E. B. CRAFT.

AUTOMATIC EXCHANGE SELECTOR.

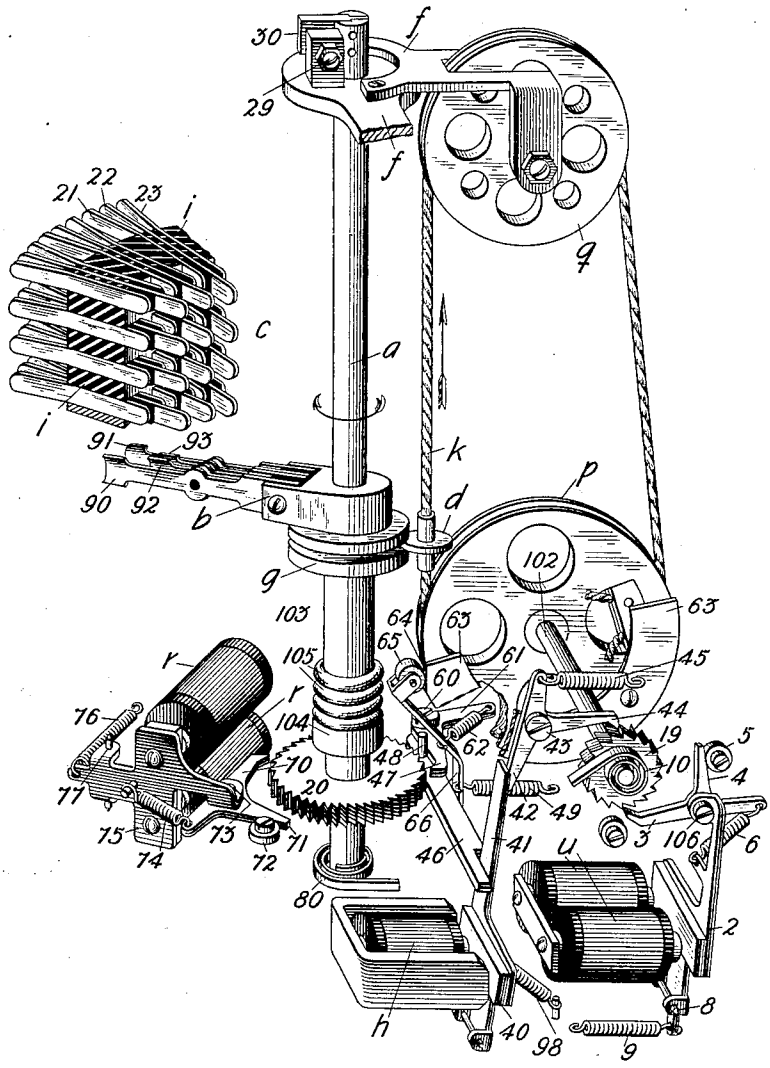
APPLICATION FILED MAR. 1, 1911.

1,099,343.

Patented June 9, 1914.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

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Inventor:

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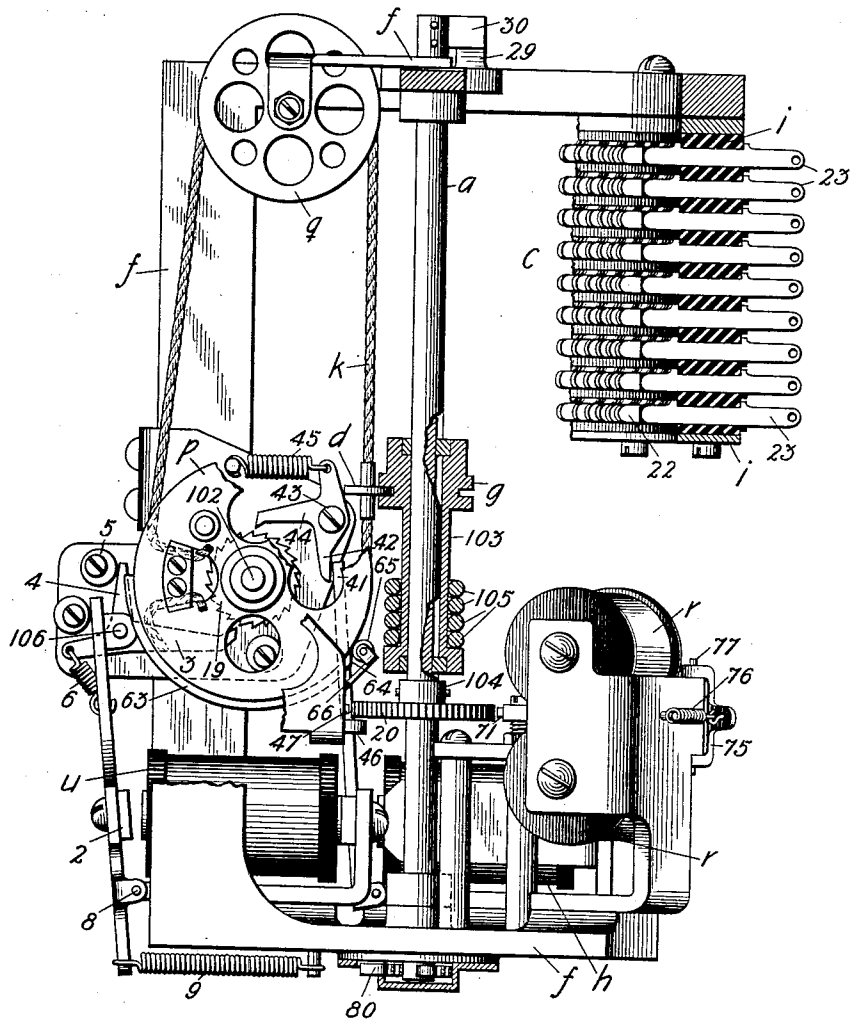
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2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

