July 25, 1967 R. F. STEHLIK 3,333,216

UNENCAPSULATED REED CONTACT RELAY

Filed Oct. 21, 1965 4 Sheets-Sheet 1

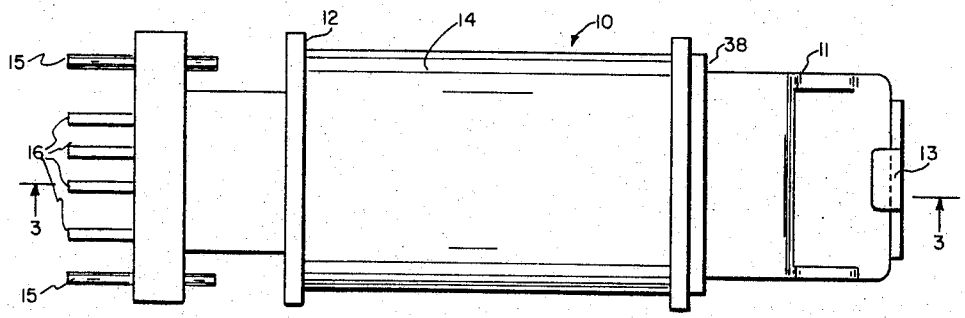

FIG. 1

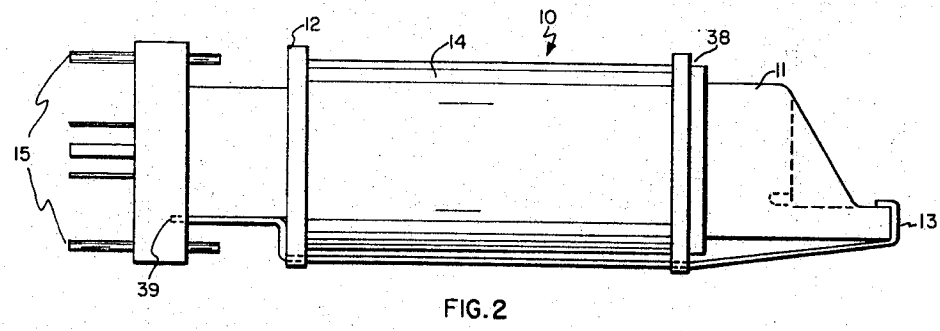

FIG. 2

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July 25, 1967 R. F. STEHLIK 3,333,216

