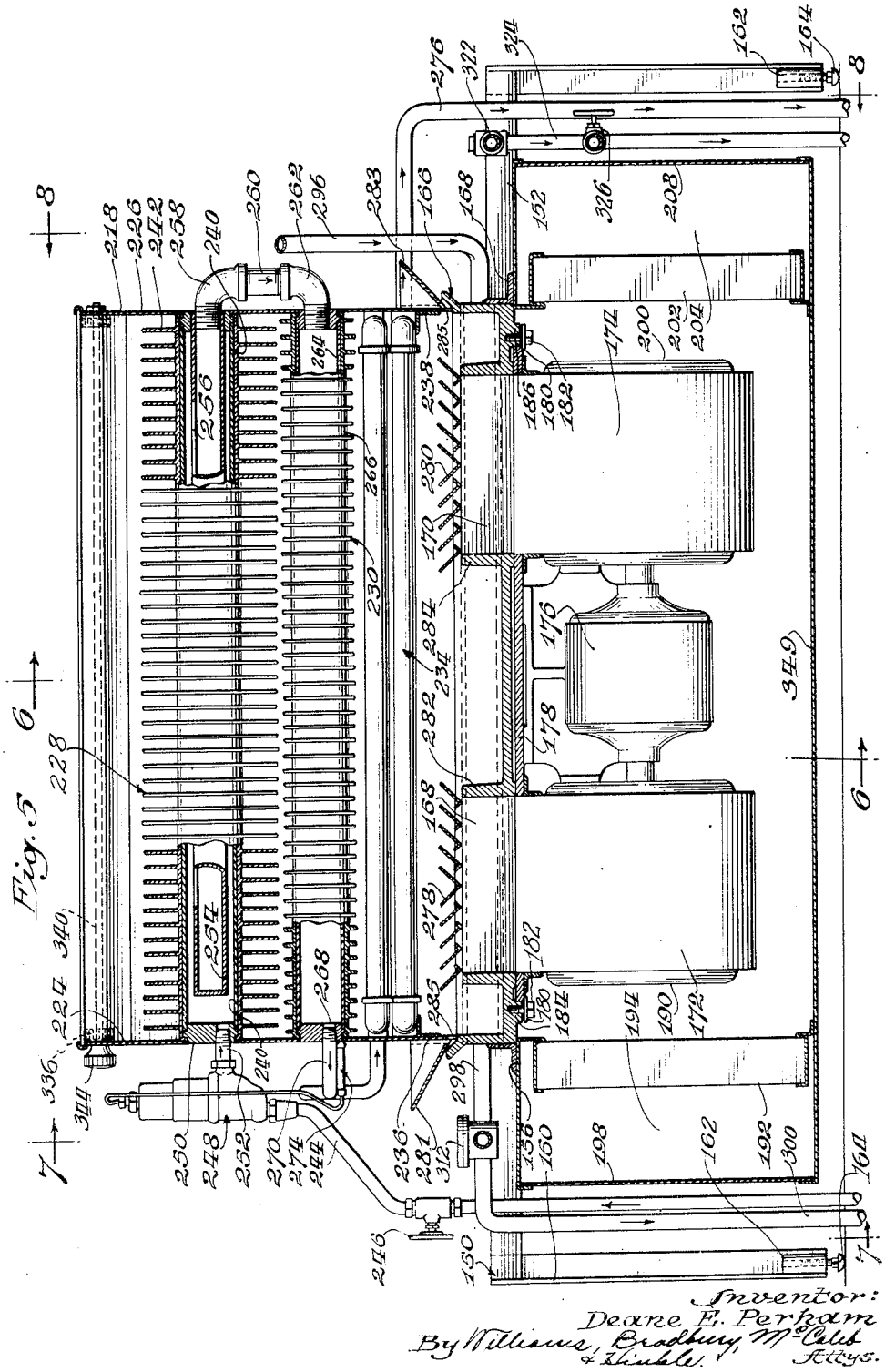

Fig. 5

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AIR CONDITIONING APPARATUS

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Fig. 9

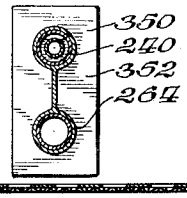


Fig. 6

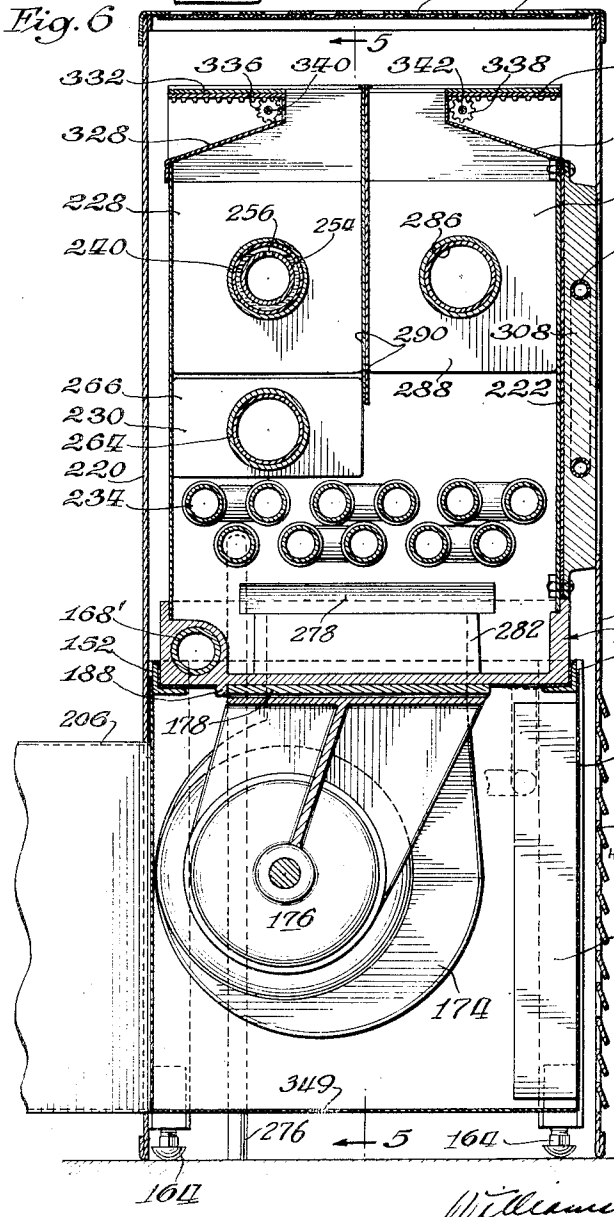
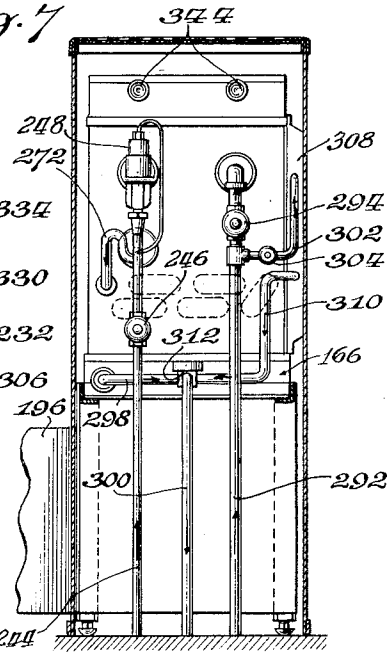


