

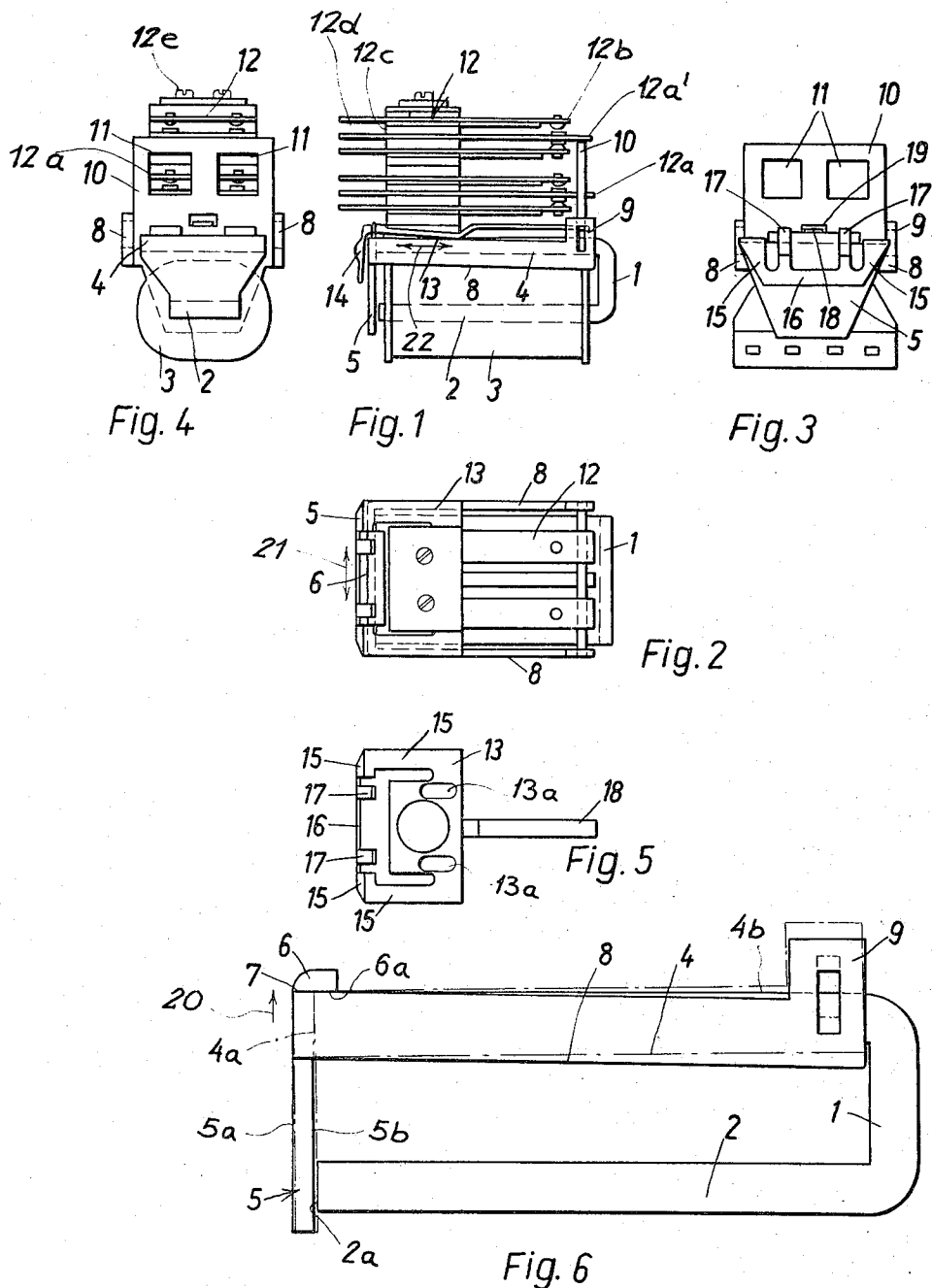
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ELECTROMAGNETIC RELAY WITH IMPROVED ARMATURE-CORE ASSEMBLY

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ELECTROMAGNETIC RELAY WITH IMPROVED ARMATURE-CORE ASSEMBLY

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ABSTRACT OF THE DISCLOSURE

Electromagnetic relay having an armature pivotally movable about an edge of the shank of a U-shaped yoke whose other shank is surrounded by the coil and provided with an arm extending along the first-mentioned yoke which carries a stack of leaf contacts. A spring is anchored by the stack of contacts to the shank and has a portion extending around the angularly bent armature for applying a storing force thereto, while a tongue of the spring extends along the shank for biasing the actuating plate remote from the fulcrum edge of the armature. The actuating plate operates upon the leaf contacts.

