# United States Patent [19]

**Lockard et al.**

[11] **3,809,830**

[45] **May 7, 1974**


[54] **SEALED THUMBWHEEL SELECTOR SWITCH**


[75] Inventors: **Joseph Larue Lockard; William Henry Rose,** both of Harrisburg, Pa.

[73] Assignee: **AMP Incorporated,** Harrisburg, Pa.



[22] Filed: **Mar. 12, 1973**

[21] Appl. No.: **340,414**

**Related U.S. Application Data**

[63] Continuation-in-part of Ser. No. 255,844, May 22, 1972, abandoned.

[52] **U.S. Cl.**..... **200/11 TW,** 200/167 R, 200/168 G

[51] **Int. Cl.**..... **H01h 19/58,** H01h 9/04

[58] **Field of Search**..... 200/11 TW, 167 R, 167 A, 200/168 G, 168 K



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,089,923 | 5/1963 | Wright | 200/11 TW X |
| 3,665,127 | 5/1972 | Lockard et al. | 200/11 TW |
| 3,655,925 | 4/1972 | Lincoln et al. | 200/11 TW |
| 3,306,993 | 2/1967 | Lien | 200/11 TW |



*Primary Examiner*—James R. Scott

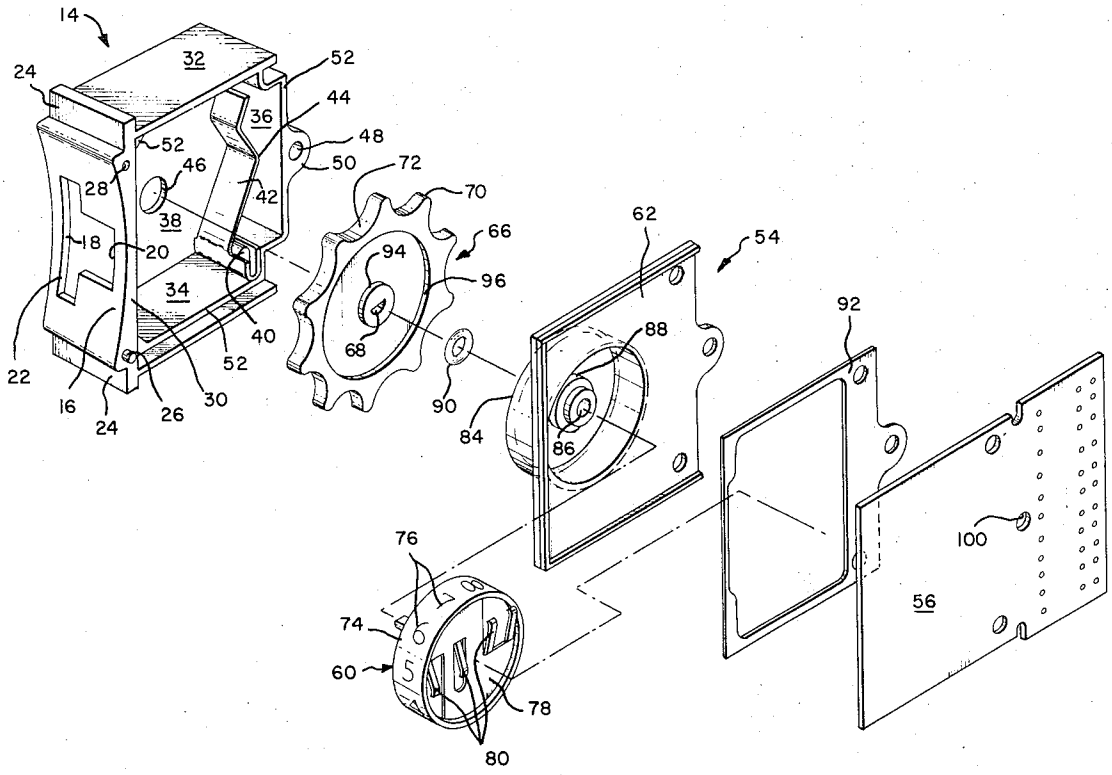
*Attorney, Agent, or Firm*—Gerald K. Kita



