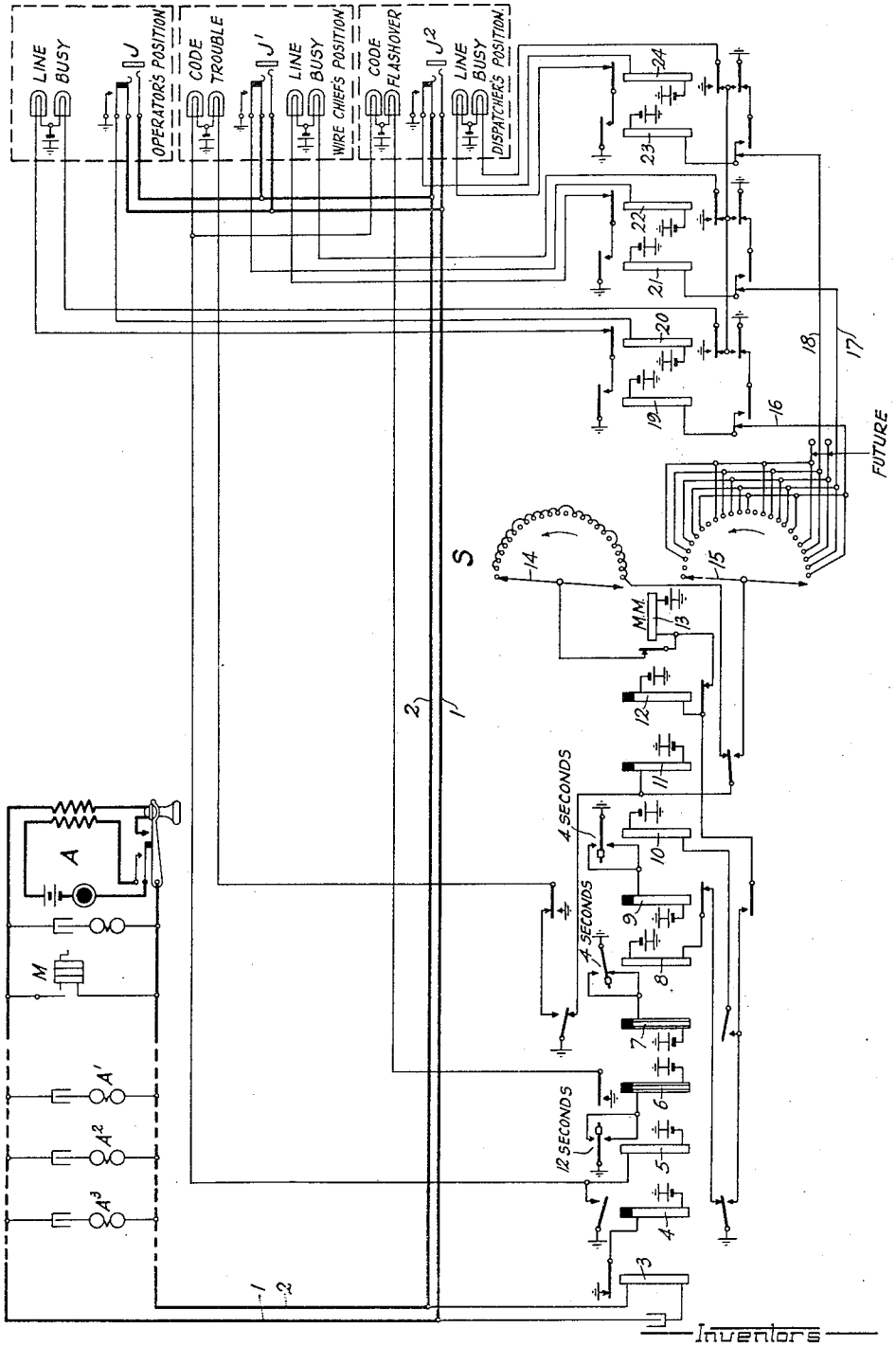
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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The present invention relates to telephone systems in general, but it relates more particularly to telephone systems of the magneto, party-line type. However, the present invention is most particularly concerned with the communication network of privately owned telephone lines serving power companies, although the features of the present invention are equally applicable to manual telephone systems providing magneto-party-line service.

