This invention relates to relays, and more particularly to a sealed relay or circuit closure particularly adapted for aircraft and explosion-proof applications.

It is among the objects of this invention to provide a relay for aircraft and explosion-proof applications in which the circuit-closing means is sealed in a chamber which is either evacuated or filled with an inert gas; to provide such a relay which is rugged and simple in construction; to provide such a relay in which the contacts are connected to external prongs adapted to plug into an electrical receptacle; and to provide such a relay which is magnetically actuated, and in which the magnetizing circuit includes prongs adapted to plug into an electrical receptacle; and to provide such a relay including a novel arrangement of magnetizing winding and movable armature.

These and other objects, advantages and novel features of the invention will become apparent from the following description taken in conjunction with the accompanying drawing. In the drawing:

Fig. 1 is a longitudinal sectional view of one form of the relay embodying the invention.

Fig. 2 is a cross-sectional view on the line 2—2 of Fig. 1.

Fig. 3 is a view on the line 3—3 of Fig. 1 looking in the direction of the arrows.

Fig. 4 is a longitudinal sectional view through a modified form of the invention.

Fig. 5 is a longitudinal sectional view through another modification of the invention.

Fig. 6 is a cross-sectional view on the line 6—6 of Fig. 5.

Fig. 7 is a left-hand end view of the relays shown in Figs. 1, 4 and 5.

Fig. 8 is a view similar to Fig. 1 showing the relay in the operated position.

Generally speaking, according to the principles of the present invention, an envelope of either magnetic or non-magnetic material is sealed at its open end to a base. The base has secured thereto sets of fixed contacts electrically connected to externally projecting prongs adapted to plug into an electrical receptacle. A magnetizing winding is mounted externally on the sealed envelope or chamber and is adapted to move a movable armature within the envelope toward the contacts. The armature supports circuit enclosing means adapted to bridge the contacts of each set. Means are provided to normally maintain the armature in a circuit opening position. Additional prongs are provided on the base for connecting the magnetizing winding to a source of current.

Referring to the embodiment of the invention illustrated in Figs. 1, 2 and 3 of the drawing, the relay is shown as comprising a base 18, preferably of insulating material, to which is sealed the open end of an envelope 15 or chamber of non-magnetic material such as glass. A magnetizable armature 20 is movably mounted within in envelope 15 and adapted to be operated by a magnetizing winding 25 mounted on the envelope. The base 10 contains sets of electrical contacts 11 which are electrically connected, or may be integral with, externally projecting prongs 12 on the base. Another set of prongs 13 is provided which are connected through conductors 14 to the ends of magnetizing winding 25. The prongs 12 and 13 are adapted to plug into a suitable electrical receptacle.

An abutment 16 is mounted adjacent the closed end 17 of the envelope 15. The armature 20 comprises an annulus 18 of magnetic material secured to a disk 21 which may be of insulating material, such as Bakelite. A spring 22 extending between disk 21 and abutment 16 normally urges armature 20 toward closed end 17 of envelope 15. Conductive strips 25, 26 are mounted on the outer face of disk 21 and are adapted to bridge the contacts 11 of each set, to electrically connect the same.

To provide a good magnetic circuit, the magnetizing winding 25 is enclosed within a shell 24 of magnetic material. Adjacent the magnetizing winding, a magnetic band or ring 25 is inserted, as by welding or soldering, in envelope 17. The band 26 is substantially the same width as the magnetic annulus 18 of armature 20. Band 26 is provided with latched lugs 27 cooperating with grooves 26 in annulus 18 and disk 21, for the purpose of holding strips 23 in proper alignment with the sets of contacts 11.

The operation of the device is as follows. The prongs 12 and 13 are inserted in a suitable electrical receptacle. Upon energization of magnetizing winding 25, armature or core 20 is moved to the left to cause the conductive strips 23 to bridge the contacts 11 of each set and complete an electrical circuit therebetween. In the operated position, the annulus 18 will be substantially aligned with the band 26, as shown in Fig. 8, the magnetic circuit being completed through shell 24, band 26 and annulus 18. Upon de-energization of winding 25, spring 22 will urge armature 20 back into engagement with abutment 16 as seen in Fig. 1.

