Jan. 27, 1925. 1,524,311

F. R. QUAYLE

AUTOMATIC TELEPHONE SYSTEM

Filed Oct. 15, 1920

Fig: 1

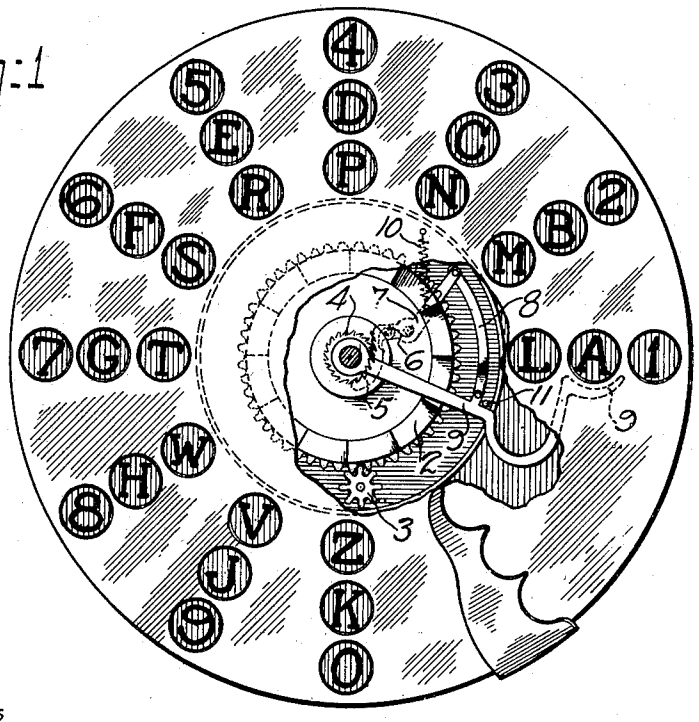
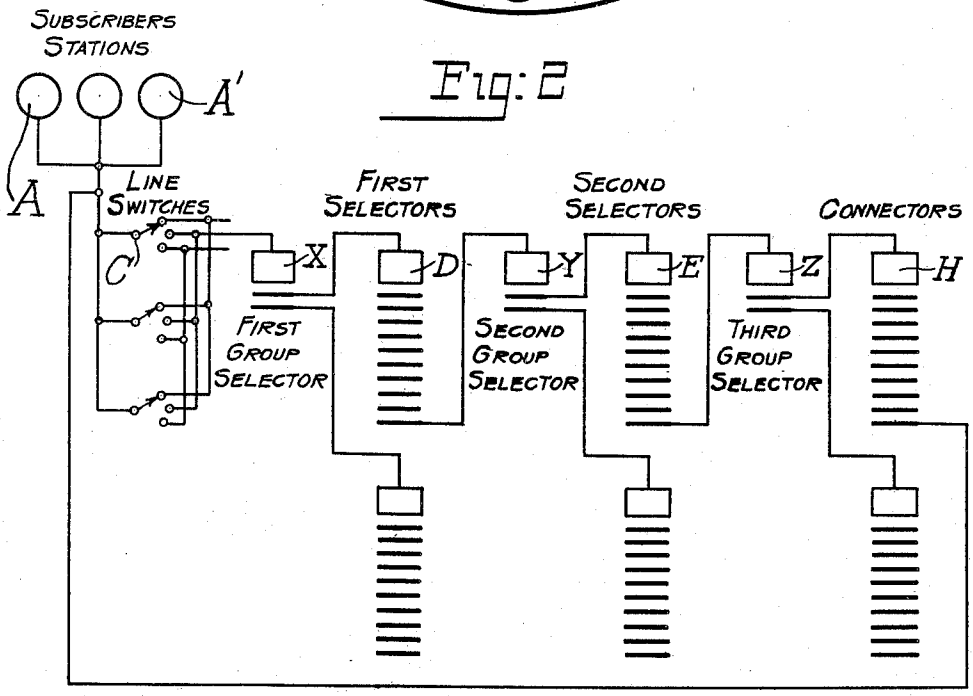


Fig: 2



Inventor

Fred R. Quayle

Chas. W. Candy

Atty.

