(No Model.) 8 Sheets—Sheet 1.

R. CALLENDER.

TELEPHONE EXCHANGE SYSTEM.

No. 530,324. Patented Dec. 4, 1894.

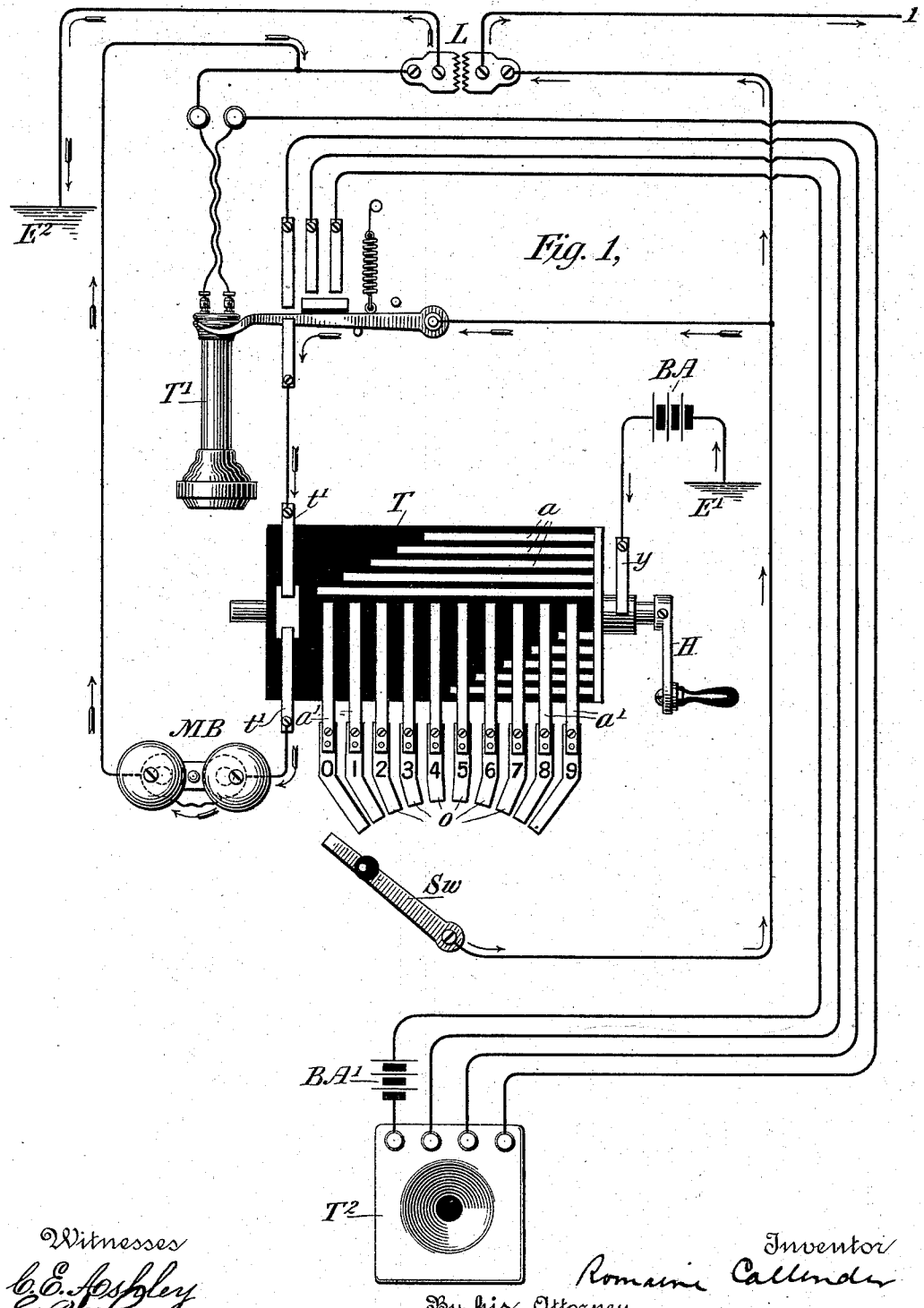

Fig. 1.

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(No Model.) 8 Sheets—Sheet 2.

R. CALLENDER.

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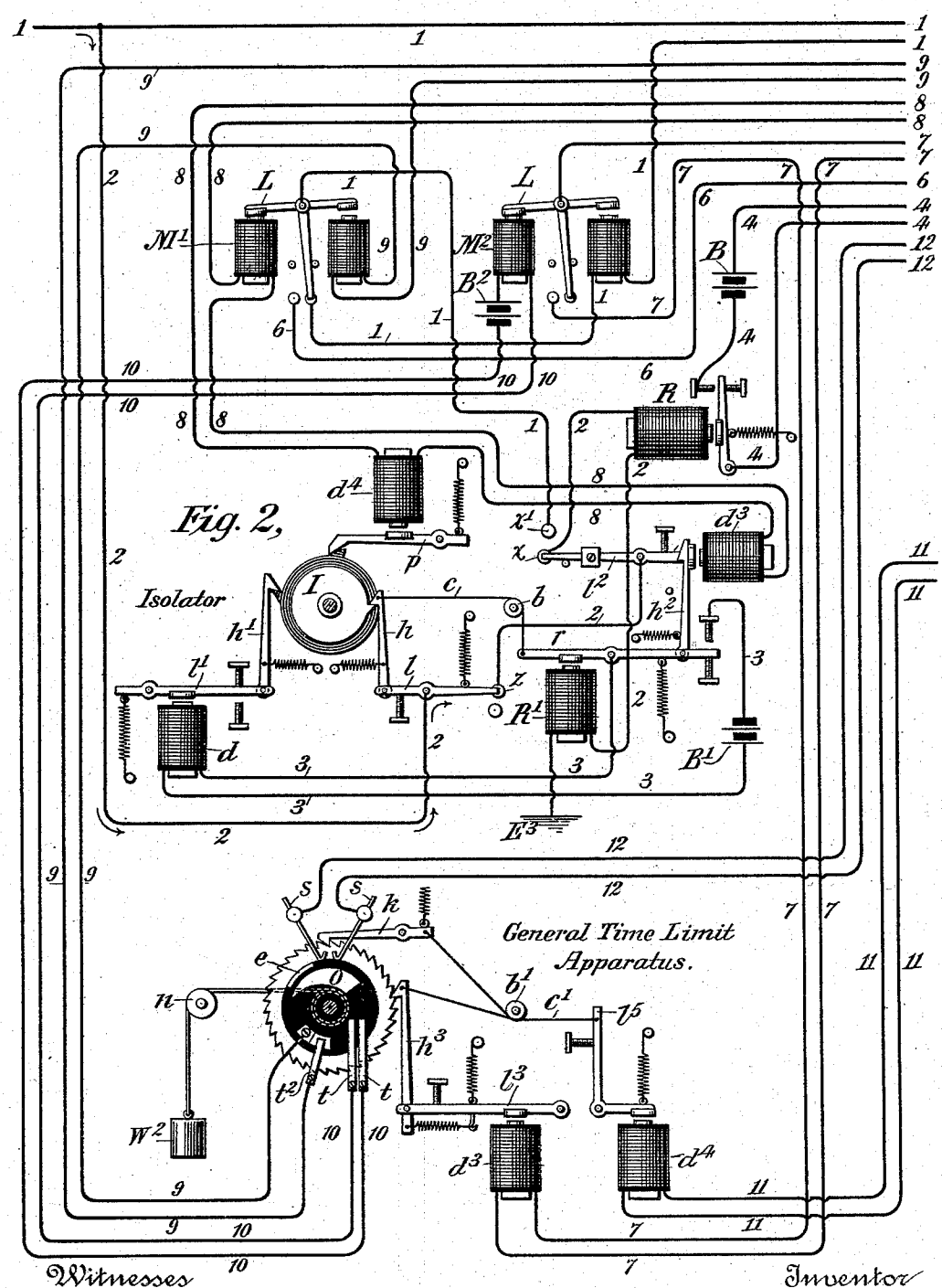

Fig. 2.

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(No Model.)

8 Sheets—Sheet 3.

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TELEPHONE EXCHANGE SYSTEM.

