

Jan. 5, 1937.

O. A. FRIEND

2,066,465

SWITCH

Filed Nov. 8, 1935

4 Sheets-Sheet 1

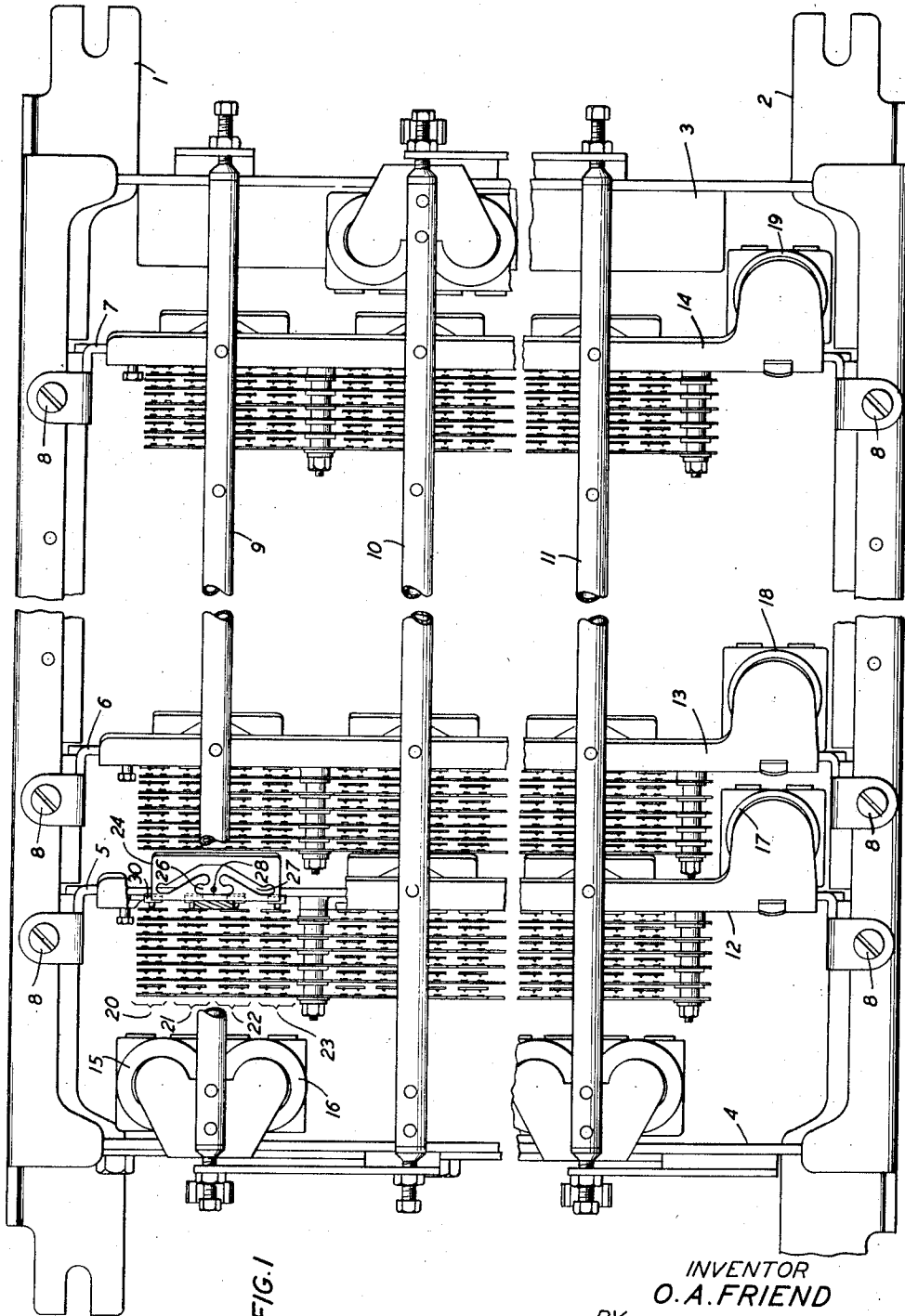


FIG. 1

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FIG. 3

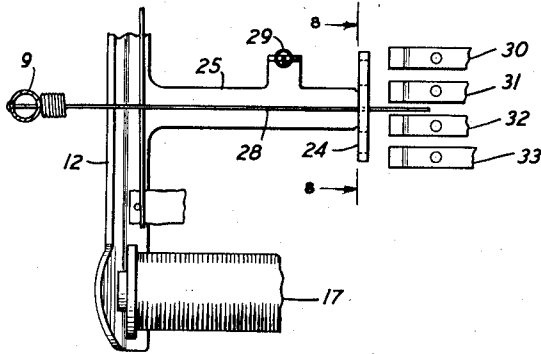


FIG. 4

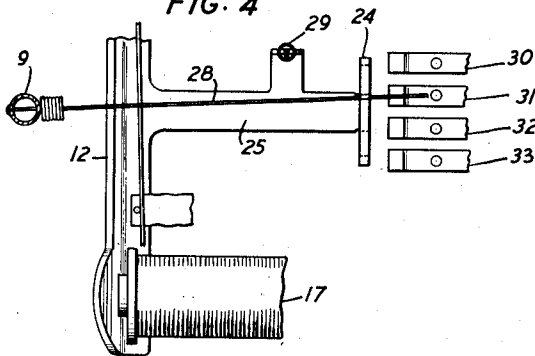
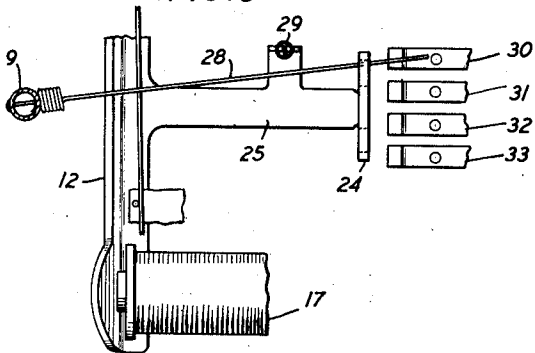


FIG. 5



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FIG. 8

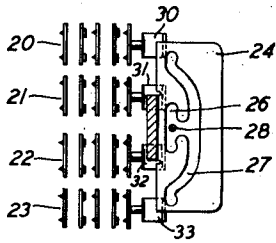


FIG. 11

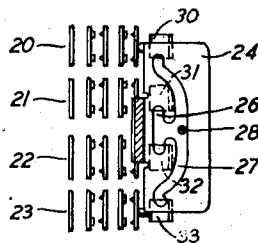


FIG. 9

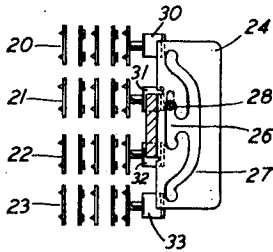


FIG. 12

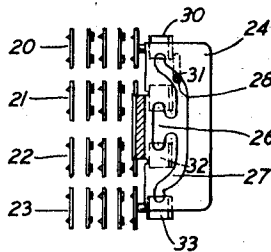


FIG. 10

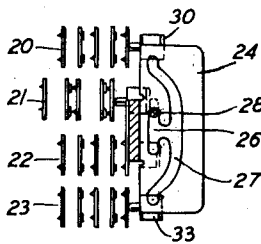


FIG. 13

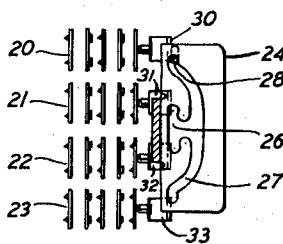
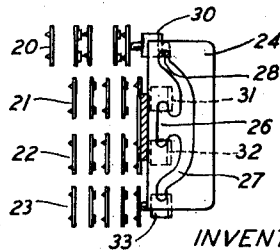


FIG. 14



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# UNITED STATES PATENT OFFICE

2,066,465

## SWITCH

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Application November 8, 1935, Serial No. 48,920

6 Claims. (Cl. 179—27.54)

This invention relates to automatic switches and particularly to those used in telephone exchange systems.

The objects of this invention are to increase the contact making capacity of selective switches without adding to or complicating the operating parts involved and in general to improve and simplify their operating and releasing functions.

