Nov. 10, 1953 F. KRAHULEC 2,658,963

ROTARY MULTIPLE CONTACT SWITCH

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Fig. 1.

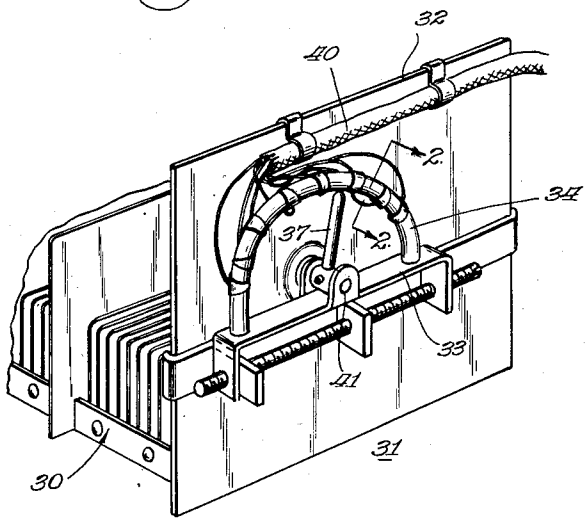
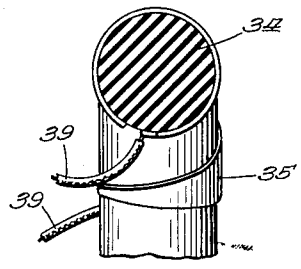


Fig. 2.



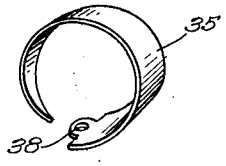
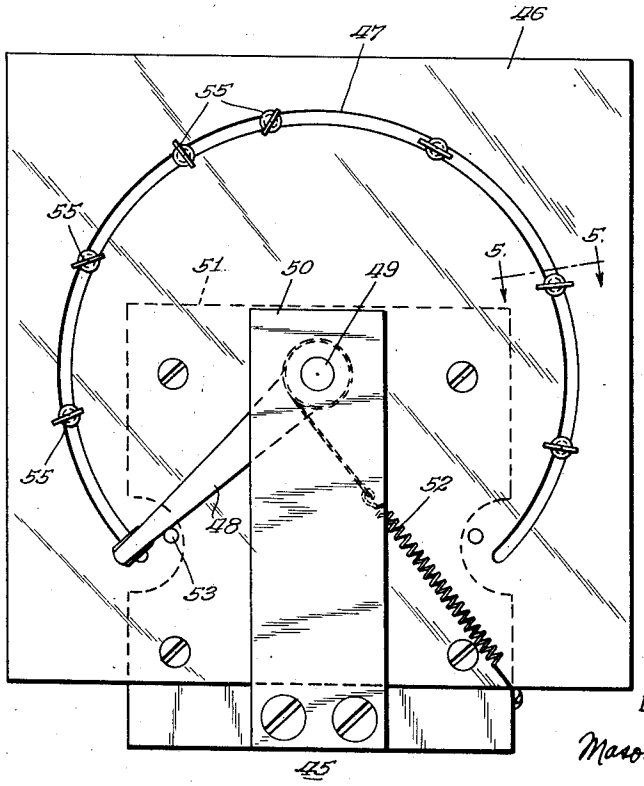


Fig. 3.



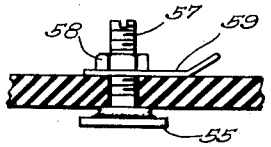


Fig. 5.

Fig. 4.

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Fig. 6.

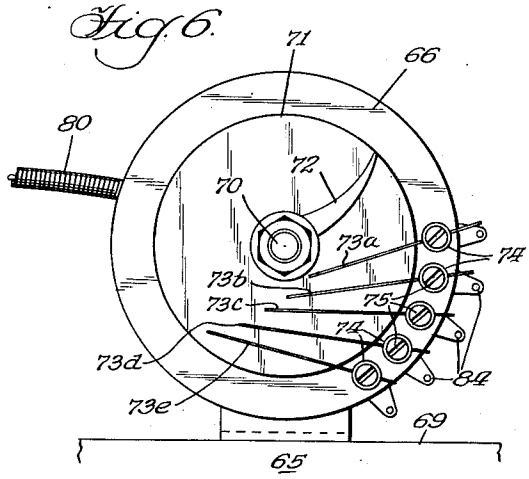


Fig. 7.

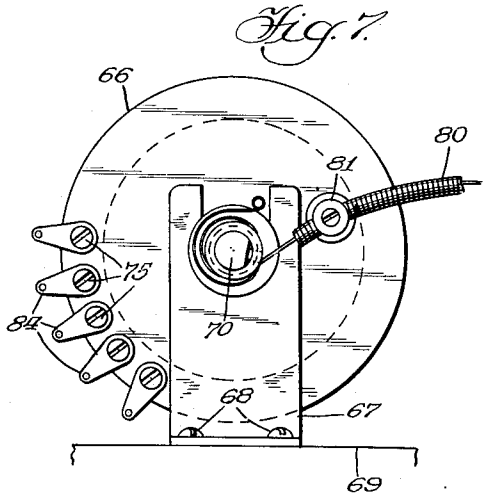


Fig. 8.

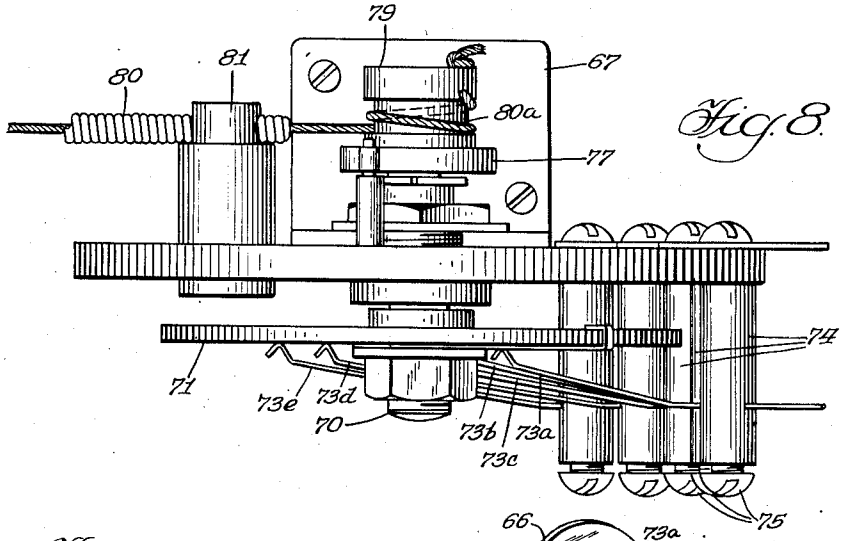
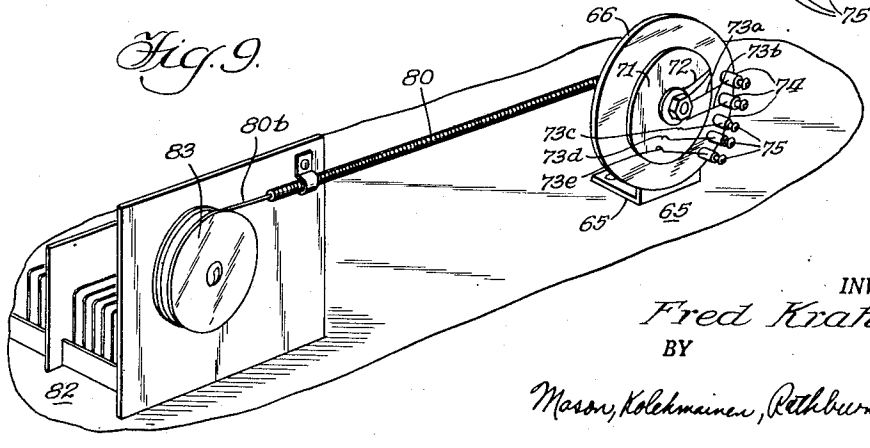


Fig. 9.