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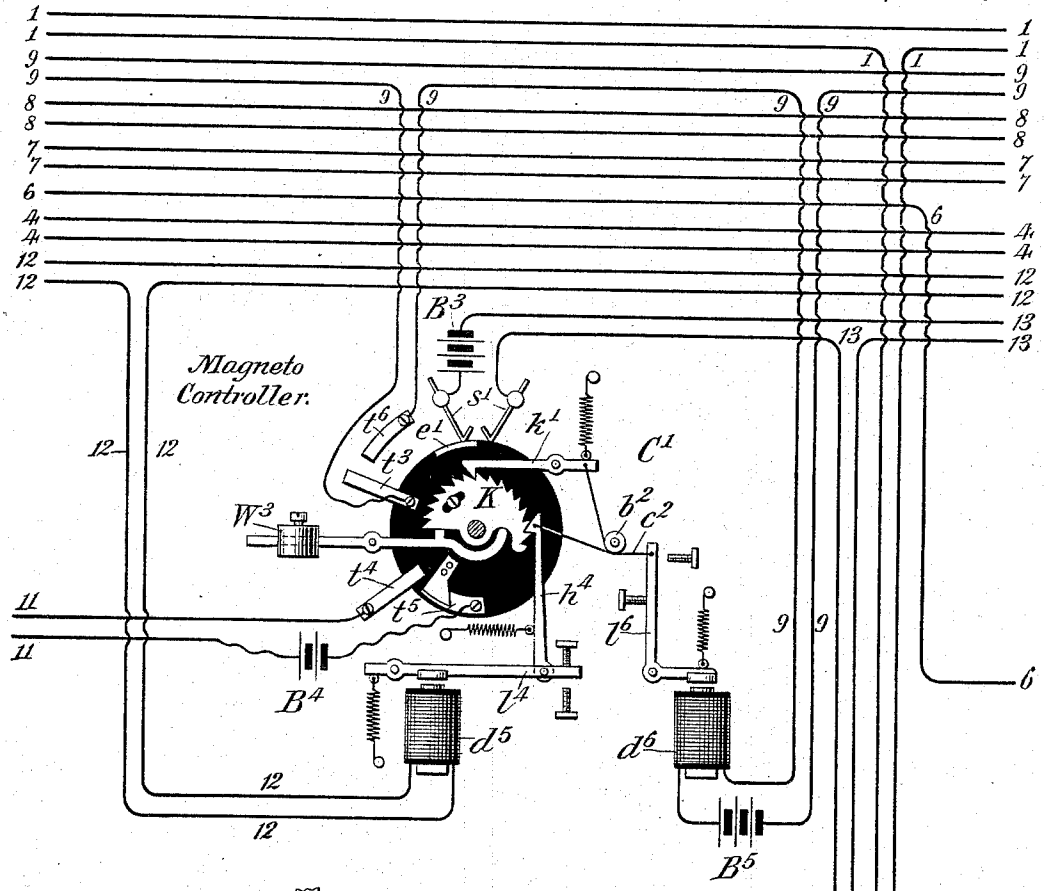
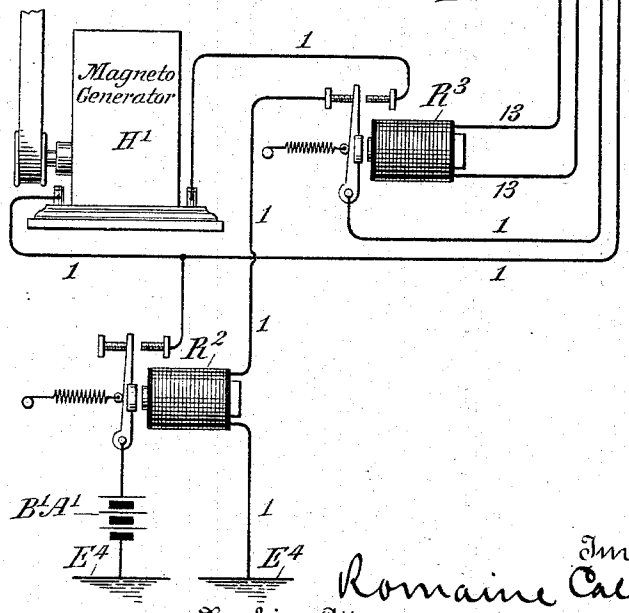


Fig. 3.



Witnesses
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(No Model.) 8 Sheets—Sheet 4.

R. CALLENDER.

TELEPHONE EXCHANGE SYSTEM.

No. 530,324. Patented Dec. 4, 1894.

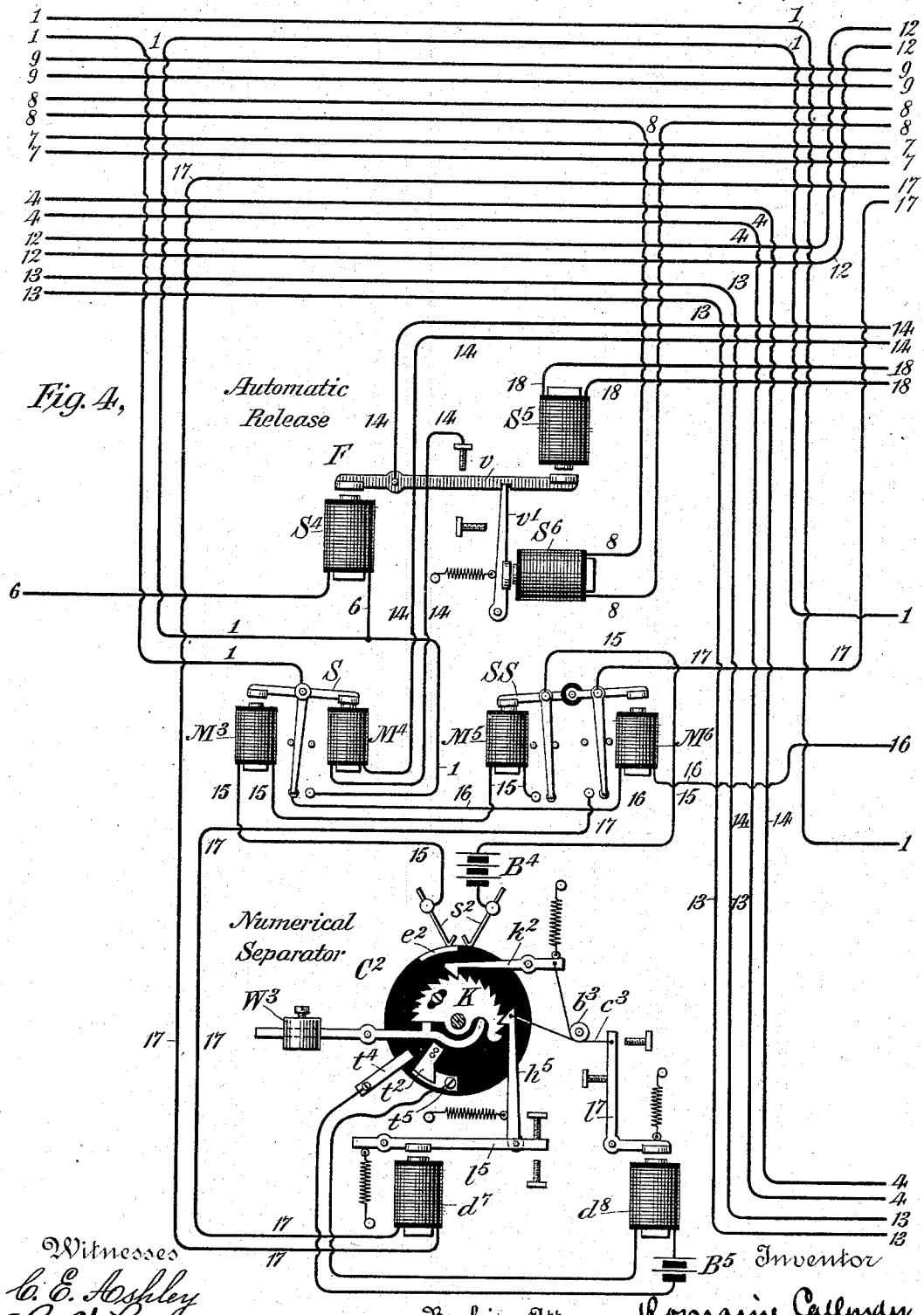

Fig. 4.

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(No Model.) 8 Sheets—Sheet 5.

R. CALLENDER.

TELEPHONE EXCHANGE SYSTEM.

