J. DAVIDSON, JR.

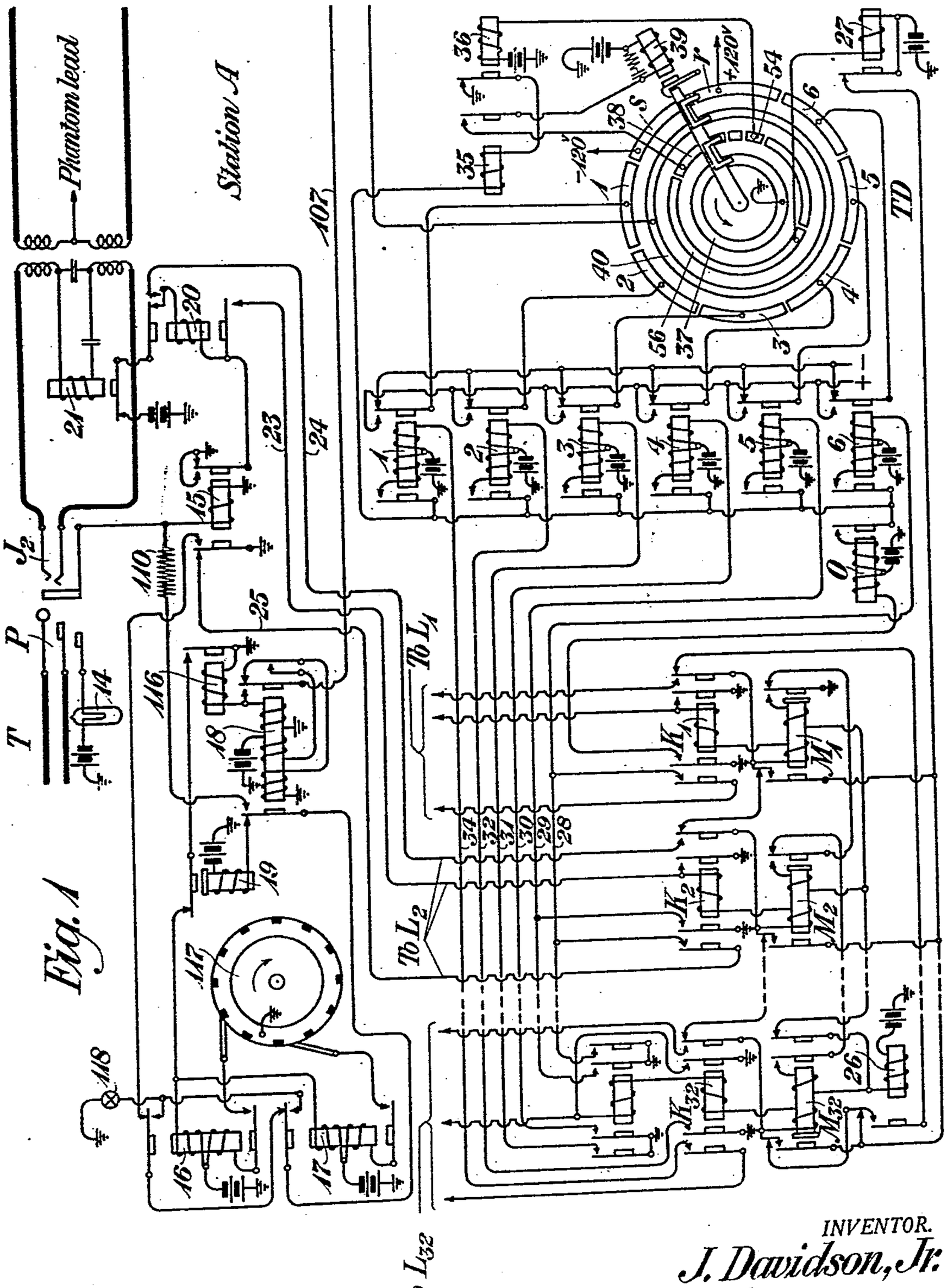
SIGNALING CIRCUITS FOR TOLL LINES.

APPLICATION FILED DEC. 12, 1918.

1,413,708.

Patented Apr. 25, 1922.

6 SHEETS—SHEET 1.



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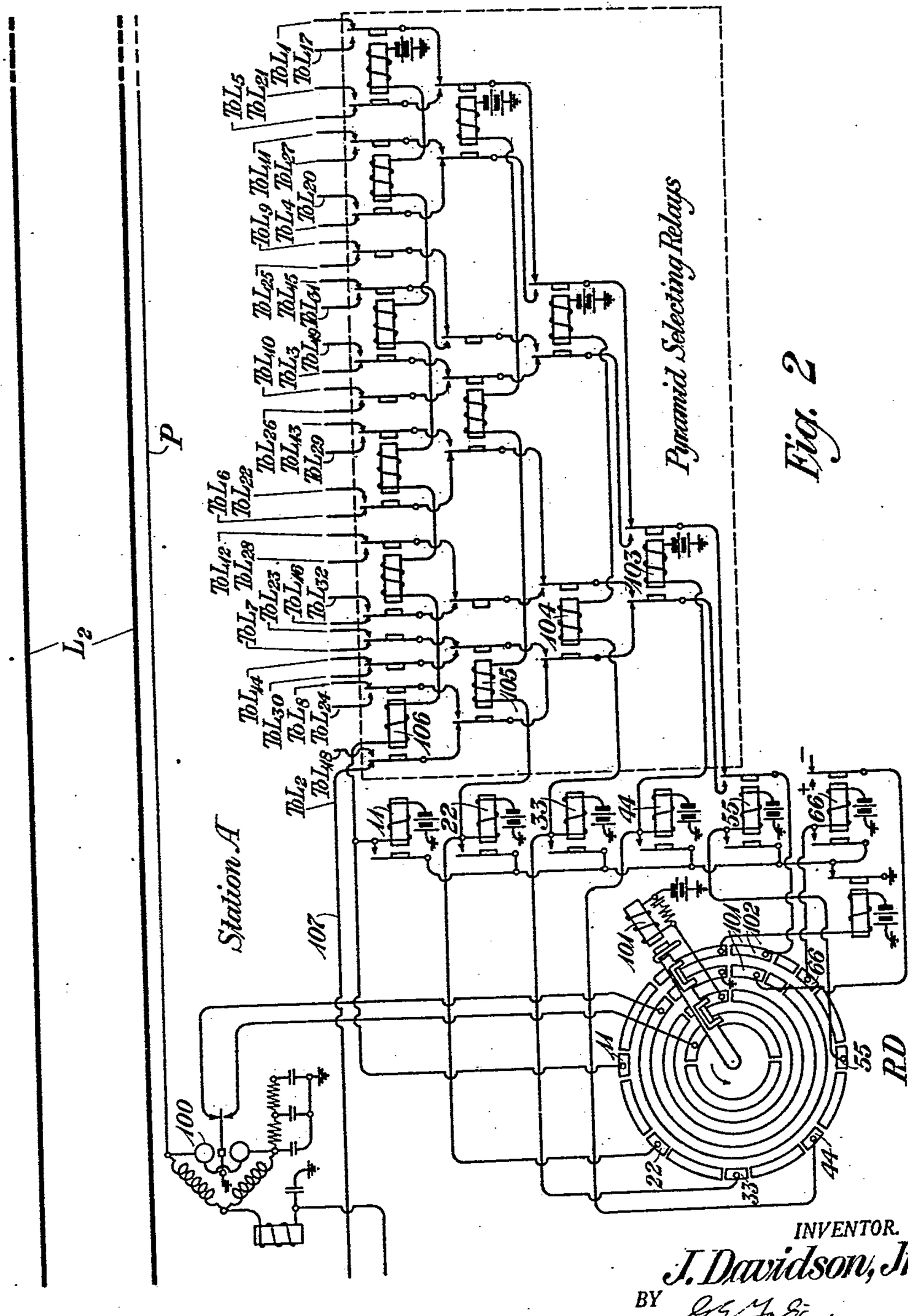

