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3,277,413

ROTARY REED SWITCH ASSEMBLY

Filed April 22, 1965

2 Sheets-Sheet 1

FIG.1

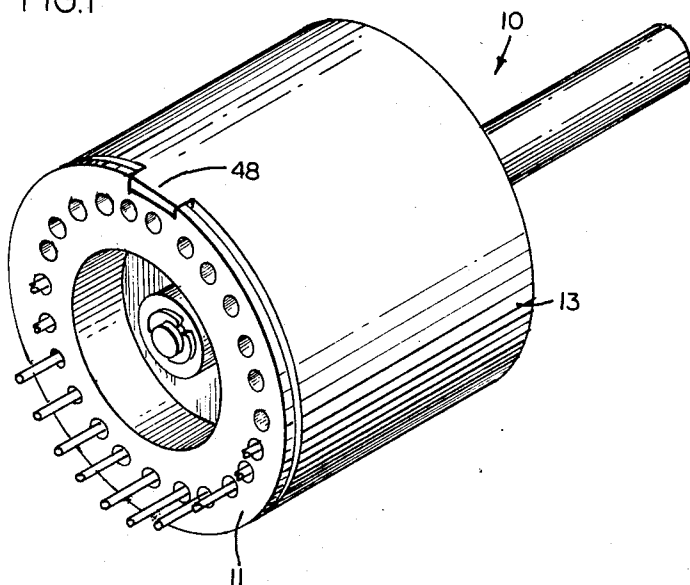
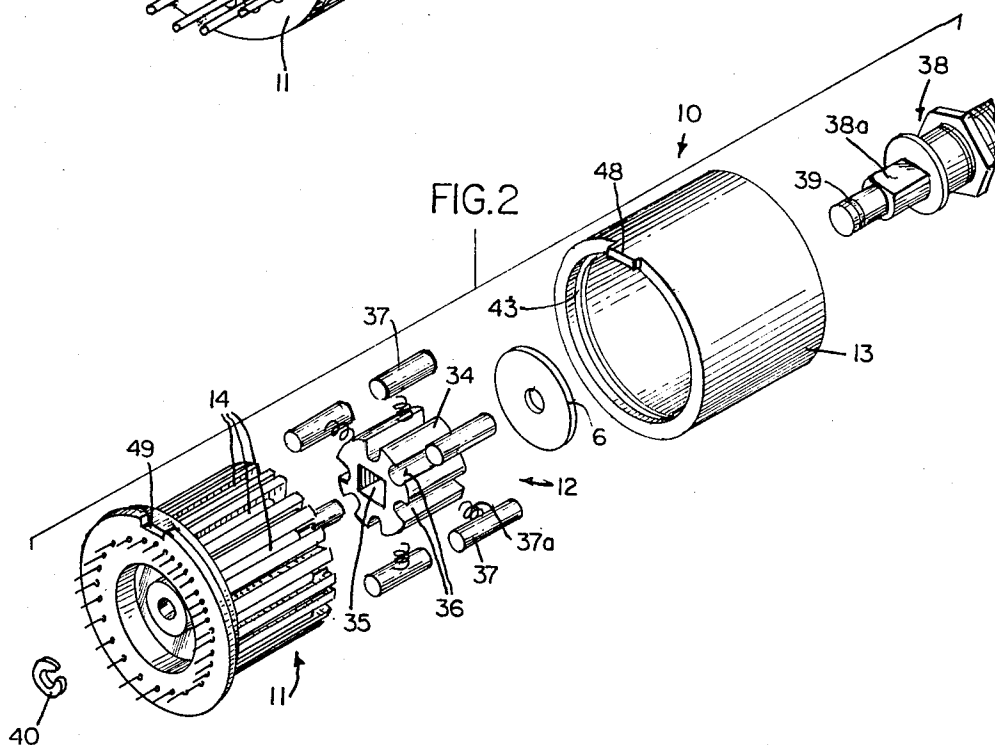