Patented Jan. 27, 1925. 1,524,311

UNITED STATES PATENT OFFICE.

FRED R. QUAYLE, OF WILMETTE, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

Application filed October 15, 1920. Serial No. 417,170.

To all whom it may concern:

Be it known that I, FRED R. QUAYLE, a citizen of the United States of America, and a resident of Wilmette, Cook County, and State of Illinois, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a specification.

This invention relates in general to automatic telephone systems, and has for its object the provision of a large capacity automatic telephone system without increasing the number of digits in the subscriber's telephone numbers.

Numerous attempts have been made before to solve this problem and with considerable success, but so far as is known all the large capacity systems proposed heretofore involved changes, or deviations from standard construction, in the automatic switches at the exchange, the object generally being to increase the capacity of the switches. The standard 10 level Strowger vertical and rotary switch has been developed to a state approximating perfection after a good many years of effort, many thousands of them are in use, and many more are being constantly manufactured. It is desirable on this account to use this standard switch without change, and those systems which require modified types of switches are consequently more or less objectionable. The new system herein proposed accomplishes the desired result by simply increasing the number of serially related switches rather than their size, and in order to operate the increased number of switches a new type of calling device has been devised which will transmit impulses on the forward movement of the dial as well as on the return. Thus it is possible to obtain a greatly increased capacity without increasing the number of digits in the telephone numbers and without departing from standard practice in the construction of the switches.

The essential features of the new system, and the preferred construction of the calling device will be fully described hereinafter, reference being had to the accompanying drawing, in which Fig. 1 is a view of the calling device, while Fig. 2 is a schematic diagram of the trunking arrangement.

Referring first to Fig. 1, the calling device there shown has the same general mechanical construction as the well known form of calling device which is described on pages 34 and 35 of Automatic Telephony, by Smith and Campbell, the departures from the construction shown in this publication being such only as are rendered necessary by the fact that the calling device is to produce impulses or interruptions in the line circuit on the down pull of the dial as well as in the return. In other words, the calling device shown in Fig. 1 is a standard calling device of the type mentioned, provided with additional mechanism for producing impulses when the dial is pulled down; and, it may be added, with a somewhat different dial having three rows of finger holds rather than one.

The additional mechanism added to the calling device may now be described more in detail. It may be stated at the start that the usual impulse sending mechanism is employed in a double capacity and is operated both on the down pull of dial and on the return, the added mechanism having the function of driving the impulse sending mechanism when the dial is pulled down. The impulse sending mechanism consists essentially of the crown wheel 2 and the pinion 3, the shaft on which the pinion is mounted having an impulse cam on the back side of the frame and a spur wheel for driving the governor. The radially spaced teeth on top of the crown wheel 2 are adapted to be engaged by a dog on the under side of the dial when the dial is returned to normal after having been rotated, and the crown wheel is thus rotated with the dial and drives the pinion 3, thereby rotating the impulse cam to produce the well known circuit interruptions or impulses. This much of the calling device is old and needs no particular description. In order to rotate the crown wheel 2 when the dial is pulled down, a ratchet wheel 4 is provided which is rigidly attached to the under side of the crown wheel between it and the frame. The lever 7 lies in the same plane as the ratchet wheel 4, is pivoted to the frame at the point indicated, and carries at one end a curved toothed member 5 which is held in mesh with the ratchet wheel 4 by means of spring 6. The other end of the lever 7 is connected to the finger lever 9 by means of the curved off set link 8. The finger lever 9 is pivoted on the shaft which carries the dial and lies between the dial and the crown wheel. A coil spring 10 is con-

nected from the lever 7 to a pin fixed in the frame and serves to hold the finger lever against the stop 11.