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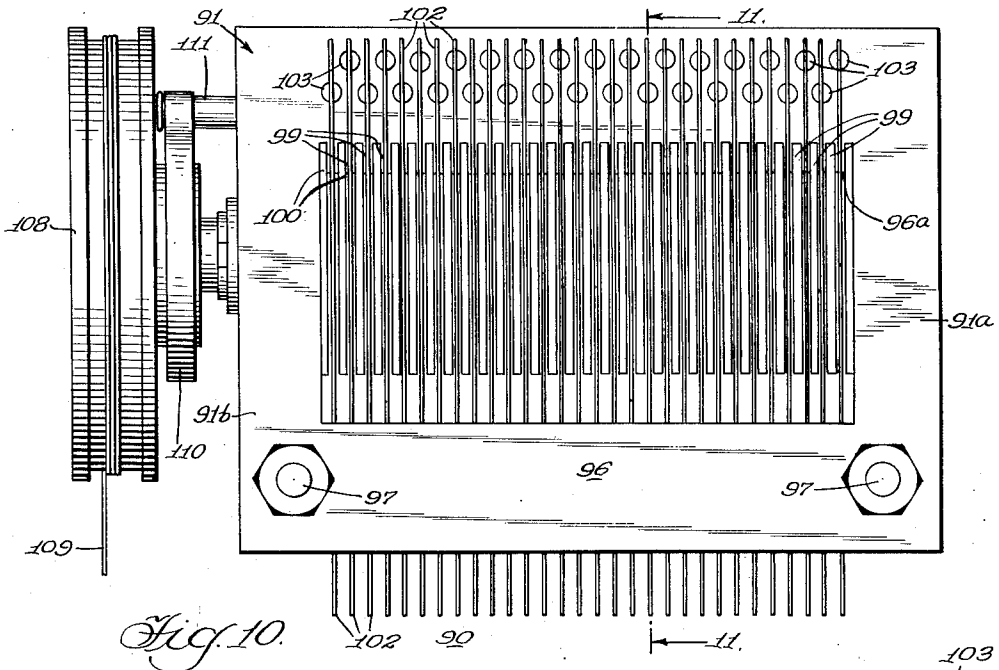


Fig. 10.

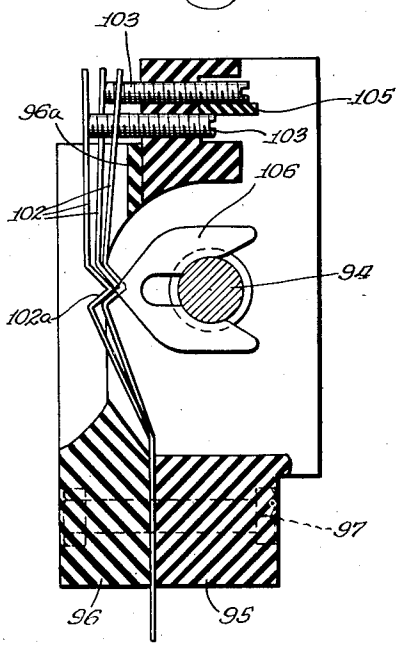


Fig. 11.

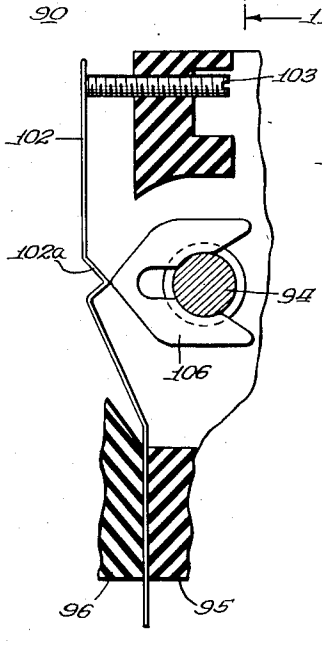


Fig. 12.

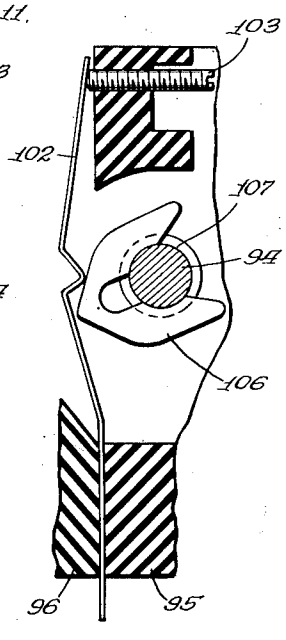


Fig. 13.

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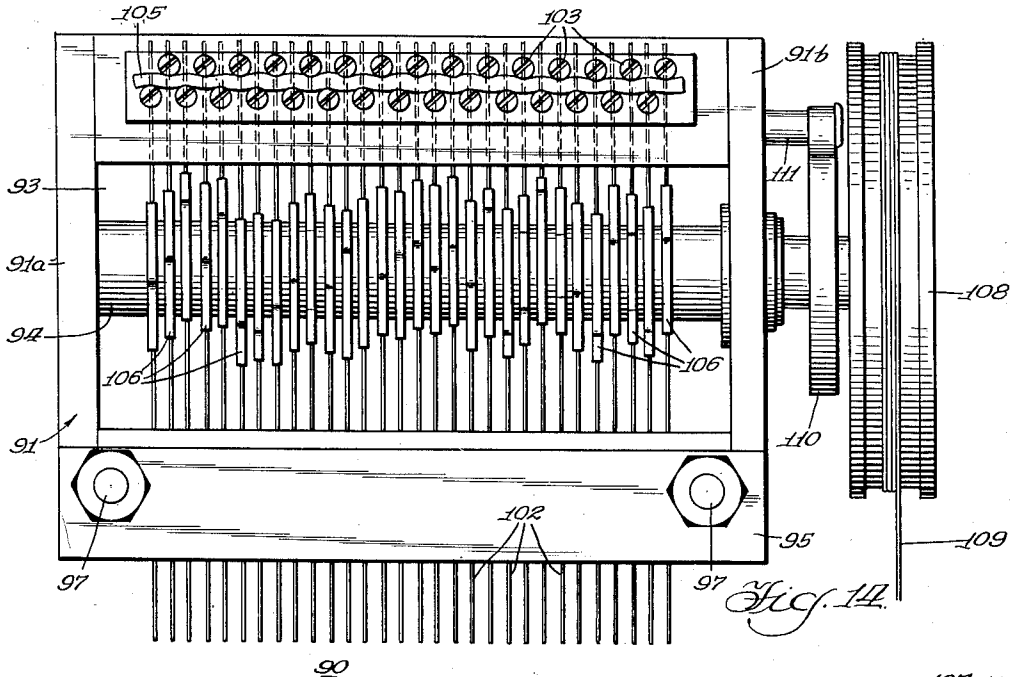


Fig. 14.

