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ROTARY SWITCH

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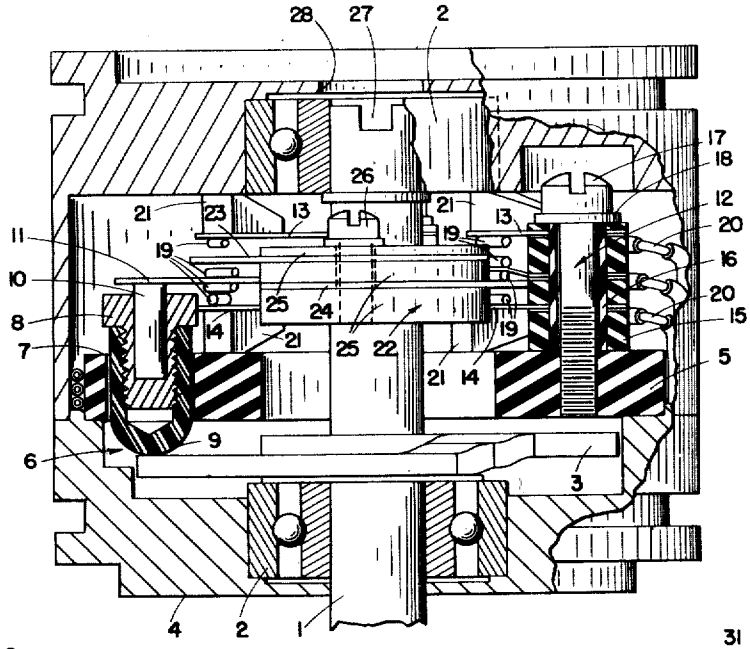

FIG. 2

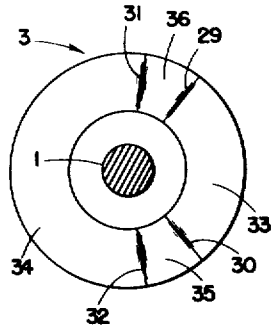

FIG. 3

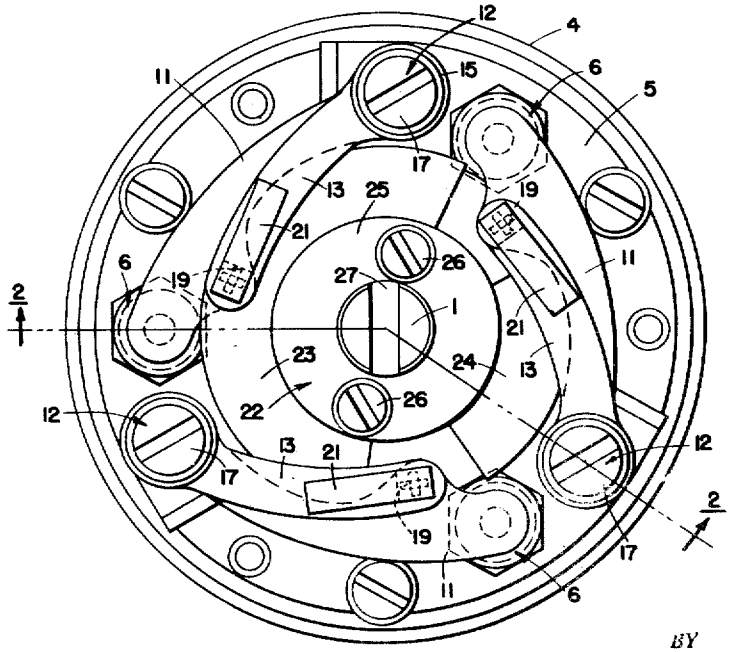

FIG. 1

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ROTARY SWITCH

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6 Claims. (Cl. 200—27)

This invention relates to a rotary switch, and more particularly to a rotary switch which is free to rotate in either direction with a minimum of friction, and which is adapted to be used in conjunction with a tachometer circuit as a tachometer commutator.

Switches which have been used as tachometer commutators are generally not reliable at high rates of rotation, nor do they have long life characteristics under varying shaft velocities, temperature, humidity, and atmospheric pressure. The device of this invention is adapted for use as a tachometer commutator for high shaft velocities because of the balance of the elements and the resistance to wear at the contact between a switch actuating cam attached to the switch shaft, and the cam followers which ride thereon. The switch of this invention is further adapted for use under conditions of high humidity, low pressure and high voltage, because of insulating inserts which are periodically inserted between the open contacts of the switch.

