June 5, 1956 W. L. TANCRED 2,749,402

RELAY

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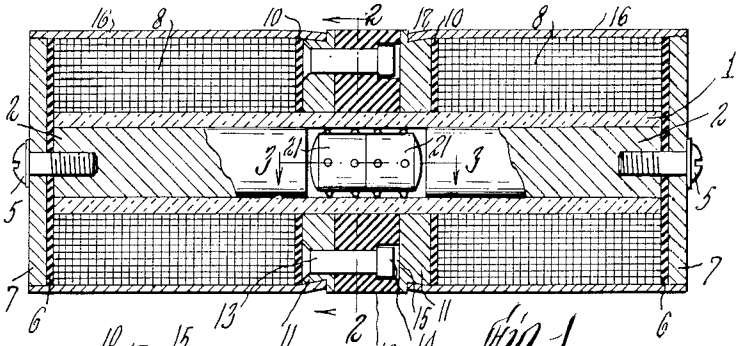


Fig. 1.

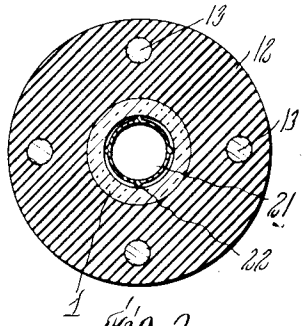


Fig. 2.

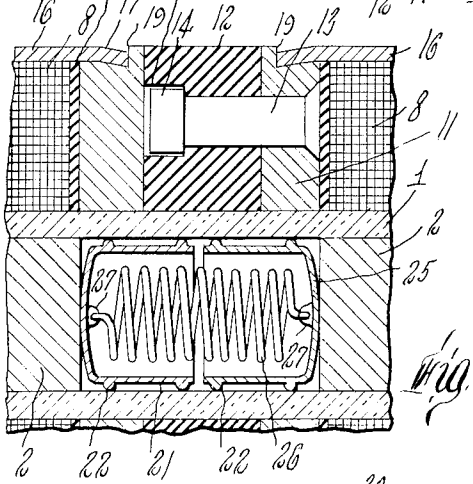


Fig. 3.

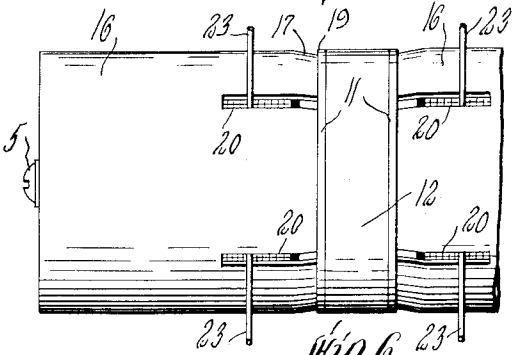


Fig. 6.

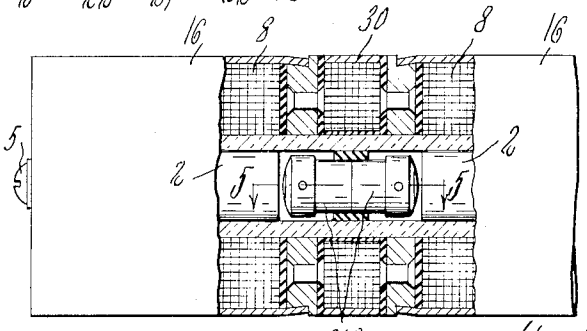


Fig. 4.

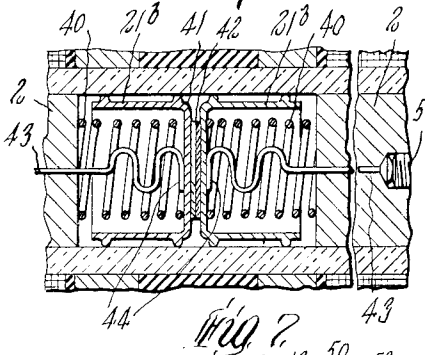


Fig. 7.

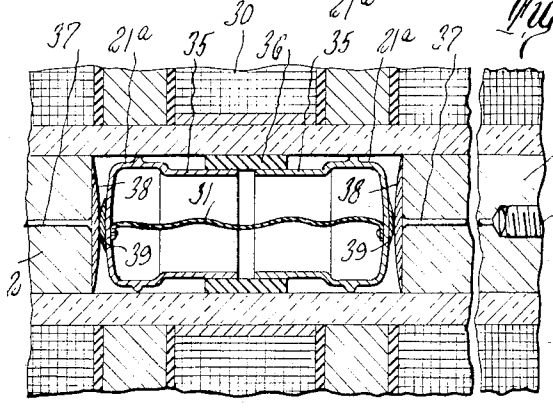


Fig. 5.