My present invention relates to electromagnetic relays and, more particularly, to improvements in electromagnetic relays having movable armatures for displacing contacts and adapted to form a magnetic path with an electromagnetically energizable core.

While many designs have been proposed for electromagnetic relays of the character described, in general, it may be noted that most were unsuitable for many applications by virtue of the fact that they were incapable of obtaining a maximum energy utilization from a magnetic coil having a small number of ampere-turns. For the most part, these disadvantages were due to the particular armature construction used inasmuch as many arrangements required considerable electromagnetic force for attracting the armature to energize the relay; moreover, disadvantages arose from the fact that conventional armature constructions could not maintain a closed magnetic path in the closed condition of the electromagnetic device or a substantially continuous magnetic path between the core and the armature in the deenergized condition. Thus, in most instances, a large part of the magnetic flux was dissipated even though large cores and armatures were provided and even though the core was in the form of a yoke designed to enhance the flux delivered to the armature. Soft-iron core-and-armature assemblies of this general character were found to be inconvenient when designed in accordance with prior practices because of the gap in the magnetic path between the core and the armature. The gaps or interruptions were especially pronounced when hinge assemblies or the like were used between the support and the armature pivotally mounted thereon.

It is, therefore, the principal object of the present invention to provide an electromagnetic relay with a substantially continuous magnetic path between a movable armature and a core assembly of such nature that the construction can be used in miniature relays, is relatively simple, is free from disadvantages creating a tendency toward failure, and is inexpensive of manufacture.

A more specific object of this invention is to provide an electromagnetic relay with a minimum number of movable component parts and which is operable with maximum assurance in the sense that there is little tendency toward breakdown and deterioration of its components.

These objects and others which will become apparent

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hereinafter are attained, in accordance with the present invention, by providing an electromagnetic relay whose core is constituted as a generally U-shaped yoke of magnetically permeable material (e.g. soft iron), while an electromagnetically operable coil surrounds one of the shanks of the yoke, the other shank having a fulcrum edge along its surface parallel to the yoke shank but remote from the coil. The armature, according to the present invention, comprises an arm fulcrumed on that edge and bridging the ends of the yokes, and an angular flange extending around the fulcrum edge and overlying the longitudinal surface of the other shank of the yoke remote from the coil. The flange and arm of the armature thus form a vertex in which the angular edge on the outer forward end of the other shank is received much in the manner of a knife edge so that a continuous path is maintained for the magnetic flux. Advantageously, the armature further comprises a pair of other arms, formed unitarily with the first-mentioned arm and the rearwardly turned flange, extending longitudinally along the other shank of the yoke while flanking the latter whereby the bent flange is disposed centrally between these further arms of the armature. Lateral movement of the armature with respect to the yoke is prevented by a spring means bearing upon the armature in such manner as to hold the latter in edge or surface contact, even during movement of the armature, with the yoke. This contact is sufficient to prevent the formation of even a momentary interruption in the magnetic continuity between the yoke and the armature. The spring, according to the invention, acts upon the armature in such manner that the bent flange is in surface contact with the longitudinal face of the other shank of the yoke when the relay is in a deenergized state. Thus, when the yoke is magnetized upon energization of the coil, there are no interruptions of the flux through the yoke and the armature as a consequence of poor magnetic-field conduction between the two. Both the edge and the edge and surface contact described above guarantee complete magnetic conduction. Advantageously, the armature is so arranged, that, when the free end of the first-mentioned arm is drawn against the free end of the shank surrounded by the coil, this arm will bear upon the front end of the other shank with surface contact to ensure the formation of a closed magnetic path through the yoke and the armature.

