April 7, 1925. 1,532,391

J. ERICKSON

MEASURED SERVICE TELEPHONE SYSTEM

Filed April 16, 1921 3 Sheets-Sheet 1

Fig. 1

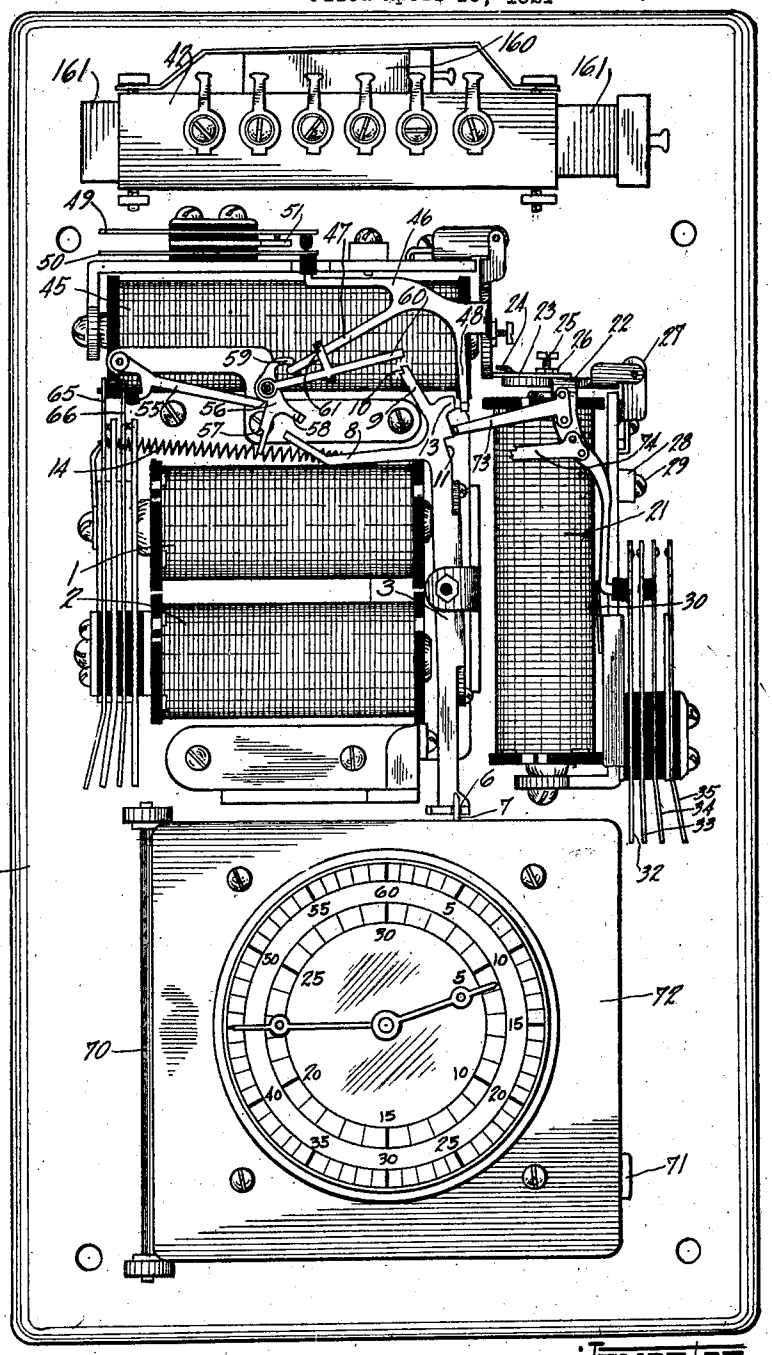

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Fig: 2

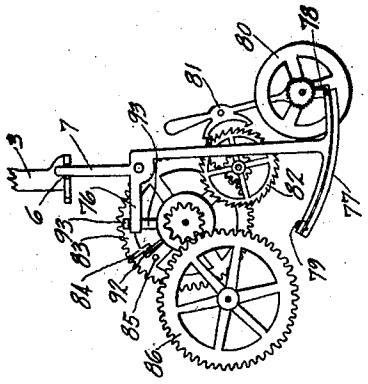


Fig: 3

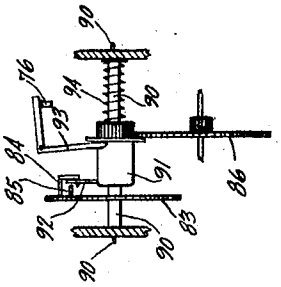
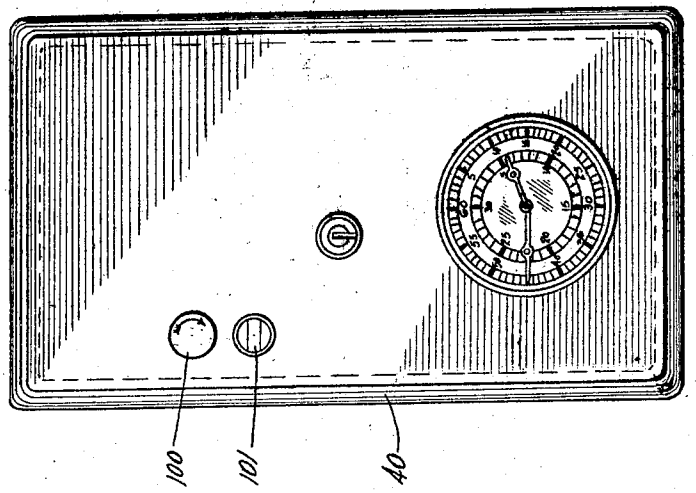


