

April 7, 1942.

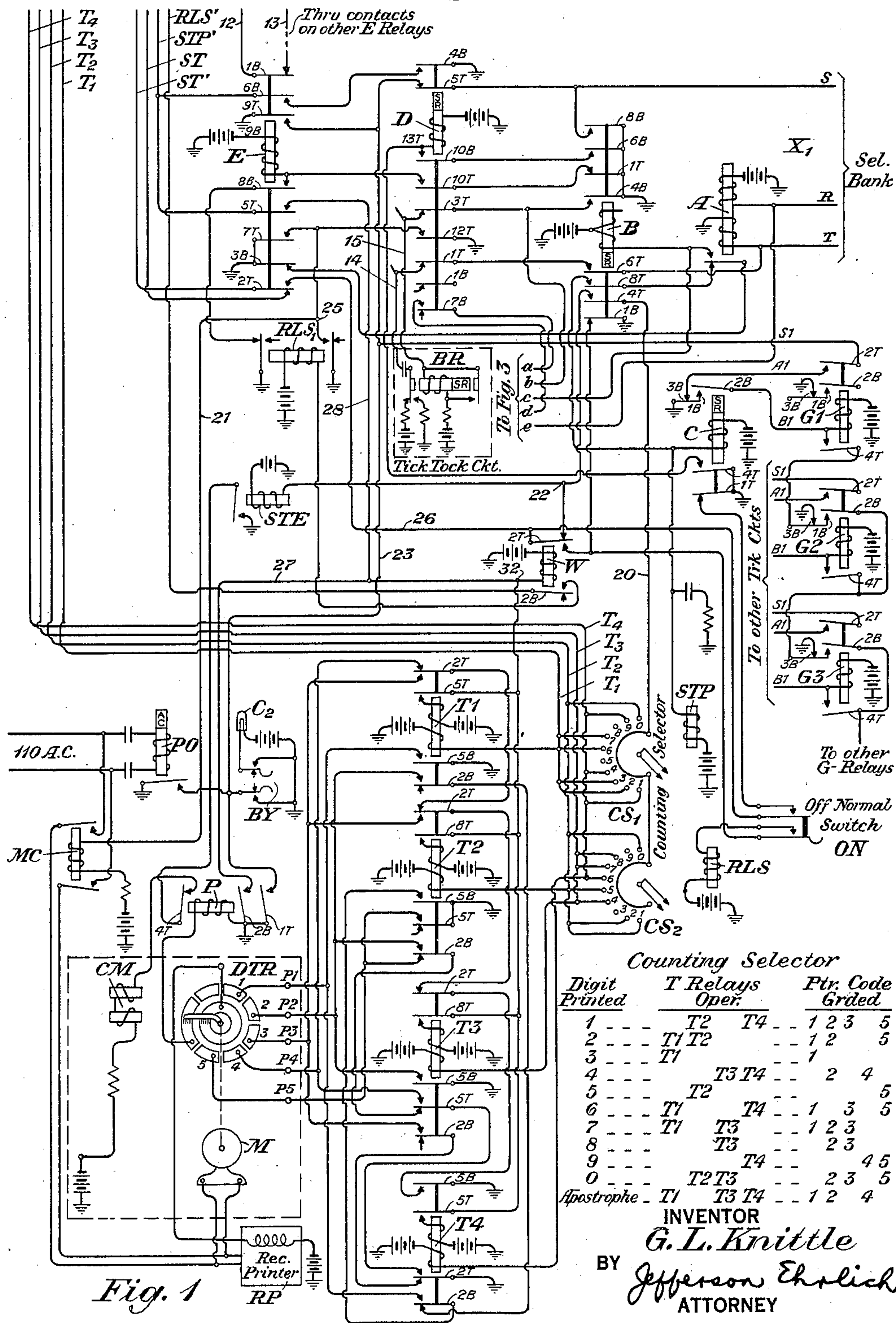
G. L. KNITTLE

2,278,703

TELETYPEWRITER RECORDING SYSTEM

Filed Aug. 7, 1941

2 Sheets-Sheet 1



Counting Selector		
Digit Printed	T Relays Oper.	Ptr. Code Graded
1	T2 T4	1 2 3 5
2	T1 T2	1 2 5
3	T1	1
4	T3 T4	2 4
5	T2	5
6	T1 T4	1 3 5
7	T1 T3	1 2 3
8	T3	2 3
9	T4	4 5
0	T2 T3	2 3 5
Apostrophe	T1 T3 T4	1 2 4

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TELETYPEWRITER RECORDING SYSTEM

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2 Sheets-Sheet 2

Time Finder Selector

Index Wheel	
22	Pass By
21	Tenths of Hour
20	Apostrophe
19	Hour Units
18	Hour Tens
17	Apostrophe
16	Apostrophe
15	Idle
14	Tenths of Hour
13	Apostrophe
12	Hour Units
11	Hour Tens
10	Apostrophe
9	Apostrophe
8	Idle
7	Tenths of Hour
6	Apostrophe
5	Hour Units
4	Hour Tens
3	Apostrophe
2	Apostrophe
1	Idle

Hour Selector

Index Wheel	Hour Marked For Printing
25	Pass By
24	00
23	23
22	22
21	21
20	20
19	19
18	18
17	17
16	16
15	15
14	14
13	13
12	12
11	11
10	10
9	09
8	08
7	07
6	06
5	05
4	04
3	03
2	02
1	01

Tenths of Hour Selector

Index Wheel	Tenths of Hour Marked For Printing
25	Pass By
24	0
23	.9
22	.8
21	.7
20	.6
19	.5
18	.4
17	.3
16	.2
15	.1
14	.0
13	.9
12	.8
11	.7
10	.6
9	.5
8	.4
7	.3
6	.2
5	.1
4	.0
3	.9
2	.8
1	.7