Fig. 7



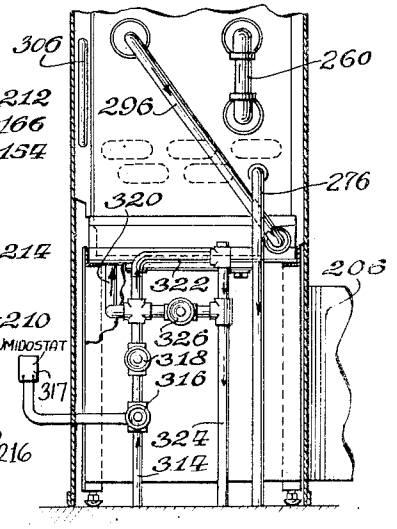


Fig. 8

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UNITED STATES PATENT OFFICE

2,186,145

AIR CONDITIONING APPARATUS

Deane E. Perham, Chicago, Ill.

Application July 6, 1936, Serial No. 89,148

32 Claims. (Cl. 257—9)

My invention pertains to air conditioning apparatus and is particularly concerned with the provision of a unit adapted to be placed in the room of a dwelling or office building to heat, cool, humidify, dehumidify, circulate, cleanse and/or replace the air therein.

An object of my invention is to provide a unit which is more compact and efficient than those now in use.

Another object is to provide an air conditioning unit which is simple and economical to make and which will give long, trouble-free service.

Another object is to provide an air conditioning unit having a more efficient heating means than any heretofore used.

Another object is to provide an air conditioning unit having means for the direct radiation of heat.

Another object is to provide improved means for directing the air against the heating and cooling elements for the purpose of promoting efficiency.

Another object is to provide an air conditioning unit having a more efficient cooling means than any heretofore used.

Another object is to provide improved means for cleansing and circulating air whereby the unit is prevented from becoming clogged with dirt and whereby the air in the room is maintained free from dust and dirt.

Another object is to provide a unit wherein the means for cleansing the air can be readily replaced at periodic intervals.

Another object is to provide improved and more efficient means for moistening the air passing through the unit.

Another object is to provide improved control means whereby the unit may be adjusted to produce any desired atmospheric condition in the room in which it is located.

Another object is to provide a unit wherein all parts are readily accessible for adjustment or inspection.

Other objects and advantages will become apparent as the description proceeds.

This application is a continuation in part of my earlier application, Serial No. 723,697, filed May 3, 1934.

In the drawings,

Figure 1 is a vertical section through an air conditioning unit embodying my invention;

Figure 2 is a vertical section taken at right-angles to the section shown in Figure 1, the section of Figure 2 being taken on the line 2—2 of Figure 1;

Figure 3 is a reduced section similar to the section shown in Figure 2 but taken on the line 3—3 of Figure 1;

Figure 4 is a horizontal section taken on the line 4—4 of Figure 1 and showing the means for controlling the admission of air to the blower;

Figure 5 is a longitudinal vertical section of an improved form of my invention, showing the cover removed, and is taken on the line 5—5 of Figure 6;

Figure 6 is a transverse vertical section of the form of my invention shown in Figure 5 and is taken on the line 6—6 of Figure 5;

Figure 7 is a reduced vertical section taken on the line 7—7 of Figure 5;

Figure 8 is a partial vertical section taken on the line 8—8 of Figure 5; and

Figure 9 shows a modified form of cooling element.

Referring to Figures 1 to 4, inclusive, of the drawings, I have illustrated a form of my invention as having four tubular legs 10 supporting an aluminum casting 12, on the lower side of which is bolted a base 14 carrying an electric motor 16 and a sirocco type of blower 18 which is driven by the motor 16. The motor 16 is supplied with current through a conductor 20 which may be plugged into a socket connected with the lighting circuit of the building in which the unit is located or with any other suitable source of electrical power.

The blower 18 is provided with an inlet duct 22 bolted to or otherwise supported from the casting 12, as indicated at 24 (Figure 1). The inlet end of the duct is formed to receive and hold in place an air cleaner 26 which is preferably formed as a square cartridge which may be readily removed and replaced by a similar fresh cartridge by simply removing the cover 28 which encloses the entire unit.

The duct 22 communicates with a chamber 30 into which air from the room may be drawn through a grilled opening 32 formed in the cover 28. I contemplate that my air conditioning unit may be located adjacent an outside wall of a building, and in Figure 4 I have shown a passageway 34 leading through the wall 36 to the outside air.

