United States Patent [19]

Maksy

[11] **3,771,321**

[45] **Nov. 13, 1973**

[54] **MODULAR AIR CONDITIONING EQUIPMENT**

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[22] Filed: **Oct. 4, 1972**

[21] Appl. No.: **294,919**

[52] **U.S. Cl.** ..... **62/298**, 62/77, 62/125, 62/127, 165/11, 165/48, 165/76, 73/432 R

[51] **Int. Cl.** **F25d 19/00**

[58] **Field of Search** ..... 62/298, 125, 127, 62/77; 165/11, 48, 76; 73/432 R

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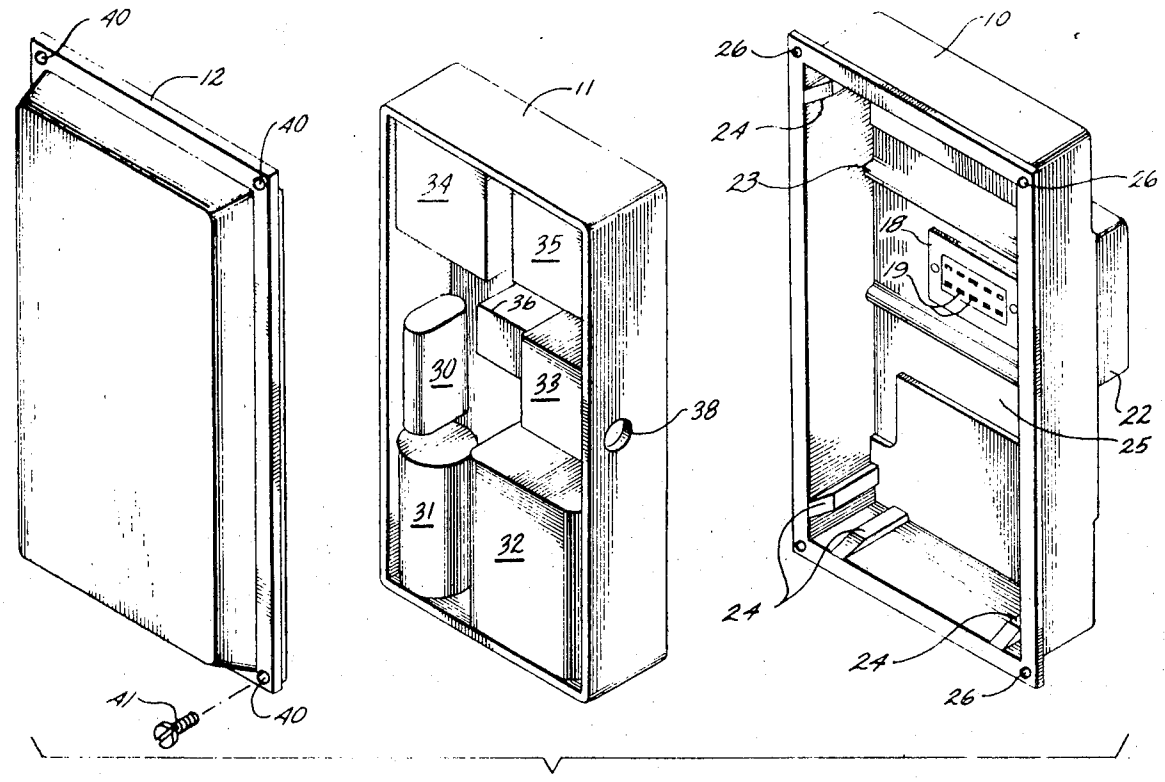
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Primary Examiner—William J. Wye
Attorney—Robert L. Parker et al.

[57] **ABSTRACT**

In air conditioning equipment having a compressor motor, a fan motor, and electrical circuitry for controlling the operation of the compressor and fan motors, a removable module fits into a stationary housing. The housing has a female connector with terminals electrically coupled to the compressor and fan motors, and the module has a mating male connector with terminals electrically coupled to the circuitry. Preferably, the housing has sides with guide rails that form a force fit with the sides of the module and form a space between the module and the housing for insertion of a module removal tool. The tool has a pair of fingers that embrace opposite sides of the module and move inwardly responsive to hand pressure to engage holes in the sides of the module. A test module contains an ohmmeter and a male connector.

