May 9, 1950 G. D. METZGER 2,506,806

MOISTURE INDICATOR

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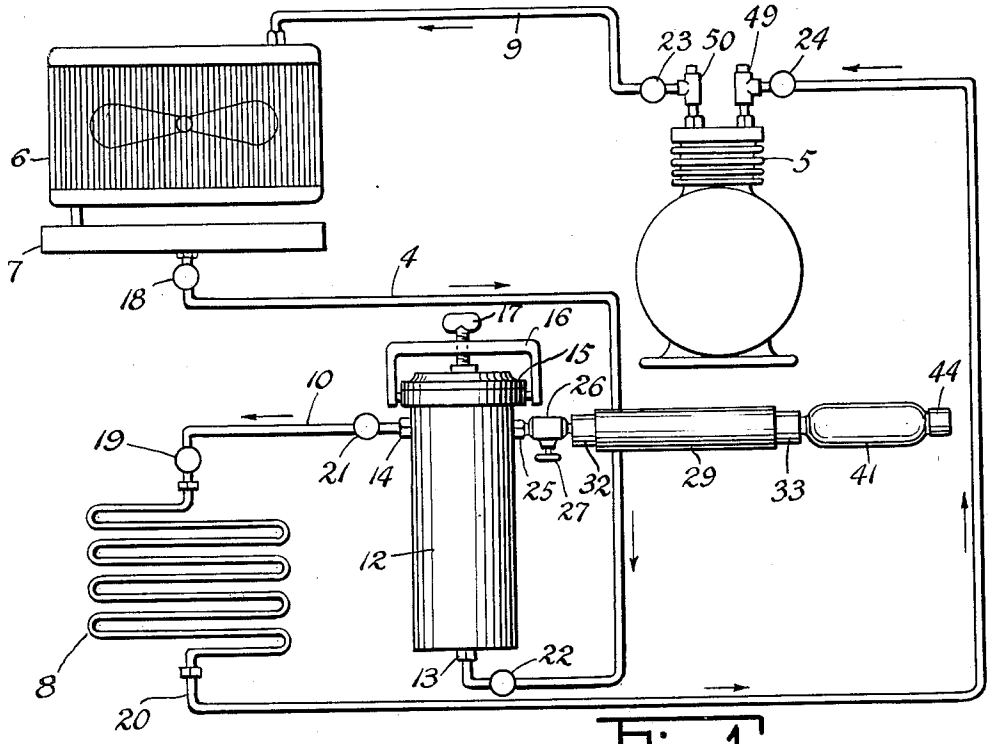


Fig. 1.

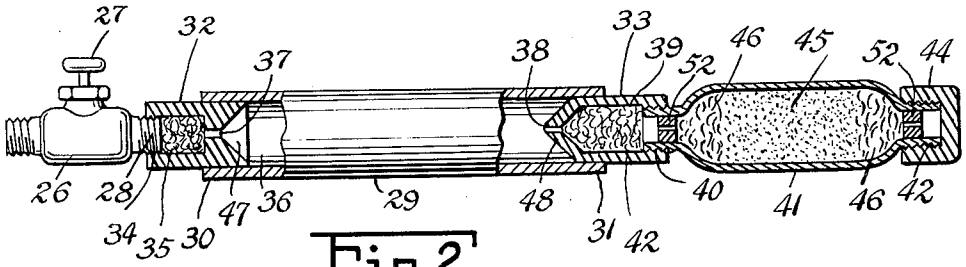


Fig. 2.

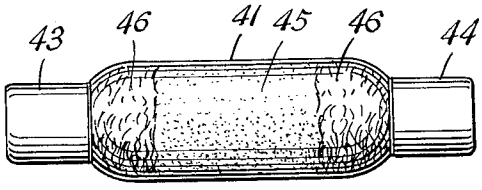


Fig. 3.

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MOISTURE INDICATOR

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13 Claims. (Cl. 62—115)

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This invention relates to a dew point and moisture indicating device adapted to determine the operating condition of mechanical refrigeration apparatus.

One of the objects of the invention is to greatly facilitate and expedite the determination of inefficiency and troublesome servicing problems occurring in mechanical refrigeration apparatus, caused by the presence of water or moisture in the refrigerant.

Another object is to provide an inexpensive, compact, and positive means quickly applicable to mechanical refrigeration apparatus, for determining the cause of faulty operation and inefficiency, whereby the apparatus may be restored to proper operating condition without substantial loss of time, and possible impairment of the quality of perishable goods depending upon refrigeration for its wholesomeness or salability.

