March 14, 1967 J. A. BURNS, JR 3,309,472

GEARING MECHANISM AND PRINTED CIRCUITBOARD FOR A ROTARY SWITCH

Filed March 18, 1966 2 Sheets-Sheet 1

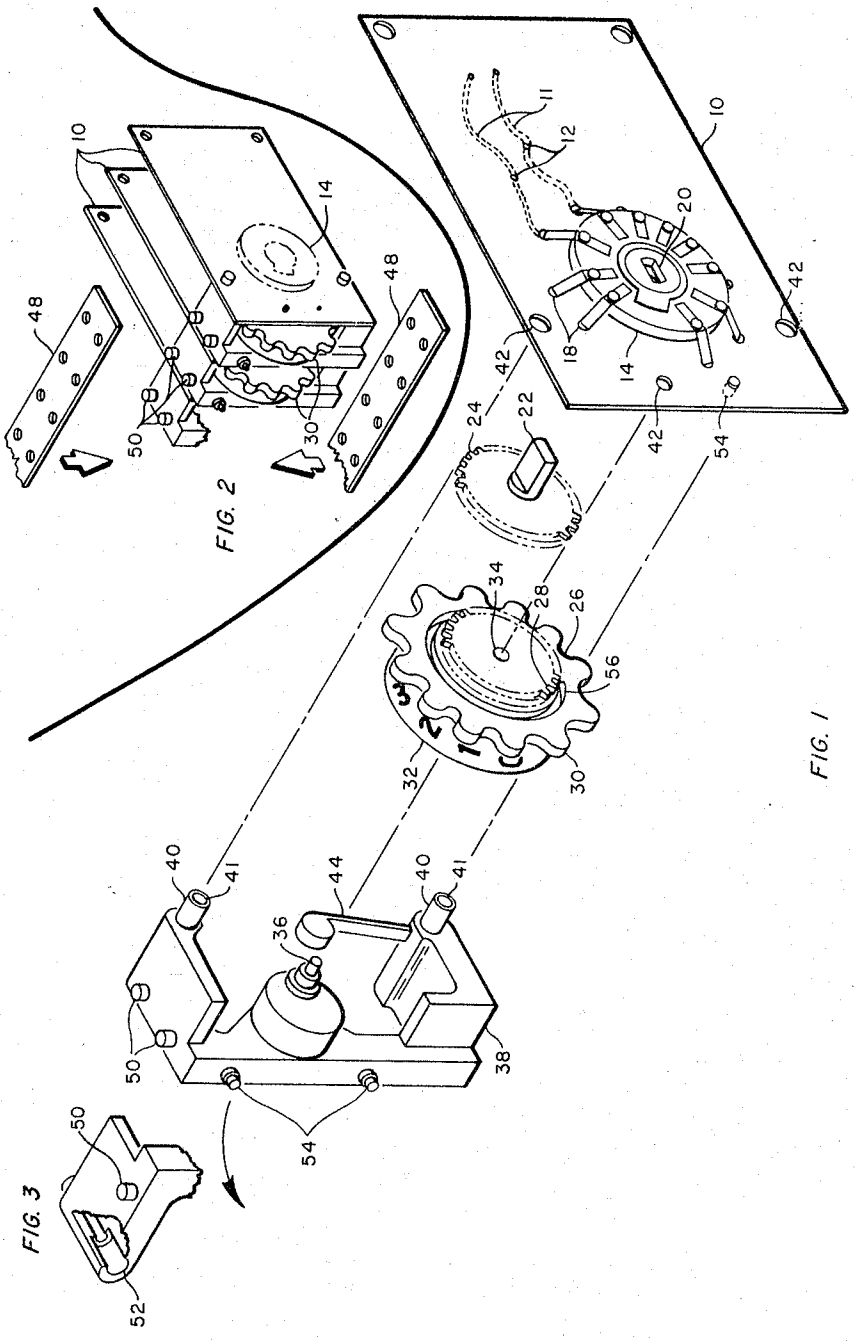


FIG. 1

FIG. 2

FIG. 3

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FIG. 4

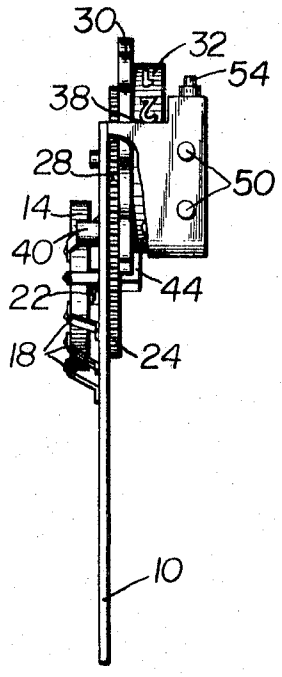


FIG. 5

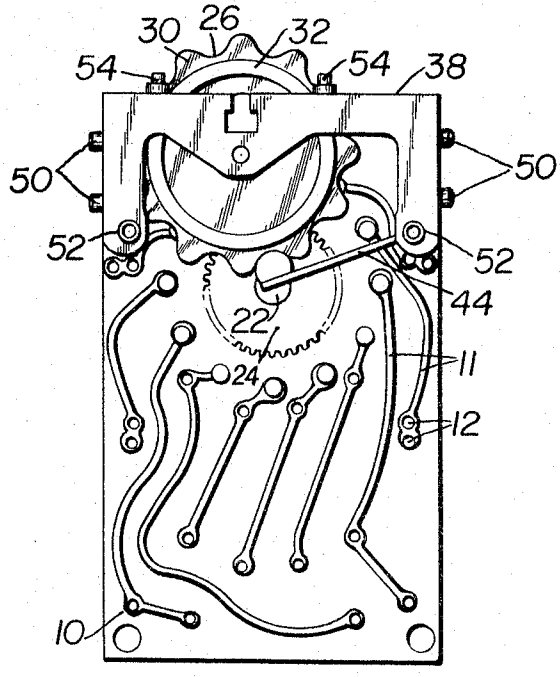
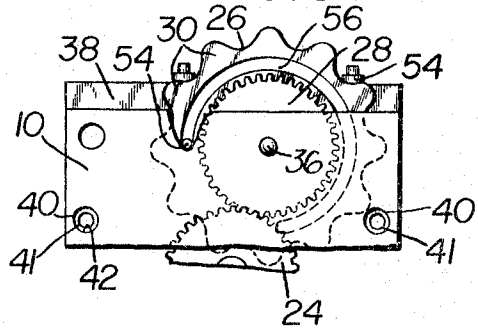


FIG. 6



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GEARING MECHANISM AND PRINTED CIRCUITBOARD FOR A ROTARY SWITCH

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This invention relates to a printed circuitboard and more particularly, to apparatus for mounting a rotary element on a printed circuitboard.

There are available today printed circuit switches that are integral with the board. Unfortunately, many of these switches have a relatively high contact resistance which is unsuitable for many applications. Conventional rotary switches have a low contact resistance, but when these are mounted on a printed circuitboard they generally occupy an excessive amount of space. This may not be a problem where a single rotary switch element is employed, but in the case where plural rotary switches are required and the rotary switches are to be mounted, say, on an instrument panel, the space requirements become intolerable.

Still another type of rotary switch is available in a form capable of being plugged into a printed circuitboard receptacle but, unfortunately, these switches do not permit the attachment of any circuit elements to the board on which the switch is mounted. Here again excessive space is required.

It is, therefore, an object of this invention to obviate many of the disadvantages inherent in the prior art apparatus for incorporating rotary elements with printed circuitboards.

Another object of this invention is to provide an improved apparatus for mounting a rotary element which apparatus occupies a reduced amount of space.

