

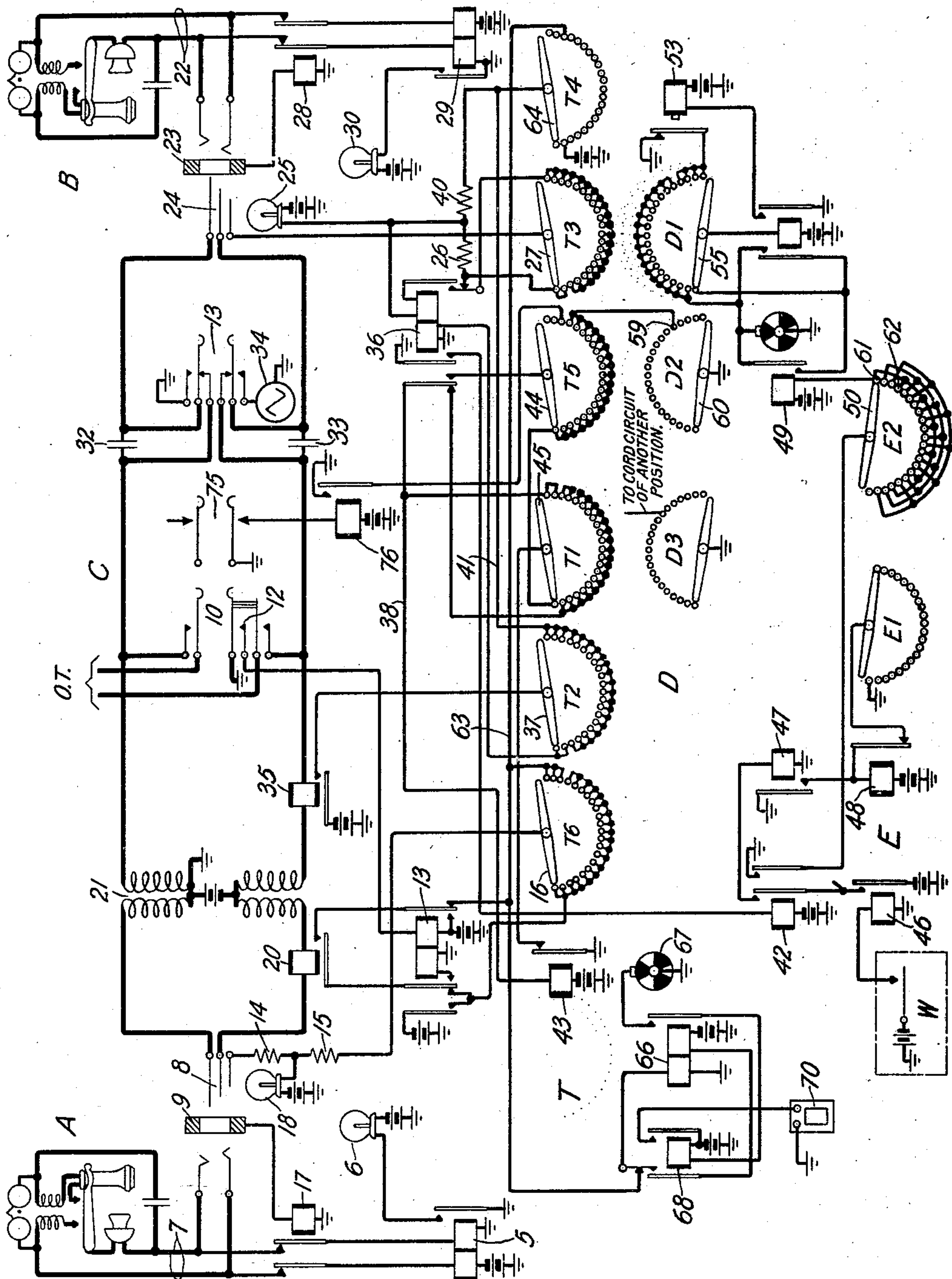
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TELEPHONE EXCHANGE SYSTEM

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TELEPHONE-EXCHANGE SYSTEM

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This invention relates to telephone exchange systems, and more particularly to such systems wherein link circuits are employed in the establishment of telephone connections.