UNENCAPSULATED REED CONTACT RELAY

Filed Oct. 21, 1965 4 Sheets-Sheet 2

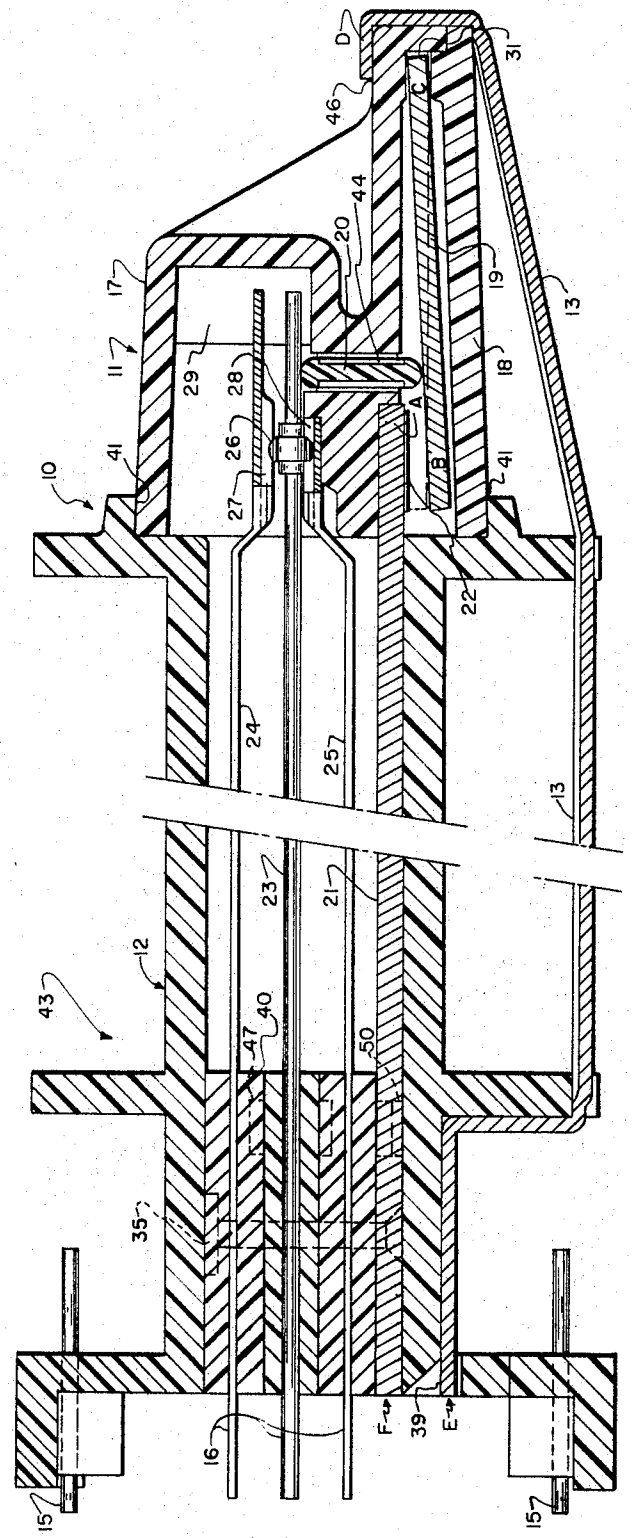

FIG. 3

UNENCAPSULATED REED CONTACT RELAY

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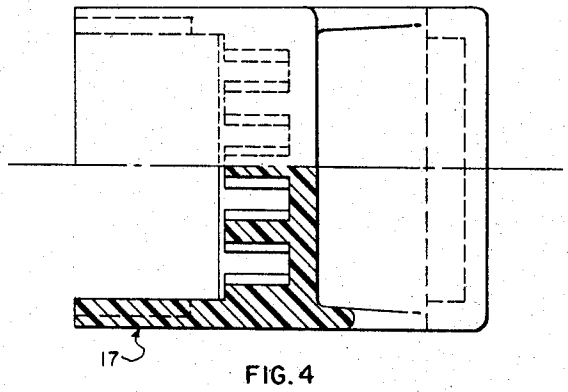

FIG. 4

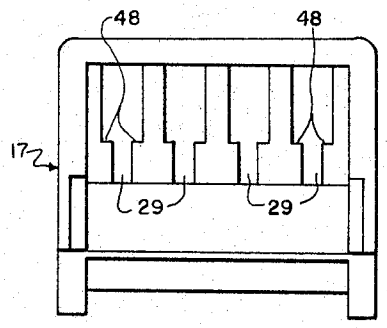

FIG. 5

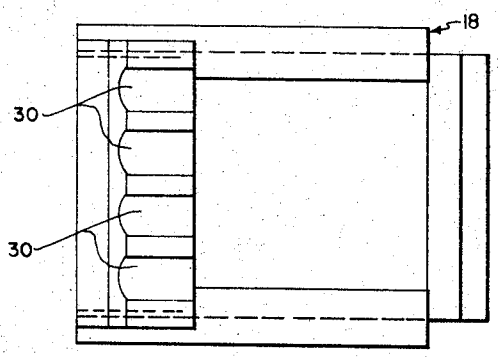

FIG. 6

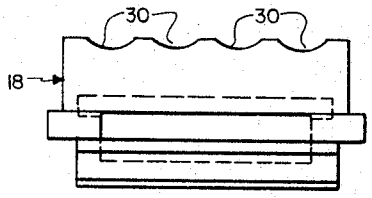

FIG. 7

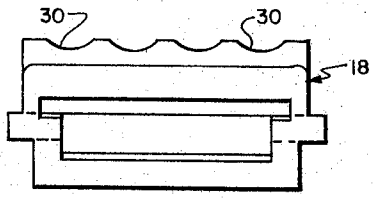

FIG. 8

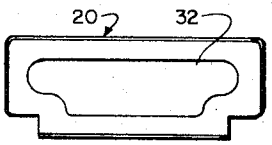

FIG. 9

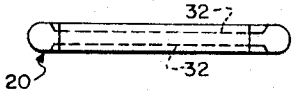

FIG. 10

UNENCAPSULATED REED CONTACT RELAY

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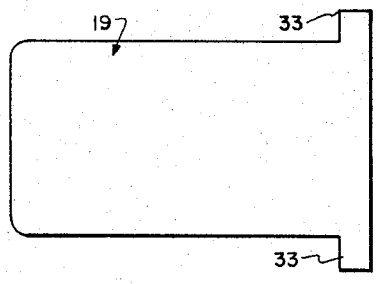

