June 19, 1923.

1,458,985

L. L. LEWIS

AIR CONDITIONING APPARATUS

Filed Sept. 1, 1921

3 Sheets-Sheet 1

Fig. 1.

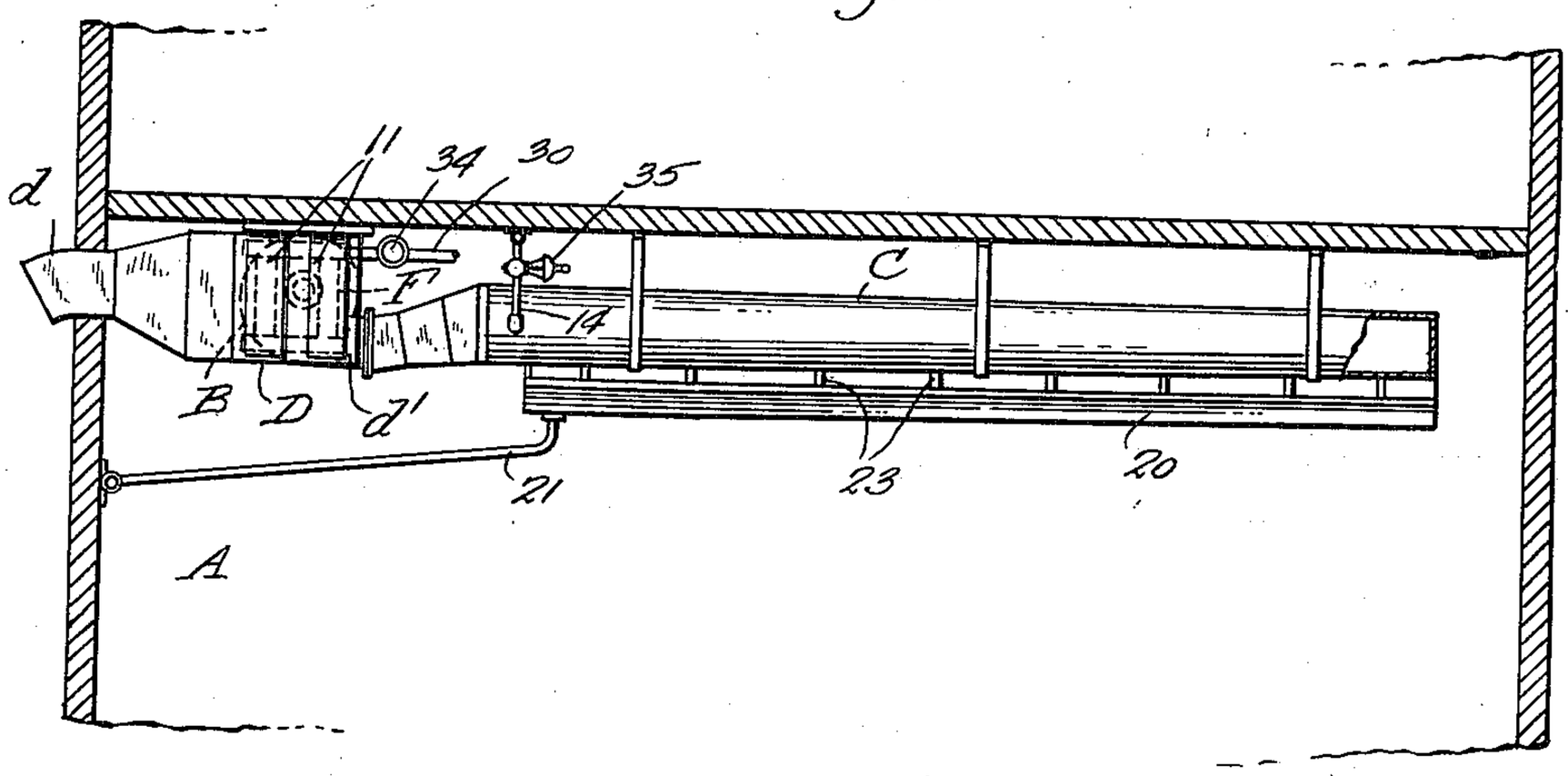
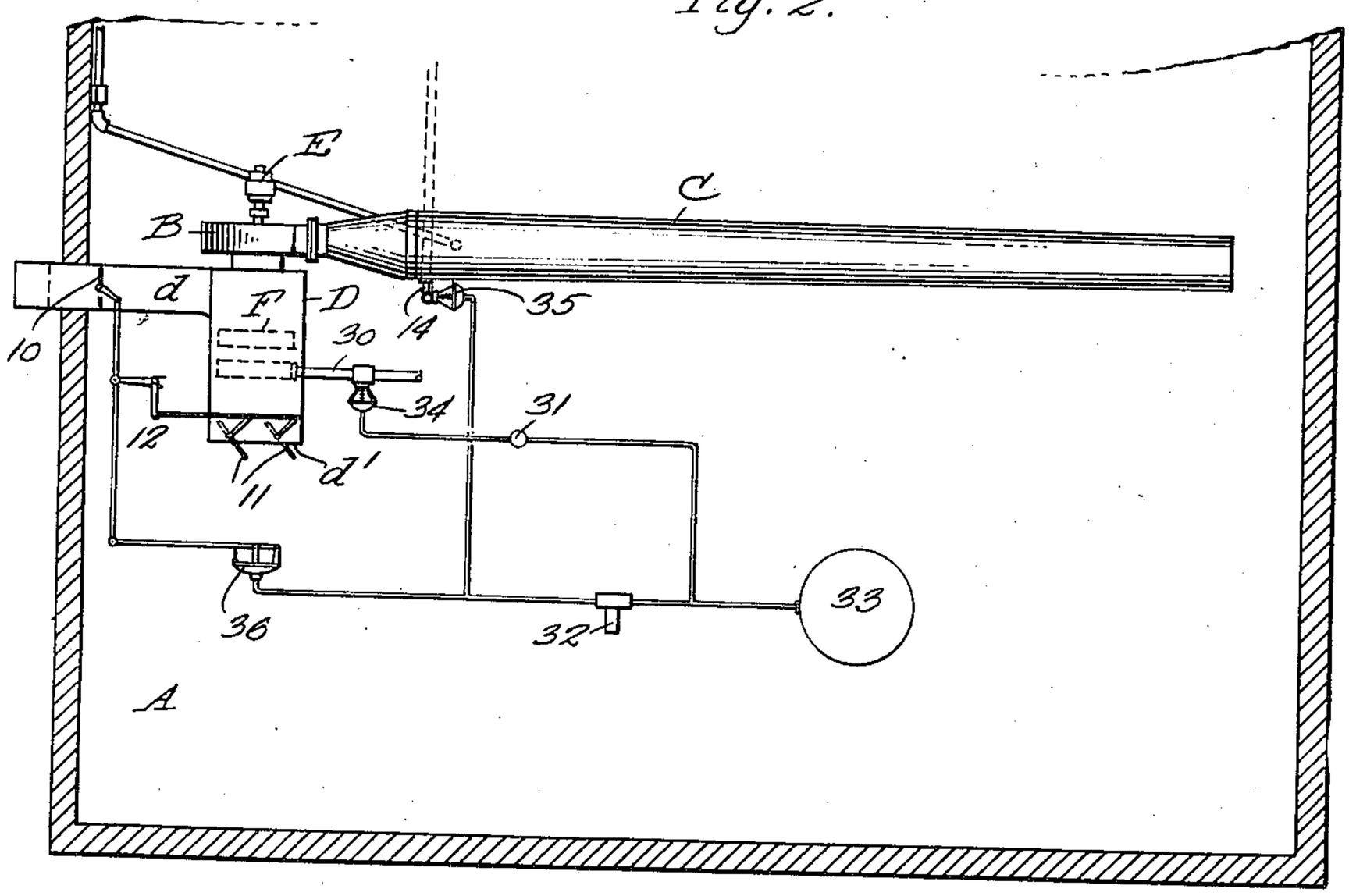


