Feb. 14, 1950 C. E. HASTINGS 2,497,547

MAGNETIC SWITCH

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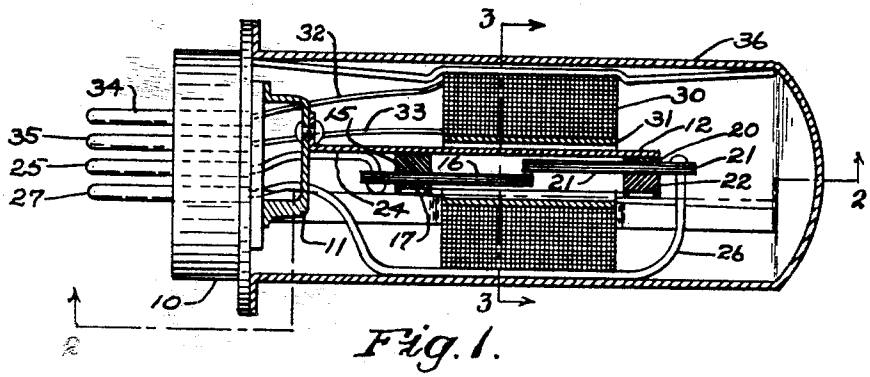

Fig. 1.

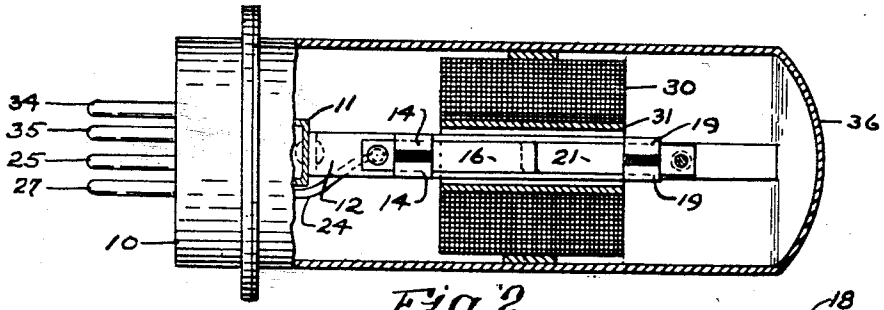

Fig. 2.

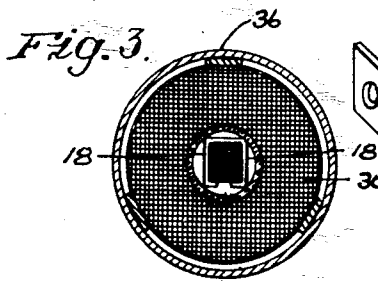

Fig. 3.

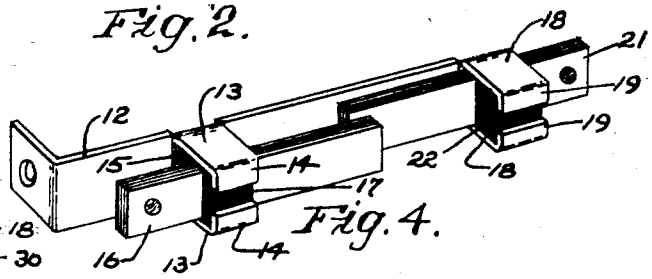

Fig. 4.

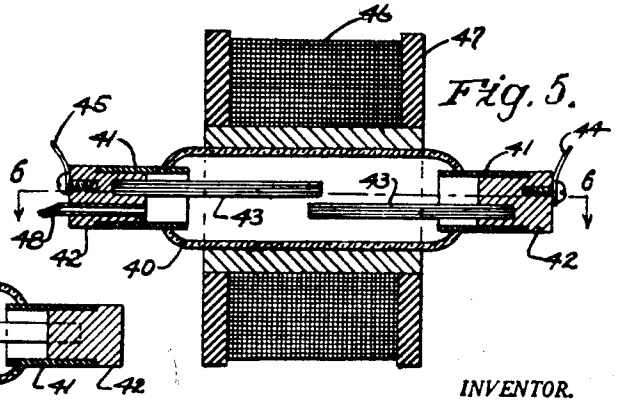

Fig. 5.

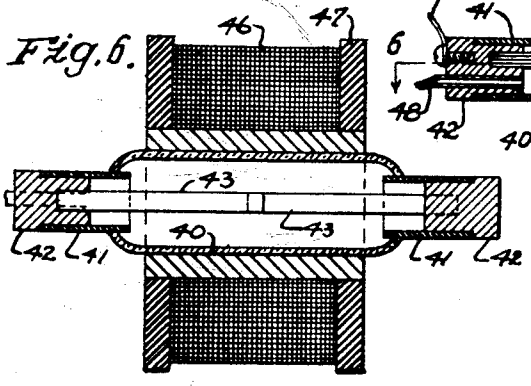

Fig. 6.

