Feb. 24, 1970 A. E. WOOD, JR., ETAL 3,497,841

MAGNETIC LATCH RELAY

Filed Aug. 30, 1967 2 Sheets-Sheet 1

FIG. 1.

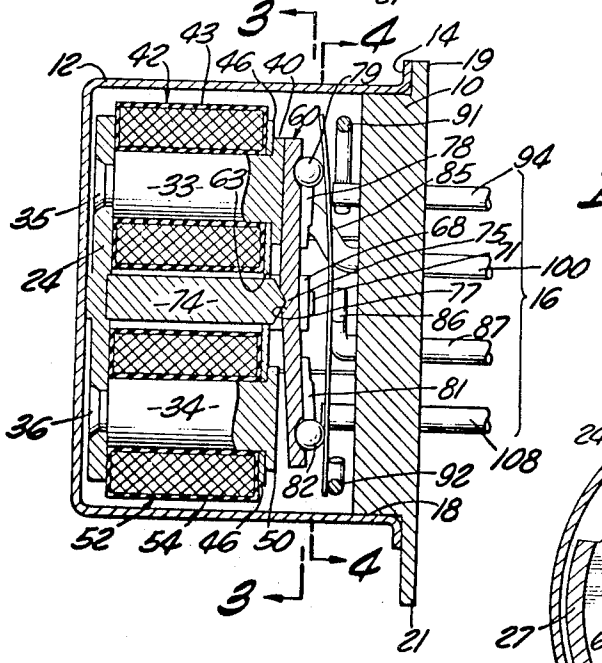

FIG. 2.

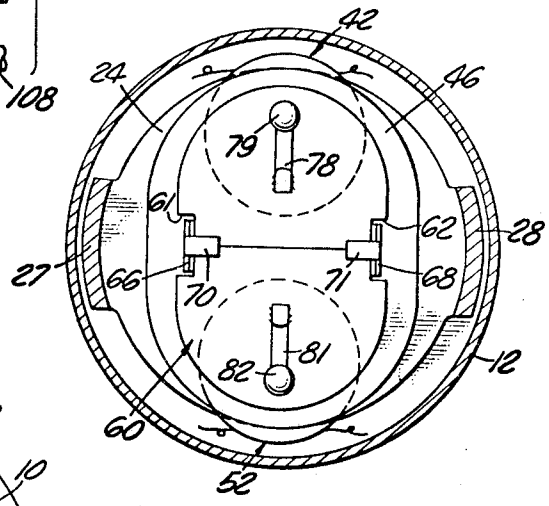

FIG. 3.

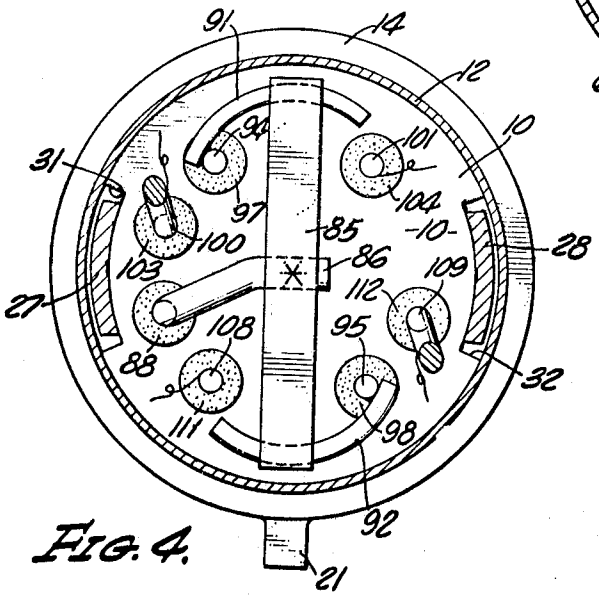

FIG. 4.

