April 8, 1969 R. H. AHRENS 3,437,766

TAP SWITCH ASSEMBLY WITH IMPROVED DETENT AND CONTACT STRUCTURE

Filed Nov. 15, 1966

Sheet 1 of 2

Fig. 1

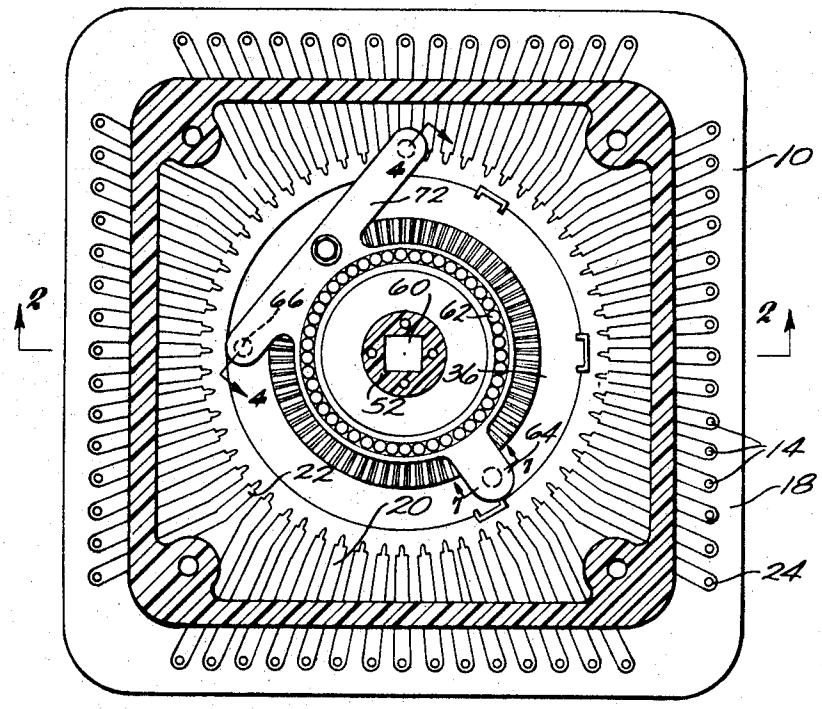
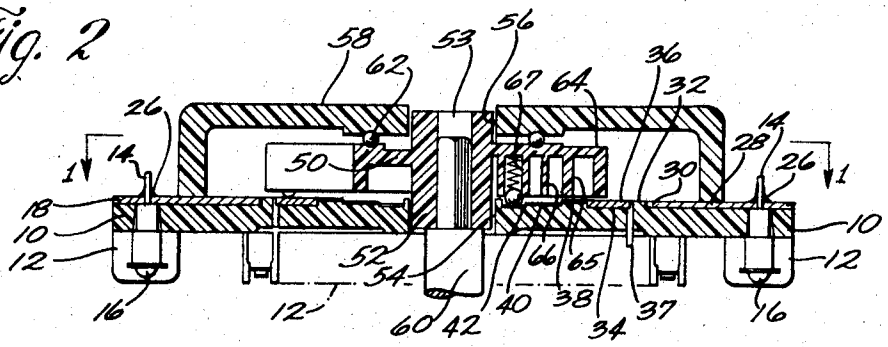


