

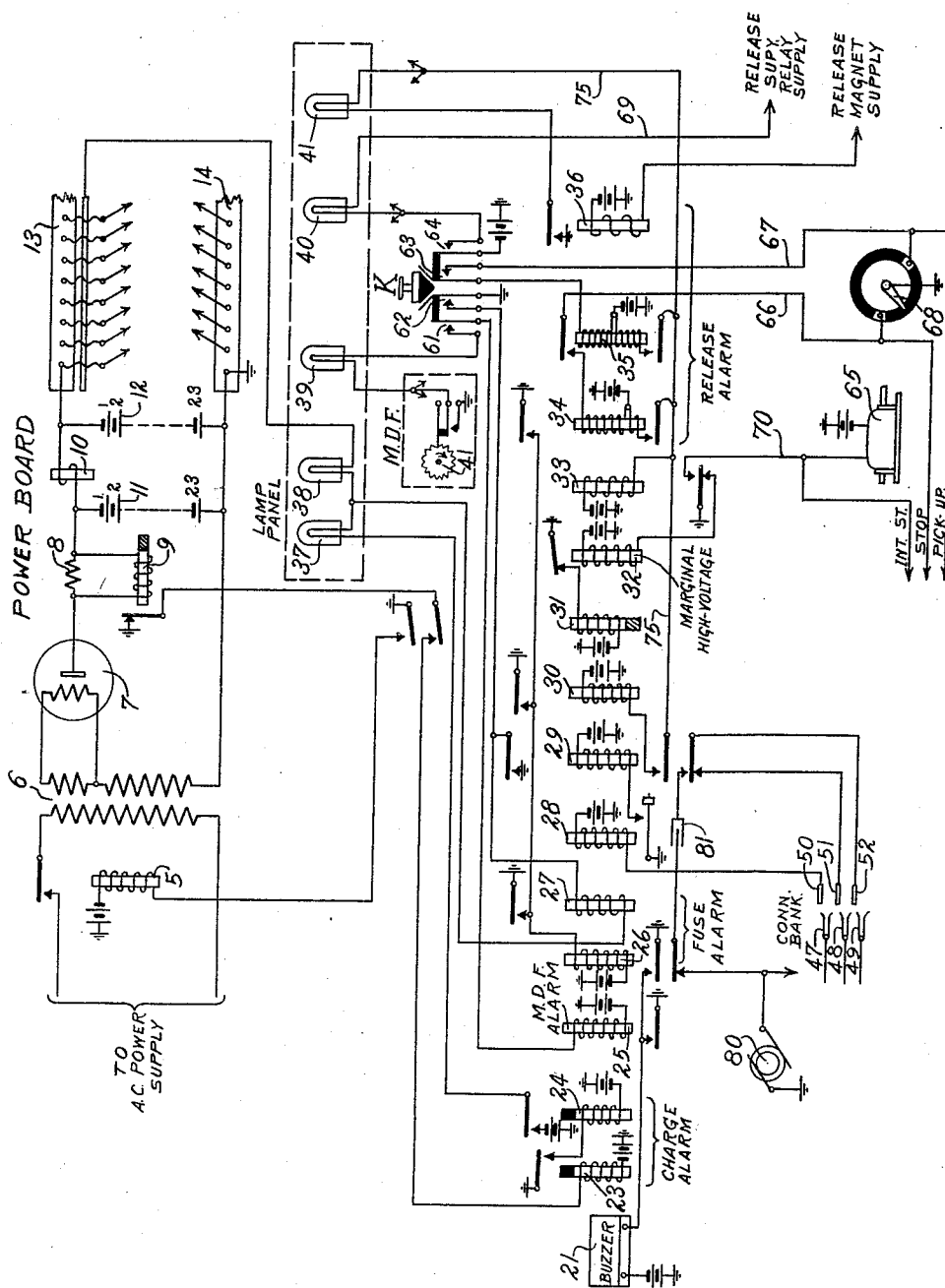
April 21, 1931.

C. E. LOMAX

1,802,179

TELEPHONE SUPERVISORY SYSTEM

Original Filed May 25, 1928



—Inventor—
Clarence E. Lomax

Wm Walter Owen. Atty.

UNITED STATES PATENT OFFICE

CLARENCE E. LOMAX, OF OAK PARK, ILLINOIS

TELEPHONE SUPERVISORY SYSTEM

Original application filed May 25, 1928, Serial No. 280,433. Divided and this application filed July 12, 1929.
Serial No. 377,639.