It is therefore an object of this invention to provide a rotating switch which is adapted for use as a tachometer commutator.

It is another object of this invention to provide a rotating switch which has outstanding wear properties at high velocities of its actuating shaft.

It is another object of this invention to provide a rotary switch which is adapted to prevent arcing between the contacts when the contacts are open.

It is another object of this invention to provide a rotary switch which has closely spaced switch contacts adapted for use under high voltage conditions.

It is another object of this invention to provide a tachometer commutator which is particularly adapted for use under ambient operating conditions in an aircraft.

It is another object of this invention to provide a rotary switch which does not arc under high humidity conditions.

It is a further object of this invention to provide a rotary switch which does not arc at high altitudes.

Other objects of invention will become apparent from the following description taken in connection with the accompanying drawings, in which

Fig. 1 is a top view with the bearing and top of the case removed, of a preferred embodiment of this invention adapted as a tachometer commutator;

Fig. 2 is a sectional view of the device with the top bearing and case replaced, taken at 2—2 in Fig. 1; and

Fig. 3 is a typical actuating cam for the device shown in Fig. 1.

In Figs. 1 and 2, actuating or drive shaft **1** turns upon bearings **2**. Actuating cam **3** is attached to shaft **1**. Bearings **2** are supported by frame **4**. Support **5** is mounted on frame **4** immediately above cam **3**. Cam follower **6** rides upon face cam **3** and is slidingly engaged by hole **7** in support **5**. In the preferred embodiment of this invention there are three cam followers **6** uniformly spaced at the same radius about the axis of shaft **1**.

Cam followers **6** preferably have an exterior bearing surface **9** of nylon because of the durable properties and the shock absorbing qualities of that material. Insert **8** is a screw inside of bearing material **9** of cam follower **6** so that the height of movable contact post **10** and movable contact arm **11** can be adjusted. Fixed contact post **12** is attached to support **5** between cam followers **6**. In the preferred embodiment of this invention there are three sets of fixed contacts and corresponding contact posts. Each set of contacts electrically engages a different set of movable contacts corresponding to each cam follower **6**. For purposes of further explanation the construction and operation of one set of fixed and movable contacts only is described herein. Fixed contact post **12** comprises upper fixed contact arm **13**, lower fixed contact arm **14**, and movable contact arm **11** mounted between insulating washers **15** which are placed over an insulating bushing **16** which is upon screw **17** which in turn threadingly engages support **5** and presses against washer **18** which holds insulating washers **15** rigidly in place. Thus, passing up post **12** from support **5** to the head of screw **17** the sequence of elements is as follows: insulating washer **15**, lower fixed contact arm **14**, insulating washer **15**, movable contact arm **11**, insulating washer **15**, upper fixed contact arm **13**, insulating washer **15**, retaining washer **18**, and the head of screw **17**. Fixed contact arms **13** and **14** extend outward from fixed contact post **12** to form an opposing set of electrical conductors. Movable contact arm **11** extends outward from fixed contact post **12** between arms **13** and **14** and slidingly engages the top of movable contact post **10**, whereby arm **11** is flexed and moves up and down with follower **6**. Arms **13** and **14** each have a single electrical contact **19**. Arm **11** has two electrical contacts **19**, one facing the electrical contact upon its assocaited arm **13**, and the other facing the electrical contact upon its associated arm **14**. Arms **11**, **13**, and **14** are fabricated of conducting material, and at least arm **11** must be resilient to move easily up and down in response to the movement of follower **6**. Arms **11**, **13**, and **14** are connected to external devices (not shown) from terminals **20** upon post **12**. Arms **13** and **14** are supported at the end next to contacts **19** by resilient tips **21**, preferably of rubber. These tips act as shock mounts to reduce vibration of fixed contact arms **13** and **14**. Arc shield bracket **22** is rigidly atached to shaft **1** upon a level with contacts **19**. Bracket **22** comprises a portion of arc shield **23** and a portion of arc shield **24**, together with spacers **25** and screw **26** to hold the assembly together. Arc shields **23** and **24** are fabricated of an insulating material and are circular in that portion which is within bracket **22**, while there are segments of a circle in that portion which extends radially outward from the axis of shaft **1** beyond bracket **22**. Shield **23** is spaced axially upon shaft **1** so that its effective portion which extends beyond bracket **22** just fits between and clears upper contact **19** upon arm **11** and contact **19** upon arm **13** when cam follower **6** is in its lowered position. Arc shield **24** is axially positioned upon shaft **1** so that the effective portion which extends beyond bracket **22** just fits between and clears lower contact **19** upon arm **11** and contact **19** upon arm **14** when cam follower **6** is in the position of farthest travel upward. The angular extensions of the effective portions of arc shields **23** and **24** are adjusted circumferentially upon shaft **1** to synchronize with the movement of cam followers **6** and cam **3**. The upper end of shaft **1** is fitted with notch **27**, while frame **4** has hole **28** opposite notch **27** into which the shaft **1** of a second unit may be placed in order that a plurality of devices of this invention can be operated from the same mechanical power source.

