Oct. 6, 1931. D. L. LIENZÉN 1,825,911

SELECTOR

Filed Feb. 12, 1930 3 Sheets-Sheet 1

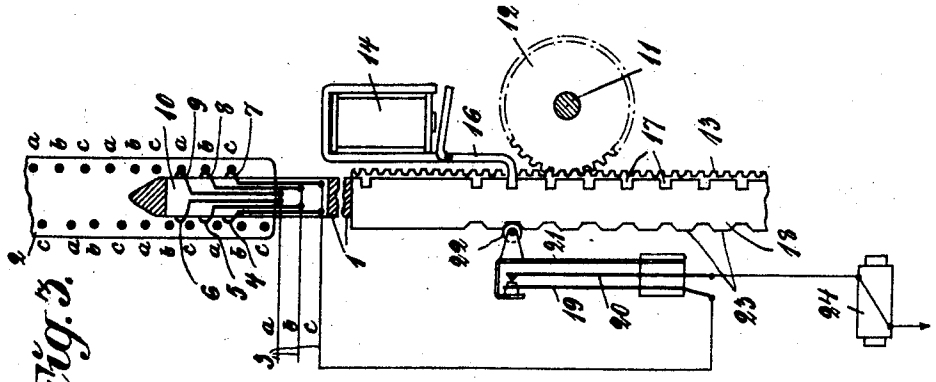


Fig. 3.

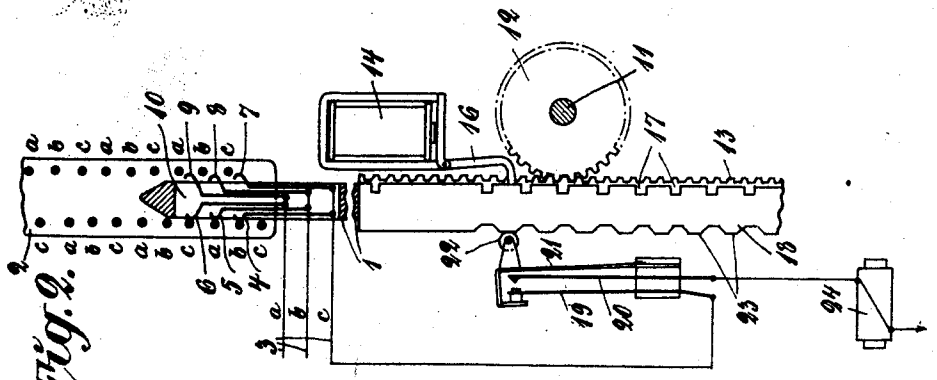


Fig. 2.

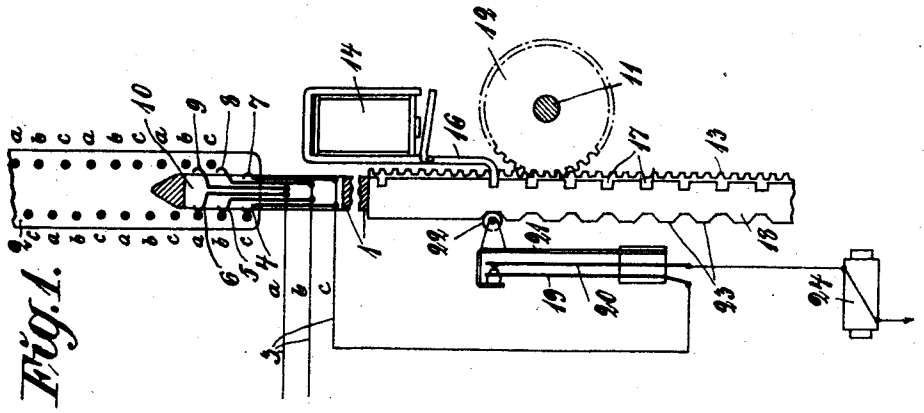


Fig. 1.