A damper 38 is mounted on hinges carried by the inner end of the wall of the passageway 34 and is manipulated by means of a handle 40, whereby the damper 38 may be moved from the position shown to a position closing the grilled inlet 32, or to any intermediate position therebetween, so as to have any desired blending of out-

side air with room air. The handle 40 is provided with any suitable ratchet or friction mechanism for maintaining the damper 38 in adjusted position. This handle 40 projects through a horizontal slot in the cover 28 when the handle is in the position shown in Figure 4. When it is desired to remove the cover 28, the handle 40 is turned until it lies along the wall of the passageway 34, whereupon the cover may be lifted off of the unit.

The air cleaner 26 removes all particles of dust and dirt from the air, whether this air come from the outside or be drawn in from the room, or both. This insures only clean air being forced through the air conditioning unit and thus prevents the parts of the unit, and particularly the heating and cooling elements thereof, from becoming coated with a layer of dust or dirt which would materially interfere with the interchange of heat between the air and the heating and cooling elements.

The blower 18 is provided with an elongated outlet 42 which communicates with the elongated opening 44 provided in the casting 12. Above the opening 44 is a cover 46 having air distributing openings therein. This cover 46 performs the dual function of preventing drippage of moisture from the cooling coils into the fan outlet and also of properly distributing the air to the heating and cooling units. The cover 46 is supported and rigidly held in place by legs 48 screwed into or otherwise attached to the casting 12.

A rectangular sheet metal frame 50, which is open at the top and bottom, is supported on the casting 12. In the upper part of the frame 50 are mounted the heating element 52 and two cooling elements 54 and 56. The heating element 52 comprises a steel pipe 58 which is first coated with an alloy, after which it is placed in a mold and the fin-like aluminum structure 60 is then cast integrally therewith. The result is a cast integral unit providing a steel pipe which conducts the steam, hot water or other heating medium and which has sufficient strength and resistance to pressure to be entirely safe and to conform to all building law requirements.

The integral union between the steel pipe and the aluminum fin structure affords excellent heat transmitting qualities which result in rapid transmission of heat from the heating medium in the pipe to the aluminum fins. This characteristic of my improved heating element is increased by the particular design of aluminum fin structure which provides, as best shown in Figure 1, a substantially tubular aluminum body 62 which surrounds the steel pipe throughout its entire length and receives the maximum amount of heat therefrom. The heat received by this tubular body of aluminum is then rapidly transmitted to the tapered aluminum fins 64, from whence the heat is readily picked up by the passing air. As best shown in Figure 2, these fins are of generally rectangular shape, being preferably twice as long as they are broad.

The cooling elements 54 and 56 may be similarly formed except that in the cooling elements the central portions of the pipes contain cores 66 and 68, respectively, which reduce the stream of cooling medium from a solid column to what may be described as a thin shell which more readily absorbs heat.

While I have described the heating and cooling elements as including steel pipes about which the aluminum fin structure is cast, these pipes may, if preferred, be made of copper or any other suitable material which will form an effective heat transmitting bond with the aluminum structure cast thereabout. The pipes of these elements are provided with threaded ends which project through the end members 50a and 50b of the frame 50 and serve as supports for the heating and cooling elements.

The cooling elements are supplied with a cooling medium through supply pipes 70 provided with a control valve 72 which can be reached through a door 74 provided in the cover 28. The supply pipe 70 connects with one end of the pipe of the cooling element 68, and the other end of this cooling element is connected by means of a U-shaped pipe 76 with the adjacent end of the lower cooling element 54.

The right-hand end of the cooling element 54, as viewed in Figure 1, is connected to a pipe 78 leading to a coil 80 which surounds the cover 46 over the blower outlet. In normal operation all of the liquid cooling medium should be converted into vapor in the cooling elements 54 and 56, but any small quantities of this cooling medium which may escape vaporization in the elements 54 and 56 will be vaporized in the coil 80. This coil 80 functions as a super-heater for the cooling medium wherein the cold gas received from the cooling elements 54 and 56 is heated to substantially the temperature of the air passing through the entire unit before this gas is returned through pipe 82 to the refrigerating mechanism which is preferably located in the basement of the building.

This coil 80 also breaks up the stream of air received from the blower and distributes this air more evenly to the heating and cooling elements.

The heating element 58 is supplied with steam or hot water through a pipe 84 having a control valve 86 which may also be reached through the door 74 in the cover 28. The other end of the heating element connects with a return pipe 88 leading back to the furnace or other heating mechanism which is ordinarily located in the basement of the building.

It will, of course, be understood that the heating and cooling elements are not used at the same time but are used alternately, and I therefore provide other damper means whereby the air discharged from the blower may be passed over either the heating means or the cooling means. This other damper means comprises the dampers 90 and 92. The damper 90 is supported by a shaft which extends through and is carried by the end members 50a and 50b of the frame 50, and the damper 92 is similarly supported. These dampers are respectively adjusted by means of hand controls 94 and 96 which may be reached through the door 74. The hand controls 94 and 96 are provided with either ratchets or friction means to maintain the dampers in any adjusted position.

In unusual circumstances it may be desirable temporarily to pass part of the air over the heating means and part of the air over the cooling means. For example, if my air conditioning apparatus is being used to heat the air in the room and the room becomes too hot, the occupant might shift the damper 92 so that part of the air will pass over the heating element 52 and part will pass over the elements 54 and 56 which would not be functioning as cooling elements but would simply serve as a bypass to prevent heating of part of the air circulated by the blower. Similarly, if the air were being cooled and the room should suddenly become too cold, this condition

could be quickly overcome by bypassing part of the air over the element 52.

It is important that the air which passes over the heat exchange elements be so directed that the maximum exchange of heat takes place. Each of the heat exchange elements, whether it be a cooling element or a heating element, consists of a central pipe and a plurality of fins extending therefrom. That point of the element immediately adjacent the pipe necessarily is at the greatest temperature difference from the air which is forced into contact with the element by the blower, and it is particularly desirable that the air be so directed as to cause the greatest possible flow past the heat exchange element immediately adjacent its central pipe. I accomplish this by providing a deflector plate extending longitudinally along each heat exchange element and so conformed as to give proper direction to the air passing over the element.