No. 530,324. Patented Dec. 4, 1894.

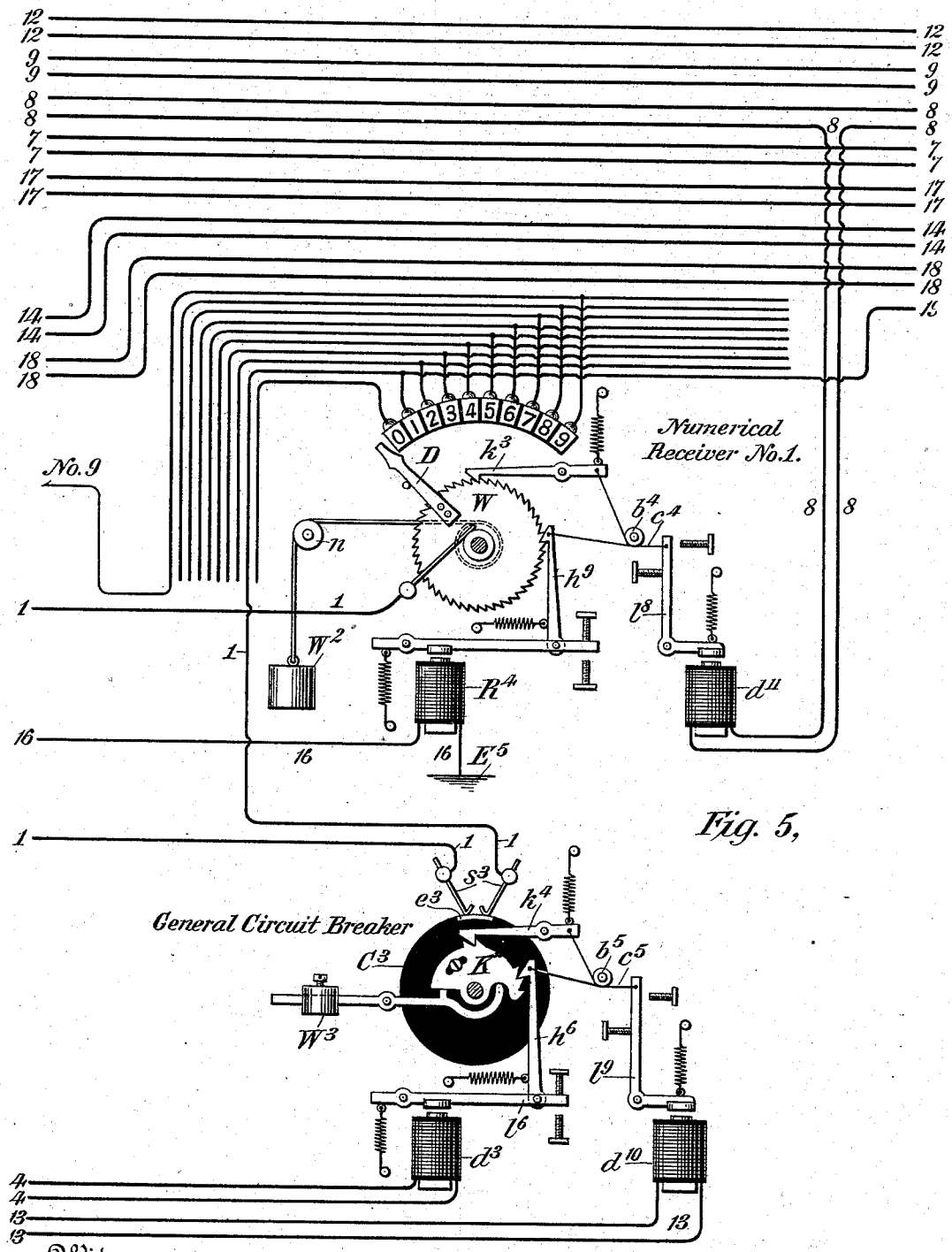

Fig. 5,

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(No Model.) 8 Sheets—Sheet 6.

R. CALLENDER.

TELEPHONE EXCHANGE SYSTEM.

No. 530,324. Patented Dec. 4, 1894.

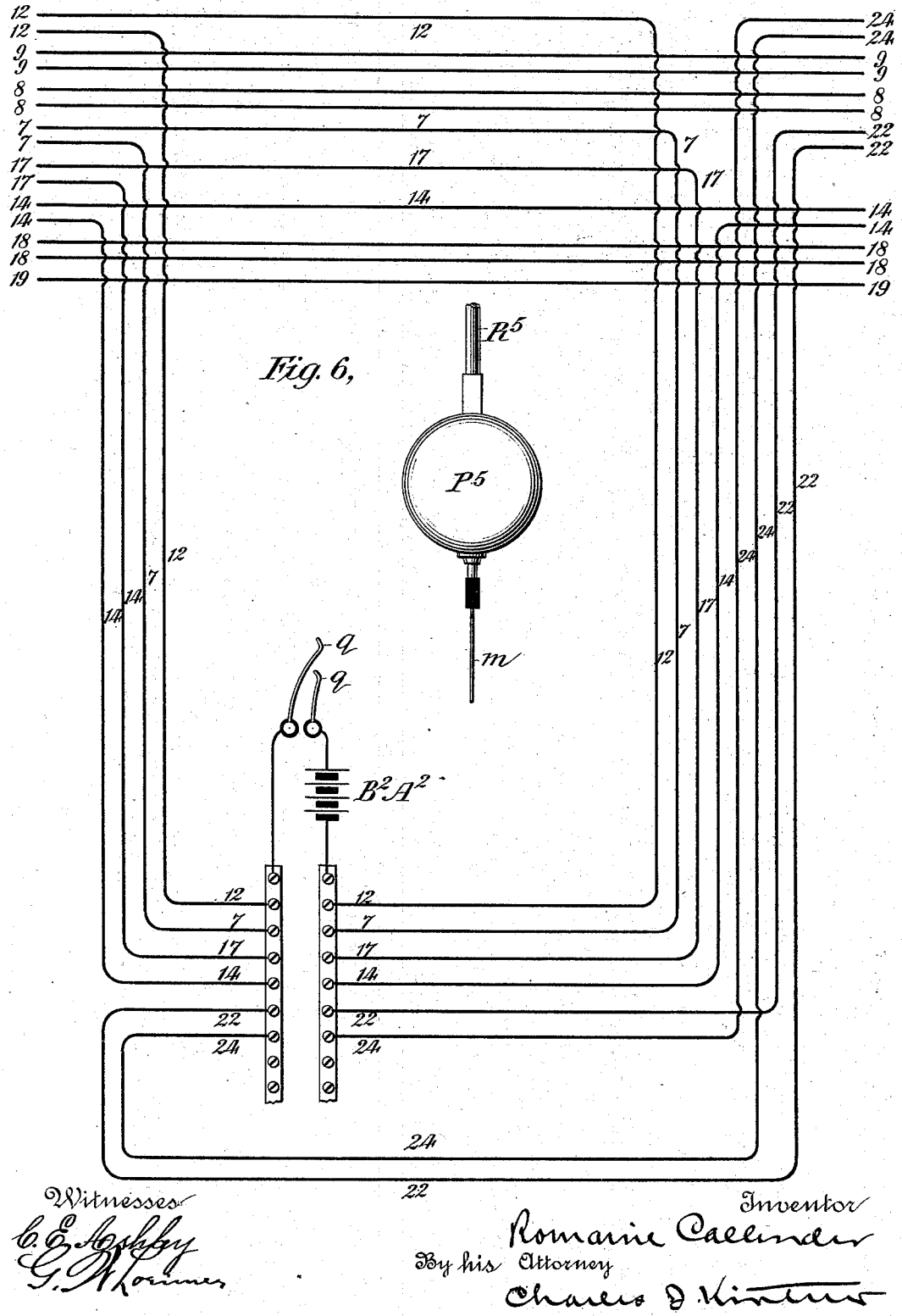

Fig. 6,

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(No Model.) 8 Sheets—Sheet 7.

R. CALLENDER.

TELEPHONE EXCHANGE SYSTEM.

