United States Patent

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[54] **AUXILIARY STARTER DEVICE FOR AIR CONDITIONER COMPRESSOR**
4 Claims, 4 Drawing Figs.

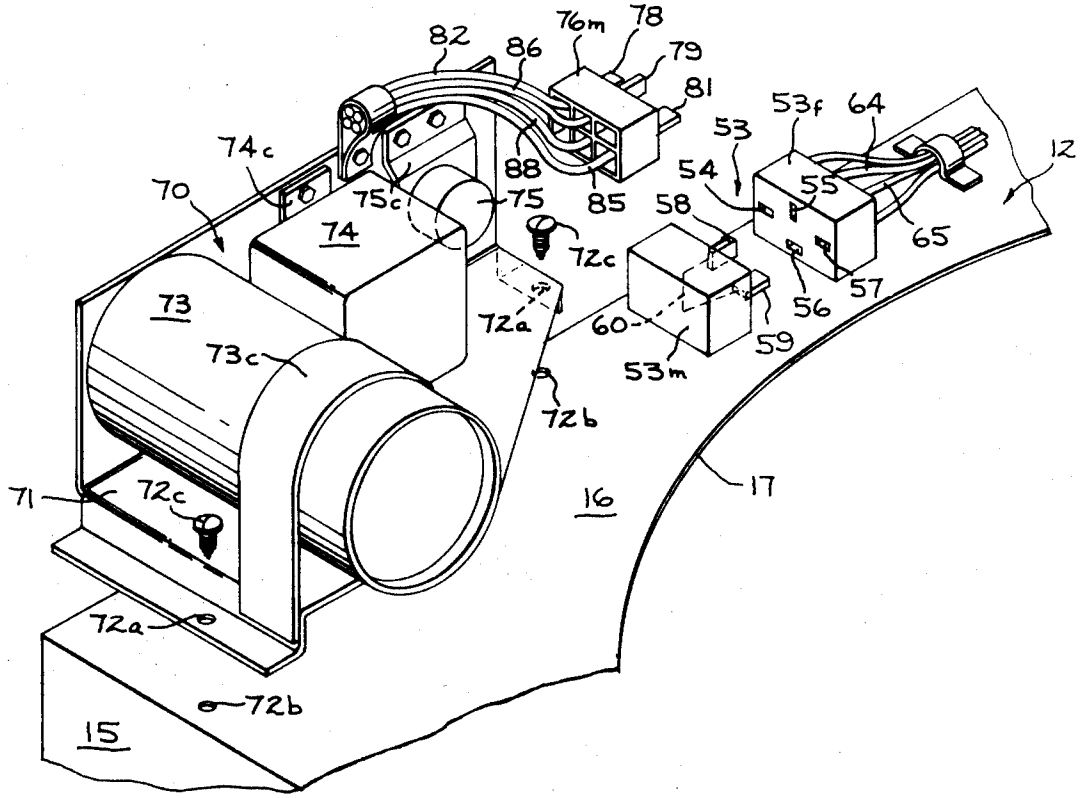
[52] **U.S. Cl.** **307/149,** 310/71, 318/221
[51] **Int. Cl.** **H02j 1/00**
[50] **Field of Search** ..... 310/66, 71; 318/221 A, 221 G, 221 D; 307/149

[56] **References Cited**
UNITED STATES PATENTS

2,181,734	11/1939	Mooney	318/221 D
3,350,586	10/1967	Otto	310/71
2,338,515	1/1944	Johns	318/221 A

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ABSTRACT: This invention is directed to a factory-assembled device which provides field installation personnel with accurate, quickly installed means for adding extra capacitance to the starting circuit of the electric motor for the fluid compressor of an air conditioner.