Fig. 2.



Inventor:
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AIR CONDITIONING APPARATUS

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3 Sheets-Sheet 2

Fig. 3.

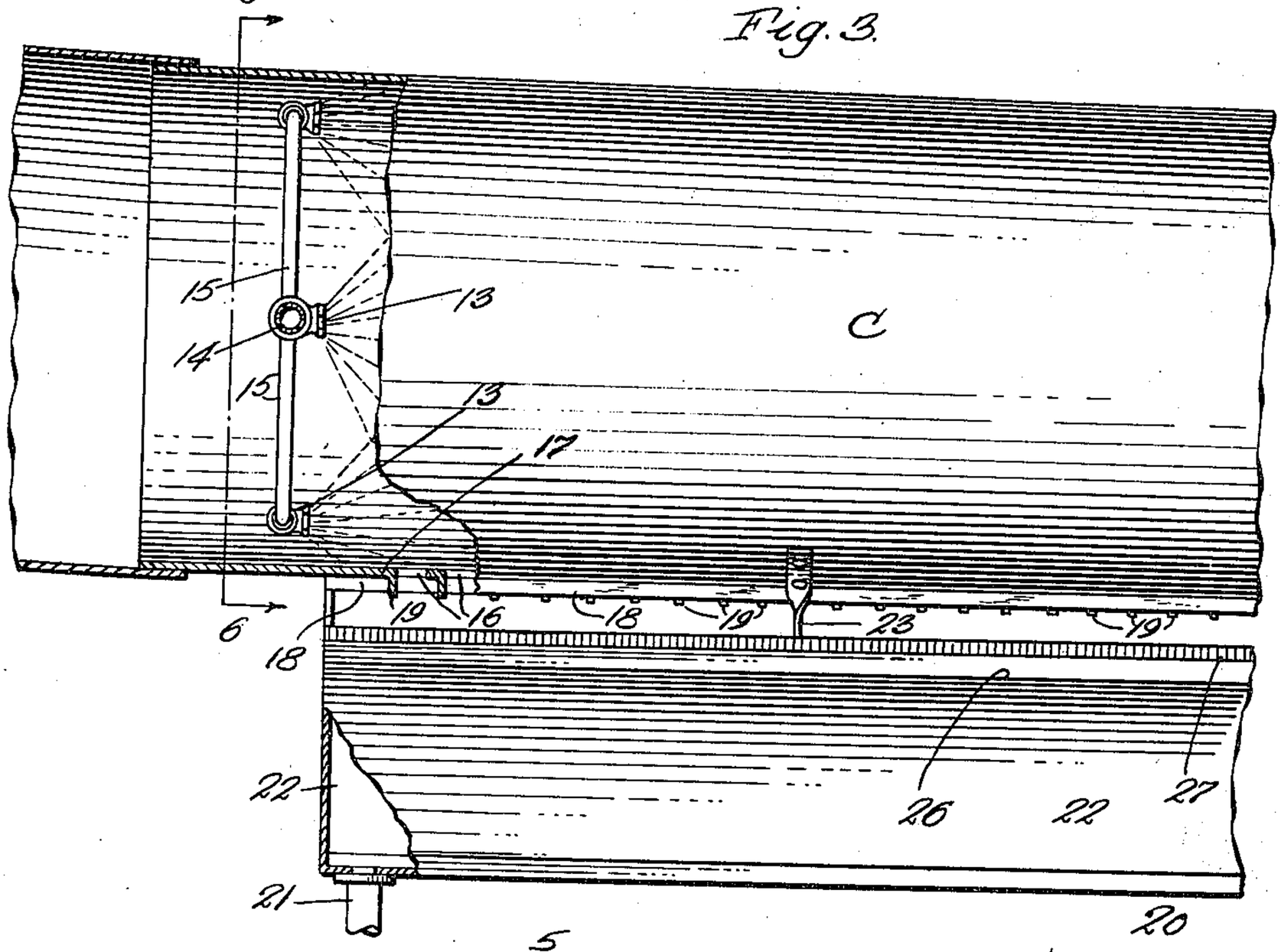
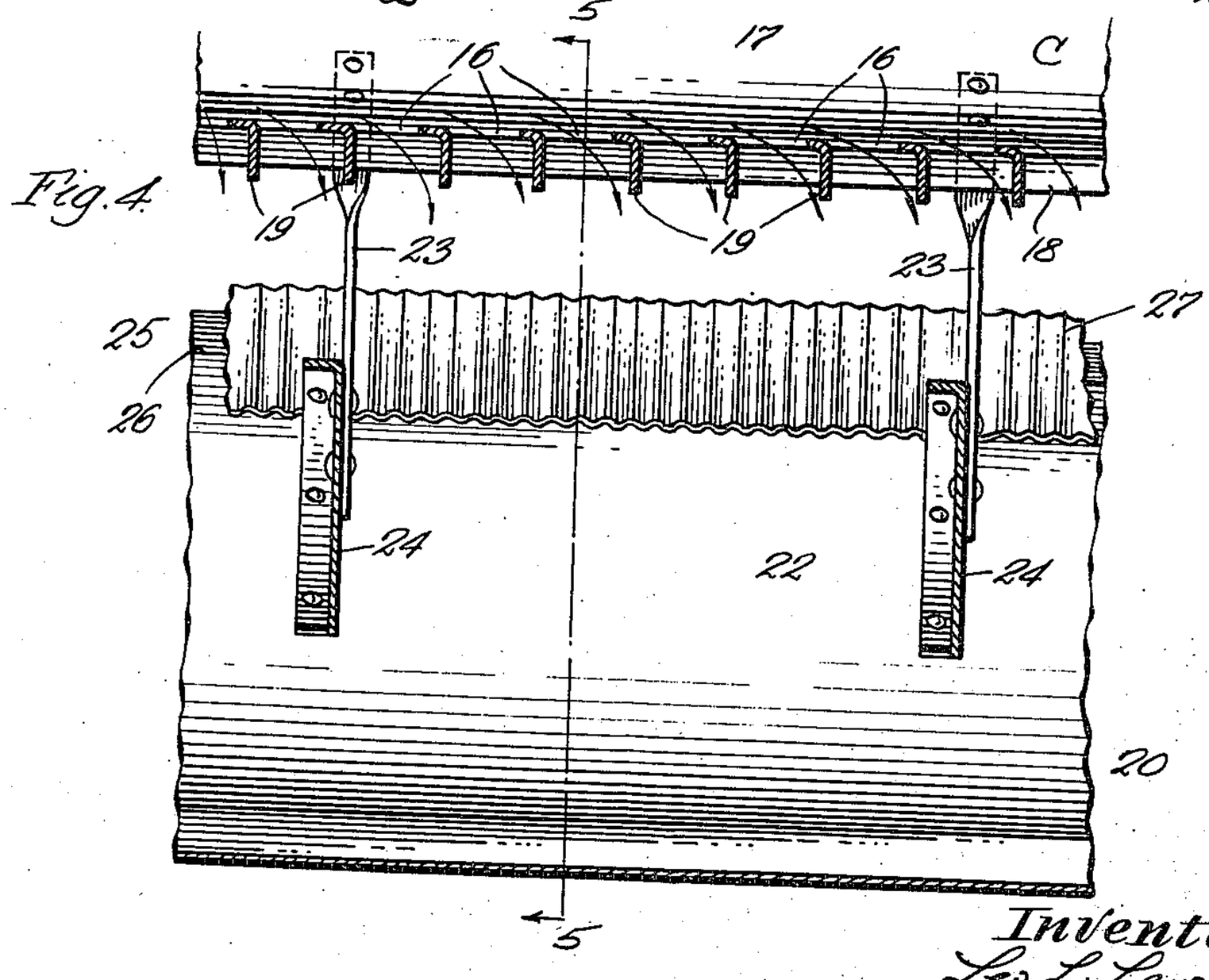


Fig. 4.



