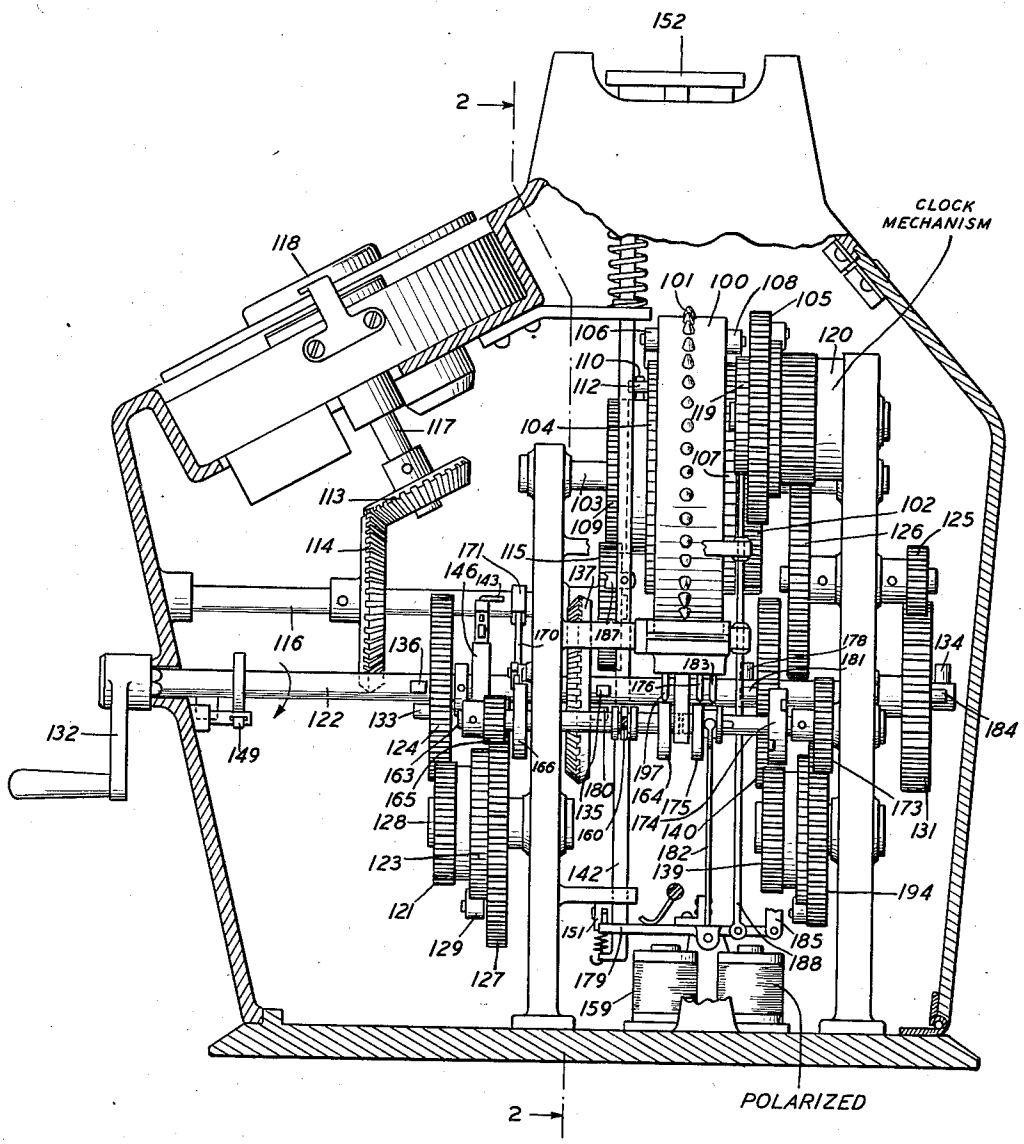
Sept. 17, 1935. C. L. GOODRUM 2,014,525

TELEPHONE APPARATUS

Filed May 12, 1933 3 Sheets-Sheet 1

