Sept. 22, 1931. L. E. KITTREDGE ET AL 1,823,944

TIME RECORDING

Filed June 22, 1927 3 Sheets-Sheet 1

FIG. 1

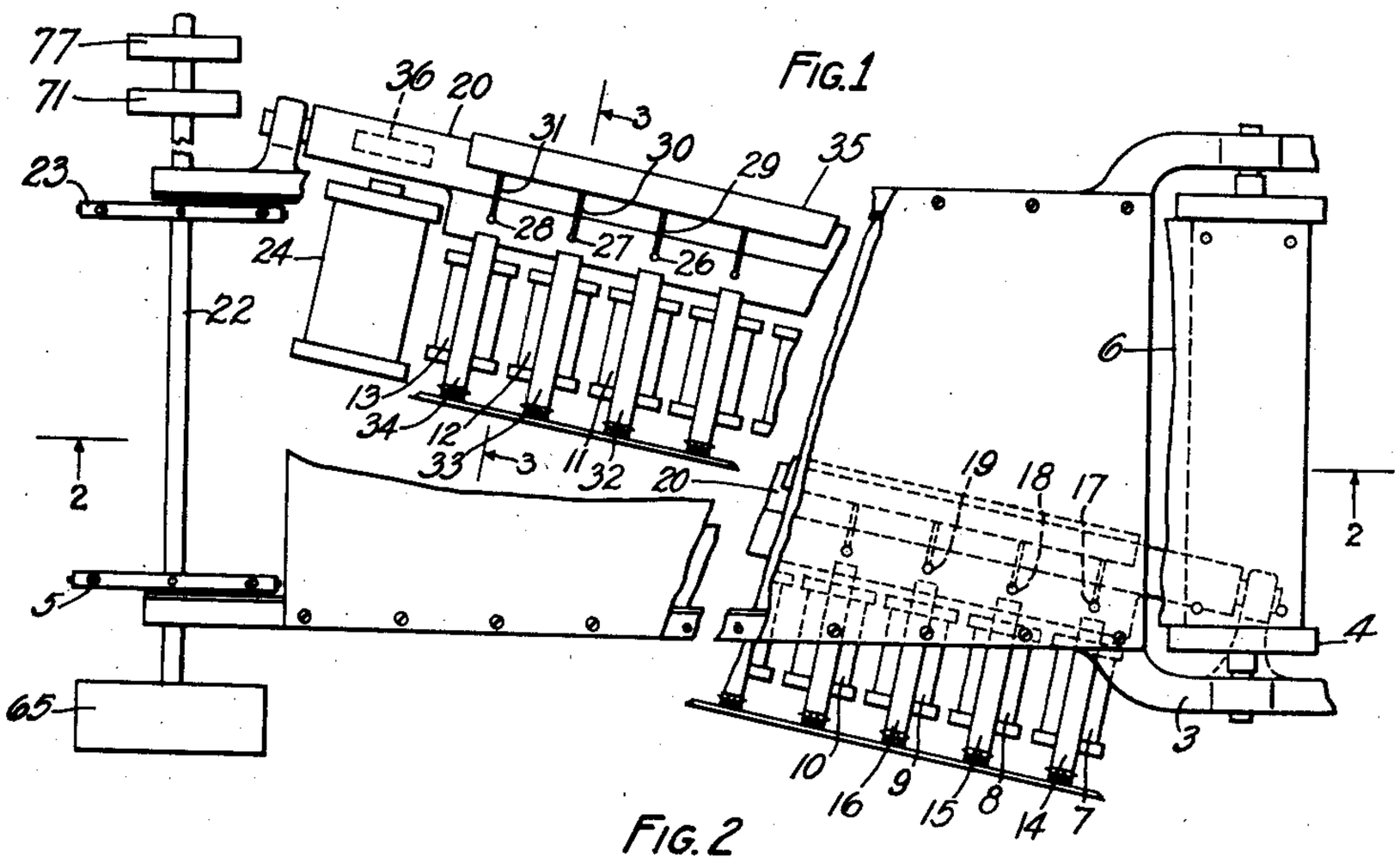