The embodiment of the invention shown in Fig. 4 is substantially the same as that shown for Fig. 1. However, in this instance, the envelope 20 is of magnetic material and is provided with a band 31 of non-magnetic material adjacent winding 25. The operation is exactly the same as that of the embodiment shown in Fig. 1. However, in the embodiment shown in Fig. 4, the magnetic circuit is completed from shell 24 through envelope 20.
Fig. 5 illustrates a different arrangement of the means for moving the armature towards the closed end of the envelope. In this embodiment of the invention, an envelope 40 of non-magnetic material, such as glass, is secured to the base 10 and provided with a band 25 of magnetic material adjacent the magnetizing winding 25 enclosed in shell 24. The armature 20 is urged toward the closed end 41 of envelope 40 by a spring 42 mounted in a sleeve 43 secured to base 10. A pin 44 is secured to disk 21 and extends into sleeve 43 where it engages the compression spring 42. The operation of this embodiment of the invention is the same as that described in Fig. 1.

The invention has been shown and described as having two contact bridging strips 23 secured to the armature 20, and each adapted to cooperate with a pair of contacts 11. It will be obvious, however, that the arrangement of contacts may be varied as desired. Thus the arrangement may be such as to provide a single pole, double throw switch, or to provide for the bridging of any number of sets of contacts 11. For the particular arrangement disclosed in Figs. 1 through 6, the prong arrangement may be as shown in Fig. 7. As illustrated, the contacts 12 are arranged at the corners of a square, and the contacts 13 are aligned with each other and with one contact 12.

In all embodiments of the invention, the envelope may be either evacuated or filled with an inert gas, such as nitrogen, argon, etc., under a few atmospheres of pressure. By increasing the pressure of the inert gas, large inductive currents can be effectively handled with small gaps between the contacts. As the operating contacts are sealed in the chamber or envelope, the device is particularly adapted for use in locations where there is an explosion hazard. Due to the plug-in feature of the invention, the device is readily and easily mounted where desired, without much danger of dislodgement.

While, for the purpose of illustrating the principles of the invention, certain embodiments have been shown and described, it will be understood that the invention may be otherwise embodied without departing from the scope of such principles.

What is claimed is:

1. A circuit controller comprising, in combination a sealed chamber having a section of magnetic material and a section of non-magnetic material; sets of spaced electrical contacts fixedly mounted in said chamber; a core of magnetic material movable longitudinally of said chamber with respect to said electrical contacts; means urging said core away from said contacts; circuit closing means secured to said core and arranged to cooperate with said sets of contacts to electrically connect the contact of each set; a magnetizing winding mounted on said chamber in alignment with one of said sections and operative, when energized, to move said armature toward said contacts; and an annular housing of magnetic material enclosing said winding and extending longitudinally beyond said one section in both directions; said circuit closing means engaging said contacts when said core is aligned with said one section; said magnetic housing and said one section cooperatively effecting such alignment of said core.

2. A circuit controller comprising, in combination a sealed chamber containing an inert gas and having a section of magnetic material and a section of non-magnetic material; sets of spaced electrical contacts fixedly mounted in said chamber; a core of magnetic material movable longitudinally of said chamber with respect to said electrical contacts; means urging said core away from said contacts; circuit closing means secured to said core and arranged to cooperate with said sets of contacts to electrically connect the contacts of each set; a magnetizing winding mounted on said chamber in alignment with one of said sections and operative, when energized, to move said core toward said contacts; and an annular housing of magnetic material enclosing said winding and extending longitudinally beyond said one section in both directions; said circuit closing means engaging said contacts when said core is aligned with said one section; said magnetic housing and said one section cooperatively effecting such alignment of said core.