FIG. 1



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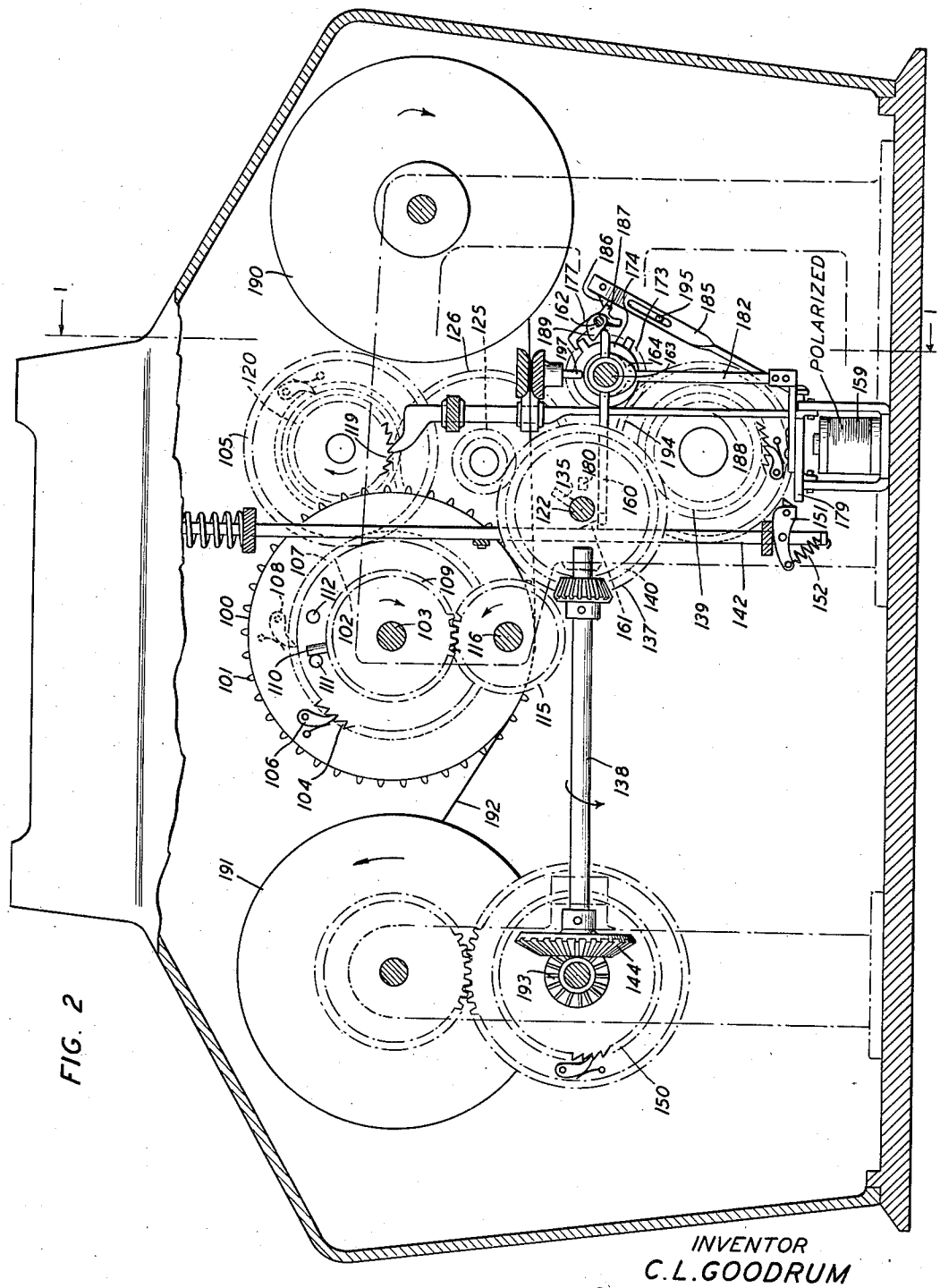