FIG. 11

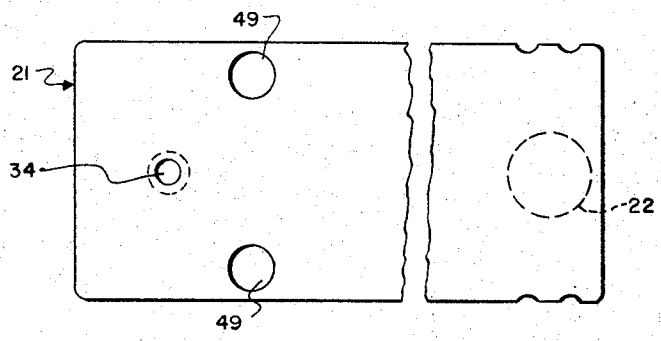

FIG. 12

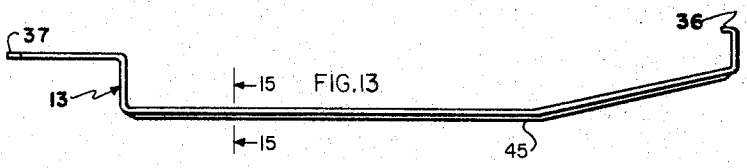

FIG. 13

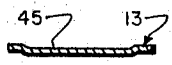

FIG. 15

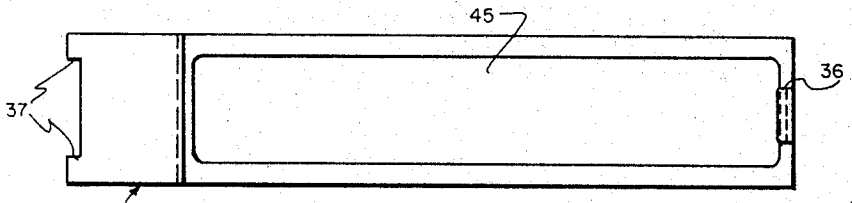

FIG. 14

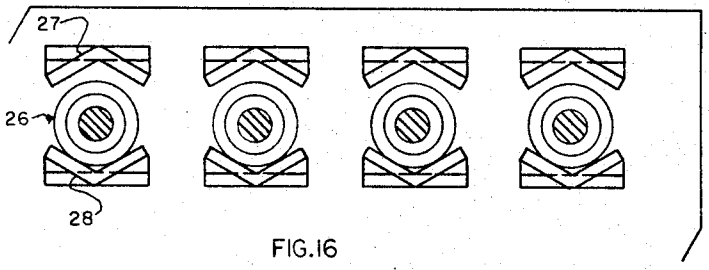

FIG. 16

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UNENCAPSULATED REED CONTACT RELAY

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Filed Oct. 21, 1965, Ser. No. 499,800
5 Claims. (Cl. 335—106)

ABSTRACT OF THE DISCLOSURE

An electromagnetic relay with a housing having first and second interlocking portions. Within the first portion, about which there is wound an operating coil, there is mounted a magnetic core and contact sets comprising "make" and "break" springs with V-shaped contact areas and armature springs with circular contact areas. The free ends of the contact springs and magnetic core extend into the second housing portion, which itself comprises two interlocking sections between which there is mounted an armature and an armature cam to operate the contact springs. In the second housing portion, the free ends of each set of contact springs protrude into a chamber-like opening, formed when the sections of the second portion are interlocked, and each opening includes a back stop and a shoulder portion upon which the "make" and "break" springs rest, respectively, to prevent bounce. The first and second housing portions are maintained interlocked by means of a magnetic coupling strip attached thereto, which also serves as a magnetic return path between the relay armature and core.

This invention relates to relays and in particular to plug-in relays having unencapsulated contact springs protected by an outer housing.

U.S. Patent 3,128,356 to G. S. Lychyk et al., issued April 7, 1964, shows a dry reed relay of the plug-in variety comprising an insulating bobbin which houses glass encapsulated reed switches, and which may be in conjunction with a printed circuit matrix card of the general type shown e.g. in U.S. Patent 3,193,731, P. K. Gerlach et al., issued July 6, 1965.

The relay according to the present invention is, in a way, an improved alternative to the aforementioned dry reed relay, and it may be used in connection with a printed circuit matrix of a design similar to that shown in the above patent although many other uses are also possible.