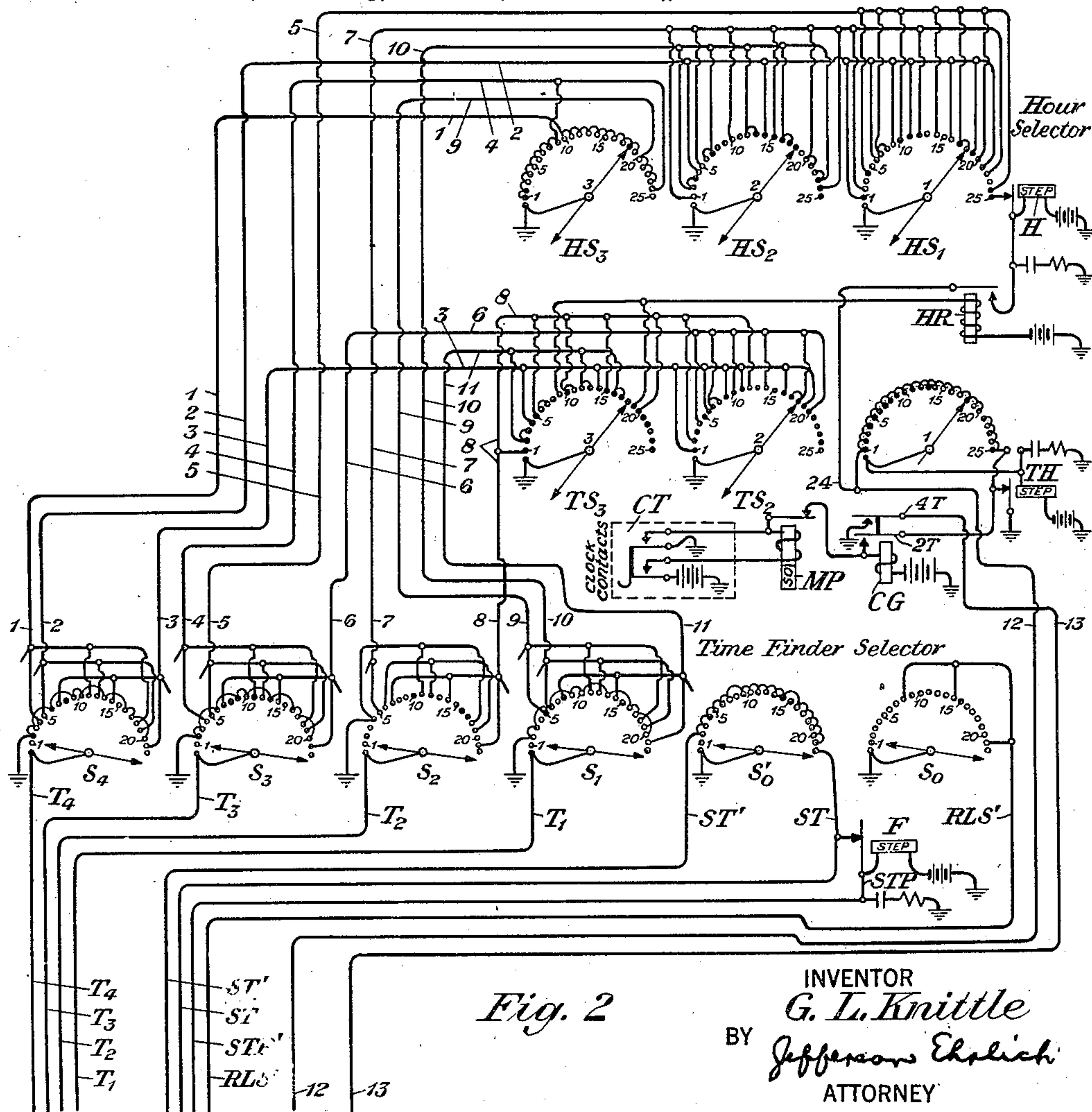
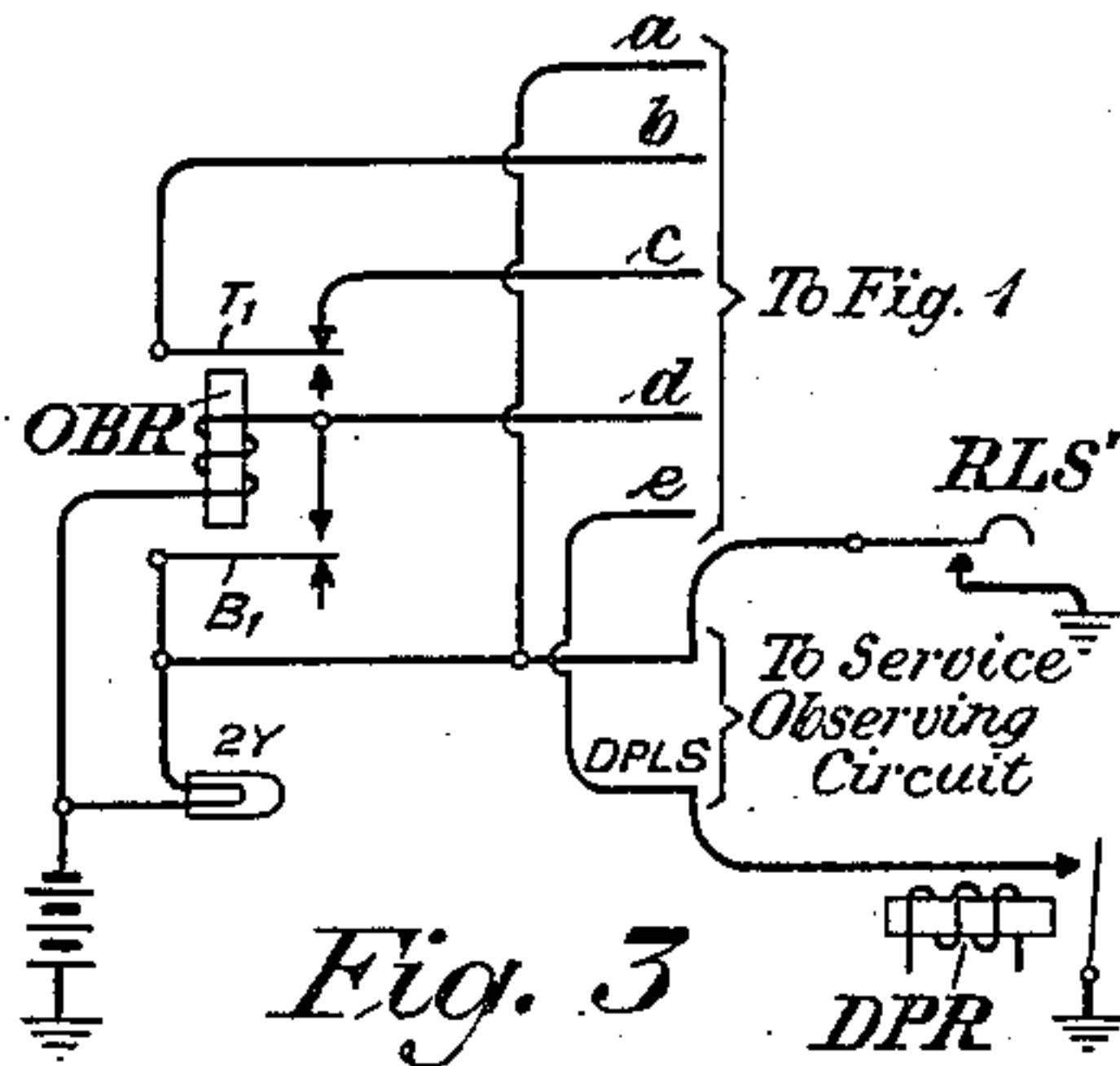


Fig. 2

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2,278,703

TELETYPEWRITER RECORDING SYSTEM

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Application August 7, 1941, Serial No. 405,728

10 Claims. (Cl. 179—4)

This invention relates to recording systems, and while the system herein disclosed is adapted for many other purposes, it is particularly useful for recording data with respect to jobs or tasks assigned to workmen or other employees in factories, offices, machine shops, etc.

GENERAL DESCRIPTION

It is the common practice today to provide telephone service between various departments in a factory, office, or machine shop by means of a dial-operated private branch exchange or so-called dial P. B. X. In accordance with the present invention it is proposed to associate with such a dial P. B. X system a recording circuit arrangement whereby any workman or other employee taking up a job or task, may, by dialing a special code obtain access to the recording circuit, after which he will dial a number assigned to him as a workman and a number assigned to the job. The digits dialed after connection has been made to the recording circuit will be recorded and immediately thereafter the time of day as given by a master time clock will be recorded. Depending upon the number of stations in the dial P. B. X, one or more such recording circuits will be provided in order that the workmen will not be unduly delayed in obtaining access to an idle recording circuit. By dialing a special code the dial-controlled switch will obtain access to a group of terminals corresponding to the several recording trunks, and will then automatically select from the group an idle trunk.

Each recording circuit will be provided with a recording apparatus for recording the identifying digits dialed by the workmen and for recording the time of day. While various types of recording mechanisms may be employed for this purpose, as herein disclosed, a printing telegraph receiver is used as the recording mechanism. Since a printing telegraph receiver operates on a Baudot or five-unit code and the subscriber's number and the job number are dialed on a decimal basis, it is necessary to provide some translating arrangement to translate the dialed decimal code into a five-unit code for printing purposes. Consequently, each recording circuit is provided with a counting selector which is operated on a decimal basis by means of the dialed impulses, and this selector controls circuits to operate a group of relays and store upon the relays the necessary five-unit code combinations to properly operate the receiving printer.

As already stated, it is proposed to follow the recording of the workman's number and the job number by a record of the time of day. For this purpose each recording circuit is provided with a so-called time finder selector through which connections are established to a time indicator which is common to the several recording circuits.

The time indicator, as herein disclosed, involves a type of switch which is moved step-by-step at successive intervals determined by a master time clock. Two time indicating selector switches are involved, one being an hour selector which is advanced once each hour, and the other being a tenths-of-hour selector which is advanced once every six minutes, the progression of these switches being controlled by a contact operated by the clock. The tenths-of-hour selector at any given instant is advanced to a point representing the time at that instant, and controls the circuit corresponding to the particular tenth of an hour existing at that time. Likewise the hour selector is at any given instant advanced to a point representing the hour, and controls a circuit corresponding to the particular hour at that time indicated by the clock.

Preferably the hours are registered in continental time, so the hours are successively numbered from 1 to 24 (the twenty-fourth hour being printed as 00, however), and to record the indicated hour involves translating a registration on a basis of 24 into a five-unit code. For this purpose the time finder selector is so wired and associated with the hour selector and the translating relays already referred to as to convert the hour indication into a five-unit code for recording the number of the hour upon the receiving printer. The tenths-of-hour selector is, of course, operated on what is equivalent to a decimal basis, and the particular tenth of an hour indicated must be converted into a five-unit code combination for recording. For this purpose the time finder selector is so wired, with respect to the tenths-of-hour selector and the relay translating arrangement previously mentioned, as to make a translation such that the indicated tenth of an hour will be recorded by a digit printed upon the receiving printer.

Thus it will be seen that the relay translating arrangement is at different times controlled by three different devices—first, by a counting selector during the reception of the dialed pulses; next, by an hour selector during the recording of the indicated hour; and finally, by a tenths-of-hour selector during the recording of the particular tenth of an hour indicated by the clock.