Fig. 2



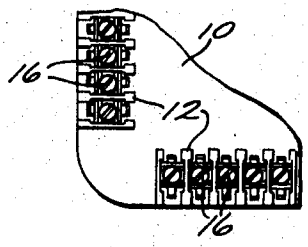


Fig. 3

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TAP SWITCH ASSEMBLY WITH IMPROVED DETENT AND CONTACT STRUCTURE

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Fig. 1

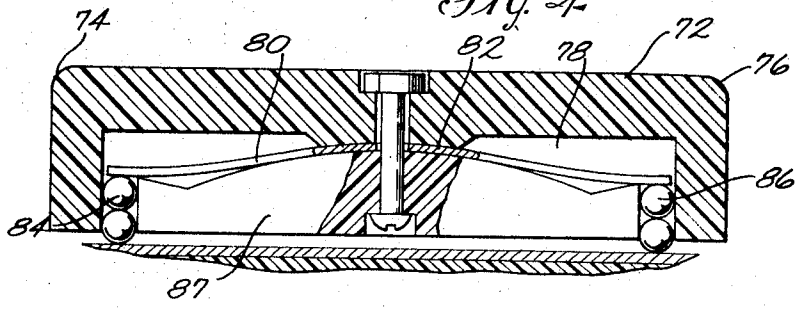


Fig. 5

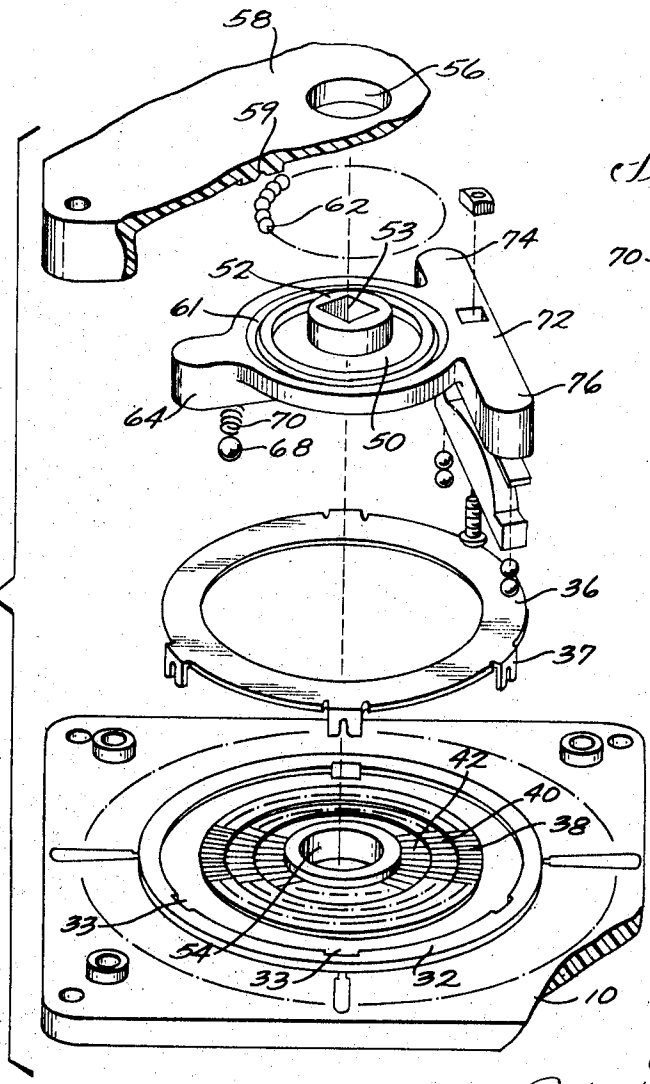


Fig. 4

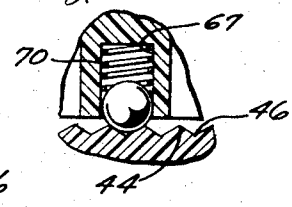
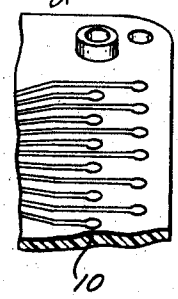


Fig. 6



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TAP SWITCH ASSEMBLY WITH IMPROVED DETENT AND CONTACT STRUCTURE

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U.S. Cl. 200—11 11 Claims

ABSTRACT OF THE DISCLOSURE

Terminal mounting blocks are mounted along the side or sides of a base plate. Centrally thereon is a printed circuit board having printed conducting leads radiating to the respective terminals and traversed by a rotatable contactor.

