

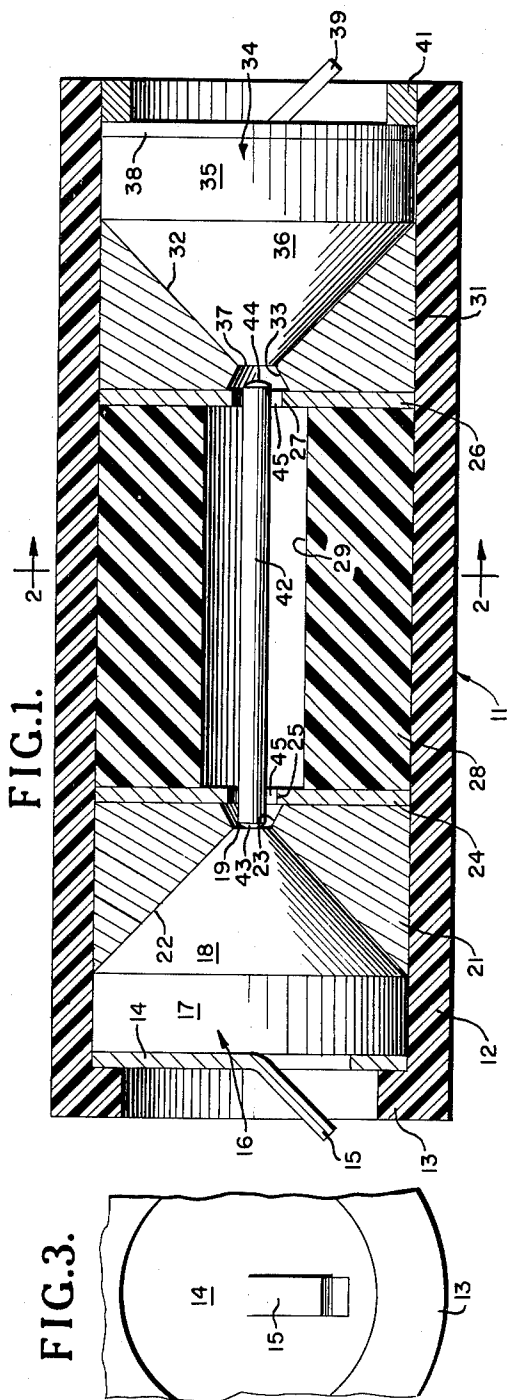
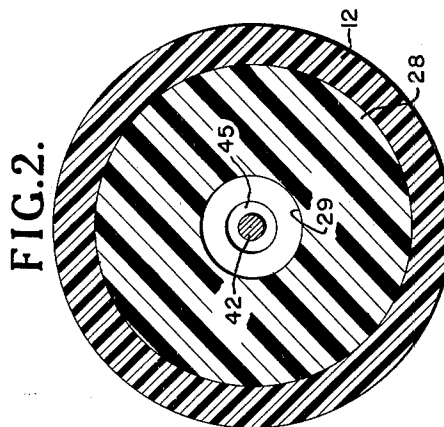
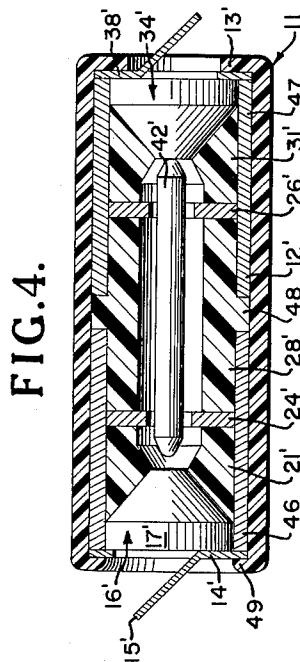
Aug. 15, 1961

M. E. SHINDLEDECKER ET AL

2,996,586

MAGNETIC TREMBLE SWITCH

Filed Oct. 28, 1955



INVENTORS
M. E. SHINDLEDECKER
E. F. BRANAGAN
C. S. HORSMAN

BY

L. O'Brien
W. O. Greenberry
ATTORNEYS

1

2,996,586

MAGNETIC TREMBLE SWITCH

Maurice E. Shindledecker, Laurel, and Edward F. Brangan, Rockville, and Charles S. Horsman, Beltsville, Md., assignors to the United States of America as represented by the Secretary of the Navy

Filed Oct. 28, 1955, Ser. No. 543,635

11 Claims. (Cl. 200—61.45)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to a vibration sensitive device for use in an ordnance item having an electrical circuit and more particularly to a normally open tremble switch employing a pair of magnets to resiliently support a contact rod in spaced relation with respect to contact members so the rod may respond to vibrational waves to momentarily close the circuit.