Communication networks owned by power companies are called upon to furnish a number of widely different services such as load dispatching; commercial department contacts between main offices and outlying districts; contacts between sub-offices and district offices, etc. Usually the telephone lines are terminated in a communication center wherein they are connected to one or more dispatchers' boards, to a wire-chief's board, and to a telephone switchboard for making the connections to main offices and other lines. A large majority of these lines are of the party-line type, having a number of stations on the same line, over which the desired party is called by a code-ring consisting of a combination of long and short rings.

Under the old method of operation, if a magneto station desired to call another magneto station on the same line or any one of the several boards, the code ring was received on both the dispatcher's board and the telephone switchboard, thus necessitating a constant vigil on the part of the operators in order that they might be able to determine when they were being called, which, from an operating standpoint, was very unsatisfactory. The present invention has for its principal object the provision of a system in which this objection has been overcome practically from both an engineering and a commercial standpoint.

The principal object of the invention is accomplished by providing equipment by means of which it is possible for a magneto station to selectively signal the board desired, by a special code ring consisting of an initial long ring which will always be of greater duration than the ordinary long ring. By this arrangement, if a magneto station is calling another magneto station on the same line, no signal will be received by the operator on any of the boards connected to the selective signalling device.

If a magneto station desires to call either the dispatcher's board, the wire-chief's board, or the telephone switchboard, the initial long ring will be of sufficient length to start the operation of the selective signalling circuit, or ringing circuit, while successive short rings, succeeding the long ring, will select the boards as desired, lighting the line lamp on only the particular board desired. This selective signalling equipment will hereinafter be termed an alternating current selector, or, briefly, an A. C. selector, since it is actuated by the 16⅔ cycle alternating current of the usual telephone magneto generator and since it is capable of selecting and extending connections to as many as twenty-five switchboards or toll lines. The result is, insofar as the dispatchers and operators are concerned, that the lines do not appear as party lines, their lamps lighting only when they are wanted and remaining lighted until answered.

One of the features of the present invention is that, with the A. C. selector disclosed herein, it is not necessary to change or add any equipment on the magneto line since the A. C. selector will operate from the usual type of telephone magneto or standard ringing machine.

Other features of the invention are embodied in the various arrangements for notifying the wire-chief and dispatcher in case of trouble.

A complete understanding of the equipment and operation of the system and an appreciation of all of the features of the invention may be had from a study of the detailed description which follows, reference being had at the same time to the associated drawing, which, by means of the usual symbols diagrammatically depicts the system and apparatus of this invention.

In the drawing, there is shown one of a plurality of telephone lines, comprising conductors 1 and 2. This line has been shown as a party line having a plurality of stations A—A^3, inclusive, connected thereto. The line 1—2 is multiply connected to the various boards, terminating in the jack J in the telephone switchboard, denoted in the drawing as operator's position, in the jack J^1 in the wire-chief's board, or position, and in the jack J^2 in the dispatcher's board, or position.

The station A consists of the usual ringer, transmitter, receiver, local battery, transformer, and hand generator, or magneto M, commonly used on lines of this character. Stations A^1, A^2, and A^3 are similar to station A although they have been represented by only the ringers.

The A. C. selector consists of a series of pendulum-type relays, slow-acting relays 3—12, inclusive, and a rotary-line switch S, which is of the well-known type, the wipers of which move in a forward direction only. In the present system, there is one such A. C. selector for each party line

which is to be provided with selective ringing service. Associated with each party line is a group of quick-acting relays 19—24, inclusive, arranged in pairs and allotted one pair to each position connected to the switch S. This relay group is considered as a part of the A. C. selector and the function of it is to control the lighting of the line lamp in the selected position and the busy lamps in all positions when a call is answered.

The line relay 3 is an alternating current relay connected in series with a condenser in a bridge circuit across the line conductors 1—2 and operated by the alternating current generated by the magnetos such as M.

Relays 5, 8, and 10 are relays of the pendulum type having weighted reed-like armature springs which vibrate between contacts for a considerable period of time upon the deenergization of the coil windings, finally coming to rest out of engagement with both contacts. The desired duration of the vibrating period of relays of this character may be secured by regulating the position of weight on the vibrating member.