5 In such systems it is desirable to provide means whereby an attending operator may be informed that the period of conversation between subscribers' stations on interconnected lines has reached a definite allotted time, so
10 that overtime charges may be recorded for time consumed in excess of the allotted period.

It is the object of this invention to transmit to an operator supervising a connection between subscribers' lines, a distinctive signal
15 upon the expiration of a predetermined period of time after the response of a called subscriber.

This object is attained in accordance with a feature of the invention by the provision of
20 timing equipment which comprises a plurality of cooperating selector switches associated with an operator's cord circuit, which are controlled by a calling supervisory relay in the cord circuit and function to cause the
25 flashing of the answering and calling supervisory lamps after a predetermined period of time has elapsed since the response of a called subscriber.

Another feature of the invention resides in
30 the provision of means whereby an untimely operation of the supervisory relay in the operator's cord circuit does not cause the timing equipment to function to transmit a false signal to the attending operator.

35 This second feature is accomplished by delaying the locking of the selector control relay until the selector individual to the cord circuit has advanced a predetermined number of positions. In this manner the premature
40 operation of a calling supervisory relay, which controls the locking relay just referred to, does not cause the immediate registration of time against the calling subscriber and insures against the subscriber being charged
45 for time not actually consumed in conversation.

It is believed that the invention will be readily understood from the following detailed description made with reference to the
50 accompanying drawing which discloses a call-

ing subscriber's station A, a called subscriber's station B and an operator's cord circuit C with associated timing equipment, which is employed to interconnect the two stations. The timing equipment comprises
55 a plurality of power driven selector switches or multi-position switches of the well known type and it is believed a description of their mechanical design and operating circuits is unnecessary. The selector switches are co-
60 functioning and clock-regulated.

The following description is directed to the establishment of a connection between stations A and B through the medium of the cord circuit C, and the functioning of the
65 selector switches T, D and E in transmitting an overtime signal to the supervising operator.

A subscriber at station A, upon initiating a call, removes the receiver from the switch-
70 hook and in so doing causes relay 5 to operate in an obvious circuit. Relay 5 in operating causes the line lamp 6 to be lighted as a signal to an operator at the central office that
75 a call on line 7 is awaiting attention. An operator at the central office proceeds to answer the call by inserting plug 8 of the cord circuit C located at her position, into jack 9 associated with the lighted line lamp 6, and
80 actuating the talking key 10.

The actuation of talking key 10 connects the operator's telephone set (not shown), but indicated at OT, with the talking leads of the cord circuit C. At contact 12 of the talking
85 key an obvious circuit is prepared for relay 13, which relay thereupon operates.

The insertion of plug 8 into jack 9 establishes a circuit which may be traced from grounded battery, outer left hand armature and front contact of relay 13, the No.
90 1 terminal of arc T⁶ of selector switch T, switch arm 16, resistance elements 15 and 14, sleeve contacts of plug 8 and jack 9, winding of sleeve relay 17 to ground. Relay 17 operates in this circuit, opening the circuit for
95 line relay 5 which releases, causing line lamp 6 to be extinguished. The resistance element 15 is relatively low and shunts the answering supervisory lamp 18 preventing it from lighting at this time. Relay 20 now operates in a
100

circuit extending from grounded battery, lower left hand winding of repeating coil 21, winding of relay 20, ring contacts of plug 8 and jack 9, the closed subscriber's line loop at station A, tip contacts of jack 9 and plug 8, upper left hand winding of repeating coil 21 to ground. Relay 20, in operating, establishes a locking circuit for relay 13 which may be traced from grounded battery, front contact and right hand armature of relay 13, front contact and armature of relay 20, inner left hand armature and front contact of relay 13, winding of relay 13 to ground. Relay 13 is now held operated under the control of the calling subscriber.