Devices of this character heretofore devised have employed a spring with a weight on the end in a cantilever type arrangement or have used a weight exerting a force through a lever against a spring, thus necessitating jewels or low friction bearings to reduce damping due to friction, and have required considerable space. Such devices are usually too large for the space available in a fuze, and when reduced in size to fit fuze requirements, do not possess the necessary resonant frequency. Or to avoid great variation in sensitivity due to change in position, two or more such devices must be incorporated in the fuze.

The device of this invention is small and compact, having a body but one inch in length and in which a rod between a pair of magnets is supported by the magnets in spaced relation to annular contact members adjacent the ends of the rod, thereby conforming to critical space requirements and eliminating the necessity for jeweled or low friction bearings.

An object of the invention is to provide a new and improved normally open tremble switch.

A further object of the invention is the provision of a tremble switch that is small and compact and is normally maintained open by the force of magnetism.

A final object of the invention is to provide a tremble switch which possesses the necessary vibrational properties and in which the parts thereof are of such a size and so related as to fit within the space available to house the switch in a fuze.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 shows a longitudinal sectional view of a preferred embodiment of the invention;

FIG. 2 shows a section of the device taken on the line 2—2 of FIG. 1 looking in the direction of the arrows;

FIG. 3 is a fragmentary detail view of one end of the switch; and

FIG. 4 illustrates a modification of the device.

Referring now to the drawing, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 1 a tremble switch generally designated 11 comprising a hollow cylindrical body or casing 12 having at one end thereof an inwardly directed flange 13; casing 12 being composed of insulating material, such as "Lucite" or the like.

Disposed within casing 12 and seated against flange 13 is a disc 14 of metal or other electro-conducting material. Disc 14 is suitably slitted and a portion thereof is

2

pressed out of the plane of the disc to form a terminal tab 15 extending outwardly between the edges of flange 13; best understood by reference to FIGS. 1 and 3.

Also disposed within casing 12 is a magnet 16 comprising a cylindrical base portion 17 and a tapered portion 18; with said base portion lodged against disc 14 to hold the same in place. The tapered portion of the magnet is in the form of a frustum of a cone, the base thereof being joined to said base portion 17. The tapered portion has a flat surface 19 parallel to the base portion. Surrounding the tapered portion 18 of the magnet is a magnet seat 21 which is provided with a recess 22 which receives said tapered portion of the magnet. Magnet seat 21 is composed of electro-conducting material having non-magnetic properties, such as brass or the like, and extends beyond flat surface 19; the seat being cut away as at 23 to expose said flat surface.

Abutting magnet seat 21 is an annular contact member in the form of a circular metallic disc 24 having a circular opening 25 centrally thereof. A similar annular contact member comprising a metallic disc 26 with opening 27 is located in casing 12 and spaced from disc 24 by means of spacer 28 of insulating material, such as "Lucite" or the like, the discs 24 and 26 being composed of non-magnetic material. Extending longitudinally of spacer 28 is a central bore 29.

Lodged against metallic disc 26 on the side thereof opposite spacer 28 is a magnet seat 31 similar to magnet seat 21, said magnet seat 31 having a recess 32 and being cut away as at 33. A magnet 34 comprising a cylindrical base portion 35 and a tapered portion 36 is disposed in casing 12 so that said tapered portion 36 is received in recess 32 of magnet seat 31. Similar to magnet 17, magnet 34 has a flat surface 37 which faces disc 26 across the cut away portion 33 of magnet seat 31.

Backing up magnet 34 is a metallic disc 38 which is provided with a terminal tab 39 formed similarly to tab 15. A retainer ring 41 fits snugly within casing 12 and abuts disc 38 to hold the aforementioned parts in proper relation, with surfaces 19 and 37 and openings 25 and 27 coaxially disposed in casing 12 and longitudinally spaced therein.

