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L. R. GEORGE  
ELECTRIC SWITCH

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2 Sheets-Sheet 1

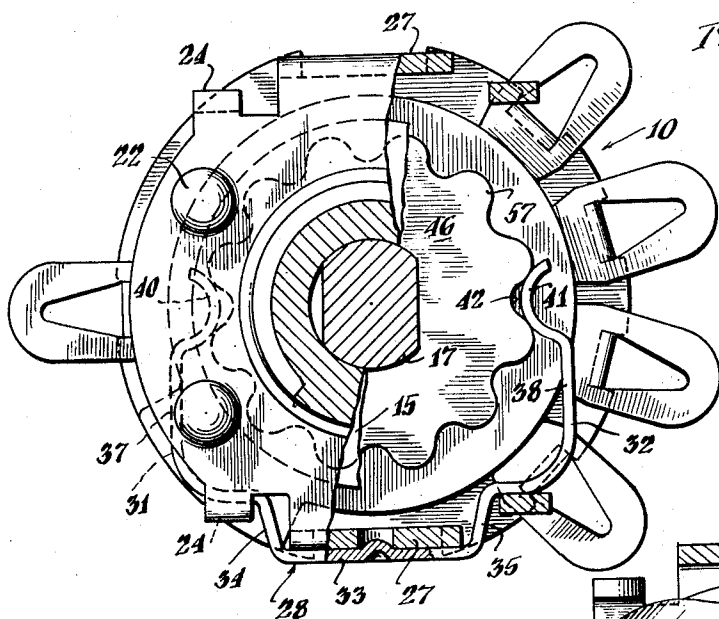


Fig. 3

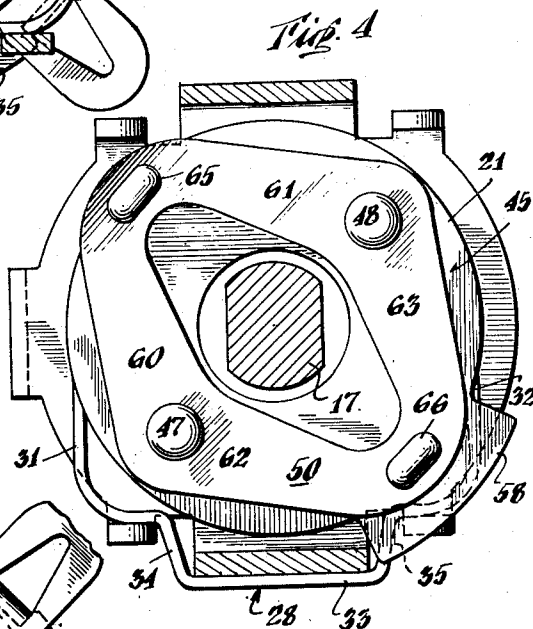


Fig. 4

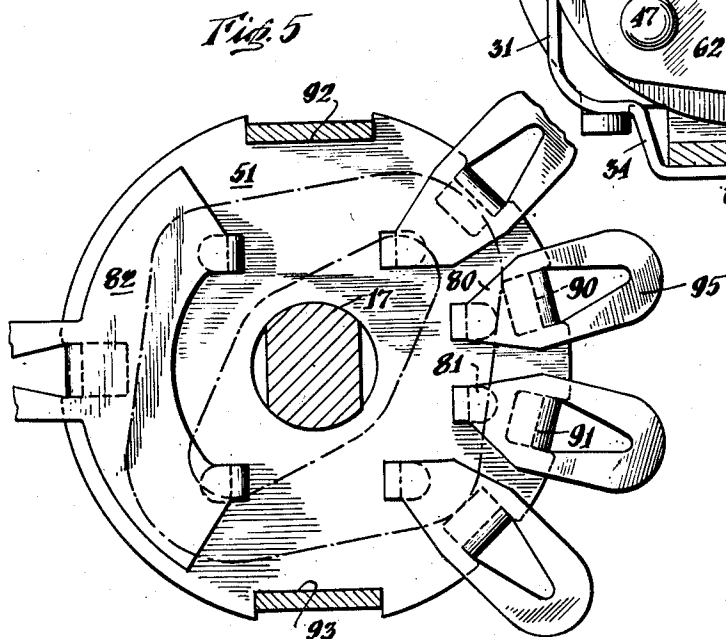


Fig. 5

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**ELECTRIC SWITCH**

2 Sheets-Sheet 2



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## ELECTRIC SWITCH

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9 Claims. (Cl. 200—14)