Each recording trunk has associated with it certain relays which take control of the circuit during the dialing of impulses representing the workman's number and the job number. The circuits set up by these relays operate a counting selector which involves a 10-point selector switch having two banks of 10 contacts each, over which the brushes may be operated step by step as the dialed impulses come in. This counting selector, depending upon the decimal point to which it is operated, sets up a circuit combination upon selected ones of four translating or T relays. The

selected relays are then locked up, and, depending upon the combination of relays selected, control the circuits to the distributor of the receiving printer to mark thereon the appropriate Baudot code. The printer thereupon proceeds to print the indicated digit under the control of the locked-up relays. In the meantime the counting selector is restored to normal and is ready to be again operated in response to the received impulses corresponding to another dialed digit. In this way there may be a certain amount of over-lap between the operation of receiving the dialed impulses and making the corresponding record by the printer.

After the workman's number and job number have been dialed, certain other relays associated with the trunk come into operation and take control of the circuit. In this condition of the circuit the time finder selector, the hour selector, and the tenths-of-hour selector come into play to take control of the selective operation of the set of translating or T relays.

The hour selector consists of a 25-point selector switch having three used banks of terminals. Twenty-four of these points represent hours of the day, the hours being numbered from 1 to 24. The resulting circuit combinations set up through the time finder selector on the translating relays cause the printer to print the appropriate hours from 01, 02, etc. through 24, except that the 24th hour is printed as 00. The wiring controlled by the hour selector at its 24th point is such as to set up the Baudot codes corresponding to the digits 00 instead of the digits 24. The hour selector makes a half-revolution every 24 hours and the 25th point is not used except as a pass-by point to step the switch to the first contact for the next half-revolution.

The tenths-of-hour selector is also a 25-point switch having three used banks of contacts. This switch makes a half-revolution every two hours and marks the tenths-of-hours on the time finder selector. The time finder selector in turn passes the indications on to the translating relays in such form as to record a Baudot code corresponding to the particular tenth of an hour indicated. The first ten points of the tenths-of-hour selector correspond to the ten divisions of one hour. The next ten points from 11 to 20, inclusive, correspond to the ten divisions of the succeeding hour. The last five points of the switch have no utility other than as pass-by points serving to automatically step the switch until its wiper is again brought into connection with its first contact, which corresponds to the first tenth of the next hour. Each tenth of an hour indicated by a setting of tenths-of-hour selector is marked on the time finder selector which, in turn, sets up a proper combination of translating relays to record the corresponding digits 1, 2, 3, —, 9 or 0 as the case may be.

During all of the time, after the workman has hung up, that these operations are taking place, the recording trunk is made to appear busy so that no one else can obtain access to it until the time has been fully recorded. In order to provide for more uniform use of the various trunks provided, an arrangement has been devised and is disclosed herein so that when the first of a series of trunks has been used for making a record, it will appear busy until all of the trunks higher in the series have in turn been used, when the busy indication will be removed and the trunk will again be available. The same, of course, holds true for the succeeding trunks in

the series so that each trunk, when once used, remains busy until all of the other trunks have in turn been used.

The invention will now be more clearly understood from a description of the operation of the circuit, when read in connection with the accompanying drawings, Figure 1 of which shows the circuit arrangement of a recording trunk with the associated counting selector, translating relays, and receiving printer apparatus, while Fig. 2 illustrates the time finder selector, the hour selector, and the tenths-of-hour selector which are used to record the time on the receiving printer through the translating relays, and Fig. 3 illustrates a circuit arrangement which may be added to that of Fig. 1.

GENERAL OPERATION

The workman who desires to make a record first dials the number assigned in common to the recording trunks and obtains access to an idle recording trunk, whereupon he receives a tick-tock signal indicating that the trunk is ready to make a record. The code combination dialed in order to make the connection to the trunk, is not, of course, recorded. The workman then dials the number by which he is identified in the shop, and follows this by dialing the number assigned to the job. These two numbers are dialed in succession and without any separating character, in order to avoid the complications involved in recording on the printer some character indicating a separation between the two dialed numbers. Each workman will be given a number involving the same number of digits, for example, three. When he dials his particular number of digits, followed by whatever number of digits represent the job, the recording printer will print the three digits corresponding to the workman's number, and, without a break, the succeeding digits representing the job number. The two numbers may be readily distinguished by the fact that the first three, or whatever other number of digits may be assigned to a workman, represent the workman's number, and the following digits always represent the job number.

After recording the workman's number and the job number, two apostrophes will be automatically recorded, followed in turn by the tenths digit and units digit of the indicating hour. Then another apostrophe is printed, this in turn being followed by the digit representing the tenth of an hour. The use of apostrophes as separating elements rather than a period or other character is adopted here merely because it is a very simple matter to automatically set up an apostrophe combination. Of course, the circuit may be wired to set up any other printed indication as a separating mark.

DETAILS OF OPERATION

(a) Preparation for dialing

Assuming that a workman has dialed the number assigned to the recording trunks and the appropriate direct switch has selected an idle recording trunk, the relay A of the selected trunk X_1 of Fig. 1 will be operated by a circuit completed over the tip and ring contacts of the recording trunk. At its front contact relay A completes a circuit from battery, through the operating winding of the slow release relay B, and over the back contact of the armature 3B of relay E. Relay B, being slow to release operates and holds up its armatures during the brief open circuit interruptions due to dialing.

Relay B, upon operating, grounds the sleeve conductor S over the front contact of its armature 8B. At the front contact of its armature 4B it completes the circuit over the back contact of armature 3T of relay D to the buzzer relay BR of the tick-tock circuit. As the buzzer relay BR is alternately energized and deenergized, due to the short-circuiting action of its right-hand armature around the winding of relay BR, it alternately connects battery and ground over the circuit 14, over back contact of armature 1T of relay D, and the front contact of armature 6T of relay B to the tip conductor T of the trunk. This causes a tick-tock sound to be heard in the workman's receiver due to the charge and discharge of the condenser in series with conductor 14 so that the workman may know his circuit is now connected to an idle trunk, ready for recording his number and the number of the job assigned to him.

In addition to the foregoing functions the relay B prepares a locking path at the front contact of its armature 6B for the D relay, which will be operated after dialing starts, in a manner to be presently described. At the front contact of its armature 8T the relay B prepares a path to be later controlled by the relay A during dialing for the slow-release relay C and the step magnet STP of the counting selector switches CS₁ and CS₂. At the back contact of its armature 1T, relay B opens the operating path for the relay E, which would otherwise be closed at the front contact of armature 10T of relay D when the latter is operated during dialing, as will be described later. It is necessary to prevent the operation of the relay E at this time as the relay E controls the recording of the time of day which, of course, must be deferred until the workman's number and the job number have been recorded. At its armature 1B, relay B disconnects ground from the lower contact of the off-normal switch ON. Finally at 4T, relay B prepares a path which will later be completed over the conductor 20 to the counting selectors CS₁ and CS₂. This circuit will be closed after the dialing of each digit to select the proper combination of the translating relays T₁, T₂, T₃, and T₄. The circuits are now in condition for the dialing operation.

(b) Dialing operation

Upon hearing the tick-tock signal the workman then proceeds to dial his number and the job number. Each pulse of each digit dialed produces a momentary open circuit condition, followed by a closed circuit condition. The armature of the relay A falls off with each pulse and is then again attracted, but the relay B being slow to release, does not permit its armatures to fall back during the interruptions due to the dialing operation.

When the first interruption occurs, the armature of the relay A at its back contact operates the relay C in parallel with the stepping magnet STP of the counting selector over a circuit from ground, back contact of armature 3B of relay E, back contact of the armature of relay A, front contact of armature 8T of relay B, thence in parallel through the winding of the relay C and the winding of the stepping magnet STP. The relay C is also slow to release, and being once operated holds up during the entire pulsing operation of each digit dialed. It is not released during the momentary periods during which the armature of the relay A is attracted, but only releases when the circuit remains closed for an appreciable time

at the end of the pulsing operation for each digit. The stepping magnet STP causes the counting selector to advance one step for each pulse of the digit dialed.

Upon operation of the C relay, at the front contact of its armature 4T it connects a circuit from ground through the winding of the relay D to ground and battery, causing the relay D to pull up. At its contacts 1B and 2B, relay C when operated closes the circuit of the relay G₁. Relay G₁ locks up over its lower front contact, over the contacts 1B and 3B of the relay G₂ of the next idle trunk in order, and thence to ground. The function of the relay G₁ is to apply a busy ground over the front contact of its armature 2T to the sleeve conductor S of the trunk X₁, under conditions which will be described later.

Returning now to the relay D which has just been operated by the relay C. The relay D, when operated, locks to ground over the front contact of its armature 10B and the front contact of the armature 6B of relay B. Consequently, the relay D will remain operated until after the completion of the entire dialing operation of all the digits. At the front contact of its armature 4B, relay D prepares a circuit over conductor STP' for the stepping magnet F (see Fig. 2) of the time finder selector. This circuit will not be completed, however, until after the dialing operation has been finished.