Disposed between said surfaces 19 and 37 and within openings 25 and 27 is an elongated contact rod 42, said rod extending through bore 29 in spacer 28. Each end of rod 42 is rounded off as at 43 and 44 and said rounded off ends as well as surfaces 19 and 37 have a smooth finish to reduce friction between the rod and surfaces. The rod is made of steel or other material that has a high magnetic permeability and is adapted to be supported by the force of magnets 16 and 34 substantially centrally of openings 25 and 27 so that there is a gap 45 between the rod and the annular contact members, one end of the rod normally being in contact with one of said magnets.

The switch described above is assembled by placing disc 14 in casing 12 with the disc against flange 13 and tab 15 directed outwardly. Magnet 16 is inserted with base portion 17 thereof in contact with disc 14. Magnet seat 21 is placed so that the walls of recess 22 are in engagement with tapered portion 18 of magnet 16. Disc 24 is slipped into place next to magnet seat 21 followed by spacer 28 and disc 26. Rod 42 is dropped in and extends through openings 25 and 27. Magnet seat 31, magnet 34 and disc 38 follow in the order named with terminal tab 39 being directed outwardly. Retainer ring 41 is pressed firmly into casing 12 and into engagement with disc 38 to hold the parts in proper relationship.

FIG. 4 illustrates a switch 11' which is a modification of switch 11 and similar thereto in that casing 12' has as at its ends discs 14' and 38' each having a terminal tab 15' and 39', respectively. Also similar to switch 11, switch 11' has a pair of magnets 16' and 34', a pair of metallic

discs 24' and 26', each with a central opening, a spacer 28' between the discs and a contact rod 42'. Magnet seats 21' and 31' are provided but, unlike switch 11, these magnet seats are of insulating material, such as "Lucite" or the like, the same as the casing and the spacer. In order that disc 14' and disc 24' be electrically connected there is provided a connecting cylinder 46 of metal or other electro-conductive material. Connecting cylinder 47 serves the same purpose between discs 26' and 38'. Connecting cylinders 46 and 47 are kept out of contact with each other by means of an enlargement 48 on spacer 28' which keeps the connecting cylinders separated.

The assembly of switch 11' should be readily apparent. Briefly, disc 38' is placed against flange 13' of casing 12 and connecting cylinder 47 is inserted to hold disc 38' in place. Magnet 34', magnet seat 31', disc 26' and spacer 28' are inserted in the order named. After connecting cylinder 46 has been placed around spacer 28 and brought into firm engagement with enlargement 48 thereof, and disc 24' has been inserted in cylinder 46 with disc 24' in contact with spacer 28', rod 42' is dropped in so as to be disposed in the openings in discs 24' and 26'. Seat 21' is placed against disc 24' and magnet 16' is inserted in the seat followed by disc 14', the parts being retained in proper relation by suitably crimping the end of casing 12' as at 49.

In the operation of switches 11 and 11', the contact rod is supported by the magnetic force of the magnets so as to be disposed substantially centrally of the openings in the discs of the annular contact members, it being understood, of course, that the tapered portions of the pair of magnets of each switch are of opposite polarity. The resonant frequency of the rod is determined by the pole strength of the magnets, the length of the rod, the permeability of the rod, and the mass of the rod. The contour of the end of the rod in contact with the flat surface of a magnet and the finish of said rod end and flat surface will also to a less degree determine the resonance. Any desired resonant frequency may be obtained by varying the factors named. With a switch made up to possess vibrational properties such that the switch is responsive to the vibrational waves emitted by a vehicle or machine that it is desired to destroy, the switch is inserted in the firing circuit of an ordnance item and the item is located by suitable means along the route of the vehicle or machine, and the item is armed. Normally, the contact rod is supported spaced from the annular contact members and the firing circuit of the ordnance item is therefore open. However, when the rod is set into vibration in response to the vibrational waves of the vehicle or machine and the vehicle or machine is within the effective range of the ordnance item, the extent of such vibration is sufficient to cause the end of the rod not in contact with a magnet to engage the annular contact member adjacent said end so as to close the firing circuit and detonate the ordnance item.