In the copending application of H. H. Schneckloth, Serial No. 48,926, filed Nov. 8, 1935, there is disclosed and claimed a cross-bar switch in which the capacity is increased by providing a plurality of contact sets at each cross-point controlled by a pair of magnets comprising a horizontal magnet and a vertical magnet, in which the contact sets are selectively closed according to the order in which the two magnets are sequentially energized and deenergized, in which the operated contacts are maintained closed by independent means to allow the magnets to be released for further use, and in which the closed contact sets at any cross-point are selectively restored by the energization and deenergization of both magnets in different sequential orders.

A feature of the present invention is a switch of this general character having a plurality of sets of contacts at each cross-point controlled by a horizontal magnet and a vertical magnet, the contact sets at a cross-point being selectively closed by the energization and deenergization of the two magnets in different orders, and in which any set of operated contacts is held closed by the continued energization of one of said magnets. By this arrangement it is possible to effect the release of any one of the operated sets of contacts by merely opening the circuit of the holding magnet. Another advantage of this switch is that the contacts are always operated by the energizing force of one of the magnets, thus obviating the use of the retractile spring for moving the contacts and the consequent need for a more powerful magnet.

A feature of the invention is a switch of this kind in which one of the operating magnets of a pair is arranged to operate a plurality of times for the purpose of selecting and closing one of the contact sets controlled by it.

These and other features of the invention will be set forth more in detail in the following specification and also in the appended claims.

In the drawings, which also constitute a part of the specification:

Figure 1 is a front view showing as a whole a cross-bar switch incorporating the features of this invention. In this figure certain duplicate

parts have been broken away and omitted to conserve space;

Fig. 2 is a fragmentary perspective of the essential operating elements of the switch;

Figs. 3, 4 and 5 are side views of a portion of the contact operating mechanism illustrating the horizontal operating bar in three different positions;

Figs. 6 and 7 are top views of the contact operating mechanism showing one of the vertical bars in two different positions; and

Figs. 8 to 14 are diagrams showing the contact operating elements in different relative positions involved in the selective operation of the different contact sets.

The invention is applicable in general to switches of the cross-bar type in which the bars of a plurality of sets cooperate with each other to bring about the selective operation of a desired set of circuit-making contacts. A switch of this kind is shown and described in the application of J. N. Reynolds, Serial No. 702,453, filed December 15, 1933, granted as Patent 2,021,329, Nov. 19, 1935. In the Reynolds patent and in the switch illustrated herein the cross-bars are rendered active by imparting a rotary movement thereto. Other switches of this general kind make use of a sliding bar instead of the rotary bar, and the present invention may also be applied to switches of this kind.

Referring now to the drawings, the switch illustrated therein comprises two channel-shaped frame members 1 and 2 and two side members 3 and 4. The side members 3 and 4 fit into the channels of members 1 and 2 and are secured therein in any suitable manner, as by means of welded joints.

The contact sets and the contact operating mechanism are mounted in units on the vertical mounting plates 5, 6, 7, etc. These plates are secured by means of screws 8 to the upper and lower frame members 1 and 2. The number of these vertical units is variable and depends upon the desired capacity of the switch; however, one convenient capacity for switches of this kind is afforded by providing ten of these vertical units. The contact bank, which is formed by the contacts carried by the several mounting units, may be considered as divided into two multiples, a horizontal multiple and a vertical multiple. The horizontal contact sets appearing at successive cross-points along a horizontal row may be multiplied together by means of strap wires. Although not shown in detail in the drawings, this method of multiplying the horizontal contact sets is well

known in the art. Likewise the cooperating vertical contact sets appearing at successive cross-points in the vertical row may be formed in multiple. This arrangement of connecting the vertical contacts in multiple is obtained, as seen in Fig. 1, by stamping the successive vertical springs from a single piece of sheet metal. To effect a connection at any particular cross-point it is necessary to bring about a closure between the horizontal contact springs and the corresponding vertical contact springs. This is accomplished by means of the contact selecting and operating mechanisms which will be described presently. Before taking up these mechanisms, however, a description will be given of the cross-bars which control them.