[57] **ABSTRACT**

A thumb selector switch structure is disclosed which is particularly suitable for use in corrosive or dusty environments. The selector switch includes a printed circuit panel having an angularly encoded conductive pattern printed thereon. A rotatable contact carrying indicia wheel is rotatably mounted to the printed circuit panel so that the contacts carried by the indicia wheel selectively engage various portions of the angularly encoded printed circuit pattern, thereby producing digital output signals in response to the rotation of the contact carrying wheel. The contact carrying wheel is permanently hermetically sealed to the printed circuit board by means of a clear plastic casing. An actuator wheel is provided for rotating the indicia and contact carrying wheel. A suitable housing having a detent spring mounted therein is provided to enclose the above described structure.


**20 Claims, 4 Drawing Figures**



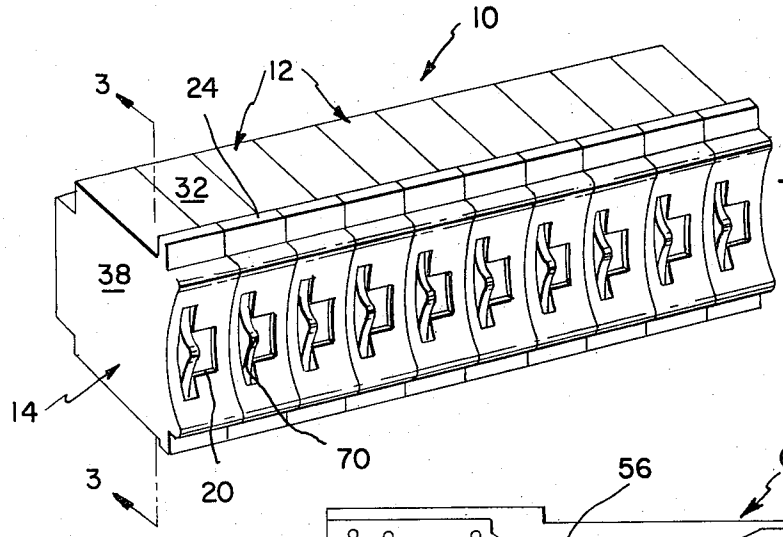



FIG 1

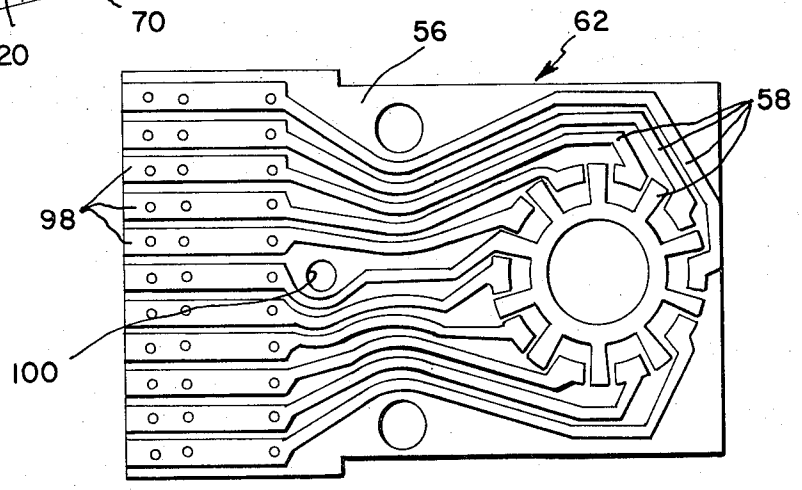



FIG 4

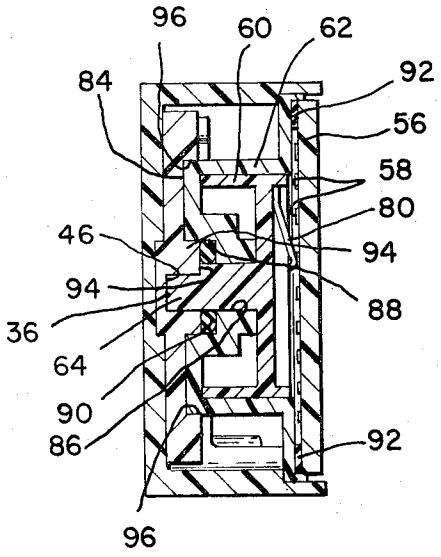



FIG 3

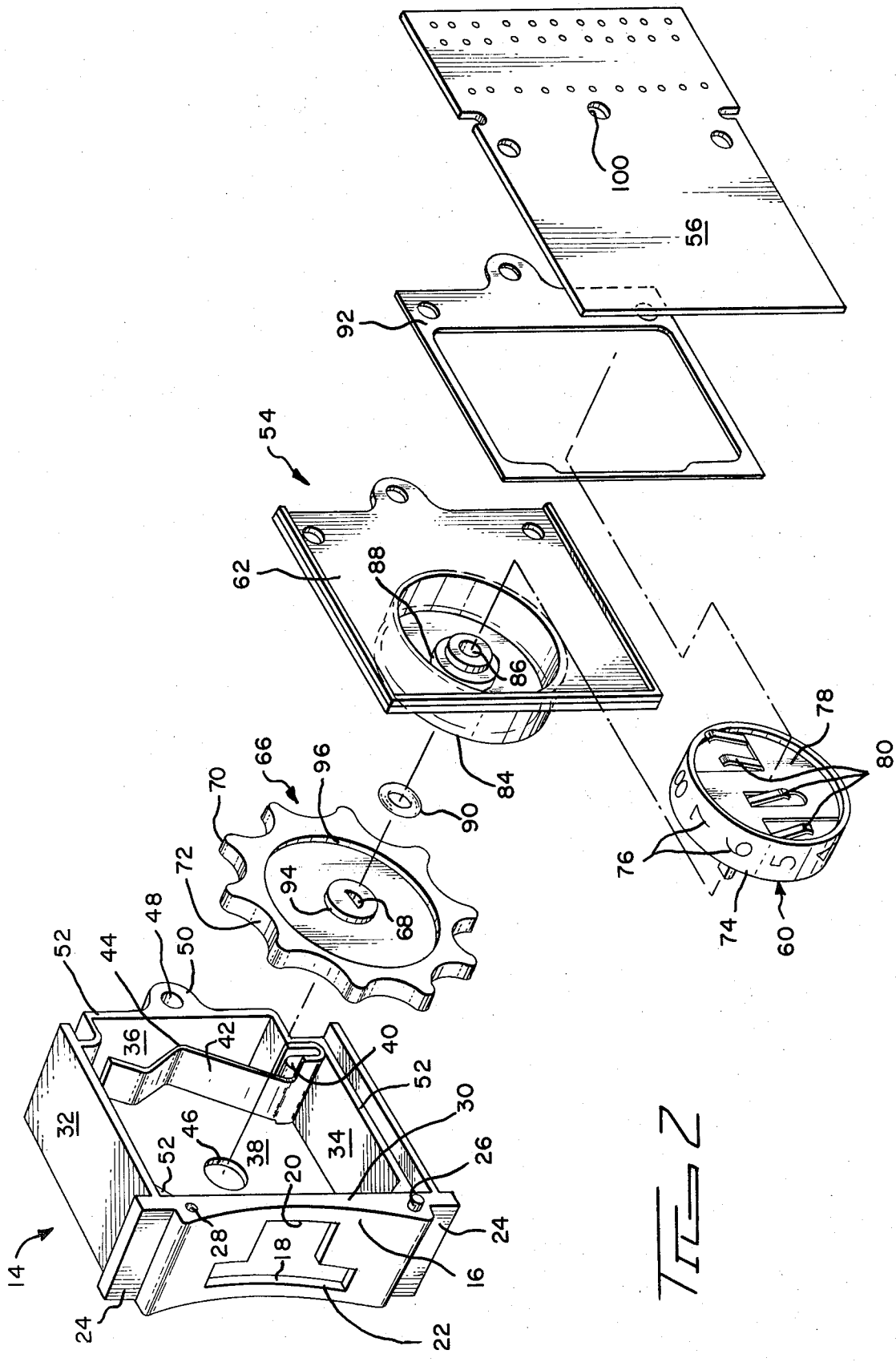

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FIG 2

# SEALED THUMBWHEEL SELECTOR SWITCH

This application is a continuation-in-part of application Ser. No. 255,844, filed May 22, 1972, and now abandoned.

## BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to rotatable indicator switch structures, and more particularly to a sealed, thumb actuated rotary indicating switch.

2. Description of the Prior Art

At the present time a substantial need exists for a small, compact, reliable thumb actuated selector switch which can be conveniently and inexpensively mass produced without impairing its quality. A thumb selector switch which has been highly satisfactory in meeting these requirements is disclosed in