

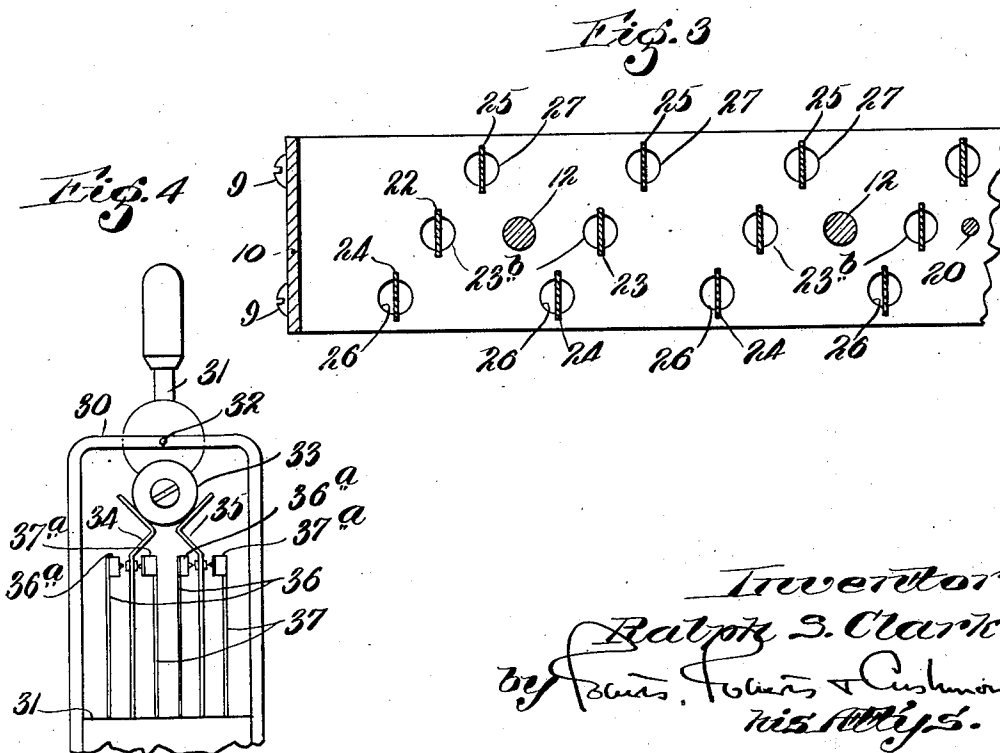
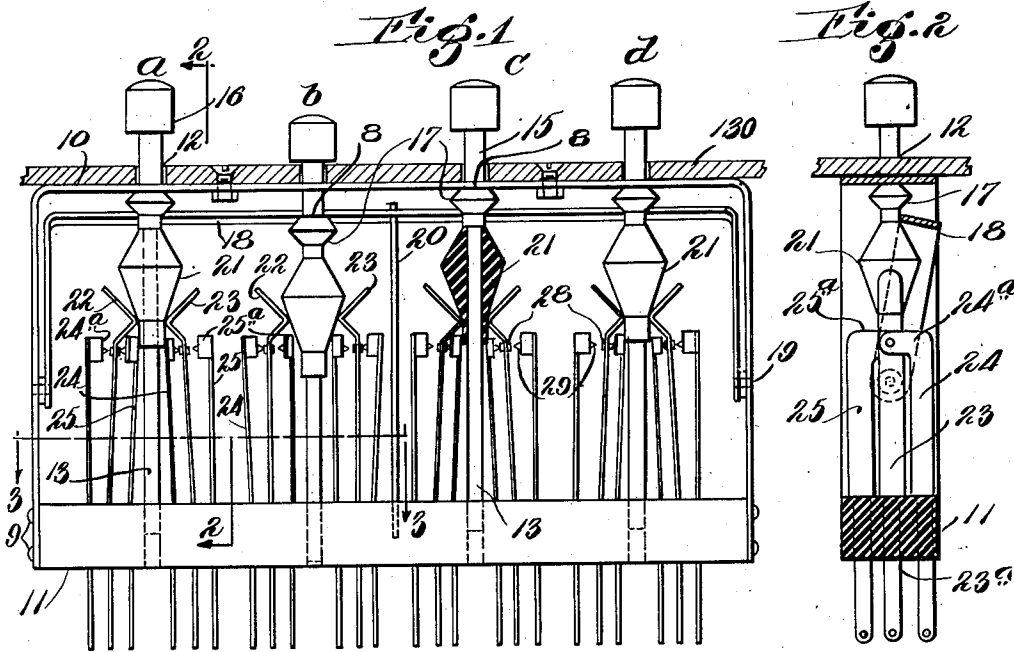
May 11, 1926.