Fig. 2

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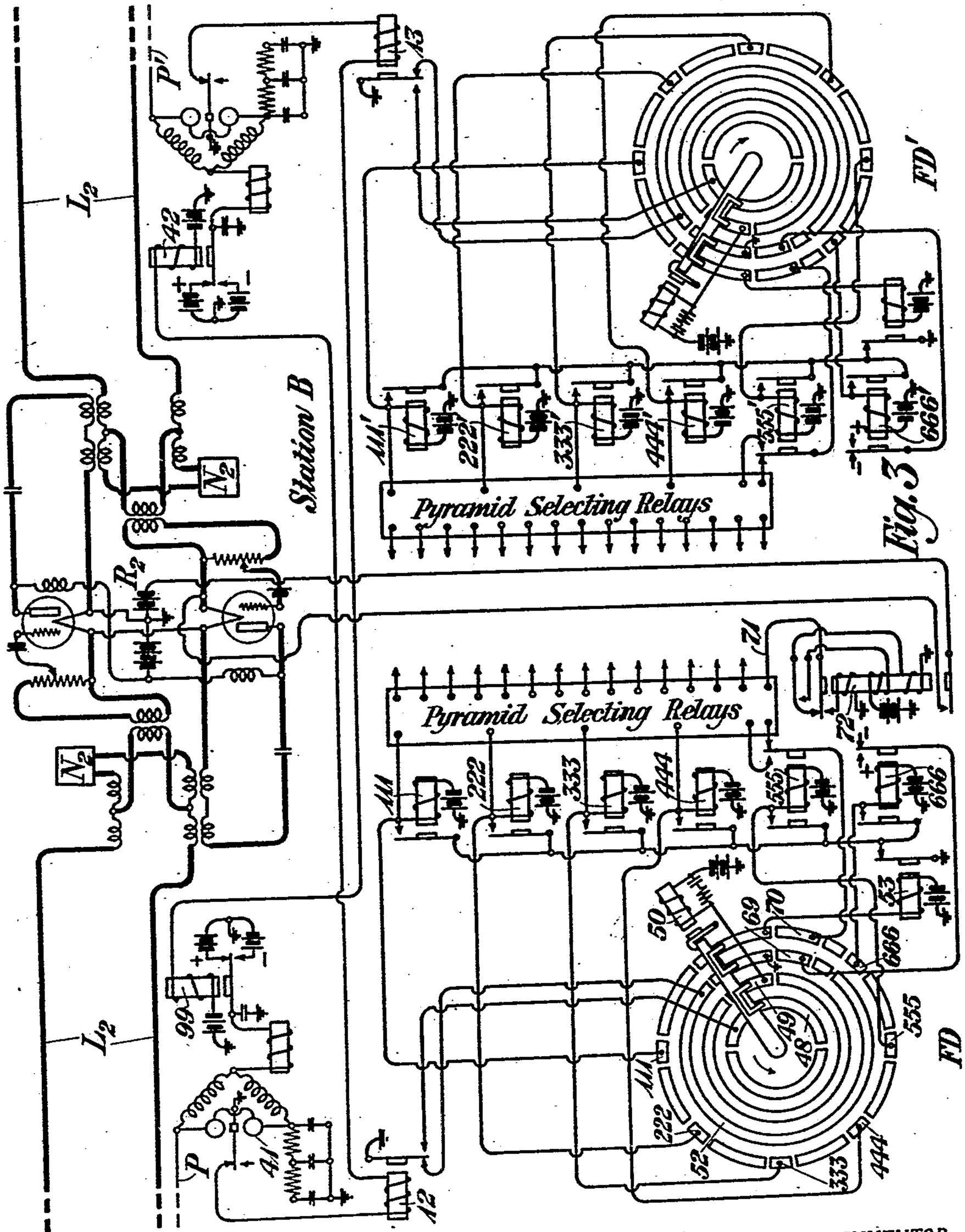

Fig. 3

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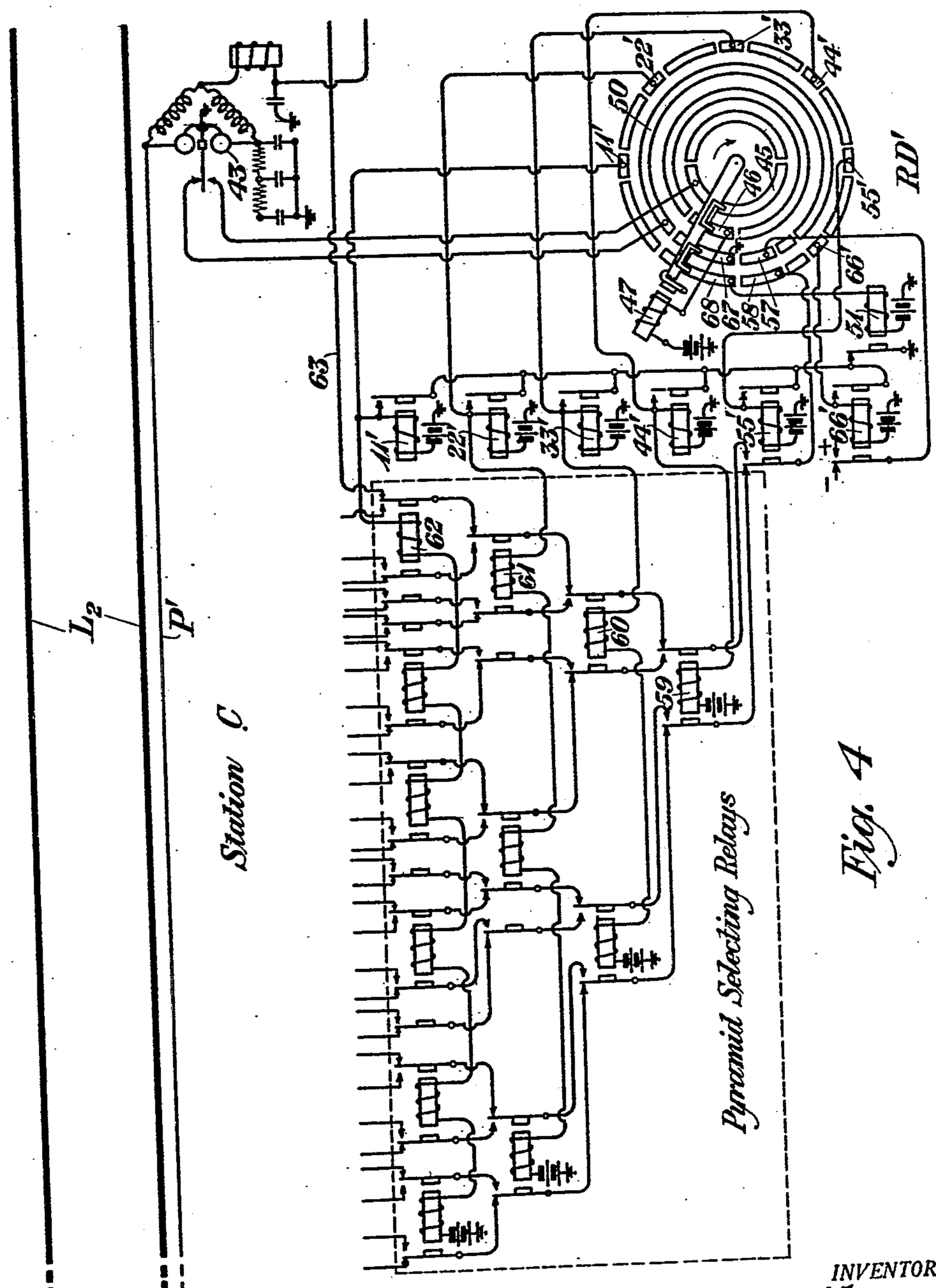

Fig. 4

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6 SHEETS—SHEET 5.

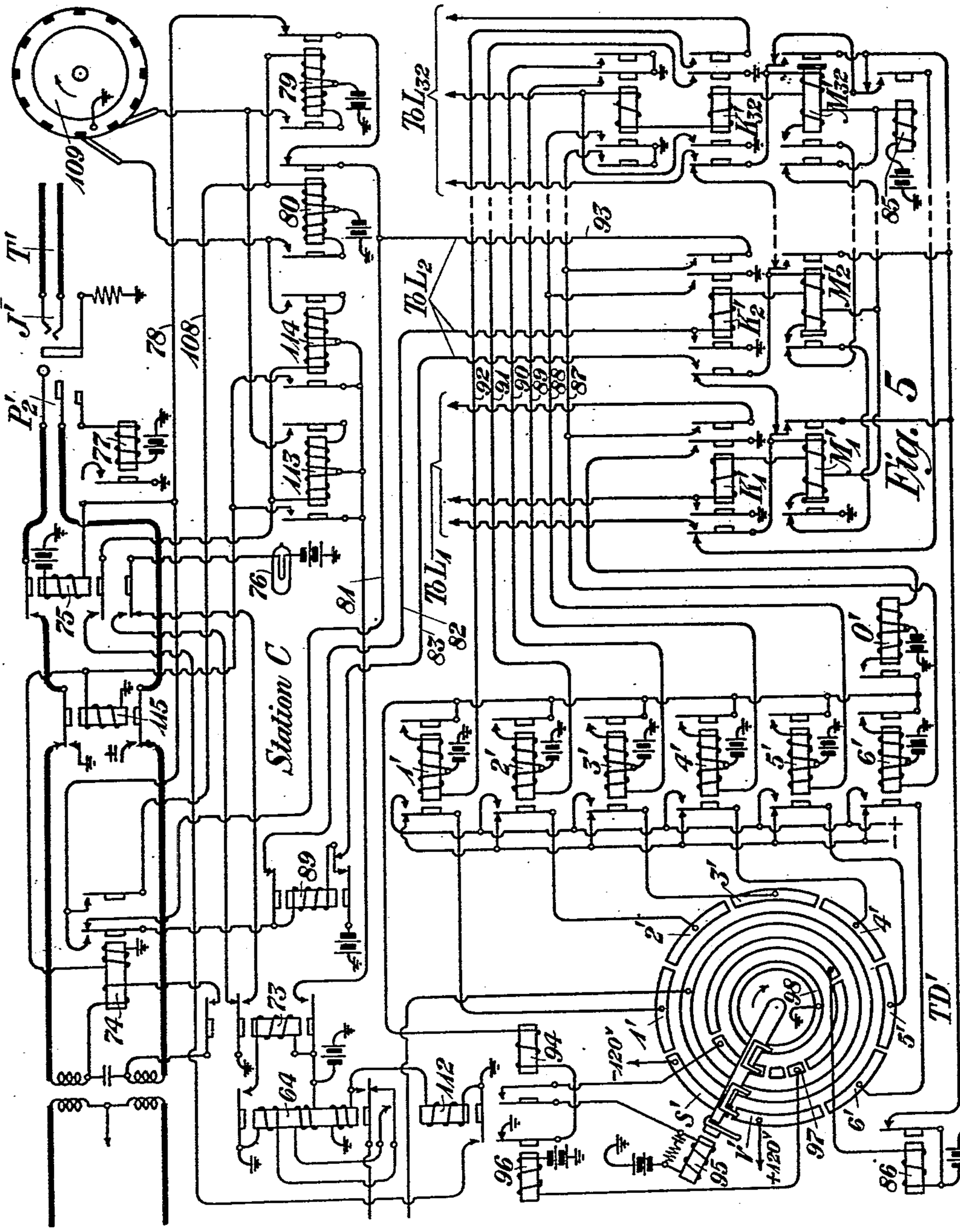

Fig. 5

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6 SHEETS—SHEET 6.

