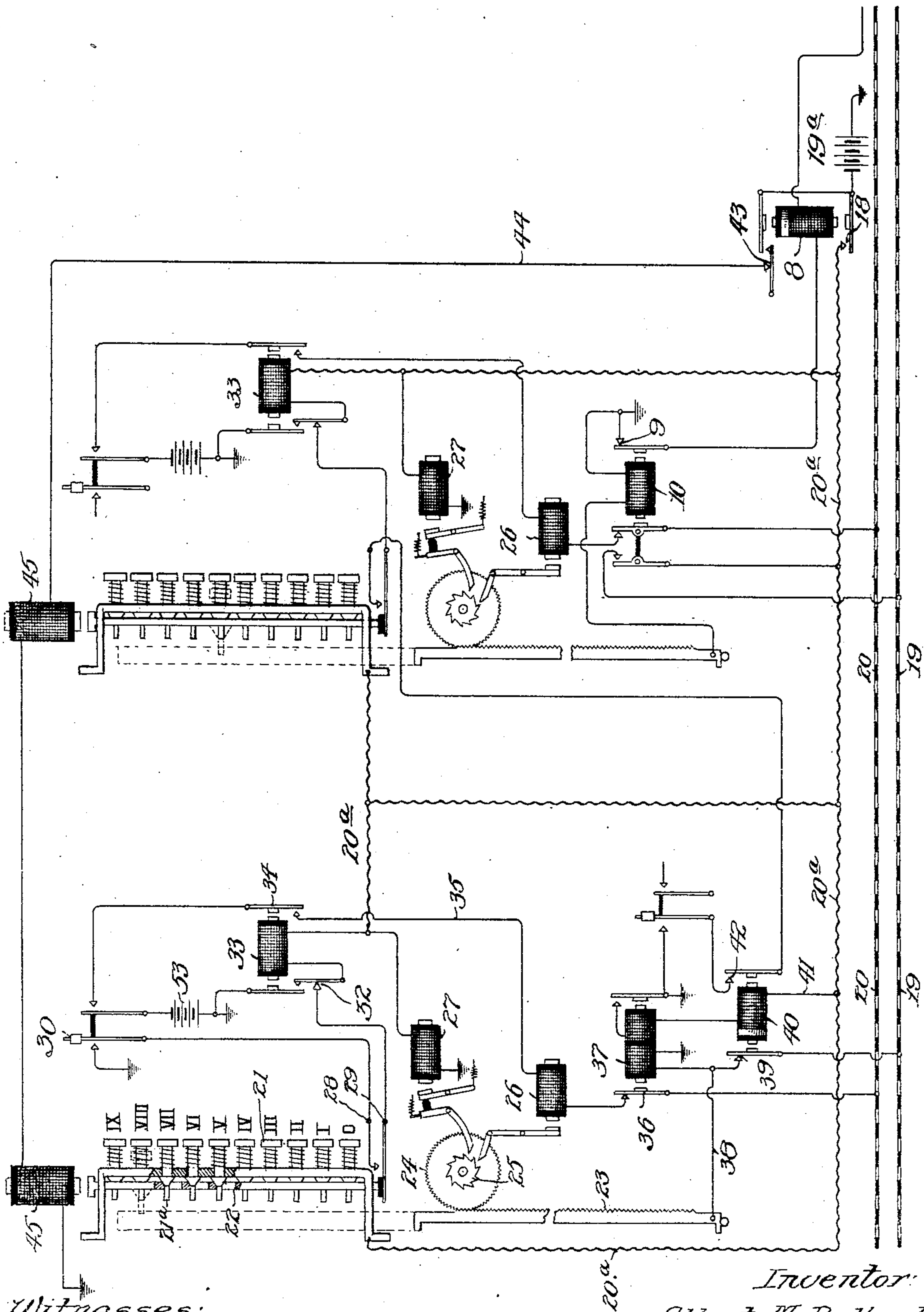


A. M. BULLARD.
SEMI-MECHANICAL TELEPHONE SYSTEM.
APPLICATION FILED FEB. 19, 1908.

944,537.

Patented Dec. 28, 1909.

2 SHEETS—SHEET 1.



Witnesses:
Irving Mac Donald
M. Clelland Young.