This invention relates in general to power and supervisory systems, but is concerned more particularly with power and supervisory equipment for automatic telephone systems of relatively small size, such as branch exchanges which are intended for use in small communities and which would not warrant the expense of employing an attendant at the exchange for constant supervision and maintenance.

All the maintenance in these small exchanges is usually taken care of from the distant main exchange, and formerly an operator at the main exchange, at specified time intervals, dialled a special number which automatically connected her with the alarm system of the branch exchange. In systems of this kind the alarm signals such as lamps, buzzers, and bells, which are operated whenever an abnormal condition occurs that requires attention, remain in operated condition until the trouble has been corrected or until the distant operator ascertains this condition by dialling the branch exchange and sending an attendant out to correct it. The continued operation of the alarm signals, before an abnormal condition is corrected, causes needless consumption of current, which in a branch exchange where a small battery is usually installed, may at times be quite serious. In some other cases separate alarm leads to the main exchange are provided for giving the alarms, but if the distance is too great this arrangement is objectional.

The object of this invention, therefore, is the provision of means for economizing on battery current consumption in unattended branch exchanges by arranging the alarm signal circuits in such a manner that they will not become operated until a time when an attendant is present and can correct the abnormal condition indicated by the alarm signals.

A feature of the invention is the means whereby the distant exchange operator can dial a special number in the branch exchange and, by receiving a tone over the trunk, be informed that the branch exchange is operating satisfactorily, and if no tone is re-

ceived, an indication that some abnormal condition exists in the exchange which requires immediate attention, whereupon an attendant is despatched to the branch exchange to immediately correct it.

A further feature of the invention resides in the provision of a special key and suitable circuit arrangements at the branch exchange whereby the various alarm signals are brought into operation only at a time when the attendant can attend to the abnormal condition indicated, and correct it.

Other objects of this invention, as will be hereinafter related, have been claimed in application Serial No. 280,433, filed May 25, 1928, of which the present application is a division.

Another feature resides in a new and improved voltage regulating arrangement for an unattended branch exchange, comprising a high voltage relay arranged to control both the starting and stopping of the charging of the battery, that relay being energized to stop the charge when the voltage of the battery reaches a predetermined high limit. However, instead of depending on the rather uncertain low voltage release of a relay, the circuit of the high voltage relay is opened at the end of each call through the exchange, that relay falling back to retest the voltage and start the charge so that the battery is immediately charged up to the maximum voltage.

There are other features not specifically mentioned, but which will become apparent by a perusal of the following detailed description which, together with the single sheet of drawings, constitutes a preferred embodiment of the invention.

Referring now to the drawing, the apparatus shown therein will be briefly described. The apparatus is all shown as being in its normal operating state. The power board in the upper portion of the drawing contains the batteries 11 and 12 which supply current to the bus bars 13 and 14 and are in turn supplied with charging current through the rectifier 7 from the A. C. current power supply. The rectifier 7 is of the well-known two-element vacuum tube type,

the filament of the bulb being supplied with lighting current from the upper right-hand portion winding of the transformer 6.

The key K is a locking key that completes the circuits to the various alarm lamps in the lamp panel in conjunction with various relays, when it is operated by an attendant.

In the lower portion of the drawing the reference characters 47, 48, and 49 indicate a set of wipers of a connector switch, which under control of the distant operator are adapted to come into engagement with a set of bank contacts 50, 51, and 52 in well-known manner. The other bank contacts of this switch lead to various subscribers' lines in the branch exchange. This type of switch is well known in the art, and it is not thought necessary to go into a detailed explanation of its operation.

The ringing interrupter machine 65 is operated each time a call originates in the branch exchange, and operates its shaft to rotate switch arm 68 through a suitable gear arrangement (not shown). The ringing generator 80 is also mounted on this shaft. A further explanation of the operation will be given later on.

Separate batteries and ground connections are shown in the drawing on all the apparatus, in order to make the drawing clearer, but it must be understood that these are all connected to the bus-bars 13 and 14, as indicated by the arrow-headed leads thereon.