EDWARD B. CRAFT, OF HACKENSACK, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, OF NEW YORK, N. Y., A CORPORATION OF ILLINOIS.

AUTOMATIC-EXCHANGE SELECTOR.

1,099,343. Specification of Letters Patent. Patented June 9, 1914.

Application filed March 1, 1911. Serial No. 611,640.

To all whom it may concern:

Be it known that I, EDWARD B. CRAFT, a citizen of the United States, residing at Hackensack, in the county of Bergen and State of New Jersey, have invented a certain new and useful Improvement in Automatic-Exchange Selectors, of which the following is a full, clear, concise, and exact description.

This invention relates to electromagnetic selecting devices or switches for automatically connecting electrical circuits together for intercommunication, as in the automatic telephone exchange.

The object of this invention is to provide a selector that is simple and efficient for the purpose intended.

The invention employs contacts having blades or flat, spring-metal strips preferably fixed in rows in the surface of a cylinder, so arranged that the plane of each blade is parallel with the major axis of the cylinder; these contacts are combined with a complementary movable contact located on a radial arm on a vertical shaft at the axis of the cylinder; means are provided for rotating the radial arm with respect to the bank of fixed contacts to select a given vertical row, and then moving the arm longitudinally of such row to a particular fixed contact thereon, the sequence of these events being called "around and up" to distinguish from other possible arrangements.

Three electromagnets are employed; one operates to hold rotating parts in set position; another steps the radial arm around, and another raises the arm by steps after it is rotated. Each step-by-step magnet operates in response to current impulses in the actuating circuit or circuits in which it is located. After the desired contact has been attained the magnet which controls the holding pawls is released or demagnetized and a retracting device on the vertical shaft acts to return the shaft to its normal position of rest. This tends to establish such a frictional engagement between the radial arm and the fixed blade contacts that the radial arm cannot descend; to avoid this frictional engagement a mechanical holding device acts to retain the radial arm in the position in which it was held by the holding pawls, so that the arm is free to move to a point free from, or below, the lowest row of fixed contacts when the retracting device returns it to normal position.

The accompanying drawings illustrate the invention.

Figure 1 is a perspective view of the essential elements in operative relation; Fig. 2 is a view partly in section showing the frame of the apparatus with the various elemental parts fixed thereto.

There is a vertical shaft *a* rotatable in bearings in the frame *f;* a spiral spring 80, having one end fixed to the frame and its opposite end fixed to the shaft *a*, tends to rotate the shaft in one direction and in its normal position the stop 30 on shaft *a* is in engagement with the fixed stop 29 on the frame. Arranged for sliding movement on the shaft *a* but rotatable therewith is a radial contact arm *b* carrying contact springs 90, 91, 92, 93 suitably insulated with respect to each other and their support. A series of fixed contacts arranged in groups of three each, 21, 22, 23, are supported on an insulating foundation *i* in such manner that the inner contact terminals thereof are in the surface of a cylinder *c*. Means are provided for rotating the arm *b* below the plane of the fixed contacts until it reaches a point in vertical line with the particular contact desired, and means are provided for raising the contact *b* into engagement with the vertical row of contacts in which the desired contact is located. The contacts 21, 22, 23 are flexible blades or strips of metal and the surface of each blade is in a vertical plane so that the surface presents no lodging place for dust or foreign material which might tend to impair the electrical contact. The means for rotating shaft *a* consists of a toothed wheel 20 fixed on the shaft *a*, a propelling pawl 70 pivoted at 73 is retracted by a spring 74 against a back stop 72, in the