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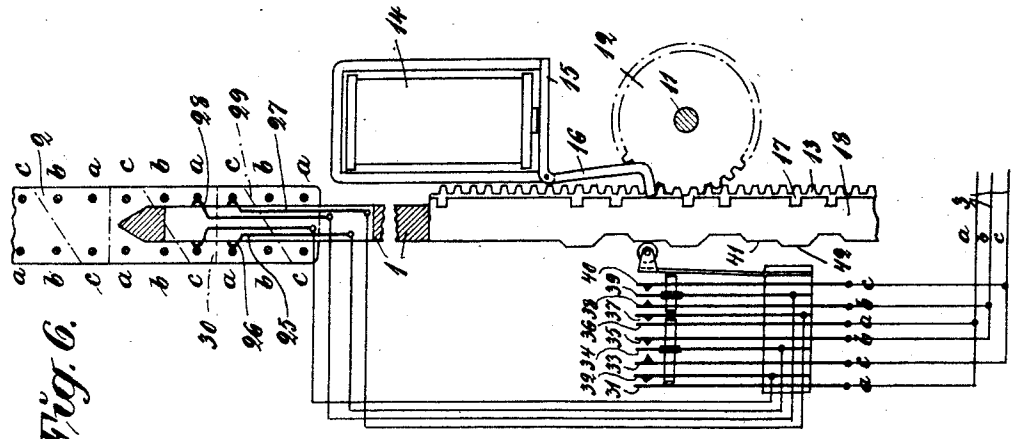


Fig. 6.

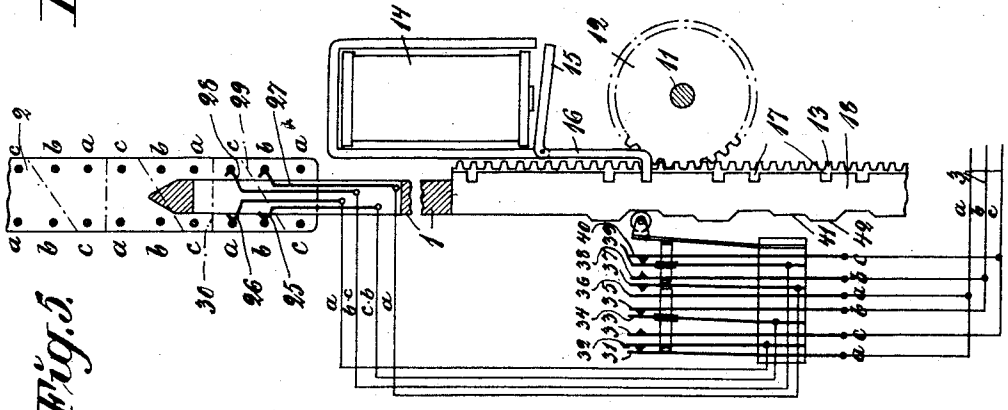


Fig. 5.

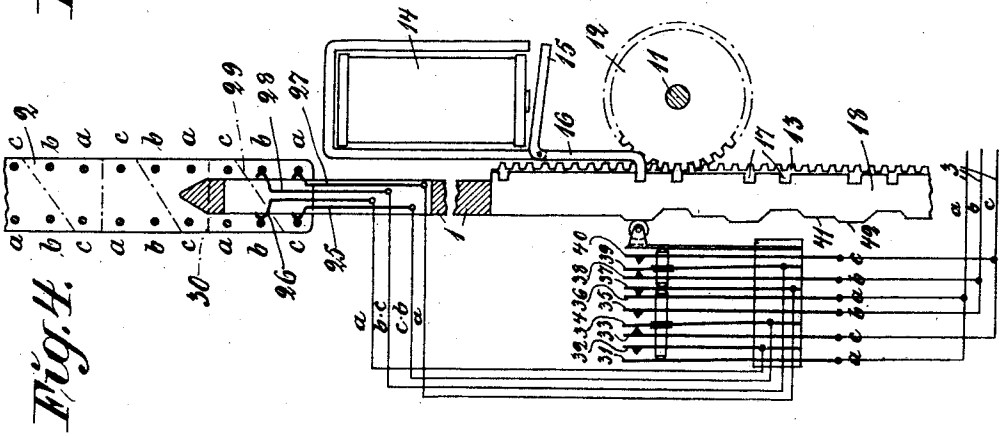


Fig. 4.

