F. R. McBERTY.

SEQUENCE SWITCH.

APPLICATION FILED SEPT. 5, 1908.

1,105,811. **Patented Aug. 4, 1914.**

2 SHEETS—SHEET 1.

Fig. 1.

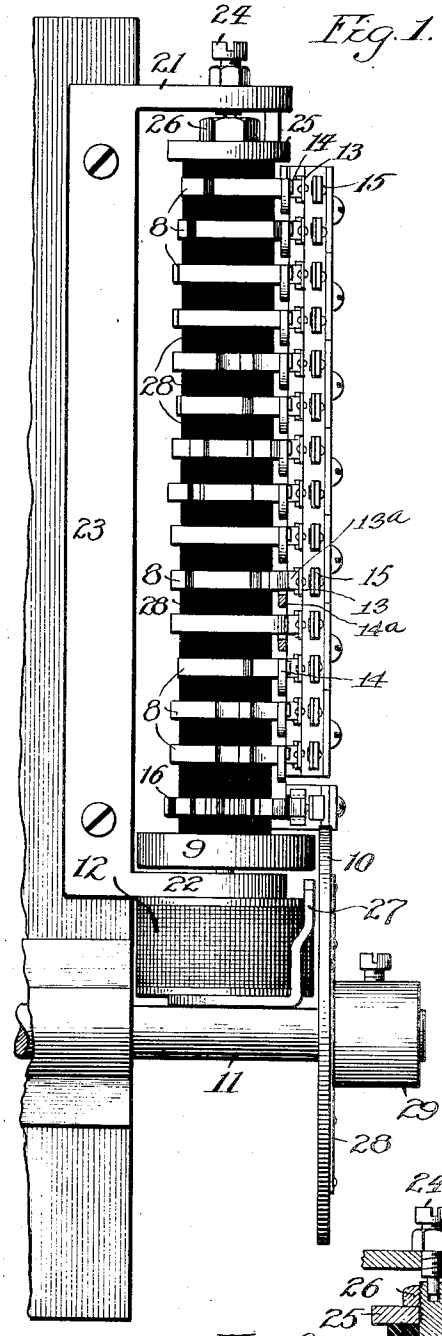


Fig. 2.

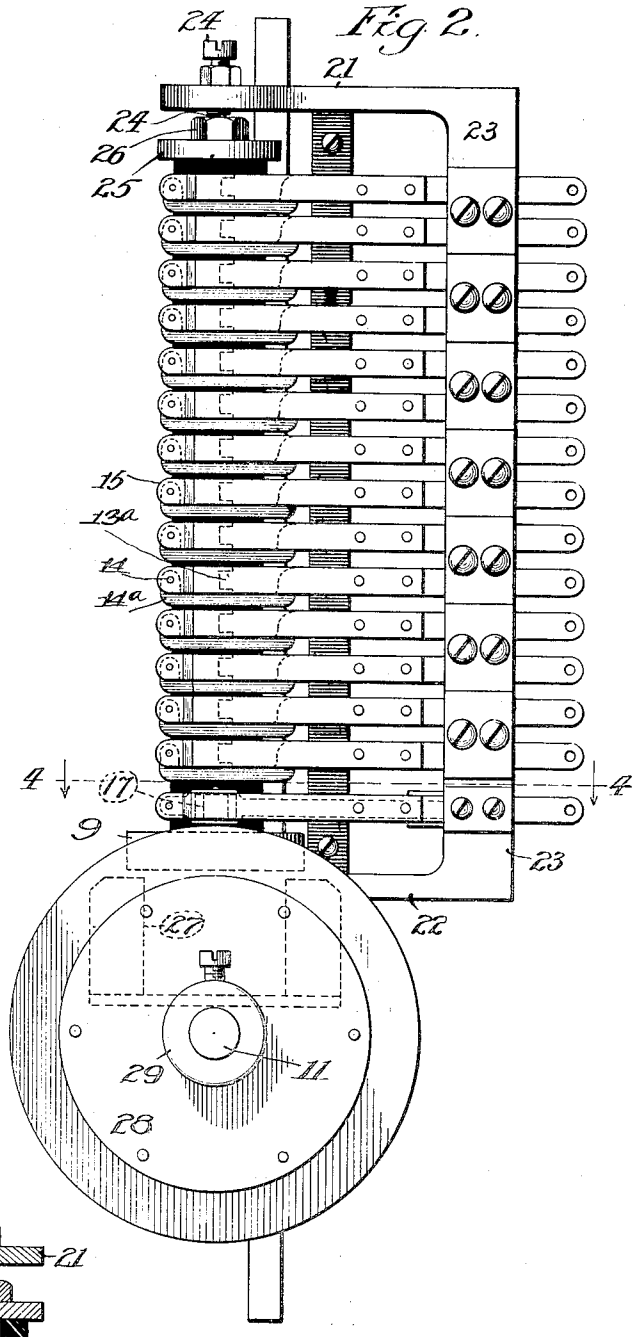
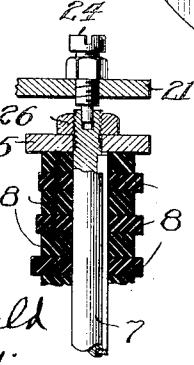


