Aug. 23, 1955 R. W. WILSON 2,715,992

COMPRESSOR UNLOADER

Filed June 26, 1951

FIG. 2

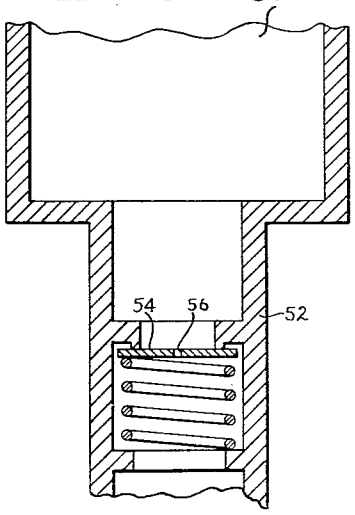
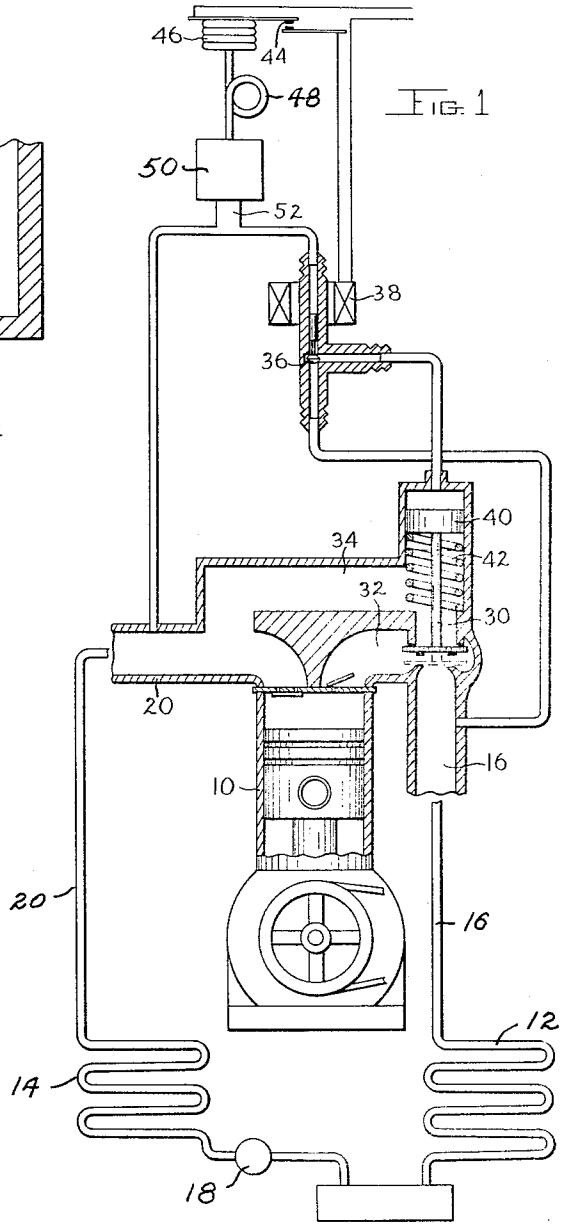


FIG. 1



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COMPRESSOR UNLOADER

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4 Claims. (Cl. 230—31)

This invention relates to a compressor unloader and more particularly to an unloader of the type in which a refrigerant bypass valve is provided for unloading one or more of the compressor cylinders when the suction pressure falls below a predetermined value.

It is now common practice in the refrigerant industry to provide one or more bypass valves directly in the cylinder head of a multiple cylinder compressor which serve to unload the compressor not only for starting purposes but also for unloading one or more of the cylinders when the capacity of the compressor exceeds the demand. A solenoid valve controlled by a switch which responds to the suction pressure is then used for operating the bypass valve. The difficulty with a control of this type is that when the bypass valve moves from one position to the other, it momentarily permits some high side refrigerant to escape to the low side of the compressor so as to momentarily build up the low side pressure to a point where it causes the pressure responsive unloader to re-close the bypass valve. This then results in a hunting action which is very objectionable. It is an object of this invention to provide an arrangement whereby the momentary inrush of high pressure gas into the suction line will not cause the unloader to reload the compressor.

Other objects and advantages reside in the construction of parts, the combination thereof and the mode of operation, as will become more apparent from the following description.

In the drawing:

Figure 1 is a fragmentary sectional elevational view diagrammatically showing my control applied to a compressor; and

Figure 2 is a sectional view somewhat diagrammatic showing the construction of the check valve which is provided in the refrigerant line leading to the pressure operated unloader control switch.

For purposes of illustrating my invention, it has been shown applied to a refrigerating system, whereas it could also be applied to air compressor systems and the like.

Referring now to the drawing wherein there is shown a preferred embodiment of my invention, reference numeral **10** is intended to designate one cylinder of a conventional multiple cylinder compressor provided with an unloader control embodying my invention. Reference numerals **12** and **14** designate the condenser and evaporator respectively of a refrigeration system. The compressed refrigerant normally leaves the compressor through the high pressure refrigerant line **16** which conveys the compressed refrigerant gas to the condenser **12** wherein the refrigerant is condensed. The condensed refrigerant then flows through a suitable pressure reducing device **18** into the evaporator **14** where the refrigerant vaporizes before returning to the suction side of the compressor through the low pressure suction line **20**.

In air conditioning installations, for example, it is

desirable to modulate the output of the compressor, so as to prevent the suction pressure from going below the point where the evaporator would operate at temperatures low enough to freeze the condensate. This may be done by unloading one or more of the cylinders of the compressor.

