

H. J. W. FAY & E. C. MOLINA.

SYSTEM FOR DIVIDING CALLS AMONG TELEPHONE OPERATORS' POSITIONS.

APPLICATION FILED OCT. 12, 1907.

1,073,748.

Patented Sept. 23, 1913.

2 SHEETS-SHEET 1.

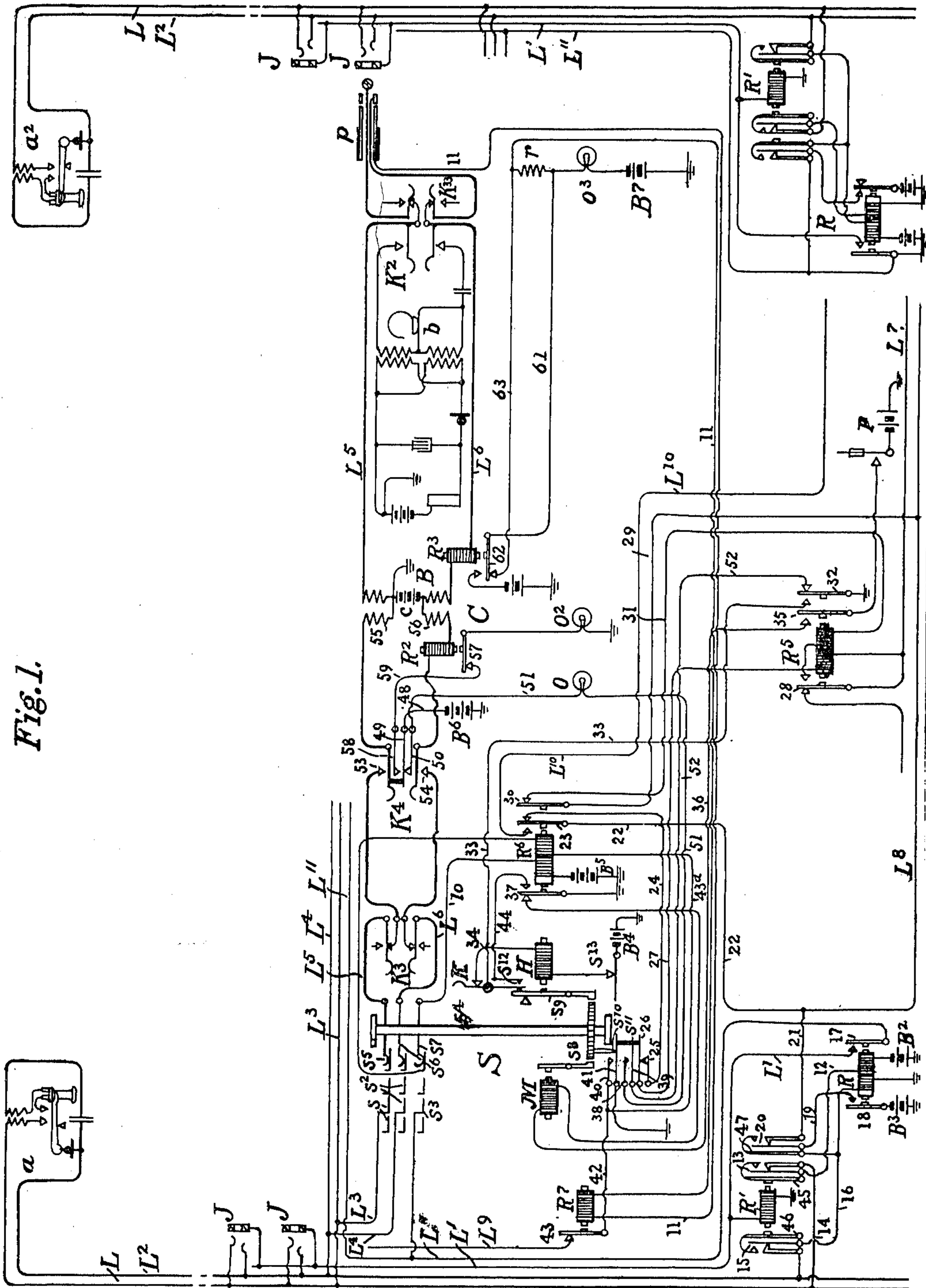


Fig. 1.

