

[54] **PRESSURIZED REFRIGERANT FEED WITH RECIRCULATION**
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[73] Assignee: **Frick Company, Waynesboro, Pa.**
[22] Filed: **Jan. 3, 1973**
[21] Appl. No.: **320,794**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 71,487, Sept. 11, 1970, Pat. No. 3,643,460, and a continuation-in-part of Ser. No. 186,750, Oct. 5, 1971, abandoned.
[52] U.S. Cl. **62/174, 62/218, 62/512**
[51] Int. Cl. **F25b 41/00**
[58] Field of Search **62/174, 218, 512**

References Cited

UNITED STATES PATENTS

2,590,741 3/1952 Watkins 62/174

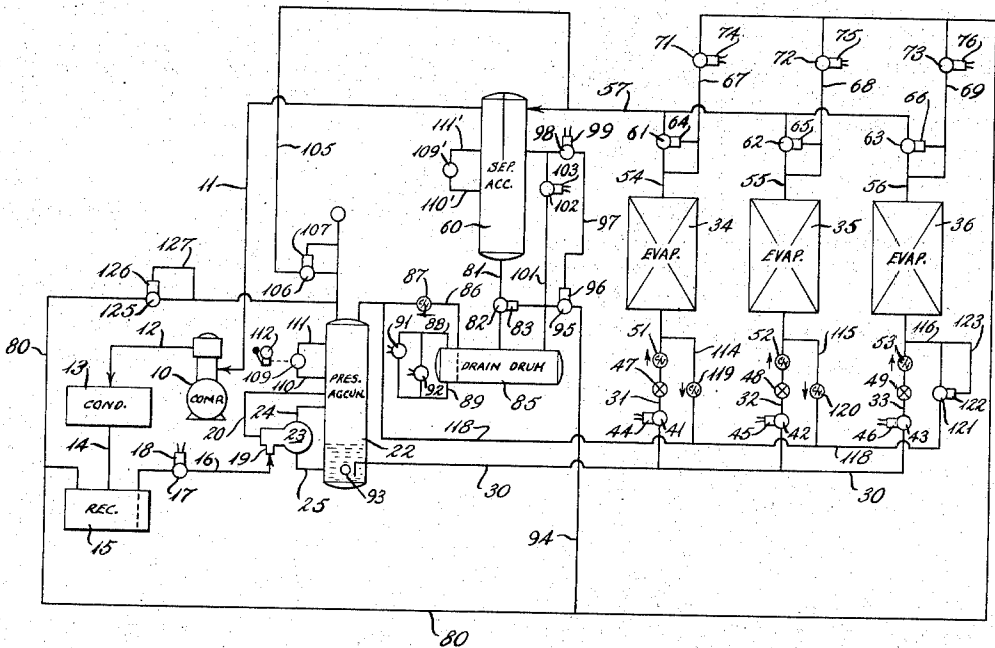
2,952,137 9/1960 Watkins 62/174
2,978,877 4/1961 Long 62/174
3,164,973 1/1965 Watkins 62/174