The cam shown in Fig. 3 is representative of a typical cam 3 of this invention. The portion between lines 29 and 30 is a raised portion, while the portion between lines 31 and 32 is a lowered portion. The portions between lines 29 and 31 and between lines 30 and 32 are transition portions between the upper and lower cam surfaces. These transition portions preferably have high rates of ascent and descent near their ends so that contacts 19 are separated rapidly when shaft 1 is turning at slow speeds. When one of cam followers 6 rides upon portion 33 of cam 3, arm 11 is electrically connected to arm 13. When one of cam followers 6 is riding upon portion 34 of cam 3, arm 11 is electrically connected to arm 14. When one of cam followers 6 is riding upon portion 35 or portion 36, arm 11 is not electrically in contact with either arm.

In operation, shaft 1 is rotated by some external device such as a motor or an aircraft engine, which turns cam 3 and bracket 22. The motion of only one of cam followers 6 and its associated contact arms is described as follows. Cam follower 6 follows the contours of cam 3. Cam follower 6 pushes up against the spring tension of arm 11 and causes arm 11 to follow the movements of cam follower 6. Follower 6 and arm 11, therefore, move simultaneously to electrically engage alternately arm 13 and arm 14. When arm 11 is in contact with arm 14, arc shield 23 is thrust between arm 11 and arm 13 but does not touch contacts 19. When arm 11 starts to move upward from arm 14 toward arm 13, arc shield 23 is withdrawn by the movement of shaft 1 from the space between arm 11 and arm 13. When arm 11 has moved into contact with arm 13, arc shield 24 is thrust by further movement of shaft 1 between arm 11 and arm 14, but does not touch contacts 19. When arc shield 23 or 24 is placed between a pair of contacts 19, the shield breaks any arc that has formed and prevents the further formation of an arc.

While the described invention shows three cam followers, together with three fixed contact posts and their associated contacts, more than three cam followers may be utilized. Similarly, although each set of contacts shows only one movable arm which alternates between two fixed arms, more than one movable arm can easily be made to follow the movement of one cam follower 6, and a plurality of contacts may be engaged or disengaged by the movement of arm 11. Likewise, while bearing material 9 has been described as nylon, other long-life surfaces can be used. Although shaft 1 is shown as turning on ball bearings, other types of spin bearings can be used. Fig. 3 shows a cam that alternates cam follower 6 up and down once per revolution of shaft 1. A plurality of oscillations can be achieved by modifying the contour of cam 3.

The device of this invention has a long life under high speeds of rotation of shaft 1 because of the balanced structure of the switch and the long wearing and shock absorbing qualities of the cam follower. It is usable under adverse conditions of temperature, humidity, and high altitude because of arc shields 23 and 24.

Although the invention has been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of this invention being limited only by the terms of the appended claims.

I claim:

1. A rotary switch comprising fixed and movable contacts, a continuously rotatable shaft, face cam means attached to said shaft, cam follower means positioned to be responsive to the movements of said cam means and mechanically connected to cause said movable contacts to electrically engage said fixed contacts in accordance with the rotation of said cam, and arc shields attached to and positioned upon said shaft to pass between said fixed and said movable contacts when said contacts are open without touching said contacts.

2. A rotary switch comprising a continuously rotatable shaft, a fixed frame, said shaft being bearing mounted to said frame, a face cam attached to said shaft and continuously rotatable therewith, a plurality of fixed contacts and a plurality of movable contacts, a plurality of cam followers mechanically engaging said cam and said movable contacts to move said movable contacts against and away from said fixed contacts in response to the contour and movement of said cam, a plurality of arc shields attached to and rotating with said shaft, said shields being positioned upon said shaft and shaped to pass between each movable contact and its opposing fixed contact when said contacts are open, without touching said contacts.