FIG. 2

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FIG. 3

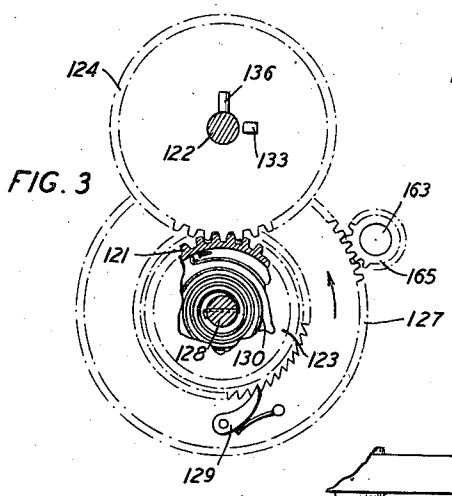


FIG. 4

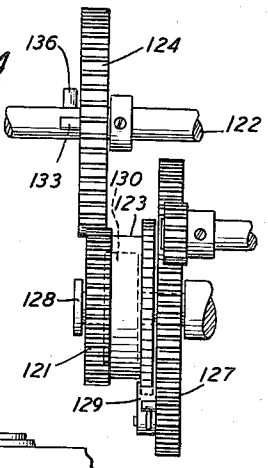


FIG. 5

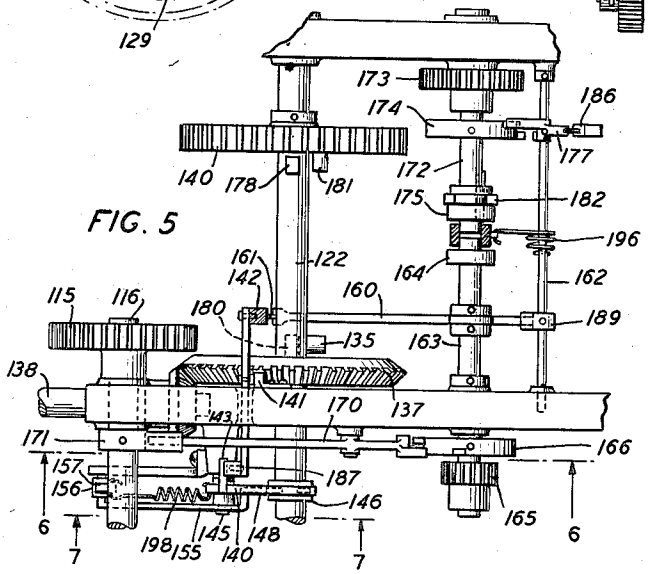


FIG. 6

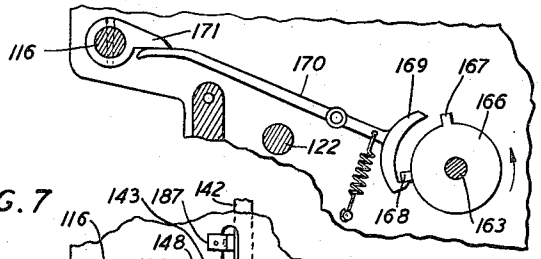
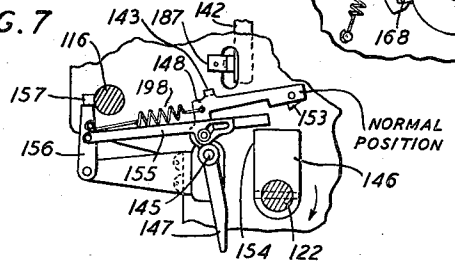


FIG. 7



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Patented Sept. 17, 1935 2,014,525

UNITED STATES PATENT OFFICE

2,014,525

TELEPHONE APPARATUS

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Application May 12, 1933, Serial No. 670,690

7 Claims. (Cl. 179—7.1)

This invention relates to telephone systems and more particularly to dial systems arranged for measured service.

The object of this invention is to provide more reliable and satisfactory equipment at the subscriber's station for automatically recording the calls made by a subscriber and the duration of each answered call, the records thus obtained serving as the basis for billing the subscriber.

