Aug. 9, 1966 G. D. AUTRY ET AL 3,265,826

ROCKER SWITCH UTILIZING MAGNETIC REEDS

Filed Feb. 10, 1965 4 Sheets-Sheet 1

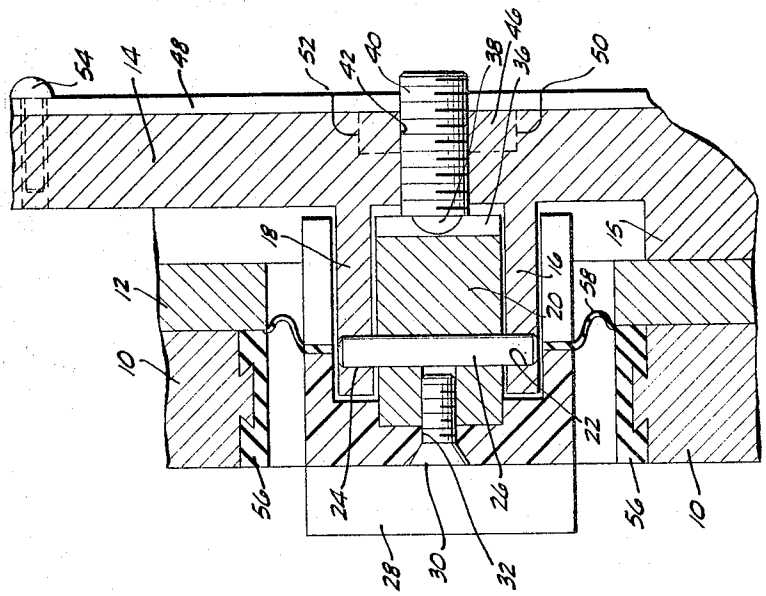


FIG. 2.

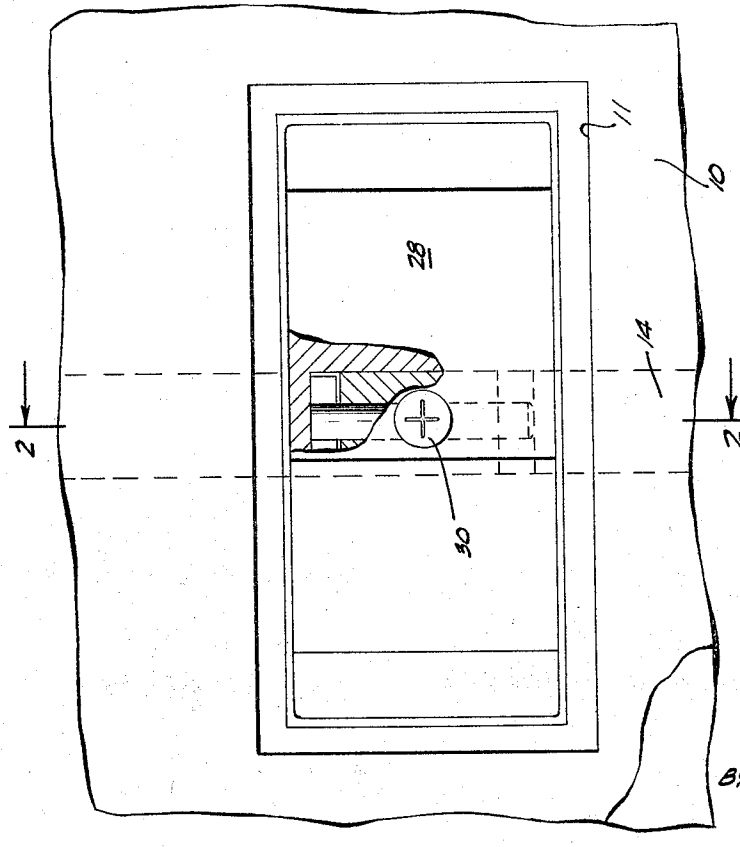


FIG. 1.