According to a more specific feature of this invention, the spring means simultaneously forms a yieldable retaining member for the armature. Thus, the spring means, which can be mounted upon the aforementioned surface of the other shank of the yoke by the contact stack, can have formations yieldably bearing upon the armature via, for example, the outer surface of the flange for retaining the armature against sidewise movement (i.e. movement in the longitudinal direction of the first-mentioned arm). The spring means thus not only biases the armature to bring the flange into surface contact with the yoke in the de-energized position of the relay but also resiliently holds the armature in place during its swiveling movement about the edge.

The above and other objects, features and advantages of the present invention will become more readily apparent from the following description, reference being made to the accompanying drawing in which:

FIG. 1 is a side-elevational view of an electromagnetic relay embodying the invention;

FIG. 2 is a plan view of the relay;

FIG. 3 is an end elevational view of the relay of FIG. 1 taken from the left-hand side thereof with the contacts removed;

FIG. 4 is an end-elevational view of the assembly of FIG. 1 taken from the right-hand side thereof with the contacts in place;

FIG. 5 is a plan view of the spring means of the assembly; and

FIG. 6 is a side-elevational view, drawn to an enlarged scale of the yoke and armature of the assembly.

From the drawing, it can be seen that the electromagnetic relay of the present invention comprises a core-forming yoke 1 of magnetic permeable material (e.g. soft iron) of generally U-configuration, whose shanks 2 and 4 are mutually parallel and are joined together at the 'bight' of the U. The energizing coil 3 of the relay is mounted upon shank 2 while the other shank 4 carries a magnetically attractable armature generally designated 5.

The armature 5 is provided with a rearwardly angularly bent flange 6 at right angles to the arm 5a of the armature bridging the ends 2a and 4a of the yoke shanks. The flange 6 thus forms with the arm 5a a right-angle vertex which receives the outer forward edge 7 of shank 4 this edge constituting a fulcrum for the armature and snugly engaging same so that a continuous magnetic path is maintained between the armature and this leg of the yoke. The relatively short flange 6 is so disposed that, in the energized state of the relay and the coil 3, the arm 5a is attracted toward the core face 2a so that the surface 5b of the arm 5a is in surface contact with both ends 2a and 4a of the legs of the yoke 1. In the de-energized state of the relay, the inner surface 6a lies along the outer surface 4b of shank 4 with surface contact as indicated by the solid-line position of the armature in FIG. 6. In the energized condition, the armature 5 assumes the position indicated by dot-dash lines in FIG. 6. Laterally of the flange 6 and disposed below the fulcrum edge 7, the armature 5 is provided with a pair of further arms 8 which flank the leg 4 of the yoke while extending generally parallel thereto. The arms 8 are provided with upstanding formations 9 at their free ends remote from the fulcrum for receiving an actuating member in the form of a plate 10.

The plate 10 of the contact-actuating means is provided with a plurality of throughgoing openings (FIGS. 1, 3 and 4) through which the leaf contacts 12a of the contact means can pass for actuation by the plate 10. The contact means 12 comprises the usual stack of stationary or "rest" leaf-spring contacts 12b and movable contacts 12a, 12a' adapted to be shifted into engagement with the stationary contacts by the actuating member 10. Insulating layers 12c are disposed between the contact while the latter are provided with terminal tabs 12d for affixed leads to the contacts 12a, 12a' and 12b. The stack is held in place by a pair of bolts 12e passing vertically through the stack and anchored in tapped bores in the shank 4. As will be apparent from FIGS. 1 and 5, a spring means 13 is disposed between the stack 12 of contacts and the yoke shank 4 which forms a seat for this spring element. The latter is provided with openings 13a through which the bolts 12c can pass.