FIG. 2

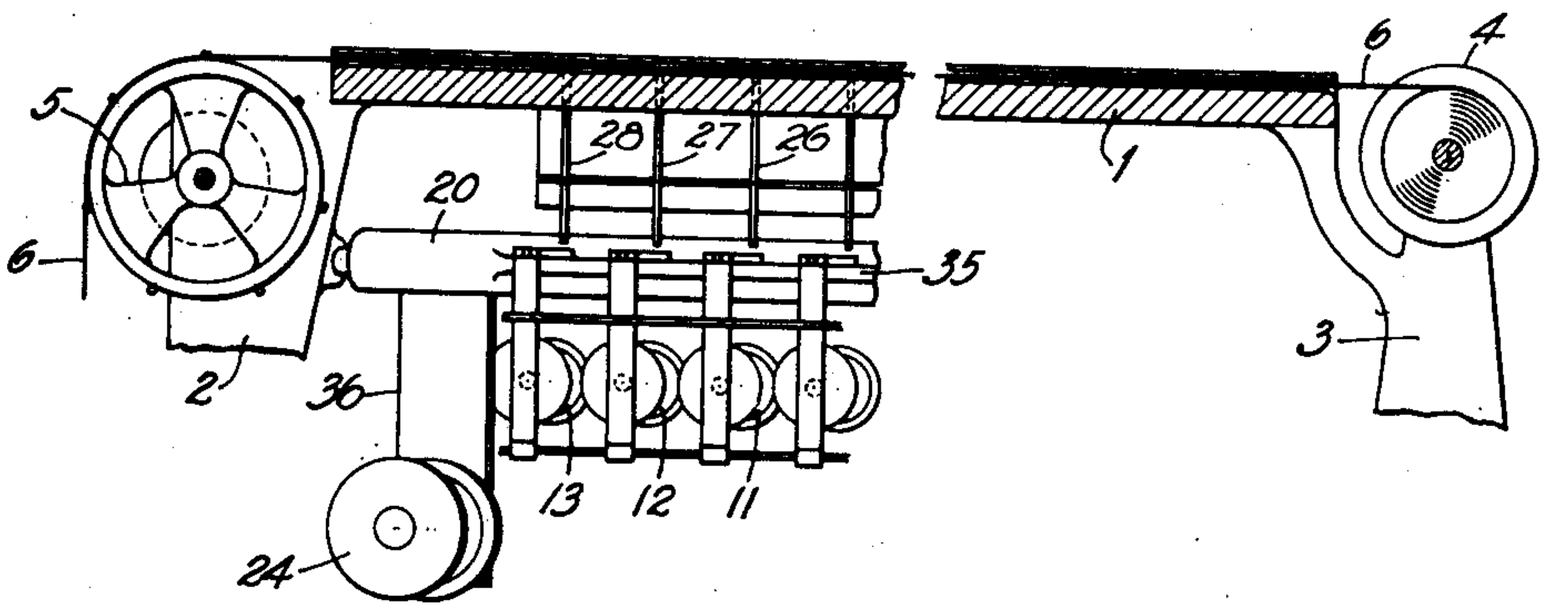

FIG. 3

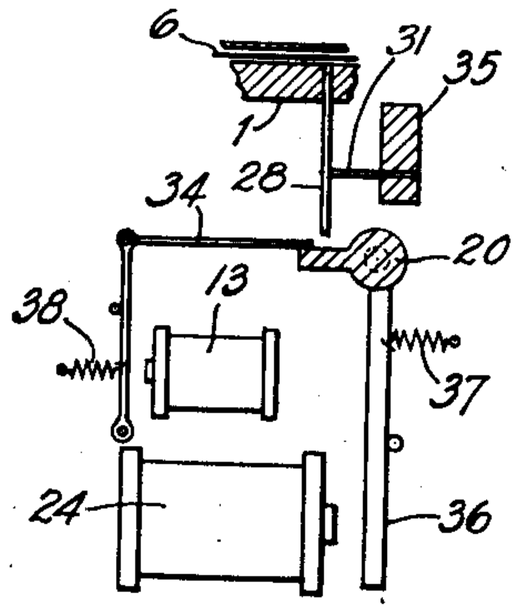