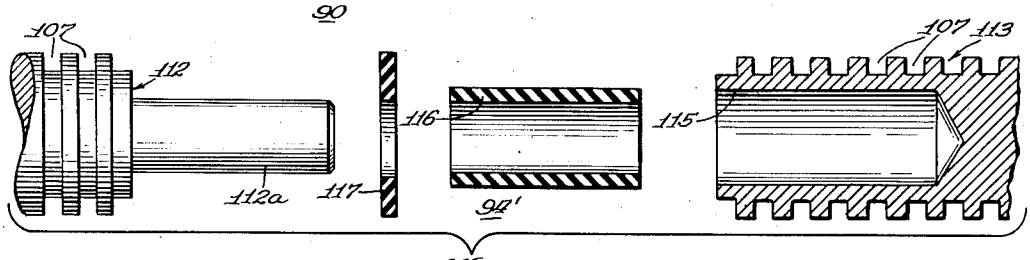


Fig. 15.

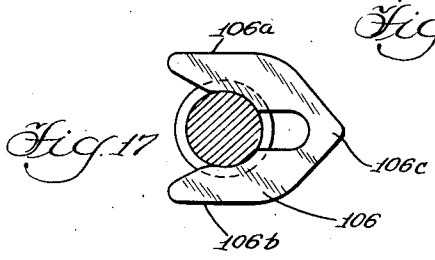


Fig. 17.

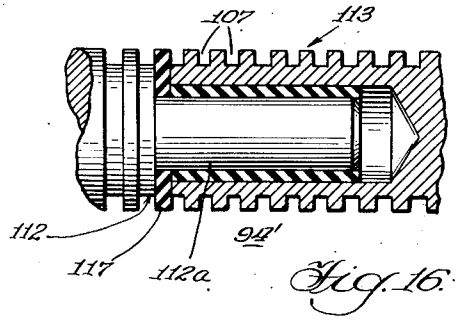


Fig. 16.

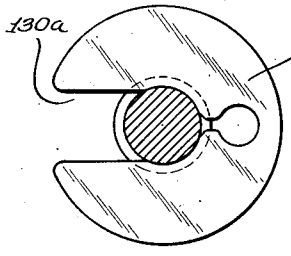


Fig. 21.

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Fig. 18.

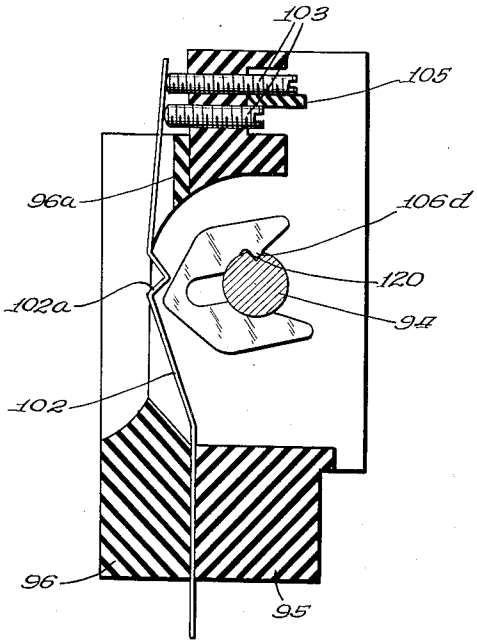
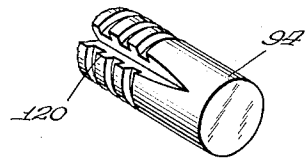


Fig. 19.



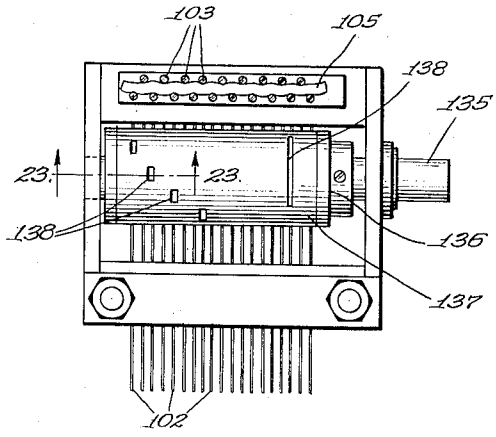
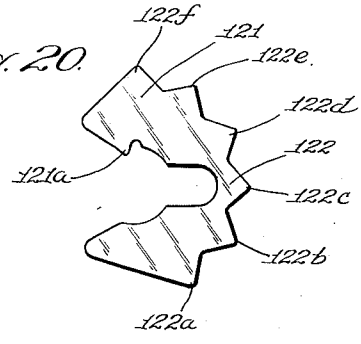


Fig. 23.



Fig. 22.

Fig. 20.



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Patented Nov. 10, 1953

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UNITED STATES PATENT OFFICE

2,658,963

ROTARY MULTIPLE CONTACT SWITCH

Fred Krahulec, Skokie, Ill., assignor to A. C. Nielsen Company, Chicago, Ill., a corporation of Illinois

Application March 1, 1949, Serial No. 78,921

19 Claims. (Cl. 200—8)

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The present invention relates to a rotary multiple contact switch and in some respects is an improvement on the switch disclosed in copending application Serial No. 7,648 of Rahmel, filed February 11, 1948, and assigned to the same assignee as the present application.

Multiple contact rotary switches have many applications. In the arrangement disclosed in the above mentioned copending Rahmel application a multiple contact switch is employed in connection with a device for recording the listening habits of wave signal receiver users, the switch being used to convert variable positions to a plurality of uniformly spaced indications and records thereof on a recording element or tape. By virtue of employing such a switch which in effect serves as a channelizing switch, the traces produced on such a recording element or tape may, for example, be equally spaced transversely of the tape regardless of the actual relative relationship of the different channels with respect to frequency. Where a multiple contact switch is employed in connection with recording devices of the type mentioned, it is essential that the contact positions be adjustable and also that the effective widths of the contacts be adjustable. This is because the various channels to which a wave signal receiver is likely to be tuned are spaced in quite a haphazard manner across the frequency spectrum. Consequently, it is essential that the positions of these contacts may be adjustable so that effectively, as far as the recording element is concerned, the channels are equally spaced. It will, furthermore, be apparent to one who has had any contact with tuning a radio receiver that certain stations may be tuned in over a substantial area on the tuning dial, whereas other stations are tuned in on only a very small increment of the tuning dial. Obviously to record correctly the tuning condition of the receiver, it is essential that such variable positions of the tuning dial for the same channel will effectively control only a single contact of the rotary switch.

Such a rotary multiple contact switch must be associated with the wave signal receiver in such a manner that tuning of the receiver causes movement of the switch. It is important therefore, that such a rotary switch have a very low torque so as not to interfere with the tuning action to any substantial extent, since the user of the receiver should generally be unaware of any different receiver operation caused by attachments to the receiver.

In certain cases it is desirable to convert the

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tuning position of such a wave signal receiver to some form of code which can readily be recorded on a movable recording element. The rotary multiple contact switch of the present invention may readily be employed for this purpose when combined with a position switch as mentioned above and as will become apparent from the following description.

Accordingly, it is an object of the present invention to provide a new and improved rotary multiple contact switch.

It is another object of the present invention to provide a rotary multiple contact switch in which the contacts may be selectively positioned in various ways with respect to each other and in which by limited movement of the contacts the effective width thereof may be controlled.