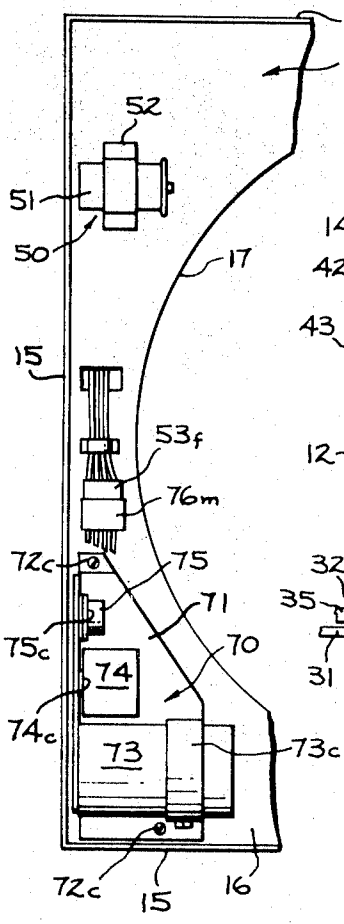


FIG. 2

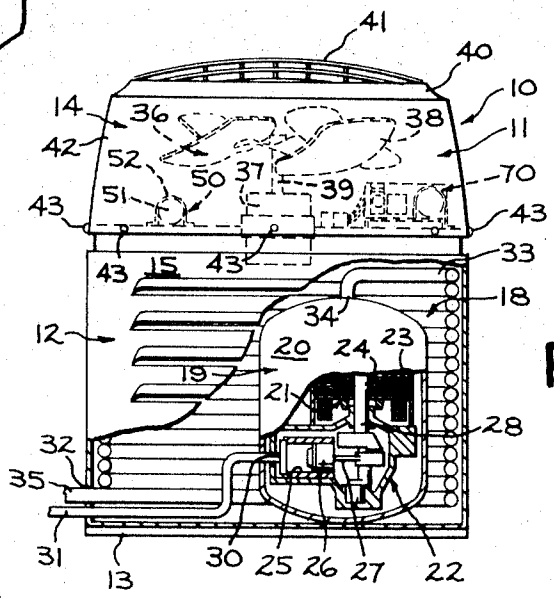


FIG. 1

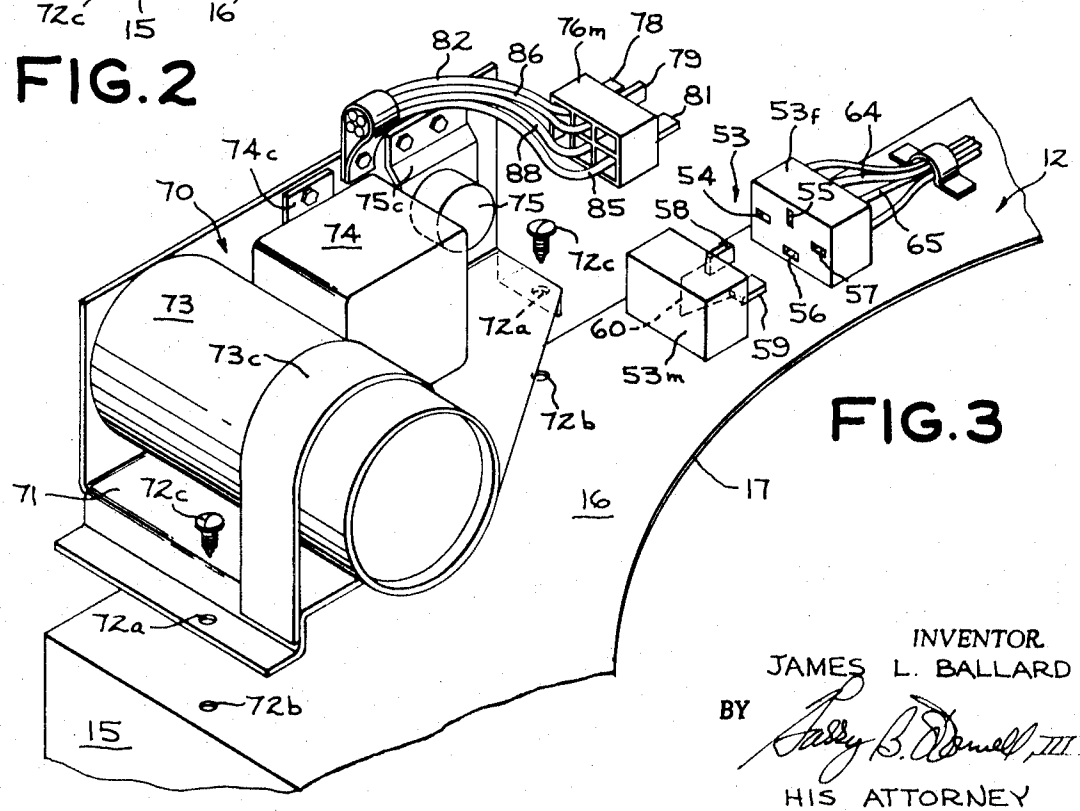
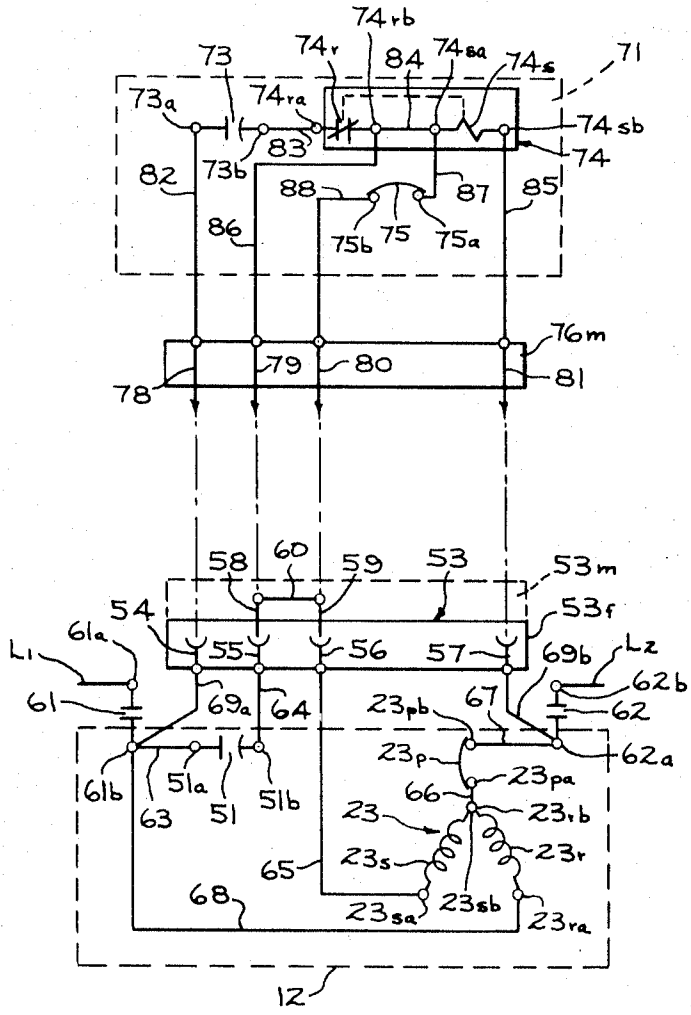


FIG. 3

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FIG. 4



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AUXILIARY STARTER DEVICE FOR AIR CONDITIONER COMPRESSOR

BACKGROUND OF THE INVENTION

This invention is related to air conditioners and, more particularly, to an auxiliary starter device for the fluid compressor of a central air conditioner of the so-called split system variety.

Split system air conditioner cooling units generally comprise two basic sections, one of which is referred to as the evaporator section that is mounted within the building to be cooled, and the other of which is referred to as the condenser-compressor section that is housed within a cabinet that is mounted outside of the building. The evaporator, condenser and compressor are, of course, fluid-interconnected in a well-known manner by conduit means.

Because of various reasons, e.g. exposure to the weather, etc., it is usually necessary to replace the condenser-compressor section long before the evaporator section. Many such split-system air conditioner cooling units have been in service in the field for several years and now require replacement of their condenser-compressor sections. However, most of the evaporator sections of these older central air conditioner units differ from modern evaporator sections in that they employed expansion valve means to expand the liquid refrigerant fluid into a gaseous state prior to its entry into the evaporator coil from the condenser-compressor section, rather than the capillary means presently used for this purpose. And, if one attempts interconnection of a modern replacement condenser-compressor section with one of these old evaporator sections, he is almost certain to find that the capacitance provided in the starting circuit for the electric motor of the fluid compressor of the modern replacement condenser-compressor section, as supplied from the factory, is then insufficient to permit starting of the replacement compressor.