10 Claims, 7 Drawing Figures



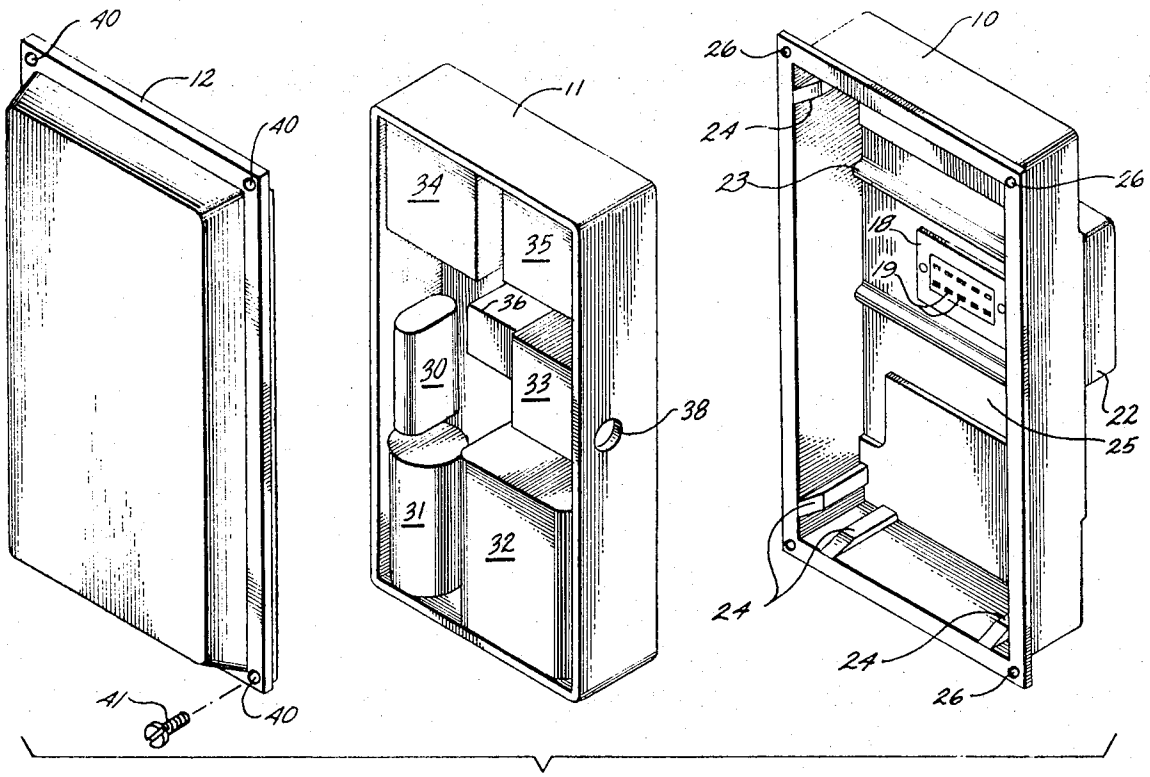

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Fig. 1

Fig. 4

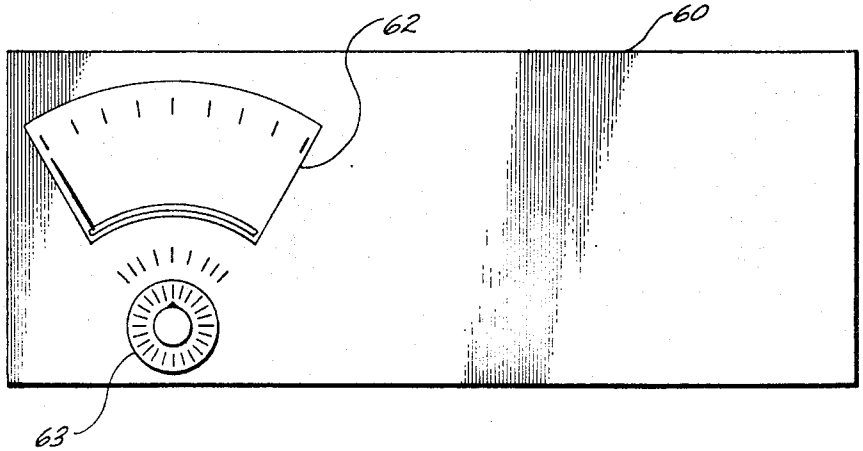

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60
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Fig. 2

