Oct. 1, 1940. B. D. WILLIS 2,216,528

TELEPHONE SYSTEM

Filed July 8, 1937

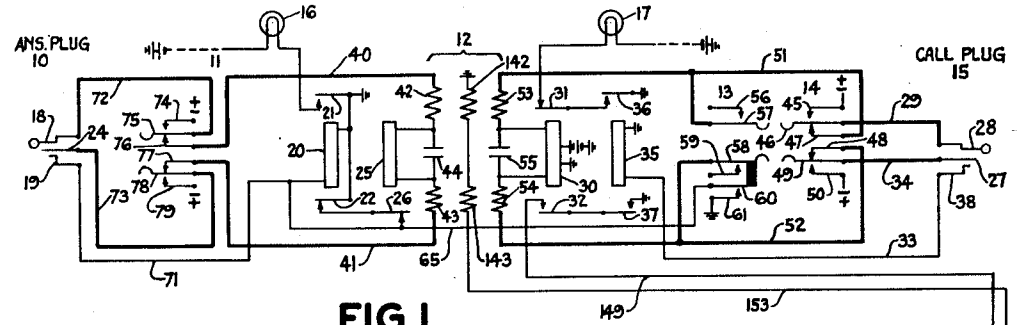



FIG. 1

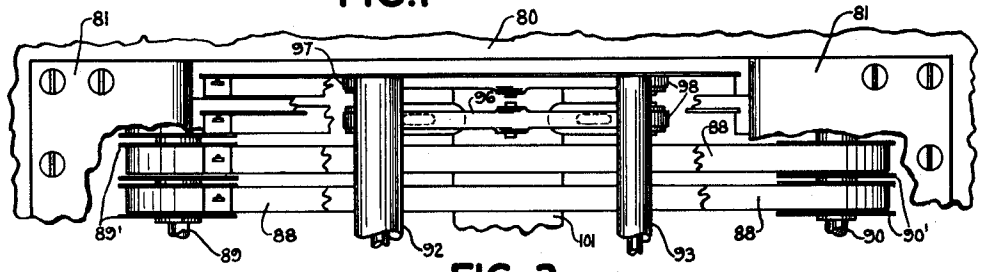


FIG. 3

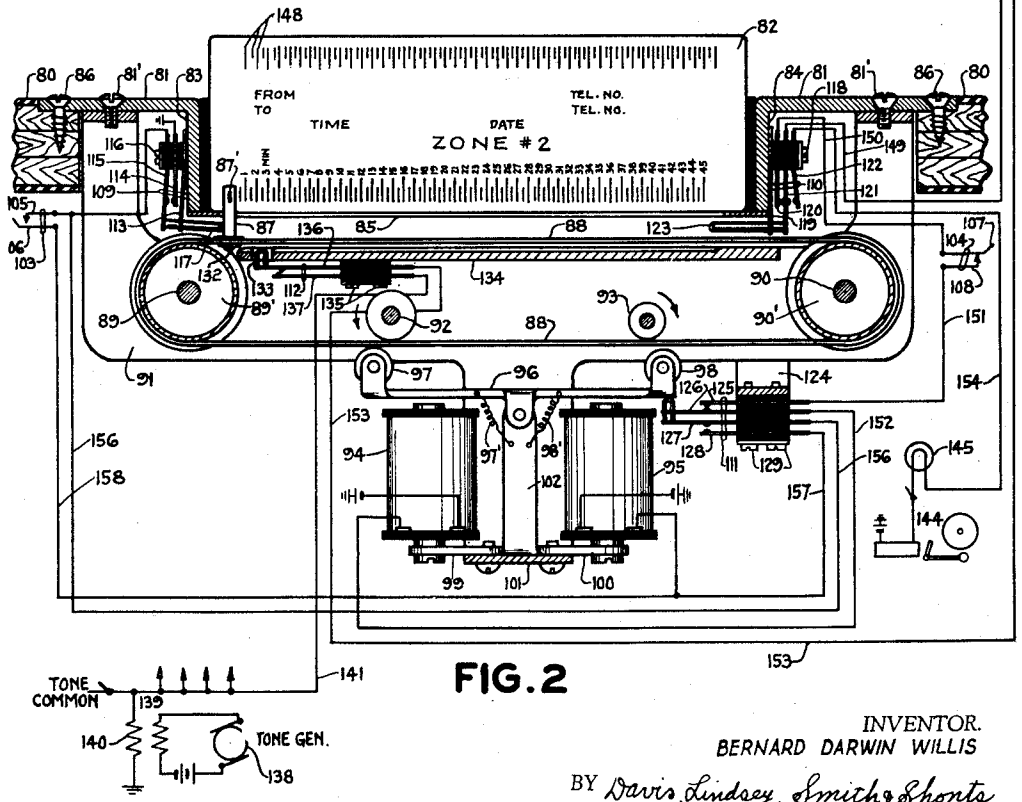



FIG. 2




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ATTORNEYS.

