

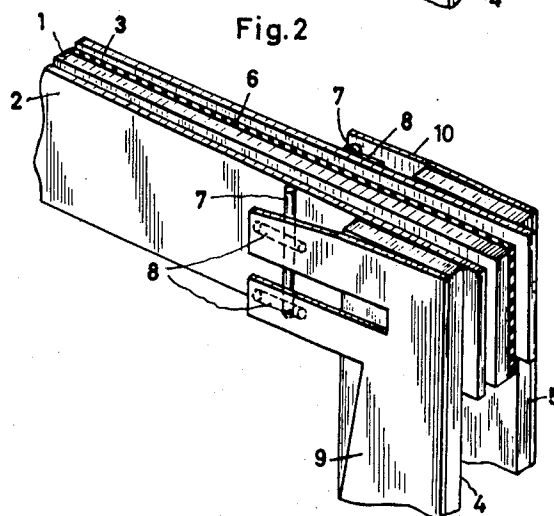
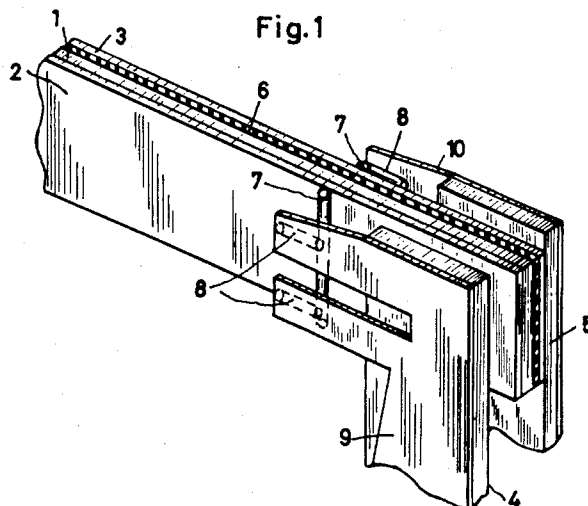
May 26, 1959


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ELECTROMAGNETIC RELAYS

2,888,532

Filed Jan. 25, 1956

3 Sheets-Sheet 1



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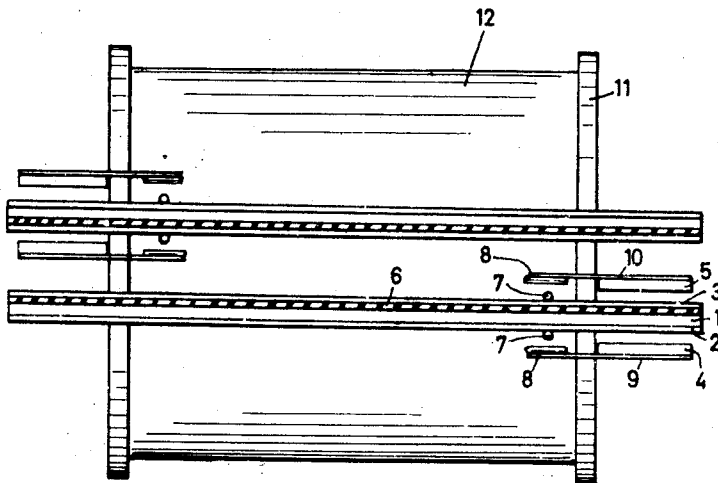
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**Fig. 3**



