

H. E. A. ANDRÉ.

CONNECTION REGISTER FOR TELEPHONE EXCHANGES.

APPLICATION FILED JULY 9, 1903.

4 SHEETS—SHEET 1.

Fig. 2.

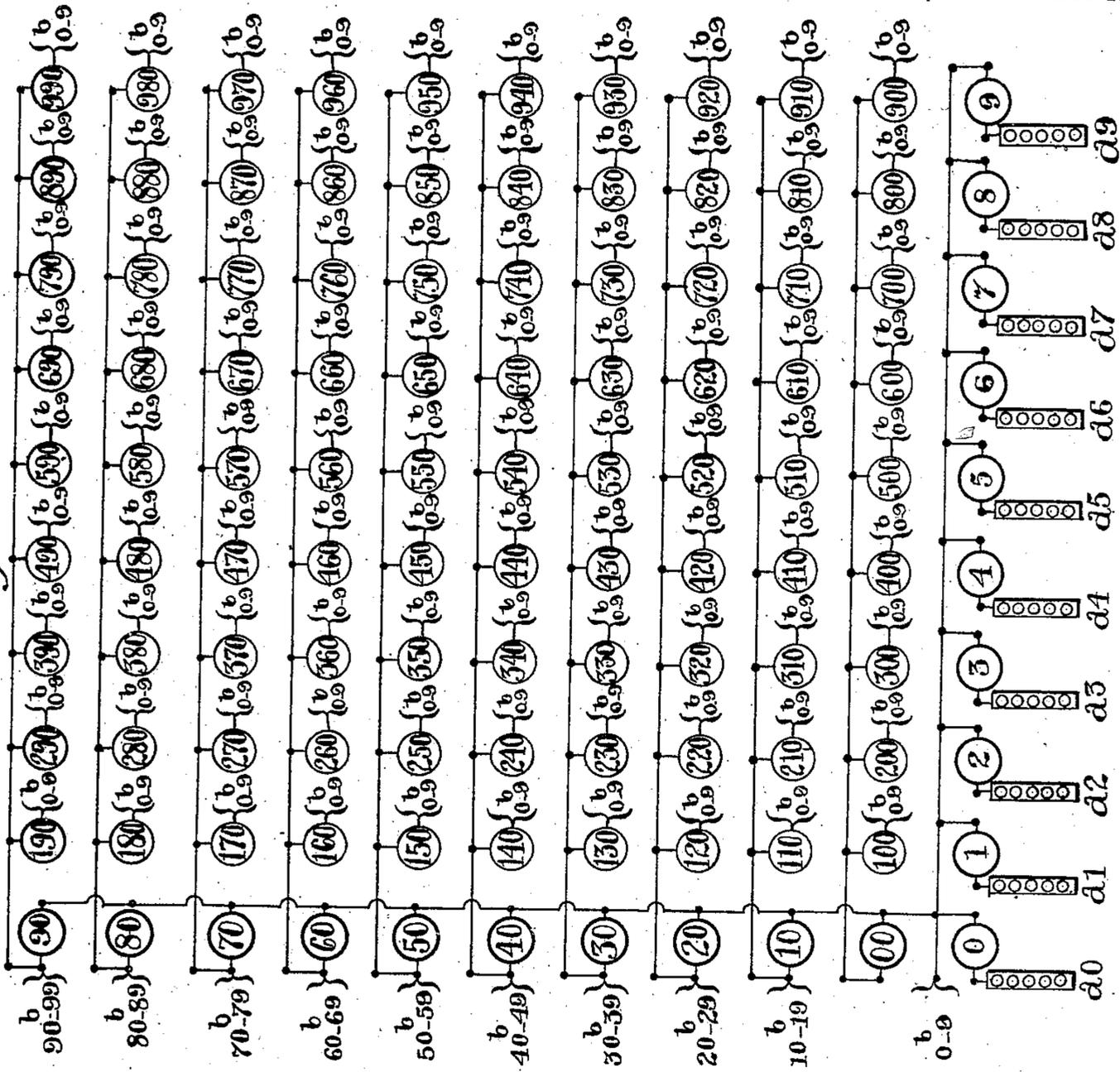
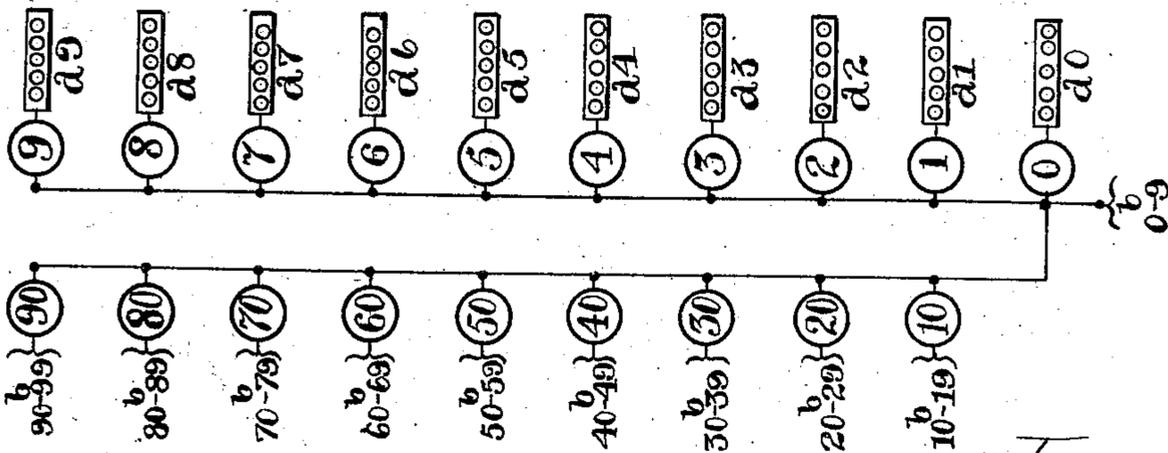


