

April 28, 1942.

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2,281,472

SWITCH FOR AUTOMATIC TELEPHONE PLANTS

Filed Dec. 20, 1939

4 Sheets-Sheet 1

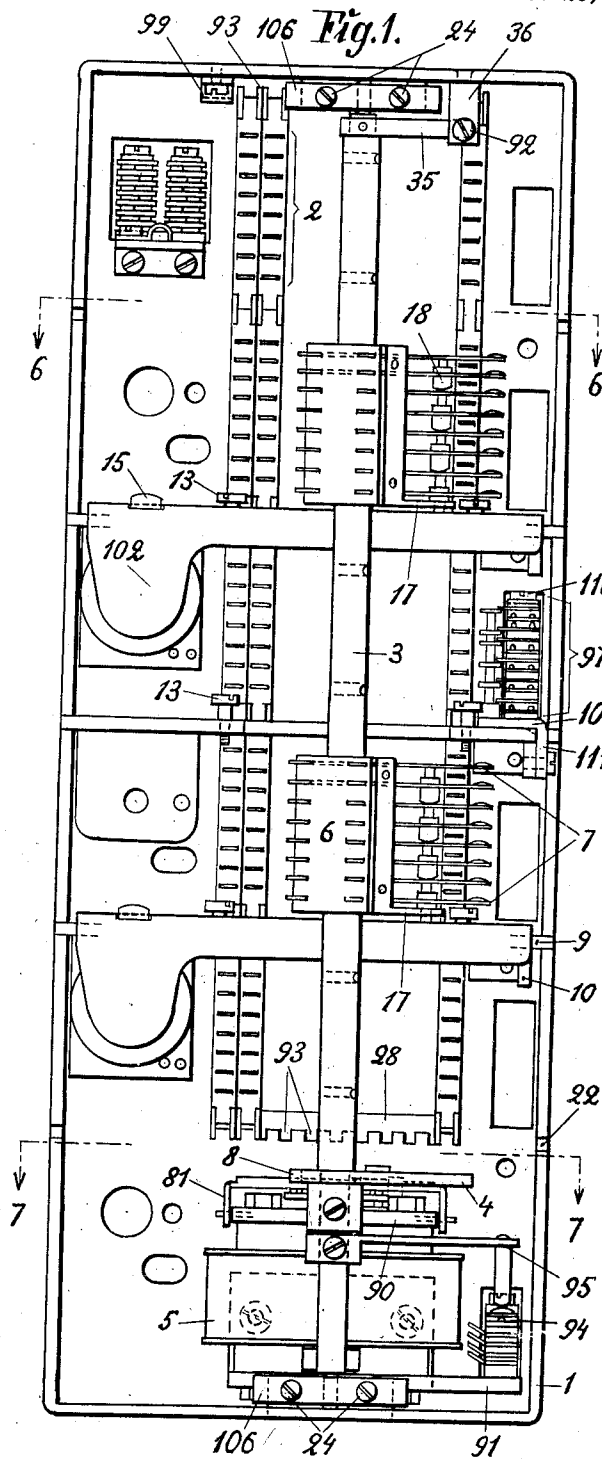
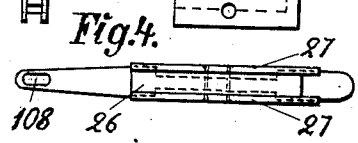
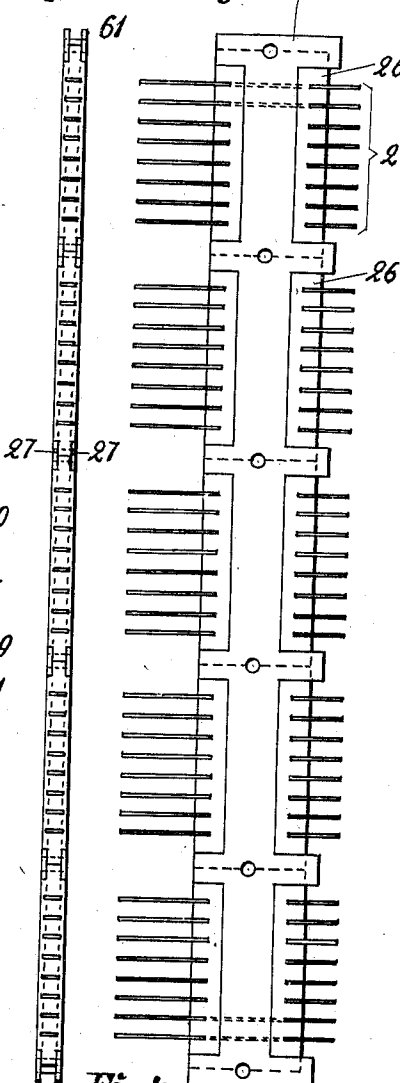