This invention relates to rotary tap electric switch devices and has specific pertinency to such devices including means and methods for making and breaking circuits connected to multiple wafer sections.

The present invention provides a subminiature switch, the dimensions of which are extremely small, and, in point of fact, have not heretofore been available. The switch, as constructed, includes two basic assemblies of exceedingly small dimensions.

The switch, for example, uses a  $\frac{1}{8}$ " shaft with two C rings controlling its lateral motion. It has a frame which has a three-fold function. The frame offers a mounting means for a  $\frac{1}{4}$ " bushing; it further holds an indexing spring and also has a locating tab formed toward the panel side for aligning the switch in rapid fashion. Another important feature of the switch is that the rotor not only carries the contactor spring, but also has the detent surface for the indexing mechanism.

The second assembly of the switch comprises the stator of the switch and includes the rear frame for the switch to hold the multiple sections of the switch. The stator of the switch is constructed from two pieces, namely, a metal stamping or terminal ring card and a laminated phenolic stamping for the stator. These are assembled by having ears cut out of the metal piece and protruding the same through the stator laminate. The hole caused by a lance is then used as a solder lug.

Circuit combinations for the switch are obtained by blanking the outer ring of the terminal ring at various positions to obtain the desired switching arrangement required for that section. The rear frame then is used to stack the multiple sections to the first section.

It is therefore an object of the present invention to provide a new and novel subminiature switch of simplified construction and utilizing few parts.

It is another object of the present invention to provide a multiple-sectioned wafer type switch of extremely small physical dimensions capable of being used in printed and miniaturized circuit assemblies.

Another object of the present invention is to provide a subminiature type switch fulfilling the requirements established for normal switching operations and wherein the indexing and detenting mechanism is exceedingly simplified and accomplished by a novel construction thereof.

Yet another object of the present invention is to provide a new and novel subminiature switch having utility in environments where physical space and size are important factors to be considered and where ruggedness and simplicity of construction are essential features to be considered.

Still another object of the present invention is to provide an extremely small rotary tap switch having a multiplicity of sections, each of such sections being of simplified rotor and stator construction incorporating novel formed detent and indexing mechanisms.

The above and further objects and advantages of the invention will be more readily apparent from the following description when read in connection with the accompanying drawings, in which:

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Fig. 1 is a side elevational view of the novel subminiature switch, substantially many times amplified, in a preferred embodiment thereof as adapted to illustrate the many novel constructional and assembly features of the multiple sections included thereby;

Fig. 2 is another side elevational view of the subminiature switch, many times amplified, taken from a position as adapted to illustrate the interfitting of the separate sections and the mounting thereof to form an interrelated unitary construction;

Fig. 3 is a cross-sectional, horizontal view with portions in elevation of an embodiment of the present invention as adapted to illustrate the indexing and constructional arrangement thereof and is taken along line 3—3 of Fig. 2;

Fig. 4 is a cross-sectional, horizontal view of an embodiment of the present invention as adapted to illustrate the rotor and contact wiper construction thereof as taken in the direction of the arrow as shown in line 4—4 of Fig. 2; and

Fig. 5 is a cross-sectional, horizontal view of an embodiment of the present invention as adapted to illustrate the stator and terminal arrangement thereof as taken in the direction of the arrow as shown in line 5—5 of Fig. 1.

Generally speaking, the present invention has as its aim the provision of a subminiature rotary tap switch which is adapted to be used in printed and miniature circuits. The switch is readily adapted to automatic fabrication and assembly in that the individual components have been fabricated so that each is utilized in cutting down the physical dimensions of analogous type structures and whereby the mountings and frames have been combined to minimize the need for costly staking, welding and joining techniques usually required for such small devices.

