

Jan. 4, 1927.

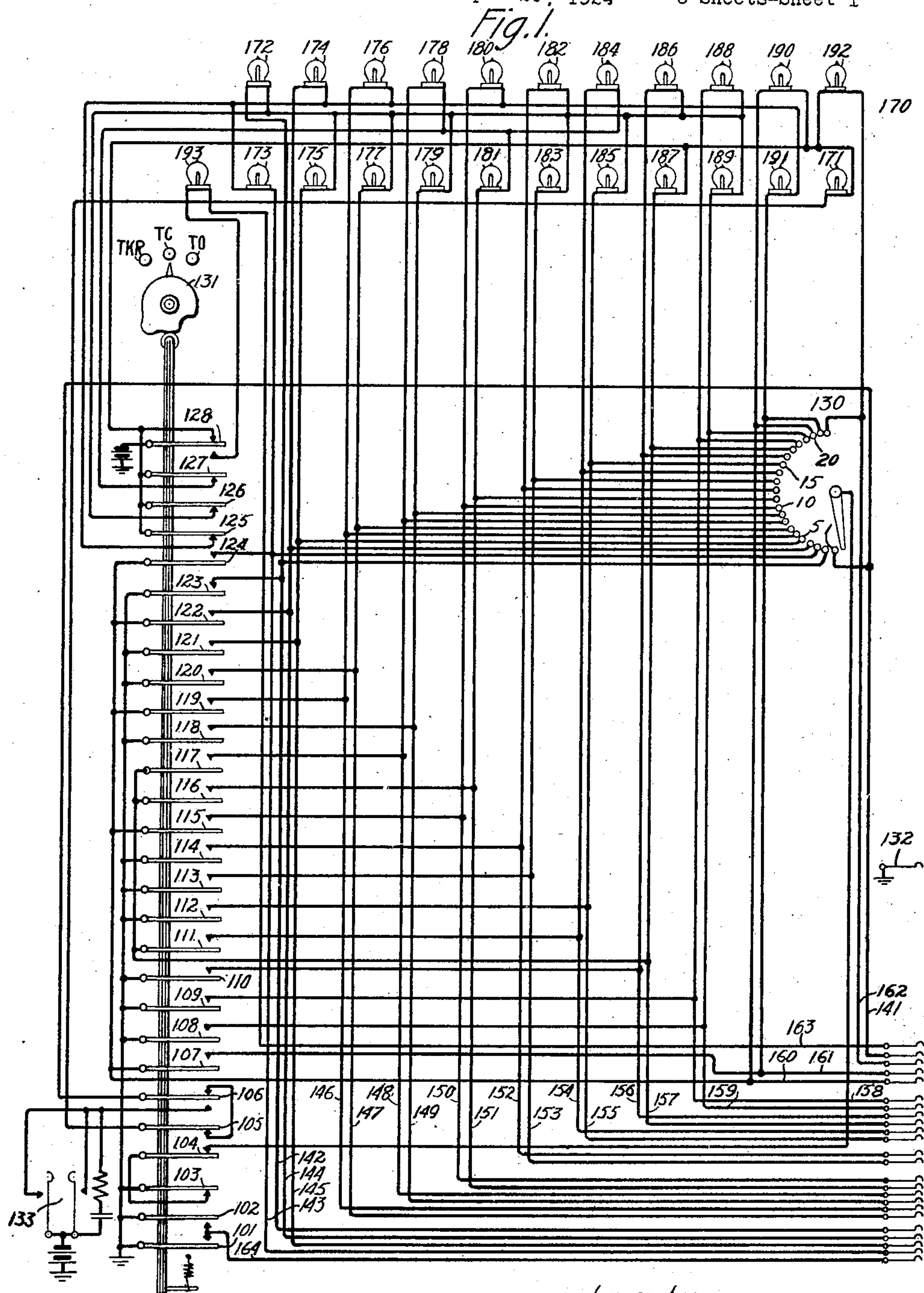
G. T. ANDERSON ET AL

1,612,849

TESTING DEVICE

Filed Sept. 26, 1924

3 Sheets-Sheet 1



Inventors:  
Grenville T. Anderson & Carleton V. Taplin.  
by *g. E. Fole* Att'y

