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Weihl

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[54] **PROTECTIVE DEVICE FOR REFRIGERATION COMPRESSORS**

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[52] **U.S. Cl.** **62/158,** 307/293, 318/484

[51] **Int. Cl.** **G05d 23/32**

[58] **Field of Search** 62/158; 318/484; 307/293

[56] **References Cited**

UNITED STATES PATENTS

3,127,754 4/1964 Mobarry 62/158

3,707,661 12/1972 King 62/158

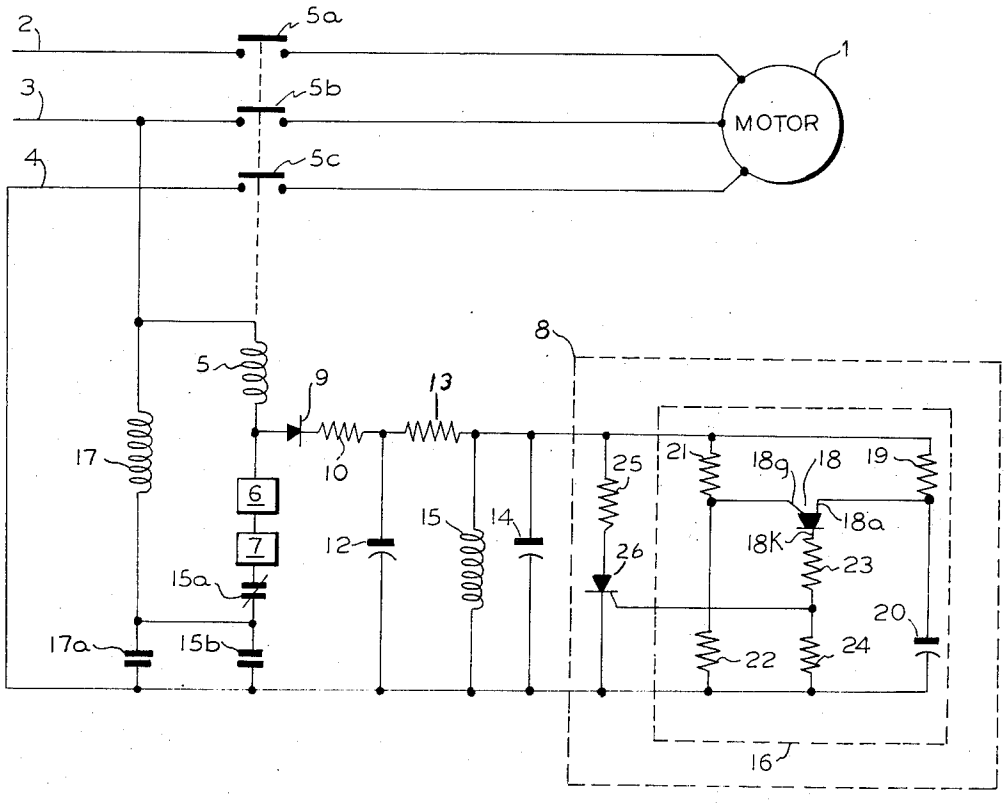
Primary Examiner—Meyer Perlin

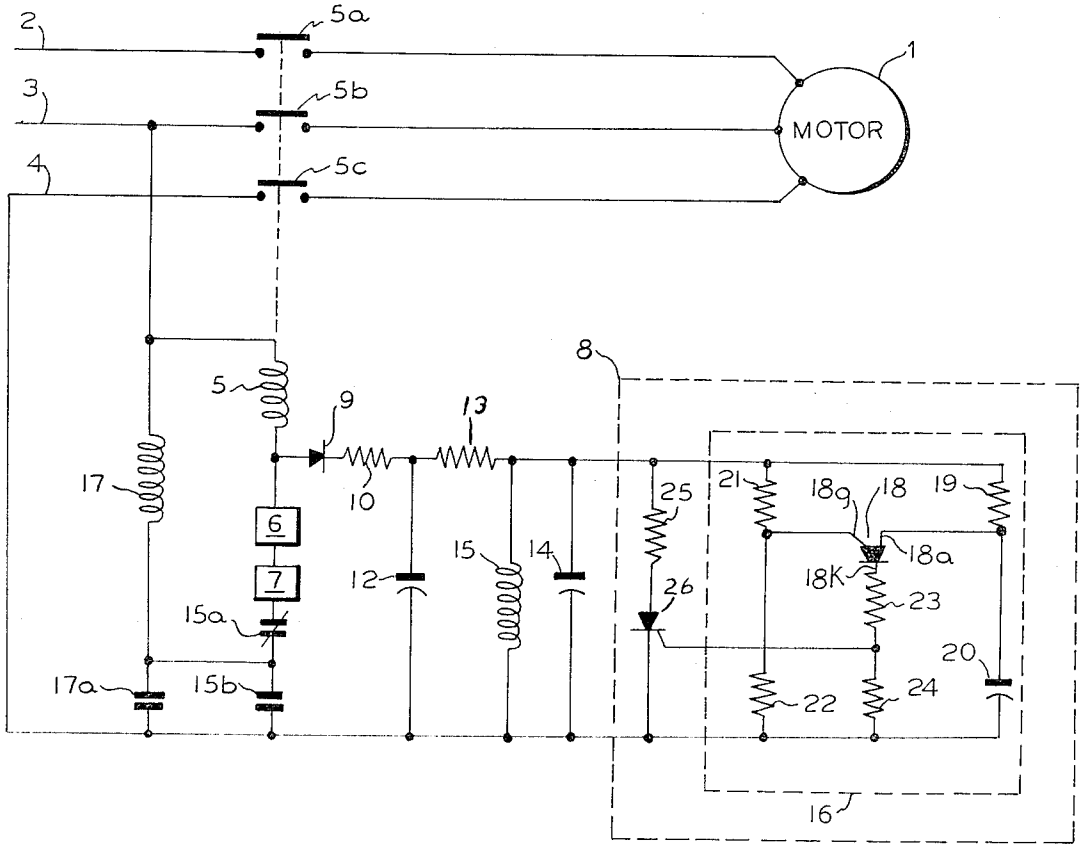
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[57] **ABSTRACT**

A protective device for protection of a refrigeration compressor from burnout caused by short cycling. A time delay means is provided which prevents the compressor motor from being started again until a predetermined time interval has elapsed after the system thermostat has opened. If a power failure should occur, the compressor motor is prevented from being started until a predetermined time interval has elapsed after power resumption to the refrigeration system.

6 Claims, 1 Drawing Figure




2
3
4
5a
5b
5c
1
MOTOR
5
9
13
10
17
6
7
15a
17a
15b
12
15
14
8
25
21
18g
18
19
18a
18K
23
26
20
22
24
16

PROTECTIVE DEVICE FOR REFRIGERATION COMPRESSORS

BACKGROUND OF THE INVENTION

The present invention is concerned with refrigeration systems and, in particular, is concerned with preventing burnout of the compressor motor caused by short cycling.

In the past, refrigeration systems have been protected from compressor short cycling. However, these previous protective devices do not always afford complete protection.

In one prior art system a timing motor in conjunction with a cam is used to prevent compressor short cycling. When the system thermostat opens, the timing motor is actuated and prevents the compressor from being started until the timing motor has timed the proper interval. However, if a power failure should occur while the system thermostat is closed, it is possible that the compressor motor will be restarted when power is resumed to the system. And if the power failure is short enough in duration, the compressor can short cycle, possibly burning out the compressor motor.

Another prior art device employs a bimetallic element as a time delay means. When the system thermostat opens the bimetallic element prevents reenergization of the contactor controlling the compressor motor until the time interval has elapsed. If a power failure should occur while the thermostat is closed, compressor short cycling is still possible.

