Oct. 1, 1968 R. G. MINER 3,403,725

AXIAL FLOW FAN ARRANGEMENT FOR FAN COIL UNIT

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FIG. 1

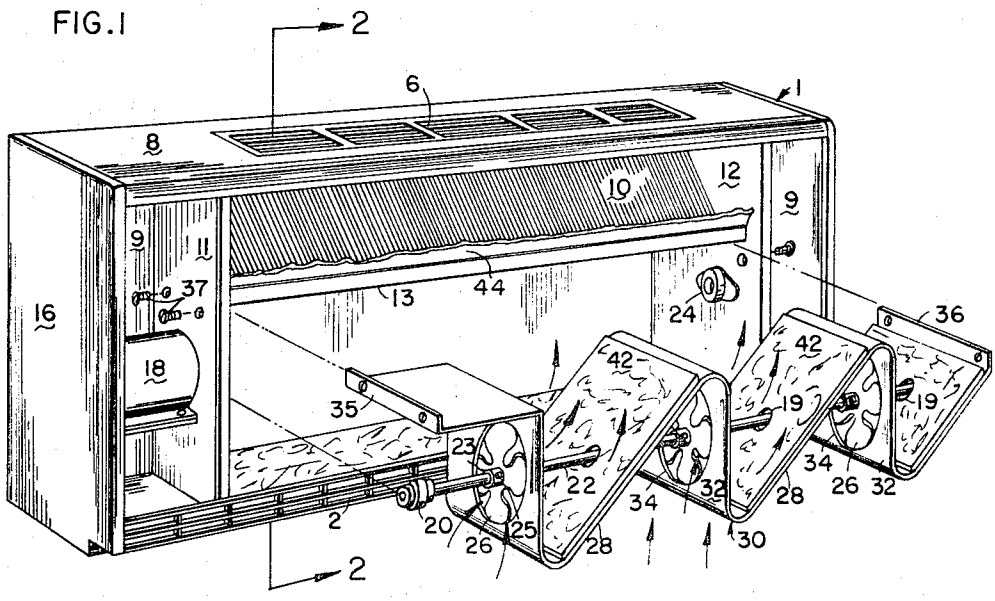
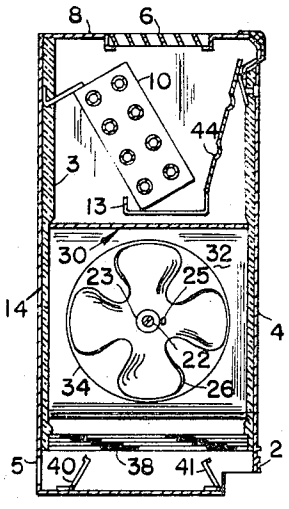


FIG. 2



INVENTOR.
ROBERT G. MINER

BY Malcolm L Moore
ATTORNEY

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FIG. 3

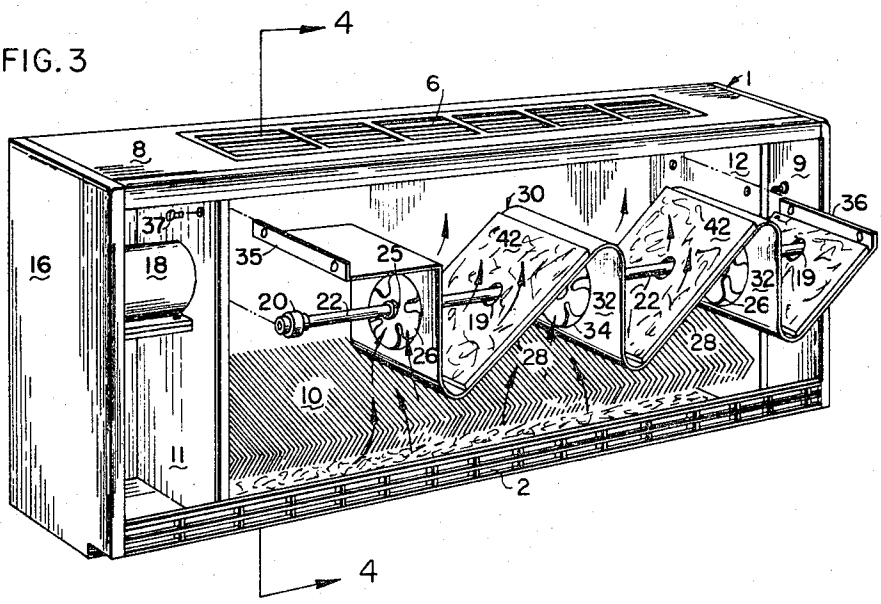
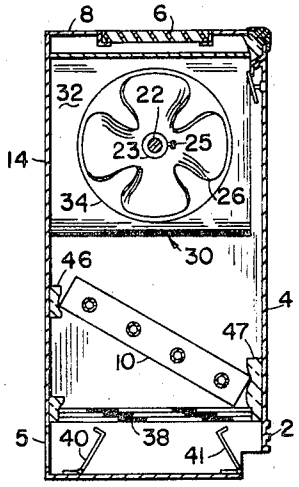