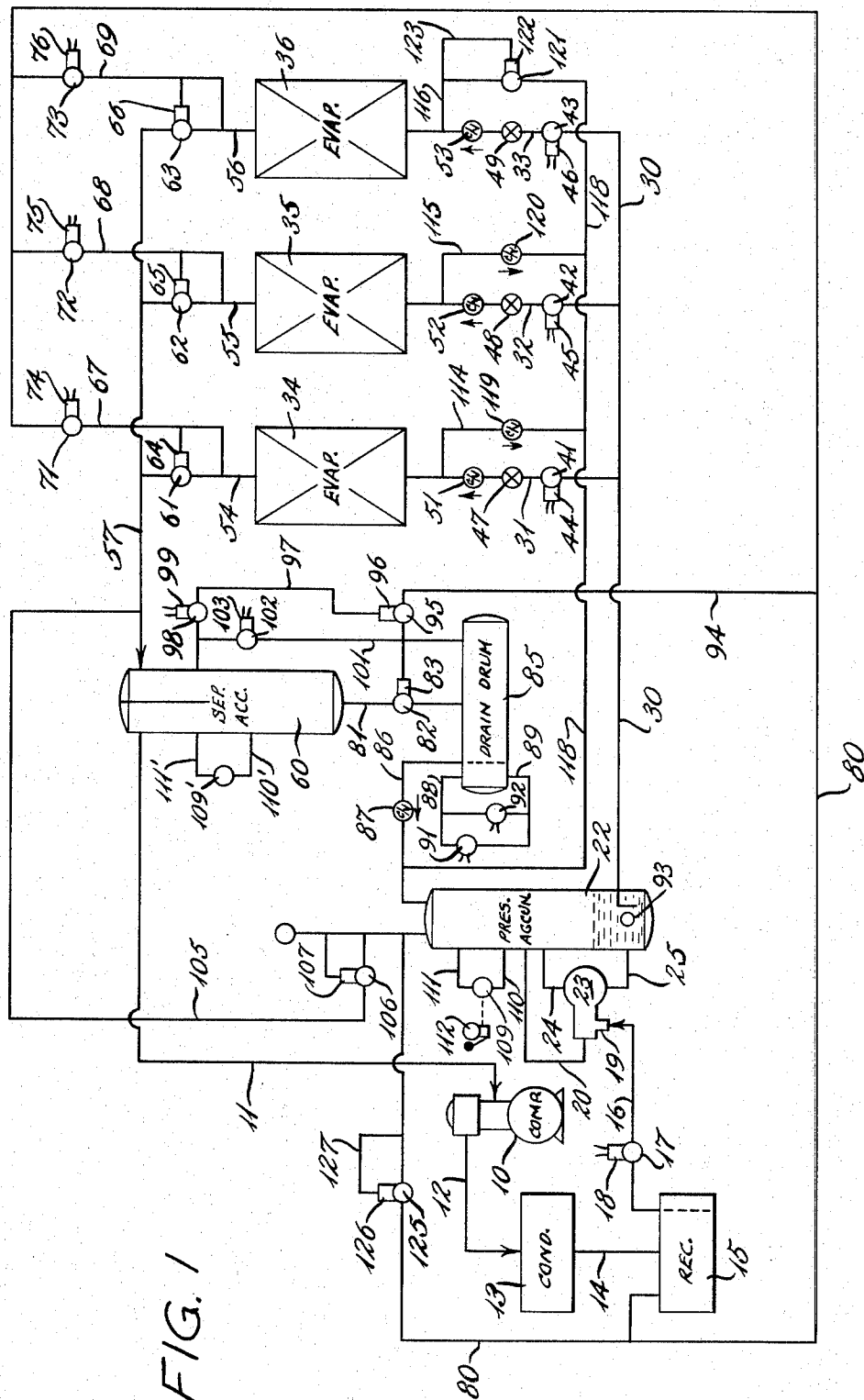
Primary Examiner—Meyer Perlin
Attorney, Agent, or Firm—A. Yates Dowell, Jr.

[57] **ABSTRACT**

A pressure accumulator receives liquid refrigerant from the receiver and supplies it to the evaporators. Liquid from the evaporators is temporarily stored in an upper accumulator from which it may drain to a drum which can be pressurized to return it to the pressure accumulator. A gaseous refrigerant connection from the receiver supplies pressure for the accumulator and for defrosting the evaporators, the arrangement eliminating the need for individual back pressure valves for each evaporator or group of evaporators during defrosting.