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June 19, 1923. 1,458,985

L. L. LEWIS

AIR CONDITIONING APPARATUS

Filed Sept. 1, 1921 3 Sheets-Sheet 3

Fig. 5.

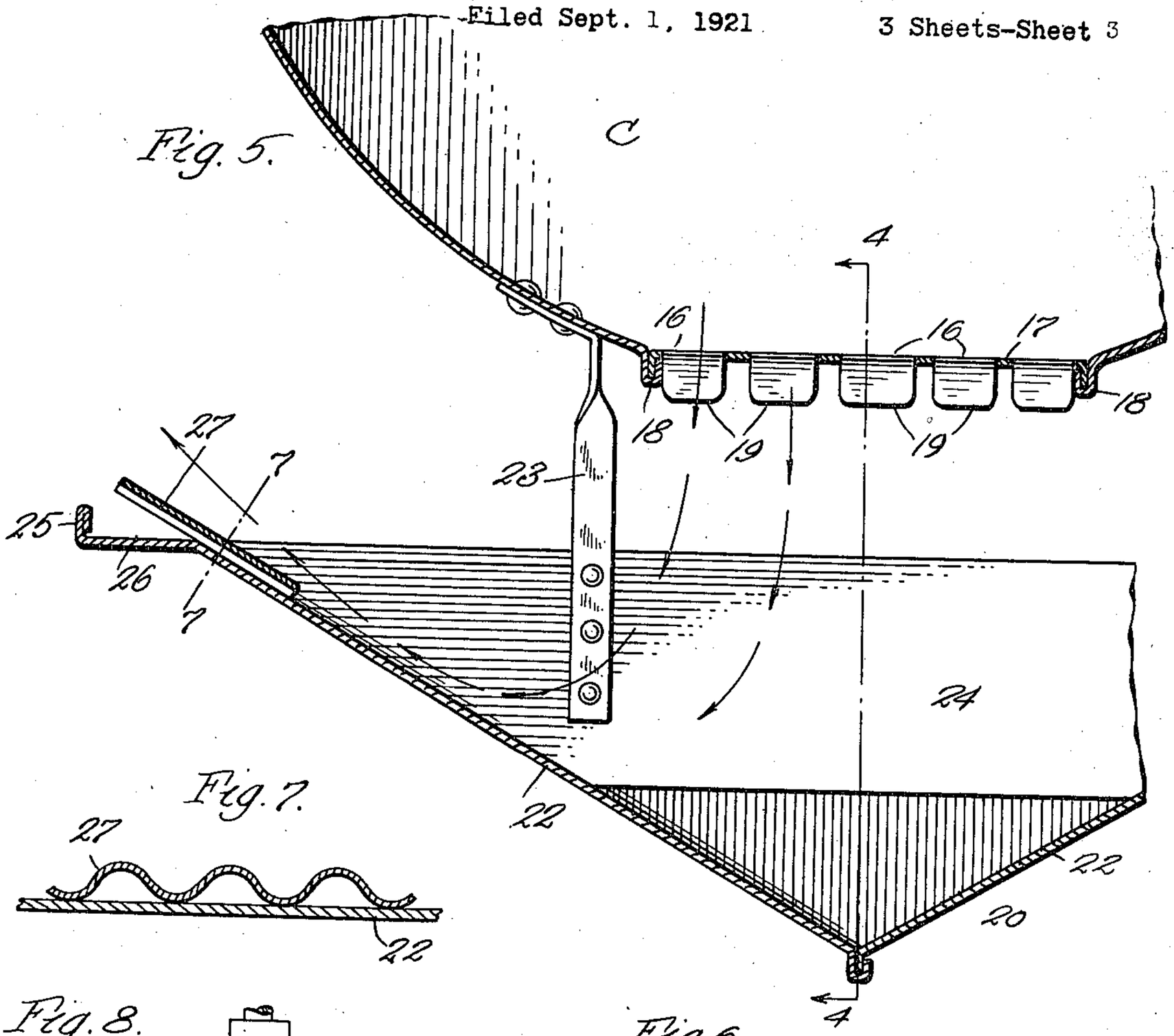


Fig. 7.

Fig. 8.