Patented Oct. 1, 1940

2,216,528

# UNITED STATES PATENT OFFICE

2,216,528

## TELEPHONE SYSTEM

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Application July 8, 1937, Serial No. 152,497

6 Claims. (Cl. 179—7.1)

The present invention relates to signalling apparatus and more particularly to apparatus for indicating the time during which two telephone lines are connected together for communication thereover.

As is well known, the conventional method by which a telephone toll charge is computed is that of measuring the elapsed time during which the toll connection is established and computing the charge therefor on the basis of the elapsed time and the distance between the calling and called subscribers' substations as determined generally by the zones in which the two substations are located. The type of connection noted, namely, a toll connection, is invariably established through the medium of an operator located in the exchange terminating the calling subscriber's line who first causes the connection to the called subscriber's substation to be set up by way of the proper interexchange toll trunk lines and then interconnects the calling subscriber's line with the outgoing trunk line to complete the desired connection. Various methods of computing the elapsed time during which the connection is established are employed. All such methods, however, involve operations requiring strict attention on the part of the operator with a consequent likelihood of error in accurately computing the charges to be assessed for the call.

It is an object of the present invention, therefore, to provide a new and improved mechanism which automatically operates accurately to measure the elapsed time during which a pair of signalling lines, and more particularly a pair of telephone lines, are connected for communication thereover.

It is another object of the invention to provide a device of the above character for permanently recording the elapsed time during which two telephone lines are connected for conversation thereover, which device is operative independently of the operator who sets up the desired connection.

More specifically, it is an object of the invention to provide apparatus for performing the functions described in the two immediately preceding paragraphs which is of simple construction and is thoroughly reliable in operation.

In brief, the objects as set forth above are attained in accordance with the present invention by providing a mechanism of the character noted which comprises an indicating element movable at substantially constant speed to indicate elapsed time, means automatically operable when the connection between the two subscribers' substations is established for initiating the movement of the indicating element, and means automatically operable to interrupt the movement of the indicating element when the connection is broken. More specifically, the mechanism comprises a marking element mounted on supporting means in the form of an endless belt which extends over idler rollers, which element is normally retained in a home position and is movable with said belt in one direction over a card bearing indicia evenly spaced to provide a measure of time. Movement of the belt to cause movement of the marking element away from or to the home position thereof is accomplished by providing driving means comprising a pair of driving shafts adapted to be driven in opposite directions at substantially constant speeds. For the purpose of operatively associating the belt with either of the two driving shafts, a pair of electromagnets are provided which are individually associated with the shafts and which, when energized, move the belt to a position to be driven by the associated shaft. Circuits are included in the apparatus for energizing each of the two magnets, that for the magnet which causes the marking element to be moved away from its home position being completed by a supervisory relay included in the operator's apparatus, which relay operates in response to the completion of the connection between the calling subscriber's line and the called subscriber's line. In order to transmit to the parties conversing over the connection a signal indicating the near completion of a minimum charge time period, there is provided a switch, controlled by the movement of the marking element, which is operated in response to a predetermined movement of the marking element, and means responsive to the operation of this switch for impressing a warning signal voltage on the established connection. At the termination of the conversation over the established connection, when the connection is broken and the above-noted supervisory relay restores, the operating circuit for the energized one of the two magnets is broken to interrupt the movement of the marking element. A manually operated switch is provided for interrupting the energizing circuit for this magnet independently of the supervisory relay, thereby to permit the operator to cut in on the connection without recording the time during which the intrusion interferes with the ensuing conversation over the established connection. A second manually operable switch is provided for completing the circuit for energizing the second of the two magnets, thereby to cause the marking element to be returned to its home

position. A further feature of the invention relates to the provision of a second switch operative in response to a predetermined movement of the marking element to interrupt the circuit of the magnet causing movement of this element away from its home position and to complete the circuit of a signal device to indicate to the operator that the connection has been established for a predetermined length of time. The arrangement is such that only a momentary operation of the manually operable switch controlling the homing magnet is required, this magnet, upon operating, completing a holding circuit for itself which is interrupted only when the marking element is returned to its home position. In accordance with a further feature of the invention, an arrangement is provided whereby two or more timing mechanisms may be actuated from the same pair of driving shafts, thereby eliminating duplication in respect to the elements included in the apparatus.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the specification taken in connection with the accompanying drawing in which Figure 1 illustrates a cord circuit of conventional form adapted to be used by a toll operator in setting up toll connections, and Figs. 2 and 3 illustrate the details of a plurality of timing mechanisms, each constructed and arranged in accordance with the present invention.