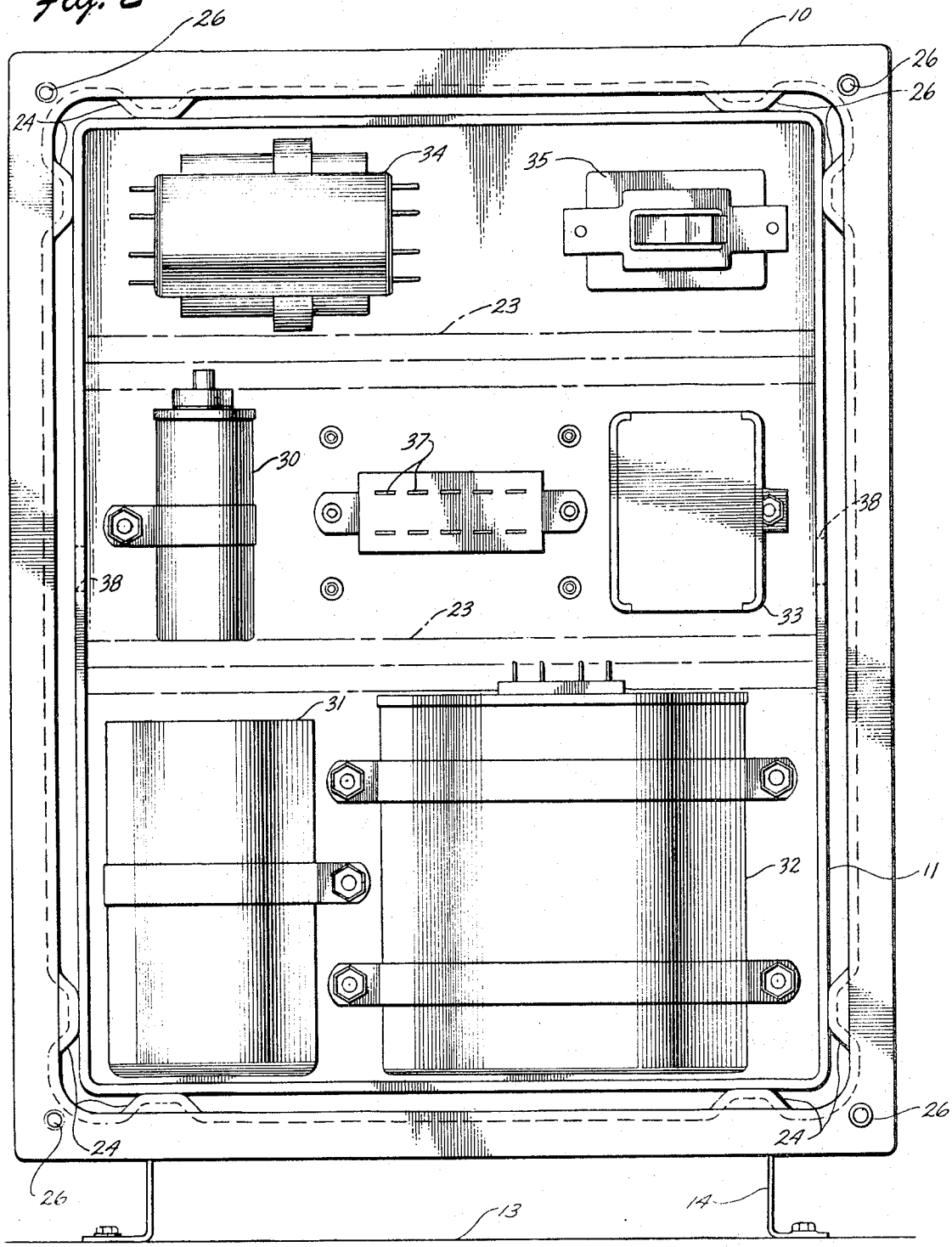


Fig. 3

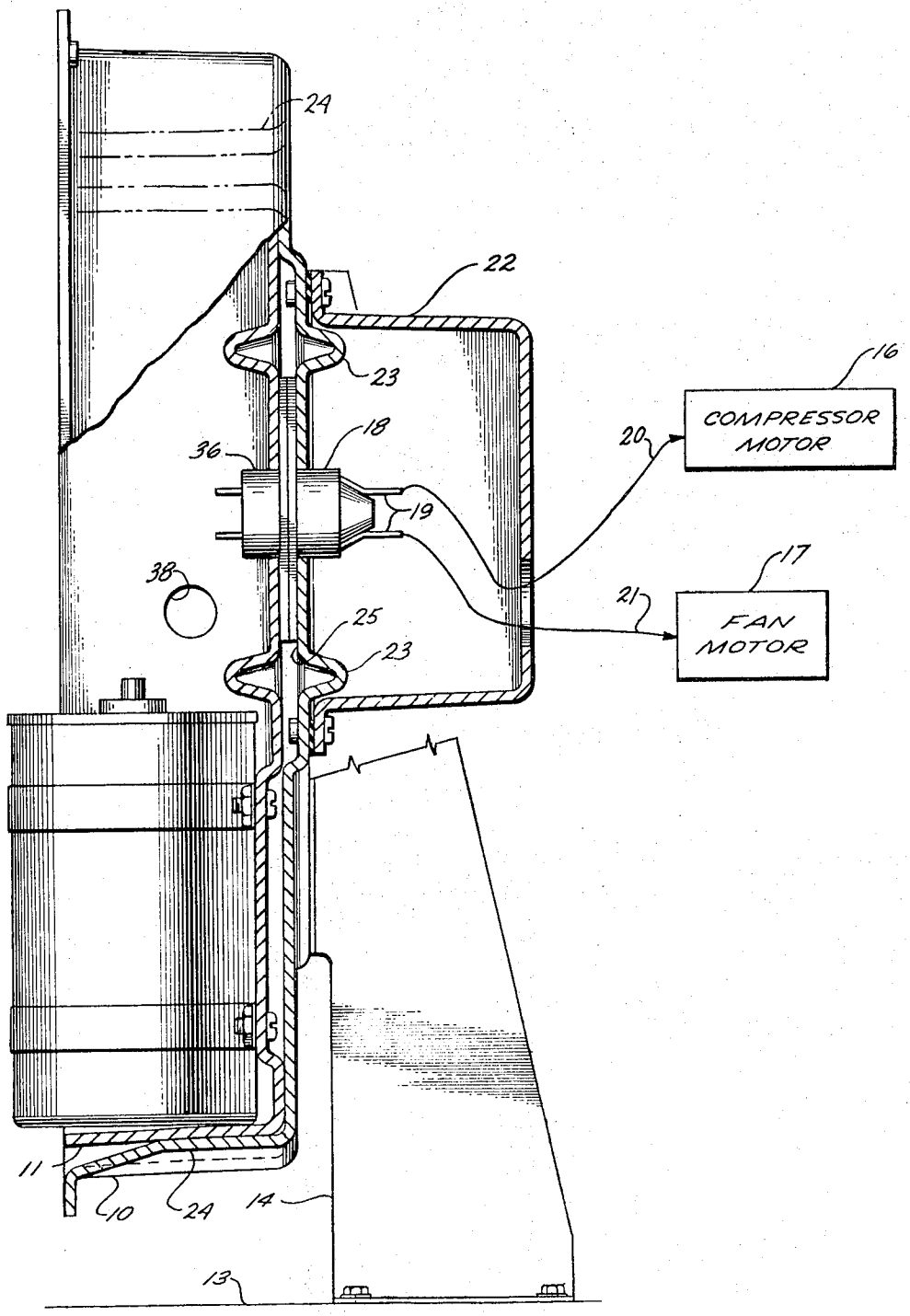

24
22
23
16
COMPRESSOR MOTOR
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18
36
19
17
38
21
FAN MOTOR
25
23
11
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Fig. 5