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FIG. 4

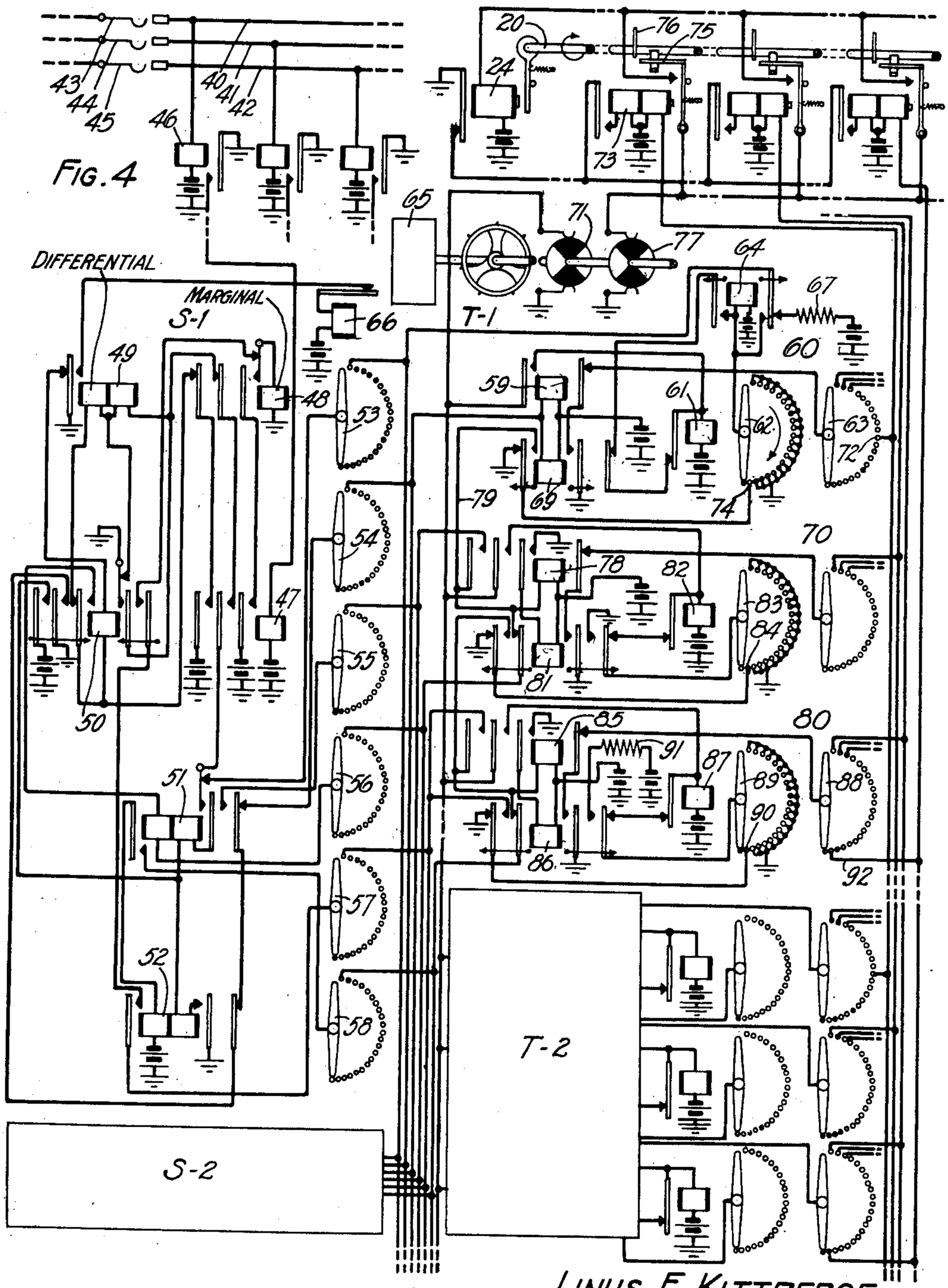

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FIG. 5.

