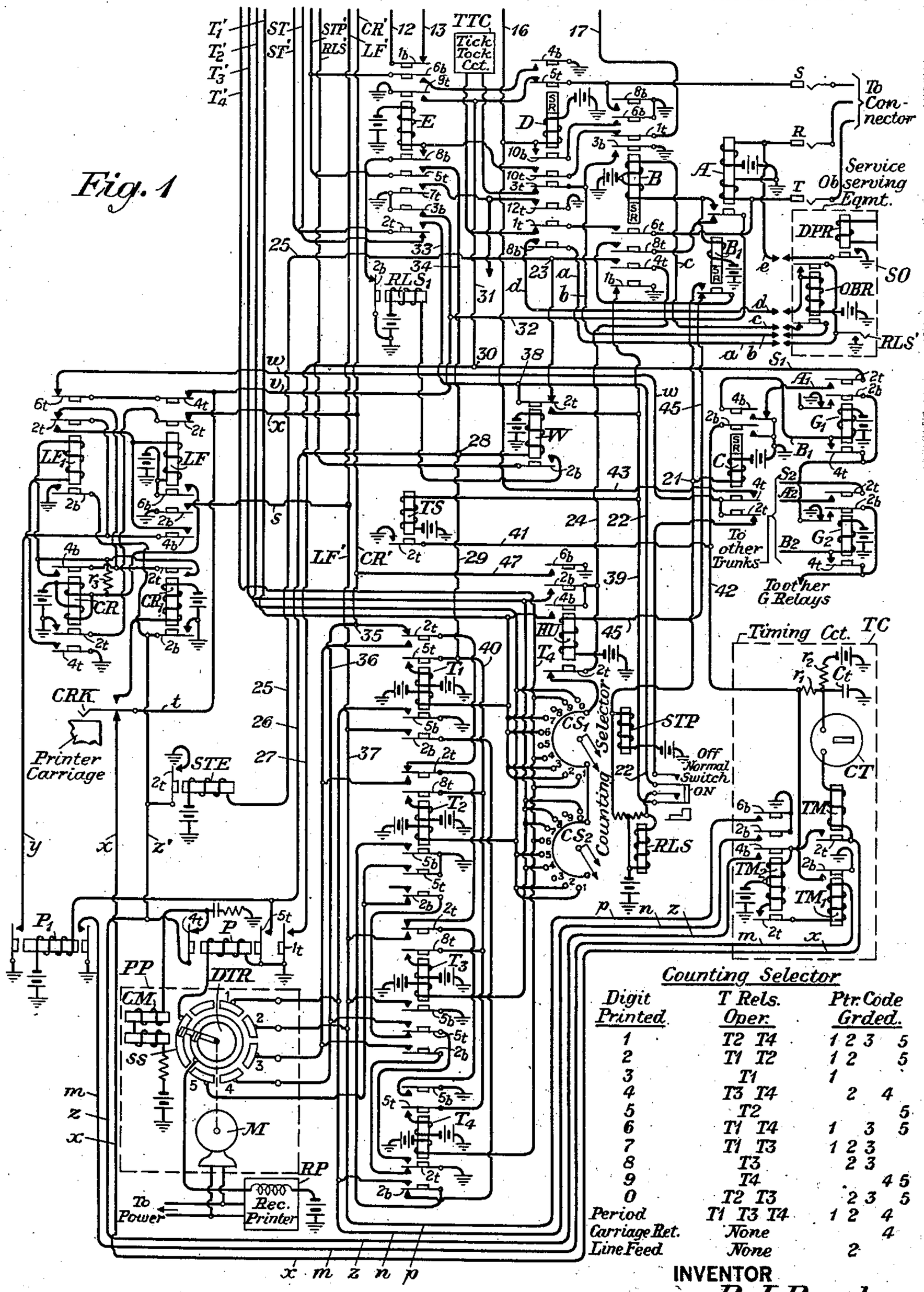
Sept. 19, 1944. P. J. RANK 2,358,593

TELETYPEWRITER RECORDING SYSTEM

Filed March 19, 1943 2 Sheets-Sheet 1

Fig. 1



Counting Selector

Digit Printed	T Rels. Oper.	Ptr. Code Grded.
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
Period	T1 T3 T4	1 2 4
Carriage Ret.	None	4
Line Feed	None	2

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TELETYPEWRITER RECORDING SYSTEM

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Time Finder Selector		*Hour Selector*		*Tenths of Hour Selector*	
Index Wheel		*Index Wheel*	*Hour Marked For Printing*	*Index Wheel*	*Tenths of Hour Marked For Printing*
22	Pass By	25	Pass By	25	
21	Release	24	00	24	
20	Line Feed	23	23	23	Pass By
19	Carriage Return	22	22	22	
18	Tens of Hour Digit	21	21	21	
17	Period	20	20	20	.0
16	Hour Units	19	19	19	.9
15	Hour Tens	18	18	18	.8
14	Period	17	17	17	.7
13	Period	16	16	16	.6
12	Idle	15	15	15	.5
11	Pass By	14	14	14	.4
10	Release	13	13	13	.3
9	Line Feed	12	12	12	.2
8	Carriage Return	11	11	11	.1
7	Tenths of Hour Digit	10	10	10	.0
6	Period	9	09	9	.9
5	Hour-Units Digit	8	08	8	.8
4	Hour-Tens Digit	7	07	7	.7
3	Period	6	06	6	.6
2	Period	5	05	5	.5
1	Idle	4	04	4	.4
		3	03	3	.3
		2	02	2	.2
		1	01	1	.1

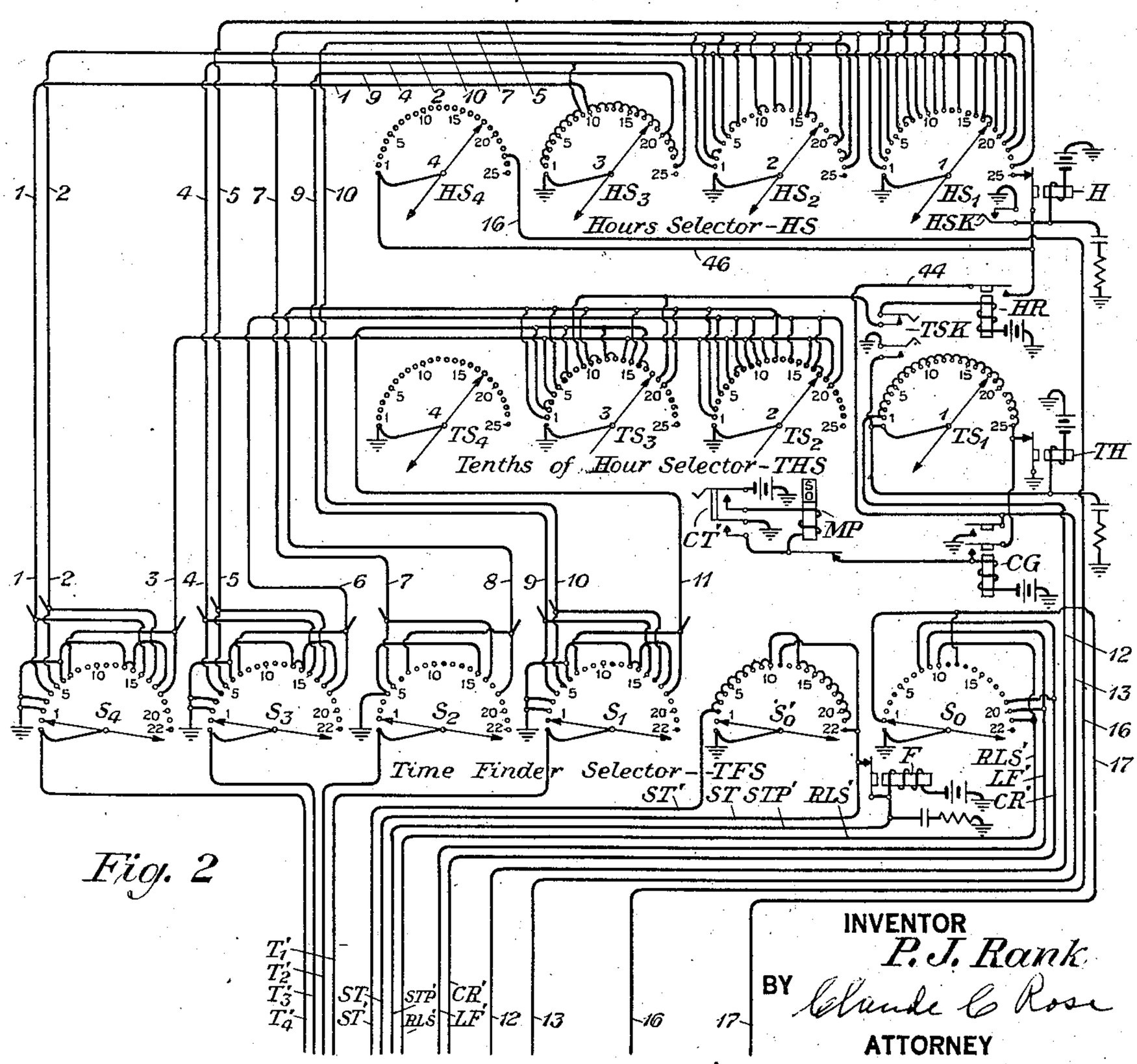

Fig. 2

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Patented Sept. 19, 1944 2,358,593

UNITED STATES PATENT OFFICE

2,358,593

TELETYPEWRITER RECORDING SYSTEM

Paul Jones Rank, Berwyn, Ill., assignor to American Telephone and Telegraph Company, a corporation of New York

Application March 19, 1943, Serial No. 479,692

19 Claims. (Cl. 179—4)

This invention relates to recording systems and particularly to recording systems using teletypewriters as the recording media. Systems such as herein disclosed are particularly useful for recording the operations of telephone lines under service observation, and for recording data with respect to jobs or tasks assigned to workmen or other employees in factories, offices, machine shops, etc.

A system of the type to which the improvements invented by applicant are applicable has been disclosed and claimed in U. S. Patent No. 2,278,703, issued April 7, 1942, to G. L. Knittle. The general purpose of applicant's invention is to improve the system of the Knittle patent and broaden its field of usefulness.