A further object is to reduce to a minimum the cost of serving such equipment as is referred to above.

The foregoing and other objects are attained by the means described herein and illustrated upon the accompanying drawing, in which:

Fig. 1 is a diagrammatical view showing a conventional mechanical refrigeration apparatus incorporating the device of the invention.

Fig. 2 is an elevational view, partly broken away and showing in cross-section on an enlarged scale, the dew point and moisture indicating unit of the invention.

Fig. 3 is an enlarged elevational view of a cartridge constituting part of the invention.

It is a well known fact that the maintenance of refrigeration equipment is a troublesome undertaking, for the reason that faults or impairments of operation are often elusive, and will vary under different conditions and environments. At times, the inefficiency or failure of operation may be traced to purely mechanical or electrical maladjustment, or normal wear of parts, whereas on other occasions the trouble is basically chemical of nature. In the past, therefore, it was the practice of the mechanic or serviceman to check and adjust all suspected mechanical and electrical parts of the apparatus, in the hope of restoring it to operative condition without having to cope with the chemical phase involving the refrigerant, which heretofore required the use of elaborate testing equipment not generally understood by the serviceman. As the result of such practices, many refrigeration systems were left in worse mechanical condition

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by the serviceman, than it was prior to the servicing thereof.

By means of the device herein disclosed, the ordinary mechanic or serviceman is enabled to quickly, easily, and accurately check the refrigerant for chemical deficiencies which in many cases are attributable to the presence of water or moisture in the circulatory system. Water or moisture will sometimes occur in the system by reason of condensation processes, or possibly by reason of careless charging of the system with refrigerant. Irrespective of the manner of entry, however, water or moisture in the system may cause various operating deficiencies as it freezes in the expansion valve, or constricts the evaporator coil. It will often cause serious mechanical difficulties by combining chemically with the refrigerant to form a corrosive compound destructive of metal parts such as valves, fittings, coils and the like. From the foregoing, it will be understood that refrigeration apparatus servicing should by all means include tests for the presence of water or moisture in the refrigerant, if a lasting and efficient repair is to be effected. To make the proper servicing procedure feasible, and performable on the job, is one of the primary objectives of the present invention.

Referring to the accompanying drawing, Fig. 1 illustrates conventionally a refrigeration apparatus consisting of the compressor 5, condenser 6, receiver 7, evaporator 8, and the necessary pipe or tubing for connecting those elements in a closed system. The pipe 9 is the pressure line which carries refrigerant in the hot vapor state to the condenser 6, which in turn delivers refrigerant to the receiver 7. A pipe 4 leading from the receiver carries the liquid refrigerant to a dehydrator 12, the purpose of which is to remove water, moisture and other foreign substances from the system as the refrigerant circulates therein. The dehydrator ordinarily consists of a casing having a fitting 13 at which the refrigerant enters, and an outlet as at 14 to deliver refrigerant to the evaporator by means of pipe 10. Within the dehydrator is the usual drying material or desiccant, such as calcium chloride or kindred compounds. The desiccant is tightly sealed within the casing in any suitable manner, as by means of a cover 15 firmly held in place upon the upper open end of the casing. In the example illustrated the cover is held in place by a pivot yoke 16 and a cooperative clamping screw 17 which bears upon the top of the cover.

As is usual in refrigeration systems, the re-

frigerant under pressure passes through condenser 6 and receiver 7, from which latter it is forced through the dehydrator by way of pipe 4, and leaves through pipe 10. Pipe 10 leads the refrigerant to an expansion valve 19 which directs the refrigerant in vapor form into the coil or evaporator 8. The vapor upon leaving the coil or condenser, flows through the pipe 20, which is sometimes referred to as the suction line, and is carried thereby to the compressor 5. The cycle above referred to is repeated as the vapor is placed under pressure by the compressor, and discharged into pipe 9 as a superheated vapor. The characters 21, 22, 23, 18 and 24 indicate simply a series of shut-off valves or cocks generally incorporated in the system to prevent loss of refrigerant as any component parts of the refrigeration apparatus undergo repair or dismantling. Such valves or cocks may be interposed in the system at any desirable locations.

