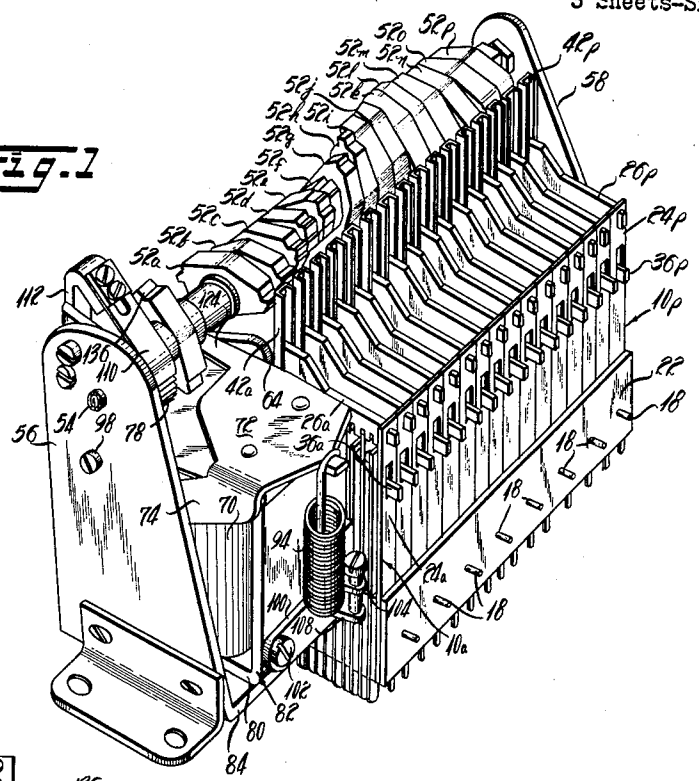
Jan. 15, 1963 O. A. OLSSON 3,073,928

ELECTRICAL SWITCHING DEVICE

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Fig. 1



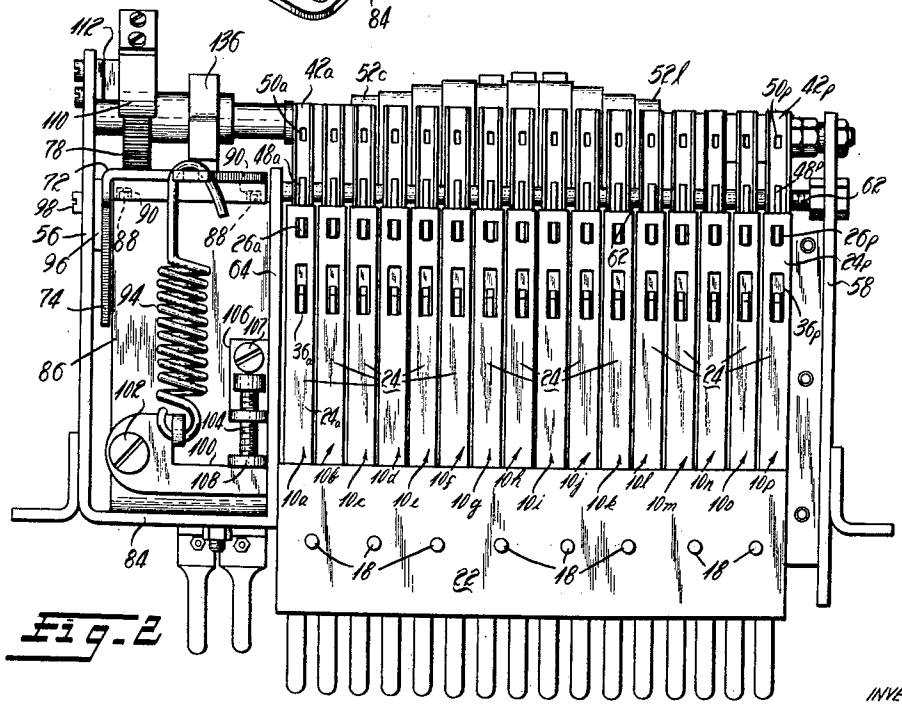


Fig. 2

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Jan. 15, 1963 O. A. OLSSON 3,073,928