Referring now more particularly to Fig. 1 of the drawing, there is illustrated, as noted above, an operator's cord circuit of conventional form which may be utilized by a toll operator in setting up connections between two subscribers' lines. In brief, the circuit comprises an answer plug 10, a ringing key 11, a repeater 12, an answer key 13, a ringing key 14, and a call plug 15, together with control relays 20, 25, 30, and 35, and signal lamps 16 and 17. The answer plug 10, which is adapted to be inserted in the jacks terminating lines incoming to the toll operator's board at the exchange in which the apparatus shown is located, includes a tip contact 18 connected to a line conductor 72 of the cord, a ring contact 24 connected to the other line conductor 73 of the cord, and a sleeve contact 19 connected to a conductor 71 included in the circuit for energizing the relay 20. Similarly, the call plug 15 comprises a tip contact 28 connected to one line conductor 29 of the cord, a ring contact 27 connected to the other line conductor 34, and a sleeve contact 38 connected to a conductor 33 included in the circuit for energizing the relay 35. The ringing key 11, includes contact springs 74, 75, 76, 77, 78, and 79 for selectively connecting the line conductors 72 and 73 by way of line conductors 40 and 41 to the primary windings 42 and 43 of the repeater 12 or to the terminals of the alternating current ringing generator, as indicated. The windings noted are bridged across the line conductors 40 and 41 by means of a condenser 44 shunted by the windings of the supervisory relay 25. Similarly, the ringing key 14 includes contact springs 45, 46, 47, 48, 49 and 50 for selectively connecting the line conductors 29 and 34 to the ringing generator, or connecting these line conductors by way of conductors 51 and 52 to the secondary windings 53 and 54 of the repeater 12. The last-mentioned windings are bridged in series with a condenser 55 across the conductors 51 and 52, and the condenser 55 is shunted by the windings of the supervisory relay 30 in series with the exchange battery. The answer key 13 includes contact springs 56, 57, 58, 59, 60 and 61, the springs 57 and 58 being connected to the line conductors 51 and 52, and the springs 56 and 59 being connected to the operator's telephone, not shown.

In the operation of the cord circuit as described above, and when the operator is informed by a signal lamp on her board that an incoming call awaits attention, she may insert the answer plug 10 in the jack terminating the line on which the call is initiated, thereby operatively to associate her telephone with the line leading to the calling subscriber's telephone. When this operation is performed, a loop is completed, in a well-known manner, for energizing the relay 25 and battery from the cut-off relay associated with the incoming line is extended by way of the sleeve contact 19 and the conductor 71 to energize the relay 20. This latter relay does not operate until the relay 25 operates its armature 26 to open the obvious circuit short-circuiting the winding of the relay 20, but upon operating, completes, at its armature 21, an obvious circuit for energizing the signal lamp 16. At its armature 22 the relay 20 opens a further point in the path for short-circuiting its winding. The operator, upon witnessing the lighted condition of the lamp 16, may operate the answer key 13 to its off-normal position thereby to complete a loop, extending by way of the repeater 12, between her telephone and the calling subscriber's telephone. Upon operating the answer key 13 to its off-normal position, a path is completed, at the springs 60 and 61, for again short-circuiting the winding of the relay 20, this path extending from ground at the spring 61 by way of the spring 60, the conductor 65, the winding of relay 20, and back to ground. The relay 20 now restores to interrupt, at its armature 21, the circuit for energizing the signal lamp 16.

