Aug. 8, 1961 C. L. RINGQUIST ET AL 2,995,078

AIR CONDITIONING UNIT WITH MEANS FOR MAINTAINING CONSTANT AIR DELIVERY

Filed Feb. 13, 1957 2 Sheets-Sheet 1

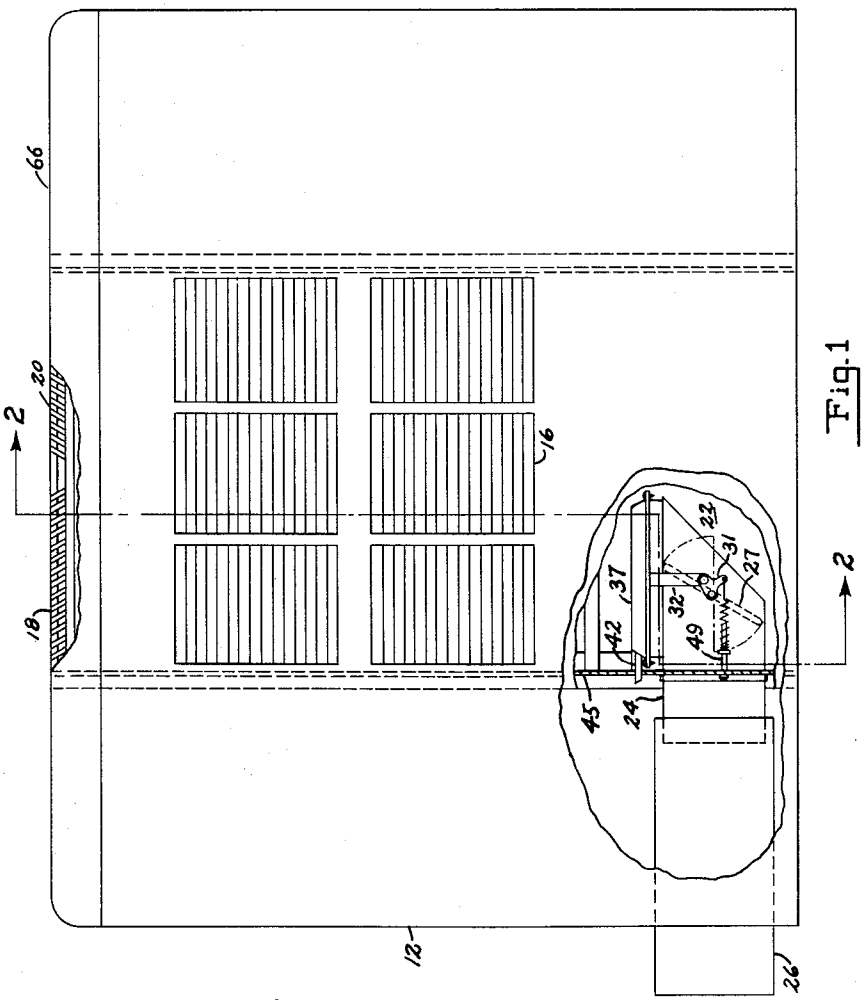

Fig. 1

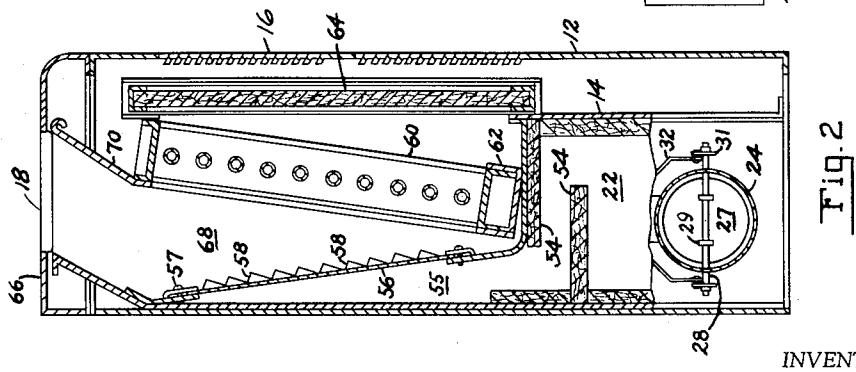

Fig. 2

INVENTORS.
CLARENCE L. RINGQUIST
ROBERT G. MINER
BY Holmes & Anderson
ATTORNEYS.

