April 22, 1969 H. S. WOODHEAD 3,440,583

REED RELAY EMPLOYING FLUX COLLECTORS AND A PIVOTED ARMATURE

Filed May 2, 1966 Sheet 1 of 2

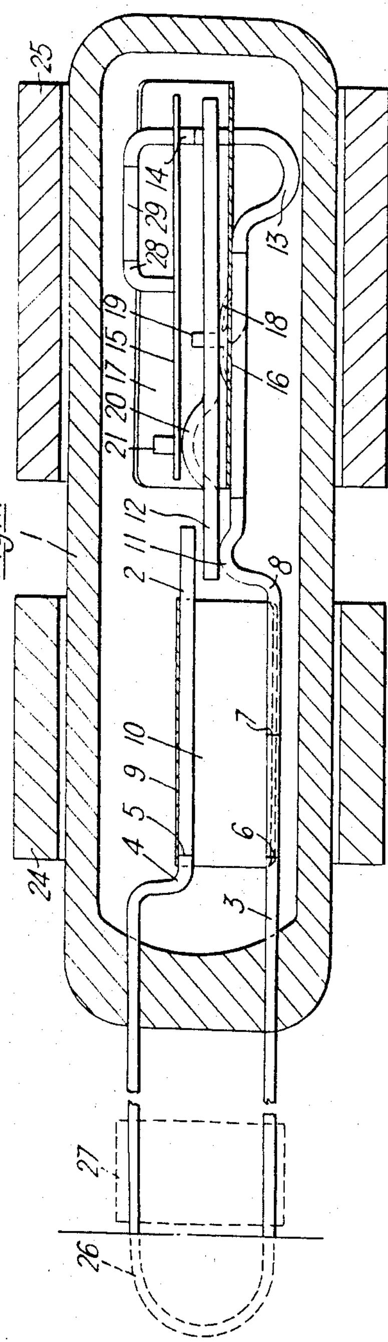


Fig.1.

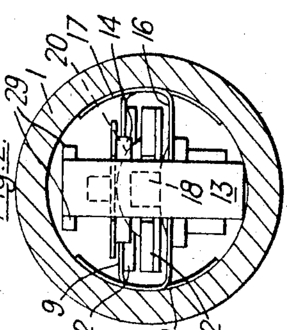


Fig.2.

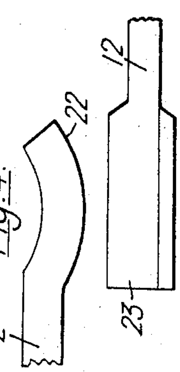


Fig.4.

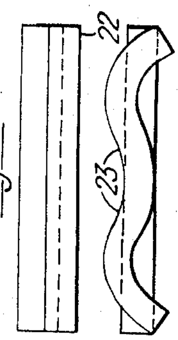


Fig.5.

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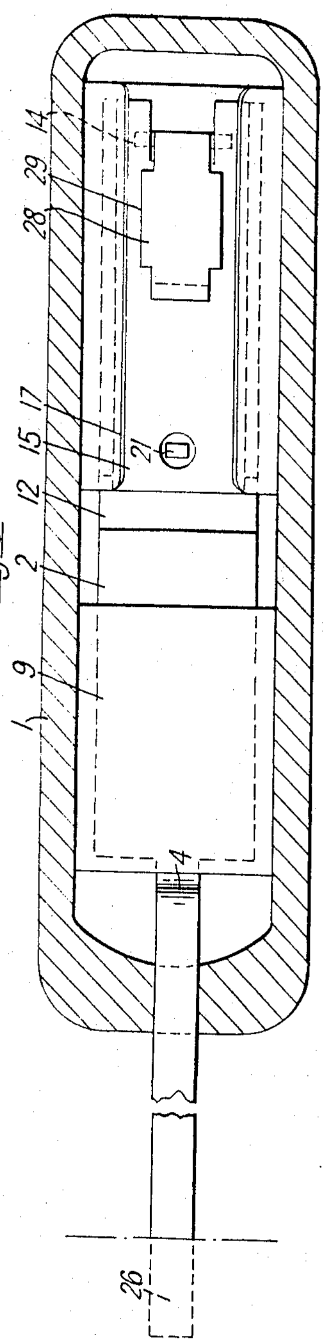


Fig. 3.

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3,440,583

# REED RELAY EMPLOYING FLUX COLLECTORS AND A PIVOTED ARMATURE

Harry Stanley Woodhead, Harlow, England, assignor to International Standard Electric Corporation, New York, N.Y., a corporation of Delaware

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U.S. Cl. 335—154 17 Claims

## ABSTRACT OF THE DISCLOSURE

A magnetic reed switch is equipped with internal flux collectors in the form of magnetic channel sections which reduce the reluctance of the switch and which are shaped to conform to the curvature of a protective tube. The reed, or armature, is centrally pivoted over a dome shaped supporting surface and is biased by a leaf spring to a selected position against that surface and other supporting surfaces.

This invention relates to electrical and magnetic contact devices.