The heating element 52 is shown as being provided with a pair of deflector plates 98 and 100, each plate having its upper end extending laterally toward the vertical center of the heating element. This provides a slightly restricted outlet for the air passing over the heating element and directs the air more closely around the upper surface of the pipe 58, thereby insuring maximum efficiency of operation.

The cooling element 54 is similarly provided with a pair of deflector plates 102 and 104 having inwardly-directed upper edges. The inwardly-directed upper edges of the plates 102 and 104 cause the air passing over the element 54 to follow more closely around the upper edge of the central pipe in the element, and also direct the air leaving the element 54 so that it tends to impinge around the central pipe in the element 56. The element 56 is also provided with deflector plates 106 and 108 having inturned upper edges which cause the air passing over the element to follow more closely around the central pipe and immediately adjacent fin surface of the element.

Another important feature of my invention lies in the particular means provided for moistening the air passing through the unit. The casting 12, which has previously been referred to, is formed of aluminum which is cast integral with the steam-conducting pipe 110. This pipe 110 is preferably of steel, and the plate is cast thereabout by the same process used in casting the heat exchange elements 52, 54 and 56, although the pipe 110 may be made of copper or other suitable material, as explained in that part of the specification describing the structure of the elements 52, 54 and 56. The casting 12 is in the form of a plate having an upwardly-projecting ridge which extends the entire length of the casting and which is formed by that part of the casting which immediately surrounds the pipe 110. This pipe 110 receives its steam from the steam supply pipe 84 and discharges into the return pipe 88.

Immediately above the projecting ridge which contains the pipe 110 I locate a water pipe 112 which extends substantially the entire length of the casting 12 and which at intervals throughout its length is provided with drip openings 114 from which water can drip on the top of the longitudinal projection containing the pipe 110. The pipe 112 is closed at one end by a cap 116 (Figure 1) and has its other end connected to a water supply pipe 118.

The casting 12 is not only made of a material which facilitates the transfer of heat therefrom into the water which has dripped thereon, but is also made of a special configuration to facilitate the introduction of moisture into the air which is forced through the unit by the blower. The water dripping from pipe 112 falls upon the projection immediately above the steam pipe 110 and a large part, if not all, of the water is thereupon immediately vaporized and picked up by the air passing through the unit. When the water is supplied faster than it can be vaporized in this manner, the water trickles down on both sides of this projection and further vaporization takes place along the sides of the projection.

The casting 12 is provided with a peripheral flange 120 and a further flange 122 surrounding the opening 44. These flanges cause the main part of the casting 12 to form a trough or shallow basin which holds any moisture which is not vaporized by its travel down the sides of the pipe-containing projection, and thus exposes a large shallow body of water to the air passing through the unit. This shallow body of water is in intimate contact with the aluminum casting 12 which transmits heat thereto by conduction through the metal of the casting.

The admission of water to the pipe 112 may be controlled by any manual or humidostat operated valve in any conventional manner. Drain pipes 124 and 126 carry off any excess water which may be supplied to the unit. It should be noted that one of these drain pipes is located on each side of the pipe-containing projection, and that the casting 12 is provided with annular flanges adjacent the upper ends of these drain pipes which serve to limit the depth of the sheet of water which may be maintained over the upper surface of the casting.

The frame 50 rests on the casting 12 within the peripheral flange 120, and notches 128 are provided at spaced intervals in the lower edge of the frame 50 so that any moisture condensing on this frame may pass through these notches and be carried away by the drain pipes 124 and 126.

The cover 28 encloses the entire unit and is so designed as to give the unit an attractive appearance. The upper surface of the cover is provided with openings 130 which permit the air to enter the room after it has passed over the heat exchange elements. The cover is preferably designed so that it closely fits the casting 12 at the front and back thereof, and felt strips 132 are preferably inserted between the cover and the casting 12 so that any vibration created by the motor and fan will not be transmitted to the cover. A baffle 134 (Figure 1) is attached to one end of the casting 12 so that air cannot pass from the blower outlet back to the blower inlet without passing outside of the cover.

I contemplate the use of a filter 26 of such size and type that it need be replaced only at intervals of a year or two under normal conditions. If it be found desirable to substitute a smaller filter or one which for other reasons requires more frequent replacement, a suitable door may be provided in the cover to make such replacement more convenient.

Another important feature of this unit lies in the accessibility of the several parts for inspection and repair. When the cover 28 is removed the entire blower and motor assembly is readily accessible and can in fact be entirely removed by simply unbolting this assembly from the casting 12 without otherwise disturbing the apparatus. I also prefer to bolt or otherwise attach the side

members of the frame 50 to the end members 50a and 50b thereof so that these side members can be easily removed to permit inspection of the heating and cooling elements without in the least disturbing such elements.

In Figures 5, 6, 7 and 8 of the drawings I have shown a preferred embodiment of my invention having a frame 150 comprising longitudinal angle irons 152 and 154 and transverse angle irons 156 and 158. The longitudinal members 152 and 154 are attached to the upper ends of legs 160, each leg being provided at its lower end with a block 162 carrying a screw 164 whereby the height of the frame may be readily adjusted or whereby the length of the individual legs may be adjusted to compensate for irregularities of the floor.

The frame 150 supports an aluminum evaporator plate 166 which has cast therein a pipe 168' which may be of steel, copper or other suitable material, as described in connection with the previous embodiment of my invention. This plate 166 has a pair of openings 168 and 170 adapted to be located immediately above the outlets of blowers 172 and 174, respectively. These blowers are driven by an electric motor 176, the blowers and motor being mounted as a unitary assembly on a base 178. The base 178 is supported by straps 180 carried by bolts 182 threaded into flanges 184 and 186 of plate 166. These flanges define the longitudinal position of the base 178.