Fig. 2.



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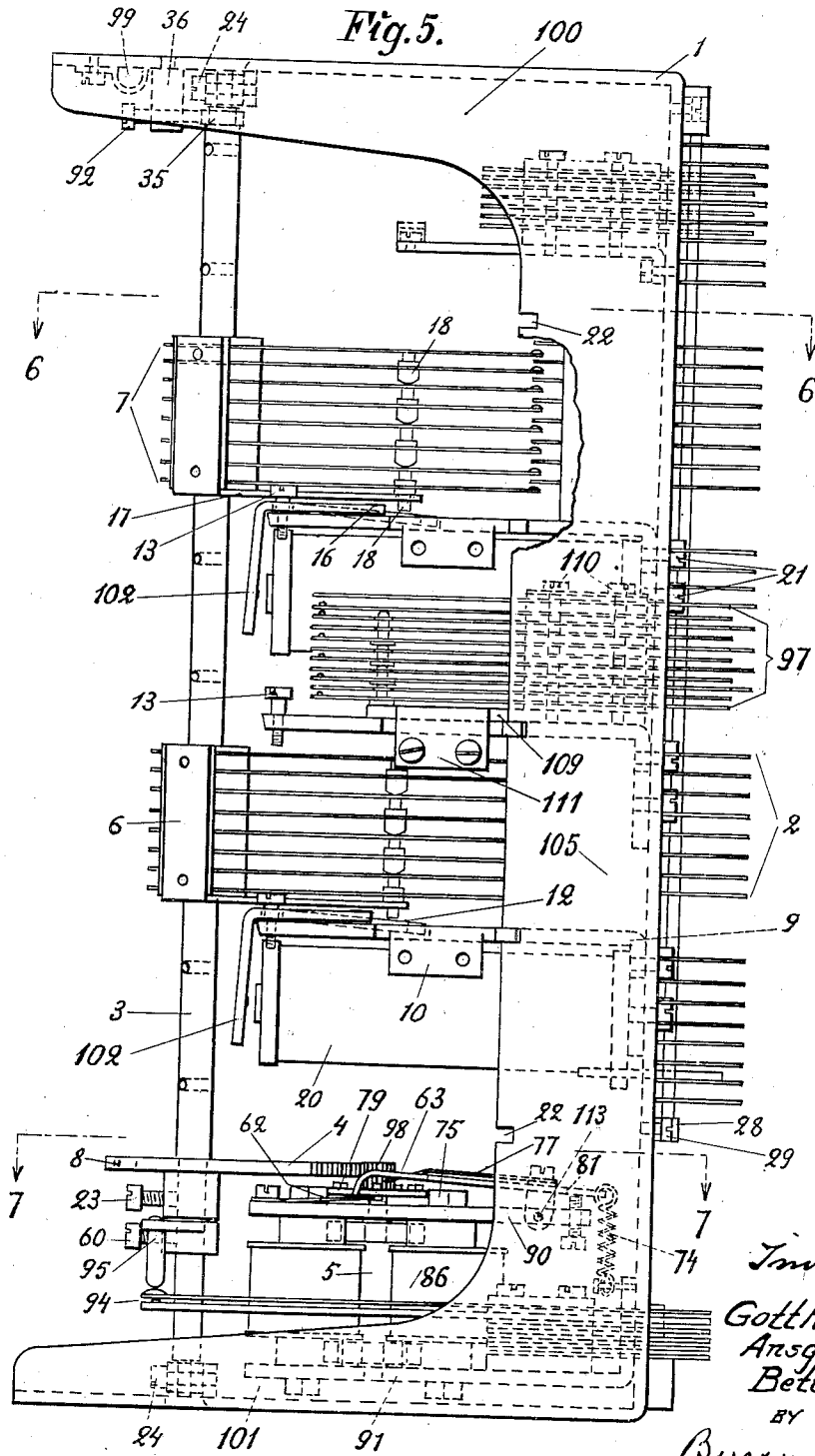
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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

