Sept. 28, 1954 N. J. ANDERSON 2,690,487

RELAY

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Fig. 1

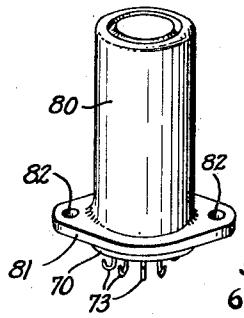


Fig. 2

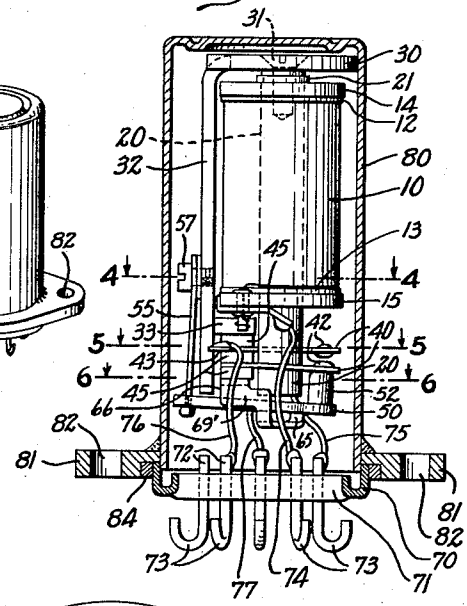


Fig. 3

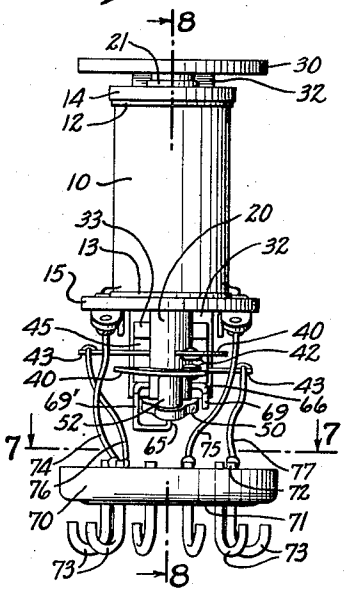


Fig. 4

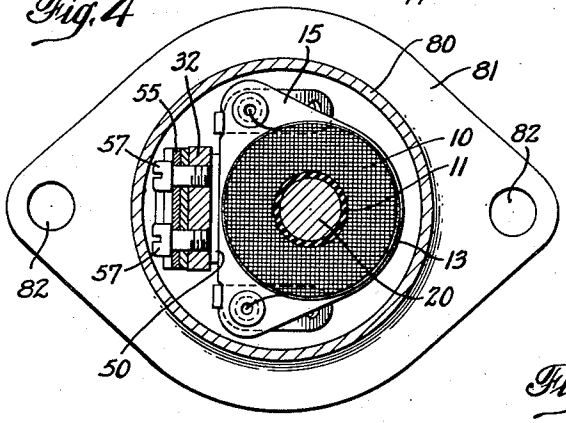


Fig. 5

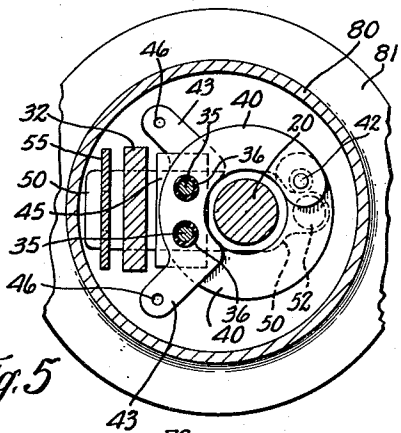


Fig. 6

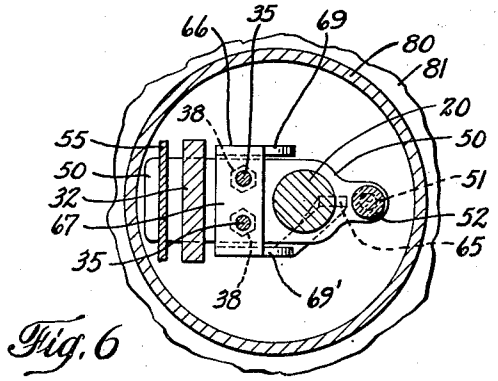
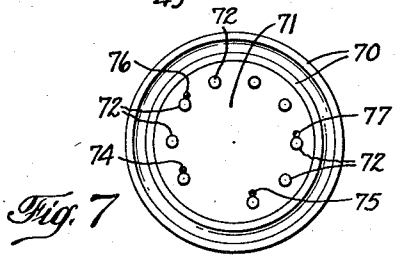


