# United States Patent

**Toutain**

[15] **3,694,589**

[45] **Sept. 26, 1972**


[54] **ELECTRICAL COMMUTATING SWITCHES WITH BALL BRIDGING CONTACTS**


[72] Inventor: **Gerard Roland L. Toutain,** 24, rue de Valognes, 78 Mantes La Ville, France



[22] Filed: **Oct. 22, 1970**

[21] Appl. No.: **83,001**

[52] **U.S. Cl.**.....**200/11 A,** 200/166 BH

[51] **Int. Cl.**.....**H01h 1/16**

[58] **Field of Search**.....200/8 R, 11 A, 11 J, 11 K, 200/166 BB, 166 BE



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,284,584 | 11/1966 | Didyk | 200/11 A |
| 3,534,194 | 10/1970 | Speller | 200/166 BH |
| 1,832,869 | 11/1931 | Macy | 200/11 A X |
| 1,254,331 | 1/1918 | Le Blanc | 200/11 K |
| 1,714,680 | 5/1929 | Levinson | 200/DIG. 29 |
| 3,263,033 | 7/1966 | Metzger | 200/11 K |



*Primary Examiner*—J. R. Scott

*Attorney*—Oberlin, Maky, Donnelly & Renner



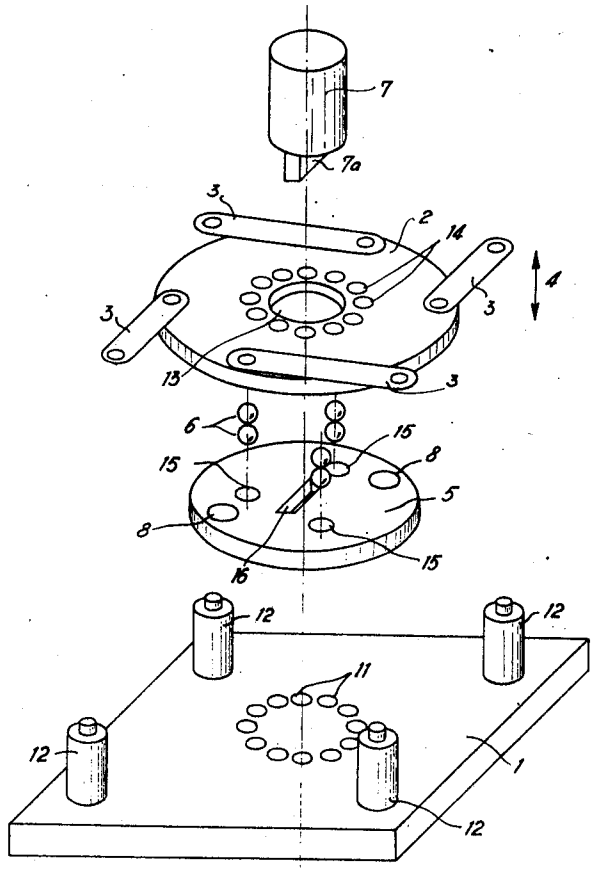
[57] **ABSTRACT**

The invention relates to rotary commutation devices and particularly though not exclusively to rotary electrical commutators.

A commutating switch device comprises a rotor capable of turning between two stators which are continuously biased resiliently towards one another. The rotor has a plurality of transverse holes serving to hold locating balls, and the stators each have on their face directed toward the rotor, a plurality of locating holes for the balls, so that the passage from one commutation location in which the balls cooperate with holes of the stators to an intermediate position in which the balls lie against the faces of the stators gives rise to an increased relative spacing of the two stators.

Sensitivity is thus improved while decreasing the moment required for adjusting the control switch.


