April 3, 1945. W. H. T. HOLDEN 2,372,782

SELECTOR SWITCH

Filed Jan. 7, 1943

FIG. 3.

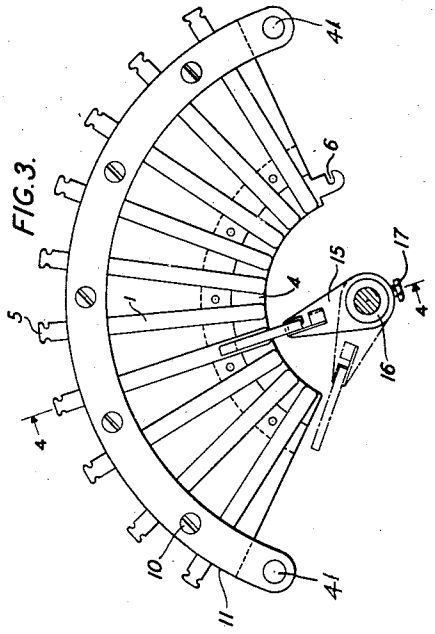


FIG. 4.

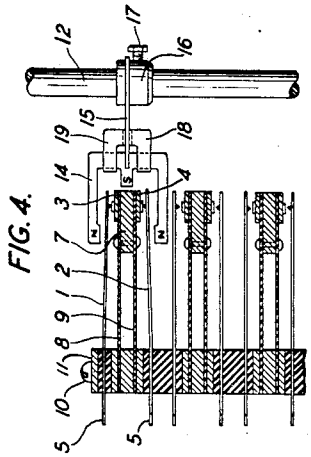


FIG. 1.

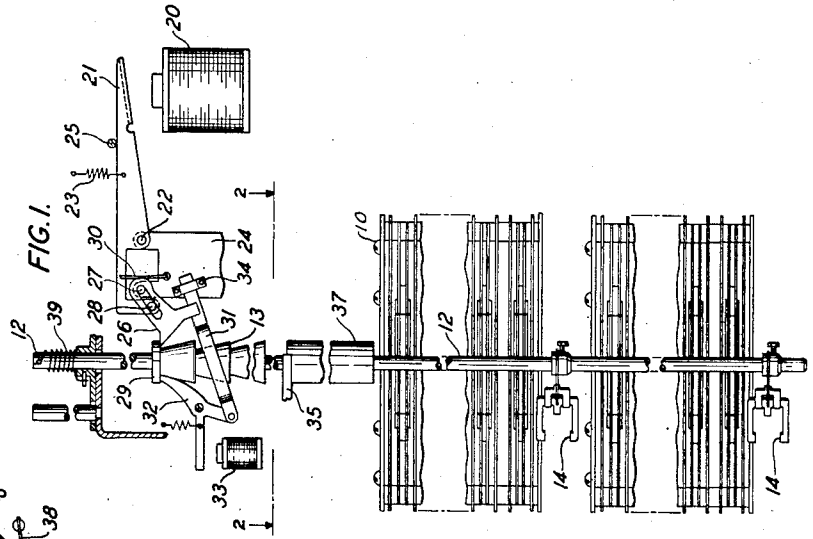
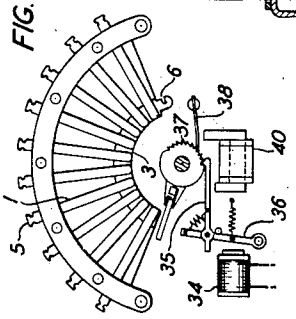


FIG. 2.



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Patented Apr. 3, 1945

2,372,782

# UNITED STATES PATENT OFFICE

2,372,782

## SELECTOR SWITCH

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Application January 7, 1943, Serial No. 471,548

4 Claims. (Cl. 179—27.52)

This invention relates to selector switches and more particularly to selector switches for use in automatic telephone systems. More specifically, the object of the invention is a switch structure in which the contact members are not of the brush and commutator type which are subject to excessive wear but of the relay type wherein a movable member may be selectively set in juxtaposition with a group of terminal members to cause their engagement.