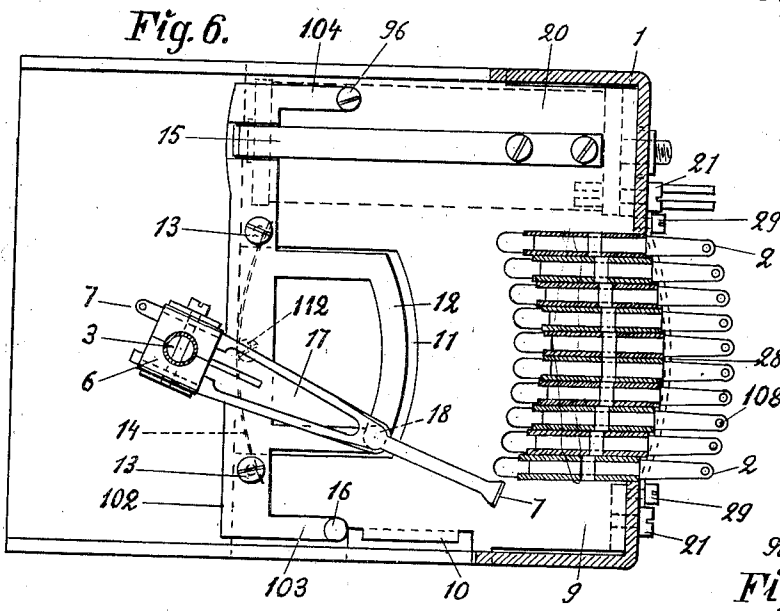


Fig. 8.

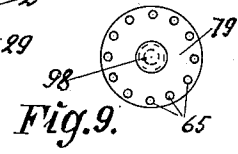
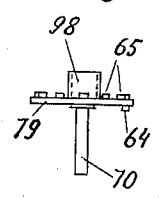
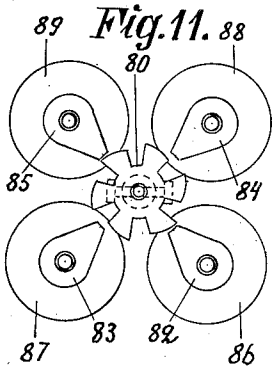
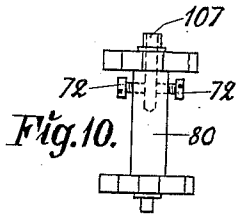
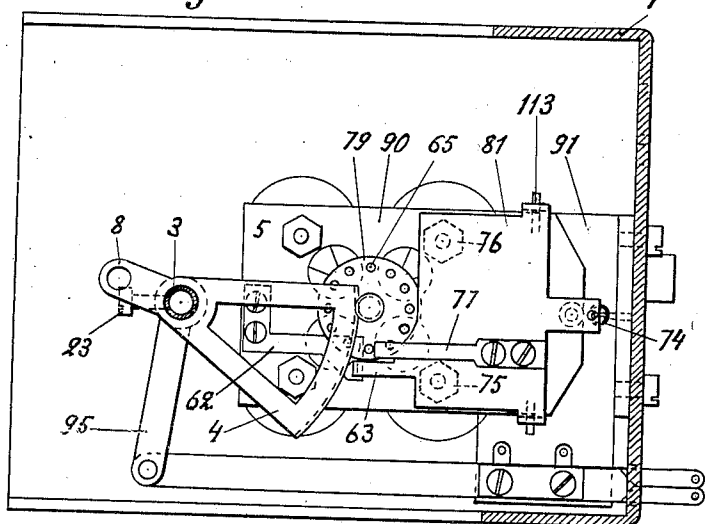


Fig. 7.