In the preferred construction the contactor comprises a switch carrier having a plurality of spring pressed contact balls, one of which moves from one to another of the radial printed contacts while another may traverse an annularly continuous contact ring.

The base board or the cover may have separate annular series of radial grooves for fixing operative circuit closing positions of the rotor, the rotor having spring pressed ball means or the like successively engaged in the grooves.

The rotor may provide 3-point engagement with supporting surfaces of the circuit board and base plate.

Background of the invention

I am aware of the fact that prior art switch contactors have moved to and from engagement with printed terminal contacts as shown, for example, in United States Patent 3,243,531.

Description of the invention

FIGURE 1 is a view taken in cross section on the line 1—1 of FIG. 2.

FIG. 2 is a view taken in cross section on the line 2—2 of FIG. 1.

FIG. 3 is a fragmentary detail view of the base board as it appears in plan when inverted.

FIG. 4 is an enlarged detail view in cross section on the line 4—4 of FIG. 1.

FIG. 5 is an enlarged fragmentary detail view showing several component parts in perspective as they appear when mutually separated.

FIG. 6 is a fragmentary detail view similar to a portion of FIG. 5 to show a modified base board embodiment.

FIG. 7 is a detail view on an enlarged scale taken on the line 7—7 of FIG. 1.

The form of the instant base **10** happens to be generally square. Along its margins on its under side are terminal blocks **12** which have terminals **14** projecting through the base **10** and have terminal screws **16** for appropriate wiring connections.

Superimposed on the base **10** and registering therewith is a circuit board **18** having printed circuit conductors **20** having their inner end portions **22** in annular series and their outer end portions **24** apertured to receive the terminals **14**, which are electrically connected thereto, as by a drop of solder **26** (FIG. 2). As will be apparent from FIG. 1, the printed circuit conductor leads **22** are not precisely radial. Although their inner ends are preferably spaced at equal annular intervals, their outer

end portions have to conform to the terminals **14** provided by the generally rectilinearly terminal blocks **12**.

The base **10** has a shallow recess **28** in which the printed circuit board **18** is disposed. The inner margin **30** of the circuit board is circular in plan and abuts a circular rib **32** with which the base is provided. Immediately within the rib the base has a channel **34** within which is provided an annular common circuit or live contact ring **36**.

The common or "hot" contact ring **36** encircles one or more generally radially grooved detent portions **38**, **40** and **42** of the base. Contact ring **36** is not printed in the specific embodiment illustrated but is a prefabricated ring provided with lugs **37** as best shown in FIG. 5. These lugs extend through appropriate openings **33** within rib **32** (FIGS. 5 and 6) and may be used to make electrical connection to the ring **36** from the lower side of the base **10**. By way of example and not by way of limitation, it may be noted that the detent portion **38** of the base is divided into a hundred equidistant and generally radial ribs and intervening grooves. Similarly the area **40** is divided into sixty grooves and ribs and the area **42** is divided into thirty grooves and ribs. The ribs are shown at **44** and the grooves at **46** in FIG. 7, it being understood that the ribs and grooves of areas **40** and **38** are similar except in number and size.

Rotatable centrally of the printed circuit board and the base is a contactor comprising rotor **50** having a hub portion **52**. Hub **52** is received into an opening **54** in the base and a corresponding opening **56** in a cover **58**. The cover has the form of an inverted cup bolted to the base and having its periphery engaged with the circuit board. An opening **53** in the hub **52** is preferably non-circular to receive a complementary driving shaft **60**.

A thrust bearing may conveniently be provided between the cover **58** and the contactor rotor **50**. To this end, these parts may have registering grooves **59** and **61** filled with thrust balls **62**. The rotor **50** preferably has 3-point support from the base and the support means provided is preferably an anti-friction ball at each point.