According to this invention, a call recording mechanism is provided at each subscriber's station. The mechanism is of the tape recording type provided with apparatus for making a perforated record of the data necessary to bill the calls made from the station.

According to one feature of the invention, said call recording mechanism is arranged to perforate the tape to record the number dialed upon the origination of a call and the duration of each answer call, the tape being advanced after the called subscriber answers, one step for each unit period during which the talking connection is maintained.

Another feature of the invention resides in the provision of means to perforate the tape to indicate "no-charge" if the call is a no-charge call or if the calling party releases the connection before the call is answered.

Another feature of the invention resides in the provision of a number of energy storing devices in said mechanism whereby the energy stored therein is used for operating the tape advancing and tape perforating devices, the manipulation of the calling dial being conditioned by the storage of energy in said storing devices.

Briefly considered, the invention is a recording mechanism for recording on a moving tape (1) a perforation for each digit of the number dialed, (2) a perforation indicating whether or not the wanted subscriber has answered (3) another perforation indicating the termination of a connection. The entire mechanism may be placed within the base of an ordinary telephone stand and provided with external means for supplying energy to the several energy storing devices contained within the mechanism and from which the tape advancing and tape perforating devices obtain the requisite power for the performance of their separate operations. In the present embodiment of the invention said energy storing devices comprise spring motors which are wound up through suitable winding gears by a winding shaft manipulated by the subscriber prior to dialing the called number, although any other suitable energy supplying means may be employed with equal advantage.

In accordance with the present embodiment of the invention, therefore, after the subscriber has removed his receiver from the switchhook, the winding shaft is rotated and allowed to return to normal, after which he may proceed to dial the called number in the usual way. The energy thus stored in the power springs of the separate motors is then utilized during the establishment of the connection and afterwards for operating the tape advancing device and the separate punch perforators to record on said tape the information above mentioned.

A clearer conception of the scope and purpose of the invention will be obtained from a consideration of the following description and appended claims taken in connection with the attached drawings in which:

Fig. 1 is a side view assembly taken along section line 1—1 of Fig. 2 of the recording mechanism that comprises the invention;

Fig. 2 is a front view along section line 2—2 of Fig. 1 showing the power storing and tape control devices;

Figs. 3 and 4 are detailed front and side views, respectively, of the winding gear of a typical power storing device;

Fig. 5 is a top view of the latching mechanisms for controlling the tape punching and the dial locking device;

Fig. 6 is a detailed front view of the dial control punch locking fixture taken along section line 6—6 of Fig. 5; and

Fig. 7 is a detailed front view of a dial control fixture taken along section line 7—7 of Fig. 5.

Referring to the figures, the two wheels 190 and 191 represent the pay-out and take-up reels, respectively, for the recording tape 192. Take-up reel 191 is geared to a spring motor 150 so that, at the proper time, wheel 191 may be revolved in the direction shown for winding up the tape as it is propelled by sprocket or tape-advance wheel 100. The tape advance wheel 100 is provided with projections 101 around its periphery for engaging the feed holes of the tape (not shown). This wheel is rotatably mounted on the fixed shaft 103. At one side of said wheel 100 (right side in Fig. 1) a ratchet wheel 107 is mounted rotatably on shaft 103 and is rigidly connected to gear 102 which, in turn, is in mesh with gear 105. Gear 105 is rotatable in the direction of the arrow by a clock controlled power spring encased within shell 120 when the device is timing a call. A pawl 108, mounted on wheel

100, is held in engagement with the teeth of wheel 107 by a spring so that when wheel 107 rotates, it drives wheel 100, but when it is at rest does not interfere with the rotation of wheel 100 by other means, pawl 108 in this case riding idly over the teeth of wheel 107.

