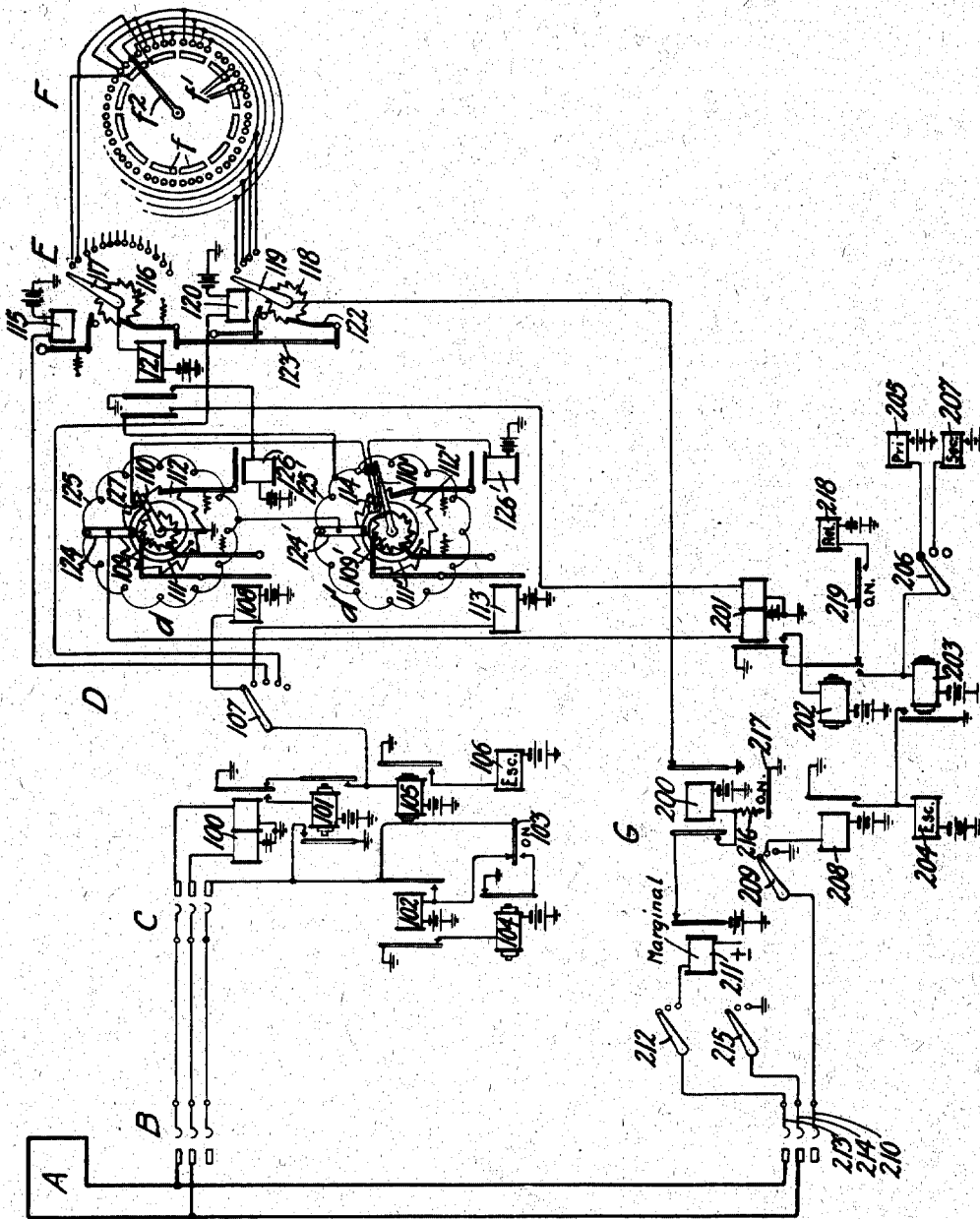


H. P. CLAUSEN AND C. L. GOODRUM.
TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED DEC. 17, 1918.

1,302,767.

Patented May 6, 1919.



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UNITED STATES PATENT OFFICE.

HENRY P. CLAUSEN, OF MOUNT VERNON, AND CHARLES L. GOODRUM, OF NEW YORK, N. Y., ASSIGNORS TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TELEPHONE-EXCHANGE SYSTEM.

1,302,767.

Specification of Letters Patent.

Patented May 6, 1919.