In the system disclosed in the Knittle patent a special recording trunk is provided, and this trunk may be reached by dialing a special number in the automatic P. B. X. system installed in a factory, office, machine shop or the like. A teletypewriter, arranged to print upon a tape, is associated with the recording trunk. After this trunk has been reached by dialing its number, the workman dials his identifying number and the teletypewriter prints the number so dialed. After this number has been recorded the workman dials the number assigned to his job, which is also printed by the teletypewriter.

After these two numbers have been printed, certain clock-controlled apparatus for indicating the time of day is associated with the recording trunk, and this automatically causes the printer to print the time of day indicated by the clock controlled apparatus. In this manner a record is made of the workman's number, the number of his job, and the time that the job was started or finished, as the case may be.

The arrangement disclosed in the Knittle patent above referred to is also adapted for recording the operations of a telephone line to which a service observing trunk has been attached. When the recording trunk, including the teletypewriter, is connected to a service observing trunk, the teletypewriter will automatically record all numbers dialed by the subscriber of the line under observation.

When the Knittle circuit is used for recording service observations no arrangement is provided for noting the time-of-day. Furthermore, no arrangement is provided in the Knittle circuit for noting (1) the length of the interval occurring between the removal of the receiver from the switchhook and the start of the dialing; (2) the intervals occurring during the dialing of successive digits; and (3) the interval occurring between the end of the dialing operation and hanging up of the receiver at the end of a conversation.

The present invention has as its general object the improvement of a recording trunk of the type disclosed in the Knittle patent to overcome the difficulties above mentioned.

Specifically, one object of the present invention is to arrange the recording circuit so that a page printer may be employed instead of a teletypewriter printing upon a tape.

Another object is to arrange the recording circuit so that when recording service observations some character, such as the letter *a*, or an equivalent symbol, will be printed at successive time intervals during the period elapsing between the removal of the subscriber's receiver from his switchhook and the start of the dialing operation.

Still another object is to arrange the trunk to record a character such as the letter *a* or its equivalent during the intervals between the dialing operations for the different digits of the dialed number.

A further object of the invention is to print timed characters such as the letter *a* or its equivalent during the interval between the completion of the dialing operation and the hanging up of the receiver at the end of the conversation.

A still further object of the invention is to time the relatively long intervals during which no telephone line under observation is in use, by causing the printer to print some other symbol such as the letter *k* or an equivalent symbol, followed at regular intervals by periods or other symbols during such time as the subscriber's receiver is on his switchhook.

An additional object of the invention is to so arrange the recording circuit that when the recording trunk is used for service observations, the carriage return and the line feed mechanisms of a page printer will be automatically operated each time the end of a line is reached.

Yet another object of the invention is to cause the carriage return and line feed operations to be performed after each time-of-day record when the trunk is used for recording workmen's numbers and job numbers in shops, factories and the like.

One further object of the invention is to prevent the printer from recording a digit dialed during the line feed operation which automatically follows the carriage return operation in accordance with the present invention.

In accomplishing the elapsed time objectives

above enumerated, the printer may be modified by changing the type bars so that to indicate elapsed time intervals a dot will be printed, for example, instead of the letter *a* and a dash instead of the letter *k*.

These objects, and other objects not herein enumerated, are accomplished by the circuit arrangements illustrated in Figures 1 and 2 of the drawings and described in the following description.

In the drawings, Fig. 1 represents that part of the service trunk which is used for printing dialed digits, and for recording elapsed time intervals before, during, and after dialing operations, when the trunk is used either for service observations or for making records of workmen's jobs. Fig. 2 illustrates the clock-controlled time-recording arrangements which may be associated with the trunk to print the time of day after certain types of dialing operations.

General Description of the Invention

The recording trunk disclosed in Fig. 1 terminates in contacts of a final connector switch so that when the trunk is used for recording the operations of workmen or employees in factories and the like, access to the trunk may be had by merely dialing a number assigned to the trunk. The trunk has associated with it certain relays and a counting selector switch, including switch elements CS_1 and CS_2. After connection has been established to the trunk, these switches will be advanced step-by-step as a digit to be recorded is dialed. The step-by-step switches CS_1 and CS_2 control translating relays T_1, T_2, T_3 and T_4, which operate to translate the decimal code used for dialing into a Baudot code to operate a printer to print the dialed number.

Page printing apparatus PP may be connected to the translating relays T_1 to T_4, inclusive, for recording the dialed digit. As shown, this printing apparatus includes a start-stop distributor DTR, a motor M for operating the same, a tripping magnet CM for releasing the distributor, and a receiving printer apparatus conventionally represented at RP.

The recording trunk also includes a timing circuit including a cold cathode tube CT and associated relays TM, TM_1 and TM_2, which causes the printer at successive timed intervals to automatically print special symbols, such as the letter *a* (or, if desired, a dot) before, after, and between the dialing of digits by a subscriber whose telephone line is under observation. Arrangements are also provided so that when such a subscriber is not using his line, the timing apparatus will cause the printer to print another special character such as the letter *k* (or, if desired, a dash) followed by periods or other symbols at successive intervals, at such times as the telephone circuit under observation is idle. In this manner a record can be made of all elapsed time intervals involved during the use or non-use of a telephone line under observation.

For making service observations the trunk is provided with conductors *a*, *b*, *c*, *d* and *e* leading from certain elements of the recording trunk apparatus. These may be connected, when desired, to the service observing equipment illustrated schematically at SO. As shown, this consists of a relay DPR which responds to dialing operations of the telephone circuit under observation, and which operates in a manner which will appear later to cause the apparatus associated with the trunk to make a record of all operations and elapsed time intervals in connection with the observed line. The service observing apparatus also includes a release key RLS_2 for releasing the recording trunk from the service observing equipment at the will of an operator.

In connection with the recording of workmen's numbers and job numbers, the timing apparatus already described may be used for recording elapsed time intervals before and after the dialing operation and elapsed time intervals between the dialing operations for successive digits. In this connection the apparatus associated with the trunk operates to print the letter *a* or a dot in substantially the same manner as in connection with the recording of similar time intervals during service observations.

In order that a page printer may be employed instead of a teletypewriter printing upon tape, an automatic carriage return and line feed operation is provided. In this connection a key or switch CRK is arranged to be operated whenever the printer carriage approaches the end of a line. The operation of this key automatically sets in operation a train of relays CR_1, CR, LF_1, and LF, which function to control the recording printer so that it will automatically perform the carriage return and line feed functions, as will be described in more detail later.

When the recording trunk is used for either recording workmen's jobs or for recording the operations of a telephone circuit under service observation, a clock-controlled time recording mechanism is provided to enable the printer to print the time of day. This clock-controlled mechanism is illustrated in Fig. 2. It consists of three main elements—a time finder selector TFS, a tenths-of-hour selector THS, and an hour selector HS.

The hour selector HS consists of four switches or switch banks HS_1, HS_2, HS_3 and HS_4, operated step-by-step so that the switch advances one point each hour of the 24-hour day. The switches, in cooperation with the other selectors involved, control circuits for printing the digit corresponding to the hour of the day. The switches making up the hour selector HS are 25-point switches. Twenty-four of these points correspond to each of the twenty-four hours of the Continental day, the extra point being merely pass-by contact over which the switch rapidly steps to start a new day cycle commencing with the first point.

In order to record the time of day in smaller divisions than hours, a tenths-of-hour selector THS is provided. This includes three sets of switches or switch banks TS_1, TS_2 and TS_3. A fourth switch bank TS_4 is illustrated because it is a part of the switch selector unit, but in practice it is not used. These four switches are, like the hour selector, advanced step-by-step, one step for each division of the hour. In the case here assumed the hour is divided into ten 6-minute intervals instead of the sixty 1-minute intervals used ordinarily in keeping time. This larger interval is used in order to simplify the equipment and because in keeping a record of a workman's time a finer division of the hour is unnecessary.

The tenths-of-hour selector THS controls circuits whereby the recording printer will print digits representing the particular tenth of an hour indicated by the controlling clock, which, by actuating a key switch CT, advances the selectors HS and THS to the positions corre-

sponding to the existing time of day. The switches making up the tenths-of-hour selector THS are 25-point switches. Of these points two groups of ten points each are used for indicating the ten divisions of two successive hours. The remaining points are merely pass-by positions over which the switch automatically steps to start the next hourly cycle.

The hour selector HS and the tenths-of-hour selector THS are associated with the recording trunk of Fig. 1, and particularly with the printing equipment PP associated therewith, by means of a time finder selector TFS. This time finder selector includes the six switches or switch banks S_0, S_0', S_1, S_2, S_3, and S_4. These are 22-point switches and the points are divided into two groups of eleven each. One point of each group of eleven is a by-pass position over which the switch advances to start the next cycle. Of the other ten points of each group, eight are used for controlling the successive operations incident to printing the time of day, and these eight points are followed by two points which are utilized to automatically effect the carriage return and line feed operation of the printer. The provision of this feature enables the recording system to employ a page type of printer, rather than a teletypewriter printing upon a tape such as is used with the recording system of the Knittle Patent No. 2,278,703.

When the trunk is used for service observation the time finder selector TFS, the tenths-of-hour selector THS, and hour selector HS are employed to make a record of the time an observed line is released from the recording trunk by operating the RLS key. However, when the trunk is used for recording workmen's numbers and job numbers, these selector switches automatically come into play to cause the printer to print the time of day after it has printed the numbers of the workman and the job.

Operation

Further details of the apparatus will be clear from a description of the operation. The operation of the circuit when used for recording workmen's numbers and job numbers will be described. This will be followed by a description of the circuit when used for service observation records.

(a) *Preparation for dialing*

A workman desiring to record his number and the number of the job upon which he has commenced work or which he has just finished, will first dial the number which is assigned to the trunk or trunks used for recording purposes. Actually more than one trunk may be provided so that more than one workman can make a record at any given time if the number of workmen or operatives involved is sufficient to require this. In case more than one trunk is provided, the trunks will all appear upon a certain level of the final selector of the machine switching system (not shown) and said selector will automatically hunt until it finds an idle trunk or if the trunks are all busy, until it receives a busy signal. Assuming that the trunk illustrated in Fig. 1 is idle, the wipers of the connector switch come to rest upon the tip, ring and sleeve contacts T, R and S, respectively, shown in Fig. 1. This causes the double wound line relay A to be energized over the workman's line.

