July 24, 1934. J. G. FORD 1,967,770

METHOD OF MANUFACTURING REFRIGERATING APPARATUS

Filed April 28, 1933 2 Sheets-Sheet 1

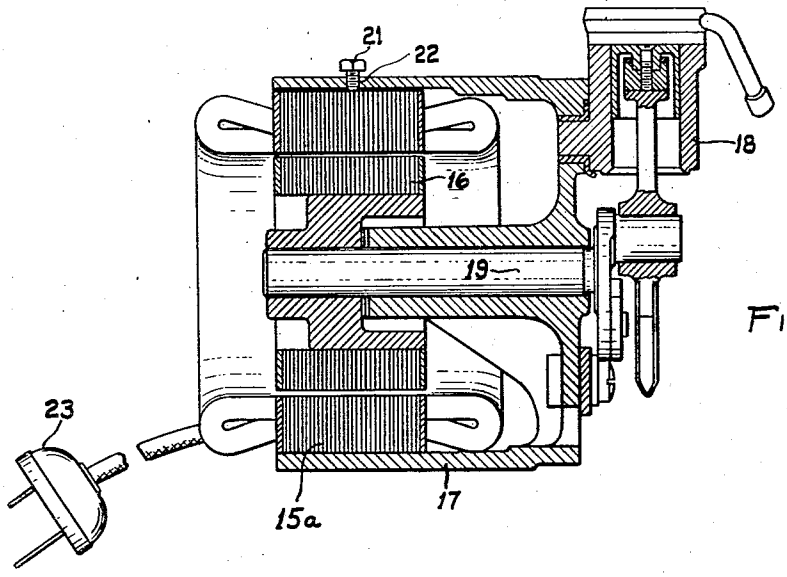



FIG. 1.

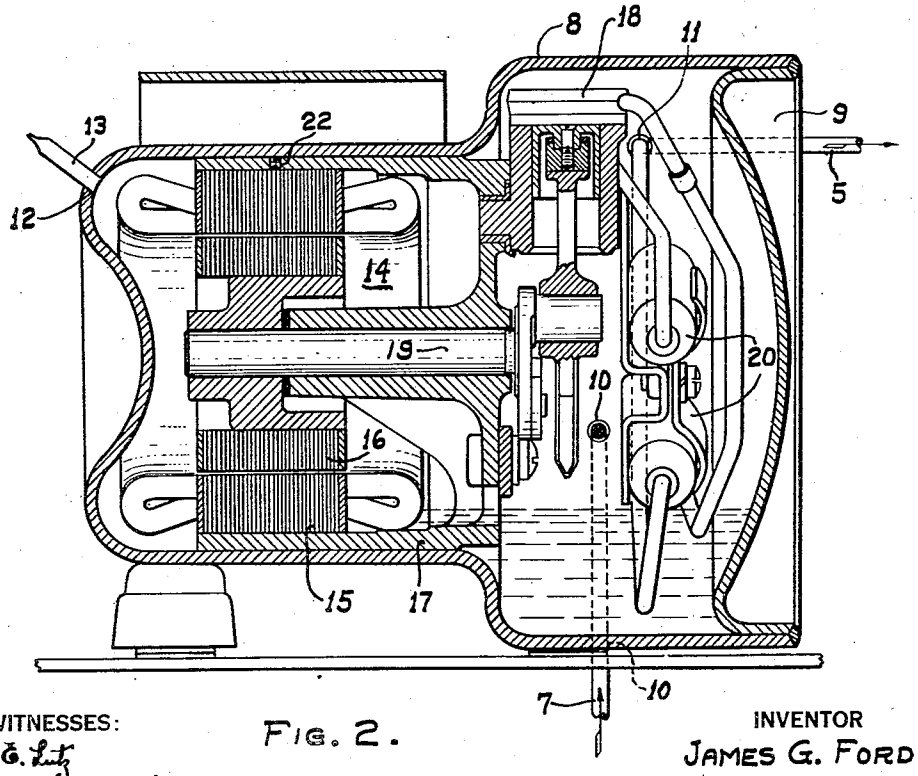



FIG. 2.