In one specific embodiment of the invention which is disclosed herein by way of illustration, the terminal members are arranged in conventional terminal bank form, each terminal row in the bank comprising two common terminal strips which are separated from each other at the front end thereof by a number of equally spaced magnetic spacers interposed therebetween, and by as many pairs of magnetic reeds as there are spacers, one reed of each pair being mounted above one of the terminal strips in alignment with a spacer and the other reed being mounted below the other terminal strip also in alignment with said spacer. The moving element of the switch, instead of being provided with the usual brush wipers for engaging the terminals, is equipped with a suitable magnet which, when selectively positioned so that the spacer is between the poles of the magnet, a magnetic circuit is completed through the pair of reeds and the spacer, to cause the reeds thereby to be attracted into engagement with their respective common terminal strips. Thus the contact members in the switch of my invention are operated as relay contacts, which makes it possible to obtain more reliable circuit closures than would otherwise be attainable with the usual wiper brush type of switch.

The invention is herein disclosed in connection with a two-motion step-by-step switch, although it will be readily understood that the principle of my invention is readily applicable to other types of switches such as, for example, single motion step-by-step switches and so-called panel switches.

Referring now to the drawing:

Fig. 1 shows a front elevation of a selector switch having two terminal banks, a shaft with a magnetic element mounted thereon for each bank, a mechanism for stepping and releasing the shaft, magnet for stepping said mechanism in the vertical direction and a release magnet for restoring the shaft to normal. The terminal banks are shown in an abridged form to indicate omitted terminal rows therein;

Fig. 2 shows a top elevation of the switch particularly disclosing the mechanism for stepping the shaft in the horizontal direction, a magnet for actuating said mechanism and another magnet for releasing said mechanism;

Fig. 3 is an enlarged showing of the top of the switch taken along the section line 2—2 of Fig. 1, particularly to show the top of a terminal row, to indicate the magnet-carrying shaft in a normal position and to show said shaft in an operated position; while,

Fig. 4 shows a side elevation taken along section line 4—4 of Fig. 3 particularly to show the structure of a terminal set in each of the terminal rows and the position of a magnet element on the shaft when positioned to operate a terminal set.

Referring to the drawing, each set of contact making elements in the terminal bank comprises a magnetic spacer 7 of any suitable magnetic material, two insulating strips 8 and 9 between which a spacer 7 is secured at the forward end thereof in any suitable manner, a portion of each of two arcuate common terminal strips 3 and 4 each having a wiring lug 6 formed at one end thereof, strip 3 being mounted on the upper faces of insulating strips 8 substantially flush with the ends thereof and strip 4 being secured to the lower faces of insulating strips 9 substantially flush with the ends thereof, and two magnetic reeds 1 and 2, disposed to be in substantial vertical alignment with the spacer 7 and of a length such that, when flexed, will engage the common terminal strips 3 and 4, respectively. Each reed is formed with a wiring lug 5 on its rear end.

The two rows of terminal sets constituting each terminal level of the bank comprises the requisite number of pairs of magnetic reeds 1 and 2, their interposed spacers 7, and the associated common terminal strips 3 and 4. The reeds 1 and 2 and the insulating strips 8 and 9 are radially disposed in the conventional manner for a step-by-step switch as shown in Fig. 3, the same being mounted in stacked formation to form a terminal bank with a required number of terminal levels. The reeds 1 and 2, the spacers 7 and the terminal strips 3 and 4 of each terminal level are insulated from each other and from the reeds of adjacent levels by suitable insulating members as shown in Fig. 4. The entire terminal bank is securely held together by insulated clamping screws 10 passing through aligned openings (not shown) in the supporting member 11 on top of the terminal stack, similar supporting member (not shown) at the bottom

of the stack and the insulating members (not shown) interposed in the space between successive pairs of magnetic reeds. An aperture 41 is provided at each end of the upper supporting member 11 and also at each end of the lower supporting member (not shown) for tie rods by which two or more terminal banks may be stacked together.