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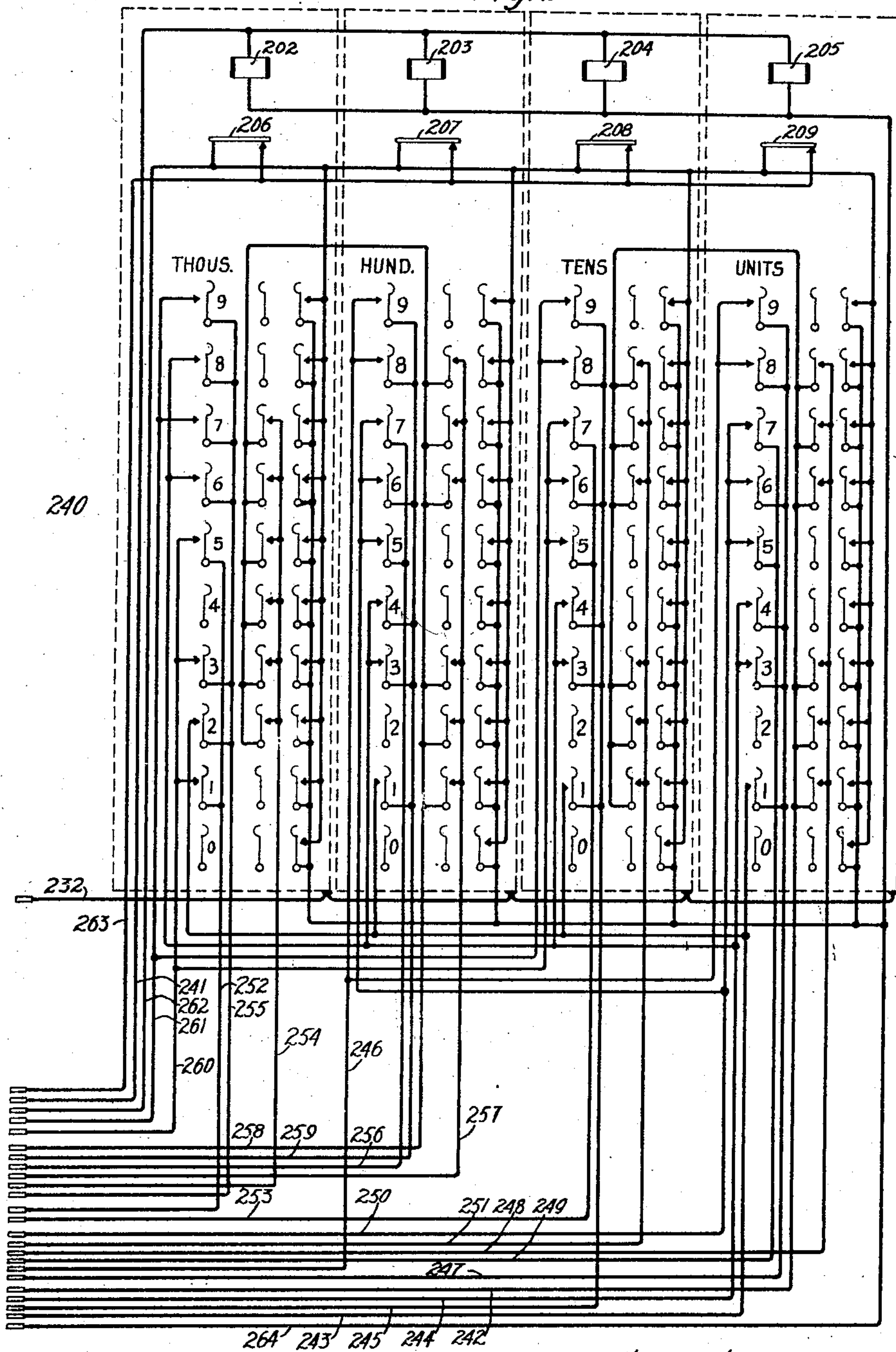
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Fig. 2



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Fig. 4.