It is accordingly one of the objects of the present invention to provide a relay which incorporates many of the advantages of a dry reed relay, and at the same time has many advantages which the dry reed relay lacks.

More particularly, it is an object of the invention to provide a relay whose springs are entirely removed from the magnetic circuit of the relay, thus allowing for the use of larger, thicker springs, which in turn provide for higher contact ratings and longer spring life.

Another object of the invention is the provision of a relay permitting the use of a variety of spring combinations rather than mere "makes" as in conventional dry reed relays.

Another object of the invention is to provide a relay, the springs of which are independent of the armature of the relay, and are accessible at any time for adjuting without interference with the armature adjustment.

Still another object of the invention is to provide a relay which can be used in conjunction with a printed circuit card and, more particularly, a printed circuit matrix card.

A feature of this invention is an interlocking housing which comprises the outer closure of the relay according to the invention.

Another feature of the invention is a strip which has a two fold purpose of: (1) providing a spring for maintaining the housing portions of the relay according to the invention in an interlocking relation and (2) providing a magnetic return path for the magnetic circuit of the relay according to the invention.

Still another feature of the relay according to the invention is that a portion of its housing receives the free ends of the springs to provide individual chambers for each set of springs and supports for dampening oscillations of the springs during operation.

Another feature of the relay according to the invention is the V-shape of the break and make springs at their contact areas and the circular contact area on the armature springs which fit into the V-shaped make and break springs to insure adequate contact mating.

Other objects and features of the invention will become more apparent by reference to the following description taken in conjunction with the accompanying drawings of which:

FIG. 1 is a top view of a preferred embodiment of a relay according to the invention.

FIG. 2 is a side view of the relay of FIG. 1.

FIG. 3 is a sectioned view of the relay of FIG. 1 along the line 3—3.

FIG. 4 is a top view of the upper section of the right hand interlocking portion of the relay shown in FIG. 3.

FIG. 5 is a front view of the section of FIG. 4.

FIG. 6 is a top view of the lower section of the right hand interlocking portion of the relay shown in FIG. 3.

FIG. 7 is a rear view of the section of FIG. 6.

FIG. 8 is a front view of the section of FIG. 6.

FIG. 9 is a front view of the armature cam of the relay of FIG. 3 according to the invention.

FIG. 10 is a top view of the armature cam of FIG. 9.

FIG. 11 is a top view of the armature of the relay of FIG. 3 according to the invention.

FIG. 12 is a top view of the core of the relay of FIG. 3 according to the invention.

FIG. 13 is a side view of the magnetic return strip of the relay of FIG. 3 according to the invention.

FIG. 14 is a top view of the magnetic return strip of FIG. 13.

FIG. 15 is a sectioned view of the magnetic return strip of FIG. 13 along the line 15—15.

FIG. 16 is sectioned view of the contacting portion of the relay springs of the relay of FIG. 3 according to the invention.

FIG. 1 shows a preferred embodiment of a relay according to the invention. Relay **10** comprises two interlocking housing portions **11** and **12**. The left hand portion **12** has coil **14** wound thereabout. Coil terminals **15** and terminal portions **16** of the relay springs protrude from portion **12** so that the relay may be plugged into a printed circuit card.

FIG. 2 shows a side view of relay **10**. Here, magnetic return strip **13** can be seen snapped on to right hand portion **11** and secured in portion **12** at point **39**.

FIG. 3 is a sectional view of relay **10**. Looking first at the left hand portion **12**, it can be seen that relay springs **23**, **24**, and **25** and core **21** are held in position within portion **12** by means of assembly pin **35**, and are insulated from one another by insulation **40** which also serves to lock the relay springs and core in place by means of protrusions **47**. Moving to the right of FIG. 3, section **43** is provided so that operating coil **14** (FIGS. 1 and 2) may be wound about portion **12** of the relay housing. As can be seen, the free ends of armature, make and break springs **23**, **24**, and **25**, respectively, extend into portion **11** of relay **10**. Portion **11** comprises two interlocking sections **17** and **18**, which in turn interlock with portion **12** at point **41**. Armature **19** is pivotly

mounted in groove **44** which is formed when sections **17** and **18** are joined together.

On the free end of core **21** there is located a residual disc **22** which prevents armature **19** from sticking to the core end upon deenergization of the coil. Once again magnetic return strip **13** can be seen holding inter-locking sections **17** and **18**, which comprise portion **11**, and portion **12** securely in place.