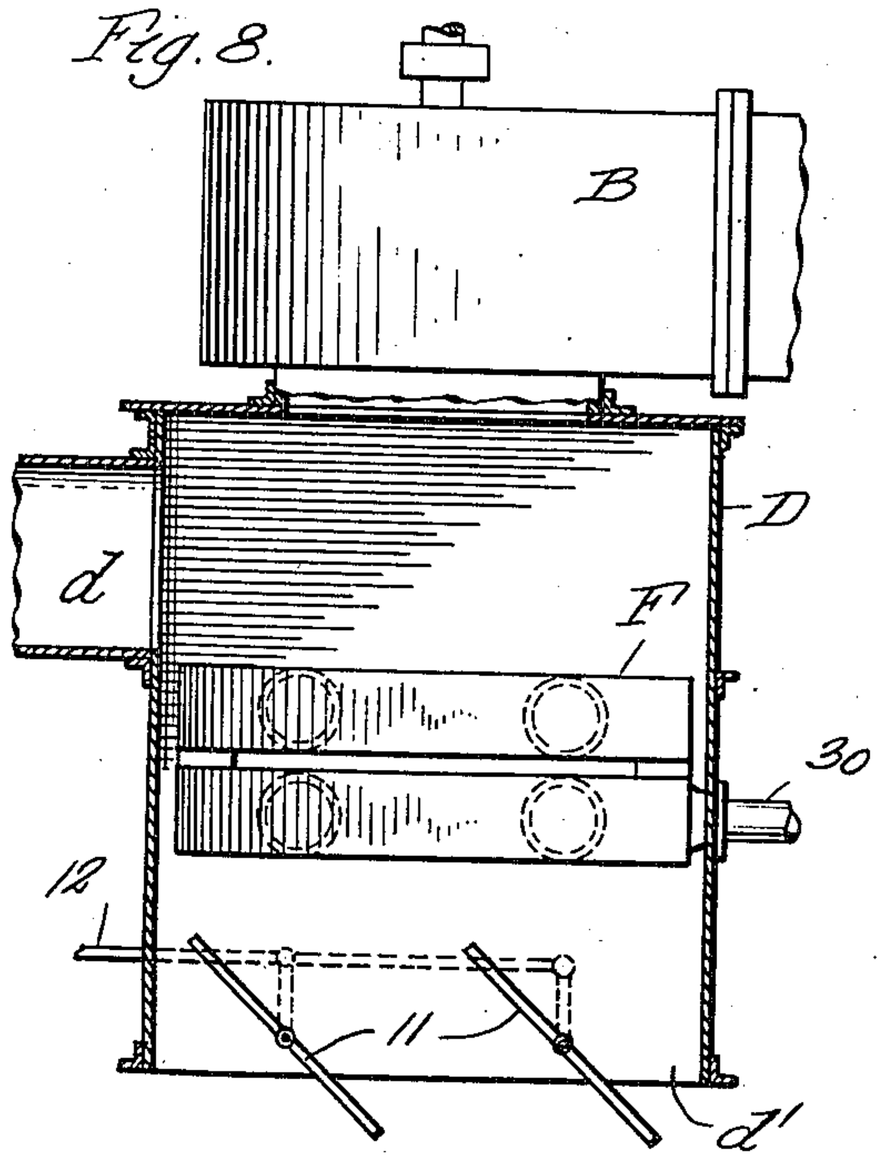
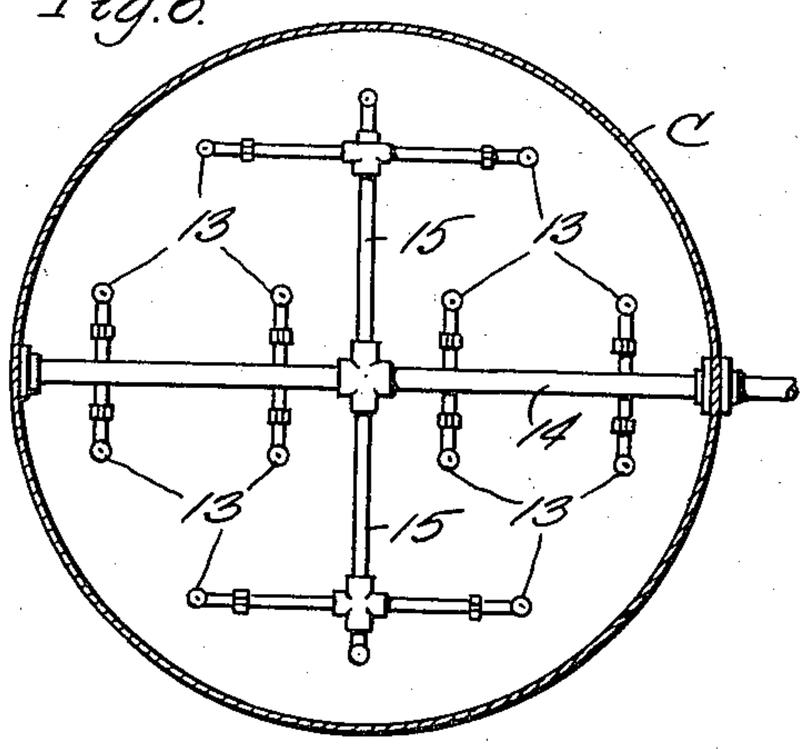


Fig. 6.



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Patented June 19, 1923. 1,458,985

UNITED STATES PATENT OFFICE.

LEO L. LEWIS, OF PLAINFIELD, NEW JERSEY, ASSIGNOR TO CARRIER ENGINEERING CORPORATION, OF NEWARK, NEW JERSEY.

AIR-CONDITIONING APPARATUS.

Application filed September 1, 1921. Serial No. 497,752.

To all whom it may concern:

Be it known that I, LEO L. LEWIS, a citizen of the United States, residing at Plainfield, in the county of Union and State of New Jersey, have invented a new and useful Improvement in Air-Conditioning Apparatus, of which the following is a specification.

This invention relates more particularly to air humidifying or conditioning systems of the so-called "unit type" in which humidifying devices for supplying humidified air to different departments, portions or rooms of buildings, are arranged at the points in the rooms or building where it is desired to deliver the humidified air.

