United States Patent

[11] **3,569,890**

[72] Inventor **Ezio Baratelli**
Via Cavour 14, Buguggiate, Varese, Italy

[21] Appl. No. **787,004**
[22] Filed **Dec. 26, 1968**
[45] Patented **Mar. 9, 1971**
[32] Priority **Dec. 29, 1967**
[33] **Italy**
[31] **24517A/67**

[54] **BI-STABLE MAGNETIC LATCHING RELAY**
5 Claims, 1 Drawing Fig.

[52] **U.S. Cl.** 337/170, 335/234
[51] **Int. Cl.** **H01h 9/24**
[50] **Field of Search** ..... 335/230, 229, 234, 253, 254, 170, 179, 79, 128 (Cursory)

[56] **References Cited**

UNITED STATES PATENTS

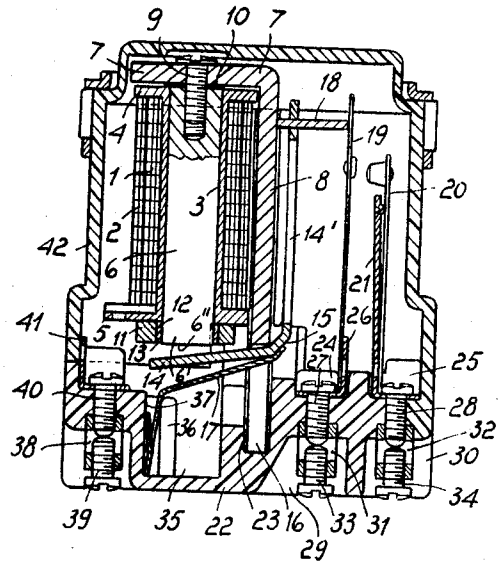
2,811,601	10/1957	Somers	335/170
3,076,880	2/1963	Ehrismann	335/128
3,153,178	10/1964	Martin	335/234

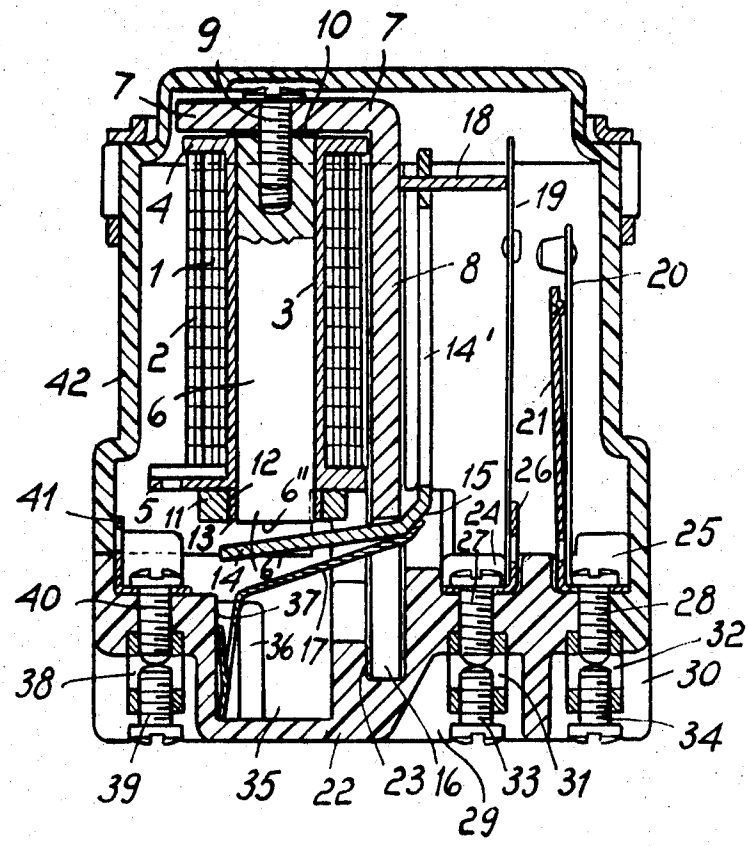
FOREIGN PATENTS

983,303	2/1965	Great Britain	335/230

Primary Examiner—Harold Broome
Attorney—Michael S. Striker

ABSTRACT: A magnetic-latching relay in which an armature is movable between a closed position engaging one end face of a core and an open position spaced from this end face and in which two windings are provided about the core, one of which provides, when energized, a magnetic field moving the armature to closed position and the other, when energized, moving the armature to open position. The relay includes further an annular permanent magnet, surrounding the end portion of the core on which the end face cooperating with the armature is provided, to keep the armature, when brought to the closed position by energizing the one winding, in said closed position even after the one winding is deenergized.





