United States Patent [19]

Herweg

[11] **3,740,964**

[45] **June 26, 1973**

[54] **PORTABLE AIR CONDITIONER**

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[22] Filed: **June 14, 1971**

[21] Appl. No.: **152,558**

[52] **U.S. Cl.** **62/262**, 62/448

[51] **Int. Cl.** **F25d 19/02**

[58] **Field of Search** 62/297, 298, 299, 62/262, 448, 449, 450

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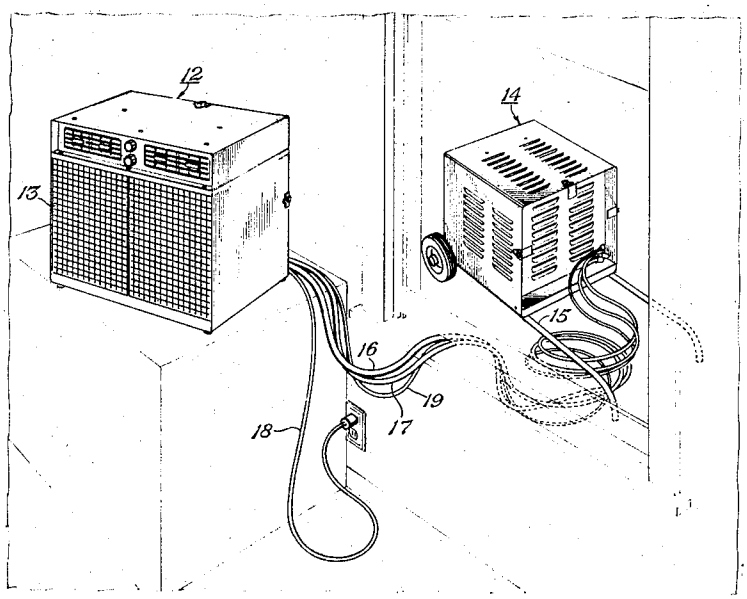
Attorney—William T. Wofford et al.

[57] **ABSTRACT**

A portable air conditioner comprising a cooling unit to be placed in a zone to be cooled, for example, a room of a house, and a refrigerant condensing unit to be placed outside of the zone. Located in the cooling unit is a heat exchanger and an air moving device. Located in the condensing unit is a compressor, a heat exchanger, and an air moving device. Flexible fluid conduits are provided for coupling the cooling unit to the condensing unit.

The two units have two ends respectively adapted to be locked together for forming a single unit. Storage space located between the two ends is provided for storing and concealing the flexible conduits when the two units are locked together.