Upon conversing with the calling party and obtaining the information as to the substation desired by this party, the operator may proceed to set up a connection ultimately to be extended to the called party's telephone by inserting the call plug 15 in the jack terminating an idle outgoing trunk line leading to the desired exchange. This operation completes a circuit for energizing the relay 35, this circuit extending from battery at the sleeve contact of the jack in which the plug 15 is inserted, by way of the sleeve contact 38, the conductor 33 and the winding of the relay 35 to ground. The relay 35, upon operating, completes at its armature 36 a circuit for energizing the signal lamp 17 and prepares at its armature 37a circuit, traced hereinafter for initiating the operation of the mechanism shown in Figs. 2 and 3 of the drawing. It is pointed out that if the telephone desired by the calling party is connected to a line terminating at the exchange in which the equipment illustrated is located, this telephone may be rung directly by manipulation of the ringing key 14. The ringing key 11 is used only in those instances wherein the operator instructs the calling party to hang up and recalls the calling party when the connection to the called party is ultmately established. If, on the other hand, the call must necessarily be extended through a number of exchanges in tandem, the operator in the last exchange will ring the desired party and, if this party is located, complete a connection extending by way of the cord circuit

shown between the calling party's telephone and the desired called telephone.

It is pointed out that during the preliminary operations of extending the toll line connection to the exchange terminating the called subscriber's line, the supervisory relay 30 remains de-energized, the battery potential applied to its upper winding being in opposition to that impressed thereon through the windings of a supervisory relay included in the cord circuit terminating the trunk line outgoing from the exchange including the apparatus shown and extended to the windings of the relay 30 over the loop including the trunk line noted. When, however, the called substation answers and is connected to the last-mentioned trunk line, battery is reversed over the conductors of this line, in a well-known manner, and the supervisory relay 30 is caused to operate. When the relay 30 operates, it interrupts, at its armature 31 the energizing circuit for the lamp 17 and completes, at its armature 32, the above-mentioned circuit for initiating the operation of the timing apparatus illustrated in Figs. 2 and 3 of the drawing. When the established circuit is broken at the called party's substation, battery is again reversed over the trunk line extending to the call plug 15 and the relay 30 is de-energized. This relay, upon restoring, interrupts, at its armature 32, the operating circuit leading to the timing mechanism described below and at its armature 31 completes the energizing circuit for the signal lamp 17.

Referring now more particularly to Figs. 2 and 3 of the drawing, the timing mechanism there shown is adapted to be mounted beneath the shelf of the toll operator's board directly adjacent the operator's position. Such a shelf is fragmentarily indicated at 80 and is provided with an enlarged opening for accommodating a member 81 for supporting the timing apparatus. This supporting member 81 is slotted at spaced intervals to accommodate indice-bearing cards, one of which is shown at 82. Projecting downwardly from the top portion of the member 81 are guide mmbers 83 and 84 which have mounted along the lower edges thereof a card-support plate 85. As indicated, the supporting member 81 is fixedly mounted on the shelf 80 by means of screws 86.

Arranged to cooperate with a card inserted in the slot in the manner illustrated is an indicating or marking element 87 carried by supporting means comprising an endless belt 88 and movable therewith relative to the surface of the card 82. This element 87 is provided at its upper end with a stylus 87' for inscribing a line on the card 82 in the manner described hereinafter. The belt 88 extends around idler rollers 89' and 90' mounted on rotatable shafts 89 and 90 supported between a pair of bracket members 91 mounted on the supporting member 81 by screws 81'. For the purpose of driving the belt 88, there are provided a pair of driving rollers 92 and 93 arranged to be driven in opposite directions, as indicated by the arrows, at substantially constant speeds by small synchronous motors, not shown. Preferably, the outer surface of each of the rollers 92 and 93 is constructed of comparatively soft rubber or other similar material to enhance the frictional engagement thereof with the belt 88.

The two rollers 92 and 93 are normally continuously driven by their respective driving motors and the belt 88 occupies a position out of driving engagement with either thereof. In order to associate the belt with either of the two rollers noted, there are provided electromagnetic means comprising a pair of clutching magnets 94 and 95 arranged selectively to be energized, in the manner described hereinafter, to rotate a rocker arm 96 in one direction or the other and bring one of two rollers 97 and 98 carried by the arm 96 into engagement with the belt 88, thereby operatively to associate the belt with one of the driving rollers 92 or 93. As indicated, the magnets 94 and 95 are supported on bracket pieces 99 and 100 mounted on a shelf portion 101 extending between the two brackets 91. A cut out and upwardly bent portion 102 of the shelf 101 carries pivotally mounted at its upper end the rocker arm 96 in the manner shown, this rocker arm normally being biased to the position shown by springs 97' and 98'.