INVENTORS.
GILBERT D. AUTRY,
LAWRENCE L. PANKEY,
BY Walter J. Odam
ATTORNEY.

Aug. 9, 1966 G. D. AUTRY ET AL 3,265,826

ROCKER SWITCH UTILIZING MAGNETIC REEDS

Filed Feb. 10, 1965 4 Sheets-Sheet 2

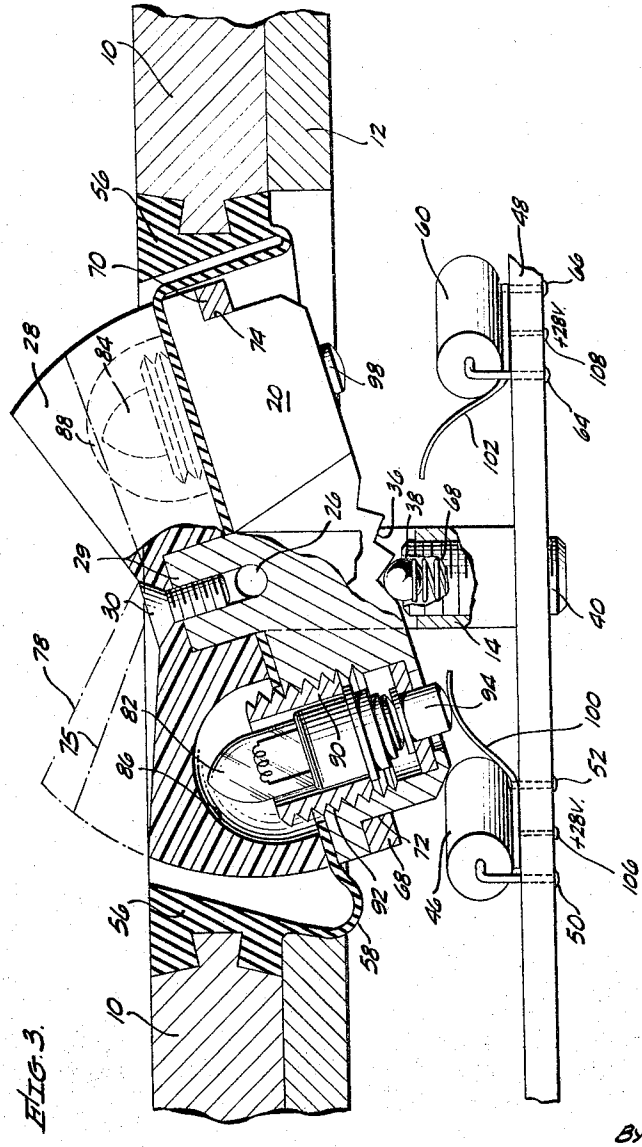


FIG. 3.

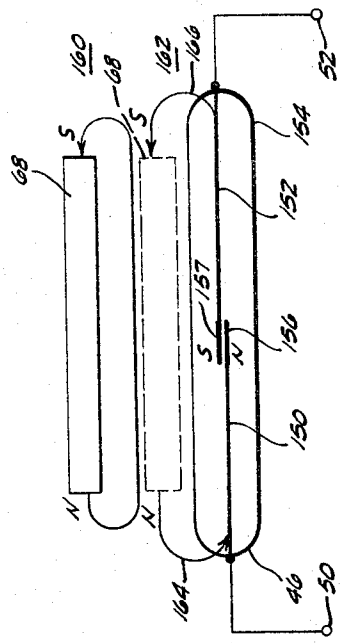


FIG. 10.

INVENTOR.
GILBERT D. AUTREY,
LAWRENCE L. PANKEY,
BY
Walter J. Adams
ATTORNEY

Aug. 9, 1966 G. D. AUTRY ET AL 3,265,826

ROCKER SWITCH UTILIZING MAGNETIC REEDS

Filed Feb. 10, 1965 4 Sheets-Sheet 3

FIG. 5.