The switches of the instant invention have the advantage that the resonant response thereof can be adjusted by varying the strength of the magnets, or the space between them, so that by selection of suitable magnets properly spaced, a switch may be provided which possesses the desired vibrational properties and at the same time is sufficiently small and compact to meet critical space requirements. Also, the gap setting is substantially uniform for all normally open positions of the switch. Furthermore, the materials in the device are inexpensive and not difficult to obtain and the parts are easily produced with standard machine shop equipment, the tolerances on the parts being easily adhered to in production.

In an alternative arrangement, the contact rod and one of the magnets may be replaced by a metallic spring having a mass on one end thereof, the other end of the spring being fixed by suitable means and electrically connected to a terminal tab. The mass is composed of steel or other material having a high magnetic permeability

and is normally held by the force of the remaining magnet substantially centrally in the annular contact member adjacent the magnet.

Thus, applicants have achieved the objects of the invention and have provided a magnetically restored tremble switch which possesses the desired vibrational properties and at the same time is sufficiently small and compact to meet the critical space requirements of a fuze in an ordnance item.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A magnetic tremble switch comprising a casing, a pair of magnets supported in said casing in spaced relationship with oppositely solid portions thereof facing each other, a pair of spaced apart contacts interposed between said magnets, each of said contacts having an opening therein, and a rod extending through said openings and in contact with one of said portions.

2. A tremble switch of the character disclosed, comprising a tubular casing of insulating material, a pair of magnets spaced apart in said casing and disposed adjacent the ends thereof, respectively, said magnets each having a portion mutually facing each other of opposing polarities, a pair of annular contact members spaced apart in said casing between said magnets and disposed adjacent each of said magnets respectively, a pair of magnet seats disposed in said casing, each of said magnet seats being arranged between each magnet and the adjacent contact member, said contact members each having a central aperture therein, and a magnetic contact rod normally centrally disposed within said apertures and disengaged from said contact member with one end of the rod normally held by magnetic attraction in contact with one of said magnet portions.

3. A magnetic tremble switch of the character disclosed, comprising a hollow cylindrical casing of insulating material, a cylindrical spacer member of insulating material snugly fitting within said casing and located at the mid portion thereof, said spacer member having a central bore therein coaxial with said casing, a pair of metallic discs, each of said discs abutting one end of said spacer member, respectively, a pair of spaced apart magnet seats in said casing, each of said magnet seats being in engagement with each of said discs, respectively, each of said magnet seats having a tapered recess therein, a pair of spaced apart magnets, each of said magnets having a tapered portion received in the tapered recess of one of said magnet seats, respectively, said tapered portions being of unlike polarity and a pair of terminal tabs at the ends of said casing, each tab being connected to the adjacent magnet, said discs having openings therein coaxial with said casing, and a magnetic contact rod normally coaxially disposed within said openings normally spaced from said discs and with one end of the rod in contact with one of said tapered portions.

4. A tremble switch of the character disclosed, comprising a hollow cylindrical casing of insulating material, a pair of spaced apart magnets within said casing, each of said magnets being disposed at the ends of said casing respectively, each magnet including a cylindrical base portion and an inwardly directed tapered portion in the shape of a frustum of a cone having a flat circular surface disposed coaxially of said casing, said tapered portions being of unlike polarity, a pair of magnet seats, each magnet having a magnet seat adjacent thereto, each magnet seat being formed with a recess complementary to the tapered portion of the adjacent magnet and receiving the same, each of said magnet seats also having a tapered opening exposing the flat circular surface of the adjacent magnet, each magnet seat being made of electro-

5

conducting material having non-magnetic properties, a pair of metallic discs, each of said discs being in abutting engagement with each of said magnet seats, respectively, a spacer member of insulating material interposed between said discs and having a central bore, each disc having a central aperture therein, said apertures and said flat circular surfaces being disposed longitudinally of said casing and coaxially thereof, and a magnetic contact rod substantially centrally disposed within said apertures and normally spaced from said discs, said rod also being disposed on the axis of said casing and with one end of said rod engaging the flat circular surface of one of said magnets.

5. A magnetic tremble switch as defined in claim 4, characterized in that the ends of the contact rod are rounded off.

6. A magnetic tremble switch as defined in claim 5, characterized in that said flat circular surfaces of the magnets and the rounded ends of the contact rod have a smooth finish.