9 Claims, 12 Drawing Figures



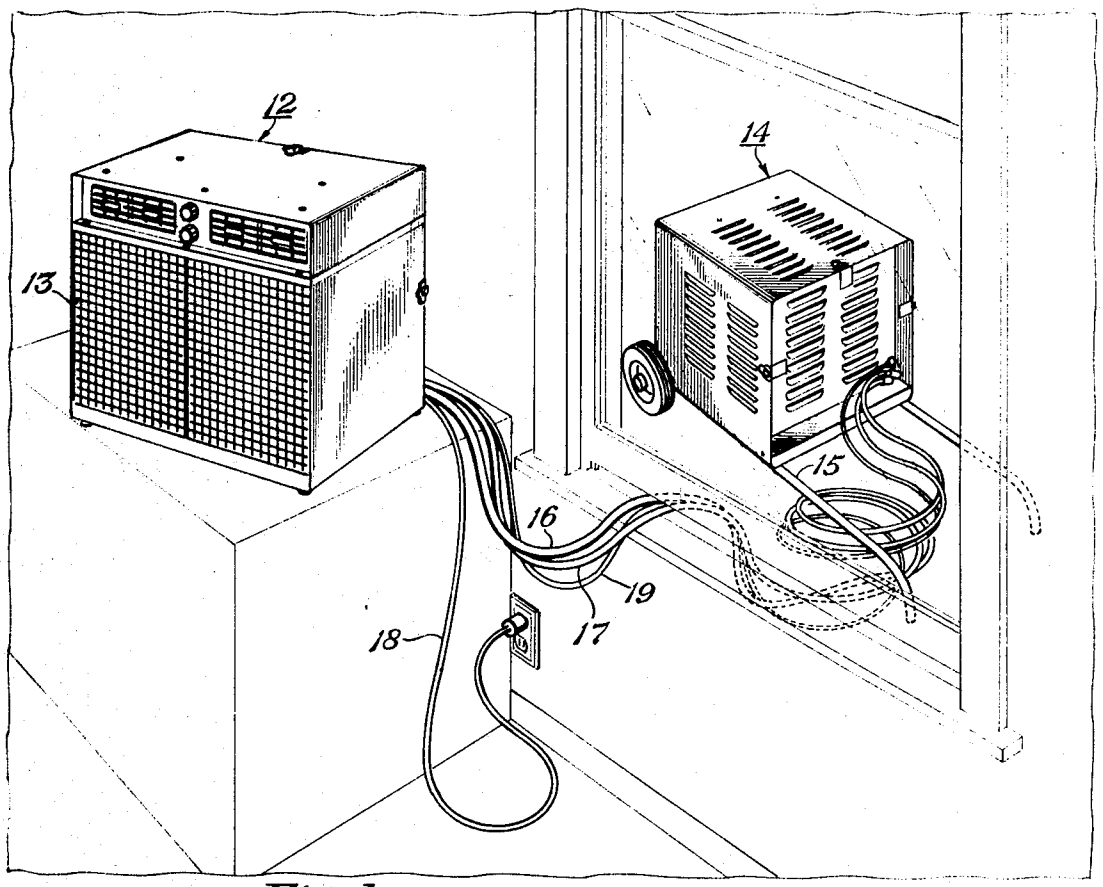


Fig. 1

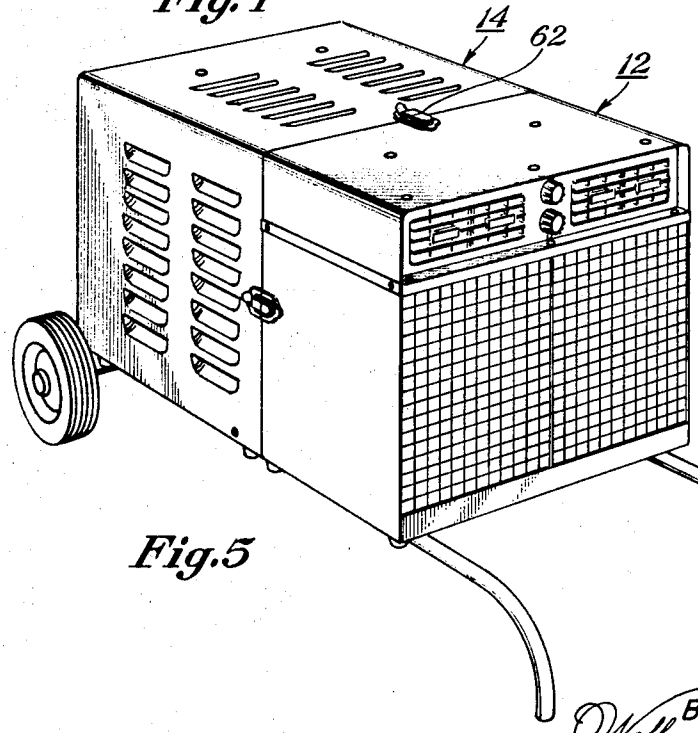


Fig. 5

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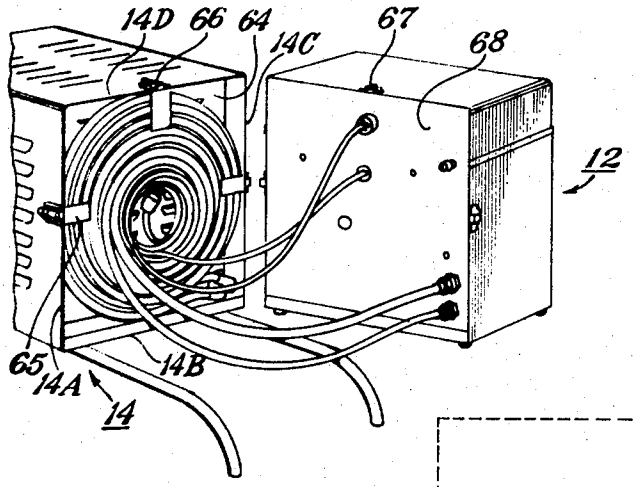