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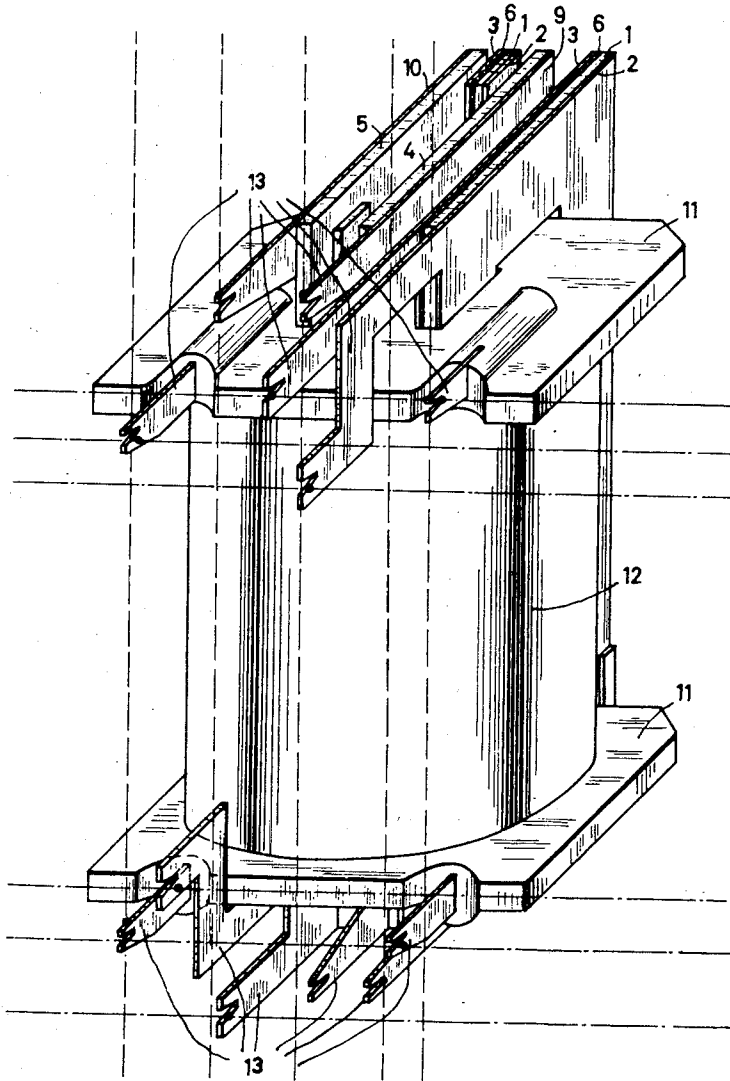
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Fig. 4



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2,888,532

## ELECTROMAGNETIC RELAYS

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Application January 25, 1956, Serial No. 561,320

Claims priority, application Germany February 5, 1955

5 Claims. (Cl. 200—87)

This invention is concerned with electromagnetic relays.

Relays of this type are provided with a current carrying coil surrounding a core of magnetically conductive material which is at its opposite ends magnetically oppositely polarized. In known embodiments, there are provided projecting pole pieces, one of such pole pieces carrying at one end thereof a movable member constituting an armature. The core is magnetized upon energization. The magnetic flux attempts to flow in a closed circuit over the pole pieces and the armature and across the air gap between the armature and the opposing pole piece, thereby causing attraction of the armature. The armature motion resulting from the attractive force of the opposing pole piece is utilized for the actuation of switching elements.

In prior relay arrangements, various attempts were made, partly by using suitable materials and partly by structural changes, to improve the switching effect at identical energization by reduction of losses occurring in the conversion of electrical into mechanical and thence into the motion energy which effects the switching operation. For example, the mass to be moved or displaced was held small by various expedients.

The invention points a new way toward a solution of the problems involved in obtaining with a given energization a switching effect as great as possible and achieves this aim by the provision of an armature in the form of a springy and magnetically conductive leaflike element which engages one pole piece, facing across an air gap the opposite pole piece, the pole pieces being laterally mutually displaced and overlapping at their free ends, the armature leaf engaging the pole piece being upon energization identically polarized and repelled by such pole piece and being at the same time attracted by the other pole piece which is upon energization oppositely polarized.

The advantage of the new arrangement as compared with prior structures is that the springy armature leaf is not only acted upon by the attractive force of the oppositely polarized pole piece but also by the repellent force of the identically polarized pole piece. The force acting upon the leaflike armature is thereby with identical energization increased and the switching effect is accordingly similarly improved. The arrangement according to the invention therefore makes it possible to provide with considerably reduced structural relay size for a switching effect equal to that of previously known relays.

In accordance with another object and feature, the number of switching operations to be performed by the relay are doubled by the arrangement of two springy leaflike members outside of one of the pole pieces and cooperation therewith of corresponding pole pieces which are upon energization oppositely polarized.

Further increase of the number of switching operations may be effected by providing a relay coil or winding with several mutually independent magnetic circuits each

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comprising a pole piece with one or two springy leaflike elements engaging the outside thereof and pole pieces respectively associated therewith which are upon energization oppositely polarized. The individual magnetic circuits are for space-saving reasons disposed mutually displaced.