As an example of the extremely small dimensions here being used, the contact spring is .450" in diameter; the rotor is .484" in diameter; each switch section is approximately  $\frac{3}{8}$ " deep, while a three-sectioned switch from rear to bearing is approximately  $\frac{3}{4}$ " long overall; the bearing itself is no more than  $\frac{1}{4}$ " in length, while the shaft is approximately  $\frac{1}{8}$ " in diameter. Thus, within these extremely small specifications, a precision rotary type tap switch having a severality of discrete positions for switching a number of different circuits has been accomplished. To do this, the rotor has been constructed so as to contain the detent teeth. Moreover, an indexing spring has been novelly mounted and a stator having several contacts and terminals has been constructed for making contact with the contactor spring. The entire assembly has been stacked and mounted by a unique frame construction for predeterminedly spacing and providing bearing surfaces and supports.

Referring now particularly to the accompanying drawings, in which like numerals have been applied to like parts throughout the several views, the numeral 10 generally designates the multi-sectioned switch shown especially in Fig. 1. The switch may be assembled, as hereinafter described, to comprise a plurality of substantially similar sections, such as 11, 12 and 13. Since one section is substantially similar to the next, the description of an individual section will apply with equal pertinency to each of the others, with the reference numerals being applied to structures of similar nature in any of the sections.

The stacked subminiature section switch 10 of the invention is constructed to be mounted to a chassis through the use of a threaded bushing 14 held within the switch frame by means of a rear disc-like apertured plate or collar 15 which fits against the inside wall of the front plate of the sectionalized frame, which is adapted to con-

tain the separate components of the stacked sections of the switch. The bushing surrounds a shaft 17 which is adapted to rotate the several rotors of the switch. This shaft is locked against axial movement by a C washer 18 held within a groove cut in the shaft in front of the bushing.

The front section of the switch is held in links comprising parts of the entire switch frame strap. The links of the frame strap are adapted, as hereinafter described, to interfit with one another in a locking fashion, thus holding the individual sections of the switch tightly together. As seen from Figs. 1-3, the front frame link comprises a front face 20 having its center cut out to form a circular opening of a diameter sufficient to pass the threaded bushing therethrough. The bushing has a rear collar 15 which abuts the inside surface of the front face, which acts as a bearing surface therefor. At the same time, the rotor 21 of the front section of the switch is adapted to ride on the collar of the bushing. It is to be noted that, as finally assembled, the entire switch has the links or frames tightly strapped together so that the individual rotors of the separate sections will smoothly and evenly ride on its bearing surface.

On the front frame surface there are placed a plurality of dimples 22 which are located at spaced points adjacent the circular opening formed through the said surface. These dimples are used for aligning and centering the switch with respect to the supporting chassis to which it is attached. To further aid in the alignment of the switch with reference to the chassis, a longitudinal tab 23 extends out from the face of the front frame to fit within a cooperating slot formed in the chassis. This tab acts as a non-turn mounting locating tab. Thus, the switch is easily adapted to be seated and connected to its associated chassis.

On the opposite sides of the front face, directly above and below the links of the frame, are pairs of rearwardly extending tongues 24 and 25. These, in cooperation with a frame link 27 contained therebetween, are adapted to provide pivoting mounting means for an indexing spring 28 as it is constructed to ride on the rotor detent.

As shown in Fig. 3, the indexing spring 28 comprises a thin strip of soft type annealed carbon spring steel flat wire approximately .010" thick, which is formed and then hardened. As finally constructed, it forms a generally U-shaped configuration, comprising two legs 31 and 32 interconnected by a mid-portion 33 placed substantially horizontally to the legs. The horizontal section is slightly bowed, with the bottom-most portions 34 and 35 of the interconnected legs angulated at approximately 15° thereupon. The bottom portions of each of the legs are connected to larger, vertical, central sections 37 and 38 which are horizontally offset from the bottom portion by a slight arc. The top of each central section comprises hook-shaped portions 40 and 41 which, as seen by referring more particularly to Fig. 3, provide the index finger adapted to ride in the detented portion, such as 42, of the rotor. Both hooks act on opposite sides of the rotor to form a positive detenting and indexing action for the switch.