Fig. 6



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2 SHEETS—SHEET 2.

Fig. 3.

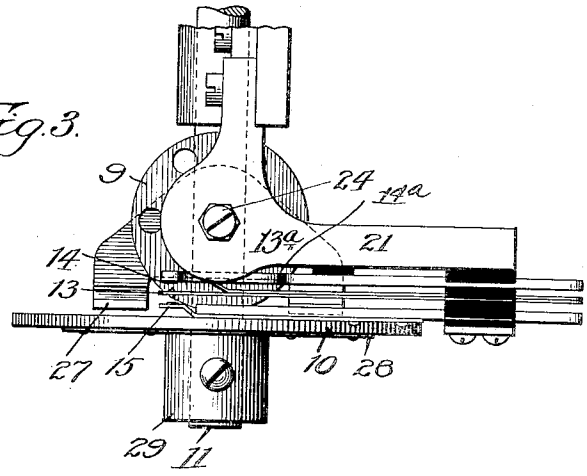


Fig. 4.

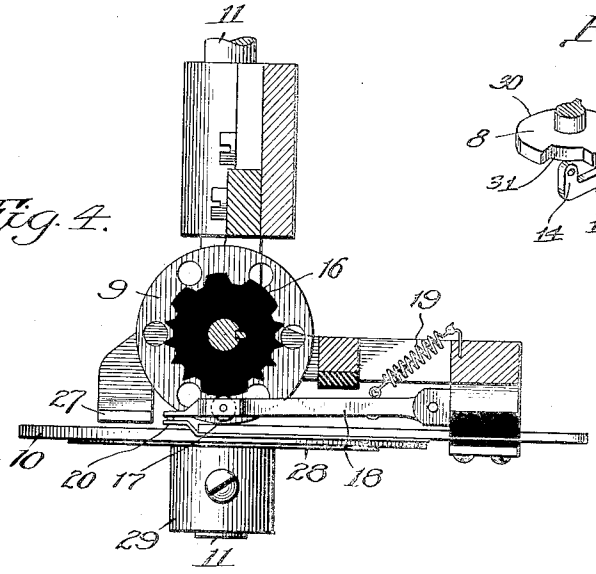


Fig. 7.

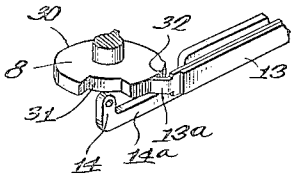
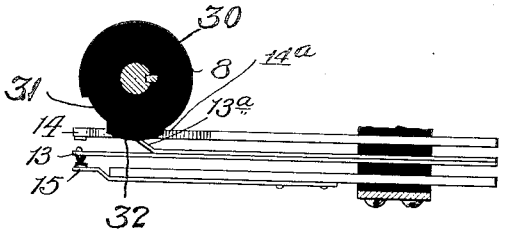


Fig. 5



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UNITED STATES PATENT OFFICE.