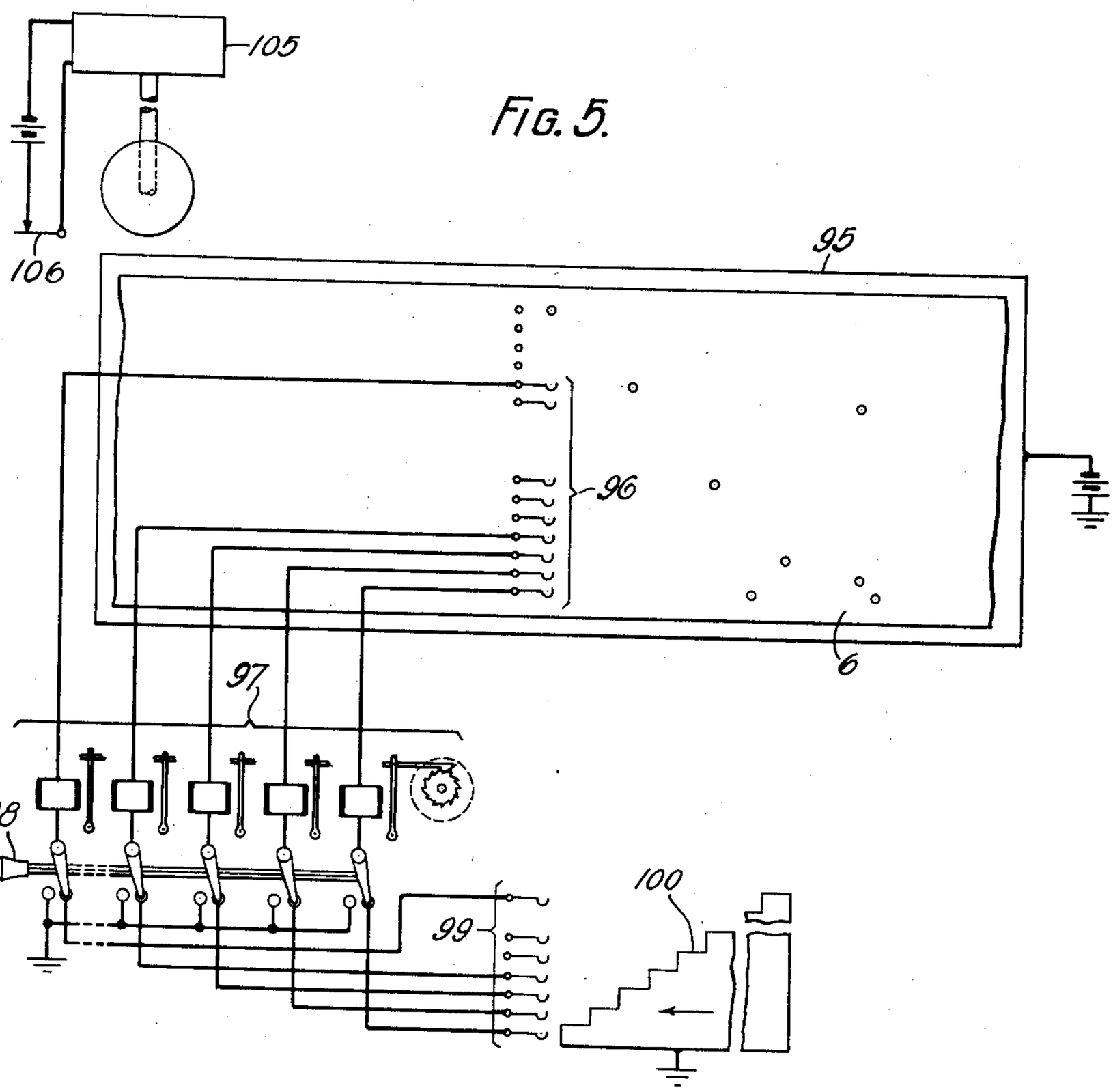
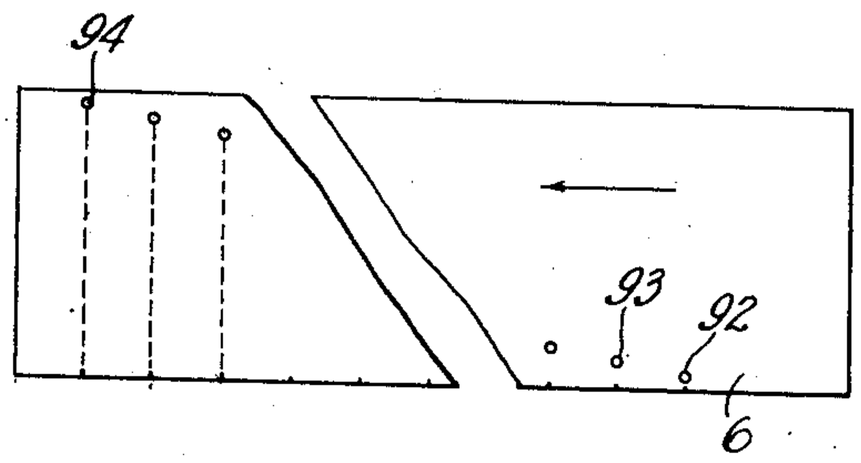


FIG. 6.



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1,823,944

UNITED STATES PATENT OFFICE

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TIME RECORDING

Application filed June 22, 1927. Serial No. 200,733.

This invention relates to time recording and its object is to improve the method of and apparatus for making and analyzing time records in telephone systems.

According to the invention a time record of telephone apparatus may be made and analyzed by punching a tape in such manner that the location of the perforation determines not only the holding time of the apparatus but the time of seizure as well.

A feature of the invention is a tape perforating device having a series of perforating pins arranged diagonally across the width of the tape. By this arrangement the position of the perforation along the tape marks the time the apparatus is seized and its distance from the tape's edge indicates the holding time.

Another feature is a device for analyzing the prepared tape to determine the total number of holding times of any given duration and the number of pieces of apparatus in use simultaneously at any given time.

The invention is particularly applicable to time recording devices for use in studying the traffic in telephone exchange systems. For example, it is desirable to examine from time to time the traffic conditions in a group of trunks. One of the important items is the holding time of the trunks and another is the time of day when the trunks are taken into use. In the system disclosed it is proposed to make a record of the information concerning a group of trunks by perforating a moving tape.