WITNESSES:
G. Lutz
W. M. VanSciver

INVENTOR
JAMES G. FORD
BY A. B. Rivis
ATTORNEY

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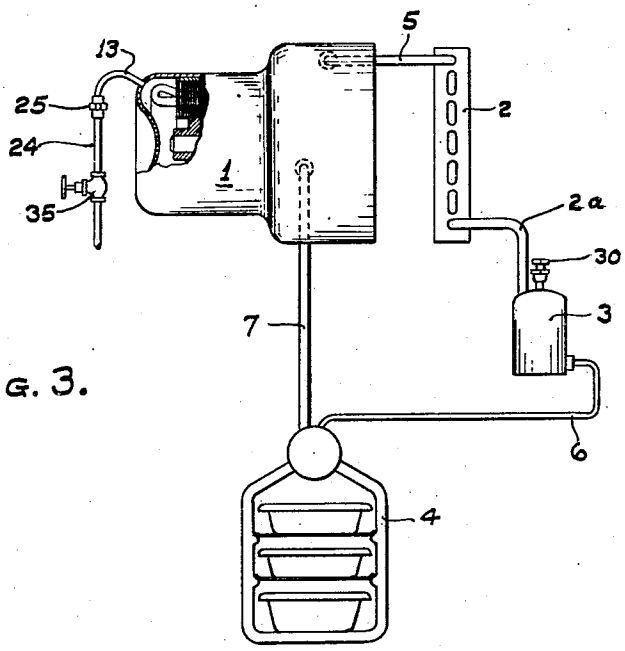



FIG. 3.

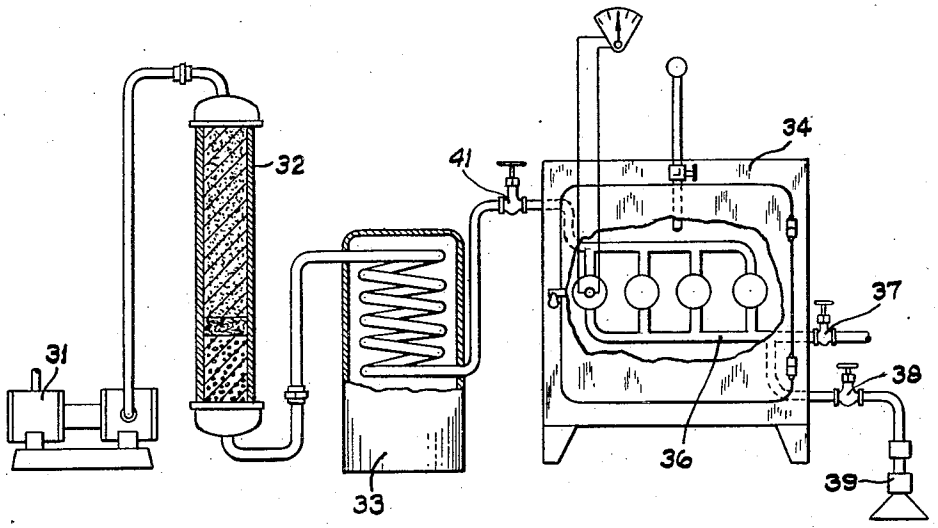



FIG. 4.

WITNESSES:
E. Lutz.
W. M. Crane Seiver

INVENTOR
JAMES G. FORD
BY A. B. Rivers
ATTORNEY

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# UNITED STATES PATENT OFFICE

1,967,770

## METHOD OF MANUFACTURING REFRIGERATING APPARATUS

James G. Ford, Forest Hills, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application April 28, 1933, Serial No. 668,441

11 Claims. (Cl. 62—115)

My invention relates to a method of manufacturing refrigerating apparatus and particularly to refrigeration apparatus of the hermetically sealed compression type, and is a continuation in part of application Serial No. 564,455, filed by me September 22, 1931 for Drying process and apparatus therefor.

In the manufacture of refrigeration apparatus of the hermetically sealed compression type, it is necessary in practice to run in the bearing surfaces of the apparatus and to test the compressor before the apparatus is charged with refrigerant and lubricant. The apparatus must also be freed of moisture by drying before it is charged. The running in and test of the apparatus and the subsequent drying thereof gives rise to several difficulties in the steps of the manufacture thereof.

One of the difficulties arises from the fact that the run in and test are preferably completed before the apparatus is assembled in a sealable casing, so that the parts of the apparatus are accessible and so that inspection may be made as to clearances and wear on the motor and compressor bearing surfaces, without having to remove the apparatus from the casing and replacing it. Since the apparatus is, therefore, handled outside of the sealable casing during test and run in in actual practice, it is exposed to rough handling in the shop. The most vulnerable part of the apparatus is the cloth or paper insulated stator, and bumps or knocks are liable to break the insulation and cause a short circuit in the stator.