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MAGNETIC LATCH RELAY

Filed Aug. 30, 1967 2 Sheets-Sheet 2

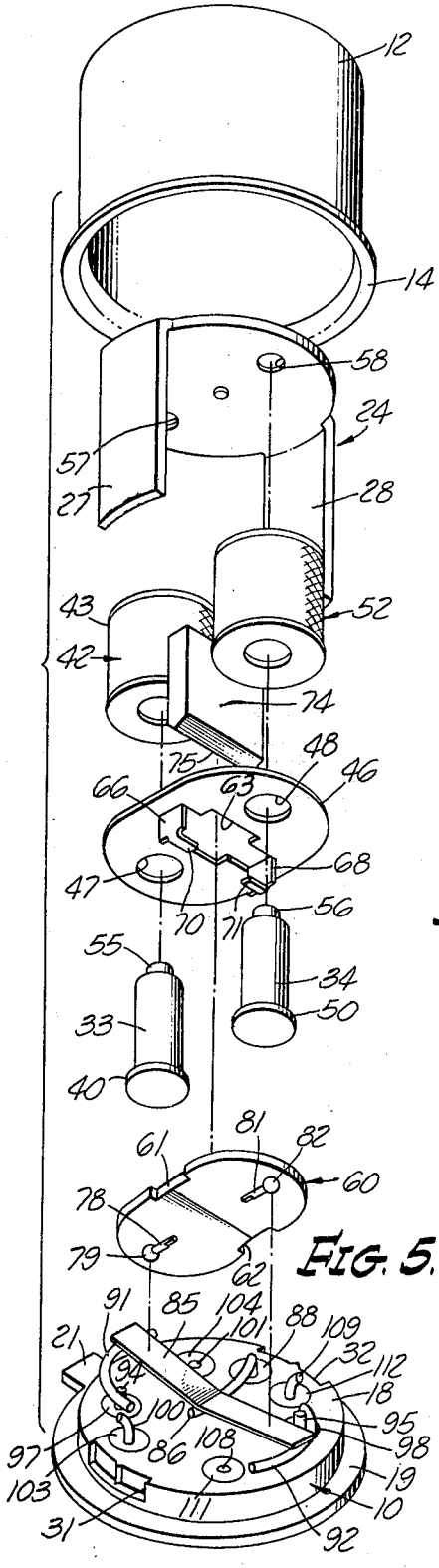

FIG. 5.

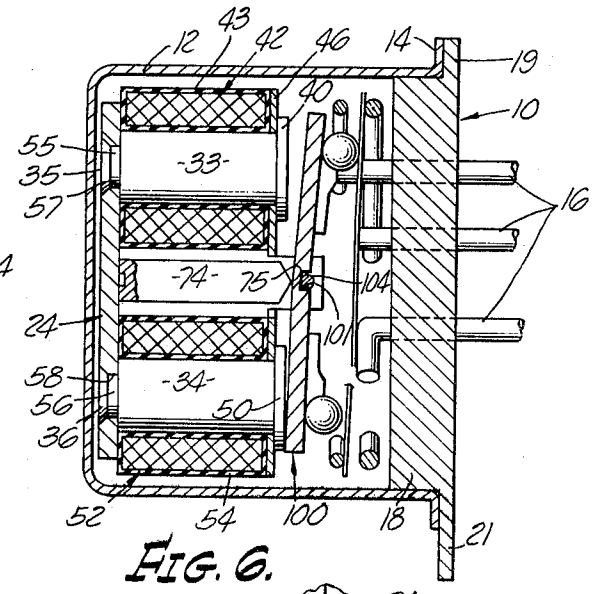

FIG. 6.

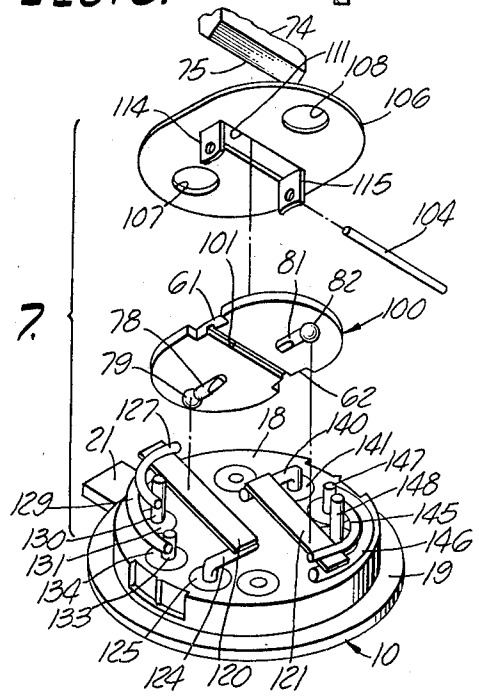

FIG. 7.

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United States Patent Office 3,497,841 Patented Feb. 24, 1970

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MAGNETIC LATCH RELAY

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Continuation-in-part of application Ser. No. 456,226, May 17, 1965. This application Aug. 30, 1967, Ser. No. 664,419

Int. Cl. H01h 9/02

U.S. Cl. 335—179 10 Claims

ABSTRACT OF THE DISCLOSURE

A magnetic latch relay is disclosed in which a pair of electromagnets, a centrally disposed permanent magnet and an associated pivotable armature are all mounted from a common yoke element which supports the components away from the relay base assembly. The armature is supported by an intermediate plate and is adapted to pivot about a knife edge formed from one end of the permanent magnet.