U.S. Pat. No. 3,665,127 to Joseph L. Lockard and William H. Rose, filed Feb. 26, 1971, and assigned to the same assignee as the present application. However, while the thumb selector switch disclosed in the above noted patent was found to be most reliable and desirable for use in certain environments, it possessed a disadvantage in that its contact structure was exposed to the atmosphere. Accordingly, when exposed to particularly harsh conditions, such as salty sea air, particularly humid tropical weather or air containing high concentrations of corrosive chemicals, it was found that corrosion could develop in the contact and printed circuit board assembly of the switch. In addition, in particularly dirt or dust laden atmospheres, dust particles could enter the contact and printed circuit board assembly of the above described thumb selector switch, resulting in abrasive wear to the contact and printed circuit board assembly disclosed therein. Both corrosion and abrasive wear naturally tend to reduce the operational life and reliability of any type of switch, and particularly a rotatable selector switch.

In addition, the thumb selector switch described in the above referenced patent included a floating indicator wheel which required the construction of a switch housing having an internal bearing or supporting surface surrounding the outside of the floating indicator wheel. Since the incorporation of this bearing surface into the switch housing complicates the structure of the switch housing, and therefore increases the cost of producing the switch housing, it has been found desirable to simplify the switch housing, and to eliminate this bearing surface.

## SUMMARY OF THE INVENTION

Accordingly, one object of this invention is to provide a novel thumb actuated selector switch structure.