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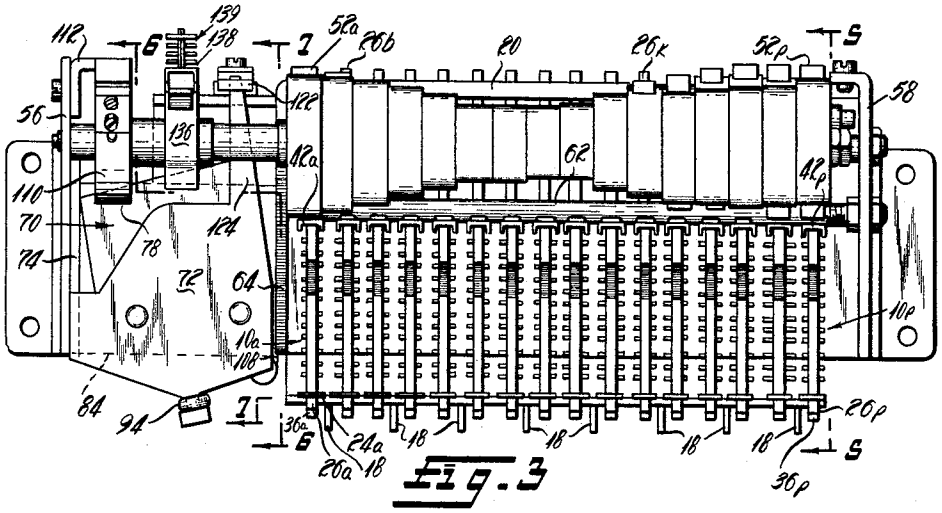