Fig.4

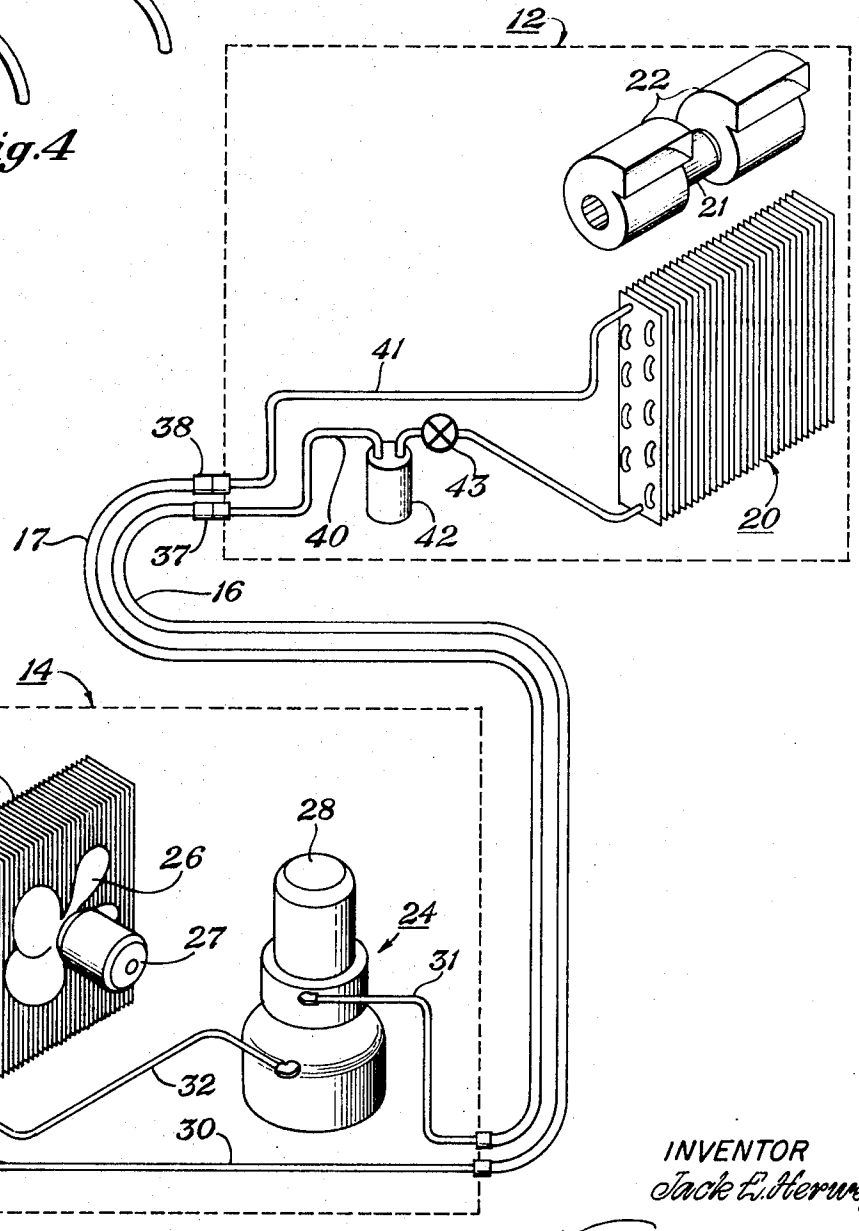


Fig.2

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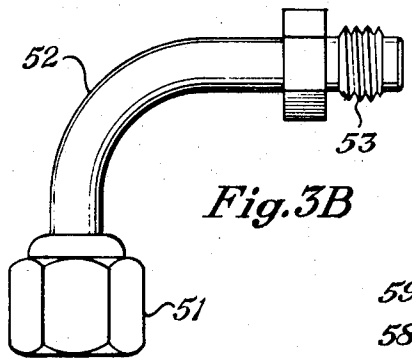