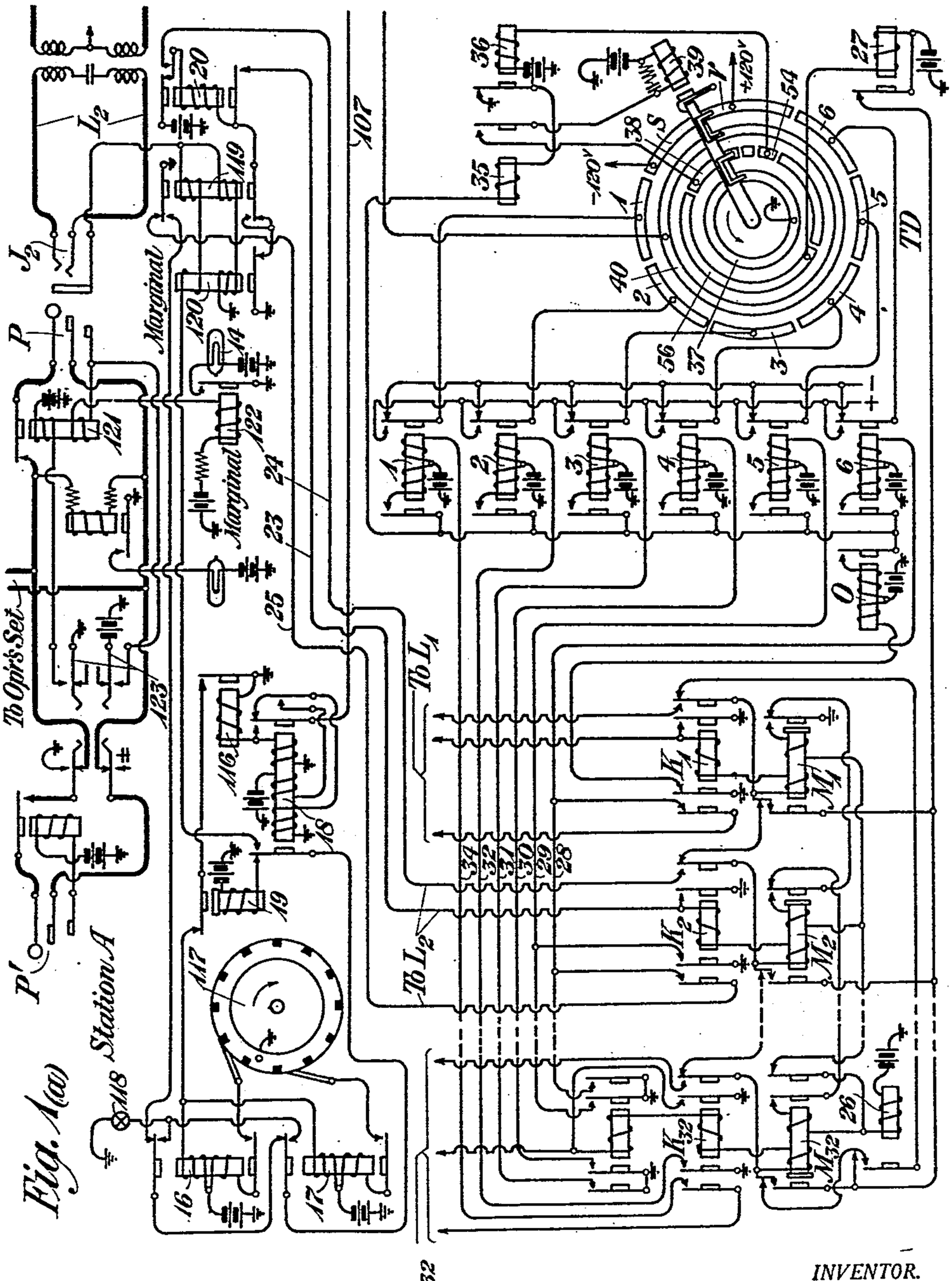

Fig. A(a)

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UNITED STATES PATENT OFFICE.

JOHN DAVIDSON, JR., OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

SIGNALING CIRCUITS FOR TOLL LINES.

1,413,708. Specification of Letters Patent. Patented Apr. 25, 1922.

Application filed December 12, 1918. Serial No. 266,486.

To all whom it may concern:

Be it known that I, JOHN DAVIDSON, Jr., residing at Montclair, in the county of Essex and State of New Jersey, have invented certain Improvements in Signaling Circuits for Toll Lines, of which the following is a specification.

This invention relates to signaling circuits and more particularly to signaling circuits for use in connection with long distance telephone lines.

Heretofore it has been customary to provide for each toll line used for long distance connections a signaling path to be used for supervisory and other signals necessary in connection with the establishment of such connections. In order to reduce the expense involved in such an arrangement, it has been proposed to provide a common signaling path for a plurality of lines and successively connect said common path with local signaling circuits individual to the lines at each end thereof by means of a rotary distributor or equivalent device. Arrangements of this character are disclosed in United States patents to Bancroft Gherardi, Numbers 1,251,363 and 1,251,364, granted December 25, 1917.

One of the objects of the present invention is to improve and simplify the apparatus and system of the patents above referred to, although other and further objects of the invention will be apparent from the description hereinafter given.

These objects are accomplished by using an intermittently operating distributor for sending code signals over the common path, each toll line having a definite set of code combinations individual thereto so that signals over a particular toll line will be transmitted by the code combination assigned to it.

Where a number of distinct signals must be transmitted over each toll line, it will, in general, be necessary to assign to each line a code combination for each signal to be transmitted. The invention further contemplates the use of the same code combination to transmit more than one signal over a given toll line, by arranging the receiving and translating apparatus to differentiate between code combinations transmitted at different stages of the establishment of the connection.

Since the intermittently operating distributor transmits but one signal for each operation thereof, the invention contemplates the provision of suitable means for delaying the signals of a plurality of toll lines which may be simultaneously in signaling condition, as well as means for determining the order in which the signals for a plurality of lines are to be transmitted. These functions are accomplished, as herein disclosed, by means of sets of relays associated with each line, said relays being arranged so that when the relays corresponding to one toll line are actuated the circuits of the sets of relays associated with other toll lines are rendered inoperative. Said sets of relays are also provided with contacts whereby the code combinations transmitted by the distributor will be determined.

In order to translate the transmitted code combinations into suitable signals for the proper toll line, the invention contemplates the provision of a receiving apparatus which will respond to a particular combination to set into operation the signal for a particular line and which is represented by that code combination. The receiving apparatus is herein disclosed as a pyramid relay combination of a type well known in the signaling art, but it will be understood that any suitable translating apparatus may be used for this purpose.

Since the translating apparatus must be arranged to translate and transmit a large number of brief impulses to the signaling apparatus, it is desirable that in certain instances some arrangement be provided for prolonging the impulses to maintain the signal for a definite period. The invention, therefore, contemplates the provision of means for securing this result. Said means, as disclosed, comprises a pair of locking relays responsive to the impulses and arranged to separably maintain the impulses, the locking circuits of said relays being so controlled by an interrupter that at least one of the relays will always be maintained energized for a predetermined minimum period of time.

In long distance toll trunks repeaters are

frequently used for amplifying the talking currents transmitted over the trunk. Where through line repeaters are used it is desirable that some means be provided whereby the repeaters at distant or intermediate stations may be rendered operative from the originating station. Means are therefore provided, in accordance with this invention, whereby the transmission of a signal originating with a given toll line, not only operates signaling apparatus associated at the distant end of said toll line, but operates suitable translating apparatus at intermediate repeater stations, whereby the repeater of the particular line with which the signal originated is rendered operative. In a similar manner, the apparatus is arranged so that the disconnect or other signal sent at the termination of a conversation may render the repeaters inoperative.

Still another feature of the invention relates to means for transmitting ringing signals. Where the toll trunks are composited for telegraphic purposes the transmission of ringing current over the toll trunk interferes with the operation of the Morse apparatus because of the low frequency of the ringing current. In accordance with certain aspects of this invention, therefore, the apparatus may be so arranged that when it is desired to ring the called subscriber, the ringing key, instead of applying ringing current to the toll trunk will transmit a special signal over the local sleeve conductor of the toll cord, which will be transmitted as a special code combination over the common signaling path to operate ringing apparatus at the distant end of the toll trunk, whereby the called line may be rung. The called party may, therefore, be signaled without interfering with the Morse apparatus.

The invention may now be more fully understood by reference to the following description, when read in connection with the accompanying drawings, Figures 1, 2, 3, 4 and 5 of which when placed end to end in regular order constitute a circuit diagram of one embodiment of the invention; while Fig. 1ª, when substituted for Fig. 1 and taken with the remaining figures constitutes a circuit diagram of a modified form of the invention.