Relay A upon being energized closes a circuit to operate the slow release relay B through its lower winding, said circuit extending from ground over the back contact of armature 3_b of relay E, over conductor **32**, front contact of relay A, and through the lower winding of relay B to battery. The relay B will therefore be energized and will remain energized as long as the subscriber's receiver is off the switchhook, relay B being sufficiently slow in releasing so that it holds up its armature during the momentary interruptions caused by the relay A in response to dialing.

At the front contact of its armature 8_b, relay B applies a busy ground to the sleeve conductor of the trunk. At the front contact of the armature 3_b, relay B connects ground to a tick-tock circuit TTC which is set into operation to send tick-tock impulses over the back contact of armature 1_t of relay D, and over the front contact of armature 6_t of relay B to the tip conductor T of the trunk. The subscriber upon hearing this signal knows that he now has access to a recording trunk and is ready to dial. The details of the tick-tock circuit TTC are not here shown but are fully illustrated and described in the above mentioned Knittle Patent 2,278,703.

Returning to relay B, at the front contact of its armature 8_t it prepares a dialing circuit to be described later. At the front contact of its armature 4_t it prepares a circuit for operating the selected translating relays T_1, T_2, T_3 and T_4 through switches CS_1 and CS_2 after the digit has been dialed. At its armature 1_b, relay B opens the normally closed circuit of the relay TS.

(b) *Operation of timing circuit*

If, after the foregoing operations have been completed, the workman does not immediately dial his number, the timing circuit TC comes into operation. The release of the relay TS disconnects ground over conductors **41** and **42** and through the resistance r_1 from the timing circuit, thereby causing the condenser C_t to charge up. After the condenser starts to charge it takes a definite interval of time, say 1¼ seconds, to reach a potential sufficient to break down the gap of the cold cathode tube CT. When the tube breaks down, the condenser discharges through the tube and operates the relay TM, unless, as will be described later, before the tube breaks down the dialing operation commences. The circuit for the relay TM extends from battery through the resistance r_2, through the tube CT, through relay TM, over conductor x, normal contact of switch CRK, over conductor t, thence over conductor v and over the back contact of the armature 3_b of relay E to ground.

Relay TM upon operating completes the circuit of relay TM_2 from battery, through the upper winding of relay TM_2, over the front contact of armature 2_t of relay TM, and thence via conductor x to ground over the circuit previously traced for relay TM. Relay TM2 upon operating prepares a locking circuit through its lower winding over the front contact of its armature 2_t, and thence through the winding of relay TM_1, over conductor m to ground over the right-hand contact of relay P_1. This locking circuit is not completed until the relay P_1 is operated as will be described later.

Relay TM_2 at the front contact of its armature 4_b completes a circuit to operate the release magnet CM of the distributor DTR of the printing apparatus PP. This circuit extends from battery through the winding of the magnet CM, over the front contact of armature 4_t of normally energized

relay P, over conductor *z*, front contact of armature 4_b of relay TM_2, front contact 2_t of relay TM, and thence via conductor *x* over a path previously traced to ground at the back contact of armature 3_b of relay E.

(*c*) *Operation of printing apparatus to record elapsed time*

The energization of release magnet CM releases the rotating arm of the distributor DTR which now commences to revolve. As the brush passes off the start segment *ss*, the circuit of normally operated relay P is opened and relay P releases. This at once opens the circuit of the release magnet CM so that its latch (not shown) will be able to stop the rotating arm of the distributor when it completes its rotation. At the back contact of its armature 5_t, relay P completes a circuit for the relay P_1 which now operates. Relay P_1 at its right-hand front contact connects ground to conductor *m* and thus completes the circuit previously traced for the locking winding of relay TM_2 of the timing circuit in series with the winding of relay TM_1. Relay TM_1 is now energized and connects ground over its armature 2_b, o_t, resistance r_1, thereby instantaneously completing the discharge of the condenser C_t so that relay TM is released.

Locked up relay TM_2 at the front contacts of its armatures 6_b and 2_b connects ground over conductors *p* and *n*, respectively, which are connected to segments No. 2 and No. 1 of the distributor DTR. Consequently, as the distributor rotates it completes a Baudot code combination consisting of marking impulses for segments 1 and 2 and spacing impulses for segments 3, 4 and 5. This results in the printer printing the letter *a* or equivalent symbol in accordance with the usual printer code. If it is desired to print a hyphen or a dot to indicate elapsed time the type bar may be changed to print one of these characters instead of the selected letter *a*.

When are arm of the distributor completes its rotation and comes to rest upon the starting segment *ss*, relay P is again energized. At the front contact of its armature 4_t it again prepares the circuit for the starting magnet CM and at its armature 5_t it opens the circuit for the relay P_1, which releases. Relay P_1 at its right-hand armature opens the locking circuit previously traced for the relays TM_1 and TM_2 in series. These relays are at once released, the relay TM_1 again opening the ground connection over its armature 2_b to the charging circuit for the cold cathode tube CT.

(*d*) *Repeating operation of the timing circuit*

If after the foregoing operation has been completed the workman has not yet started to dial, the operation of the timing circuit will be repeated. The release of the relay TM_1 permits the condenser C_t to charge up again, causing the operation of the relays TM, TM_2 and TM_1 as above described, with the consequent release of the distributor DTR to again print the letter *a* or a dot, as the case may be. This operation is repeated until further operation of the timing circuit TC is prevented by the dialing operation, as will be described later. The number of dots printed will indicate the time elapsing between the time the workman takes his receiver off the hook and the beginning of the dialing operation.

(*e*) *Dialing operation*

Upon hearing the tick-tock signal previously described, the workman will ordinarily proceed to dial the first digit of his individual number. For each interruption of the dialing circuit the relay A releases its armature. Each time the relay A releases its armature in response to the dialing of the first digit, the stepping magnet STP of the counting selectors CS_1 and CS_2 is operated over a circuit as follows: From ground, over the back contact of armature 3_b of relay E, over conductor 32, back contact of relay A, front contact of armature 8_t of relay B, front contact of slow release relay B_1 (which was operated in parallel with relay B) to point 21, and thence through the winding of stepping magnet STP to battery. A parallel circuit extends from point 21 through the winding of slow release relay C to battery. Relay C is at once energized and remains energized until after the first digit has been dialed. Relay B_1, above referred to, being a slow-release relay, like the relay B it remains operated so long as the subscriber has his receiver off the switchhook.

Relay C upon being operated, at the front contact of its armature 4_b, completes a circuit for the sequence relay G_1. The function of the sequence relays such as G_1, G_2, etc., associated with each trunk, is to maintain a busy condition on the trunk after it is once used, until such time as all the other available trunks have been used in sequence. The operation of the sequence relays and their function is fully described on page 10 of the above mentioned Knittle Patent 2,278,703, under the heading "Sequential selection of trunks," and reference is made to said patent for further details of the operation of the sequence relays.

At the front contact of its armature 2_b, relay C connects ground to the timing circuit TC through the resistance r_1 to at once discharge the condenser C_t. If the workman dials promptly after removing his receiver from the switchhook, this ground connection will be established before the condenser has charged up sufficiently to operate the cold cathode tube CT for the first time, and the operation of the timing circuit will be defeated. In this case no dots will be printed by the apparatus PP, and in any event operation of the timing circuit during the dialing of the first digit will be prevented. If, on the other hand, the workman did not commence dialing immediately and one or more dots have already been printed, further printing of dots is prevented when the relay C operates to discharge the condenser C_t and stop the timing circuit in the manner just described.

Each time the armature of the relay A is released in response to dialing, the stepping magnet STP advances the counting selector switches CS_1 and CS_2 one step. No circuits are operated by the stepping of the counting selector switches until the end of the dialing of the first digit, however. This is because the relay C at its armature 2_t prevents the establishment of circuits through any of the translating relays T_1 to T_4, inclusive, over a path which will be described later.

The operation of relay C at the front contact of its armature 4_t closes the circuit of the relay D as follows: From battery, through the winding of relay D, over conductor 43, over front contact of armature 4_t of relay C, over conductor *w*, back contacts of armatures 6_t and 4_t of relays LF_1 and LF, respectively, and thence over conductor *v* to ground over back contact of the armature 3_b of relay E. Relay D is energized over the circuit above traced and at the front contact of its armature 10_b is locked to ground over the front contact of armature 6_b of relay B.

At its armatures 3_t and 1_t relay D opens the tick-tock circuit previously traced to the tip conductor T of the workman's line so that the tick-tock signal ceases at the beginning of the dialing operation. Other circuits controlled by the relay D will be described later. The relay D, locked up as above described, remains operated until the workman, when hanging up, releases the relay B as will appear later.

(f) Translating dialed pulses to printer codes

When the first digit has been dialed the relay A again attracts its armature and holds it upon its front contact so that the circuit previously traced for the relay C is opened. After an interval the relay C releases its armature. At the back contact of its armature 2_t relay C, upon releasing, establishes circuits for such of the translating relays T_1 to T_4, inclusive, as were previously selected by the stepping of the counting selector switches CS_1 and CS_2.

Let us assume the digit dialed is **6** so that the counting selector switches CS_1 and CS_2 are upon their sixth contacts. The circuit for operating the T or translating relays is as follows: From ground, over the back contact of armature 3_b of relay E, over conductor *v*, back contacts 4_t and 6_t, respectively, of relays LF and LF_1, over conductor *w*, back contact of armature 2_t of relay C, over the upper closed contact of off-normal switch ON, over conductor **22** to point **38**, over the back contact of armature 2_t of relay W to point **23**, from point **23** over the front contact of armature 4_t of relay B, over conductor **24**, over back contact of armature 2_t of relay HU, thence over the sixth contacts of the counting selector switches CS_1 and CS_2, respectively, and through the lower operating windings of relays T_1 and T_4 to battery. At the front contacts of their 5_t armatures, relays T_1 and T_4 will be locked up over a circuit to be described later. At point **23** of the circuit previously traced for the T relays, the circuit divides and a parallel circuit is extended over conductor **25** to operate the relay STE, which, by the closing of its armature 2_t, initiates the printing operation about to be described.

(g) The printing operation for dialed digits

We now have translating relays T_1 and T_4 selected and operated. These relays apply ground connections to selected ones of the segments **1** to **5**, inclusive, of the distributor DTR to print the digit 6. By reference to the chart in the lower right-hand corner of the first sheet of the drawings, it will be seen that the first, third and fifth segments of the distributor must be energized in order to print the digit 6. The first segment is energized by a connection from ground over the front contact of armature 5_b of relay T_1. The third segment is energized by a connection from ground over the front contact of armature 5_b of relay T_4, over the normally closed contacts of the 2_t armatures of relays T_3, T_2 and T_1 and thence to said third segment. The fifth segment is energized by a connection from ground, over the front contact of armature 2_t of relay T_4, over the back contact of armature 5_t of relay T_3, over the back contact of armature 2_b of relay T_2, and thence to said fifth segment.

