June 6, 1944. A. C. KELLER 2,350,464

SWITCHING MECHANISM

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FIG. 1

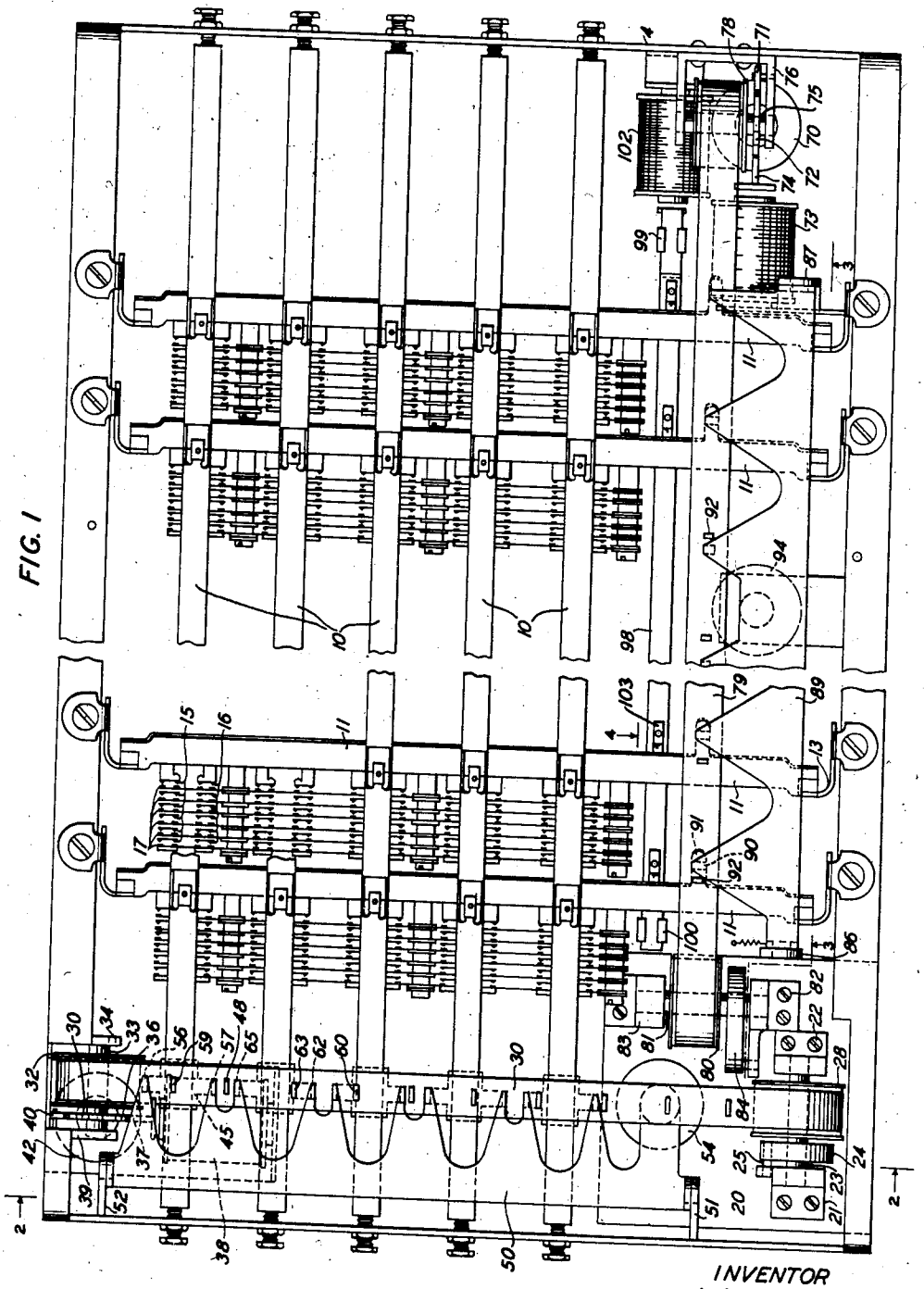

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FIG. 2

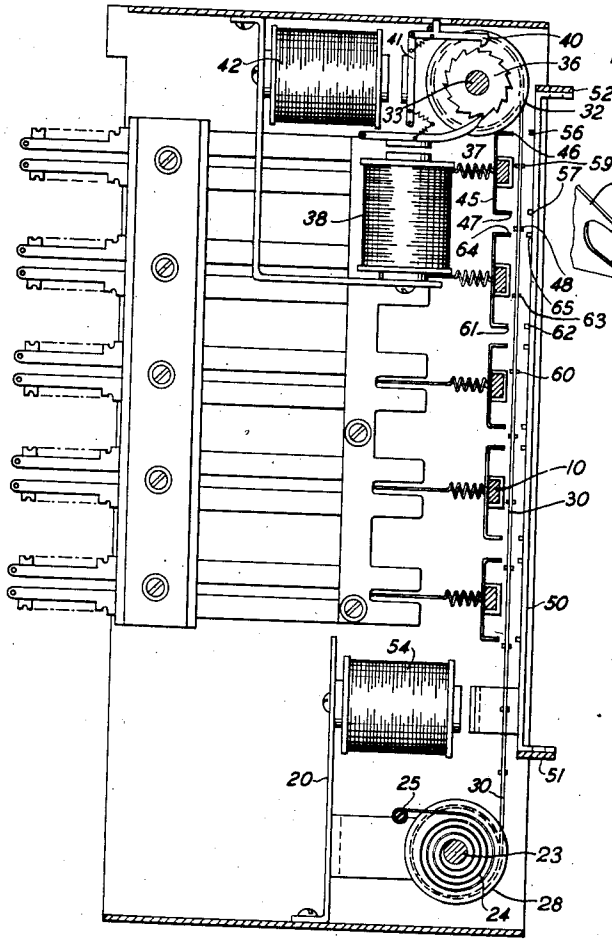


FIG. 5

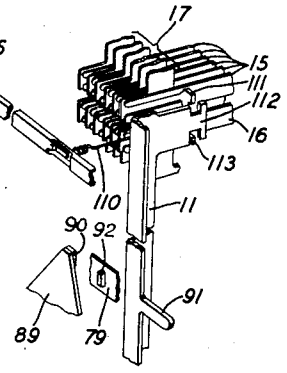


FIG. 4

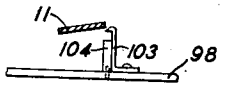
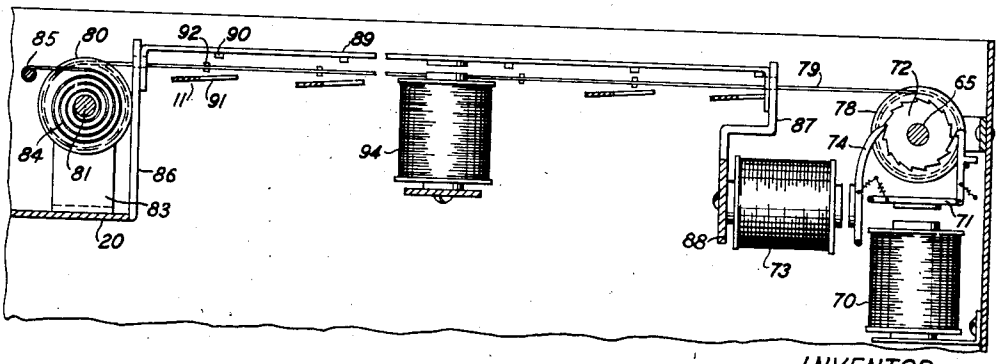


FIG. 3



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2,350,464

SWITCHING MECHANISM

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Application May 18, 1943, Serial No. 487,432

7 Claims. (Cl. 179—27.54)

This invention relates to switching mechanisms and particularly to such mechanisms as are employed in automatic telephone systems for establishing of connections.

An object is to simplify and reduce the cost of such mechanisms and to make them more readily and simply controlled by outside electrical circuits.

Heretofore so-called cross bar switches have been used in telephone systems in which select bars and hold bars and rows of contacts are coordinately arranged so that the operation of a select bar by a corresponding select magnet followed by the operation of a hold bar by a corresponding hold magnet causes connections to be established between the contacts at the cross-point of said bars. In certain types of cross bar switches each select bar is arranged to serve two rows of contacts by rotating it in one direction or the other by a corresponding select magnet. In the copending application of F. H. Hibbard, Serial No. 487,433, filed May 18, 1943, a cross bar switch is disclosed in which in place of the individual select magnets for the select bars two common magnets and associated control mechanisms are substituted for the control of said bars to select and operate the desired select bar under control of dial pulses incoming to said switch. This mechanism includes a shaft at one end of the select bars having helically arranged projections thereon, a pawl and ratchet mechanism and a pulse responsive magnet for rotating said shaft in steps to place a particular projection in a position where it will cause the operation of the corresponding select bar under control of another magnet.

