Aug. 22, 1961 M. E. SHINDLEDECKER ET AL 2,997,558

SPRING ROD TREMBLE SWITCH

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FIG.1.

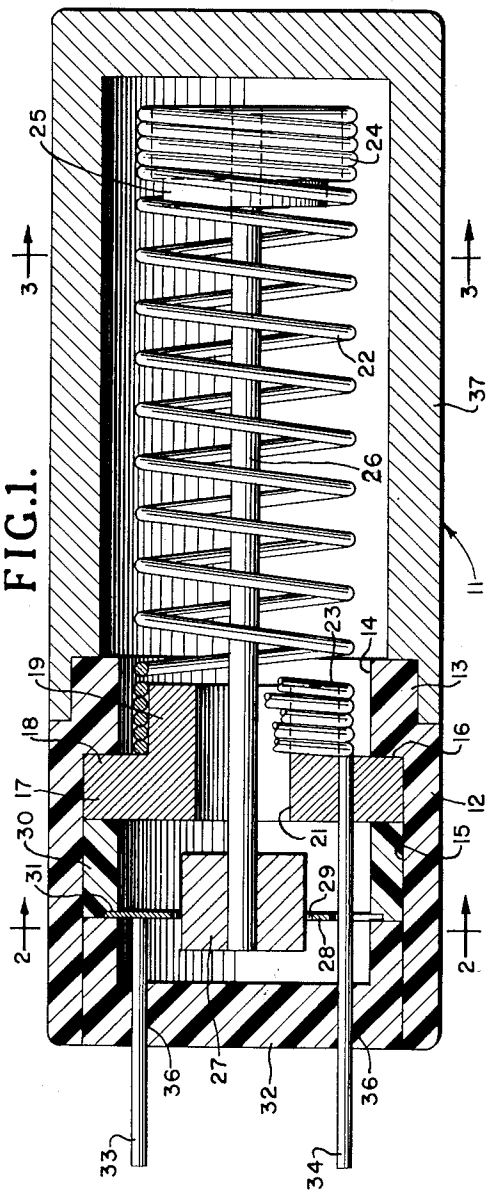


FIG.3.

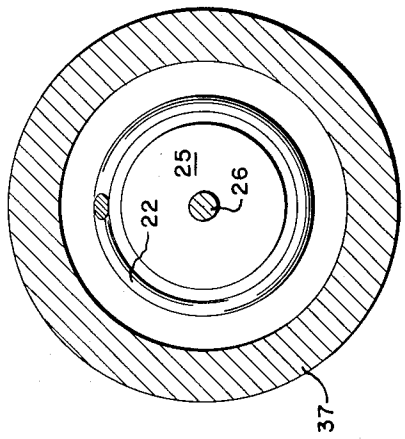
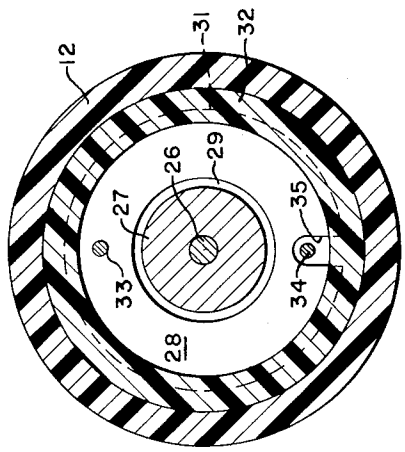


FIG.2.



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

BY

ATTORNEYS

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SPRING ROD TREMBLE SWITCH

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

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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 spring and rod to resiliently support a weighted movable contact so the same may respond to vibrational waves to close the circuit.

Devices of this character heretofore devised have employed a spring with a weight on the end thereof 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 space requirements, do not possess the necessary resonant frequency. Or to avoid great variations in sensitivity due to change in position, two or more such devices are usually incorporated in the fuze.

The device of this invention is small and compact, having a body about one inch in length and in which a vibratory mass is supported at one end of a rod in spaced relation to an annular contact member, the other end of the rod being secured to one end of a helical spring encircling the rod and the opposite end of the spring being supported at a point intermediate the mass and said other end of the rod, thereby conforming to critical space requirements and eliminating the necessity for jeweled or low friction bearings.

It is therefore an object of the present invention to provide a new and improved tremble switch.

A further object of the invention is the provision of a tremble switch that is small and compact and employs a spring and weighted mass to maintain the switch normally open.

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 therein:

FIG. 1 is a longitudinal sectional view of a preferred embodiment of the invention with parts in full or broken away;

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

FIG. 3 is a sectional view of the device taken on the line 3—3 of FIG. 1 looking in the direction of the arrows.