As the refrigeration apparatus operates, either continuously or intermittently, oil and water or moisture is trapped by the dehydrator 12 until such time as the desiccant within the dehydrator becomes overloaded, thereby making it necessary to renew the desiccant or drying substance. Heretofore it has been impossible to determine the degree of saturation of desiccant within the dehydrator, so that through carelessness or indifference on the part of the serviceman, or through leakage of the pipes or fittings, water or moisture found its way through the entire system, resulting in inefficiency of operation and, in some instances, serious injury to the component parts of the apparatus. To overcome such an occurrence, the present invention proposes to connect into the circuit of the refrigerant at some suitable location, a dew point and moisture indicator which may be depended upon to visually indicate the presence or absence of water or moisture in the system. While it is possible to connect the dew point and moisture indicator into the circuit at various other locations, there is indicated upon the drawing by way of example, a connection made with the casing of the dehydrator 12. Thus, the casing of the dehydrator is furnished with a fitting 25, preferably near the discharge end of the dehydrator, and through which may be exhausted a small quantity of refrigerant subsequent to its having passed through the desiccant of the dehydrator casing. The system may include a plurality of dehydrators such as 12, at which the tests may be made.

The fitting 25 is furnished with a small orifice valve 26, which may be in the form of a needle valve or other flow controlling element. The valve may have a suitable shut-off handle or actuator 27 adapted for manipulation to permit the escape of refrigerant. The outer end 28 of the valve 26 may be threaded as illustrated upon Fig. 2, so that it may be coupled to a member 29 referred to as an indicator cartridge holder or connector, this element being in the form of a hollow body or tube serving as an expansion chamber and as a trap for lubricating oil released through valve 26. The tube has its opposite ends 30 and 31 fitted with plugs or couplings 32 and 33, respectively. Coupling 32 is bored and internally threaded at the location 34, to receive the threaded end 28 of the valve, and within the bore is located also a filter or pad 35 to absorb any lubricating oil passing from the system through the valve. Vapor passing the filter 35 enters the expansion chamber 36 through an axial bore 37 which is flared as at 47 for a purpose to be explained. As the vapor fills the expansion chamber, it drops therein any remaining oil or oil-water vapor, and continues through a small orifice 38 in the conical end 48 of the coupling or plug 33. This orifice 38 leads to an enlarged bore 39 of part 33, which is internally threaded to receive the externally threaded end 49 of the dew point and moisture indicating cartridge 41. A filter or oil absorber pad 42 may be fitted within the bore 39, as shown.

It may here be observed that plugs or couplings 32 and 33 are fixed relative to the ends of holder 29 in any suitable manner. The flare or concavity 47 of plug 32 serves to aid in dispersing incoming gas throughout chamber 36, and in addition, it ensures complete drainage of any oil or moisture from the chamber when the holder is detached from valve 26 and stood on end subsequently to a test period. As to the other plug 33, it may be noted that the bore 38 in the conical end 48 is quite restricted in size, to avoid passage of any oil from chamber 36 to cartridge 41. The constricted bore 38, being formed at the apex of the cone, will be elevated above any reasonable amount of oil in the chamber, whether the holder is used in horizontal or upright position, so that flow of gas through bore 38 will not tend to carry over any oil into the indicator cartridge. Bore 37 preferably is not so constricted in size.

Initially, the dew point and moisture indicator cartridge 41 has its opposite threaded ends 40 and 41 closed by means of removable caps 43 and 44 (Fig. 3), which serve to exclude atmospheric moisture from the cartridge normally. The body of the cartridge preferably is formed of glass or other transparent material, and its interior is packed with a chemical indicator shown at 45. This chemical indicator is of a type which will change color, or otherwise visibly alter its normal characteristics, when subjected to moisture in the refrigerant or gas undergoing test. The chemical indicator may be confined between two wads of porous or permeable inert material such as cotton or the like, indicated at 46—46, and held in place by the bored retainers 52—52. As was previously pointed out, the opposite reduced ends of the cartridge 41 are threaded to enter either a cap such as 43, or an internally threaded plug or coupling such as 33.