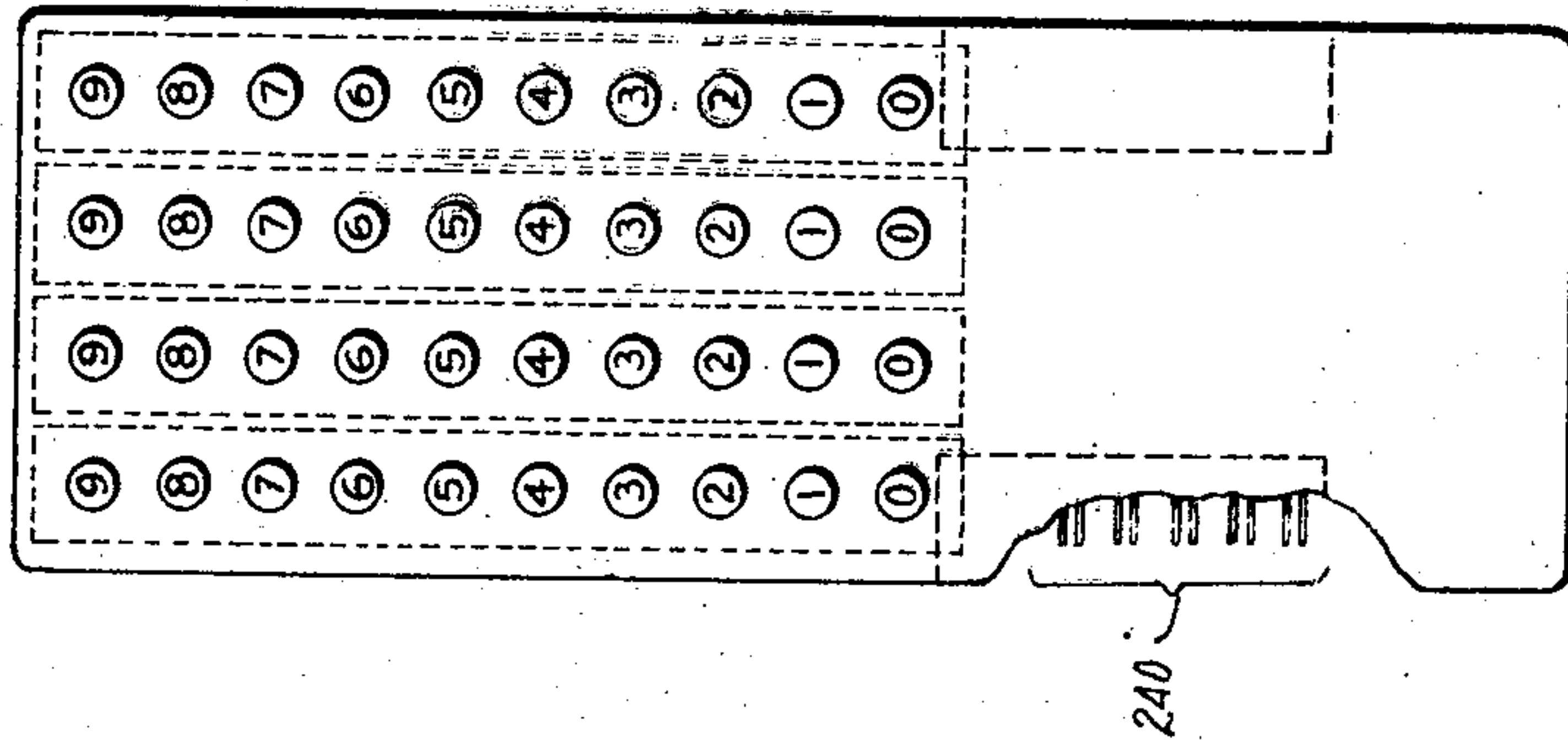