It is to be noted that the magnetic circuit of relay **10** follows the path *a, b, c, d, e, f* and thus relay springs **23**, **24** and **25** are entirely removed therefrom. Armature cam **20**, which is non-magnetic, supplies the physical link to operate the springs. Thus the springs of the relay need not be made of magnetic material, and because they are not within the magnetic circuit of the relay, may be larger, thicker springs to provide higher contact ratings and longer spring life.

In the embodiment shown, both housing portions **11** and **12** are made of a transparent polymethyl methacrylate material.

FIGS. 4 and 5 show more detailed views of section **17** which comprises the upper half of portion **11** as shown in FIG. 3. Looking at these views, it becomes apparent that relay **10** has four sets of contacts each comprising an armature make, and break spring, as shown in FIG. 3. Each of the sets of springs has been provided with its own chamber-like opening **29** to guide and house the free ends of the armature and make springs. In this manner, it is less likely that any one of the sets of springs will interfere with the other sets during the operation of the relay. Also, each set has its own guide to insure positive functioning of the relay. Portions **48** serve as back stops for make springs **24** to prevent oscillations thereof.

FIGS. 6, 7 and 8 show in more detail, section **18** which is the lower half of portion **11** as shown in FIG. 3. Here, shoulder portions **30** provide a stop for the break springs **25**. Shoulder portions **30** also help to dampen spring oscillations which may occur upon deenergization of the relay coil.

FIGS. 9 and 10 show in detail armature cam **20** which is located at position **44**, FIG. 3, between sections **17** and **18**. As can be seen in FIG. 9, armature cam **20** is wide enough to operate all of the four armature springs **23** of relay **10** (see FIG. 3) at once. Also, in a preferred embodiment of the relay, armature cam **20** is made of lightweight acetal delrin and in addition has a cut-out center portion **32** to provide an even lighter load for the relay armature **19**, thus using a minimum of current to operate the relay.

FIG.11 shows armature **19**. Here, edge portions **33**, by which armature **19** is pivotally mounted between sections **17** and **18** can be readily seen. Armature **19** is slightly wider than armature cam **20** at their contact area to insure that an equal force is applied to all of the armature springs as they are operated.

FIG. 12 shows a top view of core **21** of the relay. Residual disc **22** is provided at the free end of core **21** to prevent the relay from being held operated when the coil is deenergized. Core **21** is wider than armature **19** at their point of contact, also to insure adequate mating. Aperture **34** is provided to allow assembly pin **35** (FIG. 3) to secure core **21** along with the relay springs, in position in portion **12** of the relay, and apertures **49** are provided to receive a pair of insulation protrusions **47** and a raised portion of the housing **50** to prevent the core from shifting.

A preferred material for core **21** is nickel-iron.

FIGS. 13, 14, and 15 show in detail magnetic return strip **13**. The strip is wide with an indented center portion **45** and is located along one side of relay **10**.

Portions **37** are fitted into portion **12** at points **39** of the relay housing and then lip **36** is snapped over portion **11** (as shown in FIG. 3) to secure the housing of relay **10**. Magnetic return strip **13** has the additional function

of completing the magnetic circuit of the relay. A preferred material for return strip **13** is pure soft iron with a zinc plating which has been chromate treated.

FIG. 16 shows a cross section of the contact areas **26**, **27**, and **28** of springs **23**, **24**, and **25**, respectively. The armature spring contact area **26** is circular and the make and break spring contact areas **27** and **28** are V-shaped, preferably at a 120° angle. The purpose of designing the springs as shown is to insure a good contact when the relay is operated. More contact surface area is provided by shaping the contacts as shown, thus better mating is provided. In the embodiment shown, the springs are made of nickel-silver with a silver-palladium inlaid strip covering the contact surface.

A more detailed description of the relay and its operation according to the invention will now be given.

First the relay will be plugged into position on a printed circuit card by means of its terminal portions **15** and **16**. Now it is ready for operation. To operate relay **10**, the relay coil is energized. This moves the free end of armature **19** which is pivotally mounted at position **31** between sections **17** and **18** upward toward the free end of core **21**. As armature **19** is drawn close to core **21**, armature cam **20**, which is movably mounted at position **44**, between sections **17** and **18** (see FIG. 3), substantially perpendicular to armature **19**, is lifted. In turn armature cam **20** rests against armature springs **23** and lifts them so that their contact areas **26** will break with contact areas **28** of break springs **25** and make with contact areas **27** of make springs **23**.