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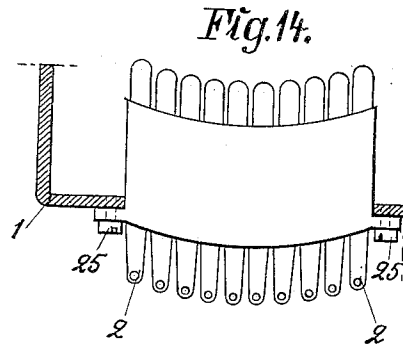
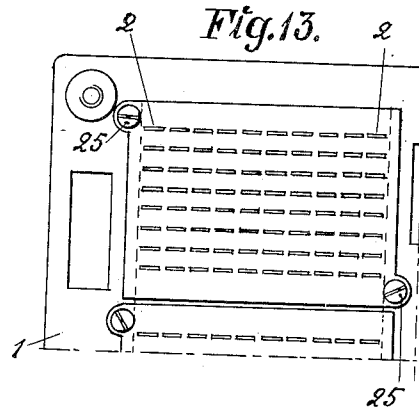
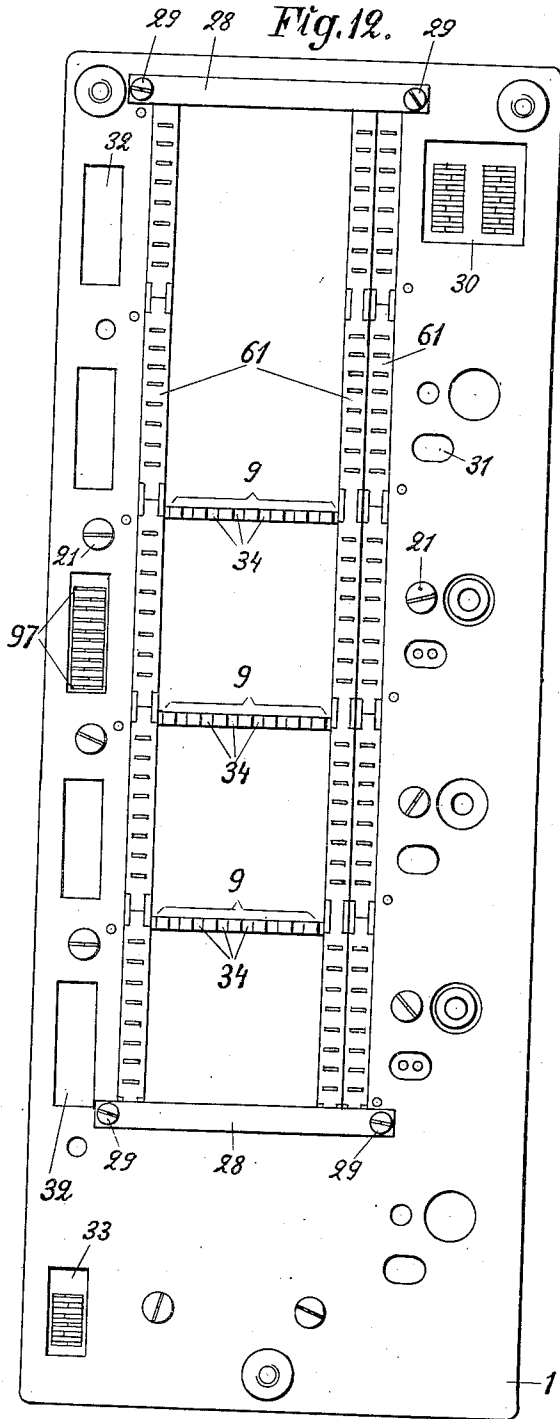
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SWITCH FOR AUTOMATIC TELEPHONE PLANTS

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4 Sheets-Sheet 4



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# UNITED STATES PATENT OFFICE

2,281,472

## SWITCH FOR AUTOMATIC TELEPHONE PLANTS

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11 Claims. (Cl. 179—27.5)

The present invention relates to switches for automatic telephone plants of a type that could be classified as a combination of a rotating switch and a coordinate switch. Such switches find an extensive use as selectors and searchers in plants of the kind in question.

The present invention has for its object, inter alia, to combine in one switch the advantageous properties of rotating switches with those of coordinate ones, when each type is used separate, and, at the same time, to avoid most of their inconveniences.