Heretofore, various schemes have been improvised by field installation personnel in an effort to overcome the aforenoted incompatibility between the modern replacement compressor and the old evaporator section with which it is sought to be coupled. However, these prior art methods have required field rewiring of the replacement compressor motor starting circuit. And, such field rewiring has presented problems, e.g. use of oversized auxiliary capacitors, failure to provide means for disconnecting the auxiliary capacitor from the circuit after the motor starts and is running, etc., which may possibly ruin the compressor motor.

SUMMARY OF THE INVENTION

In accordance with the present invention, it has been found that the aforenoted prior art problems can be overcome with a novel, factory-assembled auxiliary starter device which provides field installation personnel with accurate, quickly installed means for adding extra capacitance to the starting circuit of the electric motor for the fluid compressor of an air conditioner. Basically, the present invention comprises: auxiliary capacitor means; auxiliary switching relay means; auxiliary conductor means electrically interconnecting the auxiliary capacitor and switch relay means; base means mounting the auxiliary means and being adapted for ready attachment and detachment to and from cabinet means housing the compressor; and plug means electrically connected to the auxiliary conductor means and readily engageable and disengageable to and from complementary plug means electrically connected to the compressor motor starting circuit to quickly electrically connect and disconnect the auxiliary means to and from the compressor motor starting circuit.

BRIEF DESCRIPTION OF THE DRAWING

The present invention is illustrated in the accompanying drawings, wherein:

FIG. 1 is a side elevational view of the condenser-compressor section of a typical, modern air conditioner cooling unit of the so-called split-system variety incorporating a presently preferred form of the auxiliary starting device of the present invention, with portions of the section cabinet and the compressor housing being broken away and elements normally enclosed by the removable top cover of the cabinet being shown in shadow;

FIG. 2 is an enlarged fragmentary top plan view of the condenser-compressor section illustrated in FIG. 1, with the cabinet being rotated 90° leftward about the vertical axis and the cabinet top cover removed;

FIG. 3 is a still further enlarged fragmentary elevation perspective view of FIG. 2 and illustrates the means provided for the ready attachment and detachment of the auxiliary starting unit to and from the cabinet and for its quick electrical connection and disconnection to and from the compressor motor circuit; and

FIG. 4 is a schematic wiring diagram showing the electric circuit for the auxiliary starting device illustrated in FIGS. 1–3 and its relationship to compressor motor circuit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing and particularly to FIG. 1 thereof, there is illustrated a condenser-compressor section **10** of a typical air conditioner cooling unit of the so-called split-system variety. The condenser-compressor section **10** comprises a generally rectangular, hollow boxlike cabinet **11** which includes a lower portion **12** that rests atop a concrete pad **13** which is provided outside the building (not shown) that is to be cooled, and removable cover portion **14**. The cabinet lower portion **12** includes four vented, generally vertical side walls **15** and a generally horizontal top wall **16** (partly shown in FIGS. 2 and 3) that is perforated by a large generally circular central opening **17**.

As illustrated in FIG. 1, there are housed within the cabinet lower portion **12**, among other things, a condenser **18** and compressor **19**. The condenser **18** is of a well-known type and comprises a finned tube coiled around the interior of the vented side walls **15** of the cabinet lower portion **12**. The compressor **19** is a well-known hermetic type and includes a generally vertically arranged hollow cylindrical housing **20** which contains an electric motor **21** in its upper portion and a reciprocating type pump **22** in its lower portion. The compressor motor **21** includes a stator **23** and a rotor **24** and, as shown schematically in FIG. 4, its stator **23** includes a start winding **23***s* and a run winding **23***r*. The compressor pump **22** includes a cylinder block **25** having at least one piston **26** housed therein which is reciprocated by a piston rod **27** that is connected to a crank shaft **28** which is, in turn, connected to the motor rotor **24** in a well-known manner.