Referring to the drawing, a toll line L_2 is illustrated as extending between two stations, A and C, said toll line being provided with a two way repeater R_2 at an intermediate station B. At the originating station A the toll line terminates in the jack J_2 with which a plug P of a toll cord T is adapted to cooperate, the toll cord being used in establishing a connection between the calling subscriber's line and the toll line. At station C the toll line L_2 terminates in a plug P_2' adapted to co-operate with the jack J' of a toll switching trunk T', whereby the toll line may be connected with a called subscriber's line. It will be understood that while but one toll line is shown, any desired number of toll lines may extend between stations A and C.

In order to provide for the transmission of supervisory and other signals necessary in connection with the establishment of a connection over any of the toll lines, a signaling path P extends from station A to station B, said path being common to a large number of toll lines. A similar path P' extends from station B to station C. The signaling paths P and P' terminate at stations A and C, respectively, in bridged polar duplex sets of the type commonly used in telegraphic transmission, while at station B the two paths are interconnected by means of a duplex repeater set which consists essentially of two bridged polar duplex sets. The duplex repeater set is provided in order that the filament circuit of the repeaters may be controlled in a manner hereinafter described. In installations where the repeaters are not used, the duplex repeater set may be omitted and the paths P and P' directly connected.

Signals are transmitted from station A to the path P by means of an intermittently operating distributor TD similar to the so called start-stop distributors used in printing telegraphy. Associated with each toll trunk is a set of relays such as K_1, M_1, K_2, M_2, and so forth. When a signal originates with a toll line such as L_2, the corresponding relays K_2 and M_2 operate to perform the triple function of locking out the relays of other lines on which signals are originated at the same time, of determining the order in which the signals shall be transmitted, and of translating the signals into code combinations which are transferred to a set of storing relays 1 to 6, inclusive, for the purpose of storing the code combination until it has been transmitted by the distributor. The code combinations transmitted over the path P are repeated at station B by means of the duplex repeater set and are then transmitted over the path P' to station C. At station C the code combinations are received by means of an intermittently operating receiving distributor RD', similar in character to the so called start-stop receiving distributors used in printing telegraph systems. In order to translate received code combinations into suitable signals and to appropriate the signals to the proper line, a pyramid relay combination of a well known type is provided as indicated in Fig. 4.

In order to control the filament circuits of the repeaters, such as R_2, of the various lines, line relays 12 and 13 are provided in the duplex repeater set to impress the re-

peated code combinations upon receiving distributors FD and FD′, located at the repeater station. These receiving distributors are identical in character with the distributor RD′, already described, and are associated with pyramid relay combinations similar to that shown in Fig. 4. These pyramid relay combinations translate the received code combinations into signals for selectively operating filament control relays of the various repeaters. In the arrangement shown the distributor FD and the associated pyramid relay combination control the filament circuits of repeaters in lines which are used for connections originating at station A and extending to station C. The receiving distributor FD′ and associated pyramid relay combination, on the other hand, is used for controlling repeaters of toll lines which are used for connections completed in the opposite direction.

For transmitting signals originating at station C, a sending distributor TD′ is provided at said station and sets of relays, such as K_1', M_1', K_2', M_2', and so forth, comprising an endless chain, are associated with the various toll lines for the same purpose as the similar relay sets described in connection with station A. In order to receive the signals transmitted from station C, a receiving distributor RD similar to the distributor RD′ is provided at station A, and a pyramid relay combination is associated therewith for the purpose of translating the received signals.

Further details of the structural embodiment disclosed will be clear from a description of the operation, which is as follows:

Assuming that a call is originated at station A and is to be extended over the line L_2 to the station C, the toll operator at station A inserts the plug P of the toll cord T into the jack J_2 of the toll line L_2, thereby connecting the calling subscriber to said toll line. By this operation a circuit is completed from battery, through the lamp 14, over the sleeve contacts of the plug and jack and through the winding of the relay 15 to ground. The relay 15 is energized over this circuit, but the lamp 14 does not glow when connected in series with the relay 15. Relay 15 at its left hand front contact closes a circuit from ground over the upper back contacts of relays 16 and 17, over the back left hand contact of relay 18, through the winding of slow release relay 19 to battery, thereby energizing the relay 19. Relay 19 upon being energized holds open the initial energizing circuit of relays 16 and 17 to prevent their actuation.

The right hand armature of relay 15, in passing from its back to its front contact, momentarily opens the circuit of a locking relay 20, which may be traced as follows: from ground, back right hand contact of relay 15, winding of relay 20, upper front contact of said relay, lower back contact of relay 21 to battery. Relay 20 is thereby deenergized and a circuit is closed from ground, over the front right hand contact of relay 15, lower back contact of relay 20, over conductor 23, through the winding of relay K_2, left hand winding of relay M_2, left hand back contact of relay M_2, and thence in series over the right hand back contacts of the relays corresponding to K_2 of other lines, and finally over the right hand back contact of relay K_{32}, thence over the back left hand contact of relay M_{32}, back left hand contact of relay 26 and thence over the back contact of relay 27 to battery. The circuit above traced is only established in the instance that relays corresponding to K_2 and M_2 of some other line have not already been energized, as will be hereinafter pointed out.

The relays K_2 and M_2 are energized over the circuit above described, and relay K_2 at its inner right hand contact closes a locking circuit from ground, through the winding of said relay, through the left hand winding and left hand front contact of relay M_2 and thence to battery, at the back contact of relay 27. Relay M_2 at its right hand front contact completes a locking circuit from ground, over the back right hand contact of relay M_1, front right hand contact of relay M_2, and through the right hand winding of said relay, thence over the back right hand contact of succeeding relays of other lines and finally over the back right hand contact of relay M_{32} through the winding of relay 26 to battery. Relay 26 is thereby energized and at its front contact opens the circuit previously traced, from battery over the back contact of relay 27. Battery from said point is now connected directly over the front left hand contact of relay M_2.

The result of the circuits thus established is that for lines simultaneously originating signals, the line having relays nearest to the relays K_2 and M_2 and on the right of said relays will have preference beginning with line L_1, then line L_{32}, line L_{31}, and so forth. For instance, suppose that signals were simultaneously originated on lines L_1 and L_{32}. With the circuits in the condition above described, the relays of line L_1 will take preference, since the energizing circuit for the relays of line L_{32} will extend over the right hand contact of relay K_1, which will be opened. Said circuits may be traced in part as follows: through the winding of relay K_{32}, left hand winding of relay M_{32}, back left hand contact of said relay, front contact of relay 26, back right hand contact of relays K_1 and K_2 and over the front left hand contact of relay M_2 to battery over the back contact of relay 27. Relays K_1 and M_1, however, may not be

operated until the relay K_2 is restored to normal, since the circuit of said relays passes over the back right hand contact of relay K_2, which is now open. As soon as the relay K_2 is deenergized, which occurs as soon as the code combination controlled thereby is transmitted, as hereinafter described, relays K_1 and M_1 may be energized over a circuit as follows, it being remembered that the relay M_2 remains locked up through its right hand winding and the winding of relay 26, after the relay K_2 has been deenergized: through the winding of relay K_1, left hand winding of relay M_1, back left hand contact of said relay, back right hand contact of relay K_2 front left hand contact of relay M_2 and over the back contact of relay 27 to battery. As soon as the relay M_1 is energized it is locked up over its right hand front contact, right hand winding in series with the winding of relay 26. The locking circuit of relay M_2 is at the same time opened and the said relay is deenergized.

The relays M_1, M_2, etc., may be considered as an endless chain so that to one standing within the chain and looking out, the relay M_{32} will be immediately to the right of relay M_1, although for convenience shown to the left thereof in the drawing. When thus considered, it will be seen that each of the relays M_1, M_2, etc., is locked up when energized and can only be unlocked by a relay immediately to the right thereof, as viewed by a person situated as above described. It will also be clear that as soon as such a relay is energized and unlocks the circuit a new order of precedence is established, beginning with the new relay locked up, which, in this case is relay M_1. It will be noted that battery is now connected to the circuit from the back contact of relay 27, over the front left hand contact of relay M_1. As soon as the relay K_1 is restored to normal a circuit through relays K_{32} and M_{32} may be established over the back left hand contact of relay M_{32}, front contact of relay 26, back right hand contact of relay K_1 and left hand front contact of relay M_1 to battery. The relay M_{32} when energized opens the locking circuits of any M relay which happens to be locked up to the right thereof, and is in turn locked up through its right hand winding in series with the winding of relay 26. It will be seen, then, that when the relays of any one line have been actuated and signals originate with a plurality of other lines simultaneously thereafter, that the line whose relays lie nearest on the right of the relays last signaling will take precedence in regular order.

Returning now to the signal which energized and locked up the relays K_2 and M_2, a circuit is completed over the right hand front contact of relay K_2 as follows: from battery over the back contact of relay 27, front left hand contact of relay M_2, right hand front contact of relay K_2, over conductor 24, upper back contact and winding of relay 20 and front contact of relay 15 to ground. Relay 20 is thereby energized and is locked up over a circuit from ground, front contact of relay 15, winding and upper contact of relay 20, and over the back contact of relay 21 to battery. Relay K_2 at its inner left hand front contact connects ground to conductor 29 of a series of conductors controlling the circuits of the storing relays 1 to 6 inclusive. The K relays of the various lines are arranged to ground the conductors controlling the relays 1 to 5 in various combinations, depending upon the line which is signaling. Each of the K relays is also provided with an additional contact; viz., its extreme left hand contact, whereby a special ground is applied to conductor controlling relay 6, thereby giving an additional code signal for each line.