A further object of the present invention is to provide a new and improved multiple contact switch having very low torque requirements.

A still further object of the present invention is to provide a rotary multiple contact switch of sturdy, foolproof construction, in which wiping action of the switch contacts occurs to insure good electrical engagement between adjacent conducting parts.

It is a further object of the present invention to provide a rotary multiple contact switch of relatively few and simple parts, in which the contact sequence is such that when properly associated with a suitable circuit, operation thereof will result in the production of pulses to form a code or the like.

Further objects and advantages of the present invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the present invention, reference may be had to the accompanying drawings, in which:

Fig. 1 is a perspective view of one embodiment of a multiple contact rotary switch associated with the resonant frequency varying device of a wave signal receiver;

Fig. 2 is an enlarged sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a perspective view of one of the contacts of the rotary multiple contact switch of Fig. 1;

Fig. 4 is an elevational view of a rotary multiple contact switch illustrating a modification of the present invention;

Fig. 5 is a sectional view taken on line 5—5 of Fig. 4;

Fig. 6 is an elevational view of a rotary multiple contact switch illustrating still another embodiment of the present invention;

Fig. 7 is an elevational view of the switch of Fig. 6 viewed from the opposite side to that shown in Fig. 6;

Fig. 8 is a top view of the multiple contact switch shown in Fig. 6 of the drawings;

Fig. 9 is a perspective view showing the multiple contact switch of Fig. 6 associated with the tuning apparatus of a wave signal receiver;

Fig. 10 is a top view of a rotary multiple contact switch embodying still another modification of the present invention and comprising what at present is considered to be the preferred embodiment of the present invention;

Fig. 11 is a sectional view taken on line 11—11 of Fig. 10;

Fig. 12 is a sectional view illustrating the associated contacts of one circuit controlling element of the multiple contact switch when adjusted for substantially minimum contact width;

Fig. 13 is a view similar to Fig. 12 with the switch adjusted for substantially maximum contact width;

Fig. 14 is a bottom view of the switch of Fig. 10;

Fig. 15 is an exploded view of a portion of a rotary shaft which may be employed in the switch of Fig. 10 to illustrate a detail of the present invention;

Fig. 16 illustrates an enlarged assembled view of the portion of the rotary shaft shown in exploded form in Fig. 15;

Fig. 17 illustrates one form of cam which may be employed in connection with the rotary switch of Fig. 10;

Fig. 18 is a view somewhat similar to Fig. 11 showing a modified arrangement of the cam supporting means when the rotary switch is employed as a coding switch;

Fig. 19 is a partial perspective view of the cam supporting means shown in Fig. 20;

Figs. 20 and 21 are two forms of cams which may be employed with the rotary multiple contact switch of Fig. 18;

Fig. 22 is a bottom view of a multiple contact rotary switch illustrating still another embodiment of the present invention; and

Fig. 23 is an enlarged sectional view taken on line 23—23 of Fig. 22.

Although the rotary switch of the present invention has many different applications, it is especially adapted for use with devices and apparatus for recording the listening and/or viewing habits of wave signal receiver users where instrumented methods for obtaining this information are employed. By instrumented method is meant a method whereby information with respect to the listening habits of wave signal receiver users is obtained by instruments or devices associated with the various wave signal receivers of a representative group of the public so as continuously to record with respect to time the tuning condition of such receivers, thereby providing the basic information from which an analysis can be made. In connection with such analysis, it will be understood that the listening habits of users of wave signal receivers of a representative group will be recorded and the selection of the particular homes of such representative group will be made on the basis that all the various factors affecting any process of sampling public opinion such as the number of potential

listeners, religion, economic affluence, etc. are accounted for on a weighted basis.

In any particular locality it has been found that wave signal receivers are tuned to the various stations of a particular group of stations almost exclusively. By that is meant that in any particular area, perhaps four to eight stations are regularly listened to and although the receiver may be capable of receiving many other stations, it is rarely tuned to such other stations for reasons such as poor reception, duplication of program, or the like. Consequently, if the tuning position of a wave signal receiver across the frequency spectrum for a predetermined number of channels usually tuned in by the receiver would be used to control a predetermined number of contacts of a multiple contact switch, it is apparent that the operation of such switch in response to the tuning of the receiver may be used to produce a control function such as recording the tuning condition of the receiver directly on a recording element or for producing a code which may readily be recorded, or performing any similar function.

Referring now to Figs. 1 to 3 of the drawings, there is illustrated somewhat schematically the resonant frequency varying means, generally designated at 30, of a conventional wave signal receiver. This resonant frequency varying means has been specifically illustrated as a variable capacitor, although it might equally well comprise some other suitable device. Associated with the resonant frequency varying means 30 is a multiple contact rotary switch 31 forming one embodiment of the present invention. As illustrated, the rotary switch 31 comprises an insulating support 32 which is suitably mounted adjacent the resonant frequency varying means 30 of a wave signal receiver. Mounted on the insulating support 32 is an adjustable element generally designated at 33, for supporting a stationary contact support 34 in the form of a portion of a torroid, preferably formed of insulating material. A complete torroid could be employed but since with conventional wave signal receivers only about 180 degrees of a tuning dial are employed, a portion of a torroid is sufficient.

Mounted at spaced points along the torroid portion 34 are a plurality of stationary contacts 35, which contacts, although termed stationary contacts, are capable of having limited relative movement. These contacts 35, best shown in Figs. 2 and 3, each comprise a triangular shaped member having substantially zero width at one end thereof and an appreciable width at the other end thereof and are adapted to be bent around the torroid portion 34 so as to form a plurality of spaced contacts, the spacing of which may be adjusted in any predetermined manner. These contacts 35 are adapted to be electrically engaged in a sequential manner by a movable switch arm 37 pivotally mounted about the geometrical center of the torroid having the portion 34. The switch arm 37 in moving through an angle of 180 degrees or thereabouts, successively engages the contacts 35. These contacts 35 will be positioned in various ways along the torroid portion 34 in dependence upon the particular channels to which the associated wave signal receiver is likely to be tuned, thereby providing adjustably positioned contacts.

In order to provide variable contact widths, the contacts 35 may be rotated about the cross section of the torroid portion 34 so as to expose

the desired width thereof to the movable switch arm 37. Each of the contacts 35 is provided with a portion 38 which is connected to a suitable conductor 39 forming a part of a cable 40 which may extend to any desired control circuit, not shown.

It will be understood that the movable switch arm 37 is connected by suitable means with the resonant frequency varying device of a receiver. For example, the supporting shaft 41, of the movable switch arm 37 might be connected directly to the tuning shaft of the resonant frequency varying means 30, whereupon the movable switch arm 37 is directly moved with rotation of the tuning shaft. When the tuning shaft is in a predetermined position denoting a particular channel to which the receiver is tuned, a particular one of the contacts 35 is engaged by the switch arm 37 and a suitable control circuit may be rendered effective to perform any desired control function for recording the tuning condition of the receiver. The details of one such control arrangement are fully disclosed in the copending Rahmel application referred to above.

In view of the detailed description included above, particularly with reference to Figs. 1 to 3 of the drawings the operation of the rotary switch described above will be apparent to those skilled in the art and no further discussion thereof is included herein. It will be obvious that there has been provided a variable position, variable width contact, multiple contact switch.