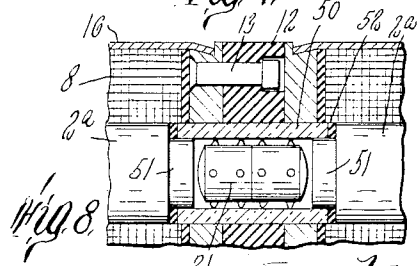


Fig. 8.

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RELAY

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8 Claims. (Cl. 200—98)

This invention relates to relays, and has for an object to provide a relay of small dimensions, which can be mounted and operated while in any angular position, and which cannot be jarred out of its normal condition whether that be open or closed, wherein friction is reduced to a very low value, and which is capable under very small controlling current flow of controlling relatively heavy load output.

Further objects and advantages will become apparent from a description of certain embodiments shown in the accompanying drawings in which

Figure 1 is a central longitudinal sectional view through a normally open relay embodying the invention.

Figure 2 is a transverse sectional view on line 2—2 of Figure 1.

Figure 3 is a fragmentary view similar to a portion of Figure 1, but to a larger scale and showing the contact elements in central longitudinal section.

Figure 4 is a side elevation partly broken away and in central longitudinal section showing a modified construction.

Figure 5 is a fragmentary longitudinal central sectional view showing the modification of Figure 4.

Figure 6 is a fragmentary side elevation of a relay such as is shown in Figures 1 to 5, inclusive.

Figure 7 is a view similar to Figures 3 and 5, but showing a normally closed relay.

Figure 8 is a view similar to a portion of Figure 1 and illustrating a further modification.

Referring to the construction shown in Figures 1 to 3, the relay comprises a tube **1** which may be of non-conductive, non-magnetic material as, for example, glass. Within this tube at each end is a core **2** of magnetizable material as, for example, soft iron, the two cores **2** being held in spaced relation by any suitable means such, for example, as a screw **5** threaded into the outer end of each core and extending through a disk wall member **6** of insulating material and an end wall **7** which may be of metal, these two walls together closing off the outer ends of the tube **1**.

The tube **1** has positioned thereover at each end portion a solenoid coil **8** by energization of which the cores **3** may be magnetized. These cores may be retained between the insulating disks **6** and insulating ring members **10** as by annular pole members **11** spaced apart by an insulating ring **12**. Each of the members **11** may be secured to the insulating spacer ring **12** as by screws **13** having their heads embedded in one of the members **11** and each having a cylindrical nut **14** threaded on its opposite end and seated in a socket **15** in the insulating ring. The solenoids **8** may be surrounded by cylindrical casing members **16** which may have their adjacent ends of reduced diameter at **17** and engaging annular shoulders **19** on the members **11**. Slots **20** through the casing members **16** permit the passage of conductors **23** leading to the solenoids **8**.

Between the cores **2** are positioned a pair of magnetizable armatures **21**, and as shown and for the purpose

of reduced friction these may be provided with annular ribs **22** which bear slidably against the inner face of the tube **1**. The solenoids **8** provide the actuating means for the controlling current by which the relay is operated while the cores **2** or conductors extending therethrough as shown in Figures 5 and 7 and the armatures **21** provide portions of the switch in the controlled circuit, the screws **5** providing the terminals for the controlled circuit. As shown, for example, in Figure 3, the armatures **21** may be cup-shaped having round ends **25** facing the cores **2** and they may be connected together as by a conducting spring **26** housed therein and having its ends secured in lugs **27** projecting inwardly from the closed ends **25**. The spring **26** normally pulls the armatures together into mutual contact as shown in Figure 1, so that one or both of the armatures **21** is out of electrical contact with its core **2**. However, when the solenoids **8** are energized, the armatures are drawn away from each other by repulsion between like poles of the armatures and into contact by attraction between opposite poles of the armatures and cores, with their cores **2**, thus making electrical connection between one of the terminal screws **5** at one end of the relay through its core **2** or conductor, its armature **21**, the connecting spring **26**, the other armature **21**, its core **2** or conductor and the opposite terminal screw **5**. Thus whenever the solenoids **8** are energized, electrical connection is completed, closing the controlled circuit.

In Figures 4 and 5 a modification is shown in which instead of employing a spring such as **26** to open the main circuit by pulling the armatures out of contact with their respective cores, a central solenoid **30** arranged between the solenoids **8** performs this function, energization of this central solenoid **30** causing the armatures **21***a* to be drawn together by attraction between opposite poles thereof and separating them from their cores **2**. In order that the main circuit may be closed when the solenoids **8** are energized, the armatures **21***a*, as shown in Figure 5, are connected by a flexible conductor **31**. This conductor has the conductive function of the spring **26** shown in Figure 3, but has no effect to pull the armatures toward each other and away from contacting with the cores **2**, which function is performed in this modification by energization of the central solenoid **30**. Also in this figure the inner ends of the armatures are shown as of reduced diameter as at **35** and they are slidably guided in a non-conductive non-magnetic sleeve **36**. Likewise for the sake of insuring better electrical conductivity, the adjacent ends of the cores **2** and the cooperating ends of the armatures **21***a* are shown as provided with buttons **38** and **39** of high conductive material such as silver or the like and the button **38** may be connected to the terminal screw **5** by conductor elements **37** having lower resistance than the cores **2** and which extend through these cores.

