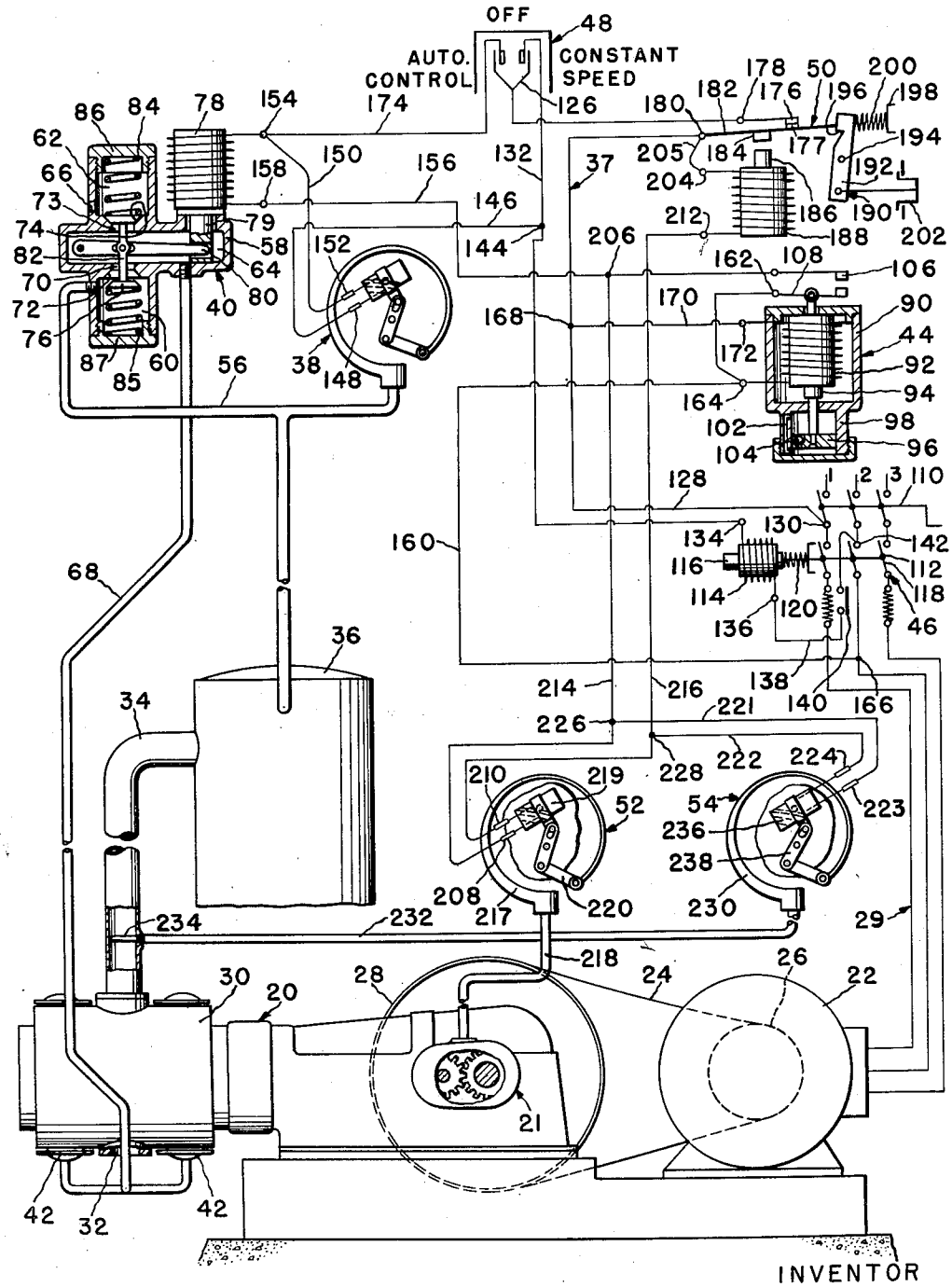
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CONTROLLING DEVICE FOR COMPRESSORS

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CONTROLLING DEVICE FOR COMPRESSORS

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This invention relates to compressors, and more particularly to an improved controlling device for compressors having force-feed lubrication.

It is common practice to control the output of a compressor according to the variation in discharge pressure by means of so-called dual-control, as, for example, "constant-speed" control and automatic "start-stop" control in a single unit, in which is also provided means for selecting the type of control to be used in accordance with the demand for air.

In many units of this type a three-way valve is used for controlling the operation of the compressor-unloading valves and is actuated by a pressure-operated valve which acts responsively to changes in discharge pressure. It is also used in conjunction with a pneumatically or electrically-actuated time-delay device to insure an unloaded condition of the compressor until the motor attains normal speed.

