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Martelli

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[54] **REED SWITCH**

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[30] **Foreign Application Priority Data**

Jan. 9, 1970 Italy....................9310 A/70

[52] **U.S. Cl.**..........**335/154,** 200/166 BH, 200/166 J

[51] **Int. Cl.**..........**H01h 1/54,** H01h 51/28

[58] **Field of Search**..........335/151, 154; 200/166 BHJ, 200/166 G

[56] **References Cited**

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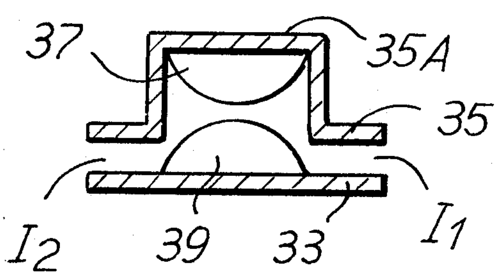
Primary Examiner—Roy N. Envall, Jr.
Attorney—Hopgood & Calimafde

[57] **ABSTRACT**

A reed switch includes two ferromagnetic strips supported in a sealed housing. At least one of the strips is supported from the housing by a resilient member. When a magnetic field links the strips the resilient member allows its associated strip to move towards the other strip until the two strips make electrical contact.

7 Claims, 9 Drawing Figures



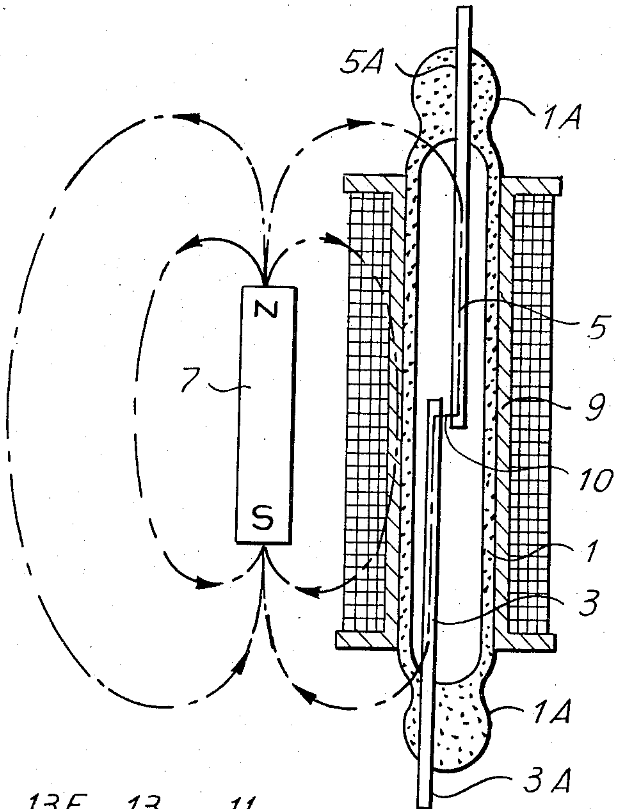


Fig. 1

PRIOR ART

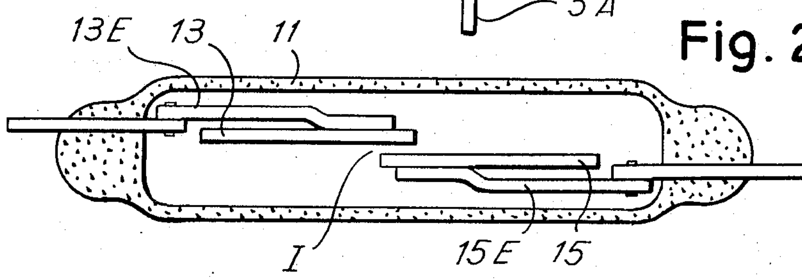


Fig. 2

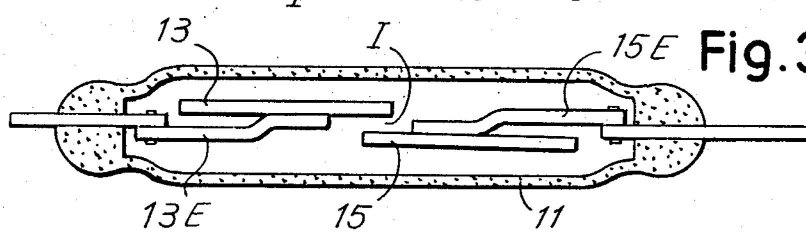


Fig. 3

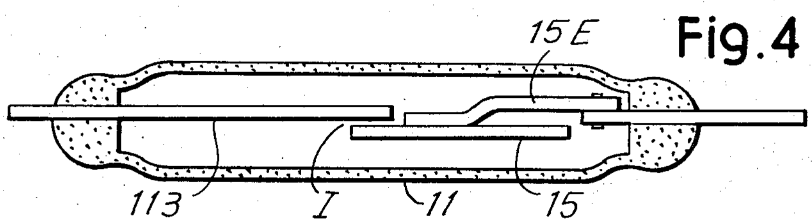


Fig. 4

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Fig. 5

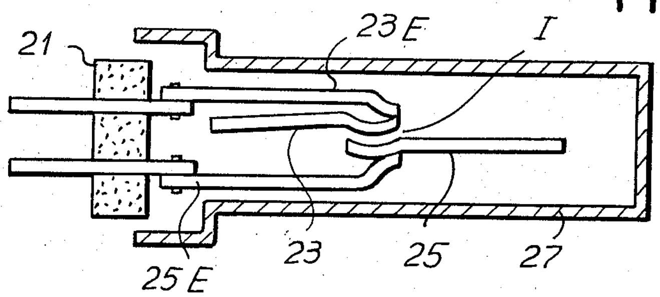


Fig. 6

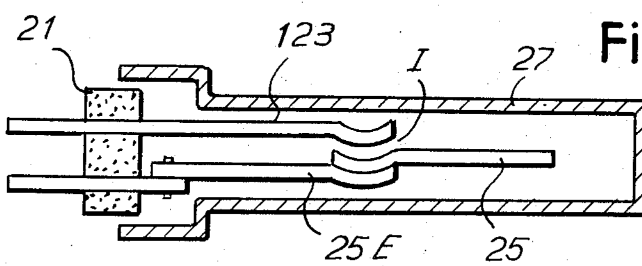


Fig. 7

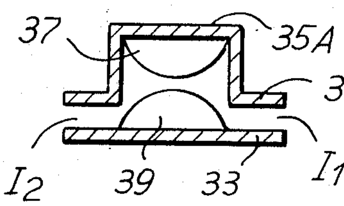


Fig. 9

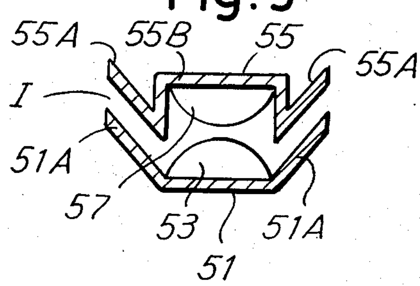
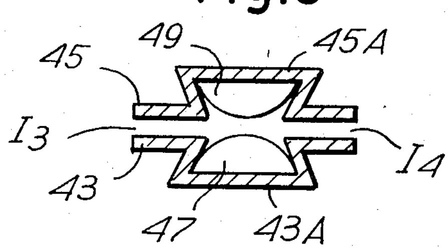


Fig. 8



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REED SWITCH

BACKGROUND OF THE INVENTION

1. Field of Invention

The present invention relates to reed switches which are operated in response to the presence or absence of a magnetic field.