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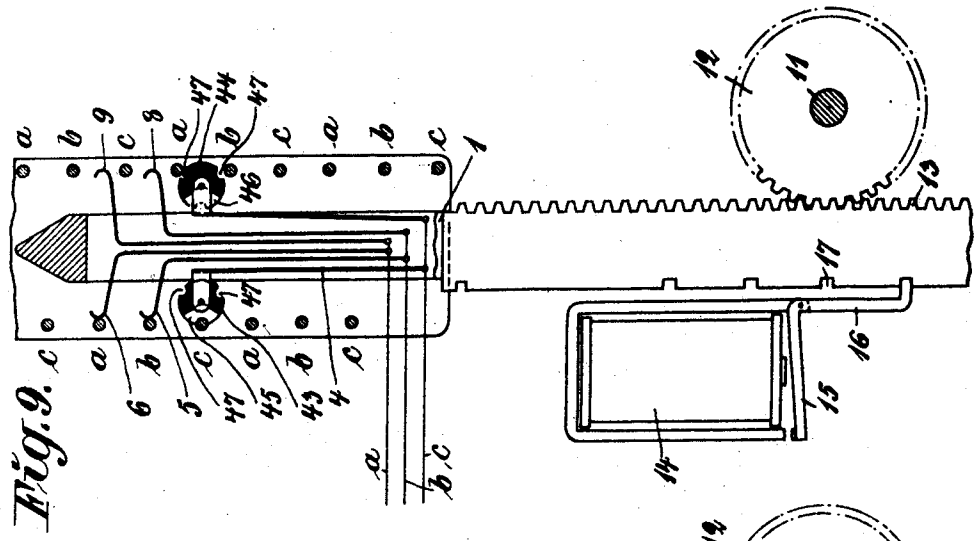


Fig. 9.

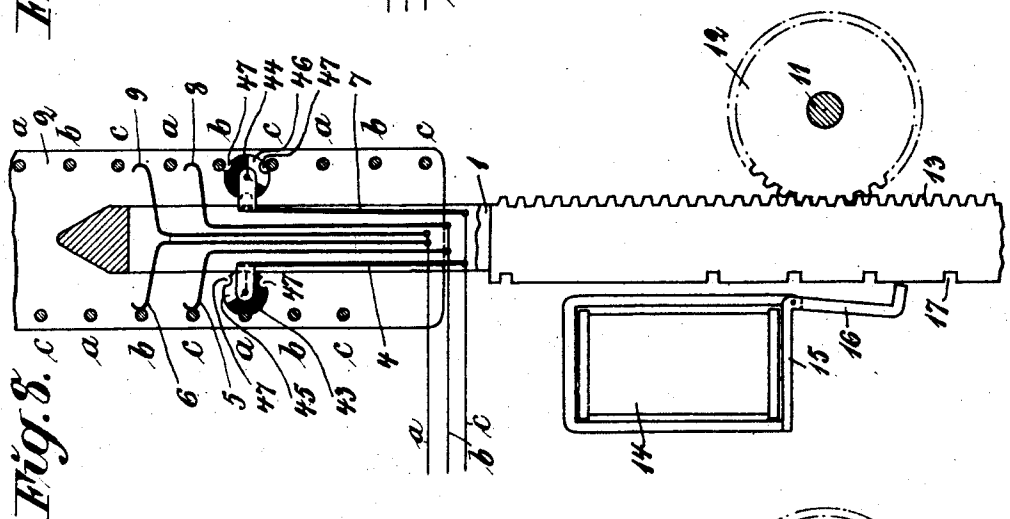


Fig. 8.

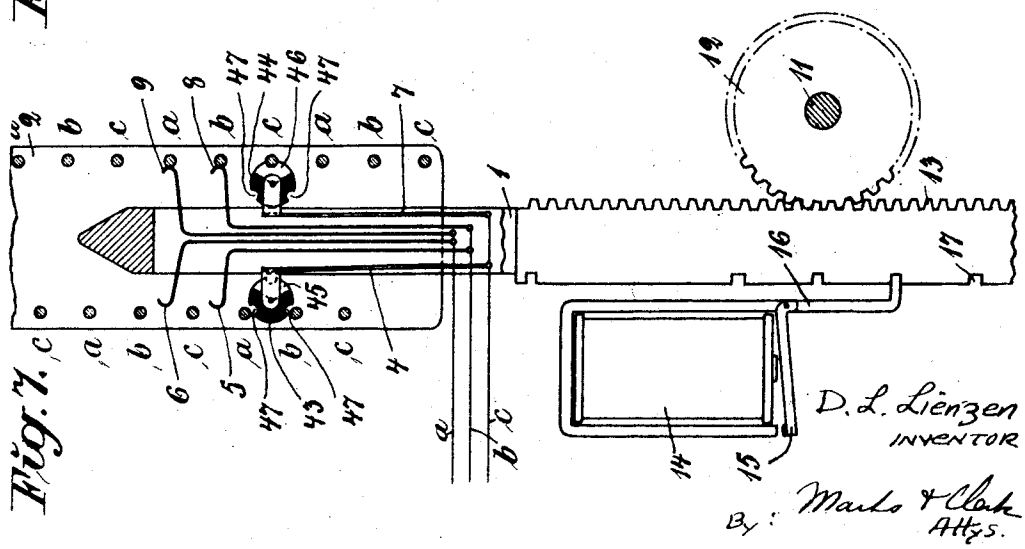


Fig. 7.