In order to understand the invention reference will be had to the annexed drawings illustrating, by way of example, a preferred embodiment which by no means is limitative. In this connection other objects and features of the invention will also be set forth.

On the drawings,

Fig. 1 is a front view of the switch, a cover being removed,

Figs. 2, 3 and 4 show a detail of Fig. 1 in front, side, and end views respectively,

Fig. 5 is a view of the switch from the right hand side of Fig. 1,

Figs. 6 and 7 are cross-sections on the lines 6—6 and 7—7 respectively in Figs. 1 and 5.

Figs. 8 and 9 show a detail of Figs. 1, 5 and 7 in side and end views respectively,

Fig. 10 is an armature of a motor in side view,

Fig. 11 shows the motor in end view,

Fig. 12 is a back view of the switch, and

Figs. 13 and 14 are modified details of Figs. 12 and 6 respectively.

In the embodiment illustrated, the switch is intended to operate as a selector. A cover not shown on the drawings is intended to be pushed over the switch frame 1. This is made of channel-shaped plate which, according to Fig. 5, is formed with lateral end projections 100, 101 supporting the cover. According to Figs. 5 and 12 a number of stationary contact sets 2 are inserted through an aperture in the back of the frame 1. Their contacts form soldering lugs 108, Fig. 6, on the rear side of the switch for attacking the necessary conductors.

Between both end walls of the frame a longitudinal shaft 3 is rotatably mounted. The shaft carries a toothed sector 4 which is meshing with a pinion 98 mounted on the driving shaft of an electric motor 5, preferably arranged for a step-wise rotary movement.

Diametrically opposed to its teeth the sector 4 carries a cable or wire lug 8 intended to hold those interconnecting wires which are associated

with rotatable contact spring sets 7 described below. To fix the interconnecting wires to the frame there is further provided a clip 99 at the one end of the frame.

Instead of the electric motor 5 shown on the drawings, any other driving means, such as a driving pawl mechanism or the like, can be used. On the shaft 3 there are further rigidly mounted insulating blocks 6 which each carry one contact spring set 7 cooperating with and corresponding to one of said stationary contact sets 2. The contact springs of each rotatable set 7 are forked and enclose together with the corresponding block the shaft 3, compare Fig. 6, and are rigidly connected with said shaft. The switch is provided with five blocks and five movable spring sets 7, but for the sake of clearness only two of them are shown on the drawings.

In the switch frame there are accommodated five bridges 9 of which only three are shown for the sake of simplicity. For the purpose of illustration the bridge closest to the midst of the switch is shown without any electromagnet or armature. The bridges are at their one side provided with bent down tongues 10 adapted to carry operating spring sets 97 operated by the bridge magnet armatures described below.

For this purpose each of said spring sets 97 is secured by means of screws 110 to a plate 109 provided with a bent down tongue 111 which cooperates with and is detachably secured to said tongue 10. Of said operating spring sets 97 there is one embodiment shown as fixed to the bridge being closest to the midst of the bridge. Ordinarily there is such a spring set 97 provided for each bridge. The composition of the spring sets 97 depend upon the field of application of the switch. In said bridges there are provided recesses 11, Fig. 3, in which operating frames 12 are swingably mounted and adapted to be operated by electromagnet armatures 102 forming bent portions of said frames 12. The armatures 102 are loosely held in their proper positions, in a manner known per se, in regard to the bridge 9 by means of screws 13 and a leaf spring 14 engaging an abutment 112 of the frame 12 according to Fig. 3. This spring together with another spring 15 fixed to the bridge 9 produce also a tendency to hold the armature 102 in the starting position shown on the drawings. The armature is further, on its one side, provided with a tongue 103 with an operating abutment 16 adapted to operate the operating spring sets 97 secured to the tongues 10. In coordinate selectors said operating spring sets 97 are termed

"bridge spring sets" in conformity with the so called "bridge magnets" 20 mounted on the bridges. On the other end the armature 102 carries a finger 104 cooperating with an adjusting screw 96 intended to adjust the angle of rotation of the armature 102. In the just mentioned rotatable spring set 7 there are further included an operating column 18 of known type, having several separate abutment elements loosely bearing on one another which column is governed by the contact springs 7, on the one hand, and by a rigid control plate 17, on the other hand, against which latter the column 18 will bear in the normal position of the frame 12 on account of a certain biasing tension of the contact springs. In rotating the shaft 3 the contact spring sets 7 will participate in the rotation and said column 18 will move freely along an arcuate slide path on said frame 12 in the unattracted position of the armature 102. On the other hand, in its attracted position the armature 102 will raise the frame 12 to parallelism with the bridge 9 so that it will engage the outermost element of the column 18 and force the contact springs of set 7 to bear against the stationary contacts 2 in any position of rotation of the contacts 7.