On the opposite side of wheel 100 (left side in Fig. 1) is a second ratchet wheel 104 that is likewise rotatably mounted on shaft 103. Wheel 109 is also rotatably mounted on shaft 103 adjacent to wheel 104 but is not rigidly connected to it. Wheel 109 carries a projection 110 that is positioned between pins 111 and 112 fixed on the side of ratchet wheel 104, and normally in engagement with pin 111. Wheel 109 is provided with gear teeth by means of which it is driven by gear wheel 115 mounted on shaft 116 and driven through gears 114 and 113 from the dial shaft 117 of the calling dial 118. A pawl 106, also mounted on wheel 100, engages the ratchet teeth of wheel 104. Now when dial 118 is operated, assuming that the winding shaft 116 has been previously rotated as described hereinafter, rotation is imparted to shaft 116 through gears 113 and 114 and hence to gear 115. Since gear 115 is permanently meshed with gear wheel 109, said wheel rotates in the direction of the arrow, and, when the dial has moved the amount allowed in the excess of the impulse motion, projection 110 engages pin 112 so that thereafter wheel 109 drives wheel 100 through the engagement of wheel 104 with pawl 106. On the return movement of the dial wheel, wheel 109 rotates in the opposite direction and projection 110 engages pin 111, thus returning wheel 104 to its original position, the teeth of wheel 104 passing under pawl 106 without effect. Thus, at each operation of the dial, wheel 100 is operated to advance the tape a number of feed holes corresponding to the value of the digit dialed and a punch 197 is operated to perforate a hole opposite the last feed hole of the tape corresponding to the last impulse of the dial, as more completely described hereinafter. When wheel 109 is rotated by ratchet wheel 107, pawl 106 rides over the teeth of wheel 104 without effect.

There are four separate spring motor boxes, namely, 121, 139, 120 and 150 all controlled from shaft 122 as described hereinafter; box 120 further containing a suitable clock mechanism. Each of the boxes mentioned is geared to a part of the mechanism for the purpose of supplying power thereto when required for operation, as described hereinafter.

The construction of any of these spring motors is typified by that identified as 123 and shown in detail in Figs. 3 and 4. On the fixed shaft 128 are rotatably mounted the spring box 123 and gear 127. Box 123 contains a spiral spring 130 one end of which is fastened to the shaft 128 and the other to box 123. On the side next to gear 127, box 123 is provided with ratchet teeth which are engaged by a pawl 129 attached to gear 127. When the spring unwinds, box 123 is rotated in the direction of the arrow and drives gear 127 through pawl 129, thus supplying power to any mechanism meshed to gear 127. When box 123 rotates in the opposite direction, spring 130 is wound and the teeth pass under pawl 129 without effect. On the periphery of box 123 are formed gear teeth 121 which mesh with the teeth of gear wheel 124 that is loosely mounted on shaft 122, said shaft also carrying winding gear 131 for rotating spring box 120 through gears 125 and 126 and winding gear 140 for rotating spring box 139, and beveled gear 137 with the latter of which is meshed a pinion gear on shaft 138 for driving gear box 150 through gears 144 and 193. These separate gear mechanisms are for the purpose of supplying power to other independent spring mechanisms 120, 139 and 150, respectively.

Shaft 122 may be rotated manually by a crank 132 or other suitable means. It carries projections 136, 135, 178 and 134, the first of which can engage with a lug 133 on gear 124, the second with lug 180 on gear 137, the third with lug 181 on gear 140 and the last with lug 184 on gear 131. The movement of shaft 122 is limited by stops to less than one complete revolution, and the gears 124, 137, 140 and 131 are so proportioned that the movement of shaft 122, from normal to extreme position, will wind fully the spring in every one of the gear boxes 123, 120, 139 and 150. When for instance, spring 130 in box 123 is unwound sufficiently to require full winding, lug 133 engages projection 136. In the same way, as each of the springs in every other gear box unwinds to require full winding, each of the lugs connected to the respective winding gears engages its respective projection on shaft 122. When shaft 122 is rotated in the direction of the arrow, projection 136 engages lug 133 and rotates gears 124 and 121 and, therefore, box 123 in the proper direction to wind up spring 130. The amount of motion of shaft 122 required before projection 136 and lug 133, and every other pair of projections and lugs engage depends on how far springs 130 in each of the boxes have unwound since the last winding. Thus, a single operation of shaft 122 fully winds up all the springs regardless of the relative amount of operation of the devices driven by each of them.