FIG. 4



INVENTOR.
ROBERT G. MINER

BY Malcolm L. Moore
ATTORNEY

United States Patent Office 3,403,725 Patented Oct. 1, 1968

3,403,725

AXIAL FLOW FAN ARRANGEMENT FOR FAN COIL UNIT

Robert G. Miner, La Crosse, Wis., assignor to The Trane Company, La Crosse, Wis., a corporation of Wisconsin

Filed Oct. 4, 1966, Ser. No. 584,198
3 Claims. (Cl. 165—122)

ABSTRACT OF THE DISCLOSURE

A heat exchange unit comprising: a casing having air inlet opening and air outlet openings with a heat exchange coil therebetween, a unitary fan housing air directing member within the casing having a plurality of spaced apart sections with apertures therein and a plurality of air diverting portions disposed opposite each of said apertures, a drive shaft extending through said member and flow fans mounted on said drive shafts within said apertures.

This invention relates to air conditioning units of the type comprising a fan and heat exchange coil positioned within a casing. The casing is normally provided with inlet and outlet openings through which air from a conditioned space, as well as fresh air in some instances, may be circulated over the coil. Individual units of this type are installed in rooms to be conditioned, and are commonly referred to as unit ventilators.

The installation of such units along room walls necessarily results in the utilization of space which could normally be beneficially employed for other purposes. Therefore, a major portion of the design work in this field has been directed towards reducing the size of fan-coil units to the absolute minimum consistent with satisfactory engineering performance.

The current, substantially universal use of centrifugal fans in fan-coil cabinets has limited the extent to which the depth of the cabinet can be reduced. An example of the installation of centrifugal fans within a unit ventilator cabinet is shown in U.S. Patent No. 3,129,753. As is clearly indicated in that patent, the cabinet depth must be maintained at a certain minimum level in order to accommodate the relatively large discharge scroll peculiar to centrifugal fans.

With the aforesaid cabinet size considerations in mind, the primary object of my invention is to provide a fan-coil unit of smaller depth than units of comparable capacity now available.

The salient feature of my invention which permits me to accomplish this objective is a unique arrangement of a plurality of small axial flow fans within a fan-coil housing.

My invention is particularly characterized by the mounting of spaced apart axial flow fans on a common drive shaft extending longitudinally of a rectangular fan-coil cabinet having inlet openings in one wall and outlet openings in a second wall extending parallel to said drive shaft, the air discharging from said fans being diverted towards said outlet openings by a plurality of baffle means extending across the discharge path of each of said fans.

My improved fan-coil unit has as a further distinctive feature thereof a unitary fan housing-air diverter member mounted longitudinally within a casing and having spaced apart sections with concentric openings therein in which axial flow fans are positioned and a plurality of air diverting portions disposed opposite each of said openings, said air diverting portions being inclined towards outlet openings in the casing.

Still another feature of my invention is the utilization of sound absorbing material on the above mentioned baffle or air diverting portions so as to dampen the noise generated by axial flow fans.