Application filed December 17, 1918. Serial No. 287,139.

To all whom it may concern:

Be it known that we, HENRY P. CLAUSEN and CHARLES L. GOODRUM, citizens of the United States, residing at Mount Vernon, in the county of Westchester and State of New York, and at New York, in the county of New York and State of New York, respectively, have invented certain new and useful Improvements in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to improvements in automatic telephone exchange systems, and has particular reference to a night-alarm service system whereby a subscriber may render his line selectable for the application of a source of signaling current thereto at a predetermined time.

An object of the invention is the provision of an improved system in which an impulse-storing mechanism, under the control of a variably operable impulse-sending device at a subscriber's substation, is set in accordance with a portion of said subscriber's number and released at a predetermined time to operate a switching mechanism which connects to the subscriber's line and applies a signaling current thereto.

Another object is to provide a step-by-step operated mechanism associated with a clock and adjustable to correspond with different hours of the day by the actuation of the impulse-sending device at the subscriber's substation whereby said mechanism will, after a definite lapse of time, initiate the operation of the impulse-storing mechanism.

The inventive idea involved is capable of receiving a variety of expressions, one of which, for the purpose of illustrating the invention, is shown in the accompanying drawing; but it is to be expressly understood that said drawing is employed merely for the purpose of facilitating the description of the invention as a whole and not to define the limits thereof, reference being had to the appended claims for this purpose.

The drawing is a diagrammatic illustration of the circuits and mechanism employed for enabling a subscriber to have his bell rung at a predetermined time.

In the preferred embodiment shown, there is provided at the central office of an automatic exchange a time-controlled signaling apparatus selectable by the subscriber at sub-

station A through line finder and selector switches B and C of any desired construction, and set in accordance with impulses transmitted from said substation. Said apparatus consists of an impulse-storing mechanism D, the two units d and d' of which are designed to receive impulses corresponding to the tens and units digits respectively of the subscriber's number. The apparatus further comprises a step-by-step mechanism E also under the control of the subscriber at substation A and adjustable to correspond to different hours of the day. Associated with this mechanism is a dial F including hour and quarter-hour contact segments f and f' respectively, and movable over these segments is a brush or wiper f^2 controlled by a clock (not shown). At a predetermined time after the setting of mechanism E, wiper f^2 movable with the hour hand of the clock, will engage an hour segment f and one of the quarter-hour segments f' associated therewith and thereby establish certain circuit changes to successively release the units d and d' of the impulse-storing mechanism, whereby the impulses delivered therefrom will operate a directly controlled switch G similar to a connector and arranged so that its brushes will cooperate with the multiple terminals of the regular connector bank. Under the control of the impulses, switch G is connected to the line of substation A and signaling current is then applied, provided the line is not otherwise busy. Should the line be busy, this signaling current will be applied upon the hanging up of the receiver at substation A provided wiper f^2 has not moved off of the particular quarter-hour segment f' .

Specifically, a subscriber at substation A wishing to have his bell rung at a certain time, first removes his receiver to automatically operate the line finder B, and upon seizure of the subscriber's line, said line finder will extend the line to selector switch C. The subscriber now manipulates his impulse-sending device to set the selector C on a level of trunks leading to a time-controlled apparatus at the central office exchange, and the brushes of the selector then automatically seize an idle trunk leading to one of these apparatus in the usual manner. Line relay 100 of the selecting mechanisms D and E is now energized over a circuit