The normal state of the apparatus is as shown in the drawings, with the marginal high voltage relay 32 energized, holding relay 31 energized. The arrangement is such that each time a call is made in the exchange the charge is started for the batteries. This takes place each time the relay 33 is energized momentarily due to the release of a call in the exchange, as will be fully explained hereinafter. Upon the energization of relay 33, the circuit of the marginal high voltage relay 32 is opened. Relay 32 falls back and opens the circuit of the slow-acting relay 31. Relay 31 in turn closes, at its upper contact, a circuit for the heavy duty relay 5, whereupon relay 5 energizes and applies the commercial power to the left-hand winding of the transformer 6, causing the rectifying tube 7 to light up and start to charge the battery. The charging current to the battery passes through resistance 8 around which relay 9 is shunted. As a result of this, relay 9 operates and opens the circuit of relay 23 before relay 23 can operate responsive to the closure of its circuit at the inner armature of the slow charge-starting relay 31. The charging current is delivered first to battery 11, and this battery receives the pulsating current just as it is rectified. Between the battery 11 and the battery 12, there is an impedance 10, which smoothes out the current flow and en-

ables the potential of battery 12 to remain constant.

Although the circuit of the marginal relay 32 was only momentarily opened by relay 33, it will not pull up when its circuit is closed again due to its marginal adjustment. It will only pull up when the critical predetermined voltage of the battery is reached, at which time the charge is cut off.

When the voltage reaches the required predetermined amount, which time may be after a long or short time interval depending upon the drain on the battery, due to the operation of the switches in the exchange, the marginal high-voltage relay 32 reoperates and closes the circuit of relay 31. Relay 31 reoperates and opens the circuit of relay 5, at the same time opening, at its upper contacts, another point in the circuit of relay 23. Relay 5 falls back and cuts off the charge. Relay 9, therefore, deenergizes and closes a point in the circuit of relay 23. The circuits remain in this condition until another call comes in, when the charge is started again by relay 33 opening the circuit of relay 32.

It will now be assumed that all of the apparatus is operating satisfactorily and the operator at the main exchange wishes to make her periodical supervision of the conditions at the branch exchange. She will seize an idle trunk leading to the unattended branch exchange and then manipulate her calling device in accordance with a special number to set the wipers 47, 48, and 49 of the connector switch onto the bank contacts 50, 51, and 52. Ground potential is now fed through wiper 47, bank contact 50 through relay 28 to battery. Relay 28 energizes and closes its weighted armature onto the make contact after a slight interval and energizes relay 29. This slight time interval before relay 29 pulls up its lower armature allows sufficient time for the circuit of the ring-cut-off relay of the connector switch to become energized and cut off the ringing current in the connector, as is well known. When relay 29 becomes energized, a circuit is completed from the ringing generator 80, lower contacts of relay 26, small tone condenser 81, lower closed contacts of relay 29, through bank contact 52 and wiper 49 and over the trunk to the operator's head set. The operator will thereby hear a distinctive tone in her headset which indicates to her that all the apparatus, including the ringing machine at the branch exchange, is operating in a satisfactory manner.

Assume now that some abnormal condition existed at the branch exchange prior to or at the time the operator makes her periodic call. In this event, the relay 26 would be energized, as will be explained hereinafter, and this relay will open its lowermost contacts to disconnect the generator 80 from the circuit through bank contact 52. When the operator makes her call, she will not receive

any tone in her headset and she will thereby known that an emergency condition exists at the branch exchange requiring immediate correction. She immediately dispatches an attendant to the branch exchange who will perform as his first act the operation of the key K. This key completes the circuits of the lamp or relay that is responsive to the above abnormal condition, and the attendant is thereby immediately appraised of the nature and location of the trouble, and corrects it.

The various alarm signals and their functions will now be explained in detail, it being assumed that the attendant is at the branch exchange and has operated the key K preparatory to correcting any trouble which may be evident in the exchange.

