Aug. 18, 1959 L. E. THOMAS, JR., ET AL 2,900,462

ROTARY SELECTIVE SWITCH

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Fig. 1.

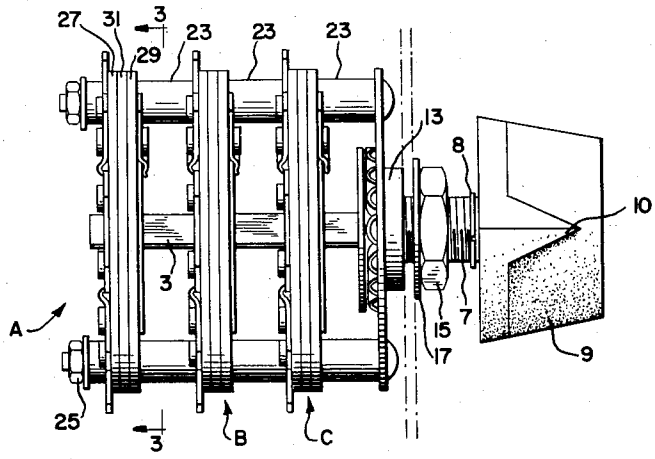


Fig. 2.

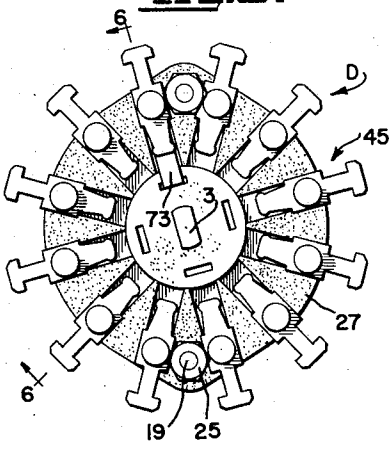


Fig. 3.

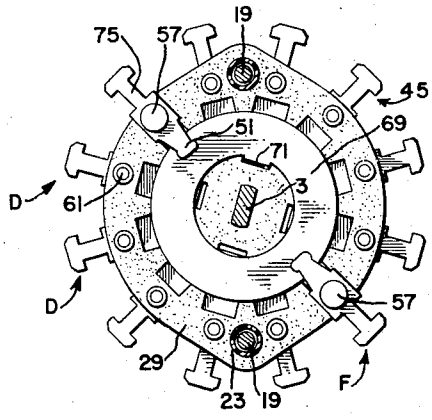
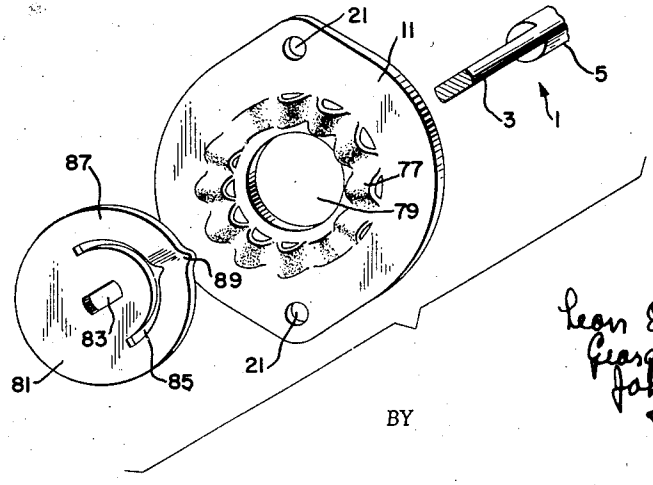


Fig. 4.



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FIG. 5.