While in the structures previously described the main circuit has been closed by energization of the controlling solenoids **8** so that the relay is a normally open relay, it may be arranged to be normally closed, such an arrangement being shown, for example, in Figure 7. Referring to this figure, it will be noted that the armatures **21***b* are arranged reversed end to end from the showing of the previous figures and they are normally held into electrical contact with each other as by springs **40** housed thereby and reacting between the ends of their cores **2** and the closed heads **41** of the armatures. As shown these closed ends have conductive buttons **42** which are normally held into contact with each other by the springs **40**.

This Figure 7 shows, also, instead of the cores **2** being employed as conductive portions of the control circuit, separate conductors **43** are extended through the cores **2** and secured at their adjacent ends as at **44** to the closed

ends of the armatures 21*b*. Here, it will be noted, that whenever the controlling solenoids 8 are energized the armatures are pulled away from each other by repulsion between like poles of the armatures and attraction between opposite poles of the armatures and cores, thus breaking contact between the buttons 41 and so opening the controlled circuit.

In Figure 8 a further modification is shown which may be adapted to either normally open or normally closed relays and shown therein as applied to a normally open relay. In this modification instead of employing a tube 1 which houses not only the armatures but the cores 2, the armatures only are housed within a relatively short insulating tube 50 which may be seated in reduced diameter end portions 51 of the cores 2*a* and preferably with sealing rings 52 therebetween. The cores 2*a* may then directly carry the controlling solenoids 8.

In all of these structures, however, it is possible to seal the armatures hermetically so they are not subject to atmospheric conditions of moisture and the like and, if desired, the sealing made effective with a suitable inert atmosphere enclosed within the space in which the armatures are positioned.

From the foregoing description of certain embodiments of this invention it should be evident to those skilled in the art that various further changes and modifications may be made without departing from the spirit or scope of this invention.

I claim:

1. A relay comprising a tube of non-conducting material, a pair of magnetizable cores arranged in coaxial relation within said tube and spaced apart a predetermined distance, a pair of magnetizable armature elements magnetizable upon energization of said cores and slidably guided within said tube and together of insufficient length to bridge the space between said cores, means biasing said armatures toward one another and out of contact with at least one of said cores when said cores are unenergized, and axially spaced solenoids surrounding said cores and when energized causing said armatures to be separated from each other and each to contact with its respective core.

2. A relay comprising a tube of non-conducting material, a pair of magnetizable cores arranged in coaxial relation within said tube and spaced apart a predetermined distance, a pair of magnetizable armature elements magnetizable upon energization of said cores and slidably guided within said tube between said cores and together of insufficient length to bridge the space between said cores, means biasing said armatures toward one another and out of contact with at least one of said cores when said cores are unenergized, axially spaced solenoids surrounding said cores and when energized causing said armatures to be separated from each other and each to contact with its respective core, and an electric circuit including said cores and armatures and controlled by the positions of said armatures.

3. A relay comprising a tube of non-conducting material, a pair of magnetizable cores arranged in coaxial relation within said tube and spaced apart a predetermined distance, a pair of magnetizable armature elements magnetizable upon energization of said cores and slidably guided within said tube and together of insufficient length to bridge the space between said cores, axially spaced solenoids surrounding said cores and when energized causing said armatures to be separated from each other and each to contact with its respective core, means normally holding said armatures in mutual contact and out of contact with at least one of said cores, and a conducting element connecting said armatures.

4. A relay comprising a tube of non-conducting material, a pair of magnetizable cores arranged in coaxial relation within said tube and spaced apart a predetermined distance, a pair of magnetizable armature elements slidably guided within said tube and together of insufficient length to bridge the space between said cores, axially spaced solenoids surrounding said cores and when energized causing said armatures to be separated from each other and each to contact with its respective core, means normally holding said armatures in contact with each other comprising a conductive tension spring secured to said armatures, and an electric circuit including said armatures and tension spring controlled by the position of said armatures.

5. A relay constructed as in claim 1 in which said armatures each comprise a cup-shaped element having closed ends.

6. A relay constructed as in claim 1 in which said armatures each comprise a cup-shaped element having closed ends facing said cores and a conducting element connecting said closed ends.

7. A relay constructed as in claim 4 in which said armatures each comprise a cup-shaped element having closed ends facing said cores and said tension spring being enclosed thereby.

8. A structure as recited in claim 3 wherein the means normally holding said armatures in mutual contact comprises a solenoid surrounding said tube and located adjacent to the confronting portions of said armatures.

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