Fig. 3

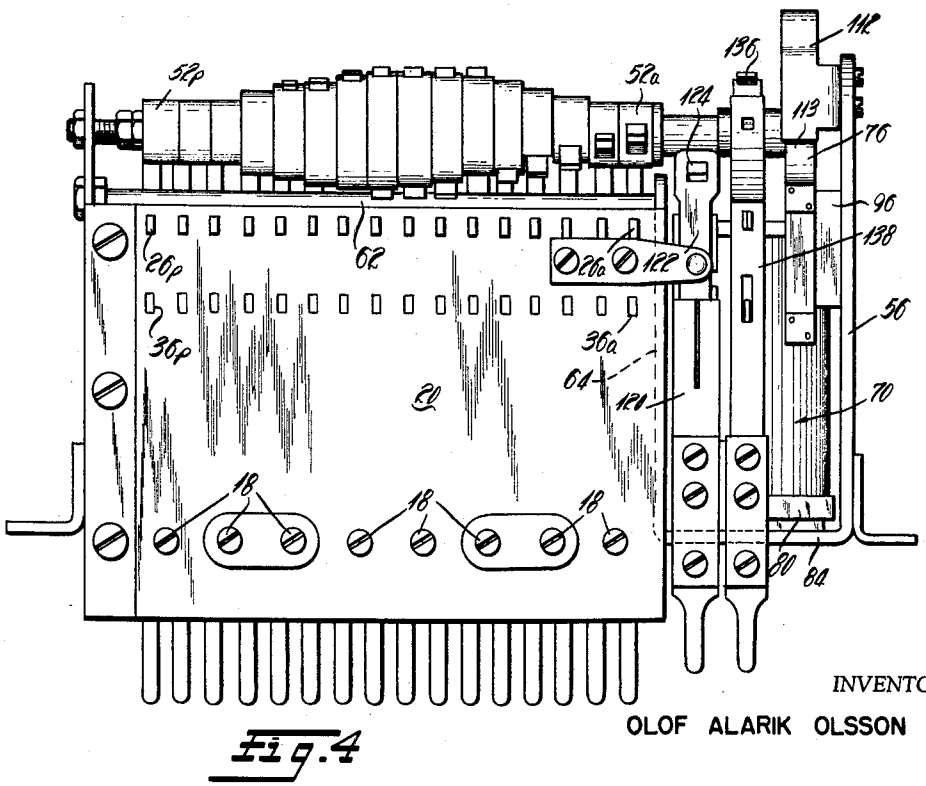


Fig. 4

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3 Sheets-Sheet 3

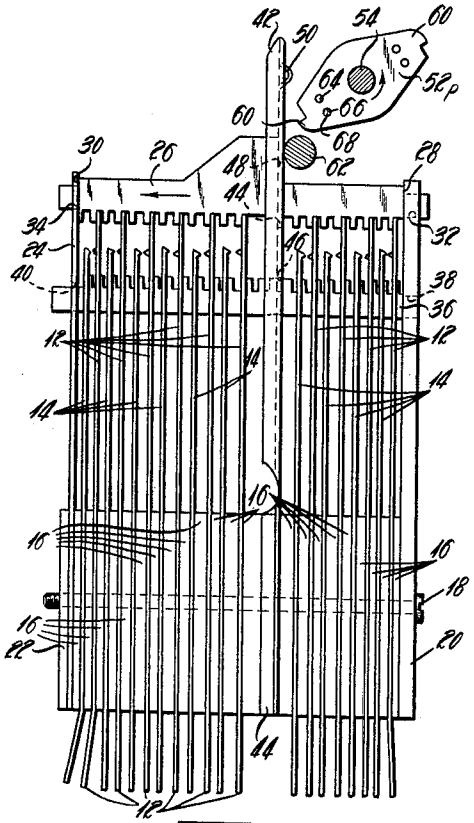


Fig. 5

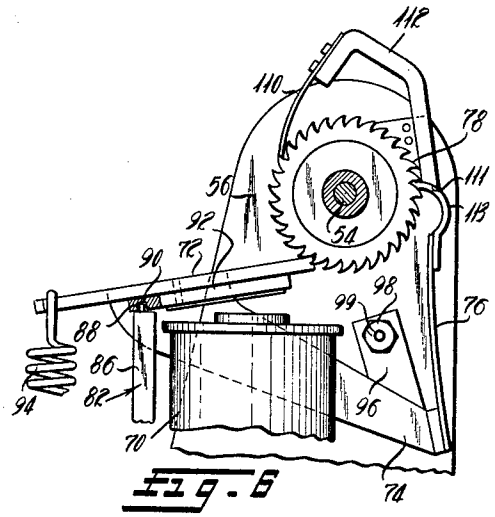


Fig. 6

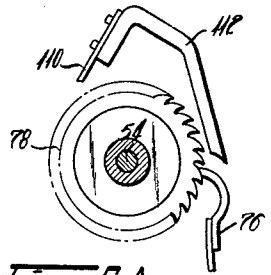


Fig. 6A

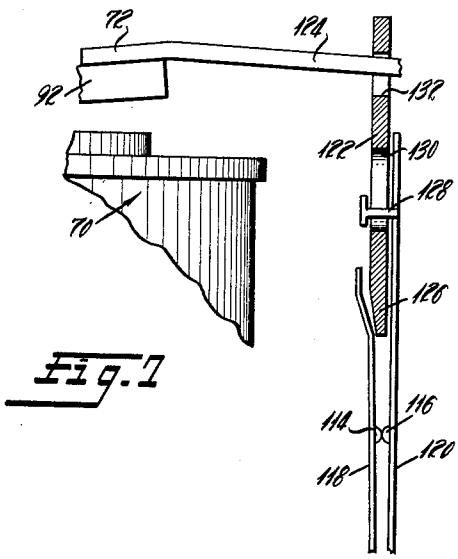


Fig. 7

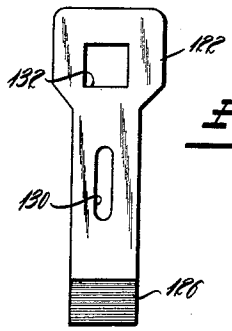


Fig. 8

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United States Patent Office

3,073,928

Patented Jan. 15, 1963

3,073,928

ELECTRICAL SWITCHING DEVICE

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Filed Feb. 2, 1960, Ser. No. 6,283
5 Claims. (Cl. 200—105)

The present invention relates to an electrical switching device comprising a plurality of sequentially actuatable contact spring sets which are arranged side by side and each of which sets comprises movable as well as fixed contact springs and is provided with an actuating member which is displaceable in its longitudinal direction and adapted to actuate all the movable contact springs of the associated set.