To prevent the dial 118 from being operated until winding shaft 122 has been rotated, the following mechanism is provided: A shaft 145 (see Figs. 5 and 7) suitably supported for rotation carries a bell crank lever having arms 147 and 148, projecting at right angles to each other about the axis of rotation. The lever is normally held in the position shown in Fig. 7 by the spring 198 the other end of which is attached to stop member 156. The latch 187, pivoted at 161 to a suitable support, is engaged by an extension rod 142 of the switchhook 152 of the telephone set so that, when the receiver is removed, latch 187 is lowered to a position to engage a projection 143 on arm 148 to hold said arm in its operated position. When, at the time that the winding mechanism is being wound up, shaft 122 is rotated in the direction indicated by the arrow, arm 146 engages arm 147 of the bell crank lever and rotates arm 148 so that if the receiver is off the hook, latch 187 engages the projection 143 on arm 148. The forcing down of arm 148 brings spring latch 153 on arm 148 into a position to engage arm 146 on the return of shaft 122 to its normal position and prevents said shaft from operating again until latch 187 has been disengaged from arm 148 by the subscriber restoring the receiver. The movement of arm 148 through a pin and cam slot connection with lever 155 moves the free end of lever 155 down. When shaft 122 returns to normal under the power stored in spring 149 and after arm 148 has been latched in its operated position, the edge 154 of cam 146 engages the depressed end of lever 155 and forces it over, moving stop member 156, to which it is pivotally con-

nected, out of engagement with the lug 157 which is attached to the dial shaft 116 and whose engagement with member 156 prevents the operation of the dial. Thus, it is necessary to remove the receiver, then operate the winding shaft 122 of the spring motors to its full extent and allow it to return to normal before the calling dial can be operated. When arm 142 is raised at the time that the subscriber removes his receiver from the hook, the spring latch 151 is moved into a position to engage beneath the end of armature 179 (see Fig. 2) of the polarized magnet 159 which operates when the called party answers to hold said armature in an operated position even after the magnet releases, which it does when the called subscriber restores.

The number punching mechanism (see Figs. 5 and 6) comprises a rotatable shaft 163 supported on suitable bearings to which are rigidly attached cam 164, gear 165 and an escapement wheel 166. The spring motor 123, connected therewith through gear 127 which meshes with gear 165, supplies power for rotating shaft 163. A punch 197 (see Fig. 2) is operable by cam 164 for perforating the tape, the guides and anvil for which are not shown in detail, being such as are used in telegraph tape perforators. Wheel 166 carries two lugs 167 and 168 which engage the teeth of the escapement 169. Normally, wheel 166 is prevented from rotating by lug 168 engaging the escapement 169. This escapement is connected to one end of a pivoted lever 170 the other end of which engages a dog 171 operated by the dial shaft 116. When the dial is moved out of its normal position, escapement 169 rocks in a clockwise direction releasing lug 168 and engaging lug 167. When the dial returns to normal, it restores 169 to the position shown, releasing lug 167 so that shaft 163 makes a complete revolution under spring power before it is stopped by lug 168 engaging the escapement 169. Lugs 167 and 168 and the corresponding escapement teeth are so staggered as to permit wheel 166 to make a complete revolution. As shaft 163 revolves, cam 164 operates punch 197 to perforate the tape for every return of the dial.

The conversation recorder comprises a shaft 172, which corresponds to shaft 163 of the number punch, to which is rigidly attached a gear 173 through which it is driven by the spring motor 139 by means of gear wheel 194 and the escapement wheel 174 for controlling its motion. It also carries a cam 175 which is free to slide upon the shaft but rotates with it. In its normal position with respect to shaft 172 cam 175 is in a position to operate punch 176 (see Fig. 1) when the cam is rotated to perforate the tape to indicate that the called subscriber has not answered; or in the case of a "free call" such as an official call, it indicates the same thing so that when the perforated tape is passed through the tabulating mechanism the call will not be charged.