The compressor **19** has its discharge outlet **30** located at the lower end of its housing **20** and fluid connected to a conduit **31** which extends outward through an opening **32** provided in one of the sidewalls **15** of the cabinet lower portion **12**. The condenser coil **18** has its discharge end connected by another conduit **33** to the compressor inlet **34** provided at the top of the compressor housing **20**, while the opposite or inlet end of the condenser coil **18** is fluid connected to yet another conduit **35** which extends outward though the cabinet opening **32** generally parallel to the outer end of the conduit **31** that is fluid connected to the compressor discharge outlet **30**. It is to be understood that the parallel outer ends of two conduits **31** and **35** can be readily fluid connected by well-known means (not shown) to the inlet and outlet ends, respectively, of the evaporator coil (not shown) which is contained within the building (not shown) that is to be cooled.

As further shown in FIG. 1, the cabinet lower portion **12** also supports a fan **36** which circulates outdoor air across the condenser coil **18**. The fan **36** includes its own electric motor **37** which is supported generally vertically within the opening **17** in the top wall **16** of the cabinet lower portion **12** by spider means or the like (not shown). And, the fan **36** also includes an impeller **38** mounted on a rotary output shaft **39** that extends upwardly from the fan motor **37**.

The cabinet cover portion **14** includes a top wall **40** having a screened, generally circular opening **41** and four downwardly extending sidewalls **42**. The screened central opening **41** overlies the fan impeller **38** and lower edges of the cover portion sidewalls **42** fit snugly around the upper edges of the four sidewalls **15** of the cabinet lower portion **12** and are attached thereto by removable fastener means, such as sheetmetal screws **43**. When installed over the top of the cabinet lower portion, as shown in FIG. **1**, the cabinet cover portion **14** encloses the condenser fan impeller **38** and also covers certain electric control means that are provided for the compressor motor **21** in particular accordance with the present invention and will be described in detail hereinafter. As shown in FIG. **1**, these compressor motor control means include standard control means **50** mounted on the left front portion of the top wall **16** of the cabinet lower portion **12** and an auxiliary starting device **70** which can be readily attached to the right front portion of the top wall **16** of the cabinet lower portion **12**, if required.

As best shown in FIGS. **2–4**, the standard compressor motor control means **50** comprises a first or standard capacitor **51**, which is attached to the top wall **16** of the cabinet lower portion **12** by a clamp **52** that is fastened thereto at its opposite ends, and a polarized electric plug **53** which includes a female portion **53***f* and a removable male portion **53***m* (FIG. **3**). The female portion **53***f* of the plug **53** has four socketlike terminals **54**, **55**, **56** and **57**, two of which **55** and **56** are particularly adapted to receive a pair of pronglike terminals **58** and **59** that are provided on the male portion **53***m* of the plug **53** and are electrically interconnected by conductor **60**.

In accordance with the present invention, it is intended that the condenser-compressor section **10** will be shipped from the factory with the female and male portions **53***f* and **53***m* of the polarized electric plug **53** joined together and having the pronglike terminals **58** and **59** of the male plug portion **53***m* inserted into and electrically convected with the socketlike terminals **55** and **56** of the female plug portion **53***f*. With this factory-shipped, standard arrangement, as shown schematically in FIG. **4**, the standard capacitor **51** and the compressor motor stator start winding **23***s* are connected in electrical series across a pair of main power supply lines L_1 and L_2 by circuitry which also includes an internal current overload protector device **23***p* mounted adjacent the compressor motor stator **23** and a pair of main power disconnect relays **61** and **62**. More specifically, one **61** of the two main power disconnect relays **61** and **62** has its first terminal **61***a* electrically connected to the first main power supply line L_1, while its second terminal **61***b* is electrically connected by a conductor **63** to the first terminal **51***a* of the standard capacitor **51**. The second terminal **51***b* of the standard capacitor **51** is electrically connected to one **55** of the two socketlike terminals **55** and **56** of the female portion **53***f* of the polarized plug **53** by a conductor **64**, while the other **56** of these two socketlike terminals **55** and **56** is connected to the first terminal **23***sa* of the compressor motor stator start winding **23***s* by a conductor **65**. Another conductor **66** electrically connects the second terminal **23***sb* of the compressor motor stator start winding **23***s* to the first terminal **23***pa* of the internal current overload protector device **23***p*, while yet another conductor **67** electrically connects the second terminal **23***pb* of the internal current overload protector device **23***p* to the first terminal **62***a* of the other one **62** of the pair of main power supply disconnect relays **61** and **62**. Finally, the second terminal **62***b* of the second disconnect relay **62** is electrically connected to the other main power supply line L_2. And, as further shown in FIG. **4**, the compressor motor stator run winding **23***r* is connected in electrical parallel with the series-connected standard capacitor **51** and compressor motor stator start winding **23***s* by having its first terminal **23***ra* electrically connected by a conductor **68** to the second terminal **61***b* of the first main power disconnect relay **61** and its second terminal **23***rb* electrically connected to the second terminal **23***sb* of the compressor motor stator start winding **23***s*. It should also be noted that, for a reason that will subsequently be apparent, the socketlike terminal **54** of the female portion **53***f* of the polarized plug **53** is electrically connected by a conductor **69***a* to the second terminal **61***b* of the first power disconnect relay **61** and the socketlike terminal **58** of this female plug portion **53***f* is electrically connected by another conductor **69***b* to the first terminal **62***a* of the second power disconnect relay **62**.