When the operator's telephone set is associated with the cord circuit C, the operator inquires of the calling subscriber the nature of the desired connection, and upon learning that the subscriber at station B associated with line 22 is desired, she proceeds to set up the connection by testing the jack 23 associated with line 22 in the usual well known manner, and finding the line idle inserts the calling plug 24 of the cord circuit C into jack 23.

The insertion of plug 24 into jack 23 establishes a circuit extending from grounded battery, filament of lamp 25, resistance element 26, No. 1 terminal of switch arc T^3 , switch arm 23, sleeve contacts of plug 24 and jack 23, winding of sleeve relay 28 to ground. Relay 28 operates in this circuit and opens the circuit for line relay 29 to prevent its operation and the subsequent lighting of line lamp 30. The lamp 25 is lighted in the circuit just traced.

The operator now actuates ringing key 31 which removes the short circuits from condensers 32 and 33 and connects the ringing current source 34 to the called line. The removal of the short circuits from the condensers 32 and 33 effects a path for the ringing current back to the answering end of the cord circuit C and to the calling subscriber's station A, so that the calling subscriber may hear the ringing signal. The signaling equipment at station B is actuated by current from the source 34. The operator then restores the ringing key 31, removing the source 34 from the connection and again short circuiting the condensers 32 and 33.

When the called subscriber at station B removes the receiver from the switchhook in answer to the ringing signal, a circuit is established extending from grounded battery, lower right hand winding of repeating coil 21, winding of relay 35, lower normal contacts of ringing key 31, ring contacts of plug 24 and jack 23, over the subscriber's line loop at station B, tip contacts of jack 23 and plug 24, upper normal contacts of ringing key 31, upper right hand winding of repeating coil 21 to ground. Relay 35 operates in this circuit and causes relay 36 to be energized in a

circuit extending from grounded battery, armature and front contact of relay 35, switch arm 37 of arc T^2 , conductor 38 to ground, through the left hand winding of relay 36.

Relay 36, in operating as described, establishes an obvious circuit for relay 42 by way of its inner left hand armature and front contact. At its outer left hand armature and front contact a circuit is established extending from grounded battery, winding of step magnet 43, outer left hand armature and front contact of relay 36, switch arm 44 and terminal No. 1 of arc T^5 , terminal No. 1 and switch arm 45 of arc T^1 , back contact and armature of magnet 43 to ground. At its right hand armature and front contact, relay 36 prepares a locking circuit for itself which is completed when the selector T is advanced to position No. 3, as will be described directly. The selector T advances from position 2 to position 20 under control of the selector D, as will appear from a later description.

When selector T reaches position #2, battery associated with terminal #2 of arc T^4 shunts the lamp 25 causing it to be extinguished. When the selector T reaches position #3 a circuit is established in which the resistance element 40 is connected in parallel with lamp 25, causing the lamp to remain extinguished after the switch arm 64 of arc T^4 moves off position #2. This shunt path may be traced from grounded battery, armature and front contact of relay 35, switch arm 37 and terminals of arc T^2 , conductor 41, resistance element 40, resistance element 26, terminals and switch arm 27 of arc T^3 to ground on the sleeve connection.

It will be noted that when selector T reaches position 3, the locking circuit originally prepared by the operation of relay 36 is completed, and may be traced from grounded battery, filament of lamp 25, right hand winding of relay 36, right hand armature and front contact of relay 36, terminals 3 to 22 and switch arm 27 of arc T^3 to ground on the sleeve connection. Lamp 25 is still connected in parallel with resistance element 40 by way of arc T^2 and the front contact and armature of relay 35 and accordingly does not receive sufficient current to be lighted at this time.

The purpose for completing the locking circuit for relay 36 only after the selector T has passed through the first two positions is to prevent the premature locking of the timing equipment should supervisory relay 35 be actuated accidentally. Relay 35 being connected in the cord circuit may receive a momentary kick or impulse due to the association of the calling end of cord circuit C with connecting links in which bridge circuits may be encountered, such as trunk circuits. A tripping bridge across a trunk circuit with which the cord circuit C may be associated or a surge following the plugging in of the cord

to a link circuit would momentarily establish an operating circuit for relay 35, which in functioning causes relay 36 to operate and start the timing equipment to be set in motion.