Fig. 1.



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PATENTED JULY 25, 1905.

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4 SHEETS—SHEET 2.

Fig. 3.

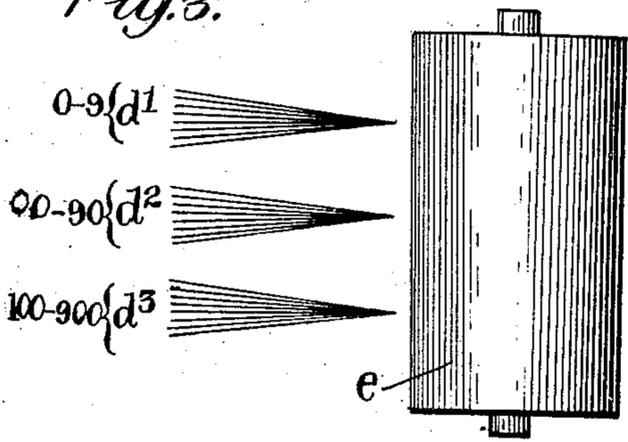


Fig. 4.

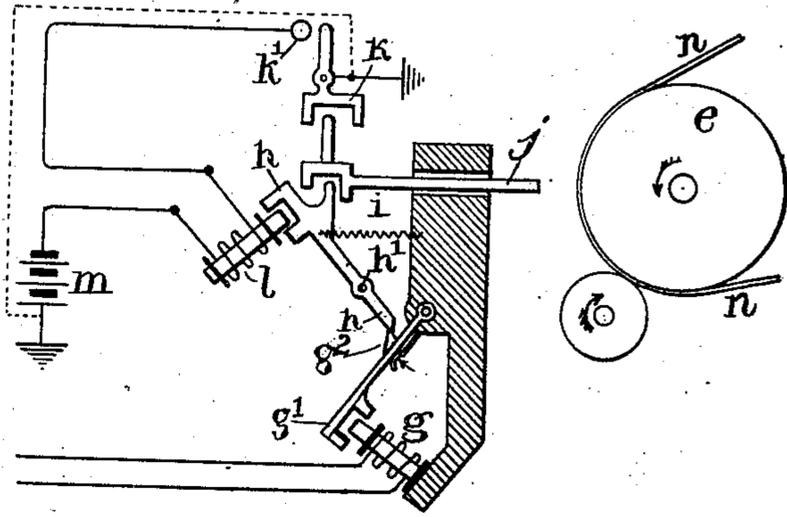


Fig. 5.