It will be recalled that the relay STE was energized at the same time that the selected T relays were operated. At its front contact relay STE connects ground to the conductor *z'*, thence over the front contact of armature 4_t of normally energized relay P, and through the release magnet CM to battery. The release magnet CM releases the arm of the distributor DTR, which commences to rotate, and in so doing prints the digit 6. As soon as the arm leaves the segment *ss* of the distributor, relay P deenergized, and at the back contact of its armature 5_t it connects ground to conductor **26**, which leads to point **28** where the circuit divides, one path continuing through the winding of the relay W to battery, and the other continuing over the conductors **29** and **40** to lock up relays T_1 and T_4 over the front contacts of their 5_t armatures.

The relay W upon being energized operates the release magnet RLS of the counting selector switches over a circuit closed by the front contact of its armature 2_t. Said circuit extends from ground over the normal back contact of the armature 3_b of relay E, over conductor *v*, back contacts of armatures 4_t and 6_t of relays LF and LF_1, respectively, over conductor *w*, back contact of armature 2_t of deenergized relay C, upper front contact of off-normal switch ON, over conductor **22** to point **38**, over front contact of armature 2_t of relay W, over conductor **39**, lower front contact of off normal switch ON, and through the winding of release magnet RLS to battery. The counting selector switches are now restored to normal so that the subscriber may proceed to dial a new digit, while the distributor DTR is rotating to print the digit previously dialed.

When the brush of the distributor DTR returns to its stop position after having printed the digit previously dialed, relay P is again operated, At its armature 5_t relay P opens the circuit previously traced for the relay W and the locking circuit for the relays T_1 and T_4. These three relays are accordingly restored to normal. Regardless of whether the subscriber is dialing a new digit or not the relay D will still remain locked up and the slow release relay B will still be energized. If the subscriber is not dialing, relay A will be energized and relay C will be deenergized.

(h) Dialing of additional digits

If the subscriber should delay dialing the second digit so that the relay C remains deenergized for a sufficiently long period, the removal by relay C of the ground which it had previously connected over its armature 2_b to the resistance r_1 of the timing circuit TC, will cause said timing circuit to be set into operation in the manner previously described. This will cause the printer to print dots or the letter *a*, as the case may be, in the manner previously described, until such time as the workman starts to dial the second digit. As soon as the workman starts dialing the second digit, relay A sends pulses over the circuit previously described to operate the stepping magnet STP to advance the counting selector switches CS_1 and CS_2 to a setting corresponding to the new digit. During the dialing operation relay C is again energized to hold up its armature 2_b, thus stopping any further action of the timing circuit TC, by connecting ground over the front contact of its armature 2_b and through the resistance r_1, to discharge the condenser C_t of the timing circuit. The segments of the distributor DTR will be marked in accordance with the new digit and the printing operation will take place as before.

If the workman dials successive digits at the normal rate the condenser C_t of the timing circuit will not have an opportunity to be charged up sufficiently to start the timing circuit into opera-

tion to print dots in the manner previously described between the dialing operations for successive digits. When the last digit has been dialed the same condition will exist as previously described after dialing the first digit, namely the relay A will still be energized, relays B and B_1 will still be held up, the relay C will have been released, and the relay D will remain locked up.

When the workman hangs up his receiver after dialing he releases the relay A. This in turn actuates the relay C, and the stepping magnet STP is operated over the back contact of said relay C by means of a circuit previously described. This causes the counting selector switches to be advanced one step, but they will be immediately released as will presently appear. After a brief interval the slow release relays B and B_1 will be released. Relay B at its armature 4_t opens the circuit which would otherwise be closed over the conductor **24** to the contacts of the counting selector switches when the relay C releases. This prevents false selection of the translating relays T_1 to T_4, inclusive. Relay B at the back contact of its armature 1_b closes the circuit previously traced for the release magnet RLS of the counting selector, which is at once restored to normal. Relay B_1 in falling off opens the circuit of relay C, which, after the usual delay, releases.

It will be noted that in the operations above described no provision is made for separating the digits representing the workman's number and the number of the job upon which he is working into two separate groups. This is unnecessary as in practice it will be understood that each workman's number will always have the same number of digits. If this number is three, for example, the first three digits dialed will always represent the workman's number, while the remaining digits will represent the number of the job.

(i) Preparation of trunk circuit apparatus for time-of-day recording

When the relay B is released as above described it will disconnect busy ground from the sleeve conductor of the connector switch over its 8_b armature. This permits the release of the automatic switch which established the connection to the trunk. The removal of ground from the sleeve conductor S is only momentary, however, and only long enough to permit the release of the switches, for presently, after the armature of the relay C has fallen off, ground will be connected over the normal contact controlled by armature 4_b of relay C, over the front contact 2_t of locked up relay G_1 to point **30**, and thence over conductor **31**, over the back contact of the armature 5_t of relay D (which releases shortly after the relay B at its contact 6_b opens the locking circuit of relay D), and thence to the sleeve conductor S of the connector switch. Also after relay D is released, a busy ground will be applied to said sleeve during such times as the distributor DTR is rotating. This is by reason of the fact that the relay P is released during the rotation of the distributor, and at the back contact of its armature 1_t connects ground over conductor **27** to point **30**, and thence over conductor **31** and the back contact of armature 5_t of relay D to the sleeve S.

It will be noted that the relay D, being slow to release, does not release until a short interval after the relay B has released. During this interval an operating circuit for the relay E is established from battery through the winding of said relay E, over the front contact of armature 10_t of relay D, over the back contact of armature 1_t of relay B, over conductor **17**, and thence to ground over the idle contact (No. 1 or No. **12**, depending upon the position of the switch) of the switch S_0 of the time finder selector TFS. In this connection it should be observed that the time finder selector has two idle positions, No. 1 and No. **12**, and it will be in one or the other of these two positions when it is at rest, depending upon which half of its cycle it last operated over.

(j) Preparation of time finder selector for recording time of day

Relay E upon being energized immediately establishes a locking circuit over the front contact of its armature 8_b and the back contact of relay RLS. The relay D does not release until a moment after the relay E has been energized. Consequently relay E at the front contact of its armature 6_b closes a momentary stepping circuit for the stepping magnet F of the time finder selector TFS from ground, over the front contact of the armature 4_b of relay D, over the front contact of armature 6_b of relay E, over the conductor STP', and through the winding of stepping magnet F to battery. This circuit will be opened as soon as the relay D releases, so that the stepping magnet F of the time finder selector is released a moment after it is energized, and thereby causes the time finder selector to take one step from its idle position. Assuming that the wipers of the switches of the time finder selector had previously been resting on their No. 1 idle contacts, they will thus be advanced to contact No. **2** with results to be described later.

(k) Operation of tenths-of-hour selector

The purpose of the time finder selector is to connect the time-indicating apparatus with the trunk, and to control the printing of the indicated time in digits representing hours and tenths of hours. Before describing the printing operations it is therefore desirable to understand the operation of the mechanisms which indicate the time of day.

The relay E at its armature 1_b disconnects conductor **12** from conductor **13** and thereby prevents any change of the setting of the hour selector of tenths-of-hour selector until the time of day has been printed in a manner to be presently described. Normally the tenths-of-hour selector is advanced one step each time the clock control contact CT is closed. The operation of the contact CT closes a circuit for the slow operating relay MP. During the short interval required for the relay MP to operate a momentary circuit is established from ground over the lower contact of the switch CT', over the back contact of the armature of the relay MP, and through the winding of the relay CG to battery. Relay CG is at once locked up over the back contact of the stepping magnet TH of the tenths-of-hour selector THS.

At its upper front contact relay CG connects ground to conductor **13** from which conductor a circuit extends over the back contact of the armature 1_b of relay E (when relay E is not energized), thence over the conductor **12** and any one of the contacts 1 to **20** of switch TS_1, over the wiper of said switch, and through the winding of the stepping magnet TH to battery. The stepping magnet will be energized, thereby unlocking the relay CG, which releases and opens the stepping circuit just traced so that the tenths-of-hour selector THS is advanced one step. 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 to which it is connected through time finder selectors such as TFS 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 at the armature 1_b of the E relay of such trunk until the record is completed. Under these conditions the relay CG, which was locked up as previously described when the clock contact CT' operated, will remain locked up over the back contact of the stepping magnet TH until the circuit of the said stepping magnet is completed by the release of the armature of the E relay of the trunk which is then printing the time-of-day record. When this occurs the time finder selector TFS will be advanced one step although this step will be taken a short interval after the actual tenths-of-hour is indicated by the clock (not shown).

(l) Operation of hour selector

The hour selector HS 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 revolution every two hours, taking one step each six minutes. After the expiration of nine-tenths of each hour, a circuit will be completed from ground, over the wiper of the switch TS_3, over the ninth or nineteenth contact of said switch (depending upon the arc in which the switch is being operated), over the contact of key TSK, and through the winding of relay HR to battery. This relay is energized and held up, and so remains until the tenths-of-hour selector advances to its tenth (or twentieth) contact. When this occurs a circuit will be established for the stepping magnet H of the hour selector from battery, through the winding of said magnet, over the front contact of relay HR, over conductor **44** and thence to ground over the upper front contact of the relay CG. Thus, at the end of each hour the hour selector HS and tenths-of-hour selector THS will each take one step together and the hour selector HS will be advanced to its next hour indication.

If this step occurs when the tenths-of-hour selector is resting upon its twentieth contact, the switch TS_1 of the tenths-of-hour selector is advanced to its twenty-first contact. An automatic stepping circuit is then formed for the stepping magnet TH which automatically steps the tenths-of-hour selector to its first position, where it will be ready to repeat a cycle of operations involving another two-hour interval.

(m) Printing first period

The time of day will be printed by the printer PP as will be described presently; but to distinguish the digits representing the time of day from those representing the workman's number and his job number, it is desirable that the time-of-day digits should be separated from the digits representing the job number by printing one or more periods before the time of day is printed. As shown, the circuit is arranged to print two periods.