**3 Claims, 7 Drawing Figures**



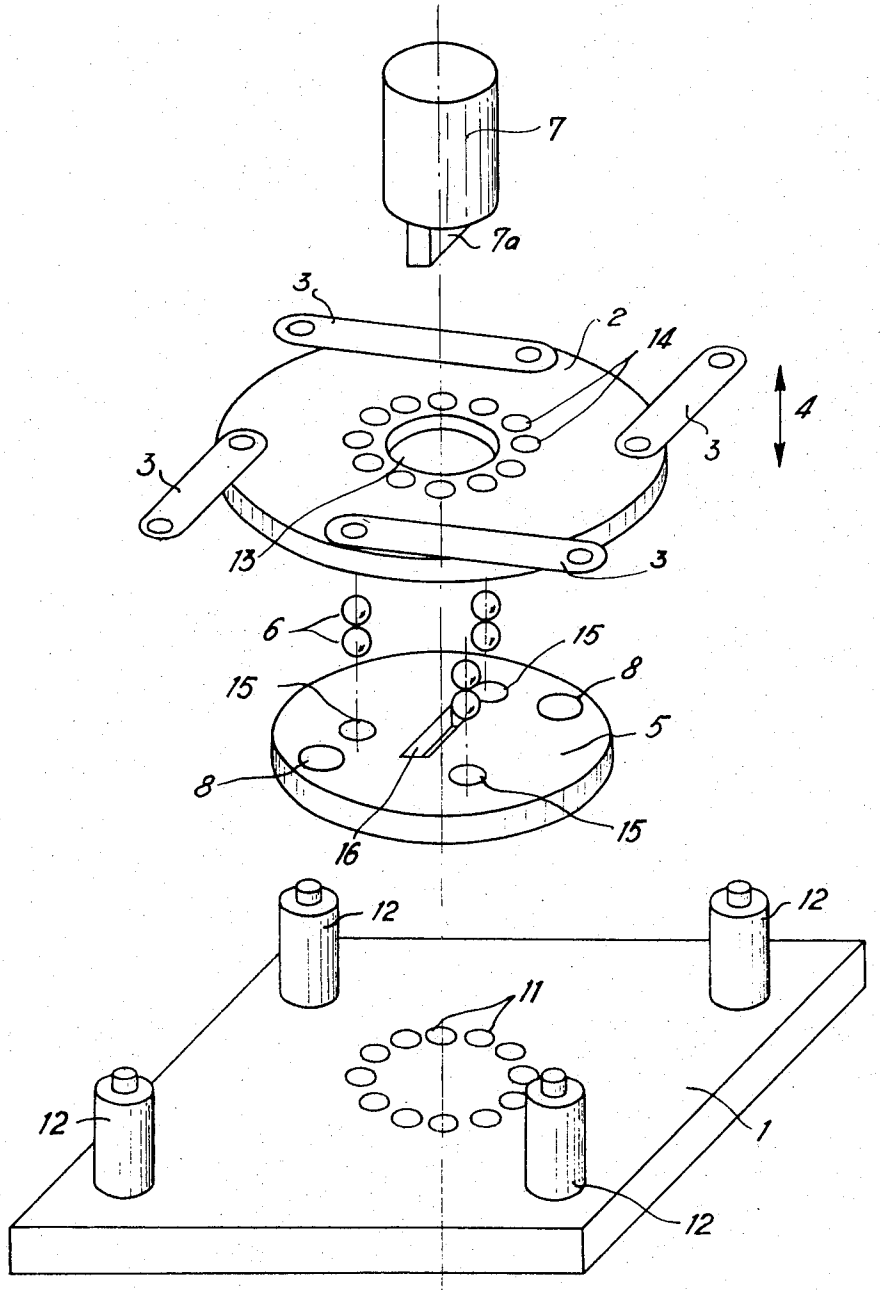



Fig. 1

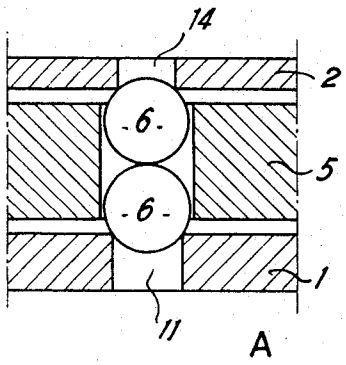



Fig. 2a

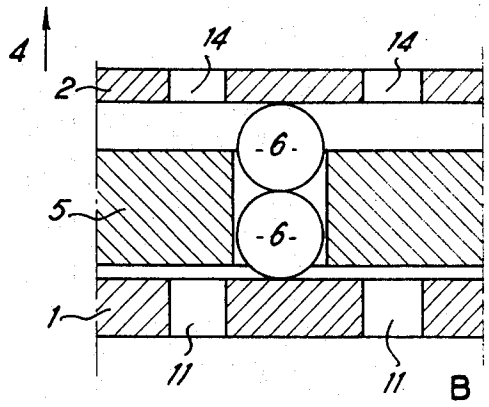



Fig. 2b

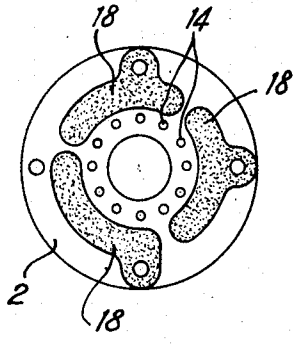



Fig. 3a

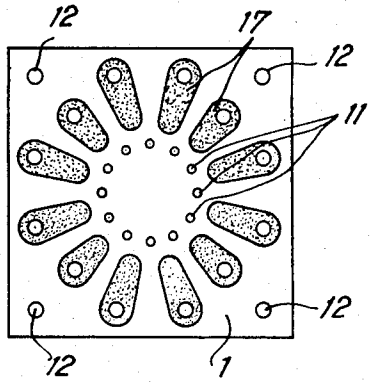



Fig. 3b

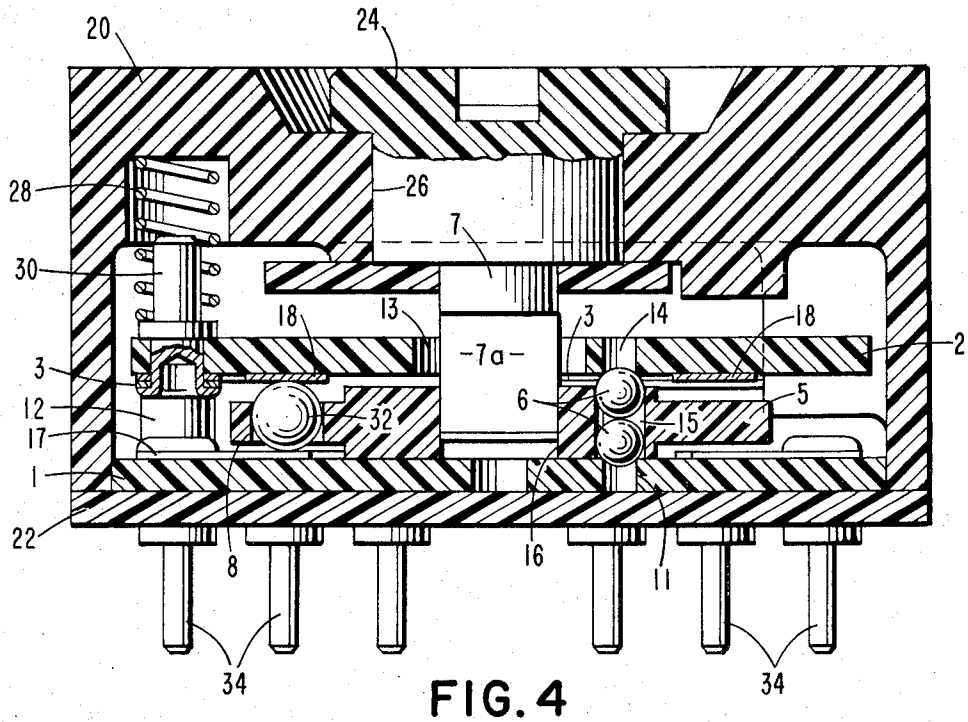

20
24
28
26
7
30
18
13
3
14
18
2
-7a-
3
6
5
12
32
15
17
1
22
8
16
11
34
34

FIG. 4

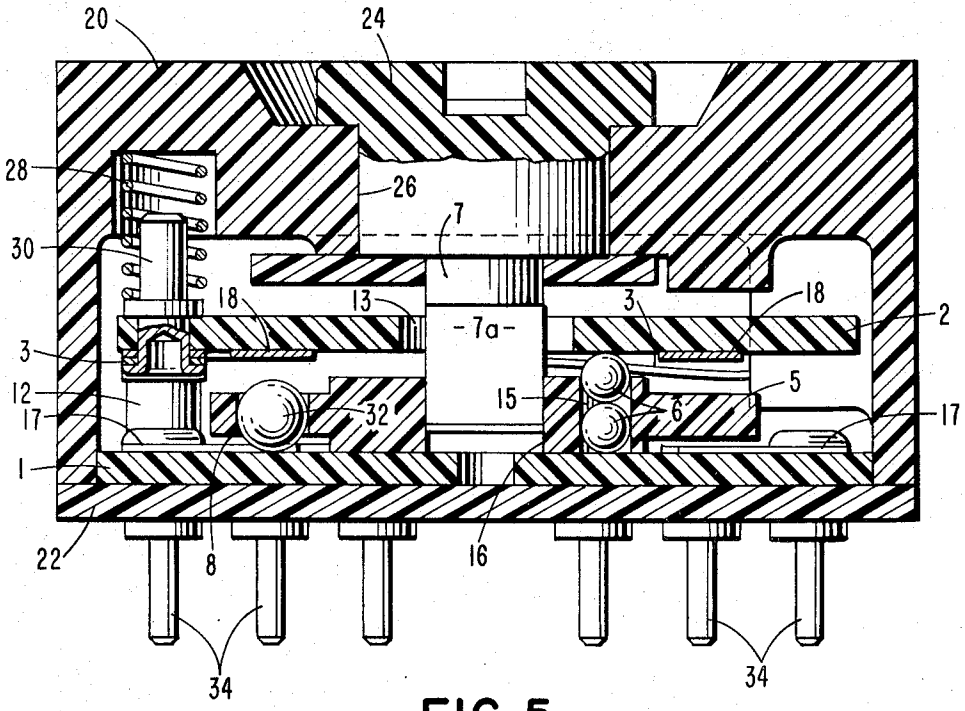

20
24
28
26
7
30
18
13
3
18
2
-7a-
3
15
5
12
32
6
17
17
1
22
8
16
34
34

FIG. 5

# ELECTRICAL COMMUTATING SWITCHES WITH BALL BRIDGING CONTACTS

## BACKGROUND OF THE INVENTION

1. Field Of The Invention

This invention relates to rotary commutation devices and particularly, although not exclusively, to rotary electrical commutating switches.

2. Description Of The Prior Art

The general principle of rotary commutation devices is well known: a rotor is rotatable with respect to a fixed assembly and locking means are provided for holding the rotor in a certain number of predetermined angular positions which constitute commutation positions. In general, this locking is provided by locating balls which come into engagement in notches or other location means in various commutation positions. For electrical commutators, the rotor serves to establish, corresponding to various commutation positions, an electrical connection through the intermediary of sliding contacts, frequently comprising flat fingers cooperating with resilient holders.

For all of the rotary devices of the type above set forth, it is essential that the user who effects manual rotation of the rotor should clearly sense the passage over commutation positions. For electrical contact commutators, the resisting moment is the sum of the moment caused by the locking ball action and of the frictional moment due to the contact members. In order that the commutator operator should clearly sense the commutation positions, it is necessary that the moment caused by the locking ball action should be in excess of the moment due to friction, so that the friction of the contact members does not succeed in masking variations in the control moment which are characterized by the correct functioning of the lock ball system. Because of this, it has become the practice to use locking ball devices giving rise to relatively high locating moments.

In contrast to the previously proposed technique, referred to hereinbefore, the invention proposes a novel commutating switch structure particularly of an electrical commutator with a low locking ball moment.