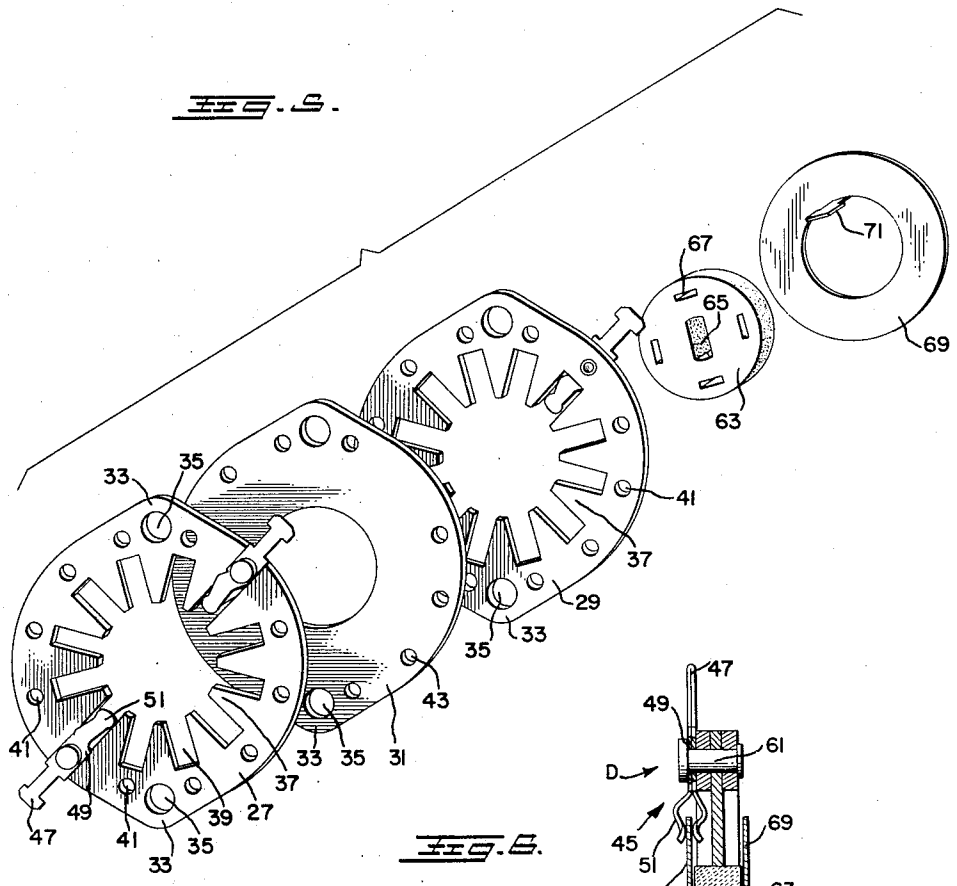


FIG. 6.

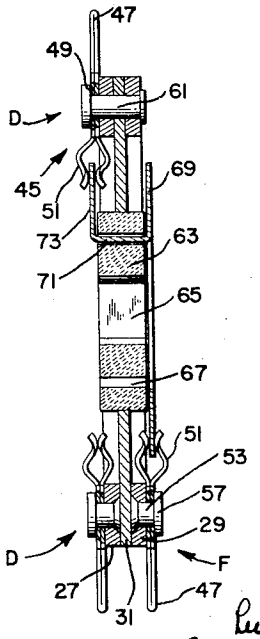
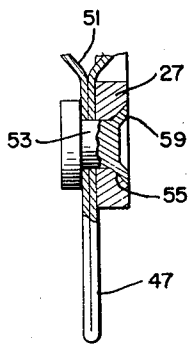


FIG. 7.



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Fig. 8.

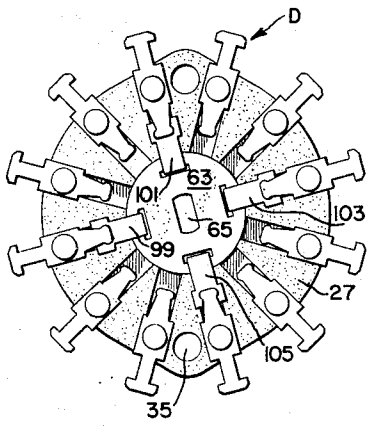


Fig. 9.