At its armature 5T, relay D opens a path to apply busy ground to the sleeve conductor S either from the ground connection controlled by the relay G₁ already referred to, or from an alternative ground connection passing over the back contact of the armature 1T of the relay P when the latter is released, as later described. Busy ground, however, is applied to the sleeve conductor S at this time over the front contact of the armature 8B of the relay B, as previously described.

At the front contact of its armature 10T, relay D prepares an operating circuit for the relay E which, however, is held open at this time at the armature 1T of the relay B, and will remain so held open until the end of the dialing operation. At its armatures 3T and 1T, respectively, the relay D opens the operating circuit 15 of the tick-tock circuit and disconnects the tick-tock signal circuit 14 from the tip conductor of the trunk X₁. At its contact 12T, relay D connects a circuit from ground to point 25 and over the conductor 21, to the motor control relay MC. Relay MC upon operating connects power to the receiving printer RP and to the driving motor M of the receiving distributor DTR. The distributor, however, is prevented from revolving because it is held in a well known manner by the clutch magnet CM which is not yet operated.

(c) Translating dialed pulses to printer code

When all of the pulses corresponding to the first digit have been received, the relay A operates for a longer interval than between pulses, thus permitting the relay C to release. Relay B at this time is still held up by a circuit over the front contact of the relay A. When relay C releases, it closes its contacts 1B and 3B, and thereby prepares a circuit over conductors A₁, S₁ to apply ground to the sleeve S. This circuit is not completed until relay D closes the back contact of its armature 5T upon being released when the workman hangs up at the end of the dialing operation.

At the back contact of its armature 1T the

relay C, when released, closes a circuit over the upper contacts of the off normal switch ON and over the back contact of armature 2T of relay W to point 22. From this point one branch extends and another applies ground over the front contact of the armature 4T of relay B, over the conductor 20, and through contacts of the counting selectors CS₁ and CS₂ to operate the selected relays of the translating group T₁ to T₄, inclusive, as will be described in more detail later.

It will be remembered that the stepping magnet STP was operated over the back contact of the relay A with each pulse to step the counting selector switches a step at a time to a point corresponding to the number of pulses of the digit dialed. Let us assume that the digit dialed was 6 and that the counting selector switches CS₁ and CS₂ were each consequently operated to the sixth position. The off-normal switch ON was closed as soon as said switches took their first step. Therefore, when relay C fell off at the end of the dialing of the first digit, a circuit was closed from ground over the back contact of the armature 1T of the relay C, over the upper contacts of the off-normal switch, over the back contact of the armature 2T of the relay W to point 22, where, as previously described, the circuit divides, one branch continuing through the winding of the relay ST to operate the latter, and the other branch continuing over the front contact of the armature 4T of the relay B and over conductor 20 and the wipers of the counting selector switches CS₁ and CS₂ to the 6th points of said switches. From the sixth point of counting selector CS₁ the circuit continues through the winding of the relay T₁ to operate said relay. Likewise, the circuit continues from the sixth point of the switch CS₂ through the operating winding of the relay T₄, causing the latter to be energized.

(d) The printing operation

We now have the translating relays T₁ and T₄ selected and operated, and these relays apply ground connections to selected ones of the segments 1 to 5, inclusive, of the distributor DTR to print the digit 6. For example, the front contact of the armature 5B of the translating relay T₁ connects ground to segment No. 1 of the distributor. No ground is applied to segment No. 2. Ground is applied to segment No. 3 of distributor DTR over the front contact of armature 2T of relay T₁, back contacts of armatures 2T of unoperated relays T₂ and T₃, respectively, over front contact of armature 5B of relay T₁ to ground. No ground is applied to segment 4, but ground is applied to segment 5 of the distributor over the front contact of armature 2T of relay T₄, back contact of armature 5T of relay T₃, back contact of armature 2B of relay T₂, and thence through the terminal P₅ to the segment No. 5. Segments 1, 3 and 5 are therefore grounded. From the chart of the counting selector shown in the lower right hand corner of Sheet 1 of the drawings it will be seen that this is the Baudot code for digit 6.

The operation of the relay STE which occurred as above described when the relay C fell off after the dialing of the first digit, results in the completion of a circuit from ground, over the front contact of the relay STE over front contact of armature 4T of operated relay P (relay P being operated at all times when the brush of the distributor is on its stop segment), and

through the winding of the clutch magnet CM to battery. The brush of the distributor DTR now begins to rotate, and as soon as it passes off the stop segment the circuit for the relay P, which had been completed over said segment and the inner ring of the distributor to a battery connection in the receiving printer, is opened. Relay P falls off and remains released during the rotation of the brush arm of the distributor until the brush arm again returns to the stop segment.

The release of the relay P at its armature 4T opens the circuit of the clutch magnet CM so that the magnet can stop the brush arm at the end of its rotation. Over the back contact of its armature 2B, the relay P connects ground to terminal 32, from which a circuit is completed to operate the relay W, and a branch circuit completes a connection through the upper locking windings of the relays T₁ and T₄, respectively.

As soon as the selected translating relays T₁ and T₄ have been locked up, the counting selectors CS₁ and CS₂ may be released to receive a new set of dialed impulses corresponding to the next digit. The operation of the relay W causes the release of said switches by operating the release magnet RLS over a circuit from ground, over the back contact of the armature 1T of the relay C, over the upper contacts of the off-normal switch ON, over the front contact of armature 2T of relay W, over the lower contacts of the off-normal switch ON, and through the winding of the release magnet RLS to battery. The operation of the release magnet RLS restores the switches CS₁ and CS₂ to normal.

The operation of the relay W, by attracting its armature 2T from its back contact, opens the circuit previously traced to apply ground to the contacts of the counting selectors CS₁ and CS₂. The same armature 2T of the relay W also opens the circuit of the relay STE which in turn opens the circuit of the clutch magnet CM. As soon as the counting selector switches are restored to normal, the off-normal switch ON opens its contacts. The counting selector is now ready to receive the impulse corresponding to a new digit. It is therefore seen that there is an overlap in the operation, in that the next digit may be received and permitted to operate the counting selector while the digit recorded by the previous operation of the counting selector is being recorded on the printer.

Returning again to the relay W, the operation of this relay, at the front contact of its armature 2B, prepares a circuit for the relay RLS₁. This circuit is not completed at this time and, indeed, is not completed by future operations of the relay W during dialing. Indeed it is not completed until a circuit is closed by the switch S₀ of the time finder selector over the conductor RLS', and this does not occur until after the workman's number and the job number have been dialed and the workman has hung up, as will be described later.

It might also be noted at this point that the release of relay P during the rotation of the distributor DTR, at the back contact of the armature 1T of said relay, prepares a busy ground connection to be applied to the sleeve conductor S over the armature 5T of relay D. This circuit is not effective at this time, however, because the relay D is operated and, in fact, this ground connection serves no purpose at any time during the transmission of the dialed numbers. It only

becomes effective under certain conditions during the operation of printing the time of day, as will be described later.

When the distributor brush of the distributor DTR returns to its stop position after having printed the digit which has been dialed, the relay P is again operated and at the front contact of its armature 4T prepares a path for the re-operation of the clutch magnet CM after the next digit is dialed. Relay P by disconnecting its armature 2B from its back contact releases the circuit above described for the locking windings of the translating relays T1 and T4 and restores them to normal. It also releases the relay W at the same time. If the workman has not already commenced to dial the next digit, relay A at this time will be energized, the relay B will still be held up, the relay C will be de-energized, and the relay D will still remain locked up. In this condition the circuit is ready to receive the dialed impulses of the next digit.

(e) *Dialing of additional digits*

The dialing of additional digits causes the same circuit operations to take place as have already been described. As each digit is dialed the counting selector is advanced step by step, and when the last impulse has been received the proper translating relays of the group T1 to T4, inclusive, are selected. The segments of the distributor DTR are marked accordingly and the printing operation takes place as already described.

After the last digit has been dialed the circuit will be in the condition already described as existing after dialing the first digit, namely, the relay A will still be energized, the relay B will still be held up, the relay C will have been released, and the relay D will remain locked up. The workman now hangs up his receiver and releases the relay A. The relay A in releasing operates the C relay and the stepping magnet STP over its back contact by means of a circuit already described. This causes the counting selector switches CS1 and CS2 to be advanced one step, but they will be immediately released without producing any effect, as will presently appear. After a brief interval the slow release relay B releases, and at its armature 4T opens the circuit which would otherwise be closed, when the relay C releases, over the conductor 20 to the counting selector switches. This prevents false selection of the translating relays T1 to T4, inclusive. The relay B now closes the circuit previously described for the release magnet RLS and again restores the counting selector switches to normal. Armature 8T of relay B opens the circuit previously described for energizing the relay C, which after a short delay will release.