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of an earlier filed application Ser. No. 456,226, filed May 17, 1965, now abandoned.

This invention relates to improvements in electrical relays particularly as to mounting and packaging of parts. Exemplary forms of the invention are disclosed as magnetic latch type relays having a novel and improved construction. The relay is referred to as a latch type relay inasmuch as it is a bi-stable device, that is it is stable in two different positions which, may, for example, represent the "on" and "off" positions of a switch. In one form of the invention, as described in detail herein, it takes the form of a bi-stable electromagnetic relay providing single pole, double throw contact operation. In another form of the invention double pole, double throw contact operation is provided. The relay is of a type wherein the bi-stable operation is achieved through the use of a permanent magnet associated with an electromagnetic means and an armature. The electromagnetic means can, of course, be energized and de-energized. In the invention as described herein, the energization and de-energization of the electromagnetic means changes the magnetic flux in a manner so as to cause the armature to shift between its bi-stable positions. The flux produced by the permanent magnet is utilized to hold the armature in its two stable positions. The magnetic fields are utilized in this way so that the result is realized without the use of biasing springs or any other similar types of devices. Only a single permanent magnet is used. In the forms of the invention as described herein, two electromagnetic cores and associated windings are used. The permanent magnet and the electromagnetic cores and windings are arranged in a symmetrical relationship. The armature is preferably symmetrically arranged about a pivot point at one end of the permanent magnet. In the preferred form of the invention the magnetic cores are mounted upon a common magnetic yoke which yoke also supports the permanent magnet. This assembly is supported by a base member or contact header.

A special feature of both forms of the invention is the particular manner and construction utilized in the packaging of the parts of the assembly. A significant aspect of this construction is that there is provided a magnetic yoke upon which are supported the magnetic cores, the coils and the permanent magnet and the armature. These parts as well as the contacts and terminals are contained within the cap or cover which is attachable to a circular base or header. The yoke has legs that are secured to the header so that the yoke with its attached parts stands off from the header. The terminal members extend through the header, thence through insulating members into the space between the header and the part is carried by the yoke. This provides an extremely simple, compact way of packaging and holding the parts in their proper relationship. This structural relationship is a primary feature of the herein invention and may be utilized in relays other than latch type relays.

In light of the foregoing, a primary object of the invention is to provide a relay characterized in having an improved arrangement of parts, mounting thereof, and containment in a circular housing having a header wherein the essential parts are carried by a magnetic yoke having legs whereby it stands off from the header.

A further object of the invention is to provide an improved bi-stable latch type relay, utilizing a single permanent magnet which is carried by the magnetic yoke member, and the relay having contacts, providing for either single pole, single throw operation or double throw operation. In either relay operation, however, contacting means is positioned between the header and the part is carried by the magnetic yoke.

In the forms of the invention described in detail herein, the armature is preferably mounted upon a knife edge at the end of the permanent magnet which is positioned between the relay windings. In one form of the invention the armature is held on the knife edge by way of metal fingers, brackets or clips extending from a plate positioned at the ends of the windings or coils through which the cores extend. These fingers or clips engage with cutouts on opposite sides or edges of the armature allowing it to move angularly on the knife edge. In this form of the invention, the knife edge is received in a V-notch in the armature. In a further and preferred form of the invention, instead of having the V-notch in the armature, a transverse groove is provided in the armature on the side opposite from the knife edge support. A transverse pivot shaft, having its ends journalled in brackets extending from the plate which is carried by attachment to the coils fits in the transverse groove cores. This armature mounting thus described has improved reliability and effectiveness.

Further objects and additional advantages of the invention will become apparent from the following detailed description and annexed drawings wherein:

FIGURE 1 is an elevational view of the exterior of one form of the invention;

FIGURE 2 is a cross-sectional view taken through the form of the invention shown in FIGURE 1;

FIGURE 3 is a sectional view taken along the line 3—3 of FIGURE 2;

FIGURE 4 is a sectional view taken along the line 4—4 of FIGURE 2;

FIGURE 5 is an exploded view of the form of the invention shown in FIGURES 1, 2, 3 and 4;

FIGURE 6 is a sectional view of a modified form of the invention; and

FIGURE 7 is a partial exploded view of the form of the invention shown in FIGURE 6.