1,584,010

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ELECTRICAL SWITCH

Filed Nov. 12, 1923



UNITED STATES PATENT OFFICE.

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ELECTRICAL SWITCH.

Application filed November 12, 1923. Serial No. 674,106.

This invention relates to electrical switches of the kind having a low initial electrostatic capacity and adapted to operate with minimum change of the capacity and other qualities of the circuits controlled.

In telephony, and in radio telegraphy and telephony particularly, it is often necessary or desirable rapidly to shift connections, to substitute one circuit for another, or selectively to connect one or more units of apparatus into relations with other units of apparatus. In many cases, such shifts, substitutions and new connections involve circuits in which efficient adjustment bears a necessary relation to the electrostatic capacity or the mutual inductance, or other constants, of those parts of the circuit necessarily interfered with to perform the shift, substitution or change controlled by the switching devices. If, in this case, the switching device is so constructed as to vary substantially, for example, the resistance, the inductance or the mutual capacity of its connected circuits upon change, then its principal function can not be achieved successfully, because it will not be possible instantaneously to shift the apparatus connections with its aid without also making it necessary at the same time to readjust the adjunctive or controlled apparatus to compensate for the changed condition attributable to the different adjustment of the switch itself.

In many classes of apparatus, particularly alternating or pulsating current apparatus having circuits carrying currents whose frequencies are of the order of audible sound waves, or far greater, such as the frequencies suitable or appurtenant to radio waves of lengths as low as from one to one hundred metres, the specific self-inductance, surface area, and capacity of any connection to the circuits is necessarily subject to critical evaluation, and, in general, apparatus for use in such situations is valuable in proportion to the low value of these qualities introduced by it into the controlled circuits, whether or not the switch is adapted to be operated without changing the value of these qualities in its different positions.

Objects of this invention are in general to provide a switching device, adaptable in a preferred form to the control of mul-

tiple circuits which will in itself avoid the introduction into its connected circuits of any large electrostatic capacities, self-inductances, or resistances, and which is capable of being operated to shift circuits without substantial change of any of these qualities on shifting from one circuit to another. Further objects are to provide for efficient multiple changes of circuit without substantial change of electrostatic capacity between parts of or contacts in the circuits controlled; to reduce the capacity between parts of the switch, such as contact springs and other conductors in the vicinity thereof; to reduce the variation of capacity between contact springs and adjacent conductors incident to changes in their contact relationship; and generally to provide an improved form of switch particularly adapted for use in connection with circuits in which a low or a constant electrostatic capacity or a low mutual capacity between the switching controls or their connections is important.

The invention will now be explained in connection with certain typical practical forms only of devices chosen to illustrate the invention, and particularly adapted for telephone switchboard or radio telegraph or telephone station uses, as shown in the accompanying drawings, in which:—

Fig. 1 is an elevation partly in section of a plunger-type multiple-circuit switch according to the present invention;

Fig. 2 is a section on line 2—2 of Fig. 1;

Fig. 3 is a plan view in section on line 3—3 of Fig. 1; and

Fig. 4 is an elevation showing a modified form for use as a switch of the key type.

Referring to Figs. 1 to 3, the parts of a switch for the control of a plurality of circuits may be carried by a stiff U-frame 10 having an insulating block 11 of any suitable material, such as one of the mica or fibre-and-binder or bakelite aggregates held across its open end by screws 9, so that a sufficient number of plungers 12 may be mounted to move axially in aligned holes in the frame 10 and block 11. As shown, there are four plungers 12, at *a*, *b*, *c*, and *d* respectively, and each of these is arranged to control by its motions one or more circuits. Preferably, as shown in Fig. 1, the frame

10 is mounted on a panel 130 bored for the plungers 12, which have finger caps 16, preferably of insulation material, beyond the face of the panel 130.