The control means for the two magnets 94 and 95 comprises, in addition to the usual circuit conductors, a pair of manually operable switches 103 and 104 including, respectively, springs 105, 106 and 107, 108. Also included in the control means for the two magnets noted are four off-normal switches 109, 110, 111 and 112, each of which includes two or more springs mounted on various portions of the supporting structure, as described above. Thus, the switch 109 includes three springs 113, 114, and 115, and insulating pieces for insulating the springs one from the other mounted on the guide member 83 by means of a screw 116. This switch includes a control element 117 arranged to cooperate with the marker element 87 to control the positions of the springs 113 and 115. The switch 110 is mounted on the opposite guide member 84 by means of a screw 118 and includes insulating pieces interposed between the various springs 119, 120, 121, and 122, and making up the switch spring assembly. The control element 123 for the last-mentioned switch which is also adapted to be operated by the marker element 87, is arranged to control the position of the springs 119 and 121. The switch 111 is mounted on a bracket 124 extending from the member 91. This latter switch comprises springs 125, 126, 127 and 128 interspaced with insulating pieces in the manner shown and secured to the supporting bracket 124 by screws 129. Of these springs, the springs 126 and 127 are arranged to be actuated by the rocker arm 96 from their respective normal positions to their off-normal positions upon energization of the magnet 95. The switch 112, which comprises only two springs 136 and 137, is arranged to be actuated during movement of the marker element 87 across the card 82 by the engagemnt of a cap 132, attached to the lower end of the element 87, with a control element 133 carried by the spring 136. The springs 136 and 137 of this switch and insulating pieces interposed between the springs are supported on a guide member 134 for the belt 88 by screws 135, as shown. This guide member 134 may be supported on the member 81 in any desired manner.

As pointed out in detail hereinafter, the switch 112 forms a part of means for applying a warning signal voltage to an established connection a predetermined time interval after the connection is set up. This means includes, in addition to the switch 112, a tone or warning signal generator 138 connected to a transformer 139 having its secondary winding 140 connected by a conductor 141 across two series-connected tertiary windings 142 and 143 included in the repeater 12 shown in Fig. 1 of the drawing. The apparatus

also includes means operable to signal the operator at a predetermined time interval following the establishing of the connection. This means includes the bell 144 and the indicating lamp 145, connected and arranged in the manner described hereinafter.

Since the toll operator may be required to handle a number of toll calls at the same time, it is desirable to provide a number of mechanisms of the character briefly described above, to assist her in determining the time intervals during which the various connections are maintained. Considerable duplication in the matter of the apparatus involved is avoided by utilizing the arrangement illustrated more particularly in Fig. 3, wherein the two driving rollers 92 and 93 extend transversely with respect to a plurality of belts 88 for driving any one thereof in either direction when the selected belt is operatively associated therewith. These belts extend over the oppositely disposed idler rollers 89' and 90'. It will be understood that a card slot is provided in association with each of the belts 88 and, further, that all of the apparatus illustrated in Fig. 2, with the exception of the independent driving rollers 92 and 93 and rollers 89' and 90' is embodied in each unit mechanism. It will further be understood that, by this arrangement, a duplication of rollers as well as the motors for driving the rollers 92 and 93 is obviated.

As pointed out above, each of the cards 82 is marked with indices suitably spaced to provide a measure of time when the marker element 87 is moved thereacross to inscribe a line along the bottom edge thereof intersecting the indices. Thus, the card 82 illustrated in Fig. 3 has inscribed along each longitudinal edge indices 148 evenly spaced apart with the spacing therebetween so related to the speed at which the marking element 87 is moved relative to the card that the distance between adjacent indices represents an elapsed time interval of one minute. The indices indicated on the card 82 along each edge are limited to a total elapsed time of forty-five minutes so that, when the card is completely marked along one edge and is then reversed, a total measured time of one hour and a half may be recorded. This card may also bear suitable spaces for logging the data concerning the calling party, the telephone number of the calling party, the called party, the time of the call, the date when the call is made and the charges to be rendered. As an alternative, zone cards may be used, these cards bearing indices graduated in dollars and cents to indicate directly and without computation the charges to be made for the call. In this latter instance, the spacing of the indices will be different for different cards representing calls between telephones located in different zones, these spacings being calculated on a time basis, taking into account the zone from which the call originates and the zone in which the called subscriber's substation is located.