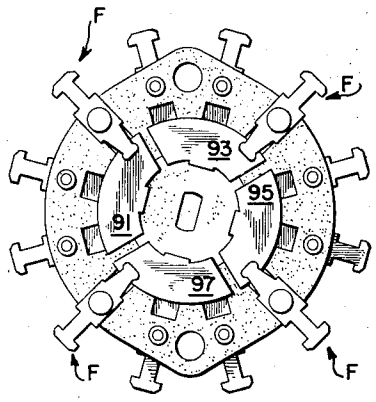


Fig. 10.

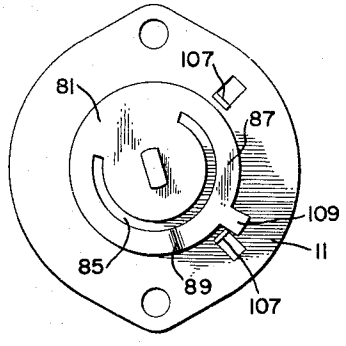
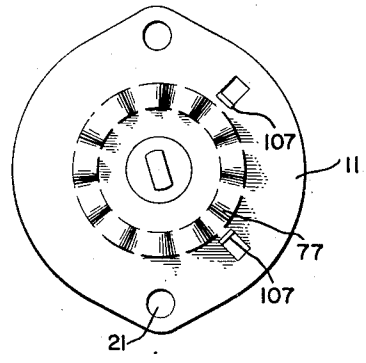


Fig. 11.



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ROTARY SELECTIVE SWITCH

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Application June 27, 1957, Serial No. 668,509

7 Claims. (Cl. 200—11)

This invention relates broadly to the rotary electric switch arts and in its more specific aspects it relates to rotary selective switches of the miniature type, where space saving is important, performance standards high and where it is highly desirable to provide a maximum number of distributor positions on each deck of a unit; and the nature and objects of the invention will be readily recognized and understood by those skilled in the arts to which it relates in the light of the following explanation and detailed description of the accompanying drawings illustrating what we at present believe to be preferred embodiments or mechanical expressions of our invention from among various other forms, arrangements, combinations and constructions, of which the invention is capable within the spirit and scope thereof.

The rotary selective switches in which we are particularly interested generally comprise a one, two or three deck unit wherein it is possible in each deck to switch individual electric currents so as to serve independent electric circuits for performing the desired function in various miniature electrical circuits. While we are aware that rotary selective switches are now known we do not know of any prior art switches of the miniature type which combine essential space saving characteristics with maximum capacity to increase the versatility and usefulness of the device.

Workers in the field of rotary selective switches up to this invention have been unable to evolve a miniature rotary selective switch which meets the requirements and demands of such switches. For instance, the small space which can be allotted to each switch in a miniature device of the character with which we are particularly concerned demands a small switch to which many individual circuits may be connected and distributed to a maximum number of selective circuit positions or contacts. This problem of space and switch capacity has been a serious one which has retarded the full usefulness and potential of switches of this type. We have solved this and other problems by devising a switch endowed with maximum capacity without sacrificing size requirements.

It has therefore been a primary purpose of our invention to provide a rotary selective switch of minimum size to fit in small miniature devices which switch is characterized by its capacity for connecting a larger number of circuits with more distributing contacts than is now possible with switches now known and in use. It will be recognized that an increase in capacity of a switch of this type while maintaining the switch within size requirements will substantially increase usefulness and its area of use.

In achieving our aims it was appreciated that the relative positioning of the feed contacts with respect to the distributor contacts on each deck of a unit constituted an important aspect of the problem of increasing capacity while maintaining or reducing size and meeting strength, weight and other requirements. It was recognized that the capacity could be increased if a feed contact could be fixed to a deck of a switch unit without taking the

place of or causing removal of a distributor contact to thereby reduce the number of circuits controlled by the switch.