extending from grounded battery, left winding of relay 100, lower side of the telephone line, substation apparatus A, upper side of the telephone line and right winding of relay 100 to ground. Slow-to-release relay 101, due to the energization of relay 100, is also operated by the circuit extending from grounded battery, winding of relay 101, front contact and armature of relay 100 to ground. The operation of relay 101 places ground at the left armature thereof and establishes a busy test to prevent seizure of the time-controlled apparatus by any other subscriber. Relay 102 is now energized over a circuit extending from grounded battery, winding of said relay, off-normal contact 103, front contact and left armature of relay 101 to ground, and said relay is locked up by a circuit extending from grounded battery, winding of relay 102, front contact and right armature thereof, front contact and left armature of relay 101 to ground. Slow-to-release relay 104 is energized by the circuit extending from grounded battery, winding of relay 104, front contact and left armature of relay 102 to ground. Relay 104 in attracting its armature removes the ground therefrom. The subscriber may now manipulate his sending device to transmit impulses corresponding to the tens digit of his number. Upon the first retraction of the armature of line relay 100, a circuit is closed for slow-to-release relay 105 extending from grounded battery, winding of said relay, front contact and right armature of slow-to-release relay 101, back contact and right armature of relay 100 to ground. Relays 101 and 105 remain energized during the sending of impulses. Escape magnet 106 is also energized by the circuit extending from grounded battery, winding of magnet 106, front contact and armature of relay 105 to ground, said circuit being also maintained while impulses are sent. Side-switch wiper 107, being in its first position, will cause the impulses of the tens digit of the number to be transmitted to the primary stepping magnet 108 of the unit *d* over a circuit extending from grounded battery, winding of magnet 108, wiper 107, front contact and right armature of relay 101, back contact and armature of relay 100 to ground. Upon each energization of the magnet 108, its armature operates the ratchet wheel 109 and associated contact arm 110, and in so doing a coil spring 111, having one end secured to said contact arm and its other end to large ratchet wheel 112, is placed under tension. At the termination of the transmission of the set of impulses to the unit *d* of the storing mechanism, relay 105 releases and breaks the circuit for the escape magnet 106, thus causing the side-switch wiper 107 to

move to position 2. Movement of the side-switch wiper operates off-normal contact 103, which remains in its operated position until the side switch is again returned to normal.

Unit *d'* of the storing mechanism is now selected for receiving the unit impulses of the subscriber's number and in response to the first impulse slow-to-release relay 105 and escape magnet 106 are again energized and a circuit closed for stepping magnet 113 of unit *d'* extending from grounded battery, winding of said magnet, side-switch wiper 107, in position 2, front contact and armature of relay 101, back contact and armature of line relay 100 to ground. Magnet 113 continues to operate in response to the impulses transmitted, and in attracting its armature steps small ratchet wheel 109' around to tension the spring 111' in the same manner as described in connection with unit *d*, the large ratchet wheel 112' remaining stationary. Arm 110' of unit *d'* operates off-normal contacts 114 which are closed upon the first step of ratchet wheel 109' for a purpose which will later appear. When this set of impulses ceases, relay 105 and escape magnet 106 are again deenergized and side-switch wiper 107 is moved to position 3.

In accordance with any suitable code, the subscriber may now dial his impulse-sending device to transmit the necessary number of impulses to adjust the step-by-step mechanism E to correspond with the particular time he wishes his bell to be rung. Two sets of impulses are required for this purpose, and in response to the first set, stepping magnet 115 is energized over a circuit extending from grounded battery, winding of said magnet, wiper 107 in position 3, front contact and right armature of relay 101, back contact and armature of line relay 100 to ground. In attracting its armature, magnet 115 steps ratchet 116 and wiper 117 onto the desired terminal in the bank corresponding to the hour at which the subscriber's bell is to be rung. At the termination of this set of impulses, escape magnet 106 is again released, as previously described, and wiper 107 is moved into position 4. The last set of impulses determines the quarter-hour at which the bell is to be rung, and if this time is on the hour, only one impulse need be transmitted in order to step the ratchet 118 and wiper 119 onto the first terminal in the associated bank. To accomplish this stepping operation, magnet 120 is energized over a circuit from grounded battery, winding of said magnet and wiper 107 in its fourth position to ground at the right armature of line relay 100, as previously set forth. Escape magnet 106 was again energized during the transmission of the last set of impulses, and at

the termination thereof said magnet is again released and wiper 107 moved into position 5. After operating his sending device the last time, the subscriber at substation A hangs up his receiver and causes the release of line relay 100, which in turn releases first slow-to-release relay 101 and removes ground from the front contact and left armature thereof. Removal of this ground breaks the locking circuit for relay 102, and in releasing its left armature also breaks the circuit for slow-to-release relay 104, and the armature of the latter relay will engage its back contact and place ground upon the test wire, which causes the same to test busy to a selector switch C operated by any other subscriber. It will be apparent that since relay 104 is slow to release, a certain interval of time will elapse between the removal of ground at the left armature of relay 101 and the placing of ground on the right armature of relay 104, and no ground being on the test wire during this interval, the selector switch C and line finder B will be released in accordance with the well-known practice. The storing mechanism D and step-by-step mechanism E are now set and remain in this position until the predetermined time indicated by the setting of the mechanism E arrives.