According to the invention there is provided an electrical contact assembly including a stationary contact member, and a movable contact member pivotable upon and spring urged on to a dome shaped supporting surface. The assembly incorporates a magnetic contact device including a sealed insulating vessel having electrical contact means therein operable in response to a magnetic flux exerted thereon externally of said vessel. The contact means include two cooperating contact members of magnetic material each having in contact therewith a member of magnetic material so shaped as to collect the externally exerted contact operating magnetic flux and thereby reduce the reluctance of the path traversed by the magnetic flux between the vessel wall and the contact members.

A preferred embodiment of the invention will now be described with reference to the accompanying drawings, in which:

FIG. 1 is a side view of a sealed magnetically operable switch, partly sectioned to show constructional details,

FIG. 2 is a sectional end view of the switch,

FIG. 3 is a sectional plan view of the switch,

FIGS. 4 and 5 are enlarged side and end views respectively of the switch contacts.

A protective glass tube **1** has sealed through one end thereof two rectangular cross-section electrically conducting strips **2** and **3** each of magnetic material having a coefficient of expansion matching that of the glass, for example an alloy of iron, cobalt and nickel.

The strip **2** is cranked at **4** inside the tube **1** and then widens at **5** and extends approximately half way along the length of the tube to form the stationary contact of the switch.

The strip **3** widens at **6** inside the tube **1** and terminates at **7** where it is butt-welded to an electrically conducting strip **8** of similar cross section but of nonmagnetic material such as copper alloy or nonmagnetic stainless steel.

Attached to the upper surface of the stationary contact strip **2** is a channel member **9** of magnetic material such as nickel iron, the sides **10** of the channel being curved to conform with the curvature of the inside of the tube **1** and extending so as to partially enclose a length of the composite strip **3, 8**.

The strip **8** extends from the channel member **9** and is formed as shown in FIG. 1 to provide a back stop **11** for the movable contact or armature **12** of the switch, to be described later, a leg **13** forming part of a centralizing arrangement for the contact assembly in the tube **1**, shoulders **14** for supporting one end of a leaf spring **15** for biasing the armature **12** in to the off position of the switch, and the end of the strip **8** bears on the spring **15** to establish the required restoring force.



The length of the strip **8** between the back stop **11** and the leg **13** is of wider cross-section than the remainder, and to the upper surface of this length is attached a channel member **16** of magnetic material such as nickel iron, the sides **17** of the channel being curved to conform with the curvature of the inside of the tube and extending so as to partially enclose the armature **12**.

An area of the base of the channel member **16** is formed into a dome shaped support **18** on which the armature **12** is centrally pivoted. A locating post **19** bent up from the material of the strip **8** extends through the support **18** and the armature **12**.

The armature **12** is a rectangular cross-section electrically conducting strip of magnetic material, and is biased on to the back stop **11** by the action of the leaf spring **15**. The spring **15** is supported at one end by a dimple **20** formed in the armature **12** with a locating post **21** extending therefrom through the spring **15**. The other end of the spring **15** extends on either side of the strip **8** and is supported by the shoulders **14**.

As shown in FIGS. 4 and 5, the contact face of the fixed contact **2** is formed as a single transverse part-cylindrical surface **22**, and the contact face of the armature **12** is formed as a twin longitudinal part-cylindrical surface **23**.

The part-cylindrical surfaces on both contact faces are preferably of equal radii and of fairly large radius.

The armature **12** being pivoted on a dome shaped surface permits rotation about its longitudinal axis, and with the twin armature contacts provides a balance of contact pressure. Thus equality of contact pressure is obtained without recourse to either extra manual adjustment or to great accuracy in manufacture.

Central pivoting of the armature **12** provides a measure of balance and immunity from the effect of acceleration on contact pressure and clearance.

The contact material is formed by electroplating with palladium.

Aligned with each of the channel members **9** and **16** are external pole pieces **24** and **25** respectively (shown only in FIG. 1) for operation of the switch by external permanent magnet or electromagnetic means.

The channel members **9** and **16**, being of magnetic material, lower the reluctance of the nonmagnetic gap between the pole pieces and the fixed contact member **2** and the armature **12** by virtue of their comparatively large surface area. The channel members **9** and **16** may therefore appropriately be terminated flux collectors.

It will be noticed that the strip **3, 8** passes through both flux collectors **9** and **16**. It is attached to **16** and has a small clearance from **9**. If the strip **3, 8** were entirely of magnetic material, leakage flux would flow in the neighborhood of the small clearance and hence an entirely magnetic strip would act as a shunt to the working gap between the fixed and movable contact faces thereby reducing the gap flux.

By insertion of the nonmagnetic strip **8** the shunting effect is reduced to a minimum.

In order to manufacture the switch, the first step is to produce a subassembly forming the contact assembly. Initially the fixed contact member **2** and the strip **3** are joined as indicated by the dashed lines **26** in FIGS. 1 and 3, and form a hairpin shape. The limbs of hairpin are off parallel, and spring outwards. By sliding an encircling ring **27** of appropriate dimensions along the limbs the contact gap can be varied and set to a desired dimension. A shadow graph might assist in the gap measurement, or the assembly could be placed in a test coil and the gap varied to produce a prescribed "pull in" ampere-turn figure.

