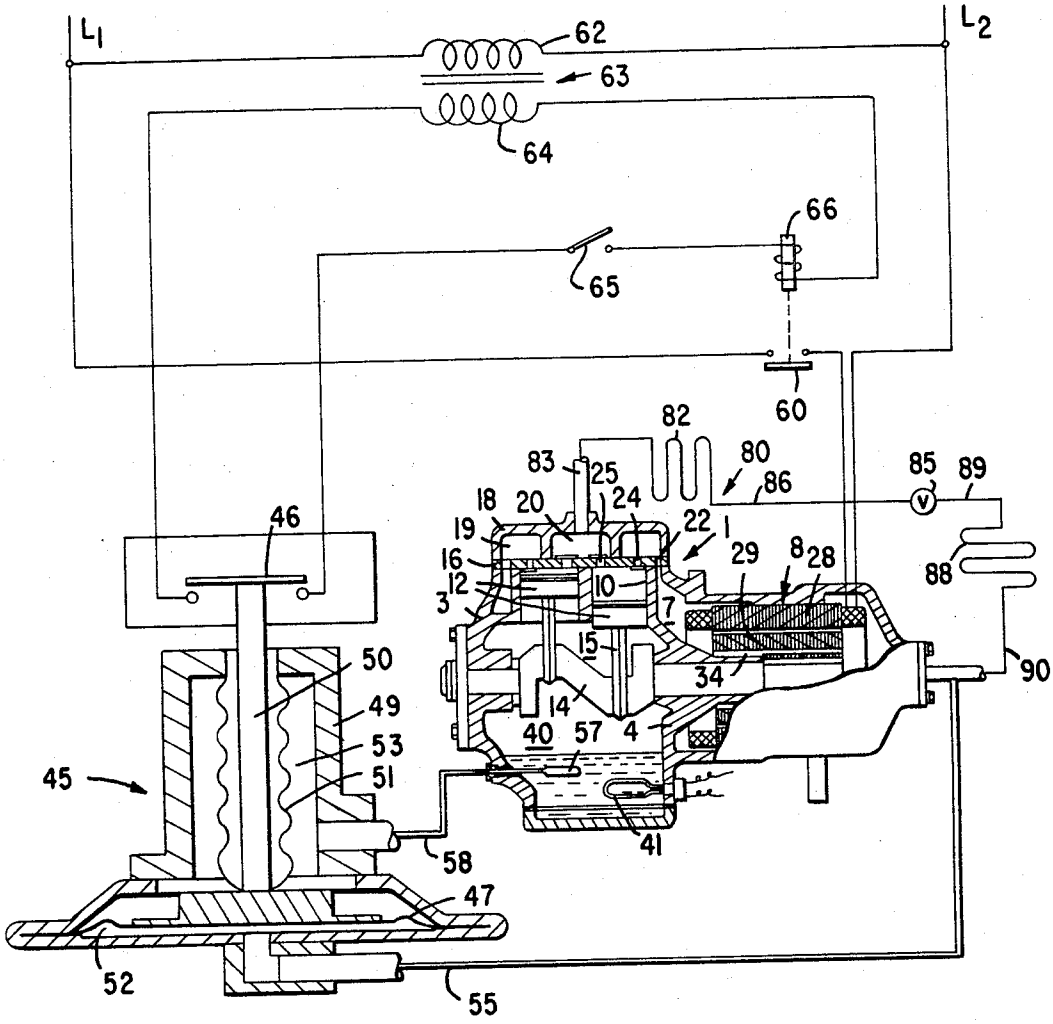
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COMPRESSOR PROTECTIVE CONTROL

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COMPRESSOR PROTECTIVE CONTROL

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ABSTRACT OF THE DISCLOSURE

Compressor protective control responsive to predetermined differential in pressure between gaseous pressure in the low side of the compressor and a pressure corresponding to lubricant temperature to shut down the compressor upon intake of liquid medium by the compressor and dilution of the compressor lubricant by the liquid medium.

This invention relates to compressors, and more particularly, to a protective device for compressors.

In hermetic type compressors, the compressor lubricant and the medium being compressed are in close proximity to one another, and in certain compressor types in face-to-face contact. Excess dilution of the lubricant through mixture with the medium being compressed impairs the effectiveness of the lubricant and can seriously damage or destroy the compressor. This problem is particularly acute where the compressor is used in a refrigeration system. There the marked affinity of the refrigerant for lubricant often results in substantial intermixture of the lubricant with the refrigerant when the compressor is shut down for a relatively long interval and on later start-up of the compressor there is almost total lack of lubrication.

In hermetic type compressors, the incoming suction gas is normally led through the motor compartment to cool the compressor motor and thence through the compressor suction valves to the cylinder or cylinders. Where the incoming refrigerant is partially or entirely liquid, the liquid can damage or break the compressor valves.

It is a principal object of the present invention to provide a new and improved protective control for compressors.