Another object of this invention is to provide a unique thumb selector switch structure having a sealed contact assembly.

Yet another object of this invention is to provide a novel sealed selector switch structure having a simplified switch housing.

A still further object of this invention is to provide a novel thumb selector switch structure having a rotatable contact carrying indicia wheel sealed to a printed circuit device.

Briefly, these and other objects of the invention are achieved by providing a printed circuit board panel having an angularly encoded conductive pattern printed thereon. A contact carrying indicia wheel is sealed by means of a plastic casing to the printed circuit board assembly. A thumb actuatable wheel is coupled to the sealed indicia and contact carrying wheel to provide actuation thereof. The entire assembly is mounted within a protective housing having a detent spring mounted therein.



## DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendent advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a perspective view of a plurality of thumb switches in accordance with the present invention mounted together to form a switch bank;

FIG. 2 is an exploded view of the components of a thumb wheel switch assembly in accordance with the present invention;

FIG. 3 is a section view taken along the line 3—3 of FIG. 1, further illustrating the sealed contact assembly of the present invention; and

FIG. 4 is a plan illustration of the printed circuit board illustrated in FIGS. 2 and 3.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, and more particularly to FIG. 1 thereof, a ten digit switch bank **10** is illustrated. The switch bank **10** is comprised of a plurality of sealed thumb selector switches **12** mounted together. Each sealed thumb selector switch **12** includes a switch housing **14**, which is preferably constructed of a suitable plastic material.