In such switches which are now on the market for every feed contact a distributor contact is lost and it was found that the material and structure of the decks on former rotary selective switches made it impossible to provide a practical, strong, and efficient switch of minimum size wherein the maximum number of distributor contacts could be used regardless of the number of feed contacts provided in the switch.

In many rotary selective switches the feed contacts may be fixed to the deck on one side thereof while the distributor contacts are fixed to the deck on the other side thereof. It is present practice to displace such feed and distributor contacts circumferentially of the deck, hence in present switches a feed contact and a distributor contact are not customarily aligned because they cannot be in electrical contact. Prior to our invention no deck had been devised which would practically, efficiently and economically permit the production and assembly of electrically discrete aligned feed and distributor contacts thereon.

It is thus a further object of our invention to provide a deck structure on one side of which is fixedly mounted the maximum number of distributor contacts and on the other side of which is fixedly mounted one or more feed contacts which may be in alignment with one or more of the distributor contacts and electrically separated therefrom and wherein the deck and its contacts may be economically produced and assembled. Our deck and contact units allow maximum capacity, strength, light weight and minimum size to meet the rigid standards required of miniature rotary selective switches which may be used on test equipment, geophysical equipment, miniature electrical and electronic devices and the like.

In overcoming the aforementioned and other inherent objections in prior switches we have devised a laminated deck structure wherein the laminations may be formed of a material having excellent insulating qualities, is strong, easily stamped to shape and other specifications and easily assembled. Each deck is so constructed that it provides an electrically separated base ply or wafer on each side thereof to which the contacts are fixed. Hence with certain of the contacts aligned to achieve aforementioned advantages they are firmly fixed in operative position while being electrically separated.

The aligned contacts are riveted to each outer ply, base or wafer of the deck and are insulated from each other by an intermediate lamina or spacer. The wafers and spacer which form the built up laminated deck structure may be formed of any well known insulation laminates having a cloth, asbestos or glass base and we have found a glass cloth filler with melamine resin bond especially suitable for this purpose.

The recognition that a laminated contact carrying deck was advantageous for use in miniature rotary selective switches and its use for this purpose raised the further problem of the firm and tight attachment of the contacts solely to the outer very thin wafers with the intermediate lamina or spacer being undamaged by the rivets so as to continue its insulating function. This problem was solved by using a very short rivet to attach the contacts to the outer wafers and by providing means on each wafer where aligned contacts were placed to receive the headed end of the rivet for its removal from possible damaging engagement with the intermediate insulating lamina. This ingenious construction not only insures the maintenance of electrical separation of aligned contacts on a deck but maintains the contacts tightly affixed to the wafers under all operating conditions.

Due to the unique organization and arrangement

whereby feed contacts are aligned with certain of the distributor contacts we are not only enabled to obtain maximum capacity but the components of the deck are firmly maintained in abutting unitary condition by the regular or longer rivets which are used to affix the other distributor contacts to the wafer. Thus the operation of attaching the other distributor contacts to one wafer also functions to fasten all of the elements of the deck together. This construction not only adds strength to the deck but also simplifies and expedites the assembly operation.

The decks of rotary selective switches comprise the stator (the wafers and spacers discussed above) and also a rotor which carries a wiper for electrically engaging the distributor contacts, the rotor functioning to transfer current from the feed contacts to any selected distributor contacts. We have found that in the press stamping of the glass cloth filler with the melamine resin bond the periphery of the wafers may not present a smooth surface upon which the rotor bears in its rotative action. This may have an adverse effect on rotors made of many materials. This problem of adverse wear has been solved by using a rotor formed of ceramic material such as steatite which is not adversely affected by the glass strands of the wafers and spacers.

It is conventional practice to provide an indexing means on rotary selective switches and it has been our experience that most indexing means are relatively complex and expensive to produce and difficult to assemble into the unit. We have devised a simple and economical indexing means which is durable and accurate.

