Sept. 10, 1968 E. V. PAHOLEK ETAL 3,401,366

SWITCHING DEVICE RESPONSIVE TO A ROTATING MAGNET

Filed Nov. 16, 1966 2 Sheets-Sheet 1

FIG. 1

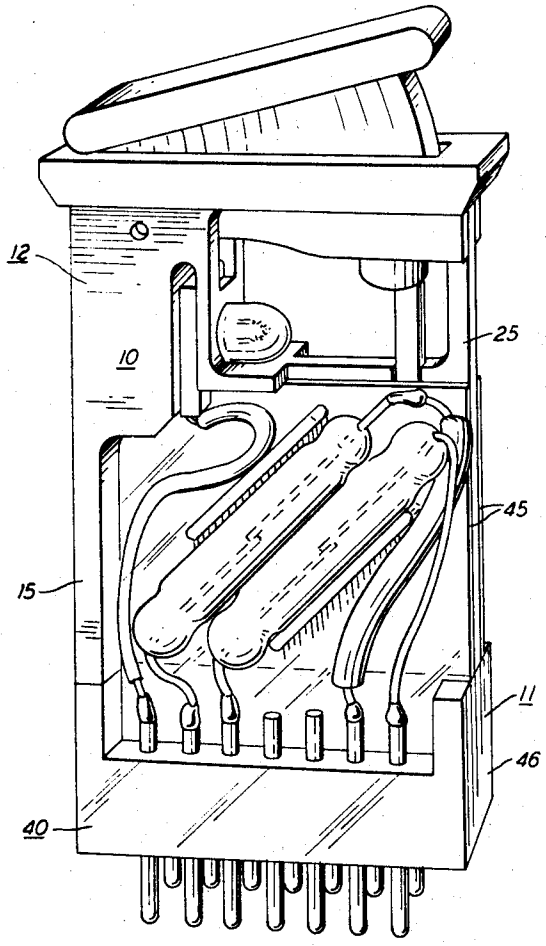
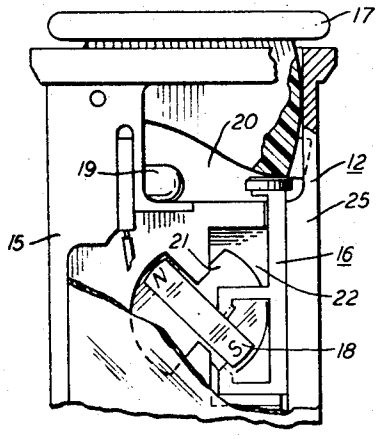


FIG. 5



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Sept. 10, 1968 E. V. PAHOLEK ETAL 3,401,366

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Filed Nov. 16, 1966 2 Sheets-Sheet 2

FIG. 4

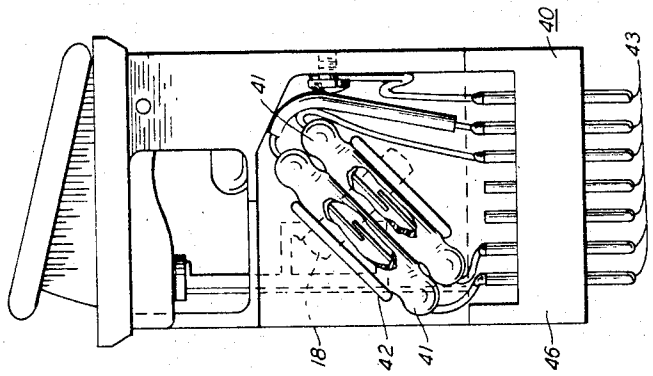


FIG. 3

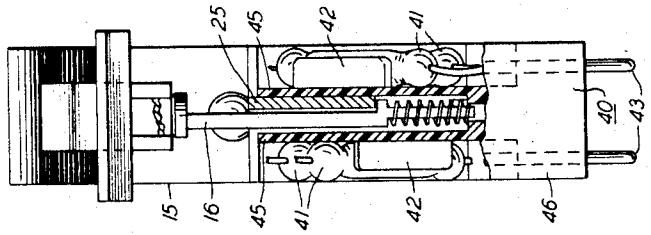
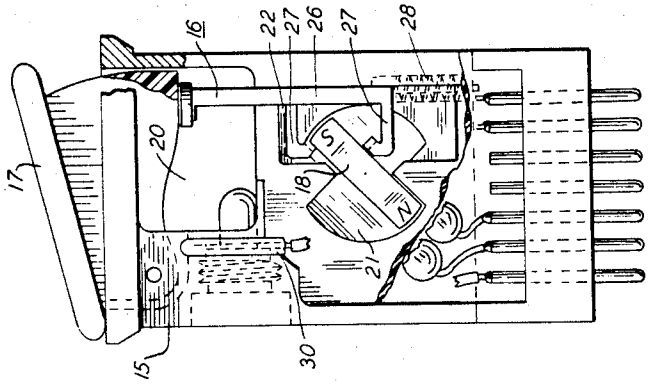


FIG. 2



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3,401,366

SWITCHING DEVICE RESPONSIVE TO A ROTATING MAGNET

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10 Claims. (Cl. 335—206)

Switching applications often require a momentary contact function or a transfer function. This invention relates to devices which perform such functions. Specifically, in accordance with this invention, the desired switching functions are achieved in a switching device which is simple to make and which uses readily available components.