7 Claims, 2 Drawing Figures





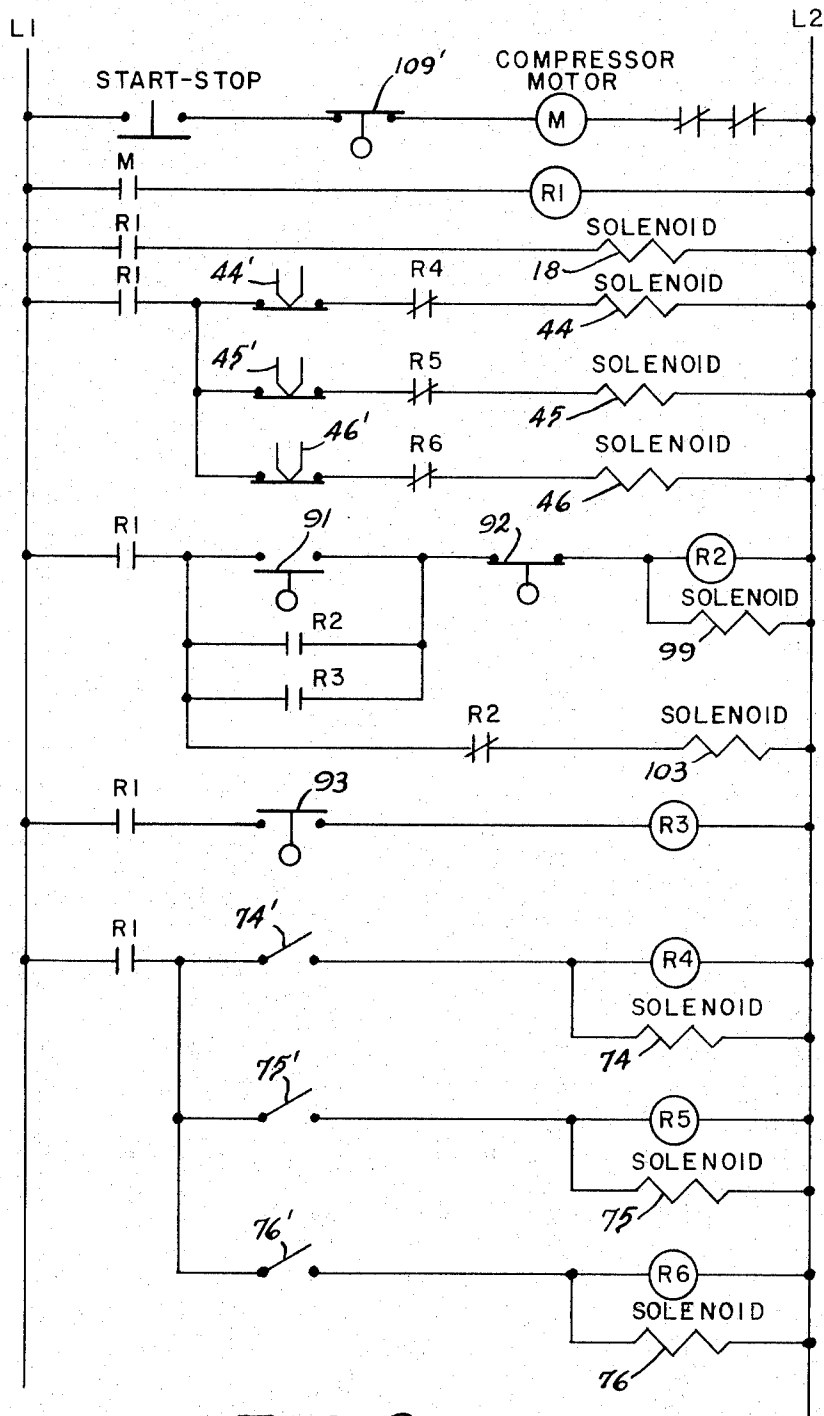


FIG. 2

PRESSURIZED REFRIGERANT FEED WITH RECIRCULATION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of applications Ser. No. 71,487 filed Sept. 11, 1970 entitled "Gravity Refrigerant Recirculation," now U.S. Pat. No. 3,643,460, and Ser. No. 186,750 filed Oct. 5, 1971 entitled "Pressurized Refrigerant Feed with Recirculation," now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to refrigeration and more particularly to the circulation of refrigerant in a system in which a pressure accumulator is maintained at a predetermined level of pressure to insure liquid supply to all evaporators and means is provided for returning the refrigerant from the evaporators to the pressure accumulator during defrosting.