Returning now to relay K_2, a circuit is completed for the relay 5 from ground, over the inner left hand contact of relay K_2, conductor 29, right hand winding of relay 5 to battery. The other relays from 1 to 6 inclusive are not energized for this particular combination, but the relay 5 is energized over the circuit above traced and at its left hand front contact completes a locking circuit through its left hand winding, through the winding of relay 35 and over the back contact of relay 36 to ground. Relay 35 is thereby energized and completes a circuit from ground over the inner ring 37, brush and segment 38 of the distributor, front contact of relay 35, through the winding of the start magnet 39 to battery. The brusharm of the distributor is now released and rotates over the segments.

In the normal condition of the brusharm positive battery is connected over the segment *r*, brush and ring 40 to the signaling path P. As soon as the brusharm passes from segment *r* to segment *s* negative battery is connected to the signaling path thereby operating the polar relay 41 to open the circuit traced from ground, over the closed contact of the polar relay 41, through the windings of relays 12 and 42 in series to battery. Relays 12 and 42 are thereby deenergized and pole changing relay 42 therefore disconnects positive battery from path P′ and applies negative battery thereto. The polar relay 43 at station C, thereupon moves its armature to its lower contact and completes a circuit from ground, over said contact, over segment 45, brush and segment 46 of the distributor and through the winding of start magnet 47 to battery, thereby releasing the brusharm which begins to rotate over the segments of the receiving distributor RD′. At the same time the relay 12 at station B releases its armature and a

circuit is completed from ground over the back contact of said relay, over segment 48, brush and segment 49 of the distributor FD and through the winding of the start magnet 50 to battery. The brusharm of the distributor FD is thereby released and rotates over the segments of said distributor.

The brusharm of the transmitting distributor TD after having passed over the start segment *s* to transmit the starting impulse, passes over the segments 1 to 6 inclusive, the polarity of which is controlled by the storing relays 1 to 6 inclusive. It will be recalled that relay 5 only was energized and, consequently, negative battery will be applied to all of the segments except segment 5 which has positive battery applied thereto. A code combination will, therefore, be transmitted to the signaling path P, consisting of four negative impulses, one positive impulse and another negative impulse. The circuit for the first negative impulse will be as follows: from negative battery over the back right hand contact of relay 1, segment 1 of the distributor, brush and ring 40 of the distributor to the path P. For each negative impulse transmitted the relays 12 and 42 are deenergized, the latter relay thereby transmitting a negative impulse over the path P′ causing the polar relay 43 to shift its armature to its lower contact. No effect is produced on the receiving distributors FD and RD′ by the negative impulses. As soon as the fifth and positive impulse is transmitted, however, the relays 12 and 42 are energized, the latter transmitting a positive impulse over the path P′, which causes the polar relay 43 to shift its armature to its upper contact. A circuit is thereby closed from ground, over the upper contact of polar relay 43, over the segment 50 of the distributor RD′, brush and segment 55′ of said distributor, through the winding of relay 55′ to battery. Relay 55′ is thereby energized and is locked up over its front right hand contact and the back contact of relay 51. At the same time the relay 12 attracts its armature and completes a circuit from ground, over its front contact, segment 52 of the receiving distributor FD, segment 555 and through the winding of relay 555 to battery. The latter relay is energized and locked up over its left hand front contact and the back contact of relay 53.

The brusharm of the distributor TD now passes over the sixth segment, transmitting another negative impulse, and finally comes to rest on the positive segment *r*, thereby transmitting a final stopping impulse, which causes the relay 12 to hold open the starting circuit of the distributor FD and the relay 42 to transmit a positive impulse over the path P′, which in turn causes the polar relay 43 to hold open the starting circuit of the receiving distributor RD′. As the arm of the transmitting distributor passes over segment 54, a circuit is completed from ground, over inner ring 37, brush and segment 54 and through the winding of relay 36 to battery. Relay 36 opens the circuit of relay 35 and the locking circuit of any of the relays 1 to 6, which had been previously energized, restoring the same to normal, so that said relays are ready to store up the next signal.

In the meantime, the brusharm, as soon as it passed from the starting segment *s* at the beginning of its rotation closed a circuit from ground over inner ring 37, brush and segment 56 of the distributor and through the winding of relay 27 to battery. Relay 27 is thereby energized during a portion of the travel of the brusharm of the distributor and during said period holds open the locking circuit of the relay K_2 which (it will be remembered), was traced through the left hand winding of relay M_2 and over the front left hand contact of said relay. Relay K_2 is therefore restored to normal so that the signal of the next line in order may be translated and stored up on the storing relays 1 to 6 inclusive.

Returning now to the receiving distributor RD′ at station C, it will be remembered that in response to the transmission of the code combination just described the relay 55′ was energized and locked up. As the brusharm of the distributor passes over segments 57 and 58 a momentary circuit is completed from negative battery, over said segments and the brush of the distributor, over the left hand front contact of relay 55′, right hand back contacts of pyramid relays 59, 60, 61 and 62, thence over conductor 63, over the lower back contact of relay 64 and through the upper winding of said relay to ground. Relay 64 is thereby energized and completes a locking circuit from battery, through its middle winding, lower front contact and upper winding to ground. The brusharm of the distributor now passes over segments 67 and 68 and comes to rest, thereby completing a circuit from ground over said segments and through the winding of relay 51. Relay 51 opens the locking circuit of relay 55′ which is thereby deenergized and the pyramid selecting circuit is restored to normal.

In the meantime the brusharm of the distributor FD, which in response to the transmission of the code combination just described energized and locked up relay 555, has passed over the segment 69 and 70 thereby closing a momentary circuit from negative battery, over the right hand back contact of relay 666, over the segments 69 and 70, over the front contact of relay 555, over the contacts of pyramid relays, similar to those shown in Fig. 4,

over conductor 71, over the upper back contact of relay 72 and through the lower winding of said relay to ground. Relay 72 is thereby energized and closes a locking circuit from battery, through its middle winding, upper front contact and lower winding to ground. At its lower front contact relay 72 completes the filament circuit of the repeater R_2 so that the repeater is now rendered operative for transmission over the line L_2.

Coming back to the relay 64 at station C, which was energized and locked up in response to the code combination previously described, said relay at its upper front contact completes a circuit for the relay 73, which upon being energized at its upper front contact prepares the circuit of the left winding relay 74 and at its middle front contact completes a circuit from ground, over the lower back contact of relay 75 and through the guard lamp 76 to battery. The guard lamp 76 is now caused to glow thereby indicating to the toll operator at station C that the originating operator has connected to the toll line L_2. The operator thereupon inserts the plug P_2' into the jack J' of the toll switching trunk T', over which the connection may be extended to the line of the called subscriber. This operation completes the circuit of the sleeve relay 77, whereupon a circuit is completed for the relay 75, which upon being energized closes the toll circuit at its upper front contact and at its lower contact opens the circuit of the guard lamp 76 which is now extinguished.

Relay 77 at its front contact also completes a circuit from ground over conductor 78, back right hand contacts of relays 79 and 80, over conductor 81, over the left-hand back contact of relay 74, upper back contact of relay 89, over conductor 82 and through the winding of relay K_2', right hand winding of relay M_2', right hand back contact of relay M_2' and thence in series over the back left hand contacts of other K' relays, over the back right hand contact of relay M_{22}', back contact of relay 85 and over the back contact of relay 86 to battery. Relays K_2' and M_2' upon being energized operate to lock out similar relays of other lines and to determine the order of preference of other lines upon which signals may simultaneously arise. Relay K_2' at its left hand front contact completes a circuit from battery, over the back contact of relay 86, front right hand contact of relay M_2', front left hand contact of relay K_2', conductor 83, lower back contact and winding of relay 89, back right hand contact of relay 74 and thence over circuit previously traced to ground. Relay 89 is now energized and is locked up over its lower front contact, thereby opening the initial energizing circuit of the relays K_2' and M_2' which, however, remain locked up.

Relay K_2' at its inner right hand front contact connects ground to conductor 88 whereby the relay 5' is energized through its left hand winding. At the outer right hand front contact of relay K_2' a circuit is closed from ground over the front contact of relay 77, back contacts of relays 79 and 80, over the conductor 93, right hand front contact of relay K_2', conductor 87, left hand winding of relay 6' to battery. Relays 5' and 6' are energized and locked up over their right hand front contacts in series with the winding of relay 94. Relay 94 upon being energized closes the circuit of the start magnet 95 whereby the brusharm of the distributor TD' is released to transmit a negative starting impulse followed by a code combination consisting of four negative impulses and two positive impulses. After transmitting the code combination the brusharm completes the circuit of relay 96 over segment 97 and inner ring 98, whereby relay 96 opens the circuit of the relay 94 and the locking circuits of the storing relays 5' and 6', restoring the apparatus to normal. Relay 86 is also operated to open the locking circuit of the relay K_2', which is restored to normal.

