Sept. 28, 1965 S. L. MADISON ETAL 3,208,232

REFRIGERATING APPARATUS

Filed Oct. 4, 1963

2 Sheets-Sheet 1

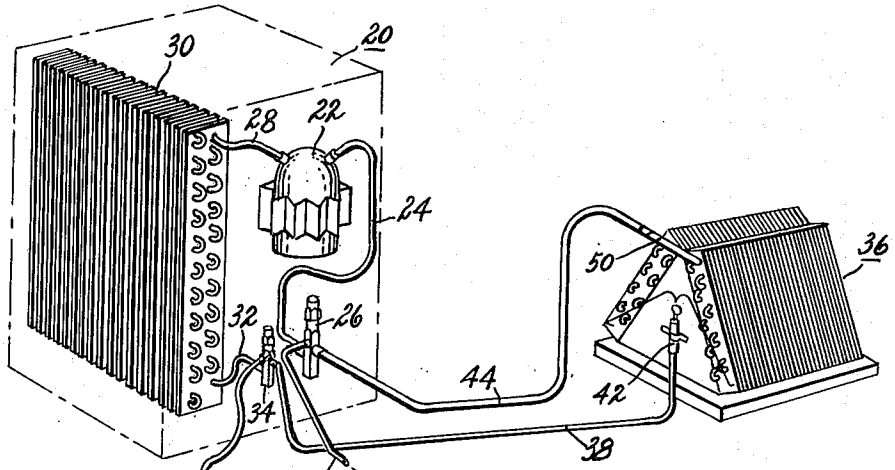
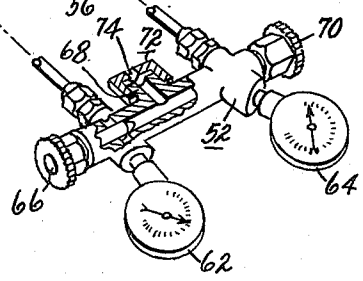


