Jan. 24, 1961 S. D. VIGREN ET AL 2,969,433

CROSSBAR SWITCHES

Filed July 30, 1954

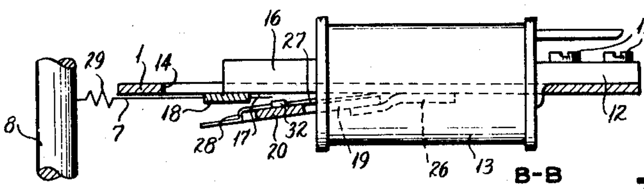

Fig. 3

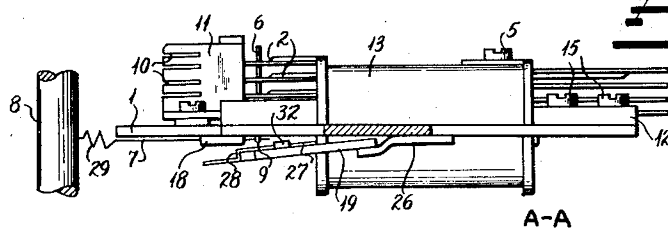

Fig. 2

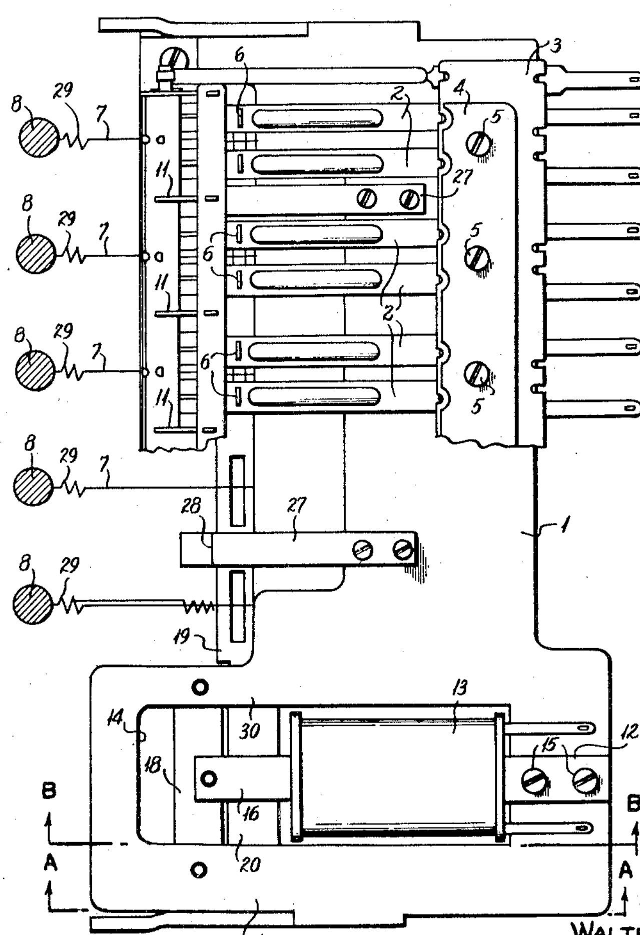

Fig. 1

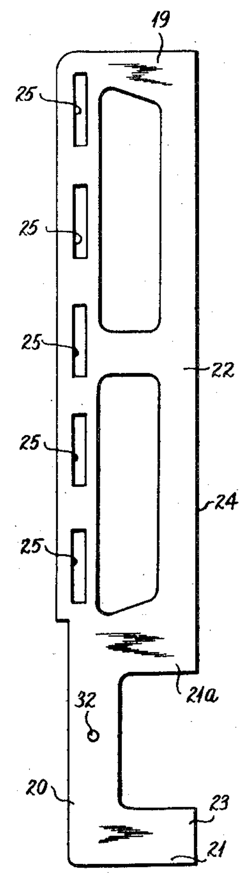

Fig. 4

INVENTORS

STEN DANIEL VIGREN
WALTER OTTO WILHELM BROBERG
ROLF ALBIN ZANDER

BY Strauch, Nolan & Diggins ATTORNEYS

United States Patent Office 2,969,433
Patented Jan. 24, 1961

2,969,433

CROSSBAR SWITCHES

Sten Daniel Vigren, 16–18 Mose-Backetorg, Stockholm, Sweden; Walter Otto Wilhelm Broberg, 6a Centralgatan, Nynashamn, Sweden; and Rolf Albin Zander, 15 Ivar Vidfamnesgatan, Stockholm, Sweden