Fig: 4



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MEASURED SERVICE TELEPHONE SYSTEM

Filed April 16, 1921 3 Sheets-Sheet 3

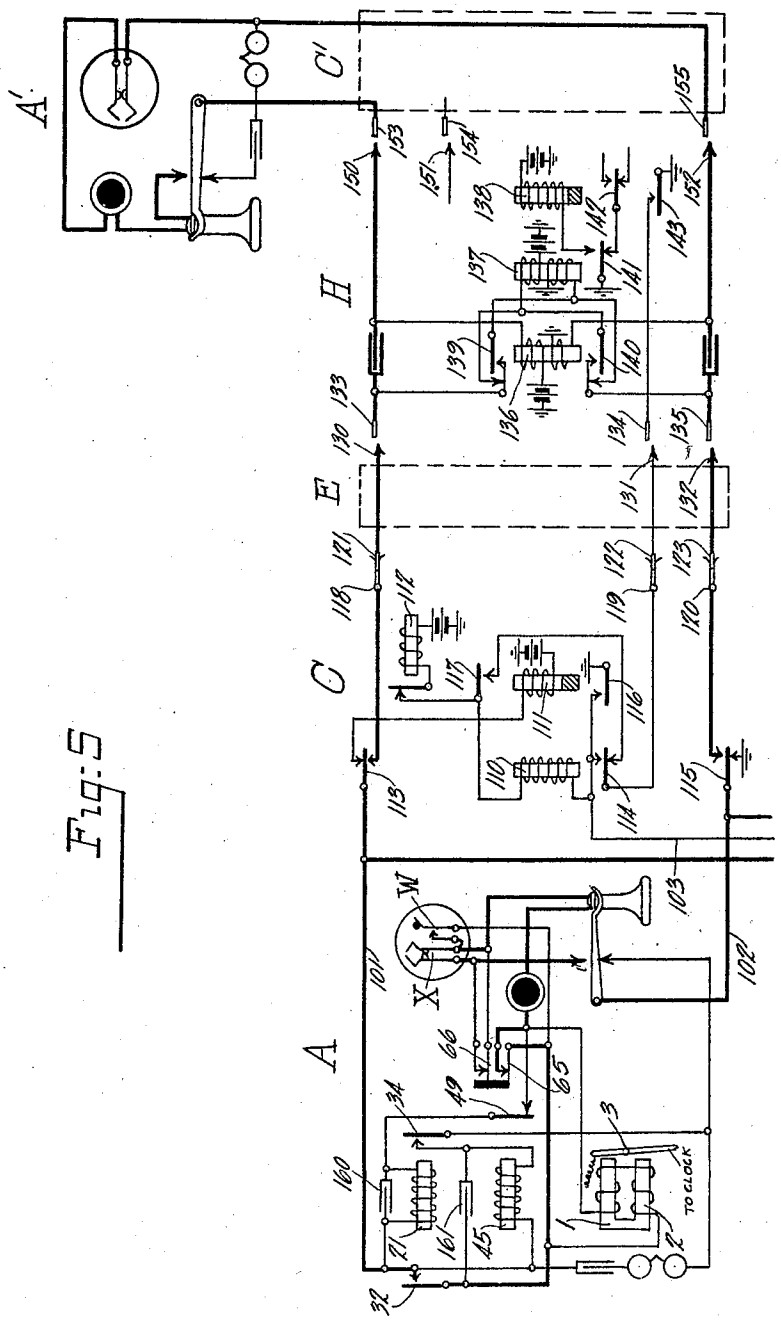

Fig. 5

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Patented Apr. 7, 1925. 1,532,391

UNITED STATES PATENT OFFICE.

JOHN ERICKSON, OF CHICAGO, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

MEASURED-SERVICE TELEPHONE SYSTEM.

Application filed April 16, 1921. Serial No. 461,760.

To all whom it may concern:

Be it known that I, JOHN ERICKSON, a citizen of the United States of America, and a resident of Chicago, Cook County, and State of Illinois, have invented certain new and useful Improvements in Measured-Service Telephone Systems, of which the following is a specification.