As a starting point of the detailed description of the operation of the system, it will be assumed that the party at station A desires to call another party on the line. The procedure in this case will be the same as in any magneto telephone system, namely, the operation of the magneto M in accordance with the long and short ring code of the desired station.

The line relay 3 of the A. C. selector operates each time the magneto M is operated and at its armature opens the normally closed circuit of slow-to-release relay 4. Relay 4 deenergizes after an interval and, at its upper armature and back contact, closes the circuit of vibrating relay 5 and in parallel therewith the circuit of the code lamps located at the wire-chief's and dispatcher's positions and individual to the line shown. Relay 4, at its lower armature and make contact, opens the normally closed circuit of vibrating relay 8 and, at the alternate contact of said lower armature, prepares a circuit for the motor magnet 13 of the rotary switch S.

Relay 5 energizes, upon closure of its circuit by relay 4, and, at the make contact of its weighted armature, closes the obvious circuit of slow-acting relay 6.

The code lamps at the two positions light to indicate to the wire-chief and the dispatcher that something is happening on the party line.

Opening of the circuit of relay 8 causes the deenergization of that relay, whereupon its armature commences to vibrate between the two contacts, thereby maintaining the circuit of slow-acting relay 7 closed sufficiently long to maintain that relay energized.

Relay 6 operates when relay 5 closes its circuit and, at its armature and make contact, completes the circuit of the flash-over lamp at the dispatcher's position for a purpose to be described subsequently.

Before proceeding further with the description, it will be explained that relays 8 and 10 are so adjusted that their contacts will vibrate for slightly less than four seconds after the deenergization of the windings, while relay 5 is adjusted to vibrate its armature for twelve seconds upon deenergization of the winding.

Upon termination of the operation of magneto M, relay 3 restores and re-establishes the circuit of relay 4, which, at its upper armature, opens the circuit of vibrating relay 5 and opens the circuit of the code lamps, and, at its lower armature, re-establishes the circuit of vibrating relay 8. Relay 5 thereupon deenergizes and the weighted contact thereof commences to vibrate. As previously stated, this vibration takes place for a period of twelve seconds, thereby maintaining relay 6 operated and, consequently, maintaining the flash-over lamp lighted for a period of twelve seconds after the restoration of relay 3.

Inasmuch as the long ring of the ringing code of any station on the line is shorter than four seconds duration, the weighted reed of relay 8 will not have ceased vibrating when the circuit of relay 8 is re-established following the restoration of relay 3, and consequently relay 7 will not have been deenergized. As operation of the switch S is is dependent upon the restoration of relay 7, as will be explained in detail a little later, no operator's position will be selected and signalled when any operation of the magneto M for less than a four-second period takes place. Therefore, it is evident that any station on the party line can call any other station thereon without causing any line lamp individual to this party line to be lighted at any one of the operator's boards.

Assuming, now, that station A desires a connection with the telephone switchboard, operator's position, the magneto M will be operated for a period of at least four seconds, this operation constituting the special initial long ring. The operation of relays 4, 5, 6, and 8, following the operation of relay 3, will be the same as described before. In this case, however, relay 4 remains deenergized sufficiently long to allow the armature of relay 8 to come to rest, whereupon relay 7 restores. Upon restoring, relay 7, at its lower armature, completes the circuit of vibrating relay 10 from ground through resting contact and armature of relay 4, and, at its upper armature, opens the circuit of relay 10 and closes the circuit of the trouble lamp at the wire-chief's board.

Relay 10 operates when its circuit is completed and, at the make contact of its weighted armature, completes the circuit of relay 9, which thereupon operates. Relay 9, at its upper armature, establishes a different circuit for the trouble lamp at the wire-chief's board; at its inner-lower armature, opens, at that point, the circuit of relay 8; and, at its lowermost armature and make contact, completes the circuit of slow-to-operate relay 12 and motor magnet 13 of switch S in parallel, relay 4 still being deenergized. Motor magnet 13 thereupon energizes preparatory to advancing the wipers 14 and 15 out of their normal positions. Relay 12 operates after a short interval and opens the circuit of motor magnet 13, whereupon the motor magnet deenergizes and advances the wipers 14 and 15 one step, in the direction indicated by the arrow, into engagement with the first contacts of their respective banks.