These and other features and advantages of my invention will become readily apparent as the following description is read in conjunction with the accompanying drawings, of which:

FIGURE 1 is an exploded, perspective view of a preferred form of the fan-coil unit of my invention;

FIGURE 2 is a vertical section view taken along line 2—2 of FIGURE 1;

FIGURE 3 is an exploded, perspective view of an alternative form of the fan-coil unit of my invention; and

FIGURE 4 is a vertical section view taken along line 4—4 of FIGURE 3.

With reference to FIGURES 1 and 2, my improved air conditioning unit comprises a rectangular cabinet **1** provided with a return air inlet grille **2** in the lower part of front wall **4** and an air outlet grille **6** in top wall **8**, and a heat exchange coil **10** of the conventional finned tube construction supported within cabinet **1** between vertical partitions **11** and **12**. An additional inlet **5** in the lower part of back wall **14** communicating with the outside atmosphere permits the unit to circulate fresh air. End pockets **9** are formed between partitions **11**, **12** and end walls **16**. Fan drive motor **18** is housed within left end pocket **9** and has its output shaft passing inwardly through partition **11** to a point of connection with flexible coupling **20**. A drive shaft **22** extends longitudinally within cabinet **1** in a direction parallel to outlet grille **6**, and is connected at one end to the other side of coupling **20**. The other end of drive shaft **22** is rotatably supported within bearing **24** mounted on partition **12**.

A plurality of spaced apart, axial flow fans **26** are mounted on drive shaft **22** in the manner shown. Coupling **20** is preferably of the angularly flexible type so as to be able to accommodate any angular displacement of relatively long drive shaft **22**. The rotation of drive shaft **22** by the operation of motor **18** will cause air to discharge from fans **26** in a path generally parallel to heat exchange coil **10** and outlet grille **6**. In order to turn the air so that it will flow over coil **10** and outwardly through discharge grille **6**, I provide a plurality of baffle elements **28** positioned across the air discharge path of each fan **26**. Baffle elements **28** form a portion of a continuous, unitary member generally indicated by numeral **30**, which also serves as a housing for fans **26**. Member **30** and the fan-shaft assembly are shown removed from cabinet **1** in an exploded view in FIGURE 1 for purposes of clarity. Member **30** includes a plurality of substantially vertically oriented sections **32** having fan openings **34** therein. Baffle elements **28** are interconnected by vertical sections **32**. Member **30** may be formed into the undulating shape shown from a single piece of sheet metal. Drive shaft **22** is passed through openings **34**, and holes **19** in baffle elements **28**, with one fan **26** being mounted at a time on shaft **22** as it is guided through the entire length of member **30**. The hubs **23** of fans **26** are secured to shaft **22** by means of set screws **25** or the like. Each fan **26** is positioned within one of the openings **34** in sections **32**. The entire assembly consisting of member **30**, drive shaft **22** and fans **26** is then positioned within casing **1**. Member **30** is secured in place by fastening flanges **35** and **36** at its opposite ends to vertical partitions **11** and **12** with sheet metal screws **37**.

An air filter **38** is located across the bottom of the unit above air inlet openings **2** and **5**. Dampers **40** and **41** control the flow of air into the unit through fresh air and return air inlet grilles **5** and **2** respectively.

In the embodiment of FIGURE 1, baffle elements **28** are shown inclined throughout their length. Baffles of other shapes may be employed satisfactorily, just so long as

there is a baffle exit portion extending towards outlet grille **6**. The inclined baffle arrangement shown is preferred, as opposed to vertically positioned baffles, because of the minimum static pressure load which it imposes upon fans **26**. Stationary turning vanes could also be employed in the discharge path of fans **26** between vertical sections **32** and baffles **28** in order to assist in turning the air in a radial direction.

In order to prevent the transmission of noise generated by axial flow fans **26**, fibrous sound attenuating material **42** is bonded to baffle elements **28**. Additional sound dampening material may be employed as desired in order to minimize sound transmission.

