April 2, 1963 H. REIFEL 3,084,234

ELECTROMAGNETIC SWITCHES

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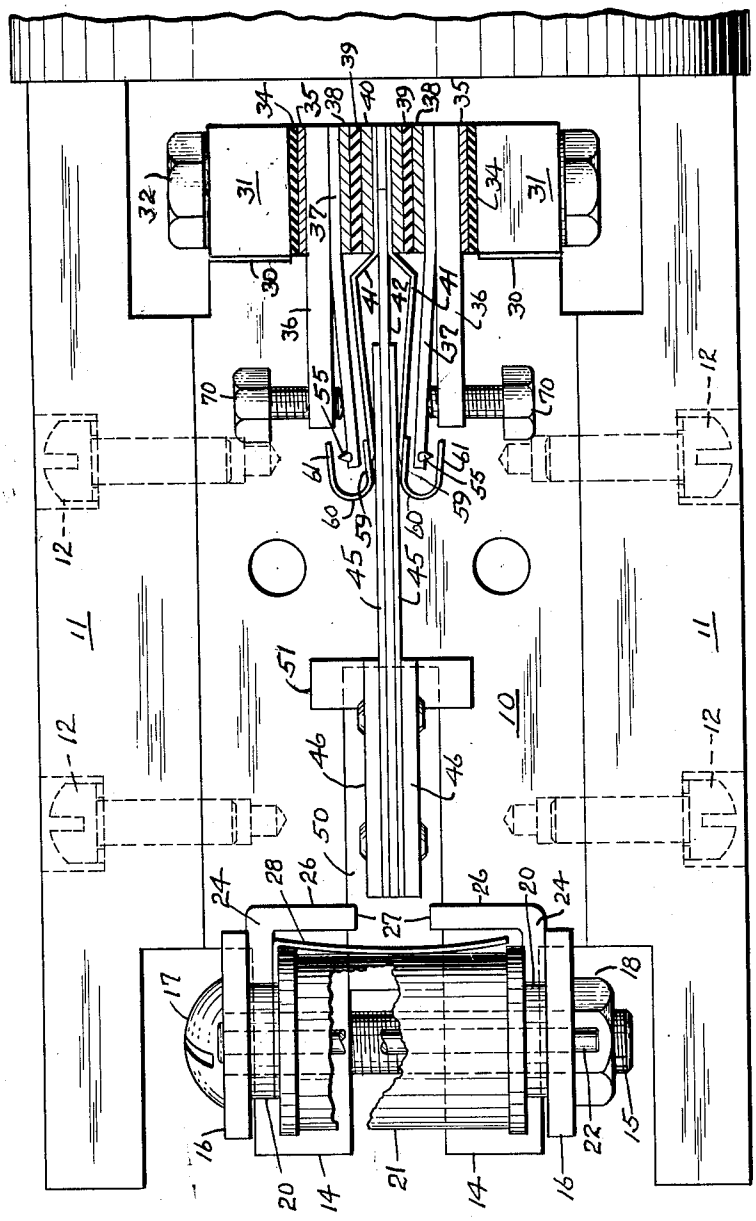