Referring now to FIG. 2, the structure of the switch housing **14** is illustrated in greater detail. The housing **14** includes a curved front panel **16** having an aperture **18** therein. The aperture **18** includes two portions, a generally square indicia viewing opening **20**, and an elongated thumb wheel opening **22**. A pair of panel mounting flanges **24** are molded integral with, and are positioned at opposite ends of, the curved front panel **16**. The panel mounting flanges **24** are useful in positioning the thumb selector switches **12** in electronic panel boards, for example.

A positioning peg **26** and a positioning aperture **28** are formed on a side surface **30** of the curved front panel **16**. The positioning peg **26** and the positioning aperture **28** are used in mounting separate sealed thumb selector switches **12** together, to form a switch bank as illustrated in FIG. **1**. The location of the positioning peg and positioning aperture is alternated on opposite sides of each switch housing **14** so that the individual housings may be readily coupled together.

In addition to the curved front panel **16**, the switch housing **14** also includes a top panel **32**, a bottom panel **34**, a rear surface **36** and one side panel **38**. A spring securing stud **40** is mounted to the side panel **38** at a position to the rear of the switch housing **14**, and near the bottom panel **34**. A detent spring **42** having a detent portion **44**, not shown, is interference fitted about the spring securing stud **40**. A shallow cylindrical in-

dentation 46 may be provided in the side panel 38 of the switch housing 14, if so desired, to interfit with a slight protrusion 39 on a thumb wheel. However, the shallow indentation 46 may be omitted, if desired. Accordingly, it will be apparent that, except for the spring securing stud 40, the interior of the switch housing 14 is substantially devoid of structural members, rendering it particularly simple and inexpensive to mass produce.

A mounting aperture 48 is provided in a protruding portion 50 of the rear surface 46 in order to facilitate assembly of the completed sealed thumb selector switch structure 12, as will be described hereinafter. In addition, the width of the rear surface 36 is slightly less than that of the front, top and bottom panels, 16, 32 and 34 respectively, providing a positioning ridge 52 which extends across the rear area of the switch housing 14. The positioning ridge 52 is extended along the interior surfaces of the top and bottom panels 32 and 34 to form a peripheral surface against which the remaining portions of the selector switch assembly can be mounted.

A sealed indicia wheel and contact assembly 54 is also illustrated in FIG. 2. This assembly includes a panel 56 of conventional printed circuit board material, on which an appropriately configured layer 58, not shown, of conductive material is positioned. A contact carrying indicia wheel 60 is secured to the panel of printed circuit board material 56 by means of a clear plastic encapsulating material 62. A D-shaped axle 64 is secured to the contact carrying indicia wheel 60, for rotating it. The D-shaped axle 64 extends through the clear plastic encapsulating material 62 to permit a thumb wheel 66 to be coupled to the contact carrying indicia wheel 60. The thumb wheel 66 includes a D-shaped aperture 68 at the center thereof for receiving the D-shaped axle 64. The thumb wheel 66 includes a scalloped outer surface including a plurality of evenly spaced projections 70 separated by grooves 72. The projections 70, are, of course, adapted to permit easy manual rotation of the thumb wheel 76. The grooves 72 cooperate with the detent portion 44 of the detent spring 42 to restrain the thumb wheel 66 and the attached contact carrying indicia wheel 60 in positions associated with particular digital outputs. The thumb wheel 66 may be provided with a short cylindrical projection 39 adapted to interfit with the shallow cylindrical indentation 46 in the side panel 38 of the switch housing 14, if so desired.

The contact carrying indicia wheel 60 is shown in greater detail in FIG. 4. The wheel 60 preferably includes a hollow, cylindrical member 74 having numerical indicia 76 printed on an outer circumferential surface thereof. The hollow cylinder 74 is preferably constructed of a conventional plastic material. A metal contact 78 having a plurality of contact fingers 80 is mounted to the base of the hollow cylinder 74.