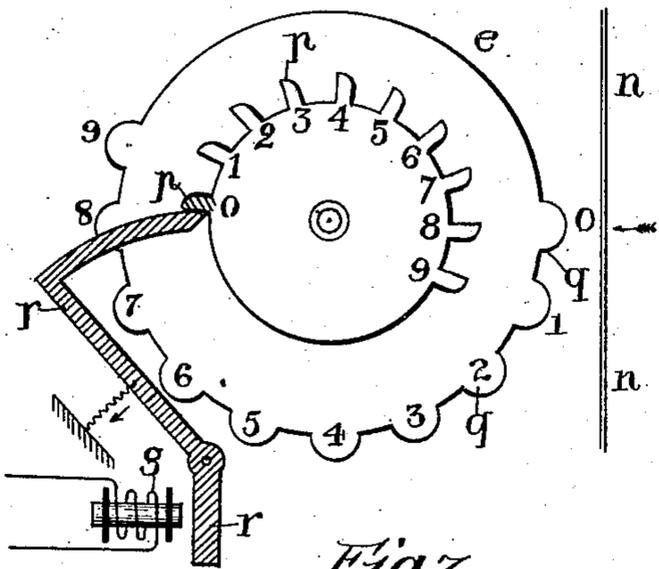


Fig. 6.

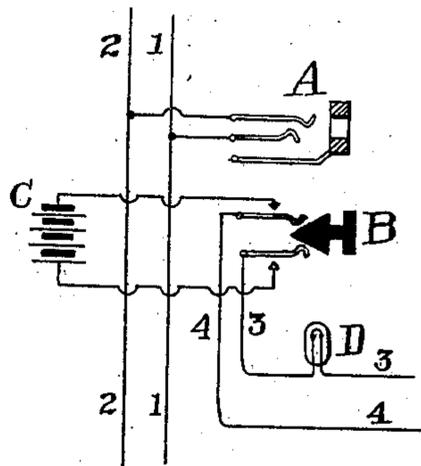


Fig. 7.

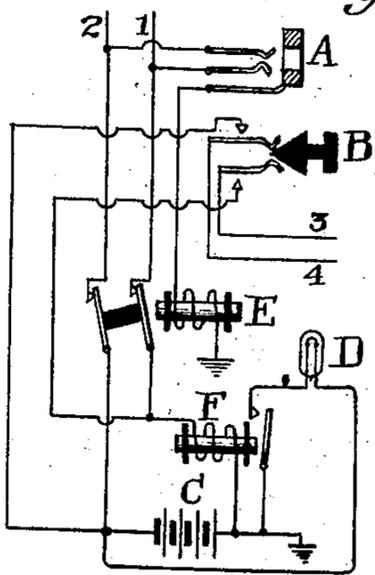
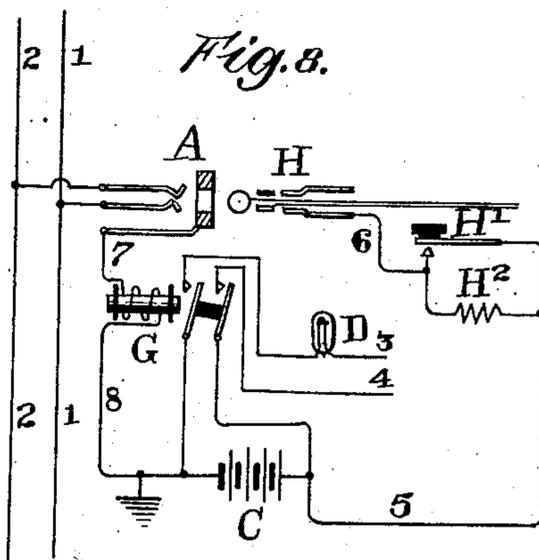


Fig. 8.



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4 SHEETS—SHEET 3.

Fig. 9.