The unit shown in FIGURES 1 and 2 is adapted for heating or cooling operation. Thus a drain pan **13** is fastened under heat exchange coil **10** in order to catch the condensate which forms when the air is being cooled. Capacity control is achieved by means of face and bypass damper **44** which may be pivoted from the position shown providing full air flow over heat exchange coil **10** through intermediate settings to a position against the face of coil **10**. In the latter position, all of the air would bypass coil **10**. Also, insulating material **3** is provided on the interior walls of the unit in order to prevent condensation on the outside of cabinet **1** when a cooling fluid is being circulated through heat exchange coil **10**.

During operation, motor **18** is energized and a hot or cold fluid is circulated through heat exchange coil **10**. As is indicated by the flow arrows in FIGURES 1 and 2, the operation of fans **26** will cause air to flow upwardly through inlet openings **2** and **5** and over filter **38** into the inlet chamber for each fan formed under baffle elements **28**. Each fan will discharge an air stream in an axial direction against its respective opposed baffle element **28**. The multiplicity of air streams will thus be diverted upwardly so as to provide air flow across substantially the entire length of heat exchange coil **10** and out discharge grille **6**. Fans **26** have been shown as the propeller type for exemplary purposes only. Fans of the vane-axial type, which would also produce flow in an axial direction, could also be employed.

FIGURES 3 and 4 illustrate a variation of my improved fan-coil unit wherein heat exchange coil **10** is placed near the bottom of the unit under fans **26**, as opposed to the top coil placement shown in FIGURES 1 and 2. Like reference numerals are used to identify the same parts illustrated in FIGURES 1 and 2. The unit of FIGURES 3 and 4 is adapted for heating and ventilating only. Thus the drain pan under the coil and the insulation on the casing have been omitted. Gasket material **46, 47** is used to form a seal between heat exchange coil **12** and the opposed walls **4** and **14** of casing **1**. Somewhat better air distribution across heat exchange coil **10** can be obtained by placing the coil under the fans **26** in the manner shown in FIGURES 3 and 4. With this arrangement the fans tend to draw air across the entire surface of the coil. The possible disadvantage with the top coil positioning of FIGURES 1 and 2 is that "dead spots" of limited air flow may exist in the portions of the coil directly above fans **26**.

These sections of the coil would be somewhat shielded from air flow on such a "blow-through" design by the portions of member **30** forming a housing over the top of fans **26**.

By the employment of a plurality of axial flow fans in combination with the unique unitary fan housing-air diverting member **30** in the manner shown, I have been able to realize a substantial reduction in fan coil unit depth in comparison with the conventional designs which incorporate centrifugal fans.

I do not intend that my invention should be limited to the particular embodiments shown, which are illustrative only. For example, a multi-stage axial flow fan arrangement could be employed in place of the single stage fans **26** shown. Such a design would comprise a number of sets of closely spaced staged fans with straightening vanes in-between the first and second stages. A plurality of such fan assemblies would be positioned along shaft **22** in spaced relation, with baffle elements **28** being disposed across the discharge path of the second or final stage of each fan set. The purpose of multi-stage fan assemblies would be to develop greater static pressures. It is anticipated that various other modifications of my improved fan-coil unit will occur to those skilled in the art, which will be within the scope of my invention as defined by the following claims.

I claim:

1. A heat exchange unit comprising: a rectangular casing having air outlet openings in one wall thereof and air inlet openings in another wall; a heat exchange coil located within said casing between said inlet and outlet openings; a unitary fan housing-air diverting member disposed substantially longitudinally within said casing; said member comprising a plurality of spaced apart sections with apertures therein and a plurality of air diverting portions disposed opposite each of said apertures and extending towards said outlet openings; a drive shaft extending within said casing through said member; power means for actuating said drive shaft; and a plurality of axial flow fans mounted on said drive shaft within said apertures.

2. A heat exchange unit as defined in claim **1** wherein said air diverting portions are inclined at an angle to the vertical.

3. A heat exchange unit as defined in claim **1** wherein said sections with apertures therein are disposed in planes substantially normal to said one wall.

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ROBERT A. O'LEARY, *Primary Examiner.*

T. W. STREULE, *Assistant Examiner.*