Fig. 7



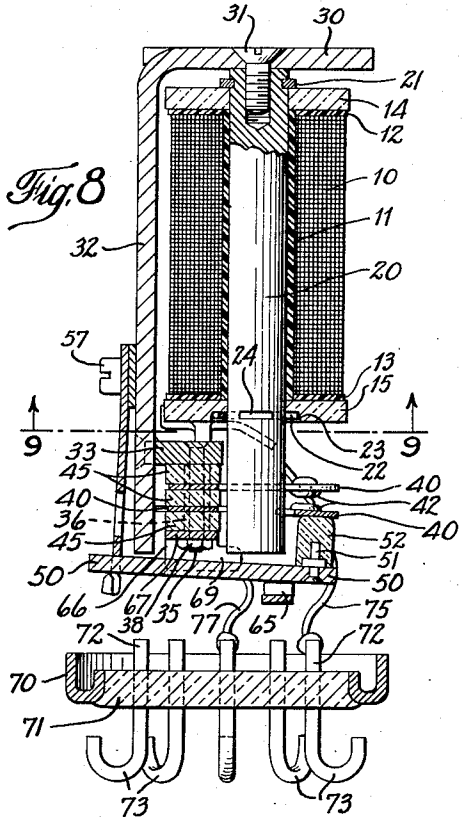
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RELAY

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Fig. 8



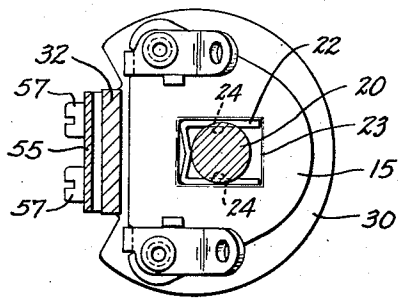


Fig. 9

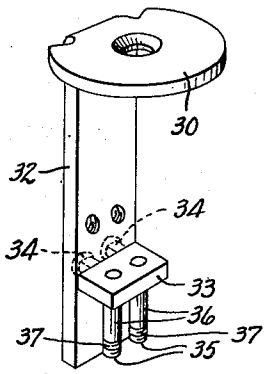
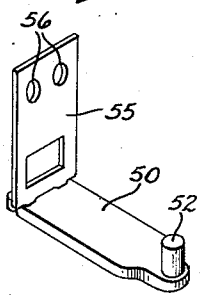


Fig. 10

Fig. 11



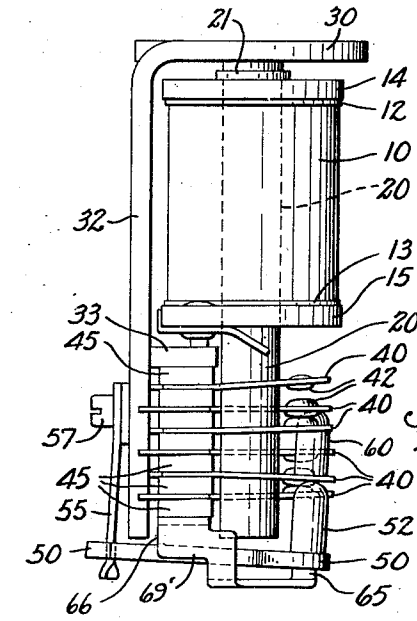


Fig. 14

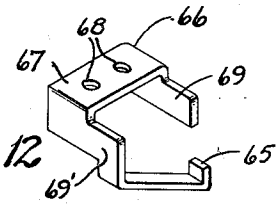


Fig. 12

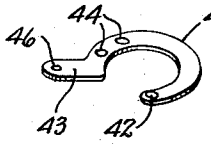


Fig. 13

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Patented Sept. 28, 1954

2,690,487

UNITED STATES PATENT OFFICE

2,690,487

RELAY

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Application May 24, 1952, Serial No. 289,837

8 Claims. (Cl. 200—104)

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The invention relates to electromagnetic relays.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the instrumentalities and combinations pointed out in the appended claims.

The invention consists in the novel parts, constructions, arrangements, combinations and improvements herein shown and described.

The accompanying drawings, referred to herein and constituting a part hereof, illustrate one embodiment of the invention, and together with the description, serve to explain the principle of the invention.