The present invention relates to improvements in switches of these general types whereby in place of the individual select magnets and hold magnets, common mechanisms are provided for automatically selecting and operating the associated select bars and hold bars under control of electrical impulses and including tapes having projections arranged in a vernier arrangement in place of the rotatable shaft and projections as arranged in the above-mentioned F. H. Hibbard application. This form of construction presents the use of relatively light moving parts and hence enables the mechanism to be operated at a very high speed.

Specifically one feature of the applicant's invention consists of a control mechanism for the select bars including a tape having projections or beads thereon, a ratchet mechanism and a magnet for shifting said tape in steps under control of impulses, such as dial pulses, said beads being arranged in a vernier arrangement so that for each succeeding step of the tape a different bead is placed opposite a different corresponding select bar in a position where the armature of an operating magnet when actuated engages the bead, placed opposite a select bar and moves or rotates this bar accordingly. This arrangement may be applied to a cross bar switch of the type in which the select bars are rotatable in two directions by having opposing levers on each select bar and beads arranged to be placed opposite these levers to rotate the associated bars in one direction or the other.

Another feature is a similar control mechanism for the hold bars including a tape having projections, a ratchet mechanism and magnet for shifting the tape in steps under control of impulses and an operating magnet and armature for actuating the hold bar selected by the tape.

Another feature associated with the hold bar operating mechanism consists of a latching means for holding an actuated hold bar in operated position and a mechanism for releasing the latched hold bar from the latching means to return it to a normal position.

The invention has been illustrated in the accompanying drawings in which Fig. 1 shows a front view of a typical cross bar switch in which the applicant's invention has been incorporated.

Fig. 2 shows a side view cross-section taken approximately on line 2—2 of Fig. 1;

Fig. 3 is a bottom view cross-section taken approximately on line 3—3 of Fig. 1;

Fig. 4 shows a detail of the latching mechanism for the hold bar; and

Fig. 5 is a fragmentary perspective view of a portion of a select bar and hold bar and the contact sets at the cross-point of said bar.

Referring now to the drawings, the switch consists of an upper frame member 1, a lower frame member 2, a left-hand frame member 3 and a right-hand frame member 4, welded together and to which the various parts of the switch mechanism have been applied. Between the members 3 and 4 are pivoted five select bars marked with the numeral 10 and between the upper and lower members 1 and 2 are mounted mechanisms generally referred to as vertical units each unit comprising contact springs and a vertical hold bar such as 11, for example, mounted on a frame 13 attached to the upper and lower frame members 1 and 2 as shown. At each cross-point of the hold bar and a select bar is located an upper group of contact springs 15

and a lower group of contact springs 16 which form parts of two horizontal rows of contact springs throughout the switch structure and associated with those sets of horizontal contact springs are vertical contact strips 17 with which the horizontal contact springs may establish individual connections on the operation of the mechanism as will be described more fully in connection with Fig. 5. It is sufficient to say at this time that the select bars 10 may be rotated in a clockwise direction looking at Fig. 1 from the left to cause the actuation of the upper contact springs 15 and rotate it in a counter-clockwise direction to cause the actuation of the lower contact springs 16 to connect with the strips 17 on the operation of the associated hold bar 11.