The required pressure exerted by the spring **15** on the armature **12** is obtained by bending the end of the strip **8**, a suitable tool being slipped over a length **28** of the strip **8** provided with side extensions **29**.

Having obtained the required contact gap and spring restoring force, the subassembly is inserted into its protective tube. Centralization of the subassembly is effected by the locating action of the curved sides of the flux collectors **9** and **16** and the leg **13**. The open end of the tube is then sealed round the strips **2** and **3**, and the base of the hairpin removed. The portions of the strips **2** and **3** extending outside the tube then form the terminals of the switch.

These terminals are of reduced section from that of the internal contact members since the switch does not depend on the flux carrying capacity of the terminals, the flux being picked up internally by the flux collectors. A two fold benefit derives from reduced terminal sections. Firstly there is more chance of the terminal bending before the breaking stress of the glass is reached, and secondly the smaller section of the terminal permits a greater section of glass.

It is to be understood that the foregoing description of specific examples of this invention is made by way of example only and is not to be considered as a limitation on its scope.

What is claimed is:

**1.** An electrical contact assembly including a stationary contact member, a movable contact member, supporting means including a dome shaped supporting surface for supporting said movable contact member, means including a spring urging said movable contact member into a pivotable position against said dome shaped supporting surface and means adjustable to affect the spring and thereby control the pressure exerted by the spring on said movable contact member.

**2.** An assembly as claimed in claim **1** in which said movable contact member is pivotable about its center.

**3.** An assembly as claimed in claim **1** in which the contact face of said stationary contact member is formed as a transverse part-cylindrical surface, and the contact face of said movable contact member is formed as a twin longitudinal part-cylindrical surface, said part-cylindrical surfaces having radii of curvature which are large relative to the thickness of the fixed and movable contact members.

**4.** An assembly as claimed in claim **1** in which the spring urging said movable contact member on to said dome shaped supporting surface comprises a leaf spring extending generally parallel to the movable contact member on the side thereof remote from said supporting surface, and in which the leaf spring bears on to the movable contact member on one side of the supporting surface and bears on to a fixed spring support on the other side of the supporting surface.

**5.** An assembly as claimed in claim **1** in which the spring is arranged to bias the movable contact member to be out of contact with the fixed contact member.

**6.** An assembly as claimed in claim **1** in which a single suitably shaped bar provides the spring supporting means for affecting the spring pressure, the stationary support for the leaf spring, and a back stop for the movable contact member.

**7.** An assembly as claimed in claim **1** in which the contact faces have a palladium surface.

**8.** A magnetic contact device including a sealed insulating vessel having electrical contact means therein operable in response to a magnetic flux exerted thereon externally of said vessel, in which the said contact means include two cooperating contact members of magnetic material each having in contact therewith a member of magnetic material so shaped as to collect the externally exerted contact operating magnetic flux and thereby reduce the reluctance of the path traversed by the magnetic flux between the vessel wall and the contact members.

**9.** A device as claimed in claim **8** in which said contact means are so constructed as to constitute an operable subassembly with stationary flux collector members, and in which said flux collector members are so dimensioned that when said subassembly is inserted into said vessel said flux collector members serve as means for locating the subassembly in the vessel.

**10.** A device as claimed in claim **8** in which one of said contact members is fixed and the other of said contact members is pivotably movable.

**11.** A device as claimed in claim **10** in which the flux collector member associated with the movable contact member is attached to an electrically conducting member of nonmagnetic material, in which said nonmagnetic member is rigidly joined at one end thereof to an electrically conducting terminal member of magnetic material sealed through one end of said vessel, and in which the fixed contact member is sealed through the same end of the said vessel so that the contact end of the fixed contact member overlaps the contact end of the movable contact member and the flux collector member of the fixed contact member partially surrounds a length of the terminal member inside the vessel.

**12.** A device as claimed in claim **11** in which the movable contact member is pivotable on a dome shaped supporting surface formed in the flux collector member associated therewith.

**13.** A device as claimed in claim **12** in which the contact end face of the fixed contact member is formed as a transverse part-cylindrical surface, and the contact end face of the movable contact member is formed as a twin-longitudinal part-cylindrical surface.

**14.** A device as claimed in claim **12** in which the movable contact member is spring urged on to said dome shaped supporting surface by a leaf spring extending generally parallel to the movable contact member on the side thereof remote from said supporting surface, the leaf spring bearing on the movable contact member on one side of the supporting surface and on to a fixed spring support on the other side of the supporting surface.

**15.** A device as claimed in claim **14** including spring supporting means adjustable to affect the pressure exerted by the spring on said movable contact member.

**16.** A device as claimed in claim **14** in which the spring is arranged to bias the movable contact member to be out of contact with the fixed contact member.

**17.** A device as claimed in claim **11** in which said nonmagnetic member is so shaped as to provide the spring supporting means adjustable to affect the spring pressure, the stationary support for the leaf spring, and a back stop for the movable contact member.


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BERNARD A. GILHEANY, *Primary Examiner.*

R. N. ENVALL, JR., *Assistant Examiner.*

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