(f) *Preparation of trunk circuit apparatus for time recording*

At its armature 8B, relay B disconnects the busy ground from the sleeve conductor S to permit the release of the automatic switch which establishes a connection to the trunk X1. The removal of ground from the sleeve conductor is only momentary, however, and just long enough to permit the release of the switches, for presently busy ground will be applied by the release of the relay C, as will be described later. At its armature 6B, relay B opens the locking circuit of the relay D, whose initial energizing circuit will be opened at the armature 4T of the relay C when the latter releases. At the back contact

of its armature 1T relay B establishes a circuit from ground over the front contact of the armature 10T of the relay D (which has not yet released) and through the winding of the relay E to battery, to operate the relay E. This energizing circuit is only momentary, being opened as soon as the relay D falls off, but the relay E when operated immediately locks itself to ground over the front contact of its armature 8B and the left hand back contact of relay RLS1.

As soon as the relay C releases it opens at its armature 4T the initial energizing circuit of the relay D already referred to, so that the latter after a brief delay releases. Upon the release of the relay D, an alternative busy ground is applied to the sleeve conductor S from ground over the contacts 1B and 3B of relay C, front contact of armature 2T of locked up relay G1, over conductor S1, over the back contact of armature 5T of relay D to the sleeve conductor S. This busy ground will remain on the sleeve as long as the relay G1 is locked up, and relay G2 will remain locked up through other G relays until all of the other trunks have been used in turn. While the last trunk is being used the locking circuit of the relay G1 will be opened and the busy ground, just traced, will be disconnected from the sleeve relay. The trunk will then be available for a new connection provided the operation of printing the time of day following the dialing of the workman's number and job number has been completed.

However, during the printing operation, other busy grounds are applied to the sleeve conductor S. For example, upon the operation of the relay E, it connects a busy ground at the front contact of its armature 9T over the back contact of the armature 5T of the relay D. The relay E remains actuated until the operation of printing the time of day has been completed. Also, as already described, each time the distributor DTR rotates, the release of the relay P during such rotation connects a busy ground over the back contact of the armature 1T of said relay P to the conductor 23, and thence over the back contact of the armature 5T of the relay D to the sleeve conductor. It may also be noted at this point that if the power should fail, the relay PO will fall off and at its back contact connect a busy ground to the conductor 23 and thence to the sleeve conductor S. Also, by operating the busy key BY, an attendant may connect a busy ground to the conductor 23 and thence to the sleeve conductor S. A lamp C2 will be lighted at the same time as this busy ground is applied.

(g) *Preparation of time finder selector for recording time*

The relay E upon being energized immediately establishes a locking circuit over the front contact of its armature 8B and over the left-hand back contact of relay RLS1, as already described. By separating its armature 2T from its back contact, relay E opens a possible automatic stepping circuit for the stepping magnet F of the time finder selector of Fig. 2. This circuit might be traced from battery through the stepping magnet F, over its self-interrupting contact, thence over the conductor ST, over the armature 2T of relay E, back contact of said armature, over conductor ST' to certain contacts of the switch So' of the time finder selector, and thence over the wiper of said switch to ground. This will prevent automatic stepping of the time finder selector after it has been advanced from any one of its idle

contacts, such as the contact 1, 3, or 15, provided the relay E is operated. At the time of the initial operation of the relay E, however, the stepping circuit above traced was not established, because the wiper of the switch S_0' is in one of its idle positions.

At the front contact of the armature 3T of the relay E, an operating circuit for the relay STE is prepared. This circuit when completed will extend from battery through the winding of the relay ST, to point 22 and thence over the back contact of armature 2T of the relay W, over conductor 25, over the front contact of armature 2T of relay E, over conductor ST' to certain contacts of the switch S_0' of the time finder selector, and over the wiper of said switch to ground. This circuit is not completed at this time, however, as the switch S_0' is in one of its idle positions.

At the front contact of its armature 6B, the relay E prepares a momentary operating circuit for the stepping magnet F of the time finder selector. This circuit will be opened as soon as the relay D releases, which, as already explained, occurs a moment after the operation of the relay E, due to the slow release action of the relay D. This circuit extends from ground over the front contact of the armature 4B of the relay D, front contact of the armature 6B of relay E, over conductor STP', and through the winding of the stepping magnet F to battery. The stepping magnet F of the time finder selector is released as soon as the relay D releases, and causes the time finder selector to take one step from its idle position. As already stated, the time finder selector has three idle positions corresponding to its first, eighth and fifteenth contacts. We will assume in this case that the wipers of the various switches of the time finder selectors were on their No. 1 idle contacts and are therefore now advanced to their No. 2 contacts, with results which will be presently described.

(h) Operation of tenths-of-hour selector

The relay E at its armature 1B disconnects conductor 12 from conductor 13 and thereby prevents any change in the setting of the hour selector or tenths-of-hour selector until the time of day has been printed in a manner which will be presently described. Normally the tenths-of-hour selector is advanced one step each time the clock control contacts CT close. The closure of this contact completes a circuit from ground over the armature and back contact of the slow operating relay MP to the winding of relay CG, thereby operating relay CG. This in turn put ground on conductor 13 through armature 4T of relay CG. This completes a circuit over conductor 13 over the contacts of the E relays of other trunks, over the back contact of armature 1B of the relay E of the trunk X_1 , over the conductor 12, through the winding of the stepping magnet TH of the tenths-of-hour selector to battery. Thus the tenths-of-hour selector will be advanced a step at a time at the end of every six minutes, provided none of the trunks is at the moment printing a time-of-day record.

If any trunk is printing such a record, the circuit just described will be held open until the record is completed. The clock contacts CT operate the relay MP, which in turn opens the operating circuit for relay CG. However, relay CG is held operated through a locking circuit which includes the armature 2T and front contact of relay CG and the back contact and arma-

ture associated with stepping magnet TH. The relay CG releases after the stepping magnet TH has operated. If, therefore, at the time the clock contacts are closed by the clock, a trunk or trunks is engaged in recording the time of day, the circuit for the stepping magnet TH will be held open until these operations are completed. As soon as they are completed, however, the circuit of the stepping magnet TH is completed from ground, over its back contact, over the front contact of the armature 4T of the relay CG, over the conductor 13, over the 1B armatures of the various E relays, and thence over the conductor 12 through the winding of the magnet TH to battery. The stepping magnet TH is thus energized momentarily, and then deenergized by the opening of its back contact. This causes the several switches of the tenths-of-hour selector to be each advanced one step to the next tenth of an hour indication. This step may be taken a short interval after the actual tenth of an hour is indicated by the clock (not shown), but it will be taken before the next tenth of an hour interval is indicated by the clock, because the printing operations of any trunks recording the time of day will take far less than the six-minute interval between successive tenths of an hour. Therefore, the holding up of the stepping operation of the tenths-of-hour selector will not cause the selector to lose the step corresponding to any tenth of an hour.

(i) Operation of hour selector

The hour selector is advanced one step each hour under the control of the tenths-of-hour selector. As already stated, the tenths-of-hour selector switches make a full half-revolution every two hours, taking one step every six minutes. At the end of the ninth step, or after the expiration of the nine-tenths of the first hour, a circuit will be completed from ground, over the wiper of the switch TS_3 , over the ninth point of said switch, through the winding of the relay HR, to energize said relay HR. This relay will be held up until the tenths-of-hour selector advances to its tenth contact. When this occurs a circuit will be completed from battery, through the stepping magnet H of the hour selector, over the front contact of the relay HR to the point 24. From point 24 the circuit extends to ground either over the contact of the clock motor or, in case the stepping of the tenths-of-hour selector has been held up because of some trunk printing the time of day, the circuit will be completed from point 24, over the front contact of the relay CG, and over the back contact of the stepping relay TH of the tenths-of-hour selector to ground. In either event, at every tenth step of the tenths-of-hour selector the stepping magnets H and TH will be simultaneously energized so that at this interval the hour selector will be advanced one step at the same time that the tenths-of-hour selector is advanced to its tenth step.

A similar connection is provided for the relay HR at the nineteenth contact of the switch TS_3 of the tenths-of-hour selector, with the result that the hour selector will be advanced another step at the end of the second hour when the tenths-of-hour selector is moved to its twentieth contact. At the end of the next six-minute interval the contact CT will close and advance the tenths-of-hour selector to its twenty-first position. Thereupon the stepping magnet TH will operate over a self-interrupting circuit extend-

ing from battery, through its winding, over successive ones of the last five contacts of the switch TS₁, over the wiper of the switch TS₁, and over the contact of the stepping magnet TH to ground, thus causing the tenths-of-hour selector to be automatically stepped to its first position to repeat the cycle.