To use the device of this invention initially, the serviceman will first apply the valve 26, being certain in advance that shut-off valves such as 22 and 21 are closed to avoid loss of refrigerant as the installation is effected. Thereafter, he may apply to valve 26 the holder assembly including the fixed plugs 32 and 33. Supplying himself with a number of indicator cartridges capped as illustrated by Fig. 3, the serviceman thereafter may apply one of these to the coupling 33 in order to test the system for water or moisture content. In conducting the test, the cap 44 of Fig. 1 will be removed, and valve 26 opened for a short period of time not exceeding two or three minutes, which will be sufficient to visibly alter the character or color of the chemical indicator within the cartridge 41, provided that moisture is present in the vapor released through valve 26. If no moisture is present, the indicator cartridge may be removed from coupling 33 and recapped, for use on another occasion. Should the chemical indicator reveal the presence of water or moisture in the refrigerant undergoing test, the serviceman will renew the desiccant or dehydrating material of the drying

apparatus 12, and take such additional action as may be necessary to restore the refrigeration system to proper operating condition. It should be understood that valve 26 may be permitted to remain in place upon the dehydrator, for use in conducting subsequent tests. This valve, of course, will normally be kept closed.

While in the accompanying drawing the dew point and moisture indicator is shown applied to the casing of dehydrator 12, it should be appreciated that it might be applied at any other location in the refrigerating system where refrigerant under pressure may be present. For example, it may be found convenient in some instances to apply the dew point and moisture indicator at the suction service plug 59, or at the service plug 58 in the high pressure side of the compressor. The herein disclosed dew point and moisture indicator will operate satisfactorily in either the horizontal position illustrated upon Fig. 1 of the drawing, or in a vertical position made possible by interposing an elbow pipe fitting between connector 25 and valve 26 in Fig. 1 of the drawing.

Various chemical indicators are available for charging the indicator cartridge 41, common examples of which are calcium chloride, phosphorous pentoxide, and kindred chemical compounds having mixed therewith water sensitive indicating substances which are visibly changeable when subjected to water-bearing refrigerant.

What is claimed is:

1. In combination, a refrigeration apparatus comprising a compressor, a condenser, an expansion valve, and an evaporator, and conduit means adapted to form a closed refrigerant circuit including the aforesaid constituents, a refrigerant releasing means interposed in said circuit including an expansion chamber body and a valve adapted to release a limited quantity of refrigerant from the circuit into the expansion chamber for vaporizing the refrigerant, and a replaceable water and moisture indicator removably attached to said expansion chamber body, said indicator being in the form of a transparent cartridge including a chemical visibly changeable as to at least one of its characteristics, when subjected to water-bearing refrigerant.

2. In combination, a refrigeration system dehydrator comprising a casing having a port for releasing to atmosphere a limited quantity of refrigerant, a moisture indicating cartridge, and a hollow cartridge holder interposed between the casing port and the cartridge, said holder including means for separating oil from the refrigerant in passing from the dehydrator casing to the moisture indicating cartridge.

3. In combination, a refrigeration system dehydrator comprising a casing having a port for releasing to atmosphere a limited quantity of refrigerant, a moisture indicating cartridge, and a hollow cartridge holder interposed between the casing port and the cartridge, said holder including means for separating oil from the refrigerant in passing from the dehydrator casing to the moisture indicating cartridge, the holder having opposite ends detachably connected to the casing and to the cartridge.

4. The combination which comprises, a dehydrator having a casing adapted for inclusion in the refrigerant circuit of a refrigeration system, said casing having a port for the release of refrigerant to be tested for the presence of moisture, valve means selectively operable for controlling the release of refrigerant through said port, a hollow transparent cartridge including means for visibly indicating the presence of moisture therein, a cartridge holder comprising a hollow elongated body constituting an expansion chamber, said body having opposite ends detachably associated with the valve means and with one end of the cartridge, and oil absorption means in the holder for precluding passage of oil from the valve means to the indicating cartridge.

5. The combination which comprises, a dehydrator having a casing adapted for inclusion in the refrigerant circuit of a refrigeration system, said casing having a port for the release of refrigerant to be tested for the presence of moisture, valve means selectively operable for controlling the release of refrigerant through said port, a hollow transparent cartridge including means for visibly indicating the presence of moisture therein, a cartridge holder comprising a hollow elongated body constituting an expansion chamber, said body having opposite ends detachably associated with the valve means and with one end of the cartridge, and oil trapping means between the dehydrator and the indicating cartridge.

6. An indicator for determining the moisture content of a refrigerant which comprises an elongated expansion chamber, said chamber having a restricted opening at one end for introducing refrigerant into said chamber, an indicator cartridge detachably attached to the other end of said expansion chamber, said cartridge having transparent walls, and a moisture responsive chemical in said cartridge, said chemical giving a visible change when subjected to moisture bearing refrigerant, a restricted opening communicating between the expansion chamber and the cartridge.