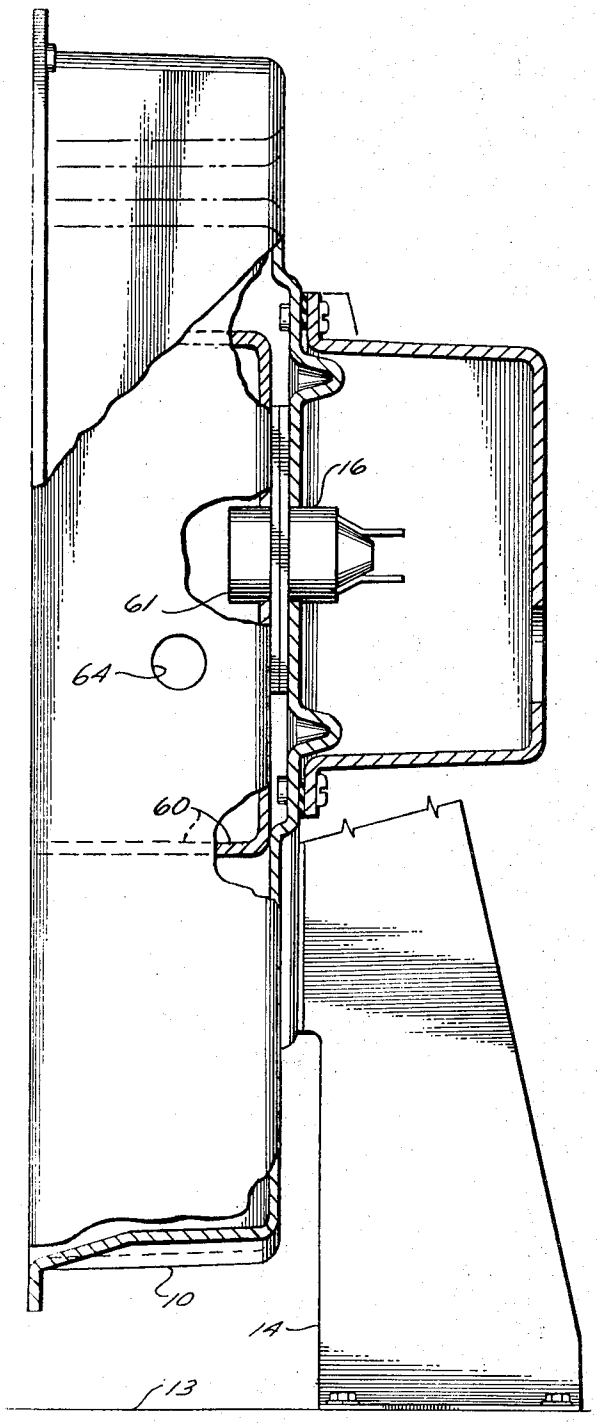


Fig. 6

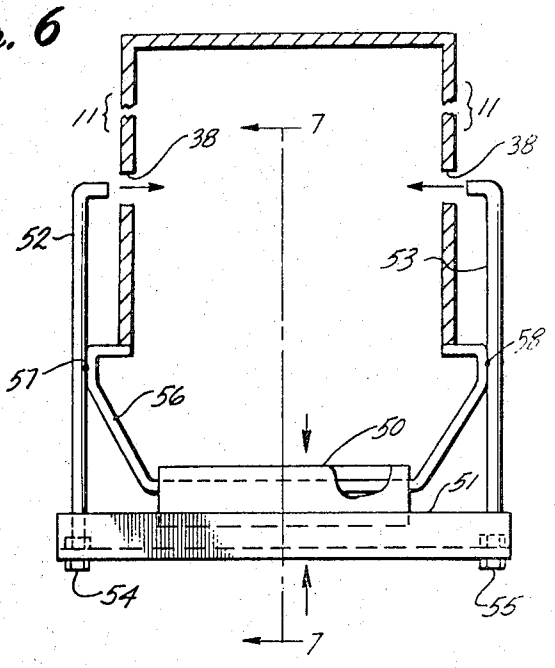
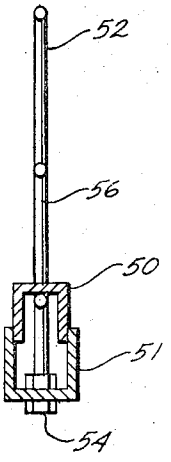