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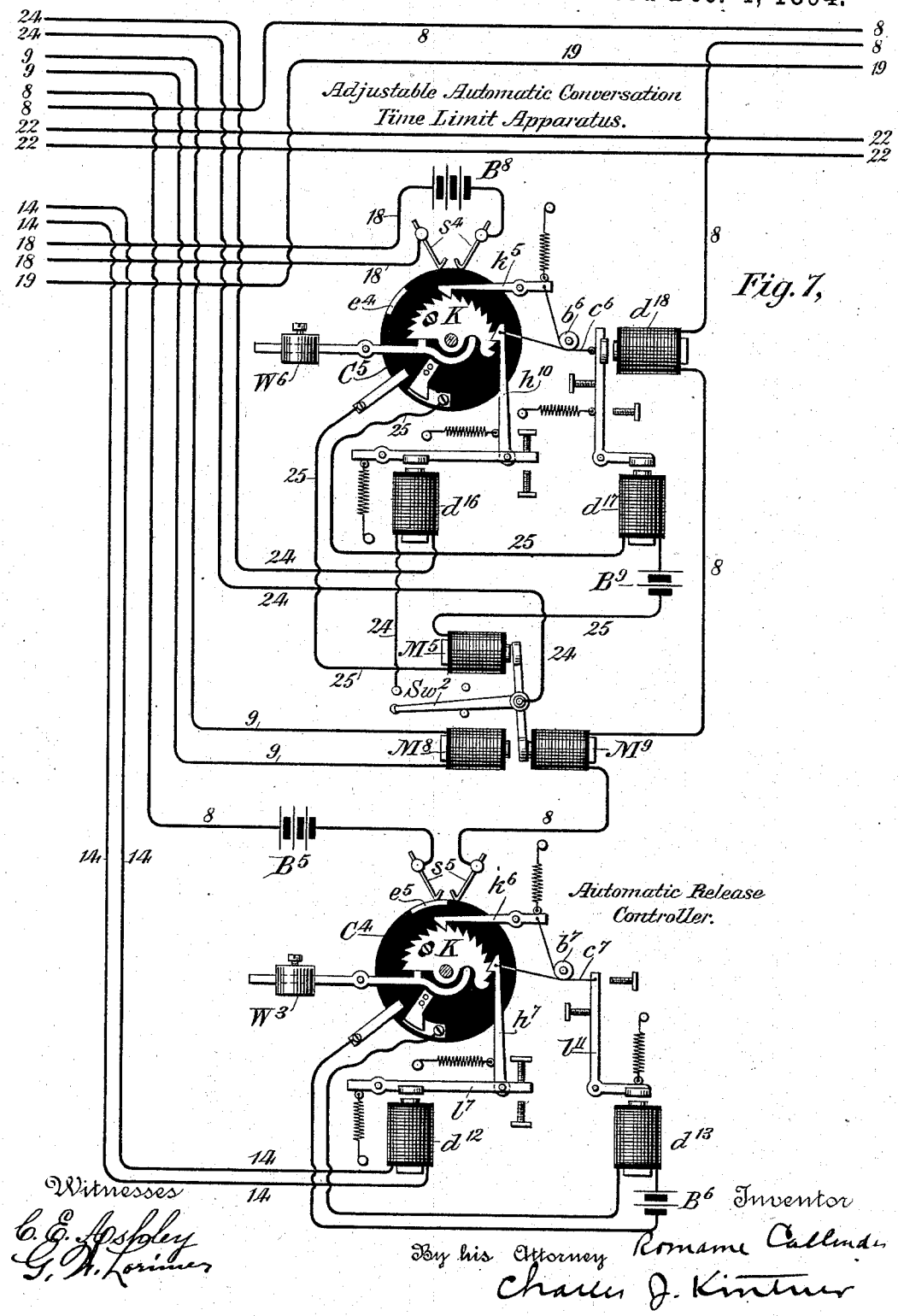

Fig. 7.

Witnesses
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(No Model.) 8 Sheets—Sheet 8.

R. CALLENDER.

TELEPHONE EXCHANGE SYSTEM.

No. 530,324. Patented Dec. 4, 1894.

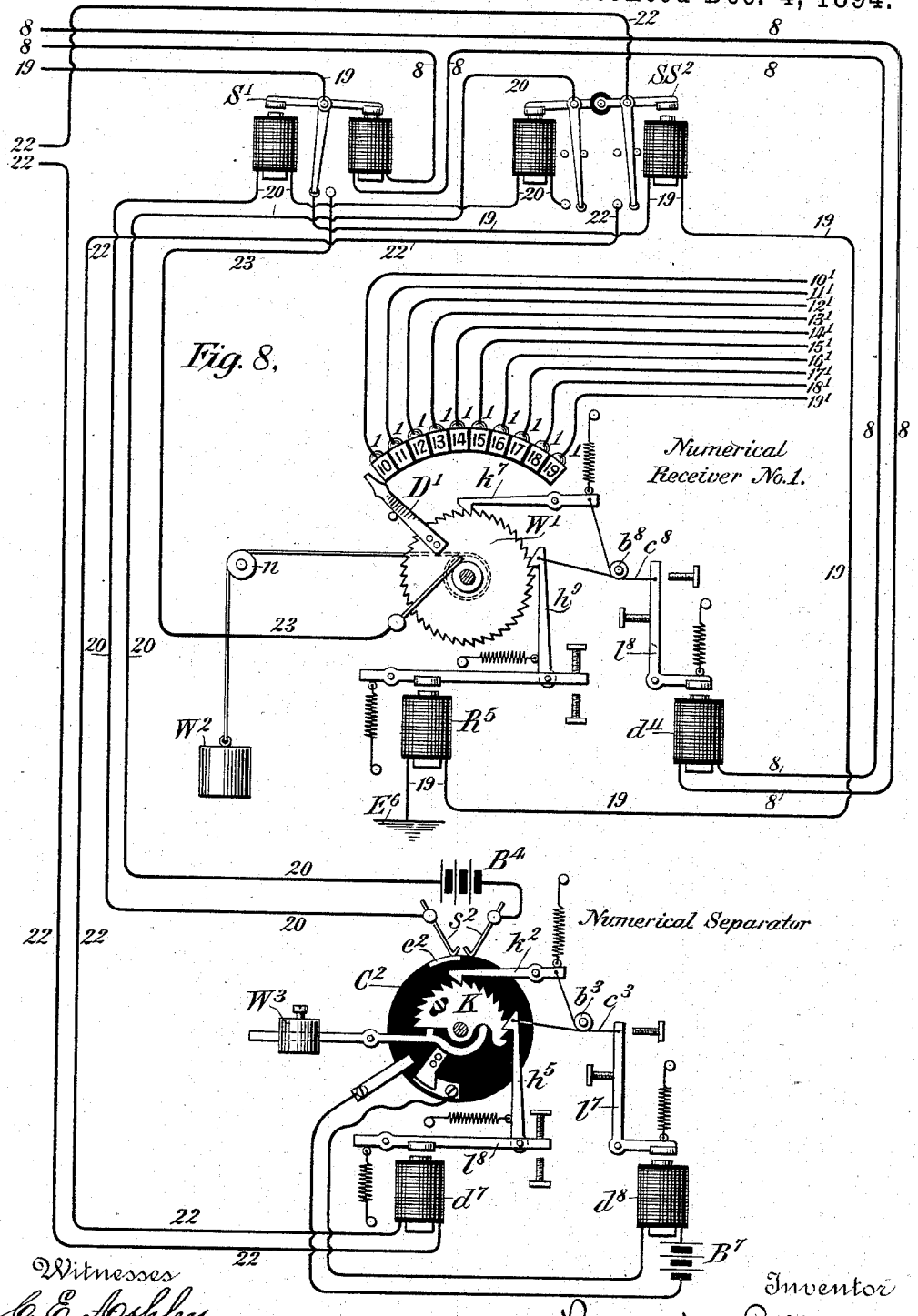

Fig. 8.

Witnesses
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UNITED STATES PATENT OFFICE.

ROMAINE CALLENDER, OF BRANTFORD, CANADA.

TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 530,324, dated December 4, 1894.

Original application filed August 13, 1892, Serial No. 442,948. Divided and this application filed December 18, 1893. Serial No. 494,003. (No model.) Patented in England January 2, 1894, No. 139; in Austria January 2, 1894, No. 2,347; in France January 2, 1894, No. 235,225, and in Belgium January 2, 1894, No. 107,937.