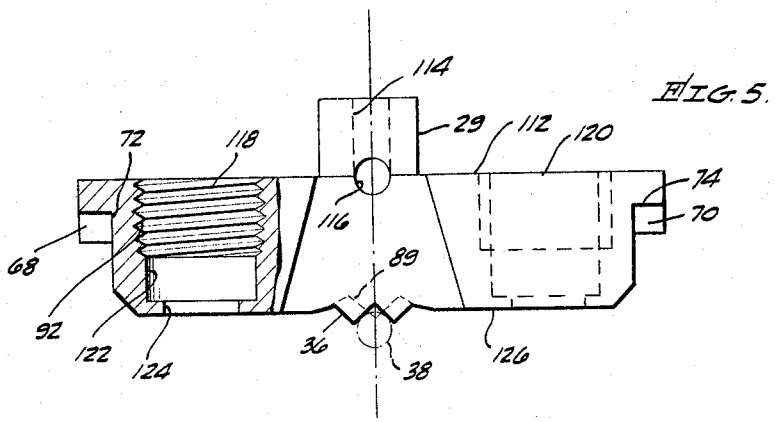


FIG. 4.

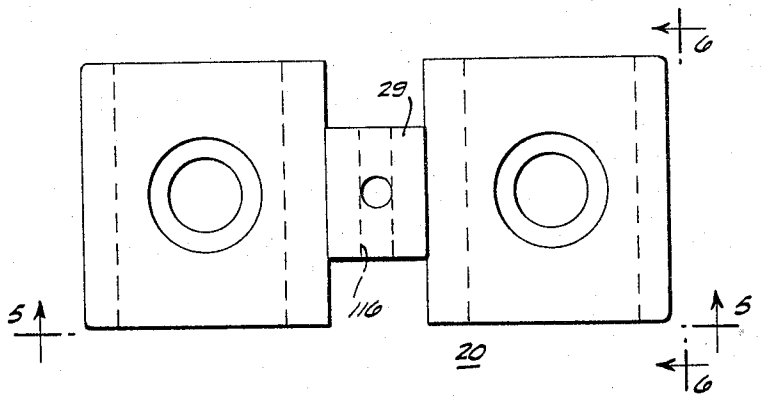
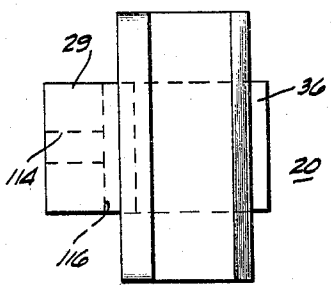


FIG. 6.



INVENTORS.
GILBERT D. AUTRY,
LAWRENCE L. PANKEY,
BY
Walter J. Adam
ATTORNEY.

Aug. 9, 1966 G. D. AUTRY ET AL 3,265,826

ROCKER SWITCH UTILIZING MAGNETIC REEDS

Filed Feb. 10, 1965 4 Sheets-Sheet 4

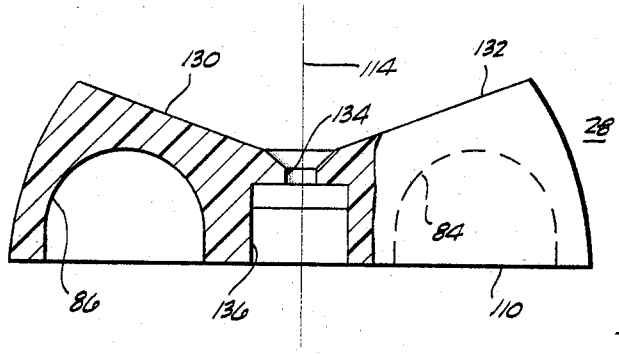


FIG. 8.