It is an object of the invention to provide a switching device which can be used for a number of different purposes, as for example, as a line finder, a group selector or a final selector in an automatic telephone system, which is rapid and reliable in operation, and which requires little space while providing a high capacity.

In accord with the present invention, the switching device comprises a rotatable shaft which is provided with a coaxial row of cams or the like which are situated before separate ones of a like number of juxtaposed contact spring sets and adapted to actuate directly or indirectly the spring set actuating members at points located between the ends of the actuating members.

The illustrated device is intended for use as a selector or line finder in an automatic telephone system. The invention will be described in greater detail in conjunction with the accompanying drawings which show, by way of example, an electric switching device embodying the invention. The foregoing and other objects of the present invention will become more fully apparent by reference to the appended claims and as the following detailed description proceeds in reference to the accompanying drawings wherein:

FIGURE 1 shows a perspective view of the selector;

FIGURE 2 is a front elevational view of the selector of FIGURE 1;

FIGURE 3 is a top elevational view of the selector of FIGURE 1;

FIGURE 4 is a rear elevational view of the selector of FIGURE 1;

FIGURE 5 shows a cross section through the selector multiple bank and the associated actuating members taken substantially along the line 5—5 of FIGURE 3;

FIGURE 6 is a fragmentary sectional view substantially along the line 6—6 of FIGURE 3 showing the driving mechanism of the selector;

FIGURE 6A is a view similar to FIGURE 6 showing the actuated position of the cam shaft drive pawl;

FIGURE 7 is a fragmentary sectional view substantially along the line 7—7 of FIGURE 3 showing the self-interrupter device for the control magnet of the selector; and

FIGURE 8 shows a detail of the device of FIGURE 7.

The multiple contact bank of the selector comprises a plurality of identical contact spring sets designated 10*a* through 10*p* which are arranged side by side as will be seen from FIGURES 1 through 4. For simplicity, but a single one of the sets 10*a* through 10*p* will be illustrated and described in detail. Corresponding parts in the several sets will be given like reference numerals with the distinguishing letter suffixes *a* through *p*.

In FIGURE 5 one of the contact spring sets 10*p* is shown in side view. It consists of a number of movable contact springs 12 and a like number of stationary contact springs 14. The lower end regions of the contact springs 12 and 14 and interposed insulating spacing members 16 are clamped together by means of screws 18 between two metal plates 20 and 22 whereby the remainder of springs 12 and 14 are in effect cantilever supported. The screws 18 are electrically insulated from the contacts 12 and 14 by any suitable electrical insulating means not shown. The plates 20 and 22 and the spacing members 16 extend across and are common to all spring sets 10*a* through 10*p* (FIGURES 2, 3 and 4). The plate 20 extends upwardly along the entire length of the springs, as is best shown in FIGURES 4 and 5 while plate 22 covers only the fixed lower end regions of the springs (FIGURES 2 and 5). In addition to the contact springs 12 and 14, each contact spring set 10*a* through 10*p* is provided with a spring 24 positioned adjacent plate 22 as shown in FIGURE 5. The lower ends of springs 12 and 14 project below the spacing members 16 to form electrical terminals to which wire connections can be made as desired and required.

Each contact spring set is provided with an actuating member 26 of rigid electrical insulating material which consists of a downwardly toothed rod, the opposite ends of which are of lesser cross section vertically than the rest of the rod so that shoulders 28 and 30 are formed at the ends, one of which ends extends through an opening 32 in plate 20 and the other of which extends through an opening 34 in the associated one of the springs 24. Spring 24 has a tensional bias so that rod 26 is resiliently clamped between spring 24 and plate 20. Rod 26 is displaceable in its longitudinal direction (to the left as viewed in FIGURE 5) in opposition to the biasing force of spring 24. When rod 26 is so displaced, it actuates, by its teeth 29, the movable contact springs 12 to the left as viewed in FIGURE 5. In the embodiment shown in the drawings, the contact springs are arranged for so called "indirect operation." This means that the movable contact springs 12 are spring biased towards the mating fixed contact springs 14 so that, when the actuating member 26 is moved in the direction indicated by the arrow in FIGURE 5, the movable contact springs 12 move against the mating stationary contact springs 14 due to their bias. So long as rod 26 is not actuated to the left, as will be explained presently, its shoulder 28 is held against plate 20 by the force of spring 24 which is of sufficient magnitude to overcome the combined force exerted on rod 26 by the spring contacts 12.