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MAGNETIC SWITCH

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2 Claims. (Cl. 200—87)

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This invention relates to magnetic switches, and relates more particularly to magnetic switches having current closing contacts on magnetic spring armatures which are moved together by being magnetized by the application of magnetic fields.

A magnetic switch of this type which has been used for high speed operation, includes a pair of magnetic springs as armatures, the springs being supported as cantilever beams with their free ends overlapping and having electric circuit closing contacts on their adjacent surfaces. Electric current through a coil around the springs causes them to become magnetized and their free ends to be attracted together causing closing of the contacts.

A disadvantage of this type of switch is that mechanical vibrations at or near the resonant frequency of the magnetic springs cause erratic performance. Other disadvantages of such a switch are that the contacts bounce away from each other when they strike, and eddy currents are set up in the springs when subjected to varying magnetic fields, causing delayed operation.

This invention provides a switch of this general type which not only does not have the disadvantages discussed in the foregoing but which has in addition, advantages not found in the prior switches.

This invention instead of using a single spring for each armature, uses a plurality of springs stacked together as laminations. The friction damping between the laminations of each armature prevents bouncing. The individual springs of each armature through being magnetized alike by the application of a magnetic field, repel each other at their free ends causing same to move apart. Thus in an armature having, for example, four laminations, the two outer laminations are forced outwardly by the magnetic repulsion between them and the two inner laminations. This causes increased speed of operation since the outer laminations are moved together by both attraction and repulsion. Another advantage is that the laminations prevent the formation of eddy currents, and the speed of operation is thereby speeded up since the magnetic flux flows more freely in the absence of eddy currents when the magnetic field is first applied. Another advantage is that increased contact pressure is provided without decreasing the speed of operation or the sensitivity.

An object of the invention is to increase the speed of operation of magnetic switches.

Another object of the invention is to prevent the contacts of a magnetic switch from bouncing.

Another object of the invention is to damp out mechanical vibrations in magnetic switches having spring armatures.

Another object of the invention is to increase

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the contact pressure of magnetic switches without as a result thereof decreasing their speed of operation or their sensitivity.

The invention will now be described with reference to the drawing, of which:

Fig. 1 is a side elevation, in section, of a magnetic switch embodying this invention, sealed in a vacuum tube type enclosure;

Fig. 2 is a sectional view along the lines 2—2 of Fig. 1;

Fig. 3 is a sectional view along the lines 3—3 of Fig. 1;

Fig. 4 is a projected view of the laminated spring armatures of Figs. 1 and 2;

Fig. 5 is a side elevation, in section, of another magnetic switch embodying this invention, and

Fig. 6 is a sectional view along the lines 6—6 of Fig. 5.

Referring first to Figs. 1–4 which illustrate the invention embodied in a magnetic switch sealed in a vacuum tube type container, the base 10 has the bracket 11 to which is riveted one end of the beam 12. The beam 12 has the pair of channel arms 13 extending perpendicular thereto and having the bent over extensions 14 forming their ends. The member 15 of electric insulating material is supported against the beam 12, and against it is supported the laminated armature 16 adjacent one end thereof. The member 17 of electric insulating material is supported between the extensions 14 and the armature 16.

The beam 12 has adjacent the other end thereof, the pair of channel arms extending perpendicular thereto, and which have the bent over extensions 19 forming their ends, supporting the member 20 of electric insulating material against the beam 12, and supporting the laminated armature 21 adjacent one of its ends, between the member 20 and the member 22 of electric insulating material.

The members 15 and 17 insulate the armature 16 from the beam 12 and space it therefrom. The members 20 and 22 insulate the armature 21 from the beam and space it therefrom. As illustrated by Figs. 1 and 4, the armatures 16 and 21 have their free ends overlapped and normally spaced apart. The armatures are rigidly held as cantilever beams in the described supports.

Each of the armatures 16 and 21, in the embodiment illustrated by Figs. 1–4, consists of four spring leaves of high permeability such as a nickel alloy of steel. The innermost leaf of the armature 16 and the innermost leaf of the armature 21, which contact when the free ends of the armatures are flexed together as will be described, are preferably coated in their contact making areas with a contact material such, for example, as silver.

The armature 16 is connected by the wire 24 to

the base pin 25, and the armature 21 is connected by the wire 26 to the base pin 27.