The spring 13 comprises a transversely bent portion 14 (FIG. 1) overlying the arm 5a of the armature 5 and thus extending around the fulcrum edge to run parallel to this arm. The bent portion 14 is formed by a pair of resilient formations 15 (FIGS. 3 and 5) connected via a bridging web 16. The resilient formations and bridge are shown bent upward (out of the plane of the paper) in FIG. 5. A pair of resilient tongues 17 extend from the bridge 16 and bear upon the flange 6 (FIG. 2) to hold it firmly against the fulcrum edge 7. On the other side of the spring element 13, a relatively narrow longitudinally extended shank portion 18 is provided. This resilient member runs parallel to the shank 4 and extends into an opening 19 in the contact-actuating member 10, the opening 19 being so disposed that the plane through the edge 7 and the point 19 at which member 18 engages the actuating plate 10 is perpendicular to the latter, thereby ensuring that a minimum friction develops between the actuating member 10 and the spring means 13, 18. The spring means 13, 15, 17 also ensures that there will be no

lateral shifting of the armature in the direction of arrows 20 (FIG. 6) and 21 (FIG. 2). The shank portion 18 serves to restore the armature to its de-energized position and is effective over a moment arm equal substantially to the product of the length of the arms 8 and the force applied by member 18 to the actuating member 10. I have also found that this arrangement makes it possible to control the restoring force applied to the armature merely by adjusting the location at which the spring element 18 bears upon the contact member 10. For this purpose, the spring element 13 may be adjusted in the direction of arrow 22 (FIG. 1) via the slotted opening 13a to vary the location in which the member 18 bears upon the contact-actuating member 10. It is important that the force-distance characteristic of the spring means have a small slope so that the tolerance of adjustment of the restoring force will be proportionately large and the ampere-turn value of the relay corresponding to the movement of the armature can be substantially negligible. It will be understood further that the spring arrangement renders the retaining function totally independent of the restoring function so that sensitivity of the device is not reduced by the need for resisting dislocation of the armature.

The invention described and illustrated hereinabove is considered to admit of many modifications and variations which will be readily apparent to those skilled in the art and are intended to be included within the spirit and scope of the appended claims.

I claim:

1. An electromagnetic relay, comprising:
 - a magnetically permeable yoke of generally U-shaped configuration having a pair of mutually parallel shanks;
 - an electrically energizable magnet coil surrounding one of said shanks;
 - a magnetically attractable armature carried by said yoke, said armature having an arm bridging the ends of said shanks and a flange extending angularly from said arm and forming with said arm an angular junction pivotally supporting said armature upon an outer edge of the other of said shanks, said other of said shanks having a surface remote from said magnet coil and said flange overlying said surface, and at least one further arm extending along said other shank;
 - contact means on said other of said shanks, said contact means including a stack of contacts affixed to said yoke at an intermediate location along said surface of said other of said shanks;
 - contact-actuating means carried by said armature and engageable with said contact means for displacing same upon energization and de-energization of said coil, said contact-actuating means including a member extending transversely to said surface and disposed at the extremity of said further arm remote from said flange and entrainable with said further arm; and
 - a spring anchored to said other shank along said surface at said stack and extending around said angular junction at one side of said stack to bear upon said armature against the magnetic force generated by said coil, said spring having an integral resiliently deflectable tongue on the other side of said stack overlying said surface and extending therealong, said tongue having a free end engaging said member and resiliently biasing same.
2. An electromagnetic relay as defined in claim 1 wherein said spring integrally includes a pair of retaining formations engaging said flange for limiting lateral displacement of said armature.
3. An electromagnetic relay as defined in claim 2 wherein said retaining formations extend parallel to the outer surface of said armature and are bridged at their extremities, a pair of resilient tongues projecting from the bridge connecting said formations and resiliently bear-

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ing against said armature for holding same resiliently against said edge of said other shank.

4. An electromagnetic relay as defined in claim 1 wherein said contact means includes a plurality of generally parallel leaf contacts extending longitudinally in the direction of said other shank, said member including a plate engageable with said leaf contacts and having a cut-out for receiving said free end of the tongue of said spring.

5. An electromagnetic relay as defined in claim 4 wherein the plane between said edge and the location on said member at which said shank portion engages same is substantially perpendicular to said member.

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6. An electromagnetic relay as defined in claim 4 wherein said plate is provided with at least one opening for receiving one of said leaf contacts.

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