The applicant's invention has been applied in this type of switch to control the operation of the select bars and hold bars by common mechanisms. Referring especially to the control of the select bars there is secured between the frame members 2 and 3 a mounting plate 20 on which, between two brackets 21 and 22, is rotatably mounted a shaft 23 carrying a spiral spring 24, one end of which is connected to shaft 23 and the other to a pin 25 secured to the bearing 23. On this shaft 23 is also mounted a drum 28. To this drum is connected the lower end of a ribbon 30 the upper end of which is connected to a similar drum 32 mounted on a shaft 33 journaled in the bracket 34 secured to the upper frame member 1. On the shaft 34 is also mounted a ratchet wheel 36 held in normal position by a holding pawl 37 controlled by a release magnet 38, mounted on the mounting plate 39 secured between the frame members 3 and 1. This ratchet wheel 36 may be rotated by a driving pawl 40 controlled by an armature 41 actuated upon by the stepping magnet 42 secured to the plate 38 so that on the operation of the stepping magnet 42 in response to impulses incoming to this mechanism the ratchet wheel 36 and drum 32 may be rotated to shift the tape 30 upwardly in equal steps corresponding to the distance between adjacent teeth in the wheel 36 and be held in the advanced positions by the holding pawl 7 and when it is desired to release the tape 30, the holding magnet 38 may be operated to remove the pawl 37 from the ratchet wheel 36 and permit the spring 34 to rotate the drums 28 and 32 back to normal position and consequently shift the tape back to its normal position. Connected to each select bar 10 is a lever, for example, 45 having an upwardly extending arm terminating in an angular projection 46 and a similar downwardly extending arm terminating in an angular projection 47. On the tape 30 at various positions are mounted beads or rivets 48, the purpose of which will be described presently and on the side of the tape opposite to the lever 45 and others is mounted an armature or gate 50 between the brackets 51 and 52 secured to the frame member 3. At the lower end of this armature 50 is located the operating magnet 54 mounted on member 20 so that on the operation of this magnet the armature 50 may be rotated towards the tape 30. Opposite each projection, such as 46 and 47 on lever 45, is located as part of armature 50 similar projections such as 56 opposite 46 and 57 opposite 47 and corresponding projections for the other corresponding levers on other select bars.

The operation of this mechanism is as follows: the bead 48 on the tape 30 is so located that on the first operation of the stepping magnet 42 and the consequent shifting of the tape 30 one step this bead 48 will be advanced to a position centrally between the projections 47 and 57. Similarly on the second step, the bead 59 will be shifted to be located between the projections 46 and 56. In the same manner, succeeding beads on the tape 30 are advanced on succeeding steps into positions between the corresponding projections of the levers of the succeeding select bars. For example, the bead 60 will be placed between the projections 61 and 62 on the third step and the bead 63 will be placed between projections 64 and 65 so that on each succeeding step of the ratchet wheel the shifting of the tape 30 causes a succeeding bead to be placed opposite corresponding projections on a corresponding select bar level and on the armature. If it is assumed, for example, that bead 48 is placed between projections 47 and 57 and then the magnet 54 is operated, the armature 50 will rotate to cause the projection 57 to engage bead 48 and cause it to move to engage projection 47 and shift the lever 45 to rotate the first select bar 10 in the clockwise direction looking at Fig. 2. If the magnet 42 had taken two steps the bead 59 would have been placed between projections 46 and 56 and on the subsequent operation of magnet 54 the first select bar would have been rotated in the counter-clockwise direction.

A similar arrangement has been provided for the rotation of the hold bars under control of dial pulses. This arrangement consists of a stepping magnet 70 operating an armature and stepping pawl 71 to rotate the ratchet wheel 72 and release magnet 73 operating on a holding pawl 74 to maintain the ratchet wheel in an advanced position. This ratchet wheel 72 is mounted on a shaft 75 journaled in a bracket 76 secured to the frame member 4. On the same shaft 74 is also mounted a drum 78 to which is attached a tape 79 at one end. The other end of this tape is connected to a drum 80 secured on a shaft 81 journaled between the brackets 82 and 83 secured to the plate 20 and on the same shaft is mounted the spiral spring 84, the inner end of which is attached to the shaft 81 and the outer end to a pin 85 secured to the plate 20. This spring holds the tape 79 in a normal position. Between an extension 86 on the plate 20 and an extension 87 on the holding plate 88 for magnet 23, a gate or armature 89 is mounted. This gate is provided with projections such as 90, each projection being opposite a similar projection 91 on the hold bars 11. On the tape 79 are provided a series of beads 92 arranged so that on the first step of the ratchet wheels 72 the first bead 92 will be placed between the first projections 90 and 91 on the armature 89 and the first hold bar 11. Then on the operation of the common magnet 94 to rotate or tilt the gate 89 the first projection 90 will, through the medium of the first bead 92, cause the projection 91 to rotate the first hold bar 11 on its knife edge on the bracket 13. Should two steps be taken the next succeeding hold bar will be operated by having a second bead placed between a projection on gate 89 and a projection on the second associated hold bar 11. In this manner any one of the hold bars 11 may be selected by dial pulses received by the magnet 70. That is, the ratchet wheel 72 is stepped the desired number of steps and then when this is done a particular bead 92 will be placed between a corresponding projection 90 on gate 89 and projection 91 of the associated hold bar to cause said bar to be oper-

ated on the subsequent operation of the magnet 94.