Aug. 8, 1961 C. L. RINGQUIST ET AL 2,995,078

AIR CONDITIONING UNIT WITH MEANS FOR MAINTAINING CONSTANT AIR DELIVERY

Filed Feb. 13, 1957 2 Sheets-Sheet 2

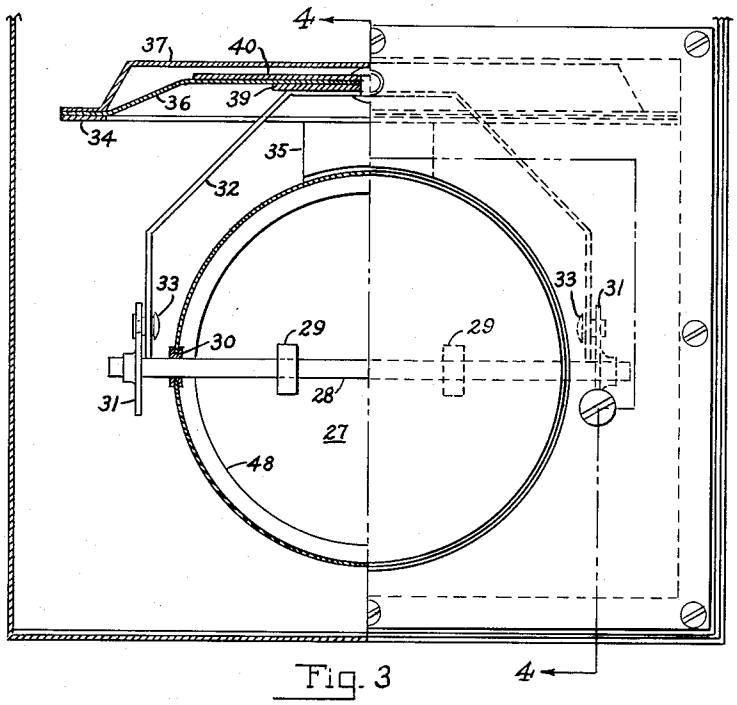

Fig. 3

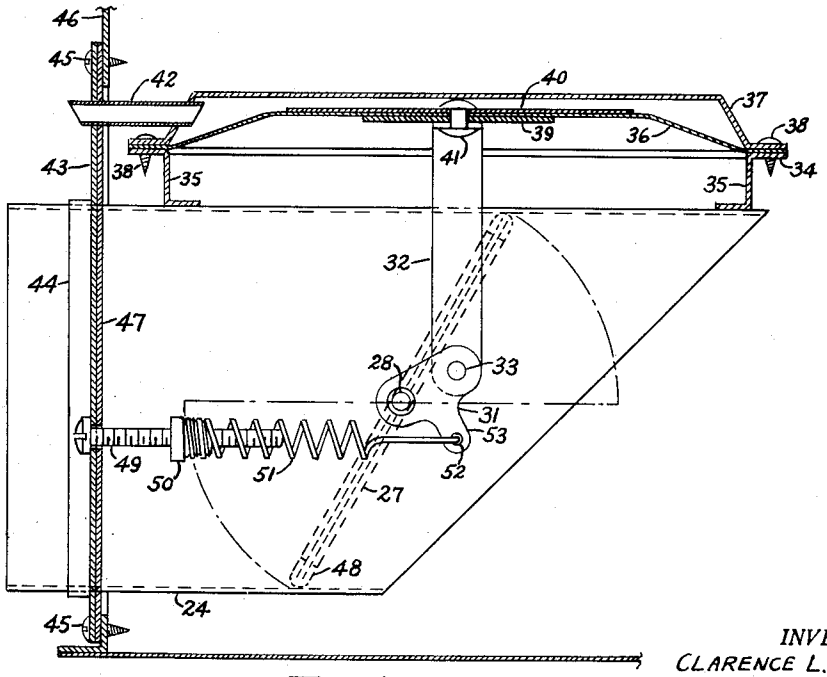

Fig. 4

INVENTORS.
CLARENCE L. RINGQUIST
ROBERT G. MINER

BY Holmes & Andersen
ATTORNEYS.