Fig. 1



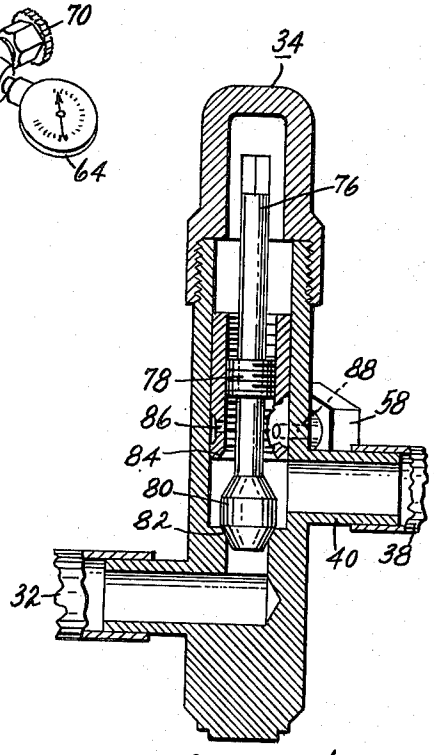


Fig. 4

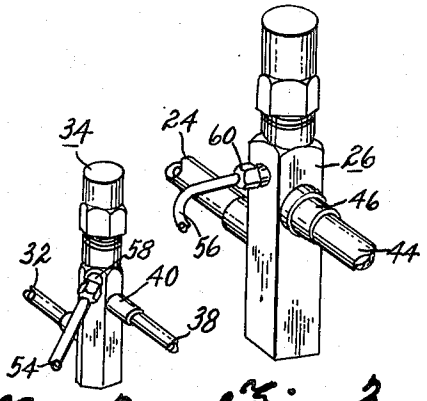


Fig. 2

Fig. 3

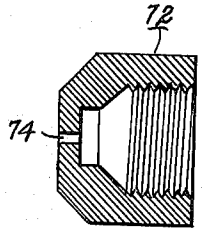


Fig. 5

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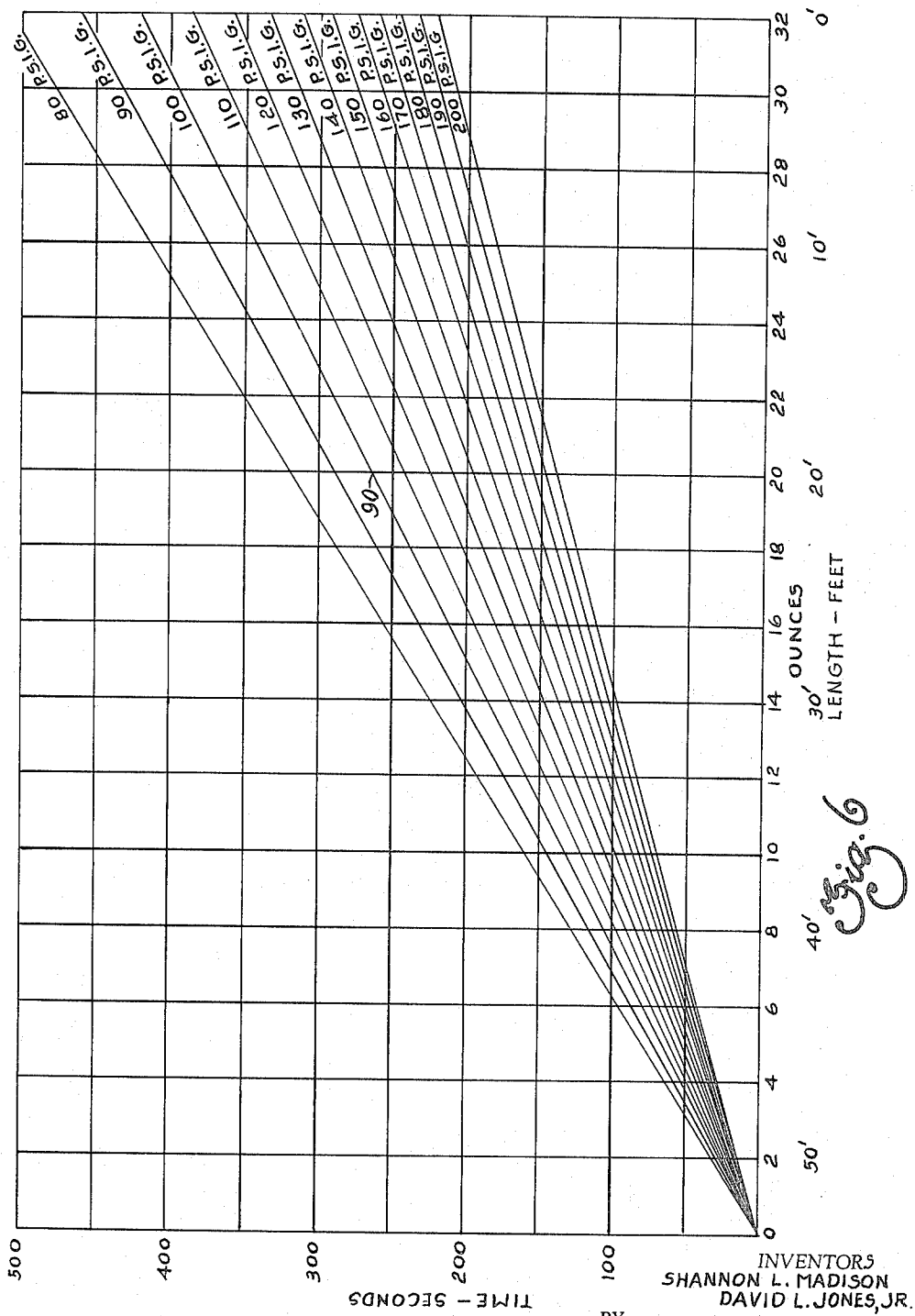

Fig. 6

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REFRIGERATING APPARATUS

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1 Claim. (Cl. 62—77)

This invention relates to refrigerating apparatus and more particularly to refrigerating systems assembled at the place of installation from major components.

When the major components of a refrigerating system are assembled at the place of installation, the life and performance thereof and the freedom from failure and servicing depend almost entirely on the care exercised by the installer in connecting the tubing between the units. Heretofore this has required the services of a trained refrigeration mechanic and often a vacuum gauge, a vacuum pump, a charging cylinder, a weighing scale and a charging restricter. All these things increase the expense of installation and therefore discourage sales of this type of system.

It is an object of this invention to provide a method of, and apparatus for connecting together the units of a refrigerating system and establishing the proper refrigerant charge in the system which is much quicker and which does not require a refrigeration technician, vacuum pump, vacuum gauge, or any charging apparatus such as a refrigerant bottle, charging cylinder, a weighing scale, or a charging restricter.