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. The switch 11 includes a hollow substantially cylindrical base member 12 having an inwardly offset portion 13; member 12 being composed of insulating material such as "Lucite" or the like. Portion 13 has a bore 14 which is of lesser diameter than a bore 15, which is the main bore of member 12, to thereby provide a shoulder 16 for a purpose which will become more clearly apparent as the description proceeds.

Disposed within member 12 is a spring mount 17 of metal or other electro-conducting material and having a base portion 18 of the same diameter as bore 15, said base portion 18 being lodged against said shoulder 16 to fix the position of the spring mount. Spring mount 17 also has a spring mounting element 19 which extends into said bore 14 and is of substantially less diameter than said bore 14. Extending through spring mount 17 is a bore 21 that is coaxial with bores 14 and 15.

Element 19 serves to mount a spring 22 of metal or the like having closely coiled end portions 23 and 24 and a loosely coiled helical mid-portion; the spring being mounted on said element 19 by means of the end portion 23. Received within end portion 24 and closely held by the same is a rod mount 25 of electro-conducting material to which an elongated metal rod 26 is secured so as to be normally disposed coaxially of said spring and bores 14, 15 and 25. Rod 26 extends through bore 21 beyond the spring mount 17 and into base member 12. Supported on the free end of rod 26 within base member 12 is a weighted vibratory mass 27 composed of metal or other electro-conducting material.

Encircling the vibratory mass 27 is an annular contact member 28 disposed in bore 15 of base member 12. Mass 27 is normally supported substantially centrally of member 28 and spaced therefrom so there is a gap 29 therebetween. Contact member 28 is of metal or the like and is held in place by means of a circular contact seat 30 of insulating material, such as "Lucite" or the like, which is provided with a notch 31 to receive member 28.

To retain contact member 28 seated in notch 31, an end cap 32 of the same diameter as bore 15 is lodged against member 28 and serves to close off the end of bore 15 of base member 12. Secured to contact member 28 and extending through the end cap 32 is an electrical terminal 33. Another electrical terminal 34 is secured to spring mount 17 and extends through the end cap 32, contact member 28 being cut away at 35, FIG. 2, to avoid contact between member 28 and terminal 34. Suitable holes 36 are provided in end cap 32 to receive terminals 33 and 34.

Enclosing spring 22 is a cap member 37 of suitable material which is secured to offset portion 13 of base member 12; the outside diameter of the cap member being the same as the outside diameter of the base member. Cap member 37 may be made of plastic or ceramic material or of metal.

To assemble the switch, spring 22 is mounted on element 19 of spring mount 17. Rod 26 is pressed into rod mount 25 and the rod mount is screwed into an end portion 24 of the spring. The mass 27 is pressed on flush with the free end of rod 26 and the two end portions of the spring are secured as by soldering to the spring mount and the rod mount, respectively. The terminal 34 is next soldered to the spring mount. The parts assembled thus far constitute a sub-assembly which is set in alignment horizontally by adjusting the spring until the deflection of the mass is within a small limit such, for example, as .001 inch, for 360° rotation of the assembled parts with respect to the major axis thereof. This subassembly is placed in base member 12 and capped by member 37. Contact seat 30 is inserted in base member 12 and placed against spring mount 17. Contact member 28, with its terminal 33 already soldered thereto, is placed in notch 31 of contact seat 30. Terminals 33 and 34 are passed through holes 36 in the end cap 32 and the end cap is cemented and pressed into place.

Uniform gap setting between the mass 27 and contact member 28 for all switch positions is maintained by making the weight of mass 27 and of rod mount 25 equal to each other.

Alternatively, base member 12 and cap member 37 could both be of metal and be used as a ground in the electrical circuit. This would eliminate the need for terminal 34.

As is apparent, the switch possesses two degrees of freedom: one in the axial plane of rod 26 and the other in a cross axial plane with respect to the rod.

In the operation of the switch, the ordnance item of which the switch forms a part is located by suitable means along the route of the vehicle or machine that it is desired to destroy and the item is armed. The vibrational properties of the switch are such that the switch is responsive to the vibrational waves emitted by the vehicle or machine. Normally, mass 27 is supported spaced from member 28 and the firing circuit of the ordnance item is therefore open. However, when said mass 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 mass 27 to engage member 28 so as to close the firing circuit and detonate the ordnance item.

Applicants have, by employment of a weighted spring rod which is coextensive in part with the spring and other parts of the switch, achieved the objects of the invention and have provided a 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.

Various modifications are contemplated and may be obviously restorted to by those skilled in the art without departing from the spirit and scope of the invention, as only a preferred embodiment thereof has been disclosed.

Having thus described the invention, what is claimed is:

1. A switch of the class disclosed, comprising a vibratory mass supported on one end of a rod in spaced relation to a contact member, the other end of the rod being secured to one end of a spring encircling the rod, and the opposite end of the spring being supported at a point intermediate said mass and the other end of the rod.