Each plunger 12 may comprise a reduced shank 13 having thereon a conical cam 21 of insulation material centrally bored to receive the reduced shank 13, and positioned by contact with an integral shoulder 14 of a portion 15 of the plunger of larger diameter. The portion 15 is provided with an integral or attached double-cone cam 17 having a plane shoulder 8 at its upper end, cam 17 being adapted on inward motion to displace, and shoulder 8 to lock under the lower edge of, a detent bar 18, preferably made as a bail pivoted at 19, and having a hole for a wire spring 20 fast in the block 11. The parts are so related that the cam 17, on depressing any plunger unlocks the detent 18 in relation to the other plungers. But any number of the plungers less than one may be simultaneously depressed and locked down by detent 18, and will then be simultaneously released on depressing any other plunger.

The plungers 12 are normally maintained in projected position by the reaction of contact-making leaf springs 22 and 23 having cam bends contacting with and stressed toward the insulating cams 21, the springs 22, 23 having narrowed parts 23^a adapted to be forced into round bores 23^b in the block 11, which bores are preferably placed in alignment with the bores for plungers 12 along the central plane of block 11.

Motion upward or downward of any plunger and its cam 21 causes or permits the springs 22, 23 to be deflected toward and away from the plunger and each other through a short path of motion.

Held in each of a front series of laterally placed bore-holes 26 in block 11 diagonally offset from the holes 23^b, a series of forward contact leaf-springs 24 having offsets 24^a reaching the path of motion respectively of the springs 22 and 23 are each so placed that in outer positions of the plungers 12 and cones 21 the springs 22 contact with offsets 24^a of alternate springs 24 only; whereas in lower positions of plungers 12 and cams 21 the offsets 24^a of the remaining springs 24 only contact with the springs 23. The springs 24 are preferably punchings from sheet metal, wider than they are thick, placed with their greater dimensions crosswise of the block 11.

In each of a rear series of laterally placed bore-holes 27 in block 11 diagonally offset from the holes 23^b, a series (similar to the series 24) of back contact leaf-springs 25 having their greater dimensions crosswise of block 11, and having upper ends 25^a offset into the line of motion of the springs 22 and 23 are each so placed that in upper positions

of the plungers 12 and cams 21, the springs 22 contact with the offset ends 25^a of alternate back contact springs 25, whereas in lower positions of plungers 12 and cams 21 the offset ends 25^a of the remaining back contact springs 25 contact with the springs 23.

Motion of any plunger 12 thus causes the springs 22 and 23 appropriate to it to break contact respectively with one pair of springs 24, 25, and to make contact respectively with another pair of said springs 24 and 25, said pairs of each having a member at opposite sides of block 11. The contacting points of the respective springs may be provided, as usual, by pellets of anti-oxidizing metal 28 inserted in holes in the springs 22, 23, and by projections 29 from the offsets 24^a, 25^a which projections may or may not bear insertions of anti-oxidizing metal. It will be observed that the contact of a spring 22 or 23 with one of the offsets 24^a, 25^a, causes a slight torsional motion of the springs 24 or 25, and that this motion at the point of contact is about a radius so short as to cause an appreciable wiping of the metal-to-metal contact upon very slight total motion of the parts.

The described arrangement of the contact springs in relation to each other and a plunger 12, see Fig. 3, is such as to leave the moving parts, i. e., the springs 22, 23, out of nearby facing relation to the static parts, i. e., the springs 24, 25, and to provide a maximum physical displacement between said elements relatively to the whole dimensions of the contact elements, which moreover are positioned in respect to each other edge-on rather than face-on. These are conditions for minimum mutual capacity. Motion of a spring 22, 23, for change of contact from the forward to the back contacting series of springs, or vice versa moreover results in bringing the respective springs into more nearly edgewise relation when they are nearer together and in contact than when they are further apart and not in contact. That pair of the four standing contact springs 25, 25, 24, 24, which are concerned in the circuit changes effected by any one plunger, (members of which pair are positioned nearer to the plunger) are, by the described arrangement, turned more nearly edgewise to the plunger than are the more remote pair. Any effect on capacity from motion of the plunger is minimized by this arrangement.

The described diagonal or echelon arrangement of the fixed ends of the contact members has other advantages. Within the permitted dimensions of the block 11, this arrangement secures a maximum separation of circuit elements of each plunger-controlled group of contact springs and also secures a maximum separation between the respective groups. The mutual electrical ef-

fect of one group on another is thus decreased without incurring undesirable physical separation of the plungers.

The projecting tails of the several contact springs below the block 11, Figs. 1 and 2, are advantageously positioned for wiring by their described arrangement. Switches of the character described may be used in many different ways, to control series or parallel connections to or from the output or input circuits of apparatus units.