Referring to Figs. 4 and 5 of the drawings, there is disclosed another embodiment of the present invention in the form of a rotary switch generally designated at 45. This rotary switch also comprises an insulating support designated as 46, which has an arcuate groove 47 defined therein. A rotatable switch arm 48 is mounted for rotation upon a shaft 49 journaled in suitable supports, such as 50 and 51, which may form an integral assembly with the insulating support 46. As illustrated, the movable switch arm 48 is biased by means of a tension spring 52 against a stop 53, thereby insuring return of said arm 48 to its initial position shown in Fig. 4 when any force tending to rotate the shaft 49 against the bias of the spring 52 is removed. Such an arrangement lends itself very well for use with a force transmitting device capable of transmitting a force in only one direction, a well known example of which is the Bowden wire.

In accordance with the present invention, there are supported within the arcuate groove 47 a plurality of contacts 55 having an elongated contact surface adapted to be engaged by the movable switch arm 48. If the elongated contact surface is positioned substantially tangetially to the groove 47, it is apparent that the switch arm 48 contacts the maximum effective area thereof or, in other words, a maximum effective contact width is provided. On the other hand, if the elongated contact portion is substantially perpendicular to a tangent to the groove 47, a very narrow effective contact is provided. This will be obvious from an examination of Figs. 4 and 5 of the drawings. Preferably, as is best shown in Fig. 5, each contact is in effect the head of a screw 57 which is clamped by means of a nut 58 into a predetermined position along the groove 47 and also with a predetermined orientation to provide the desired effective contact width. A suitable electrical terminal 59 to which electrical connections can readily be made, is also clamped into position by the screw 57 and the nut 58.

It will be understood that the shaft 49 may be connected in a suitable manner, such as by a Bowden wire, with the tuning shaft of a wave signal receiver, with the result that the various channels to which the wave signal receiver is tuned will selectively cause predetermined corresponding contacts to be engaged by the movable switch arm 48.

Referring now to Figs. 6 to 9, inclusive, of the drawings, there is illustrated still another modification of the present invention in the form of a multiple contact rotary switch generally designated by the reference numeral 65. This switch, like the preceding embodiments, also comprises a stationary insulating support 66, which may be mounted in any suitable manner adjacent a wave signal receiver by means of a suitable angle plate 67 fastened by fastening means 68 to a support generally designated at 69. The insulating support 66 and the angle member 67 support for relative rotation with respect thereto a suitable rotatable shaft 70 to which is fixed a rotatable disc 71 having mounted thereon a suitable movable switch arm 72 having a substantial width near the axis of rotation of the disc 71 and a gradually decreasing width as the periphery of the disc 71 is approached. It will be apparent from the description thus far that the switch 65 differs from the switches 31 and 45 in that the rotatable contact member, such as 72, is provided with variable widths as contrasted with the relatively stationary contacts in the switches 31 and 45, which are provided with variable widths.

In accordance with the present invention, a plurality of relatively stationary contacts designated as 73*a*, 73*b*, 73*c*, 73*d*, and 73*e* are provided, which are preferably in the form of resilient wire-like contacts adjustably supported from suitable supporting means 74 mounted on the stationary insulating support 66. The supporting means 74 are rotationally adjustable so that the angular position of the particular contact arm 73 may be adjusted in any desired manner. Moreover, the contact arms 73 extend through suitable openings in the members 74 and are clamped thereto by suitable clamping means such, for example, as the screws 75. By changing the length of the contact portion 73 extending out of the support 74, the effective position of the contacts may be controlled in any desired manner and by changing the angular relationship of the wire-like contacts 73 any desirable width of the rotatable switch arm 72 may be rendered effective to produce the desired effective variable width contact.

For the purpose of causing rotation of the disc 71 and consequently the movable contact arm 72 in response to a force applied thereto in only one direction, there is provided a torsion spring 77 which tends to bias the rotatable disc 71 to the position shown in Fig. 8 of the drawings. The rotatable shaft 70 is provided with a pulley-like member 79 about which the movable portion of one end of a Bowden wire 80 may be wrapped, as indicated at 80*a*, the Bowden wire being suitably supported from the stationary insulating support 76 by means of the member 81.

In Fig. 9 of the drawings there is illustrated the interconnection between the switch 65 and the wave signal receiver, only the resonant frequency varying means 82 of which is shown. The end 80*b* of the movable portion of the Bowden wire 80 remote from the switch 65 is illustrated as being wrapped around a suitable drum 83 which is rotatable with the tuning shaft of the associated wave signal receiver. Rotation of the tun-

ing shaft will apply a tensile force to the movable portion of the Bowden wire **80** with the result that the disc **71** is rotated against the torsional force of the spring **77**, and the stationary contacts **73** are selectively rendered effective as they are engaged by the movable switch arm **72**.

Although only five stationary contacts **73** are illustrated, it will be apparent that a great many more might be included if additional contacts are necessary or desirable. The members **74** are connected to suitable connectors **84** to which electrical connections can readily be made.

In view of the detailed description set forth with respect to the switch **65** disclosed in Figs. 6 to 9, inclusive, of the drawings, the operation thereof will be readily understood by those skilled in the art and no further discussion is included herein.

What is at present considered to be the preferred embodiment of the present invention in so far as a position switch is concerned is disclosed in Figs. 10 to 17 of the drawings. This multiple contact rotary switch generally designated at **90** comprises an insulating support **91** of generally rectangular configuration having defined therein a chamber **93** for receiving a rotatable or movable shaft member **94**. As illustrated, the shaft **94** is journaled in side walls **91***a* and **91***b* forming a part of the insulating support **91**. The insulating support **91**, as is clearly shown in Fig. 11 of the drawings, effectively comprises two molded parts **95** and **96** which in the final assembly are bolted or otherwise secured together. In the illustrated embodiment, suitable bolts **97** are provided for this purpose and preferably the heads and nuts of the bolts are disposed in recesses so as not to protrude beyond the edges of the insulating support **91**.

The portion **96** of the insulating support is provided with a plurality of parallel slots **99** defined between narrow members **100** which are in many respects quite similar to the teeth of a comb, except that the free ends of the teeth are interconnected by a member **96***a* to give rigidity thereto. Disposed within the various slots **99** defined by the teeth **100** are a plurality of relatively stationary wire-like contact fingers, generally designated by the reference numeral **102**. These contact fingers are mounted in cantilever fashion with the corresponding ends thereof clamped between the members **95** and **96** defining the insulating support **91**, as is best shown in Fig. 11 of the drawings.

If desired, one of the members **95** or **96** may be provided with serrations spaced in the same manner as the slots **99** to hold the wire-like contact fingers **102** in proper spaced relationship. However, it has been found that the ends of the members can be suitably clamped between the members **95** and **96** without the use of the serrations.

For the purpose of determining the normal position of the wire-like contacts **102** within the slots **100**, the free ends of the wires **102** are each adapted to engage with an adjustable stop member **103**. These adjustable stop members are preferably threaded in tapped openings defined in the member **95**, as is clearly shown in Fig. 11 of the drawings, and the inherent resilience of the wire contact members causes them to be biased against their respective stop members **103**. The stop members are illustrated as being staggered in two rows and to prevent their coming loose, once the adjustment has been completed, a suitable resilient member **105** formed of rubber or the like is forced between the two rows of stop members **103**, as is clearly shown in Fig. 14 of the drawings. This member **105** remains wedged between the two rows of stop members **103** at all times.