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Patented Oct. 6, 1931 1,825,911

UNITED STATES PATENT OFFICE

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SELECTOR

Application filed February 12, 1930, Serial No. 427,849, and in Sweden October 23, 1929.

The present invention relates to selectors used in automatic telephone systems and more particularly to selectors of the kind, the contact fields of which consist of mutually parallel bare wires or the like common to a group of selectors, and which are provided with a longitudinally displaceable contact arm adapted to move into the contact field between its wires to select the wanted line, a number of contact springs or wipers disposed on the contact arm then making contact with the wires of the contact field. Selectors of this kind should be so constructed as to prevent contacts between the test wiper and the talking line wires of the contact field during the setting of the selector, as the test wiper must generally be kept alive during the setting of the selector, at least in selectors having searching motion, and therefore might cause disturbances in existing talking connections. In hitherto known selectors of this kind the wires appertaining to the talking line branches have for this purpose been disposed on the one side of the path of motion of the contact arm whereas wires appertaining to the third conductors, the so called test wires, have been disposed on the opposite side of said path. In practice, this disposition has, however, the disadvantage that the space occupied by the contact field can not be entirely utilized as the wire row on the one side of the path of the contact arm will accommodate only half as many wires as that on the opposite side. The present invention has for its object to render possible a better utilization of the space in the contact field and consists substantially in certain dispositions of the wires in the contact field in combination with means to prevent the test wiper from making contact with the talking line wires during the setting operation.

The invention will be more closely described with reference to the accompanying drawings. Figures 1, 2 and 3 show diagrammatically an embodiment of the invention, the contact arm taking up three different contact positions. Figures 4, 5 and 6 show in similar manner another embodiment and Figures 7, 8 and 9 a third embodiment.

In the embodiment shown in Figures 1, 2 and 3 the wires belonging to a line group or a contact row respectively in the contact field are distributed on both sides of the path of the contact arm 1 as indicated by the letters of reference *a*, *b*, *c* whereof *a* and *b* designate those wires to which both branches of the talking line are connected whereas *c* designates that wire to which the test wire is connected. Apparently all the wires *a*, *b*, *c* appertaining to one and the same line are disposed behind each other in the same wire row and on the same side of the path of the contact arm. The wires are in known manner common to a plurality of selectors disposed above each other and extend in a manner known per se through holes in insulating plates 2 which are spaced apart by suitable distances so as to ensure a sufficient rigidity of the wires.

The connection between the line 3 terminating in the selector and the lines connected to the contact field takes place by means of two groups of contact springs or wipers 4, 5, 6 and 7, 8, 9 respectively which are disposed in a cavity 10 in the front end of the contact arm in such a manner that the contact springs 4, 5, 6 are adapted to make contact with the wires disposed on the left hand side of the path of the contact arm, whereas the contact springs 7, 8, 9 are adapted to make contact with the wires disposed on the right hand side of said path. The different contact springs are two and two electrically connected to each other and to the talking line wires *a*, *b* and the test wire *c* appertaining to the incoming line 3. The wire rows disposed on opposite sides of the path are displaced in relation to each other in such a manner that during the motion of the contact arm into the contact field connection is established alternately to lines disposed on opposite sides of the path. The same result may, of course, be obtained by a displacement of the groups of contact springs 4, 5, 6 and 7, 8, 9 in relation to each other whereas the wires *a*, *b*, *c* in the two rows are disposed rightly opposite each other.

The setting of the contact arm 1 may take place in any known manner. On the drawings only one arrangement for the longitu-

dinal displacement of the contact arm is shown consisting of a toothed wheel 12 disposed on a shaft 11 and a toothed rack 13 rigidly connected to the contact arm 1, said shaft 11 being, by way of example, adapted to be connected to a continuously rotating shaft by means of a magnetic clutch. The contact arm is adapted to be locked in each set position by means of a locking magnet 14 the armature 15 of which is provided with a detent 16 adapted to engage slots 17 in a bar 18 rigidly connected to the arm 1 so as to centre the wiper exactly in each contact position.