At said time, wiper f^2 , being movable with the hour hand of the clock, will bridge two of the contact segments f and f' , and thereby close a circuit for relay 121 from grounded battery, winding of relay 121, wiper 117, contact f , wiper f^2 , contact f' , wiper 119, back contact and right armature of relay 200 of connector G to ground. Relay 121 is of a special construction such that upon energization thereof, its right armature will cause a spring (not shown) to engage the pawl shown in contact with ratchet 116 so that upon the release of said relay the pawl will be withdrawn from the ratchet 116 and permit the return of wipers 117 and 119 to normal position. Said pawl, in operating, will also actuate pawl 122 through the medium of rod 123. An armature construction of this character is illustrated in Fig. 1 of a patent to C. L. Goodrum, issued on April 13, 1915, and numbered 1,135,011. The left armatures of relay 121 are attracted upon energization of said relay, and the outer left armature closes a circuit for line relay 201 of the connector G extending from grounded battery, left winding of relay 201, wiper 124 of unit d , conductor 125, wiper 124' of the unit d' , conductor 125', outer left armature and front contact of relay 121 and right winding of relay 201 to ground. Relay 201, in attracting its armature, closes a circuit for first slow-to-release relay 202 extending from grounded battery, front contact and armature of relay 201 to ground. Energization of relay 121 also closes a cir-

cuit for release magnet 126 of unit d extending from grounded battery, winding of magnet 126, front contact and inner left armature of relay 121 to ground. Magnet 126 in attracting its armature releases ratchet 112 which, under the influence of the spring 111 which was previously tensioned, moves around in a clockwise direction until contact 127 carried thereby engages arm 110. Wiper 124 is movable with ratchet 112 and engages the series of contacts tied to conductor 125 and consequently interrupts the circuit of line relay 201 in accordance with the number of impulses stored in the unit d , whereby the brushes of the connector G will be stepped in response to said impulses. Upon engagement of contact 127 with arm 110, the transmission of tens impulses will cease and a circuit will be closed to release the impulses stored in unit d' , which circuit extends from grounded battery, winding of release magnet 126', off-normal contacts 114, which were closed upon the first step of ratchet 109', contact 127 and arm 110 to ground. Magnet 126' in attracting its armature, releases large ratchet 112' which, under the control of spring 111', moves wiper 124' over the terminal contacts of conductor 125' to again interrupt the circuit for relay 201, whereby the impulses from unit d' are delivered to again step the brushes of connector G onto terminals of the subscriber's line.

In response to the first set of impulses from unit d , second slow-to-release relay 203 is initially energized over a circuit extending from grounded battery, winding of relay 203, front contact and armature of relay 202, back contact and armature of relay 201 to ground. The operation of relay 203 also causes escape magnet 204 to energize over a circuit extending from grounded battery, winding of escape magnet 204, front contact and armature of relay 203 to ground. Simultaneously, primary stepping magnet 205 is operated over a circuit extending from grounded battery, winding of magnet 205, side-switch wiper 206 in its first position, front contact and armature of relay 202, back contact and armature of relay 201 to ground, and in response to each impulse of the first set, stepping magnet 205 operates the brushes of connector G over the terminal bank in the well-known manner. At the termination of the first set of impulses, relay 203 deenergizes and releases escape magnet 204 which moves wipers of the side switch into position 2, and in response to units impulses from unit d' , relay 203 is again energized to operate escape magnet 204. Secondary stepping magnet 207 is also operated in response to this last set of impulses, and is energized by a circuit extending from grounded battery, winding of magnet 207, wiper 206 in

its second position, front contact and armature of relay 202, back contact and armature of relay 201 to ground. The brushes of the connector G are stepped by magnet 207 onto the terminals to which the subscriber's line is connected, and if this line should be busy, this condition being denoted by ground at the test terminal, a circuit for test relay 208 is closed extending from grounded battery, winding of relay 208, side-switch wiper 209 in its second position and test brush 210 to ground at the busy terminal. Relay 208 closes the circuit for escape magnet 204 extending from grounded battery, winding of magnet 204, front contact and armature of relay 208 to ground, and this circuit is established before slow-to-release relay 203 deenergizes, thereby preventing escape magnet 204 from releasing to step the wipers of the side switch to position 3. The side-switch wipers will remain in position 2 as long as the subscriber's line remains busy, provided wiper f^2 does not disengage contact f' before the subscriber at substation A hangs up his receiver, which would otherwise break the circuit for relay 211 and cause the release of mechanism E and switch G in a manner which will presently be described.