As heretofore constructed, none of these dual-control units having an electric time-delay switch includes safety devices for emergency shut-down of a compressor with force-feed lubrication in the event of lubricating oil pressure failure or an abnormal thermal condition of the fluid discharged by the compressor.

Therefore, an object of my invention is to include in the control circuit of a compressor having force-feed lubrication, means for preventing damage to said compressor which may be caused by the failure of lubricating oil pressure or resulting from excessive discharge-fluid temperature.

Other objects will be pointed out in the following description of the accompanying drawing, which illustrates a preferred embodiment of the invention and is a side elevation of the compressor and an electric dual-control circuit therefor, shown diagrammatically and partly broken away.

Referring to the drawing, the invention is shown as applied to a single stage compressor **20**, although it could be applied to any type of compressor. The compressor has a gear-driven oil pump **21** and is driven by an electric motor **22** by means of a belt **24** and pulleys **26** and **28** on the motor and the compressor, respectively. The motor **22** receives its power through a three-phase power line **29** having leads **1**, **2** and **3**, and air enters the cylinder **30** of the compressor through an intake port **32** and is discharged under pressure through a pipe **34** to a receiver **36**.

The control circuit, designated **37**, for the compressor includes a normally-closed pressure-actuated switch **38**, which is responsive to variations of air pressure in the receiver **36** to control a solenoid-operated three-way valve **40** for operating free-air unloaders, only the covers **42** of which are shown, to unload the compressor **20**. Directly associated with the three-way valve **40** is a time-delay relay **44**, which delays the loading of the compressor **20** upon starting and is actuated simultaneously with a solenoid-operated line starter switch assembly **46** in the line **29** for controlling the motor **22**. Completing the

circuit is a manually operated selector switch **48** for determining the type of control to be used.

In accordance with the practice of the invention, a mechanically-latched relay **50** acting as a circuit breaker is inserted in the starter switch circuit for shutting down the motor **22**, whenever energized by an oil pressure switch **52** which acts responsively to a failure of the lubricating oil pressure or by a thermal switch **54** which acts responsively to an abnormal temperature condition in the fluid discharged by the compressor.

The pressure switch **38** is normally closed and is known commercially as a "Mercoid" switch. It is connected to the receiver **36** by piping **56**, and opens the control circuit at a predetermined maximum discharge pressure and closes it at a predetermined minimum pressure, thereby acting as a pilot switch for the control circuit **37**.

Piping **56** conveys pressure fluid from the receiver **36** to the valve **40** and is threadedly connected to the body **58** thereof. It opens into an inlet chamber **60** in the lower portion of the body, which, in addition, has a discharge chamber **62** in its upper portion and a transfer chamber **64** between the chambers **60** and **62**. The discharge chamber **62** has an exhaust port **66** communicating said chamber with the atmosphere. Threadedly connected to the body **58** is piping **68** for conveying pressure fluid from the transfer chamber **64** to the free-air unloader covers **42** on cylinder **30**.

Connecting the inlet chamber **60** and the transfer chamber **64** is a port **70** having a beveled valve seat **72** at its juncture with the chamber **60**. Likewise, the discharge chamber **62** and the transfer chamber **64** are connected by a port **73** having a valve seat **74** at its juncture with the chamber **62**. The ports **70** and **73** are alternately opened and closed by a two-headed valve **76** which is actuated by a solenoid **78**, the core **79** of which interlockingly engages an end of a lever **80**, which is pivotally connected to the body **58** at its other end and to a stem **82** of the valve **76** at an intermediate point. Springs **84** and **85** are positioned in the discharge chamber **62** and in the inlet chamber **60** between the upper and lower heads of the valve **76** and two caps **86** and **87** screwed into the body **58**, respectively.

The resistance of the springs **84** and **85** and the weight of the solenoid core **79** and the lever **80** are such that, when the solenoid **78** is deenergized, the valve **76** is held in position to cover the port **73** and to uncover the port **70**, thereby admitting receiver pressure to the free-air unloaders through the piping **68**. When the solenoid **78** is energized, the valve **76** is shifted thereby to its other limiting position and cuts off the receiver pressure to the free-air unloaders and establishes communication between the chambers **64** and **62** for exhausting the fluid from the compressor unloaders.

Electrically connected to the solenoid **78** is the time-delay relay **44**. The relay **44** consists of a casing **90**, which houses a coil **92** encircling a core **94**. The core **94** carries a piston **96** at its lower end to reciprocate in a cylinder **98** at the lower end of the casing **90**. In the side wall of the cylinder **98** is a restricted passage **102** communicating with the opposite ends of the cylinder **98**. The piston **96** contains a ball check valve **104** which serves to prevent flow of a fluid, such as oil, through the piston **96** in the downward direction but allows relatively free flow in the upward direction. This cylinder construction constitutes a well known "dash-pot," which is used to retard the upward motion of the core **94** upon energization of the coil **92** for closing contacts **106** by means of a switch arm **108** pivotally connected to the upper end of the core **94**.