It is another object of this invention to provide a method of, and apparatus for connecting together with tubing a charged condensing unit and an evaporator in which the proper reference charge is established by bleeding refrigerant through a known orifice for a time determined by the pressure of the refrigerant and the length of tubing connecting the outlet of the condensing unit and the inlet of the evaporator.

These and other objects are obtained in the form shown in the drawings in which the refrigerant condensing unit is provided with a combination shutoff valve and gauge connections at both its inlet and its outlet. It is shipped with a charge of refrigerant and lubricant which is in excess of its operating requirements. Both the condensing unit and the evaporator are shipped separately and placed in their most desirable locations at the place of installation. A liquid line tube is connected to and extended from the valve at the outlet of the condensing unit to the inlet of the evaporator where it is properly connected. A suction line tube is connected and extended from the valve at the inlet of the condensing unit to the outlet of the evaporator where it is properly connected. A service manifold gauge and valve set is then connected to the two gauge connections of the valves at the inlet and the outlet of the condensing unit. The middle connection of the service manifold valve and gauge set is provided with a flare cap having a calibrated orifice of known properties.

The valve at the outlet of the condensing unit is opened until the evaporator as well as the liquid and suction line tubes are filled to a pressure of about 40 p.s.i. gauge. The connections as well as the entire system is then tested for leaks. In the absence of leaks, the valve at the outlet of the condensing unit is opened slightly and the length of the liquid line tubing connecting the outlet of the condensing unit and the inlet of the evaporator is measured. The liquid line pressure gauge is also measured. From a chart there is determined a bleed cycle time in seconds corresponding to the measured length of liquid line tubing and to the liquid line pressure. Following this, the valve on the suction side of the service manifold valve and gauge set is opened for the time corresponding to the

bleed cycle time read on the chart and then closed immediately. After this the valves at the outlet and inlet of the condensing unit are moved to their normal operating position, the service manifold is removed and the gauge connections are capped. After the unit is connected to electrical supply, it is ready for operation.

Further objects and advantages of the present invention will be apparent from the following description, reference being made to the accompanying drawings wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a perspective view of one form of refrigerating system to which our invention may be applied.

FIGURE 2 is an enlarged perspective view of the outlet valve of the condensing unit.

FIGURE 3 is an enlarged perspective view of the inlet valve of the condensing unit.

FIGURE 4 is a vertical sectional view of the valve shown in FIGURE 2 but is also typical of the valve shown in FIGURE 3.

FIGURE 5 is a sectional view showing the flare cap with the calibrated orifice which is applied to the service manifold as shown in FIGURE 1.

FIGURE 6 is a bleed cycle time chart for determining the bleeding time necessary to establish the proper refrigerant charge in the refrigerating system.

Referring now more particularly to FIGURE 1, there is indicated a refrigerant condensing unit **20** including a sealed motor compressor unit **22** having connected to it an inlet conduit **24** extending to a suction line valve **26** which is closed to keep the refrigerant charge from escaping from the inlet conduit **24**. Also connected to the sealed unit **22** is a discharge conduit **28** connecting with the condenser **30** which has its outlet conduit **32** connected to the liquid line valve **34** which is shut to maintain the refrigerant charge in the unit and to prevent its escape from the outlet conduit **32**. This unit is charged with lubricant and refrigerant to a weight sufficiently above the basic normal operating requirements of this system to provide an excess for purging and for filling the liquid line tubing to the evaporator when this connection does not exceed 50 feet. This charge may, for example, develop 80 or more p.s.i. gauge pressure as indicated by the chart in FIGURE 6.

The condensing unit **20** as well as the evaporator unit **36** are provided with suitable bases and separately installed at the location as desired. The evaporator unit is shipped with a charge of refrigerant sufficient to prevent foreign matter and moisture from getting into the tubes. It is shipped with caps over its connections. The condensing unit is also shipped with caps over the connections **46** and **40** of the valves **26** and **34**. The dehydrated refrigeration grade copper tubing need not be shipped with the units but may be purchased from local suppliers. It is extended from the condensing unit **20** to the evaporator **36** as directly as possible. The liquid line tubing **38** is connected to the outlet connection **40** of the valve **34** at one end and at its opposite end to the inlet connection **42** of the evaporator unit **36**. The suction line tubing **44** is connected to the inlet connection **46** of the valve **26** at one of its ends and at its other end to the outlet connection **50** of the evaporator unit **36**.