This invention may be embodied in other forms of switches, for example the key switch shown in Fig. 4, in which a frame 30 and insulating block 3 support in the same echelon relation as shown in Figs. 1, 2 and 3 movable contact springs 34 and 35, adapted to make contact with front contact springs 36 and rear contact springs 37 having offset portions 36^a and 37^a respectively at the extremes of their respective flexures. But in this form the motion of springs 34 and 35 is communicated by an insulating roll 33 journaled on an operating lever 31 pivoted to the frame 30 at 32, and the simultaneous motions of the springs 34 and 35 are in the same direction, instead of opposite directions.

The switch of this invention presents a minimum capacity effect between adjacent springs and between springs and adjacent conductors. The capacity effect of the switch on associated circuits is thus made as small as possible.

In any form, it will be observed that the motion of the flat movable element of the switch by bending in the direction of its lesser thickness is such as causes its displacement to alter the mutual capacities of conductors in circuit to a minimum degree, physical approach of the conductors being by motions tending to bring the flat conductors more nearly into the same plane, and physical separation being by motions bringing the separating conductors into a position more nearly facing each other at their flat surfaces, thus to compensate for altered proximity as a factor of mutual capacity by opposite alteration of the mutual projected area of the conductors.

What I claim is:

1. A switch mechanism having therein means for minimizing capacity changes on operation of the switch comprising in combination a system of flat conductors and means for holding the conductors in staggered relation, one of said conductors being movable at one end in the direction of its lesser thickness to contact with a portion of one or another of said other conductors standing in the path of motion of the said movable conductor, whereby approach of the movable and any other conductor results in decrease of the mutual projected area of the approaching conductors.

2. A switch mechanism having therein means for minimizing capacity changes on operation of the switch comprising in combination a system of flat conductors and means for normally holding the conductors nearly parallel in staggered relation with their greater thicknesses in the same direction, one of said conductors being movable at one end in the direction of its lesser thickness to contact with a portion of one or another of said other conductors standing in the path of motion of the said movable conductor.

3. A switch having a frame, cam mechanism mounted in said frame, a movable contact spring held by and insulated from said frame, and having its upper end positioned to engage with and to be variably deflected by said cam mechanism, a plurality of springs secured near their ends, to and insulated from said frame in position severally to contact at their free ends with said movable spring in one of its deflected positions, said springs being held in respect to said frame in positions defining a line oblique to the direction in which said cam mechanism deflects said movable spring.

4. A switch having a frame including a block of dielectric material, cam mechanism mounted in said frame, a movable contact spring having one end fastened to said block and having a free end positioned to engage with and to be variably deflected by said cam mechanism, a plurality of springs each secured near one end to said block and in position to contact at their free ends with said movable spring, each said spring having greater width than thickness whereby to present a surface of maximum capacity in a given direction, the portions of said springs having said surfaces lying substantially in the same direction, and said springs being arranged in echelon.

5. In a cam switch, a frame including a block of dielectric material, cam mechanism mounted in said frame, a main contact spring secured near its lower end to said block, and having its upper end positioned to engage with and to be variably deflected by said cam mechanism, a plurality of springs secured near the lower end to said block and in contacting relation at their upper ends with said main spring, said springs having broad sides below their upper ends and being positioned with their broad sides parallel and in echelon.

6. In a switch, a frame including a block of dielectric material, cam mechanism mounted in said frame, a plurality of contact springs in juxtaposition to said cam mechanism some of which are adapted to be variably deflected by actuation at said cam mechanism to make or break contact with others, the bodies of said springs below their upper ends having similarly directed broad

sides and having narrow edges joining said broad sides, said springs being positioned so that central areas of the broad sides of adjacent springs are separated further from each other than narrow edges of said spring.

7. In a switch, a conductive plunger having longitudinal freedom of motion, an insulating cam thereon, a plurality of thin, flat contact springs in juxtaposition to said cam some of which are adapted to be variably deflected by said cam into contact with others when said plunger is axially displaced, those springs nearer to said plunger having greater width than thickness and

positioned so that central regions of their broader faces are more remote from said plunger than are their narrow edges.

8. In a gang switch, a plurality of switches, each switch including a group of contact springs, said groups being positioned in a row on a common center line, the springs in any one group being positioned in a row, the rows of springs in said groups being parallel to each other and oblique to the center line of said groups.

Signed by me at Boston, Massachusetts, this ninth day of November, 1923.

RALPH S. CLARKE.