Fig.3B

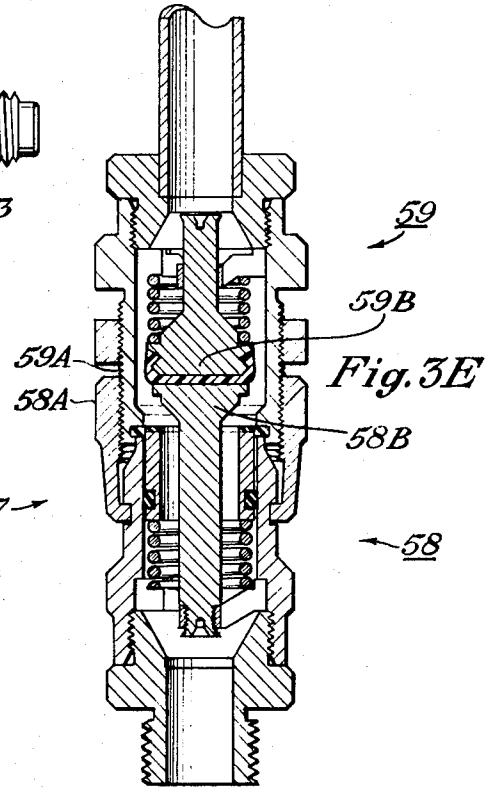


Fig.3E

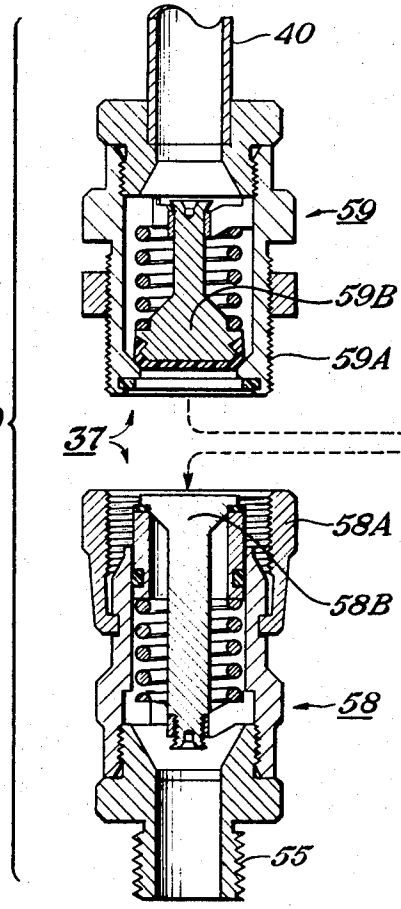


Fig.3D

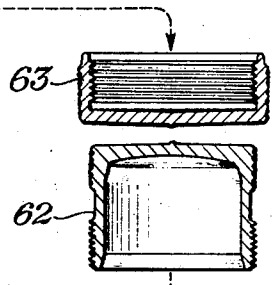


Fig.3F

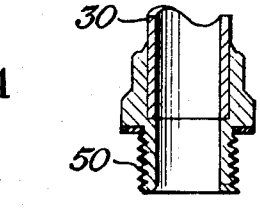


Fig.3A

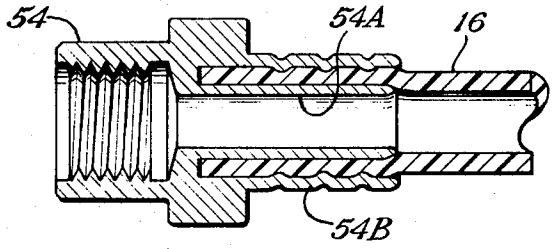


Fig.3C

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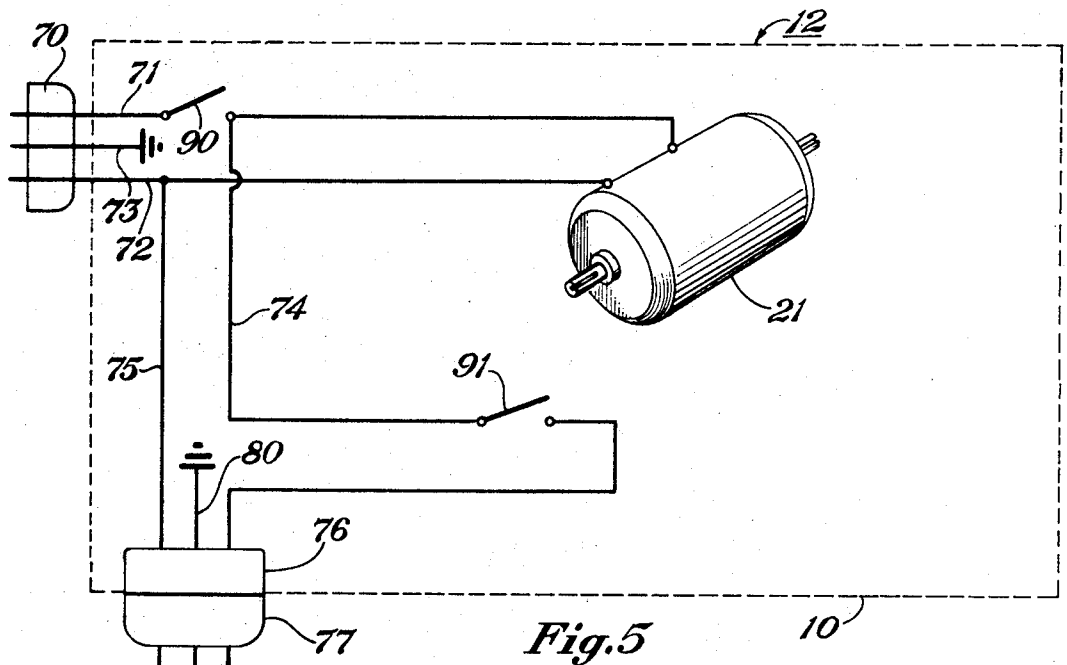


Fig.5

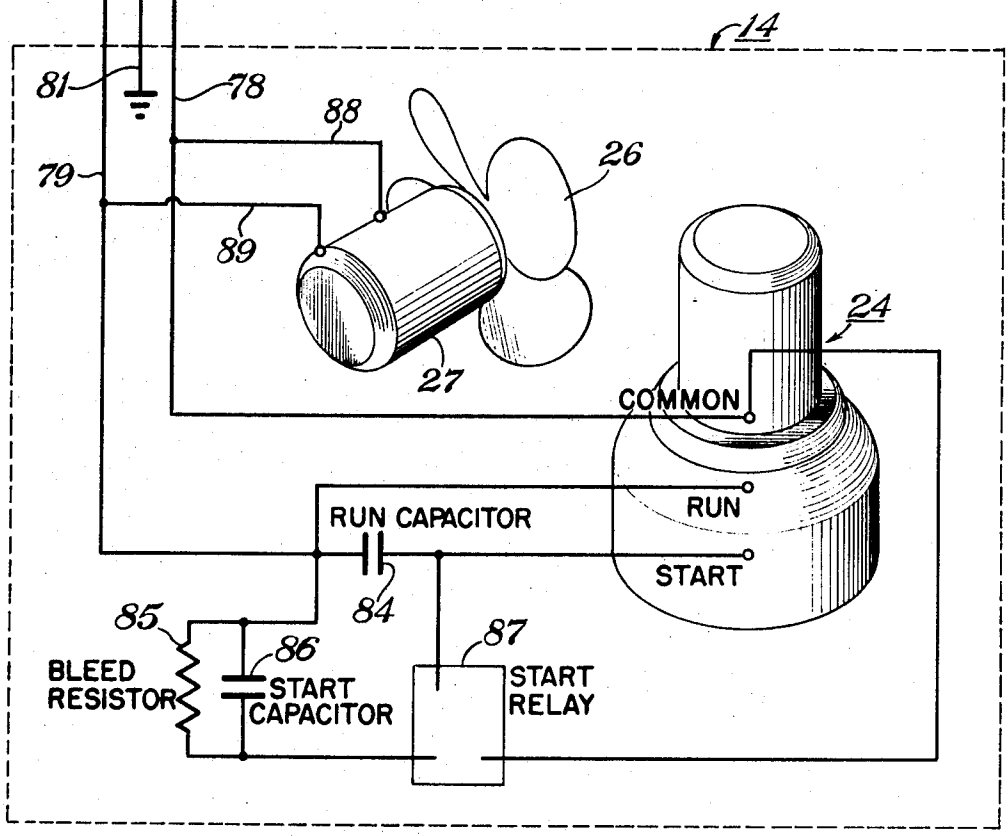


Fig.6

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PORTABLE AIR CONDITIONER

BACKGROUND OF THE INVENTION

1. Field of the Invention:

This invention relates to a portable environmental conditioning system and more particularly to a portable cooling system.