FRANK R. McBERTY, OF NEW ROCHELLE, NEW YORK, ASSIGNOR TO WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

SEQUENCE-SWITCH.

1,105,811. Specification of Letters Patent. Patented Aug. 4, 1914.

Application filed September 5, 1906. Serial No. 451,868.

To all whom it may concern:

Be it known that I, FRANK R. McBERTY, citizen of the United States, residing at New Rochelle, in the county of Westchester and State of New York, have invented a certain new and useful Improvement in Sequence-Switches, of which the following is a full, clear, concise, and exact description.

This invention relates to an automatic electric switch, and its object is to provide a simple, compact, inexpensive and efficient device which will be adapted to control a large number of independent electrical circuits, and to perform a large number of switching operations in an orderly sequence, under control from a distant point.

The device, which I term a sequence-switch, consists of a rotary shaft or member, with a series of cams or switch-operating parts mounted thereon, and a corresponding series of movable switch members adapted to be operated thereby in the rotation of said shaft, with suitable motor mechanism for rotating the shaft through its successive positions, to operate said switches in sequence. The movable switch-members to be operated by the cams carried by the shaft are contact springs mounted upon but insulated from a supporting frame in the arms of which the shaft is mounted to rotate. The free ends of said springs project across said shaft in position to be engaged by the respective cams, and are thereby caused to assume different positions as the shaft rotates, suitable stationary contact anvils being provided to be engaged by said switch springs in their different positions.

Preferably the face of each cam is cut to three different depths radially, thus allowing the movable switch member to be held, in one position, usually the normal, separated from both of said stationary contact anvils and pushed in one extreme position against one of said anvils and permitted to rest in the other extreme position upon the alternate contact anvil. In order that each of the contact members may have a definite position and not be easily put out of adjustment, while at the same time connections may be made without undue straining of the mechanism, one of the alternate contact anvils is made flexible and normally is held by its own tension against a rigid stop on which it is also supported, this anvil is the one against which the movable contact member is pushed by the cam. The other of the alternate contact anvils may be made rigid, and is provided with a recess into which both the cam and a projecting portion of the movable switch member are adapted to enter, this anvil is the one upon which the movable contact member is permitted to rest. The movable contact member is preferably a flexible spring and provided with a second spring against which the movable spring rests, this second spring engaging the face of the cam.

The motor mechanism for operating the rotary element of the switch preferably consists of a continuously-rotating power-shaft, a pair of transmission-gear members, carried by the power-shaft and switch respectively, and an electromagnet adapted when excited to draw said transmission-gear members into mutual engagement to transmit the rotary motion of the power-shaft to the shaft of the switch.

I will describe my invention more particularly by reference to the accompanying drawings, in which—

Figure 1 is a front view of an electro-mechanical sequence-switch constructed in accordance with said invention; Fig. 2 is a side view of said switch; Fig. 3 is a plan view thereof; Fig. 4 is a sectional plan view on line 4—4 of Fig. 2; Fig. 5 is a detail view of one of the switch-operated cams; Fig. 6 is a detail sectional view of one end of the rotary member of the switch. Fig. 7 is a detail perspective view of parts shown in Fig. 5 with a portion broken away.

The same letters of reference indicate the same parts throughout the several figures.

The rotary shaft 7 of the switch is mounted in bearings in the arms 21, 22, of a supporting frame 23. Switch springs 13 mounted upon but insulated from the supporting frame 23 are arranged to be operated by the cams 8 of the rotary element of the switch, each of said springs having contact anvils 14, 15, mounted on either side thereof in position to be engaged by the spring in its alternate positions away from the normal. The springs 13 and the metal tongues or strips carrying the contact anvils are mounted in sets with suitable insulating strips between the members of each set, the several sets forming a row alongside the rotary member of the switch, with the free ends of the springs 13 extending

across the cams 8 carried by said rotary element. Each of the switch springs 13 has attached thereto a projecting tongue 13ª which forms in effect a part of such spring, and bears upon the periphery of the corresponding cam, so that the spring may be maintained in its normal or intermediate position or be forced against its outer contact 15 or allowed to engage its inner contact 14, according to the radial dimension of the cam, where it is engaged by said tongue 13ª.