For the rest, the mounting and design of the different parts will be clearly understood from the drawings. It is thus clearly visible that the bridges 9 are secured by means of screws 21 to the back plate of the frame 1 and are guided in the webs 105 of the frame by means of recesses 22, Fig. 5, so that they are easily detachable after the shaft 3 has been removed. The toothed sector 4 is angularly adjustable in relation to the shaft 3 by means of a set screw 23 so that the contact spring sets 7 be exactly set in their proper angular position in relation to the corresponding stationary contact sets 2. In regard to the mounting of the shaft 3 it should be observed that the shaft could be easily removed only by untightening screws 24 holding the exterior part 106 of a bearing for the shaft 3.

On the shaft 3 there is further mounted an operating arm 95 controlling the contact 94, Fig. 5, so that the latter is closed when the selector is in its starting position. This arm 95 can be adjusted in its proper angular position by means of a set screw 60.

The disposition of the stationary contact field is rendered clear by studying Figs. 2 to 4 and 12 to 14. Fig. 13 shows a portion of the back plate of the switch having ten times eight contacts 2 mounted in a solid insulating block. Fig. 14 shows the same detail viewed from above in Fig. 13. In this case the ten contact sets are held in a common block of insulating material which is fixed to the back plate by means of screws 25 so that the entire block is easily detachable rearwards.

Another embodiment of the stationary contact field is apparent from Figs. 2 to 4 and 12. In this case the contact sets 2 are accommodated in insulating slabs 26 which are held together by lateral metal clamps 27 so that longitudinal bars 61 are formed which are secured to the back plate by means of small plates 28 disposed near the ends of the switch frame and held by screws 29, compare Fig. 12. For the sake of simplicity only the first, ninth, and tenth bars 61 are shown in Figs. 1 and 12. The bars 61 are further guided by guiding teeth 93, Fig. 1, provided in the back plate and by guiding slots 34, Fig. 12, provided in the bridges 9. The guiding slots

34 have for their purpose to guide the bars 61 so that they, upon being pushed into the frame, obtain the correct circumferential arrangement in regard to the shaft 3, compare Fig. 6. From Fig. 6 it will be clearly seen how the contact sets 7, mounted on the shaft 3, will be rotated along the arcuate slide path of the frame 12.

Fig. 7 is an end view of the electric motor consisting of four electromagnets 86, 87, 88 and 89 having pole pieces 82, 83, 84, and 85, and an armature 80. The motor is held together by end plates 90, 91 carrying the above mentioned parts of the motor. The pinion 98 and the locking disk 79 are rigidly connected with the armature 80 by means of the screws 72, Fig. 10, engaging a pin 70, Fig. 8, inserted into an axial bore 107 of the armature 80, Fig. 10. The electromagnets 86, 88 are further provided with pole tips 75, 76 cooperating with a swingable armature 81 cooperating with a detent spring 77. There is also another detent spring 62 mounted directly on the plate 90. The armature 81 is pivoted on studs 113.

The switch operates as follows. It is first assumed that the switch is mounted with the shaft 3 in horizontal position so that Fig. 5 will be a top view and Figs. 6 and 7 accordingly vertical sections. It will then be easily understood that the shaft 3 carrying the rotatable contact spring sets 7 will have a tendency, on account of its gravity, to take up the position shown in Figs. 6 and 7 being the starting position. This starting position is fixed in a manner known per se and can be adjusted by an arm 35, Figs. 1 and 5, in cooperation with the adjusting screw 92 mounted in a standard 36. Instead of gravity the force of a spring of spiral, leaf or torsional type could be used as a restoring force in which case the switch, of course, may be mounted with vertical or otherwise directed shaft 3.