If the selector is provided with a plurality of line groups and contact rows respectively the contact arm 1 must be adapted to be set in two directions in the same plane in such a manner that it initially moves outside the contact field to select a line group or contact row respectively and thereupon into the contact field between the wires in said row to select the wanted line. During the first motion the contact arm may in known manner either perform a parallel motion perpendicularly to the arm or a rotating motion the contact arm then turning about an axis parallel with the wires in the field. In the former case the contact rows are mutually parallel while, in the latter case, they are disposed radially in relation to the axis of rotation of the arm in such a manner that the arm during its motion into the contact field performs a motion in radial direction. The motion mechanisms required therefore may be of any known kind and need not be more closely described in this connection as they are of no importance for the invention.

In its normal starting position the contact arm in its entirety extends outside the front end of the wire row. During the motion of the contact arm into the contact field the two talking branches *a* and *b* of the incoming line 3 are disconnected from the appertaining contact springs 5, 6, 8, 9 provided in an apparatus not disclosed here and appertaining to the selector, by way of example a sequence switch or a relay, so that said contact springs are dead, i. e. disconnected from the current source, during the motion. Said contact springs may thus make contact during the motion of the contact arm with the different wires in the field without thereby causing any disturbances. To prevent that the test wipers 4 and 7 during the setting motion cause disturbances by making contact with the wires *a*, *b* the selector is, according to the invention, provided with a switching device which in the shown example consists of two contact springs 19, 20, whereof the spring 19 is adapted to be actuated through the intermedium of a flexible arm 21 which by means of a wheel 22 disposed thereon is in elastic engagement with the bar 18 so as to be actuated by teeth 23 disposed on the bar 18 during the motion of the contact arm into the contact field. The latter teeth are so adjusted that the contact between the springs 19, 20 is interrupted when the test wipers 4, 7 pass over the talking line wires *a*, *b*. Said switching device is included in the testing circuit of the line 3 in such a manner that the test wipers 4, 7 are tensionless or dead when they pass the wires *a* and *b*. In the testing circuit of the line 3 a testing relay 24 may be included in usual manner which relay, when the selector operates as finder, in known manner brings the selector to stop as soon as the latter find a free line.

Figure 1 shows the contact arm in its first setting position the contact springs 4, 5, 6 then making contact with the first line *a*, *b*, *c* in the left hand wire row. Figure 3 shows the contact arm in its second setting position, the contact springs 7, 8, 9 then making contact with the first line *a*, *b*, *c* in the right hand wire row which line is the second line in the line group in question. Figure 2 shows an intermediate position, which is passed by the contact arm during its motion from the first to the second position. In this intermediate position the test wiper 4 makes contact with the wire *b* appertaining to the first line in the line group but said contact may not cause any disturbance because the contact between the contact springs 19, 20 is now interrupted as the elastic arm 21 in this position is actuated by a tooth 23. The teeth 23 may, of course, be of such a nature that the contact 19, 20 is interrupted during the entire period of contact between the test wiper and the wire *b*. On account of said displacement between the wires in the two wire rows the contact springs 7, 8, 9 do not make contact with the wires *a*, *b*, *c* on the right hand side in said intermediate position. When the contact arm reaches the position shown in Figure 3 the contact springs 4, 5, 6 take up such a position that they do not make contact with any wires on the left hand side. Immediately before the contact arm reaches the exact setting position the contact 19, 20 is closed, a testing of the line then taking place just a moment before the arm takes up the exact contact position. If the selector operates as finder and the second line should be engaged the contact arm will continue its motion until it reaches a free line the testing relay 24 then operating and bringing the selector to stop. Then the locking magnet 14 becomes de-energized so that the detent 16 is released and locks the arm in an exactly centered position. On account of said mutual displacement between the two wire rows the contact arm will thus alternately establish communication with lines disposed on opposite sides of the path of the contact arm.

The described arrangement renders possible a complete utilization of the space occupied by the contact fields so that both wire rows will contain the same number of equi-

distant wires. As a consequence, a larger number of lines may be connected up within the same space of the contact field than has hitherto been possible.