Fig. 1

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Fig. 2

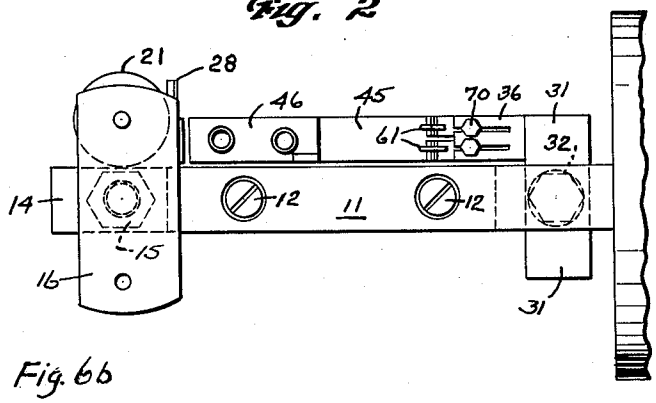

Fig. 6a

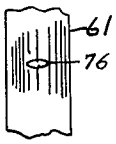

Fig. 6b

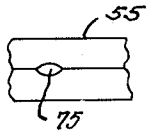

Fig. 3

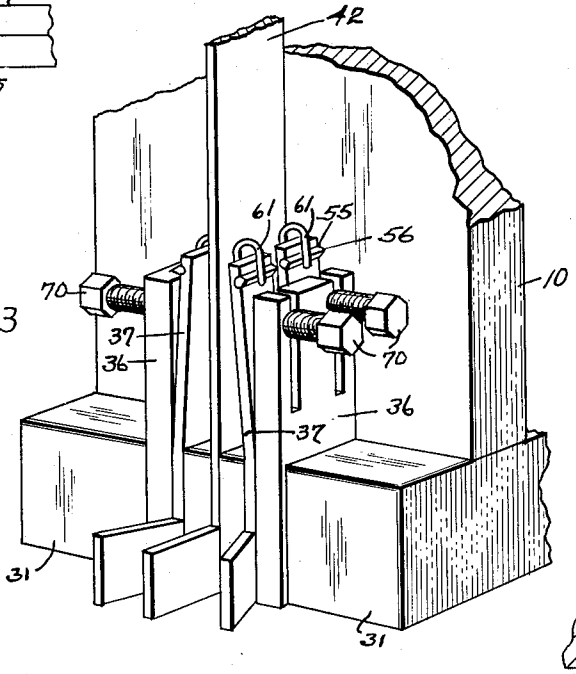

Fig. 5a

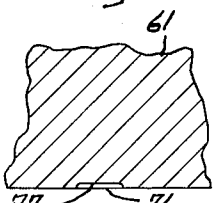

Fig. 5b

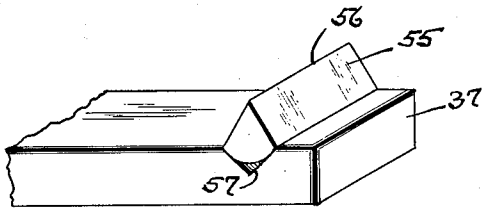

Fig. 4

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ELECTROMAGNETIC SWITCHES

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5 Claims. (Cl. 200—90)

This invention relates to magnetic switches having cantilever-supported, vibratory, contact-actuating reeds.

Magnetic switches having cantilever-supported reeds of spring metal are widely used as choppers and relays. Such reeds are deflected by magnetic fields set up by the flow of current in associated coils, and usually bear contacts which touch, or actuate contact lifters with contacts which touch, stationary contacts. The contacts are usually of a gold alloy for reducing the oxidation which occurs with copper contacts, and usually are cylindrical in outline, with corresponding fixed and movable contact surfaces in general alignment when touching, although it has been proposed as disclosed in my U.S. Patent No. 2,878,337 which issued March 17, 1959, to use a wire as a movable contact, and to use another wire extending perpendicular to the movable wire, as a fixed contact.

A disadvantage of such prior contacts is that there is rubbing wear which after a period of operation, reduces the contacting areas, and increases the contact resistance, requiring early replacement.

This invention overcomes the disadvantages of such prior contacts by using a wire for one contact, and by using as the other contact, another wire extending perpendicular to the one wire, and formed to have a wedge-shaped surface having a sharp edge at its apex where it contacts the one wire. After a short, break-in period of operation, the sharp edge of one wire produces a wedge-shaped trough in the other wire, the sharp edge being deformed to a narrow, substantially flat surface, and the trough having a correspondingly shaped bottom. This provides a large contact pressure with a small contact area.

It has previously been proposed to use a sharp point as one contact, and a flat surface as the other contact. The disadvantage of such a construction is that the point produces a round crater in the flat surface, and ambient dust collects in the crater, reducing contact pressure and increasing contact resistance. The troughs produced in the movable contact wires of this invention have converging ends, and any ambient dust collecting in the troughs is forced out their ends by the wedge-shaped contacts.

An object of this invention is to increase the lives of contacts of magnetic switches.

Another object of this invention is to increase the contact pressure per unit of contact area of two co-operating contacts of a magnetic switch.

This invention will now be described with reference to the annexed drawings, of which:

FIG. 1 is a plan view of a chopper embodying this invention, with a portion broken away, and another portion in section;

FIG. 2 is a side view on a reduced scale of the chopper;

FIG. 3 is a perspective view of the contact making and breaking portion of a chopper similar to the one of FIG. 1 except that its reed has no laminations;

FIG. 4 is an enlarged perspective view of one of the fixed contacts, showing its shape, and how it is attached to its contact plate;

FIGS. 5*a* and 5*b* are greatly enlarged, fragmentary, sectional views of a movable contact and its associated fixed contact respectively, showing the contact surfaces produced by a break-in period of operation, and

FIGS. 6*a* and 6*b* are enlarged fragmentary views of

the movable and fixed wires respectively, showing in plan the shapes of the contact surfaces produced by the break-in.