The shaft 12 is of familiar construction, it being substantially similar in form to the brush shaft of the well-known Strowger step-by-step switch. Mounted on the lower part of the shaft below the rotary ratchet wheel 37 are the permanent magnets 14 of which one is provided for each bank of terminals to which the shaft has access. Each magnet is preferably E-shaped, the width of its yoke exceeding slightly that of the terminal pile-ups as shown in Fig. 4 and with a protruding central portion to form a third magnetic pole, also as shown in Fig. 4. Each magnet is supported upon the shaft through the medium of the plate 15 which is mounted on the slidable collar 16 secured firmly to the shaft by screw 17. The plate is rectangularly slotted at its end to permit the yoke of the magnet to freely pass therethrough. After the magnet is vertically centered on the plate, the gripping members 18 and 19 are each formed to grip the yoke of the magnet on either side of its center pole-piece, said members being then drawn back until the rear of the magnet abuts the end of the slot in the plate 15 after which the members 18 and 19 are secured to the opposite faces of said plate by a common bolt or screw which is not shown. With the magnets 14 thus mounted on the plates 15 and the shaft 12 positioned to any terminal level by raising it to the height measured by the corresponding number of vertical ratchet teeth 13, the shaft is rotated to one of the terminal pile-ups in the level, the two oppositely disposed poles of the magnet are over and in substantial alignment with the reeds 1 and 2 of the pile-up and the third or middle pole is opposite the front edge of the magnetic spacer 7 thereof. Since all the terminal pile-ups in the terminal levels are in horizontal alignment, the shaft, during its rotary movement in any level, will clear each terminal pile-up.

Thus with a magnet 14 positioned around a terminal pile-up as described, a magnetic circuit is established through the three poles of the magnet, the reeds 1 and 2 and the magnetic spacer 7, the lines of force of said magnetic circuit dividing with approximate equality through the magnetic spacer 7 from the common south pole S of the magnet 14 in alignment with the right end of the spacer 7 (after traversing the reeds) to the two oppositely disposed north poles N of said magnet, thus completing the two branches of the magnetic circuit. Since the reeds disposed above and below the spacer 7 are each included in one of the two branches of the above circuit, it follows that said reeds will be attracted towards the spacer.

It will further be observed from Fig. 4 that the motion of the reed 1 away from the upper pole N of the magnet 14 is less than the distance moved by the end of the reed towards the spacer 7. Therefore the increase in reluctance at the air-gap near the upper pole N is more than offset by the decrease in reluctance as the reed tends to engage the associated terminal strip 3. Since in any magnetic system, a magnetic element will move in a direction to reduce reluctance to a minimum, the reed will continue to be attracted towards spacer 7 until it engages the terminal strip. In the same manner, a similar but an oppositely directed operation takes place with the lower reed 2, causing it to engage the terminal strip 4.

The vertical magnet 20 is adapted, when operated, to raise the switch shaft 12 step by step by means of the armature 21. This armature is pivoted at 22 on the right leg of the fixed U-shaped member 24 and is held in its unoperated position against the stop 25 by the spring 23. The portion of the armature extending beyond the pivot support at 22 is also U-shaped and is wide enough to clear the left edge of member 24 when operating and releasing. Slidably mounted by the fixed pin 27 upon the upper extremity of the left extension of member 24 and by the fixed pin 28 on the lower extremity of the left extension of armature 21, is the vertical pawl 26 which, in the normal position of the shaft 12 as shown in Fig. 1, engages the under portion of the collar 29. The vertical flat spring 30 anchored to the fixed member 24 is tensioned against the curved portion of the pawl to insure that said pawl is always yieldably engaged against the surfaces and the under portions of each of the teeth 13 of the vertical ratchet.

To the holding pawl 32 which is part of the armature of the vertical release magnet 33 and is activated thereby, is loosely pinned the slide-bar 31 which has a straight portion extending across the front of the vertical ratchet portion of the shaft 12 and an off-set portion which, curving behind the downwardly extending finger of the vertical pawl 26 is slidably supported in the bracket 34 obliquely fastened to the member 24. It is obvious that when holding pawl 32 is actuated by magnet 33, slide-bar 31 is pushed to the right, thereby engaging the finger of vertical pawl 26 and causing said pawl to slide to the right on pins 27 and 28 to disengage it from the under-side of a tooth 13 and to free the shaft for its return to normal operation as described hereinafter.

Each time armature 21 is operated, the pawl 26 lifts the shaft 12 but, in so doing, and because of the angular cut of the teeth 13, the shaft presses back against the pawl which, being slidably secured to the pins 27 and 28 and abutting against the vertical spring 30, causes the latter to be placed under tension, said tension reaching a maximum when the pawl reaches engagement with the lower edge of the tooth. At the edge of the tooth, the pawl 26, by virtue of the tension built up in spring 30, is now forced into the space between the upper tooth along the surface of which the pawl has been engaged and the tooth immediately below, the shaft being retained in the stepped position by the holding pawl 32. Thus the vertical pawl 26 is always held pressed against the surfaces of the vertical teeth 13 and in the spaces between successive teeth in preparation for succeeding vertical steps with each operation of the vertical magnet 20.