The finger lever 9 is operated when the dial is pulled down, provided that a finger hold in either the first or second row is being used, and impulses are produced as follows: Suppose that the letter L is to be called on the dial. The finger is inserted in the finger hold designated by the letter L and the dial is pulled around until the finger strikes the finger stop, when the dial is released. The finger lever 9 lies just below the dial and it follows that when the dial is rotated the finger of the operator will engage the finger lever and will move it down to the finger stop also. The finger lever is thus rotated about the dial shaft as an axis, and being connected to lever 7 by link 8, the said lever is also operated in an obvious manner to rotate the ratchet wheel 4 through the medium of the toothed member 5. Since the ratchet wheel 4 is fixed to the crown wheel, the latter is rotated by these operations, driving the pinion 3 to operate the impulse cam in the usual manner to produce one interruption of the line circuit. The dial having been released, on its return to normal it rotates the crown wheel a further amount and another impulse is produced. The operations on the return of the dial are of course the same as in the standard calling device. It should be stated at this point that the ratchet wheel 4 and the two arms of lever 7 are so proportioned that when the letter L or any other letter in the same row is called, the crown wheel 2 will be rotated an angular distance equal to the space between two adjacent crown teeth and one impulse or interruption will be produced.

Suppose now that the letter A is called. The operations which take place are just the same as those described except that now, due to the displacement of the curved extremity of the finger lever, which displacement is exactly equal to the angular distance between adjacent crown teeth, the finger lever is moved just twice as far as formerly, the crown wheel is rotated an amount equal to twice the angular distance between two adjacent crown teeth, and two impulses are produced. Thus it will be seen that if the letter A, or any other letter in the second row, is called two impulses will be produced when the dial is pulled down in addition to the impulses ordinarily produced when the dial returns to normal.

If the dial is operated from a finger hold in the outside row no impulses at all will be produced when the dial is pulled down, for the finger of the operator will miss the finger lever entirely and it will not be actuated.

From the foregoing it will be understood that the calling device has a dial with three rows of finger holds; that if the dial is operated from a finger hold in the first row one preliminary impulse will be produced in addition to the impulses ordinarily produced on the return of the dial; that if the calling device is operated from a finger hold in the second row two preliminary impulses will be produced; while if the calling device is operated from a finger hold in the third or outside row no preliminary impulses will be produced.

Attention may now be directed to the apparatus at the exchange with a view to pointing out how the modified type of calling device may be used to increase the capacity of the system. As stated, the selector and connector switches are of the standard Strowger vertical and rotary type, and are operated according to the well known two wire principles of control. The mechanical construction of these switches is shown in the U. S. patents to Keith, Erickson, and Erickson, Numbers 815,321 and 815,176, granted March 13, 1906. Suitable switch circuits are shown in the U. S. patent to Newforth, No. 13,901, reissued April 13, 1915, although any approved two wire circuits may be used. The subscribers individual line switches may be of the well known rotary type as shown in the U. S. patent to Lamb, No. 1,193,160, granted Aug. 1, 1916.

The trunking system is a modified form of the usual decimal percentage system. First selectors, second selectors, and connectors may be used, as heretofore, but the usual scheme is modified by inserting what may be termed group selectors ahead of each class of selectors and also ahead of the connectors. These group selectors are the same as first or second selectors, except that they do not need to be provided with so many trunking levels, two levels being sufficient. The use of the group selectors can best be explained with reference to Fig. 2. In this diagram three circles are shown in the upper left hand corner which indicates subscribers' stations. The lines associated with these stations terminate at the exchange in individual line switches which are indicated in the customary manner. According to the usual practice, these line switches would have access to first selector switches, but here group selectors are inserted between the line switches and the first selectors, and the line switches therefore are given access to such group selectors, one of which, the group selector X, is indicated by a square just to the right of the line switches. The group selector X is the same as an ordinary selector except that it need have only two trunking levels, as indicated. Two groups of first selectors are thus provided for, and two of these

selectors, one in each group, are indicated in the drawing by squares, properly labeled. One of these selectors is the terminal of a trunk line coming from the first level of the group selectors, while the other is associated with a trunk line coming from the second level.