The present invention relates in general to measured service telephone systems but has particular reference to measured service equipment for automatic telephone systems which may or may not include party lines. More specifically, the invention provides an improved time controlled substation meter for use in systems of the above character, and having a number of novel and useful features which will be pointed out and described hereinafter, reference being had to the accompanying drawings.

In the drawings, Fig. 1 is a front view of the improved automatic substation meter equipment in which the cover is removed to expose the internal mechanism; Figs. 2 and 3 show details of certain parts of the clock mechanism for controlling the meter; Fig. 4 is a view of the apparatus with the cover in place: and Fig. 5 is a circuit drawing showing the substation circuits complete, and sufficient of the central office circuits to explain the operation.

Referring now particularly to Fig. 1, the base 40 is formed preferably of heavy sheet metal and has a down turned rim all around to give the necessary rigidity. At the lower end of the base, the box 72 is hinged on rod 70 on one side and is held shut by a lock on the other side, the key hole of the said lock being indicated by the reference character 71. Inside of the box 72 there is a clock of which the face is clearly seen. This clock is so constructed and so interconnected with the apparatus with which it is associated that it steps forward a definite period of time, when a call is answered, and runs thereafter until the calling subscriber replaces his receiver. The controlling arm 7, extending upward from a hole suitably cut in the top of box 72, fits into a notch 6 of the armature 3 of a magnet of the well known polarized type. As shown, the arm 7 is in normal position, that is, it is forced all the way over to the right. When a call is answered the lower end of armature 3 swings to the left carrying the top end of the arm 7 with it. This causes the hands of the clock to move forward a predetermined amount, assumed in the present case to be one minute, although it is understood that they may be arranged to step forward any desired amount. When the lower end of armature 3 swings to the left it is locked in that position, in a manner to be hereinafter described, and remains so until the calling subscriber replaces his receiver. While the armature is locked in this position the clock is allowed to run so as to register not only the completed calls but also the amount of time such calls consume, as cumulative time.

The mechanism by which this result is accomplished is controlled by the polarized magnet comprising the coils 1 and 2, together with the magnets comprising coils 45 and 21. Considering first this latter magnet the usual heel piece and armature are provided, the latter being indicated by the reference character 22. The armature 22 controls the springs 32—35, inclusive. Secured to armature 22 by rivets, there is an arm 73, provided for the purpose of locking the armature 3 of the polarized magnet in its normal position so as to prevent its operation at certain times when it is undesirable to have it operated. There is a locking member 23 secured to the armature 22 by screw 25 and lock nut 26. When armature 22 operates, arm 73 moves opposite notch 11 in armature 3, and armature 46, propelled by the light spring 50, falls into place against the stop 24 of the locking member 23. This of course locks armature 22 in its operated position. The movement of armature 46 allows the arm 47 to move down, allowing the pivoted locking member 56 to move by gravity into position against the end of the lever 55. When the right end of lever 55 is moved downward far enough it is prevented from returning by the notch 57, the said lever being operated by a projection of the knob 100, Fig. 4. This knob is turned from the outside by the subscriber. The lever 55 is adapted, when operated, to separate the springs 65 and 66 from their respective contacts. As a further result of the downward movement of arm 47, the arm 60 drops on the end of projection 9 of armature 3.

When the polarized magnet comprising

coils 1 and 2 operates, the arm 8 strikes the projection 58 of piece 56 causing the latter to rotate in an anti-clockwise direction sufficiently to unlock the lever 55 which moves upward allowing springs 65 and 66 to come into contact with their respective contacts. The arm 60, at this time, falls into the notch 10 of the extension 9 of the armature 3. This arm locks the armature 3 in its operated position.

When the magnet comprising coil 45 operates, the extension 47, of armature 46, engages with the extensions 59 and 61 of locking member 56 and arm 60, respectively, causing them to move into normal position and the latter unlocks armature 3. As soon as armature 46 moves a little farther, an extension 48 strikes the extension 13 of the armature 3, so as to insure that the latter restores to normal under the influence of spring 14. Just before the armature 46 is fully operated, the armature 22 is released and allowed to restore to normal position, with the lower end thereof resting against the back stop 30. In this position the armature 22 serves as a lock or back stop for armature 46 to hold it in normal or partly operated position. Upon fully operating, the armature 46 separates the springs 49 and 51 for a purpose to be hereinafter described.

At the top of the base there is shown a binding screw mounting strip 42 to which all necessary wires are secured, together with the condensers 160 and 161.