5 The timing equipment would then continue operating and would cause the transmission of a false signal to the operator and the calling subscriber would be charged for time in excess of the period actually consumed in conversation. By delaying the completion of the locking circuit for relay 36 until selector T has reached position No. 3, relay 35, if accidentally actuated, has time to restore and open the energizing circuit for relay 36 before 10 the latter is locked in the sleeve circuit. The release of relay 35, following such a premature operation, releases relay 36, which returns the selector T to normal under the control of arc T¹.

20 The feature of delaying the locking in of the timing equipment until a certain interval of time has elapsed since the actuation of relay 35, insures against the premature transmission of an overtime signal to the operator and the consequent overcharging of the subscriber.

The object in having relay 36 lock under the control of the plug sleeve is to insure its release and consequently the resetting of the timing equipment in case the operator withdraws plug 24 from a connection and reinserts it in another jack as she would do when attempting to call a new number.

30 Relay 46 is controlled by a clock mechanism schematically represented at W and is operated at regular intervals upon each closure of the clock circuit. The clock mechanism indicated at W may be of any well known type. With relay 42 operated as hereinbefore described, relay 47 follows the operations of the clock controlled relay 46 and accordingly causes the step magnet 48 to step the selector E around one position for each operation of relay 46. It is therefore observed that the selector E is directly controlled by the clock mechanism W. For practical purposes the clock mechanism is regulated to close the circuit for relay 46 once every six seconds and the selector E is accordingly advanced one 40 position for the elapse of every like period of time.

At every third step of selector E, that is, every eighteen seconds, relay 49 is operated in a circuit extending from grounded battery, winding of relay 49, every third terminal of arc E² of selector E, switch arm 50 to ground at the outer armature and front contact of relay 42. Relay 49, in operating, connects the interrupter 51 in circuit with the winding of relay 52 by way of the normal contact and switch arm of arc D¹ of selector D. Relay 52 accordingly operates and establishes an obvious circuit for step magnet 53 which causes the selector D to be moved from normal position to position No. 2. It will be noted, that

relay 49 is employed only to advance the selector D from its normal position to position 2. From positions 2 to 19, the selector D is advanced under the control of interrupter 51. This controlling circuit may be traced from grounded battery, winding of relay 52, switch arm 55, terminals 2 to 19 of arc D¹, interrupter 51 to ground. From position 19, selector D is advanced to normal by way of a circuit extending from the armature and back contact of step magnet 53, contacts 19 to 22 of arc D¹ switch arm 55 to grounded battery through the winding of relay 52.

It will now be noted that the terminals of arc D² of selector D are distributed among a number of cord circuits, such as the cord circuit C, and that one terminal is assigned to each particular cord. In the drawing, the eighteenth terminal 59 has been assumed to be allotted to the cord circuit C, and this terminal is tied to the terminals of arc T⁵ of selector T which is individual to the cord circuit C. Therefore, for every revolution of the selector D, the terminal 59 of arc D² receives ground from the switch arm 60, whereupon step magnet 43 of selector T is energized. This energizing circuit may be traced from grounded battery, winding of magnet 43, outer left hand armature and front contact of relay 36, switch arm 44, terminals of arc T⁵ of selector T, terminal 59 of arm D² of selector D to ground, on the switch arm 60. It will therefore be observed that for every complete revolution of selector D, the selector T is advanced one position.

As long as relay 42 remains operated, selector E continues to function and every time the terminals 61, 62 and every third terminal thereafter of arc E² is engaged by switch arm 50, the selector D is caused to make one revolution as already described.