United States Patent Office 2,995,078 Patented Aug. 8, 1961

2,995,078

AIR CONDITIONING UNIT WITH MEANS FOR MAINTAINING CONSTANT AIR DELIVERY

Clarence L. Ringquist and Robert G. Miner, La Crosse, Wis., assignors to The Trane Company, La Crosse, Wis., a corporation of Wisconsin

Filed Feb. 13, 1957, Ser. No. 639,927
7 Claims. (Cl. 98—38)

This invention relates to air conditioning units and more particularly to units adapted to be connected to a source of air under pressure.

The general object of the invention is to provide a unit which produces a circulation of the air in a conditioned space by the discharge in the unit of a relatively small quantity of conditioned air.

It is another object of the invention to provide a unit having a heat exchanger for heating or cooling the air from the conditioned space and means for supplying conditioned primary air at a predetermined static pressure to nozzles in the unit to induce a flow of air from the conditioned space through the heat exchanger in such a manner that the conditioned primary air and the air from the conditioned space are intimately mixed and discharged from the unit at a predetermined volume rate of flow regardless of variations in the pressure of the primary air supply to the unit.

It is another object of the invention to provide a pressure regulator which is a unitary assembly and which is easily installed in the unit.

It is another object of the invention to provide an air conditioning unit having a pressure regulator which is unaffected by dirt accumulation, and one which permits the duct noises to be isolated within the unit.

These and other objects and advantages of the invention will more fully appear from the following description to be read in connection with the accompanying drawings, in which:

FIG. 1 is a front elevational view of the unit of this invention with portions of the cabinet broken away to disclose the interior construction;

FIG. 2 is a sectional view of the unit taken substantially on the line 2—2 of FIG. 1;

FIG. 3 is an end view partly in section of the pressure regulator of the unit; and

FIG. 4 is a side elevational view of the pressure regulator taken on line 4—4 of FIG. 3.

Referring now to the drawings, similar numerals referring to the same or similar parts, the unit has a cabinet 12 of metal or other suitable material. The cabinet 12 may be of desired width, usually three to five feet, and of a height suitable to the area to be served. The cabinet 12 may be made in various depths, and it may be partly or wholly recessed in the wall of the space to be conditioned.

In the cabinet 12 an inner casing 14 is mounted centrally of the width of the cabinet. The cabinet 12 has an air inlet grille 16 formed in the front upper portion thereof. Vanes 18 and 20 are mounted in the top 66 of the cabinet 12 to direct the air flowing from the cabinet. Vanes 18 and 20 are inclined outwardly with respect to the vertical center line of the unit in order to direct the air in a diverging stream from the unit.

The inner casing 14 has a plenum 22 to which air is delivered through conduit 24. Conduit 24 extends into the inner casing 14 and has a portion extending outside of the inner casing. The portion of the conduit 24 which extends from the inner casing 14 is adapted to be connected to a source 26 of conditioned air having a total pressure on the order of ½" to 5" water gauge. The air from source 26 has been conditioned to a desired humidity and dry bulb temperature.

The inner end of the conduit 24 terminates in a plane making a downwardly facing angle of 45° with the horizontal axial plane of the conduit. The purpose of the inclined end on the conduit is to reduce the noise of the air in flowing from the conduit. A damper 27 is secured to a shaft 28 by straps 29 which are spot welded to the damper 27 and the shaft 28. The shaft 28 is rotatably mounted in bearings 30 in the conduit 24. Levers 31 are press-fitted or otherwise secured to each end of the shaft 28. A yoke 32 is pivotally connected to levers 31 by headed pins 33 which are riveted to levers 31. A diaphragm ring 34 has downwardly extending flanges 35 which are spot welded to conduit 24. A diaphragm 36 is held at its periphery between the diaphragm ring 34 and a diaphragm chamber 37. Screws 38 hold the diaphragm chamber 37 and the diaphragm ring 34 tightly against the diaphragm 36 to prevent leakage of air into the diaphragm chamber 37. The diaphragm 36 is made from a flexible, air-impervious material such as a coated fabric. Diaphragm 36 could also be made of rubber or other flexible material.