Referring now to Figs. 2 and 3, which show part of the gear train together with the escapement, the peculiar mechanical construction of the time mechanism for controlling the meter will now be explained. It is to be understood that the parts 81—84, inclusive, and 86 are substantially the same as the corresponding parts in an ordinary desk clock. The apparatus is shown in normal position, that is, in the position it is in when the substation receiver is on the hook. It will be remembered that at this time the lower end of armature 3 is moved over all the way to the right and likewise the upper end of lever 7, which is engaged by the notch 6. There is an extension 77 on the arm 7 which carries a spring 78 adapted to engage teeth on the balance wheel 80 of the clock mechanism, the said spring being secured by screw 79. Referring now particularly to Fig. 3 the wheel 83 is rigidly secured to the shaft 90, the said shaft turning freely in holes drilled in the frame work but being prevented from sidewise movement by shoulders formed thereon. The drum 91, loosely mounted on the shaft 90, is controlled jointly, in its side-wise movement, by lever 93 and spring 94. The pin 92 mounted on drum 91 is adapted to engage either the pin 84 or the pin 85, on wheel 83, depending upon the position of the drum 91, the said pins 84 and 85 being so placed as to form an escapement for pin 92. The rotative force applied, by the main spring through the medium of the train of gear wheels (not shown), to the wheel 86 is in such a direction as to cause it to rotate in a counter clock wise direction (Fig. 2). Accordingly the drum 91 tends to rotate in a clockwise direction. This being true, the pin 92, in the position shown in the drawing, is forced against the pin 84. Now when the armature 3 moves to the left in response to the answering of a call the top part of arm 7 is carried with it. The projection 76 accordingly moves downward allowing the lever 93 to release the drum 91 Fig. 3. The drum 91 is immediately moved to the left under the propulsion of spring 94. Just before the drum 91 reaches its farthest left position the pin 92 slips off of the end of pin 84 and makes nearly a complete revolution, coming to rest in engagement with pin 85. The drum 91 is so geared to the hands of the clock as to allow them to move forward one minute, thereby assessing a charge of one minute against the calling substation. As a further result of the movement of arm 7 the lower extension 77 is moved to the right, carrying the spring 78 with it. This movement starts the balance wheel 80 to rotating and at the same time the said spring moves far enough to allow the said wheel to keep on moving. This of course is the expedient commonly made use of in starting a stop watch or similar apparatus. Accordingly the clock keeps running until the top part of arm 7 is moved to the right again, power being applied to wheel 83 by pin 92.

When the lower end of armature 3 moves back to its normal position to the right, the projection 76 is raised so as to move the bottom part of lever 93, Fig. 3, to the right, carrying the drum 91 along with it. Just before the drum 91 reaches its normal position, the pin 92 slips over the end of pin 85 and comes into engagement with pin 84, thus preparing the equipment for the next operation. As a further result of the restoration of arm 7 to normal, the lower extension 77 carries the spring 78 into engagement with the gears on the balance wheel 80 thereby stopping the latter wheel from rotating and accordingly stopping the clock from running.

In the foregoing, the more essential parts of the mechanism have been described rather briefly, principally with the view of making clear the preferred mechanical construction. It is thought that the detailed explanation of the cooperation of the various parts, together with the description of the circuits, can best be given by describing the operation of the device in establishing a

connection and, after first making brief explanation of the talking instrumentalities and the exchange equipment, such description will be proceeded with.

Referring to Fig. 5 the substation A comprises, in addition to the apparatus already described, the usual receiver, transmitter, bell and switchhook. Being an automatic substation, it is also provided with a calling device comprising the impulse springs X together with the shunt springs W. This calling device is of the well known type and accordingly need not be described in detail.

The two line conductors 101 and 102 extend to the exchange where they terminate preferably in an individual line switch or trunk selector. The line switch C, shown in the drawing, is a rotary line switch of the well known type in which the wipers have no normal position and move in a forward direction only. For the sake of simplicity the circuit of the selector switch E has been omitted. This can well be done in view of the fact that such selectors are well known in the art. Most of the circuit of the connector H has been omitted also, the drawings showing only the line, release, and back bridge relays. This causes no inconvenience, however, for the relays shown are the only ones necessary to explain the present invention. The line switch C′, indicated by the rectangle bearing that reference character, is similar to the line switch C. The substation A′ may or may not be equipped with a substation meter similar to the one shown at A. As shown, the substation A′ comprises the usual talking instrumentalities together with a calling device for controlling the central office switches.

To proceed with the description of the operation, it will be assumed that the subscriber at substation A desires to obtain connection with the subscriber at substation A′. When the receiver is removed at substation A the following bridge is placed across the line conductors 101 and 102. From line conductor 102 by way of the switchhook and its upper contact, impulse springs X, the receiver, transmitter, resting contact of armature 49 and said armature, and magnet 21, to conductor 101. The exchange battery, through line relay 111 of line switch C, is in bridge of the conductors 101 and 102 at the exchange. Accordingly the magnet 21 energizes. Relay 111, however, does not energize at this time due to the high resistance of the said magnet. Upon energizing, magnet 21 prepares a circuit for magnet 45 at armature 34 and at armature 32 places the following shunt around itself: from the left hand end of the winding magnet 21 by way of the working contact of spring 32 and said spring, spring 65 and its resting contact, resting contact of spring 49 and said spring, and the right hand end of the winding of magnet 21. The armature of the said magnet, however, does not restore at this time because of the previously described interlocking arrangement between it and the armature of magnet 45.