The contact carrying indicia wheel 60 is sealed to the printed circuit board material 54 by the clear plastic encapsulating material 62. The clear plastic encapsulating material 62 is preferably clear polycarbonate plastic, and is formed in the shape of a flat panel 82, having a cavity in the form of a raised hollow cylindrical portion 84 therein. The hollow cylindrical portion 84 is formed such that its interior dimensions correspond to the exterior dimensions of the contact carrying indicia wheel 60. Thus, in assembling the sealed thumb selector switch 12 of the present invention, the contact carrying indicia wheel 60 is inserted into the hollow cylindrical portion 84 for rotation therein. An aperture 86 is formed in the center of the hollow cylindrical portion 84 to permit the D-shaped axle 64 of the contact carrying indicia wheel 60 to project therethrough. A shallow cylindrical well 88 is formed in the outer surface of the hollow cylindrical portion 84 concentric with the aperture 86. An O-ring 90, formed of a suitable flexible sealing material, is inserted into the shallow cylindrical well 88 so that it surrounds the D-shaped axle 64, and seals the aperture 86 through which the axle 64 projects.

In order to seal the clear plastic encapsulating material 62 to the printed circuit board panel 56, a gasket 92 of a suitable bonding material is preferably used. As shown in FIG. 3, the gasket 92 may be placed on the printed circuit panel 56 substantially around the pattern of conductive material 58. The gasket 92 is preferably formed of B-stage epoxy impregnated into glass cloth, for example. This material is commercially available from New England Laminatec Company, Incorporated located at 481 Canel Street, Stamford, Connecticut. The commercial designation for the material is NELCO type 10–3205–8.

The particular pattern of the conductive material 58 may be any one of a number of suitable patterns. The pattern illustrated in FIG. 4 is substantially the same as the coded pattern disclosed in U.S. Pat. No. 3,665,127, mentioned above.

In assembling the sealed thumb selector switch 12 of the present invention, the contact carrying indicia wheel 60 is first preferably inserted into a reset portion provided by the hollow cylindrical portion 84 in the clear plastic encapsulating material, and the D-shaped axle 64 is inserted through the aperture 86. The gasket 92 is then suitably implaced, and the clear plastic encapsulating material 62 is then positioned over the gasket, and the clear plastic encapsulating material is thereby sealed to the printed circuit panel 56 to provide a cover over the printed circuit panel, the contact carrying indicia wheel and the metal contact 78 having the plurality of contact fingers 80. The O-ring 90 is subsequently inserted into the shallow cylindrical well 88 to seal the aperture 86 surrounding the axle 64. The D-shaped axle 64 may then be inserted through the D-shaped aperture 68 in the thumb wheel 66. When this is done, a short cylindrical projection 94 on the thumb wheel 66 interfits with the shallow cylindrical well 88, and applies pressure to the O-ring 90, fully sealing around the shaft 64 in the aperture 86. In addition, a cylindrical ledge 96 formed on the thumb wheel 66 surrounds the periphery of the encapsulated contact carrying indicia wheel 60, acting as a bearing and supporting surface for the thumb wheel 66. This entire assembly is then inserted into the switch housing 14 such that the thumb wheel engages the detent portion 40 of the detent spring 42, and projects through the thumb wheel opening 22 at the other side thereof. The indicia 76 of the contact carrying indicia wheel 60 are then clearly visible through the indicia viewing opening 20. In addition, peripheral edge portions of the sealed indicia wheel and contact assembly 54 abut the positioning ridge 52 of the switch housing 14, causing the sealed indicia wheel and contact assembly to be firmly positioned with respect to the switch housing. In addition, a mounting aperture 100 in the sealed indicia wheel

and contact assembly **54** then registers with the mounting aperture **48** in the rear of the switch housing **14**. Accordingly, a suitable bolt or rivet, or other fastening means may be passed through the aligned mounting apertures **48** and **100** to firmly secure the sealed indicia wheel and contact assembly to the switch housing **14**.