The transmission of the negative starting impulse actuates relay 13 and pole changing relay 99 at station B. Relay 13 releases the brusharm of the distributor FD' in a manner similar to that already described with reference to distributor TD and said brusharm rotates over the receiving segments of the distributor. At the same time the pole changing relay 99 transmits a negative impulse over the path P_2, which in turn actuates the polar relay 100 to actuate the start magnet 101 of the distributor RD, thereby releasing the brusharm of said distributor in a manner similar to that already described with reference to distributor RD'. The brusharm of the distributor RD rotates over the receiving segments 11, 22, and so forth, but as the negative impulses of the code combination transmitted are ineffective only relays 55 and 66 are energized and locked up in response to the last two positive impulses of the code combination. As the brush arm of the distributor RD passes over segments 101 and 102, a circuit is completed from positive battery, segments 101 and 102, front right hand contact of relay 55, over the back left hand contacts of pyramid relays 103, 104, 105 and 106 and thence over conductor 107, back right hand contact of relay 18 and through the left hand winding of said relay to ground. Relay 18 is energized by the positive impulse thus transmitted and completes a locking circuit from battery, through its middle winding and over its right hand front contact and left hand winding to ground. The positive impulse transmitted over conductor 107 persists long enough so that it now passes over the front right hand contact

of relay 18 and through its right hand differential winding to ground. The relay 18 is at once deenergized so that the code combination transmitted in response to inserting the plug P_2' into the jack J' is ineffective to produce any signal at the originating station A. The pyramid relays associated with the distributor FD' at station B are so arranged as to be ineffective to close any signaling circuit in response to the code combination just transmitted. In fact the pyramid relays are so arranged that no circuits are completed for code combinations transmitted from the distant end of any toll line to the originating end thereof.

After the plug P_2' has been inserted in the jack J', the B operator completes the connection over the toll switching trunk T' to the called subscriber. The receiver of the called subscriber being on his switch hook, the toll switching trunk operates in a manner well known in the art to bridge battery across its talking conductors, whereby the left hand winding of relay 74 is energized. Relay 74 upon being energized momentarily opens the locking circuit previously described for relay 89, whereby said relay is deenergized and a circuit is completed from ground over the front contact of relay 77, over the inner front contact of relay 74, upper back contact of relay 89, over the conductor 82, through the winding of relay K_2' and right hand winding of relay M_2' to battery. Relays K_2' and M_2' are thereby energized.

A circuit is completed, at the same time, from ground, over the front contact of relay 77, right hand front contact of relay 74, over conductor 108 and through the right hand winding of relays 79 and 80 in parallel. Relays 79 and 80 are energized and at their left hand front contacts complete locking circuits through their left hand windings and over the brushes of an interrupter 109 to ground. The brushes of interrupter 109 are so arranged with respect to the segments that one of these locking circuits will always be maintained closed, after the other has been opened for a period equal to the time that it takes for one of the brushes to pass over one-half of a segment of the interrupter. The speed of the interrupter may be so regulated as to make this period as long as desired, so long as one or the other of the relays 79 and 80 are maintained locked up.

Ground from the front contact of relay 77 and over the conductor 78 is disconnected by means of the relays 79 and 80, from the wires 81 and 93, so that relay K_2' when energized functions to connect ground to the conductor 88 only and no ground is connected to the conductor 87 as in the case previously described. Relay K_2' when energized, as previously described, connects battery over conductor 83 to again lock up relay 89. By applying ground to the conductor 88, the relay K_2' energizes and locks up the storing relay 5'.

Relay 5' upon being energized is locked up and sets the distributor TD' into operation to transmit a negative starting impulse followed by a code combination consisting of four negative impulses, a positive, and an additional negative impulse. The combination thus transmitted does not close any filament control circuit at the station B. At station A, however, the receiving distributor RD is set into operation and energizes relay 55 in response to the positive impulse, so that when the brush arm of the distributor passes over segments 101 and 102 a circuit is closed from negative battery over said segments, over the front contact of relay 55 and the left hand back contacts of relays 103, 104, 105 and 106 to the conductor 107 and thence over the back right hand contact of relay 18 and left hand winding of said relay to ground.

Relay 18 is now energized and completes a locking circuit from battery, through its middle winding, right hand front contact and through its left hand winding to ground. At its left hand front contact a shunt connection is completed about the winding of relay 15, from ground over the front left hand contact of said relay, over the upper back contacts of relays 16 and 17, over the front left hand contact of relay 18 and through the resistance 110. This decreases the resistance of the sleeve circuits sufficiently to cause the lamp 14 to glow thereby indicating to the toll operator at station A that the connection has been completed to the called subscriber and that ringing current should now be applied. The operator thereupon transmits ringing current from the toll cord over the talking conductors of the plug P and the jack J_2 to the ringing responsive relay 21. The locking circuit of relay 20 is thereby opened and a circuit is completed from ground over the front right hand contact of relay 15, lower back contact of relay 20, over conductor 23 and through the winding of relay K_2 and the left hand winding of relay M_2 to battery at the back contact of relay 27.

Relay K_2 now functions to connect battery from the back contact of relay 27, over its front right hand contact, over conductor 24, over the upper back contact and through the winding of relay 20 to ground at the front contact of relay 15, thereby again energizing and locking up the relay 20. At its inner left hand contact relay K_2 connects ground over the conductor 29 and through the right hand winding of relay 5 to battery. Relay 5 is accordingly energized and locked up and causes the transmitting distributor TD to be actuated to transmit a negative

starting impulse followed by a code combination of four negative impulses, one positive and one additional negative impulse. It will be noted that the code combination, as transmitted, is the same combination as had been previously transmitted to actuate the guard lamp 76.

The transmission of this code combination over the signaling path P causes the receiving distributor FD at station B to be actuated to close the circuit of relay 555, so that a circuit is again completed from negative battery, over the back contact of relay 666, over segments 69 and 70, front contact of relay 555, over the contacts of the pyramid selecting relays to conductor 71 and thence over the upper front contact of relay 72 to the upper winding of said relay to ground. The current flowing through this winding is in such a direction that the effect is cumulative with respect to the other windings of the relay and, consequently, no useful effect is produced by this code combination at station B at this time.

The starting impulse and code combination are also repeated by means of the duplex repeating set to the signaling path P′ and at station C operate to release the receiving distributor RD′ which functions as before to energize the relay 55′ in response to the positive impulse, so that just before the brush arm comes to rest a circuit is closed from negative battery, over the back left hand contact of relay 66′, over segments 57 and 58, over the front left hand contact of relay 55′ and the back right hand contacts of pyramid relays 59, 60, 61 and 62 to conductor 63 and thence over the lower front contact of relay 64 and through the winding of relay 112 to ground. Current also flows in parallel with the windings of relay 112, through the lower winding of relay 64, but this current is in such direction that the effect is cumulative with respect to the other two windings of the relay 64, so that the relay is not deenergized but remains locked up.

Relay 112 closes a circuit from ground over its front contact and over the middle front contact of relay 75, in parallel through the windings of relay 113 and 114 and thence over the lower front contact of relay 73 to battery. Relays 113 and 114 over their right hand front contacts complete locking circuits through their right hand windings, over the brushes of the interrupter 109 to ground. Said relays also complete a circuit over their left hand front contacts from battery, over the lower front contact of relay 73, left hand front contacts of relays 113 and 114 in parallel and thence through the winding of ringing relay 115 and through the right hand winding of relay 74 to ground. This circuit is maintained closed for a period determined by the action of the interrupter 109 in a manner already described in connection with relays 79 and 80. Consequently, relay 115 applies ringing current to the called line for a predetermined period and relay 74 is maintained energized through its right hand winding during the same period.

When the called subscriber responds to the ringing signal the battery which had been bridged across the talking conductors of the toll switching trunk T′ is disconnected in a manner well known in the art, so that the relay 74 is deenergized. The left hand armature of the relay 74, in passing from its front to its back contact, momentarily opens the locking circuit of the relay 89 which is deenergized. A circuit is now completed from ground, over the front contact of relay 77, over conductor 78, over the right hand back contacts of relays 79 and 80, over the conductor 81, back left hand contact of relay 74, upper back contact of relay 89, conductor 82, through the winding of relay K_2' and the right hand windings of relay M_2' to battery. Relay K_2' upon being energized, at its front left hand contact connects battery from the back contact of relay 86 over the conductor 83, over the lower back contact and through the winding of relay 89, over the back left hand contact of relay 74, over the conductor 81, back right hand contacts of relays 80 and 79, over conductor 78 and front contact of relay 77 to ground. Relay 89 is thereby again energized and locked up. Relay K_2 at its inner right hand contact connects ground to conductor 88, thereby energizing and locking up the relay 5′. At its outer right hand front contact relay K_2' completes a circuit from ground, over the front contact of relay 77, conductor 78, back right hand contacts of relays 79 and 80, over conductor 93, front right hand contact of relay K_2', conductor 87 and left hand winding of relay 6′ to ground. Relay 6′ is therefore also energized and locked up.

These relays upon closing their locking circuits actuate relay 94 to set the transmitting distributor TD′ into operation, thereby transmitting a negative starting impulse followed by a code combination of four negative impulses and two positive impulses. This combination upon being transmitted over the signaling path P′ produces no useful effect at station B, but upon being repeated by the duplex repeater set to the path P, the receiving distributor RD at station A is set into operation and locks up relays 55 and 66 in response to the two positive impulses. A circuit is thereby completed from positive battery, over the front right had contact of relay 66 over segments 101 and 102, over the front right hand contact of relay 55, over the back left hand contacts of pyramid relays 103, 104, 105

and 106, over conductor 107, over the right hand front contact of relay 18 and through the right hand differential winding of said relay to ground. The impulse thus transmitted is of such a direction that the effect on the right hand windings of said relay is differential with respect to the other two windings, so that relay 18 is deenergized and at its left hand contact opens the shunt through resistance 110, so that lamp 14 is extinguished thereby, indicating to the toll operator that the called subscriber has answered.