In the line switch C, relay 111 energizes as soon as the before mentioned shunt is placed around the winding of the high resistance magnet 21. Upon energizing, line relay 111 closes at armature 116 a circuit for the switching relay 110 and stepping magnet 112 in series, and at armature 117 connects the test wiper 119 to the above circuit at a point between the switching relay and the stepping magnet. The operation now depends upon whether the trunk line upon which the wipers of the line switch are standing is busy or idle. If it is busy the switching relay 110 is short circuited and the stepping magnet 112, which interrupts its own circuit, is operated to advance the wipers step by step in search of an idle trunk line. When an idle trunk line is reached the test wiper 119 no longer engages a grounded contact. The switching relay 110, being no longer short circuited, immediately energizes. Stepping magnet 112, however, does not energize because of the high resistance of the said switching relay. Switching relay 110, upon energizing, grounds the test wiper 119 at armature 114, and at armatures 113 and 115 disconnects the line conductors 101 and 102 from the winding of line relay 111 and from ground, respectively, and extends them by way of line wipers 118 and 120, bank contacts 121 and 123, to the upper and lower windings, respectively, of the line relay (not shown) of the selector E. The line and release relays of the selector accordingly energize and the latter (not shown) in the well known manner places ground on the release trunk conductor extending back to and terminating in bank contact 122. This establishes a holding circuit for the switching relay 110 before the slow acting line relay 111 has time to deenergize. By means of the ground potential on test contact 122 and its multiples in the banks of the other line switches the selector E is made busy to the line switches having access to it. A branch of this holding circuit also extends by way of private normal conductor 103 to multiple test contacts in the banks of the connectors having access to the line of substation A, thereby guarding the line against intrusion in the usual manner.

The subscriber at substation A now turns the knob 100 clearly shown in Fig. 4 in the direction indicated by the arrow. An arm, attached to the said knob inside the cover, operates the lever 55, Fig. 1. The lever 55, upon operating, becomes locked in the notch 57 of locking member 56 so that it cannot return to normal position when the knob

100 is released. The lever 55 also separates the springs 65 and 66 from their respective resting contacts. Referring now again to Fig. 5, spring 66, upon operating, removes the short circuit from the calling device springs X while spring 65, upon operating, removes the short circuit from the polarized magnet comprising the windings 1 and 2. The armature 3, however, of the said polarized magnet is not operated at this time because the current is flowing in a direction opposite to that in which it must flow in order to operate the said magnet.

The subscriber may now operate his calling device in accordance with the first digit of the desired number. As soon as the device is moved from its normal position the shunt springs W make contact, thereby placing a shunt around the transmitter, receiver, and polarized magnet. This is the usual expedient made use of in order to obtain first class switch control. The calling device in returning to normal interrupts the circuit of the line relay of selector E at springs X a number of times corresponding to the number for which it is operated. In response to the interruptions thus produced the selector E raises its wipers 130—132, inclusive, step by step until they stand opposite the desired level of contacts. At the end of the vertical movement the wipers are automatically rotated to pick out an idle trunk line. In the present case we shall assume that the trunk line terminating in the bank contacts 133—135, inclusive, is the first one found idle and consequently the one selected. This being the case, the selector E extends a connection through to the upper and lower windings of line relay 137 of connector H. The line and release relays 137 and 138 accordingly energize and the latter prepares the switch for operation in the usual manner and places ground on the release trunk conductor so as to provide the usual holding circuit.

The calling subscriber may now operate his calling device in accordance with the last two digits of the desired number. Thereupon, the connector H raises its wipers to the desired level and rotates them until they stand on the desired set of contacts or the one in which the line of substation A′ terminates. Upon the cessation of the rotary movement, assuming that the line of substation A′ is idle, the switching relay of the line switch C′ is operated in the well known manner removing the bridge of the line relay from the called line, and ringing current is intermittently sent out to ring the bridged bell of the called substation. When the subscriber at substation A′ answers he causes a ring cut off relay (not shown) in connector H to operate and remove the intermittent ringing current from the line and connect the back bridge relay 136 in bridge of the same. Thereupon, the said relay energizes over the called subscriber's loop. Upon energizing, relay 136, at armatures 139 and 140, reverses the trunk conductors incoming to the connector H as regards their connection with the windings of line relay 137. This obviously results in a reversal of the flow of current in the calling line.

In the substation A, the polarized magnet comprising windings 1 and 2 is now operated and the lower end of armature 3 is accordingly swung to the left. This causes the clock at the said substation to step ahead one minute as hereinbefore described after which it continues to run until it is stopped by the subsequent return of armature 3 to normal position, the said armature being locked in its operated position by the arm 60, Fig. 1. As a further result of the operation of armature 3, the extension 8 thereof comes into contact with extension 58 of locking member 56, causing the latter to move sufficiently to unlock the lever 55 thereby allowing the springs 65 and 66 to come into contact with their respective resting contacts. Spring 66 replaces the short circuit around the impulse springs. This, however, has no particular function at this time but causes no harm to result for the reason that the number has already been called and consequently there is no further need of operating the calling device. The spring 65 upon being released replaces the short circuit around the windings of the polarized magnet. This is done for two reasons; First to secure a better talking circuit for substation A, and second, to prevent any further operation of the back bridge relay 136 from having any effect on said polarized magnet.