3. A circuit controller comprising, in combination an evacuated sealed chamber having a section of magnetic material and a section of non-magnetic material; sets of spaced electrical contacts fixedly mounted in said chamber; a core of magnetic material movable longitudinally of said chamber with respect to said electrical contacts; means urging said core away from said contacts; circuit closing means secured to said core and arranged to cooperate with said sets of contacts to electrically connect the contacts of each set; a magnetizing winding mounted on said chamber in alignment with one of said sections and operative, when energized, to move said core toward said contacts; and an annular housing of magnetic material enclosing said winding and extending longitudinally beyond said one section in both directions; said circuit closing means engaging said contacts when said core is aligned with said one section; said magnetic housing and said one section cooperatively effecting such alignment of said core.

4. A circuit controller comprising, in combination, a base; a sealed envelope secured to said base; sets of spaced electrical contacts fixedly mounted in said base; an armature of magnetic material movable longitudinally of said envelope with respect to said electrical contacts; means urging said armature away from said contacts; circuit closing means secured to said armature and arranged to cooperate with said sets of contacts to electrically connect the contacts of each set; a magnetizing winding mounted on said envelope and operative, when energized, to move said armature toward said contacts; said envelope including a band of magnetic material adjacent said winding; and an annular housing of magnetic material enclosing said winding and extending longitudinally beyond said band in both directions; said circuit closing means engaging said contacts when said core is aligned with said band; said magnetic housing and said band cooperatively effecting such alignment of said band.

5. A circuit controller comprising, in combination, a base; an evacuated sealed envelope secured to said base; sets of spaced electrical contacts fixedly mounted in said base; an armature of magnetic material movable longitudinally of said envelope with respect to said electrical contacts; means urging said armature away from said contacts; circuit closing means secured to said armature and arranged to cooperate with said sets of contacts to electrically connect the contacts of each set; a magnetizing winding mounted on said envelope and operative, when energized, to move said armature toward said contacts;
5. A relay comprising, in combination, a base; an envelope of magnetic material secured at its open end to said base; sets of spaced electrical contacts fixedly mounted in said base; an armature of magnetic material movable longitudinally of said envelope with respect to said electrical contacts; means engaging said armature away from said contacts; circuit closing means securing said armature and arranged to cooperate with said sets of contacts to electrically connect the contacts of each set; a magnetizing winding mounted on said envelope and operative, when energized to move said armature toward said contacts; said envelope including a band of magnetic material adjacent said winding; and an annular housing of magnetic material enclosing said winding and extending longitudinally beyond said band in both directions; said circuit closing means engaging said contacts when said armature is aligned with said band; said magnetic housing and said band cooperatively effecting alignment of said band.

6. A relay comprising, in combination, a base; an envelope of non-magnetic material secured at its open end to said base; sets of spaced electrical contacts fixedly mounted in said base; an armature of magnetic material movable longitudinally of said envelope with respect to said electrical contacts; means urging said armature away from said contacts; circuit closing means securing said armature and arranged to cooperate with said sets of contacts to electrically connect the contacts of each set; a magnetizing winding mounted on said envelope and operative, when energized to move said armature toward said contacts; said envelope including a band of magnetic material adjacent said winding; and an annular housing of magnetic material enclosing said winding and extending longitudinally beyond said band in both directions; said circuit closing means engaging said contacts when said armature is aligned with said band; said magnetic housing and said band cooperatively effecting alignment of said band.
mounted in said base; a magnetizing winding mounted on said envelope, said envelope including a band of non-magnetic material adjacent said winding; an armature of magnetic material movable longitudinally of said envelope with respect to said electrical contacts, said armature comprising an annulus of magnetic material and a disk of dielectric material secured thereto and said annulus having a width substantially equal to that of said band; means urging said armature away from said contacts; circuit closing means secured to said disk and effective to bridge the contacts of each set; said magnetizing winding being operative, when energized, to move said armature toward said contacts; and an annular housing of magnetic material enclosing said winding and extending longitudinally beyond said band in both directions; said circuit closing means engaging said contacts when said annulus is aligned with said band; said magnetic housing and said band cooperatively effecting alignment of said annulus and said band.