It is a further object of the present invention to provide a protective device for hermetic compressors which stops the compressor on the intake of liquid by the compressor.

It is an object of the present invention to provide a control effective to prevent operation of a compressor on dilution of the compressor lubricant by the fluid being compressed.

This invention relates to a compressor for use with gaseous medium with a sump for storing lubricant, comprising in combination, circuit means adapted when completed to energize the compressor; and means to protect the compressor against both intake of liquid medium and dilution of the compressor lubricant by the medium including a control switch adapted when actuated to interrupt the circuit means, a pressure responsive actuator for the switch adapted at a predetermined signal to actuate the switch and render the compressor inoperative, and means for generating signals in accordance with temperature conditions of the compressor lubricant adapted at a present lubricant temperature signalling intake of liquid medium by the compressor and dilution of the compressor lubricant by the medium to generate the predetermined signal.

Other objects will be apparent from the ensuing description and drawings in which the figure is a sectional view with parts broken away of a hermetic reciprocating compressor incorporating the control of the present invention.

Referring to the drawing, numeral **1** designates generally a reciprocating compressor of the hermetic type embodying the present invention. In the exemplary arrangement shown, compressor **1** forms an integral part of a closed refrigeration system **80** which includes a suitable condenser **82** connected to the discharge side of compressor **1** by line **83**; expansion means **85** connected to the outlet of condenser **82** by means of line **86** and adapted to expand the liquid refrigerant discharged from condenser **82**; and an evaporator **88** connected to the outlet of expansion means **85** by line **89**. The expanded liquid refrigerant fed to avaporator **88** by expansion means **85** is vaporized in evaporator **88** through heat exchange with the medium being cooled, the relatively low pressure gaseous refrigerant leaving evaporator **88** returning through line **90** to the compressor **1**.

Compressor **1** includes a cylinder block **3** and motor compartment **7** separated by partitioning member **4**. Cylinder block **3** has cylinder openings **10** therein within which pistons **12** are fitted. While plural cylinders and pistons are shown, it is understood that compressor **1** may be a one cylinder compressor. Crankshaft **14**, suitably journaled in cylinder block **3**, operatively interconnects motor rotor **29** of motor **8** through connecting rods **15** with pistons **12**.

A valve plate **16** tightly abuts cylinder block **3** opposite cylinders **10**. Cylinder head **18**, separated into suction and discharge manifolds **19**, **20** respectively, tightly abuts valve plate **16**. Openings **22** in valve plate **16** communicate motor compartment **7** with cylinder head suction manifold **19**. Valve plate **16** includes valve controlled suction and discharge ports **24**, **25** respectively, operatively communicating cylinders **10** with the cylinder head suction and discharge manifolds **19**, **20** respectively. Conduit **83** connects discharge manifold **20** with condenser **82**.

Motor **8** includes stator **28** and rotor **29**. Stator **28** is suitably fixed within motor compartment **7**.

Suction line **90** connects motor compartment **7** with evaporator **88** of refrigeration system **80**. Rotor **29** of motor **8** has passages **34** therethrough. During compressor operation, relatively low pressure gaseous refrigerant from line **90** flows through passages **34** and the space between motor stator **28** and rotor **29** and openings **22** into suction manifold **19**. Gas from suction manifold **19** passes through suction ports **24** in valve plate **16** into cylinders **10**. Relatively high pressure gas discharges through ports **25** in valve plate **16** into discharge manifold **20**.

The lower portion of cylinder block **3** forms a crankcase **40** within which lubricant is stored. A pump mechanism (not shown) forces lubricant drawn from the crankcase **40** into various points of frictional wear throughout the compressor including the crankshaft bearings. Return lubricant accumulates in the crankcase sump. A suitable heater **41** for heating the lubricant in sump **40** is provided.

The control **45** of the present invention includes a control switch **46** series connected in the energizing circuit to the compressor motor **8** as will be more apparent hereafter with diaphragm or bellows type operating means **47** therefor housed in shell **49**. In the arrangement shown, diaphragm **47** separates shell **49** into opposing pressure chambers **52**, **53**. Suitable linkage **50** projects through pressure chamber **53** and operatively connects diaphragm **47** with switch **46**. Preferably, linkage **50** is encased in a bellows type seal **51**.

Conduit **55** connects pressure chamber **52** with the low pressure side of the compressor **1** such as crankcase **40**, or suction line **90** as shown in the drawing. Bulb type sensor **57**, connected with chamber **53** through capillary **58**, is disposed in heat exchange relation with the compressor lubricant. Preferably, sensor **57** is disposed in the body of lubricant in the compressor crankcase sump **40**. Bulb **57**,

capillary 58 and chamber 53 comprise a closed system filled with a suitable temperature responsive fluid. As temperature conditions of the lubricant in sump 40 change, there results a corresponding change in pressure of the fluid filling bulb 57 and, through the intermediary of capillary 58, in chamber 53. While a single diaphragm operator is shown, it is understood that the control switch operating means 47 may comprise a pair of individual pressure operators arranged to respond to changes in suction pressures and lubricant temperatures respectively.