The mid-section of the indexing spring fits around the link between the backwardly extending tongue of the front face in a manner such that the bottom portions of the legs are tightly held therebetween with each tongue bearing against the arc portion of the spring so as to tightly conform the remaining central portion and detent hooks against the rotor of the switch. In this fashion, a tight, resilient, positive indexing spring is mounted on the switch without the necessity for resorting to complicated mounting procedures. As the rotor turns, the hook of the spring falls in and out of the valleys between the teeth and moves in pivotal restraint because of the mode of mounting.

Each individual rotor of the switch sections, such as rotor 21, is predeterminedly constructed with many

unique features. The rotor is of one-piece construction, which may be of moulded fabrication. The minuscule size of the rotor can be seen from the fact that its outside diameter is  $\frac{3}{8}$ ". It comprises substantially a two level construction 45 and 46 having its center penetrated by a substantially "double D"-shaped opening adapted to allow the switch shaft access therethrough. The short sides of the rectangular openings are slightly bowed so that the rotor is tightly fitted on the shaft. By means of the fit, the rotor is adapted to be turned by the shaft without any other means for staking. The top surface 45 of the first level of the rotor has two moulded posts 47 and 48 placed on opposite sides of the shaft opening. These, as hereinafter described, will fit through cooperating apertures on the rotor contact spring to hold the spring on this surface as it moves along the terminal of the stator 51 placed adjacent thereto. The underside of the rotor 46 comprises the detent level, which comprises a moulded annular section connected to the first, or above, level of the rotor. Its diameter is less than the top level, but of greater thickness. The circumference of the detent level comprises a multiplicity of moulded detents or teeth 57 which cooperate with the indexing spring, described above, to provide the necessary detenting and indexing functions of the switch as the rotor revolves to place the individual circuits in operation. On the periphery of the first level of the rotor, a moulded stop or extension 58 is provided, extending horizontally outward from the rotor, which, on the radial excursion of the rotor, will be adapted to come up against a link of the frame to be stopped thereby at the proper angular rotation of the shaft and rotor.

The contact spring 50 (Fig. 4) of the subminiature switch is fabricated of non-ferrous alloy spring material of approximately .0035" thickness and can have interconnected arms 60, 61, 62 and 63 forming a generally diamond-shaped configuration. The dimensions of the spring are also very small, being .450" on the long dimension and .375" on the small dimension. On the junction formed by arms of the long dimension 60 and 61 or 62 and 63 are formed the contact wipers, which are long dimples 65 and 66 struck out from the spring arms to form belly extensions therefrom. The contact spring is preformed to give an inherent predetermined contact force, which insures proper electrical contact and avoids mechanical wear. The contact spring rides on the rotor and is mounted thereon by having the apertures formed through the other junctions of the arms fit over the posts which are moulded in the rotor, as described above. The rotor and contact arm are tightly juxtapositioned against the stator and contact terminals placed thereon by means of the unique lock fit of the links of the frame.

The stator 51 (Fig. 5), which cooperates with the rotor 21, described above, is made of a laminate, such as "Bakelite," and has a generally annular configuration, with, however, a plurality of rectangular notches 90, 91, etc., made in the periphery thereof. Two of these notches 92 and 93 are opposite each other and cut wider than the others. As hereinafter described, the smaller notches are used, in cooperation with adjacent apertures, to accept the prongs or tongues lanced out of metal contacts or rings 80, 81, 82, etc., having integrally formed terminals which are adapted to be connected to the desired electrical circuits. The wider notches are adapted to accommodate tongue and shoulder portions of the frame links as the tongues are fed through eyelets in successive links of the frame and bent over to lock adjacent links to one another in a chain-like fashion and in extremely tight fashion. The individual contact and solder lug terminals, such as 95, are of a one-piece construction. The terminal is lanced so that a metal tongue is cut out which will be adapted to be bent so as to clinch the laminate. The contact portion has an extension which goes through one of the holes in the laminate, also to be bent therethrough and to anchor the same by