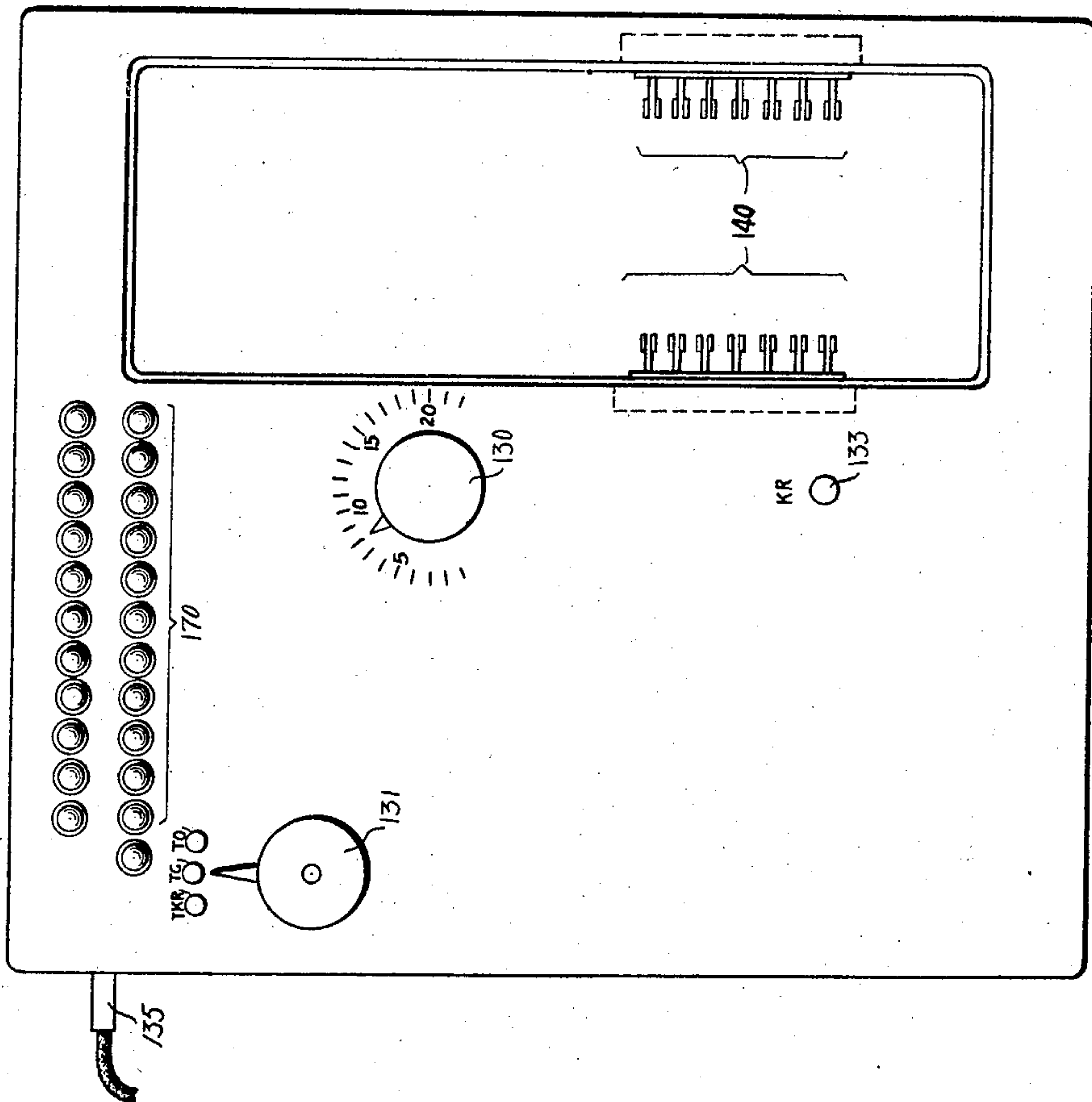