The escapement 177, which cooperates with escapement wheel 174 on shaft 172, functions to release shaft 172 for a complete revolution in much the same manner as escapement 169 controls the release of shaft 163. The escapement is mounted on a shaft 162 which is rotatable against the tension of torsion spring 196. For rocking the escapement 177 to release its upper arm from one pin of escapement wheel 174, as viewed from Fig. 2, the escapement 177 is provided with a projection 187 which is engaged by a spring latch 186 pivoted to one end of a rod 185 which slides on a support 195. The lower end of rod 185 is pivoted to one end of the armature 179 of magnet 159. When the called subscriber answers magnet 159 operates its armature 179 which is held in its operated position, since the calling subscriber's receiver is off the switchhook, by the engagement of one end of the armature with the spring latch 151 carried by rod 142. Through rod 185 and the engagement of spring latch 186 with lug 187 of escapement 177, the armature also rocks the escapement to release its upper arm from one pin of escapement wheel 174 and to engage its lower arm with a second pin on wheel 174. The shaft 172 is thereby permitted to rotate a small fraction of a revolution under the driving power of spring box 139. As rod 185 continues its movement, it disengages its spring latch 186 from lug 187 and the torsion spring 196 returns the escapement 177 to its initial position thereby disengaging its lower arm from the second pin of escapement wheel 174. Shaft 172 is now permitted to rotate the remainder of a complete revolution or until the first pin on escapement wheel 174 re-engages the upper arm of escapement 177.

At the same time that the armature 179 of magnet 159 operated the escapement through rod 185, it also swung the forked arm 182, rigidly attached thereto, to slide the cam 175 along shaft 172 out of alignment with punch 176 and into alignment with punch 183 so that, upon the rotation of shaft 172 as just described, the cam 175 operates the punch 183 to perforate the tape as an indication that the called subscriber has responded and that timing for the call has started.

Also pivotally connected to armature 179 is a slidable rod 188 which carries on its upper end a detent pawl engaging with ratchet teeth 119 of the clock spring box 120. When magnet 159 operates upon the response of the called subscriber, in addition to the function previously described, it releases the detent from the ratchet teeth 119 whereby the spring in box 120 under clock control rotates gear 105 to rotate, in turn, gear 102 and ratchet wheel 107. Ratchet wheel 107, by its engagement with the feed sprocket wheel 100 through pawl 107, rotates the wheel 100 at a predetermined rate until the call is terminated. The sprocket wheel thus advances the tape 192 through the die block associated with the punches 197, 176 and 183, the tape being wound on take up reel 191 driven by the spring of spring box 150.

When the conversation is terminated the calling and called subscribers restore their receivers to the switchhooks. The restoration of the called subscriber's receiver releases magnet 159, but its armature 179 is held in its operated position through the engagement thereof with spring latch 151 on rod 142 until the calling subscriber restores his receiver to switchhook 152 thereby depressing rod 142. The restoration of armature 179 to normal now re-engages the detent pawl on rod 188 to arrest further advance of the tape 192, restores the rod 185 to its normal position and, through arm 182, slides the cam 175 on shaft 172 into its normal position where it will, on a subsequent rotation, operate punch 176. The depression of rod 142 by lug 161 carried thereby depresses one end of lever 160 which is freely pivoted on shaft 163 between two collars as disclosed more clearly in Fig. 5. The lever 160 is thereby rocked on shaft 163 so that its other end engages with cam 189 fixed to shaft 162 and thereby rotates shaft 162 and escapement 177. The upper arm of escapement 177 is now disengaged from one pin of escapement wheel 174 to allow shaft 172 to rotate through another complete revolution. As

shaft 172 rotates, cam 175 operates punch 176 to perforate the tape as an indication that the call has terminated.

The depression of rod 142 also removes latch 187 from engagement with lug 143 of the bell crank lever and the lever is then restored to its normal position by spring 198 releasing the latch 153 from cam 146 to free the winding shaft 122 for rotation and to restore the stop arm 156 to normal to again lock the dial shaft 116.