To all whom it may concern:

Be it known that I, ROMAINE CALLENDER, a subject of the Queen of Great Britain, residing at Brantford, Ontario, Dominion of Canada, have made a new and useful Improvement in Telephone-Exchange Systems, (for which I have obtained Letters Patent in England, No. 139, dated January 2, 1894; in Austria, No. 2,347, dated January 2, 1894; in France, No. 235,225, dated January 2, 1894, and in Belgium, No. 107,937, dated January 2, 1894,) of which the following is a specification.

My invention is directed particularly to improvements in that type of apparatus known in the art as automatic telephone exchange systems in which the subscribers, through the agency of apparatus located at outlying stations and additional apparatus located at a central or main exchange, are enabled to automatically effect intercommunication with each other in any desired order, and its objects are, first, to provide automatic mechanism which shall limit the time of the conversation between the two subscribers and automatically cut their instruments out of circuit and restore the apparatus at the central station to normal condition on the expiration of the time limit; second, to provide mechanism which shall enable any subscriber to connect his line with that of any other subscriber automatically; to signal the subscriber wanted and finally after the conversation has been effected to automatically ring off both subscribers and restore the lines to their normal condition; third, to provide automatic mechanism located at the central or exchange station which shall limit the time of conversation between any two subscribers after they have been automatically put into intercommunication with each other, said automatic mechanism being controlled through the agency of the switching apparatus which performs the function of connecting the two lines of the subscribers together; fourth, to provide mechanism whereby any two subscribers having telephone instruments located in independent lines may be automatically connected together for a definite length of time from the time of such automatic connection, and may then be automatically disconnected and their line circuits put into normal condition after the end of such predetermined length of time; the entire automatic mechanism for effecting this time limit connection being located at the central station.

The present application is a division of an application filed by me in the United States Patent Office on the 13th day of August, 1892, and bearing Serial No. 442,948, and upon which Patent No. 511,875 was granted January 2, 1894. The aforesaid patent describes and claims features hereinafter described as a complete system of automatic telephonic intercommunication, the present divisional application being directed to the feature of the automatic conversation time limit apparatus for limiting the time of conversation between any two subscribers of the system.

I accomplish the several objects above set forth with the apparatus hereinafter described, for a full and clear understanding of which reference is had to the accompanying drawings, in which—

Figures 1, 2, 3, 4, 5, 6, 7, and 8 are diagrammatic views illustrating a complete system for a limited number of stations and for a clear understanding of which the several sheets of the drawings should be read as though laid side by side in sequence.

Before entering upon a detailed description of the drawings in order that a general understanding may be had of my automatic system as combined with my automatic time limit apparatus hereinafter claimed, it may be well at the outset to indicate that all of the automatic apparatus in the nature of switching apparatus, time controlled mechanism and the magneto call generator are located at the central or main office into which the subscribers lines all enter, there being one or more sets of subscribers' instruments located on each independent line, each of which sets of instruments is provided with a circuit breaking transmitter like that shown in Fig. 1 and lettered T, there being also a signaling battery BA for each independent line earthed at E'. All of the apparatus therefore shown in Figs. 2 to 8 inclusive is located at the central station and all of the incoming independent

wires on which the subscribers' instruments are located run to a rotary or oscillating general circuit breaking cylinder C^3, Fig. 5, their electrical continuity being maintained through a series of metallic contact plates or strips e^3 on the upper surface of this cylinder.

In order to simplify the illustration, I have shown a single outlying line numbered 1, Fig. 1, earthed at E^2 and provided with the usual lightning arrester L, Blake transmitter T^2, transmitting battery BA, receiving magneto telephone T′ hung upon its hook in the ordinary way all of the circuit connections thereof for the transmitter T^2 and receiver T′ being as is now well understood by those skilled in the art, the right hand side of the lightning arrester L being connected by the subscriber's line 1 to and through the upper portions of Figs. 2, 3, and 4 to the general circuit breaker C^3 (Fig. 5) through the contact springs s^3, metallic plates e^3 to No. 1 of a series of contact plates numbered from "0" to "9" which in turn are connected through corresponding subscribers' wires and similar apparatus located at outlying stations. In the telephone box of each subscriber or at some point easily accessible to the subscriber, is located a rotary transmitter T consisting of an insulating cylinder having a series of ten metallic strips *a* successively of different length located upon its surface and electrically in contact with the metallic axis of the cylinder which in turn is connected through a contact spring *y* with a signaling battery BA earthed at E′. The number of these metallic plates *a* is equal to that of a corresponding set of conducting springs *a′* the free ends of which are adapted to bear upon the cylinder T and make contact in succession with the plates *a*, while their other ends are secured to a fixed set of electrical conducting plates numbered "0," 1, 2, 3, &c., to 9 inclusive, said contact plates being lettered *o* and corresponding in number with the number of subscribers' lines under the control of the first portion of the apparatus at the central station which I denominate as "numerical receiver No. 1." See Fig. 5.

Sw is a rotating conducting switch the free end of which is adapted to contact with the ends of the conducting plates *o*, and MB is a magneto call bell electrically connected on one side to the lightning arrester L with the earth E^2 and on the other through a pair of conducting springs *t′* with a short conducting plate *i* carried by the cylinder T and in turn through the telephone hook with the subscriber's line 1 as clearly shown.

The rotary transmitter T with the transmitting battery BA and the circuit connections just described constitute the only apparatus used by me at the subscribers' stations for effecting automatic intercommunication through a central station with outlying subscribers on independent lines, and no claim is made in the present application to this transmitter and its circuit connections, as the same is made a part of the subject matter of the application upon which my prior patent, above referred to, was granted.

I shall now describe in general terms the apparatus located at the central station after which I shall describe the mode of operation of the entire system, and its circuit connections with the improved automatic time limit apparatus, which latter constitutes the subject matter of the claims of the present divisional application.

In Fig. 6 is shown at the bottom of the drawing, a battery B^2 A^2 and a series of circuits numbered 12, 7, 14, 17, 22 and 24 running to step by step mechanism illustrated in Figs. 2, 3, 4, 7 and 8. These several circuits are automatically opened and closed at the points *q q* by one or more conducting extensions *m* of a pendulum R^5 carried by a clock beating seconds or any preferred elements of time, P^5 being the pendulum ball.

Referring now to Figs. 2, 3, 4, 7 and the lower part of 8, those portions of the apparatus which disclose ratchet wheels or ratchet sectors with holding and propelling pawls and operating electro-magnets together with releasing devices are all controlled directly in their forward action step by step by the clock mechanism shown in Fig. 6.

That portion of the apparatus shown at the bottom of Fig. 2 I term the "general time limit apparatus," its object being to operate for a specified length of time under the control of a time mechanism, such as is shown in Fig. 6, during which time the subscriber shall have had an opportunity to complete his signal and make the circuit connections with the subscriber sought, after which this portion of the apparatus is automatically released and conversation proceeded with as will be fully described later on.

That portion of the apparatus illustrated in Fig. 3 by the letter C′ I denominate as the "magneto signaling controlling instrument," its function being to automatically connect the constantly driven magneto signaling generator H′ in a looped circuit between any two subscribers' lines after they have been automatically connected together through the central station.

That portion of the apparatus represented at the bottom of Fig. 4 and lettered C^2 I denominate a "numerical separator," its function being to enable any subscriber to select a certain one of the remaining subscribers' lines where the total number of those lines amounts to more than 9; that is to say, by the use of the switch *Sw* and the transmitter T for one revolution of said transmitter the subscriber may connect his line with the desired one of the lines 0 to 9 in Fig. 5, but when the number of the outlying subscriber's line is higher than 9 it will be necessary to make two or more revolutions of the transmitter T and to correspondingly change the location of the switch *Sw* to any one of the desired numerals 0, and 1 to 9 inclusive, between

which revolutions of the transmitter this and other like numerical separators act to aid in bringing about the desired connection. To make this statement last made more clear, it is to be understood that for the first system of outlying subscribers' wires illustrated in Fig. 5, the switch handle Sw is to be placed upon that one of the conducting strips 0 to 9 inclusive corresponding to the subscriber's wire wanted and one revolution given to the transmitter T by the handle H and that for connections between the subscriber and any higher number of outlying subscribers' circuits, such as is shown in Fig. 8, the switch handle Sw would be placed upon any one of the conducting strips 0 to 9 corresponding to the subscriber's wire wanted in the higher number than 9 and the transmitter T given a second rotation. In the meantime the numerical separator illustrated at the bottom of Fig. 4 will select the circuits of the higher order of numerals from those of the lower order of numerals during the interval of time between the two rotations of the transmitter T as is fully described in my prior patent above referred to.