In the system shown in the drawing, an unloader valve **30** has been provided for selectively connecting the outlet **32** of the compressor either to the high pressure refrigerant line **16** or to the bypass **34** which connects to the low pressure suction line **20**, as shown. When the valve **30** is in the position in which it is shown in Figure 1 of the drawing, all of the compressed refrigerant is required to flow into the relatively high pressure line **16** wherein the pressure may, for example, be in the neighborhood of 120 lbs. per square inch. When the valve **30** moves from the solid line position into its dotted line position, the compressed refrigerant leaving the outlet **32** is directed to the compressor inlet or low pressure side of the system through the bypass **34**, with the result that the effectiveness of the cylinder to which the bypass is attached is destroyed.

The unloader valve **30** is connected to the piston **40**, the operation of which is controlled by the two-way valve **36**, which in turn is controlled by the solenoid **38**. When the two-way valve **36** is in the position in which it is shown, the upper end of the piston **40** is subjected to the low side pressure and will move to the closed position under the influence of the spring **42**, since the pressure of the refrigerant will be the same on both sides of the piston **40**. When the valve **36** is lifted by the solenoid **38**, the upper end of the piston **40** will be connected to the high side pressure and will be forced downwardly so as to open the bypass and close off the flow of compressed refrigerant into the line **16**.

The solenoid **38** is controlled by the switch **44**, which in turn is controlled by the pressure operated bellows **46** arranged as shown. The bellows **46** is normally subjected to a pressure corresponding to the pressure in the suction line through the capillary tube **48**, the accumulator chamber **50**, and the check valve **52**. Except for the check valve **52** and the accumulator **50**, the system as thus far described represent the unloaders as now used in the industry.

It has been found that as the unloader valve **30** moves to the unloading position, gas in the line **16**, which at times may be at a pressure considerably in excess of 100 lbs. per square inch, tends to rush past the unloader valve through the bypass **34** and to the suction line **20**, thereby giving a false indication that the suction line pressure is considerably in excess of that at which the compressor should be unloaded. In the prior unloader control systems which do not have the check valve **52** and the accumulator **50**, this would cause the switch **44** to operate the unloader valve to momentarily re-close and thereby produce a hunting action. By adding the check valve **52** and the accumulator **50**, any momentary increase in the suction line pressure will be ineffective to re-close the unloader valve. It will be noted that the check valve **52** includes a conventional check valve disc or plate **54** in which there is provided a small leak port or restricted passage **56** which permits a prolonged difference in pressure to become equalized. However, any sudden decrease in the suction pressure will immediately be transmitted to the bellows **46**, as the check valve disc or plate **54** is free to open in the event of any such sudden decrease.

The check valve **56** also makes it possible for any oil trapped above the check valve plate **54** to freely flow down past the valve in response to reduction in the suction pressure. The accumulator chamber **50**, in

conjunction with the restricted passage **56**, serves to prevent re-closing of the unloader valve in response to the momentary inrush of high pressure gas from the line **16** to the suction side of the compressor but does not prevent the switch from responding to prolonged high suction pressures or to momentary reductions in the suction pressure below the pressure at which the switch is set to operate.

In a conventional air conditioning installation, the switch would be set to close the circuit to the solenoid **38** when the suction pressure drops below 28 lbs. per square inch, so as to unload the compressor and thereby prevent the frosting of the evaporator.

The unloader control shown herein could also be used with single cylinder compressors wherein it is desired to operate the compressor continuously and to control the operation of the system by unloading the compressor rather than by starting and stopping the compressor.

The control system shown herein would normally be built into refrigeration systems when first manufactured, but for those systems now in the field one would merely add the check valve and accumulator into the capillary line leading to the switch operating bellows **46**.

Although the preferred embodiment of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportion and arrangement of parts, the combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth, as disclosed and defined in the appended claims.

Having thus described my invention, I claim:

1. In combination with a compressor having a low pressure suction inlet and a relatively high pressure outlet, means forming a compressor unloading bypass between said inlet and said outlet, a valve for controlling the flow through said bypass and for shutting off the flow through said outlet, means for controlling the operation of said valve including a pressure responsive device, means for connecting said pressure responsive device to said suction inlet, a check valve in said last named means for checking the flow from said inlet to said pressure responsive device, and means forming a restricted passage at all times providing a passage between said compressor inlet and said pressure responsive device even when said check valve is closed.

2. In combination with a compressor having a low pressure suction inlet and a relatively high pressure outlet, means forming a bypass between said inlet and said outlet, a valve for controlling the flow through said bypass and for shutting off the flow through said outlet, means for controlling the operation of said valve including a pressure responsive device, means for connecting said pressure responsive device to said suction inlet, a check valve in said last named means for checking the flow from said inlet to said pressure responsive device, and means comprising a small passage provided in said check valve forming a restricted passage at all times connecting said suction line and said device.

3. In a control device adapted to be connected to the suction side of a compressor for regulating the unloading of the compressor in response to changes in the suction pressure, the combination, a pressure responsive control, conduit means connecting said pressure responsive control to the suction side of the compressor, a surge chamber intermediate the end of said conduit means, a check valve disposed between said surge chamber and the suction side of said compressor for checking the flow into said surge chamber, and means forming a leak port for bypassing said check valve.

4. In a control device adapted to be connected to the suction side of a compressor for regulating the unloading of the compressor in response to changes in the suction pressure, the combination, a pressure responsive control, conduit means connecting said pressure responsive control to the suction side of the compressor, a surge chamber intermediate the ends of said conduit means, a check valve disposed between said surge chamber and the suction side of said compressor for checking the flow into said surge chamber, and means forming a leak port for bypassing said check valve, said last named means comprising an aperture provided in said check valve whereby said control device is unaffected by momentary increases in suction pressure.

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