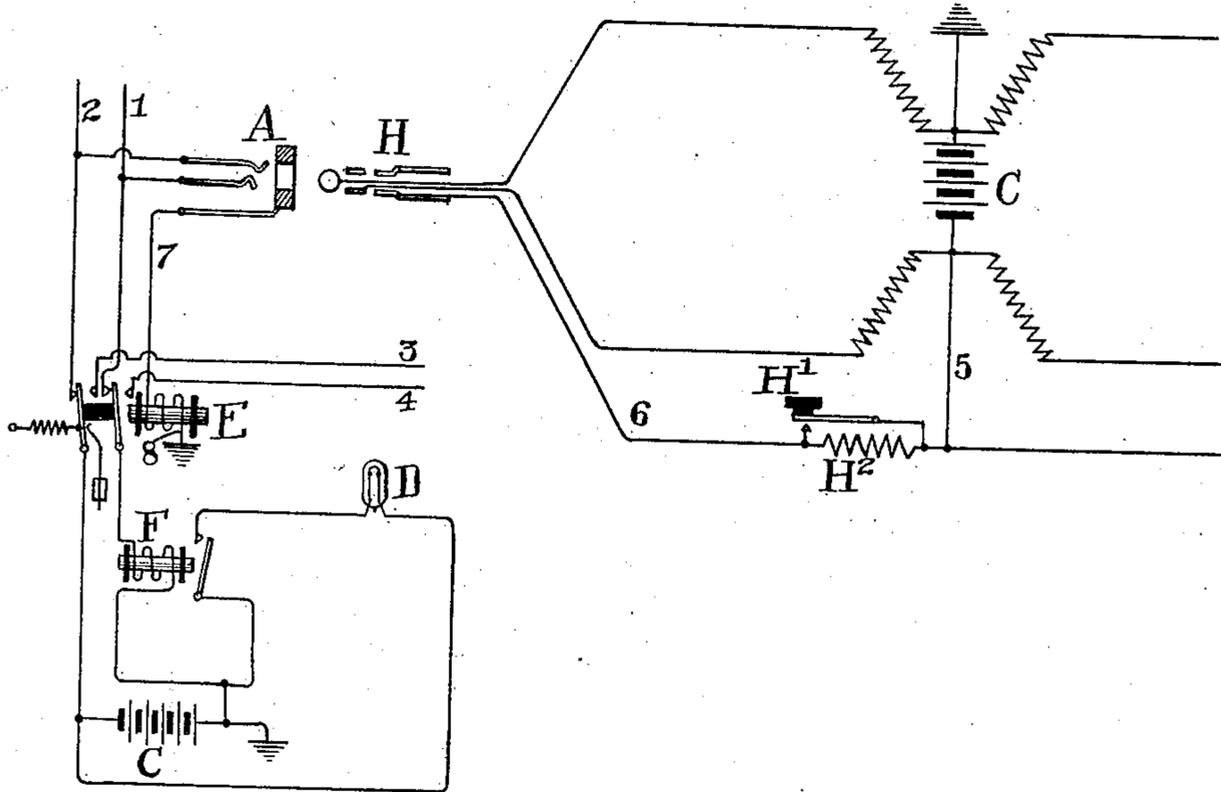
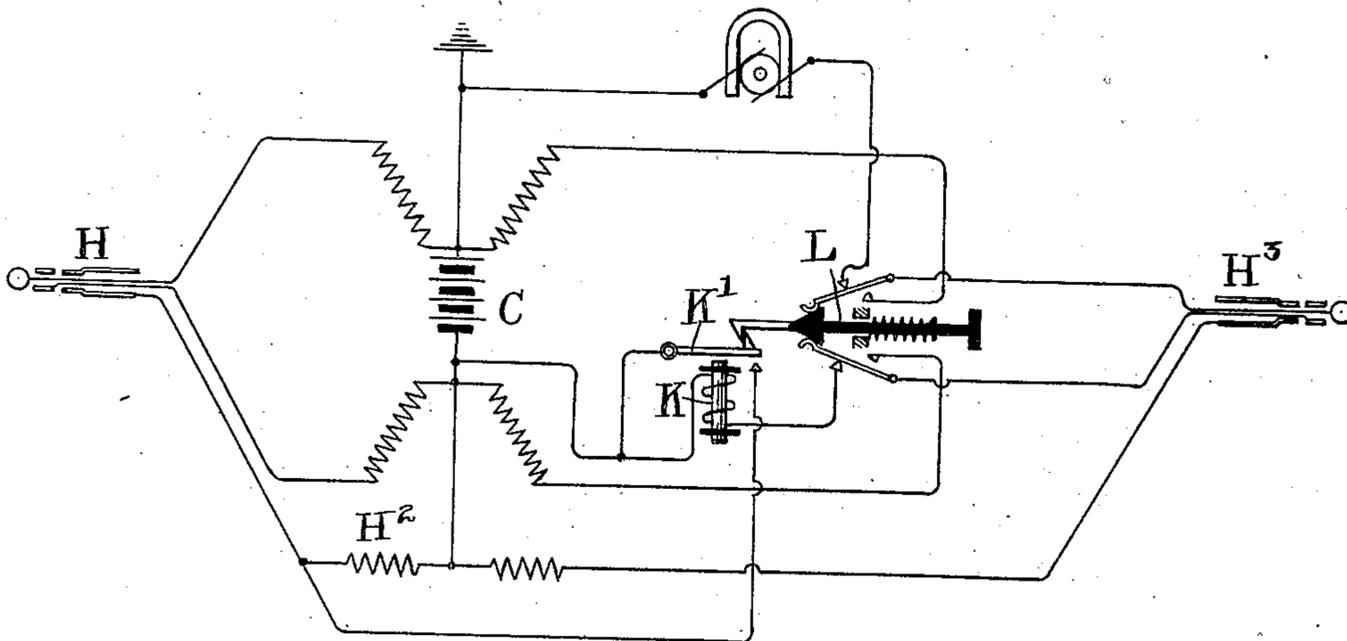