Of the drawings:

Fig. 1 is a perspective overall view of a relay embodying the invention shown in actual size;

Fig. 2 is an enlarged section, with the internal parts in elevation, of the relay of Fig. 1;

Fig. 3 is a view similar to Fig. 2 with the external casing removed;

Figs. 4, 5 and 6 are horizontal sections, further enlarged, on lines 4—4, 5—5 and 6—6, respectively, of Fig. 2;

Fig. 7 is a horizontal section on line 7—7 of Fig. 3;

Fig. 8 is a vertical section on line 8—8 of Fig. 3;

Fig. 9 is a horizontal section on line 9—9 of Fig. 8;

Figs. 10, 11, 12 and 13 are perspective details of various elements of the relay construction; and

Fig. 14 is a view similar to Fig. 2, without the outer casing and showing a modification of the relay for multiple contacts, with a double-pole, double-throw combination.

Objects of the invention are to provide a compact and conveniently shaped relay for light duty, the arrangements of the parts and the shape of the relay being such as to provide the maximum in space efficiency. The relay of the invention is particularly designed for fitting into the chassis of electrical equipment, such as in aircraft and missiles, where space requirements are paramount. Another object of the invention is to provide a relay having the approximate size and shape of a conventional, small vacuum tube so that it can be employed interchangeably with such tubes in chassis arrangement and design. Another object of the invention is to provide a relay having improved characteristics of sensitivity, reliability, low weight, resistance to shock and vibration and to a wide range of temperature so that the relay is extremely sensitive and precise in operation, but very rugged in withstanding

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conditions of use and having a long operating life.

Generally described, the novel arrangements and construction of the parts in my improved relay are such that the contact carrying springs and the elements cooperating therewith are all designed and positioned so as to occupy the annular space surrounding the core of the relay coil and to lie generally within the projected circumference of the coil itself. For this purpose I employ contact springs which are generally circular in form so that a substantial leverage can be obtained therefrom while still maintaining the springs within said annular space and conveniently arranged with respect to the other parts of the relay. The construction and arrangement of the armature which actuates the contacts, the interconnection, the insulation and the wiring of the contact carrying members and the very screws which hold the assembled contact carrying members together are all designed and arranged to fit compactly and efficiently within said restricted annular space, thereby giving the entire relay construction a generally cylindrical shape and arrangement so that it can be encased in a suitable housing of the size and shape of a small vacuum tube in accordance with the objects of the invention aforesaid.

It will be understood that the foregoing general description and the following detailed description as well are exemplary and explanatory but are not restrictive of the invention.

Referring now in detail to the present preferred embodiment of the invention, illustrated by way of example in the accompanying drawings, the cylindrical electromagnetic coil 10 of the relay is conventionally wound about an internal sleeve 11 of insulating material. The ends of the coil abut against an upper insulating washer 12 and a similar lower washer 13. The upper washer in turn abuts against the ceramic washer or annular base member 14. A generally similar ceramic base 15 underlies the lower end of the coil. A central core 20 of suitable magnetic material is fitted within the sleeve 11 and the base members 14 and 15. The upper end of the core projects a short distance beyond the upper face of the annulus 14 and is locked thereto by a riveted washer 24. The lower end of the core projects a substantial distance beyond the lower face of the annulus 15. As shown, said annulus or base plate 15 is locked to the core and thus locks together the entire coil assembly by means of a U-shaped resilient locking pin 22 which is seated in a rectangular recess 23 in the plate and passes

through slots 24, formed on either side of the core. The pin 22 fits intimately within the borders of the rectangular recess 23 and is indented at its closed end to provide spring-like contact and seating within the recess.

As will be clear from Fig. 8, there is an annular space about the projecting lower end of the core 20, the exterior of which space is defined by the projecting outer walls of the cylindrical coil assembly, and it is within said annular space that the switching and contact carrying elements of the relay are mounted for space efficiency in accordance with the invention. For so mounting said elements within said annular space, there is provided a mounting bracket fixed to the upper end of the coil, said bracket being essentially L-shaped and having a base member 30 which is centrally bored and countersunk to receive a flat-headed screw 31 which extends through the base 30 and into a threaded recess in the upper end of the core 20. The base 30 is slightly larger in diameter than the annulus 14 and is spaced therefrom by the projecting upper end portion of the core.