The cross-bars of the switch comprise two sets, the horizontal or select bars 9, 10, 11, etc., and the vertical or actuating bars 12, 13, 14, etc. Each of the horizontal bars is common to four horizontal rows of contacts. For example, the horizontal bar 9 is common to the four uppermost horizontal rows of contacts shown in Fig. 1, two of which lie immediately above the bar 9 and the other two of which lie immediately below said bar. For each of these horizontal bars there are provided two operating magnets, such as the magnets 15 and 16 associated with the horizontal bar 9. One magnet rotates the bar in one direction, and the other rotates it in the opposite direction. As shown, the magnets for some of the horizontal bars are mounted on the frame member 3, and the magnets for the remaining horizontal bars are mounted on the opposite frame member 4. The number of horizontal bars may be varied and will be determined by the desired capacity of the switch. One convenient capacity is obtained by using five horizontal bars. The several vertical bars are attached for rotary movement to their respective mounting plates. The vertical bars 12, 13 and 14, for example, are mounted on the plates 5, 6 and 7, respectively, and are operated in a rotary movement by the respective vertical magnets 17, 18 and 19. Each of these vertical bars is associated with a single vertical row of contacts.

From the above explanation it will be seen that each cross-point or point of cooperation between a horizontal bar and a vertical bar is provided with four sets of contacts. In order to select and operate any one of the four different sets of contacts at a cross-point, there is provided a contact operating mechanism which is controlled by the action of the corresponding horizontal and vertical bars. One of these contact operating mechanisms is shown in detail in the upper left corner of the switch in Fig. 1. It is common to the four sets of contacts 20, 21, 22 and 23. This contact operating mechanism, which is shown more clearly in the detailed Figures 2 to 14, inclusive, includes a slotted operating plate 24 which may be either secured to or integral with the end of the operating arm 25 of the vertical bar 12. The plate 24 is provided with an inner guiding slot 26 and an outer guiding slot 27. The purpose of these slots is to guide the flexible contact operating finger 28 into the proper one of four selective positions for operating the corresponding one of the four sets of contacts 20, 21, 22 and 23. The flexible finger 28, which is secured to the horizontal operating bar 9, projects through the slotted opening in the plate 24 and normally occupies a position midway between the upper and lower ends of the inner slot 26. This normal position is illustrated in Figs. 2 and 8. The vertical bar

12 is maintained in its normal position by a spring 29, and the horizontal bar 9 is maintained in its normal position by any suitable means, such as a spring (not illustrated) to maintain this normal relation between the flexible finger 28 and the slotted operating plate 24. In a similar manner each cross-point in the switch structure is provided with four separately operable sets of contacts and a contact operating mechanism including a slotted operating plate, an operating arm on the corresponding vertical bar and a flexible operating finger on the corresponding horizontal operating bar.

A description will now be given of the operation of the switch for the purpose of selecting and closing the contact sets at any desired one of the cross-points. In this connection it will be helpful to refer to the diagrams shown in Figs. 8 to 14. Assume first that it is desired to select and close the contacts of the set 21. To accomplish this, the horizontal bar 9 is rotated by means of the operating magnet 16 to lift the flexible finger 28. As the finger 28 comes to rest in the upper end of the inner guiding slot 26, as seen in Figs. 4 and 9, the extreme free end of the finger is positioned opposite the spring operating element 31 associated with the contact set 21. Next, the vertical bar 12 is rotated by energizing the magnet 17 to rock the arm 25 and advance the operating plate 24 toward the left to a position illustrated in Fig. 10. As the plate 24 advances to the left, the flexible finger 28 is caught in the upper portion of the inner guiding slot and is forced against the element 31, which in turn closes the several springs of the set 21. The horizontal magnet 16 is now deenergized, permitting the bar 9 to restore and return to their normal positions all other unused flexible operating fingers attached to said bar. The finger 28, however, which has been used to close the contacts 21 is held in its operated position by the force which the plate 24 exerts against the finger because of the continued energization of the vertical magnet 17. As the bar 9 restores the finger 28 flexes to permit its end to be held by the plate 24 to maintain the contacts 21 closed. The bar 9 may now be used for setting up connections at other associated cross-points.

To select and operate the contact set 22 the same sequence of movements is effected, with the exception that the horizontal operating bar 9 is rotated by the magnet 15 instead of the magnet 16 to tilt the finger 28 downwardly to the lower end of the slot 26 and opposite the spring operating element 32 associated with the contact set 22.