Filed July 30, 1954, Ser. No. 446,794

Claims priority, application Sweden Sept. 10, 1947

13 Claims. (Cl. 179—27.54)

The present invention relates to crossbar switches and is a continuation in part of our copending application, Serial No. 46,263, filed August 26, 1948, for Arrangements for Electromagnetic Switching Devices, now abandoned.

Crossbar switches have been known and extensively used for a long time in telephone exchanges and for other switching purposes. The basic elements in a crossbar switch of conventional type are a number of bridge units, also termed vertical units, each comprising a number of contact spring stackups mounted side by side on a base plate, an electromagnet or so-called holding magnet having an armature which is connected or integral with a so-called vertical bar, and furthermore a number of select units also called horizontal units, each comprising a bar normally horizontal, which is rotatable in two directions from a mid-position by an armature selectively attracted by either of two select magnets disposed each on one side of the horizontal bar rotation axis. The vertical units are mounted in a frame so that their spring stackups form horizontal rows, and the horizontal bars are pivoted on the frame between two horizontal rows of spring stackups with each horizontal bar extending transversely to the vertical bars. Each of the horizontal bars is provided with selecting fingers, usually consisting of flexible wires, in a number and with a disposition corresponding to the spring stackups. When a horizontal bar is rotated in either direction its selecting fingers are carried into positions adjacent to the spring stackups of the respective adjacent horizontal row. All spring stackups are provided with an individual actuator for actuating their movable contact springs, and these actuators are so constructed and arranged that an operated vertical bar only engages an actuator having a selecting finger interposed between the selected actuator itself and the vertical bar. In this way selective operation of a certain spring stackup can be effected by first operating a select magnet, whereby the selecting fingers of the corresponding horizontal bar are interposed between the actuators of the spring stackups in a horizontal row and the different vertical bars, and then operating that holding magnet which corresponds to the vertical row in which the respective spring stackup is situated. On the operation of the holding magnet only the spring stackup situated in the horizontal row selected by the horizontal bar will be operated. The selecting finger associated with the operated spring stackup is thus clutched between the operated vertical bar and the spring stackup, and due to the resilience of the selecting finger, the horizontal bar can be released to its normal position and used again for operation of contact stackups in the same or the opposite horizontal row that are associated with other vertical bars. In order to avoid longitudinal stresses in the engaged selecting fingers on the turning movements of the horizontal bars, the selecting fingers are provided with a helical spring portion intermediate their free end and the vertical bar to which they are attached.

A crossbar switch of this principal type is exhaustingly described in the specification of Patent No. 2,187,577, granted to S. J. Stockfleth in 1940. Switches of fundamentally this construction have been used throughout the world in the majority of all telephone systems working with crossbar switches ever since the first development of the crossbar type switch, and are still commonly used, although many attempts have been made to introduce constructions with modified operating principles. The most important merits of the conventional crossbar type switch are its safe operation and low maintenance cost as compared with telephone switches of most other types. In spite of this superiority there are still some sources of errors inherent in the conventional crossbar switch construction, which substantially alone cause errors and false operations when such occurs.