With the aforedescribed circuitry and with the female and male portions **53***f* and **53***m* of the polarized electric plug **53** joined together and having the pronglike terminals **58** and **59** of the male plug portion **53***m* inserted into and electrically connected with the socketlike terminals **55** and **56** of the female plug portion **53***f*, it can be seen that there will be two electric current paths between the main power lines L_1 and L_2 and through the compressor motor stator **23** when the disconnect relays **61** and **62** are closed. The first of these two current paths will pass from the first power line L_1 through the first disconnect relay **61** and then, respectively, through the conductor **63**, the standard capacitor **51**, the conductor **64**, the socketlike terminal **55**, the pronglike terminal **58**, the conductor **60**, the pronglike terminal **59**, the socketlike terminal **56**, the conductor **65**, the start winding **23***s*, the conductor **66**, the internal current overload protector device **23***p*, the conductor **67**, and the second disconnect relay **62** and into the second power supply line L_2. And, of course, the second of these two current paths will pass from the first power supply line L_1 through the first disconnect relay **61** and then, respectively, through the conductor **68**, the stator run winding **23***r*, the conductor **66**, the internal current overload protector device **23***p*, the conductor **67**, the second disconnect relay **62** and into the second main power line L_2.

Typically, the sizing of the standard capacitor **51** that is provided in the condenser-compressor unit **10** at the factory will be approximately 10 microfarads per horsepower of the compressor motor **21**. Thus, a 30-microfarad capacitor would be utilized for the factory-installed standard capacitor **51** in a condenser-compressor section **10** employing a compressor **19** having a 3-horsepower motor. Or, a 40-microfarad capacitor would be utilized for the standard capacitor **51** in a condenser-compressor section a 4-horsepower motor for the compressor motor **21**; etc.

It should, of course, be understood that only the standard control group **50** will be installed on the condenser-compressor section **10** at the factory, since this should provide sufficient capacitance to start the compressor motor **21** if the condenser-compressor section **10** is connected in the field to a modern evaporator section. However, as previously noted, it is not infrequently desired to interconnect a modern replacement condenser-compressor section **10** with an old evaporator section. And, for the reasons previously noted, the capacitance provided by the factory-installed standard capacitor **51** will be sufficient to start the compressor motor under these "replacement combination" conditions.

In the past, various schemes have been improvised by field installation personnel in an effort to overcome the aforenoted incompatibility between a modern replacement condenser-compressor section and an old evaporator section with which it is sought to be coupled. However, these prior art methods have required field rewiring of the replacement compressor motor circuit. And, such field rewiring has presented problems, e.g. use of oversized auxiliary capacitors, failure to provide means for disconnecting the auxiliary capacitor from the circuit after the compressor motor starts and is running, etc. which may possibly ruin the compressor motor. However, it has been found that the aforenoted prior art problems can be overcome by the novel factory assembled starter device **70** of the present invention which provides field installation personnel with accurate, quickly installed means for adding extra capacitance to the starting circuit of the electric motor **21** of the fluid compressor **19** of the condenser-compressor section **10** of an air conditioner cooling unit of the so-called split-system variety.