It has been our purpose to devise a rotary selective switch having the aforementioned and other valuable and advantageous characteristics and to incorporate into such switch substantial strength factors and features which endow the unit with long lasting qualities under actual use conditions.

The assembly of miniature rotary selective switches poses a substantial problem, however we have evolved a plurality of components which may be economically produced and expeditiously assembled into a finished operative unit. Thus, economy of production and assembly has resulted from the arrangement and organization of our switch making it a practical and highly efficient device.

With the foregoing general objects, features and results in view, as well as certain others which will be apparent from the following explanation, the invention consists in certain novel features in design, construction, mounting and combination of elements, as will be more fully and particularly referred to and specified hereinafter.

Referring to the accompanying drawings:

Fig. 1 is a view in side elevation of a three deck, one pole rotary selective switch.

Fig. 2 is a view in end elevation of the rotary selective switch illustrated in Fig. 1.

Fig. 3 is a view taken on line 3—3 of Fig. 1.

Fig. 4 is an exploded view of the indexing organization used in the switch illustrated in Fig. 1.

Fig. 5 is an exploded view of a deck of the switch illustrated in Fig. 1.

Fig. 6 is a section taken on line 6—6 of Fig. 2.

Fig. 7 is an enlarged fragmentary section illustrating the countersunk area of a wafer with the short rivet headed in the countersink.

Fig. 8 is a view in end elevation of a deck of a four pole unit rotary selective switch.

Fig. 9 is a view in end elevation of the reverse side of the deck illustrated in Fig. 8.

Fig. 10 is a view in end elevation of an indexing mechanism which may be used with a four pole switch.

Fig. 11 is a view in end elevation of the deck mounting plate which also functions as an indexing plate for the indexing organization.

In the accompanying drawings and particularly Fig. 1 thereof we have illustrated a three deck one pole rotary selective switch embodying the structural and operational principles of our invention. While we have illustrated a three deck unit it is to be understood that we may provide switches with one or two decks and the structural arrangement and operation of such switches with a greater or less number of decks than shown will be the same.

We have used the numeral **1** to designate in its entirety the operating shaft of the switch, the shaft including a noncircular portion **3** and a circular portion **5**. A threaded bushing **7** is carried on the circular portion of the shaft and is maintained in place by a C ring **8** which is pressed in a groove formed in the shaft. A shaft operating knob **9** is fixed on the end of the circular portion of the shaft. We provide a deck mounting and indexing plate **11** which may be fixed to the bushing by any suitable means such as a hub **13** which extends through the plate and is staked on the other side to securely fasten the plate and bushing together. A hex nut **15** and lock washer **17** may be provided as part of the mounting means. The switch includes three decks A, B, and C which are mounted in spaced relation on a pair of tie screws which extend through oppositely disposed apertures **21** which are formed in the deck mounting and indexing plate **11**. The decks are maintained in spaced apart relation on the tie screws by means of sleeves **23** and the assembly is held in position on the mounting plate by means of nuts **25** threaded on the ends of the tie screws.

As explained above each of the decks A, B, and C is of the same laminated construction and carries the feed and distributor contacts in the same manner and a rotor element is combined with each deck in the same manner, thus we shall only describe one of such decks in detail.

Each deck of our rotary selective switch comprises a stator organization consisting of a pair of outer wafers **27** and **29** and an intermediate or spacer lamina **31**, all of which are of generally annular shape. Each of the wafers **27**, **29** and the lamina **31** are of the same external configuration and are formed with oppositely disposed projections **33** having enlarged apertures **35** formed therein. The elements **27**, **29** and **31** are preferably formed by a press stamping operation and to reduce moisture absorption and for the necessary strength are preferably made of fine woven glass cloth impregnated with melamine. Other insulation laminates having a cloth, asbestos or glass base may be used and still fall within the spirit and scope of this invention.