In the known crossbar switches of the above described main type, invariably holding magnet armatures have been used, which have been so connected with the vertical bars and so disposed with relation to the respective holding magnet cores, that the attraction force on the armature pole face is approximately normal to the direction of the pressure exerted on the associated vertical bar by the selected spring stackup on its operation. In other words, the armature tongue cooperating with the holding magnet core has been substantially normal to the effective lifting surface of its associated vertical bar. In order to provide a turning axis for the unit consisting of the armature and the vertical bar warranting a satisfactorily low reluctance for the magnetic flux and exact positioning of the armature unit, it has been necessary to shape the armature with an L-shaped profile and use an edge or edge portions on the base plate of the vertical unit for pivotally supporting it. We have found, however, that this edge bearing considerably reduces the operation safety of the device. Since the armature is laterally disposed in relation to its associated vertical bar and the latter must be comparably long, the edge bearing or bearings will be subject to highly varying loads due to the fact that the places of application of the forces exerted by the contact spring stackups on the vertical bar perpetually change their positions along the considerable length of the same. As already mentioned, the attracting force on the armature is substantially normal to the pressure on the vertical bar, which means that the attracting force does not effect any reduction whatsoever of the pressure on the bearing edge or edges. The more or less irregular movements of the armature, due to the varying load conditions, will, in conjunction with the concentrated pressure on the bearing edge or edges, cause a substantial wear, which in turn promotes the formation of so-called frictional rust disturbing the operation of the switch.

Another essential source of false or unsatisfactory operation is the wear caused by the selecting fingers on the actuators and/or the lifting surfaces on the vertical bars. As already mentioned, the selecting fingers are clutched between the respective actuators and vertical bars on the operation of a holding magnet. It is, in practice, almost unavoidable that a small relative movement arises between the actuators and the vertical bars in a direction substantially coinciding with the longitudinal direction of the selecting finger during the actuation of the spring stackups. The result will be that a clutched selecting finger must slide either in relation to the respective actuator or the vertical bar, or both. Since the specific pressure on the selecting finger is very high, gradually a groove is worn in the actuator or the vertical bar, which groove may retain the selecting finger in operated position on the release of the holding magnet or in every case seriously disturbs the normal operation of the switch.

In known crossbar switches, this "sawing action" is material due to the armature construction used. In released condition of the holding magnet armature, the plane of the connecting lines between the lifting surface on the vertical bar and the turning axis of the latter forms, in known devices, an obtuse angle to the direction of movement of the actuators, which are as a rule guided so as to move almost rectilinearly. Due to the requirement of a free space between the actuators and the adjacent vertical bar in non-operated position of the holding magnet which is sufficiently large to permit the selecting fingers to move therein freely on the operation of the horizontal bars, the stroke of the holding magnet armature must be relatively long, and on the operation movement of the armature the said angle will be still considerably more obtuse. It will be understood that the relative movement between an actuator and the corresponding vertical bar will rapidly increase as the said angle further departs from an optimum value of 90°, and the relative movement will, thus in known devices, be considerable at the end of the operation movement of the holding magnet armature, or in other words when the contact pressures of the spring stackups is being built up, and accordingly the pressure on the selecting finger rapidly increases to its maximum value. In the known devices, the wear caused by the aforesaid "sawing" action has, therefore, been of considerable consequence.

In crossbar switches with selecting fingers, in general it is most important for the safe operation of the switch that the selecting fingers be very carefully adjusted into their proper positions. Normally the selecting fingers must not be allowed to touch in normal position either the lifting surfaces of the vertical bars or the actuators, since otherwise the movements of the fingers may be obstructed or slowed down resulting in false operation. In the known crossbar switches, the construction of the armature necessitates the provision of a cross-piece extending from the holding magnet to the armature tongue laterally along the front edge of the base plate of the vertical unit. This cross-piece obstructs easy access to the selecting fingers for adjustment and renders the inspection of their positions difficult.

It is an object of the present invention to provide, in a crossbar switch of the type having resilient selecting fingers, an improved mode of operation of the holding magnet armature and vertical bars so as to cause the wear on the armature bearings to be reduced to a minimum.