2. Description of Prior Art

Known reed switches are essentially formed by two strips or reeds of ferromagnetic material hermetically sealed within a glass sheath. The strips are generally (but no necessarily) of the same length and are partially embedded in the glass at a corresponding end of the sheath. The free ends of the strips extend into partial overlapping relationship at the center of the sheath and define a small gap between adjacent faces. When an appropriately arranged magnetic field (which can be due either to a permanent magnet or to an electrically energized winding) is present in the vicinity of the switch, the lines of flux of the field will tend to follow the two strips because they provide a low reluctance path. The portions of the strip on opposite sides of the gap will then form pole pieces of opposite polarity. Accordingly, the two strips are attracted towards one another and if this force of attraction is sufficient to overcome the resilience of the strips, they move into engagement with one another and establish an electrical contact.

The glass sheath contains a mixture of inert gases which are free from moisture so as to avoid any contamination of the contacting portions of the strips which would otherwise occur in the presence of a powder, a corrosive atmosphere, oxydising agents and the like.

The object of the invention is to provide an improved reed switch having the following combination of advantages over known reed switches;

a. requiring a smaller number of ampere turns to effect closure of the switch;
b. the switch having smaller dimensions;
c. the switch being capable of interrupting a greater amount of power in relation to its size;
d. the switch having a longer life; and
e. the switch as a whole being cheaper to manufacture, since it uses less critical components and less sophisticated production fixtures.

To achieve advantage (a) in a known reed switch, one of the following modifications must be made;

1. The gap between the two strips must be decreased. Such a modification would, however, reduce the voltage rating of the switch, increase the capacity present between the two elements of the open switch, and increase the cost of production of the switch by virtue of the fact that the switch parts have to be manufactured and assembled to tighter tolerances.
2. The resilient force of the two strips can be reduced. This modification would, however, reduce the force tending to separate the switch upon opening of the switch;
3. The cross section of at least a portion of each strip can be increased and thereby cause an increase in the coupling effect of the magnetic field between the two strips. This modification will, however, increase the capacity between the two strips of the strips when open.

One way of increasing the cross section of the strips is to increase the width of the strips at those portions thereof which define the gap by an amount allowed by the inner diameter of the glass sheath. The increase in those portions of the strips which define the gap will, however, reduce the flux density in the gap.

If the width of each strip is increased over its whole length, the amount of flux passing through the strips will increase accordingly, but the flux density in the gap will be the same as it was originally. Furthermore, because of the increase in cross-section the resilience of the strip is increased. The switch thus requires a greater magnetic field for operation.

In practice in order to reduce the ampere turns required to operate a conventional reed switch by a factor m while keeping the force which separates the strips when the switch is closed, constant, the cross section of each strip must be increased by a factor of m^2 the width of the strips must be increased by a factor of m^2 and the length of each strip must be increased by a factor of $\sqrt[3]{m^2}$.

An object of the present invention is to effectively separate the inter-dependance of the resilient characteristics of the strip from its magnetic characteristics.

The present invention provides a reed switch comprising a housing enclosing a pair of ferromagnetic strips, each strip having a fixed end portion and a free end portion, the two free end portions lying adjacent one another and being relatively movable, in response to a magnetic flux linking the two strips, to make electrical contact with each other, a contact bead mounted on each strip, said contact beads forming the electrically contacting surfaces of the switch, at least one said bead being at least partially recessed below the surface of its corresponding strip.

The present invention further provides a switch comprising first and second relatively movable ferromagnetic members, first and second contact beads respectively mounted on said first and second members, said first and second ferromagnetic members being so arranged that when linked by a common magnetic field the two contact beads are brought into engagement with one another, said contact beads being mounted on respective members in such a manner that when the contact beads are made to engage one another the smallest gap between the members is less than the gap between those surfaces of the member to which the beads are secured.