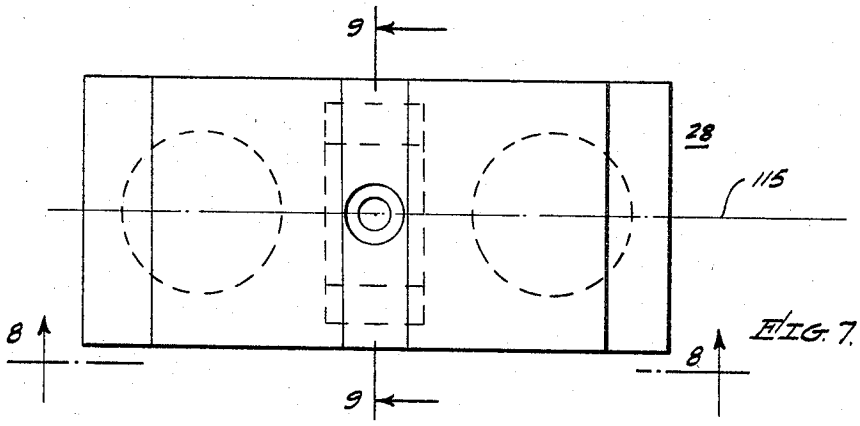


FIG. 7.

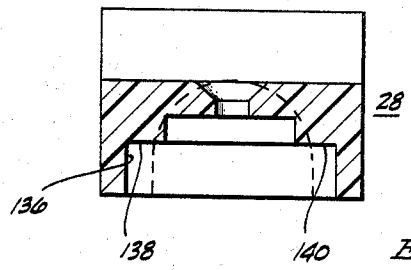


FIG. 9.

INVENTORS.
GILBERT D. AUTRY,
LAWRENCE L. PANKEY,
BY
Walter J. Adam
ATTORNEY.

United States Patent Office 3,265,826 Patented August 9, 1966

3,265,826

ROCKER SWITCH UTILIZING MAGNETIC REEDS

Gilbert D. Autry, Anaheim, and Lawrence L. Pankey, Placentia, Calif., assignors to Hughes Aircraft Company, Culver City, Calif., a corporation of Delaware

Filed Feb. 10, 1965, Ser. No. 431,556
4 Claims. (Cl. 200—87)

This invention relates to electrical switches and particularly to an improved and reliable rocker switch utilizing magnetic reeds.

Rocker switches such as may be utilized in control panels for providing manual control of electronic systems have conventionally included a relatively large rocker assembly actuating micro-switches and providing indications of the switch position by edge lighting. Also, conventional rocker switch banks are relatively difficult to construct as they are required to be wired by soldered leads. Because changing the position of the switch to close an electrical circuit requires that the contacts of the micro-switches be forceably moved together, a substantial amount of contact bounce conventionally results. The contact bounce provides control signals that have irregular leading edges and may include several pulses of short durations, which condition is undesirable for controlling devices such as logical equipment. Also, micro-switches because of the contact bounce and because of the forceful closing have a relatively short operating life.

It is therefore an object of this invention to provide an improved rocker switch having a relatively long operating life.

It is a further object of this invention to provide a rocker switch that substantially eliminates the undesirable contact bounce when being operated to close or open a circuit.

It is a still further object of this invention to provide a rocker switch that utilizes a magnetic field to close a pair of contacts so as to eliminate mechanical coupling between the rocker and the movable contacts.

It is another object of this invention to provide an improved rocker switch that is assembled with a minimum of effort.

It is still another object of this invention to provide an illuminated rocker switch that has improved lighting and that is sealed at a front panel.

Briefly the rocker switch in accordance with the principles of the invention includes a rocker movable from the front thereof on a rocker base and having permanent magnets attached to the edges thereof at the back of the switch. Positioned on a support back of the rocker are two magnetic reed structures each having two movable elongated probes or reeds, for example, of suitable low coercivity material fixed at one end and positioned relatively close to each other but without providing a contact. The fixed ends of the reeds are coupled to suitable terminals for providing a closed circuit when the reeds come into contact. When the rocker structure is moved in a first position so that one of the permanent magnets is close to one of the reed structures, the field from that permanent magnet forces the two reeds together to close the corresponding circuit. Moving the rocker structure to a second position closes the circuit at the other reed structure. Moving the permanent magnet to either position causes the reeds corresponding to the other position to return to their normal open position. Thus, the magnetic fields provide an influence actuation to the reeds without an undesirable mechanical contact with the rocker structure.