Fig 1

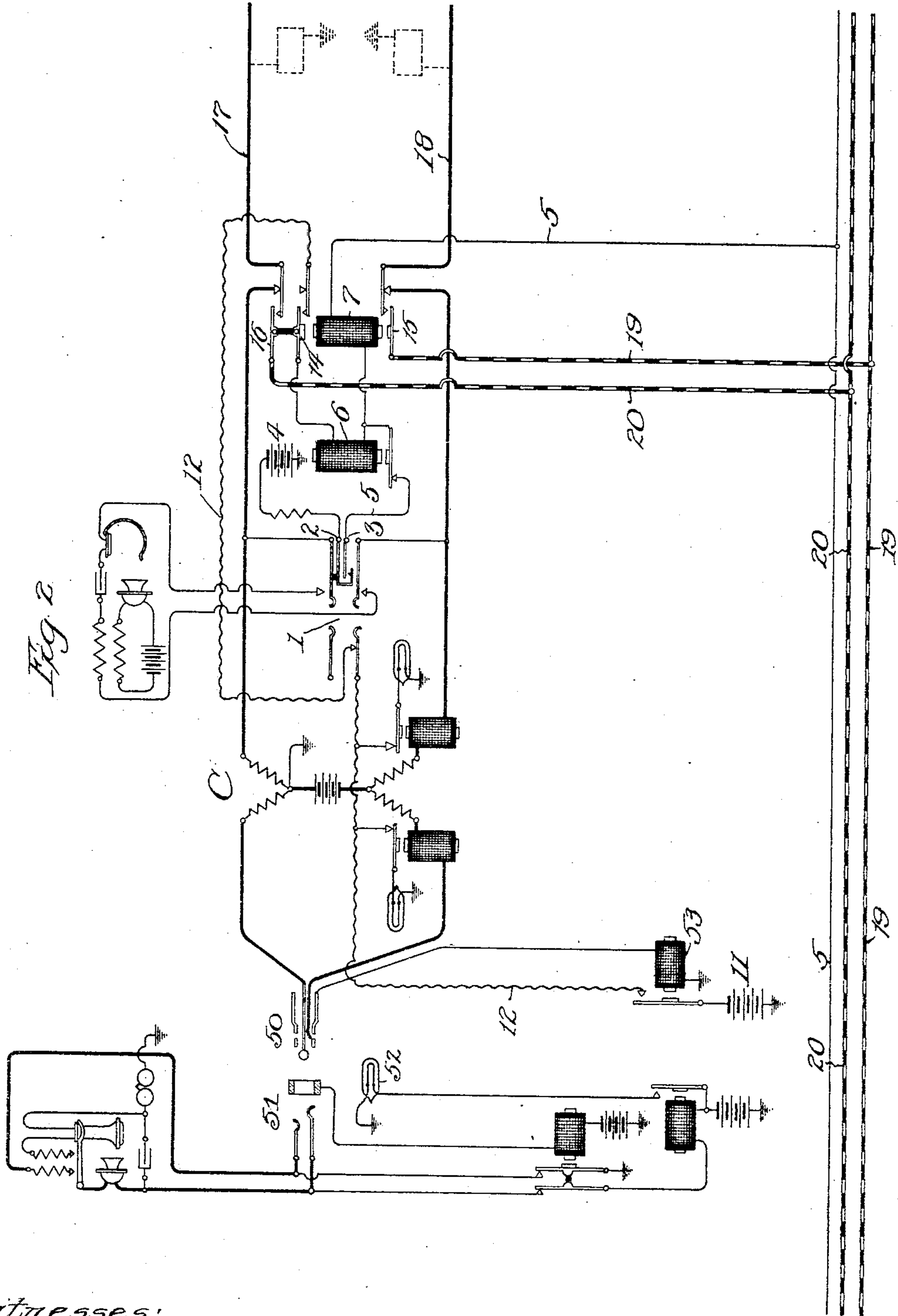
Inventor:
Albert M. Bullard
By Barton Tanner Folk
Attys.

A. M. BULLARD.
SEMI-MECHANICAL TELEPHONE SYSTEM.
APPLICATION FILED FEB. 19, 1908.

944,537.

Patented Dec. 28, 1909.

2 SHEETS—SHEET 2.



Witnesses:
Irving MacDonald
M. Belland Young.

Inventor
Albert M. Bullard
By Boston Square, N.Y.
Attys.

UNITED STATES PATENT OFFICE.

ALBERT M. BULLARD, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

SEMI-MECHANICAL TELEPHONE SYSTEM.

944,537.

Specification of Letters Patent.

Patented Dec. 28, 1909.

Application filed February 19, 1908. Serial No. 416,703.

