June 9, 1959 C. J. BISHOFBERGER 2,890,391

VALVE

Filed May 10, 1954

FIG. 1

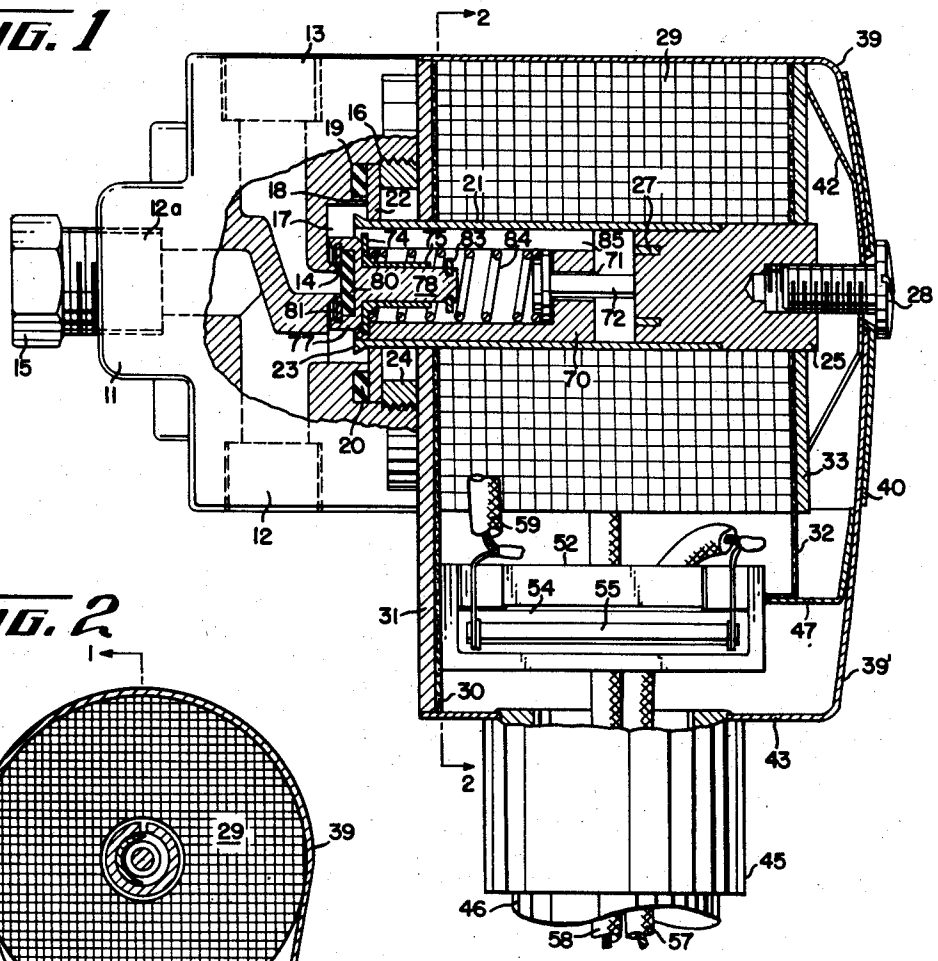


FIG. 2

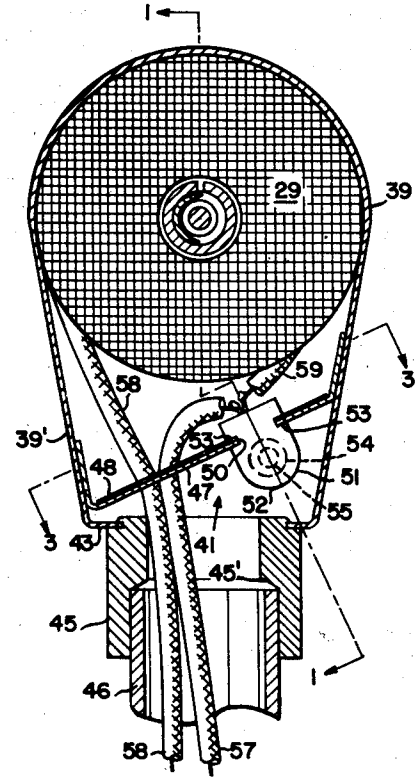
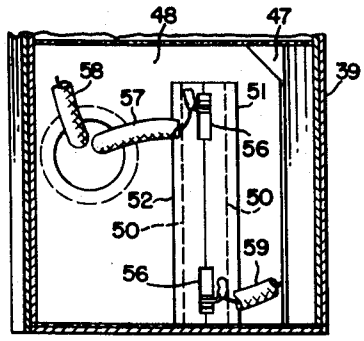


FIG. 3



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VALVE

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Application May 10, 1954, Serial No. 428,760

4 Claims. (Cl. 317—132)

This invention relates to delayed action solenoid valves and, more specifically is directed to improvements in the type of solenoid valves disclosed in copending patent applications of William J. McGoldrick, Serial No. 193,713, filed November 2, 1950, now abandoned, and of Carl J. Bishofberger, Serial No. 196,555, filed November 20, 1950, now Patent 2,735,644.