The embodiment shown in Figures 4, 5 and 6 is differentiated from the one just described substantially in that the wires *a*, *b*, *c* appertaining to the same line are mutually grouped in another manner which in turn renders possible a reduction in the number of contact springs in the contact arm. In this embodiment the arm is thus only provided with four contact springs 25, 26, 27, 28. The grouping of the wires *a*, *b*, *c* may be seen from the dashed and dotted lines 29, 30, which are drawn in such a manner that they separate the wires belonging to adjacent lines from each other. As is clearly understood from the drawings the talking wires *a* and *b* appertaining to the first line are disposed in the right hand wire row whereas the appertaining *c*-wire is disposed in the left hand wire row. On the other hand, the second line has its speaking wire *a*, *b* in the left hand wire row whereas the test wire *c* is disposed in the right hand row. In the third line the wires are disposed in similar manner as in the first line and in the fourth line they are disposed in similar manner as in the second etc. The arrangement may in certain cases be so carried out that, by way of example, the wires *a* and *c* in each individual line change places. As the mutual position of the wires appertaining to each individual line is altered when passing from one setting position to another it is clearly understood that a corresponding shifting of the contact springs 25, 26, 27, 28 must take place during the setting besides which one of the contact springs must then be disconnected in each special setting position. This shifting is brought about according to the invention by a switching device similar to that shown in Figures 1 to 3. The switching device is in this case constituted by a plurality of contact springs 31 to 40, whereof the contact springs 33, 34, 39, 40 control the connecting up of the test wire belonging to the incoming line 3 in such a manner that the contact springs 25 and 28 alternately serve as test wipers. The operation is clearly understood upon a comparison between the Figures 4, 5 and 6 showing three different positions of the contact arm. In Figure 4, the arm is shown in its first contact position, the contact springs 27, 28 and 25 then making contact with the corresponding wires *a*, *b*, *c* appertaining to the first line. The contact spring 27 is connected to the *a*-wire of the incoming line over the contact springs 36, 37 the contact spring 28 is connected to the *b*-wire of the incoming line over the contact springs 38 and 39 and the contact spring 25 is connected to the *c*-wire of the incoming line over the contact springs 33 and 34. The contact spring 26 which is directly connected to the contact spring 32 in the switching device is in this position entirely disconnected. The springs 31 to 40 are adapted to be actuated in such a manner that three different switching operations may take place. For this purpose the bar 18 is provided with teeth 41, 42 of different heights, so that the elastic arm 21 during the motion of the contact arm is successively brought to take up three different positions, i. e. a bottom position in the bottom of the toothed space, an intermediate position on a tooth 41, and finally a top position on the tooth 42. Figures 4, 5 and 6 show three consecutive positions of the contact arm corresponding to said three different positions of the switching device. The position shown in Figure 4 corresponds to the first setting position. The position shown in Figure 5 corresponds to the second setting position. Figure 6 shows an intermediate position of the contact arm between the second and third setting positions. As is understood by the figures, the step between two consecutive contact positions will vary in such a manner that the step between the second and third setting positions is twice as great as the step between the first and second setting position. In similar manner the step between the fourth and fifth setting positions is twice the step between the third and fourth setting positions etc. Every second setting step will thus be twice as long as the next preceding one.

When the contact arm moves from the first to the second setting position a shifting of the contact springs 25 to 28 takes place so that the contact spring 25 which previously was connected to the *c*-wire now is connected to the *b*-wire whereas the contact spring 26 which previously was entirely disconnected now is connected to the *a*-wire. Instead the contact spring 27 is now entirely disconnected whereas the contact spring 28 which previously was connected to the *b*-wire now is connected to the *c*-wire. When the contact arm has moved forward a further step equal to the distance between the first and the second setting positions the contact springs 25 to 28 take up the intermediate position shown in Figure 6 in which all the contact springs are entirely disconnected from the incoming line 3 as the elastic arm 21 now bears against the lower tooth 41 the switching device now taking up an intermediate position in which all the contact springs 31 to 40 are separated from each other. In this position no locking of the contact arm may take place because the bar 18 is not provided with any corresponding recess for the detent 16. The contact arm continues thus its motion until it reaches the next setting position wherein the contact

springs 25, 27, 28 make contact with the wires *c*, *a* and *b* of the line connected up in this position, whereas the contact spring 26 is entirely disconnected. The switching device is then actuated by a tooth 42 and consequently it takes up the same position as in Figure 4.

The shown embodiment having four contact springs may, as is readily understood, also be applied in systems having quad lines, all talking line wires being then preferably disposed in one wire row and the third and fourth wires in the other wire row.

Evidently the switching device may be carried out in many different manners and it may be adapted to be actuated by any movable part of the selector mechanism which is positively connected to the contact arm.