As pointed out above, the operation of the mechanism illustrated in Fig. 2 is initiated upon energization and operation of the relay 30. Thus, with the elements of the mechanism occupying the positions shown in Fig. 3 and when the relay 30 operates in response to the completion of the desired connection, a circuit is completed for energizing the magnet 94, this circuit extendng from ground at the armature 37 by way of the armature 32, the conductor 149, the springs 121 and 120, the conductor 150, the springs 107 and 108, the conductor 151, the springs 125 and 126, the conductor 152 and through the winding of the magnet 94 to battery. Upon being energized over the above-traced circuit, the magnet 94 rotates the rocker arm 96 in a counterclockwise direction to bring the roller 98 into engagement with the belt 88, thereby operatively to associate this belt with the driving roller 93. Movement of the belt 88 is thus initiated to move the marking element 87 to the right away from its home position, thereby to inscribe a line along the lower edge of the card 82, which line intersects the indices extending along this edge. During the initial movement of the marking element 87, the control element 117 of the switch 109 is moved to its normal position, thereby to prepare, at the springs 114 and 115, a circuit, traced hereinafter, for energizing the magnet 95.

At the end of a predetermined time interval corresponding to the period of minimum time charge, the cap 132 carried by the marking element 87 moves into engagement with the control element 133 of the switch 112 to make contact between the springs 136 and 137. When this occurs, a circuit is completed for impressing a warning signal voltage across the established connection between the calling and called substations, thereby to indicate to the calling and called parties that a further charge will be assessed unless they release the connection almost immediately. Thus, with the springs 136 and 137 in their contact make position, a circuit is completed for the flow of warning signal current through the tertiary windings 142 and 143 of the repeater 12, this circuit extending from ground at the lower terminal of the secondary winding 140 by way of this winding, the conductor 141, the springs 137 and 136, the conductor 153, the repeater windings 143 and 142 in series, back to ground at the upper terminal of the last-mentioned winding. The current flowing through the two windings 142 and 143 causes an induced voltage to be developed in the inductively coupled windings 42, 43 and 53, 54, which causes warning signal current to flow through the receivers of the substations by way of which the calling and called parties are conversing. The interval required for actuation of the switch 112 to its off-normal position may be of any length, although preferably is slightly less than the usual three-minute period upon the basis of which minimum toll charges are conventionally computed. If the conversation persists for a period of time greater than this minimum period of three minutes, the capped end 132 of the marking element 87, during its continued movement, rides from engagement with the control element 133, permitting the switch 112 to assume its normal position, thereby to interrupt the above-traced circuit for impressing a warning signal voltage across the established connection.

In the event the connection is released before the marking element 87 has completely traversed the card 82, the supervisory relay 30 is caused to restore, in the manner described above, thereby to interrupt, at the armature 32, the above-traced circuit holding the magnet 94 energized. Upon de-energization of this magnet, the rocker arm 96 assumes its normal position, as shown in Fig. 3 of the drawing, thereby to disassociate the belt 88 from the driving roller 93 and cause an interruption of the movement of the marking element 87 with respect to the card 82. The operator may thereupon remove the card from its slot and,

from the length of the inscribed line intersecting the indices 148 along the lower edge thereof, compute the charges to be assessed against either the calling or the called party. She may also cause the mechanism to be restored to its normal position in the manner described more particularly hereinafter.

If the operator desires, for any reason, to cut in on a connection without charging the time of the cut-in against the calling or the called party, she may do so by operating the switch 104 to its off-normal position, thereby to interrupt a point in the above-traced circuit over which the magnet 94 was initially energized and cause the de-energization of this magnet with the consequent stopping of the marking element 87. If she thereafter disconnects her telephone from the connection and the conversation between the calling and called parties is resumed, continued timing of the conversation may be had by restoring the switch 104 to again complete the circuit for energizing the magnet 94.