In delayed action solenoid valves of the type disclosed in the aforementioned patent applications, the coil member of the valves has connected in serial relationship therewith a thermistor or resistor member having a negative temperature coefficient of resistance so that as the coil and thermistor have potential applied thereto, the energization of the coil slowly builds up in accordance to the decrease in resistance of the thermistor. The amount of delay in obtaining full energization of the coil is dependent upon the characteristics of the thermistor, i.e., its initial resistance and the rate at which its resistance changes in accordance to current flowing therethrough. In general, the greater the initial resistance of the thermistor, the greater will be the delay before full energization of the coil is reached. In certain applications of delayed action solenoid valves, a relatively short delay of, for example, only a few seconds is sufficient to achieve the desired result while in other applications a greater time delay is desired. It has been found that for solenoid valves wherein a greater time delay is desired, that the thermistor or resistor members dissipate more heat for each cycle of operation than do the thermistors used in the valves having the shorter delay. One of the reasons for this is that the initial or cold resistance of the resistors is higher than that of the resistors used in the valves having shorter delay and as the amount of current flowing through the coil needed for full energization thereof may be considered to be constant for any given size of both types of valves, it follows that for a full energization of the coil in the valve having the greater delay, a greater amount of power must be dissipated in its resistor. In structures of the type disclosed in the above identified patent applications, the heat dissipated by the resistor members causes an increase in the operating temperature of the coil members. This is due to the position of the thermistors with respect to the coils. It will be appreciated that the operating temperature of a coil is to a large extent a function of the current flowing through it. The coil temperature increases until the amount of heat dissipated therefrom equals the amount of heat generated within. However, when a thermistor is placed adjacent to the coil member, then the heat developed by the thermistor is transferred to the coil. This is because the thermistor normally operates at a higher temperature than the coil and thus the coil operating temperature increases. It has been found that in delayed action valves where an increased delay is desired, the temperature rise of the coil becomes excessive when the thermistors are so located. The present invention is directed to a means of thermally isolating the thermistor from the coil member so that the heat dissipated

by the thermistor does not raise the temperature of the coil member to a point that would be objectionable. The invention further contemplates the positioning of the thermistor in such a way that the thermistor is near the portion of the housing for the coil that serves as a connection means between the housing and external conduit means or the like, which connection means and conduit means serve as additional heat radiating surfaces and thus effectively dissipate the heat generated by the thermistor in an efficient manner. The invention further provides the thermal isolation of the thermistor from the heat of the coil. This feature allows the thermistor to cool off rapidly upon denergization so as to regain its original resistance in as short a time as is practical. Thus, if the valve is energized within a short time after deenergization, the thermistor will have cooled sufficiently so as to provide a proper time delay in the pull-in of the plunger. This feature is better understood when it is realized that while the coil member will normally operate at a lower temperature than the thermistor, its large mass cools more slowly than the thermistor and hence would tend, upon deenergization, to keep the temperature of the thermistor higher than the temperature at which it must be in order to provide the correct time delay. The thermistor is not only thermally remote from the coil, but is in good thermal contact wtih the relatively cool conduit connection means and conduit means so that upon deenergization, it cools off rapidly. However, at the same time, it is protected from drafts and injury from external sources which would adversely affect the device.

It is therefore one of the objects of this invention to provide an improved delay action solenoid valve.

A further object of the invention is to provide a means in a delayed action solenoid valve for effectively thermally isolating the thermistor means connected in circuit with the coil member of the valve so that the heat generated by the thermistor during the operation of the valve does not raise the operating temperature of the coil of the valve.

Another object of the invention is to orient the thermistor within the housing for the coil with respect to a conduit connection means on the housing so that the radiating ability of the conduit connection means and conduit means connected thereto may be utilized to dissipate the heat generated by the thermistor.

Another object of the invention is to thermally isolate the thermistor means from the coil means so that the coil with its large heat capacity does not retard the cooling off of the thermistor upon deenergization thereof thus promoting a consistent time delay of the device even for relatively rapid cycling of the device.

Still another object of the invention is to provide a means of mounting the thermistor so that while it is thermally remote from the coil means it still receives a maximum of protection against drafts and the like as well as injury caused by external forces such as workmen attaching conduit means or the like to the valve housing.

Other objects of the invention will be apparent from the drawing and from the following specification and claims.