In most cases the switch is so connected up that the numerical setting is made by rotating the shaft 3. For instance, if the spring sets 7 have to be moved to make contact with the contacts of the second contact bar 61 the motor armature 80 must be rotated four steps through the action of four current impulses, it being understood that two impulses are required to move the spring sets 7 from one contact bar 61 to the next one.

When the switch is to be set the driving means, such as the motor 5, is started and brings the shaft 3 to rotate through the intermedium of the toothed sector 4. All the contact spring sets 7 mounted on the shaft are then brought to wipe over the stationary contacts 2 in the stationary contact field, however, without making any contact with the latter. The shaft is now brought to rotate a definite angle or a definite number of steps which might be in accordance with a definite number of impulses in an impulse train, whereby a definite longitudinal row 61 of stationary contacts 2 is selected. During setting the motor operates in such a manner that the magnets 87, 88 are first energized. Hereby the armature 80 is rotated one step in a clockwise direction and the contact spring sets 7 are rotated half the distance between adjacent contact bars 61. Now the other magnets 86, 89 are energized and the magnets 87, 88 deenergized, whereby the armature 80 is rotated one step further. The contact spring sets 7 have now been rotated to a position opposite the first contact bar 61. The energization of the different pairs of magnets 87, 88 and 86, 89 respectively must

take place continuously so that there is no interruption in the magnetic torque exerted by the motor it being understood that the restoring force exerted on the armature would otherwise force the shaft 3 and the armature to rotate backwards after the completion of each step forward. When the magnets 87, 88 are energized the armature 81 is attracted to the pole tip 76 and pushed by its arm 63 the spring 62 out of engagement with corresponding locking teeth on the disk 79. This is released and the armature 80 is now allowed to rotate. By the attraction of the armature 81 the spring 77 mounted thereon will engage one of the stop abutments 65 on the disk 79 and lock the armature in its position reached after the completion of the first step. When the magnets 86 and 89 are then energized before the deenergization of the magnets 87, 88 the armature 81 is still held attracted. The armature 80 is rotated one step further and is held in the position reached upon completion of this step by the next locking abutment 65 of the disk 79. The rotary contacts 7 are hereby rotated forward to the first contact bar 61. The same cycle of operation as above described will now be repeated for rotating the contacts forward to next contact bar 61 etc.

After this primary movement there will take place a secondary selecting movement by energizing a certain connecting member being in this embodiment one of the bridge magnets 20, 102 so that the corresponding slide path of the frame 12 will actuate the operating column 18 of the selected contact set so that all contact springs of this set will be raised and brought into engagement with the corresponding contacts in the selected set of stationary contacts 2.

In this manner the desired communication has been established and the driving motor can now be disconnected and deenergized. Hereby the armature 81 is released from the pole tips 75, 76 through the action of the spring 74 and the spring 62 is prepared to engage the locking abutment 64, Fig. 8 of the disk 79 and the detent 77 is moved out of engagement. The frictional engagement established between the different contacts 7 and 2 is entirely sufficient to retain the switch in the position set against the action of the restoring force. When restoration is to take place the bridge magnet 20 is brought to drop its armature so that the contact engagement is released and the shaft 3 together with all the contacts 7 are brought back to their starting positions under the action of gravity or spring power and locked in normal position by the abutment 64 of the disk 79 and the spring 62 cooperating therewith so that the switch cannot jump back and make the contact 94 unsafe.

Apparently the above described switch can be modified and the invention be applied in many different manners without departing from the idea of the invention. On the drawings there is shown a switch having five bridge magnets and eight superposed springs for each contact set. This switch can thus be used according to the so called double set principle so that each movable contact spring set corresponds to two lines each having four wires in which case one or more relays will be required to separate the two connected-up communications through one and the same spring set. It is also possible to design the switch with ten bridge magnets one for each communication, or otherwise with any arbitrary number of bridges to suit conditions.

The switch according to the invention can be used for several different purposes, such as for group selectors or final selectors etcetera. If the switch is to be used as a searcher there should be provided an additional contact row in the stationary contact field and in one of the movable contact spring sets there should be provided a sliding spring or the like which, during the rotation, wipes over said additional contact row and thus acts as a so called test contact during the searching procedure.