As illustrated, the auxiliary starter device **70** of the present invention comprises base means including a base bracket **71** that is perforated with a plurality of fastener receiving openings **72***a* which are adapted to be readily aligned over complementary fastener receiving openings **72***b* that are performed at the factory in the right front portion of the top wall **16** of the cabinet lower portion **12** (as seen in FIG. **1**) and readily attached to and detached from the top wall **16** by removable fastener means, such as the plural sheetmetal screws **72***c*, which are received in the aligned openings **72***a* and **72***b*. As best shown in FIGS. **2–4**, the bracket **71** mounts auxiliary capacitor means including an auxiliary capacitor **73**; auxiliary switch relay means **74** including a normally closed switch **74***r* that can be opened upon actuation of a current level sensitive solenoid **74***s*; auxiliary current overload protector means including a current overload protector device **75**; and auxiliary conductor means for electrically interconnecting the auxiliary capacitor means **73**, auxiliary switch plug means including an auxiliary overload protector device **75**. The auxiliary starter device **70** further comprises auxiliary plug means including an auxiliary male plug **76***m* that is adapted for quick connection to and disconnection from the female portion **53***f* of the aforedescribed polarized electric plug **53**, upon removal of the male portion **53***m* of the polarized plug **53** therefrom. This auxiliary plug **76***m* has four pronglike terminals **78**, **79**, **80** and **81**, a first pair **79** and **80** of which are particularly adapted to be respectively received in two **55** and **56** of the socketlike terminals **54–57** of the female portion **53***f* of the polarized plug **53**, and a second pair **78** and **81** of which are particularly adapted to be respectively received in the other two socketlike terminals **54** and **57** of the female portion **53***f* of the polarized plug **53**.

In accordance with the present invention, the auxiliary capacitor **73**, the auxiliary switch relay means **74** and the auxiliary current overload device **75** are accurately selected at the factory to provide the correct extra starting capacitance for a condenser-compressor section **10** having a compressor motor **21** of a particular horsepower rating, and they are then preattached to the base bracket **71** and prewired to one another and to the auxiliary plug **76***m* at the factory. To this end, factory personnel select the proper sized auxiliary capacitor **73**, auxiliary switch means **74** and auxiliary current overload protector device **75** and permanently attach them to the base bracket **71**. As illustrated in FIGS. **2** and **3**, the auxiliary capacitor **73** is attached to the base bracket **71** by a clamp **73***c*, which is, in turn, permanently secured to the base bracket **71** by welding or other suitable fastening means. And, the auxiliary starting relay means **74** and the auxiliary current overload protector device **75** are respectively attached to mounting brackets **74***c* and **75***c*, which are, in turn, permanently secured to the base bracket **71** by welding or other suitable fastening means.

Then, the following prewiring (best shown in FIG. **4**) is performed at the factory. The first terminal **73***a* of the auxiliary capacitor **73** is electrically connected by a conductor **82** to the pronglike terminal **78** of the auxiliary male plug **76***m*, while its second terminal **73***b* is connected by a conductor **83** to the first terminal **74***ra* of the normally closed auxiliary switch relay **74***r*. The second terminal **74***rb* of the normally closed auxiliary switch relay **74***r* is connected by a conductor **84** to the first terminal **74***sa* of the solenoid **74***s* of the auxiliary switch relay means **74**, while the second terminal **74***sb* of the solenoid **74***s* is connected by a conductor **85** to the pronglike terminal **81** of the auxiliary male plug **76***m*. The second terminal **74***rb* of the normally closed auxiliary switch relay **74***r* is also electrically connected by a conductor **86** to the pronglike terminal **79** of the auxiliary male plug **76***m*. And, the first terminal *74sa* of the solenoid **74***s* is connected to the first terminal **75***a* of the auxiliary current overload protector device **75** by conductor **87**, while the second terminal **75***b* of the auxiliary current overload protector device **75** is connected by a conductor **88** to the pronglike terminal **80** of the auxiliary male plug **76***m*.