The magnetizing coil 30 is supported upon the cylindrical form 31 extending around but spaced from, the inner portions of the armatures 16 and 21. The wires 32 and 33 connect the ends of the coil 30 to the base pins 34 and 35 respectively.

The metal shell extends around the armatures 16 and 21 and their supporting structure, and around the coil 30, and is attached to the base 10 as by soldering or welding, and forms a hermatic seal for the switch structure.

The base 10 of the switch is adapted to be plugged into a conventional vacuum tube socket for establishing circuit connections.

When the coil 30 is energized by the application of electric current thereto, assuming for the purpose of explanation, that direct current is applied, the resulting magnetic field magnetizes the armatures 16 and 21 causing the free end of one to have a north magnetic pole, and causing the free end of the other to have a south magnetic pole. The free ends of the armatures are attracted together and contact thus closing the electric circuit in which the armatures are connected through the wires 24 and 26 and the base pins 25 and 27.

The leaves of each armature are, of course, magnetized alike so that their free ends repel each other. This causes the free end of the inner or contact making leaf of each armature to be moved towards the corresponding leaf of the other armature through the repulsion of the adjacent leaf. This repulsion action is in addition to the mutual attracting action between the two armatures, and greatly speeds up the action of the switch.

Another factor resulting in an increase in the speed of operation of the switch, is that the laminations prevent the formation of the usual eddy currents which would oppose the building up of the magnetic flux when the magnetic field is initiated by the coil 30.

Tests have shown that the speed of operation of a magnetic switch of the type illustrated herein has been reduced from 200 microseconds to 30 microseconds by replacing single leaf armatures with ones having laminations according to this invention.

Another advantage of the laminated armature construction is that high contacts pressures can be attained without magnetic saturation, and without materially stiffening the armatures.

Still another advantage of the laminated structure is that there is frictional damping between the individual leaves of each armature, preventing bouncing of the armatures when they strike each other, and preventing mechanically resonant vibrations from causing spurious and erratic operation.

The switch illustrated by Figs. 5 and 6 has a glass tube 40 in the ends of which are sealed the metal cylinders 41 having soldered therein the metal end plugs 42. One end of one armature 43 is tightly fitted in one plug 42, and one end of the other armature 43 is tightly fitted into the other plug 42. The armatures 43 are laminated, each in the embodiment illustrated, having four leaves.

The wires 44 and 45 attached to the plugs 42, serve to connect the armatures 43 in an electric circuit.

The coil 46 wound on the spool 47 is supported around the tube 40, and when energized by electric current causes the free ends of the armatures 43 to be attracted against each other as described in the foregoing in connection with Figs. 1–4.

The tube 48 which may be of copper, extends through one of the plugs 42 into the interior of the tube 40, and may serve to evacuate the tube 40, or to introduce a gas therein such, for example, as "Freon," hydrogen or helium. After the tube 40 has been evacuated or gas introduced therein, the outer end of the tube 48 may be sealed as by crimping as illustrated by Fig. 5.

The electric current supplied to the energizing windings of the switches illustrated, may be continuous or pulsating direct current, or may be alternating current. An external magnet may be used to magnetize the armatures of each switch.

The outermost lamination of each armature may be made much heavier than the other laminations. This would result in higher speed action since substantially all deflections would be towards the lighter inner leaves forming the contacts.

While embodiments of the invention have been described for the purpose of illustration, it should be understood that the invention is not limited to the exact apparatus and arrangements of apparatus illustrated, as modifications thereof may be suggested by those skilled in the art without departure from the essence of the invention.

What is claimed is:

1. A magnetic switch comprising a pair of contact members of magnetic metal, one of said members comprising a plurality of leaves of spring metal stacked in laminations, means for supporting leaves as cantilever beams having their free ends overlapping the other of said members, and means for magnetizing said members for causing same to contact to close electrical connections between them, said leaves being free to move towards each other and away from each other adjacent their free ends whereby there is friction damping between adjacent leaves which resist bouncing when the members contact, and whereby the free ends of the leaves repel each other when magnetized thereby increasing the speed of operation of the switch.

2. A magnetic switch comprising a pair of contact making armature members, each of said armature members comprising a plurality of leaves of magnetic spring material stacked in laminations, means for supporting, the leaves of each of said armature members as cantilever beams with their free ends overlapping, and means for magnetizing said armature members for causing same to move together to close electrical connections between them, the leaves of each member being free to move towards each other adjacent their free ends whereby there is friction damping between adjacent leaves which resist bouncing when the members contact, and whereby the free ends of the leaves of each member repel each other when magnetized thereby increasing the speed of operation of the switch.

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