The other leg of the bracket is formed as a relatively narrow flat strip 32 which is bent down vertically from a notched-out portion of the circular plate 30 to extend along the coil 10 and for the length of the core 20, being spaced slightly from the outside of the coil and from the periphery of the annular member 15. For the purpose of mounting the curved contact-carrying springs within the annular space about the lower end of the core, the inner face of the bracket member 32 is provided with a shelf 33 extending at right angles from the face of the bracket leg and into said annular space. Said shelf is fixed to the inner face of the bracket 32 by rivets 34.

For the purpose of setting a plurality of contact carrying springs and spacing insulators on said shelf and within said annular space, there are provided two downwardly projecting screws 35 which are adapted to hold a pile of said insulators and contact springs. To save space while making said screws of suitable strength and also to insulate them from the members they support, the shanks of the screws are reduced in diameter between the threaded end portions thereof and the lower face on the shelf 33 and insulating sleeves 36 (Fig. 5) of "Teflon" or other suitable insulating plastic material are formed about the reduced shanks of the screws so as to lie flush with the projecting threaded ends 37 thereof. In order to assemble said sleeve of Teflon on the reduced shanks of the screws, they are first slid onto the screws over the upper, unthreaded ends thereof and then said ends are riveted into the upper face of the shelf 33.

As shown in detail in Fig. 13, contact-carrying springs 40 are provided in flat arcuate shape, the curved end of the spring carrying a button 42 of the switch contact material. These contact springs are sickle-like in shape, having a radially outwardly projecting shank 43, and are provided with two holes 44 near the shank portion. These holes are threaded over the insulated shanks 38 of the screws 35 so that the arcuate portion 40 of the spring member will lie curved about and spaced from the projecting core 20 and within the annular space described above. Rectangular blocks 45 of ceramic or other insulating material are also provided with holes to thread over the screws 35 so that a pile of alternately disposed insulating blocks 45 and

spring contact members 40 may be mounted on the screws 35 and shelf 33, as shown in Fig. 8 for example. It will be noted that in the form of relay shown in Figs. 1 to 13 a single pair of switch elements are shown, comprising switch contacts 42 on two spring members 40 which are mounted in the pile to embrace the core 20 from opposite directions, the members 40 being of such length as to bring the two contact pieces 42 in opposition to each other and being normally spaced apart so as to provide an open switch. The projecting shanks 43 on each contact spring extend angularly away from the pile and are provided with openings 46 for attachment of wires thereto as shown in Figs. 2, 3 and 4. It will be noted that these shanks also lie substantially within the annular space, and within the projected perimeter of base 15 (Fig. 4).

The invention also provides for mounting of the movable armature, which is designed to actuate the switch or switches of the relay, so that it also will lie substantially within the annular space. As embodied the armature comprises a flat strip of magnetic metal 50, the upper end of which is reduced to form a tongue to which is attached a stud 51 about which is fixed an insulating node 52 of ceramic insulating material. The latter, being cemented to the stud 51, constitutes the switch-actuating member extending at right angles from the free end of the armature. The armature 50 lies diametrically across and is normally spaced from the bottom end of the core 20, the upper end of the node 52 bearing against the bottom face of the lower contact spring 40 adjacent the free end thereof. The armature is normally held in this open position by a spring mounting comprising a flat leaf-spring member 55, the bottom end of which engages the outer end of the armature, as by the bent tongue pieces which traverse the end of the armature, as shown. The upper end of the spring 55 is provided with a pair of holes 56 by means of which it is attached by screws 57 to the outer face of the bracket member 32. It will be noted that the spring 55 is bent downwardly and outwardly away from the outer face of bracket member 32 and thereby holds the armature assembly in the open position as described. When the coil 10 is excited, the armature will be drawn toward the end of the core thereby to force the contact pieces 42 into engagement with each other and close the switch. Upon de-energization, the spring 55 returns the armature to the open position while the spring members 40 move apart under their own tensions.

In the modification of Fig. 14 there is shown a double-pole, double-throw switch relay in which six alternately arranged switch contact spring members 40 are mounted to provide two pairs of normally closed contacts, and two pairs which are normally open. An intervening insulating node 60 is mounted on the next to lowest spring contact and bears against the lower face of the next to highest contact member. Normally the two lowermost contact members are together for one closed circuit and the contacts on the second and third members from the top are similarly together. When the relay is energized, the armature breaks these pairs of contacts and makes those between the first and second and between the fourth and fifth contacts.

While two switch contact spring members 40 are shown in one form and six in the form of Fig. 14, it will be understood that greater and

lesser numbers of such springs and also of the contacts mounted thereon can be provided so as to arrange different combinations of switching and different numbers of switches within the relay.