Fig. 3.



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Patented Jan. 4, 1927.

1,612,849

# UNITED STATES PATENT OFFICE.

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## TESTING DEVICE.

Application filed September 26, 1924. Serial No. 740,116.

The present invention relates to testing devices and more particularly to testing devices for testing a portion of the equipment of a telephone exchange system.

5 In telephone systems in which connections are established by means of automatic switching apparatus; calls incoming from manual exchanges are taken care of by operators who are provided with key sets for  
10 controlling the extension of the connection to the desired substation in the machine switching office. Such an operator's position and key set are shown and described in the circular of the Bureau of Standards  
15 No. 112, Telephone Service, page 118 and Figure 40 and the circuits of such key sets are disclosed in the patent to F. A. Stearn, No. 1,517,260, issued December 2, 1924.

20 Since the correct extension of calls through such an operator's position is dependent upon the correct operation of the key set, it is the usual practice to arrange these keys in a special mounting so that one key set may be readily substituted for  
25 another. Heretofore, the testing of a key set suspected of irregularities in operation has been a tedious and lengthy procedure.

30 It is an object of the present invention to provide means for quickly and efficiently testing such key sets for faulty wiring and adjustment.

35 A feature of the invention lies in the provision of a test set equipped with a key-set mounting together with circuits and lamps whereby faulty wiring or adjustment of the keys may be readily detected.

40 In the drawing, Fig. 1 shows the circuits and apparatus included in the test set. Fig. 2 shows the circuits of the key set under test. Fig. 3 is a top view of the test set and Fig. 4 is a top view of the key set partly broken away to show the mounting  
45 springs. The same reference characters have been applied to corresponding parts of Figs. 1 and 3 and Figs. 2 and 4. Although this test set is especially adapted for testing the particular key set shown, it would, of course, be easily adaptable for key sets having a different number and  
50 arrangement of keys.

Referring now to Figs. 2 and 4, the key set is made up of four rows of keys each row numbered from 0 to 9. Each key has three

sets of contact springs which are connected to the outgoing conductors and thence to  
55 the connecting springs according to a predetermined grouping arrangement. For example, the left-hand springs of units keys Nos. 1, 3, 4, 6, 8 and 9 are connected to conductor 247 while the left-hand springs of  
60 units keys Nos. 5 and 7 are connected to conductor 249. Each outgoing conductor is connected to a particular one of the set of mounting and connecting springs 240.

Referring to the test set as shown in Figs. 65 1 and 3, a key set mounting is provided consisting of a frame into which the key set fits and a set of connecting springs 140, each of which makes contact with one of the mounting and connecting springs of set 240  
70 of the key set. It may be noted that the key set conductors and the test set conductors, which are connected together by means of the springs when the key set is in the mounting,  
75 have been given the same number in successive hundreds. Two switches are provided; test switch 131, which controls the connections from battery and ground to the other  
80 apparatus and dial switch 130 which permits the test of each conductor of the key set in turn. A set of lamps 170 is provided which serves to indicate which circuits are being closed, and whether such circuits  
85 are closed in the correct or incorrect operation of the key set. Key 133 is used for testing the release magnets. Although in  
90 Fig. 1, battery and ground are, for simplicity, shown directly connected to the various parts of the apparatus, in practice they will be connected to the test set by means of a  
95 plug such as 135, as shown in Fig. 3.