The market place abounds with switching devices of all kinds. One type in particular, however, has become especially popular. That type is the one in which the contacts are sealed in a vessel, viz, the so-called sealed contact reed switch. A typical example of such a sealed contact reed switch is shown in Patent 2,187,115 issued to W. B. Ellwood and W. H. T. Holden on Jan. 16, 1940.

All sealed contact reed switches operate generally in the same manner; that is, a change in switching state occurs when a magnetic field of suitable magnitude is applied to the long axis of the switch. Typically, the contacts close when the magnetic field is applied and open when the field is removed.

According to a preferred embodiment of this invention, the desired switching functions are achieved by combining two sealed contact reed switches with a rotatable magnetic flux source. The two reed switches each have a longitudinal axis and the magnetic flux source has two magnetic poles. The reed switches are disposed at right angles to each other on either side of the flux source, and the flux source is arranged to rotate from a position in which the magnetic poles are aligned with the longitudinal axis of one reed switch to a position in which the magnetic poles are aligned with the longitudinal axis of the other reed switch.

Thus, the magnetic poles of the flux source will always be aligned with the longitudinal axis of one reed switch and perpendicular to the other. As a result, where the reed switches are of the normally open type, The contacts in the former will be closed while the contacts in the latter will be open. When the flux source rotates, the situation reverses and the closed switch opens while the open switch closes. As a consequence, the combination exhibits a transfer function which can be either momentary or permanent in nature.

A more complete understanding of this invention will be aided by the following detailed description when taken in conjunction with the drawing in which

FIG. 1 is a perspective view of a switching device embodying this invention;

FIG. 2 is a front elevation view of the device shown in FIG. 1 with parts broken away to show internal details;

FIG. 3 is an end view of the device shown in FIG. 2 with parts broken away to show internal details;

FIG. 4 is a rear elevation view of the device shown in FIG. 1; and

FIG. 5 is a partial front elevation view of the device shown in FIG. 1 with portions broken away to show the relative position of internal parts during operation.

The preferred embodiment of this invention hereinafter described generally comprises a switch **10** which is shown in FIG. 1. The switch **10** divides naturally into two subassemblies, viz, a switch assembly **11** and a support assembly **12**. The switch assembly **11** contains the contacts while the support assembly **12** contains the mechanism for operating the contacts. In the following paragraphs, each assembly will be separately described in detail.

As shown in detail in FIG. 5 the support assembly **12** includes a support **15**, a plunger **16**, a pushbutton **17**, a magnetic member **18**, a light **19**, two apertures **20** and **21**, and a slot **22**. The support **15**, as best seen in FIGS. 1 and 3, has portions hollowed out on either side to form a central web **25**. Within the web **25** are located the apertures **20** and **21** and the slot **22**, with the aperture **20** being the uppermost. The slot **22** interconnects the apertures **20** and **21** and is adapted to accommodate the plunger **16**. The upper aperture **20** accommodates portions of the plunger **16**, the pushbutton **17**, and the light **19**, while the lower aperture **21** accommodates the magnetic member **18** and portions of the plunger **16** and the slot **22**.

The pushbutton **17** has one end hinged to the support **15** and the other end disposed in the upper aperture **20** in contact with the plunger **16**. The plunger **16**, as shown in FIG. 2, in turn, has a shaft portion **26** and two fingers **27** which fit slidably in the slot **22**.

As can be further seen, in FIG. 2, the slot **22** is narrow at each end but wide in the center. The shaft **26** of the plunger **16** fits in the narrow portions of the slot **22** while the fingers **27** fit in the wide portion. Furthermore, a spring **28** fits in one narrow portion of the slot **22** and bears against one end of the plunger **16** so as to urge the other end against the pushbutton **17**.

The magnetic member **18**, as shown in FIG. 5, is located in the lower aperture **21**. The shape of the lower aperture **21** roughly approximates an hourglass form; viz, it has a narrow neck located between two wide portions. The magnetic member **18** fits rotatably in the aperture **21** and has its central portion positioned in the neck of the aperture **21** and its ends in the wide portions. The neck or narrow portion of the aperture **21** provides pivot points on which the magnetic member **18** can rotate.