The wafers **27** and **29** which carry the feed and distributor contacts are dimensionally the same and the inner and outer peripheries thereof are conformed. The inner periphery of each such wafer is stamped to provide a plurality (twelve) of inwardly extending fingers **37** which are spaced apart to provide twelve spaces **39** and we punch twelve apertures **41** which are circumferentially spaced about each wafer, one aperture being formed radially outwardly with respect to each space **39**. Thus, each wafer is formed with a series of apertures and these apertures are adapted to receive the mounting means for the feed and distributor contacts.

The spacer or intermediate lamina **31** has a smooth interior periphery and is provided with a plurality of circumferentially spaced apertures **43** adjacent to but spaced from the outer periphery of the spacer. It is preferable to not provide apertures **43** at points on the spacer which will be aligned with aligned feed and distributor contacts as will hereinafter be explained.

When the laminations are pressed together by mounting on the tie screws which project through the apertures **35**, it will be apparent that the apertures **41** in wafers **27** and **29** will be in alignment and the apertures **43** in the spacer will also be in alignment with certain of the apertures **41**. The tongues **37** and spaces **39** of wafer **27** will

also be in alignment with the tongues and spaces of wafer **29**.

Each feed and distributor contact designated generally by the numeral **45** comprises a soldering lug portion **47**, an apertured body portion **49** and a pair of wiping jaws **51**. The feed and distributor contacts may be made of silver alloy and the double action of the wiping jaws produces low contact resistance and are self-cleaning to insure long life. As we have stated, twelve distributor contacts **45** are riveted to a laminated deck on one side thereof and for convenience and clarity of description we have designated the distributor contacts by the letter D and from one to four feed contacts **45** are riveted to the other side of the deck and we have used the letter F to designate the feed contacts.

In Figs. 1 through 7 of the drawings we have illustrated a one pole switch having one feed contact F riveted to the wafer **29** by means of a short rivet **53** which extends through an aperture **41** in the wafer **29**. As pointed out above each feed contact, whether it is a one, two, three or four pole switch, is in alignment with a distributor contact on the opposite side of the laminated deck (see Fig. 6) and to keep such aligned feed and distributor contacts electrically separated and firmly and tightly attached solely to and by means of its wafer we have devised an ingenious attachment arrangement. Each wafer **27** and **29** is formed with a countersink **55** on its inner face about each aperture **41** which is to receive a feed contact in alignment with a distributor contact as is clearly illustrated in Fig. 7 of the drawings. The short rivet **53** is inserted through the apertured body **49** of the contact **45** through the aperture **41** and with the head **57** of the rivet tight against the body of the contact the inner end of the rivet is headed or splayed into the countersink as at **59**. Consideration particularly of Figs. 6 and 7 of the drawings clearly indicates that each aligned contact is firmly attached by its short rivet to only one plastic wafer, that the spacer insulating lamina **31** electrically separates the aligned contacts and their rivets and that the countersunk construction not only firmly mounts the rivets and contacts but also disposes the headed parts thereof within the wafer in position where no damage can be done to the spacer and there is no possibility of aligned rivets coming into contact.

It is within our contemplation to form the countersinks **55** in the wafers either when the wafer is cut or as a part of the rivet heading operation.

It will be appreciated that by this construction we have eliminated the need for extraneous or separate hard to mount and expensive insulating blocks to electrically separate aligned contacts. We have provided a simple and easily assembled organization which ensures against aligned contacts coming into electrical contact with each other.

The distributor contacts D which are not in alignment with a feed rivet are attached to the deck by long rivets **61** which extend through all of the lamina forming the built up deck structure as is clearly disclosed in Fig. 6 of the drawings. These long rivets extend through the apertured body **49** of the contacts and through apertures **41** in wafers **27** and **29** and apertures **43** of the spacer **31**. There are 12 distributor contacts on each deck whether the switch is a one, two, three or four pole type to give maximum capacity to the switch. Each feed and distributor contact is mounted so that the soldering lugs project radially beyond or outwardly of the deck while the wiping jaws **51** project radially inwardly and over a space **39**. It will be understood that the laminae of each deck are maintained in tight abutting position by the long rivets **61** which fasten certain of the distributor contacts to the laminated deck.