7. A magnetic tremble switch of the character disclosed, comprising a hollow cylindrical casing of insulating material, said casing having an inwardly directed flange at one end thereof, a first contact disc in said casing seated against said shoulder and having an outwardly directed terminal tab thereon, a first magnet including a cylindrical base portion in abutting engagement with the inner side of said disc, said magnet also including a tapered portion in the form of a frustum of a cone, said tapered portion tapering inwardly and terminating in a circular flat surface having a smooth finish, a first magnet seat of electro-conducting material and having a tapered recess therein corresponding to the tapered portion of the magnet, said magnet seat being lodged against said magnet and said recess receiving said tapered portion, said magnet seat having a plane surface parallel to said circular flat surface of said magnet, a first metallic annular contact member abutting the plane surface of said magnet seat, said magnet seat being cut away between said flat surface and said disc to provide an open space therebetween, a tubular spacer of insulating material abutting the other side of said disc, a second metallic annular contact member abutting the other end of said spacer, a second magnet seat of similar formation and material as said first magnet seat in abutting engagement with the other side of said second metallic disc, a second magnet of similar formation as said first magnet having its tapered portion received in the recess of said second magnet seat, said tapered portions of the magnets being dissimilarly poled, the circular flat surfaces of said magnets being parallel and coaxially disposed in said casing, each of said metallic discs having a central aperture therein coaxially disposed in said casing, and an elongated magnetic contact rod of a length shorter than the distance between the flat surfaces of said magnets coaxially disposed in said casing substantially centrally of said apertures and normally spaced from said annular contact members, said contact rod having rounded ends and one of said ends being held in contact with the flat surface of one of said magnets by magnetic attraction, a

6

second contact disc engaging the cylindrical base portion of said second magnet and having an outwardly directed terminal tab thereon, and a retaining ring fitting snugly within said casing and abutting said second contact disc to hold the parts within the casing.

8. In a magnetic tremble switch of the character disclosed, comprising a casing of insulating material, a pair of contact tabs, each contact tab being supported at the ends of said casing, respectively, a pair of connecting cylinders of electro-conducting material, said cylinders being spaced apart within said casing, one of said cylinders being in engagement with one of said contact tabs and the other cylinder being in engagement with the other contact tab, a pair of magnets of similar configuration, each magnet including a base portion and a tapered portion, one magnet being supported in one of said cylinders with the base portion of the magnet in engagement with the associated contact tab, the other magnet being similarly related to the other cylinder and contact tab in such manner that the tapered portions of the magnets are directed toward each other, said tapered portions being of opposite polarity and terminating in parallel flat surfaces facing each other, a pair of spaced apart annular contact members parallel to said flat surfaces, said contact members being disposed in such manner that there is a contact member in each of said cylinders and engaging the same, a tubular spacer of insulating material interposed between said annular contact members, a pair of magnet seats of insulating material, each magnet having associated therewith one of said magnet seats with the magnet seat interposed between the magnet and the adjacent annular contact member, each magnet seat being cut away to expose the flat surface of the associated magnet, and an elongated magnetic contact rod encircled by said annular contact members and normally disposed centrally thereof and spaced therefrom with one end of said rod being in contact with the flat surface of one of said magnets, the ends of said rod being rounded.

9. A magnetic tremble switch as defined in claim 8, in which said spacer has an enlargement thereon interposed between the adjacent ends of said cylinders to insulate the cylinders from each other.

10. A magnetic tremble switch as defined in claim 8, in which said flat surfaces of the magnets and the rounded ends of the rod have a smooth finish.

11. A magnetic tremble switch of the character disclosed, comprising a casing, a support member in said casing, a magnetic contact element disposed in said casing with one end of the element being yieldably supported by said support member, an annular contact member encircling the other end of the element and normally spaced therefrom, and a magnet in said casing having a portion disposed adjacent said contact member and said other end of the element, said last-named end of the element and the magnet portion being of unlike polarity.

References Cited in the file of this patent

UNITED STATES PATENTS

2,436,396	McCaslin	Feb. 24, 1948
2,671,135	Woodward	Mar. 2, 1954