If the connection is held for a predetermined time interval of considerable length, which in the present assumed case is forty-five minutes, the marking element 87, as it approaches the right end of the card 82, comes into engagement with the control element 123 and actuates the switch 110 to its off-normal position. There results the breaking of the above-traced circuit for energizing the magnet 94 at the springs 120 and 121, thereby to stop the movement of the marking element 87. Simultaneously, a circuit is completed at the switch springs 121 and 122 for energizing the signal devices 144 and 145, this circuit extending from ground at the armature 37 by way of the armature 32, the conductor 149, the springs 121 and 122, the conductor 154 and through the lamp 145 and the operating magnet of the bell 144 in series to battery. Operation of the two signal devices noted indicates to the operator that the predetermined time interval required for completely inscribing one edge of the card 82 has elapsed, that the conversation over the established connection still persists, and that the card should be reversed in order to record the additional time during which the connection is utilized. She may then remove the card from its slot and operate the switch 103 to its off-normal position to complete a circuit for energizing the magnet 95. This circuit extends from ground at the spring 114 by way of the springs 114, 115, 105 and 106, the conductor 158 and through the winding of the magnet 95 to battery. The last-mentioned magnet, upon being energized, attracts the right arm of the rocker arm 96 to move the roller 97 into engagement with the belt 88, thereby operatively to associate this belt with the driving roller 92. Since the roller 92 rotates in a direction opposite to the direction of rotation of the roller 93, the marking element 87 is caused to be returned to its normal or home position. Immediately upon the energization of the magnet 95 to attract the arm 96, the switch 111 is operated to its off-normal position to complete a holding circuit, independently of the switch 103 for maintaining the magnet 95 energized, this circuit extending from ground at the spring 114 by way of the spring 115, the conductor 156, the springs 127 and 128, the conductor 157 and through the winding of the magnet 95 to battery. This holding circuit is maintained until the marking element 87 is returned to its home position. During the initial movement of the marker element 87 toward its home position, the switch 110 is restored to its normal position, thereby to interrupt the previously traced circuit for energizing the signal devices 144 and 145 and to reprepare the circuit, traced above, for reenergizing the magnet 94.

When the marker element 87 is restored to its home position, the above-traced holding circuit for the magnet 95 is interrupted at the switch springs 115 and 114. The resulting de-energization of the magnet 95 and restoration of the rocker arm 96 to its normal position, causes the restoration of the switch 111 to its normal position to again complete, at its springs 125 and 126, the circuit for energizing the magnet 94. At this time the card 82 is re-inserted in its slot in a position reversed from that shown in Fig. 3 so that the upper set of indices, as shown in the drawing, are disposed in the path of movement of the marking element 87. The marking element 87 again moves away from its home position to inscribe on the other set of indices the additional time during which the established connection is maintained in use.

In the event the connection is released before the marking element 87 moves into engagement with the control element 123 of the switch 110, movement of the element 87 is stopped, in the exact manner described above in response to the restoration of the relay 30. In order to restore the mechanism to normal, it is only necessary that the operator actuate the switch 103 to its off-normal position to complete a circuit for energizing the magnet 95 whereupon the sequence of operations described immediately above is caused to occur. It is pointed out that the operator need only momentarily operate the switch 103 to its off-normal position since once the magnet 95 is energized it is held energized over the above-traced holding circuit until the marking element 87 is fully restored to its home position.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is contemplated to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

I claim:

1. A mechanism for recording the time during which two telephone lines are connected for conversation thereover comprising, in combination, a card bearing indicia evenly spaced to provide a measure of time, a member for supporting said card, a marker element having a home position, movable means for supporting said element, said last-named means being arranged to move said element away from said home position, driving means for moving said element supporting means in a direction to move said element away from said home position and over the indicia of said card at a substantially constant speed to indicate elapsed time, electromagnetic means for operatively associating said driving means with said supporting means, a circuit for energizing said electromagnetic means, means responsive to the completion of said connection for completing said circuit, means responsive to the breaking of said connection for interrupting said circuit, and means for restoring said element to its home position.

2. A mechanism for recording the time during which two telephone lines are connected for conversation thereover comprising, in combination, a card bearing indicia evenly spaced to provide a measure of time, a member for supporting

said card, a marker element having a home position, movable means for supporting said element, said last-named means being arranged to move said element away from said home position, driving means for moving said element supporting means in a direction to move said element away from said home position and over the indicia of said card at a substantially constant speed to indicate elapsed time, electromagnetic means for operatively associating said driving means with said supporting means, a circuit for energizing said electromagnetic means, means responsive to the completion of said connection for completing said circuit, means responsive to the breaking of said connection for interrupting said circuit, driving means for moving said element supporting means in a direction to return said element to its home position, electromagnetic means for operatively associating said last-mentioned driving means with said element supporting means, a circuit for energizing said last-mentioned electromagnetic means, and means for completing said last-mentioned circuit.