To maintain an actuated hold bar 11 in its actuated position, the special latch mechanism has been provided which consists of a bar 98 mounted for longitudinal movement in sliding mountings 99 and 100 and operative in the direction towards the right looking at Fig. 1 by a magnet 102. This bar 98 is provided at each hold bar 11 with a flexible latch member 103 and stop member 104. This latch member 103 is so arranged that when a hold bar 11 is rotated, the latch member 103 will engage the edge of the hold bar and latch it into actuated position. When it is desired to release the hold bar, the magnet 102 is energized and slides bar 98 towards the right looking at Fig. 1 to thereby remove the latch 103 from the held hold bar. With these common operating mechanisms for the select bars and hold bars, the switch may be operated by dial pulses, first to select and operate a select bar for rotation by sending dial pulses into the stepping magnet 42 and then by sending dial pulses through magnet 70, a particular hold bar may be operated. It should be observed, of course, that after a hold bar has been actuated and locked succeeding connections may be established through the switch by succeeding operations of the select bars and hold bars in the same manner. If the switch is employed as the register, the succeeding connections may be maintained until the complete registration has been made, that is, at ten cross-points with the ten hold bars all held in operated position, the cross-points being selected by the various operations of the select bars and when the mechanism is to be released the release magnet 102 is operated to release all of the latched hold bars.

As stated, the operation of a select bar followed by the operation of a hold bar causes a corresponding connection to be established at the intersecting point of each two bars. Fig. 5 has been provided to show how this takes place. The first operation is the rotation of a select bar 10 in the manner described. If the select bar is rotated in a clockwise direction looking from the left side of Fig. 1, the select finger 110 will move upwardly to be placed between the operating card 111 and a projection 112 on the hold bar 11. When the hold bar 11 is rotated, the projection 112 will engage the finger 110 to cause it to engage the card 111 to shift the contacts 15 into engagement with contacts 17. Had the select bar 10 been rotated in a counter-clockwise direction, finger 110 would have engaged the card 113 for the lower set of contacts 16 and on the operation of hold bar 11, the projection 112 would have engaged this card through the medium of the finger 110 to actuate the contacts 16 to engage contacts 17.

It will be understood that the present invention may be applied to switches which are controlled either directly by dial or other transmitted pulses or by central office control mechanisms such as senders and markers.

What is claimed is:

1. In a cross bar switch, select bars and hold bars coordinately arranged, contacts at each cross-point of said bars, a select bar, selecting and operating means including a tape having projections thereon, a ratchet mechanism for said tape, a magnet for actuating said ratchet mechanism to lift said tape in steps, said projections being so arranged that for each succeeding step of the tape a different projection is placed opposite a different corresponding select bar, an operating magnet having an armature which when operated by the magnet engages the projection placed opposite the select bar and moves it against said select bar to actuate said bar, and means responsive to the actuation of a select bar followed by the operation of a hold bar for actuating the contacts at the cross-point of said bars.

2. In a cross bar switch, select bars and hold bars coordinately arranged, contacts at each cross-point of said bars, a common operating magnet having an armature for actuating said select bars, a selecting means for said select bars including a longitudinally movable tape having projections thereon so arranged that any projection may through the movement of the tape be placed between the armature and a corresponding select bar and thereby cause said select bar to be operated when the magnet is energized, and means responsive to the operation of a select bar followed by the operation of a hold bar for actuating the contacts at the cross-point of said bars.

3. In a cross bar switch, select bars and hold bars coordinately arranged, contacts at each cross-point of said bars, a tape, a ratchet mechanism for said tape, a magnet for actuating said ratchet mechanism to move said tape longitudinally in steps, projections on said tape arranged in relation to the select bars so that on each succeeding step a succeeding different projection is placed opposite a succeeding corresponding select bar and all other projections are out of phase with the corresponding select bars, means for actuating any select bar through the medium of its associated projection when it is placed opposite said select bar, and means operative in response to the operation of a select bar followed by the operation of a hold bar for actuating the contacts at the cross-point of said bars.