When the base 178 is properly located beneath the plate 166, the rear edge of this base engages a longitudinal flange 188. The base 178 may be maintained in the desired position simply by screwing up on the bolts 182 to clamp the base firmly between the straps 180 and the plate 166. To remove the base with the motor and blower supported thereby, it is only necessary to loosen the bolts 182 whereupon the base may be slid out from between the flanges 184 and 186, it being, of course, necessary to first remove the cover from off of the entire unit before such removal can take place.

The blower 172 has an inlet 190 adjacent a removable filter 192. To the left of the filter 192, as viewed in Figure 5, is a space 194 which may be provided with a duct 196 (Figure 7) passing through the wall of the building to the outside air. The partition 198 forming one wall of the space 194 is preferably provided with an opening similar to the opening 32 of Figure 4, to admit room air to the space 194. It will be understood that a damper, similar to the damper 38 shown in Figure 4, is preferably provided to permit any desired blending of room and outside air. All air admitted to the space 194 must pass through the filter 192 before it can reach the blowers.

The blower 174 has an inlet 200 adjacent a removable filter 202 interposed between this inlet and a space 204 which may communicate with the outside air through a duct 206 (Figure 8). The partition 208 forming one wall of the space 204 is preferably provided with an opening like the opening 32 of Figure 4, to admit room air to the space 204. A damper is preferably provided to permit any desired blending of room and outside air to be admitted to the space 204.

Whenever desired, additional means may be provided to admit air to the blowers 172 and 174. In Figure 6 I have shown such means as comprising a grill work 210 provided in the front part of the cover 212 which is opposite the blowers 172 and 174. Inside of this grill work 210 is a screen 214 carried by the frame 150, and back of this screen is one or more filters 216.

The screen 214 is made readily removable to permit replacement of the filters 216 and also to permit removal and replacement of the base 178 carrying the motor 176 and blowers 172 and 174. It will be understood that the ends of the cover 212 are provided with louvers like those shown at 32 in Figure 1 to admit room air to the end spaces 194 and 204.

The plate 166 carries a second frame 218 comprising longitudinal plates 220 and 222 and transverse plates 224 and 226. This frame carries the cooling elements 228 and 230, the heating element 232, and the super-heater coil 234 which is supported on angle irons 236 and 238 attached to the transverse members of this frame.

The cooling element 228 comprises a pipe 240 of steel, copper or other suitable material cast into an aluminum finned structure 242. Refrigerant or other cooling medium is supplied to the pipe 240 through supply pipe 244 provided with a manually-operated valve 246. The supply pipe 244 is provided with an automatic thermostatic expansion valve 248 which is connected to the plug 250 in the end of the pipe 240 by way of nipple 252.

A smaller pipe 254 is located inside of pipe 240 so that the latter is filled with liquid refrigerant up to the top of the pipe 254, as best shown in Figure 6. The pipe 254 has a slot 256 in the upper side thereof and extending almost the entire length of the pipe 254. This slot provides an overflow outlet for the liquid in the pipe 240 and also an outlet for the gas generated in the pipe 240 by boiling of the cooling medium therein.

The gaseous and liquid cooling medium passing through the slot 256 into the pipe 254 flows through the elbow 258, nipple 260 and elbow 262 into the lower cooling element 230. This element 230 comprises a pipe 264 of steel, copper or other suitable material cast integral in a finned aluminum structure 266 which is smaller than the finned structure 242 of the cooling element 228. As best shown in Figure 5, the fins of the two cooling elements are preferably located in staggered relationship to afford the maximum heat transfer between these fins and the air passing over them.

The pipe 264 of the lower cooling element is preferably unobstructed and has an outlet 268 located slightly above the lowest portion of the pipe 264, whereby the latter forms a liquid trap. This outlet communicates with a pipe 270 having a gooseneck 272 (Figure 7) and leading to one end of the super-heater coil 234.

In the normal operation of the cooling elements, all of the liquid refrigerant will be converted into a gas before passing through the outlet 268 of the lower cooling element. Any liquid which may pass through this outlet 268 will be trapped in the pipe 270 between this outlet and the gooseneck 272 and will chill a thermostatic bulb 274 located beneath this part of the pipe 270. This thermostatic bulb 274 controls the thermostatic valve 248 so that chilling of the bulb 274 reduces the supply of refrigerant to the pipe 240 of the upper cooling element.

The gaseous cooling medium discharged from the lower cooling element 230 through the pipe 270 flows into the super-heater coil 234 wherein this cooling medium is super-heated to approxi-

mately the temperature of the air entering the unit, since the air impinges upon this super-heater coil immediately after its discharge through the openings 168 and 170 in the plate 166. It is to be noted that the super-heater coil 234 consists of two superposed layers of longitudinally-extending loops, the longitudinal pipes of one layer of loops being staggered with respect to the longitudinal pipes of the other layer. This provides maximum heat transfer between the air and the super-heater coil and also effectively breaks up the columns of air discharged by the blowers so that the air flows more evenly over the finned heating and cooling elements. The super-heated gas is returned from the coil 234 to the refrigerating mechanism through pipe 276.

The openings 168 and 170 in the plate 166 are provided with louvered covers 278 and 280, respectively. These covers are carried on upstanding flanges 282 and 284, respectively, provided by the plate 166. The covers 278 and 280 catch any moisture dripping from the heat-exchanging elements and super-heater coil 234, and these covers are so inclined that the collected moisture flows from one end of each cover onto the upper surface of the plate 166.

Drip plates 281 and 283 are preferably attached to the ends of the frame 250 to catch any moisture dripping from those portions of the piping of the cooling system which extend beyond the ends of the frame 250 and on which moisture is likely to collect. These drip plates 281 and 283 drain onto the upper surface of plate 166 through notches 285 provided in the frame 250.

