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PRESSURE PACKAGED REFRIGERANT LEAK DETECTOR AND METHOD OF PACKAGING SAME

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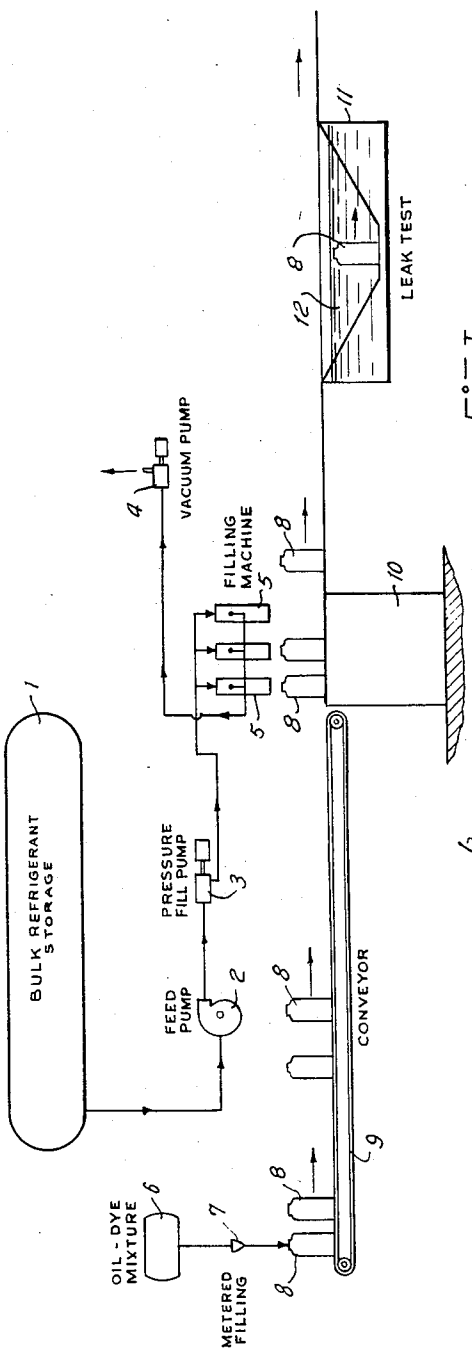


Fig. I

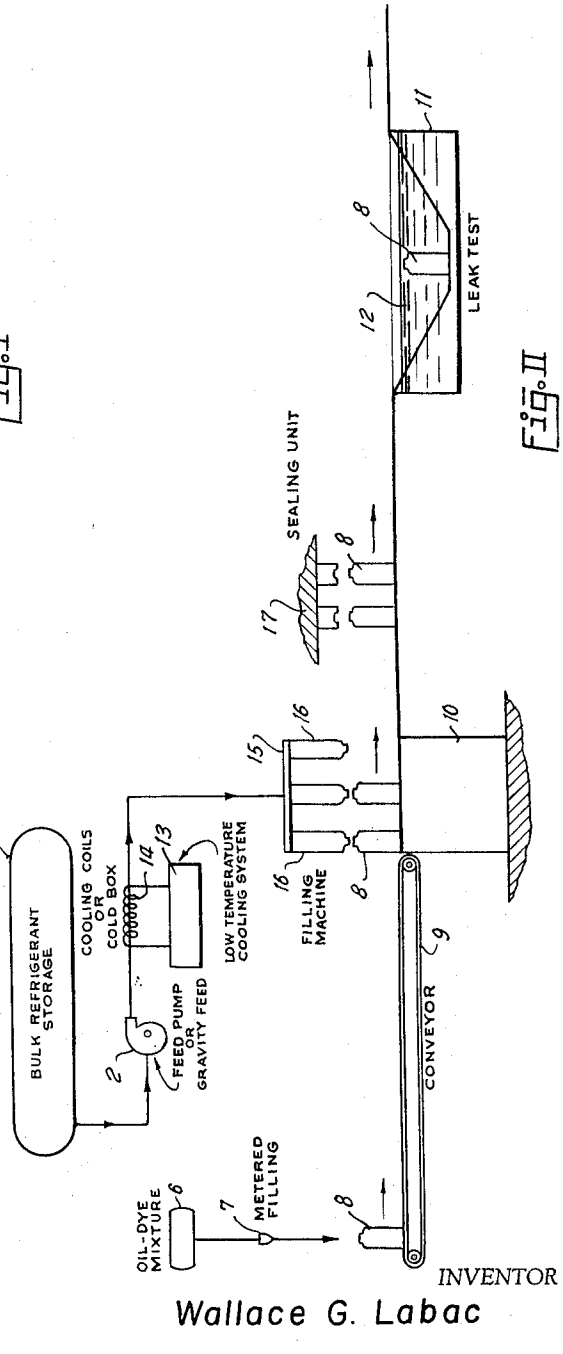


Fig. II

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PRESSURE PACKAGED REFRIGERANT LEAK DETECTOR AND METHOD OF PACKAGING SAME

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ABSTRACT OF THE DISCLOSURE

A leak detecting solution. The solution is packaged under pressure to provide a means to introduce the solution into a refrigerating system. The solution is composed of refrigerant, oil and dye, which constituents remain soluble and stable at temperatures encountered in such a refrigerating system.

