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TIME DELAY CIRCUIT USING THERMISTORS

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FIG. 1.

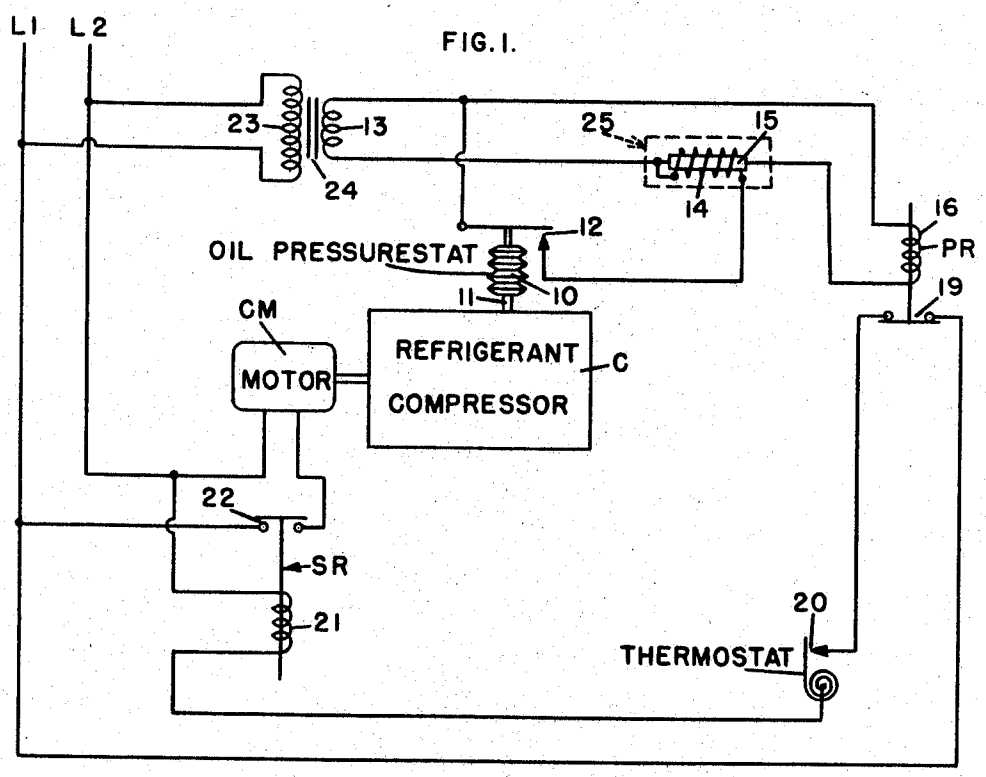


FIG. 2.

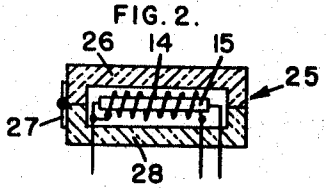
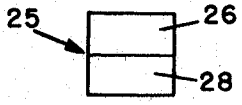


FIG. 3.



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TIME DELAY CIRCUIT USING THERMISTORS

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This invention relates to time delay relays, and relates more particularly to time delay relays for use in protecting refrigerant compressors when their lubricating oil pressures are low.

A refrigerant compressor has an oil pump which, when the compressor is started, builds up a normal oil pressure after a few minutes (up to five minutes) of operation, this build-up period depending upon the ambient temperature and the amount of refrigerant in the oil. A protective circuit for stopping the compressor motor when the oil pressure is low, must take this build-up period into account, else it may stop the compressor during the build-up period. The conventional, thermal, time delay relay using a bimetallic switch element is not suited for such a circuit since it is not satisfactory for time delay periods of over two or three minutes.

This invention uses a thermistor, preferably one having a positive temperature coefficient of resistance, in a thermal time delay relay instead of the usual bimetallic switch element. A heater resistor is used to heat the thermistor when the oil pressure of a refrigerant compressor is low. The thermistor is connected in series with an energizing coil of a protective relay to electric supply connections, and normally the resistance of the thermistor is so low that the protective relay is energized, and has a normally closed switch in the energizing circuit of the compressor motor. The heater resistor is connected in series with a normally open switch of an oil pressure responsive control to electric supply connections, which switch closes when the oil pressure is low, and energizes the heater resistor which heats the thermistor to such a temperature that its resistance increases to such a value that the protective relay is deenergized and opens its switch to deenergize the compressor motor. The time required for the thermistor to be heated to such a temperature is sufficient for normal oil pressure build-up.

A feature of this invention is that the heater resistor and the thermistor are enclosed within a housing of heat insulation for insulating them from ambient heat, the housing having a removable or openable portion for permitting the heater resistor and the thermistor to cool for resetting the protective circuit after it has operated to deenergize the compressor motor.

An object of this invention is to use a thermistor having a positive temperature coefficient of resistance in a thermal relay.

Another object of this invention is to use a thermal relay including a thermistor having a positive coefficient of resistance, in a protective circuit of a refrigerant compressor for stopping the compressor when its oil pressure is low except during oil pressure build-up.