To all whom it may concern:

Be it known that I, ALBERT M. BULLARD, citizen of the United States, residing at New York, in the county of New York and State of New York, have invented a certain new and useful Improvement in Semi-Mechanical Telephone Systems, of which the following is a full, clear, concise, and exact description.

My invention relates to an improvement in controlling apparatus adapted to govern the automatic switching or selector mechanism of telephone exchange systems, such, for example, as the system set forth in the joint application of James L. McQuarrie and myself, Serial No. 366,401, filed September 27, 1906.

The present invention is concerned particularly with the control of transmitter mechanism by keys arranged to be actuated by the operator; and it contemplates the direct mechanical association of the "transmitter", "sender" or "controller" apparatus with the keys. That is to say, the keys are arranged to actuate movable stops which serve to limit the travel of a movable member coöperating therewith, the transmitter or circuit controller for governing the operation of a distant selector being operated according to the extent of travel of said movable member. Motor mechanism for advancing the movable member is brought into service when any key is actuated; and when said movable member has reached the point determined by the stop set by such key, the motor mechanism and transmitter mechanism are thrown out of service.

I will describe my invention in detail by reference to the accompanying drawing, in which—

Figure 1 is a diagram illustrating an operator's keyboard and sending apparatus; and Fig. 2 is a continuation from Fig. 1, and shows the sender leads extending to the operator's connecting circuit.

While in the interests of clearness specific descriptive language must be used with reference to the particular apparatus and circuits shown in the drawing, it will be apparent to those skilled in the art that the invention is capable of extensive modification, and that the novel features disclosed may be embodied in systems which as a whole may differ widely from the one here shown. The

parts, improvements or combinations which I regard as novel will be pointed out in the appended claims.

The sending apparatus shown on Fig. 1 is normally disconnected from the operator's cord circuits, one of which is shown in Fig. 2, but each operator's cord circuit is provided with apparatus (relays 6 and 7) whereby the sending apparatus may be automatically seized when the cord circuit is put into use in answering a call. The answering end of the cord circuit is in the system shown equipped with the usual answering plug 50, which is adapted to be inserted in the springjack 51 of a line in answer to a call from such line indicated in the usual way by the lighting of the signal lamp 52. The link conductors 17 and 18 of the cord circuit will extend to an automatic selector (not shown) which is intended to be operated by selecting impulses sent out or controlled by the sending apparatus shown in Fig. 1. I have merely indicated in dotted lines magnets connected in ground taps from the conductors 17 and 18, as devices adapted to respond to selecting impulses; the present invention being concerned wholly with the sending apparatus by which these impulses may be transmitted.

The operator's listening key is equipped with a pair of contacts 2, 3, which are adapted to be closed when the listening key 1 is actuated by the operator in answering a call, (after the answering plug has been inserted in the springjack of the calling line) and the closing of these contacts completes a circuit from a battery 4 through the back contact of relay 6, and through the winding of slow release relay 7 to a conductor 5, thence through a relay 8 of the sending apparatus, and through a back contact 9 of another relay 10 of said sending apparatus to earth. Relay 7 in this circuit is for purposes which will hereinafter appear made slow releasing and is adapted when excited to break the continuity of the cord circuit conductors 17 and 18, and to unite the "connecting" extensions thereof to the sender leads 20 and 19 respectively. Relay 7 is also adapted when excited to close a contact 14 controlling the application of current from battery 11 over conductor 12, to the relay 6, and through the winding of relay 7, over the path previously traced to ground at the back contact 9 of relay 10, (Fig. 1) this being a lock-

ing circuit for relay 7 independent of contacts 2, 3. Relay 6, in operating, breaks the circuit from battery 4. Relay 8 in operating closes a contact 18 by which current is applied from battery 19^a to the feed wire 20^a of a sending apparatus.

The keys on the left of Fig. 1 may be the tens keys, and those on the right the units keys. It is intended when the sending apparatus shown on Fig. 1 is associated with an operator's connecting circuit, that the operator by actuating one key of each set may cause the sending apparatus automatically to transmit over the sender leads impulses adapted for the operation of the distant selector mechanism in such a way as to choose the line represented by the depressed keys. The mechanism controlled by the tens keys will operate first, after which the mechanism governed by the units keys will be brought into service; and finally when the required impulses have been transmitted, the sending apparatus will be caused automatically to free itself from the connecting circuit, leaving the latter free for telephone transmission, the keys being also restored.