The novel features of this invention, as well as the invention itself, both as to its organization and method of operation, will best be understood from the accompanying description, taken in connection with the accompanying drawings, in which like reference characters refer to like parts, and in which:

FIG. 1 is a plan view of the magnetic reed rocker switch in accordance with the principles of the invention looking from a front panel;

FIG. 2 is an end sectional view of the rocker switch taken at line 2—2 of FIG. 1;

FIG. 3 is a partially broken away side sectional view of the magnetic reed rocker switch of FIG. 1 showing the switch in a closed position for explaining the operation thereof;

FIG. 4 is a plan view of the rocker base structure shown in FIG. 1;

FIG. 5 is a partially broken away side view of the rocker base structure taken at line 5—5 of FIG. 4;

FIG. 6 is an end view of the rocker base structure taken at line 6—6 of FIG. 4;

FIG. 7 is a plan view of the rocker of FIG. 1;

FIG. 8 is a partially broken away side view of the rocker taken at line 8—8 of FIG. 7;

FIG. 9 is an end view of the rocker taken at line 9—9 of FIG. 7; and

FIG. 10 is a schematic circuit diagram of a magnetic reed structure that may be utilized in the switch of FIG. 1.

Referring first to the plan or front view of FIG. 1 and to the sectional view of FIG. 2, the rocker switch in accordance with the principles of the invention may be mounted in an opening **11** of a front panel **10** which is formed of a suitable material such as plastic positioned over a subpanel **12** which in turn may be formed of any suitable material such as aluminum. A rocker mounting bar **14** shown dotted in FIG. 1 is positioned behind the plate **12** and maintained at a predetermined distance therefrom by extensions such as **15**. Support flanges or extensions **16** and **18** protrude from the top surface of the bar **14** being substantially the same width as the bar **14** and being separated by a selected distance in which a rocker base **20** is mounted. The bars **16** and **18** have respective holes **22** and **24** therein in which a rocker pin **26** is retained by a forced fit, for example. A rocker **28** is positioned over the rocker **20** and may be formed of a suitable transluscent material such as plastic. A rocker hold down screw **30** is tapped into a hole **32** in the rocker base **20** for maintaining the rocker in position during switching operations. At the lower side of the rocker base **20** are notches or serrations **36** which are best seen in FIG. 3, for contacting a ball **38** maintained in a plunger **40** having a spring therein (FIG. 3). The plunger **40** is threaded into a tapped hole **42** in the mounting bar **14**. A magnetic reed **46** shown dotted is mounted on an etched card **48** with terminals **50** and **52** for connecting external circuitry (not shown) and providing an open or a closed current path. The card **48** may be mounted to the rocker mounting bar **14** by suitable screws or rivets such as a rivet **54**. For sealing the front of the panel from moisture and dirt, for example, a boot **56** of molded rubber or nylon, for example, is attached to the front panel **10** by a dove tail configuration with a flexible portion **58** extending between the rocker **28** and the rocker base **20**.

Referring now also to the side view of FIG. 3, the rocker base **20** and the rocker **28** are shown rotated on the pin **26** to a first position as maintained by the serrations **36** pressing against the ball **38**. The magnetic reed **46** and a magnetic reed **60** are shown in position at opposite ends of the rocker **28** and may be at a slight angle from the axis of the pin **26** to minimize the space required in the direction parallel to the axis of the pin **26**. The reed **60** is connected to terminals **64** and **66** for providing a selected closed or an open contact therebetween. Also in accordance with the invention, the reed can be flow

soldered to an etched card with terminations utilizing a plug-in connector.