Another difficulty arises from the fact that gas drying is used since it is advantageous and extremely effective in the manufacture of hermetically sealed refrigerators. Drying is used so that substantially all the moisture in the apparatus will be removed before it is charged with refrigerant and lubricant. It is necessary that the apparatus be substantially moisture free because of the fact that many refrigerants, for example $SO_2$, react with water and form substances which attack and corrode various parts of the apparatus. In addition to this, it is necessary to obtain substantially moisture free apparatus because any moisture therein collects at the expansion or float valve and forms ice, since this point is one of the coldest in the system, and thereby impairs the operation of the apparatus. However, if any lubricant is present in the apparatus when it is dried by an oxygen containing gas, breakdown of the lubricant usually occurs, and moisture is continuously formed in the apparatus until the breakdown ceases due to exhaustion of certain materials from the lubricant which combine with the oxygen. The exhaustion of these materials from the lubricant is very slow and the time for drying a lubricant impregnated unit, therefore, is not practical when air is used.

When a gas is used which does not break down the lubricant, such as nitrogen, the presence of the lubricant in the cellulose fibers of the stator retards the evolution of moisture therefrom. The gas used for drying, however, is preferably air, because of its accessibility and economy.

It is an object of my invention, therefore, to provide a novel method of manufacturing hermetically sealed refrigerating apparatus.

It is another object of my invention to provide a cheap method of obtaining moisture free hermetically sealed refrigerating apparatus.

It is another object of my invention to provide hermetically sealed refrigerating apparatus with a perfect motor stator after test and run in, without any substantial additional expense.

It is another object of my invention to provide a completely lubricant free refrigerating apparatus so that gas drying may be used without in any way retarding the time necessary to obtain substantially moisture free apparatus.

It is still another object of my invention to provide refrigerating apparatus completely lubricant free so that it may be dried by air or other gas which breaks down lubricants, so that moisture is not formed before charging with refrigerant and lubricant.

These and other objects are effected by my invention, as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a view, partly in section, of the working parts of a compression refrigerator showing a test stator attached to a supporting frame;

Fig. 2 is a view, partly in section, of a sealed motor compressor refrigerating unit manufactured in accordance with a preferred embodiment of my invention;

Fig. 3 is a view, partly in section, of a complete refrigerating apparatus of the hermetically sealed compression type with proper connections for drying and charging the same, and,

Fig. 4 is a schematic view of a drying system for refrigerating apparatus.

My invention generally comprises placing a test stator in operable relation with the rotor of a refrigerating apparatus to run in the bearing surfaces of the apparatus and to perform certain tests thereon. After these steps are performed, the test stator is removed, all traces of lubricant are washed from the remainder of the apparatus and a permanent stator which is free of lubricant is disposed in operable relation with the rotor. The remaining steps in the manufacture of the apparatus are then completed.

Referring more particularly to the drawings, a refrigerating apparatus is shown in Figs. 1, 2 and 3 similar to that disclosed in a co-pending

application Serial No. 641,284, filed November 4, 1932 for Refrigeration apparatus by M. C. Terry et al, and assigned to the assignee of the present application. The apparatus generally comprises a sealed motor-compressor unit 1, a condenser 2, a float valve 3, and an evaporator 4. A conduit 5 connects the motor-compressor unit 1 with the condenser 2 and a conduit 2a connects the condenser 2 with the float valve 3. A conduit 6 connects the float valve 3 with the evaporator 4 and a suction line 7 connects the evaporator with the motor compressor unit 1. The operation of the refrigerating apparatus need not be described since it is well known in the art and forms no part of the present invention.

The motor-compressor unit 1 further comprises a cup-shaped casing 8 having a sealing cap 9 welded at the open end thereof. Restricted openings 10, 11 and 12 are provided in the casing. The suction conduit 7 is inserted in the opening 10 and soldered therein, while the discharge conduit 5 is inserted in the opening 11 and soldered therein. The opening 12 is provided for the insertion of a conduit 13 for a purpose hereinafter described.

The motor-compressor unit 1 further comprises a motor, generally designated, at 14, which includes a stator 15 and a rotor 16 both supported by a frame 17. The frame also supports a compressor 18, a drive shaft 19 between the motor and compressor, and mufflers 20, as fully explained in the aforesaid application of Terry et al.

The assembly of the apparatus, more particularly the motor-compressor unit 1, is accomplished in the following manner: Referring first to Figs. 1 and 2, the rotor 16 is assembled on the shaft 19, and the shaft is disposed in the frame 17. The compressor 18 is then fastened to the frame 17, and the shaft 19 is operatively connected to the compressor in a manner well known in the art. A test stator 15a is then disposed within the frame 17 and it is fastened securely therein by any suitable means, for example, by a set screw 21 fitting a tapped hole 22 in the frame 17. The assembly, as shown in Fig. 1, is then partially immersed in a lubricant containing trough (not shown), the stator is energized by connecting the plug 23 to a suitable source of electrical energy, and the working parts of the unit are run in. It is obvious that the cloth or paper insulation of the test stator 15a becomes soaked with lubricant at this time, and it is, of course, used over again in this state. Varnish or gum impregnated test stators are preferably used to prolong their life. After run in, the efficiency of the compressor is tested. If the unit shown in Fig. 1 successfully passes test and inspection, the test stator 15a is removed from the frame 17 and the rest of the unit, being entirely metallic, may be easily washed thoroughly with an oil solvent, such as xylol to remove substantially all of the lubricant.