Each of the contact spring sets 10*a* through 10*p* is further provided with a rod-shaped upwardly toothed supporting member 36 of electrical insulating material, one end of which is tightly fitted into an opening 38 in plate 20 and the other end of which protrudes through an opening 40 in spring 24. The opening 40 is slightly larger than the associated end of supporting member 36 and the end of member 36 projects sufficiently far through opening 40 that spring 24 can be bent outwardly to the left as viewed in FIGURE 5 sufficiently to permit engagement of contact springs 12 with contact springs 14 without moving supporting member 36 or removing its left end support by spring 24. The supporting member 36 extends through openings in all the contact springs 12 and 14 of the associated contact spring set, and the fixed contact springs 14 are tensioned to the right as viewed in FIGURE 5 so that they rest against the left side of the teeth of the supporting member 36 as shown. While the openings through springs 12 and 14 must be sufficiently large to permit insertion of supporting member 36 through them, in the assembly, the top edge of those openings lies between the teeth on the supporting member 36.

Each contact spring set is also provided with a resilient tongue 42 which is anchored at its lower end in the

spring set between a plate 44 and an adjacent insulating spacer member 16 and is disposed at a place located at or adjacent to the center of the spring set. In the illustrated embodiment, the tongue 42 has a U or channel shaped cross section except at its anchored lower end region and extends at its free end beyond the free ends of the contact springs 12 and 14. The tongue is provided with through apertures 44 and 46 respectively for the actuating member 26 and the supporting member 36. The actuating member 26 has a shoulder 48 which is in contact with tongue 42. Adjacent to its free end, tongue 42 has a raised portion 50 which may consist of a part punched or pressed out of the material of the tongue 42.

Since the tongues 42 are all electrically insulated from all of the contact springs 12 and 14, the spacing member or plate 44 which bears against the fixed ends of tongues 42 but not against the contact springs, may be made of metal instead of insulating material in order to give the contact bank increased stability and rigidity.

The selector has a rotatable roller formed by a plurality of cams 52, each formed of electrical insulating material and which are arranged in juxtaposition to each other on a common shaft 54. Shaft 54 is journalled at its opposite ends in two side plates 56 and 58 which form parts of the frame of the selector as is best shown in FIGURE 1. For each contact spring set 10*a* through 10*p* there is a corresponding cam 52*a* through 52*p* aligned with its tongue 42*a* through 42*p*. The contour or profile of cams 52*a* through 52*p* are all identical to that of cam 52*p* illustrated in FIGURE 5. When a cam 52 rotates, one of the diametrically opposed cam projections or lobes 60 thereon comes into engagement with the raised portion 50 of the tongue 42 whereby the tongue 42 is pressed against the shoulder 48 on the actuating member 26 so that member 26 is displaced in the direction indicated by the arrow in FIGURE 5, thus permitting the movable contact springs 12 to make electrical contact with the cooperating fixed contact springs 14. When a projection or lobe 60 on a cam 52 has passed by the raised portion 50 on the aligned tongue 42, the actuating member 26 and tongue 42 are restored to their initial or unactuated positions as illustrated in FIGURE 5 under the action of spring 24. In order to define the initial (or unactuated) position of tongues 42, a rod 62 is provided which extends along all the tongues 42 in parallel relation to the shaft 54 and is attached to the frame of the selector between plate 58 and a further parallel plate 64 as is shown in FIGURE 3.

The shaft 54 with cams 52 fixed thereto is adapted to be driven step by step. The cams 52*a* through 52*p* are arranged with the projections 60 angularly displaced with respect to each other so that they actuate the respective tongues 42 in sequence as the shaft 54 is rotated step by step. When double lobe cams are utilized as shown, each tongue will be actuated twice during each revolution of shaft 54. Single lobe cams may be utilized and are preferable in certain applications. Adjacent each lobe 60, each of the cams 52 are provided with a pair of through apertures 64 and 66 spaced and located as shown in FIGURE 5. The cams 52 are interconnected in circumferentially offset relation by a projecting stud 68 or the like. For example, a stud 68 extends through the hole 64 in cam 52*n* and the hole 66 in cam 52*o* and a further stud 68 extends through the hole 64 in cam 52*o* and the hole 66 in cam 52*p*. The angle between the radii from the rotational axis of the cam 52 to the apertures 64 and 66 is equal to the angle of rotation corresponding to the rotation of one step of shaft 54. The cams are so shaped and constructed that they have minimum inertia, being preferably formed from light weight laminated plastic sheet material.