The starter switch assembly **46** is of conventional construction and comprises a manually-operable switch **110** and an electrically operated switch **112**. The switch **112**

water pressure, a break in the water line or leaky fittings. It could also be caused by the heat of friction developing between the piston and the cylinder due to the lack of lubrication. When such a condition occurs, the thermal switch 54 may act before the oil pressure switch 52 acts to stop the motor 22 and the compressor 20.

It is to be understood that, although switches 52 and 54 can act independently of each other, they may also act at or near the same time to effect the cutting off of the power supply to the motor 22, whenever the conditions controlling the operation of said switches prevail in the compressor.

I claim:

1. The combination of a compressor having force-feed lubrication, an electric driving motor for the compressor, an electric control circuit for the compressor, electrically actuated load-controlling means in the circuit for loading and unloading the compressor, an electrically actuated starter switch in the circuit for controlling the flow of power to the motor, pressure responsive means in said circuit connected to the compressor discharge and operatively associated with the starter switch for starting and stopping the motor in response to predetermined minimum and maximum discharge pressures respectively, an electrically actuated circuit breaker in the circuit, an oil pressure switch in the control circuit operatively associated with the circuit breaker and acting responsively to a predetermined minimum compressor lubricating oil pressure for energizing the circuit breaker to open the control circuit, and an electrically actuated time delay device in the circuit energized simultaneously with the starter switch and connected to delay the load-controlling means in loading the compressor upon starting thereof until it attains a predetermined speed and connected to prevent the oil pressure switch from energizing the circuit breaker before the loading-controlling means acts to apply the load to the compressor upon starting thereof.

2. The combination as stated in claim 1 in which a thermally responsive switch in the control circuit is also operatively associated with the circuit breaker and acts responsively to a predetermined maximum compressor discharge temperature for energizing the circuit breaker to open the control circuit.

3. The combination of a compressor having force-feed lubrication, an electric driving motor for the compressor, an electric control circuit for the compressor, electrically actuated load-controlling means in the circuit for loading and unloading the compressor, an electrically actuated starter switch in the circuit for controlling the flow of power to the motor, pressure responsive means in said circuit connected to the compressor discharge and operatively associated with the load-controlling means for loading and unloading the compressor in response to predetermined minimum and maximum discharge pressures respectively, an electrically actuated circuit breaker in the circuit, an oil pressure switch in the control circuit operatively associated with the circuit breaker and acting responsively to a predetermined minimum compressor lubricating oil pressure for energizing the circuit breaker to open the control circuit, and an electrically actuated time delay device in the circuit energized simultaneously with the starter switch and connected to delay the load-controlling means in loading the compressor upon starting thereof until it attains a predetermined speed and connected to prevent the oil pressure switch from energizing the circuit breaker before the load-controlling means acts to apply the load to the compressor upon starting thereof.

4. The combination as stated in claim 3 in which a thermally responsive switch in the control circuit is also operatively associated with the circuit breaker and acts responsively to a predetermined maximum compressor discharge temperature for energizing the circuit breaker to open the control circuit.

5. The combination of a compressor having force-feed lubrication, an electric driving motor for the compressor, an electric control circuit for the compressor, electrically actuated load-controlling means in the circuit for loading and unloading the compressor, electrically-actuated starter switch means in the circuit for starting and stopping the motor, pressure responsive means in said circuit in communication with the compressor discharge and connected to control both the starter switch means and the load-controlling means in response to predetermined maximum and minimum discharge pressures, a manually operable switch in the circuit connected to selectively render the pressure responsive means effective to control one of said starter switch and load-controlling means, an electrically actuated circuit breaker in the circuit, an oil pressure switch in the control circuit operatively associated with the circuit breaker and acting responsively to a predetermined minimum compressor lubricating oil pressure for energizing the circuit breaker to open the control circuit, and an electrically actuated time delay device in the circuit energized simultaneously with the starter switch and connected to delay the load-controlling means in loading the compressor upon starting thereof until it attains a predetermined speed and connected to prevent the oil pressure switch from energizing the circuit breaker before the load-controlling means acts to apply the load to the compressor upon starting thereof.

6. The combination as stated in claim 5 in which a thermally responsive switch in the control circuit is also operatively associated with the circuit breaker and acts responsively to a predetermined maximum compressor discharge temperature for energizing the circuit breaker to open the control circuit.

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