A service manifold **52** is then connected by the conduits **54** and **56** to the gauge connections **58** and **60** of the valves **34** and **26**. This service manifold **52** is provided with a liquid line gauge **62** and a suction line gauge **64**. The service manifold **52** at its opposite ends is provided with a liquid valve **66** which controls the flow from the conduit **54** to the central portion of the manifold **52** which is provided with a middle connection **68**. The opposite end

of the service manifold **52** is provided with a suction side valve **70** which controls the flow from the conduit **56** to the middle connection **68** of the service manifold **52**. This middle connection **68** is provided with a flare cap **72** having a calibrated orifice **74**. Preferably this is shipped to the installation with the units so as to make certain that the proper sized calibrated orifice is used.

The valve **34** is specifically illustrated in FIGURE 4 in the closed position in which it is normally shipped as a part of the condensing unit **20**. It includes a valve stem **76** having an intermediate threaded portion **78** and at the opposite end a double seating valve **80** which during shipping is seated upon the lower seat **82** to hold the refrigerant charge in the condensing unit **20**. During normal operation of the refrigerating system, it is seated against the upper seat **84** which allows free flow of refrigerant from the outlet conduit **40** of the condensing unit **20** to the liquid line tubing **38**. When the double seating valve **80** is adjusted to an intermediate position or when it is seated on the lower seat **82**, access is provided through the passages **86** and **88** to the gauge connection **58**. This permits flow of refrigerant through the conduit **54** to the service manifold **52**. The valve **26** is similarly constructed.

To establish the proper refrigerant charge in the system, the liquid line valve **34** is first opened slightly until the suction line gauge **64** indicates approximately 40 p.s.i. gauge pressure after which the valve **34** is closed. The valve **26** is in the position at this time to allow flow to the gauge **64**. The system is then checked for leaks at all the joints. In the absence of leaks, the service line valve **34** is opened about one-fourth turn and the length of the liquid line tubing **38** is measured and the liquid line pressure gauge **62** is read. From the chart shown in FIGURE 6, the bleeding cycle time for the calibrated orifice **74** is read from the column on the left opposite the graphical interesection of the liquid line tubing length and the pressure read on the gauge **62**. For example, if the liquid line tubing **38** has a length of 20 feet and the gauge **62** has a reading of 100 p.s.i. gauge, these two will intersect on the chart at the point **90**. Applying this point **90** to the time scale on the left edge of the chart, indicates a reading of **262** seconds. The valve **70** on the suction side of the service manifold **52** is opened at the same time a count is started on a stop-watch or a watch with a sweep second hand. When the determined time such as 262 sec. has elapsed, this valve **70** is then closed immediately. The proper charge in the system is thereby established. The liquid and suction line service valves **34** and **26** are then seated to their upper positions for the normal position for refrigeration operation.

If required, a condensate drain may then be installed for the evaporator unit **36**. The electrical service connections for the condensing unit are then made and the

apparatus checked for satisfactory operation. At the conclusion of this checking, the service manifold **52** and its connecting conduits **54** and **56** are removed from the gauge connections of the valves **34** and **26**, and these gauge connections are then closed by flare nuts. The installation is thus completed without the use of a vacuum pump, a vacuum gauge, a refrigerant bottle, a weighing scale or a charging restricter. The system requires no expensive expansion valves since a simple restricter may be used. No sight glasses are required to ascertain a liquid level. The system does not require purging with another gas such as nitrogen. The installation can be made in much less time than has been previously required. It is estimated that the installation can be made in less than one-fourth the time required to install what previously has been a standard system. The installation is so simple that when proper directions are followed, a trained refrigeration mechanic is not required.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

The method of installing and reducing the charge in a refrigerating system comprising a refrigerant evaporator and a separate refrigerant condensing unit charged with lubricant and an excess of refrigerant in which the condensing unit is sealed with valves connected to its outlet and inlet which includes connecting with tubing the inlet and outlet of the evaporator respectively with the valves connected to the outlet and inlet of the condensing unit, measuring the pressure within the condensing unit, measuring the length of the tubing connecting the inlet of the evaporator with the valve connected to the outlet of the condensing unit, connecting an orifice outlet of known size and characteristics to the refrigerating system, and bleeding the refrigerating system through said orifice outlet for a period of time dependent upon the measured pressure within the condensing unit and the measured length of the tubing connecting the inlet of the evaporator and the valve at the outlet of the condensing unit.

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