The calling and called subscribers may now converse with each other in the usual manner, the talking circuit being outlined by the heavy conductors. When the conversation is completed both subscribers replace their receivers upon the switchhooks. When the receiver is replaced at substation A, a circuit is closed by way of the switchhook and its lower contact, spring 34 and its working contact, and the magnet 45 to conductor 101. Referring now particularly to Fig. 1, magnet 45, upon energizing, operates its armature 46 whereupon the extension 47 engages the extensions 59 and 61 thereby moving locking member 56 and arm 60 to normal position. When the arm 60 is moved to normal position the armature 3 of the polarized magnet is unlocked and allowed to return to normal position also. In case the said armature becomes stuck, the projection 48 of armature 46 strikes against the projection 13 to insure that it returns to normal position. In the meter or clock, the arm 7 upon returning to normal position stops

the movement of the said clock and prepares it for the next operation in a manner hereinbefore explained. As a further result of the operation of armature 46 the armature 22 of relay 21 is unlocked and allowed to return to normal position. Referring now to Fig. 5, magnet 21, upon falling back, opens the circuit of magnet 45 at armature 34 and at armature 32 removes the short circuit formerly placed around itself, so as to be prepared for the next operation. The apparatus at substation A is now all in normal position.

In the connector H the circuit of line relay 137 is broken as soon as the switchhook at substation A moves downward and the connection is released in the usual manner. The bridge including the magnet 45 at substation A does not interfere with the release because of the high resistance of the said magnet. The apparatus is now all restored to normal and ready for another call.

It is common practice to give connection to the city fire and police departments and certain departments of the telephone company free of charge. Accordingly when such numbers are called the current flow in the calling line is not reversed when the called man answers, and the meter is obviously not operated. In that event, however, the operating magnet comprising coils 1 and 2 is left in series with the talking instrumentalities at the calling substation. This causes no serious depreciation in the talking circuit however owing to the small number of turns on the said coils 1 and 2, and the talking circuit is further improved by the condenser 160 which is in multiple with the said operating magnet at this time, the circuit being as follows: From coil 2 by way of armature 32 and its working contact to the left hand terminal of condenser 160, and from coil 1 by way of the resting contact of spring 49 and said spring to the right hand terminal of condenser 160. These two things combined make the losses very small.

Mention will now be made of a certain feature tending to prevent the ill effects of misuse by the subscriber. Since the hanging up of the receiver results immediately in the restoration of all parts of the substation equipment to normal with the consequent short circuiting of the polarized magnet, it might occur to an unscrupulous subscriber that, after having dialled the number but before the called subscriber has answered, he might depress his receiver hook just long enough to cause the apparatus at the substation to be restored to normal but not long enough to release the established connection. To prevent the successful issue of such an attempt, the magnet 21, which has a large number of turns, is given a stiff adjustment so that when its circuit is closed an appreciable amount of time elapses before the said magnet energizes. This can well be done in view of the high impedence of the said magnet 21. Assume now that the subscriber has turned the knob 100, so as to cause the lever 55 to be depressed and locked, and has dialled the desired number and that the called subscriber has not yet answered. If the receiver hook is then jerked down momentarily, the instant the hook engages its lower contact the magnet 45 is energized and the lever 55 is released and magnet 21 is allowed to restore itself to normal position. Then, when the receiver hook makes contact with its upper contact again, an energizing circuit is closed as usual for the magnet 21 but due to the before mentioned stiff adjustment the said magnet is prevented from energizing immediately and the established connection is accordingly released owing to the high resistance of the said magnet. In due time the magnet 21 energizes and prepares the equipment for operation again but the established connection has been released and in order to call again the subscriber must turn the knob and will by that act reinsert the operating magnet in the circuit as before. It is seen that a subscriber cannot by design or accident obtain a connection without a consequent registering of the same by the substation meter.

It has been mentioned before that the present improved automatic substation is adapted for use on party lines as well as on individual lines and some of the features relating to the prevention of interferences between substations on the same line will now be described. For this purpose it will be assumed that another substation which may be similar to substation A′ and which will be denominated substation A^2 is connected in bridge of the line conductors 101 and 102, and it will be assumed further that the subscriber thereat is engaged in conversation either as a calling or as a called subscriber. With this condition existing we shall assume that the subscriber at substation A removes his receiver to make a call. Accordingly magnet 21 which is connected across the line by the removal of the receiver is shunted by a low resistance talking bridge at substation A^2 whereby the said magnet 21 is prevented from energizing because of its relatively high resistance. Upon referring to Fig. 1, an extension 74 will be seen riveted onto the armature 22. This extension is shown broken off for the sake of simplicity but it actually extends to the opposite side of the case where a target secured thereto is normally held just above the door 101 in the cover, Fig. 4. Now under normal conditions when a calling subscriber removes his receiver the magnet 21 is operated and the said target moves before the door so as to inform him that he may proceed

with the call. In the case under discussion, however, since magnet 21 does not operate the said target will not be displayed and the subscriber is notified that he cannot make a call at this time.