(j) *Stepping time finder selector from its idle position*

Returning again to the relay E: at the front contact of its armature 9T it connects a busy ground to the sleeve S, as already described. At its armature 3B it disconnects ground from the operating circuit of the relay B, thereby preventing said relay from being re-operated. The non-operated condition of relay B prevents the application of the tick-tock tone to the trunk X₁ in the case of an attempted connection to the trunk by some other workman during the brief interval between the release of the relay B and the slightly later release of the relay D. During this interval, as already described, the busy ground is withheld from the sleeve conductor of the trunk, this being necessary in order to cause the release of the selecting switches by which the connection was established. Any other workman who may make a connection to the trunk during this short interval will hear no tick-tock signal. This will indicate to him that he should hang up and, after a short interval, again attempt to establish connection to the recording trunk. Relay E, by closing the front contact of its armature 7T, connects ground to the point 25 and thence to the conductor 21 to maintain the motor control relay MC operated. If this were not done, the circuit for the motor control relay would be opened by the armature 12T of relay D when the latter relay falls off.

As already stated, the slow release relay D falls off shortly after the relay E is actuated and, by permitting its armature 10T to fall away from its front contact, it opens the operating path of the E relay so that the latter will be held up solely by its locking circuit already traced. Relay D in falling off also prepares at its armatures 1T and 3T, circuits to apply the tick-tock tone to the trunk whenever a new connection is established thereto. At its armature 12T, relay D disconnects ground from the motor control relay MC, leaving the latter under the control of the relay E and the relay RLS₁. Finally, as already stated, when relay B falls off, the circuit previously established over its armature 4B and conductor STP' to energize the stepping magnet F of the time finder selector, is opened so that the time finder selector takes one step from its idle position 1, 8, or 15 as the case may be, to its first printing position 2, 9, or 16.

(k) *Printing first apostrophe*

Assuming that the time finder selector is stepped from position 1 to position 2, connections are established for printing an apostrophe. In this connection it should be noted that apostrophes are here used to separate the dialed digits from the digits representing the time of day, and also to take the place of the usual decimal point between the digits representing the hour and the digit representing tenths of an hour. The apostrophe is used rather than a period for this purpose because it happens to be simpler to automatically set up the code combination for the apostrophe than it would be to set up a period.

It will be noted by referring to the counting selector chart at the lower right-hand corner of Fig. 1, that relays T₁, T₃ and T₄ of the translating relays must be selected to print an apostrophe.

In order to accomplish the proper control of the translating relays T₁ to T₄, inclusive, the time finder selector is provided with four switches S₁, S₂, S₃ and S₄, whose wipers have connections T₁, T₂, T₃ and T₄ connected to the operated windings of the translating relays T₁, T₂, T₃ and T₄, respectively. When the time finder selector is in its second position it will be noted that ground is connected over the wipers of switches S₁, S₃ and S₄ to the conductors T₁, T₃ and T₄, respectively, but no ground is connected to conductor T₂. Consequently, the relays T₁, T₃ and T₄ are operated, and then locked up in the manner already described.

A circuit is also completed by the switch S'₀ of the time finder selector for the relay STE, said circuit extending from ground, over the wiper of said switch, over the conductor ST', armature 2T of relay E on its front contact, conductor 26, back contact of armature 2T of relay W to point 22, and thence through the winding of relay STE to battery. The relay STE upon being operated causes the clutch magnet CM to release the printer distributor DTR with the result that the printer prints an apostrophe. As soon as the distributor DTR leaves its stop segment, the relay P releases, opening the circuit of the clutch magnet in a manner already described.

At the back contact of its armature 2B, relay P completes the locking circuit for the operating translating relays in the manner previously pointed out and also operates the W relay. The W relay, of course, re-opens the circuit previously traced for the relay STE, and when the relay STE falls off, it opens the circuit with the clutch magnet CM so that the clutch will stop the wiper of the distributor DTR at the end of its rotation.

(l) *Printing second apostrophe*

At the back contact of its armature 2B, relay P also completes a circuit for the time finder stepping magnet F from ground, over conductor 27, conductor 28, front contact of armature 5T of relay E, over the conductor STP' and through the winding of the stepping magnet F to battery. As soon as the brush of the distributor returns to its stop segment, the relay P is re-operated and opens the path just traced to the stepping magnet F of the time finder selector, thus permitting the time finder selector to step to its next position which, in the case assumed, is the third position.

The relay P upon being energized also opens the locking circuits of the translating relays T₁, T₃ and T₄ so that they fall off. The relay P furthermore opens the circuit of the W relay so that it is released. The release of the W relay again causes the operation of the relay STE by connecting ground, over the brush of the switch S'₀, and over the third contact of said switch to the conductor ST', from whence the circuit continues and may be traced through the winding of the relay STE over the path previously described. The relay STE again releases the clutch of the distributor DTR so that a second apostrophe is printed.

The second apostrophe combination is set up in the third position by reason of the fact the wipers of the switches S₁, S₃ and S₄ in position 3 connect ground to the conductors T₁, T₃ and T₄ to operate and lock up the translating relays

T1, T3 and T4 as previously described. Thus a second apostrophe is printed. While it is not necessary that two apostrophes be printed to separate the dialed digits from the time-of-day digits, it is thought better to use two apostrophes at this point so as not to cause confusion with the single apostrophe later used to separate the hour digit from the digit representing tenths of an hour.

(m) Printing first digit of the hour

As before, the relay P is released at the beginning of the rotation of the brush of the distributor DTR. At the back contact of its armature 2B, relay P again establishes the circuit previously traced for the stepping magnet F of the time finder selector, and also operates the relay W causing the release of the relay STE, with the effect upon the clutch magnet previously described. As soon as the brush of the distributor returns to its stop segment the relay P is again operated, with the consequent opening of the circuit of the stepping magnet F of the time finder selector and of the relay W. The time finder selector is thus advanced to its fourth position. Upon the release of the relay W a circuit is again established for the relay STE over a path previously described, to start the distributor and cause the printing of the first digit of the time of day.

In positions 4, 5, 6 and 7 of the time finder selector, the time of day is printed in continental time in tenths of hours in accordance with the setting of the hour selector and the tenths-of-hour selector. The use of continental time avoids the need for printing a. m. and p. m. and, as already stated, an apostrophe is used instead of a period to indicate tenths of hours, the apostrophe being printed in position 6 of the time finder selector.

It will be remembered that upon the operation of the relay E, the stepping circuit for the tenths-of-hour selector and the hour selector was disabled, so that the time indication registered at that time could be printed without any error due to the movement of one or the other or both of these selectors during the several steps of the printing operation. Let us suppose the time of day in continental time is 18.8 hours. The brushes of the switches HS₁, HS₂ and HS₃ of the hour selector will then be resting upon the eighteenth contacts of said switches. The brushes of the switches TS₁, TS₂ and TS₃ of the tenths of hour selector will also happen to be resting upon their eighteenth contacts instead of their eighth contacts, if we assume that tenths of the odd hours are registered in the second portion of the tenths-of-hour selector, and tenths of the even hours in the first portion.

The time finder selector is now in its fourth position. Connections from the conductors T₄, T₃, T₂ and T₁ are extended through the switches S₄, S₃, S₂ and S₁ to contacts of the hour selector and tenths-of-hour selector. The circuits completed through the four switches of the time finder selector in position 4 will depend upon the tens digit of the hour indicated by the hour selector. In the case assumed the tens digit is 1. From switch HS₃ of the hour selector a circuit is completed from ground, over the eighteenth point of said switch, conductor 1, fourth point of the switch S₄ of the time finder selector, over the wiper of said switch to the conductor T₄, and thence over a circuit previously traced to operate and lock up translating relay T₄.

An inspection of the circuit will show that no connections are completed through the switches S₃ and S₁ over conductors 4 and 9 through any of the switches of the hour selector. Consequently circuits are not completed over conductors T₁ and T₃ to operate the corresponding translating relays T₁ and T₃. In the case of switch S₂ of the time finder selector, in this fifth position no conductor is extended to any of the points of the hour selector switches, but instead the fifth point of said switch S₂ is grounded. A circuit is therefore completed from this grounded point over the wiper of the switch S₂ to the conductor T₂, and thence over a circuit previously traced through the winding of the relay T₂, causing said relay to be operated.

We now have translating relays T₂ and T₄ selected. This marks first, second, third and fifth segments of the distributor DTR over circuits as follows: From ground over front contact of armature 5B of relay T₂, front contact of armature 2B of relay T₄ to segment 1; from ground over the front contact of armature 2T of relay T₄, back contact of armature 5T of relay T₃, front contact of armature 2B of relay T₂ to segment 2; from ground over the front contact of armature 5B of relay T₄, back contact of armature 2T of relay T₃, front contact of armature 2T of relay T₂ to segment 3; and from ground over the front contact of armature 5T of relay T₂ to segment 5.