It is a further object of this invention to provide in such a crossbar switch an improved mode for cooperation between the vertical bars, the selecting fingers and the actuators of the spring stackups so as to eliminate or at least reduce to a minimum the formation of grooves in the actuators and/or the vertical bars by wear.

Another object of this invention is to provide a novel construction of the vertical units permitting ready access to the free ends of the selecting fingers for adjustment and inspection, thereby highly reducing the manufacturing cost of the switch.

Still another object of this invention is to provide a novel construction of the vertical units which is characterized by the simplicity of the forms and assembly of parts and which enables these parts to be adapted for high volume, low cost manufacture, and also to provide a simple and efficient magnetic circuit.

With these and other objects in view, we will now proceed to describe in detail our invention, having reference to the drawing affixed to this specification and forming part thereof, which illustrates an embodiment of the invention diagrammatically by way of example.

Fig. 1 is a plan view of a vertical unit of a crossbar switch according to this invention together with a number of select or horizontal bars in cross-section and a row of selecting fingers.

Figs. 2 and 3 show identical vertical units as mounted in the frame of the crossbar switch and a select or horizontal bar with selecting fingers. The vertical units are shown in end views, partly in section on the lines A—A and B—B respectively in Fig. 1.

Fig. 4 is an elevational view of a vertical bar with its holding armature.

In all figures similar reference numbers refer to similar parts.

Referring to the drawings, the supporting element of each vertical unit is in a manner known per se as a base plate **1**, preferably of ferromagnetic material. Stacks of contact springs **2** are attached to the base plate **1** as by means of insulating strips **3**, a top metal strip **4** and fixing screws **5** screwed into the base plate in a conventional manner. The contact springs **2** are assembled into spring stackups each being provided with an actuator **6** of insulating material for the actuation of its contact springs. In the illustrated embodiment, the actuators are of flat rectangular cross-section and project with their ends cooperating with the selecting fingers somewhat ahead of the plane of the opposite side on the base plate **1**. The horizontal bars, designated **8**, are in the usual way constructed and arranged to hold in their neutral positions each selecting finger in a midposition between two spring stackups forming a pair cooperating with the same selecting finger. When a horizontal bar **8** turns in one or the other direction in response to the energization of one or the other of its associated select magnets (not shown), its selecting fingers **7** are moved into a position adjacent the ends of the actuators **6** of the spring stackups in a horizontal row on one or the other side respectively of the horizontal bar **8**. For determining the lateral end positions of the selecting fingers **7**, the actuators **6** are provided at their ends with a small projection **9** as shown in Fig. 2 and as is conventional practice. The contact springs cooperate with fixed multiple contact bars **10** supported by supporting pieces **11** attached to the base plate **1**.

Having the objects of this invention in mind, we have disposed the holding magnet core **12** with its winding **13** so as to substantially coincide with the plane of the base plate **1**. An aperture **14** is provided in the base plate **1** for receiving the core and winding, and the core is attached to the base plate by means of screws **15**. The portion of the core **12** juxtaposed on the base plate **1** is thinner than the rest of the core by an equal amount to the thickness of the base plate, so that the core end **16** projecting ahead of the winding **13** has its surface opposite to the one visible on Fig. 1 coplanar with the corresponding side of the base plate **1**. This surface forms the pole face of the core and is designated **17** in Fig. 3. In order that this coplanar relation shall be maintained unchanged on the operation of the electromagnet, there is provided a bar **18** of non-magnetic material attached on one hand to portions of the base plate adjacent to the aperture **14** and on the other hand to the end of the core **12**.