The keys are arranged so that when any key 21 of a set is depressed, it will be locked in its depressed position by a longitudinally movable plate or locking bar 22, which in its movement closes contact 28, 29, governing the starting of the sending mechanism. Each key is also adapted when depressed to push a stop 21^a (shown as an extension of the stem of the key) into the path of a movable member 23, to limit the travel thereof. Said member 23 is shown as a longitudinally movable rack bar adapted to be advanced by a pinion 24 which may be rotated step by step by a pawl engaging a ratchet 25, said pawl being actuated by a stepping magnet 26. The ratchet wheel 25 may be retained in its step-by-step advance by a holding pawl arranged to be brought into service by a holding magnet 27. The holding magnet is supplied with current from the battery feed 20^a, and is excited while the sender is in use. At the end of the sender operation current will be cut off from the feed wire, and the holding magnet 27 being deprived of current, will cause the ratchets controlled thereby to return to normal position.

The contact between the springs 28, 29, closed when any key is depressed, governs a circuit through a relay 33 by which pulsations of current from the battery 53 may be applied to the stepping magnet 26 and to the sender lead 20, this circuit being controlled at the back contact of a cut-off relay 37. The particular key depressed determines the number of pulsations of current which are applied to the sender leads. This is accomplished as follows: The movable member 23 forms one terminal of a circuit for the cut-off relay 37, which is arranged

to stop the sending operation, the other terminal of this circuit being the projecting stop of the key which is depressed. The framework in which the keys are mounted is shown connected to the battery feed 20^a, while the movable member 23 is connected to a wire 38 which leads through a winding of relay 37 to earth. A locking circuit for relay 37, derived from the battery feed 20^a, includes a relay 40 of the slow-approach type. This relay 40 controls at back contact 39 a connection from the movable member 23 to the sender lead 19. Said relay 40 is also arranged to close a contact 42 which controls a circuit for the starting relay 33 of the sending mechanism governed by the units keys. This mechanism governed by the units keys is in general the same as that governed by the tens keys. The cut-off relay 10 of this apparatus is, however, arranged to connect the battery feed 20^a to the sender lead 19, and also to break contact 9 and release relays 8, 7 and 6. Each set of keys is provided with a release magnet 45 which is adapted when excited to shift the longitudinally movable locking bar of the corresponding set of keys. The magnets 45 are included in a restoring circuit 44 which is arranged to be closed momentarily from battery 19^a when relay 8 is released at the end of the sending operation. The armature of relay 8 is connected to the free pole of battery 19^a, and is adapted when attracted to engage a contact spring which normally rests against an anvil connected through wire 44 and magnets 45 to earth. It is thus seen that when relay 8 is released, its armature in returning to normal will deliver a momentary impulse of current from battery 19^a to said restoring magnets.

The operation of the apparatus is as follows: When the subscriber calls the central office by removing his telephone from its switch hook, it results in the lighting of the line signal lamp 52 in the usual way. The operator responds to the call by inserting her plug 50 in the springjack 51, completing circuit for a relay 53 connected with the third strand of the cord circuit. This relay 53 in operating connects the free pole of battery 11 to the feed wire 12 of the cord circuit. The operator now works her listening key to switch her telephone into circuit, so that she may inquire the number of the subscriber wanted. This operation of the listening key also closes contacts 2, 3, completing the circuit from battery 4 through the sender seizing relay 7 and sender relay 8, these relays, together with relay 6, being now locked up from the battery feed 12 in a circuit 5 controlled at the back contact 9 of relay 10. The sender is thus associated with the operator's cord circuit for the purpose of controlling the operation of the distant selector. The operator now presses a tens