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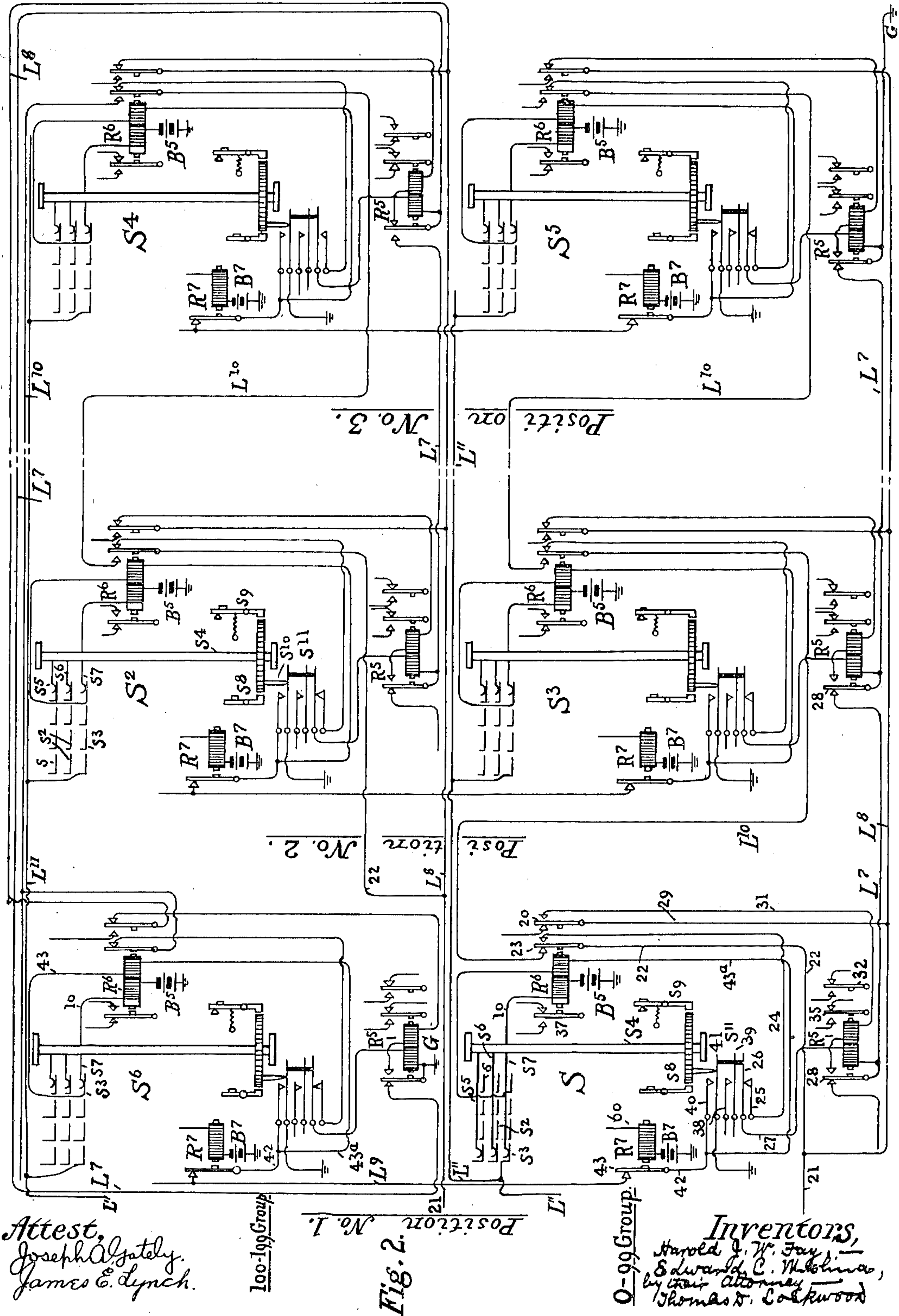
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UNITED STATES PATENT OFFICE.

HAROLD J. W. FAY, OF WESTBORO, MASSACHUSETTS, AND EDWARD C. MOLINA, OF EAST ORANGE, NEW JERSEY, ASSIGNORS TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF NEW YORK.

SYSTEM FOR DIVIDING CALLS AMONG TELEPHONE-OPERATORS' POSITIONS.

1,073,748.

Specification of Letters Patent.

Patented Sept. 23, 1913.