Each deck A, B, C includes a disc-like rotor **63** of a diameter and thickness to fit in the central openings within the wafers and the spacer which form a built up deck structure. The rotor is formed of a ceramic material such as steatite which is not adversely affected by the glass particles or strands which may be present along the inner peripheries of the laminations of a deck. Each rotor is formed with a non-circular opening **65** therethrough through which portion 3 of shaft **1** extends and is also provided with four circumferentially spaced slots **67** therein.

We provide an annular rotor contact **69** which is fixed to the rotor for rotation therewith by means of a tab **71** bent from the inner periphery thereof and inserted through a slot **67** in the rotor and then bent outwardly to form a rotor wiper **73**. In assembling a deck the rotor is positioned so that the rotor contact **69** is on the same side as the feed contacts F and the rotor contact extends between and in wiping contact with the wiping jaws **51** of the feed contacts while the rotor wiper **73** is in wiping electrical contact with the wiping jaws of a selected distributor contact D.

While the switch illustrated in Figs. 1 through 7 is a one pole switch we have provided an extra contact **75** on the feed side of each deck to help maintain the rotor contact **69** in position. If desired the radially extending soldering lug portion of this contact may be cut off.

We have devised novel indexing means for maintaining the rotor and its parts in any selected switching position. The mounting and indexing plate **11** which, as is now apparent, is a fixed or non-rotatable component of the switch is formed with a circumferential series of spaced dimples or projections **77** which may be pressed up from the plate. The series of projections **77** are formed adjacent the central aperture **79** of the plate. A metallic disc **81** having a non-circular central aperture **83** and an arcuate slot **85** therein is adapted to cooperate with the projections **77** in the following manner. The segment **87** between the arcuate slot and the periphery of the disc is bent or stamped to form a diametric furrow on one side of the segment and a diametric projection **89** on the other side of the disc, the projection **89** being adapted to ride over the projections **77** and into the valleys therebetween in the nature of a cam follower as will be explained. The segment **87** has a degree of flexibility, as will be apparent, and as it rides over the projections **77** it will snap into its normal position between such projections.

With the switch unit assembled in the condition illustrated in Fig. 1 the non-circular portion of the operating shaft will extend through the circular apertures in plate **11**, wafers **27** and **29** and spacer **31**, so that upon rotation of control knob **9** with resultant rotation of shaft **1** the aforementioned elements will not be affected. However since the non-circular portion of the shaft will also extend through the non-circular aperture **83** in disc **81** and the non-circular aperture **65** in each rotor **63**, these elements will be rotated upon actuation of the control knob. The control knob, which may be provided with a pointer **10** for association with a graduated scale (not shown), may be rotated to bring the rotor wiper **73** into electric engagement with a selected distributor contact D to feed current from the feed contact F through rotor contact **69** and rotor wiper **73** to any one of the twelve distributor contacts. During this rotation of each rotor on each deck the projection **89** rides over projections **77** and when the selected distributor contact is reached, the projection **89** will snap into the hollow between projections **77** to maintain the switch in the selected position.

In Figs. 8 through 11 we have illustrated a four pole switch, wherein each rotor on each deck is provided with four poles rather than the one pole switch just described. Since the decks are of the same laminated construction as described, the wafers and spacers and the contacts are also the same, they will be given the same reference characters and not described again. In the four pole construction we provide four rotor contacts in the form of metallic segments **91**, **93**, **95** and **97** each of which is fixed to the rotor **63** by tabs bent therefrom which extend

through slots 67 and are bent outwardly to form four rotor wipers 99, 101, 103 and 105 which extend radially outwardly and are adapted to extend between the wiping jaws 51 of the distributor contacts D. We provide four feed contacts F each of which is aligned with a distributor contact D, the contacts all being mounted in the same way the contacts in Figs. 1 through 7 are mounted.