Referring now to Figure 4 the vertical bar unit comprises a bar-formed portion **19** having the actual lifting surface thereon for cooperation with the selecting fingers, which portion is hereinafter termed lifting bar. In the illustrated embodiment, the lifting bar is integral with the armature portion **20** for cooperation with the pole face **17** on the holding magnet core **12**. The lifting bar **19** and the armature portion **20** are substantially in alignment with each other and are in turn made integral with supporting or lever portions **21** and **22** forming bearing edges **23** and **24** respectively. The lifting bar **19** is provided with elongated apertures **25**, each for two actuators **6** to be selected by a common selecting finger **7**. As appears from Figures 1–3, the vertical bar unit is swingably mounted on that side of the base plate **1** which is turned away from the spring stackups so that armature portion **20** faces pole face **17** on the core **12**, and lifting bar **19** extends sideways beneath the actuators of the spring stackups with its apertures 25 in opposite relation to the respective pair of actuators 6. The bearing edges 23 and 24 on the vertical bar unit are kept in position adjacent to the base plate 1 by means of overlapping pieces 26 secured, one at each end of the unit, to the base plate 1. The bearing edges 23 and 24 will, in this way, form a turning axis of the vertical bar unit which is situated behind the lifting bars as seen from the contact ends of the contact springs. The vertical bar unit is kept in engagement with the overlapping pieces 26 by means of leaf springs 27 at one end screwed to the base plate 1 and at the other end provided with a bent-down portion 28 engaging the outer edge of the lifting bar 19. The springs 27 are pre-tensioned so as to keep the vertical bar unit in retracted position when the holding magnet is not energized, leaving a free space between the lifting bar 19 and the actuators 6 sufficiently large to permit the selecting fingers to move freely therein. The selecting fingers 7 extend in their neutral position across the apertures 25 at their longitudinal midpoints, so that the corresponding actuators pass through the aperatures when the lifting bar is operated through the energization of the holding magnet. When horizontal bar 8 is operated in one or the other direction through the operation of one of its select magnets, its selecting finger is moved to one or the other end of the corresponding aperture 25 to a position determined by the projection 9 of the respective adjacent actuator 6, whereby the passage of the respective actuator through aperture 25 is barred and the actuator is lifted by the lifting bar 19 on its operation and operates the springs 2 of the selected spring stackup. The select magnet is then deenergized, so that horizontal bar 8 returns to its neutral position, while the selecting finger is kept in engagement with the lifting bar and the actuator through clutch action as long as the holding magnet is energized. The aforementioned helical portions of the selecting fingers for preventing longitudinal stresses are designated 29 on the drawing.

As will be seen on the drawing, the armature portion 20 of the vertical bar unit will be magnetically coupled to the portions of the base plate 1 adjacent to the aperture 14 through the shank-like portions 21 and 21*a* (Fig. 4). The edges need not be in direct magnetic contact with the base plate 1 in deenergized condition of the holding magnet, and there may be a small space as shown in Fig. 2 in order to avoid pressure from the overlapping pieces 26 on the bearings. When the holding magnet is energized, the portions 21 and 21*a* will then first be attracted to bear against the base plate 1, whereupon the actual operation movement of the armature begins. The shank-like portions 21 and 21*a* and the transverse armature portion 20 are overlapped by the portions 30 and 31 of the base plate 1 adjacent to the aperture 14. Particularly in operated position of the vertical bar unit, a part of the magnetic flux will take a return path by passing directly from the armature 20 and its shank-like portions 21 and 21*a* to the flux return portions 30 and 31 across the comparably small air spaces defined by the conventional non-magnetic separator 32 on the armature 20. In this way, attracting forces will also arise between the portions 30 and 31 on one hand and the armature 20 on the other hand, which will successively increase as the operation movement of the vertical bar proceeds.

An important feature of the described device is that the attracting forces of the armature 20 have substantially the same direction as the reaction forces on the lifting bar 19 arising when the spring stackups are operated. It will easily be understood that in this way the bearing edges 23 and 24 can be disloaded to any extent. To assure a low magnetic reluctance path at the bearings, it is desirable to provide during operation of the magnet, a certain relatively small pressure on the bearing edges, this pressure may be effected by the positioning of the attraction center of the armature 20 substantially in alignment with, or only slightly inwardly of, the points where the loads are applied on the lifting bar 19 in relation to the turning axis of the vertical bar unit. A gradual displacement outwardly of the armature in relation to the lifting bar will cause a gradually reduced pressure on the bearings, and if pivot pins or the like are used for journalling the vertical bar unit, no pressure is required to maintain satisfactory magnetic contact. The armature portion 20 and the lifting bar 19 may even have such relative positions in the radial direction, that substantially no load arises on the pivots at the end of the operation movement.