As shown most clearly in Fig. 7 the contact member 14 is provided with a recess at 14ª into which recess both the cam 8 and the projecting portion 13ª of switch spring 13 are adapted to enter. This construction permits the parallel contact members to be mounted close together with their contact points at their free ends where they are exposed to view and readily accessible for repair or adjustment. It also permits a construction in which the cam 8 moves the intermediate switch spring member 13 only through short distances in order to bring it into contact with one or the other of its adjacent contact members 14 or 15, or into a position between the two and free from contact with either of them. The relation between the cam 8 and the parts 14 and 13ª is also shown in Fig. 1 where the ends of two of the members 14 near the middle of the figure have been cut off in order to more clearly show the engagement of the projection 13ª with the cam 8. The parts 13ª and 14 are also shown partly in dotted lines in Fig. 2, and in full lines in Figs. 3 and 5.

The cams 8 may be rubber disks having their faces cut to three different depths radially as designated by the numerals 30, 31, 32 and strung upon the shaft with suitable spacing washers 28 between them, the shaft being provided with a spline or feather to keep the parts in their proper relative positions. The projecting tongue 13ª, of the spring 13, contacting with the faces 30, 31 and 32 of the rotatable cam 8, moves the spring 13 away from or into contact with either of the contacts 14 and 15. The cams and washers may be compressed between end plates 9, 25, respectively, at the ends of the shaft. The lower end of the shaft may be journaled in the supporting arm 22 of the frame 23, and the upper arm 21 of said frame may carry an adjustable bearing screw 24 the point whereof forms a pivot for the upper end of the shaft. The lower end plate 9 also serves as a friction roller or member of a friction transmission gear by which the shaft may be rotated. By loosening the screw 24 the entire rotary element of the switch may be removed as a unit from the supporting frame.

The rotary element of the device is arranged to be turned to operate the various switches by mechanism which is controlled by the electromagnet 12. As shown, the lower end of the shaft carries a magnetizable roller 9, the edge of which is adapted to be engaged by the side of a friction driving disk 10 carried upon the continuously rotating power shaft 11. The magnetizing coil 12 is mounted with its axis coincident with the axis of the shaft 7, so that the roller 9 carried by said shaft serves as a rotary pole piece, so to speak, for said electromagnet 12. The magnet is also preferably provided with a bifurcated lower pole piece 27, the ends of which face the surface of the iron driving disk 10 in position to assist in attracting said disk into engagement with the roller 9. The disk 10 is preferably constructed in two parts, the central portion thereof being a thin, elastic metal plate 28 attached to the hub 29 which is fixed to the shaft 11; while the circumferential portion of the disk is a plate of somewhat greater thickness and stiffness. The thin central portion 28 is sufficiently elastic to allow the disk to be given a slight tilting or flatwise movement to bring the side of the circumferential portion into engagement with the roller 9. It will thus be seen that the driving disk 10 and the iron roller 9 form the members of a transmission-gear which is adapted to be brought into service by the clutch magnet 12 to apply power from the continuously rotating power shaft 11 to the rotary element of the switch, the latter being turned as long as said clutch magnet remains excited.