Still another object of this invention is to provide an apparatus for mounting a rotary element on a printed circuitboard which facilitates the stacking of several such elements together.

In a preferred embodiment of this invention the apparatus for mounting a rotary element includes a conventional printed circuitboard, a rotary element mounted adjacent the back face (side opposite the etched current paths) of a printed circuitboard with its axis of rotation substantially perpendicular to the plane of the board. A drive gear having a shaft is inserted in a hole through the back of the board so as to rotatably and driveably engage the rotary element. Next a retaining bracket having a pin, on which is rotatably mounted a knurled gear wheel, is positioned on the back side of the printed circuitboard such that the gear wheel captivates the drive gear and the bracket in turn captivates the gear wheel against the drive gear. A gear is formed in that face of the gear wheel which is adjacent the printed circuitboard and the gear is sized to mesh with the teeth of the drive gear. A spring ratchet arm on the bracket may be employed to engage the knurled peripheral portion of the gear wheel so as to index its rotary motion to correspond, say, to desired rotary positions of the rotary element.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention, itself, however, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIGURE 1 is an exploded perspective view of a printed circuit type switch constructed in accordance with a preferred embodiment of this invention;

FIGURE 2 is an end view of the printed circuitboard switches illustrated in FIG. 1, in a stacked array;

FIG. 3 is a partial perspective view of the bracket illustrated in FIG. 1;

FIG. 4 is a side view of the printed circuit type switch illustrated in FIG. 1;

FIG. 5 is plan view of the printed circuit type switch shown in FIG. 1; and

FIG. 6 is a back view having a partially cut away portion of the printed circuit type switch illustrated in FIG. 1.

In the drawings there may be seen a conventional printed circuitboard **10** having a desired circuit configuration **11** (shown dotted) etched thereon by conventional techniques. Holes **12** are formed in the board to receive whatever circuit elements it is desired to attach to the circuit imprinted on the board. A conventional rotary switch wafer **14** having a plurality of terminals to be switched is positioned on the front face of the board as by rivets **18**. Once this is done, additional circuit elements such as resistors, capacitors, inductors, etc. may be positioned on the board to complete the desired circuit and the back side of the board dip soldered using conventional dip soldering techniques.

Thus positioned, the plane of the rotary wafer switch **14** is substantially parallel to the plane of the board and the axis of rotation of the wafer switch is substantially perpendicular to the plane of the board. A hole (not shown) is provided in the printed circuitboard **10** along the axis of rotation of the switch wafer **14** to accommodate the shaft **22** of a drive gear **24**. The drive gear **24** and shaft **22** may be an integral unit and may be molded of a suitable plastic. The drive gear shaft is inserted through the hole in the printed circuitboard **10** from its back side so as to engage a slot **20** in the rotary switch **14**.

A knurled gear wheel **26** having gear teeth **28** formed on one face thereof is placed against the front side of the board **10** such that its teeth **28** engage the teeth of the drive gear **24**. Knurls **30** extend diametrically beyond the gear teeth **28** such that they captivate the drive gear **24** and retain it against the back face of the printed circuitboard **10**. The gear wheel **26** is formed so as to have an annular peripheral flange **32** on its face opposite the gear teeth **28** and a central axial hole **34** adapted to fit over a pin **36** on a U-shaped bracket **38**. The bracket **38** has a pair of mounting pins **40** which together with the pin **36** fit into mounting holes **42** in the printed circuitboard **10** such that the bracket **38** captivates the gear wheel **26**, and hence the drive gear **24**, against the printed circuitboard **10**. The bracket **38** may be attached by suitable means as by clamping or bolting (not shown) through axial holes **41** in the mounting pins **40** to the circuitboard **10**.