A spring **68** is shown positioned in the plunger **40** for maintaining the ball **38** in forceful contact with the serrations **36** of the rocker base **20**. The serrations **36** provide three positions to the switch, that is, a central position or positions with one or the other of the magnetic reeds **46** and **60** energized to provide a closed circuit. It is to be noted at this time that a serration **89** of FIG. 5 may be utilized to provide a two position rocker switch in accordance with the principles of the invention. For respectively energizing the magnetic reed structures **46** and **60**, elongated permanent magnets **68** and **70** are provided at respective angular positions **72** and **74** parallel to the axis of the pin **26** and arranged to be relatively close to the corresponding reed structure when the rocker is rotated to its position down toward the reed structure. The magnets **68** and **70** may extend across the width of the rocker base **20** and may be mounted thereto by a suitable bonding material such as glue, for example. In the position shown in FIG. 3, the magnetic field of the magnet **68** is applied to the reed structure **46** for providing a closed contact therein and the magnet **70** is a sufficient distance from the reed structure **60** so that it is unenergized. Also when the rocker **28** is in the central position indicated by a dotted line **75**, the magnets **68** and **70** are a sufficient distance from the respective reed structures **46** and **60** so that they both remain unenergized. When the rocker **20** is manually pushed to the position indicated by a dotted line **78**, the magnet **70** closes the contacts in the reed structure **60** and the reed structure **46** is unenergized.

For providing illumination to the depressed end of the rocker **28**, lamps **82** and **84**, the latter being shown dotted, are provided in semi-spherical openings **86** and **88** of the rocker **28**. The lamp **82** is held in a lamp retaining ring **90** which in turn is threaded into a tapped hole **92** of the rocker base **20**. The base of the lamp **82** contacts a contact assembly **94** mounted against a flange of the rocker base **20**. A lamp contact **98** is provided at the lamp **84** and a lamp retaining ring (not shown) which is similar to the arrangement at the lamp **82**. Lamp springs **100** and **102** are mounted on the circuit board **48** for contacting respective lamp contacts **94** and **98** when the rocker is in the position shown or in the position opposite from that shown. Sources of potential at terminals **106** and **108** which may be +28 volts for the lamps **82** and **84**, are connected through the board **48** to respective contact springs **100** and **102**. The lamps **82** and **84** are grounded through the mounting structure such as through the ring **92**, rocker base **20** and pin **26** for the lamp **82**. The rocker contact structure **89** shown dotted in FIG. 5 may also be utilized in accordance with the principles of the invention when the switch has only one of two "on" positions.

Referring now to FIGS. 4, 5 and 6, the rocker base **20** which may be formed of a suitable material such as steel either cast or machined, for example, has a flat surface **112** with the rectangular extension **29** extending therefrom centered on a longitudinal axis **114**. A tapped and threaded hole **114** is provided in the top surface of the extension **29** for screw **30** to hold the rocker **28** in position. A hole **116** is drilled or formed through the extension **62** for inserting the mounting pin **26** therethrough. Lamp holes **118** and **120** are provided on an axis **115** having tapped portions such as **92** for holding the lamp retaining ring therein and untapped portions such as **122** for holding the lamp contact **94**. A hole such as **124** is drilled or formed at the bottom surface of the hole **122** for the lamp contact to extend and contact the lamp contact spring **100** (FIG. 3). At a bottom surface **126** of the rocker base **20** is the serration structure **36** shown for a three position operation and contacting the bearing **38**. As discussed previously, the serration **89**, shown dotted, may be utilized for a two position rocker switch. The rocker base **20** can, in accordance with the invention, be fabricated from powder metal which eliminates all machining operations.