This invention is concerned with a pressure packaged refrigerant leak detector and solution for detecting leaks in an air conditioning system and a method of packaging said solution, and is particularly concerned with a pressure packaged refrigerant leak detector solution containing a dye which is deposited on the surface about the leak to visually indicate the location of the leak, and a method of mixing the dye with the refrigerant and compressor oil and packaging same, so that the dye is suspended in the refrigerant within the package, and is so injected into the refrigerant system, where it is carried through the system, and is emitted from any leak point in the system and deposited on the surface about the leak.

A compressor type air conditioner system is made up of a compressor to compress and liquify the refrigerant, an expansion valve to allow the refrigerant to expand into a gaseous state and a coil to cool the surrounding air resulting from the absorption of heat by the expanding refrigerant.

A refrigerated air conditioning system is a closed circuit consisting of the compressor, expansion valve and coil. The refrigerant is passed through the system by being compressed to liquid form in the compressor, allowing same to expand into gaseous form through the expansion valve, where it absorbs heat, and passes through the coil where it cools the surrounding air by reason of absorption of heat therefrom.

A compressor used in an air conditioning system includes a cylinder, a piston, and a crankcase, and like an engine it requires oil for lubrication. However, since it is in a closed system and requires no exhaust to the air, the lubricating oil from the crankcase may go past the piston into the system and travel through the system with the refrigerant. It is customary practice and desirable to allow the compressor oil to circulate through the system with the refrigerant to provide proper lubrication throughout the system.

Therefore, the compressor oil may be utilized as a carrier for a dye dissolved therein, and the dye may be carried throughout the system suspended in the oil and refrigerant, and may pass through any leak opening in the system to be deposited as a residue on the surface about the hole, to give a visual indication of a leak.

It has been proposed in Williams Patent No. 1,915,965 to mix methyl violet, crystal violet, aucomine B, rhodamine B with mineral oil, which was used as lubricant for the compressor, and to inject the mineral oil with the dye indicated into the system with the refrigerant. The refrigerating apparatus was then painted with a paint containing titanium oxide, silica or other substance stainable by methyl violet base so that any leak which would occur

in the system would permit a small amount of the mineral oil in the methyl violet base to escape with the refrigerant and permanently stain the special paint at the place of leakage.

Such composition and method was unsatisfactory and unusable for several reasons including:

(1) The dyes indicated are not completely soluble in oil and decompose at a lower temperature of about 110° F.

(2) Mineral oil is not compatible for high temperature operation due to emulsification. An oil and dye used in a compressor type of refrigerating system must withstand heat ranges of up to and above 300° F. without decomposition and emulsification.

(3) The dyes indicated due to improper solubility, remain suspended and discrete from the proposed mixture and,

(4) The proposal to mix alcohol with the solution to obtain solubility of the dye before adding same to mineral oil still permitted emulsification because the heat encountered boiled off the alcohol, allowing decomposition to set in.

(5) Decomposition and emulsification of the dye in oils in a compressor type air conditioning system renders the system inoperative due to the clogging of expansion valves and coils.

In short, the composition and method proposed by Williams was unstable and not adaptable as a permanent type leak detector as proposed herein.

It is therefore a primary object of the invention to provide a mixture of refrigerant, compressor oil, and dye, which is packaged in the desired proportions under pressure so that it may be injected into the refrigerating system simultaneously and as a unit to become permanently integrated into the refrigerating system to provide a leak indicator solution within the refrigerating system.

Another object of the invention is to provide a packaged refrigerant, compressor oil, and leak indicator dye solution which is stable and remains in solution at and above temperatures encountered in an air conditioning system.

Another object of the invention is to provide a method of packaging a solution of refrigerant, an oil soluble dye dissolved in oil packaged under pressure so that it may be injected as a solution into the air conditioning system to become a permanent part of the air conditioning refrigerant-oil solution circulating through the system to provide a permanent visual leak detector medium as an integral part of the refrigerant-oil mixture in the system.