2. Description of the Prior Art

In a flooded evaporator refrigeration system an excess of refrigerant is present in the system in order that varying loads may be met. The handling of the excess refrigerant has been done in various ways, including that disclosed in my prior patent referred to above and in patents to which reference is made in it, and in additional patents including Watkins U.S. Pat. Nos. 2,952,137; 3,164,973; and Long U.S. Pat. No. 2,978,877. Various of these disclose means of applying pressure to move refrigerant through the system including for defrosting.

SUMMARY OF THE INVENTION

The present invention is embodied in a refrigeration system having a pressurized accumulator which receives liquid refrigerant from the receiver and in which the pressure is maintained at a predetermined level. The pressure may be raised as required by gaseous refrigerant, preferably from the receiver. From the evaporators refrigerant is returned to a separator accumulator, liquid from it draining to a drum from which it may be expelled from time to time to the pressure accumulator. Defrosting by hot gas or other means is provided, refrigerant from the evaporators being returnable to the pressure accumulator, means being provided for regulating the back pressure at the evaporators during defrosting.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic of a preferred embodiment of the invention.

FIG. 2 is a schematic wiring diagram of the electrical control circuit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With further reference to the drawing, the refrigeration system illustrated includes a compressor 10 with suction line 11 and discharge line 12, and condenser 13 connected by line 14 to receiver 15. From the receiver liquid refrigerant passes by line 16 through valve 17 controlled by solenoid 18 which is normally energized and open when the compressor is operated.

Line 16 is connected through float control valve 19 to line 20 to pressure accumulator 22.

The pressure in the pressure accumulator is maintained at a predetermined level, as will be hereinafter described, to insure adequate supply of liquid to all evaporators. The float valve 19 is controlled by the operation of the float 23 which is connected by upper and lower lines 24, 25 to the pressure accumulator.

Liquid refrigerant under the pressure provided in the pressure accumulator is transported by the line 30 and branch lines 31, 32 and 33 to the three evaporators 34, 35 and 36, respectively. While three evaporators are described, this is merely for purpose of illustration as any appropriate number may be used.

The branch lines have valves 41, 42 and 43, respectively, operated by the solenoids 44, 45 and 46 which are controlled by thermostats 44', 45' and 46', respectively. On the downstream side of the valves 41, 42 and 43, respectively, are the hand throttling valves 47, 48 and 49, respectively. Downstream of the three last mentioned valves are one-way check valves 51, 52 and 53, respectively.

The evaporators are provided with return branch lines 54, 55 and 56, respectively, connected to main suction line 57 to the separator accumulator 60. The upper portion of the separator accumulator is connected to the compressor by line 11.

The branch lines just mentioned have normally open valves 61, 62 and 63, respectively, which may be closed by pressure responsive means 64, 65 and 66, respectively, which are connected to the gaseous refrigerant lines 67, 68 and 69, respectively, forming part of the defrosting system which will be described later.

Flow through the last mentioned lines is controlled by normally closed valves 71, 72 and 73, respectively, which are in turn controlled by solenoids 74, 75 and 76, respectively, operated by switches 74', 75' and 76', respectively. Lines 67, 68 and 69 are connected to refrigerant gas line 80 which is connected to the receiver 15. Connection to the receiver is preferred in order to insure that the refrigerant passing to the evaporators is free of oil.

Excess liquid refrigerant which is returned from the evaporators through main suction line 57 is separated from gaseous refrigerant by the separator accumulator 60, the gaseous refrigerant passing out through line 11 as mentioned above. Liquid refrigerant is drained from separator accumulator 60 through line 81 having the normally open valve 82 whose operation is controlled by pressure responsive means 83. Line 81 drains into drain drum 85, the lower portion of which is connected by conduit 86 having one-way check valve 87 into the pressure accumulator 22.

The drain drum is connected by lines 88 and 89 to upper and lower float switches 91, 92, respectively.