7. An indicator for determining the moisture content of a refrigerant which comprises an elongated expansion chamber, said chamber having a restricted opening at one end for introducing refrigerant into said chamber, an indicator cartridge detachably attached to the other end of said expansion chamber, said cartridge having transparent walls, a moisture responsive chemical in said cartridge, said chemical giving a visible change when subjected to moisture bearing refrigerant, a restricted opening communicated between the expansion chamber and the cartridge, and a pad of oil absorbent material disposed between the expansion chamber and the cartridge.

8. In combination with refrigeration apparatus including a compressor, a condenser, an expansion valve, an evaporator and conduits forming an enclosed refrigeration circuit, an elongated expansion chamber, means for releasing a limited quantity of refrigerant from the circuit into an end of the expansion chamber, said chamber having a restricted port at the opposite end thereof, and a replaceable indicator cartridge removably attached to said chamber in communication with said port, said cartridge having a transparent wall and containing a chemical visibly changeable when subjected to water-bearing refrigerant.

9. In combination with refrigeration apparatus including a compressor, a condenser, an expansion valve, an evaporator, and conduits forming a closed refrigeration circuit, an elongated expansion chamber, means for releasing a limited quantity of refrigerant from the circuit into an end of said expansion chamber, said expansion chamber having a restricted port at the opposite end thereof, a replaceable indicator cartridge re-

movably attached to said chamber in communication with said port, said cartridge having a transparent wall and containing a chemical visibly changeable when subjected to water-bearing refrigerant, and an oil absorbent pad between said cartridge and said chamber.

10. An indicator for determining the moisture content of a refrigerant which comprises an expansion chamber, said chamber having a restricted opening at one end for introducing refrigerant into said chamber, an outlet fixture having a conical head at the opposite end of said expansion chamber, the apex of said conical head extending into said expansion chamber, a restricted discharge opening extending through the apex of said conical head, an indicator cartridge detachably attached to said discharge fitting in communication with said discharge opening, and a moisture responsive chemical in said cartridge, said chemical giving a visible change when subjected to moisture bearing refrigerant.

11. An indicator for determining the moisture content of a refrigerant which comprises an expansion chamber, said chamber having a restricted opening at one end for introducing refrigerant into said chamber, an outlet fixture having a conical head at the opposite end of said expansion chamber, the apex of said conical head extending into said expansion chamber, a restricted discharge opening extending through the apex of said conical head, an indicator cartridge detachably attached to said discharge fitting in communication with said discharge opening, a moisture responsive chemical in said cartridge, said chemical giving a visible change when subjected to moisture bearing refrigerant, and a pad of oil absorbent material disposed in the fitting between the discharge opening and the indicating cartridge.

12. An indicator for determining the moisture content of a refrigerant which comprises an expansion chamber, said chamber having a restricted opening at one end for introducing refrigerant into said chamber, the opening for introducing refrigerant into the expansion chamber being provided with a conical nozzle, said nozzle expanding into the chamber to cause refrigerant to swirl in the chamber and throw oil carried by refrigerant entering the chamber against walls of the chamber, an outlet fixture having a conical head at the opposite end of said expansion chamber, the apex of said conical head extending into said expansion chamber, a restricted discharge opening extending through the apex of said conical head, an indicator cartridge detachably attached to said discharge fitting in communication with said discharge opening, and a moisture responsive chemical in said cartridge, said chemical giving a visible change when subjected to moisture bearing refrigerant.

13. An indicator for determining the moisture content of a refrigerant which comprises an expansion chamber, said chamber having a restricted opening at one end for introducing refrigerant into said chamber, the opening for introducing refrigerant into the expansion chamber being provided with a conical nozzle, said nozzle expanding into the chamber to cause refrigerant to swirl in the chamber and throw oil carried by refrigerant entering the chamber against walls of the chamber, an outlet fixture having a conical head at the opposite end of said expansion chamber, the apex of said conical head extending into said expansion chamber, a restricted discharge opening extending through the apex of said conical head, an indicator cartridge detachably attached to said discharge fitting in communication with said discharge opening, a moisture responsive chemical in said cartridge, said chemical giving a visible change when subjected to moisture bearing refrigerant, and a pad of oil absorbent material disposed in the fitting between the discharge opening and the indicator cartridge.

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