Compressor motor 8 is series connected through contact 60 with a suitable source of electric energy represented by leads L_1, L_2. The primary winding 62 of stepdown transformer 63 is connected across leads L_1, L_2. Control switch 65, switch 46 of control 45, and contactor coil 66 are series connected across the secondary windings 64 of transformer 63.

With switch 46 closed, closing of control switch 65 completes an energizing circuit to contactor coil 66 to close contact 60. Closure of contact 60 completes an energizing circuit to motor 8 of compressor 1. Lubricant heater 41, which may be connected across secondary winding 64 of transformer 63 is preferably continuously energized.

Diaphragm 47 of control 45 responds to pressures in chamber 53 which vary in accordance with temperature conditions of the lubricant in sump 40 as sensed by bulb 57 and the pressures in compartment 52 which vary in accordance with the operating pressure conditions of the compressor 1. Control 45 is suitably adjusted so that diaphragm 47 closes switch 46 so long as a preset differential is maintained between pressures in chamber 52, 53 of control 45.

Should amounts of liquid refrigerant pass or flood through suction line 90 into compressor 1, the relatively cold liquid refrigerant reduces temperatures within the compressor shell, particularly within motor compartment 7. Partitioning wall 4, between motor and crankcase compartments 7, 40 respectively, is also chilled cooling the lubricant in sump 40. On the occurrence of a sustained flood back in liquid refrigerant into compressor 1, substantial cooling of the lubricant in sump 40 ensues.

When compressors such as compressor 1 are shut down for appreciable periods of time, refrigerant from the system will migrate into the body of lubricant stored in the compressor sump if the lubricant is permitted to cool due to failure or non-use of heater 41.

Reduction in temperature of the fluid in the sump 40 of compressor 1 due to the flood through of liquid refrigerant into the compressor or through non-use or failure of lubricant heater 41 results in a pressure decrease in control chamber 53. The decrease in pressure in chamber 53 decreases the pressure differential acting on diaphragm 47 and, at a predetermined low pressure differential, diaphragm 47 acting through linkage 50, causes control switch 46 to open.

When compressor 1 is operational, opening of control switch 46 deenergizes contactor coil 66 to open contacts 60 and interrupt the energizing circuit to the compressor motor 8 thereby stopping compressor 1. When compressor 1 is inoperative, opening of switch 46 prevents completion of the energizing circuit to contactor coil 66 to prevent startup of compressor 1.

While we have described a preferred embodiment of our invention it is understood that the invention is not limited thereto, but may be otherwise embodied within the scope of the following claims.

We claim:

1. In a compressor adapted for use with a gaseous medium said compressor including a sump portion for storing lubricant, the combination of circuit means adapted when completed to energize said compressor; and means to protect said compressor against both intake of liquid medium and dilution of the compressor lubricant by said medium including a control switch adapted when actuated to interrupt said circuit means; a pressure responsive actuator for said switch responsive to a predetermined differential in pressure between gaseous pressure in the low pressure side of the compressor and a pressure corresponding to lubricant temperature to actuate said switch and render said compressor inoperative; and means for reflecting a preset lubricant temperature signalling intake of liquid medium by said compressor and dilution of the compressor lubricant by said medium to vary said pressure differential to actuate said switch to render the compressor inoperative.

2. A compressor according to claim 1 in which said pressure responsive actuator includes flexible wall means forming first and second pressure compartments, and linkage means operably connecting said flexible wall means with said control switch; said reflecting means including a sensing element cooperable with said first pressure compartment to form a closed fluid system having a temperature sensitive pressure fluid therein, said sensing element being disposed in heat exchange relation with said compressor sump.

3. A compressor according to claim 2 in which said sensing element is immersed in the body of lubricant in said compressor sump.

4. In a compressor adapted for use with a gaseous medium said compressor including a sump portion for storing lubricant, the combination of circuit means adapted when completed to energize said compressor; and means to protect said compressor against both intake of liquid medium and dilution of the compressor lubricant by said medium including a control switch adapted when actuated to interrupt said circuit means; a pressure responsive actuator for said switch adapted at a predetermined signal to actuate said switch and render said compressor inoperative; means for generating signals in accordance with temperature conditions of the compressor lubricant adapted at a preset lubricant temperature signalling intake of liquid medium by said compressor and dilution of the compressor lubricant by said medium to generate said predetermined signal, said pressure responsive actuator including flexible wall means forming first and second pressure compartments, and linkage means operably connecting said flexible wall means with said control switch; said signal generating means including a sensing element cooperable with said first pressure compartment to form a closed fluid system having a temperature sensitive pressure fluid therein, said sensing element being disposed in heat exchange relation with said compressor sump, said sensing element being immersed in the body of lubricant in said compressor sump and means connecting said second pressure compartment with the suction side of said compressor.

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