13. A relay comprising, in combination, a base; an envelope of non-magnetic material secured at its open end to said base and containing an inert gas; sets of spaced electrical contacts fixedly mounted in said base; a magnetizing winding mounted on said envelope, said envelope including a band of magnetic material adjacent said winding; an abutment adjacent the closed end of said envelope; an armature of magnetic material movable longitudinally of said envelope with respect to said electrical contacts, said armature comprising an annulus of magnetic material and a disk of dielectric material secured thereto and said annulus having a width substantially equal to that of said band; resilient means urging said armature toward said abutment; circuit closing means secured to said disk and effective to bridge the contacts of each set; said magnetizing winding being operative, when energized, to move said armature toward said contacts; and an annular housing of magnetic material enclosing said winding and extending longitudinally beyond said band in both directions; said circuit closing means engaging said contacts when said annulus is aligned with said band; said magnetic housing and said band cooperatively effecting alignment of said annulus and said band.

14. A relay comprising, in combination, a base; an envelope of magnetic material secured at its open end to said base and containing an inert gas; sets of spaced electrical contacts fixedly mounted in said base; a magnetizing winding mounted on said envelope, said envelope including a band of non-magnetic material adjacent said winding; an abutment adjacent the closed end of said envelope; an armature of magnetic material movable longitudinally of said envelope with respect to said electrical contacts, said armature comprising an annulus of magnetic material and a disk of dielectric material secured thereto and said annulus having a width substantially equal to that of said band; resilient means urging said armature toward said abutment; circuit closing means secured to said disk and effective to bridge the contacts of each set; said magnetizing winding being operative, when energized, to move said armature toward said contacts; and an annular housing of magnetic material enclosing said winding and extending longitudinally beyond said band in both directions; said circuit closing means engaging said contacts when said annulus is aligned with said band; said magnetic housing and said band cooperatively effecting alignment of said annulus and said band.
energized, to move said armature toward said contacts; and an annular housing of magnetic material enclosing said winding and extending longitudinally beyond said one section in both directions; said circuit closing means engaging said contacts when said core is aligned with said one section; said magnetic housing and said one section cooperatively effecting such alignment of said core.

18. A relay comprising, in combination, a base; an envelope of non-magnetic material secured at its open end to said base and containing an inert gas; sets of spaced electrical contacts fixedly mounted in said base; a magnetizing winding mounted on said envelope; said envelope including a band of magnetic material adjacent said winding; an armature of magnetic material movable longitudinally of said envelope with respect to said electrical contacts; said armature comprising an annulus of magnetic material and a disk of dielectric material secured thereto and said annulus having a width substantially equal to that of said band; a guide tube secured to said base; a pin secured to said armature disk and slidably engaging said guide tube; a compression spring in said guide tube engaging said base and the end of said pin; electrically conductive strips secured to said disk and effective to bridge the contacts of each set; said magnetizing winding being energized, to move said armature toward said contacts; and an annular housing of magnetic material enclosing said winding and extending longitudinally beyond said band in both directions; said circuit closing means engaging said contacts when said annulus is aligned with said band; said magnetic housing and said band cooperatively effecting alignment of said annulus and said band.

19. A relay comprising, in combination, a base; an envelope of non-magnetic material secured at its open end to said base, and containing an inert gas; sets of spaced electrical contacts fixedly mounted in said base; a magnetizing winding mounted on said envelope, said envelope including a band of magnetic material adjacent said winding; an armature of magnetic material movable longitudinally of said envelope with respect to said electrical contacts; means urging said armature away from said contacts; circuit closing means secured to said armature and arranged to cooperate with said sets of contacts to electrically connect the contacts of each set; contact prongs extending from said base and arranged to engage an electrical receptacle; circuit means connecting certain of said prongs to said contacts; other circuit means connecting a pair of said prongs to the opposite ends of said magnetizing winding; said magnetizing winding being operative, when energized, to move said armature toward said contacts and an annular housing of magnetic material enclosing said winding and extending longitudinally beyond said band in both directions; said circuit closing means engaging said contacts when said core is aligned with said band; said magnetic housing and said band cooperatively effecting alignment of said band.

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