That portion of the apparatus illustrated in the upper portion of Fig 5, I denominate as "numerical receiver No. 1." It consists of a ratchet wheel W and conducting arm D, operating electro-magnet R^4 and releasing electro-magnet d^{11}, propelling pawl h^9, holding pawl k^3, releasing cord c^4 passing under pulley b^4 and releasing armature l^8, W^2 being a weight attached to a cord passing over a pulley n and secured to the shaft of the wheel W, the function of the conducting arm D being to convey the current from the subscriber's wire 1 to the desired outlying subscriber whose wire is connected with one of the conducting plates 0 to 9 inclusive. This numerical receiver is positively propelled by the action of the electro-magnet R^4 and pawl h^9 through current impulses sent over the signaling subscriber's line by the transmitter T when rotated, as already described.

That portion of the apparatus illustrated at the bottom of Fig. 5, I denominate as the "general circuit breaking instrument," controlled by electro-magnets d^9 and d^{10}, armature levers l^6, l^9, propelling pawl h^6 and releasing pawl k^4, releasing cord c^5 passing under the pulley b^5.

That portion of the apparatus illustrated in the upper portion of Fig. 7 and lettered C^5, I denominate as the "adjustable automatic conversation time-limit apparatus," its function being to regulate the time for which the conversation between the subscribers may be held, and it is controlled by electro-magnets d^{16}, d^{17}, and d^{18} with propelling pawl h^{10}, releasing pawl k^5, releasing cord c^6 passing under pulley b^6. The claims of the present divisional application are directed to this conversation time-limit apparatus and its circuit connections for controlling the time of the conversation between any two subscribers and all other features hereinbefore or hereinafter described, in so far as they relate to an automatic telephone exchange system are covered by claims in my prior patent, such other matters being simply shown in the present application for the purpose of illustrating the general application of my improved conversation time-limit apparatus to a telephone exchange system.

That portion of the apparatus shown at the bottom of Fig. 7 and lettered C^4, I denominate as the "automatic release controller" which releases all of the apparatus not already released when the adjustable automatic conversation time-limit restores all of the apparatus at the central station to normal condition ready for the next signal.

That portion of the apparatus shown near the top of Fig. 8, I denominate "numerical receiver No. 2," it being a mere extension of the like portion of the apparatus shown in Fig. 5 and denominated "numerical receiver No. 1" each one of the several subscribers' lines numbered from 1 to 9 inclusive, Fig. 5, being connected to an instrument like "numerical receiver No. 1." In other words each subscriber's line running out from "numerical receiver No. 1" in Fig. 5 would be connected to a corresponding conducting arm D' on a second "numerical receiver" adapted to be connected with any one of a secondary set of subscribers, like that shown in Fig. 8, thereby largely increasing the connecting capacity of the system, as more particularly pointed out in my prior patent above referred to. That portion shown at the bottom of Fig. 8 of the drawings is a duplicate numerical separator and is identical with that shown at the bottom of Fig. 4 of the drawings lettered C^2.

Referring now to Fig. 2, L L are switches controlled by magnets M' M^2. d^3 is a releasing magnet for releasing the weighted switch lever l^2, there being one of these releasing magnets for each subscriber's line and all operatively connected with the circuit 8 with the releasing mechanism controlled by the adjustable automatic conversation time-limit apparatus illustrated in Fig. 7.

S^4, S^5, and S^6, Fig. 4, are releasing magnets operated either by the transmitter T or by the apparatus connected to the adjustable automatic conversation time-limit.

S and SS, Fig. 4, are switches controlled by electro-magnets M^3, M^4, M^5 and M^6. S' and SS^2, Fig. 8, are substantial duplicates of the switches S and SS shown in Fig. 4.

K, K, K, K, K, K, Figs. 3, 4, 5, 7 and 8, are ratchet sectors adjustably secured to the rotary parts C^1, C^2, C^3, C^4 and C^5, the size and number of the ratchet teeth being made dependent upon the proportionate times in which it is desired to rotate the disks or cylinders to which they are attached.

W^3, W^3, W^3, &c., are weights carried by levers pivoted to the frame of the apparatus, their inner or free ends bearing under or beneath the curved portions of the sectors K so

that as the disks are rotated the weights W^3 are lifted and when said disks are released, these weights, acting through the levers, will cause the disks and sectors to assume their normal positions. In place of these weighted levers I may use weights and cords passing over pulleys like that shown at W^2 and n in connection with the ratchet wheel of the general time-limit apparatus in Fig. 2.

At the top of Fig. 4 I disclose what I denominate as an "automatic release" consisting of electro-magnets S^4 S^5 and S^6, together with armature levers and circuit connections running to the switch magnets S and SS on the same sheet of drawings, and additional circuit connections running to the adjustable automatic conversation time limit apparatus shown in Fig. 7 and also to the switches L L, Fig. 2, the complete circuit relations of all of which will be fully disclosed in connection with the description of the mode of operation of the apparatus.

I will now describe the mode of operation of the entire apparatus by tracing the circuit connections for connecting up two subscribers where the number of the subscribers' wires so connected lies between 1 and 9, reference being had to my prior patent for a clear understanding of the circuit connections and operation where the number of subscribers is more than nine.

Suppose it is desired to connect the subscriber on wire No. 1 and whose signaling and telephone instruments are shown in Fig. 1 with another subscriber whose instruments are located on said wire No. 9. The several parts of the apparatus at the outset are in the position shown in the drawings of Figs. 1 to 8 inclusive. The operator on wire No. 1 turns the switch Sw into contact with that contact plate o lettered "O" and then rotates the transmitter T through the agency of handle H one complete revolution, thereby sending to line in the direction of the tailless arrows a single impulse from battery BA by wire 1, switch lever l (Fig. 2) wire 2, weighted switch lever l^2, wire 2, relay R, wire 2, relay R', earth E^3, thus actuating these relays R and R'. The relay R being energized causes its armature to close the circuit of battery B through the circuit 4—4 and magnet d^9 (Fig. 5) thereby causing the armature lever l^6 and propelling pawl h^6 to act upon the ratchet sector K and rotate the "general circuit breaker" C^3 a fractional part of a revolution interrupting the circuit, thus disconnecting all of the local branch lines in the central station connecting the numerical receiver between the metallic strips e^3 and the corresponding series of contact springs s^3. At the same instant the relay R' which was energized as already described causes the armature lever r to be drawn down so that the hook lever h^2 near its right hand end catches the free end of the weighted switch lever l^2. The cord c attached to the other end of the armature lever r and to a detent hook h is simultaneously drawn down over the pulley b, thereby drawing the hook h out of the path of a catch on the face of the isolator cylinder T, there being a separate relay R' and corresponding circuit and mechanical connections for each of the incoming subscribers' lines 1 to 9 inclusive, the arrangement being such that the operator signaling will draw his particular detent hook h out of the path of its catch, while the remaining detent hooks h will remain in the paths of their catches. At the same instant that the armature r is drawn down by the relay R' a local circuit will be closed from the battery B' to the local electro-magnet d' imparting to its armature l' and detent hook h' a forward motion, thereby rotating the isolator cylinder I a fractional part of a revolution and allowing a detent pawl p to fall behind a stop on a disk attached to the shaft of the isolator cylinder. This forward motion of the isolator cylinder causes all of the switch levers l to be tilted forward under the influence of their hooks h except that one which has just been described as having been disconnected from the isolator cylinder by the cord c. It will thus be seen that the circuit is interrupted between all of the incoming subscribers' wires at the switch l and the contact points z by this action of all of the switch levers l except the one last referred to, so that no circuit can now be closed for incoming signals from other outlying subscribers' instruments. It is to be noted also that the clock or other time mechanism illustrated in Fig. 6 is supposed to be running continuously, thus constantly making and breaking the circuit of the battery B^2 A^2 between the yielding contact springs q q and through the circuits 12, 7, 14, 17, 22 and 24 and apparatus connected therewith when any of said circuits are closed at other points as will be described later on. The preliminary impulse sent in by the transmitter T through contact plate "0" switch Sw and circuit No. 1 as just described, has thus disconnected all of the outlying subscribers' lines, save the one who has just signaled. As soon therefore as the relay R' (Fig. 2) was demagnetized, its armature r and hook lever h^2 shifted the circuit from the lower contact point x at its left hand end to a second contact point x' just above, and a new No. 1 circuit was established by wire 1, left hand switch L, wire 1, right hand magnet M^2 of the right hand switch L thence by wire 1 through back contact stop of the armature lever of relay R^3 and finally through relay R^2 to earth at E^4, both of said relays being found in Fig. 3 of the drawings. The electro magnets R^4, R^5, &c., which control the movements of the numerical receivers and the switching magnets SS^2, &c., Fig. 8, which control the circuits in connection therewith, should be somewhat more sluggish than the relays R and R', Fig. 2, in order that the preliminary impulse sent in from any outlying station may not affect such of those magnets as may be in circuit before the branch circuits are all interrupted