In the drawing:

Figure 1 is a side elevational view in section of a delayed action solenoid valve embodying the teachings of my invention;

Figure 2 is a view in section of the valve shown in Figure 1 as seen along section lines 2—2 and which illustrates the details of the improved thermistor mounting means; and

Figure 3 is a detailed view of the thermistor holding means as seen along section line 3—3 of Figure 2.

Referring to Figure 1 of the drawing, the solenoid

valve comprises a valve body **11** having an inlet **12** and an outlet **13** and a valve seat **14** therebetween. A plug **15** seals an alternate inlet **12***a*, which may be used instead of inlet **12**, if it is so desired. Openings **12**, **12***a*, and **13** have threaded portions or other suitable means therein for connecting fluid conduit means, not shown. The valve body **11** has a stepped bore through a side wall thereof, coaxial with the valve seat **14**. The stepped bore consists of an internally threaded bore **16** and an unthreaded, smaller diameter bore **17** extending inwardly from the bottom of bore **16** to the valve seat **14**, and which forms a shoulder **18** between said bores **16** and **17**. An annular groove **19** in the shoulder **18** has a sealing ring **20** therein for sealingly engaging a solenoid plunger tube assembly.

A nonmagnetic tube **21** has one of its ends extending through a washer **22**, which is retained on said end by staking over said end as shown at **23**, and/or by brazing said washer to said end. Washer **22** and solenoid tube **21** are held against sealing ring **20** by a clamping nut **24** screwed into threaded bore **16**. The other end of the tube **21** is closed by a plug **25** of magnetic material, the plug being secured to the tube by brazing, welding or other means. The inner end of the plug **25** has an annular groove therein which holds a copper shading ring **27**, while the other end of the plug has a threaded bore therein to receive a machine screw **28**.

A solenoid coil **29** slidably fits over and around the tube **21** and bears at its inner end against an insulation washer **30** and a washer **31** of magnetic material, which, in turn, abuts against the valve body. Positioned against the opposite end of the coil **29** is a second insulation washer **32** and a second magnetic washer **33**.

A cover member or housing **39** surrounds coil member **29** and is asymmetrically shaped with respect to the coil in that an elongation **39′** of the cover defines a void space **41** (see Figure 2) between one end **43** of the cover and the coil **29**. A spring washer **42** positioned between washer member **33** and the inside end surface of cover **39** serves to resiliently hold the washers **30**, **31**, **32** and **33** and coil **29** in assembled relationship. Cover **39** is secured to the coil and tube assembly by machine screw **28** which passes through suitable apertures in cover **39** and a name plate **40** and engages the threaded bore of plug **25**. A conduit fitting **45** is attached to end **43** of the cover **39** so as to provide a means of attaching the cover to conduit means **46**, a portion of which is shown. A partition member **47** is secured to the inside of cover member **39** by spot welding or other suitable means and is located diagonally across the void space **41**. An insulation member **48** abuts the surface of partition member **47** facing the coil **29**. A slot **50** is provided in partition member **47** and extends from the bottom of the partition **47** longitudinally to a point near the top thereof. A similar slot is provided in insulation member **48**. Disposed in slot **50** are a pair of cooperable thermistor enclosures **51** and **52** made out of a ceramic or other suitable material, each of which has a longitudinal slot **53** along the outer surface thereof, slots **53** being slightly wider than the combined thickness of partition **47** and insulation member **48** and of such a depth that when members **51** and **52** are placed in back to back relationship, the assembly thereof may be inserted snugly into slot **50**. The thermistor enclosures **51** and **52** have semicylindrical recesses **54** therein so that when the two members are placed in back to back abutting relationship, a cylindrical enclosure is provided for a thermistor **55** of the rod type. Members **51** and **52** have additional notches **56** shown in Figure 3 which provide openings between the hollow interior and the outside thereof and serve to provide a passageway for leads connecting thermistor **55** and coil member **29** in electrical series relationship. To this end a connection lead **57** from an external source of power (not shown) is connected to one end of thermistor **55** while a second connection lead **58** is connected to one side of coil member **29**, the other end of the coil being connected to the other end of thermistor **55** by lead **59**. The heat generated in thermistor **55** by current passing therethrough is transmitted to the enclosure members **51** and **52** by conduction and radiation and the enclosure members **51** and **52** in turn conduct and radiate the heat to the portions of cover member **39** and which are in immediate proximity thereto. This for the most part is the portion **39′** of cover member **39** which has conduit fitting **45** fastened integrally thereto and as above indicated conduit **46** is secured to the fitting **45**. Thus the fitting **45** and the conduit **46** constitute an effective heat dissipation means and since most of the heat generated by thermistor **55** is transmitted to this portion of the cover, it follows that most of the heat will be dissipated off of the relatively cool conduit **46** and fitting **45** and therefore will not serve to appreciably increase the operating temperature of coil member **29**.