2. Description of the Prior Art:

Commercial window units employing a refrigerant for cooling homes or other enclosures have disadvantages due to their weight and bulkiness. These factors make installation and removal of the units difficult. Proposals have been made for separating the window units into two parts. However, the known proposals and prior art locate the compressor and evaporator coil in the room to be cooled with the condenser being located outside of the room. This arrangement has disadvantages due to the weight of the compressor as well as the heat and vibration produced by the compressor when it is operating.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided a portable environmental conditioning system comprising a first unit including a heat exchanger to be placed at least partially in the zone to be conditioned. Also included is a second unit comprising a compressor and a heat exchanger to be placed outside the zone. Flexible fluid conduits are provided for coupling the two units together.

In the embodiment disclosed, the first unit is a cooling unit while the second unit is a refrigerant condensing unit. Both units include air moving devices. Also located in the cooling unit is a device for storing refrigerant and removing moisture from the refrigerant.

The flexible conduits are long enough whereby the condensing unit may be supported outside while the cooling unit may be located on a table within the room to be cooled. This system has advantages in that the cooling unit is very light in weight and hence may be readily moved to different positions in the room. In addition, the undesirable heat and vibration produced by the compressor will remain outside with the compressor.

Self-sealing disconnects are provided for connecting and disconnecting the flexible conduits to facilitate installation.

In a further aspect, the two units have two ends respectively which are adapted to be locked together to form a single unit. In addition there is provided structure for forming storage space between the two units when locked together for storing and concealing the flexible conduits.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates the portable conditioning system of the present invention with one unit located in the room of a house and the other unit located outside;

FIG. 2 illustrates the components of the two units of FIG. 1;

FIGS. 3A–3F illustrate the fittings and self-sealing disconnects employed for coupling the two units together with flexible conduits;

FIG. 4 illustrates storage space in the end of one of the units for storing the flexible conduits;

FIG. 5 illustrates the two units locked together having the flexible conduits stored between two ends of the unit; and

FIG. 6 illustrates the electrical system for the two units comprising the portable conditioning system.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. 1, there is disclosed a portable environment conditioning system for conditioning a zone, which, in FIG. 1 is illustrated as a room 10 of a house. This system comprises a cabinet 12 which is shown located in the room and cabinet 14 which is shown supported outside of the room or house on a wheeled dolly 15. Conditioned air flows from the cabinet 12 into the room by way of a grill 13. Extending between the two cabinets or units are a pair of flexible conduits 16 and 17 for passing operating fluid between the two units.

In the embodiment disclosed, unit 12 is a cooling unit or cabinet for cooling a room or zone, while unit 14 is a refrigerant condensing unit. The zone to be cooled may be a room of a house, the cabin of a boat, the interior of a camper, etc. Electrical energy is supplied to the components of the units 12 and 14 by way of electrical conduits illustrated at 18 and 19. If the system is employed for recreational use for cooling boats, campers, etc., the electrical energy may be obtained from a portable generator.

Referring to FIG. 2, the cooling unit 12 has supported therein an evaporator coil 20 or heat exchanger for heat removal. Also supported within the unit 12 is an air moving device comprising a motor 21 and a blower 22 which is provided for moving air across the heat exchanger 20. Located within the refrigerant condensing unit 14 is a compressor 24 and a condensing coil or heat exchanger 25. Also provided is an air moving device comprising a fan 26 and a driving motor 27 for moving air across the heat exchanger 25. The compressor 24 may comprise a sealed motor-compressor unit in which a motor drive is incorporated and illustrated at 28.

Extending from the heat exchanger 25 is a metal refrigerant liquid conduit 30 which is supported by the unit 14. A metal refrigerant return conduit 31, also supported by the unit 14, extends to the compressor 24. Extending between the compressor 24 and heat exchanger 25 is a metal compressor discharge conduit 32.

Coupled to conduits 30 and 31 are the flexible conduits 16 and 17, which preferably are non-metallic and are of plastic material. Conduit 16 is a liquid line while conduit 17 is a suction line.

Self-sealing disconnects 37 and 38 have coupling halves secured to the other ends of conduits 16 and 17 and to metal conduits 40 and 41 which are supported by the unit 12. These coupling devices are provided for connecting and disconnecting the flexible conduits 16 and 17 to and from metal conduits 40 and 41. When disconnected, the coupling halves maintain a seal against fluid or gas loss. Conduit 40 is a metal inlet conduit which leads to the heat exchanger 20 by way of a refrigerant receiver 42 and a refrigerant expansion valve 43. Conduit 41 is a metal return conduit which extends from the heat exchanger 20 to the wall structure of the unit 12.

In operation of the system, the compressor 24 takes the low pressure refrigerant gas from the evaporator or cooling unit 12 and compresses the gas to a high pres-

sure, high temperature refrigerant gas. At that point, it is passed to the condenser or heat exchanger **25** where the heat is rejected to the atmosphere by means of the air moving device **26** and **27.** Thus, the gas is condensed to a high pressure liquid and is passed on to the accumulator **42** by way of conduits **30, 16** and **40.**

The receiver **42** stores liquid refrigerant and removes moisture. The expansion valve **43** meters refrigerant flow through an orifice creating a pressure drop. As liquid passes through the orifice, the pressure is reduced thereby causing the liquid to evaporate and hence causing the refrigerant to become cool. The low pressure, low temperature saturated gas is passed through the evaporator coil or heat exchanger **20** which absorbs the heat from the air moved across it by the motor **21** and blower **22.** The gas then is returned to the compressor by the conduits **41, 17** and **31** and the cycle is repeated.