Group selectors are also inserted between the first selectors and the second selectors and the first selectors therefore have access to group selectors rather than to second selectors. This is indicated in the diagram, in which a trunk line is shown extending from the first level of the first selector D to the second group selector Y. The second group selectors also have two levels and obviously serve to double the number of second selector groups to which the first selectors have access just as the first group selectors double the number of first selector groups to which the line switches have access.

From the foregoing the function of the third group selectors, which are inserted between the second selectors and the connectors, will be apparent. These switches serve to double the number of connector groups to which the second selectors have access.

From the alternate arrangement of the group selectors and the regular selectors it will be surmised that the former switches respond to impulses produced on the forward movement of a calling dial while the latter switches respond to the regular impulses produced on the return, and this is in fact the way the system operates. To illustrate, let it be assumed that the subscriber at substation A desires to obtain a telephone connection with the subscriber at substation A′, the telephone number of the latter substation being #AAA[3]. When the receiver is removed, the line switch C associated with the calling line is operated automatically to extend the line to an idle group selector, which may be the group selector X. The calling subscriber now operates his calling device in accordance with the first letter in the desired number, or the letter A. When the dial is pulled down, two impulses or interruptions are produced in the line circuit, as explained before, and the wipers of the group selector are raised to the second level, after which a trunk line leading to an idle first selector is automatically selected. Assuming that the first selector D is the switch taken for use, when the dial is released another impulse is sent in which operates this first selector to raise its wipers to the first level. The automatic trunk selecting movement is now initiated and a trunk line leading to an idle group selector of the second class, group selector Y, for example, is selected and connected with. The second letter in the number, which is also the letter A, may now be called in the same manner. As a result, the group selector Y is operated by the two impulses produced on the down pull of the dial and selects and connects with an idle trunk line in the second level, which we will assume to be the trunk line leading to the second selector E; and this second selector is operated by the single impulse produced on the return of the dial to select and connect with a trunk line in the first level, such as the trunk line leading to the group selector Z. The third letter may now be called. Since this is the letter A also the group selector Z will connect with an idle trunk in the second level, the trunk extending to the connector H, for example, when the dial is pulled down, and the connector H will raise its wipers to the first level when the dial returns. The final letter, or rather digit, is the digit 3 When the dial is operated in accordance with this digit, no preliminary impulses are sent in and nothing happens until the dial returns to normal, when three impulses will be produced which cause the connector wipers to be rotated three steps. The normal conductors of the line of substation A[1] terminate in the third set of contacts in the first level at the connector H and other connectors in the same group, and it follows therefore that the desired connection has been established.

Other connections are established in the same manner. The group selectors always operate on the preliminary impulses and raise their wipers either one or two steps depending on whether the letters called are in the first or second rows, or series; while the regular selectors and the connectors operate on the regular impulses as in the systems in common use. It will be observed that preliminary impulses are never sent in when the last character or digit is called. This is because of the fact that the connector responds to two digits, and for this reason the last character in every telephone number must be a digit rather than a letter. On the other hand, every character in each number except the last must be a letter, for group selectors are inserted ahead of each class of regular switches and these group selectors must be operated in order to trunk through to the connectors. Of course the system need not be fully expanded as is shown in Fig. 2 unless the full capacity is required; and the group selectors may be omitted at some point, between the second selectors and connectors, for example. If this is done the last two characters in all telephone numbers will be digits instead of only the last.

It will be seen from the foregoing that I have devised a simple and effective method of and means for increasing the capacity of an automatic

telephone system without increasing the number of digits in the call numbers, and without altering the construction of the automatic switches. The system is capable of modification, in the manner which has been pointed out, and in other ways which will be evident to persons skilled in the art, and the principles involved will no doubt be found applicable to other situations; I do not therefore wish to be held strictly to the form of any invention which is disclosed herein, but desire to include and have protected by Letters Patent all modifications thereof which come fairly within the scope of the appended claims.

What I claim as my invention is:

1. In a telephone system, a calling device, a setting member for said device variably operable in accordance with each of the digits in a called number, means controlled by said setting member adapted to produce a plurality of series of like momentary impulses at each operation of said member, and serially related trunking switches at the exchange each responsive to a separate series of impulses.