Fig. 10.



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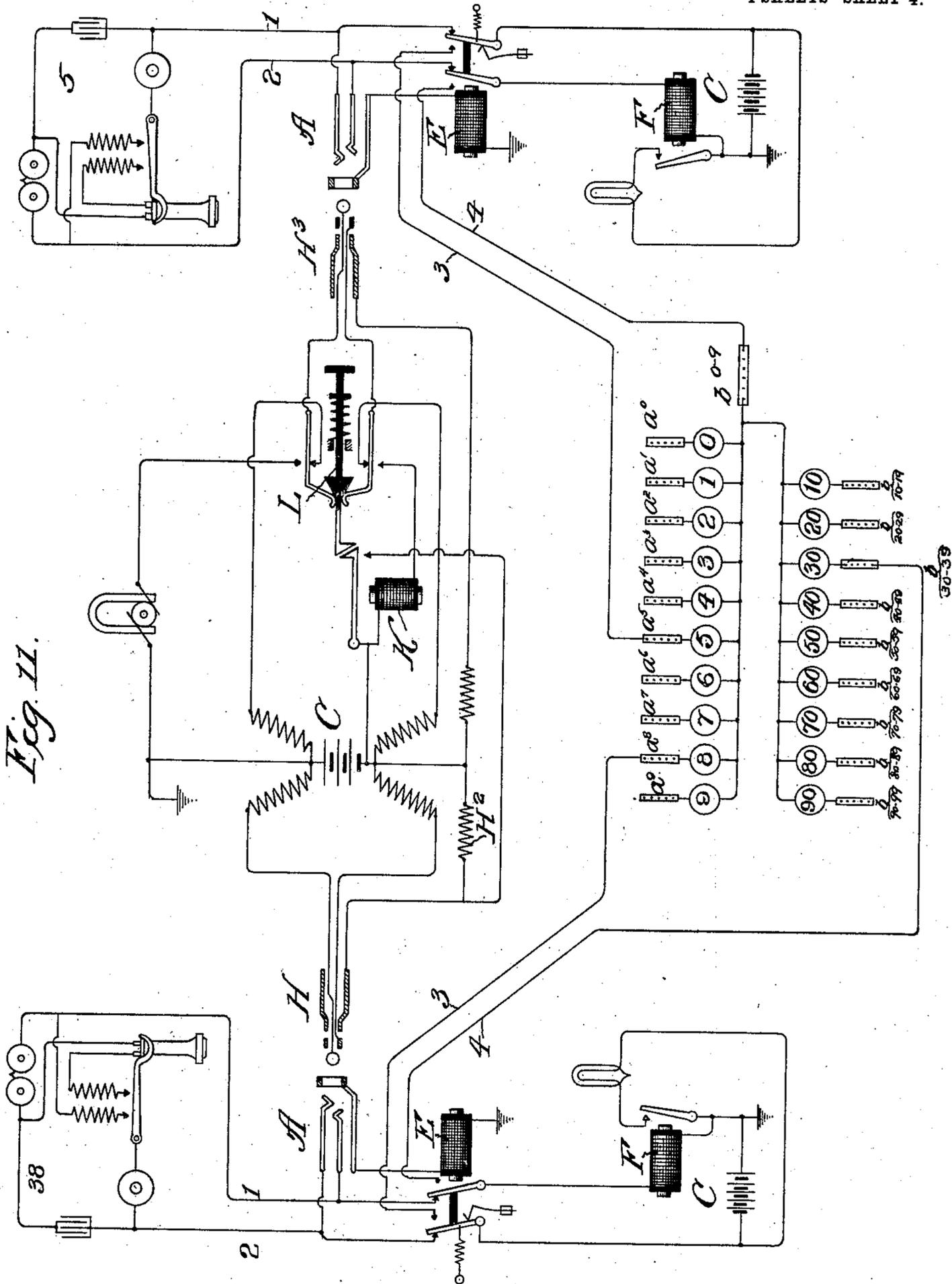
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4 SHEETS—SHEET 4.