It will be appreciated that not only is the heat generated by thermistor **55** prevented from raising and operating temperature of coil **29**, but the high heat capacity of coil **29** is ineffective in retarding the cooling off of thermistor **55** upon deenergization of the device. The thermistor **55** within enclosure **51—52**, being in good thermal contact with the relatively cool end **39′** of cover **39** as well as conduit connection means **45** and conduit **46**, will cool off rather rapidly. Thus the resistance of thermistor **55** will increase toward its initial or cold starting resistance soon after deenergization, and thus be ready to provide a proper time delay in the pull-in of the valve upon subsequent energization thereof.

It will be further appreciated that while the thermistor **55** is effectively thermally isolated from coil **29** and in good thermal contact with end **39′**, it still is protected by the cover and conduit fitting from drafts which might adversely affect the operating characteristics of the valve. Further, the thermistor is protected from mechanical shock and injury in that it is firmly held in position with respect to the cover. Conduit fitting **45** has an internal shoulder **45′** that prevents an unskilled workman from inserting an improperly threaded piece of conduit into void space **41** and injuring the thermistor **55**.

A cup-shaped plunger **70** of magnetic material has a small coaxial bore **71** through the closed end thereof through which extends the stem of a headed pin **72** in engagement with the inner end of plug **25**. The other end of the plunger extends inwardly over the peripheral edge of a flange **74** on a collar **75** to hold said flange against a shoulder in said other end of the plunger. A valve having a head **77** and a stem **78** which extends through the sleeve, is adapted to cooperate with the valve seat **14** to control the flow of fluid therethrough. The head has a sealing disc **80**, positioned in a centrally disposed recess in said head, to provide the seal. Said disc **80** is retained in said recess in the head by means of a washer **81** overlying the peripheral edge of the disc, while the washer **81**, itself, is retained in position by staking the peripheral edge of the head inwardly over the outer peripheral edge of the washer **81**. The stem **78** extends beyond the collar or sleeve **75** and carries an abutment washer **83** positioned in an annular groove near the end of the stem. It is thus seen that due to the spacing between the abutment washer **83** and the adjacent end of sleeve **75**, which provides a lost motion connection between said valve and plunger **70**, the plunger may move slightly away from the head **77** without causing any movement of the valve sealing disc **80**. The disc is held against the valve seat **14** and the outer end of headed pin **72** is held against plug **25** by means of a coil compression spring **84** positioned within plunger **70** and bearing at opposite ends thereof against the head of the pin and the flange. It is thus seen that the plunger will be held against the head of the valve and the disc held in engagement with the seat by the same amount of

force that the pin bears against the plug, as long as the plunger is substantially horizontal. A longitudinal slot 85 is provided in the side of the plunger which helps to prevent any dashpot action of the plunger in the tube as well as preventing any undesired induced currents in the plunger.

While I have shown and described a specific embodiment of this invention, further modifications and improvements will occur to those skilled in the art. I desire it to be understood, therefore, that this invention is not limited to the particular form shown and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of this invention.

What I claim is:

1. A delayed action electromagnetic device comprising a coil, a housing for said coil, said housing being made of good heat conducting material and being asymmetrical with respect to said coil so that when said housing and said coil are in assembled relationship, a void space is defined therebetween, good heat conducting partition means on said housing separating said void space and said coil, holding means on said partition means, a thermistor positioned in said space by said holding means and connected in circuit with said coil, and means on said housing adjacent said space for connecting good heat conductive conduit means to said housing.

2. A delayed action electromagnetic device comprising a coil, a housing for said coil, said housing being asymmetrical with respect to said coil so that when said housing and said coil are in assembled relationship, a void space is defined therebetween, partition means on said housing separating said void space and said coil, slot means in said partition, enclosure means positioned in said slot means with substantially all of said enclosure means in said space, a thermistor positioned in said enclosure means and connected in circuit with said coil, and means on said housing adjacent said space for connecting heat conductive conduit means to said housing.

3. In a delayed action electromagnetic device, the combination comprising a coil, a thermistor in series with said coil, cover means made of good heat conductive material, means for connecting heat conductive means to said cover means, means attached to said cover means for supporting said thermistor, said supporting means being made of good heat conductive material and positioning said thermistor adjacent to said connecting means and providing a partition between said thermistor and coil so that said thermistor is thermally isolated from said coil means.

4. In a delayed action electromagnetic device, the combination comprising a coil, a thermally responsive resistor connected in series with said coil, a housing for said coil and said resistor, means for connecting heat conductive conduit means to said housing, and good heat conductive means within said housing for positioning said resistor so that said resistor is thermally isolated from said coil and is in thermal communication with said connecting means.

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