Failure of switch to release

Each time a switch in the exchange releases, the series supervisory relay 36 energizes due to the fact that current for the release magnet of the switch is supplied through this relay. Ordinary relay 36 operates only momentarily and falls back again as soon as the release operation has been completed. When relay 36 operates, it connects ground from its upper contacts through the lamp 41, to conductor 75 and through the low wound relay 33 to battery. Relay 33 operates and opens the circuit of the high-voltage relay 32, which, upon falling back, opens the circuit of relay 31. When the relay 31 falls back and closes its contacts the circuit for the charging control relay 5 is closed and the rectifier 7 begins to charge the batteries. Relay 33 in addition to opening the circuit of the high-voltage relay 32 also closes ground on conductor 70 to the ringing interrupter machine 65. This machine which is also operated each time the interrupter-start conductor Int.St. is grounded by the operation of a switch in the exchange has mounted on its shaft the ringing machine 80 which feeds ringing current to all the switches. In addition, the machine has a number of cams mounted on its shaft for the purpose of interrupting the ringing current. One such cam 68 is shown, and this places ground first on the pick-up conductor which may be used to start the ringing and subsequently, when the arm travels around, ground on the stop conductor which may be used to stop the ringing. In addition, this cam feeds ground first to conductor 67 and then to conductor 66.

It may happen occasionally that a switch does not release properly for some cause, and the release magnet circuit, therefore, remains closed for an undue length of time. In this case, relay 36 remains operated long enough for an alarm to be brought in, as will now be explained.

In case relay 36 remained operated for an undue length of time, ground is placed on

conductor 75 through lamp 41 and also to the ringing machine 65. The cam 68 will then place ground on conductor 67 and energize relay 35 through contacts 63 of the operated key K. Relay 35 energizes and locks up through its lower contacts to the grounded conductor 75. If relay 36 should fall back before the cam 68 has grounded conductor 66, relay 35 falls back and relay 34 is not operated. However, if relay 36 remains operated, relay 34 is operated through the upper contacts of relay 35 from the stop conductor 66. Relay 34 locks itself up through its lower winding in parallel with the lower winding of relay 35 to conductor 75. The lower winding of relay 35 is of relatively high resistance, and the lamp 41 does not light through this lower winding. The lower winding of relay 34, however, is of relatively low resistance, and the lamp 41 now becomes permanently lighted. Relay 34 at its upper contacts closes a circuit for relay 26 which, upon energizing, disconnects the generator 80, so that the operator, upon calling into the exchange, will be aware that an abnormal condition exists. At its innermost contacts relay 26 closes the circuit for the buzzer 21 to call the attendant's attention to the trouble, which is in addition to the lighting of the lamp 41. The attendant repairs the switch which had failed to release and then restores the key K to normal. The release of relay 36 restores all the circuits again to their normal condition. Should the operator call and energize relays 28 and 29, as has been explained, before the attendant operates the key K, the relays 34 and 35 would not be operated, but the ground on conductor 75 will energize relay 30 through the closed inner contacts of relay 29. Relay 30 operates its contacts to close the circuit of relay 26, whereupon the tone generator 80 is cut off and the operator is appraised that an abnormal condition exists by not receiving a tone.

Fuse blown

In case a fuse blows in the exchange, the spring contacts on the fuse will make contact, in the well-known manner, with the fuse bar that is just below the main bus-bar 13, thereby closing a circuit for the fuse alarm lamp 38, from battery on the blown fuse, through lamp 38, low wound relay 27, to ground at springs 62 of the operated key K. Relay 27 energizes and closes the circuit of relay 26 which pulls up and cuts off the generator 80 and in addition closes the circuit to the buzzer 21.

Should the operator have called the exchange after the fuse was blown and before the key K was operated, the relays 28 and 29 would thereupon become operated, as has been explained, and in addition relay 29 would place ground at its upper contacts through relay 27 and through the lamp 38 to

battery at the blown fuse. Relay 27 closes its contacts and operates relay 26, which in turn cuts off the generator 80, indicating to the operator that a case of trouble exists. Relay 26 also closes at its inner contacts the circuit for the buzzer 21 to call the attention of the attendant to the lighted fuse lamp 38.

Failure of charging circuit

It will be assumed now that the high-voltage relay 32 falls back, due to a drop in voltage of the battery. As a consequence, the relay 31 has its circuit opened at the contacts of relay 32. This relay 31 will thereupon fall back and close the circuit of the charge starting relay 5 at its upper contacts, but in this case the charge fails to start. This may be due to a failure on the part of the commercial power or in the rectifier 7, or possibly in the contacts of relay 5, or the transformer 6 may be burned out. At any rate, if the charge fails to start, relay 9 does not operate and the circuit for relay 23 is closed through the inner contacts of relay 31. When relay 23 operates, after a slight interval, it closes a circuit for relay 24 whereupon relay 24 operates and, after a slight interval, closes a circuit from battery, at its upper contacts, to the charge alarm lamp 37 and relay 27 in series to ground on springs 62 of the key K, which is assumed to be in operated position. If the key K were not operated and the operator called into the exchange, relays 28 and 29 would be energized and at its upper contacts relay 29 would energize relay 27 and light the lamp 37, but in this case the lamp 37 would only be lit while the operator was listening in. Relay 27, in this case, would close the circuit to relay 26 to cut off the generator 80, informing the operator of a case of trouble at the exchange. The attendant notes the lighted condition of lamp 37, and in addition the buzzer 21 operates from the inner contacts of relay 26 to call his attention to the fact that the charging circuit has failed.