In order that the calling subscriber may know whether his line is in use or out of order a condenser 160 is bridged around the magnet 21. The calling subscriber may listen in the receiver and thereby ascertain if any one is talking on the line. If he hears no one talking he will probably assume that the line is out of order and report the same to the proper authorities. Obviously if the condenser is omitted the system is transformed into a positive lock out system. When a calling subscriber finds that the line is busy he hangs up his receiver and waits a reasonable interval before attempting to call again.

Another condition will now be assumed namely that the subscriber at substation A^2 has removed his receiver to initiate a call and has turned the knob such as knob 100 shown in Fig. 4 preparatory to operating his calling device but has not yet operated the said device. With this condition existing, we shall assume that the subscriber at substation A removes his receiver. The magnet 21 at the latter substation is shunted as before and prevented from energizing. It will be noticed that the shunt includes the polarized magnet at substation A^2 but this magnet, being of comparatively low resistance, allows sufficient current to flow through substation A^2 to prevent the magnet 21 of substation A from energizing. Suppose now that the subscriber at substation A^2 begins to operate his calling device. Although the impulse springs of the said substation are shunted by magnet 21 of the substation A, this magnet is of such high resistance and impedance that its effect on the interruptions of the line circuit produced by the calling device is practically negligible. While, as before stated, the high impedence of magnet 21 prevents the building up of current flow in its winding sufficiently to practically prevent interference with the operation of a calling device at another substation, an impulse of current, though delayed passes through the magnet 21 every time the line circuit is interrupted by the calling device at substation A^2 and the cumulative effect of successive impulses would tend to energize the said magnet, were it not for special provisions designed to prevent such occurrence. At each interruption of the circuit of substation A^2 the condenser 161 at substation A is charged over the following path: line conductor 102, the switchhook and its upper contact, the impulse springs X, the receiver, the transmitter, resting contact of spring 65 and said spring, condenser 161, and magnet 45 to line conductor 101. The condenser is of course discharged over the same path by the closure of the circuit following each interruption. While the armature of magnet 21 is in retracted position the armature of magnet 45 is held quite close to the core (see Fig. 1) so that the latter armature is able to respond to the current produced by the charging and discharging of condenser 161. It follows then that the spring 49 is separated from its resting contact momentarily, each time the line circuit is interrupted at substation A^2, to break the circuit of magnet 21 to prevent it from energizing. From these descriptions it will be apparent that under no circumstances can a calling subscriber interfere with another subscriber on his own line after the line has already been taken for use.

The features of the invention having been described and ascertained, what is considered to be new and desired to have protected by Letters Patent will be pointed out in the appended claims.

What I claim as my invention is:

1. In a measured service telephone system, means for connecting a calling and a called line, a cumulative time indicating device, driving means for operating said device to assess an invariable and fixed line charge against the calling subscriber when the called subscriber answers, and time mechanism controlling said driving means to operate said indicating device to record the exact duration of the conversation.

2. In a measured service telephone system, means for connecting a calling and a called line, cumulative time registering mechanism at the station on the calling line, means for automatically advancing said registering mechanism a predetermined amount at the beginning of the conversation to assess a definite charge independent of the length of the conversation, means for continuing the advance of said mechanism uninterruptedly while the subscribers are talking, and means for stopping the advance of said registering mechanism when the conversation is finished.

3. In a measured service telephone system, means for connecting a calling and a called line for conversation, cumulative time registering mechanism at the station on the calling line, said mechanism comprising cumulative time indicating means and time controlled driving means, means for permitting the advance of said indicating means independent of time control to assess a fixed line charge when the connection is completed, and means for continuing the advance of the indicating means without pause under the normal control of the driving means to assess an additional variable charge according to the duration of the conversation.

4. In a measured service telephone system, a series of automatic switches for connecting a calling and a called line, cumulative time registering mechanism at the station on the calling line, said mechanism comprising cumulative time indicating means and time controlled driving means, a control circuit for said registering means, means in one of said switches for altering the control circuit upon the response of the called subscriber to uninterruptedly advance the said indicating means under control of said driving means to assess a charge in accordance with the exact duration of the conversation, and means operated automatically at the beginning of the conversation for causing the driving means to advance the said indicating means a definite amount independent of time control to assess a fixed line charge.