When selector T reaches position 20 under the control of selector D, the lamps 18 and 25 are flashed in a characteristic manner as follows: The twentieth terminal on the arcs T⁶ and T⁴ are joined together by the conductor 63, so that when switch arm 64 reaches the terminal of arc T⁴ and switch arm 16 reaches a corresponding terminal of arc T⁶, the lamps 18 and 25 will be connected in parallel to the twentieth terminal of arc T⁶ which is associated with the low resistance left hand winding of relay 66. Accordingly with the lamps 18 and 25 now connected in parallel and the low resistance left hand winding of relay 66 included in the circuit, the lamps receive sufficient current to be lighted, and relay 66 to be operated. Upon the operation of relay 66, the interrupter 67 is placed in circuit with relay 68, so that this relay operates when the interrupter brush engages a conducting segment, and causes the audible signal 70 to function. At its left hand armature relay 68 causes relay 66 to lock in an obvious circuit and at the same

time opens the circuit to the lamps 18 and 25, whereupon these lamps are extinguished. When the brush of interrupter 67 engages the next insulating segment, the operating circuit for relay 68 is opened and this relay restores, silencing the audible signal 70 and again connecting lamps 18 and 25 in circuit with the low resistance, left hand winding of relay 66. These lamps accordingly are again lighted. The next conducting segment encountered by the brush of interrupter 67 re-actuates relay 68 to again cause the audible signal 70 to be sounded and the lamps 18 and 25 to be extinguished. In this manner the supervisory lamps 18 and 25 are caused to flash and the audible signal to be actuated intermittently as long as the selector D is in its twentieth position.

Upon receipt of such a signal the operator tallies overtime in any suitable manner so as to charge the calling subscriber in accordance with the time consumed in conversation. The operator then actuates key 75 and immediately releases it. Relay 76 is accordingly operated and places ground on the twentieth terminal of arc T^5 of selector T, whereupon step magnet 43 is actuated in a circuit extending from grounded battery, winding of magnet 43, outer left hand armature and front contact of relay 36, switch arm 44 and twentieth terminal of arc T^5 to ground on the armature and front contact of relay 76. The step magnet thereupon advances selector T to position 21 and at this point it is advanced to normal position under the control of arc T^1 by way of the back contact of step magnet 43. This circuit is obvious.

If the subscribers continue to converse after the transmission of an overtime signal, the switches continue to function in the same cycle of operations, as just described and for every complete revolution of selector T, the lamps 18 and 25 flash and the audible signal 70 is sounded to indicate to the operator to record overtime.

At the termination of conversation the calling and called subscribers replace their receivers on the switchhooks, whereupon relays 20, 35 and 13 are released. The release of relays 20 and 35 causes the resistance elements 15 and 40 to be removed from the circuits of lamps 18 and 25, respectively, whereupon these lamps are lighted steadily over the sleeve circuits as a disconnect signal. The operator thereupon proceeds to take down the connection by withdrawing the answering and calling plugs from jacks 9 and 23 respectively. The removal of the calling cord from jack 23 effects the release of relays 36 and 42. If at this time the selector T is off terminal No. 1, which is its normal position, it is advanced to normal under control of arc T^1 . The circuit for step magnet 43 under this condition is believed to be obvious.

When relay 42 releases, the circuit for relay 47 is opened and ground is removed from selector E at arc E^2 , which causes the release of relay 49 if operated at this time. If selector E is off normal at this time, it is advanced to normal under control of arc E^1 and the circuit is restored to normal.

From the foregoing description it is evident that the selectors E, D and T cooperate to effect the transmission of an overtime signal to the supervising operator and that the answering and calling supervisory lamps are flashed simultaneously. The selector E is directly controlled by the clock mechanism indicated at W and is so arranged that the office load is distributed equally. The terminals of arc E^2 are so interconnected that the entire office load is divided into three groups and every third terminal of arc E^2 serves the same group of cord circuits. For every operator's position there is assigned one arc, such as arc D^2 of selector D, each cord of the same position being allotted one terminal, such as 59, on the same arc such as D^2 . Other arcs, such as D^3 of selector D are assigned to other operators' positions. The selector D therefore serves a plurality of positions at the exchange, each arc thereof being assigned to one position, whereas each cord circuit, such as cord C, has a selector T individually allotted thereto.