M. D. F. alarm

The M. D. F. alarm consists of the so-called "heat coils" 41 associated with each line in the exchange, and in case of trouble outside the exchange in the line, these "heat coils" 41 become fused and a ground is placed on the associated common conductor, closing a circuit to battery through the alarm lamp 39, springs 61 of the operated key K, and thence to relay 25. Relay 25, upon operating, closes the circuit to the buzzer to call the attendant's attention to the lighted lamp 39. It will be noted that in connection with this alarm the relay 26 will not be energized to cut off the generator 80, when the operator calls in. It is not necessary for the operator to be aware of an M. D. F. alarm, as only one line will be affected in the exchange, all the other equipment being in operative condition.

Subscriber fails to hang up

The conductor 69 leads to a release supervisory relay which feeds battery potential to a relay in a switch each time a call originates in the exchange, in well-known manner. This supervisory relay energizes to place ground on conductor 69 to light the lamp 40 through springs 64 of the operated key K. In the event that a subscriber fails to replace his receiver on the hook, the switch will not restore to normal, and consequently the supervisory relay will not release. The attendant will, therefore, be aware of this "permanent" condition by the lighting of the lamp 40 and by well-known means, such as applying a "howler tone" to the line, attract the subscriber's attention to it, and request him to replace his receiver on the hook.

Failure of ringing generator

In the event that the ringing generator 80 fails to function, due to the inoperativeness of the interrupter machine 65 or some other cause, the operator, upon making her periodic call into the exchange, will energize relays 28 and 29, but she will receive no tone and thereby will know that something is wrong at the exchange and dispatch the attendant to connect it. If no trouble is apparent when the attendant operates the key K, by no lamps lighting up he will know that the generator or ringing machine is not operating properly.

While the exact nature of any of the above described abnormal conditions at the branch exchange cannot be determined by the operator at the distant exchange, she will only know, by not receiving a tone in her headset, that some trouble exists. Therefore, as she cannot remedy the trouble herself from the main exchange, it is only necessary for her to know that it exists, and the attendant will be promptly despatched to the branch exchange in any case to remedy the trouble. The operation of the key K discloses the exact nature of the trouble to him.

It will thus be seen that a novel supervisory system for an unattended branch exchange has been designed whereby the trouble alarms do not function and put an unnecessary drain upon the battery until such time as the distant operator has become aware of the condition and has despatched an attendant to the branch exchange who will operate a key to render all alarm signals operative. This system utilizes a minimum amount of equipment for performing a large number of different operations of the alarm signals in an economical and efficient manner in any kind of unattended branch exchange.

What is considered new and is desired to have protected by Letters Patent is pointed out in the appended claims.

What is claimed is:

1. In a telephone system, an exchange, a plurality of fault-responsive devices in the exchange, an indicator for each device normally inoperative, an operator's position, means controlled by any of said devices to signal the operator to indicate the presence of a fault, and means for rendering the associated indicator operative to indicate the specific fault.

2. In a telephone system, an exchange, a plurality of fault-responsive devices in the exchange, an indicator for each device normally inoperative, an operator's position, an automatic switch controlled by said operator, contacts in said switch corresponding to said devices, means controlled by any of said devices to indicate the presence of a fault by controlling the condition of said contacts, means controlled by the operator for operating said switch to seize the contacts and test the condition thereof, and means for rendering the indicators operative to indicate the specific fault.

3. In a telephone supervisory system, a telephone exchange, a distant supervisory point, an automatic switch in said exchange controlled over a line extending to said exchange from said supervisory point, a plurality of devices in said exchange each responsive to a certain abnormal condition arising in said exchange, a certain position of said switch assigned to said devices, means controlled by an operator at said supervisory point over said line for positioning said switch on said certain position to determine if an abnormal condition exists at said exchange, and signalling means at said exchange controlled over said line by any of said devices for notifying said operator of said abnormal condition.