Plates 39 and 40 and yoke 32 are secured to diaphragm 36 by rivet 41. A tube 42 is connected to the diaphragm chamber 37 as by brazing or soldering. The outer end of the tube 42 extends through and is secured to a plate 43. The interior of the cabinet 12, except for the inner casing 14, is at atmospheric pressure and therefore the interior of the diaphragm chamber 37 is maintained at atmospheric pressure by tube 42. Plate 43 has a flange 44 encircling and secured to conduit 24. Plate 43 is secured by screws 45 to the end wall 46 of the inner casing 14 of the unit. A gasket 47 of compressible material lines the inner side of plate 43 to seal the opening in end wall 46 and to prevent sound transmission through the plate 43. A flexible gasket 48 encircles the periphery of the damper 27 to prevent leakage. The gasket 48 also prevents noise in the event of sudden closing of the damper 27. The gasket 48 is not essential to operation of the device and may be omitted if desired. A screw 49 is threaded in nut 50 to which one end of a spring 51 is secured. The other end of spring 51 hooks into a hole 52 in arm 53 of lever 31. Prior to installation of the pressure regulator in the unit, the crew 49 is adjusted according to the pressure desired in the plenum chamber 22 of the unit.

The manner in which the pressure regulator operates will now be described. Let us assume that the pressure in plenum 22 increases above the desired point due to a change in pressure in source 26. This increased pressure in plenum 22 acts upon the lower side of diaphragm 36 and moves it upwardly, because the pressure in diaphragm chamber 37 is always maintained at atmospheric pressure by tube 42. When diaphragm 36 moves upwardly damper 27 is moved toward closed position to throttle the flow into plenum 22 and re-establish the desired predetermined pressure. If it is desired to increase the output of the unit it is only necessary to adjust the screw 49 to move the nut 50 to the left in FIGURE 4 to increase the tension of the spring 51. This adjustment will increase the pressure which will be maintained in plenum 22. An adjustment of the screw 49 in the other direction will decrease the pressure maintained in plenum 22.

The interior of plenum 22 is provided with a plurality of sound absorbing baffles 54, constructed of any suitable sound absorbing material, which cause the air delivered to the plenum 22 to flow in a circuitous path to the top of the plenum. The top of the plenum 22 is provided with an extension chamber 55 extending substantially the length of the inner casing 14. A plurality of nozzle plates 56 are secured by screws 57 to the front face of the extension chamber 55. The nozzle plates 56 make an angle of 8° with respect to a vertical plane. It should be understood that angles other than 8° might be used.

However, we prefer that this angle be in the range of 5° to 30°.

The nozzle plates **56** have a plurality of nozzles **58** through which air flows from the plenum **22**.

A heat exchanger **60** is mounted in the inner casing so that it is inclined upwardly toward the front of the cabinet. The heat exchanger **60** is preferably of the fin and tube type in which a heat transfer fluid such as water is circulated through the tubing. The tubing of the heat exchanger **60** is connected to a source of supply of heat transfer fluid and the supply fluid may be varied in temperature to heat or cool the air flowing through the coil **60** from the grilles **16** in the front of the cabinet. A drain pan **62** is provided under the heat exchanger **60** to receive condensate flowing by gravity from the heat exchanger **60**. The drain pan **62** has an outlet (not shown) which is adapted to be connected to a sewer pipe (not shown). The heat exchanger **60** is inclined with respect to the vertical at an angle of 8°; however this angle may be somewhat less or greater than 8°. By mounting the coil at 8° we have obtained a unit which has the desired depth, and yet the heat exchanger **60** is inclined at a suitable angle with respect to the direction of air flow from the nozzles **58**. On the inner casing **14** the usual filter **64** is mounted for removing dirt from the air on its way from the inlet grilles **16** to the heat exchanger **60**. The top **66** of cabinet **12** is mounted for removal for the purpose of removing the filter to inspect it, replace it, or clean it.