The heating element 232 comprises a pipe 286 of steel, copper or other suitable material cast into an aluminum finned structure 288. This heating element is separated from the cooling element 228 by a dividing plate 290. Heat in the form of steam, hot water or other suitable heating medium, is supplied to the pipe 286 through a supply pipe 292 containing a manually-operated valve 294. The other end of the pipe 286 is connected to a U-shaped pipe 296 connected with one end of the pipe 168' in the plate 166. The pipe 168' discharges through pipe 298 to return pipe 300 leading back to the boiler or other heating apparatus.

The steam supply pipe 292 also supplies steam by way of pipe 302 and manually-controlled valve 304 to the U-shaped pipe 306 cast integrally in a heat radiating plate 308 whose right-hand surface, as viewed in Figure 6, is made of attractive appearance and is exposed to the room through a registered opening formed in the cover 220. This heat radiating plate 308 may be of any desired length but is preferably made as long as the heating element 232.

The other end of the U-shaped pipe 306 in the heat radiating plate 308 is connected to the rear pipe 300 by way of a short section of pipe 310. A heat responsive valve 312 is preferably located at the junction of the pipes 298, 300 and 310, and provides automatic heat regulation of the unit.

The most convenient way of controlling the room temperature is by means of a thermostat controlling the motor which operates the blowers. When the unit is operating to heat the room, much less heat is given off when the blowers are not operating, and similarly, when the unit is being operated to cool the room, much less heat is absorbed from the room when the blowers are not operating. Thermostatic control of the motor for operating the blowers thus forms a convenient way of maintaining the room at any desired temperature.

Water is supplied to the upper surface of the plate 166 by a water supply pipe 314 provided with an automatic valve 316 controlled by a humidostat 317 and also provided with a manually-controlled valve 318. The supply pipe 314 is connected with the upper surface of the plate 166 by a pipe 320 which communicates with the upper surface of the plate 166 at the lowest part thereof. An overflow pipe 322 connects the supply pipe 314 and its branch 320 with a drain pipe 324. It is to be noted that the horizontal portion of the pipe 322 is located slightly above the upper surface of the plate 166 and determines the depth of water covering this plate.

When it is desired to drain the water from the upper surface of the plate 166 as, for example, when the unit is operating to cool the air, the valve 318 is closed and a valve 326 in a bypass is opened. This bypass connects the pipe 320 directly with the drain 324 at a level below that of the plate 166 and thus carries off any moisture which may drip onto this plate from the cooling elements and super-heater coil.

I have provided an improved damper arrangement whereby all of the air supplied by the blowers may be passed either over the heating element or over the cooling elements or whereby the air may be divided between the heating and cooling elements in any desired ratio. This damper mechanism comprises aprons 328 and 330 mounted on top of the upper box-like frame 224. An opening is formed between each apron and the center plate 292, and sliding dampers 332 and 334 are provided to control these openings. The dampers are regulated through gearing 336 and 338 associated with shafts 340 and 342, respectively. These shafts extend longitudinally of the unit and each shaft is provided with a conveniently-located operating handle 344.

The top of the cover 220 is provided with openings 346 beneath which is a screen 348 so that small articles cannot fall through these openings and clog up the unit. This cover may also be provided with suitable doors to permit ready access to the various valves and damper control means.

The plates 198 and 208 are part of a housing 349 which encloses the blowers and motor and removably carries the filters. This housing is so designed that all air drawn into the blowers must first pass through the filters. While I have shown my improved unit as being enclosed in a cover adapted to be located in the room, my unit has such a high efficiency that it may be made sufficiently small in size to permit an installation in which the unit is either completely or partially located within a wall of the room.

The automatic control valve 248 shown in Figure 5 is particularly designed for use in connection with a unit supplied with a cooling medium which changes from liquid to gas at room temperatures. In some instances it may be desirable to provide the cooling elements with cold water instead of such a refrigerant, and where cold water is used the automatic valve 248 shown in Figure 5 is replaced by a different type of automatic valve adapted to control cold water flow to maintain the desired conditions of operation.

In some instances the same heat transfer elements may be used in winter as heating elements and in summer as cooling elements, and in some instances hot water or cold water may be sup-

plied to the same heat transfer elements through the same supply pipe and carried away by the same return pipe, it being understood that hot or cold water is supplied, depending upon whether the unit is to be used to heat or to cool the room. Where the same heat transfer elements are used for both heating and cooling, the heating pipe 168' of the evaporator plate is connected in parallel with the heat transfer elements and is provided with a valve so that this pipe 168' may be disconnected when the unit is being used to cool the air.

The operation of the improved unit shown in Figures 5 to 8, inclusive, is essentially the same as the operation of the type of unit shown in Figures 1 to 4, inclusive. Therefore, it is deemed unnecessary to describe in detail herein the operation of the improved unit.

In Figure 9 I have shown a modified form of cooling element 350 comprising a single cast aluminum finned structure 352 containing both the pipes 240 and 264. This cooling element of Figure 9 may be used in lieu of the two cooling elements 228 and 230, best shown in Figure 6.

While I have shown the embodiment of Figures 1 to 4, inclusive, as being provided with hand valves only, it is to be understood that these hand valves may be replaced by automatically controlled valves, where so desired. It is further to be understood that the particular arrangement of piping and control valves may vary with different installations and that the various features of my invention may assume numerous forms, and that my invention is not limited to the details disclosed in this application.

I claim

1. In an air conditioning unit of the class described, the combination of a frame, a cooling element mounted thereon, a heating element mounted on said frame, a fan for forcing air over said elements, a plate separating said elements, an apron above each element, a sliding damper carried by each apron and coacting with said plate to regulate the flow of air over the corresponding element, and an independent adjustment for each damper.

2. In an air conditioning unit of the class described, the combination of a frame, a pair of cooling elements carried thereby, a finned heating element mounted on said frame, a fan for forcing air over said elements, a second heating element having a surface adapted to radiate heat therefrom, a common source of supply for said heating elements, and a cover enclosing said unit, said cover having a frame provided with an opening exposing said surface.