INVENTOR.
ELIO BARATELLI

BY

Michael S. Striker
Attorney

BI-STABLE MAGNETIC LATCHING RELAY

This invention relates to a bistable magnetic latching relay of a type employing a mobile armature kept in stable attracted position also after the power of the excitation coil has been removed, by means of a proper magnetic-latching field and is released only by the excitation of an auxiliary coil generating a magnetic field reverse to the latching field.

Known relays of this kind belong to two separate types:

the first type employs a magnetic core saturated by the excitation of a tripping coil, apt to keep a residual magnetism which is great enough to hold the armature in stable latching position against the reset springs, also after the excitation of the coil has been finished.

The release of the armature is achieved by generating (by means of an auxiliary coil) a magnetic field which is reversed to the residual one.

The second type employs a permanent magnet placed near the end of the core which has the greatest distance from the useful gap with regard to the armature. This permanent magnet, which is inserted in series with the core, may generate two magnetic circuits, a main and secondary circuit.

The armature has two useful surfaces, the main surface forming the useful gap and which is designed to rest on the core, and a secondary surface which is attracted by the permanent magnet in the open armature position.

Due to those components the main circuit generated by the permanent magnet is realized when the armature is attracted for the excitation of the main coil and remains attracted also when this excitation stops.

The main circuit involves the permanent magnet, the core and the armature.

When the armature is released for the excitation of the secondary coil, the secondary useful surface of this armature comes to rest on the permanent magnet establishing a derived circuit which involves only the permanent magnet and the secondary surface of the armature. As a consequence the armature is kept in the two stable positions, i.e.; "closed" and "open" due to the influence of the permanent magnet.

For the first type of relay it is necessary to use high quality materials in order to obtain a sufficient residual magnetic field and to manufacture the relay with utmost precision to reduce to a minimum the gaps which requires employing high skilled workers and expensive equipment.

For the second type beside the use of high quality materials and precision manufacture it is necessary to have a rather strong permanent magnet and a convenient operation is obtained only owing to a particular shape which has to be given to the armature and to the magnetic circuit. In fact, if there were no secondary useful surface of the armature, which acts in the phase of the open relay, the armature would always be attracted in the closed position, overwhelming the antagonistic force of the reset springs.

This invention relates to a bistable latching relay employing a permanent magnet placed on the end of the core next to the latching surface of the armature while the latter has a simple shape.

The permanent magnet has a latching force which allows not to attract the armature when it is open, but to keep it stably closed when the armature has been brought in closed position through the excitation of the main tripping coil, while a secondary coil generates a magnetic field reverse to the field of the core in order to allow that the reset springs reset the armature in the open position.

According to a preferred constructive form, the end of the electromagnet's core upon which the armature drops, projects by a predetermined length beyond the coil. The permanent magnet is placed on this end and takes a ring shape with a prefixed polarity. The end of the core projects beyond this electromagnet for a length sufficient to allow the armature to rest on it.

Between the permanent magnet and the core is left a sufficient ring-shaped gap to avoid that the lines of force of the permanent magnetic field close directly on the core, but are compelled to pass for the greatest part through the mobile armature when in closed position.

The first advantage offered by this invention is that the presence of the permanent magnet in the proximity of the armature does not require a perfect fitting between the surface in contact with the armature and the end of the core and therefore eliminates the necessity of precision manufacture.

An additional advantage is that the presence of a little residual magnetism of the core does not impair operation of the relay, on the contrary it is possible to exploit advantageously the sum hole the magnetic field of this residual magnetism and of the magnetic field of the permanent magnet to keep the armature latched; this allows to use a weak permanent magnet and to use for the core a less expensive material thus realizing a magnetic-latching relay at low cost and easy to produce while maintaining unaltered the requirements of a safe and stable latching of the armature.

The invention is illustrated as a not limiting example of a constructive form in the FIGURE of the drawing showing in enlarged scale a longitudinal cross section of the relay.

With reference to this FIGURE the relay which is object of the invention, consists of a double winding comprising a main coil of excitation **1** and an auxiliary coil **2** for the demagnetization. These windings are wound on a sleeve **3** limited at the two ends by two flanges **4** and **5** and sleeve **3** houses in its cylindrical portion the magnetic core **6** which is of a material apt to keep a little residual magnetism. This core is fixed to the bent surface **7** of a yoke or L-shaped member with a fixing screw **9** passing through the mentioned part **7** and threading into a blind, threaded hole of the core. Between the support **7** and the adjacent core is placed a washer **10** serving to keep the core **6** in a fixed axial position with regard to the sleeve **3**.

The core **6** is longer than the sleeve and its free end **6'** projects beyond the side **5** by a predetermined length, as explained below.