The distributor in the meantime has been released by the operation of the relay STE over the circuit previously traced over the conductor ST', through the fourth contact of the switch S₀' of the time finder selector to ground. This circuit it will be recalled was established as soon as the time finder selector was stepped into its fourth position. The distributor DTR as it rotates causes the printing of the digit 1, due to the ground connections previously traced to its first, second, third and fifth segments.

(n) Printing second digit of the hour

At the beginning of the rotation of the distributor, the relay P was released, again establishing a circuit over conductors 27, 28 and STP' to energize the stepping magnet F of the time finder selector and locking those relays T₁—T₄ previously operated. When the relay P is again energized at the end of the printing operation, it opens the previously established circuit for the stepping magnet F and causes the time finder selector to advance to its fifth position. It also unlocks the selected translating relays and releases the relay W. Relay W over the back contact of its armature 2T again establishes an energizing circuit for the relay STE over the conductor ST' and the grounded fifth contact of switch S₀'.

In the fifth position, as will be seen from the chart of Sheet 2 of the drawings, the units digit of the hour will be printed. This digit, it will be remembered, in the case assumed was 8. It will be seen from an inspection of the circuit of Fig. 2 that in the fifth position of the time finder selector no connection is established over conductors T₄, T₂ and T₁ through switches S₄, S₂ and S₁, respectively, of the time finder selector, and thence over conductors 2, 7 and 9 and 10, respectively, to the number 18 contacts of any of the switches HS₁, HS₂ and HS₃ of the hour selector. However, a circuit is established from the grounded brush of switch HS₁ over its eighteenth contact, over conductor 5, over the fifth contact and brush of switch S₃ of the time finder selector,

and thence over conductor T₃ and the circuit previously traced to relay T₃. Relay T₃ is thus operated and locked up. Relay T₃ marks ground on segments 2 and 3 of the distributor DTR which is released upon the energization of the relay STE, and as it rotates causes the printing of the digit 8 by the printer RP.

(o) *Printing third apostrophe*

In a manner similar to that previously described, the time finder selector is advanced to its sixth position at the end of this printing operation for the purpose of putting in an apostrophe. The apostrophe combination is determined by the fact that ground is connected to the sixth contacts of switches S₁, S₃ and S₄ of the time finder selector and that no ground appears on the sixth contact of switch S₂. Consequently circuits are completed over conductors T₁, T₃ and T₄ to operate and lock up the translating relays T₁, T₃ and T₄. The distributor DTR, of course, started to rotate practically coincidentally with the stepping of the time finder selector to its sixth position, and the resultant apostrophe is printed by the printer RP.

(p) *Printing the tenths-of-hour digit*

Next, the time finder selector is advanced to its seventh position, in which it prints the digit representing the indicated tenth of an hour, which it will be recalled was 8 in the case assumed. The tenths-of-hour selector is in its eighteenth position and the time finder selector is, as already stated, in its seventh position. By inspection of the circuit of Fig. 2 it will be seen that no connections are established through switches S₁, S₂ and S₄ of the time finder selector over conductors 3, 8 and 11, respectively, to any live segments of either of the switches TS₂ or TS₃ of the tenths-of-hour selector. However, a circuit is established from ground over the brush and eighteenth contact of the switch TS₂, thence over conductor 6, over seventh contact and brush of the switch S₃ of the time finder selector, over conductor T₃, and thence over the circuit previously traced to operate the relay T₃. The operation of the relay T₃ applies ground to segments 2 and 3 of the distributor DTR, which, during its rotation, causes the printer RP to print the digit 8.

(q) *Restoring equipment to normal*

When the relay P is released after the wiper of the distributor DTR leaves its stop segment at the beginning of the printing operation for the tenths-of-hour digit, the relay W operates over the back contact of the armature 2B of the relay P. The time finder selector at this instant is in position 7 and, therefore, a circuit is completed for the release relay RLS₁ from ground, over the seventh contact of the switch S₀ of the time finder selector, over the conductor RLS', over the front contact of armature 2B of the relay W, and through the winding of the relay RLS₁ to battery. At its right-hand front contact, relay RLS₁ completes a holding circuit from the motor control relay MC, extending from ground to point 25, thence over the conductor 21 and through the winding of the relay MC to battery. This holds the relay MC until the printing operation of the tenths-of-hour digit is printed. At its left-hand contact relay RLS₁ opens the locking circuit for the relay E, which is permitted to release.

The relay E upon being released, at the back

contact of its armature 2T closes a circuit for the stepping magnet F of the time finder selector, from ground over the wiper of the switch S₀', seventh contact of said switch, conductor ST', back contact of armature 2T of relay E, and thence over conductor ST and the interrupting armature of the stepping magnet F, and through the winding of said stepping magnet to battery. The stepping magnet upon being energized immediately releases itself through its armature and thereby steps the wipers of the several switches of the time finder selector to their eighth contacts. As said eighth contact of switch S₀' is not connected to ground, the magnet F remains released and the time finder selector remains in its eighth position until such time as it is called upon to function again in connection with the recording of time.

In addition to the foregoing, the relay E upon being released, at its armature 9T removes ground from the sleeve S of the trunk X₁ so that the trunk is now free to be again selected, except for the action of the relays G₁, G₂, G₃, etc., as will be described later. At its armature 7T relay E disconnects ground from the motor control relay MC but, as previously described, said motor control relay is held by ground applied to its circuit by the relay RLS₁. At the back contact of the armature 3B, relay E applies ground to the back contact of the relay A, so that the latter is now in position to receive dialed impulses on a subsequent call.

Finally, by closing the back contact of armature 1B, relay E establishes a circuit for the stepping magnet TH of the tenths-of-hour selector, which extends from ground, over the back contact of the stepping magnet TH, front contact of relay CG (which, it will be recalled, was locked up when the tenths-of-hour selector was seized), over conductor 13, back contact of armature 1B of relay E, over conductor 12, and through the winding of the stepping magnet TH to battery. The stepping magnet operates and at once by its armature opens the circuit above traced and the locking circuit of the relay CG. The release of stepping magnet TH advances the tenths-of-hour selector from its eighteenth to its nineteenth contact.

When the tenths-of-hour selector is on its nineteenth contact (or its ninth), a circuit is closed from ground over the wiper of the switch TS₃, over its nineteenth (or ninth) contact, through the winding of the relay HR to battery. If under these conditions the clock control contact CT is closed to advance the tenths-of-hour selector to its twentieth (or tenth) point, a circuit will be completed from said contact CT, over the front contact of the relay HR, to the stepping magnet H of the hour selector, this circuit being in parallel with the circuit of the stepping magnet TH of the tenth-of-hour selector. Both stepping magnets are energized and as soon as they are released by the opening of the contact CT, the tenths-of-hour selector is advanced to its twentieth (or tenth) point, and the hour selector is advanced to its nineteenth point. Thus it will be seen that the hour selector is advanced once every hour under the control of the tenths-of-hour selector.

Returning now to the printing operation in connection with the tenths-of-hour digit, as soon as the distributor DTR returns to its stop segment after transmitting the code for the tenths-of-hour digit to the printer RP, the relay P is re-operated. Relay P releases at its armature 2B the

relay W and the locked-up translating relays of the group T1 to T4, inclusive. At its armature 2B, the relay W upon releasing opens the circuit previously traced for the relay RLS₁, which in turn removes ground from the circuit of the motor control relay MC. The latter releases and stops the motor M in case the trunk X₁ has not been again seized. Relay RLS₁ at its left-hand contact of course prepares the locking circuit for the relay E for subsequent operation.

If for any reason the time finder selector is moved off normal without the relay E being operated, it will be automatically stepped to its next idle position by a self-interrupted circuit from ground, over the wiper of switch S₀', grounded contacts of said switch, over the conductor ST', back contact of armature 2T of relay E, conductor ST, and over the armature of the stepping magnet F to battery. The magnet F automatically interrupts itself until the wiper of the switch S₀' is advanced to the next idle contact. The other switches of the time finder selector are of course advanced to the same point.

(r) *Sequential selection of trunks*

Where more than one recording trunk is provided, it may be desirable to arrange the circuit to distribute the load somewhat uniformly over all of the trunks. Where such is the case the trunk X₁ has associated with it a relay G₁, the next trunk in order has associated with it the relay G₂, the third trunk, the relay G₃, etc. As soon as the trunk X₁ is seized, the relay A is energized and in turn closes the circuit to energize the relay B, whereupon as already described, a circuit for the relay C is completed in response to the dialing of the first digit. Relay C at its contact 1B—2B, closes the circuit for the relay G₁, which is at once locked up over the front contact of its armature 4T to ground over the 1B—3B contacts of the next G relay which is idle. This we will assume is the relay G₂.