The paper tape is marked along its length according to the time of day and has a width sufficient to include the longest holding time of interest. Beneath the tape is arranged a series of punch pins with selecting and operating magnets. These pins are arranged diagonally across the width of the tape. By starting certain time mechanism in operation when a trunk is seized, it may be made to select, on release of the trunk, the particular pin in the diagonal series which is located from the edge of the tape a distance corresponding to the holding time of the trunk. Inasmuch as the pins are arranged diagonally the perforation of the tape will occur on a perpendicular to the edge of the tape coinciding with the time of day at which the trunk was seized. Thus at a glance a single perforation indicates both the time of seizure and the holding time of the trunk.

The timing mechanism consists of a stepping switch arrangement which operates during the interval the trunk is engaged to measure the holding time. When the trunk is released this counting mechanism selects and operates the proper punch pin selecting magnet.

The invention is illustrated in Figures 1 to 6 of the drawings. Fig. 1 shows a top view of the tape perforating mechanism. Fig. 2 shows a side view of said mechanism. Fig. 3 illustrates a detail of the punching device. Fig. 4 shows the timing mechanism. Fig. 5 illustrates the tape analyzing device. Fig. 6 shows a portion of perforated tape.

Referring to Figs. 1 to 3, a description will first be given of the tape perforating mechanism. The table 1, supported by the standards 2 and 3, serves to support and guide the paper tape 6 during its movement. The tape roll 4 is rotatably supported at one end of the table and the driving shaft 22, having sprockets 5 and 23, is arranged at the opposite end. The shaft 22 is driven by any suitable source of power 65 and by means of the sprocket wheels 5 and 23 causes the tape to pass over the surface of the table 1. The speed of the moving tape may be chosen to correspond to any suitable scale of time printed or otherwise marked along the edge of the tape.

Located beneath the table 1 is a series of punch pins including the pins 17, 18, 19, 26, 27 and 28. These pins are supported by springs such as the springs 29, 30 and 31 secured to the support 35. These pins are arranged along a diagonal so that each successive pin occurs at a successively increasing distance from the edge of the tape. This distance from the punch pin to the edge of the tape is a measure of the holding time. For example, the pin 17 represents the shortest holding time whereas the pin 28 repre-

sents the greatest holding time. The punch pins are provided with individual selecting magnets 7, 8, 9, 10, 11, 12 and 13. These magnets have armatures to which are attached the arms 14, 15, 16 * * * 32, 33 and 34. These arms are normally out of alignment with the punch pins but when their magnets are energized they project to a point between the end of the punch pin and the punch bar 20. The punch bar 20 is common to all punch pins and is rotated by the common operating magnet 24.

From this it will be seen that to perforate the tape at any particular point it is only necessary to energize the proper selecting magnet such as magnet 13 shown in Fig. 3. Magnet 13 attracts its armature and moves the arm 34 under the punch pin 28. Thereafter the magnet 24 operates, attracting its armature 36 to rotate the punch bar 20, moving the punch pin 28 upward to perforate the tape 6. When the magnet 24 releases, spring 37 restores the punch bar 20. The magnet 13 on releasing allows the spring 38 to withdraw the arm 34. The pin 28 is restored to its normal position by the spring 31.

A description will now be given of the manner in which the time counting mechanism is seized and operated, when the trunk becomes busy, for the purpose of operating the tape perforating mechanism. In Fig. 4 three trunks 40, 41 and 42 are diagrammatically shown which may be seized by automatic selector switches represented by the brushes 43, 44, and 45. For each trunk to be studied there is an individual selecting mechanism S—1. The mechanism S—1 shown in full is individual to the trunk 40 and consists of a step-by-step switch having the brushes 53 to 58 inclusive and a number of relays. Another individual mechanism S—2 is schematically illustrated. These individual mechanisms have access to a number of common time counting devices. One of these devices T—1 is shown in full and comprises three step-by-step switches, 60, 70 and 80, together with a number of relays. A second time counting device, T—2 is also illustrated.