Assuming that the time finder selector was resting upon its first contact when the relay E was energized, it will have been advanced from its first to its second position by the operation of the stepping magnet F in the manner previously described. In this position ground connections are established by the wipers of switches S_1, S_3 and S_4 to conductors T_1', T_3' and T_4', respectively, which are connected to and operate the translating relays T_1, T_3 and T_4.

It will be noted by referring to the counting selector chart at the lower right-hand corner of the first sheet of the drawings, that relays T_1, T_3 and T_4, when selected, cause the printing of a period. To print this period a circuit is completed by the switch S_0' of the time finder selector for the relay STE, said circuit extending from ground, over the wiper of switch SO_1, second contact of said switch, over the conductor ST', over front contact of armature 2_t of relay E, over conductor **33** to point **38**, thence over the back contact of the armature 2_t of relay W to point **23**, and finally over conductor **25**, through the winding of the relay STE to battery. The relay STE being operated over this circuit starts the printer into operation and causes the printing of the period recorded by the translating relays T_1, T_3 and T_4, which energize segments **1**, **2** and **4** of the distributor of the printer.

During this printing operation the relay P falls off as usual, operating relay W over its contact 5_t and conductor **26**, locking the translating relays T_1, T_3 and T_4 over the back contact of its armature 5_t and conductors **26** and **29**, and establishing a stepping circuit for the stepping magnet F of the time finder selector TFS as follows: From ground, back contact of armature 5_t of relay P, conductor **26** to point **28**, thence over conductor **34**, front contact of armature 5_t of relay E, stepping conductor STP', and through the winding of stepping magnet F to battery. Magnet F moves its pawl to the next ratchet tooth, but relay W performs no useful function. At the end of the printing operation the relay P releases and opens the circuits of the stepping magnet F and the relay W.

(n) Printing second period

As soon as the circuit of the stepping magnet F is opened as just described, the pawl of said stepping magnet advances the time finder selector TFS from its second to its third position. In this position circuits are again completed over the conductors T_1', T_3' and T_4' (which were unlocked at the end of the previous printing operation by the reoperation of the relay P), and these relays upon being again energized, condition the distributor to print a second period. This printing operation is initiated by operating the relay STE from ground, over the wiper and third contact of the switch S_0', and thence over conductor ST' and the circuit previously traced through the winding of the relay STE. The falling off of the relay P during this printing operation again operates relay W (without useful result) and reestablishes the stepping circuit previously traced for the stepping magnet F. When the relay P is energized at the end of the printing of the second period the circuit of the magnet F is opened and the time finder selector is advanced to its fourth position.

(o) Printing the first digit of the hour

In accordance with the system herein disclosed the twenty-four hours of the day are numbered consecutively beginning with 01 through 23, and the twenty-fourth hour is numbered 00 instead of 24. To print the complete hour it is therefore necessary to print the hour tenths digit in the fourth position of the time finder selector, this operation being followed by the printing of the hours unit digit in the fifth position of the time finder selector.

Upon being stepped to its fourth position, stepping magnet STE is again energized over a circuit from ground, over the wiper and fourth contact of the switch S_0', over the conductor ST' and thence over the circuit previously traced through the winding of the relay STE to battery. Relay STE releases the distributor of the printer to initiate the printing operation.

At the same time the relay STE was energized the segments of the distributor were conditioned to print the tens digit of the hour. Let us assume that the time of day in Continental time is registered by the switches HS and THS as 18.8 hours. The brushes of switches HS_1, HS_2 and HS_3 will then be resting upon the eighteenth contact of said switches. The brushes of switches TS_1, TS_2 and TS_3 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 the tenths of the even hours are registered in the second portion of the tenths-of-hour selector, and the tenths of the odd hours in the first portion.

As the time finder selector is now in its fourth position, the connections from the conductors T_4', T_3', T_2' and T_1' are extended through the switches S_4, S_3, S_2 and S_1 of the time finder selector 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 HS_3 of the hour selector a circuit is completed from ground, over the eighteenth point of said switch, over conductor **1**, fourth point of switch S_4 of the time finder selector, and over the wiper of said switch to the conductor T_4', and thence over the circuit previously traced to operate and lock up translating relay T_4.

An inspection of the circuit will show that no connections are completed through the switches S_3 and S_1, over conductors **4** and **9** through any of the switches of the hour selector. Consequently circuits are not completed over conductors T_1' and T_3' to operate the corresponding translating relays T_1 and T_3. In the case of switch S_2 of the time finder selector in its fourth position, no conductor is extended to any of the points of the hour selector switches, but instead the fourth point of said switch S_2 is grounded. A circuit is therefore completed from this grounded point over the wiper of the switch S_2 to the conductor T_2' to operate the translating relay T_2.

We now have translating relays T_2 and T_4 selected. This marks the first, second, third and fifth segments of the distributor DTR over circuits which are obvious and need not be traced. The distributor in the meantime having been released by the operation of the relay STE, rotates and causes the printing of the digit 1, which, it will be seen from the chart of the counting selector in the lower right-hand corner of the first sheet of the drawings, results from activating the first, second, third and fifth segments of the distributor.

(p) Printing second digit of the hour

At the beginning of the rotation of the distributor relay P was released as before, to establish a circuit similar to that previously described over the conductor STP' for the stepping magnet F. When the relay P is again energized it opens this circuit and causes the time finder selector TFS to be advanced from its fourth to its fifth position.

In this position the units digit of the hour will be printed, this digit being 8 in the case assumed. In position 5 of the time finder selector a circuit is completed from ground, over the wiper of the switch HS_1 of the hour selector HS, over the eighteenth contact of said switch, over conductor **5**, contact **5** of switch S_3 of the time finder selector, and thence over conductor T_3' and the circuit previously traced to operate the translating relay T_3. At the same time the relay STE is operated over the fifth point of switch S_0' and a circuit similar to the circuits previously traced for relay STE, to set the distributor DTR into operation to print the digit 8, this digit being printed when relay T_3 alone is selected. It will be noted that in position 5 of the time finder selector no circuits are established over conductors T_1', T_2' and T_4'.

(q) Printing third period

In a manner similar to that previously described the time finder selector is advanced to its sixth position at the end of its printing operation for the purpose of printing another period. This period combination is determined by the fact that ground is connected to the sixth contacts of switches S_1, S_3 and S_4 to establish circuits over the conductors T_1' T_3' and T_4' to energize relays T_1, T_3 and T_4. The distributor DTR, of course, starts to rotate practically coincidentally with the stepping of the time finder selector to its sixth position, and the resultant period is printed by the printer RP.

(r) Printing the tenths-of-hour digit

Next, the time finder selector is advanced to its seventh position, in which it prints the digit represented by 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 the switches S_1, S_2 and S_4 of the time finder selector over the conductors **3**, **8** and **11**, respectively, to any live segments of either of the switches TS_2 or TS_3 of the tenths-of-hour selector. However, a circuit is established from ground, over the brush and eighteenth contact of the switch TS_2, over conductor **6**, seventh contact of switch S_2 of the time finder selector, and over conductor T_3' to operate the relay T_3. The operation of relay T_3 applies ground to segments **2** and **3** of the distributor DTR which, during its rotation, causes the printer RP to print the digit 8.

(s) Automatic carriage return

The time finder selector is now advanced, in a manner similar to that already described, to its eighth position. In order to use a page printer to make records of workmen's jobs it is necessary, after the workman's number, his job number, and the time of day have been printed, to automatically operate the carriage return of the printer and follow this by the operation of the line feed, to start the next record on a new line. The carriage return operation occurs in the eighth position of the time finder selector. In this position a circuit is completed from ground, over the wiper and eighth contact of switch S_0 of the time finder selector, over conductor CR', to point **35**, thence over conductor **36** to the fourth

segment of the distributor DTR. At the same time the relay STE will be operated over the eighth contact of the switch S_0' of the time finder selector. This causes the distributor arm to be released as before. By reference to the chart of the counting selector at the lower right-hand corner of the first sheet of the drawings, it will be seen that when only the fourth segment of the distributor is energized, no printing operation is performed, but a carriage return operation is initiated by the printer in a manner well understood in the art.

(t) Line feed operation

When the distributor DTR ends the rotation which produced the carriage return operation, the time finder selector is advanced from its eighth to its ninth position. In this position the switch S_0 connects ground over its ninth contact to the conductor LF' which leads over conductor **37** to the second segment of the distributor DTR. At the same time relay STE is operated, and the distributor as it rotates, causes the line feed operation as will be clear from the counting selector chart.

(u) Restoring equipment to normal

At the end of the line feed operation the time finder selector TFS is advanced from its ninth to its tenth position in a manner similar to the stepping operations previously described. Relay STE is again energized over the tenth contact of switch S_0' to start the distributor DTR. As no segments of the distributor are marked, a "blank" results. Stepping magnet F and relay W are again energized by the falling off of relay P. In the tenth position, while relay W is energized, a circuit is established from ground, over the tenth contact of switch S_0, over conductor RLS', over the front contact of armature 2_b of relay W, and thence through the winding of the relay RLS to battery. At its left-hand contact relay RLS opens the locking circuit for the relay E which is permitted to release. Stepping magnet F is released when distributor DTR comes to rest, and advances time finder selector TFS to its eleventh position. An automatic stepping circuit is at once established for stepping magnet E over the eleventh contact of switch S_0', causing selector TFS to be advanced to its twelfth position where it comes to rest.

Upon being released as above described, relay E at its armature 9_t removes holding ground from the sleeve S of the trunk, so that the trunk is now free to be again selected in its order as determined by the action of the G or "sequence" relays. The action of the G or "sequence" relays is described under the heading "Sequential selection of trunks" on page 10 of the above-mentioned Knittle Patent 2,278,703. At the back contact of the armature 3_b relay E applies ground to the back contact of relay A so that the latter is now in condition to receive dialed impulses on a subsequent call.

Finally, by closing the back contact of armature 1_b, relay E prepares a circuit for the stepping magnet TH for the tenths-of-hour selector over conductors **12** and **13** so that on the operation of the relay CG in response to the clock-operated switch CT, the tenths-of-hour selector can be advanced to the next tenth of an hour. Such action would be prevented during the time-recording operations previously described because during these operations the relay E held the stepping circuit of the magnet TH open.

(v) Automatic separation of twenty-four hour periods

Where records are being made of the operations of workmen or other employees as above described, it is desirable that the job-time record of an employee or of a number of employees for any given day be separated from similar records for other days. This may be accomplished by arranging the time-indicating apparatus of Fig. 2 so that it will automatically cause the printer to print the time at the end of each 24-hour day.