Reed switches embodying the invention will now be described by way of example, with reference to the accompanying diagrammatic drawings in which;

FIG. 1 is a longitudinal section of a previously proposed reed switch;

FIGS. 2, 3 and 4 are longitudinal sections through three different embodiments of reed switches;

FIGS. 5 and 6 are longitudinal sections through two further embodiments of reed switches; and

FIGS. 7, 8 and 9 show cross-sections of three different configurations of contact portions which can be incorporated in the reed switches of any one of FIGS. 1 to 6.

As shown in FIG. 1 a previously proposed reed switch includes two ferromagnetic strips 3 and 5 mounted in a glass tube 1. The strips are partially embedded in the end portions 1A of the glass tube so that an end portion of each strip 3 and 5 extends outwardly from the tube 1 to form a respective terminal 3A and 5A. The opposite end portions of the strips 3 and 5 extend inwardly into partial overlapping relationship. The switch can be operated by means of a permanent magnet 7 or an electro-magnet 9. To close the switch, magnetic lines of flux must be displaced or induced so that they are directed substantially along the longitudinal axis of the tube 1 and in alignment with the strips 3 and 5. Strips 3 and 5 will form a low reluctance path for the magnetic flux so that the magnetic flux will be concentrated across a gap 10 lying between the strips. The facing end portions of the strips 3 and 5 then act as pole pieces of opposite polarities. Consequently, the end portions of the strips 3 and 5 are attracted towards one another and because at least one strip is flexible, relative movement occurs until the two strips make contact and close the electric circuit between the terminals 5A and 3A.

In the embodiment shown in FIG. 2 a sealed tube 11 houses ferromagnetic strips 13 and 15 whose adjacent end portions overlap to define a gap I. The strips 13 and 15 are supported by resilient members 13E and 15E which are partially embedded in opposite ends of the tube 11. The resilient members 13E and 15E are connected to respective strips 13 and 15 in the vicinity of the gap I. The end portions of the members 13E and 15E remote from the gap form the terminals of the switch.

In FIG. 3 parts similar to those in FIG. 1 are similarly referenced. Here, however, instead of the resilient members 13E and 15E being connected at the faces of the corresponding strips 13 and 15 lying opposite the gap (as shown in FIG. 2) they are connected at the same faces of the strips which define the gap I.

In FIG. 4 parts similar to those in FIG. 3 are similarly referenced. In place of the members 13 and 13E of FIG. 3 a single ferromagnetic strip 113 is provided. The ferromagnetic strip 113 is itself partially embedded in a corresponding end portion of the tube 11.

In the embodiment shown in FIG. 5, the reed switch includes a supporting member 21 (which may be made of glass or other electrically insulating material) two ferromagnetic strips 23 and 25, for example of a Fe—Ni alloy and two resilient members 23E and 25E which are supported by the member 21 and in turn support at their free ends a respective one of the strips 23 and 25. The strips 23 and 25 are arranged in partial overlapping relationship to define a gap I. It will be seen that the strip 25 forms an extension on the resilient member 25E. A sheath or housing 27 for example of glass, non-magnetic material or the like is welded on to the member 21 to enclose the strips 23 and 25.

In FIG. 6 parts similar to those in FIG. 5 are similarly referenced. In FIG. 6, a ferromagnetic strip 123 directly fixed into the supporting member 21 replaces the resilient member 23E and the strip 23 of FIG. 5.

FIGS. 7, 8 and 9 show modifications of the ferromagnetic strips of the reed switches in FIGS. 2 to 6. A bead contact is provided on the face of each strip defining the gap I.

In FIG. 7 one ferromagnetic strip 33 has a flat end portion, while the end portion of the other strip 35 has a recess 35A which completely accommodates a contact bead 37. A contact bead 39 is mounted on the strip

33 opposite the recess 35A. The strips 33 and 35 are such that two portions I_1 and I_2 of the gap formed on opposite sides of the bead 37 and 39 have substantially the same spacing as between the two engaging portions of the bead contacts 37 and 39.