key and a units key, designating the number of the line wanted. Assume that key VIII of the tens and key V of the units keys are depressed. These keys lock in their depressed position, and contact springs 28, 29, of the ten keys close a circuit from battery feed 20^a, through starter relay 33, to ground at the pulsator 30. Starter relay 33 completes a locking circuit for itself from the feed wire 20^a to earth, and also closes contact 34 by which the battery side of the pulsator 30 is connected to wire 35, leading through stepping magnet 26 and back contact 36 of cut-off relay 37 to the sender lead 20. At each stroke of the pulsator an impulse of current is thus delivered through the stepping magnet 26 and out over the sender lead 20 to operate the distant selector; and at each impulse the stepping magnet 26 advances the ratchet 25, and thus causes the rack bar 23 to travel. This continues until the rack bar 23 comes in contact with the stop 22 which has been interposed in its path by the depressed tens key. When this occurs, a proper number of impulses corresponding to the depressed key having been delivered over the sender lead, the circuit for the cut-off relay 37 will be completed. The cut-off relay in operating will interrupt the stepping circuit previously traced, and will also complete the locking circuit, including relay 40. This relay, however, being slow to attract its armatures, leaves a momentary path for current which may be traced from the battery feed 20^a through the depressed key to the movable member 23, through wire 38, and back contact 39, to the sender lead 19. This momentary impulse will be utilized at the distant selector in governing the required sequence of operations. Relay 40 also closes contact 42, and thereby completes a circuit for the starter relay 33 of the controller mechanism of the units keys. This controller mechanism is now operated, in a manner similar to that of the tens keys already described, causing impulses to be sent out on the sender lead 20. When the movable member of this sending apparatus reaches the point predetermined by the depressed units key, a circuit is completed for the cut-off relay 10. This relay, in operating, breaks the stepping circuit for the units controller, applies current from the battery feed 20^a to the sender lead 19 (battery being cut off from the wire 20^a a moment later) and also breaks contact 9, releasing the slow releasing relay 7 and relays 8 and 6. Relay 8, in recovering, momentarily establishes the circuit for the restoring magnets 45 of both sets of keys, and cuts off current from the battery feed wire 20^a of the sending outfit. Relay 7 in recovering reestablishes the normal cord circuit connections, leaving the cord circuit free for telephone transmission, and leaving

the sender apparatus free to be seized by another cord circuit. Since, however, this relay 7 recovers slowly, the impulse from the battery feed 20^a over the sender lead 19 will be allowed to pass before the relay armature 15 has retracted.

I claim:

1. In a controller for an automatic telephone exchange system, the combination with a series of keys, of a movable member, and means associated with and actuated by the respective keys to positively stop said movable member. 75
2. In a controller for a semi-automatic telephone exchange system, the combination with a series of keys, of a movable member, stops for said member, each stop being adapted to be introduced in the path of said member by the depression of one of said keys to positively limit the movement of said movable member, and means controlled by the depression of any one of said keys for advancing the movable member to said stop. 80
3. A controlling device comprising a movable member, a series of movable stops adapted to limit the travel of said movable member, and keys corresponding to said stops for actuating the same to positively determine the extent of travel of said movable member. 85
4. A controlling device comprising a movable member, a series of movable stops, a corresponding series of keys, each key being adapted to cause its corresponding stop to be moved into the path of said movable member to positively stop said movable member, motor mechanism for advancing said movable member, and means controlled by the coöperation of said movable member and any of said stops for controlling said motor mechanism. 90
5. A controlling device comprising a movable member, motor mechanism for advancing the same, a series of movable stops and corresponding keys adapted to cause said stops to be interposed in the path of said movable member, an electric circuit controlled by the engagement of said movable member and any of said stops, and means responsive to current in said circuit, adapted to stop the advance of said movable member. 95
6. A controlling device comprising a movable member, a series of movable stops adapted to positively limit the travel of said movable member, a corresponding series of keys mechanically connected to actuate the respective stops, motor mechanism adapted to advance said movable member, means operated upon the actuation of any of said keys for bringing said motor mechanism into service, electrical transmitter mechanism brought into action upon the actuation of any of said keys, and means actuated when said movable member reaches the point limited by the stop, to render ineffectual 100

said motor mechanism and said transmitter mechanism.

7. In a telephone exchange switchboard, the combination with a set of keys, of a movable member mechanically associated with said keys, stops arranged to be thrust into the path of said movable member by corresponding keys to positively limit the movement of said movable member, transmitter mechanism operated during the travel of said movable member, and means, actuated by the engagement of said movable member with any of said stops, for determining the operation of said transmitter mechanism.

8. A controlling device comprising a movable member, a series of movable stops, corresponding keys arranged to actuate said stops to positively limit the travel of said movable member, motor mechanism brought into service by the actuation of any of said keys, adapted to advance said movable member, electrical transmitting mechanism actuated according to the extent of travel of said movable member, and means actuated as the movable member reaches the point predetermined by the stop, to render said motor mechanism ineffectual.

9. The combination with a series of keys, of a movable member adapted when advanced to engage an operated key, a stepping magnet for said member, a circuit for said magnet including a source of current, completed upon the operation of any of said keys, and means for opening said circuit, operated upon the engagement of said member and depressed key.