path of the arm 71. An electromagnet *r* has an armature 75 pivoted at 77 and retracted by a spring 76; each of the electrical impulses in the circuit in which the magnet *r* is included causes the propelling pawl 70 to engage with one tooth of wheel 20 and advance the wheel one step. A holding pawl 47 is pivoted at 60 on an arm 46 pivoted at 60; arm 46 is retracted by the spring 49 and holding pawl 47 has a tendency to engage the teeth of wheel 20 imparted to it by the spring 62 connected to the arm 66; a stop 48 on arm 46 limits the movement of pawl 47. There is a holding magnet *h* having an armature 40 retracted by the spring 98; an arm 41 is fixed to the armature 40 in position to engage the arm 46 and when the circuit through magnet *h* is closed, armature 40 is attracted and moves arm 46 into a position such that the holding pawl 47 engages the teeth of wheel 20. When magnet *r* operating through the propelling pawl 70 moved wheel 20 one tooth holding pawl 47 retained wheel 20 against the tendency of spring 80 to rotate it in the opposite direction and successive impulses in the coil of magnet *r* will operate to advance wheel 20 step-by-step, each step being held by the holding pawl 47 so long as armature 40 of magnet *h* is retained in its attracted position.

The means for elevating the radial arm *b* after it has been rotated to the desired radial point includes a grooved disk *g*, on a sleeve 103, splined to and sliding on shaft *a*. In the groove of the disk *g* is placed a disk *d* fixed on a belt or cord *k;* a grooved wheel *p* is fixed on a rotating shaft 102; shaft 102 is rotated in one direction by a spiral spring 10, one end of which is fixed to the shaft and the other end of which is fixed to the frame of the machine; a grooved wheel *q* is journaled at or near the top of the apparatus and the cord or belt *k* travels over the two grooved wheels *p* and *q* carrying the disk *d* upward in the direction of the arrow carrying with it the disk *g* and the radial arm *b*. When the desired contact is attained and before the disk *d* can strike the wheel *q*, the belt or cord is released and drops to its normal position as shown. The grooved disk *g* is on a sleeve 103 on the shaft *a;* on the sleeve 103 is fixed a collar 104 and to increase the weight of this sleeve, lead rings 105 may be placed on the sleeve as shown. The means for elevating the radial arm *b* include an electromagnet *u* having an armature 2 pivoted at 8 and retracted by the spring 9. The armature bar carries a propelling pawl 3 pivoted at 106 to the armature bar and retracted by a spring 6; an arm 4 integral with pawl 3 engages a stop 5 so that on the forward movement of the armature 2 the pawl 3 engages the teeth of ratchet wheel 19 fixed on shaft 102. There is a holding pawl 44 pivoted at 43 and held by spring 45 in position to engage the teeth of wheel 19; an arm 42 integral with holding pawl 44 projects into the path of arm 41 so that when arm 41 is retracted by spring 98 it operates to withdraw holding pawl 44 as well as holding pawl 47. After shaft *a* has been rotated to a point where radial arm *b* is in line with the desired row of vertical contacts impulses are transmitted in the circuit which includes the coils of magnet *u* and the radial arm *b* is raised until it engages with the horizontal row of contacts in which the desired contact is located. When it is desired to return the arm to its normal position, circuit through the magnet *h* is broken; this ultimately withdraws the holding pawls 44 and 47, the parts returning to their normal position under the influence of the spiral springs 10 and 80. Under the influence of the spring 80 the arm *b* would make such frictional engagement with the vertical row of fixed contacts that it would not drop under the influence of gravity, and to obviate this difficulty a mechanical means is provided for temporarily holding the arm 46 in the position to which it was moved by the magnet *h*. This includes a metal shoe or cam 63 fixed to the surface of the grooved wheel *p* and projecting slightly beyond its periphery. The outer surface of the cam 63 is concentric with the periphery of the wheel *p*, except that one end of said cam is beveled off as shown at 64. The arm 66 carries a roller 65 arranged to engage the periphery of the cam 63. When the switch is not in use, the beveled portion 64 of the cam 63 is opposite the roller 65 and the arm 66 is free to assume the position shown in Fig. 1 in which it permits the arm 46 to take the position shown in that figure. When, however, in the operation of the device the wheel *p* has been advanced even a single step, the roller 65 as engaged by the periphery of the cam 63 and the arm 66 is so moved as to hold the arm 46 in the position to which it has been moved by the energization of the magnet *h*.

With the construction just described, it is evident that while the switch is returning to its normal position after deënergization of the holding magnet *h*, although the holding pawl 44 will be released immediately by being engaged by the arm 41 carried by the armature 40, the holding pawl 47 will not release the ratchet 20 until the wheel *p* has returned to normal position, and the beveled portion 64 of the cam 63 has come opposite the roller 65. By the arrangement herein shown and described, therefore, the means which prevents the rotation of the movable contact member does not become ineffective during the restoring operation until the longitudi-

nal movement of said member toward normal position has been completed.