at the "general circuit breaker;" or the same may be effected by utilizing a signaling battery BA, Fig. 1, at each subscriber's station of considerably less electro-motive force than the battery B′ A′, Fig. 3, which controls the aforesaid electro-magnets. The operator at station 1 now places the switch *Sw* in contact with the plate No. 9. Supposing he desires to connect his wire with some operator on wire No. 9, he then gives to the transmitter T one complete revolution as before, thus sending ten impulses over the line in the same direction as before through the lever l^2 (Fig. 2) upper contact *x′*, wire 1, left hand switch L, wire 1, right hand portion of magnet M^2 which controls and turns the switch L, thence to earth at E^4 at the bottom of Fig. 3 as already described. These ten impulses therefore actuate the relay R^2 and cause the battery B′ A′ at the bottom of Fig. 3 to send ten successive impulses forward from earth E^4 by armature of relay R^2 and front contact stop by wire 1 through the left hand switch S (Fig. 4) thence through wire 16 and right hand magnet M^6 which controls the two point switch SS (Fig. 4) thence by wire 16 through electro-magnet R^4 to earth at E^5. These ten impulses therefore impart to the numerical receiver No. 1 in Fig. 5, ten forward steps through the agency of the hook h^9 and retaining pawl k^3 thereby placing the conducting arm D of this receiver ultimately in contact with the right hand plate 9 and hence with the circuit running to the subscriber desired.

Returning now to the right hand switch L at the top of Fig. 2, it will be seen that by the act of shifting the lower end of its switch arm to the left a clock circuit was established from the battery B^2 A^2 (Fig. 6) by way of the conductors 7—7 which circuit includes the actuating electro-magnet d^3 at the bottom of Fig. 2 so that as the pendulum vibrates the general time-limit apparatus is set in motion through the operation of the armature lever l^3 and propelling pawl h^3. This mechanism continues to advance step by step for a period of say twenty seconds or twenty beats of the clock pendulum and during the first fifteen seconds of this forward motion, the contact plate *e* of the general-time-limit apparatus is brought under the two conducting springs *s s*, while the holding pawl *k* retains the apparatus as it is advanced step by step and the restoring weight and cord W^2 are drawn up over the pulley *n*. When the contact plate *e* passes beneath the conducting springs *s* a new clock circuit 12 is established through the contact points *q q* and battery B^2 A^2, said circuit 12 including an actuating electro-magnet d^5 for the magneto signaling controlling instrument represented by the letter C′, (Fig. 3) so that the ratchet sector K through the agency of the propelling pawl h^4, armature lever l^4 and retaining hook *k′* is caused to advance step by step as the clock closes the circuit at *q q* in Fig. 6. During the first of the forward steps of the tooth sector K and hence of the magneto signaling controlling apparatus C′, the conducting plate *e′* carried thereby is brought under the two conducting springs *s′ s′* and an additional circuit is thereby closed through the conductor 13—13 from the battery B^3 which circuit includes a releasing magnet d^{10} for the general circuit-breaker shown at the bottom of Fig. 5, thereby performing two functions at the same time, namely: first releasing the general circuit-breaking cylinder C^3 through the agency of the armature lever l^9, releasing cord c^5, propelling pawl h^6 and detent pawl k^4 and allowing this cylinder to assume its normal position or that now shown in Fig. 5, thereby again restoring all of the subscribers' circuits into through connection with the contact plates e^3 and the numerical receiver circuits. It will be noted at this time that although the general circuit has been re-established for all of the local branch circuits at the general circuit-breaker, all of the subscribers' circuits except the signaling circuit are now broken at their points of juncture with the switch levers *l* by virtue of the previous rotation of the isolator cylinder I (Fig. 2) so that there is only one path for an incoming current.

The circuit 13 which includes the battery B^3, contact springs *s′ s′* and the releasing magnet d^{10} includes also a relay R^3 located near the bottom of Fig. 3, and it is therefore apparent that during the time that the conducting plate *e′* of the magneto signaling controlling instrument C′ remains under the contact springs *s′ s′* the armature of relay R^3 will be held forward on its front contact stop. The result therefore is that the constantly operating magneto generator H′ is now looped in circuit with both of the incoming subscribers' lines 1 and 9, and the magneto bells MB at both stations continue to ring during the time that the contact plate *e′* is under the springs *s′ s′*. As the instrument C′ continues to rotate circuit is made through conductor 9 and contact springs t^3 and t^6 and the battery circuit B^5 near the center of Fig. 3 is closed through circuit 9 including the releasing magnet d^6, (Fig. 3,) the right hand magnet of the left hand switch L at the top of Fig. 2 and the left hand switch magnet M^8 of the switch which controls the adjustable conversation-time-limit apparatus in Fig. 7. Consequently the left hand switch L at the top of Fig. 2 is turned with its lower point in contact with the left hand contact point. The contact spring t^4 of the magneto controller C′, Fig. 3, has ridden over the insulated plate i^2 and assumed a central position, thereby closing the circuit of battery B^4 through wire 11 to the releasing magnet d^4 thus releasing the the general time-limit apparatus E in Fig. 2, and allowing it to return to normal position, it having first advanced far enough to close the circuit 10 through contact springs *t* with a conducting plate *o* so as to energize the left hand magnet M^2 of the right hand switch L

at the top of the drawing and return it to normal position, thereby rupturing the clock circuit 7—7. The general time-limit apparatus for controlling the time of turning in the signal has been returned to normal position and has shifted the switch of the right hand switch L at the top of Fig. 2 to its normal position, the magneto signaling controlling instrument has been returned to normal position through the agency of the releasing magnet d^6 and the magneto generator cut out of circuit. The adjustable automatic time-limit conversation apparatus has been set in motion through the agency of the circuit 9, magnet M^8 and switch Sw^2 (Fig. 7) a circuit having been established through said switch, the conductor 24, operating magnet d^{16} and the clock circuit at Fig. 6.

It will be noticed that the circuit 9 is provided with circuit closing devices at two points, one on the apparatus C′ in Fig. 3, and the other on the general time-limit apparatus in Fig. 2, the arrangement being such that although electrical contact is made between the plates t^3 and t^6 as C′ advances, the circuit will not be closed between the plate t^2 and the rotary plate carried by the general time-limit apparatus until the latter has been released and returned to normal position, thereby allowing the general time-limit apparatus to be released first and to afterward release the instrument C′ and to perform the other functions already described.