An induction chamber **68** in the inner casing **14** between the nozzle plates **56** and the heat exchanger **60** provides a space in which secondary air flow is induced and mixed with the primary air from the nozzles **58**. In this chamber **68** the flow of primary air from the nozzles **58** induces a flow of secondary air from the conditioned space through the grilles **16** thence through the filter **64** and thence through the heat exchanger **60**. The shape of the chamber **68** is such that its cross-section in the direction of air flow increases in proportion to the increase in volume of air flowing therethrough. The nozzles arrangement is such that the nozzles **58** act in succession upon the air flowing from the heat exchanger in a staged manner.

The inner casing **14** has a duct **70** for conducting the air from the chamber **68** to the discharge vanes **18** and **20**. The axis of the duct **70** in the direction of air flow is substantially parallel to the direction of flow of air from the nozzles **58**. The cross-sectional area of the duct **70** increases slightly from inlet to outlet to convert some velocity air pressure to static air pressure in the passage of the air from the chamber **68** to the discharge vanes **18** and **20**.

The conditions of temperature, humidity and pressure of the primary air and the conditions of temperature and rate of flow of the heat transfer fluid through the heat exchanger **60** may be controlled in a manner well known in induced air systems. For instance these conditions may be controlled as shown and described in U.S. patent to W. H. Carrier No. 2,363,294, issued November 21, 1944.

Although we have described specifically the preferred embodiments of our invention, we contemplate that changes may be made without departing from the scope or spirit of our invention and we desire to be limited only by the claims.

We claim:

1. A self-contained pressure regulator for a plenum of an air conditioning unit comprising a plate adapted to be secured in an opening in the plenum, a first conduit secured to said plate and adapted to be connected to a source of air under pressure, a damper rotatably mounted in said first conduit for controlling the flow through said first conduit, a diaphragm chamber mounted on said first conduit, a diaphragm secured to and closing said diaphragm chamber, a second conduit in fluid communication with the interior of said diaphragm chamber and extending through said plate to put said diaphragm chamber under atmospheric pressure, a lever secured to said damper, a spring secured at one end to said lever, means extending through said plate for holding said spring under tension to force said damper toward open position and means secured to said lever and to said diaphragm to force said damper toward closed position when the pressure in said plenum exceeds a predetermined point said last mentioned means being entirely outside of said first conduit.

2. A pressure regulator for an air conditioning unit comprising a plate adapted to be secured across an opening into a first plenum of an air conditioning unit, a conduit secured to and extending through said plate and being adapted to supply air under pressure to the plenum of an air conditioning unit, a damper pivotally mounted in said conduit for controlling the flow of air through said first conduit, a diaphragm chamber mounted upon said first conduit, a diaphragm secured in air tight engagement with said diaphragm chamber and closing said diaphragm chamber, a second conduit in fluid communication with the interior of said diaphragm chamber and a point outside of the plenum to connect the interior of said diaphragm chamber to the atmosphere, a lever secured to said damper, means connecting said lever to said diaphragm, a spring connected at one end to said lever and at the other end to a nut, a screw rotatably supported on said plate and in threaded engagement with said nut whereby adjustment of said screw in said nut varies the tension in said spring to change the pressure which is maintained in the plenum.

3. An air conditioning unit comprising a casing, a plenum in said casing, a conduit extending into said plenum for supplying air under pressure to said plenum, nozzles in said plenum for discharging air from said plenum, a damper mounted in said conduit, a diaphragm chamber mounted in said plenum, a diaphragm secured in air tight engagement with said diaphragm chamber and closing said diaphragm chamber, fluid conducting means connecting the interior of said diaphragm chamber to the exterior of said plenum, a shaft on said damper, said shaft extending through the wall of said conduit and being pivotally mounted therein, a lever secured to said shaft and means entirely outside of said conduit and connecting said diaphragm to said lever to force said damper toward closed position under influence of the pressure in said plenum upon said diaphragm.