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To all whom it may concern:

Be it known that we, HAROLD J. W. FAY and EDWARD C. MOLINA, residing at Westboro and East Orange, in the counties of Worcester and Essex and States of Massachusetts and New Jersey, respectively, have invented certain Improvements in Systems for Dividing Calls Among Telephone-Operators' Positions, of which the following is a specification.

In systems for the apportionment or division of telephone calls among switching operators at central stations, there are at least two distinct arrangements of apparatus and methods of procedure. In one, each substation line terminates in the movable arms of an electromechanical switch, to the fixed terminals of which operators' cord or connecting circuits are joined. The removal of the receiver from its hook at a substation causes the arms of its distributing switch to travel over the terminals until those belonging to an idle cord are encountered, whereupon they stop; a signal is displayed; and the operator upon receiving the subscriber's order, completes or endeavors to complete the connection by means of a suitable switch. The second system differs from the first in having each automatic finding switch individual to a cord circuit, with its arms connected thereto and its fixed contacts multiplied with those of similar switches and joined to a group of substation lines. The arms of one or more switches, or "collectors," as they are sometimes termed, started by the taking down of the receiver by a subscriber, advance until the terminals of the originating line are reached; they then stop and the talking circuit may be completed as previously indicated.

Our invention is more especially applicable to the organization last outlined, its principal objects being to furnish simple and effective means for giving the lines control of a plurality of switching mechanisms, and also to provide for the intercontrol of said mechanisms, whereby the lines have access in a definite order to those which are disengaged and the rate at which calls are

received at each operating position is governed.

In the accompanying drawings, in which the same characters are applied to like parts in all figures, Figure 1 illustrates diagrammatically a single switching apparatus and its associated cord circuit, together with two substation lines arranged in accordance with our invention; and Fig. 2 is a skeleton diagram showing a portion of the central station apparatus belonging to two groups of lines and situated at three operating positions, only those elements appearing which play a part in the mutual control of the apparatus.

Reference being had to Fig. 1 for the details of the system and Fig. 2 for the interrelation of the central station apparatus, a and a^2 designate substations connected by their lines L , L^2 , to the tip and ring contacts of multiple jacks J located at the various operators' positions at a central station. Then instead of each line having an answering jack before a particular operator, it is multiplied by leads L^3 and L^4 to the terminals or fixed contact members s , s^2 , of a suitable number of electromechanical switches common to the numerical group to which the line belongs. The third conductor L' of each line is connected to the thimbles of its jacks, and a third set of test terminals s^6 of the switches are multiplied throughout a group of switches by a lead L'' . Substation a , which is to be considered for the purpose of this description as that originating a call, belongs to the group of numbers which are comprised between 0 and 99 and, its line may appear at three switches S , S^3 , S^5 , located at operating positions No. 1, No. 2 and No. 3, respectively. The magnitude of the groups of subscribers' lines is governed by the number of fixed terminals with which it is feasible to provide each switch, while the number of switches to which each group has access is determined by the maximum number of simultaneous calls which may be expected from it. Besides the switches of the 0-99 group, there are also illustrated in Fig. 2 three switches S^2 , S^4 , S^6 of the 100-199 group, situated respectively at