The attracting forces exerted by the base plate portions 30 and 31 on the armature 20 and the shank-like portions 21 and 21*a* will warrant that the bearing edge 22 is kept in its proper position against the base plate 1 during the operation of the holding magnet in spite of the fact that there is no appreciable magnetic attraction between the end of the vertical bar unit opposite to the armature end and the base plate. When a spring stackup situated at this end is selected and operated, a considerable turning moment arises on the lifting bar with regard to an axis normal to the actual turning axis of the vertical bar unit. Due to the spaced apart attracting portions 30 and 31, the armature is subject to a counteracting turning moment in said direction even at a moderate degree of magnetization of the holding magnet thereby overcoming the first mentioned turning moment and accordingly maintaining the bearing edge 24 in its proper position against the base plate 1.

Due to the position of the armature portion 20 in the plane of the lifting bar 19 and the arrangement of the turning axis of the vertical bar unit behind the actuators and the lifting bar as seen from the contact ends of the contact springs, the selecting fingers will be readily accessible for inspection and adjustment and no obstructing parts in front of the actuators and lifting bar will be required.

Another important feature of the described device according to the invention is that this vertical bar unit, or more precisely the plane of the connecting lines between the turning axis of the vertical bar unit and the lifting surface, forms an acute angle to the main direction of movement of the actuators in non-operated position of the unit. When the load approaches its maximum value at the end of the operation movement of the vertical bar unit, the said angle approaches 90°, whereby the aforementioned "sawing action" between the selecting fingers and the lifting bar and actuators respectively is reduced or eliminated. A further favorable feature with regard to the reduction of the sawing action in the illustrated embodiment of the invention is that the lifting surface on the lifting bar lies in a radial plane through the turning axis of the vertical bar unit.

All the above-mentioned advantages are achieved in a device having very simple parts easy to manufacture by stamping without the need of complicated bending operations and with a minimum of work required for assembly and adjustment.

The present disclosure illustrates the preferred embodiment of the invention, but there may be many variations and modifications thereof without departure from the spirit of the invention. For instance, it is possible to use, in place of the bearing edges 23 and 24 bearing against that side of the base plate 1 which is flush with the core pole face 17, projections or shanks engaging edge portions, e.g. of apertures or recesses in the base plate 1, so that such edge portions situated on the opposite side of the base plate form the bearings. Furthermore, the illustrated embodiment with integral armature and lifting bar necessitates that the whole vertical bar unit is of ferromagnetic material. It is, of course, possible to construct the lifting bar as a separate part fixed or coupled to the armature portion, and the lifting bar may, if desired, have the conventional shape of an edgewise disposed strip of nonmagnetic material. It will further be understood that only one of the flux return portions **30** and **31** is necessary and that the other may be dispensed with or replaced by a portion of non-magnetic material. Also the portion of the base plate **1** supporting the spring stackups may, of course, be non-magnetic.

What is claimed is:

1. A crossbar switch comprising a base plate; a number of contact spring groups mounted thereon side by side to extend across said base plate; operating members, one for each spring of the different spring groups; an electromagnet adjacent to one end of the base plate including a core, an operating winding on said core and an armature attracted by a pole surface on said core; a lifting bar extending from the armature in one sideward direction only to be under the operating members of the spring groups, said armature and said lifting bar forming a unit the overall length of which in said sideward direction is many times greater than the dimension of the armature in said sideward direction; means for positioning said unit relative to said base plate for causing said unit to swingably move about an axis parallel with said lifting bar on the attraction of said armature; said electromagnet further comprising a magnetic flux return portion extending from the core pole surface coextensive with said core, said core pole surface and said return portion having coplanar surfaces substantially parallel with the plane of said base plate and said armature having an attraction surface traversing said coplanar surfaces substantially in alignment with the operating members of the contact spring groups; selecting fingers; and means for optionally inserting said selecting fingers between said lifting bar and said operating members.