Assume that the trunk 40 is seized and held for a given time. Upon seizure of trunk 40 a relay 46 operates and closes an obvious operating circuit for relay 47. Relay 47 operates the differential relay 49 in a circuit from battery, to the outer contact of relay 47, outer contact of relay 48, inner left back contact of relay 50, left winding of relay 49 to ground at the contact of relay 50. Relay 49 operates and closes the interrupting circuit of the stepping magnet 66 which starts the switch to hunt for an idle time counting device. The terminals corresponding to busy timing devices will be grounded in the bank cooperating with the wiper 53. As soon, however, as the wiper 53 reaches an ungrounded terminal, a circuit is completed from ground, through the contact of relay 50, right winding of relay 49, middle contacts of relays 48 and 47, normal contact of relay 51, wiper 53, through the right back contact of relay 64, resistance 67 to battery. Current flowing through the right winding of relay 49 neutralizes the effect of the left winding and allows the relay to release. Relay 49 in releasing opens the stepping circuit of the switch, allowing it to come to rest. Ground potential is temporarily applied to the test terminal through the right winding of relay 49 as previously traced to prevent seizure of the timing device T—1 by another individual switch. Relay 49 operates the slow operating relay 50. The circuit may be traced from ground through the back contact of relay 49, winding of relay 50, outer contacts of relays 48 and 47 to battery. Relay 50 disconnects both windings of relay 49 and closes the following circuit for applying ground potential to the test terminal of the selecting switch; through the inner right contact of relay 50, middle contacts of relays 48 and 47, contact of relay 51 to the wiper 53.

Relay 50 operates the relays 59 and 69 to start the switch 60 in operation to count time. A circuit for these relays may be traced from battery, through their windings in parallel, wiper 54, back contacts of relays 51 and 52 to ground at the contact of relay 50. Relay 59 in operating closes a circuit for the stepping magnet 61 of the timing switch 60. This circuit leads from battery through the winding of the magnet, contact of relay 59, through the commutator 71 to ground. The commutator 71 is driven by the motor mechanism 65 which also operates the moving tape. The commutator 71 may be cut and geared in such a manner that it closes the above mentioned circuit at periodic intervals, say every five seconds. Thus the magnet 61 operates every five seconds and steps the brushes 62 and 63 from one set of terminals to the next. On the first step of the switch a circuit is closed from ground through the brush 62 and the winding of slow release relay 64 to battery. Relay 64 operates and extends the grounded conductor through its right front contact to the terminal bank 53 maintaining the timing device T—1 non-selective.

It will be assumed that the holding time of the trunk 40 in the present instance is not great enough to allow the switch 60 to step over its entire bank. Suppose that the trunk 40 is released at the instant the wiper 63 reaches the terminal 72. The release of the trunk removes ground from relay 47 and this relay deenergizes in turn releasing relay 50. Relay 50 opens the circuit of relays 59 and 69. Relay 59 releases immedi-

ately but relay 69 being slow to release maintains its armature for an interval. During this interval, a circuit is completed for operating the proper punch selecting magnet. This circuit may be traced from ground through the right contacts of relays 59 and 69, wiper 63, terminal 72 through the right winding of magnet 73 to battery. Magnet 73 locks through its left winding and front contact to ground through the back contact of the common punch magnet 24.

The slow relay 69 on releasing after an interval completes a circuit from battery through the winding and contact of magnet 61, outer right contact of relay 69, contact of relay 64, wiper 62 to ground. Magnet 61 interrupts its circuit and steps the switch 60 until the wiper 62 passes off the grounded terminals. When the wiper 62 reaches the terminal 74 a new circuit is completed for relay 64 from battery through its winding, wiper 62, terminal 74 to ground at the back contact of relay 69. The stepping magnet 69 is now operated in a circuit from battery through its winding and contact, right contact of relay 69, left contact of relay 64, wiper 62, terminal 74, to ground at the back contact of relay 69. The switch takes one more step into its normal position whereupon relay 64 releases.

The selecting magnet 73 in operating advances the arm 75 under the punch pin 76 preparatory to punching the tape. When the magnet 73 fully operates it closes a circuit from battery through the winding of the punch magnet 24, front contact of magnet 73 to the brush of commutator 77. As soon thereafter as the commutator 77 closes, the magnet 24 operates and rotates the punch beam 20. The punch beam elevates the pin 76 and places a perforation in the tape. Magnet 24 in operating opens its back contact releasing the magnet 73. Magnet 24 then releases restoring the punch pin to its normal position.