The relay according to the invention is particularly suitable for switching electrical circuits. The leaflike elements and also the pole pieces are for this purpose made of electrically conductive material. They may however also be provided with coatings, for example, galvanically provided layers of electrically conductive material, or with conductive coatings, for example, in the form of foils.

The contact points are advantageously made of high-grade material, for example, silver. It is in this connection favorable to provide the cooperating contacts in the form of elongated elements which are arranged for crossing operation.

The mutually independent magnetic circuits are for better space utilization nestled in the coil body so that the contact points are disposed alternately at the opposite coil ends.

The coil body which is advantageously made of artificial material by pressing, die casting or molding is in accordance with a further object and feature of the invention provided with several parallel extending hollow spaces for receiving the individual iron or magnetic circuits. Each hollow space may be provided with suitably spaced grooves for receiving the individual parts of the corresponding iron circuits. The interposition of special insulating material is thereby avoided. In order to avoid the use of fastening means for the individual parts, such parts are made in undulating form or provided with projections for wedgelike disposal in the grooves.

The terminal members for the current-carrying elements of the relay according to the invention are particularly advantageously formed. They are provided in staggered different lengths and wedge- or fork-shaped at their free ends to extend over the rim of the corresponding coil disks. This formation makes it possible to slip the relay pluglike upon a likewise staggered bare wire multiple having perpendicularly extending elements. The relay is in this manner fixed in position without requiring any special fastening means outside of the necessary soldering at the terminal points.

If the relay is to be used in a circuit containing other electrical elements, for example, rectifiers, such elements may be built into the coil body and provided with corresponding terminal members for connection with the bare wire multiple. The ends of the coil winding are advantageously also connected with the multiple by means of such terminals.

The above indicated and additional objects and features will be brought out in the description of an embodiment of the invention which is rendered below with reference to the accompanying diagrammatic drawings. In these drawings

Figs. 1 and 2 illustrate the magnetic action in connection with an embodiment comprising two springy leaves engaging a pole piece, Fig. 1 showing the arrangement in deenergized and Fig. 2 in energized condition, the coil winding being omitted;

Fig. 3 is a plan view of a relay with two mutually independent iron circuits; and

Fig. 4 shows a perspective view of a relay with the terminal members for engagement with the bare wire multiple.

Referring now to Figs. 1 and 2, numeral 1 indicates a pole piece with associated springy leaves 2 and 3. Respectively associated with the leaves 2 and 3 are the pole pieces 4 and 5 which are also made of electrically con-

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ductive material or provided with suitable corresponding conductive coatings or layers. An insulating member 6 separates the two circuits thereby also insulating the pole pieces 4 and 5 against the leaves. When the relay is energized, the pole piece 1 and the leaves 2 and 3 will be similarly polarized and 1 will accordingly repel 2 and 3. The leaves 2 and 3 are at the same time attracted by the pole pieces 4 and 5 which are upon energization oppositely polarized, and the leaves 2 and 3 accordingly assume the positions shown in Fig. 2. The circuits to be switched are closed by way of elongated mutually crossing contact members 7 and 8, carried respectively by the leaves 2 and 3 and springs 9 and 10. Upon conclusion of the energization, the leaves 2 and 3 return due to their springy action into the normal position shown in Fig. 1.

In Fig. 3 is shown a relay coil 12 provided with several iron circuits for the purpose of increasing the number of switching circuits to be controlled. Numeral 11 indicates the coil spool. The contact points are mutually displaced for better utilization of the available space. Parts corresponding to those shown in Fig. 1 are similarly referenced.

An iron circuit may comprise a pole piece or shoe with springy leaves and respectively associated pole shoes or pieces disposed along its opposite sides, as shown in Figs. 1 and 2, or in simpler form, one pole piece associated with one leaflike element and a pole piece associated therewith.