In air conditioning or humidifying systems of the central station type in which air for the various departments or portions of a building is humidified or conditioned at a common or central conditioning apparatus, the air ducts or conduits through which the air is delivered from the central station to the various portions of the building are of necessity very large. Where they can be run inside of the building, both the horizontal and vertical ducts are usually made of galvanized iron, but where there is no space available inside of the building, which is frequently the case in existing buildings, they must be run outside of the building, and then the most practicable construction is to make the ducts of brick or concrete. In most cases, the air conditioning or humidifying apparatus has to be placed outside of the building, requiring the construction of a fairly large house or room for the apparatus.

In the unit system forming the subject matter of this application, the air humidifiers and fans, and the heaters, when heaters are required, are de-centralized or are arranged in the rooms or portions of the building where the air is to be delivered, and the air humidifiers, heaters and fans with the driving motors for the fans are of such design and arrangement that they can be suspended from the average ceiling of the room and therefore occupy space which is available. Any required number of humidifying or conditioning units can be provided, depending upon the size or character of the room or building to be supplied. The water for humidifying the air in the several humidifiers can be supplied by a central or common pumping system because the pump and motor for driving it are small and these parts, together with the water reservoir on the suction side of the pump, require comparatively little space, which is available in practically all cases. A central pumping station must, of course, be connected up to the various humidifying units by means of a system of water supply pipes and a system of water return pipes, but these pipes are small and space can usually be found for them.

There are two main reasons for a unit humidifying system of this sort, first the need for a low-priced apparatus which will give the necessary humidifying and also such heating or cooling as may be required, and second the need for a humidifying and cooling or heating apparatus which can be installed in the building without requiring expensive alterations and additions to the building structure. Attempts have been made to provide humidifying systems in which the movement of air through the humidifier and distributing ducts and the discharge of the air into the building is produced by the aspirating effect of the water sprayed for humidifying the air. Such arrangements are impracticable since the air pressure created by such an aspirator is so limited that any humidifying duct depending upon a water jet aspirator is subject to the whims of a positive and negative pressure created by the effect of the contour of the building upon the velocity and direction of the wind. Such humidifiers cannot be used as heating equipments for the reason that if the heater for the air is kept to a practical size, the air loss or air friction through the heater is too great to be overcome by the aspirating effect of the water spray, whereas on the contrary, to make the heater of proper design to adequately reduce the friction requires it to be of such enormous size that there is usually no available space for it in the building.

One of the objects of this invention is to provide an efficient and desirable unit humidifying system in which the air can be not only thoroughly saturated by the humidifying sprays through which the air is passed by the air propelling fan, but in addition, the air can be caused to carry along with it into the room a considerable amount of moisture in a very finely divided condition which assists materially in humidifying

and cooling the air in the room or building but which moisture is so fine that it will be evaporated in the room before coming in contact with machinery or objects in the room and therefore will not wet the same. Other objects of the invention are to provide a humidifier having an air discharge duct which extends along the room or building, and a water drain or catch-pan or trough extending beneath the duct, the duct and water trough being constructed and arranged so as to provide a substantially continuous delivery opening extending along the duct and so as to deflect the discharging air and reduce its velocity at the points of discharge of the same and prevent any large particles of water from being carried into the room, but permit only moisture in an extremely fine condition to be discharged into the room; and also to improve humidifying apparatus in the other respects hereinafter described and set forth in the claims.

In the accompanying drawings:

Fig. 1 is a sectional elevation of a portion of a building equipped with humidifying apparatus embodying the invention.

Fig. 2 is a sectional plan view thereof.

Fig. 3 is a fragmentary elevation partly in section, on an enlarged scale, of the air delivery duct and water trough.

Fig. 4 is a longitudinal sectional elevation thereof on a still larger scale, on line 4—4, Fig. 5.

Fig. 5 is a transverse sectional elevation thereof on line 5—5, Fig. 4.

Fig. 6 is a transverse sectional elevation of the humidifier on line 6—6, Fig. 3.

Fig. 7 is a detail section of the water trough, on an enlarged scale, on line 7—7, Fig. 5.

Fig. 8 is a plan view, partly in section, on an enlarged scale, of the air fan and heater.

A represents a portion of a building and B represents an ordinary centrifugal fan or blower located in one of the rooms of the building and connected with a discharge or delivery duct C arranged horizontally to extend in any direction necessary to deliver air as required to the room. The fan is adapted to supply to the discharge duct outside or fresh air, return air from the room, or a suitably proportioned mixture of outside and return air, and for this purpose the fan inlet is preferably connected with a casing D provided with a portion *d* extending through the outside wall of the building for the admission of fresh air, and with an admission opening *d'* for return air from the room. The fan B, duct C and casing D, as well as a suitable motor E for driving the fan, are located adjacent to and suitably suspended from the ceiling of the room so as to be out of the way in available space in the upper portion of the room. The fresh air and return air inlet openings of the casing D are provided with suitable dampers 10 and 11 which can be adjusted so that the fan will supply to the room only outside air, only return air from the room, or both return air and outside air in any desired proportions. Preferably these dampers are connected by mechanism 12 of any suitable sort whereby one damper closes as the other is opened.