In the modification shown in FIG. 8 end portions of two ferromagnetic strips 43 and 45 have similar but facing recesses 43A and 45A. Bead contacts 47 and 49 are mounted respectively in the recesses 43A and 45A so that the engaging surfaces of the bead contacts 47 and 49 project slightly beyond the surfaces of the strips which form the gap zones I_3 and I_4 on opposite sides of the recesses 43A and 45A. The recesses 43A and 45A taper so that the narrowest portion of the recess lies adjacent the gap zones I_3 and I_4, that is at the orifice of the recess. This enables the surface area of the gaps I_3 and I_4 to be relatively large.

In the embodiment of FIG. 9 a ferromagnetic strip 51 bearing a bead contact 53 has an outwardly extending fins or wings 51A on opposite sides of the bead contact 53. A second ferromagnetic strip 55 arranged to cooperate with the strip 51 has a recess 55B which accommodates the bead contact 57. The bead contact 53 also extends partially into the recess 55B even when the switch is open. The strip 55 is provided with fins or wings 55A on opposite sides of the recess 55B which are complementary to the fins or wings 51A.

I claim:

1. A reed switch comprising:

a housing,

a pair of ferromagnetic strips, each strip having an active end portion,

means mounting the strips in the housing so that the active end portions lie adjacent one another and are adapted for relative movement, in response to a magnetic flux linking the two strips, to make electrical contact with each other,

a contact bead mounted on said active end portions of each strip, at least one said bead being at least partially recessed below the surface of its corresponding strip, said contact beads forming the electrically contacting surfaces of the switch, wherein the bead contacts are flanked by surfaces of the strip forming a path through which the magnetic flux can link the two strips.

2. A switch according to claim 1, wherein the flanking surfaces are inclined with respect to the plane lying tangential to the beads at their contact surfaces.

3. A reed switch comprising:

a housing,

a pair of ferromagnetic strips, each strip having an active end portion,

means mounting the strips in the housing so that the active end portions lie adjacent one another and are adapted for relative movement, in response to a magnetic flux linking the two strips, to make electrical contact with each other,

a contact bead mounted on said active end portions of each strip, at least one said bead being at least partially recessed below the surface of its corresponding strip, said contact beads forming the electrically contacting surfaces of the switch, wherein the said active end portion of said one strip defines the recess in which said one bead lies, said recess becoming progressively narrower towards its orifice.

4. A reed switch comprising:
a housing,
a pair of ferromagnetic strips, each strip having an active end portion,
means mounting the strips in the housing so that the active end portions lie adjacent one another and are adapted for relative movement, in response to a magnetic flux linking the two strips, to make electrical contact with each other,
a contact bead mounted on said active end portions of each strip, at least one said bead being at least partially recessed below the surface of its corresponding strip, said contact beads forming the electrically contacting surfaces of the switch, wherein said active end portion of said one strip defines the recess which wholly accommodates its associated contact bead and at least partially accommodates the other contact bead when the two contact beads make contact.

5. A switch comprising,
first and second relatively movable ferromagnetic members,
first and second contact beads,
means supporting said first and second ferromagnetic members for relative movement,
means mounting said contact beads on respective members in such a manner that when the members are linked by a common magnetic field, the contact beads are moved by magnetic attraction to engage one another, the smallest gap between the members being less than that gap existing between those surfaces of the members to which the beads are secured, wherein the first contact member has a recess which accommodates said first contact bead and partially accommodates the second contact bead when the first and second contact beads make contact.

6. A switch comprising,
first and second relatively movable ferromagnetic members,
first and second contact beads,
means supporting said first and second ferromagnetic members for relative movement,
means mounting said contact beads on respective members in such a manner that when the members are linked by a common magnetic field, the contact beads are moved by magnetic attraction to engage one another, the smallest gap between the members being less than that gap existing between those surfaces of the members to which the beads are secured, wherein the first and second members have recesses which partially accommodate respectively the first and second contact beads.

7. A switch according to claim 6, wherein said recess has a smaller cross-section at its orifice than at its base.

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