In operation, the portion of the thumb wheel, and particularly the projections **70** thereof, which protrude through the thumb wheel opening **22** may be manually engaged to rotate the thumb wheel. As the thumb wheel rotates, it is caused to jump from one digital position to the next with the detent spring **42** registering in a corresponding groove **72**, to retain the thumb wheel in its positions selected. Rotation of the thumb wheel drives the contact carrying indicia wheel **60** coupled thereto by the D-shaped shaft **64**. As the contact carrying indicia wheel **60** is caused to rotate, the contact fingers **80** sweep across the conductive pattern **58** on the printed circuit board **56**. Accordingly, various connections are made within the thumb switch, causing the selective energization of a plurality of individual output terminals **98**. However, as pointed out above, the entire contact assembly is hermetically sealed, preventing dust or any type of corrosive atmosphere from entering into the sealed indicia wheel and contact assembly **54**. Thus, the sealed thumb selector switch **12** of the present invention is completely moisture and dust proof, and is compatible with the sealed rotary switch requirements set forth in Military Specification MIL—S–22710C.

Obviously numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

What is claimed is:

**1.** A rotary switch, comprising: a housing of electrical insulation material, a thumb wheel mounted for rotation in said housing and having projecting portions exposed through said housing and adapted to be manually engaged for rotation of said thumb wheel, a printed circuit board mounted generally in said housing and having a plurality of electrical circuit paths thereon, a cover having a cavity portion, a wheel having electrical contact fingers protruding therefrom, said wheel being mounted for rotation in said cavity portion of said cover, said cover overlying at least portions of said electrical circuit paths, said electrical contact fingers projecting towards said portions of said electrical circuit paths for making selective engagement therewith upon rotation of said wheel to selected positions, sealing means sandwiched between said cover and said circuit board, thereby sealably enclosing said portions of said electrical circuit paths and said wheel and said contact fingers between said cover and said printed circuit board, a rotary shaft connecting said thumb wheel and said wheel for simultaneous rotation, said cavity portion having an aperture therethrough, said shaft protruding through said aperture in said cavity portion, and a sealing ring encircling said shaft and sealing said aperture about the periphery of said shaft.

**2.** The structure as recited in claim **1**, wherein, said wheel is provided with a cylindrical surface having indicia thereon indicative of the selected portions to which said wheel is rotated.

**3.** The structure as recited in claim **1**, wherein, said cavity portion includes a hollow cylindrical portion receiving said sealing ring, and said sealing ring is compressed between said hollow cylindrical portion of said cavity portion and said thumb wheel to provide a seal for said aperture about the periphery of said shaft.

**4.** The structure as recited in claim **1**, and further including: a resilient spring mounted in said housing and engageable on said thumbwheel to restrain said thumbwheel from inadvertent rotary movement.

**5.** The structure as recited in claim **1**, and further including: additional portions of said circuit paths protruding from said cover to provide electrical leads externally of said cover, said cover sealably overlying said additional portions of said circuit paths.

**6.** A rotary switch, comprising: a housing, a printed circuit board received substantially in said housing and having electrical circuit paths thereon, a rotatable wheel received in said housing and having indicia thereon about the periphery thereof, said wheel further being provided with electrical contact fingers extending therefrom for electrical engagement on selected ones of said circuit paths upon rotation of said wheel to selected positions, means received in said housing for rotating said cylindrical wheel to selected positions, a cover received in said housing and mounted on said printed circuit board, said cover being enclosed over said cylindrical wheel and said contact fingers and at least portions of said circuit paths which extend between said cover and said printed circuit board, and sealing means providing a seal between said cover and said circuit board.

**7.** The structure as recited in claim **6**, wherein, said printed circuit board projects externally of said cover, said circuit paths include additional portions thereof on said printed circuit board protruding externally of said cover to provide electrical leads, said cover sealably overlying said additional portions of said circuit paths.