Upon termination of the prolonged operation of the magneto M, relay 3 restores and re-energizes relay 4, which thereupon attracts its armatures. At the upper armature of relay 4, the code lamps are extinguished and the circuit of relay 5 is opened, whereupon the weighted armature of relay 5 commences to operate to maintain the flash-over lamp lighted for twelve seconds longer. At the lower armature of relay 4, the circuits of relays 10 and 12 are opened and the circuit of relay 8 prepared, this circuit being open at the inner-lower armature of relay 9.

Relays 12 restores and relay 10 deenergizes,

whereupon the armature of relay 10 commences to vibrate. After a period of four seconds, the armature of relay 10 comes to rest and the circuit of relay 9 is opened, whereupon relay 9 releases, re-establishing the circuit of relay 8 and the original circuit of the trouble lamp.

Relays 8 and 7 operate in turn following the restoration of relay 9. Relay 7, at its lower armature, opens the circuit of relay 10 at that point, and, at its upper armature, opens the circuit of the trouble lamp and re-establishes the circuit of slow-to-operate relay 11.

Before relay 11 attracts its armature, the following circuit is completed: ground, upper armature and make contact of relay 7, armature and resting contact of relay 11, wiper 15 of switch S, first position bank contact of wiper 15, conductor 16, normally closed contacts controlled by the lower armature of relay 19, and thence through the winding of relay 19 to grounded battery. Relay 19 operates in this circuit, at its upper armature, completing the circuit of the line lamp at the telephone switchboard, operator's position, and, at its lower armature, completing the obvious holding circuit for itself.

When relay 11 operates after a short interval, it opens the circuit just traced, and, at the make contact of its armature, connects ground to all of the contacts of the bank of wiper 14 which are multiply connected. This ground is then extended by way of wiper 14 and interrupting contacts of motor magnet 13 to the winding of the motor magnet, whereupon the motor magnet acts in a self-interrupting circuit to rotate the wipers 14 and 15 to the sixth bank contacts of the respective wipers. It will be noted that the sixth, twelfth, eighteenth, and last contacts of the bank of wiper 14 are not connected with the other bank contacts. Therefore, when wiper 14 reaches its sixth contact, no circuit will be completed for motor magnet 13 and, consequently, the wipers will come to rest. By this arrangement, a plurality of normal positions for the wipers is provided, thereby eliminating unnecessary rotation of the wipers.

The telephone operator, noticing the lighted condition of the line lamp at her position, answers the call by inserting the answering plug of her cord circuit into the jack J, whereupon the jack contacts are closed to complete the obvious circuit of relay 20. Relay 20 thereupon operates, at its upper armature, extinguishing the line lamp at the called position; at its inner-lower armature completing the obvious circuit of the busy lamp at the operator's position; and, at its lower armature, opening the holding circuit of relay 19 and completing, by way of resting contacts and inner-lower armatures of relays 22 and 24, the circuits of the busy lamps at the wire-chief's board and the dispatcher's board, respectively.

Thus, it will be seen, one prolonged operation, of at least four seconds, of the hand generator results in the ringing, or signalling, of the telephone switchboard, but no other board, while answering of the call by the telephone operator results in the giving of a busy indication at all multipled positions.

When it is desired to signal the wire-chief's board, the initial long ring will be followed, after an interval of about one second, by a short ring of about one second duration. This short ring operates relay 3 again, which restores relay 4 for the second time. Inasmuch as less than four seconds has lapsed between the initial long ring and the short ring, the armature of relay 10 is still vibrating when relay 4 restores, and, consequently, relay 9 is still operated. Therefore, restoration of relay 4 this time completes, at its lower armature and resting contact, the circuits of slow-to-operate relay 12 and motor magnet 13 in parallel, whereupon the switch wipers 14 and 15 are advanced the second step, the first step being as before described.

Inasmuch as relay 9 is energized for four seconds after the termination of the long ring, relay 8 is not reoperated until a period of at least four seconds between rings occurs. Therefore, no circuit for one of the line lamp relays 19, 21, and 23 is completed until at least four seconds after the last ring have lapsed. Consequently, since the short ring occurred within about one second after the long ring, relay 7 was deenergized and no circuit was completed for relay 19 while wiper 15 was standing on its first bank contact.