The relay of this invention is highly adapted to miniaturization and has many applications in different types of components and environments. An exemplary form of the relay as shown in FIGURE 1 comprises a base or header **10** and a cap or cover **12** having a flange **14** adjacent the base **10**. The cap or cover **12** encloses the mechanism of the relay. Extending outwardly from the base **10** are a group of connecting leads designated collectively at **16**.

As shown in the cross-sectional view of FIGURE 2 and in FIGURE 5, the base **10** has a portion **18** of smaller diameter so as to provide an extending flange **19**. The cap **12** fits over the part **18** of smaller diameter with the flange **14** flush against the flange **19**. Numeral **21** designates an extending tab which indicates the position of the armature and the contacting mechanism within the housing **12**.

Supported within the housing are electromagnetic cores, electromagnetic windings and a permanent magnet. Numeral **24** designates a common magnetic yoke or yoke frame which supports the magnetic cores. The frame **24** has extending legs **27** and **28** (FIGURE 5) which are received in cutouts **31** and **32** in the header or base member **10** and which may be welded thereto. The magnetic yoke **24** supports cylindrical cores **33** and **34** which are suitably attached to the top of the yoke **24** as shown at **35** and **36** (FIGURE 2). The core **33** has an end flange **40**. Numeral **42** designates an electromagnetic winding which is wound on the core **33**, the winding being encased in a suitable insulative sheath **43**.

The core **34** has an end flange **50**. Numeral **52** designates an electromagnetic winding on this core, this winding having a suitable insulative sheath **54**. The cores **33** and **34** have end parts **55** and **56** which fit through apertures **57** and **58** in the base or bottom of yoke or frame **24**. See FIGURE 5.

The armature is designated at **60**. In this form of the invention, it has a shape or configuration as shown in FIGURES 3 and 5 having side cutouts as designated at **61** and **62** (FIGURE 3). A support plate **46** has openings **47** and **48** through which the cores **33** and **34** extend (FIGURE 5) plate **46** has a center slot or opening **63** from which depend legs **66** and **68** having end tabs **70** and **71** which are bent over to engage the armature **60** as shown in FIGURE 3. Legs **66** and **68** fit in cutouts **61** and **62**. Between the electromagnetic cores and windings there is an elongated permanent magnet **74** supported from the yoke frame **24**. It has a knife edge **75** formed at its end. The armature **60** is shaped as may be seen in FIGURE 2 so that when one portion as shown, contacts an end face of the core **33** the other portion of the armature is spaced from the end face of the core **34** to provide an air gap therebetween. The armature **60** has an intermediate transverse groove **77** which engages the knife edge **75** so that the armature has a pivotal mounting at the end of the permanent magnet **74**. From the foregoing it may be seen that the legs **27** and **28** of magnetic yoke **24** stand it off from header **10**. The yoke **24** carries and supports the coils, and armature. The contacts are located in the space between the winding assembly and the header with the terminals extending through the header into this space.

The armature **60** has a stem **78** attached to it having a ball **79** at its end positioned to engage and operate a contact as will be described. Numeral **81** designates a second stem with a ball **82** attached to it for similar purpose. As may be observed the armature has a pivotal mounting provided by the knife edge **75**, groove **77** and the tabs **70** and **71**.

The armature in its pivotal movements operates a flexible contact strip **85** which is secured to the end **86** of a conductive contact pin or stem which extends through an insulator **88** in the base or header **10**. The flexible contact strip **85** selectively engages one of two curved contact members **91** and **92** which are attached respectively to contact pins or stems **94** and **95** as shown in FIGURE 4. Stems **94** and **95** extend through insulators **97** and **98** respectively in the base or header **10**.

Additional current pin leads are provided as designated at **100** and **101** extending through insulators **103** and **104**. Numerals **108** and **109** designate additional current pin leads extending through the insulators **111** and **112** respectively in the base or header **10**. These leads are for the purpose of conducting current to the electromagnetic windings **42** and **52**. The windings are wired so that they may be individually energized to produce magnetic flux in a direction to neutralize the permanent magnetic flux in either of the cores **33** or **34**, as will be described.

FIGURE 2 shows the armature **60** in one of its positions in which it is in contact with the end face of the core **33**. The other end of the armature **60** forms an air gap with the end face of the core **34**. In this position the insulated actuator ball **82** on the armature **60** presses one end of the flexible contactor **85** into engagement with the contact member **92**. As will be observed by those skilled in the art, the relay provides for single poles, double throw contacting operation. Double pole, double throw contacting operation can of course be provided for as shown in the embodiment of FIGURES 6 and 7. It will be observed that the relay as described in detail herein accomplishes all of the objects and advantages as described herein as well as having many additional advantages that are apparent from the detailed description.