This result is obtained by connecting the winding of the relay D over conductor **16** to the twenty-third point of switch HS_4 of the hour selector HS, and by connecting the brush of this switch over conductor **46** to the contact of the relay HR. When the hour selector HS and the tenths-of-hour selector THS indicate that the time is 23.9 of the Continental day, ground will be connected over the ninth contact of the switch TS_3 of the tenths-of-hour selector THS to operate the relay HR. Relay HR is thus energized and remains held up until the tenths-of-hour selector THS advances to its tenth contact.

When this occurs the clock contact CT' operates the relay CG in the manner previously described. Relay CG locks up over the back contact of the stepping magnet TH, and at its upper front contact relay CG connects ground over conductors **13** and **12** as previously described to operate the stepping magnet TH. Relay CG also applies ground over its upper front contact, over conductor **44**, front contact of relay HR, and thence through the winding of stepping magnet H of the hour selector HS to battery. Consequently the stepping magnets H and TH are operated simultaneously, the one to move the hour selector HS to its twenty-fourth position, and the other to move the tenths-of-hour selector THS to its tenth position.

At the same time that the relay CG was operating the stepping magnets TH and H as above described, it also closed a circuit from ground over its upper front contact, over conductor **44**, front contact of relay HR, over conductor **46**, wiper of switch HS_4 of hour selector HS, over conductor **16**, and through the winding of relay D to battery. The relay D is thereby energized. This energization is only momentary, however, for the relay HR is released as soon as the tenths-of-hour selector THS is advanced from its ninth to its tenth position, and this opens the circuit above traced for the relay D. Nevertheless, the momentary operation of the relay D is long enough to cause the relay E to be energized and locked up over circuits previously traced under headings *(i)* and *(j)* above. This sets the time finder selector TFS into operation to control the printing of the digits 00.0 to which selectors HS and THS are set, thus recording the end of the Continental day. The printing of these digits will take place in a manner similar to the printing operations described under the above headings *(j)* to *(r)*, inclusive.

(aa) Service observation—Preliminary operations

The foregoing discussion relates to the use of the trunk circuit of Fig. 1 for making a record of the time that a workman or other employee is engaged on a particular job. The trunk apparatus may also be used, however, for making a record of the operations taking place upon a telephone line which is under service observation.

In order that the trunk may be employed for

service observation conductors *a*, *b*, *c*, *d* and *e* are associated with certain relays and relay contacts of the trunk of Fig. 1, and these five conductors are connected to five conductors leading into the service observation apparatus SO, shown within the dotted rectangle in the upper right-hand corner of Fig. 1. This service observation equipment SO includes a dial pulsing relay DPR, whose contact is connected over the conductor *e* to operate the relay A of the trunk in response to dialing operations. The service observation equipment also includes a release key RLS' and a relay OBR for restoring the trunk apparatus to normal when it is no longer being used for service observation.

In practice when a subscriber's line is associated with the service observation equipment SO, the relay DPR is connected so that it is energized whenever the telephone subscriber's line circuit is closed, and it responds to dial pulses. The system is also designed so that a dash or equivalent symbol, followed by a succession of periods, will be printed at all times when the line under observation is not being used either for dialing or talking. Dots or equivalent symbols will be printed, however, during the talking period and during periods intervening between dialing operations.

When the service observation equipment SO is connected to a telephone line to be observed and the line is at the time not in use, the subscriber's circuit will be open and therefore the relay DPR will be deenergized. In order to start the recording trunk to printing a dash or other symbol followed by periods, the operator actuates a key (not shown) to cause momentary operation of the relay DPR. This closes a circuit over the conductor *e* through the upper winding of the relay A of the trunk circuit and causes momentary actuation of the relay A. Relay A upon being energized causes relays B and B_1 to be operated in the manner already described in connection with the recording of workmen's operations.

Relay B upon being operated performs one function not hitherto described. It closes at the front contact of its armature 3_b a locking circuit, which extends from ground over said contact, over conductor *b*, over the back contact of relay OBR of the service observation equipment, over conductor *c* and through the upper winding of relay B to battery. Therefore, when the relay A falls off after the momentary operation of the relay DPR of the service observation equipment, relay B remains energized and stays energized so long as the service observation equipment is connected to the trunk. Relay B_1, however, after being momentarily energized by relay A, permits its armature to fall off shortly after its circuit is opened by the release of relay A.

During this brief interval following the release of relay A and before the armature of relay B_1 falls off, the operating circuit for relay C and the stepping circuit for stepping magnet STP of the counting selector will be closed. Both of these circuits have been previously traced and pass from conductor **32** over the back contact of relay A, over the front contact of armature 8_t of locked up relay B, and over the front contact of relay B_1 to point **21**, and thence in parallel through the windings of relay C and the stepping magnet STP. After a moment these circuits are opened by the release of the slow release relay B_1, and both relay C and the stepping magnet STP become deenergized. In the meantime, however, the stepping magnet STP has advanced the counting selector one step so that the off normal switch ON is closed.

The closure of the off normal switch does not operate the release magnet RLS in this instance, however, as the circuit of the release magnet, which extends over the lower contact of off-normal switch ON and over conductor **39** to the back contact of armature 1_b of relay B is held open by locked up relay B. Consequently, the counting selector, which has been advanced one step, remains so advanced until it is released by the action of the relay W, as will be described later.

(*bb*) *Service observation—Printing elapsed time symbols when line is idle*

In the meantime while relay B remains energized, relay B_1 falls off after the momentary actuation of the line relay A as already described. This completes a circuit for the relay HU over the back contact of the relay B_1 as follows: from ground, over the back contact of armature 3_b of relay E, over conductor **32**, over the back contact of relay A, front contact of armature 8_t of locked up relay B, back contact of relay B_1, and thence over conductor **45** and through the winding of relay HU to battery. Relay HU, when operated, remains operated so long as the telephone line under observation is not in use, for under these conditions the relay A will be released and, consequently the relay B_1 will also be released, although the relay B will remain locked up as already described.

Relay HU upon being energized opens at its armature 2_t the marking circuit controlled by the counting selector switches CS_1 and CS_2. At the upper front contact of its armature 6_b it connects ground over conductor **47** to conductor **36** and thus marks the fourth segment of the distributor. At the front contacts of its armatures 2_b and 4_b relay HU operates translating relays T_3 and T_1, respectively, over the following circuits: From ground, over the back contact of armature 3_b of relay E, over conductor *v*, over back contacts of armatures 4_t and 6_t of relays LF and LF_1, respectively, over conductor *w*, over the back contact of armature 2_t of relay C, over the upper contact of the off normal switch ON, over conductor **22** to point **38**, thence over back contact of armature 2_t of relay W to point **23**, thence over the front contact of armature 4_t of locked up relay B, over conductor **24** and over front contacts of armatures 2_b and 4_b of relay HU through the windings of relays of T_3 and T_1, respectively. It will be noted that the circuits just traced depend upon the fact that switch ON is off normal.

As will be seen by reference to the chart of the counting selector shown in the lower right-hand corner of Fig. 1, the energization of relays T_1 and T_3 marks the first, second and third contacts of the distributor. Since the front contact of armature 6_b of relay HU marked the fourth segment of the distributor, we now have the first four segments of the distributor DTR marked. Relay C when released by release of relay B_1 as previously described, sets the distributor into operation by operating relay STE, over a path from ground at 3_b of relay E, over conductor *v*, over back armature contact 4_t of relay LF, back armature contact 6_t of relay LF_1, over conductor *w*, over back armature contact 2_t of relay C, over upper contacts of switch ON, over conductor **22** to point **38**, over back armature contact 2_t of relay W to point **23** thence over conductor **25**

and through the winding of relay STE, to battery, operating relay STE. Relay STE in operating causes the distributor to rotate as already described. Since the first four segments were marked by relay HU as already described, the printer will print a distinctive character, such as ½, or such other character as may be desirable.

While the distributor is rotating the relay P falls off, as already described, and at the back contact of its armature 5_t operates the relay W and locks up relays T_1 and T_3 over their 5_t front armature contacts. This causes relay TS to operate and disable the timing circuit, causing the release magnet RLS to be actuated over a circuit extending from battery through the winding of said magnet, over the lower contact of off normal switch ON, over conductor **39**, front contact of the armature 2_t of relay W to point **38**, over conductor **22**, over the upper make contact of off normal switch ON, over the back contact of armature 2_t of relay C, over conductor *w*, and thence over a circuit previously traced to ground via the back contact of armature 3_b of relay E. The magnet RLS releases the counting selector which is restored to normal and opens the off normal switch.

When the distributor completes its revolution relay P is again energized and releases relays W, T_1, T_3 and TS. Release of relay TS permits the timing condenser CT to charge and break down tube CT as before described. This energizes relay TM and starts the cycle of the timing circuit as already described, to once more release the distributor and cause it to rotate.

As the counting selector has been returned to normal relays T_1 and T_3 have been released. Therefore, during this operation of the distributor the first and second segments of the distributor are marked over conductors *n* and *p* by means of ground applied over armatures 2_b and 6_b of relay TM_2, as already described. Segment **4** of the distributor DTR is also marked by means of the front contact of armature 6_b of relay HU. Relays T_1 and T_3, however, are not again energized because their operating circuits are held open by the upper contact of the off normal switch. Therefore, segments **1**, **2** and **4** only of the distributor are marked, with the result that for this cycle of the timing circuit TC and for successive cycles thereof a period will be printed.

Periods will continue to be printed until the telephone subscriber of the observed line dials another subscriber as will be described later. Consequently, the interval of time after the telephone line is connected to the service observation circuit SO and until the subscriber dials a number, is indicated by a dash followed at equal successive intervals by periods. This indicates to the observer, who knows the time between successive periods, the total time which has elapsed between putting the line under observation and the first dialing operation.

(cc) *Service observation—Recording dialing and talking periods of line*

During the period that the observed line is idle the relay TS remains deenergized because its circuit is open at the armature 1_b of relay B, which is locked up. Relay C is also deenergized because its circuit is held open by the armature of relay B_1 which is deenergized when the line is idle. Therefore, both ground connections are removed from conductor **42** so that the timing circuit TC continues to operate successively in the manner above described. When, however, the subscriber on the observed line takes up the line for use by removing the receiver from the switchhook, the condition changes so that the timing circuit now causes the printer to print dots or hyphens instead of periods.