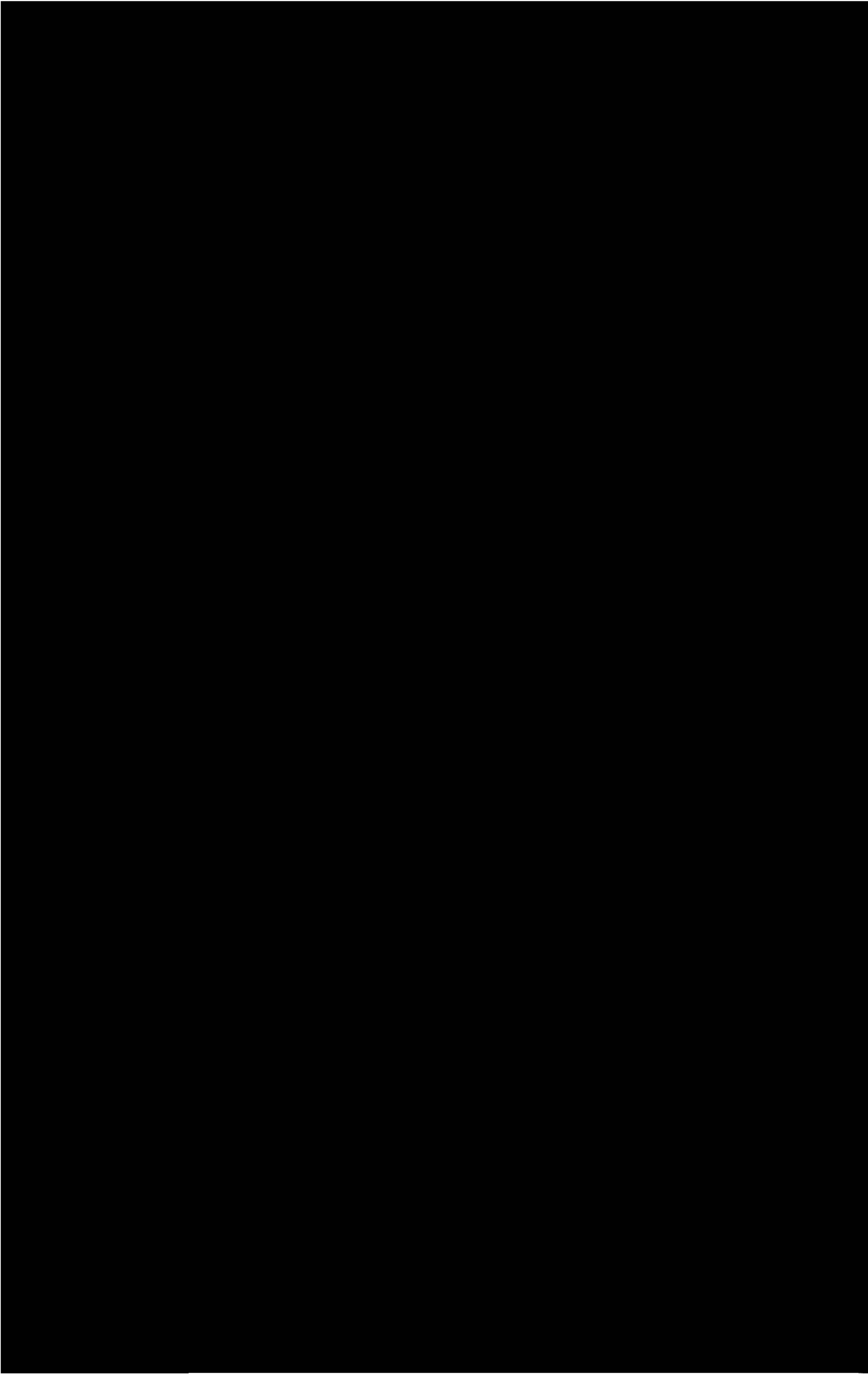
and the detailed circuits over which they are effected will be made clear in the description of operation of the system which will now be given.

5 When a person at substation *a*, desiring to call another substation removes the receiver from its hook, the line circuit is closed and the line relay *R* energized by current from battery *B*², through one winding of relay *R*,
10 conductor 12, spring 13 and its resting contact in relay *R'*, conductor 14, limb *L* of the line, substation set, limb *L*² of the line, resting contact and spring 15 of relay *R'*, conductor 16 and second winding of relay
15 *R* to ground, said relay closing the front contacts of its two armatures. Armature 17 completes a path from lead *L''*, multiplying the test terminals *s*³ belonging to the substation *a* in the switches of its group, to the
20 cut-off relay *R'*, placing it in condition to be energized when the moving test arm *s*⁷ engages said test terminal. Armature 18 allows a flow of current from battery *B*³ through conductor 19, spring 20 and its resting
25 contact in relay *R'*, conductors 21 and 22, armature 23 and its back contact in relay *R*⁶ of the first switch *S* of the series serving this line group (it being for the present assumed that this switch is not already in
30 use), conductor 24, normal contact springs 25 and 26 of contact device *s*¹¹ in the switch *S*, conductor 27, one winding of the starting relay *R*⁵ of switch *S*, lead *L*⁷, back contact and armature 28 of the starting relay
35 of switch *S*³ at operating position No. 2 (Fig. 2) and so on through all the switching apparatus of the 0-99 group to ground at *G* at the end of lead *L*⁷ beyond the last group switch, energizing the starting relay
40 *R*⁵ of the switch *S*. This relay *R*⁵ by its armature 28 thereupon locks up from battery *B*³ by way of armature 18 and its front contact in relay *R*, conductor 19, spring 20 and its resting contact in relay *R'*, con-
45 ductors 21, *L*⁸ and 29, armature 30 and its back contact in relay *R*⁶, conductor 31 and second winding of relay *R*⁵ to the ground *G* by lead *L*⁷ and the path previously traced. The armature 32 of relay *R*⁵ completes a
50 circuit from ground to battery *B*⁴ through conductor 33, release key *K*, conductor 34, winding of retaining magnet *H* and contact device *s*¹³, energizing the retaining magnet which applies its detent to the ratchet wheel.
55 The actuation by relay *R*⁵ of its armature 35 allows an intermittent flow of current from pulsator *P* through conductor 36, including the winding of motor magnet *M*, to ground at the armature 37 of relay *R*⁶, op-
60 erating said motor magnet and driving forward the arms of switch *S* step-by-step over the fixed terminals.