A central brass, base plate **10** has side plates **11** of brass secured thereto by brass screws **12**. The base plate **10** has spaced-apart extensions **14** at one end (the left end of FIG. 1) through which extends a screw **15** which clamps straps **16** onto the outside surfaces of the extensions **14**, and which has a screw head **17** in contact with one of the straps **16**, and has a nut **18** in contact with the other strap.

Core **20** of an electromagnet **21** is clamped between the straps **16** at corresponding ends thereof, with a locating pin **22** extending through the core **20** and the straps **16**. Pole pieces **24** contact the ends of the core **20**, and have extensions **26** bent through angles of 90°, and which have spaced-apart ends **27**. An electromagnetic shield **28** extends between the pole piece extensions **26** and the electromagnet **21**, and is supported by having one end clamped between one pole piece **24** and the adjacent plate **16**.

The center plate **10** has rectangular cut-outs **30** in the corners of its opposite end, within which are supported brass blocks **31** which are clamped to the plate **10** by a bolt **32** which extends through the blocks **31** and the central end portion of the plate **10** between the cut-outs **30**. Clamped between corresponding ends of the blocks **31** are insulators **34**, brass spacers **35**, the outer ends of brass plates **36**, the outer ends of brass contact plates **37**, brass spacers **38**, insulators **39**, brass spacers **40**, the outer ends of brass contact lifters **41** and the outer end of a brass reed **42**.

The reed **42** has brass laminations **45** secured thereto on opposite sides thereof starting adjacent to where the reed is clamped and extending to the free end of the reed. The reed **42** at its free end has soft iron plates **46** riveted to opposite sides thereof, the free end of the reed and the corresponding ends of the iron plates terminating closely adjacent to the ends **27** of the pole piece extensions **26** of the electromagnet **21**. The laminations **45** are added to the reed for loading it so that it vibrates at a selected resonant frequency.

The center plate **10** has a central recess **50** aligned with the space between the extensions **14** of the plate **10**, and extending inwardly of the plate **10** to a location opposite the soft iron plates **46**. A permanent magnet **57** extends within a transverse slot in the center plate **10** near the inner end of the slot **50**. The magnet **51** magnetizes the iron plates **46** on the end of the reed so that they are influenced by field changes in the pole piece extensions **26** when A.C. is supplied to the electromagnet **21**, and cause the reed to vibrate at the frequency of the applied A.C.

The inner ends of the contact plates **37** have attached thereto and extending transversely thereof on their outer sides, wedge-shaped contact wires **55** having sharp edges **56**. As shown by FIG. 3, there are two, aligned, spaced-apart, contact plates **37** on each side of the reed **42**, having aligned contact wires **55**. The wires **55** are attached to the contact plates as shown by FIG. 4. A transverse recess **57** is formed across each plate **37**, the recess being triangular in section. A wire **55** which is round at the time of installation, is placed in the recess, the wire being larger than the recess so that its major portion protrudes from the recess. The portion of the wire within the recess is spot welded to the plate **37**, and the portion of the wire which protrudes from the recess is ground away to the wedge shape shown by the drawings, with a sharp edge **56** at its apex.

The outer side of the inner end of each contact lifter **41** has spot welded thereto, the outer end of one leg **59** of a U-shaped contact wire **60** which straddles the outer

end of its associated contact plate **37**, and which has its other leg **61** opposite the sharp edge **56** of its associated contact wire **55**. The edge **56** of a wire **55**, and the axis of its associated contact wire leg **61** extend in planes which are perpendicular to each other.

The plates **36** have small bolts **70** threaded therein, and the inner ends of which touch the outer sides of the contact lifters **36**, and which are used for adjusting the spacings between the contact wires **55** and **61**.

FIG. 2 shows one electromagnet **21**, and one reed and contact assembly on one side of a center plate **10**, and its side plates **11**. Another electromagnet and another reed and contact assembly could be supported on the other side of the center and side plates for combining two choppers in one over-all assembly.