4. In a cross bar switch, vertical bars and horizontal bars arranged coordinately, contacts at each cross-point of said bars, a cross member at one end of each horizontal bar, said cross members being arranged in a vertical line, a vertical tape located adjacent said cross members and in parallel relation thereto, a ratchet mechanism at one end of said tape, a magnet for actuating said ratchet mechanism to lift said tape one step for each actuation of the magnet, an armature located in parallel relation adjacent said tape opposite the cross members, a magnet for actuating said armature, beads on said tape arranged so that on each succeeding step of the tape a different bead is placed between the armature and the outer end of a cross member of a corresponding horizontal bar so that on the operation of said armature it will actuate a horizontal bar to rotate in one direction or the other depending on whether a bead has been advanced between one end or the other of the cross member of said horizontal bar, said armature acting through the medium of said bead for the rotation of said horizontal bar, and means responsive to the rotation of a horizontal bar followed by the rotation of a vertical bar to actuate a corresponding set of contacts.

5. In a cross bar switch, vertical bars and horizontal bars coordinately arranged, two sets of contacts at each cross-point of said bars, two levers at one end of each horizontal bar for rotation of said bars in opposite directions, a vertical tape located adjacent said levers, a ratchet wheel, a mechanism associated therewith for lifting said tape vertically one step for each rotary step taken

by said wheel, a magnet having an armature and a pawl attached to the armature and engaging said ratchet wheel to rotate it one step for each operation of the magnet, another magnet having an armature provided with projections, each projection located opposite the free end of a corresponding lever on said horizontal bars, beads on said tape arranged to be moved by the tape between the free ends of the levers and the associated projections on said armature, and located on the tape in a vernier arrangement so that on each step taken by the tape a succeeding bead is placed between a succeeding corresponding free end of a lever and a corresponding projection on said armature, said armature when controlled by said second-mentioned magnet causing a certain horizontal bar to be actuated in one direction or the other as determined by the presence of a bead between the free end of a lever of said horizontal bar and the corresponding projection on said armature, and means responsive to the rotation of a horizontal bar followed by the rotation of a vertical bar for actuating a corresponding set of contacts at the cross-point of said bars.

6. In a cross bar switch, select bars and hold bars coordinately arranged, contacts at each cross-point of said bars, a select bar selecting and operating means including a tape having projections thereon, a ratchet mechanism for said tape, a magnet for actuating said ratchet mechanism to shift said tape in steps, said projections being so arranged that for each succeeding step of the tape a different projection is placed opposite a different corresponding select bar, an operating magnet having an armature which when operated by the magnet engages the projection placed opposite the selected bar and moves it against said selected bar to actuate said bar, a hold bar, selecting and operating means comprising the identical elements included in the means for selecting and operating a select bar, a holding means for holding any of said hold bars in actuated position, means for releasing any of said hold bars to normal position, and means operative in response to the actuation of a select bar followed by the actuation of a hold bar for actuating the contacts at the corresponding cross-point.

7. In a cross bar switch, vertical bars and horizontal bars arranged coordinately, contacts at each cross-point of said bars, a cross member at one end of each horizontal bar, said cross members having arranged in a vertical line a vertical tape located adjacent said cross members and in a parallel relation thereto, a ratchet mechanism at one end of said tape, a magnet for actuating said ratchet mechanism to lift said tape one step for each actuation of the magnet, an armature located in parallel relation adjacent said tape opposite the cross members, a magnet for actuating said armature, beads on said tape arranged so that on each succeeding step of the tape a different bead is placed between the armature and the outer ends of the cross member of a corresponding horizontal bar so that on the operation of said armature it will actuate a horizontal bar to rotate in one direction or the other depending on whether a bead has advanced between one end or the other of the cross member of said horizontal bar, said armature acting through the medium of said bead for the rotation of said horizontal bar, a vertical bar selecting and operating means including a tape and projections thereof, a ratchet mechanism for said tape, a magnet for actuating said ratchet mechanism to shift said tape in steps, said projections being so arranged that for each succeeding step of the tape a different projection is placed opposite a different corresponding vertical bar, an operating magnet having an armature which when operated by the magnet engages the projection placed opposite the selected vertical bar and moves it against said bar for the rotation thereof, a horizontal tape located across the vertical bars and having latch members for latching the associated vertical bars when actuated to hold said bars in actuated position, a magnet for operating said latching tape to release held vertical bars when said magnet is operated, and means operative in response to the actuation of a horizontal bar followed by the actuation of a vertical bar for actuating contacts at the corresponding cross-point.

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