When the trunk corresponding to the relay G₂ is seized in its turn, the relay G₂ is locked up over a contact of the next idle G relay, and the locking circuit for the relay G₁ is extended over the armature 2B of the relay G₂ to ground over the 1B—3B contact of said next idle G relay. In this manner the relay G₁ is locked up until all of the successive trunks have been used in turn, whereupon its locking circuit is opened and it releases. During the time that the relay G₁ was locked up, ground was applied over the contacts 1B and 3B of the relay C, and over the front contact of the armature 2T of the relay G₁, to the sleeve conductor S of the trunk X₁, thus rendering the trunk busy until such time as the relay G₁ is released after all successive trunks have been used in order.

The invention as herein described is designed to print the number of the workman, the number of his job, and the time of day. The circuit can, practically without revision, be used for a number of other purposes. For example, by connecting the trunk X₁ to a service-observing circuit of an automatic exchange, the numbers dialed by a subscriber's line may be recorded by means of the printer, this in turn being followed by printing a record of the time of day.

Fig. 3 illustrates an arrangement which may be added to the circuit for following and recording numbers that may be taken by the service observer. Dial pulses received in the service observing circuit (not shown) cause the operation of the dial pulses repeater DPR which therefore

grounds its armature in accordance with these pulses. This causes current to traverse conductor e and the winding of relay A of Fig. 1 to operate relay A. Relay A follows the dial pulse signals, causing the operation of the counting selector CS₁ and CS₂ to translate these pulses into the Baudot code for recording purposes as already described.

During the reception of dial pulses, relay B operates and due to its slow-release feature, remains operated during dialing. The relay B operating circuit includes grounded armature 3B of relay E and its back contact, armature and front contact of relay A₁, winding of relay B to battery. As relay A follows the dial pulses, relay C will be operated over a circuit which includes the grounded armature 3B of relay E and its back contact, armature and back contact of relay A, armature 8T and front contact of relay B, winding of relay C and battery. The operation of relay C operates relay D over a circuit comprising grounded armature 4T and its front contact of relay C, winding of relay D and battery. A locking circuit for relay D is also completed through front contact and armature 10B of relay D, front contact and armature 6B of relay B, and ground. Relay B is also locked up over a circuit including grounded armature 4B and front contact of relay B, conductor b extending to Fig. 3, armature T₁ and its back contact of relay OBR, conductor C, winding of relay B and battery. In other words, the arrangement so far described operates as already explained hereinabove, except for the locking circuit of relay B. This locking circuit holds relays B and D operated until the release key RLS' of Fig. 3 is operated.

When release key RLS' is operated as, for example, when the observation is completed, then relay OBR will be operated to open the locking circuit of relay B. Relay OBR is operated over a circuit which includes the grounded contact of release key RLS', conductor a, armature 7B of relay D and its front contact, conductor d, winding of relay OBR to battery. Lamp 2Y is also illuminated during the operation of release key RLS'. Relay OBR is also locked up during the operation of release key RLS', the locking circuit including the grounded release key RLS', armature B₁ of relay OBR and its front contact, the winding of relay OBR and battery. The operation of relay OBR releases relay B. Relay B releases upon the opening of the back contact of armature T₁ of relay OBR which is in series with the winding of relay B as already explained. The release of relay B operates relay E as already explained so that the time may be recorded on the receiving printer RP. Relay D which is of the slow-release type, releases soon after the release of relay B, the release of relay D taking place with the opening of the front contact of armature 8B of relay B. For service observing, the dial pulses are received by the winding of relay DPR of Fig. 3 and not over conductors R and T of Fig. 1.

It will be understood that upon the release of release key RLS', relay OBR will be released due to the removal of ground from its winding. Upon the release of relay OBR, lamp 2Y will also be extinguished.

Various other uses will suggest themselves and it will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated, without departing from the spirit of the invention as defined in the following claims.

1. In a teletypewriter recording system, the combination of means for producing a predetermined number of pulses of current, means for translating said pulses of current into a teletypewriter code signal which corresponds to the number of pulses, clock-controlled means for producing a predetermined number of pulses of current corresponding to the time of day, means for translating said letter pulses of current into a second teletypewriter code signal corresponding to the number of such pulses, and means for recording both of said teletypewriter code signals.

2. In a teletypewriter system, the combination of a telephone circuit over which dialing pulses may be transmitted, a teletypewriter recording circuit, means for translating said dialing pulses into teletypewriter code signals, a clock-controlled circuit for producing pulses corresponding to the time of day, means for translating said clock-controlled pulses into teletypewriter code signals and means for operating said recording circuit in accordance with the code signals corresponding both to the dialing pulses and to the clock-controlled pulses.

3. The combination of a dial operated private branch exchange, a recording circuit, means responsive to a first predetermined code signal transmitted from said private branch exchange to operate said recording circuit, said recording circuit including a selector, a plurality of relays, a distributor, a clock-controlled apparatus, means responsive to a second predetermined code signal transmitted from the private branch exchange to said recording circuit to operate said selector and a predetermined combination of said relays corresponding to said second code signal, and means for subsequently operating said distributor and said clock-controlled apparatus to indicate the time when said second code signal is received by said recording circuit.

4. The combination of a dial operated private branch exchange system, a plurality of recording circuits, means responsive to a first predetermined code signal transmitted from said private branch exchange system for connecting but one of said recording circuits to said private branch exchange system, each recording circuit including selector apparatus, a plurality of relays, a distributor, clock-controlled apparatus, means responsive to a second predetermined code signal transmitted from said private branch exchange system to operate said selector apparatus and a predetermined combination of said relays corresponding to said second code signal, means controlled by the combination of relays operated by said second code signal for operating the distributor of the recording circuit connected to the private branch exchange system, and means controlled by the clock-controlled apparatus to operate the distributor to indicate the time when the second code signal is received from the private branch exchange system.

5. The combination of a dial operated private branch exchange system, a plurality of recording circuits, each recording circuit including a printing telegraph receiver, means for translating pulses received from the private branch exchange system into the Baudot code, a clock mechanism, means for translating the time registered by said clock mechanism into the Baudot code, and means for applying both Baudot codes on only one of said recording circuits.

6. In a teletypewriter system, the combination of a dial operated private branch exchange, a plurality of recording circuits, each recording circuit including a printing telegraph receiver, a selector operated by pulses received from the dial-controlled private branch exchange, a plurality of relays controlled by said selector, a distributor controlled by the relays operated under the control of said selector, means for operating said distributor so as to actuate said telegraph receiver, clock-controlled mechanism, means for translating the time registered by said clock mechanism into the Baudot code, and means for actuating said telegraph receiver to record the Baudot code corresponding to the time registered.

7. In a teletypewriter system, the combination of a dial-controlled private branch exchange, a plurality of recording circuits, each recording circuit including a printing telegraph receiver, means for translating pulses received from the private branch exchange into the Baudot code, clock mechanism, first and second selectors, means including the first selector for producing a plurality of pulses corresponding to the number of hours passed by the clock mechanism, means including the second selector for producing a plurality of pulses corresponding to the number of tenths of an hour passed by the clock mechanism, means for translating the latter two groups of pulses into the corresponding Baudot codes, and means for recording the latter two Baudot codes on the printing telegraph receiver.

8. In a teletypewriter system, the combination of a circuit over which dial impulses may be transmitted, a clock mechanism, a plurality of relays, a first selector operated by said dial impulses, means including said first selector for operating a predetermined combination of said relays in accordance with dial pulses, a second selector, means including said second selector for obtaining a plurality of pulses corresponding to the number of hours passed by the clock mechanism and to operate a predetermined combination of said relays, a third selector, means including said third selector for obtaining a plurality of pulses corresponding to the predetermined fractions of hours passed by said clock mechanism and to operate a predetermined combination of said relays, a printing telegraph receiver, and means for translating the various combinations of said relays into corresponding Baudot codes to be recorded by said printing telegraph receiver.

9. In a teletypewriter system, the combination of a clock mechanism, a time controlled switch coupled to said clock mechanism, a selector, a teletypewriter, means including said selector and said switch for producing a plurality of pulses corresponding to the time indicated by said clock mechanism, and means for recording said pulses on said teletypewriter.

10. In a teletypewriter system, the combination of a clock mechanism to indicate time, a switch mechanically coupled to said clock mechanism, a printer device, means responsive to the operation of said switch for producing a plurality of pulses corresponding to the time indicated by said clock mechanism, and means for applying said pulses to said printer device.

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