clinchling it to the underside of the laminate. In a similar fashion, the contact ring 82, which is of crescent shape, has a unitarily formed solder terminal connected thereto, with the ring and terminal being clinched to the laminate by ears bent through the apertures cut there-through. This construction again simplifies the staking of the terminals and provides an exceedingly simple structure for performing a complexity of functions.

For providing the necessary circuit combinations, the metal contact ring is blanked to obtain the described switching required for the switch section.

To provide bearing surfaces for the rotors of consecutive switch sections, as well as means to keep the stator of the preceding section under tight compression, a rear frame 97 is provided (Fig. 1). It comprises a raised central portion 98 having an aperture cut there-through through which the shaft rod penetrates. The central portion is raised by having portions integrally connected thereto bent vertically to form individual legs, such as 99, a tip 105 of which rests against the horizontally extending portions 100 and 100', respectively, of side links 102 and 103, respectively, forming part of the frame of its section. Each side link thus comprises a top, horizontal tongue portion adapted to fit in the aperture of the succeeding side link, a bottom portion which is apertured and has a portion adapted to be horizontally bent to abut the under side of the stator. This portion, as stated above, underlies the legs of the rear frame link and is compressed against its adjacent stator by means of the tongue of the preceding side link of the frame. In this fashion, the side and rear links of the frame combine to provide a tight stacking unit for the individual sections of the switch. This mode of mounting may be extended indefinitely to encompass as many switch sections as required by the nature of the number of switching circuits to be connected.

By the present invention, there has been provided a subminiature switch of extremely small dimensions. The switch has made a considerable advance in the art by developing and improving means and modes for mounting aligning, indexing and fabricating components for such switches, whereby complicated assembly procedures have been eliminated and costs of fabricating have been considerably reduced. The description of the present switch, moreover, is intended to be merely illustrative of the many features which are incorporated therein and which may be utilized in other fields.

What is claimed is:

1. A subminiature rotary tap switch adapted for use in the switching of a multiplicity of electric circuits comprising a hollow threaded bushing, a front plate having an aperture of a diameter sufficient to fit over said bushing, a rotor having separate levels attached to each other, one smaller diameter level thereof having a periphery formed as a multiplicity of detents, a shaft passing through said bushing being connected to said rotor, a bearing surface upon which said rotor is adapted to rotate, a frame for said rotary switch including interlockable side links, an indexing spring having a pair of opposing fingers held by said links of said frame for cooperating with said detents of said rotor to positively index the same as desired on rotation of said switch shaft, a contact spring having wipers thereon adapted to be moved with said rotor, a stator placed adjacent said rotor having discretely spaced contacts and contact ring thereon, terminals connected thereto, said contact spring on said rotor adapted to move against said contacts and ring so as to determine the proper circuits to be switched thereby, and means placed against said stator for locking the same to said rotor and contact spring components of the switch tightly together under compression.

2. A subminiature rotary tap switch adapted for use in the switching of a multiplicity of electric circuits comprising a hollow threaded bushing, a front plate having an aperture of a diameter sufficient to fit over said bush-

ing, a rotor having a pair of integral levels attached to each other, one level thereof being of smaller diameter and having a periphery formed as a multiplicity of detents, a shaft passing through said bushing being connected to said rotor, a raised portion of a frame upon which said rotor is adapted to rotate, said frame for said rotary switch further including interlockable side links, an indexing spring having a pair of opposing fingers held by tongues bent back from said frame for cooperating with said detents of said rotor to positively index the same as desired on rotation of said switch shaft, a contact spring having wipers thereon adapted to be moved with said rotor, a stator placed adjacent said rotor having discretely spaced contacts and contact ring thereon, terminals connected thereto, said contact spring on said rotor adapted to move against said contacts and ring so as to determine the proper circuits to be switched thereby, and means placed against said stator for locking the same to said rotor and contact spring components of the switch tightly together under proper compression.