As shown in FIG. 2, the two fingers **27** are positioned in the slot **22** in such a manner that they bracket one end of the magnetic member **18**. Thus, when the plunger **16** slides back and forth in the slot **22** in response to actuation of the pushbutton **17**, the fingers **27** rotate the magnetic member **18** in the aperture **21**.

The light **19** fits primarily in the portion of the support **15** which is not hollowed out. The bulb end, however, extends into the aperture **20**. As shown mainly in phantom in FIG. 2, it screws into place in the support **15** against an insulating plate **30**. The plate **30** fits in a slot in the support **15** and conveniently carries an electrical connector for making contact between the light **19** and a suitable wire.

The pushbutton **17** is advantageously made of a transparent material. As a consequence, when the light **19** is lit the pushbutton **17** will be illuminated. The light **19** can, therefore, be used to indicate either an operated or unoperated state of the switch **10**.

Turning now to the switching assembly **11**, as shown in FIGS. 1, 3 and 4, it comprises a support member **40**, four switches **41** of the normally open sealed contact reed variety, two cradles **42** and a plurality of terminals **43**.

As seen most clearly in FIG. 1, the support member **40** comprises two tongues **45** joined by a base **46**. As shown in FIG. 4, the terminals **43** are mounted in the base **46**, while the switches **41** and the cradles **42** are mounted on the tongues **45**. Specifically, two switches **41** and a cradle **42** are mounted on each tongue **45**. Each cradle **42** is attached firmly to a tongue **45** and positions and holds in place two switches **41**. The cradles **42** are mounted on the tongues **45** so that the two switches **41** each carries are disposed at substantially right angles to the switches **41** carried by the other.

The terminals **43** in the base **46** are used to connect

the switch **10** into a suitable socket. As shown in FIG. 4, they are connected to the respective switches **41** and the light **19** by suitable wiring.

The tongues **45** are separated from each other to form a space wide enough to accept the web **25**. As shown in FIGS. 1 and 3, the tongues **45** slide over the web **25** while the base **46** abuts against the support **15** when the switching assembly **11** is joined to the support assembly **12**. The junction between the switching assembly and the support assembly **12** is conveniently maintained by screws (not shown).

In addition to facilitating the junction between the two assemblies **11** and **12**, the tongues **45** serve as guides which hold the magnetic member **18** and the plunger **16** in place. When the tongues **45** are in place on either side of the web **25**, the magnetic member **18** can rotate in the aperture **20** and the plunger **16** can reciprocate in the slot **22**, but neither can move laterally.

Furthermore, the tongues **45** serve to place the switches **41** in proper position with respect to the magnetic member **18**. As shown in FIG. 4, when the tongues **45** are in place on the web **25**, the magnetic member **18** will be aligned with the longitudinal axis of two switches **41** (not shown) and substantially perpendicular to the longitudinal axis of two other switches **41**.

Operation of the switch **10** is best understood by comparing FIGS. 2 and 5. FIG. 2 shows the switch **10** unoperated, while FIG. 5 shows it operated. When the pushbutton **17** is depressed, the fingers **27** rotate the magnetic member **18** from one position to another, viz., through an arc of approximately 90°. When the magnetic member **18** rotates in such a fashion, its magnetic poles change from an alignment parallel to the longitudinal axes of switches **41** on one cradle **42** to an alignment parallel with the longitudinal axes of switches **41** on the other cradle **42**.

When the magnetic member **18** has its poles aligned with the longitudinal axes of any pair of switches **41**, the contacts therein will close. When, on the other hand, the poles are perpendicular to the longitudinal axes of any pair of switches **41**, the contacts will open. Thus, as the magnetic member **18** reciprocates in 90° increments in response to movement of the pushbutton **17**, the alignment of the magnetic poles shifts from one set of switches **41** to the other and allows the contacts in the former to open and compels the contacts in the latter to close. As a result, at any given time, the contacts in one set of switches **41** will be open while the contacts in the other set will be closed.

While in the embodiment disclosed, the magnetic member **18** reciprocates to perform a momentary contact function; viz., it returns to its original position when the pushbutton **17** is released, it is readily adaptable to continuous rotation as, for example, in response to a ratchet and pawl mechanism operated by the pushbutton **17**. In the latter case, the switch **10** will provide a transfer or stepping function as it rotates from one position to the next. Furthermore, any number of switches **41** could be used and the operation can be automatic. Many well-known electrically operative mechanisms are available which can be used in place of the manually operated pushbutton **17**.

Finally, the magnetic member **18** need not be a bar magnet as illustrated. Instead, it can be a core wound with a coil or any other convenient source of magnetic flux.