When magnet *H* applied its retaining pawl, it closed its contact *s*¹² and rotated the
65 shaft of the switch *S* sufficiently to operate

all of the contacts of device *s*¹¹. Contact *s*¹² prepares for the closing of a circuit to ground for the continued operation of the retaining magnet, which circuit is to be substituted by the stopping relay *R*⁶ for
70 that provided by the starting relay *R*⁵. As to the contact device *s*¹¹, the path through which the starting relay was operated is broken at springs 25 and 26. By the springs 38 and 39 a portion of a circuit from the
75 calling lamp *O* is closed, whereby said lamp will be lighted when the switch arms reach the terminals of the calling line. The springs 40 and 41 give a path from ground through conductor 42, armature 43 and its
80 back contact in the busy release *R*⁷, lead *L*⁹ and then in parallel through similar contacts in the relays *R*⁷ of all the switches of the other line groups at position No. 1 (switch *S*⁶ only being illustrated in Fig. 2),
85 conductors 42 and 43^a including one winding of relays *R*⁶ of said other switches, resting contacts *s*³ of the arms *s*⁷, conductors 10, second winding of the stopping and transfer relays *R*⁶ to batteries *B*⁵. By this multiple
90 circuit all the relays *R*⁶ at the first position are operated, transferring the capability of control of the switch apparatus by all the lines of their groups to apparatus at the position of operators who are not busy, or
95 at least whose work in the completing of a connection has reached a particular stage. Thus the operator is for the time enabled to concentrate her attention upon a single call, doing away with the liability of error caused
100 by an overload resulting from simultaneous or rapidly succeeding calls. The precise manner in which the transfer of control is effected will be later developed in connection with a statement as to the originating
105 of a call when the first of the group switching apparatus in the series is in use.

Upon the arrival of the arms of switch *S* at the terminals of the calling line, the test arm *s*⁷ completes a circuit from battery *B*⁵
110 through conductor 10 including one winding of the stopping and transfer relay *R*⁶ lead *L*⁷, front contact and armature 17 of line relay *R*, third conductor *L*⁷ of the line and winding of cut-off relay *R'* to
115 ground, causing both relays *R*⁶ and *R'* to operate. Armature 37 of relay *R*⁶ opens the circuit of the motor magnet, stopping the switch arms upon the line terminals of substation *a*, and closes a path for the re-
120 taining magnet *H* from battery *B*⁴ through contact device *s*¹³, conductor 34, release key *K*, contact device *s*¹² and conductor 44 to ground, thus preventing the retaining magnet from releasing when relay *R*⁵ is de-ener-
125 gized. Armature 23 of relay *R*⁶ connects conductor 22 to lead *L*¹⁰, which furnishes a path to the starting relay of some succeeding switch in the 0-99 series to provide
130 apparatus for other calls originating in the



a local circuit from battery B⁶ through conductor 48, springs 49 and 58 of the connecting key K⁴, conductor 59 and lamp O² to ground, lighting said lamp. The operator, observing the steady illumination of both supervisory lamps, knows that the connection is no longer desired and proceeds to take it down, first withdrawing the plug from the jack. This opens the circuit of and extinguishes the lamp O³, and releases the cut-off relay of the called line, restoring to the line relay the power to initiate control over one of the switches of its group series. The busy release relay R⁷ of switch S is also deenergized. At substantially the same time as she thus disconnects the called line, the operator depresses the release key K and throws back the connecting key K⁴. The former interrupts the current flow through the retaining magnet H and allows the holding detent to be withdrawn from the ratchet wheel of switch S. The switch arms returning to their initial position break contact with the terminals of the calling line, the arm s⁷ severing the circuit of the cut-off relay R⁷ and the stopping and transfer relay R⁶. The armatures of these relays are retracted, also releasing the line relay R. When the arms reach their starting point the test arm coöperates with its resting terminal s³, and the contact device s¹¹ assumes its normal position. The line equipment of substation α is now ready for another call, and the switch S is in condition to be controlled by any of the lines of its group.