In installation, the unit **14** is left outside of the room or zone to be cooled. This is desirable not only because of its greater weight but because the compressor creates vibrations and generates heat in its operation. For practical purposes the conduits **16** and **17** are permanently connected to the unit **14.** Since conduits **16** and **17** are flexible and self-sealing disconnects are employed, a convenient arrangement for hookup, handling, and storage is provided. For example conduits **16** and **17** may be disconnected from unit **12** whereby it may be readily brought into the room free and clear of the conduits **16** and **17.** Preferably unit **12** is placed completely inside of the room although it may be supported in the window whereby only its front end including the grill **13** is located in or exposed to the interior of the room. After the unit **12** has been located in a desired position inside of the room, for example, as illustrated in FIG. **1,** the two units are coupled together by extending the conduits **16** and **17** through the window or through a small opening formed through the wall of the house or structure desired to be cooled.

In one embodiment, the system may have a cooling capacity of 10,000 BTU. In this embodiment the unit **12** may weight on the order of 30 pounds while the unit **14** may weigh on the order of 80 pounds. Thus, due to the light weight of the unit **12,** it may be readily positioned in a room or other compartment to be cooled and then readily coupled to unit **14** by way of the flexible conduits **16** and **17.**

Preferably the conduits **16** and **17** are non-metallic synthetic hose, for example, of nylon which may be purchased on the commercial market. The conduits **16** and **17** in one embodiment each are **10** feet long and have inside diameters of 3/16 and ⅜ of an inch respectively.

As indicated previously, the purpose of the accumulator **42** is to store liquid refrigerant and to remove moisture.

It comprises a drum for holding a liquid refrigerant charge. In addition, a small container is located within the drum and which contains a disiccant for absorbing any moisture that may be carried with the refrigerant.

When the system is charged, it is overcharged with refrigerant, including the accumulator **42,** whereby the system will contain an amount of refrigerant in excess of that required for efficient operation. An adequate supply of refrigerant, thus, will be available over an extended period of time even though there will be loss of refrigerant due to connection and disconnection of the conduits **16** and **17** from unit **12** and due to effusion of refrigerant through the conduits. The use of the accumulator **42** thus minimizes recharging over an extended period of time.

By placing the accumulator **42** in the cooling unit **12,** it will operate at a lower ambiant temperature and hence can contain a greater amount of moisture. For example, the accumulator **42** in the cooling unit **12** can hold 60 drops of water with an average ambiant temperature of 60°. Whereas, of the accumulator **42** were located in the compressor unit **14,** it may hold only 45 drops of water at an average ambiant temperature of 100°.

The receiver **42** may be purchased commercially, for example, from Controls Co. of America, Milwaukee, Wisconsin.

When the system, including units **12** and **14,** is being charged with refrigerant for purposes of sale, it is charged to **44** ounces in the embodiment having a capacity of 10,000 BTU. Preferably the refrigerant used is identified as R-22 which is manufactured, for example, by DuPont under the tradename of Freon-22. Other types of refrigerants may be used, for example R-12, although the system will not have the same cooling capacity. The amount of charge needed for efficient operation, using R-22, is only about 20 ounces in the embodiment where the conduits **16** and **17** have a length each of 10 feet. Thus, the system is overcharged by about 24 ounces.

As previously indicated, the conduits **30, 31** and **32** in unit **14** and conduits **40** and **41** in unit **12** are of metal and preferably of copper. In charging the system for storage or for sale, all air is removed and the unit **12** is charged to **40** ounces of refrigerant and the coupling halves of the self-sealing disconnects secured to the ends of the tubes **40** and **41** are sealed with metal caps. Since the conduits of unit **12** are of metal or copper tubing, unit **12** may be charged, sealed and stored for purposes of sale over an extended period of time, for example, several years or more, without loss of refrigerant.

The unit **14** including the conduits **16** and **17** are charged to a holding pressure of **4** ounces and the coupling halves of the self-sealing disconnects **37** and **38** secured to conduits **16** and **17** are sealed with metal caps. The purpose of the holding charge is to provide a positive pressure in the unit **14** to keep air out during storages. Although some refrigerant may effuse through the conduits **16** and **17** of the unit **14,** it will not affect operations when the system is assembled for use since the unit **12** was initially overcharged. Thus, the complete system may be charged and stored for sale for an extended period of time without the need of recharging the system when it is sold. It will be operational regardless of the period of time between manufacture and use.