4. An air conditioning unit, comprising a casing, a plenum in said casing, a conduit extending into said plenum for supplying air under pressure to said plenum, nozzles in said plenum for discharging air from said plenum, a damper pivotally mounted in said conduit, a diaphragm chamber mounted in said plenum, a diaphragm secured in air tight engagement with said diaphragm chamber and closing said diaphragm chamber, a pressure connection from the interior of said diaphragm chamber to the exterior of said plenum, a lever secured to said damper, means secured to said diaphragm and to said lever to force said damper toward closed position and spring means entirely outside of said conduit, means connecting said spring means to said damper to force said damper toward a fully open position.

5. A pressure regulator for a plenum having a discharge opening to supply air to an air conditioning unit comprising a plate adapted to be secured in an opening in the plenum, a conduit extending from one side of said plate and adapted to be connected to a source of air under pressure, a damper rotatably mounted in said conduit for controlling the flow through said conduit, a diaphragm chamber mounted on said conduit, a diaphragm secured to and closing said diaphragm chamber, fluid conducting means connecting the interior of said diaphragm chamber and the other side of said plate to put said diaphragm chamber under atmospheric pressure, a shaft on said damper and extending through the wall of said con-

duit and being pivotally mounted therein, a spring secured at one end to said plate, means connecting the other end of said spring to said damper to force said damper toward open position, a lever secured to said shaft, and means secured to said diaphragm and pivotally secured to said lever to force said damper toward closed position when the pressure in said plenum upon said damper exceeds a predetermined amount, said last mentioned means being entirely outside of said conduit.

6. A pressure regulator for an air conditioning unit comprising a plate adapted to be secured across an opening into a plenum having a discharge opening for supplying air to an air conditioning unit, a conduit extending from one side of said plate and being adapted to supply air under pressure to the plenum of an air conditioning unit, a damper pivotally mounted in said conduit for controlling the flow of air through said conduit, a diaphragm chamber mounted upon said conduit, a diaphragm secured in air tight engagement with said diaphragm chamber and closing said diaphragm chamber, fluid conducting means connecting the interior of said diaphragm chamber to the other side of said plate to connect the interior of said diaphragm chamber to the atmosphere, a shaft on said damper, said shaft extending through the wall of said conduit and being pivotally mounted therein, lever means outside of said conduit and being secured to said shaft, means connecting said lever means to said diaphragm to force said damper toward closed position when the pressure in said plenum upon said diaphragm exceeds a predetermined amount, and spring means secured to said lever means for forcing said damper toward open position.

7. An air conditioning unit comprising a casing, a plenum in said casing, a conduit extending into said plenum for supplying air under pressure to said plenum, nozzles in said plenum for discharging air from said plenum, a damper pivotally mounted in said conduit, a diaphragm chamber mounted in said plenum, a diaphragm secured in air tight engagement with said diaphragm chamber and closing said diaphragm chamber, a pressure connection from the interior of said diaphragm chamber to the exterior of said plenum, mechanical linkage means secured to said diaphragm and to said damper to transmit movement from said diaphragm to said damper to move said damper toward closed position when the pressure in said plenum exceeds a predetermined amount, and spring means acting upon said damper to force said damper toward a fully open position.

References Cited in the file of this patent

UNITED STATES PATENTS

1,186,180	Fulton	June 6, 1916
1,936,544	Shurtleff	Nov. 21, 1933
2,282,210	Plum	May 5, 1942
2,314,569	Baker	Mar. 23, 1943
2,402,208	Read	June 18, 1946
2,757,868	Kreuttner	Aug. 7, 1956
2,765,984	Puster	Oct. 9, 1956
2,783,979	Blum	Mar. 5, 1957
2,852,036	Riza	Sept. 16, 1958
2,913,227	Bottorf et al.	Nov. 17, 1959

FOREIGN PATENTS

855,536	Germany	Nov. 13, 1952