This invention will now be described with reference to the annexed drawings, of which:

FIG. 1 is a diagrammatic view of a protective circuit of a refrigerant compressor embodying this invention;

FIG. 2 is a sectional view of the insulating housing enclosing the thermistor and its heater resistor of the circuit of FIG. 1, and

FIG. 3 is an end view of the housing of FIG. 2.

A conventional refrigerant compressor C is driven by an electric motor CM. An oil pressurestat **10** is connected by a tube **11** to the lubricating system within the compressor. The pressurestat **10** has a switch **12** which closes when the oil pressure is below its normal range of

pressures. The switch **12** is connected to one end of secondary winding **13** of step-down transformer **24**, and to one end of heater resistor **14** which is coiled around and in contact with thermistor **15**. The other end of the resistor **14** is connected to the other end of the winding **13** and to one end of the thermistor **15**. The other end of the thermistor **15** is connected to one end of energizing coil **16** of protective relay PR, the other end of the coil **16** being connected to the one end of the secondary winding **13**. The relay PR has a normally closed switch **19** connected in series with thermostat switch **20** and energizing coil **21** of motor starter relay SR to electric supply lines L1 and L2. The relay SR has a switch **22** connected in series with the compressor motor CM to the lines L1 and L2. The transformer **24** has a primary winding **23** connected to the lines L1 and L2.

The thermistor **15** is of the positive temperature coefficient of resistance type, its electrical resistance increasing abruptly when its temperature is increased to a selected operating temperature. The heater resistor **14** has a conventional coating of electrically insulating but heat conductive material.

Normally, the heater resistor **14** is deenergized by the normally open switch **12**, the resistance of the thermistor **15** is relatively low, the protective relay PR is energized, and the switch **19** is closed, so that the compressor motor CM can be started when the thermostat switch **20** closes. When the switch **20** closes, the coil **21** of the starter relay is energized, the switch **22** closes, and the motor CM is connected to the supply lines L1 and L2.

When oil pressure is low, the switch **12** closes and energizes the heater resistor **14** which heats the thermistor **15**. The resistance of the thermistor **15** increases, and if the switch **12** remains closed beyond the normal oil pressure build-up period, the resistance of the themistor increases to such a value that the coil **16** is deenergized, and the switch **19** opens. This deenergizes the starter relay SR which opens its switch **22**, deenergizing the compressor motor.

As shown by FIG. 2, the heater resistor **14** and the thermistor **15** are enclosed within a hollow housing **25** of heat insulation which insulates the resistor **14** and the thermistor **15** from ambient heat. The housing is divided in upper and lower parts **26** and **28** respectively, which are attached at one end by a hinge **27**. The wires connecting the assembly of heater resistor and thermistor to the control circuit, in the illustrated embodiment, extend through the lower housing part **28**. The upper housing part **26** can be pivoted about the hinge **27** to open position for permitting the heater resistor and thermistor to cool.

The abnormal condition which caused the oil pressure to be so low that the compressor motor was stopped, may be temporary. Opening the housing **25** permits the heater resistor and the thermistor to cool and the thermistor to return to its normal, relatively low resistance, resetting the protective circuit by again energizing the coil **16** of the protective relay PR, and reclosing the switch **19**. If the compressor motor is repeatedly stopped by the abnormal condition, trouble that requires correction is indicated, and a service man should be called.

What is claimed is:

1. A protective circuit for a refrigerant compressor having an electric driving motor, comprising an oil pressurestat connected to said compressor, a switch closed by said pressurestat when the pressure within said pressurestat is below normal, a protective relay having a switch which is closed when said relay is energized, a starter relay for said motor, said starter relay having a switch which is closed when said starter relay is energized, electric supply connections, means connecting said switch of said protective relay and said starter relay in series to said connec-

tions, means connecting said switch of said starter relay and said motor in series to said connections, a thermistor having a positive temperature coefficient of resistance, means connecting said thermistor and said protective relay in series to said connections, a heater resistor adjacent to said thermistor for heating said thermistor when said resistor is energized, and means connecting said resistor and said switch of said pressurestat in series to said connections.

2. A protective circuit as claimed in claim 1 in which said resistor and said thermistor are enclosed within a hollow housing of heat insulation, and in which said housing has a part which can be positioned to expose said resistor and thermistor to the atmosphere for cooling said resistor and thermistor after they have been heated.

3. A control circuit comprising current responsive means and a thermistor connected in series, a heater resistor adjacent to said thermistor for heating said thermistor when said resistor is energized, a control switch, means including said control switch for energizing said resistor when said control switch is closed, said switch being normally open so that said resistor is normally deenergized and said thermistor is normally not heated by said resistor, said responsive means having one condition when said switch is open and said thermistor is not heated by said resistor, and having the opposite condition when said switch is closed and said thermistor is heated by the energization of said resistor, and a housing of heat insulation enclosing said thermistor and said resistor, said housing having a part which can be positioned to expose said thermistor and said resistor to the atmosphere for permitting said thermistor and said resistor to cool after said switch has closed and then reopened, and permitting said responsive means to return to said one position.

4. A control circuit as claimed in claim 3 in which said responsive means is a relay having a switch which is in one position when said thermistor is not heated by said resistor, and which is in another position when said thermistor is heated by said resistor when said control switch is closed.

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