Reference is now had to FIGS. **3A–3F** for a description of the arrangement employed for coupling conduits **16** and **17** between the two units **12** and **14.** The description will pertain only to conduit **16** since the coupling arrangement for conduit **17** is the same. As can be seen in FIG. **3A,** a threaded male connector **50** has one end soldered or welded to copper tubing **30** of the condensing unit **14.** In assembly, this connector is threaded into a rotatable female connector **51** (FIG. **3B**) which is coupled to an L-shaped tube **52.** At the other end of tube **52,** in one embodiment, is a threaded male connector **53.** This connector is threaded into fe-

male connector **54** (FIG. 3C) which is attached to one end of conduit **16.** A leakproof seal is provided for sealing the metal connector **54** to conduit **16** by dipping the fitting including the nipple **54A** into a suitable sealing adhesive, for example, which may be purchased from Loc-Tite Corp. The nipple **54A** then is inserted into the hose or conduit **16** in a manner as shown in FIG. 3C and the outer wall **54B** then is crimped to couple the connector **54** to conduit **16** to provide a leakproof seal between the two members. The other end of the conduit **16** is coupled to a similar female connector in a similar manner. The female connector at this end of the conduit **16** is threaded onto a male connector **55** which has its other end threaded into coupling half **58** of the self-sealing disconnect **37.** As seen in FIG. 3D, this disconnect comprises coupling halves **58** and **59.** The coupling halves are connected and disconnected from each other by threading female and male connecting ends **58A** and **59A** together and apart respectively. The back end of coupling half **59** is soldered or secured to conduit **40** of cooling unit **12.**

Coupling halves **58** and **59** have a valve and sleeve assembly **58B** and a poppet valve assembly **59B,** respectively, which are employed to maintain a seal against fluid loss when the halves are disconnected as illustrated in FIG. 3D. When the two halves are connected, as illustrated in FIG. 3E, the valve assemblies open a fluid passage to allow fluid flow through the disconnect.

The two units **14** and **12** are evacuated and then charged with refrigerant, for purposes of sale, through connecting ends **58A** and **59A** of the coupling halves **58** and **59.** After charging and for storage purposes, metal caps **62** and **63** (illustrated in FIG. 3F) are threaded to female and male connecting ends **58A** and **59A** of coupling halves **58** and **59** respectively, for sealing the refrigerant in the units **14** and **12.**

In one embodiment, the self-sealing disconnects may be of the type purchased from Aeroquip Corp., and identified as the 5400 Series. Connectors **50–54,** as well as caps **62** and **63** may be of brass or stainless steel.

Insulation (not shown) is provided for covering the copper tubes **30, 31, 32, 40** and **41** and other metal parts to minimize condensation of liquid on the exterior of these parts. In addition, the flexible conduits **16** and **17** may be covered with insulation, at least that portion which will remain in the room or zone to be cooled.

Provision also is made for locking the two units **12** and **14** together and for storing the flexible conduits **16** and **17** as well as the electrical conduits between the two units unexposed from the outside. The supporting wall structure of the two units **12** and **14** is made of sheet metal iron. The storage space is provided at end of unit **14** and is illustrated at **64** in FIG. **4.** This space is formed by an extension of the four side panels **14A–14B** forming the side wall structure of unit **14.** The conduits may be stored in the storage space provided by the extending ends **14A–14B** by coiling the conduits within the space. Tabs **65** help hold the coiled conduits. They also provide supporting surface for locking the two units **12** and **14** together.

As can be seen in FIG. **4** a latching system comprising a moveable latch **66** and a catch **67** are secured to three side panels of the units **14** and **12** respectively. The latches **66** secure the tabs **65** to the side panels of unit **14.** After the conduits have been coiled within the storage space **64,** the back end **68** of unit **12** may be abutted against the front end of unit **14** and the two units latched or locked together with the latching system as illustrated in FIGS. **4** and **5.**

With this arrangement, the two units **12** and **14** may be locked together with the conduits stored between the two units whereby a convenient arrangement is provided for storing or transporting the complete unit with the conduits securely stored and concealed from the outside. For storage or transportation purposes the conduits **16** and **17** preferably will be disconnected from the unit **12** and metal caps **62** and **63** threaded to the coupling halves of the self-sealing disconnects.

Referring to FIG. **6,** the electrical system for the portable air conditioning system is illustrated. An electrical male plug **70** is provided for insertion into a wall socket for providing electrical power. Extending from the plug **70** are two leads **71** and **72** which extend to the evaporator blower motor **21.** A ground lead **73** also is provided which is coupled to the wall panel of the unit **12.** Leads **74** and **75** are coupled to leads **71** and **72** respectively and to a female plug **76.** Electrical energy is applied to the unit **14** by way of a male plug **77** and electrical leads **78** and **79.** The plugs **76** and **77** have ground connections **80** and **81** which are coupled to the wall panels of units **12** and **14** respectively. Conductors **78** and **79** extend to the compressor **24** which is a commercially available sealed motor-compressor which may be purchased, for example, from Tecumseh Corporation, Tecumseh, Michigan. The start-run components of the compressor are standard and comprise a run capacitor **84,** a bleed resister **85,** a start capacitor **86** and a start relay **87.**

Electrical energy is supplied to the fan motor **27** by way of conductors **88** and **89.**

Both systems may be turned off by opening switch **90** located at the cooling unit **12.** A thermostat illustrated at **91** is provided in the cooling unit for turning the compressor off when the temperature in the room or zone to be cooled reaches a predetermined temperature. By disconnecting the plug **77** from plug **76** the unit **12** may be operated as a fan only.

Although not shown, plug **70** and its electrical leads may extend from the back end of unit **12** whereby they may be coiled and stored in the storage space **64** when the two units are locked together.