After the xylol bath, the unit is dried with compressed air, or by other suitable means, and a new, lubricant free stator is disposed in the frame 17. The mufflers 20 are attached to the compressor and the assembly is placed within the casing 1. The muffler conduits are then attached to their respective openings (not shown) in the casing 1, electrical connections (not shown) are made to the outside of the casing, and the sealing cap 9 is welded in place. The discharge conduit 5 and suction conduit 7 are then soldered to the openings 11 and 10, respectively, after the condenser 2, float valve 3 and evaporator 4 have been operatively connected together and to said suction and discharge conduits. The float valve assembly 3 is provided with a removable plug 30, which is left open at this time for a purpose hereinafter described, as is the conduit 13.

The apparatus is now in condition for gas drying. Before drying, however, a valved conduit 24 is connected by a union joint 25 to the conduit 13 for a purpose hereinafter described. A form of drying apparatus is shown in Fig. 4, and is more fully described in my co-pending application Serial No. 564,455, filed September 22, 1931. The drying apparatus forms no part of this invention and a detailed description of it is, therefore, deemed unnecessary. The apparatus generally comprises a pump 31 which preferably draws air from the atmosphere and forces it to a dehydrator 32 where the air is dried. The air then passes through a heater 33 to a plurality of refrigerating units in an oven 34. The warm dry air enters each unit at a valve 35, is forced through conduits 24 and 13 and into the motor-compressor unit 1, where it branches, part of the air flowing through discharge conduit 5, condenser 2 and out of the open float valve 3. The float valves of a plurality of the units in the oven are connected in parallel in the oven 34, and the air leaving the float valves is conveyed by a conduit 36 to the atmosphere. The air also branches from the motor-compressor unit 1, through suction conduit 7, through the evaporator 4 and out of the float valve 3 to the conduit 36. The air may escape therefrom because the apparatus shown in Fig. 3 is placed in the oven 34 upside down so that the float valve is held open.

The air is forced through the unit at a predetermined rate and at a predetermined temperature, in order to obtain the most economical but effective drying, taking the time of drying into account as a factor in the economy thereof. As set forth in my co-pending application above referred to, the most economical temperatures for the gas are above 90° C. The most economical rates of flow for a complete unit of substantially 5 liters volume lie between .5 cubic feet per hour and 1 cubic foot per hour.

When the apparatus is completely dry, a valve 37 in the air conduit 36 is closed, and a valve 38 is opened which connects the conduit 36 to a vacuum pump 39. A valve 41 at the entrance of the air line to the oven 34 is also closed. The units are then evacuated, the valve 35 is closed, and the float valve 3 is closed by the screw plug 30. The apparatus is charged with refrigerant and lubricant through the valve 35 and conduit 13. The conduit 13 is then pinched shut above the joint 25 and may be soldered, as shown in Fig. 2, so that the unit is completely sealed. The apparatus is then ready for operation when energy is supplied to the motor 14.

From the foregoing description, it will be apparent that I have provided a novel and inexpensive method of manufacturing refrigerating apparatus. The apparatus is fully run in and tested with a test stator, thereby saving the permanent stator from rough usage, and providing lubricant-free apparatus so that gas drying, such as air, may be used to effectively remove all moisture. As hereinbefore pointed out, air drying has been found to be very economical and effective, but it is essential that lubricant be entirely removed from the apparatus.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:—

1. A method of manufacturing a hermetically sealed refrigerating unit, including a motor comprising a permanent stator and a rotor, a compressor, and a sealable casing for the motor and compressor, which includes the steps of assembling the compressor and rotor, disposing a test stator in operable relation with the rotor to provide an operative motor, energizing such motor to test the compressor and run in the bearing surfaces of the unit, removing the test stator, disposing the permanent stator in operable relation with the rotor, and hermetically sealing the casing with the motor and compressor therein.