Four seconds after the reoperation of relay 4 upon the termination of the short ring, the armature of relay 10 comes to rest and relay 9 restores, whereupon relay 8 operates and operates relay 7. Relay 7, upon operating, connects ground to the winding of slow-to-operate relay 11, and through the armature and resting contact of that relay to wiper 15. Since, at this time, wiper 15 is standing on its second bank contact, the ground is extended over conductor 17 to relay 21, which relay then operates, at its upper armature lighting the line lamp at the wire-chief's position and, at its lower armature, completing the holding circuit for itself.

Relay 11, upon operating, at its armature and make contact, completes the previously-traced circuit through wiper 14 for motor magnet 13, whereupon the wipers 14 and 15 are advanced to the next normal position.

The dispatcher's board can be signalled by following the initial long ring by three short rings of about one second each without about one-second intervals between rings. This results in the placing of wiper 15 on the fourth contact from the normal position. In this position and four seconds after the last ring, the circuit of relay 23 is completed over wiper 15, resulting in the operation of the line lamp at the dispatcher's board. The wipers of switch S are then advanced to the normal position as explained.

Answering of calls by the wire chief and dispatcher result in the operation of relays 22 and 24, respectively, as is evident, whereupon the busy lamps at all positions are lighted.

The capacity of switch S when wired as shown is five positions. However, by changing the connections of the positions to the bank contacts, the capacity of the switch can be increased to twenty-five positions. As an alternative, a rotary line-switch of any capacity desired can be substituted for the switch shown.

Attention is especially directed to the impulse-correcting and repeating arrangement whereby motor magnet 13 receives impulses of uniform length whenever the operator's code, wire-chief's code, or dispatcher's code is received by the A. C. selector. This arrangement comprises the relays 4 and 12, which, as is now evident, will repeat one impulse for every impulse of a series received by relay 3, provided the first impulse received by relay 3 is of four or more seconds duration. The alternating current impulses of varying duration received by relay 3 are repeated to motor magnet 13 by relays 4 and 12 as direct-current impulses

of uniform length since the time required for slow-to-operate relay 12 to attract its armature is constant for all practical purposes.

The purpose of the code lamps is to give the wire chief and dispatcher visual indications of the codes impressed upon the A. C. selector so that they can supervise all calls as desired, regardless of whether or not their own codes are being impressed upon the selector.

The purpose of the trouble lamp at the wire-chief's position is to give a visual indication of any trouble occurring in the A. C. selector. If any of the relays 4, 7, 8, 9, or 10 remain in a position other than shown in the drawing, permanently, the trouble lamp is brought in and maintained until the trouble has been remedied. The trouble lamp alone is lighted when any of relays 7, 8, 9, or 10 are at fault.

The flash-over lamp at the dispatcher's position is for the purpose of informing the dispatcher of the approximate location of an abnormal condition on the power transmission system. In privately owned telephone systems of the character described herein, it is common practice to build a telephone line jointly with a particular transmission line. Therefore, when an abnormal condition exists on a transmission line, the induced voltage on the joint telephone line is usually sufficient to momentarily operate a sensitive line relay such as relay 3. Such an operation of relay 3 results in a momentary deenergization of relay 4 and a consequent momentary energization of relay 5. Relay 5 thereupon operates relay 6, which brings in the flash-over indication to the dispatcher. The vibrating armature of relay 5 maintains relay 6 operated for twelve seconds after the momentary energization of relay 5. This maintains the flash-over lamp lighted for twelve seconds after the surge in the telephone line. The dispatcher gets an indication of the trouble from his instruments and an indication of the approximate location of the trouble from the flash-over lamp.

The invention having been thus described, what is considered new and is desired to have protected by Letters Patent is described in the claims which follow.

What is claimed is:

1. In a telephone system, an operator's position, a party line terminating in said position, a magneto for each subscriber on said party line, means responsive only to the operation of one of said magnetos in accordance with one particular code for signalling the operator, and means responsive to the operation of one of said magnetos in accordance with the code assigned to a subscriber on said line for preventing the operator from being signalled.