It will next be assumed that the holding time of the trunk is great enough to permit the switches 60 and 70 to operate fully and switch 80 to operate partially. When the switch 60 has advanced its brush 62 to the terminal 74 a circuit is completed for operating relay 78. The circuit of relay 78 may be traced from ground through the inner right contact of relay 50 thence as previously traced to the wiper 53, right front contact of relay 64, wiper 62, terminal 74, front contact of relay 69, conductor 79, winding of relay 78 to battery. A circuit in parallel also extends from the grounded conductor 79 through the inner left back contact of relay 81, wiper 56, left winding of relay 51, inner left front contact of relay 50, outer contacts of relays 48 and 47 to battery. Relay 51 in operating first opens its outer right back contact to sever the circuit of relays 59 and 69. Relay 59 releases at once and relay 69 releases after a slight interval. At the completion of its operation relay 51 opens its normally closed contact to sever the circuit of slow release relay 64. If relay 64 releases it is reoperated as soon as relay 69 releases in a circuit through the left back contact of relay 69. When relay 69 completes its release a circuit is closed for restoring the switch 60. This circuit may be traced from battery through the winding and contact of magnet 61, contact of relay 69, left contact of relay 64, wiper 62, contact 74 to ground at the left back contact of relay 69. After an interval relay 64 releases. Ground potential is thus removed from the multiple of wipers similar to the wiper 53 so that the timing mechanism T—1 may be seized by another trunk and the switch 60 positioned to count a second holding time while the switches 70 and 80 are still in the act of counting the first holding time.

The relay 51 in operating locks in a circuit from battery through the outer left contact of relay 50, right winding and contact of relay 51, middle contacts of relays 47 and 48 to ground at the contact of relay 50. Relay 78 closes an obvious circuit for relay 81. Relay 78 locks in circuit from battery through its winding and outer left contact, wiper 55, right front contact of relay 51, right back contact of relay 52, to ground at the middle left contact of relay 50. The second counting switch 70 is now stepped from position to position under the control of the commutator 71. The stepping circuit may be traced from battery through the winding of stepping magnet 82, middle contact of relay 78 to ground through the commutator 71.

Since the holding time is assumed to be sufficient to allow switch 70 to complete its operation, this switch will continue stepping until the wiper 83 reaches the terminal 84. The relay 85 is next operated in a circuit from battery through its winding, left front contact of relay 81, terminal 84, wiper 83 to ground at the right front contact of relay 81. A parallel circuit is also completed from battery through the left winding of relay 52, left contact of relay 51, wiper 58, inner left contact of relay 86, and thence to ground as traced at the contact of relay 81. Relay 52 operates and locks through its right winding to battery at the outer left contact of relay 50. Relay 52 at its outer right contact opens the holding circuit of relays 78 and 81. When relay 81 releases a circuit is closed from battery through the winding and contact of the stepping magnet 82, right back contact of relay 81, wiper 83, terminal 84, to ground at the left contact of relay 81. The switch 70 thereupon steps to its normal position.

With relay 52 operated the relay 85 locks in a circuit from battery through its winding and outer left contact, wiper 57, left contact of relay 52, outer right contact of relay 50 to ground through the contact and winding of relay 48. Relay 48 being marginal does not operate in series with relay 85. Relay 85 closes an obvious circuit for slow relay 86. The third time counting switch 80 commences to operate being driven step by step by the magnet 87. The circuit for this magnet may be traced from battery through its winding, middle left contact of relay 85, to ground through the commutator 71.

As soon as the trunk 40 is released, which, under the assumption, occurs while the switch 80 is in the process of counting time, the relay 47 accordingly releases. Relay 47 releases the relay 50 which in turn releases relays 51 and 52. The circuit of relays 85 and 86 is also opened. Relay 85 releases ahead of relay 86 and closes a momentary circuit from ground through the inner right contact of relay 86, right back contact of relay 85, wiper 88, through the particular terminal upon which said wiper is standing to the proper punch pin selecting magnet.

Should a trunk be held for a time greater than the maximum counting time of the mechanism T—1 the brush 89 of switch 80 finally reaches the terminal 90. In this position a circuit is closed from battery through the resistance 91, outer right front contact of relay 86, wiper 89, terminal 90, outer left front contact of relay 86, thence as traced through the contact and winding of relay 48. With current flowing through two parallel paths, the relay 48 operates and locks to the contact of relay 47. Relay 48 opens the circuit of relay 85 and also releases relays 50, 51, and 52. When relay 85 releases a circuit is closed from ground through the inner right contact of relay 86, right back contact of relay 85, wiper 88, thence over conductor 92 to the punch pin selecting magnet representing the greatest holding time. In this way all holding times exceeding the maximum are recorded by the punch pin representing the maximum holding time.

Fig. 6 represents a portion of the recording tape 6. The direction of motion is indicated by the arrow. The perforation 92 indicates that a trunk was seized at the time of day marked on the edge of the tape immediately under the perforation. The perforation 92 also indicates that the holding time of the trunk is a minimum, for example, five seconds. The perforation 93 indicates that a trunk was seized at the time of day occurring directly under the perforation and the trunk was held for an interval of say ten seconds. Similarly other perforations occurring at varying distance from the edge of the tape give the same information with respect to the trunk seizures which they represent. The perforation 94 would accordingly indicate that a trunk was held for the maximum interval. From this it will be seen that the time of seizure of the trunk may be read directly from the edge of the tape by arranging the punch pins at a diagonal with respect to the width of the tape.