## SUMMARY OF THE INVENTION

According to the present invention there is provided a rotary commutation device comprising a first stator member having a plurality of recesses arranged in a circular array, a second stator member having a plurality of recesses arranged in a circular array, a rotor mounted between the first and second stators and having a plurality of holes opposed to the recesses of the first and second stators, means biasing the stators towards one another, and at least one locating ball in each said hole of the rotor, movement of the rotor between commutating locations when the locating balls are wholly outside the recesses serving to overcome the biasing means and thus force the stators apart with respect to the rotor.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:



FIG. 1 is an exploded perspective view of the main mechanical parts of an electrical commutating switch in accordance with the invention;

FIG. 2*a* is a fragmentary developed section illustrating a pair of balls in a locked position;

FIG. 2*b* is a fragmentary developed section showing a pair of balls in a non-locked position;

FIGS. 3*a* and 3*b* shows stators forming part of the commutating switch on which the contact parts are provided by a process similar to that used for the manufacture of printed circuits, FIG. 3*a* showing the upper stator and FIG. 3*b* the lower stator, and

FIG. 4 is a vertical cross-sectional view showing the preferred form of commutating switch in accordance with the present invention, with the balls being shown in a locked position; and

FIG. 5 is a sectional view similar to FIG. 4, showing the balls in a non-locked position.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

The commutating switch comprises two stators 1 and 2 and a rotor 5. The lower stator 1 is rectangular and supports the remainder of the assembly. It has a circular series of holes 11 the center of which circle is also the center of symmetry of the stator. The stator 1 also comprises at each of its corners four stepped pegs 12 which serve to mount the upper stator 2 through the intermediary of resilient links 3. The upper stator 2 can alternatively be mounted on the lower stator by any other means which permit small translational displacements in the direction of the arrow 4.

The stator 2 is circular and has a circular aperture 13 of the same center. It has a series of holes 14 disposed on a circle of which the center is the center of the stator and the radius is the same as that of the circle on which the holes 11 are disposed.

The rotor 5 lies between the stators 1 and 2. It has three holes 15, of larger diameter than those, 11, 14, of the stators, but lying on a circle of the same diameter. The rotor 5 also has a rectangular opening 16 and two opposed holes 8 for locating contact balls. A pin 7 having a projection 7*a* passes through the opening or an aperture 13 and engages in the opening 16 which enables the rotor to be driven. A pair of ratchet balls 6 is located in each hole 15.

The number of holes 11 and 13 is for example equal to twelve if the commutating switch comprises locking positions which are spaced by 30°.

On passing from a locked ball position (FIG 2*a*) to an unlocked, neighboring position (FIG. 2*b*), by the rotation of the rotor 5, the upper stator is raised as indicated by the arrow 4 in FIG. 2*b* thus pressing the two ratchet balls which roll one on the other and on the two stators continuously together.

A first set of contact areas 17 is disposed on the stator 1 and a second set of contact areas 18 on the stator 2. The contact areas 17 and 18 are electrically connected by contact balls disposed in respective holes 8 of the rotor. The sets of contacts are preferably provided when forming the stators 1 and 2 by the process used for manufacture of printed circuits. The conductive zones have shapes necessary to ensure the continuity of the various circuits, commutated by predetermined displacement of the ratchet balls. The configura-

tions of FIGS. 3*a* and 3*b* provide four locations on three tracks.

The stators 1 and 2 are manufactured of an insulating material of high mechanical strength. The tracks of the stator 2 are preferably electrically connected by the resilient links 3 which also effect guidance of the stator and generate the necessary contact pressure.

The contact balls have a diameter lying between the values of the distance separating the stators in the two extreme positions shown respectively in FIGS. 2*a* and 2*b*. It follows that they are supported in a locked position while they do not rub on the tracks during the displacement from one commutating location to the next. In the locked position, their diameter is so determined that the desired contacts are effected.