The described embodiment of the roller formed of a series of identical cams is advantageous in view of manufacture in that all cams are identical. It is, of course, possible to make the cam roller in some other manner, such as by moulding the whole roller in one piece.

The roller with the cams is caused to rotate step by step by means of a stepping mechanism shown in detail in FIGURE 6. This stepping mecanism comprises an electromagnet 70, an armature 72 and an arm 74 extending from the armature 72, and carrying a pawl 76 which engages a ratchet wheel 78. The magnet 70 is fixed at its lower end of the lower leg 80 of an L-shaped bracket 82, the leg 80 of which extends between the plates 56 and 64 and is fixed to the interconnecting plate portion 84 which interconnects and is integral with support plates 56 and 64 as is best shown in FIGURE 2. Armature 72 is pivotally mounted upon the end of the upstanding leg 86 of bracket 82, being retained in position by pins 88 fixed to and projecting from the top edge of leg 86 into cooperating recesses 90 of slightly larger diameter in the lower face of plate 92 fixed to the armature 72. Armature 72 is biased toward its de-energized position (counterclockwise as viewed in FIGURE 6) by a spring 94 the position as shown in which arm 74 engages a stop 96 of insulating sound deadening material fixed to the interior face of plate 56 by a nut 98 and stud 99.

As is best shown in FIGURE 2, the lower end of spring 94 is connected centrally to a lever 100 pivoted on the leg 86 by a pivot and locking screw 102. The tension of spring 94 is adjustable by manipulation of an adjusting screw 104 threadedly mounted on an L-shaped bracket 106 that is fixed to leg 86 by a screw 107 and abutting an ear 108 on lever 100.

Ratchet wheel 78 is fixed to the shaft 54 of the cam roller. A resilient spring detent 110 (FIGURE 6) fixed to plate 56 by a bracket 112 overlies and bears against the teeth of ratchet wheel 78 and prevents the backward (clockwise as viewed in FIGURE 6) motion of the wheel 78 while permitting counterclockwise rotation of wheel 78 under the force of spring 94 exerted through pawl 76. Bracket 112 is formed with a curved surface 111 which cooperates with the curved surface 113 on pawl 76 to assure proper driving engagement of the latter with the teeth of ratchet wheel 78.

When current is supplied to the winding of the electromagnet 70, the armature 72 is attracted and the arm 74 carries the pawl 76 out of engagement with one tooth and into engagement with the next adjacent tooth in a clockwise direction on the ratchet wheel 78 as shown in FIGURE 6A, ratchet wheel 78 being held by detent 110. When the current through the winding ceases, the armature is restored to its initial position by a spring 94, whereby pawl 76 rotates the ratchet wheel 78 through one step in a counterclockwise direction as viewed in FIGURES 6 and 6A.

The stepping mechanism is combined with a self-interrupter contact shown in FIGURE 7. FIGURES 7 and 8 are drawn to a larger scale than the other figures. The self-interrupter contact consists of the two contact members 114 and 116 which are mounted on the contact springs 118 and 120 respectively. The self-interrupting contact also comprises a contact actuating member 122, which is shown in longitudinal section in FIGURE 7, and in rear view in FIGURE 8. The armature 72 of the magnet is provided with a second arm 124 (see also FIGURES 3 and 4). When the armature 72 is rotated to its energized position, the arm 124 actuates the contact actuating member 122 so that member 122 is displaced in its longitudinal direction. The initial position of the contact actuating member 122 is shown in FIGURE 7. When the armature 72 is attracted, arm 124 causes the member 122 to be displaced downwardly whereby a wedge-shaped portion 126 of the member 122 is pushed between the ends of contact springs 118 and 120 and separates these ends so that the contact members 114 and 116 are separated from each other and the electrical contact is broken. In the illustrated embodiment the member 122 is attached to spring 120 by means of a