The mechanical blocking device consisting of the shoe 63 beveled at 64, the roller 65 supported on the arm 46 and its independent relation with respect to the arm 41 constitute a means for enforcing the return of the arm *b* in the inverse order of the successive movements by which it was carried to the contact position.

I claim:

1. In an automatic selecting switch the combination of a plurality of stationary contacts fixed in intersecting rows in the surface of a cylindrical figure, a rotatable shaft, a sleeve slidably mounted thereon, a complementary contact fixed on said sleeve, means for rotating said shaft, and means for sliding said sleeve axially.

2. In an automatic selecting switch the combination of a plurality of stationary contacts fixed in intersecting rows in the surface of a cylindrical figure, a rotatable shaft, a sleeve slidably mounted thereon, a complementary contact fixed on said sleeve, means for rotating said shaft, means for sliding said sleeve, independent devices for holding said sleeve and said shaft at each step of advancement, means for releasing both holding devices, and means for retaining the shaft-holding device until the sleeve has returned to normal position of rest.

3. In an automatic selecting switch the combination of a plurality of stationary contacts fixed in intersecting rows in the surface of a cylindrical figure, a rotatable shaft, a sleeve slidably mounted thereon, a complementary contact fixed on said sleeve, means for rotating said shaft step by step, means for raising said sleeve step by step, independent means for holding said shaft and said sleeve at each step in its advance movement, means for releasing the sleeve, and means for releasing the shaft at the end of the return movement of the sleeve.

4. In an automatic selecting switch the combination of a plurality of stationary contacts fixed in intersecting rows in the surface of a cylindrical figure, a rotatable shaft, a sleeve slidably mounted thereon, a complementary contact fixed on said sleeve, means for rotating said shaft step by step, and means for advancing said sleeve step by step including a pair of grooved pulleys united by a flexible connection and means for uniting said flexible connection to said sleeve.

5. In an automatic selecting switch the combination of a series of fixed contacts arranged in curved lines and in right lines in planes intersecting at right angles, a movable complementary contact, means tending to retain said contact in normal position, means for advancing said contact in a curved line, means for thereafter advancing said contact in a right line into engagement with a line of fixed contacts, means for holding said movable contact against return curved line movement, means for holding said movable contact against return right line movement, and means controlled by the means for advancing said contact in a right line preventing the release of the curved line holding means during the right line return movement of said movable contact.

6. In an automatic selecting switch the combination of a series of fixed contacts arranged in curved lines and in right lines in planes intersecting at right angles, a movable contact member adapted to coöperate with said fixed contacts, means tending to retain said contact in normal position, means for advancing said contact in a curved line including a ratchet and coöperating actuating and holding pawls, means for thereafter advancing said contact in a right line including a ratchet and actuating and holding pawls, and means for preventing releasing movement of the curved line holding pawl until the right line return movement of the movable contact is completed.

7. In an automatic selecting switch the combination of a series of fixed contacts arranged in curved lines and in right lines in planes intersecting at right angles, a movable contact member adapted to coöperate with said fixed contacts, means tending to retain said contact in normal position, means for advancing said contact in a curved line including a ratchet and coöperating actuating and holding pawls, means for thereafter advancing said contact in a right line including a ratchet and actuating and holding pawls, and means controlled by the right line advancing means for preventing releasing movement of the curved line holding pawl until the right line advancing means has returned to normal position.

8. In an automatic switch, a plurality of rows of contacts, a shaft, a sleeve non-rotatably mounted thereon, a brush carried by said sleeve for engagement with said contacts, means for rotating said shaft, and means for sliding said sleeve on said shaft.

9. In an automatic switch, a shaft, a cylindrical terminal bank having longitudinally extending rows of contacts parallel to said shaft, a sleeve non-rotatably mounted on said shaft, a brush carried by said sleeve for engagement with said contacts, means for rotating said shaft, and means for sliding said sleeve on said shaft.

10. In an automatic switch, the combination with a cylindrical terminal bank having longitudinally extending straight rows of

contacts, of a support, a brush adapted to coöperate with the contacts of said rows mounted on said support, means for rotating said support to select one of said rows of contacts, a rotary holding means for preventing reverse rotation, means for thereafter moving said support longitudinally, longitudinal holding means, and means for preventing releasing movement of the rotary holding means until the longitudinal return movement is completed.

In witness whereof, I, hereunto subscribe my name this 24th day of February A. D., 1911.

EDWARD B. CRAFT.

Witnesses:

IRVING MACDONALD,

MORGAN WASHBURN, Jr.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents. Washington, D. C."