A permanent ring-shaped magnet **11** having an internal diameter which is larger than the diameter of the core **6**, is placed about the end **6'** so that there is left a ring-shaped gap which may be filled with a nonmagnetic material, for instance a ring **12** of plastic material. The permanent magnet preferably is made of plastic bonded ferrite, so that besides having good magnetic properties it may be produced at low cost.

The core **6** projects beyond said permanent magnet **11** for a small step **13**, so that its plane end face provides a suitable support for the mobile armature **14**.

The mobile armature **14** has the shape of a bent arm and its elbow **15** is fulcrummed on the bottom of a clevis **16** obtained from the yoke **8**. A blade spring **17** exercises a pressure on the armature compelling the latter against its fulcrum.

A branch **14'** of the armature **14** support a pressure member **18** allowing to move the elastic blades **19** carrying the mobile contacts towards the fixed blades **20** carrying the fixed contacts and aligned by rigid supports **21**. The elastic blades **19** form also the reset spring of the mobile armature **14**.

In a preferred constructive form there is also a base **22** of insulating material shaped to show a seat **23** for the engagement of the yoke **8**, and the seats **24** and **25** in which are fixed the supports **26** and **21** of the contacts **19** and **20**. The fixing is done by means of the screws **27** and **28** which reach to outside grooves respectively **29** and **30** of the base to support the terminals **31** and **32** to which arrive the electrical contacts connected to the contacts and which are clamped by the screws **33** and **34** respectively.

The alignment with the core **6** and the base **22** shows a groove **35** in which enters the spring **17**, while its end is engaged between the raised wall **36** and the opposite side **37** formed by the same groove **35**. The terminals **38** equipped with fixing screws **39** serve for the connection of the line conductors of the winding by means of the screws **40** and conducting plates **41**.

A housing **42** serves to cover the base and all the components standing on the latter, however, without supporting the components themselves.

The relay operates as follows:

When the coil 1 is excited, the core 6 attracts the armature 14 which comes to rest on the plane end 6'' of the core. When the power is removed from said coil 1 the armature stays attracted by the permanent magnet 11 while its lines of force pass mostly through the armature itself. In case a residual magnetism remains in the core 6, which alone is not sufficient to hold the armature against the reset force of the elastic blades 19, this magnetism is added to that of the permanent magnet thereby contributing to a rise the attraction force on said armature. The gap 12 between the magnet 11 and the core 6 serves to avoid that the lines of force of this permanent magnet close directly on the core, but are compelled to pass through the armature 14.

Thus it is possible to obtain a latching position of the armature which is so stable that it is maintained also in case of transmission of shocks an vibrations to the relay.

In order to achieve the opening of the armature 14 it is necessary to supply the coil 2, which has to create a magnetic field reverse to the field established by a possible residual magnetism of the core and by the permanent magnet 11 and which is sufficient to reset in the open position the armature by means of the antagonism of the elastic blades 19.

Of course the invention can be realized according to other constructive forms different from the one described above without trespassing the limits of the patent.

I claim:

1. A magnetic-latching relay which is maintained stable in closed as well as in open position and comprising a core having an end face and being formed from magnetizable material; an armature located adjacent said end face movable between an open position spaced from said one end face and a closed position engaging the same; a main winding about said core for generating, when energized, a magnetic field which moves said armature to said closed position; an auxiliary winding about said core for generating, when energized, a magnetic field opposite to the field generated by said main winding, said core having at said one end face an end portion projecting beyond said windings; and a ring-shaped permanent magnet surrounding said end face of said core radially spaced therefrom to define an annular gap between said core and said permanent magnet, said permanent magnet producing a magnetic field in the same direction as the main winding so that said armature, after being moved by energizing said main winding to said closed position, will be directly attracted by said permanent magnet and stay in said close position after said main winding is deenergized until said auxiliary winding is energized.

2. A relay as defined in claim 1, and including a ring of non-magnetic material substantially filling said annular gap.

3. A relay as defined in claim 1, and including biassing means for biassing said armature to said open position, and wherein said core is formed of a material apt to keep a notable residual magnetism which, however, alone is not sufficient to keep said armature in said closed position against the force of said biasing means, but will do so in combination with the force of said permanent magnet.

4. A relay as defined in claim 3, and including an L-shaped member of magnetizable material having a short arm in magnetic contact with the other end face of said core, said armature being in the form of a two-arm lever having one arm facing said one end face and being pivotally mounted intermediate its ends on the end of the other arm of said L-shaped member, said biasing means comprising a leaf-spring carrying a movable contact of said relay, said leaf-spring cooperating with the other arm of said two-arm lever.

5. A relay as defined in claim 1, wherein said permanent magnet is made from plastic bonded ferrites.