A special cam 16 carried by the rotary shaft of the device is adapted to determine its successive positions of rest, or in other words to insure that the rotary element of the switch shall be brought to rest accurately in each position in which it is intended to stop. As shown in Fig. 4, the cam 16 is provided with notches the edges whereof are inclined, and a cam roller 17 carried by a pivoted switch lever 18 is arranged to travel over the periphery of said cam 16 and come to rest in the bottoms of the notches in said cams. A spring 19 is arranged to act upon said pivoted lever 18 so as to press the cam roller 17 against the edge of the cam 16. When the roller 17 rides upon a tooth or high part of the cam, said lever 18 may close a contact 20 controlling a local circuit for the motor magnet 12. The cam roller 17 after riding over the point of a tooth is forced down the opposite slope by the action of the spring 19, and thus tends to push against the cam and continue the rotation thereof until the roller 17 reaches the bottom of the following notch. In the operation of the device a circuit may first be closed for the motor magnet through one of the springs 13, and one or the other of the contact anvils 14 or

15 of such spring. Now as the motor magnet is excited and the shaft of the sequence-switch begins to rotate the contact which closed the initial energizing circuit of the motor magnet may be broken, but a local circuit will be maintained for the motor magnet through the contact 20 closed by the cam 16, and the rotary element will thus continue to advance until the cam roller 17 reaches the bottom of the next notch of the cam 16, thereby opening the contact 20 and permitting the magnet 12 to release the driving disk 10 from its engagement with the roller 9.

The automatic switching device above described will be particularly useful in controlling the circuits of automatic electrical machinery. For example, it may be used in automatic telephone exchange systems, to bring about, one after another, the many different circuit-changes which are necessary to cause the required sequence of operations of a selector switch. The sequence-switch in each position may establish a circuit whereby a given operation can be brought about, and at the same time may establish a circuit to be completed for its own motor magnet when such operation has been accomplished, whereby the sequence-switch may be again advanced to bring about another operation, and so on. It is not intended in this application, however, to claim the complete system of circuits and switches for controlling automatic apparatus, this being claimed in my application, Serial No. 452,539 filed September 11, 1908. The present application is directed toward the mechanical features of the particular type of sequence-switch shown in the drawings; but it will be understood that modifications may be made from the particular form shown without departing from the principles of construction herein set forth.

I claim:—

1. In a switching appliance the combination with a rotary shaft, of a cam mounted thereon and having its face cut to three different depths, a plurality of switch springs mounted adjacent said cam, and having contact points at the end thereof, the middle one of said plurality of springs being provided with a projecting portion located intermediate the ends thereof and extending into the path of the cam whereby said middle spring may be moved away from or into contact with either of the other switch springs.

2. In a switching appliance the combination with a rotary shaft, of a cam mounted thereon and having a face cut to three different depths, a switch composed of three parallel contact members insulatively secured together at one end and tangentially mounted in respect to said cam, the intermediate one of said members being provided with a projecting portion which engages said cam and in conjunction therewith controls said intermediate member in its three positions of rest.

3. In a switching appliance the combination with a rotary shaft, of a cam mounted thereon and having a face cut to three different depths, a switch composed of three parallel contact members insulatively secured together at one end and tangentially mounted in respect to said cam, the intermediate one of said members being provided with a projecting portion which engages said cam and in conjunction therewith controls the movement of said intermediate member, and the member next adjacent said cam being provided with a recess into which both the cam and the projecting portion of the intermediate member are adapted to enter, the whole forming a compact structure wherein the parallel contact members are mounted close together and have their contact points located at their free ends where they are readily accessible and wherein the intermediate contact member need only be moved through a short distance in order to contact with one or the other adjacent parallel members, or be maintained out of contact with either of them.

4. In a switching appliance the combination with a rotary shaft, a cam mounted thereon and having its face cut to three different depths, a switch mounted adjacent to said cam having an intermediate spring contact member and two alternate contact members, each having a contact point located at its free end, and a projecting portion located between the ends of said intermediate contact member and maintained in engagement with the edge of said cam to hold said intermediate contact member in a position between said alternate contact members or against one of them, and also to allow it to be brought into engagement with the other alternate contact member depending on which portion of the cam is engaged.

In witness whereof I hereunto subscribe my name this first day of September, A. D. 1908.

FRANK R. McBERTY.

Witnesses:
D. C. TANNER,
A. H. MOORE.