Other and further objects of the invention will become apparent upon reading the detailed specification hereinafter following and by referring to the drawing annexed hereto.

The drawing shows diagrammatically the equipment and arrangement of equipment for packaging the refrigerant leak detection solution.

In the drawing,

FIGURE I is a schematic drawing of the equipment and arrangement thereof employed in packaging the refrigerant-oil-dye mixture in liquid form under pressure;

FIGURE II is a schematic view of the equipment and the arrangement thereof for packaging the refrigerant-oil-dye mixture in semi-solid state while under refrigeration.

In referring to the drawings numeral references are employed to indicate the elements and parts thereof, and like numerals indicate like elements and parts throughout the various figures of the drawings.

Several types of refrigerants are employed in compressor type air conditioning systems. Such refrigerants usually consist of those which are generally classified as fluori-

nated hydrocarbons, such as fluoromethanes and fluoroethanes.

The types most commonly used are dichlorodifluoromethane (sold under the trademark of "Freon–12"); monochlorodifluoromethane (sold under the trademark of "Freon–22") and dichlorotetrafluoroethane (sold under the trademark of "Freon–114"). These refrigerants have a boiling point of from —42° F. to +70° F. and are maintained in a liquid state at a pressure of from 75 p.s.i. to 250 p.s.i., depending upon the grade. Therefore, it has been the custom to ship and package such refrigerants in pressure containers sufficient to maintain same in liquid state.

Compressor oil employed in air conditioning systems is a highly refined wax-free petroleum oil generally of the napththenic type falling within the API gravity range of 22.5–26.5 degrees API, with a viscosity of 40–60 Saybolt seconds, at 210° F. Thus, it is of relatively low viscosity. A typical oil is that which is known as "Texaco Capella Oils." This oil is highly stable and provides lubrication at all expected operating temperatures without emulsification. Such oil is compatible with the refrigerants mentioned above and is free from excess moisture.

Such oil is customarily placed in the compressor crankcase prior to charging the system with refrigerant and upon the system being charged with refrigerant, some of the oil will be circulated through the system with the refrigerant.

In providing the solution and practicing the method disclosed herein an oil soluble dye is provided.

The dye employed is an organic dye compound, typical of which are as follows:

(1) Methyl derivatives of azobenzene-4-azo-2-naphthol
(2) Phenyl-azo-2-naphthol and methyl derivatives of azobenzene-4-azo-2-naphthol
(3) Phenyl-azo-2-naphthol
(4) Para-diethylamino-azobenzene.

These dyes maintain their stability at temperature ranges of from —65° F. to above 300° F. which is well within the range of the temperatures normally encountered in an air conditioning system. They are completely soluble in oil of the type mentioned above without emulsification.

In carrying out the method of packaging the refrigerant, oil, dye solution under pressure reference will be made to the drawing annexed hereto.

In the drawing, numeral **1** indicates a bulk refrigerant storage container wherein the refrigerant of the type indicated above is stored under a pressure of from 75 p.s.i. to 250 p.s.i., depending on the type of refrigerant, to maintain the refrigerant in liquid state. The refrigerant is drawn from the container **1** by a feed pump **2** and is passed through a pressure fill-pump **3** to the filling machine, which includes filling heads **5** of conventional construction through which the refrigerant under pressure is injected into the pressure containers **8**.

A vacuum pump **4** is alternately operated to withdraw air from the containers **8** prior to filling in the manner which will be hereinafter described in connection with the operation of the apparatus.

Prior to filling the pressure containers **8** with refrigerant in the manner hereinafter described, a small quantity of oil of the type described above in which has been dissolved a small quantity of dye of the type described above is injected from the oil dye mixture container **6** through a metered filling valve **7** into the container **8**. At this point the oil-dye mixture is in liquid state at the bottom of the pressure container **8**.

The pressure container **8** is moved on a conveyor **9** where it is deposited on the rotating table **10**.

The head **5** is moved downwardly in timed sequence over the container **8**, a vacuum is drawn on the can **4** sufficient to remove the air therefrom but not sufficient to remove the oil-dye mixture from the container. With the container **8** evacuated, the pressure fill pump injects

refrigerant in liquid form into the container **8**, and the lid is sealed thereon to close the refrigerant and oil-dye mixture within the can at a pressure of about 175 p.s.i. Due to the fact that it is sealed under pressure, the refrigerant, oil and dye become mixed and integrated in the can.

The mixture may be injected into a refrigerating system through a suitable fitting as is customary in the art, and when injected, the refrigerant, oil and dye mixture is mixed with the lubricating oil and refrigerant in the system so that the integrated solution is carried throughout the system. When a leak occurs, the mixture will force its way through the opening causing the leak and the oil dye mixture is deposited on the surface thereof, to indicate visually the position of the leak.