A stop member 65 is provided to underlie the free end of the armature in both forms (Figs. 12 and 14) so as to limit the outward or switch-opened movement of the armature. This stop member lies at the end of the angular bracket 66 which is provided with a cross piece 67 apertured at 68 to be threaded onto the screws 35 and is fixed to the bottom ends thereof by the nuts 38 which bind the entire pile on the screws 35 (Fig. 6). The sides of the bracket constitute side guard members 69 and 69'. The side members 69 and 69' of the bracket enclose the sides of the armature and restrict it against lateral movement.

Referring now to the embodied means for seating or connecting the relay to sockets in the chassis or the like, there is provided a bottom closure comprising a channeled ring 70 to the inner surface of which is bonded a ceramic closing plate 71 of glass or the like. Projecting through said plate and bonded therein is a plurality of hook-like contact members 72, the upper ends of which project above the top of the plate and the lower portions of which extend through the plate downwardly and are curved upwardly to form a plurality of terminal hooks 73 for the attachment of wires or for seating in suitable female receptacles as may be required. It is understood that these contact members may be of different shapes depending upon the type of receptacle or wiring which may be required. The upper ends of the members 72 serve for connection by welded and soldered wires 74 and 75 to the terminals of the coil 10 while the other wires 76 and 77 are attached to the terminal shanks 43 of the contact springs. In the form of Fig. 14 it will be understood that the other hooks are wired to the other contact members as required.

For sealing the relay from moisture, dust, etc. and to protect it from shock, or the like, a cylindrical housing 80 is provided. Said housing is large enough to surround entirely the working parts of the relay while leaving ample space for clearance. The upper end of the housing is integral and closed, slightly overlying the upper face of bracket member 30. The housing is preferably locked to the relay by a crimping or indentation (not shown) just below the lower face of the bracket plate 30. The lower portion of the housing is provided with an integral flanged base terminating in ears 81 which are apertured at 82 for attachment of the relay to a chassis or other surface. The upper and outer edge of the base ring 70 is seated in an annular socket in the lower surface of the flanged base 81 just outside the outer walls of the cylindrical housing 80 and is preferably sealed thereto as by a solder seal 84. The sealed housing and assembly are preferably exhausted of air and filled with a dry inert gas just before hermetic sealing so as to avoid condensation of moisture and the like.

Due to the fact that the insulating plastics used on the coil and other insulated surfaces are resistant to wide temperature ranges, as are the ceramic insulators, the relay as shown and described is highly temperature resistant, and may have a working ambient temperature range as high as −65° C. to +200° C. The operating characteristics are unchanged for vibration frequency of 0 to 81 cps. at a total excursion of .06 inches. Under accelerations of 50 g. the operating characteristics remain practically unchanged from the non-accelerating condition. At no time will forces of this magnitude change the contact condition, whether the relay be energized or non-energized.

The invention in its broader aspects is not limited to the specific mechanisms shown and described but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

What I claim is:

1. A relay having in combination a cylindrical coil, a magnetic core therein projecting a substantial distance beyond one end of the coil, a plurality of curved contact-carrying springs fixed and supported on fulcra lying within the annular space around the projecting end of the core and within the projected outer cylindrical circumference of the coil, said springs lying around the core and having switch contact points also within said annular space, and an armature positioned adjacent the end of said core and operable when the coil is energized to move said switch contacts relatively to each other.

2. The relay of claim 1, wherein the armature also lies substantially within said annular space.

3. The relay of claim 1, wherein the number of said springs is more than two.

4. The relay of claim 1, wherein a double-pole, double-throw switch is provided by having at least three of said contact-carrying springs so mounted and movable within said annular space.

5. The relay of claim 1, wherein a double-pole, double-throw switch is provided by having six of said contact-carrying springs so mounted and movable within said annular space and the armature also lies substantially within said annular space.

6. The relay of claim 1, wherein the fulcra of said springs comprise an insulated pile supported by screws having insulating sleeves all located within said annular space, said sleeves being flush with the threaded portions of the screws.

7. The relay of claim 1 wherein the curved contact-carrying springs are formed in a flat arcuate shape so as to lie around the projecting core.

8. The relay of claim 1 wherein the curved contact-carrying springs are formed in a sickle-like shape so the springs will lie around the projecting core and have outwardly projecting shanks to be fixed and supported on fulcra lying within the annular space around the projecting core.

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