3. In apparatus of the class described, the combination of a frame, a cooling element carried thereby, said element comprising a finned casting, a pipe embodied therein, and a second pipe enclosed in said first pipe and spaced from the walls thereof, said second pipe having a longitudinal slot in its upper surface, means for supplying a cooling medium to said cooling element, and a fan for blowing air over said element.

4. In an air conditioning unit of the class described, the combination of a finned cooling element comprising a pair of telescoped pipes providing an annular space therebetween, the inner pipe having an opening in its upper portion forming the sole communication between said pipes, a second cooling element connected to said inner pipe, means for supplying a cooling medium to the outer pipe of said first cooling element, a discharge pipe for said second element, and valve means controlled by the temperature of said discharge pipe for regulating the supply of cooling medium to said first cooling element.

5. In an air conditioning unit of the class described, the combination of a frame, a first cooling element comprising a pair of telescoped pipes providing an annular space therebetween, the inner pipe having an opening in its upper surface providing the sole communication between said pipes, a second cooling element connected to said inner pipe, said second cooling element having an outlet whereby said second element forms a trap for a limited amount of liquid cooling medium, a discharge pipe for said second element, said discharge pipe having a portion extending above said outlet, supply means including an automatic valve for said first element, and a control bulb for said valve associated with said discharge pipe between said outlet and said portion.

6. In an air conditioning unit of the class described, the combination of a frame, heating and cooling elements mounted on said frame, a pair of blowers for forcing air over said elements, and a superheater coil connected with said cooling element and comprising staggered layers of pipe positioned to distribute air supplied by said blowers equally over said elements.

7. In apparatus of the class described, the combination of a frame, an evaporator plate carried by said frame, a fan for blowing air over said plate, a motor for driving said fan, a common base for said motor and fan, means carried by said plate for removably supporting said base, a water supply pipe terminating at a point below said plate, a connection between the upper end of said water supply pipe and the lowest portion of said plate, a drain pipe, a horizontal connection between said drain pipe and the upper end of said water supply pipe, a valve in said connection, a second connection between said water supply pipe and said drain pipe, said second connection extending above said plate and determining the maximum level of water permitted thereon, and a valve in said water supply pipe.

8. In an air conditioning unit of the class described, the combination of a frame, a finned heating element carried thereby, a heat radiating element mounted on said frame, an evaporator plate carried by said frame, a heat supply pipe connected to said elements, a connection between one of said elements and said evaporator plate, a return pipe for the heating medium, a connection between said other heating element and said return pipe, a connection between said evaporator plate and said return pipe, an automatic control valve located at the junction of said connections with said return pipe, means for supplying water to said evaporator plate, and means for forcing air over said plate and said finned element.

9. In apparatus of the class described, the combination of a frame, a finned heating element carried thereby, a radiant heating element carried by said frame, a blower for forcing air over said finned heating element, a common source of heat supply for said heating elements, and a cover having inlet and outlet openings for said air and having a further opening registering with said radiant heating element to permit radiation of heat therefrom.

10. In an air conditioning unit of the class described, the combination of a frame, an evaporator plate supported thereon, said plate having a pair of spaced openings therethrough, a blower for each opening, a motor for driving said blow-

ers, a base on which said motor and blowers are mounted, means for removably attaching said base to said plate, means for supplying water to said evaporator plate, and means for supplying heat to said plate.

11. In an air conditioning unit of the class described, the combination of a frame, an evaporator plate supported thereon, said plate having an opening therethrough, a heat exchange element supported above said plate, means for supplying a heat conveying medium to said element, means for supplying heat to said plate, a blower for forcing air through said opening and over said plate and element, a motor for driving said blower, a base carrying said motor and blower, said plate having a flange defining the position of said base, means carried by said flange for removably attaching said base to said plate, means for supplying water to said plate, means for supplying heat to said plate, and a cover having an opening for admitting air to said blower and a second opening for the discharge of air passing over said plate and element.

12. In apparatus of the class described, the combination of an evaporator plate, a support therefor, a blower supported below said plate, a motor supported by said plate for operating said blower, an air filter removably associated with said blower, said plate having an opening therethrough and said blower having an outlet communicating with said opening, a cover for said opening carried by said plate, means for supplying moisture to said plate, means for heating and cooling the air from said blower, and air control damper mechanism for said last-named means, said heating means, cooling means and damper mechanism being supported on said plate.

13. A compact air conditioning unit of the class described comprising a pair of cooling elements, each cooling element comprising a pipe and a finned aluminum body cast integrally with said pipe, a single heating element comprising a pipe and a finned aluminum body cast integrally therewith, said heating element being located beside said cooling elements and having an air contacting surface of area equal to one of said cooling elements, air circulating means, means for cleaning the air before it reaches said elements whereby said elements are maintained free from deposits of dust and dirt, and means for directing air over said heating element and cooling elements alternatively or simultaneously.

14. In a unitary air conditioning device of the class described, the combination of a pair of superimposed finned cooling elements each having given dimensions, a similar finned heating element having the same dimensions as one of said cooling elements, a unitary casting for supporting said heating element to one side of said cooling elements, means for supplying air to said elements, means for supplying a cooling medium to said cooling elements, means for supplying a heating medium to said heating element, and means to cause air to pass through either said heating elements or said cooling elements or all simultaneously.

15. In apparatus of the class described, the combination of an evaporator plate, a water supply pipe having a branch connected to said evaporator plate and a second branch extending above said evaporator plate, a drain pipe connected to the latter branch whereby said branch determines the maximum depth of water overlying said plate, a connection between said first-mentioned branch and said drain pipe, and valve means controlling said connection and said supply pipe.

16. In a device of the class described, a single self-contained unit for installation in the room of a dwelling or office comprising the combination of a cooling unit having a given fin surface, a heating unit having materially less fin surface, a blower beneath said units for supplying air to either or both of said units, said units being located side by side and each of said units providing an independent outlet for said air, and a damper above said blower for apportioning air supplied by said blower.