Now, assuming field installation personnel have interconnected a modern condenser-compressor section **10** with an old previously-installed evaporation section (not shown) or that for some other reason the compressor motor **21** of the condenser-compressor unit **10** will not start as shipped from the factory, they may quickly and easily solve this problem by performing the following steps:

1. procuring an auxiliary starter device **70** of the present invention which is sized for use with the particular horsepower rating of the compressor motor **21** that has been factory-installed in the condenser-compressor section **10** (several assorted sized should be carried on their service truck);
2. removing the sheetmetal screws **43** from the cabinet cover **14** and the cover **14** from the cabinet bottom portion **12**;
3. aligning the fastener receiving openings **72***a* in the base bracket **71** of the auxiliary starter device **70** with the fastener receiving openings **72***b* in the top wall **16** of the cabinet lower portion **12** and then inserting the sheetmetal screws **72***c* which are provided with the auxiliary device **70**;
4. disconnecting the factory-installed male portion **53***m* from the female portion **53***f* of the polarized plug **53** of the standard motor control means **50**;
5. connecting the auxiliary male plug **76***m* of the auxiliary starting device **70** the female portion **53***f* of the polarized plug **53**, with the pronglike terminals **78**, **79**, **80** and **81** being respectively inserted into and electrically connected to the socketlike terminals **54**, **55**, **56** and **57**.

Having done this, it can best be seen by reference to FIG. **4** that closure of the two main power disconnects **61** and **62** will initially cause current to flow between the power lines L_1 and L_2 and through the compressor motor stator start winding **23***s* via both the standard capacitor **51** and the auxiliary capacitor **73**, which will then be electrically paralleled with one another and connected in electrical series to the compressor motor stator start winding **23***s* through the auxiliary current overload protector device **75**. Thus, during this initial or starting period, the capacitance in the circuit for the compressor motor stator start winding will equal the sum of the capacitive values of the standard capacitor **51** and the auxiliary capacitor **73**. And, during this initial period, there will also be a flow of current through the solenoid **74***s* and, when (usually within 10 seconds after closure of the disconnect switches **61** and **62**) the intensity of this current flow becomes sufficient to actuate the solenoid **74***s* to open the normally closed auxiliary switch relay **74***r*, the opening of the auxiliary switch relay **74***r* will then, of course, stop the flow of current through the auxiliary capacitor **73**. However, in the event that the auxiliary switch relay means **74** should malfunction and the switch relay **74***r* remain closed after the compressor motor **21** is started and running, the auxiliary current overload protector device **75** is sized to open thus stop all current flow across the compressor motor stator start winding **23***s* and thus avoid destruction of the motor **21**.

It should be apparent to those skilled in the art that while there has been described what, at present, is considered to be a presently preferred embodiment of this invention in accordance with the patent statutes, changes may be made to the disclosed apparatus without actually departing from the true spirit and scope of this invention. For example, the auxiliary start device **70** of the present invention obviously could also be used to provide extra capacitance in the starting circuit of the compressor motor for an air conditioner of the heat pump variety. It is, therefore, intended that the appended claims shall cover such modifications and applications that do not depart from the true spirit and scope of the present invention.

What is claimed is:

1. An auxiliary starter device for quickly and accurately providing extra capacitance in the starting circuit of the electric motor for the fluid compressor of an air conditioner comprising:

a. auxiliary capacitor means;

b. auxiliary switching relay means;

c. auxiliary conductor means electrically interconnecting said auxiliary capacitor and switch relay means;

d. base means mounting said auxiliary means and being adapted for ready attachment and detachment to and from cabinet means housing the compressor; and

e. plug means electrically connected to said auxiliary conductor means and being readily engageable and disengageable to and from complementary plug means electrically connected to the compressor motor starting circuit to quickly electrically connect and disconnect said auxiliary means to and from the compressor motor starting circuit.

2. The invention of claim 1, further including auxiliary current overload protector means mounted on said base means and electrically interconnected with said auxiliary capacitor and switch relay means by said auxiliary conductor means.

3. The invention of claim 2, further including fastening receiving means provided on said base means and being readily alignable with complementary fastener receiving means provided on the cabinet means.

4. The invention of claim 1, further including fastener receiving means provided on said base means and being readily alignable with complementary fastener receiving means provided on the cabinet means.

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