stud or rivet 128 which extends through an elongated opening 130 in the member 122. The opening 130 is lengthened to allow the member 122 to be displaced through a certain distance. The free end of arm 124 of the armature 72 extends through an opening 132 in the member 122. When the armature 72 is attracted by the electromagnet 70, the end of arm 124 is pressed against the bottom edge of this opening 132 and thus pushes the member 122 downwardly, and when the armature 72 is restored to its initial de-energized position, member 122 is restored to its initial position by the end of arm 124 engaging the top edge of opening 132. As appears from FIGURES 7 and 8, the distance between the top edge and the bottom edge of opening 132 is larger than the thickness of arm 124. When the armature is attracted or released, the end of arm 124 will accordingly move a certain distance without actuating member 122, that is, the actuation of member 122 takes place in both directions with a certain predetermined slight time delay.

When contacts 114 and 116 are connected in series with the energizing coil of the magnet 70 and a steady direct voltage is applied in series in this circuit, the electromagnet will receive energizing current as long as member 122 is in the position shown in FIGURE 7. The armature 72 is thereby attracted and actuates, after a predetermined time delay, the member 122 so that it is pushed in between the springs 118 and 120 causing the contacts 114 and 116 to be separated from each other so that the energizing current through the energizing coil of the magnet 70 is interrupted. The armature 72 is then returned to the initial position by the spring 94 and arm 124 restores, with a predetermined time delay, the member 122 to its initial position, whereby contacts 114 and 116 are closed again so that the energizing coil of the magnet 70 receives current and the armature 72 is attracted again. Each to and fro movement of the armature 72 causes a rotation of one step of the roller formed by cams 52*a* through 52*p*. Due to the said time delay in the actuation of member 122 by arm 124, the time interval between the closure and break of the energizing current will be sufficient to allow the armature 72 to perform the maximum angular movement so that pawl 76 (FIGURE 6) in the stepping mechanism always is carried out of engagement with one tooth and into engagement with the next adjacent tooth on the ratchet wheel 78 when the armature 72 is attracted. In spite of the said time delay, the selector operates very rapidly when it is connected for self-driving. It has proved in practice that selectors in accord with the present invention can operate satisfactorily at a rate up to 60 steps per second.

In the illustrated embodiment, the shaft 54 carries a separate cam 136 (FIGURES 1 through 4) which is adapted to actuate a separate contact spring set 138 serving as a home position contact. In the specific illustrated embodiment, cam 136 is positioned to transfer contacts 138 after tongue 42*p* has been released from engagement by cam 52*p* but before tongue 42*a* is engaged by cam 52*a*. Contacts 138 of contact set 139 are arranged in the control circuit for magnet 70 so that the shaft 54 will be driven 180° to actuate in sequence all of the contact sets 10*a* through 10*p* and stop with all of the contacts 12 and 14 open. Other contact pairs of set 139 may be utilized in other circuits for control or indicating purposes. Initiation of a cycle of operation is effected by closing external contacts not shown connected in parallel with contacts 138.

Due to the fact that tongues 42 which serve as lifting springs operated by cams 52 are located adjacent to or at the center of the contact spring sets, a saving of space is achieved, in spite of the fact that the contact spring sets, as is the case in the illustrated embodiment, may contain as much as twenty contact springs.

In the illustrated embodiment all of the contact springs are arranged as make contacts, but of course they can be arranged to perform other functions such as break and changeover functions.