2. A selecting device comprising a base plate, a number of contact springs assembled into spring groups mounted side by side on said base plate, operating members, one for each spring group, for operating the movable ends of the springs of the different spring groups, a lifting bar, an electromagnet having a core with an attracting surface thereon acting on an armature with an attracting surface thereon facing the first mentioned attracting surface, said armature being substantially flat and integral with said lifting bar, a plurality of selecting fingers displaceable in the space between said operating members and a working surface of said lifting bar for connecting any one of said operating members to said lifting bar, controlling means for selectively displacing said selecting fingers and pivoting means for said lifting bar and said armature defining a turning axis which is parallel with the longitudinal direction of said lifting bar and extending behind this bar as seen from the movable ends of the contact springs, said armature as well as said core extending substantially parallel with the plane of said base plate, said core having its attracting surface substantially parallel with its longitudinal direction and edge portions of the unit consisting of said lifting bar and said armature forming part of said pivoting means and abutting against that side of said base plate, which has the same orientation in relation to said plate as said attracting surface of said core in relation to said core.

3. The device of claim 2, in which said pivoting means include pieces rigidly connected with said base plate and overlapping said edge portions of the unit consisting of said lifting bar and said armature.

4. A selecting device comprising a flat base plate having planar surfaces on opposite sides, a plurality of contact springs assembled into spring groups mounted side by side on one of said planar surfaces on said base plate, operating members, one for each spring group, for operating the movable ends of the springs of the different spring groups, a lifting bar having a working surface spaced from said operating members, an electromagnet having a core with an attracting surface coplanar with the surface opposite said one planar surface of the base plate, an armature having an attracting surface thereon facing the attracting surface on said core and being adapted to actuate said lifting bar, a plurality of selecting fingers axially extendable and displaceable in the space between said operating members and said working surface for connecting any one of said operating members to said lifting bar, controlling means for selectively displacing said selecting fiingers, and pivoting means for said lifting bar and said armature defining a turning axis which is parallel with the longitudinal direction of said lifting bar and extending behind this bar as seen from the movable ends of the contact springs.

5. A selecting device comprising a base plate, a plurality of contact springs assembled into spring groups mounted side by side on one side of said base plate, an operating member for each spring group for controlling movable ends of said springs in each spring group, a lifting bar having a working surface, an electromagnet core with an attracting surface parallel to the longitudinal axis of the core, an armature with an attracting surface facing the attracting surface on said core, said armature and said lifting bar being mounted for concomitant pivotal movement about an edge integral with the armature to provide a turning axis lying on the same side of the armature as said attracting surface, a plurality of selecting fingers displaceable in the space between the operating members and said lifting bar for optionally connecting said operating members to move with movement of said lifting bar, and controlling means for selectively displasing said selecting fingers.

6. The selecting device as defined in claim 5 wherein the lifting bar and armature are coplanar and the edge providing the turning axis abuts against the base plate on the side of said base plate opposite said one side.

7. The selecting device as defined in claim 5 wherein the attracting surface on said core is parallel to said one side of said base plate whereby the attracting forces on the attracting surface of the armature are in substantially the same direction and have the same sense as the reaction forces on the lifting bar.

8. A selecting device comprising a base plate, a number of contact springs assembled into spring groups mounted side by side on said base plate, operating members, one for each spring group, for operating the movable ends of the springs of the different spring groups, a lifting bar, an electromagnet having a core with an attracting surface thereon acting on an armature with an attracting surface thereon facing the first mentioned attracting surface and a coil surrounding said core, said armature and said lifting bar being formed as an integral unit and substantially flat, a plurality of selecting fingers displaceable in the space between said operating members and the working surface of said lifting bar for connecting any one of said operating members to said lifting bar, controlling means for selectively displacing said selecting fingers, pivoting means for said lifting bar and said armature defining a turning axis lying on the same side of the armature as said armature attracting surface and being parallel with the longitudinal direction of said lifting bar, the armature in its attracted position and the attracting surface on the core extending substantially parallel with the plane of the base plate, the core having its attracting surface substantially parallel with and its longitudinal axis perpendicular to said turning axis, and the turning axis extending rearwardly of the lifting bar and in front of the middle transversal plane of said core as seen from the movable ends of the contact springs.