Preferably the proportion of refrigerant to oil-dye mixture injected into the pressure can **8** is in the ratio of 12 oz. of refrigerant to 3 oz. of oil-dye mixture. Enough of the dye is dissolved in the oil placed in the container **8** to color the refrigerant-oil mixture in the air conditioning system sufficiently to give visual indication of a leak when the oil-dye mixture is deposited on the surface about the leak.

In the mixture indicated above the dye would be in the order of four percent of the mixture. A considerable range of proportions of refrigerant, oil and dye may be provided in the mixture and still accomplish the desired results. For instance the range may be as follows:

	Percent
Refrigerant	50–99
Oil	1–50
Dye	.01–10

A typical mixture might be as follows:

	Percent
Refrigerant	76
Oil	20
Dye	4

An alternate method of packaging the refrigerant, oil, dye mixture is shown in FIGURE II wherein the refrigerant is passed through a low temperature cooling system **13** including a cooling coil **14** where it is cooled to a suitable temperature (depending upon the grade of refrigerant) sufficient to cause it to maintain a liquid state at atmospheric pressure for a temporary period. The liquid may be flowed by gravity through the filling nozzle **16** of the filling machine **15** into the pressure cans **8** and the cans are sealed under pressure, as indicated above, by a sealing unit **17**, which places caps thereon. The oil-dye mixture is placed in the cans **8** from the container **6** in the manner described above prior to being passed on the conveyor **9** to the filling machine **10**. The expansion of the chilled refrigerant in the can **8** will cause the mixture of the oil-dye solution and the refrigerant to provide a product substantially the same as that described with reference to FIGURE I.

In both methods the filled and sealed containers **8** are passed through a test tank **11** where they are immersed in a liquid to detect leaks, if any.

It may be desirable in some instances to mix the dye with the refrigerant prior to placing it in the containers **8** and sealing it under pressure as described above; in such event the dye in the refrigerant would mix with the oil in the compressor crankcase and be circulated through the system.

Thus, there is provided a packaged leak detector mixture which is injected with the refrigerant into the refrigerating system, which may be injected simultaneously with the refrigerant, and there is provided a stable solution of leak detector which remains stable and does not emulsify or decompose at temperatures within the expected range encountered in an air conditioning refrigerating system.

Having described my invention I claim:

1. A packaged leak detector solution for an air-con-

ditioning system consisting essentially of a pressure can and a mixture of 5 to 99% fluorinated hydrocarbon refrigerant, 1 to 50% of a highly refined refrigerant compressor oil comprising a substantially wax-free petroleum oil having a viscosity of 40 to 60 at 210° F., and a color-effective quantity of oil-soluble dye sealed under pressure in said can, said dye being an azo dye which is stable over the temperature range from −65° F. to 300° F., and which remains soluble in the said oil without emulsification.

2. A packaged leak detector solution for an air-conditioning system consisting essentially of a pressure can, and a mixture of fluorinated hydrocarbon refrigerant, highly refined refrigerant compression oil and .01 to 10% of an oil-soluble dye sealed under pressure in said cam, said dye being an azo dye which is stable over the temperature range from −65° F. to 300° F., and which remains soluble in the said oil without emulsification, said oil being a highly-refined, wax-free petroleum oil of the naphthenic type within the API gravity range of 22.5 to 26.5 degrees API, and with a viscosity of from about 40 to about 60 Saybolt seconds at 210° F.

3. A packaged leak detector solution for an air-conditioning system consisting essentially of a pressure can, and a mixture of fluorinated hydrocarbon refrigerant, oil, and oil-soluble azo dye dissolved in said oil and stable over a temperature range from −65° F. to 300° F., without emulsification, sealed under pressure in said can, said oil being a naphthenic oil having an API gravity in the range of 22.5 to 26.5 degrees API, and a viscosity of from about 40 to 60 Saybolt seconds at 210° F., the range

of proportion of refrigerant, oil and dye being as follows:

	Percent
Refrigerant	5–99
Oil	1–50
Dye	.01–10

4. The packaged leak detector solution of claim **3** wherein said dye is azobenzene-4.

5. The packaged leak detector solution of claim **3** wherein said dye is azo-2-naphthol.

6. The packaged leak detector solution of claim **3** wherein said dye is phenyl-azo-2-naphthol.

7. The packaged leak detector solution of claim **3** wherein said dye is a methyl derivative of azobenzene-4-azo-2-naphthol.

8. The packaged leak detector solution of claim **3** wherein said dye is para-diethylamine-azobenzene.

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