FIG.2



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FIG. 3

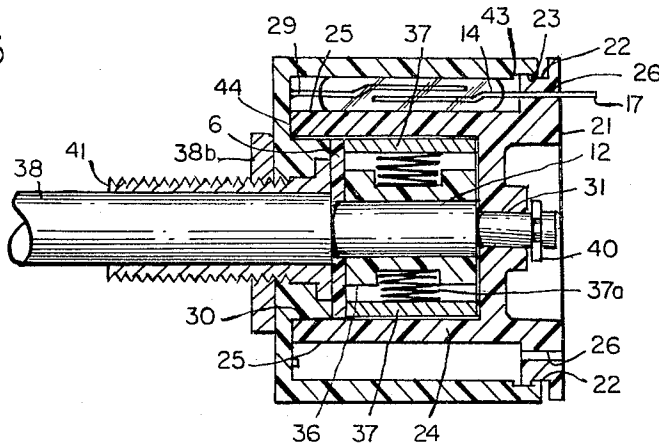
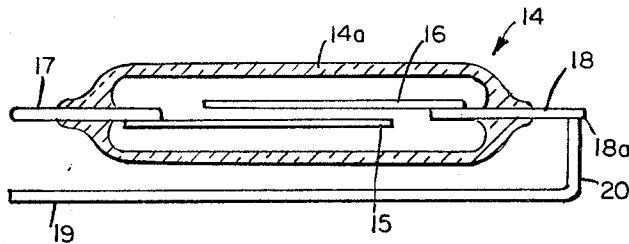


FIG. 4

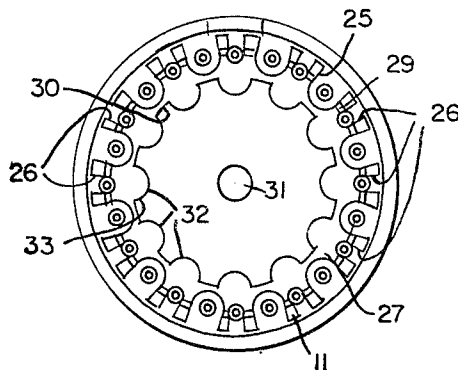


FIG. 5

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ROTARY REED SWITCH ASSEMBLY

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16 Claims. (Cl. 335-152)

The present invention relates to a rotary switch assembly and more particularly to a circular arrangement of reed switches in a compact rotary switch assembly which is highly resistant to damage and is suitable for a wide variety of applications.

Reed switches are well known in the electrical arts and normally comprise an elongated, glass enclosed, set of substantially aligned contacts which are capable of being actuated by a magnet to close contact and ordinarily spring open when not under the influence of a magnet. Such switches normally have coaxial leads extending outwardly at first and second ends substantially along the axis of the glass housing. The switches are normally small in size, extremely delicate and easily subjected to mechanical damage of the housing by stresses exerted on the leads or housing itself. For this reason it has been difficult to form assemblies of reed switches for use in various circuit arrangements. Particular weak points of such reed switches are at the ends of the glass housing through which the leads pass. Even slight stress tending to bend the leads from the axis of the housing often results in fracture of the housing at the ends.

An important object of this invention is to provide a novel and improved circular arrangement for a plurality of reed switches to form a compact rotary reed switch assembly which can be relatively easily mass-produced with a minimum rejection rate of finished assemblies.

Another object of this invention is to provide an assembly in accordance with the preceding object which provides accessibility to each of a plurality of reed switches for ease of replacement in the event of damage or malfunction.

Still another object of this invention is to provide a rotary reed switch assembly in accordance with the preceding objects which provides for actuation of one or more of a plurality of reed switches in either a make before break or break before make arrangement (shorting or non-shortening operation).

Still another object of this invention is to provide a suitable rotary reed switch assembly capable of highly reliable operation within a wide latitude of physical size dimensioning and ampere turn switch rating.

According to the invention, a rotary switch assembly is provided having a plurality of reed switches arranged about a central rotor. The rotor carries at least one magnet means for selectively actuating at least one of said plurality of reed switches upon selected rotation of said rotor with respect to said plurality of reed switches. In the preferred embodiment of this invention, a housing support is arranged about the rotor and has a first end and a second end. The housing support defines a plurality of elongated switch channels substantially parallel with each other and with the axis of the rotor. A plurality of reed switches lie in the switch channels. The housing support defines a plurality of lead channels with one lead of each of the reed switches extending towards the first end in a corresponding switch channel and the other lead of each of the reed switches being reversed at a point spaced from its housing to extend towards the first end in one of the lead channels allowing access to both leads of each reed switch from one end of the housing support. Means are provided for positioning and holding the reed switches in the housing so that only axially aligned forces are exerted on the leads. Since the forces on the reed switches

within the switch assembly are all axially aligned with the leads, there is little tendency for breakage of the individual reed switches and forces are exerted thereon at the strongest parts of the reed switches.