3. A subminiature rotary tap switch adapted for use in the switching of a multiplicity of electric circuits comprising a hollow threaded bushing, a front plate having an aperture of a diameter sufficient to fit over said bushing, a rotor having separate top and bottom levels attached to each other, said bottom level being of lesser diameter and having its periphery formed as a multiplicity of detents, a shaft passing through said bushing being connected to said rotor, a bearing surface upon which said rotor is adapted to rotate, a frame for said rotary switch including side links, an indexing spring having a pair of opposing fingers held by said frame for cooperating with said detents of said rotor to positively index the same as desired on rotation of said switch shaft, a contact spring of diamond-shaped configuration having wipers integrally formed thereon adapted to be moved with said rotor, a stator made of laminate placed adjacent said rotor having discretely spaced contacts and contact ring staked thereto, terminals unitarily connected thereto, said contact spring on said rotor adapted to move against said contacts and ring so as to determine the proper circuits to be switched thereby, and tongues bent from said sides of said frame placed against said stator for locking the same to said rotor and contact spring components of the switch tightly together under proper compression.

4. A subminiature rotary tap switch adapted for use in the switching of a multiplicity of electric circuits comprising a hollow threaded bushing, a front plate having an aperture of a diameter sufficient to fit over said bushing, a unitary formed rotor having a plurality of discrete levels attached to each other, a level thereof being of lesser diameter and having its periphery formed as a multiplicity of detents, a shaft passing through said bushing being connected to said rotor, a raised bearing surface upon which said detent level of said rotor is adapted to rotate, a frame for said rotary switch including interlockable side links, an indexing spring passing over one of said side links and having a pair of opposing fingers held by said frame for cooperating with said detents of said rotor to positively index the same as desired on rotation of said switch shaft, a contact spring having wipers thereon adapted to be moved with said rotor, a stator placed adjacent said rotor having discretely spaced contacts and contact ring thereon, terminals connected thereto, said contact ring on said rotor adapted to move against said contacts and ring so as to determine the proper circuits to be switched thereby, and means placed against said stator for locking the same to said rotor and contact spring components of the switch tightly together under proper compression.

5. A subminiature rotary tap switch adapted for use in the switching of a multiplicity of electric circuits comprising a hollow threaded bushing, a front plate having an aperture of a diameter sufficient to fit over said bush-

ing, a unitarily formed rotor having a plurality of plastic discrete levels attached to each other, a level thereof being of lesser diameter having a periphery formed as a multiplicity of detents, a shaft passing through said bushing being connected to said rotor via an aperture, a raised bearing surface connected to said front plate upon which said rotor is adapted to slidably rotate, a composite frame for said rotary switch including side links and said front plate, an indexing spring passing over one of said side links and having a pair of opposing fingers held by said frame for cooperating with said detents of said rotor to positively index the same as desired on rotation of said switch shaft, a contact diamond-shaped spring having a plurality of arms with portions formed of two of said arms adapted to act as wipers and to be moved with said rotor, a stator placed adjacent said rotor having discretely spaced contacts and contact ring thereon, terminals connected thereto, said contact ring on said rotor adapted to move against said contacts and ring so as to determine the proper circuits to be switched thereby, and means placed against said stator for locking the same to said rotor and contact spring components of the switch tightly together under proper compression.