In summary, therefore, a switching device has been disclosed and described which is capable of a momentary contact function or a transfer function and which is simple to make and uses readily available components. While only one preferred embodiment has been disclosed to illustrate the principles of this invention, other embodiments which fall within the scope of the invention will readily occur to others skilled in the art.

What is claimed is:

1. In a switching device the combination comprising:

first means for switching, said first means for switching having a longitudinal axis and being operable in response to a magnetic flux applied along such longitudinal axis;

second means for switching, said second means for switching having a longitudinal axis and being operable response to a magnetic flux applied along said longitudinal axis, said second means for switching being disposed with said longitudinal axis substantially at right angles to the longitudinal axis of said first means for switching; and

flux means for supplying a magnetic flux, said flux means having opposite magnetic poles disposed between said first and second means for switching and being adapted to rotate from a position wherein said poles are aligned with the longitudinal axis of said first means for switching to a position wherein said poles are aligned with the longitudinal axis of said second means for switching whereby the switching state of said first and second means for switching alternates.

2. In a switching device the combination comprising:

a support having a central aperture;

first switching means mounted on one side of said support, said first switching means having a longitudinal axis and being operative in response to magnetic flux applied along said longitudinal axis;

second switching means mounted on the other side of said support, said second switching means having a longitudinal axis and being operative in response to magnetic flux applied along said longitudinal axis, said second switching means being mounted on said support with said longitudinal axis disposed at substantially right angles to the longitudinal axis of said first switching means;

a flux source having opposite magnetic poles, said flux source being mounted in said aperture between said first and second switching means; and

means for alternating said magnetic poles from a position in alignment with the longitudinal axis of said first switching means to a position in alignment with the longitudinal axis of said second switching means whereby a transfer switching function is achieved.

3. A combination in accordance with claim **2** wherein said aperture comprises two wide openings connected by a narrow opening and said flux source comprises an elongated magnetic member disposed with its center in said narrow opening and its ends in said wide openings.

4. A combination in accordance with claim **3** wherein said means for alternating said magnetic poles comprises a plunger mounted on said support and adapted to reciprocate an end of said magnetic member in one of said wide openings.

5. A combination in accordance with claim **4** wherein said plunger includes a shaft and two projecting fingers, said shaft being adapted to reciprocate on said support and said fingers being adapted to embrace one end of said magnetic member to rotate said magnetic member when said shaft reciprocates.

6. In a switching device the combination comprising:

a first reed switch;

a second reed switch disposed perpendicularly to said first reed switch;

an elongated magnetic member having opposite magnetic poles at each end, said magnetic member being disposed rotatably between first and second reed switches with said magnetic poles aligned with one reed switch and perpendicular to the other reed switch; and

means for rotating said magnetic member in 90 degree increments whereby first one switch and then the other is aligned with said magnetic members.

7. A switching device comprising:

a support having a central web containing a slot and an aperture, said aperture having two wide openings and

a narrow opening and said slot being disposed to pass over a portion of one of said wide openings;

a first sealed contact reed switch mounted over said aperture on one side of said web;

a second sealed contact reed switch mounted over said aperture on the other side of said web, said first and second sealed contact reed switches being disposed substantially at right angles to each other;

a permanent magnet having an opposite magnetic pole at each end, said permanent magnet being pivotally mounted on said support in said narrow opening with each end free to reciprocate in one of said wide openings; and

a plunger arranged to reciprocate in said web from a first position to a second position, said plunger having a shaft slidably disposed in said slot and two fingers embracing one end of said permanent magnet, said fingers being arranged to rotate said permanent magnet in response to movement of said plunger between said first and second positions.

8. In a switching device the combination comprising:

a support assembly having a web;

a switching assembly joined to said support assembly, said switching assembly including a forked portion disposed on either side of said web;

a first aperture in said web;

a magnetic member rotatably mounted in said first aperture and held in place by the forked portion of said switching assembly, said magnetic member having opposite magnetic poles spaced from each other;

means mounted on said support assembly for rotating the magnetic poles of said magnetic member from one position to another; and

switching means having a longitudinal axis, said switching means being operable in response to magnetic flux supplied from said magnetic member when the poles of said magnetic member are aligned with said longitudinal axis, said switching means being mounted on the forked portion of said switch assembly with said longitudinal axis in alignment with said magnetic poles when said magnetic member is in said one position, and substantially perpedicular to said magnetic poles when said magnetic member is in the other position.

9. The combination in accordance with claim **8** wherein said switching means comprises a plurality of sealed contact reed switches.

10. The combination in accordance with claim **8** wherein said switching means comprises two sets of sealed contact reed switches, said sets being disposed on opposite sides of said web in positions substantially perpendicular to each other.

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R. N. ENVALL, JR., *Assistant Examiner.*