Having considered in detail the operation of the system when the first switch in the series of the calling group was idle, suppose now that when the line relay of substation α was energized some other line of its group had already obtained possession of the switch S. In this case the relay R⁶ of said switch will be operated, as shown in Fig. 2, and instead of the path being furnished by the armature 23 and its back contact from battery B³ to ground through the starting relay of switch S, it will pass by armature 23 and its front contact through lead L¹⁰ to the corresponding armature of the stopping relay of the next switch S³ at the second position. Finding this relay R⁶ with its armatures retracted, no other line of the same group having appropriated it, and the switching apparatus of this position not being made temporarily busy by the multiple circuit through lead L⁹, the current traverses the winding of the relay R⁵ of switch S³, starting the switch arms upon their search for the calling line. Thus it will be seen, that the lines of a group have control of its series of switches in a definite order, the first which is not in use and which is at a position of an operator ready to receive calls, being always available.

Obviously a switch to which the lines first have access in a series will be most often used, while that to which its relay R⁶ directly transfers the calls will be next in frequency of use, and so on until those coming at or adjacent to the end of the series may only carry the peaks of the load. If the sequence in all the series were the same, the first available switch in each series being at the first operating position, the operator thereat might be constantly employed, while the last operator might receive a call at only infrequent intervals. To equalize the distribution of calls we make the order of control of the switches by the lines different in different series with respect to the different operating positions, giving each position some first switches, some second, and continuing a similar apportionment throughout the series. This feature is illustrated in Fig. 2 in which conductor 22, which connects the substation line equipments with the first switch of the series, in the 0-99 group runs to relay R⁶ of switch S at the first position, while the lead L¹⁰ successively unites said relay to like relays at the second and third positions. In the 100-199 group, however, conductor 22 joins the line equipment to the transfer relay of switch S² at the second position, lead L¹⁰ passing therefrom to the apparatus of position No. 3 and then to that of position No. 1. Similarly, the leads L⁷ and L⁸ begin the switching apparatus at the second position, the former having its ground G beyond its connection to relay R⁵ at the first position.

An inspection of the drawing will show that when one or more switches of a series are in use in connections, with their switch arms s⁷ upon the terminals s³ of the calling line, any other line of the same group the terminals of which occur later in the set will, upon the test arm of the switch it has secured passing over the intervening busy terminals, get a circuit from battery B⁶ of said switch through one winding of its stopping relay R⁶, conductor 10, arm s⁷, terminal s³, multiple lead L¹¹, and armature 17 and its front contact in the companion relay to ground at the cut-off relay of the busy line. The hunting switch does not stop upon such terminals because there is a parallel path furnished by the multiple lead L¹¹, terminal s³, arm s⁷ and the conductor 10 and winding of relay R⁶ of the busy switch. The stopping relays are of such a marginal character that the one belonging to the moving switch does not receive sufficient current to attract its armatures, and the energizing circuit of the motor magnet remaining closed the switch arms continue their movement until the calling line is reached. This divided current is great enough, however, to maintain the operation

apparatus by a line for rendering the other switches which are at the same position ir-
responsive to line control, and means for ma-
nipulation by the operator for restoring the
5 line control.

6. In an exchange system, the combination
with telephone lines and cord circuits for
connecting the same, of switching mecha-
nisms associated with the cord circuits, the
10 telephone lines being joined to a plurality of
switching mechanisms, a relay included in
each line, and a starting relay and a stop-
ping relay associated with each switching
mechanism, said starting relay being di-
15 rectly controlled by the line relay and the
stopping relay.

In testimony whereof, I have signed my
name to this specification in the presence of
two subscribing witnesses, this thirtieth day
of September 1907.

HAROLD J. W. FAY.

Witnesses:

GEO. WILLIS PIERCE,

JOSEPH A. GATELY.

In testimony whereof, I have signed my
name to this specification in the presence of
two subscribing witnesses, this second day of
October 1907.

EDWARD C. MOLINA.

Witnesses:

W. G. BLAUVIER,

ROBT. S. SUTLIFFE.