This change in operation arises from the fact that when the subscriber takes his receiver off the switchhook the relay DPR is energized and in turn operates the relay A. Relay A by removing its armature from its back contact immediately opens the circuit previously traced for the relay HU, which releases and at its armature 6_b removes the marking ground from the fourth segment of the distributor DTR. Relay A in turn closes a circuit previously traced for operating the relay B_1, which by removing its armature from its back contact holds open the circuit of the relay HU at another point. Said armature of relay B_1 at its front contact prepares the circuit for the relay C, which, however, is not operated at this time because its circuit (previously traced) is held open by the armature of energized relay A.

Relays TS and C, therefore, both remain released so that the timing circuit TC continues to operate cyclically in the manner previously described. However, since at this time the relay HU is released, only the first and second segments of the distributor DTR are marked. Hence the printer successively prints the letter *a* (or, if the type bar is altered, a hyphen) at intervals determined by the timing circuit TC. The printing of dots continues until the subscriber commences to dial another station.

When this occurs relay DPR of the service observation equipment will intermittently fall off and cause the intermittent release of the relay A in response to the dialing of the first digit. Relay B_1 remains energized during the pulsing operation due to dialing, and consequently the relay C is energized over a circuit previously traced via the front contact of the armature of relay B_1, front contact of armature 8_t of relay B, and over the back contact of relay A to conductor **32**.

As previously explained, relay C when thus energized remains energized during the dialing of the first digit. At the front contact of its armature 2_b it applies ground to conductor **42** to stop further operation of the timing circuit during the dialing of the first digit. Relay C at the front contact of its armature 4_t causess relay D to be pulled up as previously described in connection with the dialing of workmen's numbers and job numbers. Consequently, the dialing operation causes the counting selector switches CS_1 and CS_2 to function as previously described to selectively operate certain of the translating relays T_1 to T_4, inclusive, thus marking the distributor DTR so that it will cause the dialed digit to be printed.

At the end of the dialing of the first digit relay C is released. Consequently, if the subscriber delays dialing the second digit, the timing circuit will come into operation and cause hyphens or dots to be printed again. When the next digit is dialed relay C will again be energized, the timing circuit will be disabled, and the next digit will be recorded as before.

When the last digit has been dialed, relay DPR of the service observation equipment will remain energized while the calling and called subscribers are talking. Relay A will therefore be held up and after a short interval the relay C will be released. Relay D, however, will re-

main locked up over the front contact of armature 6_b of relay B and will remain locked up while the line is under service observation.

Relay C upon falling off removes the ground over conductor 42 from the timing circuit, so that the timing circuit again commences to repeat its cycle. Since the circuit of relay HU is held open by the armature of relay B_1 which is still energized, the timing circuit marks the printer over conductors *n* and *p* to send hyphens at successive timed intervals during the period between the dialing of the last digit and the time that the subscriber hangs up.

When the subscriber hangs up, relay DPR is released and it in turn releases relay A, which opens the circuit of relay B_1. As relay B_1 is slow to release, its armature does not fall off immediately and during this brief interval circuits previously traced for relay C and for the stepping magnet STP of the counting selector are established over the front contact of the armature of relay B_1, over the front contact of armature 8_t of relay B, and over the back contact of armature of relay A to conductor 32. This causes the counting selector to advance one step.

As soon as relay B_1 falls off, the circuit previously traced for the relay HU over the back contact of the armature of relay B_1, front contact of the armature 8_t of relay B and the back contact of armature A is again established. Relay HU marks segment 4 of the distributor by means of its armature 6_b, and by means of its armatures 2_b and 4_b causes translating relays T_3 and T_1 to be actuated. These two relays mark segments 1, 2 and 3 of the distributor DTR so that now the first four segments are energized, and the distributor causes a distinctive character such as ½ to be printed under the control of the timing circuit TC which was started into operation when relay C was released.

While this character is being printed relay W is energized in a manner previously described, and at the front contact of its armature 2_t completes a circuit previously traced for the release magnet RLS, which restores the counting selector (which had previously taken one step) to normal. Relays T_1 and T_3 are released at the end of the printing operation, and cannot again be energized over the front contacts of armatures 4_b and 2_b of relay HU, because their circuits pass over contacts of the off normal switch ON which are now open. Consequently, as the timing circuit TC continues to operate, relay TM_2 marks the first and second contacts of the distributor while the relay HU at the front contact of its armature 6_b marks the fourth contact of the distributor. Therefore, during further cycles of the timing circuit TC the printer prints periods to indicate the interval elapsing between the hanging up of the receiver at the end of the last conversation, and the removal of the receiver from the hook again to make a new call.

When the trunk is no longer to be used for service observation, the service observer operates the release key RLS' and thereby completes a circuit for the relay OBR from ground, over said release key RLS', over conductor *a*, front contact of armature 8_b of locked up relay D, over conductor *d*, and through the winding of relay OBR to battery. Relay OBR is energized and locks up over its upper contact so long as the key RLS' is held closed. At its lower armature relay OBR opens the locking circuit of the relay B which was previously traced over conductors *c* and *b*, so that relay B releases and in turn unlocks and releases relay D. Upon opening release key RLS' relay OBR is deenergized and all of the equipment is now restored to normal.

(dd) Service observation—Automatic carriage return

During a service observing operation the printer prints a continuous succession of characters consisting of a dash followed by successive periods when the line is not in use, and dialed digits and hyphens when the line is in use. It is therefore evident that if a page printer is employed, it will be necessary each time the record reaches the end of a line, to cause an automatic carriage return operation to take place, and follow this by a line feed operation, thus enabling the record to be continued on the succeeding line. In order to accomplish this result the printer carriage is arranged to operate a key CRK when the end of a line is reached. The operation of this switch opens the energizing circuit for the relay TM of the timing circuit which was previously traced over conductors *x* and *t*, thus preventing further operation of the timing circuit after the timing cycle then taking place has been completed.

The operation of the switch CRK completes a circuit for the relay CR_1, over a circuit from battery, through the winding of said relay, over the switch CRK, over conductor *t*, thence over conductor *v*, and over the back contact of armature 3_b of relay E to ground. If at the time the switch CRK is operated the distributor is rotating to cause the printing of the last preceding character of the record, the relay P will be in its deenergized condition and will hold open the circuit of commutator magnet CM. As soon, however, as the relay P pulls up at the end of the rotation of the distributor, commutator magnet CM is operated by a circuit from ground over the front contact of armature 2_b of relay CR_1, over conductor *z'* and over the front contact of armature 4_t of relay P, thereby releasing the brush arm of the distributor DTR.

The relay P is released as soon as the distributor starts into operation and operates the relay P_1. At its left-hand front contact relay P_1 connects ground over conductor *y*, over the back contact of armature 2_t of relay LF_1, over the front contact of armature 2_t of relay CR_1, through the resistance r_3 and the winding of the relay CR to battery. Relay CR upon being energized, locks up over a circuit from battery, through its winding, through resistance r_3, over the front contact of armature 4_b of relay CR, over back contact of armature 2_t of relay LF_1, over conductor *y* and left-hand armature of relay P_1 to ground. Relay CR connects ground over the front contact of its armature 2_t, over the back contact of the armature 2_t of relay LF, and thence over conductor *x*, over conductor CR' to point 35, and finally over conductor 36 to the fourth segment of the distributor DTR. During the rotation of the distributor only its fourth segment is marked, and this causes the distributor to select and set into operation the carriage return mechanism in a manner well understood in the art.

The operation of relay CR also prepares a circuit for relay LF_1, said circuit extending from ground, over the front contact of armature 4_t of relay CR, through the winding of the relay LF_1, and through the resistance r_3, and through the winding of relay CR to battery. Relay LF_1 is prevented from operating at this time, however, as

its winding is short-circuited by a connection extending from the upper terminal of its winding, over the front contact of armature 4_b of relay CR, over the back contact of armature 2_t of relay LF_1, over conductor *y*, and over the front left-hand contact of relay P_1 to ground. When relay P_1 is released by the energization of relay P at the end of the carriage return operation, the short-circuit above traced about the winding of relay LF_1 is opened by relay P_1, and relay LF_1 becomes energized. The carriage return operation, of course, restores switch CRK to normal and thus opens the circuit of relay CR_1, which is now released.

(ee) Service observation—Automatic line feed

The operation of relay LF_1 connects ground over the front contact of its armature 2_b, over conductor *z'*, and over the circuit previously traced through the winding of the commutator magnet CM. This circuit is established as soon as relay P is again energized after the carriage return operation and releases the distributor DTR to perform the line feed operation in a manner about to be described. As soon as the commutator starts rotating for the line feed operation, relay P is released, thus again operating the relay P_1, which at its left hand front contact connects ground over conductor *y*, over the front contact of armature 2_t of relay LF_1, and through the winding of relay LF to battery.

Relay LF upon operating locks up over a circuit from battery, through its winding, over the front contact of its armature 4_b, and over conductor *y* and left-hand front contact of relay P_1 to ground. Relay LF is thus held locked up during the rotation of the distributor. At the front contact of its armature 6_b relay LF short-circuits the winding of relay CR by means of a connection from battery, over the front contact of armature 6_b of relay LF to the common junction of resistance r_3 and the winding of relay CR. Relay CR is accordingly released and its armature 4_t opens the circuit of relay LF_1.

At its armature 2_t relay LF opens the previously traced marking circuit for the fourth segment of distributor DTR, and at the front contact of its armature 2_b relay LF establishes a new marking circuit from ground over conductor *s*, conductor LF' and conductor **37** to the second segment of the distributor DTR. During this operation of the distributor DTR only its second segment is marked, and it therefore selects and operates the mechanism for causing a line feed operation to take place in a manner well understood in the art. At the end of this operation the relay P is again energized, thus releasing relay P_1 and opening the previously traced locking circuit of relay LF at the left-hand armature of relay P_1.