If the switch is used as a group selector the free search is performed through the bridge magnets which connect themselves into circuit in a definite order of sequence until a free communication is found. If the switch is used as a final selector the bridge magnets are connected into circuit in due order of sequence in accordance with the figures dialed.

What is claimed is:

1. A switch for automatic telephone plants comprising a rotatable non-slidable shaft, a plurality of groups of flexible contact brushes rigidly connected with said shaft, a bank of stationary contact springs adapted to cooperate with said rotatable contact brushes, said contact brushes being adapted, during rotation of said shaft, to rotate out of contact with said stationary springs, a rotating abutment associated with and participating in the rotation of each one of said groups of rotatable contact brushes, a number of stationary bridge electromagnets allotted individually to each one of said groups of rotatable contact brushes, a stationary abutment path operated individually by said bridge electromagnets and extending substantially in parallel with the path of movement of the appertaining rotating abutment, said abutment path, upon being operated, actuating said rotating abutment to flex the rotating contact brushes into contact with the selected stationary contacts.

2. A switch for automatic telephone plants comprising a rotatable non-slidable shaft, a plurality of groups of flexible contact brushes rigidly connected with said shaft, a bank of stationary contact springs adapted to cooperate with said rotatable contact brushes, said contact brushes being adapted, during rotation of said shaft, to rotate out of contact with said springs, an operating abutment associated with each one of said groups of rotatable contact brushes, a number of bridge electromagnets allotted individually to each one of said groups of brushes, oscillable armatures operated by said electromagnets, flaps extending from said armatures and provided each with an abutting surface extending, in the operated position of the flap, in parallel with the path of movement of the appertaining operating abutment, then engaging said abutment and causing the brushes appertaining thereto to be flexed in the direction of the movable shaft into contact with the selected group of stationary contacts.

3. A switch as claimed in claim 2, in which said flap is in the shape of an open frame the side of which being remote from the axis of oscillation is arcuate and adapted to engage the operating abutment.

4. A switch as claimed in claim 2, comprising a stiff guiding plate allotted to each group of movable brushes, said guiding plate being rigidly connected with the shaft and being adapted to cooperate with the appertaining operating abutment so that, in the inoperated position of

the corresponding armature, said operating abutment will be held by a biasing tension of said brushes to bear against said guiding plate without touching the abutting surface on the corresponding flap in any position of rotation of the shaft.

5 5. A switch as claimed in claim 2, comprising a stiff guiding plate allotted to each group of flexible contact brushes and rigidly connected with the shaft, a number of mutually loose elements bearing against one another and constituting a column carried by the appertaining group of rotatable contact brushes to form a connecting member, abutments on said elements cooperating with the brushes in the appertaining group to force said column of elements to bear against said guide plate with a biasing tension in the inoperative position of the armature.

6. A switch as claimed in claim 2, comprising insulating solid blocks holding together each rotatable group of contact brushes and in which said brushes in each group are forked at their one end and, in cooperation with the corresponding block, firmly grip around the shaft.

7. A switch as claimed in claim 1, comprising an electric motor individual to each switch for driving its shaft in a single direction of rotation and a restoring force acting in the opposite direction of rotation independently of said motor.

8. A switch as claimed in claim 1, comprising an electric motor individual to each switch for positively driving its shaft stepwise during the setting movement thereof, means for locking the motor in the position reached after each step, and means for energizing one of said bridge electromagnets at a time to actuate the appertaining operating abutment so as to cause frictional locking action between the rotary contact brushes and the stationary contact springs.

9. A switch as claimed in claim 1, comprising a switch frame and bridges detachably mounted in said switch frame, each bridge carrying one of said electromagnetically operated brush operating means.

10. A switch as claimed in claim 1, comprising a switch frame and solid insulating blocks accommodating said stationary contact springs and being detachably mounted in said switch frame.

11. A switch as claimed in claim 1, comprising an electric driving means individual to each switch for driving its shaft stepwise during the setting movement thereof in a single direction of rotation, a restoring force acting in the opposite direction of rotation independently of said motor, and detent means acting on said driving means to retain the shaft in its starting position.

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