When it is desired to test a key set it is removed from the mounting in the key shelf and inserted in the mounting 140 of the  
100 test set. The set is first tested for crosses which may occur in the wiring or between the key springs and the mounting or otherwise. After any such faults have been corrected, it is then tested for breaks in the wiring or failure of the key springs to make  
105 contact when the keys are depressed, after which the release of the keys by the release magnets is tested.

While testing the key set for crosses, switch 131 is placed in its middle or TC  
110 position. With switch 131 in this position

and switch 130 in its normal position, as shown, battery is connected through test switch springs 125, 126, 127 and 128 and lamps 171 to 192, inclusive, to conductors 141 to 162, inclusive, and thence over the mounting springs to key set conductors 241 to 262, inclusive. It will be noted that conductor 263 is connected to conductor 262 by means of common row contacts 206, 207, 208 and 209 and that conductor 241 is connected with conductor 264 through the release magnets 202, 203, 204 and 205 in parallel so that battery is connected to each conductor of the key set. The frame of the key set mounting is connected to ground by means of conductor 232 and spring 132. If any conductor or key spring makes contact with the mounting frame, the circuit of the lamp connected with that conductor will be completed to ground and that lamp will be lighted. For example, suppose the left contact of hundreds key No. 9 has become bent so that it touches the frame, a circuit would then exist from battery through the upper contact of test switch spring 128, contact of test switch spring 125, lamp 176, conductor 146, key set conductor 246, left contact of hundreds key No. 9, frame of key set, conductor 232, spring 132 to ground causing lamp 176 to light.

The switch 130 will next be moved to its No. 1 position in which position a circuit may be traced from ground, contact of test switch springs 103 and 104, brush of switch 130 and its No. 1 terminal, upper contact of test switch spring 106, contact of test switch spring 105, through lamp 171, upper contact of test switch spring 128 to battery causing lamp 171 to be lighted. This circuit also connects ground to conductor 141, shunting the battery supplied thereto through lamp 171 and grounding conductor 241 in the key set. If no crosses exist between conductor 241 and other conductors in the key set lamp 171 alone will be lighted. If, on the contrary, such crosses exist, say with conductor 263, a circuit will exist from ground on conductor 241 over conductor 263 to common row contacts 206, 207, 208 and 209, conductor 262, mounting springs, conductor 162, lamp 192, upper contact of test switch spring 128 to battery, and lamp 192 will be lighted in addition to lamp 171 indicating that conductor 262 or 263 is crossed with conductor 241.

When switch 130 engages its No. 2 terminal, the circuit of lamp 172 is completed from battery, test switch springs 128 and 126, lamp 172, No. 2 contact and brush of switch 130 to ground as previously traced. Ground will also be connected from the brush of switch 130 over its No. 2 contact to conductors 142 and 242. If no crosses exist lamp 172 alone will be lighted, while the lighting of an additional lamp or lamps

will indicate that the corresponding conductor is crossed with conductor 242. Following is a table showing the conductor connected to ground and the lamp normally lighted for each position of switch 130.

| Position of switch 130 | Key set conductor grounded | Lamp normally lighted |
|------------------------|----------------------------|-----------------------|
| 0                      | Frame.                     | None.                 |
| 1                      | 241 and 264                | 171                   |
| 2                      | 242                        | 172                   |
| 3                      | 243                        | 173                   |
| 4                      | 244                        | 174                   |
| 5                      | 245                        | 175                   |
| 6                      | 246                        | 176                   |
| 7                      | 247                        | 177                   |
| 8                      | 248                        | 178                   |
| 9                      | 249                        | 179                   |
| 10                     | 250                        | 180                   |
| 11                     | 251                        | 181                   |
| 12                     | 252                        | 182                   |
| 13                     | 253                        | 183                   |
| 14                     | 254                        | 184                   |
| 15                     | 255                        | 185                   |
| 16                     | 256                        | 186                   |
| 17                     | 257                        | 187                   |
| 18                     | 258                        | 188                   |
| 19                     | 259                        | 189                   |
| 20                     | 260                        | 190                   |
| 21                     | 261                        | 191                   |
| 22                     | 262 and 263                | 192                   |

The switch 130 is moved slowly from position to position allowing it to remain in each position long enough for the corresponding lamp to come to full brilliance. Any other lamps which may be lighted are noted. When all the conductors have been tested switch 130 is restored, the key set removed from its mounting and all crosses which have been noted removed, after which a check test is usually made to insure that no crosses have been left.