Fig. 7



MODULAR AIR CONDITIONING EQUIPMENT

BACKGROUND OF THE INVENTION

This invention relates to modular air conditioning equipment and, more particularly, to a component arrangement that permits air conditioning equipment to be quickly serviced and easily repaired.

Conventionally, the components of air conditioning equipment such as the compressor motor, the fan motor, and the electrical circuitry for controlling the condenser and fan motors are fixedly mounted at different scattered locations within an enclosure.

Thus, repair of the equipment must be undertaken on site, which can result in high repair costs, and the equipment remains out of service until the repair is completed, which can result in long shutdown periods.

Frequent component failures occur in the electrical circuitry. The practice of scattering the electrical circuit components throughout the enclosure makes even minor repairs a difficult task. The repair man must check each component individually on site. Often this requires gaining access to some awkwardly placed component with the probes of an ohmmeter or voltmeter.

SUMMARY OF THE INVENTION

The present invention dictates that the electrical circuitry for controlling the operation of the compressor and fan motors in air conditioning equipment be mounted on a removable component mounting structure that engages a stationary structure mounted with the compressor and fan motors. The stationary structure has a first group of connector terminals electrically coupled to the compressor and fan motors, and the removable structure has a second group of connector terminals electrically coupled to the electrical circuitry. When the removable structure abuts the stationary structure, the second group of connector terminals mates with the first group of connector terminals to electrically couple the compressor and fan motors to the electrical circuitry. When a component failure occurs in the electrical circuitry, the removable structure on which the circuitry is mounted in simply replaced en toto. Thus, no repairs must be undertaken on site and the equipment is out of service only as long as it takes to replace the removable structure.

According to a feature of the invention, the removable structure is a module and the stationary structure is a housing into which the module fits. Guide rails on the sides of the housing form a force fit with the module and form a space between the housing and module for insertion of a module removal tool.

According to another feature of the invention, the removal tool comprises a pair of fingers that embrace the module and move inwardly to engage holes on opposite sides of the module responsive to hand pressure.

According to another feature of the invention, there is also provided a test module for checking the integrity of the windings of the compressor and fan motors. The test module has a group of connector terminals that mate with the first group of connector terminals when the test module abuts the stationary structure.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of a specific embodiment of the best mode contemplated of carrying out the invention are illustrated in the drawings, in which:

FIG. 1 is a schematic perspective view of a stationary housing, a removable module, and a housing cover;

FIG. 2 is a front elevation view of the module inside the housing of FIG. 1;

FIG. 3 is a side elevation view of the module inside the housing of FIG. 1;

FIG. 4 is a front elevation view of a test module having a connector that mates with the connector of the housing of FIG. 1;

FIG. 5 is a side elevation view of the test module of FIG. 4 inside the housing of FIG. 1;

FIG. 6 is a front elevation view of a module removal tool; and

FIG. 7 is a side elevation of the tool of FIG. 6.