2. A switch of the type disclosed, comprising a support, a coiled spring supported at one end thereof by said support, a rod disposed within the spring in spaced relation thereto and supported by the other end of the spring, said rod extending through said spring and beyond said support, a weighted vibratory contact on said rod, and an annular contact member encircling said weighted vibratory contact and normally disengaged therefrom, said annular contact member being adapted to be engaged by said weighted vibratory contact for closing the switch.

3. A switch of the character disclosed, comprising a support, a helical spring with closely coiled end portions, one end portion receiving said support and secured thereto, the other end portion being secured to a rod mount, an elongated rod coaxially disposed within said spring and having one end thereof secured to said rod mount, said rod extending through said spring and said support, a vibratory mass supported on the other end of said rod, and an annular contact member surrounding said mass and normally spaced therefrom, the weights of said rod mount and said mass being substantially equal.

4. A switch of the character disclosed, comprising an elongated rod, a spring mount encircling said rod and disposed intermediate the ends thereof, an elongated spring encircling said rod and disposed in spaced relation thereto, means connecting one end of said spring to one end of said rod, the other end of said spring being secured to said spring mount, a vibratory mass on the other end of said rod, and an annular contact member surrounding said vibratory mass and normally spaced therefrom, said contact member being adapted to be engaged by said vibratory mass for closing the switch.

5. In a switch of the character disclosed, in combination, an elongated rod, a spring mount disposed about said rod intermediate the ends thereof but nearer to one end thereof, a first mass secured to said one end of the rod, a second mass secured to the other end of said rod, an elongated helical spring encircling said rod in spaced relation thereto and connected at its ends with said spring mount and second mass, respectively, said first and second masses being substantially equal in weight, and a contact member encircling said first mass and normally spaced therefrom, said contact member being adapted to be engaged by said first mass for closing the switch.

6. A tremble switch of the character disclosed, operable in response to vibrations received from a vehicle, comprising a hollow substantially cylindrical base member, a spring mount disposed in said base member, said spring mount having a bore therein, an elongated helical spring secured at one end to said spring mount and extending outwardly from said base member, a rod mount secured to the other end of said spring, an elongated rod having one end portion thereof fixed in said rod mount and extending through the bore of said spring mount in such manner that the other end portion of the rod is disposed in said base member, said rod normally being disposed coaxially of said spring and base member, a vibratory mass carried by the end portion of said rod in the base member, and an annular contact member encircling said mass and normally spaced therefrom, said mass being adapted to be vibrated in response to vibrational waves emitted by said vehicle to the extent that the mass is moved into engagement with said annular contact member.

7. A switch of the character disclosed, comprising a hollow substantially cylindrical base member, said base member including an inwardly-offset end portion to thereby provide a shoulder within said base member, a spring mount within said base member, said spring mount including a base element lodged against said shoulder and a hollow spring mounting element disposed within said inwardly-offset end portion, an elongated helical spring with one end thereof disposed within said inwardly-offset end portion and connected to said spring mounting element, the other end of said spring being spaced from said spring mount and base member and carrying a rod mounting element, an elongated rod secured to said rod mounting element and disposed within said spring in spaced relation thereto, an annular contact member mounted within said base member and spaced from said spring mount, said rod extending from said rod mounting element and through said hollow spring mounting element to a point past said annular contact member, and a vibratory mass secured to said rod and carried thereby in such manner as to be encircled by said annular contact member in normally spaced relation therewith.

8. A switch as claimed in claim 7, characterized in that the weight of the rod mounting element is substantially equal to the weight of the vibratory mass.

9. A switch of the character disclosed, comprising a hollow substantially cylindrical base member having a first bore therein, said base member having an inwardly-offset end portion with a second bore therein which is of lesser diameter than said first bore to thereby provide a shoulder within said base member, a spring mount having a base element lodged against said shoulder and a hollow spring mounting element disposed within said second bore, a circular member snugly fitted in said first bore and lodged against said base element, said circular member having a seating notch formed therein, an annular contact member seated in said notch, an elongated rod extending through said hollow spring mounting element in spaced relation thereto with one end of said rod located in spaced relation within said annular contact member and the other end of said rod located at a

point substantially spaced from said spring mounting element, a rod mounting element having said other end of the rod secured thereto, an elongated helical spring having one end thereof secured to said rod mounting element, the other end of said spring being secured to said spring mounting element, a terminal secured to said spring mount and extending past said annular contact member to a point outside said base member, a second terminal secured to said annular contact member and extending to a point outside said base member, and an end cap fitting snugly within said base member, said base member being slipped over said terminals and lodged against said

annular contact member to retain the same in said notch.

10. A switch as defined in claim 9, further characterized in that a vibratory mass is secured to the end of said rod within said annular contact member, and the weight of said mass is substantially equal to the weight of said rod mounting element.

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