In operation, A.C. applied to the coil of the electromagnet **21**, produces a varying magnetic field between the ends **27** or the pole piece extensions **26**, which cause the iron plates **46** on the free end of the reed **42**, which plates are magnetized by the permanent magnet **51**, to vibrate the reed. Movement of the reed in one direction from its normal central position, causes it to move the contact lifters **41** in contact with one of its sides in that direction to force the sharp edges of their contact wires **55** against the associated contact wires **61** for closing an external circuit in which such contact wires are connected. When the reed is moved in the opposite direction, the contact lifters which were moved by the reed when the latter moved in the one direction, return to their normal position in which their contact wires **55** are spaced from their associated contact wires **61**, and the contact lifters **41** in contact with the opposite side of the reed are moved in the opposite direction so that their contact wires **55** are forced against their associated contact wires **61** for closing another external circuit in which such contact wires are connected.

The two-parallel-connected contact wires **55**, and the two parallel-connected wires **61** on each side of the reed are provided as a factor of safety in case of damage to one set of contact wires.

The illustrated contact wires are of a gold alloy. As shown in exaggerated fashion by FIG. *5b*, the sharp edge **56** of a wedge-shaped contact wire **55** is deformed after a short, break-in period of operation, so that the apex of the wedge where it contacts the wire **61**, becomes a narrow, substantially flat surface **75**. As shown by FIG. *5a*, a wedge-shaped trough **76** having a narrow, substantially flat bottom **77** is formed during the break-in period, in and transversely of the wire **61** where it contacts the wire **55**. The trough **76** has converging ends as shown by FIG. *6a*, and any dust which would tend to collect in the trough would be forced out its ends when the flat surface **75** of the contact wire **55** is forced through the dust against the bottom of the trough.

The described break-in operation is performed at the factory so that when a chopper is shipped to a customer, it has contact wires with the troughs, and contact wires with narrow flat surfaces at the apices of wedge-shaped portions as described in the foregoing. The metal of the wires is compressed during the break-in period that no further significant deformation can take place during the service operation.

What is claimed, is:

1. In an electromagnetic switch having a cantilever-supported reed of spring metal, and having means for vibrating said reed, the improvement comprising a contact wire containing precious metal movable with said reed, a fixed contact wire containing precious metal, said wires having longitudinal axes extending in mutually perpendicular planes, one of said wires having a wedge-shaped portion having an apex formed as a narrow, substantially flat surface, and the other of said wires having a wedge-shaped trough with converging ends and a narrow, substantially flat bottom opposite and normally spaced from said surface.

2. In an electromagnetic switch having a cantilever-supported reed of spring metal, and having means for vibrating said reed, the improvement comprising a contact lifter movable with said reed, a contact wire containing precious metal attached to said lifter, and a fixed contact wire containing precious metal normally spaced from said first mentioned wire, said wires having longitudinal axes extending in mutually perpendicular planes, one of said wires having a wedge-shaped portion having an apex formed as a narrow, substantially flat surface, and the other of said wires having a wedge-shaped trough with converging ends and a narrow, substantially flat bottom opposite and normally spaced from said surface.

3. In an electromagnetic switch having a cantilever-supported reed of spring metal, and having means for vibrating said reed, the improvement comprising a contact wire containing precious metal movable with said reed, a fixed contact plate having a transversely extending recess, a fixed contact wire containing precious metal having a rounded portion in said recess, and having a wedge-shaped portion extending outwardly from said plate, the apex of said wedge-shaped portion being formed as a narrow, substantially flat surface, said wires having longitudinal axes extending in mutually perpendicular planes, said first mentioned wire having a wedge-shaped trough with converging ends and a narrow, substantially flat bottom opposite and normally spaced from said surface.

4. In an electromagnetic switch having a reed of spring metal, having means for supporting one end of said reed, and having means for vibrating said reed, the improvement comprising a contact lifter movable with said reed, and having one end supported by said supporting means, a contact plate having one end supported by said supporting means insulated from said reed and lifter, said plate having attached thereto and extending transversely thereof a contact wire containing precious metal having a wedge-shaped portion extending from said plate, said wedge-shaped portion having an apex formed as a narrow, substantially flat surface, a U-shaped contact wire containing precious metal straddling the other end of said contact plate with one leg attached to said lifter and the other leg having a wedge-shaped trough with converging ends and a narrow, substantially flat bottom opposite and normally spaced from said surface, the longitudinal axes of said first mentioned wire and of said other leg extending in mutually perpendicular planes.

5. The invention claimed in claim 4 in which said plate has a wedge-shaped recess, and in which said first mentioned wire has a rounded portion opposite said flat surface in said recess.

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