DETAILED DESCRIPTION OF THE SPECIFIC EMBODIMENT

Reference is made to FIGS. 1, 2, and 3 for a description of a stationary housing 10, a removable component mounting module 11, and a cover 12, which could be molded from plastic. Housing 10 is fixed to a base 13 by a bracket 14. A compressor motor 16 and a fan motor 17, which are components of air conditioning equipment represented in block form, are also fixed directly or indirectly to base 13 by means not shown. Housing 10 is open at one end, has an end wall opposite the open end, and has side walls extending between the end wall and the open end so as to define a substantially rectangular cavity. A female connector 18 having a plurality of socket terminals 19 is mounted on the end wall of housing 10. As represented schematically by lines 20 and 21 in FIG. 3, various ones of terminals 19 are electrically coupled to compressor motor 16 and fan motor 17. Others of terminals 19 are electrically coupled to the line voltage (not represented in the drawings) to provide electrical power to the equipment. A cap 22 is attached to the outside of housing 10 to cover the region where the electrical connections are made to terminals 19. Ribs 23 are formed in the end wall of housing 10, and guide rails 24 are formed in the side walls of housing 10. Ribs 23 strengthen housing 10 structurally with regard to bending parallel to its long dimension. In addition, housing 10 has a recessed region 25 to accommodate the protrusion of connector 18 and a mating connector on module 11, discussed below, and has screw receiving holes 26 formed on the periphery of its open end.

Module 11 is also open at one end, has an end wall at the opposite end, and has side walls extending between the end wall and the open end to define a substantially rectangular cavity. A plurality of electrical circuit components, including a fan run capacitor 30, a compressor start capacitor 31, a compressor run capacitor 32, a potential relay 33, a contactor 34, and a switch 35 are mounted on the end wall of module 11 by conventional brackets. Except for switch 35, these electrical circuit components all operate in a well known manner to control the operation of compressor motor 16 and fan motor 17. Capacitor 30 is permanently connected to the windings of fan motor 17. Under the control of potential relay 33, which senses the potential difference across the windings of compressor motor 16, compressor start capacitor 31 is initially connected to the windings of compressor motor 16 as it starts up, and then after start-up is replaced in this circuit by compressor run capacitor 32. Responsive to an external thermostat, contactor 34, which is a sole-

noid operated switch, intermittently supplies line voltage to compressor motor 16 and fan motor 17 so as to run them to meet the particular air conditioning requirements. A male connector 36 with a plurality of plug terminals 37, the backs of which are shown in FIGS. 2 and 3, is mounted on the end wall of module 11. The plug terminals of connector 36 extend from the outside of module 11 and mate with socket terminals 19 of connector 18 when the end walls of module 11 and housing 10 abut one another. The depth of recessed region 25 is designed so connectors 18 and 36 abut one another when the end walls of module 11 aNd housing 10 abut one another. The electrical circuitry mounted in module 11 is electrically coupled to plug terminals 37 by wires not illustrated in the drawings to permit the components of this electrical circuitry to perform their conventional control function with regard to compressor motor 16 and fan motor 17.

As illustrated in FIGS. 2 and 3, guide rails 24 form a force fit with module 11 and form a space between the side walls of module 11 and housing 10 when the end walls of module 11 and housing 10 abut one another. The taper in guide rails 24 at the open end of housing 10 facilitates insertion of module 11 therein. Holes 38 are formed on opposite side walls of module 11 to receive a module removal tool discussed below in connection with FIGS. 6 and 7.

The periphery of cover 12 has screw receiving holes 40 aligned with holes 26. When module 11 lies inside housing 10 during normal operation of the air conditioning equipment, screws 41, which pass through holes 40 and 26, secure cover 12 to housing 10 to enclose module 11.

A tool for removing module 11 is shown in FIGS. 6 and 7. The tool has a handle formed by U-shaped members 50 and 51, which are free to move together. Fingers 52 and 53 with turned-in ends are fixed to opposite ends of member 51 by fasteners 54 and 55, respectively. A generally U-shaped connecting member 56 is turned in at its ends, fixed along its sides to fingers 52 and 53 at points 57 and 58, respectively, for example, by welding, and fixed at its center to member 50, for example, by welding. Fingers 52 and 53 and member 56 are made from spring steel or other resilient material. As illustrated by the arrows in FIG. 6, when members 50 and 51 are pushed together, fingers 52 and 53 and member 56 bend inwardly.