Preferably a cap is provided positioned over the housing support and carries means for cooperating with the housing support to positively position the reed switches by a force applied substantially along the axis of the leads. The cap preferably further carries means for positioning the rotor within the housing support and allowing rotation thereof about its axis.

It is a feature of this invention that switching can be permitted from any common source or from individual sources or individual circuits permitting various switch positions and various combinations of switch positions simultaneously as by means of a plurality of magnets in what is termed multipole switching. In the preferred embodiment of this invention, the lead channels and switch channels open at the outer perimeter of the housing support. This feature enhances rapid and relatively low cost manufacture of the rotary switch assemblies of this invention.

These and other objects, features and advantages of the invention will be pointed out and more clearly described in the following specifications and drawings, in which:

FIG. 1 is a perspective view of a preferred embodiment of the rotary reed switch assembly of this invention;

FIG. 2 is an exploded view thereof;

FIG. 3 is a cross-sectional view through the center of the assembly shown in FIG. 1;

FIG. 4 is a side view of a single reed switch used in this invention; and,

FIG. 5 is an end view of an element of the assembly of this invention.

With reference now to the drawings and more particularly FIGS. 1 and 2 a rotary reed switch assembly is shown at 10 and has a housing support 11, a centrally located rotor 12, and an outer cap 13 enclosing the housing support and providing a rotor shaft bearing. Reed switches 14 are arranged at intervals about the peripheral edge of the housing support 11.

The reed switches 14 useful in this invention are shown semi-diagrammatically at FIG. 4 and have an elongated glass casing 14a encapsulating contacts 15 and 16. Outwardly extending coaxial leads 17 and 18 are provided at both ends of the elongated reed switches 14. Such switches are well known in the art and will not be fully described here. It is sufficient to say that these switches are subject to damage at their glass ends when the leads 17 and 18 are bent or urged in directions other than axially of the reed switches. Because of the glass seals used in conventional practice, the glass casing 14a has its greatest strength, or resistance to forces, along lines coaxial with the glass casing 14 and leads 17 and 18. Preferably the switches 14 have at least one lead such as 18 bent back on itself so that an end 19 thereof extends substantially parallel to and from the same side of the glass housing as lead 17. The portion 20 bent at a right angle to the lead portion 18 provides a means for mounting the reed switches in the assembly as will be more fully described.

The housing support 11 as best shown in FIGS. 2 and 3 has a rear wall 21 with a circular outer perimeter and an indentation 22 providing an undercut continuous edge 23. The housing support is preferably formed of a non-magnetic material such as plastic having some resiliency but being relatively hard. Polypropylene has been found to be a suitable material.

The body 24 of the support 11 is generally cylindrical and has a plurality of continuous grooves 25 extending about the peripheral edge forming reed switch carrying channels. The channels preferably extend from one end

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of the body to the other end with a bore 26 being provided at the end of each switch channel through which lead 17 of the reed switch extends when the assembly is put together. The switch channels 25 preferably provide a snug fit for the glass casings of the reed switches 14 which are positioned therein. A front wall 27 of the housing support is provided preferably generally parallel to the rear wall.

A plurality of elongated lead channels 26 are provided for the reversely bent leads 18 of the reed switches 14. Lead channels 26 are preferably parallel to switch channels 25 and the axis of the rotor positioned within the housing support. Pairs of channels 26 and 25 are interconnected by channels as best shown in FIGS. 3 and 5 so that the bent portion 20 of the lead 18 lies within an interconnecting channel 29, yet, each channel 29 is dimensioned to be slightly smaller than the diameter of the lead portions 20 to provide bearing surfaces for the leads and firmly position the reed switches when a cap is placed over the support as will be further described. While a twelve reed switch assembly is shown, it should be understood that more or less reed switches may be incorporated in an assembly of this invention.