Should the called subscriber desire to attract the attention of the operator at station A by flashing his switch hook the operation of the switch hook will intermittently connect battery to the toll switching trunk, thereby intermittently energizing the relay 74. Each time the relay 74 is energized, the locking circuit of the relay 89 will be momentarily interrupted by the movement of the left hand armature of relay 74 from one contact to the other. A circuit will, therefore, be completed from ground over the front contact of relay 77, over the front left hand contact of relay 74 and over the upper back contact of relay 89 to energize the relays K_2' and M_2'. A circuit will at the same time be completed from ground, over the front contact of relay 77, over the extreme right hand front contact of relay 74, over conductor 108 and through the right hand windings of relays 79 and 80 in parallel to battery. Relays 79 and 80 are thereby energized and locked up over the brushes of the interrupter 109, as before described, to prevent a circuit being completed over conductor 78 to conductor 93.

Relay K_2' upon being energized, therefore, applies ground over its inner right hand contact to the conductor 88 to energize and lock up the relay 5'. Relay 5' upon being locked up sets the transmitting distributor TD' into operation to transmit a negative starting impulse followed by a code combination of four negative impulses, a positive and an additional negative impulse. This operation is repeated for subsequent energizations of the relay 74, whenever the line L_2 obtains control of the distributor. Consequently, a succession of code combinations, of the character just described, will be transmitted over the signaling path P', so long as the subscriber manipulates the switch hook. The transmission of these code combinations produces no useful effect at station B. Upon being repeated to the signaling path P, however, the first combination transmitted releases the receiving distributor RD and locks up the relay 55 in response to the positive impulse, thereby completing a circuit, as before described, from negative battery, through the pyramid selecting relays to conductor 107 and over the back right hand contact of relay 18 and through the left hand winding of said relay to ground. Relay 18 is thereby energized and locked up as before described. The next code combination received again locks up the relay 55 and connects negative battery through the pyramid relays to conductor 107 so that a negative impulse is transmitted over said conductor 107, through the front right hand contact of relay 18, through the winding of relay 116 to ground.

Relay 116 upon being energized completes a circuit from ground over its front contact, back contact of slow release relay 19 and thence in parallel through the upper windings of relays 16 and 17 to battery. Relays 16 and 17 are then locked up through their lower windings and over the brushes of an interrupter 117 to ground. The interrupter 117 functions in a manner similar to that already described in connection with the interrupter 109, to maintain relays 16 and 17 locked up for a definite period. A circuit is therefore closed from ground through the busy back interrupter 118, over the upper front contact of relays 16 or 17 and thence over the front left hand contact of relay 18, through the resistance 110 to shunt the winding of relay 15. The lamp 14 is thereby caused to flash intermittently, indicating to the operator that the called subscriber is flashing his switch hook.

Returning now to the completion of the connection from the toll line L_2 to the toll switching trunk T' by the toll operator, in case the B operator had found the called subscriber's line busy she would have plugged the toll switching trunk T' into the jack of a busy back circuit, thereby intermittently opening and closing the toll switching trunk circuit to intermittently connect battery across the toll switching trunk in a manner similar to that described in connection with the flashing of the subscriber's switch hook. This would cause the relay 74 to be intermittently energized, thereby transmitting signals of the character just described in connection with the flashing of the called subscriber's switch hook. The relays 18 and 116 would be energized and the circuit through busy back interrupter 118 again completed to cause the flashing of the lamp 14. The flashing of the lamp would, in this instance, occur before the ringing signal had been received so that the operator would understand that the signal indicated a busy condition of the called subscriber's line.

Upon receiving a disconnect signal from the calling subscriber the toll operator at station A would withdraw the plug P from the jack J_2, thereby deenergizing the relay 15. The right hand armature of the relay 15, in passing from front to back contact, momentarily opens the circuit of locking relay 20 which is deenergized and closes a

circuit over back right hand contact of relay 15, lower back contact of relay 20, over conductor 23, through the winding of relay K_2 and the left hand winding of relay M_2 to battery at the back contact of relay 27. Relay K_2 upon being energized connects battery from the back contact of relay 27, over its extreme right hand front contact, over conductor 24 and over the upper back contact and winding of relay 20 to ground over the back contact of relay 15. Relay 20 is again energized and locked up. Relay K_2 at its inner front contact connects ground to conductor 29 to energize and lock up the relay 5. At its outer front contact relay K_2 closes a circuit from ground over the back contact of relay 15, over conductor 25, left hand front contact of relay K_2, conductor 28 and through the right hand winding of relay 6 to battery. Relay 6 is thereby energized and locked up.

Relays 5 and 6 upon being locked up cause the relay 35 to release the transmitting distributor TD, which now functions to transmit a negative starting impulse followed by a code combination consisting of four negative impulses and two positive impulses. The transmission of this code combination over signaling path P results in the actuation of relays 555 and 666 at station B. As the brush arm of the receiving distributor FD passes over segments 69 and 70 a circuit is closed from positive battery, over the right hand contact of relay 666, over segments 69 and 70, over the front contact of relay 555, over the contacts of the pyramid relays, over the upper front contact of relay 72 and through the upper differential winding of said relay to ground. The positive impulse transmitted through this winding is of such a direction as to cause the relay 72 to be deenergized, thereby opening the filament controlling circuit of the repeater R_2.

The code combination just described, upon being repeated by the duplex repeater set, to the signaling path P', results in the actuation of the distributor RD' to lock up relays 55' and 66' at station C. A circuit is thereby closed from positive battery, over the front left hand contact of relay 66', over segments 57 and 58, over the left hand front contact of relay 55', over the right hand back contacts of pyramid relays 59, 60, 61 and 62, over the conductor 63 and over the lower front contact and lower winding of relay 64 to ground. The impulse thus received is of such a direction as to deenergize the relay 64, which is now restored to normal, thereby opening the circuit of relay 73. Relay 73 closes a circuit fom ground, over the back contact of its middle armature, over the lower front contact of relay 75 through the lamp 76 to battery. The lamp now glows indicating to the toll operator at station C that the connection should be taken down. The operator thereupon withdraws the plug P_2' from the jack J', deenergizing the relay 77, which, in turn, opens a circuit of the relay 75, thereby extinguishing the lamp 76 and restoring the apparatus to normal.

A slight modification of the circuit at station A is illustrated in Fig 1[a], whereby the ringing signal may be transmitted without applying ringing current to the toll line. Where the toll line is composited for telegraphic purposes the low frequency of the ringing current which is applied to the toll line to operate the relay 21 of Fig. 1, interferes with the Morse apparatus because of its low frequency. It is therefore desirable that the ringing signal be transmitted without applying ringing current to the toll line.

The means whereby this result is accomplished will be clear from a consideration of Fig. 1[a] in connection with Figs. 2 to 5 inclusive. In Fig. 1[a] elements similar to those shown in Fig. 1 are indicated by the same reference character. The sleeve circuit of the toll line is modified by having two relays 119 and 120 instead of a single relay 15 as in the circuit of Fig. 1. The relay 120 is marginal and is only operated when the potential of the sleeve circuit is increased, as hereinafter described. A special form of cord circuit is provided for completing connections from the toll switching trunk (not shown) to the toll line such as L_2. This cord circuit terminates in plugs P and P', the plug P being adapted to co-operate with the jacks of toll lines while the plug P' is adapted to co-operate with jacks of toll switching trunks. Relays 121 and 122 are included in the sleeve circuit of the cord, the former operating to close the talking conductors and the latter functioning to control the signal lamp 14. A ringing key 123 is also provided, said ringing key being arranged to connect direct battery potential to the sleeve circuit, thereby operating the marginal relay 120 associated with the sleeve circuit of the toll line to transmit the ringing signal.

Further details of the apparatus will now be clear from a description of the operation, which is as follows:

Upon connecting a calling line to the toll line L_2 by inserting the plug P in the jack J_2, a circuit is completed from battery through the winding of relay 122, lower winding of relay 121, sleeve contacts of the plug and jack and through the lower windings of relays 119 and 120 in series to ground. Relays 119 and 121 are energized over the circuit thus traced, but relays 120 and 122 are marginal and are not actuated at this time. Relay 119 upon being energized, at its lower armature momentarily

interrupts the locking circuit of relay 20, in a manner similar to that already described with reference to relay 15 of Fig. 1. As a result of this operation the relays K_2 and M_2 are energized and cause the transmitting distributor TD to transmit a signal consisting of a code combination of four negative impulses, one positive and an additional negative impulse, to cause the guard lamp 76 at station C to glow in a manner already described in connection with Fig. 1.

As soon as the connection has been completed to the called subscriber, the called subscriber's receiver being still upon his switch hook, a ringing signal is transmitted from station C to station A consisting of a code combination of four negative impulses, a positive impulse and an additional negative impulse. This combination upon being received by the distributor RD causes the relay 55 to be locked up and a negative impulse is thereby applied to the conductor 107, which impulse goes over the back right hand contact of relay 18 and through its left hand winding to ground, thereby energizing and locking up the relay 18. The energization of relay 18 closes a shunt circuit about the lower windings of relay 119 and 120, from ground over the upper front contact of relay 119, over the upper back contacts of relays 16 and 17, over the front left hand contact of relay 18 and through the low resistance upper windings of relays 120 and 119. The resistance of the sleeve circuit is thereby decreased so that the marginal relay 122 is actuated to close the circuit of the lamp 14, which indicates to the operator that the called subscriber should be rung.