To remove module 11 from housing 10, the user wraps his hand around members 50 and 51 and locates the tool as shown in FIG. 6 so fingers 52 and 53 embrace the side walls of module 11, their ends being aligned with holes 38. This alignment can be easily accomplished by resting the ends of member 56 on the edge of the open end of module 11, as shown in FIG. 6. After alignment occurs, the user squeezes members 50 and 51 together, thereby bringing the turned-in ends of fingers 52 and 53 into engagement with holes 38, and pulls on the tool to remove module 11 from housing 10. Then, a new module is simply pushed into housing 10 until its end wall abuts the end wall of housing 10.

In order to test the integrity of the windings of compressor motor 16 and fan motor 17 prior to replacement of module 11 with a new module, a test module 60, shown in FIGS. 4 and 5, is provided. After module 11 is removed from housing 10 as described above, test module 60 is inserted therein. Test module 60 has a male plug 61 that is identical to plug 36, so that plug 61 mates with plug 18. Module 60 is, in essence, an ohmmeter of conventional construction; it has an indicator 62 and a selector switch 63. Preferably, test module 60 has holes 64 on opposite side walls and is the same width as module 11, so the tool shown in FIGS. 6 and 7 can be used to remove test module 60. In such case, it will be understood that the distance from the edge of the open end of test module 60 to holes 64 should be the same as the distance from the edge of the open end of module 11 to holes 38.

The described embodiment of the invention is only considered to be preferred and illustrative of the inventive concept; the scope of the invention is not to be restricted to such embodiment. Various and numerous other arrangements may be devised by one skilled in the art without departing from the spirit and scope of this invention.

What is claimed is:

1. In air conditioning equipment having a compressor motor, a fan motor, and electrical circuitry for controlling the operation of the compressor and fan motors, the improvement comprising:

a stationary structure having a first group of connector terminals electrically coupled to the compressor and fan motors; and

a removable component mounting structure on which the electrical circuitry is mounted, the removable structure having a second group of connector terminals electrically coupled to the electrical circuitry, the second group of connector terminals mating with the first group of connector terminals to electrically couple the compressor and fan motors to the electrical circuitry when the removable structure abuts the stationary structure.

2. The air conditioning equipment of claim 1, in which the stationary structure is a housing and the removable structure is a module fitting into the housing.

3. The air conditioning equipment of claim 2, in which the housing has walls defining a substantially rectangular cavity open on one end and the module has a substantially rectangular shape that is dimensioned to establish a force fit with the walls of the cavity.

4. The air conditioning equipment of claim 3, additionally comprising a cover adapted to fit over the open end of the cavity to enclose the module completely.

5. The air conditioning equipment of claim 3, in which the cavity has a first wall opposite its open end where the first group of connector terminals are located, and the module has a second wall where the second group of connector terminals are located, the second wall abutting the first wall when the module is fitted into the housing, the first group of connector terminals being fixedly mounted substantially in the plane of the first wall and the second group of connector terminals being fixedly mounted substantially in the plane of the second wall to mate with each other when the second wall abuts the first wall.

6. The air conditioning equipment of claim 5, in which the first group of connector terminals are sockets located in a first connector body, and the second group of connector terminals are plugs located in a second connector body that abuts the first connector body when the second wall abuts the first wall.

7. The air conditioning equipment of claim 6, additionally comprising a removable test module having a group of plug terminals located in a third connector

body so as to mate with the sockets of the first group of connector terminals and an ohmmeter located within the test module to check the integrity of the windings of the compressor and fan motors.

8. The air conditioning equipment of claim 2, in which the housing is open at one end, has a first end wall opposite the open end, has first side walls extending between the first end wall and the open end, and has guide rails formed in the first side walls; and the module has a second end wall abutting the first end wall and second side walls forming a force fit with the guide rails of the first side walls.

9. The air conditioning equipment of claim 2, in which the module has opposite side walls with aligned holes formed therein, the equipment additionally comprising a module removal tool having a handle, a pair of fingers that embrace the opposite side walls of the module and means for moving the pair of fingers inwardly to engage the holes responsive to hand pressure on the handle.

10. The air conditioning equipment of claim 1, having a base, the stationary structure and the compressor and fan motors being fixed to the base.

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