Figures 7, 8 and 9 show a modification of the embodiment according to Figures 1, 2 and 3, the shifting of the test wipers 4, 7 being here brought about by means of a switching device co-operating with the wires in the contact field. Each test wiper 4 and 7 is thus provided with a wheel 43 and 44 respectively of insulating material rotatably disposed thereon and provided with a metallic portion 45 and 46 respectively which is in conductive communication with the contact spring 4 and 7 respectively. Said wheel is at its circumference provided with three recesses 47 adapted to engage the wires *a*, *b*, *c* in such a manner that the wheel during the motion of the contact arm is brought to rotate while maintaining a positive tooth engagement with the wires. The arrangement is then carried out in such a manner that the metallic portion 45 and 46 respectively only may make contact with the *c*-wires but on the other hand not with the *a*- and *b*-wires. Figure 7 shows the contact arm in its third setting position, the contact springs 7, 8, 9 then making contact with the corresponding wires *a*, *b*, *c* in the right hand wire row whereas the springs 4, 5, 6 in similar manner as in Figure 3 take up an intermediate position between the different wires in the left hand wire row. Figure 9 shows the contact arm in the next setting position the communication being then instead established over the contact springs 4, 5, 6 whereas the contact springs 7, 8, 9 take up an intermediate inoperative position. Figure 8 shows a contact arm in a position between the third and fourth setting positions and illustrates the test wipers 4, 7 being entirely disconnected in this position. It is also seen from the drawings that the testing contact springs may not in any position between two adjacent setting positions establish unwanted contacts with the talking line wires *a* and *b*.

In the embodiments according to Figures 1 to 3 and 7 to 9 the sets of contact springs disposed on opposite sides of the contact arm need not necessarily be connected in parallel but may be adapted to be connected alternately in consecutive setting positions of the contact arm to the incoming line 3, for instance by means of a switching device mechanically dependent upon the motion mechanism of the selector and of a similar kind as that shown in Figures 4 to 6.

In case two complete sets of contact springs each comprising three contact springs are used the arrangement may also be so carried out that both sets of contact springs in each individual setting position make contact each with one line in the contact field the incoming line 3 being adapted to be alternately connected to the one or the other of the two sets of contact springs by means of a relay or other switching device.

I claim:

1. A selector arrangement comprising a number of selectors, a contact field consisting of parallel bare conductors and common to a plurality of selectors, a longitudinally displaceable contact arm on each selector, means to move said contact arm into the contact field between the bare conductors thereof to select any of the lines connected to the contact field, the test conductors of said lines being equally distributed on both sides of the path of the contact arm and equally spaced on each side.

2. A selector as claimed in claim 1, characterized in that the test conductors are disposed on the same side of the path of the contact arm as the appertaining talking line conductors.

3. A selector arrangement comprising a number of selectors, a contact field consisting of parallel bare conductors and common to a plurality of selectors, a longitudinally displaceable contact arm on each selector, means to move said contact arm into the contact field between the bare conductors thereof to select any of the lines connected to the contact field the two talking line conductors belonging to each of said lines being disposed on the one side and the third conductor on the other side of the path of the contact arm, the mutually corresponding conductors of consecutive lines being alternately disposed on opposite sides of the path.

4. A selector arrangement comprising a number of selectors, a contact field consisting of parallel bare conductors and common to a plurality of selectors, a longitudinally displaceable contact arm on each selector, means to move said contact arm into the contact field between the bare conductors thereof to select any of the lines connected to the contact field said lines being adapted to be alternately connected in consecutive setting positions to line conductors on opposite sides of the path of the contact arm.

5. A selector arrangement comprising a number of selectors, a contact field consisting

of parallel bare conductors and common to a plurality of selectors, a longitudinally displaceable contact arm on each selector, means to move said contact arm into the contact field between the bare conductors thereof to select any of the lines connected to the contact field said lines being adapted to be alternately connected in consecutive setting positions to line conductors on opposite sides of the path of the contact arm, two sets of contact springs disposed on opposite sides of said contact arm, said two sets of contact springs being mutually displaced in such a manner, that the connections in consecutive setting positions are alternately established over the one and the other of two sets of contact springs.

6. A selector arrangement comprising a number of selectors, a contact field consisting of parallel bare conductors and common to a plurality of selectors, a longitudinally displaceable contact arm on each selector, means to move said contact arm into the contact field between the bare conductors thereof to select any of the lines connected to the contact field said lines being adapted to be alternately connected in consecutive setting positions to line conductors on opposite sides of the path of the contact arm, two sets of contact springs disposed on opposite sides of said contact arm, the line conductors being mutually displaced in such a manner that the connections in consecutive setting positions are alternately established over the one and the other of the two sets of contact springs.