2. In a telephone system, an operator's position, a party line terminating in said position, a magneto for each subscriber on said party line, a line signal for said line at said position, means responsive only to the operation of one of said magnetos in accordance with one particular code comprising a ring of predetermined duration followed by another ring for operating said line signal, and means for preventing the operation of said line signal responsive to the operation of one of said magnetos in accordance with subscriber code rings when a subscriber calls another subscriber on his own line.

3. In a telephone system, an operator's position, a party line terminating in said position, a magneto for each subscriber on said party line, a line signal for said line at said position, means responsive to the operation of one of said magnetos in accordance with a prolonged ring for preparing for the operation of said line signal, means responsive to a subsequent operation of said magneto for operating said line signal, and means for rendering said preparing means inoperative responsive to the operation of one of said magnetos in accordance with a subscriber's code ring when a subscriber calls another subscriber on his own line.

4. In a telephone system, a plurality of operators' positions, a party line terminating in said positions, a magneto for each subscriber on said line, a line signal for said line at each of said positions, means responsive to the operation of one of said magnetos in accordance with a prolonged ring for preparing for the operation of any one of said line signals, and means responsive to subsequent operations of said magneto in accordance with different codes for selecting and operating different ones of said line signals.

5. In a telephone system, a plurality of operators' positions, a party line terminating in said positions, a magneto for each subscriber on said line, a line signal for said line at each of said positions, means responsive to the operation of one of said magnetos in accordance with a prolonged ring for preparing for the operation of any one of said line signals, means responsive to subsequent operations of said magneto in accordance with different codes for selecting and operating different ones of said line signals, and means responsive to a calling subscriber operating his magneto in accordance with a subscriber's code for rendering said preparing means inoperative.

6. In a telephone system, an operator's position, a calling line terminating in said position, a line signal for said line at said position, a combined timing and selecting device, a hand generator on said line, and means responsive to the operation of said generator in accordance with a predetermined code for operating said device to select and operate said signal.

7. In a telephone system, a plurality of operators' positions, a party line terminating in said positions, a line signal at each of said positions for said line, a combined timing and selecting device, hand generators associated with each substation on said line for signalling subscribers on said line and for operating said device, and means responsive to the operation of said generators in accordance with predetermined codes for operating said device to select and operate only one of said line signals, the operated signal corresponding to the operated code.

8. In a telephone system, a wire chief's position, a party line terminating in said position, a trouble and a code lamp for said line at said position, a selecting device associated with said line, hand generators on said line for signalling by code subscribers on said line and for operating said device, means responsive to certain codes for operating said device to operate both said lamps, a busy lamp for said line at said position, means for operating said busy lamp when a call is answered, and means operative responsive to a case of trouble for lighting the trouble lamp alone whereby the wire chief is informed of the case of trouble.

9. In a telephone system, a dispatching operator's position, a subscriber's line terminating at said position, a flash-over signal for said line at said position, and means responsve to surges of alternating current induced in said line by

trouble on power transmission lines for operating said signal whereby the dispatcher is informed by the combined operation of the trouble indicators for the transmission lines and the flash-over signal the approximate location of the trouble.

10. In a telephone system, a dispatching operator's position, a subscriber's line terminating at said position, a flash-over signal for said line at said position, and means for operating said signal responsive to currents being induced in said line from an adjacent power line.

11. In a telephone system, a dispatching operator's position, a subscriber's line terminating at said position, a flash-over signal for said line at said position, and means for operating said signal responsive to a subscriber's call and responsive to currents being induced in said line from an adjacent power line in case of trouble.

12. In a telephone system, a line terminating in a plurality of operators' positions, a signal for said line at each position, a hand generator associated with said line, and means responsive to the operation of said generator in accordance with a particular code for operating only the signal at a particular one of said positions.

13. In a telephone system, a line terminating in a plurality of operators' positions, a signal for said line at each position, a plurality of subscribers' stations on said line, a hand generator for each station, and means including the generator at a calling station for selectively operating the signals at said positions.

14. In a telephone system, a line terminating in a plurality of operators' positions, a signal for said line at each position, a hand generator associated with said line, and a combined timing and selecting switch controlled by said generator for selectively operating said signals.

15. In a telephone system, a plurality of operators' positions, a different predetermined code for calling different positions, a line terminating in said positions, a line signal for said line at each of said positions, a combined timing and selecting device, a hand generator on said line for operating said device, and means responsive to the operation of said generator in accordance with a particular one of said different codes for operating said device to select and operate only the line signal at a particular one of said positions.