As shown in Fig. 4, when the relay according to the invention is plugged in engagement with a multiple comprising crossing staggered bare wire conductors, each of the terminal members 13 of the relay will, due to the staggered arrangement of the multiple and its own terminal members, always establish connection with a predetermined one respectively associated conductor of the multiple. The terminal elements or members 13 are tapered for frictional engagement with the conductors of the multiple, such frictional engagement being secured by soldering, providing good contacting and being sufficient to hold the relay in position. This effect is obtained by wedge-shaped formation of the terminal members 13 and may also be obtained by another suitable, for example, forked formation thereof. Numeral 11 indicates end members of the coil spool; 12 indicates a coil or winding; the remaining numerals indicate correspondingly marked parts shown in Figs. 1-3.

Changes may be made within the scope and spirit of the appended claims which define what is believed to be new and desired to have protected by Letters Patent.

I claim:

1. Electromagnetic relay comprising a magnetizing coil, an electrically conductive and generally U-shaped first pole piece, an electrically conductive and generally U-shaped resilient leaflike member, said leaflike member disposed alongside said first pole piece, identical legs of said first pole piece and said leaflike member extending inside of said magnetizing coil and identical opposite legs thereof extending outside of said coil, the leg of said leaflike member extending outside said coil constituting an armature, an electrically conductive and second generally L-shaped pole piece having one leg thereof extending inside said coil adjacent said first pole piece and having the other leg thereof extending outside said coil with the free end thereof disposed opposite the free end of said armature and normally spaced therefrom by an air gap, an electrically conductive and generally L-shaped contact spring disposed alongside said L-shaped second pole piece, an extension carried by said spring, elongated mutually crossing contact means carried respectively by said armature and said extension, said extension of said contact spring formed with a slot to provide two arms, said contact carried by each arm for cooperation with the contact means carried by said armature, the exteriorly disposed leg of said first pole piece and correspondingly disposed leg of said leaflike member constituting said armature

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being upon energization of said coil identically polarized to set up a repellent force therebetween causing said armature to move away from said leg in the direction of the exteriorly extending leg of said second pole piece, the exteriorly extending leg of said second pole piece being coincidently oppositely polarized to produce an attractive force for said armature, each contiguous pole piece and leaflike member forming an electrical circuit, and insulating means separating the two circuits for insulating the pole pieces from the leaflike members.

2. Electromagnetic relay comprising a magnetizing coil, an electrically conductive and generally U-shaped first pole piece, an electrically conductive and generally U-shaped resilient leaflike member, said leaflike member disposed alongside said first pole piece, identical legs of said first pole piece and said leaflike member extending inside of said magnetizing coil and identical opposite legs thereof extending outside of said coil, the leg of said leaflike member extending outside said coil constituting an armature, an electrically conductive and second generally L-shaped pole piece having one leg thereof extending inside said coil adjacent said first pole piece and having the other leg thereof extending outside said coil with the free end thereof disposed opposite the free end of said armature and normally spaced therefrom by an air gap, an electrically conductive and generally L-shaped contact spring disposed alongside said L-shaped second pole piece, an extension carried by said spring, elongated mutually crossing contact means carried respectively by said armature and said extension, said extension of said contact spring formed with a slot to provide two arms, said contact carried by each arm for cooperation with the contact means carried by said armature, the exteriorly disposed leg of said first pole piece and correspondingly disposed leg of said leaflike member constituting said armature being upon energization of said coil identically polarized to set up a repellent force therebetween causing said armature to move away from said leg in the direction of the exteriorly extending leg of said second pole piece, the exteriorly extending leg of said second pole piece being coincidently oppositely polarized to produce an attractive force for said armature, each contiguous pole piece and leaflike member forming an electrical circuit, insulating means separating the two circuits for insulating the pole pieces from the leaflike members, and terminal means extending respectively from said armature and said second pole piece to the identical side of said relay.

3. Electromagnetic relay comprising a magnetizing coil, an electrically conductive and generally U-shaped first pole piece, an electrically conductive and generally U-shaped resilient leaflike member, said leaflike member disposed alongside said first pole piece, identical legs of said first pole piece and said leaflike member extending inside of said magnetizing coil and identical opposite legs thereof extending outside of said coil, the leg of said leaflike member extending outside said coil constituting an armature, an electrically conductive and second generally L-shaped pole piece having one leg thereof extending inside said coil adjacent said first pole piece and having the other leg thereof extending outside said coil with the free end thereof disposed opposite the free end of said armature and normally spaced therefrom by an air gap, an electrically conductive and generally L-shaped contact spring disposed alongside said L-shaped second pole piece, an extension carried by said spring, elongated mutually crossing contact means carried respectively by said armature and said extension, said extension of said contact spring formed with a slot to provide two arms, said contact carried by each arm for cooperation with the contact means carried by said armature, the exteriorly disposed leg of said first pole piece and correspondingly disposed leg of said leaflike member constituting said armature being upon energization of said coil identically polarized to set up a re-