4. In a telephone system, an exchange, an automatic switch in said exchange, trouble-responsive devices in said exchange, a certain position of said switch assigned to said devices, an operator, means controlled by said operator to position said switch on said position, and signalling means controlled by said devices over said position for notifying said operator of any trouble.

5. In a telephone supervisory system, a telephone exchange, a distant supervisory point connected to said exchange, an automatic switch in said exchange controlled by an operator at said supervisory point, a plurality of devices in said exchange, each responsive to a particular abnormal condition arising in the exchange, a particular position of said switch adapted to be selected by said operator, said devices controlling the condition of said position, and signalling means connected to said line through said particular selected position of said switch and controlled by any one of said devices for noti-

fying said operator of any abnormal condition.

6. In a telephone supervisory system, a telephone exchange, a distant supervisory point connected to said exchange for the purpose of supervising the same, a plurality of devices responsive to certain abnormal conditions arising in said exchange, and a switch in said exchange controlled by an operator at said supervisory point for connecting up said devices to notify the operator of an abnormal condition.

7. In a telephone supervisory system, a telephone exchange, a plurality of relays, each responsive to a particular abnormal condition, a plurality of indicating devices associated with said relays, means for operating certain of said relays responsive to certain abnormal conditions while maintaining said indicating devices unresponsive, a manually operated key included in the circuit of said indicating devices, and means responsive to the operation of said key for indicating on said devices said abnormal conditions.

8. In a telephone supervisory system, a telephone exchange, an operator having access to said exchange, a plurality of relays at said exchange each responsive to a particular abnormal condition that may exist, a plurality of indicating devices associated with said relays respectively, signalling means controlled by said relays to notify said operator of an abnormal condition while maintaining said indicating devices normal, and means for placing said indicating devices under control of said relays to indicate abnormal conditions.

9. In a telephone supervisory system, a normally unattended telephone exchange connected to a distant operator's supervisory point, relays in said exchange responsive to a particular abnormal condition respectively, signalling means controlled by said relays for notifying said distant operator of said condition, indicating devices associated with said relays respectively but not operated thereby, and a manually operated key for placing said indicating devices under control of said relays to indicate the abnormal conditions.

10. In a telephone system, an unattended exchange, a distant operator's position, means controlled from said operator's position for establishing a connection with said exchange, fault indicating signals at said exchange, means at said exchange responsive to the occurrence of a fault for signalling said operator's position over said connection, and means at said exchange for rendering said indicating signals operative to indicate the specific fault.

11. In a telephone system, an exchange, an operator's position, means controlled from said operator's position for establishing a

connection with said exchange, trouble responsive devices in said exchange, means responsive to the operation of any of said trouble responsive devices for transmitting a trouble indication over said connection to said operator's position, signals in said exchange individual to each of said trouble responsive devices, and means in said exchange for operating a signal under control of its associated trouble responsive device to indicate the specific trouble existing in said exchange.

12. In a telephone supervisory system, an exchange, a distant operator's position, means controlled from said operator's position for establishing a connection with said exchange, a signal at said exchange, a release responsive device, means responsive to the failure to release a connection in said exchange for operating said release responsive device, means controlled by said release responsive device for permitting an indication over said connection to said operator's position, and means at said exchange for rendering said signal operative under control of said release responsive device.

13. In a telephone supervisory system, an exchange, an operator's position, means controlled at said operator's position for establishing a connection with said exchange, a plurality of protective devices operative responsive to the failure of an associated piece of equipment at said exchange, a signal at said exchange associated with each of said protective devices, means responsive to the operation of one of said protective devices for transmitting an indication over said connection to said operator's position, and means at said exchange for operating the associated signal under control of said operated protective device.

14. In a telephone supervisory system, an exchange, an operator's position, means controlled at said operator's position for establishing a connection with said exchange, battery supply means at said exchange, a trouble signal for said battery supply means, means responsive to the failure of said battery supply, means for transmitting an indication over said connection to said operator's position, and means at said exchange for operating said trouble signal under control of said battery supply means.

In witness whereof, I hereunto subscribe my name this 10th day of July, A. D. 1929.

CLARENCE E. LOMAX.