7. A selector arrangement comprising a number of selectors, a contact field consisting of parallel bare conductors and common to a plurality of selectors, a longitudinally displaceable contact arm on each selector, means to move said contact arm into the contact field between the bare conductors thereof to select any of the lines connected to the contact field said lines being adapted to be alternately connected in consecutive setting positions to line conductors on opposite sides of the path of the contact arm, an electric switching device adapted to be mechanically controlled by the motion mechanism of the selector, whereby the incoming line during the setting motion is alternately connected to the one and the other of two sets of contact springs disposed on opposite sides of the contact arm.

8. A selector arrangement comprising a number of selectors, a contact field consisting of parallel bare conductors and common to a plurality of selectors, a longitudinally displaceable contact arm on each selector, means to move said contact arm into the contact field between the bare conductors thereof to select any of the lines connected to the contact field said lines being adapted to be alternately connected in consecutive setting positions to line conductors on opposite sides of the path of the contact arm, a line terminating in the selector, the wires of said line being connected to contact springs disposed on the contact arm over an electric switching device which is adapted to be mechanically controlled by the motion mechanism of the selector in such a manner that the connections between the incoming line and the contact springs may be interrupted and shifted as required during the setting of the contact arm.

9. A selector arrangement comprising a number of selectors, a contact field consisting of parallel bare conductors and common to a plurality of selectors, a longitudinally displaceable contact arm on each selector, means to move said contact arm into the contact field between the bare conductors thereof to select any of the lines connected to the contact field said lines being adapted to be alternately connected in consecutive setting positions to line conductors on opposite sides of the path of the contact arm, two sets of contact springs disposed on opposite sides of said contact arm, said two sets of contact springs being mutually displaced in such a manner that the connections in consecutive setting positions are alternately established over the one and the other of two sets of contact springs, a line terminating in the selector, the wires of said line being connected to contact springs disposed on the contact arm over an electric switching device which is adapted to be mechanically controlled by the motion mechanism of the selector in such a manner that the connections between the incoming line and the contact springs may be interrupted and shifted as required during the setting of the contact arm.

10. A selector arrangement comprising a number of selectors, a contact field consisting of parallel bare conductors and common to a plurality of selectors, a longitudinally displaceable contact arm on each selector, means to move said contact arm into the contact field between the bare conductors thereof to select any of the lines connected to the contact field said lines being adapted to be alternately connected in consecutive setting positions to line conductors on opposite sides of the path of the contact arm, two sets of contact springs disposed on opposite sides of said contact arm, the line conductors being mutually displaced in such a manner that the connections in consecutive setting positions are alternately established over the one and the other of the two sets of contact springs, a line terminating in the selector, the wires of said line being connected to contact springs disposed on the contact arm over an electric switching device which is adapted to be mechanically controlled by the motion mechanism of the selector in such a manner that the connections between the incoming line and the contact springs may be interrupted and shifted as required during the setting of the contact arm.

11. A selector arrangement comprising a

number of selectors, a contact field consisting of parallel bare conductors and common to a plurality of selectors, a longitudinally displaceable contact arm on each selector, means to move said contact arm into the contact field between the bare conductors thereof to select any of the lines connected to the contact field said lines being adapted to be alternately connected in consecutive setting positions to line conductors on opposite sides of the path of the contact arm, an electric switching device adapted to be mechanically controlled by the motion mechanism of the selector, whereby the incoming line during the setting motion is alternately connected to the one and the other of two sets of contact springs disposed on opposite sides of the contact arm, a line terminating in the selector, the wires of said line being connected to contact springs disposed on the contact arm over an electric switching device which is adapted to be mechanically controlled by the motion mechanism of the selector in such a manner that the connections between the incoming line and the contact springs may be interrupted and shifted as required during the setting of the contact arm.

12. A selector arrangement comprising a number of selectors, a contact field consisting of parallel bare conductors and common to a plurality of selectors, a longitudinally displaceable contact arm on each selector, means to move said contact arm into the contact field between the bare conductors thereof to select any of the lines connected to the contact field said lines being adapted to be alternately connected in consecutive setting positions to the line conductors on opposite sides of the path of the contact arm, a line terminating in the selector, the wires of said line being connected to contact springs disposed on the contact arm over an electric switching device mechanically cooperating with the conductors of the contact field by means of which device the connection of the contact springs may be shifted as required.

In testimony whereof I affix my signature.

DAVID LAURENTIUS LIENZÉN.