Should the subscriber's line be idle, relay 208 finding no ground at the test terminal of the line, will not energize, and at the termination of the last set of impulses, relay 203 will release and cause escape magnet 204 to step the side-switch wipers into position 3. The ringing current will immediately be applied to the subscriber's line over a circuit extending from a grounded source of ringing current, winding of marginal relay 211, side-switch wiper 212, brush 213, apparatus at substation A, brush 214 and side-switch wiper 215 to ground. This ringing current may be applied in a characteristic manner and will continue until the subscriber at substation A removes his receiver. Relay 211, being marginal, will not attract its armature during the time that ringing current is being applied, and a short circuit for relay 200 will be maintained which will prevent this relay from becoming energized upon the first step of the brushes of the switch from their normal position. This short circuit extends from grounded battery, armature and back contact of relay 211, armature and back contact of relay 200, resistance 216 and off-normal contact 217 to ground. The removal of the receiver at substation A operates relay 211, and in attracting its armature, the short circuit for relay 200 is broken and the latter relay will immediately energize over a circuit extending from grounded battery, winding of relay 200, resistance 216 and off-normal contact 217 to ground. The circuit for relay 211 is then

broken at the back contact and right armature of relay 200, which causes the right armature of relay 211 to release and disengage the associated pawl from ratchet 116 in accordance with the construction in the above referred to patent, and as consequence of this movement of the armature, pawl 122 will be disengaged from the ratchet 118 through the medium of rod 123. Right armature of relay 121 and pawl 122 will remain out of engagement with their ratchets until relay 115 is again energized to step wiper 117 in a new setting of mechanism E. Wipers 117 and 119 and their associated ratchets will then be returned to their normal positions under the influence of a spring motor or other similar mechanism (not shown). Through any mechanical connection well known in the art, side-switch mechanism including wiper 107 is also returned to normal upon the release of mechanism E. Release of relay 121 causes the outer left armature thereof to break the circuit for line relay 201, which, upon deenergization, releases relay 202 and closes a circuit for release magnet 218 extending from grounded battery, winding of said magnet, off-normal contact 219, back contact and armature of relay 202, back contact and armature of relay 201 to ground, and through the operation of magnet 218, the several side-switch wipers and off-normal contacts are returned to normal position. Movement of wipers 212 and 215 from position 3 releases relay 211, and upon the return of off-normal contact 217 to normal position, relay 200 becomes deenergized, and the switch is again in its normal position and the subscriber may hang up his receiver.

What is claimed is:

1. In an automatic telephone exchange system, a telephone line, an impulse-sending device, an impulse-storing mechanism, means controlled by said sending device to determine the period of time necessary to expire before said storing mechanism is released, and means actuated by the release of said storing mechanism for connecting a signaling current to said telephone line.

2. In an automatic telephone exchange system, a telephone line, a variably operable impulse-sending device, an impulse-storing mechanism, electromagnetic means controlled by said sending device for transmitting impulses to said storing mechanism, a step-by-step operated mechanism also controlled by said sending device to determine the period of time necessary to expire before said storing mechanism is released, and means actuated by the release of said storing device for connecting a signaling current to said telephone line.

3. In an automatic telephone exchange system, a telephone line, an impulse-sending

device, an impulse-storing mechanism, means controlled by said sending device to determine the period of time necessary to expire before said storing mechanism is released, and a switching mechanism operated in response to impulses from said storing mechanism after the same is released for connecting a signaling current to said telephone line.

4. In an automatic telephone exchange system, a telephone line, a variably operated impulse-sending device, an impulse storing mechanism, electromagnetic means controlled by said sending device for transmitting impulses to said storing mechanism, a step-by-step operated mechanism also controlled by said sending device to determine the period of time necessary to expire before said storing mechanism is released, and switching mechanism operated in response to impulses from said storing mechanism after the same is released for connecting a signaling current to said telephone line.

5. In an automatic telephone exchange system, a telephone line, an impulse sending device, an impulse-storing mechanism, electromagnetic means for releasing said storing mechanism, means operable at a predetermined time after the actuation of said sending device for rendering said electromagnetic means effective, and means actuated by the release of said storing device for connecting a signaling current to said telephone line.

6. In an automatic telephone exchange system, a telephone line, an impulse-storing mechanism, an impulse-sending device for operating said mechanism, means responsive to said impulse-sending device to determine the time at which said storing mechanism will be released, means for rendering the last named means effective, and a switching mechanism set by impulses from said storing mechanism after the same has released to connect a signaling current to said telephone line.