In the position shown in FIGURE 2, the armature **60** being in contact with the end face of the core **33** provides a low permeability flux path for the flux from the permanent magnet **74** through the armature, the core **33** and the yoke **24**. This flux holds the armature in the position shown so that it is stable in this position. To reverse the position of the relay, the electromagnetic winding **42** may be energized in a direction (or polarity) so as to neutralize the flux in the core **33**. The armature **60** is not then held against the core **33**. The flux of the permanent magnet **74** in the air gap between the other end of the armature and the core **34** is sufficient to cause the armature to rotate about its pivot point so that its other end is brought into contact with the end face of the core **34**. Armature **60** is then held in that position. In this position the contact member **85** is brought into engagement with the contact **91**. To again change the position of the armature, the winding **52** may be energized in a direction, that is with a polarity to cancel or neutralize the flux in the core **34**.

FIGURES 6 and 7 show a modified form of the relay. This form of the invention provides for double pole, double throw contacting operation. The mounting of the armature is different as will be described hereinafter. Those parts of the relay of FIGURES 6 and 7 which are alike and correspond to similar parts in the previous embodiment are identified by the same reference characters. In this form of the invention the magnetic yoke **24** is like that of the previous embodiment having legs **27** and **28** which fit into the cutouts **31** and **32** in the header **10**.

In this form of the invention, the armature is designated at **100**. It is like the armature **60** of the previous embodiment except as follows. On the side of the armature opposite from the knife edge **75** it has a transverse groove **101** adapted to receive a pivot shaft **104**. The other side of the armature is positioned directly against the knife edge **75** without a V-notch in the armature. The plate **106** is slightly different than the corresponding plate **46** of the previous embodiment. It has openings **107** and **108** through which the cores **33** and **34** extend as in the previous embodiment. It has an intermediate slot or cutout **111** from which extend brackets **114** and **115** having apertures therein, in which the ends of the shaft **104** are journalled with the shaft positioned in the groove **101** as shown in FIGURE 6. Thus as can be seen, the armature rotates angularly about the knife edge **77**, the shaft **104** having slight clearance in the openings in the brackets **114** and **115** to allow this movement. The armature and shaft **104** are normally urged against the knife-edge **75** by the magnetic attraction so that the shaft is normally in a tangential relationship at the bottom of the aperture in the brackets **114** and **115**.

In FIGURE 7, numerals **120** and **121** designate a pair of flexible contact strips which are engageable to be operated by the balls **79** and **82** carried by the armature **100**. Strip **120** is carried at the end part of a terminal **124**

which extends through an insulated member **125** in the header **10**. This end operates between two curved contact members **127** and **129**. Contact **127** is carried by a terminal **130** which extends through an insulator member **131** in the header **10**. Contact **129** is attached to and carried by terminal **133** extending through an insulating member **134** in the header **10**.

Contact strip **121** is carried by terminal member **140** extending through insulating member **141** in header **10**. The end of strip **121** operates between curved contact members **145** and **146**. Contact member **145** is carried by terminal member **148** extending through an insulating member in header **10**, and contact **146** is carried by terminal member **147** extending through an insulating member in the header **10**. Additional terminal members as necessary are provided, carried by and extending through the header **10**.

The operation of the relay of FIGURES 6 and 7 is similar to that of the previous embodiment and therefore the description of operation need not be repeated in detail. However, as explained, the contact operation is double pole, double throw. The armature is held in position and operates as described without the requirement of having a V-notch in the armature.

From the foregoing those skilled in the art will observe that the relay of both embodiments is stable in its two positions and in each position it is held stable by the flux from the permanent magnet in a flux path including either one of the cores **33** or **34**. By the reason of the symmetrical relationship, the same permanent magnet is utilized to provide flux for causing the armature to change its position and for holding it stable in either one of its two positions.

From the foregoing those skilled in the art will observe and understand the construction, and mounting of the parts, and will appreciate that the packaging thereof is alike in the two embodiments of the invention. The magnetic yoke itself serves as the supporting frame for the parts of the relay, its legs standing these parts off from the header. The contacts are conveniently spaced just inside the header between it and the winding assembly. This provides for a very simplified, compact and effective arrangement of parts.