The operator thereupon actuates the ringing key 123 which over its lower front contact connects battery directly to the sleeve contact of the plug P, thereby short circuiting relays 121 and 122. Relay 121 is maintained energized, however, over a circuit through its upper winding and the upper contact of the ringing key 123. Upon applying battery directly to the sleeve contact of the plug P relay 120 is energized thereby opening at its lower contact the locking circuit of relay 20, which is deenergized as before. As soon as the ringing key 123 is restored, the relay 120 is again deenergized and a circuit is completed from ground over the lower back contact of relay 120, lower front contact of relay 119, lower back contact of relay 20, over conductor 23 to energize relays K_2 and M_2. The energization of these relays causes the transmitting distributor TD to transmit the same code combination as before; viz, four negative impulses, one positive and an additional negative impulse. The transmission of this code combination causes ringing current to be applied to the called subscriber's line, in the manner already described. The remaining features of the operation are identical with those described in connection with the first modification and need not be further discussed.

The operations above described with reference to the two modifications of the invention herein disclosed, are characteristic of those taking place in the course of the establishment of a connection over any one of the toll lines of a group employing the same common signaling path. The only essential difference in operation, so far as the establishment of connections over the different lines is concerned, resides in the fact that different code combinations are employed for the transmission of signals in connection with the various lines and while the invention is not limited to the employment of any particular arrangement of code signals, the code combinations shown in the following table have been found to be quite satisfactory, where a group of thirty-two toll lines employ the same common signaling path.

Line No.	Signals from outgoing to incoming end.			Signals from incoming to outgoing end.		
	Guard.	Ring.	Disconnect.	Receiver on hook.	Receiver off hook.	Flashing.
1	0	0	6	0	6	0
2	5	5	56	5	56	5
3	4	4	46	4	46	4
4	3	3	36	3	36	3
5	2	2	26	2	26	2
6	45	45	456	45	456	45
7	35	35	356	35	356	35
8	25	25	256	25	256	25
9	34	34	346	34	346	34
10	24	24	246	24	246	24
11	23	23	236	23	236	23
12	345	345	3456	345	3456	345
13	245	245	2456	245	2456	245
14	235	235	2356	235	2356	235
15	234	234	2346	234	2346	234
16	2345	2345	23456	2345	23456	2345
17	1	1	16	1	16	1
18	15	15	156	15	156	15
19	14	14	146	14	146	14
20	13	13	136	13	136	13
21	12	12	126	12	126	12
22	145	145	1456	145	1456	145
23	135	135	1356	135	1356	135
24	125	125	1256	125	1256	125
25	134	134	1346	134	1346	134
26	124	124	1246	124	1246	124
27	123	123	1236	123	1236	123
28	1345	1345	13456	1345	13456	1345
29	1245	1245	12456	1245	12456	1245
30	1235	1235	12356	1235	12356	1235
31	1234	1234	12346	1234	12346	1234
32	12345	12345	123456	12345	123456	12345

In the above table, the numbers in the first column indicate the numbers assigned to the toll lines, while the numbers in the remaining columns indicate the order of the positive impulses in each group of six. The number "0" appearing opposite the first line in the second, third, fifth and seventh columns of the table means that no positive impulses are transmitted. In other words, a code combination, in this case, consists of six negative impulses. In this connection, it will be noted, that in the drawing, Figs. 1, 1[a]

and 5, when the K and M relays associated with the line L_1 are operated, circuits are not completed to any of the relays 1 to 6, inclusive, or 1′ to 6′, inclusive, but a circuit is completed for the relays marked 0 or 0′, as the case may be, which do not alter the polarity of the segments of the distributors, but which when locked up set the distributors into operation to transmit all negative impulses.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a signaling system, a transmission circuit extending between two stations, a signaling path extending between said stations, means responsive to a change in the condition of said transmission circuit to transmit a code combination over said signaling path, means responsive to a different change in the condition of said transmission circuit to transmit the same code combination over said signaling path, and means to translate the received code combination into two different signals individual to said transmission circuit.

2. In a signaling system, a plurality of transmission circuits extending between two stations, a signaling path common to said circuits and extending between said stations, means responsive to a change in the condition of any one of said transmission circuits to transmit a code combination characteristic of said path over said signaling circuit, means responsive to a different change in the condition of the same circuit to transmit the same code combination over said path, and means to translate the code combination characteristic of any line into two different signals individual to that line.

3. In a signaling system, a transmission circuit extending between two stations, a signaling path extending between said stations, means associated with said transmission circuit at one of said stations for originating a plurality of signals of different types, means responsive to the origination of said signals for transmitting the same code combination over said signaling path to the other station, and means at said other station to translate said code combination into a plurality of signals of different types for said transmission circuit under different conditions.

4. In a signaling system, a plurality of transmission circuits extending between two stations, a signaling path common to said transmission circuits and extending between said stations, means associated with each of said transmission circuits at one of said stations for originating a plurality of signals of different types for each circuit, means responsive to the origination of said signals for transmitting the same code combination characteristic of that particular circuit over the common signaling path to the other station, and means at said other station to translate the code combination characteristic of a particular transmission circuit into a plurality of signals of different types for that circuit under different conditions.

5. In a signaling system, a transmission circuit extending between two stations and including a normally inactive repeating apparatus, a signaling path extending between said stations, means responsive to a change in the condition of said transmission circuit at one station to transmit a signal over said signaling path to the second station to actuate signaling apparatus thereat, means responsive to the transmission of said signal to render said repeating apparatus active.

6. In a signaling system, a transmission circuit extending between two stations and including a normally inactive repeating apparatus, a signaling path extending between said stations, means responsive to a change in the conditions of said transmission circuit at one station to transmit a signal over said signaling path to the second station to actuate signaling apparatus thereat, means responsive to the transmission of said signal to render said repeating apparatus active, means responsive to another change in the condition of said transmission circuit to transmit another signal over said path to operate a signaling apparatus and means responsive to the transmission of the latter signal to render said repeating apparatus inactive.

7. In a signaling system, a plurality of transmission circuits extending between two stations and each including normally inactive repeating arrangements, a signaling path common to said transmission circuits and extending between said stations, means responsive to changes in the condition of a plurality of said transmission circuits to transmit signals over said common signaling path, and means responsive to the transmission of said signals to render active the repeating arrangements of the transmission circuit with which the signals originated.

8. In a signaling system, a plurality of transmission circuits extending between stations and each including normally inactive repeating arrangements, a signaling path common to said transmission circuits and extending between said stations, means responsive to changes in the condition of a plurality of said transmission circuits to transmit signals over said common signaling path, means responsive to the transmission of said signals to render active the repeating arrangements of the transmission circuits with which the signals originated, means re-

sponsive to other changes in the condition of said circuits to transmit other signals over said common signaling path, and means responsive to the transmission of the latter signals to render said repeating arrangements again inactive.

9. In a signaling system, a transmission circuit extending between two stations and including a repeating apparatus, a signaling path extending between said stations, means associated with said transmission circuit at one of said stations for originating a signal, means responsive to the origination of said signal to transmit a code combination over said signaling path, and means responsive to the transmission of the code combination to control the action of said repeating arrangements.

10. In a signaling system, a plurality of transmission circuits extending between two stations and each including repeating arrangements, a signaling path common to said transmission circuits and extending between said stations, means associated with each of said circuits at one of said stations for originating signals, means responsive to the origination of signals at a plurality of said circuits for successively transmitting code combinations characteristic of the circuits with which the signals originated, and means responsive to the transmission of said code combinations for controlling the corresponding repeating arrangements.

11. In a signaling system, a transmission circuit extending betwen stations, a link circuit at one of said stations for establishing connections over said transmission circuit, said link circuit having tip, ring, and sleeve conductors, a signaling path extending between said stations, means associated with said link circuit for transmitting a special signal over said sleeve conductor and said signaling path to the second station and means responsive to the transmission of said signal for applying ringing current to a portion of said transmission circuit at said second station.

12. In a signaling system, a transmission circuit extending between stations, a link circuit at one of said stations for establishing connections over said transmission circuit, said link circuit having tip, ring and sleeve conductors, a signaling path extending between said stations, means associated with said link circuit for transmitting a special signal over said sleeve conductors, means responsive to the transmission of said signal for transmitting a code combination over said signaling path to the second station, means at said second station for connecting said transmission circuit to a called line, and means responsive to said code combination for ringing the called line.

13. In a signaling system, a plurality of transmission circuits extending between two stations, a signaling path common to said transmission circuits and extending between said stations, means associated with each of said circuits at one of said stations for originating signals, a plurality of relays for determining the order in which said signals shall be transmitted and means for transmitting said signals over the common signaling path in the order determined by said relays.

14. In a signaling system, a plurality of transmission circuits extending between two stations, a signaling path common to said transmission circuit and extending between said stations, means associated with each of said circuits at one of said stations for originating signals, a plurality of relays for translating said signals into code combinations and for determining the order in which said code combinations shall be transmitted, and means for transmitting said code combinations over said common path in the order determined by said relays.

15. In a signaling system, means to transmit a signaling impulse, and means to prolong the effect of said impulse comprising a plurality of relays responsive to said impulse, each relay being adapted to independently maintain the effect of said impulse, and means for maintaining one of said relays energized for a predetermined period after another of said relays has been de-energized.

16. In a signaling system, means to transmit a signaling impulse, and means to prolong the effect of said impulse comprising a plurality of relays responsive to said impulse, each relay being adapted to independently maintain the effect of said impulse, and locking circuits for said relays controlled by an interrupter, said interrupter functioning to open the locking circuit of one of said relays a predetermined interval after the locking circuit of another of said relays has been opened.

In testimony whereof, I have signed my name to this specification this 9th day of December 1918.

JOHN DAVIDSON, JR.