Refrigerant gas line 80 is connected by branch conduit 94 to pressure responsive means 83 through normally closed valve 95. Valve 95 is controlled by pressure responsive means 96, which is connected to line 97 through normally closed valve 98 to the upper portion of separator accumulator 60. Valve 98 is controlled by solenoid 99 which in turn is controlled by the upper and lower float switches 91 and 92 associated with drain drum 85. Conduit 101 connecting the upper portions of drain drum 85 and separator accumulator 60 is controlled by normally open valve 102 having solenoid 103 which is also controlled by the upper and

lower float switches 91 and 92 associated with the drain drum 85.

When the level of liquid in the drain drum 85 reaches the upper float switch 91, this deactivates solenoid 103, closing valve 102, and activating solenoid 99, opening valve 98. This permits gas from line 80 and branch 94 to act upon pressure responsive means 83, thereby closing valve 82 and pressurizing drain drum 85 through line 101. This drives accumulated liquid in the drum by conduit 86 and one-way valve 87 into the pressure accumulator 22.

When the liquid level in the drain drum is down to the float switch 92, this de-energizes solenoid 99, thereby closing valve 98, and energizes solenoid valve 103, opening valve 102, thus relieving the pressure in conduits 94 and 101 and permitting valve 82 to reopen.

Under certain conditions, such as a shortage of refrigerant in the system, it may be possible for the evaporators 34, 35 and 36 to substantially exhaust the refrigerant supply in the pressure accumulator 22 before the liquid level in the drain drum 85 is sufficient to permit the normal replenishment of refrigerant to the pressure accumulator. In order to prevent the depletion of refrigerant in the pressure accumulator, a float switch 93 is positioned slightly above the outlet conduit 30. When the refrigerant level in the pressure accumulator falls to a predetermined level, the float switch 93 closes a bypass circuit around the upper float switch 91 of the drain drum 85 to deactivate solenoid 103 and activate solenoid 99 so that the pressure responsive means 83 closes valve 82 to pressurize the drain drum 85. This causes the accumulated liquid in the drain drum to be discharged through conduit 86 and the one-way valve 87 into the pressure accumulator 22.

Pressure accumulator 22 is connected by venting line 105 to the suction line 57. Flow through line 105 is controlled by valve 106 which is governed by pressure sensing means 107 connected to the pressure accumulator.

Sensing switch 109 mounted at a high level in the pressure accumulator is connected thereto by means 110, 111 to sense liquid at a high level and may activate an alarm 112, if desired.

Similarly, sensing switch 109' is mounted at a high level in the separator accumulator 60 and is connected thereto by means 110', 111' to sense liquid at a high level and to shut down operation of the compressor if such level is reached in the separator accumulator.

FIG. 1 illustrates an arrangement for hot gas defrosting of the evaporators, although other sources such as electrical or water may be employed. The path of pressurizing and liquid return remains the same during defrosting from any heat source. The return lines from the evaporators 34, 35 and 36, respectively, are branches 114, 115 and 116, respectively, which are connected by conduit 118 to the upper portion of the pressure accumulator 22. Branch lines 114 and 115 have one-way check valves 119, 120, respectively, while branch line 116 is shown with a valve 121 which is controlled by pressure responsive means 122 and is responsive to upstream pressure in the line 116 by connection 123. The adjustment of the pressure is predetermined and preset at the defrosting temperature desired. Liquid refrigerant which passes through valve 121 enters conduit 118 and is returned to the pressure accumulator 22. A back pressure valve is ordinarily not necessary but may be

used in installations where the pressure in the pressure accumulator is so low as to delay defrosting.

For ordinary operation, it is contemplated that the return lines or branches 114, 115 and 116 may have only one-way check valves such as illustrated in branches 114 and 115. However, in a plant in which the design is such that the pressure in the pressure accumulator is less than that corresponding to 32° F. or slightly above 32° F., but at such a level as to delay defrosting, back pressure valves such as valve 121 would be installed in each of the branch lines 114, 115 and 116. The back pressure valves are adjusted for operation at any desired pressure in accordance with the defrosting temperature desired.