The central portion of the reed switch housing support 11 is hollowed out to form a bore 30 of generally cylindrical form and a smaller bore 31 interconnecting the passageway formed by bore 30 with the rear wall 21 of the switch assembly. Bores 30 and 31 are adapted to receive the rotor 12. Bore 30 while defining a generally cylindrical passageway does have parallel, longitudinally extending projections 32 at spaced intervals on the inner face of the support 11 providing recesses 33 preferably opposite each switch channel 25 and adapted to act as detent means when the rotor 12 is moved into preselected positions within the support as will be described.

The rotor 12 preferably comprises a body section 34 having a central aperture 35 of noncircular configuration. The body 34 carries on its outer circular surface a plurality of grooves or depressions 36 which act as seats for magnets such as 37. The bar magnets 37 preferably have a width no greater than the width of depressions 33 of the support 11. One or more magnets 37 are used and in the preferred embodiment six are shown. These magnets are spring biased outwardly to the position shown in FIG. 3 and have an outer surface extending beyond the outer face of the cylindrical rotor body 34. Coil springs 37a are mounted in bores provided at the bottom of each groove 36 and urge the magnets radially of the rotor.

A stem 38 has an end 38a keyed within the bore 35 and extends outwardly of bore 31 carrying a circular recess 39 into which a locking collar is placed to prevent axial movement of the stem while allowing rotation thereof. Preferably a C-shaped removable collar 40 bears against the rear wall 21 to lock the stem in position. While a circular recess is shown in the rear wall 21, this wall can be flat or have other configurations. Preferably the cylindrical wall of cap 13 carries a forwardly extending tongue 48 positioned to key into recess 49 in the support body 11 to positively position the cap always in the same radial position with respect to the support.

In the assembled form shown in FIG. 3, a circular flat washer 6 is provided over the end of the body 34 positioned coaxially with the stem. A bushing 41 surrounds the stem and is positioned adjacent the washer. The bushing 41 may carry threads or other means for attaching the switch to a control panel or other mounting board for the switch.

The flanged bushing 41 and washer are held in position by the housing cap 13 as best shown in FIG. 3. Housing cap 13 is preferably constructed of a nonmagnetic material with resilient plastics such as polypropylene being preferred. The cap 13 has a recessed inner edge surface 43 adapted to mate with the annular ring formed by 23 of the support. Thus when the cap is positioned as shown in FIG. 3, it is urged into an interlock position with the

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support thereby tending to retain the rotor in position within the support. Similarly the cap may be easily removed by snapping it over projection 23.

A lock nut 38b is threaded on the bushing to secure the bushing to the housing.

It is important that the cap 13 have a surface 44 which acts as a means for holding the reed switches in position. Inner surface 44 is substantially parallel to portion 20 of each reed switch lead 18. Since the reed switch lead portions 18 extend in the depressions 29 slightly beyond surface 27, when the cap is positioned as shown in FIG. 3, the portion 20 of each reed switch is firmly held by surface 44 against the channels 29 preventing axial movement or displacement of the reed switches. Thus all forces holding the reed switches in position are axially aligned with the axis of the switches and the outwardly extending leads.

Stem 38 is rotatable within the housing support on the bearing formed by bore 31 and bushing 41.

Assembly of the switch is easily accomplished by placing the reed switches in position in the channels provided and snapping cap 13 into position over the bushing, lock washer and rotor body. The exact means of assembly may vary. In some cases one or more parts of the assembly may be made integral.

In operation of the rotary reed switch assembly of this invention, stem 38 may be rotated by a suitable knob (not shown) to position magnets 37 in any desired location. As the stem is rotated, body 34 also rotates and the magnets 37 snap into sequential recesses 33 on the inner surface of the support 11. As each magnet reaches a corresponding recess the reed switch associated with that recess is actuated and then similarly deactuated when the magnet moves away to the next recess. It should be understood that the particular values of the magnetic fields created by the magnets can be varied depending upon the particular values required for the reed switches and magnets employed. The positioning of the reed switches substantially about the circumference of the support as well as the positioning of the magnet or magnets in the rotor body will determine actuation patterns for the switches. In some cases two or more reed switches may be simultaneously actuated by a magnet in any one position.