When the relay R^2 (Fig. 3) closed the circuit from battery B′ A′ through line 1, the left hand switch S of Fig. 4 and the right hand magnet M^6, wire 16 and magnet R^4 (Fig. 5) the first impulse sent over the line caused the two point switch SS to reverse its position and to close the clock circuit 17, thereby starting the numerical separator C^2 almost simultaneously with the general time-limit apparatus (Fig. 2). As the numerical separator advances under the action of the armature l^5 and hook lever h^5 it brings the contact plate e^2 under the contact springs s^2 s^2 thereby closing a local battery circuit 15 from battery B^4 through the left hand magnet M^5 of the double switch SS restoring the switch to its normal position and also through the left hand magnet M^3 of the switch S shifting said switch into the reverse position and hence directly in circuit with the arm D of the numerical receiver in Fig. 5 so that the magneto call currents from the magneto generator H′ were caused to take the path through the conductor 1 joining the two circuits thus connected together during the time that the armature of relay R^3 was held forward on its front contact stop, while the contact plate e' of the magneto signaling controlling instrument was passing under the springs $s's'$. The uninterrupted circuit therefore between the two lines 1 and 9 is as follows: Passing from the earth at station 1 in the direction of the tailless arrows through wire 2 (Fig. 2) lever l, wire 2, lever l^2, upper contact x' upon which lever l^2 is held by hook h^2, wire 1, switch L and left hand contact point upon which it is now resting, wire 6 through ringing off magnets S^4 in Fig. 4, wire 6, wire 1 directly to the numerical receiver through the arm D to the wire 9 and thence through the contact springs s^3 s^3, metallic plate e^3 on the general circuit-breaker directly to the outlying subscriber. As the numerical separator advances through its complete phase the local circuit of battery B^5 seen at the bottom of Fig. 4 is closed through the electro-magnet d^8 and conductors running to the contact plates t^4 and t^5, the releasing armature lever l^7 causing the hook lever h^5 and detent hook k^2 to allow the sector K and disk C^2 to return to normal position. Just before the magneto signaling controlling instrument was returned to its normal position by the releasing electro-magnet d^6 in circuit 9 and at the instant that the general time-limit apparatus returned to its normal position and closed the circuit 9—9—, the switch Sw^2 of the adjustable automatic conversation time-limit apparatus (Fig. 7) was turned into its upper position under the influence of magnet M^8 which is also in circuit 9 so that after the magneto signal has been sent in and the two subscribers connected together as already described, this adjustable automatic conversation time-limit apparatus is now put in operation by the agency of the clock circuit 24 which runs to the clock and energizes the propelling electro-magnet d^{16} thereby causing the sector K of this apparatus to advance step by step for a definite number of seconds or minutes or such time as may be allowed for conversation, the apparatus shown in Fig. 7 of the drawings merely indicating the application of this time-limit principle. As the two subscribers converse therefore the apparatus C^5 advances and ultimately the contact plate e^4 rides under the conducting springs s^4 s^4 closing the circuit of the battery B^3 through the conductors 18 to the releasing electro-magnet S^5 near the center of Fig. 4 of the drawings, thereby lifting the armature lever v and allowing the armature lever v' to be withdrawn from the notch on the under side, thus locking the armature v in its upper position in contact with a conducting contact connected to the clock circuit 14. On the first closure of the clock circuit therefore throught the circuit 14 the left hand switch S of Fig. 4 is shifted by magnet M^4 to its first or normal position and simultaneously the automatic releasing mechanism at the bottom of Fig. 7 is stepped forward under the influence of the electro-magnet d^{12} until the contact plate e^5 is carried under the contact springs s^5 thus closing the battery circuit B^5 through the conductor 8 and right hand electro-magnet M^9 shifting the conversation time-limit switch Sw^2 back to its normal position, simultaneously energizing the releasing electro-magnet d^{18} in the same circuit, thereby releasing the adjustable automatic conversation time-

limit mechanism and allowing it to rotate back to its normal position. At the same instant the releasing magnet d^{11} in the same circuit, No. 8, of the numerical receiver in Fig. 5 is actuated, allowing the weight W^2 to return the conducting arm D of the numerical receiver to its first or normal position. The electro-magnet s^6 of the ringing off apparatus F, Fig. 4, is also caused to draw the armature v' into its forward position and release the armature v. The electro-magnet M′ of the upper left hand switch L in Fig. 2 being in the same circuit 8 causes the switch to be turned to its first or normal position and the releasing magnet d^4 which is also in circuit No. 8 in Fig. 2 lifts the pawl p and allows the isolator cylinder to be restored to its normal position. The releasing magnet d^3 which is also in circuit No. 8 in Fig. 2 is caused to release the armature lever hook h^2 from the end of the weighted lever l^2, thereby allowing said lever to assume its original or normal position. Last of all the automatic release itself at the lower part of Fig. 7 of the drawings is effected through the agency of a local circuit and electro-magnet d^{13} in the same manner as the apparatus C^2 at the bottom of Fig. 4 was released as heretofore described.

It is now apparent that the several parts of the apparatus put in operation from the transmitter T at the station of the signaling subscriber have served their various functions in sequence and that the adjustable automatic conversation time-limit apparatus having limited the time of the conversation the entire mechanism at the central station has again assumed its normal condition and that the isolating cylinder I has again connected all of the outlying subscribers' lines with the signaling receiving mechanism for said lines at the central station. Any other operator may now turn in his signal and automatically connect his particular line with any other line in the system, the operation being identically the same as has heretofore been described.

Should any subscriber attempt to signal during the time that the apparatus is in use by reason of a signal previously sent in, it is apparent that he will receive no signal on his own magneto bell, his line being like that of all subscribers, save the one who has previously signaled, cut out at the isolator cylinder I, Fig. 2. He must wait therefore until he obtains a signal on his own bell on turning in a signal before he is aware of the fact that his proper circuit connections have been made. The absence of such a return signal is indicative to him of the fact that the system is in use and that he must wait until the proper circuit connections are again automatically made at the central station. It is to be understood, however, that although all of the subscribers' outlying lines, save the one who is signaling, have been cut out of circuit at the isolating cylinder (Fig. 2) for transmitting signals. All of said lines are still connected with the numerical receivers for receiving signals at the points "0" to "9" inclusive over which the conducting arm D passes and also through the contact springs s^3 s^3 and conducting plates e^3, the latter attached to the general circuit-breaking cylinder C^3. (See Fig. 5.)

Although I have shown in the present application two numerical receivers indicated as "numerical receiver No. 1," Fig. 5, and "numerical receiver No. 2," Fig. 8, and corresponding numerical separators, Figs. 4 and 8, with circuit connections on Fig. 8 for nineteen additional telephone lines running from contacts 10, 11, 12, 13, &c., to 19, and switches S′ and SS^2, Fig. 8, corresponding to switches S and SS, Fig. 4, it will be unnecessary to describe in the present application the operation of connecting up any of the telephone lines illustrated in Fig. 8, for the reason that these features are all fully disclosed in my prior patent above referred to; and for the further reason that the circuit connections with the adjustable automatic conversation time-limit apparatus are clearly traceable upon the drawings as to their connections with numerical receiver No. 2 and its adjunct parts, the operation of said adjustable automatic conversation time-limit apparatus being in every essential particular the same as already described in connection with numerical receiver No. 1, Fig. 5.

Although the restoring of all of the apparatus to normal condition is made dependent, as heretofore described, upon the automatic conversation time-limit apparatus illustrated in Fig. 7 and the circuit connections through battery B^5 and conductor No. 8 running through Figs. 2, 3, 4, 5, 6, 7 and 8 of the drawings this same function may be performed by either one of the subscribers at the end of their conversation without waiting for the termination of the time, by simply placing the switch Sw in circuit with the "0" contact and rotating the transmitter T one turn. This will cause the main battery BA at the transmitting station to energize the releasing electro-magnet S^4, Fig. 4 of the drawings, and return all of the apparatus to normal position and will also release the automatic releaser for the reason that the clock circuit 14 will be closed at the back stop of the armature lever v so that the first impulse which passes over the circuit 14 will place the contact plate e^5 under the springs s^5 s^5 thereby closing the general releasing circuit 8 which operates all of the releasing devices.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. An automatic telephone exchange system having means controlled by the subscriber for automatically connecting together any two of a series of independent outlying telephone lines, in combination with a time mechanism for automatically disconnecting

at the central office the subscribers after a predetermined time, which time mechanism is in no way under the control of the subscriber after the expiration of said predetermined time.

2. An automatic telephone exchange system having means controlled by the subscriber for automatically connecting together any two of a series of independent outlying telephone lines, in combination with a time mechanism for automatically disconnecting at the central office the subscribers after a predetermined time and additional means for restoring the parts to normal position, said time mechanism being in no way under the control of the subscriber after the expiration of the predetermined time.

3. In an automatic telephone exchange system, one or more switching devices controlled by electro-magnets; a series of subscribers' lines and circuit connections therefrom to the switching apparatus; transmitters for causing the switches to advance through their phases and time mechanism and releasing devices whereby the switches are all restored to normal condition after a predetermined length of time, said time mechanism being in no way under the control of the subscriber after the expiration of the predetermined time.

In testimony whereof I have hereunto subscribed my name this 11th day of December, 1893.

ROMAINE CALLENDER.

Witnesses:
C. J. KINTNER,
C. A. LONGFELLOW.