2. A method of manufacturing a hermetically sealed refrigerating unit, including a motor comprising a permanent stator and a rotor, a compressor, and a sealable casing for the motor and compressor, which includes the steps of assembling the compressor and rotor, disposing a test stator in operable relation with the rotor to provide a testing motor, energizing such motor to test the compressor and run in the bearing surfaces of the unit, removing the test stator, disposing the permanent stator in operable relation with the rotor, hermetically sealing the casing with the motor and compressor therein, and drying the unit by means of air flow therethrough.

3. A method of manufacturing a hermetically sealed refrigerating unit, including a motor comprising a permanent stator and a rotor, a compressor, and a sealable casing for the motor and compressor, which includes the steps of assembling the compressor and rotor, disposing a test stator in operable relation with the rotor to provide a testing motor, energizing such motor to test the compressor and run in the bearing surfaces of the unit, removing the test stator, disposing the permanent stator in operable relation with the rotor, hermetically sealing the casing with the motor and compressor therein, and drying the unit by means of forcing a dry gas therethrough.

4. A method of manufacturing a hermetically sealed refrigerating unit which utilizes a refrigerant chemically active with respect to water and which includes a motor comprising a permanent stator and a rotor, a compressor, and a sealable casing for the motor and compressor, which includes the steps of assembling the compressor and rotor, disposing a test stator in operable relation with the rotor to provide a testing motor, energizing such motor to test the compressor and run in the bearing surfaces of the unit, removing the test stator and disposing the permanent stator in operable relation with the rotor, hermetically sealing the casing with the motor and compressor therein, and drying the unit by means of gas flow therethrough.

5. A method of manufacturing compression refrigerating apparatus which includes the steps of running in the working parts of the apparatus in the presence of a lubricant, completely removing the lubricant from the apparatus, forcing dry gas through the apparatus to dry the same and charging the apparatus with refrigerant and lubricant.

6. A method of manufacturing compression refrigerating apparatus which includes the steps of running in the working parts of the apparatus in the presence of a lubricant, completely removing the lubricant from the apparatus, forcing dry gas through the apparatus to dry the same, charging the apparatus with refrigerant and lubricant and finally completely sealing the apparatus from the atmosphere.

7. A method of manufacturing compression refrigerating apparatus including working parts and a sealable casing for enclosing the same which includes the steps of running in the working parts in the presence of a lubricant before disposition of said parts in the casing, completely removing the lubricant from the apparatus, disposing the working parts in the casing and sealing the same except for restricted openings therein, forcing dry gas through said openings to dry the apparatus, charging the apparatus with refrigerant and lubricant through one of the openings and completely sealing the casing from the atmosphere by closing said openings with respect to the atmosphere.

8. The method of manufacturing a hermetically sealed refrigerator unit, including a motor comprising a rotor and a permanent stator, a compressor, and a sealable casing for the motor and the compressor, which includes the steps of assembling the compressor and rotor, disposing a test stator in operable relation with the rotor to provide a testing motor, energizing such motor to test the compressor and run in the bearing surfaces of the unit, removing the test stator, removing all lubricant from the unit, disposing a permanent stator in operable relation with the rotor, hermetically sealing the casing with the assembled motor and compressor therein and drying the unit by means of forcing gas therethrough.

9. The method of manufacturing a hermetically sealed refrigerator unit, including a motor comprising a rotor and a permanent stator, a compressor, and a sealable casing for the motor and the compressor, which includes the steps of assembling the compressor and rotor, disposing a test stator in operable relation with the rotor to provide a testing motor, energizing such motor to test the compressor and run in the bearing surfaces of the unit, removing the test stator, applying a solvent to remove all the lubricant from the units, disposing the permanent stator in operable relation with the rotor, hermetically sealing the casing with the assembled motor and compressor therein and drying the unit by means of forcing gas therethrough.

10. The method of manufacturing a compression refrigerating apparatus which includes the steps of running in the working parts of the apparatus in the presence of a lubricant, completely removing the lubricant from the apparatus by applying a solvent thereto, forcing gas through the apparatus to dry the same and charging the apparatus with refrigerant and lubricant.

11. The method of manufacturing a compression refrigerating apparatus which includes the steps of running in the working parts of the apparatus in the presence of a lubricant, completely removing the lubricant from the apparatus by applying a solvent thereto, and forcing gas through the apparatus at a predetermined rate to dry the same.

JAMES G. FORD.

## DISCLAIMER

1,967,770.—*James G. Ford*, Forest Hills, Pa. METHOD OF MANUFACTURING REFRIGERATING APPARATUS. Patent dated July 24, 1934. Disclaimer filed February 12, 1944, by the assignee, *Westinghouse Electric & Manufacturing Company*.

Hereby enters this disclaimer to claims 1, 2, 3, and 4.

[*Official Gazette March 21, 1944*]