9. In a crossbar switch comprising a holding magnet unit including a base plate on which a plurality of contact spring groups are disposed side by side, an actuating member for each contact spring group, and an electromagnet having a magnet core including a pole face parallel to the longitudinal axis of said core, an operating coil on said core, an oscillating armature having a pole face which in attracted position is substantially parallel with

the longitudinal axis of the core and a lifting surface extending from the armature pole face in the direction of the turning axis of the armature under the contact spring groups and which in retracted position of the armature is spaced from said actuating members, said turning axis lying in the plane of the core pole face, selecting fingers displaceable into and out of operative position in the space between said lifting surface and said actuating members for effecting selective operation of the contact spring groups at the operation of the magnet.

10. In a crossbar switch comprising a holding magnet unit including a flat base plate having on one side a plurality of contact spring groups having movable ends and fixed ends disposed side by side, an actuating member at the movable end of each spring group, and an electromagnet having a magnetic core, an operating coil on said core and an oscillating armature including both a pole face to be attracted by the magnet core and a lifting surface parallel to said pole face and extending from the pole face in the direction of the turning axis of the armature under the contact spring groups and which in retracted position of the armature is spaced from said actuating members, selecting fingers having a portion displaceable into and out of operative position in the space between said lifting surface and said actuating members for effecting selective operation of the contact springs groups when the armature is attracted to said core, an edge of said armature forming a line contact of substantial length with the side opposite said one side of the base plate during actuation of said armature to provide a low friction bearing, said line contact being on the same side of said actuating member as said fixed ends of the spring groups.

11. The crossbar switch as defined in claim 10 wherein the selecting fingers are oriented in a plane substantially perpendicular to the direction of movement of said actuating members with the portions of said fingers contacting said actuating members being axially extendable whereby sawing action between the lifting bar and said fingers is reduced.

12. The crossbar switch as defined in claim 10 wherein the base plate is formed of magnetic material and an aperture is provided in the base plate for receiving said electromagnet core and operating coil whereby said line contact provides reduced magnetic flux leakage and decreased pressure in the armature bearing.

13. A selecting device comprising a base plate, a plurality of contact springs assembled into spring groups mounted side by side on said base plate, operating members, one for each spring group for operating the movable ends of the springs of the different spring groups, a lifting bar member having a working surface, an electromagnet having an armature for actuating said lifting bar member, a plurality of selecting fingers axially extendable and displaceable in the space between said operating members and said working surface on said lifting bar member for connecting any one of said operating members to said lifting bar member, controlling means for selectively displacing said selecting fingers, pivoting means for said lifting bar member defining a turning axis which is parallel with the longitudinal direction of said lifting bar and located behind said working surface as seen from the movable ends of the contact springs, a single common plane defined by the turning axis, an attraction surface on said armature and the working surface on the lifting bar member forming in the non-attracted position of the armature an acute angle with the direction of movement of said operating members and forming in the attracted position of the armature when the load on the lifting bar member approaches its maximum value a corresponding angle of approaching 90° whereby "sawing" action between the selecting fingers and said members on either side of said selecting fingers is essentially eliminated, a core as part of said electromagnet having a longitudinal axis and pole face both parallel to the plane of the base plate, and said attracting surface on the armature being so arranged that attracting forces on the armature occur along substantially the same direction and in substantially the same plane as the reaction forces on the lifting bar member to thereby provide reduced pressures on the bearings forming the turning axis.

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