6. A subminiature rotary tap switch adapted for use in the switching of a multiplicity of electric circuits comprising a hollow threaded bushing, a front plate having an aperture of a diameter sufficient to fit over said bushing, a unitarily formed rotor having a plurality of separate, discrete levels integrally attached to each other, a level thereof being of lesser diameter having a periphery formed as a multiplicity of detents, a shaft passing through said bushing being connected to said rotor via an aperture, a raised bearing surface formed of said bushing upon which said rotor is adapted to slidably rotate, a frame for said rotary switch including interlockable side links and said front plate, said plate having rearwardly extending tongues, an indexing spring having a pair of opposing fingers held between said tongues of said plate over one of said side links of said frame thereof for cooperating with said detents of said rotor to positively index the same as desired on rotation of said switch shaft, a contact spring having wipers thereon, posts for seating said spring on said rotor so as to move the same therewith, a stator placed adjacent said rotor having discretely spaced contacts and contact ring thereon, terminals connected thereto, said contact ring on said rotor adapted to move against said contacts and ring so as to determine the proper circuits to be switched thereby, and means placed against said stator for locking the same in the switch tightly together under proper compression.

7. A subminiature rotary tap switch adapted for use in the switching of a multiplicity of electric circuits comprising a hollow threaded bushing, a front portion having an aperture of a diameter sufficient to fit over said bushing, a unitarily formed rotor having a plurality of plastic discrete levels attached to each other, a level thereof being of lesser diameter having a periphery formed as a multiplicity of detents, a shaft passing through said bushing being connected to said rotor via an aperture, a raised bearing surface connected to said front plate upon which said rotor is adapted to slidably rotate, a frame for said rotary switch including side links and said front portion, an indexing spring held on said front portion having a pair of opposing fingers for cooperating with said detents of said rotor to positively index the same as desired on rotation of said switch shaft, a contact spring having arms interconnected to form a diamond-shaped structure and having wipers formed thereof adapted to be moved with said rotor, a laminate stator structure placed adjacent

said rotor having discretely spaced contacts and contact ring thereon, terminals connected thereto, said contact ring on said rotor adapted to move against said contacts and ring so as to determine the proper circuits to be switched thereby, and means placed against said stator for locking the same in the switch tightly together under proper compression.

8. A subminiature rotary tap switch adapted for use in the switching of a multiplicity of electric circuits comprising a hollow threaded bushing, a front plate having an aperture of a diameter sufficient to fit over said bushing, said front plate having aligned dimples and tab for mounting on a chassis, a unitarily formed rotor having a plurality of plastic discrete levels attached one under the other, the lower level thereof being of lesser diameter and having its periphery formed as a multiplicity of moulded detents, a shaft passing through said bushing being connected to said rotor via an aperture, a raised bearing surface connected to said front plate upon which said rotor is adapted to slidably rotate, a frame for said rotary switch including side links and said frame portion, a resilient indexing spring held over one of said side links and having a pair of opposing fingers for fitting in said detents of said rotor to positively index the same as desired on rotation of said switch shaft, a contact spring having a severality of interconnected arms configured as a diamond-shaped spring, said spring adapted to move with said rotor, a laminate stator placed adjacent said rotor having discretely spaced contacts and contact ring thereon, terminals formed unitarily therewith, said contact ring on said rotor adapted to move against said contacts and ring on said stator so as to determine the proper circuits to be switched in accordance therewith, and tongue means on said side links of said frame for locking the stator, the rotor and the contact spring of the switch together under proper compression.

9. A subminiature rotary tap switch adapted for use in the switching of a multiplicity of electric circuits comprising a plurality of switch sections, each of said sections including a unitarily formed rotor having a plurality of moulded discrete levels attached to each other, a level thereof being of lesser diameter having a periphery formed as a multiplicity of detents, a shaft passing through said sections being connected to said rotor via an aperture, a raised bearing surface in each section upon which said rotor is adapted to slidably rotate, a frame for said rotary switch sections including side links and a front plate, an indexing spring held on said front plate having a pair of opposing fingers for cooperating with said detents of said rotor to positively index the same as desired on rotation of said switch shaft, a contact spring having a severality of interconnected arms configured as a diamond-shaped spring, said spring adapted to move with said rotor, a laminate stator placed adjacent said rotor having discretely spaced contacts and contact ring thereon, terminals formed unitarily therewith, said contact ring on said rotor adapted to move against said contacts and ring on said stator so as to determine the proper circuits to be switched in accordance therewith, and locking means holding said stator for locking the rotor and contact spring of the switch together under proper compression.

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