As best shown in FIG. 5, the rotor **50** has a generally radial arm at **64** in which a number of pockets are provided at **65**, **66** and **67** (FIG. 2). In pocket **67** is a ball **68** and spring **70** which, as best shown in FIG. 2 and FIG. 7, cooperate with the ribs **44** and channels **46** to provide thirty detent positions per rotation of rotor **50**. If the ball were moved outwardly into the pocket **66** in registry with the annular detent ring at **40**, sixty detent positions would be defined. If the ball were moved into the pocket **65** to register with detent series **38**, one hundred detent positions would be defined, particulars being by way of example only.

Approximately opposite the arm **64** is a generally tangential head **72** having terminal portions **74** and **76**. Since this head is oblique with reference to the diameter on which the arm **64** is located, the portions **74** and **76** are at differing radial distances from the axis of the rotor **50** (FIG. 1). Within this head **72** there is a channel **78** for a flat spring **80** which is provided with a seat at **82** within the channel and has its ends engaged respectively with balls **84** and **86** (FIG. 4). The ball **84** is at such a radius in the end **74** of the head that it rides on the annular supply contact **36**. Ball **86**, at the other end of the head **72**, is at increased radius to ride on the equally spaced portions **22** of the printed circuit leads **20**. Thus rotation of the contactor will progressively close circuits between the common contact ring **36** and successive radiating contact leads **20**. The printed leads may be pressed into, and b flush with, the board so that the contact ball **86** rolls readily across these leads and the intervening spaces, being held securely to the leads by spring **80** to make a good contact.

The flexing of spring **80** is controlled by the member **87**, which is bolted to the head **70** as shown in FIG. 4. The spring is confined between a concave surface of head **72** and a complementary convex surface of member **87** tending to flex its free ends downwardly. However, the member **87** also has terminal portions which limit the downward displacement of the ends of the spring and thereby limit thrust upon balls **84** and **86**.

According to whether the operator is interested in completing thirty circuits, sixty circuits or one hundred circuits in a given rotation of the contactor, the ball **68** will have been placed in the respective pocket **65**, **66** or **67**. In each significant circuit-closing position, the ball **68** will ride into an appropriate radial groove to define impositively the position in which the circuit is complete. Smoothness and unformity of operation is assured by the balls **62** operating in the race grooves **59** and **61** of the cover **58** and the rotor **50**.

I claim:

1. A tap switch assembly comprising a base, a contact ring mounted thereon, a printed circuit board encircling the ring and provided with printed radiating contacts, a rotating contactor having means guiding it for rotation about the contact ring and having electrically connected contacts one of which bears on said ring and another of which engages said printed contacts successively in the rotation of the contactor, said contactor and said base having cooperating detent means including a ball and a set of grooves which are uniformly spaced and which are traversed by the ball, the ball registering with one of said grooves in each of a plurality of positions in which a contact of the contactor registers with one of the printed contacts on the base.

2. A tap switch assembly comprising the combination with a rotor and a base, of means guiding the rotor for rotative movement with respect to the base, a set of printed contacts and a ball contact respectively on the rotor and base for completing successive circuits in the course of rotation of the rotor respecting the base, and ball and groove means impositively defining positions in which the ball registers with a respective printed contact of said set, said ball and groove means including a plurality of annular series of grooves provided at different radial distances from the axis of rotation of the rotor, and the ball which impositively engages the grooves having means for selectively positioning it to register with the grooves of a selected annular series, and means for impositively biasing the ball into a groove in which it registers.

3. A tap switch assembly comprising the combination with a rotor and a base, of means guiding the rotor for rotative movement with respect to the base, a set of printed contacts and a ball contact respectively on the rotor and base for completing successive circuits in the course of rotation of the rotor respecting the base, and ball and groove means impositively defining positions in which the ball registers with a respective printed contact of said set, the base being provided with a plurality of annular series of grooves, the rotor having ball guiding means registering with the grooves of each annular series and the ball being selectively positioned in a particular guiding means of the rotor to register with the grooves of a particular series, the grooves of the respective series being differently spaced angularly, whereby the rotor position is impositively defined by engagement of the ball in the grooves of the series with which it registers to define in each rotor rotation different numbers of printed contacts according to the annular series of grooves with which the ball registers, the ball being provided with means for impositively urging it toward each groove with which it registers.