**8.** A rotary switch, comprising: a housing, a thumbwheel received in said housing and being rotatable to selected positions, detent means in said housing and engageable on said thumbwheel for retaining said thumbwheel in at least one of said selected positions, a printed circuit board having a plurality of electrical circuit paths thereon, the printed circuit board being mounted generally interiorly of said housing, a cover within said housing and mounted directly on said printed circuit board and enclosing at least portions of said circuit paths, a rotatable member contained between said cover and said printed circuit board, said rotatable member having a plurality of electrical contact fingers thereon projecting toward said electrical circuit paths and being engageable on selected ones of said circuit paths upon rotation of said rotatable member to selected positions, said cover being sealably retained fixedly against at least a portion of said printed circuit board and sealably containing said rotatable member and said contact fingers and at least portions of said circuit paths between said cover and said printed circuit board, electrical leads connected to said circuit paths and protruding from said cover, and coupling means coupling said rotatable member to said thumbwheel for simultaneous rotation.

**9.** The structure as recited in claim **8**, wherein, said rotatable member includes a generally cylindrical sur-

face having indicia thereon indicative of selected positions to which said rotatable member is rotated.

**10.** The structure as recited in claim **8,** and further including: additional portions of said electrical circuit paths on said printed circuit board protruding from said cover to form said electrical leads, said cover sealably engaging and overlying across said additional portions of said circuit paths.

**11.** The structure as recited in claim **8,** wherein, said last-mentioned coupling means includes a rotatable shaft coupling said thumbwheel and said rotatable member for simultaneous rotation, said shaft protruding through an opening in said cover and extending between said thumbwheel and said rotatable member, and further including: a sealing ring encircling said shaft and covering said opening in said cover, said sealing ring being compressed between said thumbwheel and said cover and thereby sealing said opening about the periphery of said shaft.

**12.** The structure as recited in claim **8,** wherein, said rotatable member comprises an electrically conducting contact having at least some of said contact fingers integral therewith.

**13.** The structure as recited in claim **12,** wherein said coupling means includes both a wheel to which said contact is attached and a shaft connecting said wheel to said thumbwheel.

**14.** In a rotary switch having a housing, a thumbwheel mounted for rotation in said housing with manually engageable portions of the thumbwheel protruding from said housing, a printed circuit board in said housing and electrical contact fingers engageable on selected ones of a plurality of printed circuit paths on said printed circuit board upon rotation of said thumbwheel to selected positions, the improvement comprising: a covering panel sealably enclosing said electrical contact fingers and being sealably received against said printed circuit board, said thumbwheel being connected to said contact fingers through said covering panel.

**15.** The structure as recited in claim **14,** and further including: a wheel, a rotatable shaft connecting said thumbwheel and wheel, said wheel supporting said contact fingers, said covering panel having an aperture receiving said shaft therethrough, said sealing means for sealing said aperture about said shaft.

**16.** The structure as recited in claim **15,** wherein, said sealing means includes a sealing ring encircling the periphery of said shaft and in compression between said covering panel and said thumbwheel to form a compression seal for sealing said aperture about the periphery of said shaft.

**17.** The structure as recited in claim **14,** wherein, said contact fingers are mounted on a rotatable wheel enclosed within said covering panel, said rotatable wheel being rotatably received within said covering panel and connected to said thumbwheel for simultaneous rotation therewith.

**18.** The structure as recited in claim **17,** wherein, said rotatable wheel is generally cylindrical with the contact fingers projecting from an end thereof, a cylindrical surface of said wheel having indicia thereon indicative of selected positions to which said thumbwheel is rotated.

**19.** The structure as recited in claim **14,** wherein, said covering panel is secured directly to said printed circuit board with portions of said printed circuit board protruding from said covering panel, said circuit paths on said protruding portions of said printed circuit board extending from said covering panel to provide electrical leads, said covering panel sealably overlying said electrical leads.

**20.** The structure as recited in claim **14,** and further including: detent means in said housing for engaging and retaining said thumbwheel momentarily in one of said selected positions.

* * * * *

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# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3,809,830 Dated May 7, 1974

Inventor(s) Joseph LaRue Lockard, William Henry Rose

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 7, claim 11, line 10, delete "last-mentioned".

Signed and sealed this 10th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

PO-1050
(5/69)

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