5. In a cumulative time register, an indicating device, driving mechanism for said device, time mechanism normally controlling said driving mechanism, and means for temporarily releasing said driving mechanism from the control of said time mechanism to cause the driving mechanism to advance the said indicating device independent of any control.

6. In a cumulative time register, an indicating device, driving mechanism for said device, time mechanism controlling said driving mechanism, means for starting said time mechanism to permit the driving mechanism to advance the indicating device, and means for simultaneously and momentarily releasing the said driving mechanism from the control of said time mechanism, to instantaneously advance the said indicating device a definite amount at the beginning of its normal time controlled movement.

7. A cumulative time register for use at a telephone station in assessing elapsed time charges against the subscriber, said register comprising a time indicating device and means for rapidly advancing said device a given amount at the beginning of each conversation and for continuously advancing said device at a slower rate of speed from the beginning of each conversation to the end thereof.

8. A cumulative time register for use at a telephone station in assessing elapsed time charges against the subscriber, said register comprising an indicator, a dial cooperating with said indicator and calibrated in units of time, means for rapidly advancing said indicator over a certain number of divisions of the dial at the beginning of each conversation and for continuing its movement until the conversation is finished, and means for causing the continued movement to proceed at a slower rate in accordance with the time consumed.

9. A cumulative time register for a telephone substation, comprising a time indicator, a source of power for moving said indicator to assess a charge for a conversation, clockwork for causing the movement to proceed at the proper rate to enable said indicator to accurately measure the time consumed, and means operating automatically at the beginning of the conversation for causing a limited movement of the said indicator independent of control by said clockwork.

10. A cumulative time register for a telephone substation, comprising a dial calibrated in hours and minutes, hour and minute hands cooperating with their respective parts of the dial to indicate time, a source of power for moving said hands during conversation, clockwork for regulating the rate of movement in accordance with the time consumed, and means for automatically and momentarily releasing the hands from the control of said clockwork during each conversation to permit a more rapid movement thereof.

11. A cumulative time register for a telephone substation, comprising a dial calibrated in hours and minutes, hour and minute hands cooperating with their respective parts of the dial to indicate time, and mechanism for causing two distinct movements of said hands during a conversation to assess a charge against the subscriber, one movement being momentary and at a high rate, and the other movement being continuous throughout the conversation and at the proper rate to cause said hands to measure the time consumed.

12. A cumulative time register for a telephone substation, comprising a dial calibrated in units of time, a hand cooperating with said dial to indicate the total time units to be charged for, and mechanism for causing two movements of said hand during a conversation, one movement being at a relatively high rate, and the other movement being at the proper rate to measure the total time consumed.

13. A cumulative time register comprising a time indicating device, a source of power for operating said device, timing mechanism including an escapement and balance wheel for regulating the rate of operation, and a second escapement intervening between the said first escapement and said indicating device to provide for a limited operation thereof independent of time control.

14. In a measured service telephone system, means for connecting a calling and a called line, a cumulative time indicating device, driving means for operating said device to assess an invariable and fixed line charge against the calling subscriber when the called subscriber answers, and time mechanism controlling said driving means to operate said indicating device to assess

an additional charge against said subscriber always in direct proportion to the exact duration of the conversation.

15. In a measured service telephone system, calling and called lines, means for connecting said lines, a calling device at the station of each line, a timing mechanism on each line, a relay for controlling the timing mechanism to assess charges, said calling device and relay normally inoperative, means for simultaneously rendering the calling device and the relay operative, said relay energizing when the called subscriber answers to start the timing mechanism and to again render itself and the calling device inoperative, and mechanical means for releasing said relay.

16. In a measured service telephone system, a calling and a called line, means for establishing a talking circuit between said lines, a timing device on the calling line, means controlled by the response of the called subscriber for recording a definite time interval on said device as an initial charge and for starting the device, said device operated to record the actual number of seconds elapsing between the establishment and the breaking down of said talking circuit.

17. In a measured service telephone system, calling and called lines, means for establishing a connection between a calling and a called line, a timing device on the calling line which records the number of seconds the connection is maintained, said device started when the called subscriber answers and stopped when the connection is broken, and means for recording a fixed number of seconds on the device for each call independent of the time the connection is maintained.

18. In a measured service telephone system, a calling and a called line, means for establishing a connection between said lines, a meter consisting essentially of a clock mechanism associated with the calling line, means for advancing said meter to assess an initial charge automatically when the called party answers, said means also starting the clock mechanism to record the seconds duration of the call, and means for stopping the clock mechanism when the connection is broken down.

19. In a measured service telephone system, a calling and a called line, means for establishing a connection between said lines, a cumulative time register, controlled by a clock mechanism, associated with the calling line, means for advancing the register to record a definite time interval and for starting the clock mechanism when the called party answers, for advancing the register to record the time of conversation as measured by the clock mechanism, and means for stopping the clock mechanism when the connection is broken down.

In witness whereof, I hereunto subscribe my name this 9th day of April, A. D., 1921.

JOHN ERICKSON.