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UNITED STATES PATENT OFFICE.

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CONNECTION-REGISTER FOR TELEPHONE-EXCHANGES.

No. 795,571.

Specification of Letters Patent.

Patented July 25, 1905.

Application filed July 9, 1903. Serial No. 164,763.

To all whom it may concern:

Be it known that I, HENRI EMILE ALPHONSE ANDRÉ, a citizen of France, residing at Paris, France, have invented a certain new and useful Improvement in Connection-Recorders for Telephone-Exchanges, (for which Letters Patent have been granted in France, No. 315,007, dated October 13, 1902,) of which the following is a full, clear, concise, and exact description.

My invention relates to the measurement of telephone service; and its object is to provide improved means whereby an accurate account can be kept of the calls from each line in an exchange with a view to making charges proportionate to the service rendered.

It has been common heretofore to provide a special service-meter or connection-recorder for each line either at the substation or at the central office with appropriate means for actuating this counter each time a call is made for which a charge is to be rendered. In some cases the charge is made for each call transmitted to the central office; but more frequently the charge is not made unless the calling subscriber is actually placed in communication with the correspondent called for. The service-meter has been arranged to be actuated either manually by the operator or automatically as an incident to some act done in the course of putting the calling and called subscribers in communication. In accordance with my invention the individual service-meter for each line may be dispensed with and a single connection-recorder provided for a group of several lines—say those which are answered at a given "operator's position" of the switchboard—said recorder having apparatus selectively controlled by the several lines of the group, so that when actuated it will make a distinguishing record showing the particular line against which the connection is to be charged. In the preferred form of my invention a connection-recorder at each operator's position comprises tape-printing mechanism actuated by groups of magnets, one group being adapted to print on the tape the numerals of the units, another group the numerals of the tens, another the numerals of the hundreds, &c. A circuit is associated with each line to determine the actuation of a given magnet or set of magnets of the common recorder, whereby said recorder is caused to print on the tape a number corresponding

with that of the line in question. A switch for this circuit may be actuated either manually or automatically.

I will describe my invention more particularly by reference to the accompanying drawings, in which—

Figure 1 is a diagram showing the manner in which nineteen electromagnets may be connected to control the recording of the hundred numbers, "0" to "99." Fig. 2 is a similar diagram showing the connections of the magnets necessary to control the recording of the thousand numbers, "0" to "999." Fig. 3 is a diagram hereinafter to be referred to in explaining the action of the recorder. Fig. 4 is a diagram illustrating the principles upon which the mechanism of the recorder may be arranged to operate. Fig. 5 is a diagram illustrating a modified form of mechanism for the recorder. Fig. 6 is a diagram showing the manner in which the recorder-circuit may be associated with a telephone-line at the central office. Fig. 7 shows the association of the recorder-circuit with a line of a central battery system. Fig. 8 shows the recorder-circuit associated with a line in another way. Figs. 9 and 10 are diagrams showing further modifications hereinafter to be explained; and Fig. 11 shows a complete telephone-exchange system equipped in accordance with my invention.

The same characters of reference are used to designate the same parts wherever they are shown.

Referring first to Fig. 1, which illustrates the connections for nineteen electromagnets which may control the recording mechanism of a recorder in such a way as to permit the selective recording of any number from "0" to "99," the electromagnets are represented by circles, within each of which is marked the figure of units or tens to which that magnet corresponds. The ten bars a^0 to a^9 represent the terminals for the incoming wires of the recorder-circuits of the lines numbered from "0" to "99." The exponents of the letters a indicate the figures of the units of the numbers of the lines whose recorder-circuits enter at the bar to which the letter is applied. Thus the bar a^5 forms the incoming terminal for the recorder-circuits of all the lines whose numbers have the figure "5" in the units place—that is, numbers "5," "15," "25,"

&c., up to "95." The terminals *b* of the several electromagnets are connected with the other or outgoing wires of the recorder-circuits of lines whose numbers are indicated immediately below each letter *b*. Thus the terminal *b* of the electromagnet 60 is connected with the outgoing wires of lines 60 to 69, inclusive. The outgoing wires of lines numbered between "0" and "9" are connected with the terminal *b*, which is common to the ten "unit-magnets" 0 to 9.