The air supplied by the fan B to the discharge or delivery duct C is humidified or moistened by water discharged under pressure in a fine spray from nozzles 13 disposed in the discharge duct C in advance of and adjacent to the fan. These nozzles can be constructed and arranged in the duct in any suitable manner adapted when supplied with water under proper pressure to insure complete saturation of the air. As shown, a water supply pipe 14 extends into the discharge duct C through one side thereof and is provided within the duct with branch pipes 15, the pipe 14 and branch pipes 15 being provided with laterals equipped with the spray nozzles 13.

The air discharge duct C is provided along its bottom or lower portion with numerous outlets or discharge openings 16 for the humidified air. These openings preferably extend lengthwise of the duct from a point adjacent the spray nozzles 13 to the far end of the duct and extend transversely through a considerable portion of the width of the duct as shown in Fig. 5. In the construction shown the outlet openings 16 are formed in a separate horizontal plate 17 which is secured at its side edges by folded and soldered, or other suitable joints 18 to the side walls of the duct. Except for the flat perforated bottom plate the duct is of circular cross section. Deflecting lips 19 are provided at the front ends of the outlet openings 16 of the duct, these deflecting plates being preferably formed by bending downwardly or outwardly the portions of the plate 17 which are cut to form the outlet openings 16.

Extending lengthwise beneath the discharge duct C is a water drain or catch-pan or trough 20, which slopes lengthwise sufficiently for water to run therefrom through a drain pipe 21 at the lower end of the trough. This trough may be of any suitable construction but is preferably of V shape and formed by side plates 22 which incline downwardly toward each other and are joined at their lower edges by a folded and soldered or other suitable joint. The trough is preferably suspended from the air discharge duct by suitable straps or hangers 23 secured at their lower ends to vertical plates 24 which extend transversely in the trough above the bottom thereof, and are suitably secured at their ends to the sides 22 of the trough. These vertical plates

which are arranged at intervals along the trough serve to strengthen the trough and also cooperate with the lips 19 of the air duct to deflect the discharging air and cause it to change from its direction lengthwise through the duct to a direction transversely of the duct and trough. The upper side edges of the trough are preferably bent laterally outward and provided with upturned edge flanges 25 thus forming gutters 26 at the upper side edges of the trough. Preferably transversely corrugated metal strips 27 are soldered or otherwise suitably secured on the upper faces of the sides of the trough and project outwardly over the side gutters 26.

In the use of the apparatus, the air passing through the water spray from the nozzles 13 in the duct is humidified, preferably to the point of saturation, and as the air escapes from the outlet openings 16 in the bottom of the duct, it is deflected downwardly substantially at right angles to its direction of flow in the duct by the depending lips 19 on the duct. The transverse, vertical plates 24 in the trough, cooperating with the lips 19 on the duct, practically interrupt the longitudinal flow of the air and cause it to discharge laterally through the spaces between the side edges of the trough and the lower portion of the duct. The deflection of the discharging air in this manner materially reduces the high velocity thereof carried in the duct, and the drain trough and duct arranged as described form in effect continuous lateral delivery slots extending from one end of the duct to the other. The depending lips 19 and vertical deflector plates 24 in the trough tend to intercept any drops or large particles of water and cause the same to flow or drip down into the drain trough 20. As the air discharges outwardly over the side edges of the trough, any large particles of water which may be entrained with the air collect on the corrugated strips 27 along the side edges of the trough and any of this water which overflows the upper edges of the corrugated strips 27, will collect in the gutters 26 and flow back into the drain trough through the passages formed by the corrugations between the underside of the corrugated strips and the side plates of the trough. This construction of trough supplementing the action of the deflecting lips 19 and plates 24 in changing the direction and reducing the velocity of the air, remove from the air and collect all the heavy drops of water, so that only extremely fine spray is carried out into the room, and the necessity for a water eliminator in the humidifying duct is obviated.

F represents a heater arranged in the casing D for heating the air whenever this may be necessary in order to obtain the required humidification of the air or to give a desired temperature in the room or building. If the conditions required do not demand a heater, the latter may be omitted. The heater may be of any suitable sort, an ordinary steam heating coil being shown having steam supply pipe 30 equipped with a valve for regulating the heater. Different required humidity and temperature conditions of the air supplied to the room can be obtained by appropriate regulation of the spray water, adjustments of the fresh and return air dampers 10 and 11, and regulation of the heater F.

Only one humidifying unit constructed as above described is illustrated in the drawings, but it will be understood that any desired number, one or more, of the units can be employed and disposed wherever necessary in a room or building. When two or more of the units are used in a building the water supply and drain pipes 14 and 21 of the several units are preferably connected to a suitably located common or central water pumping or supply system. Likewise the heaters of the several units can be connected to a common source of steam supply. Each unit however can be separately operated or regulated to give like or different conditions.

Automatic regulation can be easily applied to this system. A practical and simple method of regulation is to control the supply of steam to the heater F by means of a dry bulb thermostat 31 located in the room, and to control the humidity by means of a hygrostat 32 in the room acting upon the water supply to the spray nozzles and on the fresh and return air dampers. The thermostat and hygrostat can effect the regulation through any usual or suitable instrumentalities. For instance the thermostat controls the pressure of compressed air supplied by a reservoir 33 for actuating a diaphragm valve 34 on the steam supply pipe, and the hygrostat 32 similarly controls the pressure of compressed air for operating a diaphragm valve 35 on the spray water pipe, and an actuating motor 36 for the fresh and return air dampers.