3. A mechanism for recording the time during which two telephone lines are connected for conversation thereover comprising, in combination, a card bearing indicia evenly spaced to provide a measure of time, a member for supporting said card, a marker element having a home position, movable means for suporting said element, said last-named means being arranged to move said element away from said home position, driving means for moving said element supporting means in a direction to move said element away from said home position and over the indicia of said card at a substantially constant speed to indicate elapsed time, electromagnetic means for operatively associating said driving means with said supporting means, a circuit for energizing said electromagnetic means, means responsive to the completion of said connection for completing said circuit, means responsive to the breaking of said connection for interrupting said circuit, driving means for moving said element supporting means in a direction to return said element to its home position, electromagnetic means for operatively associating said last-mentioned driving means with said element supporting means, a circuit for energizing said last-mentioned electromagnetic means, a manually operable switch for completing said last-mentioned circuit, a holding circuit for said last-mentioned electromagnetic means, means responsive to a momentary energization of said last-mentioned electromagnetic means for completing said holding circuit, and means operative when said element returns to its home position for interrupting said holding circuit.

4. A mechanism for recording the time during which two telephone lines are connected for conversation thereover comprising, in combination, a card bearing indicia evenly spaced to provide a measure of time, a member having a slot therein for accommodating said card, a pair of rollers, an endless belt extending over said rollers, a marking element mounted on said belt, said element having a home position and being movable in one direction over said indicia, a pair of driving shafts adapted to be driven in opposite directions at substantially constant speeds, means including an operating magnet associated with each of said shafts for moving said belt to a position to be driven by the associated shaft, a circuit for energizing each of said magnets, a relay operative in response to the establishing of said connection for completing the circuit of one of said magnets to cause said marking element to be moved over said indicia, a switch controlled by the movement of said marking element for preparing the circuit for the second of said magnets after said marker has moved a predetermined distance, a second switch operative in response to a predetermined movement of said marker, means responsive to the operation of said second switch for impressing a warning signal voltage on said connection, said relay being operative in response to the breaking of said connection to interrupt the circuit for said one magnet, a manually operable switch for interrupting the circuit of said one magnet independently of said relay, a signal device, a circuit for energizing said signal device, a third switch operative in response to a predetermined movement of said marker element for closing the circuit of said signal device and for interrupting the circuit for said one of said magnets, a second manually operable switch for completing the circuit for energizing the second of said magnets, thereby to cause said marker to be returned toward its home position, a holding circuit for said second magnet, a fourth switch operative to complete said holding circuit in response to the operation of said second magnet, and means including said first switch for interrupting said holding circuit when said marker is returned to its home position.

5. Apparatus including two mechanisms each adapted to record the time during which two telephone lines are connected for communication thereover comprising, in combination, a pair of cards each bearing indicia evenly spaced to provide a measure of time, a member for supporting said cards, a pair of marker elements respectively associated with said cards and each having a home position, movable means individual to each of said elements for supporting the corresponding element, each of said last-named means being arranged to move the element supported thereby away from its home position, driving means common to the two mechanisms for moving independently each of said element supporting means in a direction to move the element respectively supported thereby away from its home position and over the indicia of the card associated therewith at a substantially constant speed to indicate elapsed time, means responsive to the completion of a first connection between two telephone lines for operatively associating one of said element supporting means with said driving means, means responsive to the breaking of said first connection for stopping the movement of said one element supporting means, means responsive to the completion of a second connection between two telephone lines for operatively associating the other of said element supporting means with said driving means, and means responsive to the breaking of said second connection for stopping the movement of said other element supporting means.

6. Apparatus including two mechanisms each adapted to record the time during which two telephone lines are connected for communication thereover comprising, in combination, a pair of cards each bearing indicia evenly spaced to provide a measure of time, a member for supporting said cards, a pair of marker elements respectively associated with said cards and each having a home position, movable means individual to each of said elements for supporting the corresponding element, each of said last-named means being arranged to move the element supported thereby

away from its home position, driving means common to the two mechanisms for moving independently each of said element supporting means in a direction to move the element respectively supported thereby away from its home position and over the indicia of the card associated therewith at a substantially constant speed to indicate elapsed time, means responsive to the completion of a first connection between two telephone lines for operatively associating one of said element supporting means with said driving means, means responsive to the breaking of said first connection for stopping the movement of said one element supporting means, means responsive to the completion of a second connection between two telephone lines for operatively associating the other of said element supporting means with said driving means, means responsive to the breaking of said second connection for stopping the movement of said other element supporting means, driving means common to the two mechanisms for moving independently each of said element supporting means in a direction to return the element respectively supported thereby to its home position, and means individual to each mechanism for operatively associating the element supporting means thereof with said last-mentioned driving means.

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