The foregoing operations have resulted in the punching of a perforation by punch 197 for each digit dialed indicative of the designation of the line called, the punching of a perforation by punch 183 upon the response of the called subscriber if the call was successfully completed, or by punch 176 if the called subscriber did not answer, and the punching of a perforation by punch 176 upon the restoration of the calling and called subscriber's receiver to their switchhooks. The spacing between the perforations punched by punchers 183 and 176 on a successful call through the advance of the tape by clock controlled spring box 120 is therefore a measure of the duration of the call.

On unsuccessful calls the shaft 172 is released by escapement 177 through the operation of lever 160 and cam 189 when the calling subscriber restores his receiver and makes but a single revolution. Since magnet 159 is not operated cam 175 is effective to operate punch 176 for perforating on the tape 192 an indication of a no answer call.

The tape is in this manner perforated to make a record of all calls made during a billing period and may be used by the operating telephone company in conjunction with a suitable tabulating printer to prepare a bill for the services rendered.

What is claimed is:

1. In a telephone system, a calling station, a dial at said calling station for dialing the digits of the designation of a desired station, and a recording mechanism at said calling station comprising a tape, means responsive to the operation of the dial in dialing each digit of the designation for advancing said tape an amount indicative of the value of the digit dialed, means for perforating said tape at the conclusion of each advance movement thereof, clock controlled means for further advancing said tape, means rendered operative upon the response of the called station for perforating said tape in a distinctive manner and to thereupon release said clock controlled means to advance said tape at a predetermined rate, and means controlled upon the termination of the call for arresting the further advance of said tape and for perforating said tape in a further distinctive manner, the spacing between the last two mentioned perforations being indicative of the duration of the call.

2. The combination of a call recording mechanism with an automatic telephone station provided with a calling device, said mechanism comprising a tape perforating device, a tape, energy storing means coupled to said perforating device, means responsive to the operation of said calling device for operating said tape perforating device to perforate said tape by energy supplied to said device from said energy storing means through said coupling and means responsive to the absence of energy in said energy storing means for rendering said calling device inoperative.

3. In a telephone system, a telephone station, a dial at said station capable of generating a series of impulses, and a call recording mechanism for said station comprising a tape, a tape advancing device, a tape perforating device, an energy storing means, an energy transmitting means for storing energy into said storing means, coupling means between said storing means and said tape advancing device and said tape perforating device, means responsive to the storage of energy in said storing means by the operation of said energy transmitting means for rendering said dial effective for operation, and means responsive to the operation of said dial for releasing the energy stored in said storing means through said coupling means to operate said tape advancing device for advancing said tape a length proportional to the number of impulses generated by said dial and to operate said tape perforating device for perforating said tape at the time the last impulse of a series of impulses is generated by said dial.

4. In a telephone system, a telephone station, a dial at said station, and a call recording mechanism in association therewith at said station, said call recording mechanism comprising a shaft, and means responsive to the operation of said shaft for rendering said dial operative.

5. In a call recording mechanism for recording calls established to called lines under the control of a dial at the station of a calling line, a magnet connected to said calling line and responsive to the answer of a called subscriber, a tape advancing device, and a tape perforating device comprising a first punch responsive to the manipulation of said dial for perforating a hole in said tape at the end of each series of impulses generated from said dial, a second punch responsive to the operation of said magnet when said called subscriber answers for perforating a hole in said tape to indicate the starting of the talking connection and a third punch responsive to the restoration of the receiver of said calling telephone station for perforating a hole in said tape to indicate said restoration.

6. The combination in a call recording mechanism for an automatic telephone station of a tape, a tape advancing device and means responsive to the establishment of a talking connection between said telephone station and another station for operating said tape advancing device to advance said tape in proportion to the time during which said connection is maintained.

7. The combination in a call recording mechanism for an automatic telephone station of a tape, a tape advancing device, a timing device, energy storing means, said means being coupled to said tape advancing device, and means responsive to the establishment of a talking connection between said station and another station for releasing the energy in said storing means for operating said tape advancing device to advance said tape in intervals measured by said timing device during the time that said connection is maintained.

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