The rotor 5 is free to make, in the locked position, small angular displacements about the mean locating positions giving rise to friction with the contact balls on the areas of very small size. This has the effect of cleaning the contact surfaces, during each commutation action.

The rotor 5 is made of an insulating material, having, preferably, a low friction coefficient.

The contact areas of the stator 1 and the tracks of the stator 2 can be connected electrically by riveted studs of customary form employed for mounting soldered capsules in printed circuits.

The commutator can thus be directly incorporated in a printed circuit board in the same manner as other electronic components carried thereby.

There is illustrated in FIGS. 4 and 5 a preferred form of commutating switch in accordance with the present invention. Parts which are similar to those previously described and illustrated are shown by the same reference characters. In FIG. 4, the balls 6 are in a locked position, similar to FIG. 2*a*, and in FIG. 5, the balls 6 are in a non-locked position, similar to FIG. 2*b*.

The switch shown in FIGS. 4 and 5 comprises an outer housing molding 20 and a bottom closing plate 22 which together enclose the switch parts. The molding 20 and plate 22 can be secured by any suitable means, for example, assembling rivets.

A control spindle 24 is mounted in an opening 26 therefor formed in the molding 20, with the spindle having connected thereto the pin 7 for driving the rotor.

As above noted, the upper stator 2 is biased toward the lower stator 1, with spring means 28 being the preferred biasing means. The springs 28 are telescoped around pins 30 which extend upwardly from the links 3, which links in turn bear on the upper surface of the stator 2.

Contact or conducting balls 32 are disposed in the openings 8 in the rotor 5, with the balls 32 in the FIG. 4, locked, position of the ratchet balls 6 electrically connecting the contact areas 17, 18 on the stators 1 and 2, respectively, to the terminal pins 34. When the ratchet balls 6 are unlocked, as shown in FIG. 5, the electrical connection between the stators is interrupted due to the spacing of the contact balls 32 from the contact areas 18 on the underside of the stator 2.

In the case of electrical commutating switches in accordance with the invention, the structure is such that the electrical contacts do not rub against one another when the commutator passes from one commutation position to another, although they are sufficiently biased towards one other for any commutation location. Because of this, the electrical contacts are not liable to wear due to rubbing and an operator can sense clearly the passage between various commutation positions.

Further, the structure in accordance with the invention is applicable particularly well to the construction of electrical commutating switches of small dimensions.

What is claimed is:

1. A rotary commutation device comprising

a. a first stator member having a plurality of recesses arranged in a circular array,

b. a second stator member having a plurality of recesses arranged in a circular array in alignment with the recesses of said first stator member,

c. means for mounting said stator members so as to resiliently bias the same toward each other while at the same time permitting axial movement of one of said stator member relative to the other,

d. a rotor mounted between the first and second stator members and having a first plurality of holes opposed to the recesses of the first and second stator members and which sequentially communicate with said recesses in said stator members when said rotor is rotated,

e. locating ball means positioned in said holes in said rotor, said locating ball means being dimensionally in excess of the rotor thickness, whereby movement of said rotor positions said locating ball means outside the recesses in said members thereby serving to overcome the biasing means and thus force the stator members axially apart from each other,

f. means defining electrical contact areas on the faces of said stator members directed towards said rotor,

g. said rotor being provided with a second plurality of holes which are sequentially in alignment with said contact areas on the faces of the stator members when said rotor is rotated,

h. conductive ball means positioned in said second plurality of holes in said rotor, said conductive ball means having a diameter larger than the rotor thickness but smaller than the axial distance between the opposed contact areas on the faces of the stator members when the latter are resiliently biased toward their most adjacent position, whereby said conductive ball means are only operative to connect the contact areas on the faces of said stator members when the latter are in their most adjacent position with the locating ball means inside the recesses in said stator members.

2. The rotary commutation device according to claim 1, wherein said ball means comprises two locating balls in each of said first holes in said rotor.

3. The rotary commutation device according to claim 1, wherein said means for mounting said stator members comprises link means interconnecting said stators, and spring means associated with said link means for resiliently biasing said stators toward each other.

* * * * *