What is claimed is:

1. In a telephone exchange system, a plurality of lines terminating at a central office, a plurality of link circuits thereat for interconnecting said lines, signaling devices for said link circuits, a plurality of selector switches for actuating said signaling devices, and means controlled jointly by the operator and the subscriber on a connected line for actuating said selector switches to effect the operation of said signaling devices a predetermined period of time after the response of a subscriber to a connection between said lines.

2. In a telephone exchange system, a plurality of lines terminating at a central office, a plurality of link circuits thereat for interconnecting said lines, signaling devices for said link circuits, a selector switch for each of said link circuits for actuating said signaling devices upon the arrival of said switch at a predetermined position thereof, and time regulated means for advancing said selector switch to said predetermined position.

3. In a telephone exchange system, a plurality of lines terminating at a central office, a plurality of link circuits thereat for interconnecting said lines, signaling devices for said link circuits, a selector switch for each of said link circuits for actuating said signaling devices upon the arrival of said switch at a predetermined position thereof, and a plurality of time regulated selector switches

common to said plurality of link circuits for advancing said first selector switch to said predetermined position.

4. In a telephone exchange system, a plurality of lines terminating at a central office, a plurality of link circuits thereat for interconnecting said lines, signaling devices for said link circuits, a selector switch for each of said link circuits for actuating said signaling devices upon the arrival of said switch at a predetermined position thereof, a plurality of selector switches serving all of said link circuits, and subscriber controlled means for actuating all of said switches and causing said second selector switches to advance said first selector switch to said predetermined position.

5. In a telephone exchange system, a plurality of lines terminating at a central office, a plurality of link circuits thereat for interconnecting said lines, signaling devices for said link circuits, a multi-position switch for each of said link circuits adapted to effect the actuation of said signaling devices upon the arrival of said switch at a predetermined position thereof, time regulated means for advancing said switch to said predetermined position, and operator controlled means for advancing said switch from said predetermined position to its normal position.

6. In a telephone exchange system, a plurality of lines terminating at a central office, a plurality of link circuits thereat for interconnecting said lines, signaling devices for said link circuits, a multi-position switch for each of said link circuits adapted to effect the actuation of said signaling devices upon the arrival of said switch at a predetermined position thereof, time regulated means for advancing said switch to said predetermined position, and a key common to all of said link circuits for advancing said switch from said predetermined position to its normal position.

7. In a telephone exchange system, a plurality of lines terminating at a central office, a plurality of link circuits thereat for interconnecting said lines, signaling devices for said link circuits, timing means, a multi-position switch for each of said link circuits having first and second predetermined positions, said first position being a locking position for said timing means and said second position being an operating position for said signaling devices, and subscriber controlled means for moving said switch from its normal position and placing it under the control of said timing means to advance it through said first predetermined position to said second predetermined position.

8. In a telephone exchange system, a plurality of lines terminating at a central office, a plurality of link circuits thereat for interconnecting said lines, signaling devices for

said link circuits, timing means, a multi-position switch for each of said link circuits having first and second predetermined positions, said first position being a locking position for said timing means and said second position being an operating position for said signaling devices, means for moving said switch from its normal position and placing it under the control of said timing means to advance it through said first predetermined position to said second predetermined position and operator controlled means for advancing said switch from said second predetermined position to normal position.

9. In a telephone exchange system, calling and called subscribers' lines, a link circuit for interconnecting said lines, signaling devices for said link circuit, a plurality of time regulated selector switches, and means controlled jointly by the operator and a called subscriber on a connected line for actuating said selector switches to cause the distinctive operation of said signaling devices a predetermined period of time subsequent to the response of the called subscriber on a connected line.

10. In a telephone exchange system, calling and called subscribers' lines, a link circuit for interconnecting said lines having answering and calling ends, signaling devices for each end of said link circuit, a multi-position switch for said link circuit having a position thereof for controlling the circuits of both said signaling devices, means initially controlled by the response of a called subscriber for actuating said switch, and means controlled independently of said subscriber for advancing said switch to its circuit controlling position to effect the operation of both said signaling devices.