I claim:

1. A portable environmental conditioning system comprising:

a first unit adapted to be placed at least partially in a zone to be conditioned,

a heat exchanger and an air moving device supported by said first unit for applying conditioned air to said zone,

a second unit adapted to be placed outside of said zone to be conditioned,

a compressor and heat exchanger supported by said second unit,

flexible fluid conduits for coupling said heat exchanger and said compressor of said second unit to said heat exchanger of said first unit,

said two units having two ends respectively adapted to be connected together,

means for connecting said two ends together for forming a single rigid system, and

structure forming storage space in at least one of said ends for storing said flexible conduits between said

two units when said two ends of said two units are connected together,
said connecting means being operable to allow said two ends to be disconnected to form two separate units to be coupled together by said flexible conduits.

2. The system of claim **1** wherein:
said structure forming said storage space comprises side wall structure extending from one end of said second unit,
said flexible conduits comprise two flexible conduits having first ends coupled to said compressor and heat exchanger respectively of said second unit,
coupling means secured to the other ends of said two flexible conduits and to said heat exchanger of said first unit for connecting and disconnecting said two conduits to and from said heat exchanger of said first unit,
said two flexible conduits extending from said one end of said second unit within said side wall structure forming said storage space.

3. A portable air conditioning system comprising:
a cooling cabinet adapted to be placed at least partially in a zone to be cooled,
a heat exchanger and an air moving device supported by said cooling cabinet for applying cool air to said zone,
a refrigerant condensing cabinet adapted to be placed outside of said zone to be cooled,
a compressor and heat exchanger supported by said refrigerant condensing cabinet,
flexible fluid conduits for coupling said compressor and heat exchanger of said refrigerant condensing cabinet to said heat exchanger of said cooling cabinet,
said two cabinets having two ends respectively adapted to be connected together,
means for connecting said two ends together for forming a single rigid portable system, and
structure forming storage space in one of said ends for storing said flexible conduits between said two cabinets when said two ends of said two cabinets are connected together,
said connecting means being operable to allow said two ends to be disconnected to form two separate cabinets to be coupled together by said flexible conduits.

4. The system of claim **3** comprising:
an inlet conduit supported by said cooling cabinet and leading to said heat exchanger supported by said cooling cabinet,
means coupled to said inlet conduit for storing refrigerant and removing moisture from said refrigerant, and
a return conduit supported by said cooling cabinet and extending from said heat exchanger supported by said cooling cabinet,
said flexible conduits being coupled to said compressor and heat exchanger of said refrigerant condensing cabinet and adapted to be coupled to said return and inlet conduits respectively of said cooling cabinet.

5. The system of claim **4** wherein:
said flexible conduits comprise two flexible conduits having first ends coupled to said compressor and heat exchanger respectively supported by said refrigerant condensing cabinet, and
self-sealing coupling means secured to the other ends of said two flexible conduits and to said inlet and return conduits of said cooling cabinet for connecting and disconnecting said two conduits to and from said inlet and return conduits respectively.

6. The system of claim **5** wherein:
said structure forming said storage space comprises side wall structure extending from one end of said refrigerant condensing cabinet,
said two flexible conduits extending from said one end of said refrigerant condensing cabinet within said side wall structure forming said storage space.

7. The system of claim **6** wherein said self-sealing coupling means each comprise:
valve means which open when a mating pair of self-sealing coupling means are connected together to allow the passage of fluid therethrough and which close when the mating pair of self-sealing coupling means are disconnected to prevent the loss of fluid.

8. A portable air conditioning system comprising:
a cooling unit to be placed at least partially in a zone to be cooled,
a heat exchanger and an air moving device supported by said cooling unit for applying cool air to said zone,
a metal inlet conduit supported by said cooling unit and leading to said heat exchanger,
means coupled to said inlet conduit for storing refrigerant and for removing moisture from said refrigerant,
a refrigerant expansion device coupled to said inlet conduit,
a metal return conduit supported by said cooling unit and extending from said heat exchanger,
self-sealing coupling means secured to said inlet and return conduits,
said cooling unit including said heat exchanger and said refrigerant storing means being charged at least to a predetermined refrigerant operating charge,
said inlet and return conduits being sealed with removable sealing means to prevent refrigerant loss,
a refrigerant condensing unit to be placed outside of said zone to be cooled,
a compressor and heat exchanger supported by said refrigerant condensing unit,
a metal refrigerant return conduit supported by said refrigerant condensing unit and extending to said compressor,
a metal compressor discharge conduit extending from said compressor to said condensing heat exchanger,
a metal refrigerant liquid conduit extending from said condensing heat exchanger and supported by said refrigerant condensing cabinet,
flexible fluid conduits having first ends coupled to said refrigerant return conduit and to said refrigerant liquid conduit of said condensing unit
self-sealing coupling means coupled to the other ends of said flexible conduits,
said refrigerant condensing unit including said heat exchanger of said condensing unit being filled with a predetermined refrigerant holding charge,
said opposite ends of said flexible conduits being sealed with removable sealing means to prevent refrigerant loss.

9. The system of claim 8 wherein said self-sealing coupling means each comprise valve means which open when a mating pair of self-sealing coupling means are connected together to allow the passage of fluid therethrough and which close when the mating pair of self-sealing coupling means are disconnected to prevent the loss of fluid.

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