Referring now to FIGS. 7, 8 and 9, the rocker **28** has two top surfaces **130** and **132** which may each slope upward from the horizontal in the illustrated view, 21 angular degrees, for example. The rocker **28** may be formed of a suitable transluscent material such as acrylic or plastic cast or machined to the desired configuration. On the vertical axis **114** and centered on a longitudinal axis **115** is a hole **134** for the rocker cover hold down screw **30** at the top surface and at a bottom surface **110** a rectangular opening **136** is formed. Shoulders **138** and **140** are provided in the opening **136** for contacting and holding the extension **29** (FIG. 5) of the rocker base **20**. The lamp openings **86** and **88** may be semi-spherical or any desired configuration for enclosing the lamps **82** and **84**.

Referring now to FIG. 10 as well as to FIG. 3, the reed structure **46** includes reeds **150** and **152** which may be of a magnetic material such as an iron-nickel alloy selected to have a low reluctance and a high permeability. The reeds **150** and **152** are mounted to a sealed glass case **154** as is well known in the art, so as to normally provide a space between contact points **156** and **157** which may have a region of gold alloy thereat. In a position **160**, the magnet **68** is at a sufficient distance from the reed structure **46** so that a relatively small magnetic field is passed through the reeds **50** and **52**, and the switch is "off" relative to the reed structure **46**. However, when the rocker **28** is moved to the position shown in FIG. 3, the magnet **68** moves to a position **162** to apply a magnetic field indicated by lines **164** and **166** through the glass **154** and along the low reluctance path of the reeds **150** and **152**. If the magnet **68** at the position **162** has North and South poles as indicated, the contacts **156** and **157** have temporary respective North and South poles upon application of the field. As a result, the contacts **156** and **157** are forced together and a closed circuit is provided between the terminals **50** and **52**.

Thus, the switch is actuated in response to magnetic lines of force starting to induce poles in the leads or contacts of the reed switch. Each pole of the magnet induces the opposite pole at the adjacent end of each strip so that the contact ends become opposite poles and are magnetically attracted to each other. The magnetic force of attraction varies inversely with the square of the distance between contacts creating increasing actuation and velocity as the contacts close. This high speed actuating snap action reduces arcing. When the magnet **68** is selected with a strong field, a short actuating time is provided but the contact bounce is increased. As is well known in the art, both the high impact speed and the natural spring rate may result in increased contact bounce. However, the contact bounce in the rocker switch in accordance with the invention is substantially less than that provided with prior art switches and can be maintained at a minimum by proper selection of the magnetic field while still maintaining a relatively short actuation time. If the switch is to be used in a non-vibrating application, a mercury wetted reed may be utilized in accordance with the principles of the invention. Although the magnetic reed structures **46** and **60** are shown as single pole single throw switches, other type switches such as single pole double throw may be utilized by proper selection of the reluctance and permeability characteristics of the three reed extensions utilized therein. Also in accordance with the principles of the invention, several reed structures such as **46** may be arranged for responding to the single magnet such as **68**.

The rocker switch in accordance with the principles of the invention has been found to provide approximately 0.3 microsecond of bounce time when a reed structure is being turned off or to an open circuit and to provide approximately 0.8 microsecond of bounce time when the

reed structure is being turned on or to a closed circuit. However, the invention is not to be limited to any particular minimum amount of contact bounce because proper selection of parameters may greatly reduce the contact bounce from the above cited examples.

The rocker switch in accordance with the principles of the invention provides a lighted surface to indicate the "on" positions thereof. In the three position switch, the surface is not lighted when the rocker is in the central or neutral position. A feature of the switch is that the rocker **28** may be removed from the base by removing the screw **30** for replacing the lamps **82** and **84** from the front surface of the panel **10**. Also the lamp system in accordance with the invention functions without hand wiring within the switch. If tactical feedback is desired for the lights, the terminals **106** and **108** may be connected to a feedback source that applies a potential to the lamp when selected conditions are met. Because of the detent mechanism, the switch provides a definite feeling of snap action when activated.

Thus, there has been described a rocker switch utilizing influence actuators for energizing magnetic reed relays that is easily constructed, of a minimum size and operates with a minimum of contact bounce. Simplified lighting is provided with the lamps being readily changeable. A simplified and improved sealing arrangement is provided without interference during operation of the switch.