2. In a telephone system, a calling device having a reciprocating dial, impulse sending mechanism comprising a contact spring operated to send a series of impulses on the forward movement of said dial and another series on the return movement, and automatic trunking switches at the exchange responsive to said series of impulses, respectively.

3. In a telephone system, a calling device having a reciprocating dial, a plurality of selector switches at the exchange adapted to be controlled by said calling device on the return of said dial, and means variably operated on the forward movement of the dial for selecting one of said switches.

4. In a telephone system, a calling device having a reciprocating dial, impulse sending mechanism operated to send a series of impulses during the forward movement of said dial and another series during the return movement, selector and connector switches at the exchange responsive to series of impulses produced on successive return movements of the dial, and other switches inserted ahead of the selector and connector switches which are responsive to the series of impulses produced on successive forward movements.

5. In a telephone system, serially related trunking switches for connecting calling and called lines, calling devices for operating said switches, a member in each calling device set by hand for the first digit in a called number and reset for each of the other digits, and a rotary member in each calling device controlled by the setting member therein for producing a plurality of series of impulses each time the same is operated, whereby a plurality of said switches can be successively operated at each operation of a calling device.

6. In a telephone trunking system, first and second selector switches and connectors for connecting calling and called lines, directively controlled group selectors inserted in the system ahead of each class of selectors and ahead of the connectors, and mechanism in said group selectors for selecting idle selectors or connectors in selected groups.

7. In a telephone trunking system, a series of ten level selector and connector switches, a second series of two level group selectors arranged alternately with the switches of the first series, and a plurality of sets of contacts in each level of said switches.

8. In a four digit trunking system including selector and connector switches responsive to successive digits in a called number, directively controlled group selectors inserted ahead of certain of said first named switches, and means for variably operating said group selectors by preliminary impulses.

9. In a four digit trunking system including selector and connector switches responsive to successive digits of a called number, directively controlled group selectors alternating with said first named switches, and means for variably operating said group selectors by series of preliminary impulses.

10. The combination, with a numbering system for automatic telephone systems in which the last character in every telephone number is a digit, while all other characters in every number are letters, of calling device dials marked with both letters and digits, and an automatic trunking system in which the switches are controlled by the calling devices in accordance with said numbering system.

11. In a telephone system, serially related trunking switches for connecting calling and called lines, said switches each having primary and secondary selecting movements, calling devices for operating said switches, a member in each calling device set by hand for the first digit in a called number and reset for each of the other digits, and means in each calling device controlled by said member therein for producing a plurality of series of impulses each time the same is operated, whereby a plurality of said switches can be successively operated at each operation of a calling device.

12. In a telephone system, a calling device having a reciprocating dial, a plurality of automatic switches at the exchange adapted to be controlled by said calling device on the return of the said dial, said switches being arranged in groups, a selector having directive group selecting movement and auto-

matic trunk selecting movement for electing one of said switches for operation, and means for controlling said selector on the forward movement of said dial.

13. In a telephone system, a calling device having a reciprocating dial, impulse sending mechanism operative to transmit a group of impulses on the forward movement and another group of impulses on the return movement of said dial, a governor for controlling said mechanism while the same is transmitting said impulses, an automatic trunking switch responsive to the first group of impulses, and a second trunking switch responsive to the second group of impulses.

14. In a calling device, a reciprocating dial, a plurality of rows of finger holds on said dial, impulse sending mechanism, means controlled in accordance with the row used for operating said mechanism on the forward movement of the dial, and means controlled in accordance with the finger hold used for operating the same mechanism on the return movement of the dial.

15. In a calling device, a reciprocating dial, a plurality of rows of finger holds on said dial, a line circuit, means for producing a series of breaks in said line circuit on the forward movement of said dial and another series on the return movement, and mechanisms controlled, respectively, in accordance with the denominations of the row and finger hold in use for determining the number of breaks in said series.

Signed at Chicago, Cook County, Illinois, this 12th day of October, 1920.

FRED R. QUAYLE.