The key set is now tested to see whether the keys close the proper circuits when operated. Test switch 131 is moved to its right-hand or TO position and in this position, battery is connected through test switch spring 128 to lamps 171, 187, 190 and 192. The circuit of lamp 171 is open at test switch contact 105 and hence is not concerned in this test. The circuit of lamp 187 is extended to conductor 157 and by way of test switch springs 111, 116, and 117 to conductors 154, 151 and 148 respectively. The circuit of lamp 190 is extended to conductor 160 and by way of test switch springs 107, 115, 119, 122 and 124 to conductors 161, 150, 146, 144 and 143 respectively. The circuit of lamp 192 is extended to conductor 162. In this position test switch 131 also connects ground through springs 101, 108, 109, 110, 112, 113, 114, 118, 120, 121 and 123 to conductors 164, 159, 158, 156, 155, 153, 152, 149, 147, 145 and 142 respectively. Summarizing and taking into consideration the fact that each mounting spring connects a test set conductor with a key set conductor bearing the corresponding number in the next hundred, we find that key set conductors 242, 245, 247, 249, 252, 253, 255, 256, 258, 259 and 264 are connected to ground, and conductors 243, 244, 246, 248, 250, 251, 254, 257, 260,

261 and 262 are connected to battery. That is, the spring of all the keys are connected to ground while the contacts of all the keys are connected to battery through some lamp.

It will, therefore be clear that the circuit of one or more lamps will be completed each time a key is depressed. In carrying out this test each key is depressed in turn and the lighting of the lamps noted and checked against a table similar to the following:

|    | Numerical<br>keys. | Thous.             | Hund.              | Tens.              | Units.             |
|----|--------------------|--------------------|--------------------|--------------------|--------------------|
|    |                    | <i>Test lamps.</i> | <i>Test lamps.</i> | <i>Test lamps.</i> | <i>Test lamps.</i> |
| 15 | 9-----             | 190- -192          | 190- -192          | 190- -192          | 190- -192          |
|    | 8-----             | 190- -192          | 190-187-192        | 190-187-192        | 190-187-192        |
|    | 7-----             | 190-187-192        | 190-187-192        | 190-187-192        | 190-187-192        |
|    | 6-----             | 190-187-192        | 190-187-192        | 190-187-192        | 190-187-192        |
|    | 5-----             | 190-187-192        | 190- -192          | 190- -192          | 190- -192          |
|    | 4-----             | -187-192           | 190- -192          | 190- -192          | 190- -192          |
|    | 3-----             | 190-187-192        | 190-187-192        | 190-187-192        | 190-187-192        |
|    | 2-----             | 190-187-192        | -187-192           | -187-192           | -187-192           |
| 20 | 1-----             | 190- -192          | 190-187-192        | 190-187-192        | 190-187-192        |
|    | 0-----             | - -192             | - -192             | - -192             | - -192             |