From the foregoing those skilled in the art will readily understand the nature of the invention and its construction, and the manner in which its objects and advantages as outlined in the foregoing are realized as well as the many additional advantages that are apparent from the detailed description.

The foregoing disclosure is representative of preferred forms of the invention and is to be interpreted in an illustrative rather than a limiting sense, the invention to be accorded the full scope of the claims appended hereto.

What is claimed is:

1. A miniaturized magnetic latch relay comprising:

a support header having at least one pair of fixed contacts positioned above the header and coupled to contact pins extending through the header, a movable contact mounted on an additional contact pin extending through the header, said movable contact being adapted to pivot into electrical contact with one or the other of said fixed contacts in response to pivotable movement of an armature positioned for insulated engagement with the movable contact;

a magnetic yoke having a plate member parallel to the header and provided with substantially opposed downwardly depending elongated legs adapted for attachment to the header;

an armature;

an electromagnetic means for pivotably moving said armature into engagement with said movable contact and latching the armature at said pivoted position, the improvement comprising:

said electromagnetic means is mounted from said yoke plate free from contact with said base and out of contact with said legs whereby distortion of said legs does not disrupt the cooperative relationship between said electromagnetic means, said armature and said contacts, said electromagnetic means comprising:

a permanent magnet fastened to said yoke plate and aligned free of contact between said opposed legs;

a pair of electromagnetic coils positioned on opposite sides of said permanent magnet;

means pivotably mounting the armature to the permanent magnet and completing a partial magnetic circuit with the permanent magnet through the armature; and

a magnetic core means for each coil, said core means mounting the armature mounting means, and the electromagnetic coils to said yoke plate also free of contact with said yoke legs, said cores serving to complete a magnetic circuit for said armature in latched positions thereof.

2. The combination of claim **1** wherein said permanent magnet has a knife edge formed at one end, said combination further comprising:

means included in said mounting means for supporting the armature in pivotal engagement with said knife edge.

3. The combination of claim **2** wherein said armature supporting means comprises:

an armature support plate member having extending bracket clips engaging said armature and holding it in position to pivot with respect to said knife edge, said support plate member being supported by said cores.

4. The combination of claim **1** wherein said armature has a transverse groove in a side opposite from said knife edge and said supporting means comprises:

a shaft engageable in said groove;

means for supporting said shaft with the armature in a position to pivot about said knife edge.

5. The combination of claim **4** wherein said shaft supporting means comprises:

an armature support plate member supported by said cores, said armature support plate member having a bracket pair extending therefrom, each bracket having an aperture therein through which an end of said shaft is journalled.

6. A miniaturized magnetic relay comprising in combination:

a base member;

electromagnetic means including two electromagnetic coils, each coil being provided with an associated core;

a permanent magnet positioned between said two coils;

a magnetic yoke including a magnetic plate member positioned substantially parallel to said base member and having at least two elongated legs supporting said plate member away from said base member, the electromagnetic coils, associated cores and the permanent magnet being supported from said magnetic plate member off from said base member, the coils, associated cores and the permanent magnet being out of contact with said legs;

armature support means supported by said cores; and

an armature pivotally mounted on said support means and adapted to selectively contact either one or the other of said cores depending upon its pivoted position.

7. The combination of claim **6** wherein said permanent magnet has a knife edge formed at one end; said combination further comprising:

said support means mounts the armature for pivotal engagement with said knife edge.

8. The combination of claim **6** wherein said armature support means further comprises:

an armature support plate member having extending bracket clips engaging said armature and holding it

in position to pivot with respect to said knife edge, said support plate member being supported by said cores.

9. The combination of claim **16** wherein said armature has a transverse groove in a side opposite from said knife edge and said support means comprises:

a shaft engageable in said groove;

means for supporting said shaft with the armature in a position to pivot about said knife edge.

10. The combination of claim **9** wherein said shaft supporting means comprises:

an armature support plate member supported by said cores, said armature support plate member having a bracket pair extending therefrom, each bracket having an aperture therein through which an end of said shaft is journalled.

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D. M. MORGAN, Assistant Examiner

U.S. Cl. X.R.

335—181, 183, 230

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,497,841 Dated February 24, 1970

Inventor(s) Arthur E. Wood, Jr., et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, lines 6 and 7, and line 24, "part is carried", each occurrence, should read -- parts carried --; line 43, after "to the coils" insert -- and --. Column 4, line 11, "poles" should read -- pole --; line 70, "aperture" should read -- apertures --. Column 7, line 4, "claim 16" should read -- claim 6 --.

Signed and sealed this 1st day of December 1970.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
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