As is illustrated in Figs. 11, 12 and 13 of the drawings, each of the wire-like contact members is provided with a V-shaped contacting portion designated as **102***a*, the purpose of which will become apparent from the following description.

In order electrically to engage in a selective manner the relatively stationary contacts **102**, there are mounted on the rotatable shaft **94** a plurality of spaced contacts generally designated at **106**, which have a cam-shaped configuration and cooperate with the contacts **102** in a manner to be described hereinafter so as to produce a variable width contact, as desired. Preferably the rotatable shaft **94** is provided with a plurality of spaced annular grooves **107** for receiving therein the contacts **106**. The contacts **106** preferably have two flat sides **106***a* and **106***b* engageable by a suitable wrench so that the contact which preferably frictionally engages the portion of the shaft **94** within the grooves **107** may be rotated to any desired predetermined position relative to the shaft **94**. Also, as illustrated, the contacts **106** have a triangularly shaped portion **106***c*, which is adapted to engage with the wire contacts **102**, as clearly shown in Figs. 11, 12 and 13. It will be apparent from an examination of these figures that the contacts **106** in effect comprise a pair of legs which are biased into intimate frictional engagement with the base of the grooves **107**, to maintain the contacts **106** in any predetermined position to which they are set.

With the construction described thus far, it will be understood that the multiple contact rotary switch is inherently provided with variable width contacts which will be obvious upon examining Figs. 12 and 13 of the drawings. When the stop member **103** of any particular contact **102** is caused to protrude a maximum extent above the housing **91**, the portion **102***a* of the wire-like contact **102** can be moved to a position such that it never engages with the associated rotatable contact **106**. In Fig. 12 of the drawings the stop **103** is positioned so that the contact **106** just touches the stationary wire-like contact **102**, when the high point of the contact **106** which effectively is a cam surface is moved directly opposite the V-shaped portion **102***a*. With this positioning it is apparent that a contact having a very narrow effective width is provided. When the stop **103** is adjusted so as to protrude to a much less extent from the insulating support **91** a much greater surface of the contact **106** is effectively engageable by the wire-like contact **102** in response to the rotation of the shaft **94**, and as is best shown in Fig. 13, engagement of the contacts **102** and **106** occurs over a substantial rotation of the shaft **107**. By appropriately adjusting the stops **103** between the positions shown in Fig. 12 and Fig. 13, any variation in contact widths between these limits may be obtained.

It will be understood that the shaft **94** may be rotatable through an entire 360° or as illustrated in Figs. 10 and 14 the rotary shaft **94** may be rotatable through an angle less than 360°. As illustrated the shaft **94** is adapted to be rotated by means of a Bowden wire device or the like and to this end a suitable drum **108** is attached to one end of the shaft **94**. A cord **109** which may

form a portion of the Bowden wire arrangement is adapted to be wrapped around the drum 108. A suitable torsion spring 110 having one end fastened to a support 111 associated with the housing 91 may be provided to return the shaft 94 to an initial position whenever no rotational force is applied to the shaft 94 by the cord 109 and the drum 108. If desired a double Bowden wire arrangement may be employed whereby the spring 110 may be dispensed with. Also the drum 108, instead of being directly connected to the shaft 94, may be drivingly connected through a suitable gear arrangement.

It will be understood that any reasonable number of contacts may be provided for a multiple switch of the type shown in Fig. 10, the additional contacts merely increasing the length of the switch. Occasionally it becomes desirable to provide a multiple contact multiple phase switch. This can readily be accomplished with the switch 90 merely by electrically insulating certain contacts from certain other contacts. With the arrangement described thus far the contacts 102 are of course electrically insulated from each other by the insulating support means 91 and the interposed separators 100. However, if the shaft 94 comprises a conducting member, all of the contacts 106 are electrically interconnected. To provide a multiple phase switch the shaft 94 may comprise two or more electrically insulated portions. Such an arrangement of the shaft is shown in Figs. 15 and 16. As illustrated in these figures the shaft generally designated as 94' comprises a portion 112 which terminates in an extension 112*a* of reduced cross action. The other portion 113 of the shaft 94' is provided with a longitudinal recess 115, adapted to receive an insulating sleeve 116 which insulating sleeve has an internal diameter substantially of the same order as the diameter of the extension 112*a* of the shaft portion 112. A suitable insulating washer 117 is adapted to be disposed between the shaft portions 112 and 113, and the shaft portions are adapted to be united into an integral structure as shown in Fig. 16 of the drawings by means of a press fit which is readily possible by virtue of the compressibility of the insulating sleeve 116. A sufficiently strong shaft 94' with regard to torsional force applied thereto is readily obtainable in view of the relatively small torque involved. It will be apparent that any contacts 106 associated with the shaft portion 112 will be completely insulated from any contacts 106 associated with the grooves 107 in the shaft portion 113.

In view of the detailed description included above the operation of the variable position, variable width, multiple contact switch shown in Figs. 10 to 17, inclusive, will readily be understood by those skilled in the art and no further discussion thereof is included herewith.

It has been found that the multiple contact switch shown in Figs. 10 to 17, inclusive, is very satisfactory in applications where it is desired to produce a series of electrical pulses with the switch employed as a sort of commutator. In such a case, of course, the shaft 94 is continually rotatable as, for example, by being directly coupled to a driving motor or the like. One such application is disclosed and claimed in copending Krahulec et al. application Serial No. 147,304, filed March 2, 1950, and assigned to the same assignee as the present application. Where it is desired, for example, to produce a series of equally spaced or timed pulses in a number of individual circuits, the same cams or contacts 106 described above may be employed with the shaft 94 except that the contacting portions 106*c* of the cams 106 are angularly displaced by equal increments around the shaft 94. This can readily be accomplished, for example, by providing the shaft with a helical groove, a small portion of which is indicated at 120 in Figs. 18 and 19 of the drawings, and the contacts 106 are correspondingly provided with a small extension 106*d* adapted to engage with the groove 120. In this case, of course, the stops 103 would all be in the same position as shown in Fig. 18 since it would be undesirable to have effectively variable width contacts. If desired the adjustable stops may be omitted and the insulatory portion 96*a* may be of such a height as to properly and uniformly position the contacts 102. The small projections 106*d* engaging with the helical groove 120 accurately position the successive cams with respect to the shaft and the distribution of the contact surfaces relative to the shaft 94 will be a function of the shape of the keyway or groove 120.

The same effective action can be obtained by employing the cam shaft 94 with a keyway or groove parallel with the longitudinal axes of the shaft, and providing special contacts 121 such as is shown in Fig. 20 of the drawings. These contacts or cams 121 would all be spaced in the same manner on the shaft 94 with the projections 121*a* engageable with a longitudinal groove or keyway in the shaft similar to the helical groove 120. To produce the desired coding impulses successive cams would have different ones of the lobes 122 removed so as to give the desired contact effect. As illustrated the contacts 121 are provided with six lobes which are designated as 122*a*, 122*b*, 122*c*, 122*d*, 122*e*, and 122*f*. In the following chart the code numbers from 1 to 15 may be identified in a binary code by retaining the lobes 122 as set forth in the following chart. Actually in this chart four lobes, i. e., 122*b*, 122*c*, 122*d* and 122*e* are used for coding numbers from 1 to 15. The lobes 122*a* and 122*f* are used to provide other controls. It will be understood that if all six lobes are employed for coding that a much larger number of code numbers are available.

Code No.	Lobes Required
1	122*b*.
2	122*c*.
3	122*b* and 122*c*.
4	122*d*.
5	122*b* and 122*d*.
6	122*c* and 122*d*.
7	122*b*, 122*c* and 122*d*.
8	122*e*.
9	122*b* and 122*e*.
10	122*c* and 122*e*.
11	122*b*, 122*c* and 122*e*.
12	122*d* and 122*e*.
13	122*b*, 122*d* and 122*e*.
14	122*c*, 122*d* and 122*e*.
15	122*b*, 122*c*, 122*d* and 122*e*.

When the rotary multiple contact switch as described in Figs. 18 to 20 is used as a coding switch in an arrangement such as is disclosed in the above mentioned copending Rahmel application, the coding switch would be combined with a selection or position switch in the form disclosed in Fig. 10 so that the combination of the two switches results in the setting up of an electrical circuit which is periodically made and interrupted in a manner to produce a code which is a function of the angular position of the position

switch shaft. The shaft of the coding switch as was mentioned above would be driven continuously in some fashion such as one revolution per minute or the like.

It will be understood that the coding switch may, for example, be provided with special cams differing from the cams **120** to produce certain special functions. One such cam **130** as illustrated in Fig. 21 of the drawings may be employed to synchronize two motor driven synchronous switches remotely located from each other as disclosed in copending Bateman et al. application Serial No. 74,074, filed February 2, 1949, and assigned to the same assignee as the present application. The cam **130** comprises an open space **130***a* therein which functions as a synchronizing cam in the manner fully disclosed in the above mentioned copending Bateman application.

In Figs. 22 and 23 there is disclosed a modification of the coding switch of Figs. 18 and 20 in which the rotatable coding cams such as **121** are dispensed with and instead a rotatable shaft **135** is provided which has mounted thereon a suitable conducting drum **136**, The conducting drum **136** may have portions thereof insulated from each other as in the manner of the shaft **94'** described above. The drum **136** is adapted to be covered by an insulating layer **137** having suitable openings such as **138** angularly disposed with respect to each other as well as axially displaced so as to expose predetermined portions of the conducting cylinder **136**. The V-shaped portions **102***a* of the wire-like contacts **102** are adapted to engage the conducting cylinder **136** through such openings in response to a predetermined angular position of the shaft **135**. This modification of the coding switch is somewhat analagous to the arrangement disclosed in copending Black application Serial No. 45,188, filed August 19, 1948, and assigned to the same assignee as the present application. It will be understood that the insulating overlay **137** may be constructed in various ways. For example, a suitable coating may be applied to the cylinder **137** and appropriate portions thereof cut away. Another means of producing such an arrangement may be accomplished by die casting a drum of conducting material from which contact segments protrude at various points and using this die casting as the core or insert in a plastic molding process so that the space between the contact segments is filled with a plastic material. The molded cylinder can then be machined to expose the contact segments. Another means of producing such an arrangement might be to use an insulating drum such as **136** and apply by means of a printed circuit technique the desired contacts and electrical interconnections. Still another method of accomplishing this arrangement is to apply a mask or decalcomania to a cylinder and electroplate the desired contact portions through the mask so that they protrude from the surfaces of the cylinder. The mask may then be removed and replaced by a suitable plastic compound which provides a hard wearing surface so as not to be damaged by continuous engagement of the wire-like contacts **102**. It has been found that for many applications the mask may be dispensed with entirely if the contact surface portions of the conducting drum **136**, such as the portions visible through the openings **138**, are raised sufficiently above the surrounding surface of the drum. A very satisfactory arrangement has been employed in which the conducting drum **136** has its surface cut away by an engraving process leaving accurately located raised portions which comprise the contact areas engageable at predetermined times during a revolution of the shaft **135** by the wire-like contacts **102**, the contacts **102** being prevented from touching the drum surface between the raised contact areas.

From the above description it will be apparent that there have been provided various embodiments of a position switch wherein a multiple rotary switch giving effective angular contact position and variable width contacts is provided. Also with very little change such a multiple contact switch may be converted to a rotary switch which when used in conjunction with a position switch of similar construction can be employed to convert angular shaft position to a binary code of some sort.

While there have been disclosed and described various embodiments of the present invention it will be obvious to those skilled in the art that numerous changes and modifications may be made without departing from the spirit and scope of the present invention in its broader aspects and it is aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the present invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In a rotary multiple contact switch, an insulating support, a plurality of relatively stationary resilient wire-like wiper contacts mounted in spaced relationship on said support, rotatable conducting means for selectively engaging different ones of said contacts, and a plurality of contact width adjusting means mounted on said support, one for each of said contacts for selectively adjusting solely by limited movement of said contacts relative to said support the effective width of contactive engagement of each of said contacts with said movable means.

2. In a rotary multiple contact switch, an insulating housing, a shaft supported for rotation in said housing, insulating means integral with and forming a part of said housing defining a series of relatively long parallel slots in said housing, said slots defining planes perpendicular to the axis of said shaft, conducting means supported on said shaft for rotation therewith, and a plurality of resilient wiper contact arms engageable with said conducting means, each of said contact arms being disposed within a corresponding one of said slots, the major portion of each of said wiper contact arms being disposed in its corresponding slot whereby said wiper contact arms are effectively electrically insulated from each other.

3. In a multiple contact switch, a substantially rectangular insulating housing including means defining a chamber therein, a shaft supported for rotation in said chamber, insulating means integral with a part of said housing defining a series of parallel slots opening into said chamber, said slots defining planes perpendicular to the axis of said shaft, conducting means supported on said shaft for rotation therewith, and a plurality of resilient wiper contact arms engageable with said conducting means, each of said contact arms being supported within a corresponding one of said slots in said housing, the major portion of each of said wiper contact arms being disposed in its corresponding slot whereby said wiper contact arms are effectively insulated from each other.

4. A multiple contact switch, comprising an insulating housing, a shaft supported for rotation in said housing, means defining a series of parallel slots in said housing, said slots defining planes perpendicular to the axis of said shaft, conducting means supported on said shaft for rotation therewith, a plurality of resilient wiper contact arms engageable with said conducting means, each of said contact arms being disposed within one of said slots, and a plurality of selectively adjustable stop means one for each of said contact arms for limiting one extreme of movement of said contact arms in said slot.

5. In a rotary multiple contact switch, an insulating housing, a shaft of conducting material supported for rotation in said housing, insulating means forming a part of said housing and defining a series of parallel slots in said housing, said slots defining a plurality of planes perpendicular to the axis of said shaft, a plurality of conducting surfaces supported on said shaft for rotation therewith, a plurality of resilient wiper contact arms engageable with said conducting surfaces, each of said contact arms being disposed within a corresponding one of said slots, the major portion of each of said wiper contact arms being disposed in its corresponding slot whereby said wiper contact arms are effectively insulated from each other, and means for insulating some of said plurality of conducting surfaces from others of said conducting surfaces.

6. In a rotary multiple-contact, multiple-phase switch, an insulating housing, a shaft of conducting material supported for rotation in said housing, insulating means forming a portion of said housing and defining a series of parallel slots in said housing, a plurality of conducting means supported on said shaft for rotation therewith, a plurality of resilient wiper contact arms engageable with said conducting means, each of said contact arms being disposed within a corresponding one of said slots, the major portion of each of said wiper contact arms being disposed in its corresponding slot whereby said wiper contact arms are effectively insulated from each other, said shaft comprising two separate parts, and means for insulating one part of said shaft from the other whereby some of said conducting means are insulated from others of said conducting means.

7. In a rotary multiple contact switch, an insulating housing, a shaft of conducting material supported for rotation in said housing, insulating means forming a part of said housing and defining a series of parallel slots in said housing, a plurality of conducting means supported on said shaft for rotation therewith, a plurality of resilient wiper contact arms engageable with said conducting means, each of said contact arms being disposed within a corresponding one of said slots, the major portion of each of said wiper contact arms being disposed in its corresponding slot whereby said wiper contact arms are effectively insulated from each other, and means comprising an insulating sleeve and washer for insulating some of said plurality of conducting means from others of said conducting means.

8. A rotary multiple contact switch comprising a two-piece insulating housing including means defining a chamber therein, a shaft supported for rotation in said chamber, insulating means integral with one part of said two-piece housing defining a series of parallel slots in said housing opening into said chamber, said slots being perpendicular to a plane containing the axis of said shaft, a plurality of parallel grooves defined in said shaft, each groove with a corresponding one of said slots defining a plane perpendicular to the axis of said shaft, contact means supported within said grooves on said shaft for rotation therewith, and a plurality of resilient wiper contact arms each engageable with a different one of said contact means, the major portion of each of said contact arms being supported within one of said slots in said housing thereby being effectively insulated from adjacent contact arms.

9. A rotary multiple contact switch, comprising a two-piece insulating housing including means defining a chamber therein, a shaft supported for rotation in said chamber, insulating means integral with one part of said two-piece housing defining a series of parallel slots in said housing opening into said chamber, a plurality of parallel circumferential grooves defined axially along said shaft, each groove with a corresponding one of said slots defining a plane perpendicular to the axis of said shaft, conducting cams supported within said grooves on said shaft for rotation therewith, each cam having a pair of legs extending into an associated groove and frictionally engaging said shaft including the walls of said associated groove, a plurality of resilient wiper contact arms engageable with said cams, each of said contact arms being supported within one of said slots and having one end thereof clamped between said two parts of said housing, the major part of the unclamped portion of each of said contact arms being disposed within its corresponding slot, and means comprising flat sides on each of said cams to permit application of a tool for positioning said cam relative to said shaft.

10. A rotary multiple contact switch, comprising a two piece insulating housing including means defining a chamber therein, a shaft supported for rotation in said chamber, means defining a series of parallel slots in said housing opening into said chamber, a plurality of parallel circumferential grooves defined axially along said shaft, each groove with a corresponding one of said slots defining a plane perpendicular to the axis of said shaft, conducting cams supported within said grooves on said shaft for rotation therewith, each cam having a pair of legs extending into an associated groove and frictionally engaging said shaft including the walls of said associated groove, a plurality of resilient wiper contact arms engageable with said cams, each of said contact arms being supported within one of said slots and clamped between said two parts of said housing, the major part of the unclamped portion of each of said contact arms being disposed within its corresponding slot, means comprising flat sides on each of said cams to permit application of a tool for positioning said cam relative to said shaft, to control the instant of contact of each cam with its contact arm and means for adjustably controlling the limit of movement of each of said wiper contact arms toward the associated cams for selectively controlling the effective contact width.

11. A rotary multiple contact switch, comprising a two-piece insulating housing, a shaft associated with said housing and supported for rotation thereby, insulating means integral with one part of said two-piece housing defining a series of parallel slots in said housing, contact surfaces supported on said shaft for rotation therewith and disposed in predetermined positions spaced angularly and axially relative to said shaft, and a plurality of resilient wiper contact

arms engageable with said contact surfaces, the major portion of each of said contact arms being supported for relative movement within one of said slots and having one end thereof clamped between the two parts of said two-piece housing.

12. The arrangement set forth in claim 2, wherein a rotatable drum is mounted on said shaft and said conducting means are contact surfaces on said drum disposed in predetermined positions spaced angularly and axially on the surface of said drum.

13. The arrangement set forth in claim 2, wherein said housing is a two-piece housing and a rotatable drum is mounted on said shaft, said conducting means comprising contact surfaces on said drum disposed in predetermined positions spaced angularly and axially on the surface of said drum, each of said contact arms having one end thereof clamped between the two parts of said two-piece housing.

14. A rotary multiple contact switch comprising, a two-piece insulating housing including means defining a chamber therein, a shaft supported for rotation in said chamber, means defining a series of parallel slots in said housing opening into said chamber, said slots being perpendicular to the axis of said shaft, spaced contact means supported on said shaft for rotation therewith, and a plurality of resilient wiper contact arms one engageable with each of said contact means clamped between the parts of said two-piece housing so as to be held in generally parallel relationship, one disposed for movement in each of said slots.

15. A rotary multiple contact switch comprising, an insulating housing including means defining a chamber therein, a shaft supported for rotation in said chamber having an axially extending keyway defined therein, means defining a series of parallel slots in said housing opening into said chamber, said slots being perpendicular to the axis of said shaft, spaced contact cams supported on said shaft for rotation therewith each comprising a pair of fingers frictionally engaging said shaft, an extension on one of said fingers engageable with said keyway and a plurality of resilient wiper contact arms one engageable with each of said contact cams supported by said housing so as to be held in generally parallel relationship, one disposed in each of said slots.

16. A rotary multiple contact switch comprising, an insulating housing including means defining a chamber therein, a shaft supported for rotation in said chamber having an axially extending keyway defined therein, means defining a series of parallel slots in said housing opening into said chamber, said slots being perpendicular to the axis of said shaft, spaced contact cams supported on said shaft for rotation therewith each comprising a pair of fingers frictionally engaging said shaft, an extension on one of said fingers engageable with said keyway, each of said contact cams comprising a plurality of lobes, and a plurality of resilient wiper contact arms one engageable with the lobes of each of said contact cams supported by said housing so as to be held in generally parallel relationship, one disposed in each of said slots, said lobes being selectively removable to give predetermined desired contacting in response to rotation of said shaft.

17. A rotary multiple contact switch comprising, an insulating housing including means defining a chamber therein, a shaft supported for rotation in said chamber having a helical keyway defined therein, means defiining a series of parallel slots in said housing opening into said chamber, said slots being perpendicular to the axis of said shaft, spaced contact cams supported on said shaft for rotation therewith comprising a pair of fingers frictionally engaging said shaft, an extension on one of said fingers of each of said cams engageable with said helical keyway, and a plurality of resilient wiper contact arms one engageable with each of said contact cams supported by said housing so as to be held in generally parallel relationship, one disposed in each of said slots.

18. The rotary multiple contact switch of claim 1 in which said rotatable conducting means comprises a rotatable disk having a somewhat radially disposed conducting member associated therewith which conducting member has a variable width in a direction along the radius of said disk, and wherein said wire-like contacts selectively engage said conducting member in response to rotation of said disk, the selective adjustment of said contacts controlling the effective width of contacting engagement of said conducting member with each of said contacts.

19. The rotary multiple contact switch of claim 1 in which said rotatable conducting means comprises a rotatable disk having a somewhat radially disposed conducting member associated therewith which conducting member has a variable width in a direction along the radius of said disk, and wherein said wire-like contacts selectively engage said conducting member in response to rotation of said disk, the selective adjustment of said contacts controlling the effective width of contacting engagement of said conducting member with each of said contacts and also the position of the disk when contact is made.

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