If the switch assembly is to be operated with a break before make or non-shorting action, i.e. one reed switch is deactuated before another actuated, it is preferred that the lead portions 19 and 20 be of a magnetic material thereby limiting the magnetic field from each magnet to a single reed switch. The magnetic material leads in this case act as shunt bars. As best shown in FIG. 4, the lead portions 19 and 20 may be of magnetic material which may comprise suitable iron containing alloy and since portions 19 lie on either side of each reed switch, the magnetic field from each magnet 37 is limited to one switch. If a shorting arrangement is desired where one reed switch will not turn off until a sequential reed switch is turned on, upon rotation of the rotor, magnetizable materials are not employed and lead portion 19 is made of a nonmagnetic material allowing greater spreading of the magnetic flux obtained from the magnets 37.

While the reed switches are preferably formed with an integral lead 18 reversely bent as shown in FIG. 4, it is often desirable to cut lead 18 at point 18a. This prevents unwanted axial bending of the lead during processing. The lead portion formed by 20 and 19 is preferably integral and may be soldered at point 18a, or otherwise joined at 18a, to the lead 18. Thus, portions 20 and 19 of the lead can be of a magnetic or nonmagnetic material no matter what the composition of the lead material 18 itself.

In some cases where lead portions 19 and 20 are nonmagnetizable, ferrous metal containing rods (not shown) can be positioned in lead channels 26 over and parallel to lead portions 19. The rods act as shunt bars as previously described.

While specific embodiments of this invention have been shown and described, it will be obvious to those skilled in the art that many variations thereof are possible. For example while nonmagnetic material and preferably plastics are preferred for all portions of the assembly with the exception of stem 38 which is preferably a nonmagnetic metal, it is sometimes possible to use other materials. Metals, thermosetting plastics or thermoplastic materials can be employed where desired.

The particular dimensions of the assembly will vary considerably depending upon the number of reed switches used and the number of magnets used as well as their relative sizes.

While detent means are provided by cooperation between spring loaded magnets 37 and the generally semicircular faced ridges 32, conventional positive limit means may be incorporated in or on the rotor or support to lock the device in any desired position or limit movement of the rotor beyond arcs of prescribed length. Similarly the passage of leads 17 and 19 to one face of the switch assembly can provide for unlimited variation in hookup of the switches carried by the assembly in various circuit arrangements. Common grounds can be employed on the surface 26 or each reed switch can be connected to an individual circuit.

Since many variations are possible, this invention is to be limited only by the spirit and scope of the appended claims.

What is claimed is:

1. A rotary reed switch assembly comprising, a rotor carrying at least one magnetic means, a housing support arranged about said rotor and having a first and a second end, said housing support defining a plurality of elongated switch channels substantially parallel with each other and with the axis of said rotor, a plurality of reed switches lying in said channels each of said reed switches having a body and opposed axially extending leads, said housing defining a plurality of lead channels with one lead of each of said reed switches extending towards said first end in a corresponding switch channel and the other lead of each of said reed switches having a portion being reversed at a point spaced from its body to extend towards said first end in one of said lead channels whereby access to both leads of each reed switch is available from one end of said housing support, and means contacting one of said leads at said reversed portion thereof for positioning said reed switches in said housing whereby only substantially axial aligned forces are exerted on said leads.
2. A rotary reed switch assembly comprising, a rotor carrying at least one magnetic means, a housing support arranged about said rotor and having a first and a second end, said housing support defining a plurality of elongated switch channels substantially parallel with each other and with the axis of said rotor, a plurality of reed switches lying in said channels, each of said reed switches having a body and opposed axially extending leads, said housing defining a plurality of lead channels with one lead of each of said reed switches extending towards said first end in a corresponding switch channel and the other lead of each of said reed switches being reversed at a point spaced from its body to extend towards said first end in one of said lead channels whereby access to both leads of each reed switch is available from one end of said housing, and means for positioning said reed switches in said housing, said means comprising a cap positioned over said housing support and said cap cooperating with said housing support to position said reed switches

by a force applied substantially along the axis of said leads.

3. A rotary reed switch assembly in accordance with claim 2 wherein said switch channels and said lead channels are opened at the circumference of said housing support.

4. A rotary reed switch assembly in accordance with claim 2 wherein said cap further comprises means for positioning said rotor within said housing support.