7. In an automatic telephone exchange system, a telephone line, impulse-sending device under the control of the subscriber, an impulse-storing mechanism, switching means for transmitting impulses in accordance with certain digits of the subscriber's number from said sending device to said impulse-storing mechanism, means also controlled by said sending device to determine the period of time necessary to expire before said storing mechanism is released, and means actuated by the release of said storing mechanism for connecting a signaling current to said telephone line.

8. In an automatic telephone exchange system, a telephone line, an impulse-sending device under the control of the subscriber, an impulse-storing mechanism, switching means for transmitting impulses in accordance

with certain digits of the subscriber's number from said sending device to said impulse-storing mechanism, electromagnetic means for releasing said storing mechanism, a step-by-step operated mechanism also controlled by said sending device and operable at the termination of a predetermined period of time after the transmission of impulses to said storing mechanism for rendering said electromagnetic means effective, and means operated upon the release of said storing mechanism for connecting a signaling current to said telephone line.

9. In an automatic telephone exchange system, a telephone line, an impulse-storing mechanism, adjustable means for controlling the release of impulses from said storing mechanism, an impulse-sending device for transmitting impulses to said storing mechanism and adjusting said adjustable means in accordance with a definite time of the day, means actuated at said definite time for causing said adjustable means to initiate the operation of said storing mechanism, and means responsive to the impulses from said storing mechanism for connecting a signaling current to said telephone line.

10. In an automatic telephone exchange system, a telephone line, an impulse-storing mechanism, a step-by-step operated mechanism for controlling the release of impulses from said storing mechanism, an impulse-sending device for transmitting impulses to said storing mechanism and adjusting said step-by-step operated mechanism in accordance with a definite time of the day, means actuated at said definite time for causing the initiation of the operation of said storing mechanism, and means responsive to impulses from said storing mechanism for connecting a signaling current to said telephone line.

11. In an automatic telephone exchange system, a substation apparatus, a variably operable impulse-sending device thereat, an impulse-storing mechanism for receiving impulses from said sending device, other mechanism set in accordance with impulses from said sending device to determine the time at which said storing mechanism shall be released, and means controlled by the impulses from said storing mechanism for connecting a signaling current to said substation apparatus.

12. In an automatic telephone exchange system, a substation apparatus, a variably operable impulse-sending device thereat, an impulse-storing mechanism for receiving impulses from said sending device, other mechanism set in accordance with impulses from said sending device to determine the time at which said storing mechanism shall be released, means actuated by said other mechanism at the expiration of a predetermined length of time for releasing said stor-

ing mechanism, and means controlled by impulses from said storing mechanism for connecting a signaling current to said substation apparatus.

5 13. In an automatic telephone exchange system, a substation apparatus, a variably operable impulse-sending device thereat, an impulse-storing mechanism for receiving impulses from said sending device, other
10 mechanism set in accordance with impulses from said sending device to determine the time at which said storing mechanism shall be released, electromagnetic means controlled by said other mechanism and oper-
15 ated a definite period of time after the setting of said other mechanism for releasing said storing mechanism, and means controlled by impulses from said storing mechanism for connecting a signaling current to
20 said substation apparatus.

14. In an automatic telephone exchange system, a substation apparatus, a variably operable impulse-sending device thereat, an impulse-storing mechanism for receiving
25 impulses from said sending device, a step-by-step operated mechanism set in accordance with impulses from said sending device to determine the time at which said storing mechanism shall be released, circuits for

controlling the release of said storing 30 mechanism, electromagnetic means operated by said step-by-step mechanism for successively closing the circuits of said storing mechanism at the expiration of a predeter- 35 mined length of time, and means responsive to impulses from said storing mechanism for connecting a signaling current to said substation apparatus.

15. In an automatic telephone exchange system, a substation apparatus, an impulse- 40 sending device thereat, an impulse-storing mechanism, means for releasing said storing mechanism, a step-by-step mechanism set by said sending device to actuate the last named means at the termination of a definite 45 period of time after the setting of said step-by-step mechanism, a switch responsive to the impulses from said storing mechanism for connecting a signaling current to said substation apparatus, and means for return- 50 ing said step-by-step mechanism to normal position upon the removal of the receiver at said substation apparatus.

In witness whereof, we hereunto subscribe our names this 12th day of December, 55 A. D., 1918.

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