The embodiment described above and illustrated in the drawings is given by way of example only and can be modified in many ways within the scope of the invention. Thus, it is possible within the scope of the invention to arrange the cam roller and the actuating members 26 so that the cams act directly upon the actuating members in which case the tongues 42 can be omitted.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. An electrical switching device comprising a plurality of parallel juxtaposed contact spring sets, each said set comprising at least a fixed spring contact and a cooperating spring contact movable into and out of electrical contact engagement with said fixed contact, a like plurality of elongated actuating members, one of said actuating members being operatively connected to each movable spring contact of each of said spring sets and each of said actuating members being mounted for limited longitudinal displacement sufficient to so move the movable spring contact connected thereto, rotatable cam means extending across and operatively connected to all of said actuating members at points intermediate their ends to impart contact moving longitudinal movement to said actuating members in a predetermined sequence as said cam means is rotated, drive means for imparting rotational movement to said cam means; said drive means comprising an electromagnet, an armature operably connected to said electromagnet, a ratchet wheel attached to said cam means and a pawl attached to said armature adapted to engage said ratchet wheel; a control member adapted to be actuated by said armature, a contact adapted to be actuated by said control member, said control member being so designed and arranged in relation to said armature that upon movement of the armature between its released position and its attracted position the control member is not actuated by the armature until the armature has performed a part of its motion, said armature being provided with an arm which is so arranged that when the armature moves in one direction the arm comes into engagement with one part of said control member and when the armature moves in the other direction said arm comes into engagement with another part of said control member, said two parts of said control member being so positioned in relation to each other and to said arm that the arm can move a predetermined distance from engagement with said one part before it comes into engagement with said other part.

2. An electric switching device comprising a plurality of parallel juxtaposed contact spring sets, each said set comprising at least a fixed spring contact and a cooperating spring contact movable into and out of electrical contact engagement with said fixed contact, a like plurality of elongated actuating members, one of said actuating members being operatively connected to each movable spring contact of each of said spring sets and each of said actuating members being mounted for limited rectilinear longitudinal displacement sufficient to so move the movable spring contact connected thereto, rotatable cam means extending across and operatively connected to all of said actuating members at points intermediate their ends to impart contact moving longitudinal movement to said actuating members in a predetermined sequence as said cam means is rotated, and drive means for imparting rotational movement to said cam means,

each of said contact spring sets being provided with a resilient tongue which is anchored at or adjacent to the center of the spring set and the free end of which extends beyond the free ends of the contact springs and is located in the path of movement of said cam means, and each of said actuating members having a shoulder which is so positioned that said tongue is pressed against it when the free end of said tongue is displaced under the control of said cam means.

3. An electric switching device comprising a plurality of parallel juxtaposed contact spring sets, each said set comprising at least a fixed spring contact and a cooperating spring contact movable into and out of electrical contact engagement with said fixed contact, a like plurality of elongated actuating members, one of said actuating members being operatively connected to each movable spring contact of each of said spring sets and each of said actuating members being mounted for limited rectilinear longitudinal displacement sufficient to so move the movable spring contact connected thereto, rotatable cam means extending across and operatively connected to all of said actuating members at points intermediate their ends to impart contact moving longitudinal movement to said actuating members in a predetermined sequence as said cam means is rotated, and drive means for imparting rotational movement to said cam means; said drive means comprising an electromagnet, an armature operably connected to said electromagnet, a ratchet wheel attached to said cam means and a pawl attached to said armature adapted to engage said ratchet wheel; a control member adapted to be actuated by said armature, a contact adapted to be actuated by said control member, said control member being so designed and arranged in relation to the armature that upon movement of the armature between its released position and its attracted position the control member is not actuated by the armature until the armature has performed a part of its motion.

4. An electric switching device comprising a plurality of parallel juxtaposed contact spring sets, each said set comprising at least a fixed spring contact and a cooperating spring contact movable into and out of electrical contact engagement with said fixed contact, a like plurality of elongated actuating members, one of said actuating members being operatively connected to each movable spring contact of each of said spring sets and each of said actuating members being mounted for limited rectilinear longitudinal displacement sufficient to so move the movable spring contact connected thereto, rotatable cam means extending across and operatively connected to all of said actuating members at points intermediate their ends to impart contact moving longitudinal movement to said actuating members in a predetermined sequence as said cam means is rotated, and drive means for imparting rotational movement to said cam means, said cam means comprising a shaft and a like plurality of cams mounted in juxtaposition on said shaft so that said shaft and cams together form a roller, each cam on one side being provided with a protruding stud and on the other side with a recess of substantially equal cross section to the cross section of the protruding portion of the stud, the cams being fixed in relation to each other by said stud on each cam being fitted into said recess in the adjacent cam.

5. The electrical switching device defined in claim 4 wherein said stud and said recess in each cam are so positioned in relation to each other that the angle between the radii from the axis of rotation of the cam to the stud and the recess is equal to the angle of rotation of one step of the shaft under control of said drive means.

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