Assume next that it is desired to operate the uppermost set of contacts 20. To do this, the vertical bar 12 is first operated to rotate the arm 25 and move the plate 24 to the position shown in Figs. 7 and 11. In this position the flexible finger 28, which has not yet been moved away from normal, rests in the outer guiding slot 27 and at a point midway between the extreme ends of this slot. Following this the horizontal bar 9 is rotated by the magnet 16, and the flexible finger 28 slides upwardly in the slot 27. Since the plate 24 is being held in its operated position, the finger 28 encounters the spring operating element 30 before it reaches the extreme upper end of the slot 27. The obstruction thus caused by the element 30 causes finger 28 to flex slightly and prevents it from continuing its movement

to the extreme end of the slot. This condition is illustrated in Fig. 12. Next the magnet 17 is deenergized, the magnet 16 being maintained in an energized condition, to permit restoration of the operating plate 24. As the plate 24 returns to its normal position, the free end of the flexed finger 28 escapes the element 30 and moves to the extreme upper end of the slot 27, as seen in Fig. 13. Next the vertical magnet 17 is reoperated, moving the plate 24 again to its operated position. This time the plate 24 carries the flexible finger 28 against the spring operating element 30 which in turn closes the contacts of the set 20. Finally the horizontal bar 9 is released, and the operated set of contacts is maintained by the continued operation of the vertical bar 12, the action of the plate 24 against the flexible finger 28 preventing the finger from restoring to its normal position. The relative positions of the parts when contacts 20 are operated are shown in Fig. 14.

In a similar manner, the lowermost set of contacts 23 is selected and operated by a sequence of operations which consists in operating the vertical bar 12, rotating the horizontal bar 9 by the energization of magnet 15 to move the finger 28 downwardly in the slot 27, releasing the vertical bar 12 to permit finger 28 to move to the extreme lower end of the slot 27, reoperating the vertical bar 12 to close the contact set, and releasing the horizontal bar 9.

Any set of contacts which has been operated in the manner described in detail above may be released simply by deenergizing the vertical magnet 17 to permit the release of the vertical bar 12. As the operating arm 25 restores to normal, the pressure exerted by the plate 24 against the flexed finger 28 is withdrawn, permitting the finger 28 to restore to its normal position.

What is claimed is:

1. In a selective switch, two operating magnets, a plurality of separately operable contact sets controlled by said magnets, and means controlled by said magnets jointly when operated in different orders and by the continued operation of one of said magnets for selectively operating said contact sets and maintaining them in operated condition.

2. In a selective switch, a pair of operating magnets, a plurality of separately operable con-

tact sets controlled by said magnets, means effective upon the energization of said magnets in a definite sequential order for closing and holding one of said contact sets, and means effective upon the energization of said magnets in a different sequential order followed by the reenergization of one of said magnets for closing and holding another of said sets of contacts.

3. In a selective switch, a pair of operating magnets, a plurality of separately operable contact sets controlled by said magnets, means including cross-bars effective upon the operation of said magnets jointly for selecting and closing one of said contact sets, and means including said cross-bars effective upon the operation of said magnets jointly followed by the release and reoperation of one of said magnets for selecting and closing another of said sets of contacts.

4. The combination in a cross-bar switch of a pair of magnets, a plurality of contact sets controlled by said magnets, and means responsive to the operation of one of said magnets in conjunction with the repeated operation of the other of said magnets to select and close one of said contact sets.

5. The combination in a cross-bar switch of a pair of operating magnets, a plurality of contact sets controlled by said magnets, and means responsive to the operation of one of said magnets in conjunction with the operation of the other magnet followed by the momentary release and the reoperation of the latter magnet for selectively closing one of said contact sets.

6. The combination in a cross-bar switch having a select bar, a select magnet, a hold bar, and a hold magnet, of two separate contact sets controlled by said magnets and bars, a selecting element on said select bar associated with said contact sets, and means acting on said selecting element in response to the operation of the select magnet and bar followed by the operation of the hold magnet and bar to close one of said contact sets, and acting on said selecting element in response to the operation of the hold magnet and bar followed by the operation of the select magnet and bar followed by the release and reoperation of the hold magnet and bar to close the other of said sets of contacts.

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