SUMMARY OF THE INVENTION

This protective device recognizes the opening of the system thermostat or other limit device. Then in response to this opening a time delay means is energized. The purpose of the time delay means is to prevent the contactor which controls the compressor motor from being energized until a predetermined time interval has elapsed after the thermostat or other limit device has opened. A first relay and a time delay circuit are both energized when the system thermostat or limit device opens. After a predetermined time interval has elapsed, the time delay circuit acts to deenergize the first relay allowing the contactor to be energized upon thermostat closure. The contactor can be energized only when the system thermostat and all limit devices are closed and the first relay is deenergized. A second latching relay is provided to prevent compressor short cycling when a power failure has occurred.

Further features and advantages of the invention will be apparent from the following description and accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The single drawing FIGURE illustrates schematically a wiring diagram of a refrigeration system including a presently preferred form of a compressor motor protective device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, there is shown an electric motor **1** for driving the refrigerant compressor of a conventional compressor-condensor-evaporator type refrigeration system. The motor **1** is connected to alternating current electric supply lines **2, 3** and **4** through contactor switches **5**a, **5**b and **5**c. The contactor

switches are closed by a contactor coil **5** connected in a control circuit which may have its terminals connected to the supply lines **3** and **4.** The control circuit further includes a thermostat **6** or another suitable condition responsive switch responsive to refrigeration system demand and may also include one or more safety or limit switches **7** such as a low-pressure switch, a high-pressure switch and a motor thermal overload switch.

Time delay means **8** is provided to prevent energization of contactor coil **5** until it has been deenergized for a predetermined time interval. Diode **9** provides suitable rectification..Resistors **10** and **13** and capacitors **12** and **14** provide filtering for the time delay circuit **16** which is described later. An impedance relay coil **15** has corresponding normally closed contacts **15***a* and normally open contacts **15***b* in series with contactor coil **5,** thermostat **6** and safety or limit switches **7.** A latching relay with coil **17** and normally open contact **17***a* protects the refrigeration system in case of a power failure.

Time delay circuit **16** employs a programmable unijunction transistor (PUT) indicated generally by reference character **18** having anode electrode **18**a, cathode electrode **18***k*, and gate electrode **18***g*. Resistor **19,** capacitor **20,** resistor **21** and resistor **22** act in conjunction to fire the PUT **18** after the proper time interval has elapsed. Resistor **25** limits the current through the anode cathode circuit of SCR **26,** and resistor **23** and **24** bias the gate electrode of SCR **26** properly.

The time delay circuit **16** operates in the following manner:

When power is applied to the system or when thermostat **6** or limit switch of switches **7** open, the time delay circuit is actuated. Capacitor **20** begins to charge and when the voltage at the gate electrode **18***g* of PUT **18** becomes slightly negative with respect to the voltage at **18***a*, PUT **18** "fires" closing a conduction path between the anode **18***a* and the cathode **18***k*. This applies a voltage to the gate of SCR **26,** allowing the SCR **26** to conduct and latch.

The operation of the protective device for refrigeration compressors is as follows:

Upon application of power to the system through power lines **3** and **4,** relay coil **15** and time delay circuit **16** will both be energized. Since time delay means **8** does not draw enough current, contactor coil **5** will remain deenergized. When relay coil **15** is energized contacts **15***a* and **15***b* will transfer. This allows relay coil **17** to be energized, closing contacts **17***a*. After the predetermined time interval has been timed by the timing circuit **16** as previously described, SCR **26** will latch, deenergizing relay coil **15** and restoring contacts **15***a* and **15***b* to their normal positions. Assuming thermostat **6** and limit switch **7** are closed, a current path will be created through contactor coil **5,** thermostat **6,** limit switch **7,** normally closed contacts **15***a* and closed contacts **17***a*. Contactor coil **5** is energized through this path. If the thermostat should be open when relay coil **15** is deenergized by SCR **26,** the circuit will remain in this condition and contactor coil **5** will be energized when thermostat **6** closes.

It can be seen that contactor coil **5** cannot be energized after the thermostat **6** opens until the time delay circuit **16** has timed the proper interval and deenergized relay coil **15.**

If a power failure should occur, contactor coil 5 cannot be reenergized until relay coil 15 has been energized, relay coil 17 has been energized and relay coil 15 has been deenergized by SCR 26.