4. A tap switch assembly comprising a base plate having an annular rib and an annular contact positioned within the rib, said base plate having inside the annular contact

a plurality of annular series of generally radial grooves at different radii and angular spacing, printed circuit contacts leading generally radially outwardly from the rib and provided with terminals, and a rotor having means guiding it for rotation substantially coaxially with the rib and provided with a first contact coacting with said annular contact of the base, said rotor having a second contact at a greater radius than the said first contact of the rotor and positioned for successive engagement with the printed contacts of the base, said rotor having detent ball means positioned opposite a selected annular series of grooves and adapted to define rotor positions in which the second rotor contact engages selected printed contacts of the base, the rotor further having means for electrically connecting its first and second mentioned contacts with each other.

5. A tap switch assembly comprising a base, a rotatable contactor, means mounting the contactor for rotation about a predetermined axis with respect to the base, the base being provided wtih fixed contacts mutually spaced in circumferential series about the axis, said rotating contactor having electrically connected contact means positioned for simultaneous engagement with certain of said fixed contacts which are angularly spaced in such series, said contactor having a portion extending to the other side of said axis from the fixed contacts so engaged, said portion having bearing engagement with said base, whereby said contactor is supported from the base at three points including the fixed contacts so engaged and the said portion, and means for holding the rotating contactor to the base.

6. A tap switch according to claim **5** in which said base is provided with a plurality of series of generally radial ribs and grooves, the respective series being concentric with said axis at different radii therefrom, and the said movable contactor portion having spring detent means projecting toward the base and adjustable as to radius to cooperate with different series of ribs and grooves, the fixed contacts of the base being so disposed as to be engaged by contact means of the contactor in selected positions of the rotatable contactor as defined by engagement of the spring detent means in engagement with ribs and grooves of the various series.

7. A tap switch assembly comprising a base, a rotatable contactor, means for guiding the contactor for rotation with respect to the base upon a predetermined axis, said contactor having an arm projecting at one side of the axis and provided at a different side of the axis with a generally tangential head, means providing movable contact means mounted on said head for rotation with said contactor, the movable contact means including contacts disposed at differing radii from said axis, electrical means for connecting the movable contacts of said head, means for providing fixed contacts on said base with which the contacts of said head are engaged in various positions of rotation of the rotatable contactor, and means on the said arm of said rotatable contactor for providing bearing support for said contactor from the base, whereby the rotatable contactor receives such support from at least three points angularly spaced about said axis, said points including said last mentioned means and the respective electrical contacts of the head.

8. A tap switch assembly according to claim **7** in which said head is provided with a channel which is oblique with reference to a diameter that includes the said axis and the bearing means of said arm, and a flat spring conductor disposed in such channel and engaged at its ends with said movable contact means, said head including means for biasing said spring toward the base to subject the movable contact means to bias toward the fixed contacts of the base.

9. A tap switch according to claim **7** in which the means for subjecting the spring to bias includes a downwardly concave surface provided by said head and exposed to the channel and engaged by an intermediate

portion of the spring, and means connected with said head and engaging the spring from below to force it into conformity with said surface.

10. A tap switch according to claim **7** in which said last means comprises an arm extending in general parallelism with the spring and having its ends spaced from the ends of said channel to define small pockets containing balls which constitute said movable contacts, said balls being engaged by the ends of the spring.

11. A tap switch according to claim **7** in which the said head is disposed at an oblique angle with regard to the arm of the contactor, one of the fixed contacts of the base comprising a ring constantly engaged by one of the contacts of the head, the other fixed contact means of base comprising angularly spaced contacts in angular series and engaged by the other contact of the head.

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