When the coil is deenergized armature cam **20** will be pushed against armature **19** due to the force of the tensioned armature springs **23** and make springs **24**. Armature **19** will in turn move away from core **21** without sticking because of residual disc **22** at the free end of core **21**. Thus the relay is returned to its normal state.

It will be noted that shoulder portions **30** of section **18**, shown best in FIGS. 6, 7, and 8, and portions **48** of section **17** serve to dampen the oscillations of break springs **25** and make springs **24**, respectively, which may tend to bounce when the relay returns to its unoperated condition.

Adjustment of the relay springs is simple to accomplish. It may be done without unplugging relay **10** from its position in the printed circuit card.

First magnetic return strip **13** is snapped away from the relay housing by removing it first from point **46**. Next it is pulled out of its imbedded position **39** in portion **12**. When magnetic return strip **13** is disconnected, portion **11** may be removed from portion **12** exposing the free ends of the relay springs and making them accessible for adjustment. If need be, sections **17** and **18** making up portion **11** can be separated and armature cam **20** may be replaced. Also, armature **19** may then be removed and replaced or any necessary work then may be done on it.

Replacement of the parts after an adjustment has been made is accomplished in a manner reverse from the disassembling procedure mentioned above.

Thus, the relay according to the invention may be adjusted with very little effort and all parts are easily replaceable if the need arises.

In summary the relay according to the invention incorporates many of the advantages of a dry reed relay such as speed of operation and the use of an enclosed housing to keep the relay contacts dust and dirt free. An additional advantage is that the springs and thus the contact areas are removed from the magnetic circuit of the relay to permit the use of larger contacts to allow higher contact ratings, and to make it possible to use springs made of non-magnetic material. Also the relay according to the invention provides an increased magnetic circuit efficiency, allowing, e.g., groups of break-make contact combinations to be used in a single relay.

It will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broadest aspects and therefore the aim in the appended claims is to cover all such changes and modifications as in the true spirit and scope of this invention.

What is claimed is:

1. An electromagnetic switching device comprising: housing means of non-magnetic material having a first and second portion; said first portion carrying winding means and having mounted therein a magnetic core and a plurality of non-magnetic spring contact members and insulated from one another and from said core, one end of each said spring members protruding from one end of said first portion to form terminals, said second portion comprising mutually interlocking sections, with an armature and armature cam located between said sections, said second portion being removably interlocked with said first portion, and said armature through the medium of said armature cam upon energization of said winding means being magnetically attracted by said core to actuate the free end of said spring members; and a coupling strip for maintaining said first portion and said section of said second portion in an interlocked relation and providing a magnetic return path between said armature and said core.

2. An electromagnetic switching device as claimed in claim 1, wherein said armature is pivoted between said sections of said second portion at a point remote from said first portion and said armature cam is substantially perpendicular to said armature and located between said sections at another point intermediate said first portion and said first mentioned point.

3. An electromagnetic switching device as claimed in claim 1, wherein said plurality of non-magnetic spring contact members comprise one third make, one third break and one third armature springs, wherein one of said sections of said second portion has integrally molded therein a plurality of chamber-like openings, each having back stop portions, and the other of said sections has integrally molded therein a plurality of correspondingly aligned shoulder portions and wherein the free ends of said armature and make springs enter said chamber-like opening with the free ends of said make springs resting on said back stops and said break springs resting on said shoulder portions so that upon deenergization of said winding means said make and break springs are substantially prevented from bouncing.

4. An electromagnetic switching device as claimed in claim 3, wherein the contact area of each of said make and break springs is substantially V-shaped and the contact area of each of the armature springs is substantially circular to insure adequate mating of said contacts.

5. An electromagnetic switching device comprising: a housing of non-magnetic material having a first and second portion; said first portion including a plurality of spring contact members and a magnetic core, and carrying winding means, said second portion being removably interlocked with said first portion, armature means supported in said second portion and upon the energization of said winding means, being magnetically attracted by said core to actuate said spring contact members; and a coupling strip of magnetic material, external of, and removably attached to said first and second portions and being in close relation with said armature means, for maintaining said portions in said interlocked relation and providing a magnetic return path between said armature means and said core.

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BERNARD A. GILHEANY, *Primary Examiner.*

H. A. LEWITTER, *Assistant Examiner.*