I claim as my invention:—

1. In an air conditioning apparatus, the combination of a horizontally extending air duct having discharge openings along the bottom thereof, a fan arranged to deliver air to said duct and having inlet connections for return air from the room in which said duct is located and for outside air, adjustable dampers controlling said outside and return air inlets, nozzles and connections adapted to spray water under pressure into said duct in advance of said fan, a water drain trough extending lengthwise under said air duct with its sides spaced from the walls of the duct, and deflectors for deflecting the discharging air downwardly from

said duct and causing it to issue laterally through the spaces between the duct and said trough.

2. In an air conditioning apparatus, the combination of a horizontally extending air duct having discharge openings along the bottom thereof, a fan arranged to deliver air to said duct, a casing communicating with the fan inlet and having an air inlet, an air heater in said casing, nozzles and connections adapted to spray water under pressure into said duct in advance of said fan, a water drain trough extending lengthwise under said air duct with its sides spaced from the walls of the duct, and deflectors for deflecting the discharging air downwardly from said duct and causing it to issue laterally through the spaces between the duct and said trough.

3. In an air conditioning apparatus, the combination of a horizontally extending air duct having discharge openings along the bottom thereof, a fan arranged to deliver air to said duct, a casing communicating with the fan inlet and having inlets for return air from the room in which said duct is located and for outside air, adjustable dampers controlling said return and outside air inlets, an air heater in said casing, nozzles and connections adapted to spray water under pressure into said duct in advance of said fan, a water drain trough extending lengthwise under said air duct with its sides spaced from the walls of the duct, and deflectors for deflecting the discharging air downwardly from said duct and causing it to issue laterally through the spaces between the duct and said trough.

4. In an air conditioning apparatus, the combination of a horizontally extending air duct which is open for the discharge of air along one side thereof for a substantial portion of the length of the duct, a fan arranged to deliver air to said duct, means for altering the condition of the air delivered by said fan to the duct, nozzles and connections adapted to spray liquid under pressure into said duct in advance of said fan, an air deflecting device extending lengthwise of said duct opposite said air discharge opening and having its sides spaced from the walls of the duct for the escape of the discharging air, and deflectors for changing the course of the discharging air and causing it to issue laterally through the spaces between the duct and said deflecting device.

5. In an air conditioning apparatus, the combination of a horizontally extending air duct having air discharge openings along one side thereof, a fan arranged to deliver air to said duct, means for altering the temperature and humidity conditions of the air delivered by said fan to the duct, nozzles and connections adapted to spray liquid under pressure into said duct in advance of said fan, an air deflecting device extending lengthwise of said duct opposite said air discharge openings and having its sides spaced from the walls of the duct for the escape of the discharging air, and deflectors for changing the course of the discharging air and causing it to issue laterally through the spaces between the duct and said deflecting device.

6. In an air conditioning apparatus, the combination of a horizontally extending air duct having air discharge openings along one side thereof, a fan arranged to deliver air to said duct, nozzles and connections adapted to spray liquid under pressure into said duct in advance of said fan, an air deflecting device extending lengthwise of said duct opposite said air discharge openings and having its sides spaced from the walls of the duct for the escape of the discharging air, and deflectors arranged to deflect the air discharging from the duct and causing it to issue laterally through the spaces between the duct and said deflecting device.

7. In an air conditioning apparatus, the combination of a horizontally extending air duct having discharge openings along the bottom thereof, a fan arranged to deliver air to said duct, nozzles and connections adapted to spray water under pressure into said duct in advance of said fan, a water drain trough extending lengthwise under said air duct with its sides spaced from the walls of the duct, and deflector plates extending transversely in said trough for deflecting the air discharging from the duct and causing it to issue laterally through the spaces between the duct and said trough.

8. In an air conditioning apparatus, the combination of a horizontally extending air duct having discharge openings along the bottom thereof, a fan arranged to deliver air to said duct, nozzles and connections adapted to spray water under pressure into said duct in advance of said fan, a water drain trough extending lengthwise under said air duct with its sides spaced from the walls of the duct, vertical plates extending transversely in said trough, and hangers secured to said vertical plates for suspending the trough.

9. In an air conditioning apparatus, the combination of a horizontally extending air duct having discharge openings along the bottom thereof, a fan arranged to deliver air to said duct, nozzles and connections adapted to spray water under pressure into said duct in advance of said fan, a water drain trough extending lengthwise under said air duct with its sides spaced from the walls of the duct, whereby the air discharging from the duct can issue laterally through the spaces between the duct and the sides of the trough, and corrugated strips projecting outwardly from the sides of said trough and forming passages through which water overflowing

the edges of said strips can flow back into the trough.

10. In an air conditioning apparatus, the combination of a horizontally extending air duct having discharge openings along the bottom thereof, a fan arranged to deliver air to said duct, nozzles and connections adapted to spray water under pressure into said duct in advance of said fan, a water drain trough extending lengthwise under said air duct with its sides spaced from the walls of the duct whereby the air discharging from the duct can issue laterally through the spaces between the duct and the sides of said trough, gutters along the side edges of said trough, and corrugated strips on the sides of said trough and overhanging said gutters and forming passages through which water overflowing into said gutters can flow back into the trough.

LEO L. LEWIS.