11. In a telephone exchange system, calling and called subscribers' lines, a link circuit for interconnecting said lines having answering and calling ends, a signal lamp for each end of said link circuit, a flashing control circuit for said signaling lamps, a multi-position switch for said link circuit having a predetermined position thereof associated with said flashing control circuit, means initially controlled by the response of a called subscriber on a connected line for actuating said switch, and means effective subsequent to the response of said called subscriber for advancing said switch to said predetermined position and associating said flashing control circuit with said signaling lamps.

12. In a telephone exchange system, calling and called subscribers' lines, a link circuit for interconnecting said lines having answering and calling ends, a signaling device for each end of said link circuit, timing equipment including a multi-position switch for said link circuit adapted to effect the actuation of said signaling devices upon the arrival of said switch at a predetermined position

tion, a control relay for said timing equipment, a relay associated with said link circuit operated in response to a called subscriber on a connected line for actuating said control relay, and a locking circuit for said second relay established subsequent to a predetermined period of operation of said timing equipment and prior to the arrival of said switch at said predetermined position.

13. In a telephone system, a calling subscriber's line, a called subscriber's line, a link circuit interconnecting said lines, signaling devices associated with said link circuit, and a plurality of selector switches actuated upon the response of a subscriber on said called subscriber's line for actuating said signaling devices a predetermined period of time subsequent to said response.

14. In a telephone system, a calling subscriber's line, a called subscriber's line, a link circuit interconnecting said lines, signaling devices associated with said link circuit, a subscriber controlled relay in said link circuit, a second relay actuated in response to the operation of said subscriber controlled relay, and a plurality of selector switches actuated upon the operation of said second relay to effect a locking circuit for said second relay and the distinctive actuation of said signaling devices.

15. In a telephone system, a plurality of lines terminating at a central office, a link circuit thereat for interconnecting said lines, signaling devices for said link circuit, and timing means including a plurality of multi-position switches initially controlled by a subscriber on one of said lines, and subsequently controlled independently of said subscriber for actuating said signaling devices upon the arrival of said switches at predetermined positions thereof.

16. In a telephone system, a calling station, a called station, a link circuit interconnecting said stations, signaling devices for said link circuits, a first selector switch, a second selector switch, means controlled by the response of a called subscriber to a call for simultaneously actuating said first and second selector switches, and means intermediate said first and second selector switches for translating the movements of said first selector switch to said second selector switch in a certain predetermined manner to cause said signaling devices to be actuated a predetermined period of time after the response of the called subscriber.

17. Timing means comprising in combination, means for producing electrical pulses periodically, registering means operable by said electrical pulses, means for connecting said registering means to said pulse source for operation thereby, signaling means controlled by said registering means and operable thereby after registration of a predetermined number of pulses.

18. Timing means comprising in combination, means for producing electrical pulses periodically, registering means operable by said electrical pulses, means for connecting said registering means to said pulse source for operation thereby, signaling means associated with said registering means and operable thereby after a fixed number of operations of said registering means.

19. Timing means comprising in combination, means for producing electrical pulses periodically, registering means operable by said electrical pulses, means for connecting said registering means to said pulse source for operation thereby, signaling means associated with said registering means and operable thereby after a fixed number of operations of said registering means, means for extinguishing said signaling means and starting anew the operation of said registering means.

20. Timing means comprising in combination, means for producing electrical pulses periodically, registering means for registering the number of said pulses up to a fixed limit, means for normally maintaining said registering means in a non-registering condition, means for connecting said registering means to said pulse source for operation thereby, signaling means associated with said registering means and operable thereby upon registration of said limiting number of pulses.

21. Timing means comprising in combination, means for producing electrical pulses periodically, registering means for registering the number of said pulses up to a fixed limit, means for normally maintaining said registering means in a non-registering condition, means for connecting said registering means to said pulse source for operation thereby, signaling means associated with said registering means and operable thereby upon registration of said limiting number of pulses, means for extinguishing said signaling means and for restoring said registering means to the non-registering condition for starting anew the registering of said pulses.

In witness whereof, we hereunto subscribe our names this 7th day of May, 1928.

ALFRED E. HAGUE.
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