In this form of our invention stops 107 are struck up from the mounting and indexing plate 11 and the segment 87 of the disc 81 is provided with a radially extending finger 109 which engages a projection to stop rotation of the rotor when the necessary rotation has been accomplished.

As we have stated the switch of this invention may be either a two or a three pole switch in which event two or three rotor contact segments, respectively, would be provided.

It will now be recognized that the rotary selective switch which we have devised provides maximum capacity with minimum size, is of durable construction and may be economically produced and assembled.

We claim:

1. A rotary electric switch comprising a laminated stator having a central aperture, and a plurality of distributor contacts fixed to said stator on one side thereof and at least one feed contact fixed to said stator on the other side thereof in alignment with one of said distributor contacts, each of said aligned contacts being fixed solely to the respective outer lamina of said laminated stator and separate means fixing each of said aligned contacts to its respective lamina, said stator including insulating means insulating said aligned contacts from each other, further means extending through all the laminae of said stator for fixing the remaining distributor contacts to their respective lamina and for maintaining said lamina in abutting stator forming position, and a rotor operatively mounted in said aperture and operable to electrically connect said feed contact with a selected distributor contact.

2. A rotary electric switch comprising a laminated stator having a central aperture and composed of a pair of outer laminae and an intermediate insulating lamina, each of said outer lamina having a plurality of circumferentially spaced apertures formed therein adjacent to the peripheries of the laminae, the apertures in one outer lamina being aligned with the apertures in the other outer lamina and the inner faces of each outer lamina being countersunk about certain of said aligned apertures, a plurality of distributor contacts being fixed to said stator on one side thereof and at least one feed contact being fixed to said stator on the other side thereof in alignment with one of said distributor contacts, independent means extending through said feed contact and one of said certain apertures in the respective outer lamina and pressed into the countersink to fix said feed contact to said respective outer lamina, and further independent means extending through the aligned distributor contact and the aligned certain aperture on its respective outer lamina and pressed into the countersink on its respective outer lamina to fix the aligned distributor contact to its respective outer lamina, and said aligned contacts being insulated from each other by said insulating lamina, and a rotor operatively mounted in said central aperture and operable to electrically connect said feed contact with a selected distributor contact.

3. A rotary electric switch in accordance with claim 2, wherein said independent means and said further independent means comprise rivets having their inner ends headed into said countersinks.

4. A rotary electric switch in accordance with claim 2, wherein said independent means and said further independent means comprise rivets having their inner ends headed into said countersinks and said insulating lamina extends between said headed ends of the rivets and that portion thereof extending between said headed ends is imperforate.

5. A rotary electric switch in accordance with claim 2, wherein each of said distributor contacts which is displaced relative to said feed contact is mounted on one side of the stator at an aperture in the outer lamina and a rivet extends through each distributor contact, the outer laminae and the insulating lamina to maintain said laminae in stator forming position and said distributor contacts in position on the stator.

6. A rotary electric switch comprising a laminated stator having a central aperture, and a plurality of distributor contacts fixed to said stator on one side thereof and at least one feed contact fixed to said stator on the other side thereof, said feed contact and certain of said distributor contacts being fixed solely to the respective outer lamina of said laminated stator and separate means fixing said feed contact and said certain distributor contacts to its respective lamina, said stator including insulating means insulating said feed contacts and said certain distributor contacts from each other, further means extending through all the laminae of said stator for fixing the remaining distributor contacts to their respective lamina and for maintaining said lamina in abutting stator forming position, and a rotor operatively mounted in said aperture and operable to electrically connect said feed contact with a selected distributor contact.

7. A rotary electric switch in accordance with claim 6, wherein said separate means is of reduced length relative to said further means.

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