Fig. 5 shows a portion of the apparatus for analyzing the tape after its perforation. The perforated tape is caused to move over the metallic table 95 by any suitable driving mechanism such as shown in Figs. 1 and 2. The brushes 96, which press against the paper, are connected each to a counting device 97. The counting devices 97 are also connected through a switch 98, to brushes 99. The brushes 99 engage a commutator 100. The commutator 100 is shown developed for simplicity and is so shaped that as it moves under the brushes 99 the brushes close their circuits in succession. The successive intervals of closure may be chosen to correspond to the intervals between successive holding time perforations in the tape. Thus a complete movement of the commutator 100 represents the maximum holding time of a trunk. Accordingly, the total number of operations of the counting device 97 for a complete movement of the commutator 100 equals the number of simultaneous calls at the particular time of day which the end of that portion of the tape 6 represents. It will be understood of course, that as the tape 6 passes under the brushes 96 whenever a perforation is encountered a circuit is closed from battery through the table 95 and the corresponding brush 96 through the counting device 97, switch 98, brush 99 to ground through the commutator 100. In order that a reading may be taken at the completion of each cycle of commutator 100, the circuit of the driving motor 105 may be opened by switch 106 to stop the mechanism.

If it is desired to count the number of holding times of each different duration which occur over any given portion of the day this may be done by throwing the switch 98 to its alternate position. In this position, a counting device 97 operates whenever its associated brush 96 encounters a perforation representing a particular length of holding time.

What is claimed is:

1. The method of making a time record of apparatus which comprises perforating a tape in such manner that the location of a single perforation indicates both the time of seizure and the holding time of the apparatus.

2. The method of recording the time of seizure and the holding time of apparatus which comprises perforating a tape in such

manner that the longitudinal position of the perforation indicates the time of seizure and the lateral position the holding time.

3. The method of recording the operation of telephone apparatus which comprises perforating a tape and measuring the distance between the perforations and the edge of the tape to determine the holding time of said apparatus.

4. The method of recording traffic over a group of trunks which comprises perforating a moving tape with a single perforation per trunk in such a manner that the longitudinal position of the perforation indicates the time at which a trunk is seized and the lateral position indicates the time during which said trunk is held.

5. The method of recording traffic over a group of trunks which comprises perforating a moving tape and measuring the distance from each perforation to the edge of said tape to determine the number of trunk seizures which endure for a given interval of time.

6. The method of recording traffic over a trunk group which comprises perforating a moving tape in accordance with each holding time of a trunk in such a manner that the number of perforations in a line across the tape indicates the number of trunks in use simultaneously at any given time.

7. The combination in a telephone system of telephone apparatus, means for seizing said apparatus, a tape, and means for perforating the tape at variable distances from its edge to indicate the holding time of said apparatus.

8. The combination in a telephone system of telephone apparatus, means for seizing said apparatus, a tape marked in accordance with the time of day, and means for perforating the tape opposite the mark indicating the time said apparatus was seized and at a distance from the tape's edge indicating the holding time.

9. In combination, trunks, a paper, means for moving the paper at a given rate, and means for perforating the paper in such manner that each perforation indicates both the time of seizure and holding time of trunk.

10. In combination, trunks, a paper, means for moving the paper at a given rate, and a series of punch pins for perforating the paper at variable distances from its edge to indicate the holding time of said trunks.

11. In combination, trunks, a tape, a series of punch pins arranged at successively increasing distances from the edge of the tape to represent various holding times of said trunks, and means to select and operate the pins.

12. In combination, trunks, means for seizing said trunks, a paper, a series of punch pins arranged at successively increasing distances from the edge of the paper, each pin representing a different trunk holding time, a device for counting time during the engagement of a trunk, and means controlled by said device for selecting and operating the punch pin corresponding to the holding time of the engaged trunk.

13. In combination, trunks, means for seizing said trunks, a paper, a series of punch pins arranged at successively increasing distances from the edge of the paper, each pin representing a different trunk holding time, a time counting device comprising a plurality of progressively movable switches, means for seizing the device and setting the first switch in operation responsive to the engagement of the trunk, means for rendering the device busy while the first switch is operating, means for rendering the device selectable to other trunks when the first switch has completed its operation, and means controlled by said switches for selecting and operating said pins.

In testimony whereof, we have signed our names to this specification this 21st day of June 1927.

LINUS E. KITTREDGE.
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