3. A rotary switch comprising a frame, a shaft rotatable with respect to said frame, a face cam attached to said shaft, a plurality of cam followers circumferentially arranged about said shaft positioned to move in an axial direction of said shaft against the surface of said cam, support means between said followers and said frame for slidingly engaging said followers to restrain their movement to a direction parallel with the axis of said shaft, a plurality of contact posts mounted upon said support means and extending therefrom in a direction away from said cam, said contact posts being circumferentially arranged around the axis of said shaft, each of said contact posts carrying a plurality of fixed and movable contacts, each said movable contact being a resilient member which is actuated by the movement of said cam followers, each said movable contact being opposite at least one of said fixed contacts, a plurality of resilient shock mounts placed between said fixed contacts and said frame for damping oscillations of said contacts, a plurality of insulating arc shields attached to said shaft, each said shield being in a plane perpendicular to the axis of said shaft and rotatable therewith, each said shield extending outward from the axis of said shaft to form a circular segment, the angular size of said segment being dependent upon the contour of said cam, each said shield being positioned along the axis of said shaft to pass between an opposing pair of said contacts, one said contact being movable and the other fixed, one of said shields being positioned between each pair of said opposing electrical contacts when said contacts are in an open position whereby high humidity, elevation, or voltage do not cause arcing between said open contacts of said switch, and said switch is freely operable at high angular velocities of said shaft.

4. A rotary switch comprising a frame, a shaft rotatable with respect to said frame, a face cam attached to said shaft, a plurality of cam followers circumferentially arranged about said shaft positioned to move in an axial direction of said shaft against the surface of said cam, support means between said followers and said frame for slidingly engaging said followers to restrain their movement to a direction parallel with the axis of said shaft, a plurality of contact posts mounted upon said support means and extending therefrom in a direction away from said cam, said contact posts being circumferentially arranged around the axis of said shaft, each of said contact posts carrying a plurality of fixed and movable contacts, each said movable contact being a resilient member which is actuated by the movement of said cam followers, each said movable contact being opposite at least one of said fixed contacts, a plurality of insulating arc shields attached to said shaft, each said shield being in a plane perpendicular to the axis of said shaft and rotatable therewith, each said shield extending outward from the axis of said shaft to form a circular segment, the angular size of said segment being dependent upon the contour of said cam each said shield being positioned along the axis of said shaft to pass between an opposing pair of said contacts, one contact being movable and the other fixed, one of said shields being positioned between each pair of said

opposing electrical contacts when said contacts are in an open position whereby high humidity, elevation, or voltage do not cause arcing betwen said open contacts of said switch, and said switch is freely operable at high angular velocities of said shaft.

5. A rotary switch comprising a frame, a shaft rotatable with respect to said frame, a face cam attached to said shaft, a plurality of cam followers circumferentially arranged about said shaft positioned to move in an axial direction of said shaft against the surface of said cam, support means between said followers and said frame for slidingly engaging said followers to restrain their movement to a direction parallel with the axis of said shaft, a plurality of contact posts mounted upon said support means and extending therefrom in a direction away from said cam, said contact posts being circumferentially arranged around the axis of said shaft, each of said contact posts carrying a plurality of fixed and movable contacts, each said movable contact being a resilient member which is actuated by the movement of said cam followers, each said movable contact being opposite at least one of said fixed contacts.

6. A rotary switch comprising a rotatable shaft, a cam attached to rotate with said shaft, a plurality of cam followers circumferentially arranged about said cam positioned to move against the surface of said cam, fixed support means slidingly engaging said followers to restrain their movement to a single direction, a plurality of contact posts mounted upon said support means and extending therefrom in a direction away from said cam, said

contact posts being circumferentially arranged around the axis of said shaft, each of said contact posts carrying a plurality of fixed and movable contacts, each said movable contact being a resilient member which is actuated by the movement of said cam followers, each said movable contact being opposite at least one of said fixed contacts, a plurality of insulating arc shields attached to said shaft, each said shield being rotatable with said shaft, each said shield being positioned to pass between an opposing pair of said contacts, one said contact being movable and the other fixed, one of said shields being positioned between each pair of said opposing electrical contacts when said contacts are in an open position whereby high humidity, elevation, or voltage do not cause arcing between said open contact of said switch, and said switch is freely operable at high angular velocities of said shaft.

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