(ff) Preventing interference from dialing during carriage return and line feed

Arrangements are provided for preventing false operation of the printing equipment due to a digit being dialed by the subscriber of a line under observation while the carriage return and line feed operations, above described, are taking place. When the distributor DTR is rotating during the carriage return operation the relay P is released and consequently the relay W is energized over a circuit previously traced. Dialed impulses during the carriage return operation operate the stepping magnet STP to advance the counting selector in the usual manner. However, the counting selector is prevented from establishing circuits for any of the translating relays T_1 to T_4, inclusive, by reason of the fact that the circuits of said relays normally pass through the contacts of the switches CS_1 and CS_2, and thence over the back contact of armature 2_t of relay HU, over conductor **24**, front contact of armature 4_t of relay B, to point **23**, and then over the front contact of armature 2_t of relay W to point **38**, over conductor **22**, over the upper contact of off normal switch ON, over back contact of armature 2_t of relay C, over conductor *w*, back contacts of armature 6_t and 4_t of relays LF_1 and LF', respectively, over conductor *v* and back contact of armature 3_b of relay E to ground. This circuit, however, is held open during the carriage return operation by relay W.

At the completion of the carriage return operation, relay P is again energized and releases relay W, but it also simultaneously releases the relay P_1, which in turn removes the short-circuit previously traced for the winding of relay LF_1. Relay LF_1 operates and at its armature 6_t opens the circuit above traced for the translating relays at another point. Relay LF, which as above described was operated immediately after relay LF_1, also holds open the energizing circuit for the translating relays T_1 to T_4, inclusive, at its armature 4_t. Consequently none of the translating relays can be actuated to mark the segments of the distributor DTR in accordance with the dialed impulses coming in over the line, until relays LF_1 and LF have both been released by the left-hand armature of relay P_1 falling off at the end of the line feed operation.

The above described carriage return and line feed operations are not ordinarily used in recording workmen's numbers and the numbers of workmen's jobs, for the reason that after printing the time of day the carriage return and line feed operation are automatically established by the time finder selector TFS. However, if any workman should delay his dialing operations, or should use up an inordinate amount of time between the dialing operations of successive digits, thereby causing a large number of dots or hyphens to be printed in connection with his record so that it would extend beyond the end of the line, the carriage return and line feed equipment above described will come into play to carry the record over to a succeeding line.

It will be understood that the automatic separation of twenty-four periods, as described under heading *(v)* above, will come into play at the end of each day in connection with the making of records of service observations, as well as in connection with the recording of workmen's identification numbers and job numbers.

While this invention has been described in certain specific arrangements which are deemed desirable, it will be obvious that the general principles herein set forth may be embodied in many other organizations widely different from those illustrated, without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. In a recording system, a recording trunk having a teletypewriter connected therewith and adapted to be associated with a telephone line

having a receiver and a dial, means to receive dial signals from said line and record them as digits by means of said teletypewriter, and means to cause said teletypewriter to print timed symbols after the telephone subscriber removes his receiver from the switchhook and until dialing commences.

2. In a recording system, a recording trunk having a teletypewriter connected therewith and adapted to be associated with a telephone line having a receiver and a dial, means to receive dial signals from said line and record them as digits by means of said teletypewriter, and means to cause said teletypewriter to print timed symbols between the dialing operations for successive digits.

3. In a recording system, a recording trunk having a teletypewriter connected therewith and adapted to be associated with a telephone line having a receiver and a dial, means to receive dial signals representing digits from said line, means to convert said dial signals into corresponding printing telegraph signals representing digits, means to record the latter signals as digits by means of said teletypewriter, and means to cause said teletypewriter to continuously print uniformly timed symbols after the dialing operations and before the hanging up of the receiver by the telephone subscriber.

4. In a recording system, a recording trunk having a teletypewriter connected therewith and adapted to be associated with a telephone line having a receiver and a dial, means to receive dial signals representing digits from said line, means to convert said dial signals into corresponding printing telegraph signals representing digits, means to record the latter signals as digits by means of said teletypewriter, a timing device operable in successive timed cycles during periods when said trunk is associated with a telephone line and dial signals are not being transmitted over said telephone line, and means controlled by said timing device for causing said teletypewriter to print special symbols each time said timing device operates through its cycle.

5. In a recording system, a recording trunk having a teletypewriter connected therewith and adapted to be associated with a telephone line having a receiver and a dial, means to receive dial signals representing digits from said line, means to convert said dial signals into corresponding printing telegraph signals representing digits, means to record the latter signals as digits by means of said teletypewriter, a timing device operable in successive timed cycles during periods when said trunk is associated with a telephone line and dial signals are not being transmitted over said telephone line, and means controlled by said timing device for causing said teletypewriter to print special symbols after the telephone subscriber removes his switchhook and until dialing commences.

6. In a recording system, a recording trunk having a teletypewriter connected therewith and adapted to be associated with a telephone line having a receiver and a dial, means to receive dial signals representing digits from said line, means to convert said dial signals into corresponding printing telegraph signals representing digits, means to record the latter signals as digits by means of said teletypewriter, a timing device operable in successive timed cycles during periods when said trunk is associated with a telephone line and dial signals are not being transmitted over said telephone line, and means controlled by said timing device for causing said teletypewriter to print special symbols between the dialing operations for successive digits.

7. In a recording system, a recording trunk having a teletypewriter connected therewith and adapted to be associated with a telephone line having a receiver and a dial, means to receive dial signals representing digits from said line, means to convert said dial signals into corresponding printing telegraph signals representing digits, means to record the latter signals as digits by means of said teletypewriter, a timing device operable in successive timed cycles during periods when said trunk is associated with a telephone line and dial signals are not being transmitted over said telephone line, and means controlled by said timing device for causing said teletypewriter to continuously print uniformly timed special symbols after the dialing operations and before the hanging up of the receiver by the telephone subscriber.

8. In a recording system, a recording trunk having a teletypewriter connected therewith, a telephone line having a receiver and a dial, means to receive dial signals representing digits from said line, means to convert said dial signals into corresponding printing telegraph signals representing digits, means to record the latter signals as digits by means of a teletypewriter, service observing equipment for associating said telephone line with said trunk, and means causing said teletypewriter to continuously print a special symbol at uniformly timed intervals when the trunk is associated with said telephone line through said service observing equipment and the line is not in use.

9. In a recording system, a recording trunk having a teletypewriter connected therewith, a telephone having a receiver and a dial, service observing equipment for associating said telephone line with said trunk, means causing said teletypewriter to print a special symbol at timed intervals when the trunk is associated with said telephone line through said service observing equipment and the line is not in use, and means to cause said teletypewriter to print a different symbol at timed intervals after the telephone subscriber removes his receiver from the switchhook and until dialing commences.

10. In a recording system, a recording trunk having a teletypewriter connected therewith, a telephone having a receiver and a dial, service observing equipment for associating said telephone line with said trunk, means causing said teletypewriter to print a special symbol at timed intervals when the trunk is associated with said telephone line through said service observing equipment and the line is not in use, and means to cause said teletypewriter to print a different symbol a timed intervals between the dialing operations for successive digits.

11. In a recording system, a recording trunk having a teletypewriter connected therewith, a telephone having a receiver and a dial, service observing equipment for associating said telephone line with said trunk, means causing said teletypewriter to print a special symbol at timed intervals when the trunk is associated with said telephone line through said service observing equipment and the line is not in use, and means to cause said teletypewriter to print a different symbol at timed intervals after the dialing operations and before the hanging up of the receiver by the telephone subscriber.

12. In a recording system, a recording trunk having a page-type teletypewriter connected therewith and adapted to be associated with a telephone line having a receiver and a dial, means to receive dial signals from said line and record them as digits by means of said teletypewriter, means to cause said teletypewriter to print the time of day after a succession of dial signals have been received, and means to cause said teletypewriter to execute a carriage return operation after recording the time of day.

13. In a recording system, a recording trunk having a page-type teletypewriter connected therewith and adapted to be associated with a telephone line having a receiver and a dial, means to receive dial signals from said line and record them as digits by means of said teletypewriter, means to cause said teletypewriter to print the time of day after a succession of dial signals have been received, and means to cause said teletypewriter to execute a carriage return operation and a line feed operation after recording the time of day.

14. In a recording system, a recording trunk having a page-type teletypewriter connected therewith and adapted to be associated with a telephone line having a receiver and a dial, means to receive dial signals from said line and record them as digits by means of said teletypewriter, means to cause said teletypewriter to print the time of day after a succession of dial signals have been received, means to cause said teletypewriter to execute a carriage return operation and a line feed operation after recording the time of day, and means causing said teletypewriter to print the time of day at the end of each day.

15. In a recording system, a recording trunk having a teletypewriter connected therewith and adapted to be associated with a telephone line having a receiver and a dial, means to receive dial signals representing digits from said line, means to convert said dial signals into corresponding printing telegraph signals representing digits, means to record the latter signals as digits by means of said teletypewriter, and means causing said teletypewriter to automatically print the time of day at a predetermined time each day.

16. In a recording system, a recording trunk having a page-type teletypewriter connected therewith and adapted to be associated with a telephone line having a receiver and a dial, means to receive dial signals from said line and record them as digits by means of said teletypewriter, means causing said teletypewriter to print special symbols at timed intervals when the trunk is associated with said telephone line and dial signals are not being transmitted over the line, and means to cause said teletypewriter to automatically execute a carriage return operation at the end of each line.

17. In a recording system, a recording trunk having a page-type teletypewriter connected therewith and adapted to be associated with a telephone line having a receiver and a dial, means to receive dial signals from said line and record them as digits by means of said teletypewriter, means causing said teletypewriter to print special symbols at timed intervals when the trunk is associated with said telephone line and dial signals are not being transmitted over the line, and means to cause said teletypewriter to automatically execute a carriage return operation and a line feed operation at the end of each line.

18. In a recording system, a recording trunk having a page-type teletypewriter connected therewith and adapted to be associated with a telephone line having a receiver and a dial, means to receive dial signals from said line and record them as digits by means of said teletypewriter, means causing said teletypewriter to print special symbols a timed intervals when the trunk is associated with said telephone line and dial signals are not being transmitted over the line, means to cause said teletypewriter to automatically execute a carriage return operation at the end of each line, and means to prevent said teletypewriter from printing a received dialed digit while executing said carriage return operation.

19. In a recording system, a recording trunk having a page-type teletypewriter connected therewith and adapted to be associated with a telephone line having a receiver and a dial, means to receive dial signals from said line and record them as digits by means of said teletypewriter, means causing said teletypewriter to print special symbols at timed intervals when the trunk is associated with said telephone line and dial signals are not being transmitted over the line, means to cause said teletypewriter to automatically execute a carriage return operation and a line feed operation at the end of each line, and means to prevent said teletypewriter from printing a received dialed digit while executing said line feed operation.

PAUL JONES RANK.