17. In mechanism of the class described, the combination of an evaporating plate, supporting means therefor, means for supplying moisture and heat to said plate, air-circulating means carried by said plate, and heat-exchanging means carried by said plate.

18. In apparatus of the class described, an evaporating plate providing a substantially flat base of relatively large dimensions, an upwardly extending projection lying lengthwise of said base and at one side thereof, said projection providing a passage for a heating medium, said base having a central orifice, a fan beneath said base discharging through said central orifice, heat exchange means located above said base, means for supplying moisture to said plate, and means for limiting the depth of water which can collect on said flat base.

19. In apparatus of the class described, the combination of an evaporator plate, a support therefor, a blower supported below said plate, a motor supported by said plate for operating said blower, an inlet duct for said blower carried by said plate, an air filter removably located in said duct, said plate having an opening therethrough and said blower having an outlet communicating with said opening, a cover for said opening carried by said plate, means for supplying moisture to said plate, means for heating and cooling the air from said blower, and air control dampers for said last-named means, said moistening means, heating means, cooling means and damper means being supported on said plate.

20. In mechanism of the class described, the combination of an evaporator plate comprising a base and an upwardly-extending ridge, means for applying heat directly to said ridge, and means for trickling moisture on said ridge.

21. An evaporator plate comprising a steel pipe, an aluminum body surrounding said pipe, said body having a portion of minimum thickness and miximum heat-transmitting efficiency immediately above said pipe, and a base portion of lesser heat-transmitting efficiency providing a receptacle for holding a predetermined quantity of water.

22. A compact air conditioning unit of the class described, comprising a pair of cooling units, each cooling unit comprising a steel pipe having a core therein and a finned aluminum body cast integrally with said pipe, a single heating unit comprising an unobstructed steel pipe, and a finned aluminum body cast integrally therewith, said heating unit being located beside said cooling units and having an air-contacting surface of area equal to one of said cooling units, air-circulating means, means for cleaning the air before it reaches said units whereby said units are maintained free from deposits of dust and dirt, and means for directing the air against said heating unit and said cooling units alternatively or simultaneously.

23. In apparatus of the class described, the combination of a heating unit, a cooling unit located beside said heating unit, a plate extending beneath said units for collecting any moisture dripping from said units, heating means associated with said plate, and means for supplying moisture to said plate whereby the latter becomes an evaporating unit.

24. In mechanism of the class described, the combination of an evaporating plate, supporting means therefor, means for supplying moisture and heat to said plate, said plate having an air duct therein, a fan carried by said supporting means beneath said plate and communicating with said duct, and heat exchanging means carried above said plate.

25. In apparatus of the class described, an evaporating plate comprising a substantially flat base of relatively large dimensions, an upwardly-extending projection lying lengthwise of said base and at one side thereof, said projection providing a passage for a heating medium, said base having an orifice located therein, a fan beneath said base discharging through said orifice, means for supplying moisture to said plate, and means for regulating the depth of water which can collect thereon.

26. In mechanism of the class described, the combination of an evaporator plate comprising a substantially flat base of relatively great width and a narrow, upwardly-extending ridge located at one side of said base, means for applying heat to said plate and ridge, said base having an orifice, a fan beneath said plate discharging through said orifice, means for supplying water to the upper side of said plate and in contact with said ridge, means limiting the depth of water collectible on said base to a shallow sheet, and heat exchange means supported above said plate.

27. An evaporator plate comprising a metal pipe, and a body of high heat conductivity surrounding said pipe, said body having a portion of minimum thickness and maximum heat transmitting efficiency immediately adjacent said pipe, and a base portion of less heat transmitting efficiency providing a receptacle for holding a predetermined quantity of water.

28. In a unitary air conditioning device of the class described, the combination of a pair of identical superimposed finned cooling units each having given dimensions, a similar finned heating unit having the same dimensions as one of said cooling units, a unitary casing for supporting said heating unit to one side of said cooling units, means for supplying air to said units, means for supplying a cooling medium to said cooling units, means for supplying a heating medium to said heating unit, and means to cause air to pass through either said heating units or said cooling units or all simultaneously.

29. A compact device for the room of an office or dwelling comprising the combination of an evaporating plate, supporting means therefor, means for supplying moisture and heat to said plate, said plate having an air duct therein, a fan carried by said plate, said fan being located beneath said plate and communicating with said duct, a motor carried by said plate for driving said fan, and means carried by and located above said plate for distributing the air supplied by said fan over the surface of said plate.

30. In an air conditioning unit of the class described, the combination of an evaporator plate comprising a substantially flat base of relatively great width and a narrow upwardly-extending ridge located at one side of said base, said ridge being formed by the presence of a pipe cast into said base, means for supplying moisture to said plate, means for supplying a heating fluid to said pipe to evaporate said moisture, means for limiting the depth of water collectible on said plate, a blower located below said plate, said plate having an orifice through which said blower discharges, and a motor beneath said plate for driving said blower.

31. In apparatus of the class described, a cooling unit, a heating unit, an evaporating plate located below said units and spaced therefrom, said evaporating plate having a retricted orifice, a blower discharging through said orifice, a superheater coil interposed between said orifice and said units and designed and arranged to distribute the air supplied through said orifice, a connection between said coil and said cooling unit, and a casing inclosing said units, coil and plate.

32. In a device of the class described, a single, self-contained unit for installation in the room of a dwelling or house, comprising the combination of an evaporator plate, a support therefor, a blower supported below said plate, a motor for operating said blower, an inlet duct for said blower carried by said plate, an air filter removably located in said duct, said plate having an opening therethrough and said blower having an outlet communicating with said opening, a cover for said opening carried by said plate, means for supplying moisture to said plate, means for heating or cooling the air supplied from said blower, and an air-controlling damper for said last-named means whereby the air supplied by said blower may be apportioned between said heating and cooling means in any desired ratio.

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