16. In a telephone system, an operator's position, a combined timing and selecting device terminating a branch of said line, a line signal for said line at said position, hand generators associated with each substation on said line for signalling the subscribers on the line and for operating said device, and means responsive to the operation of one of said generators in accordance with a predetermined code for operating said device to select and operate said line signal.

17. In a telephone system, a line extending from a subscriber's station to a plurality of operators' positions, a current generating device associated with the line at the station, a signal for the line at each position, and a switch controlled by said device for selectively operating said signals.

18. In a selecting device adapted to receive series of impulses varying in numbers of impulses and durations of impulses, the combination of means for directively operating said device in accordance with the number of impulses in a series, and timing means for rendering said first means effective only when the first impulse of the series is of a particular minimum duration.

19. In a selecting device adapted to receive series of impulses varying in numbers of impulses and durations of impulses, the combination of means for receiving said impulses and repeating them as impulses of uniform duration, a multi-position device operated by the uniform impulses to a position corresponding to the number of impulses of the received series, and timing means for rendering said first means effective to repeat impulses only when the first impulse of the received series is of a particular minimum duration.

20. In a selecting device adapted to receive series of alternating-current impulses varying in numbers of impulses and durations of impulses, the combination of means for receiving a series of alternating current impulses and repeating them as direct-current impulses of uniform duration, a multi-position device operated by the direct-current impulses to a position corresponding to the number of impulses comprising the received series, and timing means for rendering said first means effective to repeat impulses only when the first impulse of the alternating-current series is of a particular minimum duration.

21. In a selective signalling system, a multi-position switch, a different signal operable in each position of said switch, means responsive to successive impulses for progressively operating said switch to its different positions, and timing means for automatically operating the signal of the position in which said switch is standing whenever a definite interval of time lapses between two successive impulses.

22. In a selective signalling system, a multi-position switch having a normal position, a different signal operable in each position of said switch except the normal position, means responsive to successive impulses for progressively operating said switch from its normal position to its different positions, and timing means for automatically operating the signal of the position in which said switch is standing whenever a definite interval of time lapses between two successive impulses and for thereafter returning said switch to its normal position.

23. In a selective signalling system, a multi-position switch having a normal position, a different signal operable in each position of said switch except the normal position, means responsive to series of impulses of varying durations for progressively operating said switch from its normal position to its other positions, timing means for rendering said first means effective to operate said switch only whenever the first impulse of a series is of a particular duration, and other timing means for operating the signal of the position in which said switch is standing whenever a time interval of definite duration lapses between successive impulses and for restoring said switch to its normal position.

24. In a telephone system, a telephone line having means associated therewith for transmitting series of impulses varying in numbers of impulses and durations of impulses, a plurality of operator's positions multiply connected to said line, means controlled by a series of impulses transmitted over the line for signalling the operator's position corresponding to the number of impulses comprising the series, and timing means for rendering said signalling means effective to signal an operator's position only when the first impulse of the series is of a particular minimum duration.

25. In a telephone system, a line, a plurality of stations connected to said line, a signal for said line at each station, a hand generator associated with said line, and means responsive to the operation of said generator in accordance with a particular code for operating the signal at a particular one of said stations only.

26. In a telephone system, a line, two groups of stations on said line, a signal for said line at each station of each group, a hand generator associated with said line, the signals of one group of stations operating responsive to the operation of said generator in accordance with any code, and means responsive to the operation of a particular code for operating the signal of a particular station only of the second group.

27. In an impulse correcting and repeating device, an alternating current relay adapted to receive a series of alternating current impulses varying in duration and adapted to respond to each impulse of the series, means for transmitting direct-current impulses of uniform duration, and timing means for placing said impulse transmitting means under the control of said alternating-current relay only when the first alternating-current impulse of the series is of a particular minimum duration.

28. In an impulse correcting and repeating device, a relay adapted to receive a series of impulses varying in duration and to respond to each impulse of the series, means for transmitting impulses of uniform duration, and timing means for placing said impulse transmitting means under the control of said relay only when the first impulse of the series is of a particular minimum duration.

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