10. The combination with a series of keys, of a movable member adapted when advanced to engage an operated key, a stepping magnet for said member, a conductor including said magnet, a source of pulsating current, means, operated upon the actuation of any key, for connecting said source of current with said conductor, and means for opening said conductor operated upon the engagement of said member and depressed key.

11. The combination with a series of keys, of a movable member adapted to engage a depressed key, a stepping magnet for said member, a circuit for said magnet including a source of pulsating current, contact mechanism actuated upon the depression of any one of said keys and controlling said circuit, and means operated upon the engagement of said member and depressed key, adapted to open said circuit.

12. The combination with a series of keys, of a movable member adapted to engage a depressed key, a stepping magnet therefor, a circuit for said magnet including a source of current, means for closing said circuit actuated upon the depression of any one of said keys, a relay adapted to open said circuit,

and a circuit for said relay closed by said member and depressed key when in engagement.

13. The combination with a series of keys, a movable member adapted to engage a depressed key, a stepping magnet for said member, a circuit for said magnet including a source of pulsating current, a pair of contacts, actuated upon the depression of any one of said keys, controlling said circuit, a relay adapted to open said circuit, and a circuit for said relay closed by said member and depressed key when in engagement.

14. The combination with a series of keys, of a movable member adapted to engage a depressed key, a stepping magnet for said member, a relay adapted to complete a circuit for said stepping magnet, a source of pulsating current in said circuit, a pair of contacts operated upon the depression of any of said keys adapted to complete a circuit for said relay, and electromagnetic mechanism operated upon the engagement of said member and key for opening said circuit.

15. The combination with a series of keys, of a movable member adapted to engage a depressed key, a locking bar for said keys adapted to maintain a depressed key in such position, a stepping magnet for said member, a circuit for said magnet including a source of pulsating current, means actuated upon the depression of any of said keys, for completing said circuit, a relay adapted to open said circuit, a circuit for said relay terminating upon said locking bar and member, and completed when said member engages a depressed key, and means actuated upon the opening of said circuit for moving said locking bar to release the depressed key.

16. The combination with a series of keys, of a movable member adapted to engage a depressed key, a locking bar moved by a key when depressed to hold said key in its operated position, a stepping magnet for said member, a pair of contacts operated by said locking bar in its movement, a circuit for said stepping magnet controlled by said contacts, means actuated upon the engagement of said member and depressed key for opening said circuit, and means actuated when said circuit is open for releasing said locking bar.

17. The combination with a series of keys, of a movable member adapted to engage a depressed key, a stepping magnet for said member, means for locking a depressed key in such position, a circuit for said magnet, including a source of current, completed upon the operation of any one of said keys, means for opening said circuit, operated upon the engagement of said member and depressed key, and means actuated upon the engagement of said parts adapted to release said key.

18. The combination with a series of keys, of a movable member adapted to engage a depressed key, a stepping magnet for said member, a locking bar adapted to hold a depressed key in its operated position, a circuit for said magnet, including a source of current, completed upon the operation of any one of said keys, means for opening said circuit upon the engagement of said member and depressed key, a release magnet adapted to move said locking bar to release the depressed key, and a circuit for said magnet controlled in the engagement of said member and depressed key.

19. The combination with a series of keys, of a longitudinally movable rack bar adapted when advanced to engage a depressed key, means for locking a depressed key in such position, a ratchet adapted to engage said rack bar to move the same, a stepping magnet adapted to operate said rack bar and move the same a number of steps dependent upon the key depressed, a circuit for said stepping magnet, mechanism for opening said circuit actuated upon the engagement of said rack bar and the depressed key, and means actuated when said rack bar has been

advanced the predetermined number of steps adapted to release said key.

20. The combination with a series of keys, of a longitudinally movable rack bar adapted when advanced to engage a depressed key, a longitudinally movable locking bar adapted to be moved by a key when depressed to hold such key in its operated position, a stepping magnet for said rack bar, a pair of contacts closed by said locking bar in its movement, a circuit for said stepping magnet controlled by said contacts, a relay adapted to open said circuit, and a circuit for said relay terminating upon said locking bar and rack bar respectively, the depressed key being electrically connected with said locking bar; whereby when the rack bar engages the depressed key, said relay is operated to open the stepping magnet circuit.

In witness whereof, I, hereunto subscribe my name this 14th day of February A. D., 1908.

ALBERT M. BULLARD.

Witnesses:

J. N. REYNOLDS,
J. C. FIELD.