A spring arm **44** extends from the end of one of the upright members of the U-shaped bracket **38** so as to engage the knurls **30** thereby to index the motion of the gear wheel **26** to correspond to the several switching positions of the rotary switch wafer **14**. If in an alternative embodiment, another rotary element such as a potentiometer, is substituted for the switch wafer **14** the spring arm **44** may be removed. In a preferred embodiment of the invention each of the bracket **38**, gear wheel **26** and drive gear **24** are molded plastic members of a suitable electrical insulating, self lubricating plastic. A suitable plastic for this purpose is one of the acetyl resins such as that sold under the trade name Celcon by Celanese Corporation of America or Delrin sold by E. I. du Pont de Nemours & Company.

By forming the front and back faces **46** of the bracket **38** to be planar and substantially parallel to each other, a plurality of the switch assemblies may be stacked in a side by side array, as illustrated in FIGURE 2 and held together by suitable straps **48** which engage pins **50** on

the upright members of the U-shaped mounting bracket **38**. For this purpose the mounting pins **40** are formed somewhat elongated so as to extend through the mounting holes **42** in the board **10** and be capable of engaging complementary positioning holes **52** (FIG. 3) formed in the face of the mounting bracket **38**. If desired, additional pins **54** may be formed on the bottom member of the U-shaped mounting bracket **38** so as to facilitate the positioning of the switch in the panel of an instrument, for example. Also, if desired, an annular groove **56** may be formed in the gear face of the gear wheel **26** immediately outside the diameter of the gear teeth **28** so as to engage a stop pin **55** which may be inserted in the printed circuitboard **10**. This provides a stop for the rotary motion of the switch **14** or other rotary element. Alternatively, the stop pin **55** may be integral with the mounted bracket **38** and extend through the circuitboard **10**. The advantage of this arrangement is that an additional step in the manufacture of the switch is eliminated, and the pin itself is formed as part of the moulding operation of the bracket itself.

There has thus been described a novel printed circuitboard switch arrangement which occupies considerably less volume than those heretofore available and yet facilitates the use of dip soldering techniques for incorporating circuit elements with the rotary switch. This unique construction also permits plural boards each mounting a rotary element to be stacked in side by side array such that plural switches, for example, may be positioned in the panel of an instrument without occupying an undue amount of panel space.

It will be obvious that various modifications may be made in the apparatus and in the manner of operating it. It is intended to cover such modifications and changes as would occur to those skilled in the art, as far as the following claims permit and as far as consistent with the state of the prior art.

What is claimed is:

1. Apparatus for mounting a rotary element, having a plane and an axis of rotation perpendicular to said plane, on a printed circuitboard having a plane and first and second planar faces comprising, in combination:

means for electrically and mechanically mounting said element adjacent said first face of said circuitboard such that the planes of each are substantially parallel, thereby to permit said second face to be dip soldered,

a drive gear positioned adjacent said second face and having a shaft rotatably extending through said circuitboard to rotatably and driveably engage said rotary element, the axis of said shaft coinciding with the axis of said rotary element,

a gear wheel having a gear formed in one face thereof adapted to engage said drive gear,

said gear wheel being positioned over said drive gear whereby the face of said gear wheel retains said drive gear between said circuitboard and said gear wheel,

a retaining bracket having a pin adapted to rotatably mount said gear wheel and additional pins adapted to engage said board, and

means to clamp said bracket and board together.

2. The combination set forth in claim **1** wherein each of said named elements except for said rotary element is a molded plastic.

3. The combination set forth in claim **1** wherein said bracket is U-shaped and includes a spring arm adapted to engage the periphery of said gear wheel thereby to control its rotary motion.

4. The combination set forth in claim **3** wherein said gear wheel is knurled to engage said spring arm and provide rotary indexing of said gear wheel.

5. The combination set forth in claim **4** wherein said gear wheel includes an annular groove in the face adjacent said circuitboard and wherein said circuitboard includes a pin positioned therein to engage said groove and provide limit stops for the rotary motion of said gear wheel.

6. The combination set forth in claim **5** wherein said rotary element comprises a rotary electrical switch wafer.

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