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pellent force therebetween causing said armature to move away from said leg in the direction of the exteriorly extending leg of said second pole piece, the exteriorly extending leg of said second pole piece being coincidentally oppositely polarized to produce an attractive force for said armature, each contiguous pole piece and leaflike member forming an electrical circuit, insulating means separating the two circuits for insulating the pole pieces from the leaflike members, and said magnetizing coil comprising a spool body, said spool body having channels formed therein for respectively receiving the leg of said first pole piece and the cooperating leg of said leaflike member and the legs of said second pole piece and cooperating contact spring.

4. Electromagnetic relay comprising a magnetizing coil, an electrically conductive and generally U-shaped first pole piece, an electrically conductive and generally U-shaped resilient leaflike member, said leaflike member disposed alongside said first pole piece, identical legs of said first pole piece and said leaflike member extending inside of said magnetizing coil and identical opposite legs thereof extending outside of said coil, the leg of said leaflike member extending outside said coil constituting an armature, an electrically conductive and second generally L-shaped pole piece having one leg thereof extending inside said coil adjacent said first pole piece and having the other leg thereof extending outside said coil with the free end thereof disposed opposite the free end of said armature and normally spaced therefrom by an air gap, an electrically conductive and generally L-shaped contact spring disposed alongside said L-shaped second pole piece, an extension carried by said spring, elongated mutually crossing contact means carried respectively by said armature and said extension, said extension of said contact spring formed with a slot to provide two arms, said contact carried by each arm for cooperation with the contact means carried by said armature, the exteriorly disposed leg of said first pole piece and correspondingly disposed leg of said leaflike member constituting said armature being upon energization of said coil identically polarized to set up a repellent force therebetween causing said armature to move away from said leg in the direction of the exteriorly extending leg of said second pole piece, the exteriorly extending leg of said second pole piece being coincidentally oppositely polarized to produce an attractive force for said armature, a further leaflike member similar to said first named leaflike member disposed alongside the other side of said first pole piece, an insulating member for mutually insulating the armature-forming legs of said leaflike members, and a third pole piece having a contact spring cooperating therewith for contact making cooperation with said further pole piece.

5. Electromagnetic relay comprising a magnetizing coil, an electrically conductive and generally U-shaped first

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pole piece, an electrically conductive and generally U-shaped resilient leaflike member, said leaflike member disposed alongside said first pole piece, identical legs of said first pole piece and said leaflike member extending inside of said magnetizing coil and identical opposite legs thereof extending outside of said coil, the leg of said leaflike member extending outside said coil constituting an armature, an electrically conductive and second generally L-shaped pole piece having one leg thereof extending inside said coil adjacent said first pole piece and having the other leg thereof extending outside said coil with the free end thereof disposed opposite the free end of said armature and normally spaced therefrom by an air gap, an electrically conductive and generally L-shaped contact spring disposed alongside said L-shaped second pole piece, an extension carried by said spring, elongated mutually crossing contact means carried respectively by said armature and said extension, said extension of said contact spring formed with a slot to provide two arms, said contact carried by each arm for cooperation with the contact means carried by said armature, the exteriorly disposed leg of said first pole piece and correspondingly disposed leg of said leaflike member constituting said armature being upon energization of said coil identically polarized to set up a repellent force therebetween causing said armature to move away from said leg in the direction of the exteriorly extending leg of said second pole piece, the exteriorly extending leg of said second pole piece being coincidentally oppositely polarized to produce an attractive force for said armature, a further leaflike member similar to said first named leaflike member disposed alongside the other side of said first pole piece, an insulating member for mutually insulating the armature-forming legs of said leaflike members, a third pole piece having a contact spring cooperating therewith for contact making cooperation with said further pole piece, a plurality of first and second pole pieces respectively coacting with associated leaflike members and contact springs, and the contact making parts of said elements being disposed at opposite ends of said magnetizing coil.

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