What is claimed is:

1. A rocker switch comprising

a panel structure with a front and back surface and having a rectangular opening therein,

a rocker support structure mounted to said panel structure and having first and second projections extending toward the front surface and having a pivot pin therethrough,

a rocker having a projection positioned between the first and second projections of said rocker support and having end portions movable on said pivot pin to first and second positions,

first and second magnetic reed relays mounted behind the back surface of said rocker at the end portions, each relay having first and second magnetic reeds mounted so as to be normally separated from each other and to contact each other in the presence of a magnetic field,

first and second permanent magnets mounted on the respective first and second end portions of said rocker to respectively apply a magnetic field to said first or second relays when said rocker is in said first or second positions,

and terminal means coupled to the reeds of said first and second relays.

2. A rocker switch comprising

a mounting structure having an axis,

a rocker structure having an axis movable to first and second positions on the axis of said mounting structure,

first and second magnetic reed structures mounted on said mounting structure on opposite sides of the axis thereof, each of said reed structures having first and second magnetic reeds with contact points normally separated,

and first and second permanent magnets mounted on said rocker structure at opposite sides of the axis thereof, said first magnet being adjacent to said first magnetic reed structure when said rocker structure is in said first position, said second magnet being adjacent to said second magnetic reed structure when said rocker structure is respectively in said second position,

whereby when said rocker structure is moved to said first position a magnetic field is applied from said first magnet to the reeds of said first magnetic structure to provide a closed circuit therethrough and when said rocker structure is moved to said second position a magnetic field is applied from said second magnet to the reeds of said second reed structure to provide a closed circuit therethrough.

3. A rocker switch comprising

a mounting bar having first and second extensions with axial holes therethrough,

a rocker base having a top and a bottom surface with a selected width and length and having an axial hole along the width substantially at the center of said length,

a pivot pin positioned through the axial holes of said mounting bar and the axial hole of said mounting base, said rocker base being rotatable on said pin through a selected angle,

a plurality of serrations at the bottom surface of said rocker base substantially at the center of the length thereof,

detent means positioned to contact said serrations to maintain said rocker base in a first or a second position,

first and second magnetic reed structures positioned a selected distance from the bottom surface of said rocker base and adjacent to the ends of the length thereof,

first and second elongated permanent magnets mounted to the ends of said rocker base to be respectively close to the first or second reed structure when said rocker base is in the first or second positions,

and a rocker mounted in the front surface of said rocker base for responding to forces exerted thereon to move said rocker base to said first or said second positions.

4. A rocker switch comprising

a mounting structure having a mounting axis,

a rocker structure having a front surface and a back surface with each surface having first and second ends and first and second sides, said rocker structure having an axis substantially centered between said first and second ends therethrough from said first to said second sides,

means rotatably mounting said rocker structure to said mounting structure with the axis thereof coincident with said mounting axis,

first and second elongated permanent magnets respectively mounted to first and second ends of said rocker structure substantially parallel to the first and second ends,

first and second magnetic reed structures positioned a selected distance from the back surface of said rocker structure and respectively adjacent to the first and second ends thereof, each reed structure including first and second elongated magnetic reeds having contact points normally separated to provide an open circuit,

and detent means positioned to contact the back surface of said rocker structure for establishing first and second rotated positions thereof, said first magnet applying a field to said first reed structure to provide a closed circuit thereat when said rocker structure is in said first position and said second magnet applying a field to said second reed structure to provide a closed circuit thereat when said rocker structure is in said second position.

References Cited by the Examiner

FOREIGN PATENTS

1,194,042 6/1959 France.

OTHER REFERENCES

Berkman, J. W.: IBM Technical Bulletin, "Toggle Switch," vol. 4, No. 11, page 19, April 1962.

BERNARD A. GILHEANY, *Primary Examiner.*

J. J. BAKER, *Assistant Examiner.*