In order to maintain the necessary pressure in the pressure accumulator, the gas line 80 from the receiver is connected through valve 125 to the pressure accumulator, flow therethrough being controlled by pressure responsive means 126 which is connected by line 127 between the valve 125 and the pressure accumulator 22.

Accordingly, it will be understood that the system described provides for the storage and handling of excess liquid refrigerant in the system and for the application of defrosting procedures which under ordinary conditions do not require the necessity for individual back pressure valves at each evaporator or group of evaporators. The pressure in the pressure accumulator may be maintained at a desired level for supply of adequate liquid to the evaporators.

I claim:

1. A refrigeration system comprising means for supplying liquid refrigerant and for compressing and condensing refrigerant vapor, a pressure accumulator having a first inlet from the supplying means for liquid refrigerant, means to control the flow to said inlet in accordance with the level of liquid refrigerant in the pressure accumulator, a second inlet into said pressure accumulator, said second inlet connected to receive refrigerant vapor from the liquid supplying means, means to control the flow to said second inlet in accordance with the pressure in said pressure accumulator, evaporator means, means connecting said pressure accumulator to said evaporator means for supplying liquid refrigerant thereto, a separator accumulator, means connecting said evaporator means to said separator accumulator, said separator accumulator connected to the compressing means, a drain drum, a drain line from said separator accumulator to said drain drum, means for applying pressure to the refrigerant within said drain drum, means connecting the lower portion of said drain drum with said pressure accumulator, whereby liquid from said separator may flow to said drain drum and from said drain drum to said pressure accumulator.

2. The invention of claim 1 in which said means for increasing the pressure in said drain drum comprises means responsive to the level of liquid in said drain drum, means connecting a refrigerant vapor line from the liquid supplying means with said drain drum, said means controlled by the level within said drum.

3. The invention of claim 2 in which said means responsive to the level of liquid in said drain drum comprises upper and lower liquid level responsive switches, first pressure responsive valve means in said line from the lower portion of said upper accumulator to said drain drum, said pressure responsive valve means connected to said refrigerant vapor line, second pressure

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responsive valve means in said refrigerant vapor line, means connecting said pressure responsive valve means to the upper portion of said separator accumulator through valve control means, means connecting the upper portion of said drain drum to the upper portion of said separator accumulator through a second valve control means, said first and second valve control means being operable in response to said upper and lower level responsive switches.

4. The invention of claim 1 in which said means for applying pressure to the refrigerant within said drain drum includes switch means responsive to the liquid level in said pressure accumulator.

5. The invention of claim 1, and means for defrosting said evaporator means, comprising valve control means connecting a refrigerant vapor line from the liquid supplying means with the outlet of said evaporator means, valve means in the means connecting said evaporator means to said separator accumulator, said valve means being normally open and connected to said refrigerant vapor line, whereby said valve means is closed when the refrigerant vapor line is open, and one-way flow means connecting the inlet of said evaporator means to said pressure accumulator, whereby refrigerant in said evaporator means may be returned to said pressure ac-

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cumulator during defrosting.

6. The invention of claim 3 in which means is provided in the connecting means from the inlet of the evaporator means to the pressure accumulator for regulating the pressure in the evaporator during defrosting.

7. A refrigeration system comprising means for supplying liquid refrigerant and for compressing and condensing refrigerant vapor, a pressure accumulator having an inlet from the supplying means, means to regulate the pressure within the pressure accumulator, evaporator means, means connecting the pressure accumulator to the evaporator means, a separator accumulator, means connecting the evaporator means to the separator accumulator, suction line means connecting the separator accumulator to the compressing means, a drain drum, a first drain line connecting the separator accumulator to said drain drum, a second drain line connecting said drain drum to the pressure accumulator, a heat source, means connecting the heat source to the evaporator means for defrosting the same, and one-way means connecting the evaporator means to the pressure accumulator for returning refrigerant thereto during defrosting.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,797,265 Dated March 19, 1974

Inventor(s) Milton W. Garland

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

First page, name of inventor shown as "Milton E. Garland" should read -- Milton W. Garland --

Signed and sealed this 30th day of July 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents