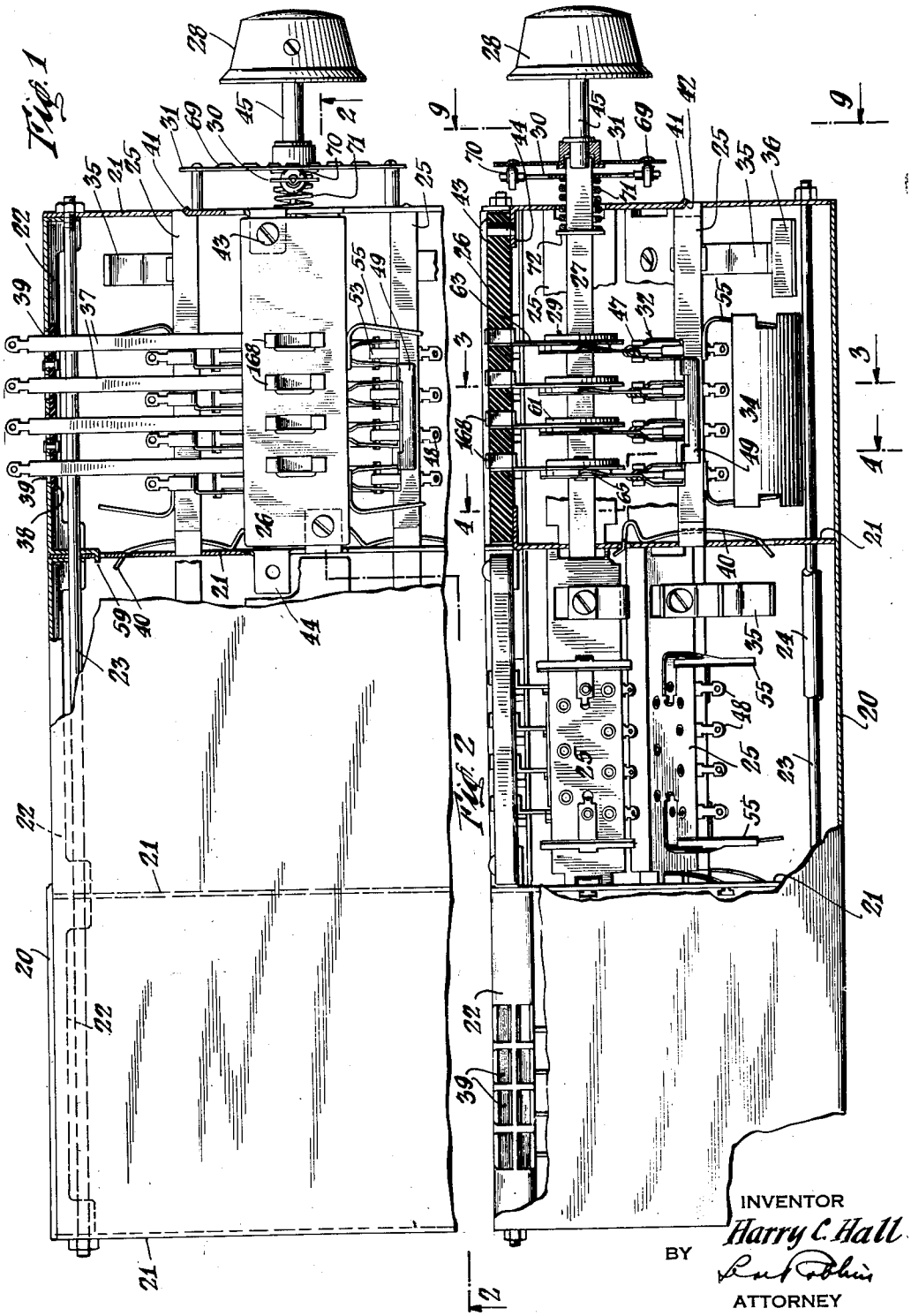
April 5, 1938. H. C. HALL 2,113,463

ELECTRIC SWITCH

Filed April 16, 1935 6 Sheets-Sheet 1



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April 5, 1938. H. C. HALL 2,113,463

ELECTRIC SWITCH

Filed April 16, 1935 6 Sheets-Sheet 2

Fig. 3

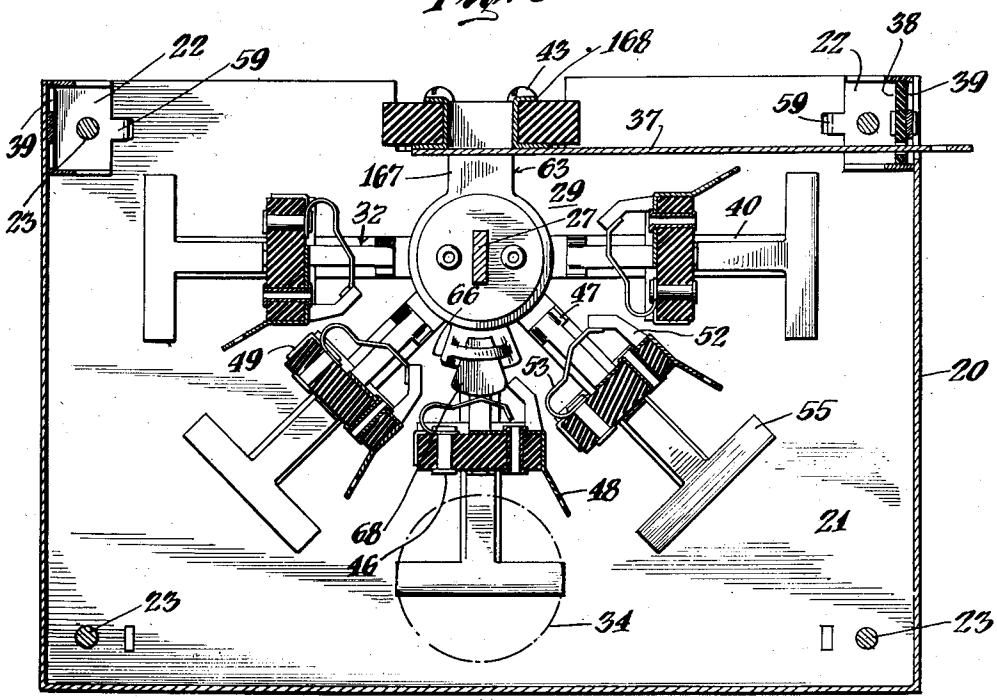
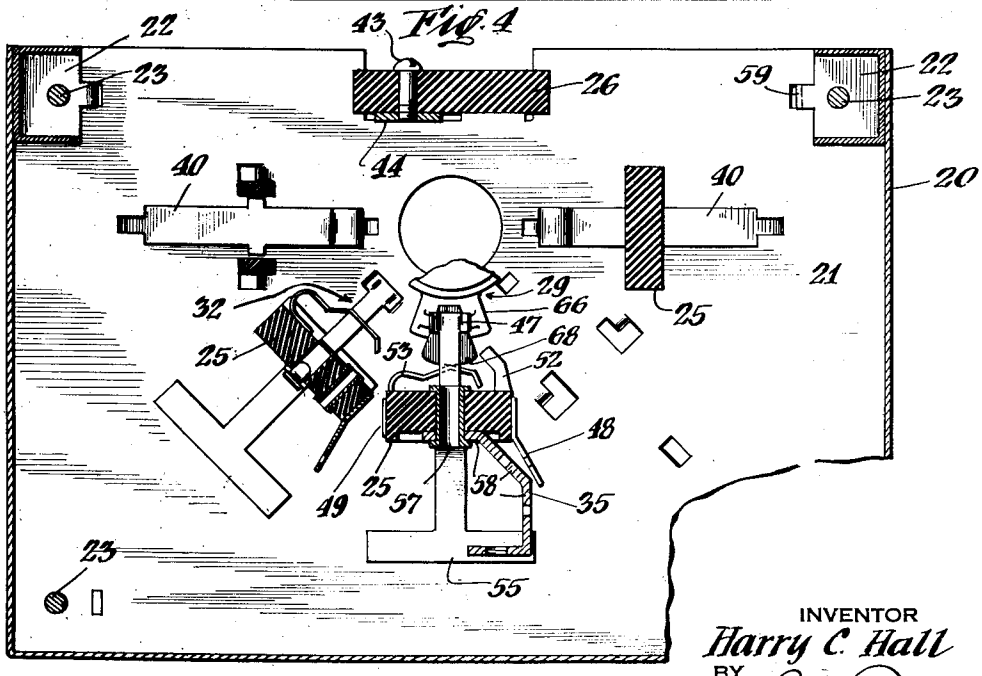


Fig. 4

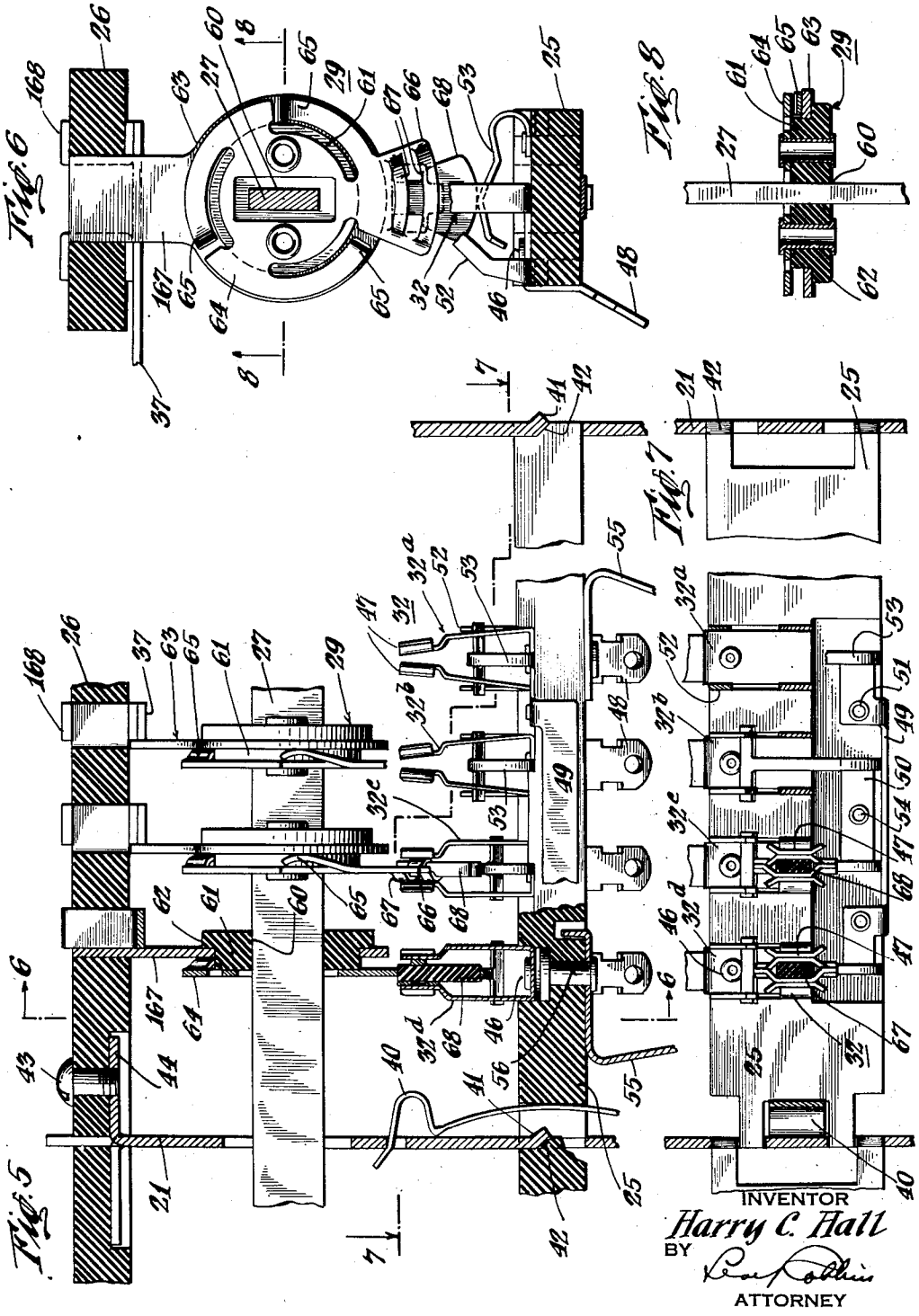


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ELECTRIC SWITCH

Filed April 16, 1935 6 Sheets-Sheet 3



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April 5, 1938. H. C. HALL 2,113,463

ELECTRIC SWITCH

Filed April 16, 1935 6 Sheets-Sheet 4

Fig. 9

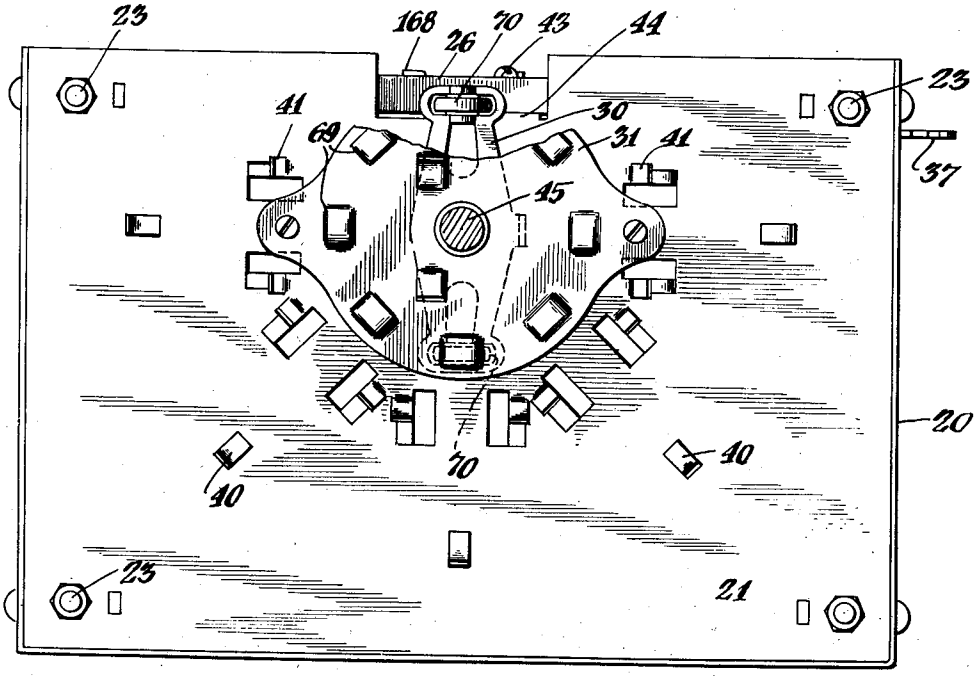


Fig. 10

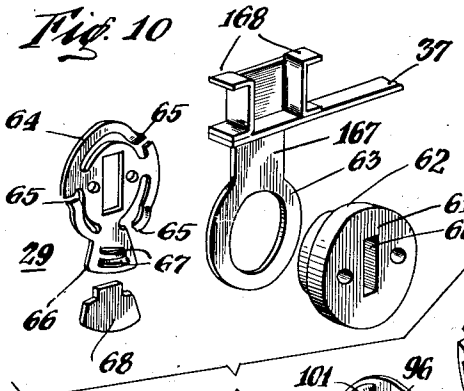
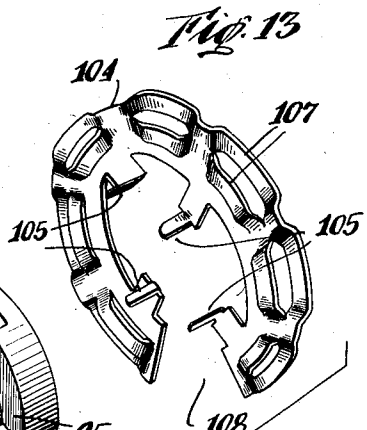
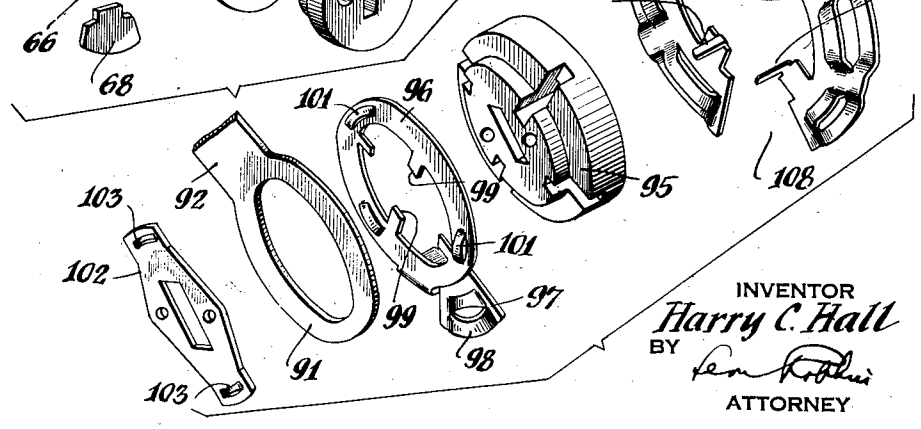


Fig. 13





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April 5, 1938. H. C. HALL 2,113,463

ELECTRIC SWITCH

Filed April 16, 1935 6 Sheets-Sheet 5

Fig. 11

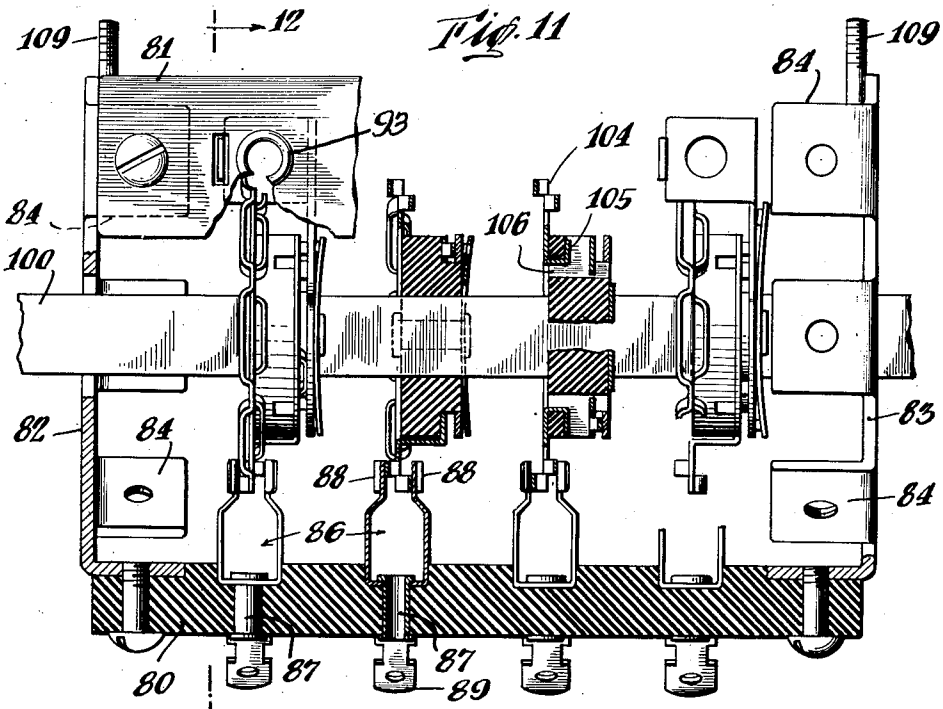
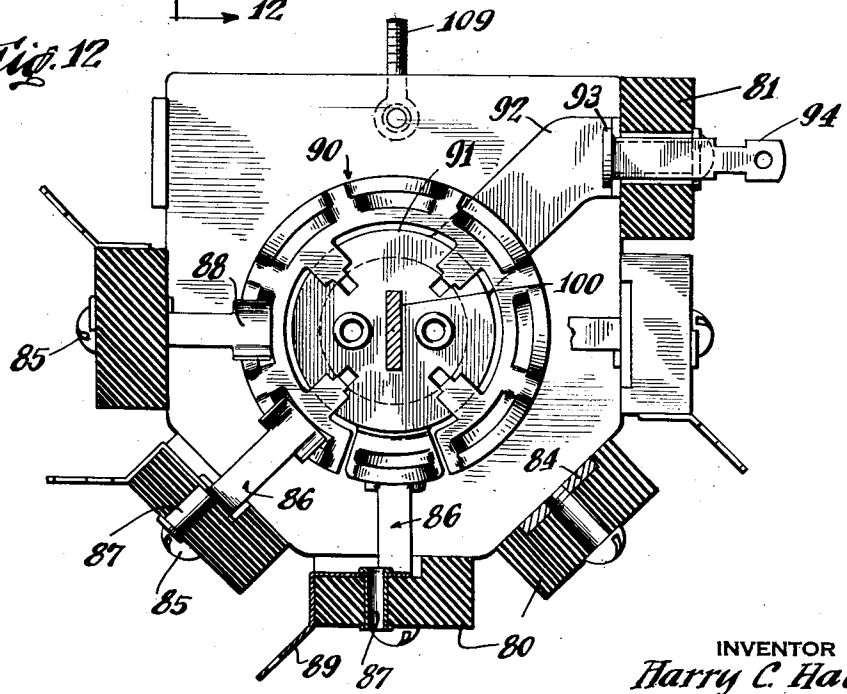


Fig. 12



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April 5, 1938. H. C. HALL 2,113,463

ELECTRIC SWITCH

Filed April 16, 1935 6 Sheets-Sheet 6

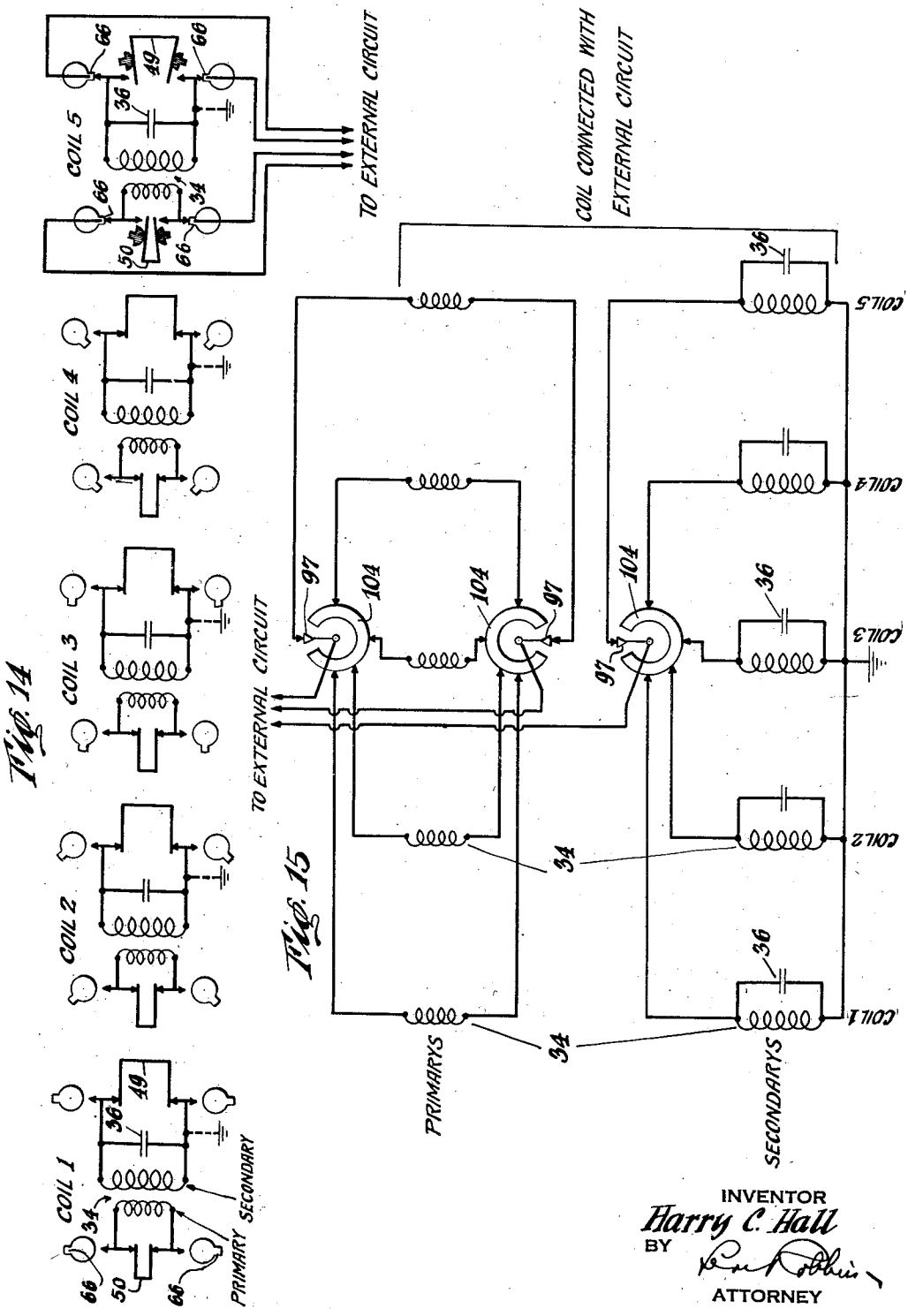


Fig. 14

Fig. 15

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UNITED STATES PATENT OFFICE

2,113,463

ELECTRIC SWITCH

Harry C. Hall, Indianapolis, Ind., assignor, by mesne assignments, to P. R. Mallory & Co., Inc., Indianapolis, Ind., a corporation of Delaware

Application April 16, 1935, Serial No. 16,603

9 Claims. (Cl. 200—6)

This invention relates to switches and more particularly to electric switches for changing circuit connections.

An object of the invention is to produce an improved switch whereby a plurality of circuits may be changed simultaneously or in sequence.

Another object is to provide an improved switch mounting and improved mounting means for parts associated with the switch structure or with the switch circuits.

A more specific object is to provide a coil-changer switch and associated structure for use in radio sets and the like wherein separate coils and circuits are used for different frequency bands.

Other objects of the invention will be apparent from the following description and accompanying drawings taken in connection with the appended claims.

In one form the invention may be embodied in a switch structure for use in radio sets to switch different sets of coils and other apparatus into and out of the radio circuits. It may preferably be embodied in a unit-type structure wherein any desired plurality of units may be assembled together, depending upon the number of switching connections required for the particular circuit in which the switch is to be used.

The invention accordingly comprises the features of construction, combination of elements, arrangement of parts, and methods of manufacture referred to above or which will be brought out and exemplified in the disclosure hereinafter set forth, including the illustrations in the drawings, the scope of the invention being indicated in the appended claims.

For a fuller understanding of the nature and objects of the invention as well as for specific fulfillment thereof, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a top view of the switch with parts broken away and parts in section to better illustrate the structural details;

Figure 2 is a side sectional elevation taken on the line 2—2 of Figure 1;

Figure 3 is an end sectional elevation taken on the line 3—3 of Figure 2;

Figure 4 is an end sectional elevation taken on the line 4—4 of Figure 2;

Figure 5 is a detail view, with parts broken away showing the switch contacts;

Figure 6 is a sectional view taken on the line 6—6 of Figure 5;

Figure 7 is a sectional view taken on the line 7—7 of Figure 5;

Figure 8 is a section on the line 8—8 of Figure 6;

Figure 9 is an end elevation taken on the line 9—9 of Figure 2;

Figure 10 is an exploded view of a switch rotor;

Figure 11 is a side sectional elevation of a modified switch structure;

Figure 12 is an end section taken on the line 12—12 of Figure 11;

Figure 13 is an exploded view of the rotor of the modified switch structure shown in Figure 11;

Figure 14 shows one form of circuit arrangement in which the switch may be used; and

Figure 15 shows a circuit arrangement for the modified switch structure.

Like reference characters denote like parts in the several figures of the drawings.

While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method of procedure and the construction of parts without departing from the spirit of the invention. In the following description and in the claims, parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

General description

Referring to the drawings, the above switch comprises, in general, a supporting and shielding framework, stationary electrical parts and rotatable electrical parts.

The supporting and shielding framework is provided in a unit type of assembly enabling any desired number of units to be fitted together depending upon the number of switch connections required. The parts of the frame are interchangeable so that a relatively few basic pieces are necessary for the assembly. These pieces include a rectangular metal outer side wall or shield **20**, metal partitions or end plates **21**, metal spacing struts **22**, threaded tie rods **23** and insulating mounting blocks **25** and **26**.

The stationary electrical parts include stationary switch contacts **32**, terminal bars **37**, electrical coils **34** and condensers **36** as required for the specific circuit in which the switch is used.

The rotatable electrical parts comprise rotatable contact members or rotors **29** controlled by a rotor control shaft **27** and control knob **28**. The rotational setting of the shaft **27**, and hence

the rotors, is determined by an indexing arm **30** in co-operation with an indexing plate **31**.

Supporting and shielding framework

The supporting and shielding framework is of a generally rectangular shape. The partitions or end places **21**, most clearly shown in Figures 4 and 9, are all identical rectangular metal plates having suitable punched-out portions and holes for receiving various other parts of the supporting structure.

The rectangular partitions or end plates **21** are held in spaced parallel relationship by a plurality of similar metal struts **22** arranged at the upper corners of the switch. (See Figures 1, 2, 3, and 4.)

The struts **22** are formed of single pieces of sheet metal bent into generally a channel shape and punched with a plurality of rectangular holes **39**. (See Figures 1, 2, and 3.) An ear **59** is provided at one end of each of struts **22** and fits into a punched hole in the partition plate **21** against which it abuts. (Figs. 1, 3 and 4.) The partitions **21** are held spaced at the lower corners by bushings **24** and are held together at all four corners by threaded tie rods **23** within these bushings and within metal struts **22**.

It will be readily seen that any number of switch sections can easily be built up and added to the switch by merely adding additional spacing struts **22** and partitions **21**, increasing the length of threaded tie rods **23**, and adding additional bushings **24** thereto.

Within each switch section and extending between the two parallel partition plates **21** forming the walls of that section are five removable rectangular blocks **25** of insulating material, each provided at its ends with dovetailing portions adapted to fit into suitable punched-out holes in the partitions. (Mounting blocks **25** are best illustrated in Figures 5, 6, and 7.) It will be noted that the ends of each of said blocks are arranged to dovetail with the abutting ends of similar blocks in the next adjacent switch section. Thus it is possible for the blocks in all the switch sections to be aligned with abutting and inter-fitting ends with both ends of each block supported in the cut-out parts of the partitions.

In order to prevent lateral vibration or movement in the individual insulating mounting blocks **25** and to hold them in place a plurality of tightening springs **40** are provided, one for each mounting block. Springs **40** are all identical and each comprises a metal leaf spring, the ends of which are fitted into suitable holes punched in the partition plates and are held thereby under sufficient compression so that they normally take a convex arcuate form. The convex arcuate portion of each spring **40** passes through a suitable cut-out portion in one end of one of the blocks **25** so as to press the block longitudinally against the partition plate supporting the opposite end thereof. Portions of partition plates **21** are bent up at an angle as shown at **41** in Figure 5 and blocks **25** are provided with co-operating tapering portions **42** whereby a wedging arrangement is provided to tighten blocks **25** against lateral vibration. It will thus be seen that individual springs **40** hold blocks **25** in place against both lateral and longitudinal vibration or displacement. They can be individually removed from the switch, however, without disturbing the other blocks or parts by merely compressing the leaf spring **40** associated with any one of the blocks so that the opposite end of the block will come out of its socket.

Blocks **25** are arranged about a central axis of the switch structure in such a manner as to provide several sides of a polygon figure, or cage, as shown most clearly in Figures 3 and 4.

Another insulating mounting block **26**, in general similar to blocks **25** but somewhat wider and having different types of cut-outs and holes therein, is secured along the top of each section of the switch to complete the polygon formed by the other mounting blocks **25**. Mounting blocks **26** are bolted by means of bolts **43** to suitable bent down ears **44** formed on the partition members.

Stationary electrical parts

The above described rectangular insulating blocks **25** and **26** provide the immediate supporting structure for the stationary switch contacts and terminal members. Each of these blocks **25** and **26** is provided with suitable cut-outs or holes for receiving parts of the contact members and for providing support therefor by means of rivets and the like.

Since all of the insulating mounting blocks **25** are identically formed and the switch contacts mounted thereon are arranged similarly on each, it will suffice for purposes of description to confine the references to one of these blocks.

In the form of switch illustrated herein each block **25** is provided with four switch contact members **32**, each riveted to the block **25** by means of a tubular rivet **46**. Contacts **32** are each formed of a single piece of sheet metal, punched and bent into such form as to provide a pair of wiping fingers **47** with their contact surfaces facing each other and adapted to co-operate with contacts on the rotary switch structure. Contacts **32** are likewise provided with terminals **48** for soldering or otherwise attaching electrical conductors thereto.

Co-operating with the four contacts **32** and also mounted on block **25** therewith are two short circuiting members. Short-circuiting member **49** is arranged to electrically connect the two end contacts **32***a* and **32***d*, and short circuiting member **50** is arranged to electrically connect contact members **32***b* and **32***c*, positioned in the two middle positions on insulating blocks **25**. Member **49** consists of a suitably punched and bent metal strip having a central shank portion fitted against one edge of block **25**, securing portions at each end of the shank portion riveted to block **25** by rivets **51**, and T-shaped spring portions **53** extending between the wiping fingers **47** of contacts **32***a* and **32***d*, respectively, and with the cross arm of the T in each portion engaging a pair of hook portions **52** forming part of contacts **32***a* and **32***d*. The stems of T-shaped spring arms **53**, disposed between wiping fingers **47** and somewhat below these fingers, are of convex arcuate form so as to be engaged and pressed down by parts of the rotating switch structure to thereby disengage the T-shaped arms **53** and the hook-shaped portions **52** of contacts **32**, opening the circuit through short-circuiting member **49**.

Short-circuiting member **50** adapted to electrically connect contacts **32***b* and **32***c* is constructed in a generally similar manner to member **49** but is provided with a shorter central shank portion which is riveted by rivet **54** to the upper face of block **25**. Member **50** is likewise provided with a pair of T-shaped spring arms **53** adapted to co-operate with hook-shaped portions **52** of contacts **32***b* and **32***c* in order to electrically connect this pair of contacts.

Mounted upon the back face of block 25 are a pair of large T-shaped spring arms 55 for supporting electrical coils 34 (Figure 3) and the like, which are included in circuits with the switch contacts, and which may comprise primary and secondary windings. Arms 55 are secured to blocks 25 by tubular rivets 56.

Also riveted to the back of block 25 by rivet 57 is a mounting bracket 35 suitable for mounting a small condenser, such as an adjustable "trimmer" condenser 36. In this connection it will be noted that bracket 35 is bent into an angular shape, providing a number of angularly related polygon faces 58 (Figure 4). Each face is provided with a suitable hole for receiving a rivet such as 57 if necessary. Bracket 35 is thus made into a universal member suitable for mounting on any one of the five blocks 25 independently of the position in which said blocks are mounted. It is thus possible to mount condenser 36 in suitable position for adjustment regardless of the position in which supporting block 25 is mounted in the switch, since universal bracket 35 allows condenser 36 to be mounted at the desired angle by placing rivet 57 through the desired hole 58.

Rotatable electrical parts

The rotatable electrical parts comprise in general a number of rotors or rotatable contacting elements 29, one rotor 29 being individual to each circular series of stationary contacts 32. Rotors 29 are each provided with a rectangular central opening 60, through which passes the rotor control shaft 27, as is shown most clearly in Figures 3, 5, 6, and 8.

Each one of rotors 29 is formed of a disk of insulating material 61, being formed with a thinner flange portion 62, shown most clearly in Figures 5, 8, and 10. Disk 61 is thereby arranged to fit into a circular ring-shaped metal punching 63 having an integral shank portion 167 extending upward through holes in stationary support block 26 and secured thereto. Riveted to the unflanged face of disk 61 is a metal punching 64, (Figures 5, 6, and 10), comprising a generally disk-shaped piece having three spring-like contact fingers 65 bent so as to press against the surface of ring member 63. It will be noted that rotor 29 is thereby held within ring member 63 by flange 62 on one side thereof and spring fingers 65 pressing against the opposite side thereof. Rotor 29 is free to rotate within ring 63 under control of rotor control shaft 27.

Punching 64 on rotor 29 likewise is provided with an integral projecting flange 66, having suitably cut and bent integral loops or strips 67 to form a receptive socket portion. Sector member 68 of insulating material is fitted within the socket portion thus provided.

Each rotor member 29 cooperates with its respective stationary electrical contacts 32 in the following manner: upon rotation of the rotor control shaft 27 the rotors 29 are all simultaneously rotated from one row of contacts to the next, each traversing its individual circular series of contacts. As any rotor approaches one of the contacts in its rotational path the peripheral arcuate surface of its insulating sector member 68 slides along the top of the shank of T-shaped spring arm 53 associated with the stationary contact, thereby pressing this arm downward toward its supporting block 25 and opening the contact it normally makes with its respective contact. Simultaneously therewith the rounded-out parts or loops 67 of metal projection 66 are moved between the two contacting fingers 47 of stationary switch contact 32 making electrical contact therewith.

As previously mentioned, each of ring members 63 is staked to its supporting block 26 by a shank portion 167 which extends up from the ring portion 63. Shank 167 may conveniently be attached to block 26 by integral bent over ears 168 (Figs. 6 and 10) on both the top and bottom sides of block 26. Soldered or welded to the ears 168 on the under side of block 26 are individual terminal bars 37 which extend out through the side of the switch and provide external circuit connecting means. Terminal bars 37 pass through punched openings 39 in metal struts 22 and are supported therein by punched sheet insulation pieces 38 riveted to struts 22 (Figs. 1 and 3).

Circuits will thus be completed through the switch in the following manner: From the outer end of any one of terminal bars 37, through the terminal bar 37, shank 167, ring 63, fingers 65 and metal piece 64, integral flange 66, contact fingers 47 of contact 32, body of contact 32, to connecting terminal 48 on contact 32.

Rotor control shaft 27 for rotating rotor elements 29 extends through the entire length of the switch structure and has a round welded extension 45 projecting therefrom at one end. A knob 28 is suitably attached to the projecting end 45 of shaft 27 for manual rotation thereof.

In order to aid in registering rotors 29 with their respective contacts an indexing arm 30 is keyed to shaft 27 and an indexing plate 31 is bolted to the end of the switch frame and spaced therefrom. Plate 31 comprises a generally disk-shaped metal member having a plurality of hollowed out portions 69 arranged in a circle on one of its faces. Indexing arm 30 has pivotally mounted at its ends a pair of roller bearings or casters 70, which are adapted to roll on the surface of plate 31 and rest in hollows 69. A helical spring 71 is positioned over shaft 27 and is compressed between a washer 72 clamped to shaft 27 and spring arm 30, thereby holding this arm with its casters 70 tightly spring-pressed against indexing plate 31. Thereby a positive indexing arrangement is provided for the switch.

Operation

It is contemplated that a plurality of coils, such as 34, will ordinarily be mounted within the switch frame on T-shaped spring supports 55 and that the ends of the coils may be connected to a pair of contact terminals 48, such as the terminals of stationary contacts 32*a* and 32*d* and/or 32*b* and 32*c*. It will accordingly be noted that all the coils will be normally short-circuited by short-circuiting members 49 or 50, but can be connected at will to the external circuits by the switch rotor 29 under control of shaft 27 and knob 28 at which times the short-circuit will be removed.

Figure 14 illustrates one manner in which the circuits may be arranged. Of the five coils 34 mounted in any switch section, each coil including a primary and a secondary winding, four of the coils are normally short-circuited by short-circuiting members 49 and 50 associated with the contacts on the particular block 25 on which the coil is mounted. This is illustrated in Figure 14 by coils 1 to 4. A "trimmer" condenser 36 may be permanently connected across the secondary winding of each coil. One side of any winding may be grounded if desired.

Coil 5 illustrates a condition where the windings are connected to the external circuit and the short-circuiting members 49 and 50 are disconnected in the manner previously described.

The primary object in short-circuiting the coils when not in use is to change the natural resonance period of the coil to such a value that it will not interfere with the tuned oscillations of an adjacent coil which is connected into the external circuit, such as a radio circuit. If the natural period of the unused coil were not made considerably different from that of the adjacent coil which is in use the unused coil may absorb energy from the operating coil circuit and cause a "dead spot" on the receiver dial where reception is greatly diminished.

Modified structure

Referring to Figures 11, 12, and 13, a modified switch structure is shown. This structure is basically similar to that previously described but has a modified mounting means and a modified arrangement for short-circuiting coils not in use.

Contact mounting blocks 80 and terminal mounting block 81 are bolted to bent-over flanges 84 on the two end plates or partitions 82 and 83 by bolts 85. Four stationary contacts 86 are riveted to each of blocks 80 by rivets 87.

Contacts 86 each comprise a pair of contact fingers 88 and a connecting terminal 89 for soldering or otherwise securing an electrical conductor thereto.

The switch rotor 90 (shown in exploded view in Figure 13) is mounted to rotate in ring-shaped rotor support 91 having integral shank 92 riveted to mounting block 81 by rivet 93. Shank 92 is provided with a double bend to provide for riveting to block 81 and to provide a connecting terminal 94 extending through a hole in block 81.

Rotor 90 (see Figure 13) is formed of a disc 95 of insulating material having suitable cut-out portions to receive the metal parts of the rotor and a rectangular hole in the center to receive rotor control shaft 100. Metal ring contact member 96 is fitted between disc 95 and rotor support ring 91 and has an integral contacting flange 97 having parts bent out into curved surfaces 98 to make contact with stationary contacting fingers 88. Contact ring 96 is provided with inner projecting tongues 99 to provide keying to disc 95 and a plurality of bent-up curved surfaces 101 to make sliding contact with support ring 91.

Holding spring or piece 102 is riveted to disc 95 with support ring 91 held between the ends of spring 102 and ring 96 so that the rotor will slidably rotate in ring 91. Spring 102 has a pair of bent up curved surfaces 103 to provide bearing surfaces against ring 91.

For short-circuiting the coils when not in use a ring segment 104 is clamped to the remaining face of disc 95 by lugs or tabs 105 which pass through rectangular holes 106 in disc 95. Ring segment 104 has an open segment 108 to accommodate contacting flange 97 and has a series of bent-out curved contact surfaces 107 adapted to make contact with all unused stationary contact fingers 88. Ring segments 104 thereby serve to short-circuit the coils when not in use.

Figure 15 shows one method of connecting the coils 34. It will be noted that the primaries and secondaries of coils 1 to 4 are all connected in parallel by ring segments 104 in order to change their natural periods and thereby avoid interference with coil 5 which is connected in the external circuit.

The modified switch structure shown in Figures 11, 12 and 13 is otherwise generally similar to the preferred form of the switch previously described. It may be assembled with any desired number of sections in series on the same rotor control shaft. For example, the switch sections may be bolted to the radio chassis by bolts 109. It is also contemplated that an indexing arrangement may be provided in the modification as in the preferred form.

Conclusion

It will be seen that the present switch provides a perfectly adapted coil-changing device for radio receivers and the like. It is arranged to change simultaneously a number of coils or other electrical elements in a circuit and replace one group of coils by another. At one rotary setting of the indexing plate the circuit can be arranged to receive signals in one frequency band and at another setting a band of higher or of lower frequency.

The whole assembly may be tested with ease before placing in the radio set and repairs are easily made because of the ready accessibility of parts, the few replacement parts required, and the interchangeability of elements.

Both coils and condensers can be mounted within the unit where they are adequately shielded. The connecting conductors are thus reduced to minimum length.

Because of the standard spacing of the structure the coils can be wound to compensate for any inductive effects in the shield or other parts.

The rectangular form of the shield makes it possible, where fewer coils are to be mounted, to cut down the size of the shield and partition plates to make a smaller switch structure. This would not be possible if a circular housing were used.

The switch can be bolted underneath or on top of the radio set chassis with equal facility. While the indexing plate 31 is shown herein as bolted directly to the end of the switch housing it will be readily apparent that it can be secured to the radio set chassis instead.

The simplicity of most of the parts enables a wide variety of materials to be used in the switch construction. The rectangular shield 20 can suitably be made of aluminum or other metals, mounting blocks 25 and 26 of "Isolantite" or "Alsimag", et cetera. The materials of the prior art are, of course, quite satisfactory.

The rotor control shaft can be inserted from either end of the switch, and the control knob and indexing plate may accordingly be placed at the end found most convenient for assembly in the radio set structure.

The unitary assembly makes it possible for the switch manufacturer to supply the parts to a radio set maker who will then be able to assemble as many sections into a single switch as are desired. The rotor control shaft may accordingly be cut to the length necessary for the number of sections used.

The electrical characteristics of the present switch are remarkably good, the switch providing for:

(1) Good contact. The pairs of contact fingers 47 providing duplicate contacting parts. This is likewise true of the short-circuiting arms 53.

(2) Shorter conductors. The mounting of the coils within the switch makes very short leads possible.

(3) Individual coil mountings. The coils are each mounted on separate insulating members.

(4) Elimination of vibration. The dovetailing and wedging mountings for blocks **25** prevents vibration such as might otherwise be caused by the radio loudspeaker, etc.

(5) The circuits can be easily tested.

(6) Tests have shown that stray capacities in the present switch are of negligible magnitude.

(7) The switch is adaptable to any type or size of circuit. Various combinations are possible.

(8) Readily adapted to mounting on chassis to obtain short connecting leads between the switch and external circuit elements.

While the present invention, as to its objects and advantages, has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. In an electric switch structure, a plurality of parallel spaced walls dividing said switch into separate sections, contact supporting blocks mounted in said sections with their ends supported from the pair of said walls defining their individual sections, stationary contacts mounted on said blocks, a common central rotatable shaft passing through openings in said walls and through all said sections, and contacting units in each said section controlled by said shaft and having contacting parts adapted to co-operate with said stationary contacts.

2. A sectional electric switch structure comprising a plurality of interchangeable wall members, a plurality of interchangeable strut members for holding said wall members in spaced parallel relation, thereby dividing said switch into a row of separate sections, and a plurality of interchangeable contact support blocks, said blocks and wall members having co-operating means for supporting said blocks at their ends between any adjacent pair of said wall members.

3. In a rotary switch for radio receiving sets and the like, a plurality of rectangular wall members dividing said switch into sections and a rectangular shield enclosing at least three sides of said switch and secured directly to the edges of said wall members.

4. In an electric switch, a plurality of spaced parallel walls having punched-out openings therein and dividing said switch into a plurality of sections, a plurality of contact mounting blocks in said sections and having the ends thereof supported in said wall openings, said blocks having dovetailing ends whereby a block mounted in one section will dovetail with a block mounted in an adjacent section and supported in the same wall opening.

5. In an electric switch, a plurality of spaced parallel walls having tapered receptive sockets therein, contact mounting blocks having their ends supported in said sockets, and spring members holding one of the ends of each said blocks against the tapered portion of its receptive socket by spring pressure, thereby wedging said block in position.

6. In an electric switch, a first contact member, a cam-operated contact member normally in contact with said first member, a cam assembly comprising a metal socket and a cam member held therein, and means to operate said cam assembly to bring said socket into contact with said first member and simultaneously operate said cam to open the normally closed contact between said cam-operated member and said first member.

7. In an electric switch, a plurality of blocks arranged with their longitudinal axes parallel and forming the bars of a cage-like framework, contacts mounted thereon within said cage, another block forming a bar of said cage and supporting a terminal conductor, and a rotor within said cage connected to said terminal conductor and co-operating with said contacts.

8. In an electric switch, a flat block of insulating material having a rectangular hole therein, a terminal member comprising a flat strip of metal staked in said rectangular hole, said terminal metal strip being bent in channel shape where it passes through said hole, said channel fitting within said hole, and ears integral with said channel portion and bent down against both faces of said block.

9. In an electric switch, a pair of parallel wall members, a contact mounting block supported at its ends in recesses in said wall members, a spring pressing one end of said block into its supporting recess, the spacing of said block and wall members being arranged so as to permit removal of said block from said switch by compressing said spring.

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