When the rotary magnet 34 is operated, the shaft 12 is rotated one step by means of the rotary pawl 35 which is pivotally linked to the armature 36, said pawl being itself one of the two armatures of the rotary release magnet 40, the other armature being the holding dog 38. With each rotary step taken by the shaft, tension is applied to spring 39 which is coiled around the upper end of the shaft 12 one end of said spring being hooked to said shaft and the other to the switch frame. The shaft, however,

is prevented from restoring from any rotary position by virtue of the holding dog **38** which becomes lodged in the space between two teeth of the rotary ratchet **37**.

With each rotary step taken by the shaft **12**, the magnets **14** carried thereon are positioned over correlated terminal sets in their respective terminal banks, and because of the magnetic circuits established through the magnets and the magnetic spacers opposite which they are respectively positioned, the reeds **1** and **2**, for example, are attracted into engagement with their respectively associated common terminal strips **3** and **4** to complete circuits thereover. When it is undesirable to cause each contact set to operate as the magnet passes over it, separate cut-through relays may be used to electrically activate only the contact set which is within the magnet when the shaft comes to rest.

When the shaft **12** is to be restored to normal, release magnets **33** and **40** are simultaneously operated. Magnet **40** attracts the pawl **35** and the holding dog **38** out of engagement with their respective rotary teeth spaces, thereby leaving the shaft free to rotate in the counter-clockwise direction to its normal elevated position under the influence of tensioned spring **39**.

The operation of magnet **33** moves the holding pawl **32** to the left causing its disengagement from the under portion of one of the vertical teeth **13** and further moves the slide-bar **31** to the right which, by engaging the finger of the vertical pawl **26**, trips this pawl out of engagement with the under portion of the same vertical tooth. The shaft **12** is now free to fall of its own weight to the normal position. When magnets **40** and **33** release, rotary pawl **35** is released to engage the first rotary tooth on the shaft while the holding pawl **32** and the vertical pawl **26** will become positioned beneath the rest **29**.

What is claimed is:

1. A selector switch for automatic telephonic systems including a plurality of magnetically movable resilient contact members and cooperating stationary contact members arranged in stacked relation to form a terminal bank, a magnetic spacer interposed between each two pairs of movable and cooperating stationary contact members, and a shaft having a permanent magnet mounted thereon, said shaft being arranged for movement over said movable members and in proximity to their associated magnetic spacers, whereby said movable members are attracted and flexed into electrical contact with said stationary members, and whereby upon the movement of said shaft away from a set of movable members and their associated magnetic spacer said movable members release and break contact with said stationary contact members.

2. A selector switch for automatic telephone systems comprising stationary and magnetically movable contact members arranged in a stack to form a terminal bank, a magnetic spacer for each pair of magnetically movable members interposed between two stationary contact members and in substantial alignment with the associated pair of movable contact members, insulating means interposed between all of said magnetic spacers, and a tri-polar permanent magnet structure arranged to be moved over said terminal bank with two of its poles passing over each pair of movable contact members and the third pole moving in proximity to the magnetic spacer associated with said pair of movable contact members, whereby said pairs of movable contact members are attracted to and subsequently released from contact engagement with the associated stationary contact members.

3. A selector switch comprising the combination of a terminal bank having a plurality of terminal rows each including two common fixed contact members, cooperating magnetically movable contact members disposed above and below each common fixed contact member, a magnetic spacer for each pair of movable contact members interposed between said fixed contact members and aligned with said movable contact members, and actuating means for said movable contact members comprising a permanent magnet adapted to move past and free from engagement with said movable contact members, whereby to attract and release them in succession.

4. A selector switch comprising a terminal array having a plurality of magnetic spacers, a contact terminal disposed above and another contact terminal disposed below each of said spacers, both of said contact terminals being insulated from their associated spacers, a pair of magnetic reeds for each pair of contact terminals, one of said reeds being disposed over the upper terminals and the other of said reeds being disposed below the lower terminal, each of said reeds being normally out of engagement with its associated terminal, and a permanent magnet adapted for selective movement over said terminal array whereby the alignment of said magnet with a pair of reeds and an associated spacer causes the flux of said magnet to traverse the spacer and reeds and causes said reeds to be brought into engagement with their associated pair of contact terminals.

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