Having completed the test for correct operation of the keys, made any adjustments necessary and checked them, the operation of the release feature is next tested. Switch 131 is moved to its left-hand or TKR position. In this position battery is connected over the lower contact of test switch spring 128, through lamp 193 to conductors 163 and 263 and disconnected from all of the other lamps. Ground is connected over the test switch spring 102 to conductors 164 and 264. One key in each row of keys is then depressed. When the first key is depressed, say thousands key No. 9, a circuit is completed from battery through lamp 193, conductor 163, conductor 263, common row contacts 207, 208 and 209, outer right-hand contact and spring of thousands key No. 9, conductor 264 to ground on conductor 164. Lamp 193 lights. As each key is depressed, the common row contact corresponding to such key is opened so that when one key in the thousands, hundreds, tens and units rows has been depressed, common row contacts 206, 207, 208 and 209 will have been opened and lamp 193 will be extinguished. Key 133 will then be operated closing a circuit from battery, contact of key 133, lower contact of test switch spring 106, conductor 141, conductor 241, through release magnets 202, 203, 204 and 205 in parallel, conductor 264, conductor 164, contact of test switch spring 102 to ground. The release magnets should operate releasing all the keys. If any one of the keys fails to release the lamp 193 will again light over a contact of the operated key and the circuit previously described indicating that the releasing mechanism of the key set requires adjusting.

It will be seen from the foregoing description that the test set of the present invention permits the rapid and simple testing of key sets, therefore making feasible the frequent

testing of key sets and consequently improving the service given by the operators using such sets.

What is claimed is:

1. A test set, for testing an operator's key set made up of more than five individually operable keys in a mounting each key having a plurality of contact springs, comprising variably operable apparatus, means to simultaneously associate the terminals of the key springs of all keys in said mounting with said apparatus, means under the control of said apparatus to variably test said key set and signaling means also under the control of said apparatus to indicate faults in said key set.

2. In a testing device for testing an operator's key set made up of mechanically locked and electrically released keys, means for mounting said key set having a frame for receiving said key set and a plurality of springs for making electrical connection with the conductors of said key set, a test switch and means under the control of said test switch when in one position to test said key set for cross connections, when in another position to test for incomplete connections and when in a third position to test the means for releasing the keys of said key set.

3. In a testing device for testing an operator's key set, means for mounting said key set having a frame for receiving said key set and a plurality of springs for making electrical connection with the conductors of said key set, means for testing said key set for crosses comprising a switch for preparing a circuit over each of the key conductors of said key set in turn which may be completed only by means of such crosses and means for indicating over which conductor the circuit has been completed.

4. In a testing device for testing an operator's key set, means for mounting said key set having a frame for receiving said key set and a plurality of springs for making electrical connection with the conductors of said key set, a plurality of lamps, means for applying battery through said lamps to all of the key conductors of said key set, means for grounding each of said conductors in turn and means comprising said lamps for indicating which conductor is so grounded, for indicating whether a cross exists between said grounded conductor and any other conductor and which conductor is so crossed.

5. In a testing device for testing an operator's key set, means for mounting said key set having a frame for receiving said key set and a plurality of springs for making electrical connection with the conductors of said key set, means for testing said key set for crosses comprising a switch for applying battery to all of the key conductors of said

key set, a second switch for applying ground to each of said conductors in turn and a group of lamps for indicating which conductor has been grounded and which conductors, if any, are crossed with said grounded conductor.

6. In a testing device for testing an operator's key set, said key set comprising more than five keys in a common frame, each key having a plurality of contact springs and associated conductors, means for mounting said key set comprising means for connecting with the contact springs of said key set, means for applying ground to the frame of said key set means to simultaneously apply battery to all of said contact springs, and means for indicating the existence of crosses between said contact springs or said conductors and said frame.

7. In a testing device for testing an oper-

ator's key set, said key set comprising a plurality of locking keys arranged in rows and a plurality of magnets for releasing said keys, means for mounting said key set comprising a frame for receiving said key set and a plurality of springs for making electrical connection with the conductors of said key set, a lamp, means for lighting said lamp in response to the depression of one of said keys, said lamp being extinguished when a key has been depressed in each of said rows of keys, means for energizing said releasing magnets and means for relighting said lamp if said releasing magnets fail to release all of said depressed keys.

In testimony whereof, we have signed our names to this specification this 25th day of September 1924.

GRENVILLE T. ANDERSON.  
CARLETON V. TAPLIN.