As a specific example, the following circuit components operated as previously described although certain changes can be made without departing from spirit of the invention:

Diode 9	IN 4002	
Resistor 10	22 ohm	
Capacitor 12	3.3 mfd.	
Resistor 13	1000 ohm	
Capacitor 14	3.3 Mfd	
Relay Coil 15	Essex Controls	Division Type Ms64
Relay Coil 17	Essex Controls	Division Type 184
PUT 18	2N6027	
Resistor 19	14.7 Megohm	
Capacitor 20	20 Mfd.	
Resistor 21	2.2. Megohm	
Resistor 22	3.9 Megohm	
Resistor 23	22 ohm	
Resistor 24	1000 ohm	
Resistor 25	22 ohm	
SCR 26	General Electric C 106 F	

What is claimed is:

1. A protective device for use with a refrigeration system having a refrigerant compressor driven by an electric motor, a contactor switching device including a contactor coil and a contactor switch for closing an energizing circuit to said motor when said contactor coil is energized, a condition responsive switch means responsive to refrigeration system demand, and a control circuit for energizing said contactor coil having two terminals for connection to a source of electric power, said control circuit including said contactor coil and said condition responsive switch means in series with said contactor coil being connected to one of said terminals, said protective device comprising:

an impedance relay having an impedance coil and a normally closed switch which opens when said impedance relay coil is energized;

means for connecting said normally closed impedance relay switch in said control circuit between said condition responsive switch means and the other of said terminals to prevent energization of said contactor coil when said normally closed impedance relay switch is open;

means for connecting said impedance relay coil across said other terminal and the junction of said contactor coil with said condition responsive switch means for energization of said impedance relay coil from said source of electric power through said contactor coil;

and time delay means connected in parallel with said impedance relay coil for deenergizing said impedance relay coil a predetermined interval of time after said time delay means is energized.

2. A protective device according to claim 1 wherein said time delay means comprises:

semiconducted switching means connected said impedance relay coil and operative to substantially short out said impedance relay coil when said semiconductor switching means is in a conductive state;

and a time delay circuit connected to said semiconductor switching means and operative to render said semiconductor switching means conductive a predetermined interval of time after said time delay means is energized.

3. A protective device according to claim 2 wherein:

a diode member connects said impedance relay coil and said time delay means to the junction of said contactor coil with said condition responsive switch means;

said semiconductor switching means is a silicon controlled rectifier having anode and cathode electrodes connected across said impedance relay coil;

and said time delay circuit comprises a resistance-capacitance timing circuit and a programmable unijunction transistor responsive to energization of said resistance-capacitance timing circuit for a predetermined interval of time to provide a firing signal to the gate electrode of said silicon controlled rectifier.

4. A protective device according to claim 1 further comprising:

a latching relay having a coil and a normally open switch which closes when said latching relay coil is energized;

a normally open impedance relay switch which closes when said impedance relay coil is energized;

means for connecting said latching relay switch and said normally open impedance relay switch in parallel with each other in said control circuit between said normally closed impedance relay switch and said other terminal;

and means for connecting said latching relay coil between said one terminal and the junction of said normally closed impedance relay switch with said latching relay switch and said normally open impedance relay switch.

5. A protective device according to claim 4 wherein said time delay means comprises:

semiconductor switching means connected to said impedance relay coil and operative to substantially short out said impedance relay coil when said semiconductor switching means is in a conductive state;

and a time delay circuit connected to said semiconductor switching means and operative to render said semiconductor switching means conductive a predetermined interval of time after said time delay means is energized.

6. A protective device according to claim 5 wherein:

a diode member connects said impedance relay coil and said time delay means to the junction of said contactor coil with said condition responsive switch means;

said semiconductor switching means is a silicon controlled rectifier having anode and cathode electrodes connected across said impedance relay coil;

and said time delay circuit comprises a resistance-capacitance timing circuit and a programmable unijunction transistor responsive to energization of said resistance-capacitance timing circuit for a predetermined interval of time to provide a firing signal to the gate electrode of said silicon controlled rectifier.

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