5. A rotary switch assembly comprising, a rotor carrying at least one magnetic means, a housing support arranged about said rotor and substantially coaxial therewith, said housing support having a first end and a second end,

said housing support defining a plurality of elongated switch channels substantially parallel with each other and with the axis of said rotor,

a plurality of reed switches lying one each in each of said channels with each reed switch having an elongated glass casing snugly received within its corresponding channel and having opposed outwardly extending substantially axially aligned leads,

said housing defining a plurality of lead channels with one lead of each of said reed switches extending towards said first end in a corresponding switch channel and the other lead of each of said reed switches being reversed at a point spaced from its casing to extend towards said first end in one of said lead channels whereby access to both leads of each reed switch is available from one end of said housing support,

and means for positioning said reed switches in said housing whereby only substantially axially aligned forces are exerted on said leads, said means for positioning comprising a surface cooperating with said housing support to lock a nonaxially aligned portion of said reversed lead therebetween.

6. A rotary reed switch assembly in accordance with claim 5 wherein a cap is positioned over said housing support and carries said surface for cooperating with said housing support whereby only substantially axially aligned forces are exerted on said leads.

7. A rotary reed switch in accordance with claim 5 wherein said housing support defines a hollow center portion thereof extending axially of said support, said rotor being positioned within said center and carrying a plurality of radially biased magnets whereby said magnets are urged radially outwardly of said rotor.

8. A rotary reed switch assembly in accordance with claim 7 wherein said center portion of said support carries a plurality of substantially axially extending projections defining recesses therebetween,

said magnets being adapted to move into and out of said recesses as said rotor is rotated about its axis to actuate ones of said reed switches mounted on said support outwardly of said recesses.

9. A rotary reed switch assembly in accordance with claim 5 wherein said reversed leads of said leads are formed of at least two pieces with one of said pieces joined to said lead substantially along an axis of said glass housing.

10. A rotary reed switch in accordance with claim 9 wherein magnetic material shunt means are provided extending substantially parallel to and surrounding at least one of said reed switches mounted in said housing support.

11. A rotary reed switch construction in accordance with claim 10 wherein said shunt means comprises a portion of said reversely bent lead constructed of a magnetizable material.

12. A rotary reed switch assembly comprising, a rotor carrying a plurality of magnets about its circumference,

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said magnets being spring biased outwardly of an axis of said rotor,
 a housing support arranged about said rotor and having a first end and a second end,
 said first housing support end comprising a wall with an axially aligned aperture for mounting of said rotor therein, a central portion of said housing being hollow and carrying a plurality of positioning means for coaxing with said magnetic means to position said magnetic means in preselected positions within said housing,
 said housing support further defining a plurality of elongated switch channels substantially parallel with each other and with the axis of said rotor,
 said channels being open at the circumference of said housing support,
 a plurality of reed switches lying in said channels with each of said reed switches having a glass casing and opposed axially extending leads,
 said housing defining a plurality of lead channels with one lead of each of said reed switches extending towards said first end in a corresponding switch channel and the other lead of each of said reed switches being reversed at a point spaced from its body to extend toward said first end in one of said lead channels whereby access to both leads of each reed switch is available from said one end of said housing support,
 and cap means for positioning said reed switches in said housing whereby only substantially axially aligned forces are exerted on said leads thereby preventing axial movement of said leads with respect to said elongated glass casing.

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13. A rotary reed switch assembly in accordance with claim 12 wherein said cap means is positioned over said housing support and comprises means for cooperating with said housing support to position said reed switches by a force applied to a reversely bent portion of said lead to prevent bending of said lead about said axis of said casing.

14. A rotary reed switch assembly in accordance with claim 13 wherein said cap defines an outer edge carrying means for releasably engaging an outwardly extending circular flange formed on said housing support to lock said rotor and said housing support in operative relationship.

15. A rotary reed switch assembly in accordance with claim 12 wherein said rotor comprises a stem and a mounting bushing surrounding said stem whereby rotation of said stem causes rotation of said rotor with its magnets.

16. A rotary reed switch assembly in accordance with claim 12 wherein shunt means are provided between each of said plurality of reed switches for limiting magnetic flux from a magnet carried by said rotor opposite a reed switch.

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