By means of the nineteen electromagnets shown in Fig. 1 it is possible to control all numbers from "0" to "99," inclusive. The current is caused to enter by that one of the bars *a* whose exponent indicates the figure in the units-column of the number in question, said current leaving by the terminal *b* corresponding to the figure in the tens-column of the number in question, all the other terminals being disconnected.

Fig. 2 shows the extension of the principle illustrated in Fig. 1 to permit the control of the thousand numbers from "0" to "999," inclusive. This extension involves the employment of a number of additional magnets corresponding to the figures indicating the hundreds. In Fig. 2 the horizontal row of circles at the bottom indicates the ten electromagnets 0 to 9 which are reserved, as in Fig. 1, for the units of the numbers to be controlled. Thus the bar a^0 of Fig. 2 represents the terminals for the incoming wires of all lines whose numbers end in "0" -- "240," "320," &c. In like manner the vertical row of ten magnets 00 to 90 above the magnet 0 is reserved for the tens. Thus the electromagnet 00 is reserved for all the numbers in which the figure in the tens-column is "0," such as "100," "101," "307," &c., up to "909." Similarly, the vertical row of ten electromagnets 100 to 190 shown in line above the circle 1 is reserved for numbers in which the figure in the hundreds-column is "1." Similarly, the vertical row of ten magnets 200 to 290 shown in line above the circle 2 is reserved for the numbers having the figure "2" in the hundreds place, and so in like manner up to the vertical row 900 to 990, which includes the ten magnets reserved for numbers of which the figure in the hundreds place is "9." The total number of magnets shown in Fig. 2 is one hundred and ten. The several terminals *b* are connected with the outgoing wires of the circuits having the numbers (in units, tens, or hundreds, as the case may be) indicated immediately below the letters. Thus the terminal *b* of the electromagnet 450 is connected with the outgoing wires of the ten circuits numbered 450 to 459, inclusive. It may be remarked that the number of electromagnets involved in the control of one thousand numbers in the manner illustrated in Fig. 2 may be reduced to nineteen by providing ten independent windings for each of

the nine electromagnets corresponding to the hundreds -- 100 to 900, inclusive. In such case the ten independent windings of each magnet would be indicated by the ten circles in the vertical row. Thus the electromagnet 400 would have ten windings, which would be indicated diagrammatically by the ten circles in the vertical row above the circle 4. The magnet should be adapted in this case to be excited when any one of its windings is energized. If in any case the ten windings for a single magnet is considered undesirable, two or more magnets may be provided, with the windings distributed between them, it being sufficient if the connections are as indicated in the diagram. An apparatus having only nineteen electromagnets arranged as above explained is capable of controlling the thousand numbers from "0" to "999," inclusive. It is simply necessary to cause the current to enter at that one of the terminals *a* whose exponent indicates the figure in the units place of the number and to have the current leave by that one of the several terminals *b* which corresponds to the figures in the hundreds and tens places, the other terminals of the apparatus being disconnected. The connections between the electromagnets of Fig. 2 are such that when the current passes between any two terminals selected as above mentioned the only electromagnets traversed by this current are those which represent the figures of units, tens, and hundreds of the number in question. Thus to control No. 47 the current should enter at a^7 and leave at b^{40-49} . To control the number "738," the current should enter at a^8 and leave by $b^{730-739}$, and so on. To record any number, therefore, it is only necessary to connect the incoming and outgoing wires of the circuit to the two terminals *a* and *b*, respectively determined as above described. Given this method of selecting the magnets to control any number as above set forth, it is evident that a record can be made of this number by having the armatures of the several electromagnets selected actuate directly or indirectly a recording apparatus of any desired model. These electromagnets may, for instance, actuate the type-bars of a writing-machine in such a way as to produce the same effect as the finger of an operator in working an ordinary type-writer. The number of recording-levers or type-bars which would be actuated in recording any number would be only as many as there are digits in the number. Thus for the number "786" the recording-levers actuated would be those corresponding to the figure "6" of units, "8" of tens, and "7" of the hundreds.

The paper tape of the recording apparatus may, if desired, be arranged to travel continuously at a constant rate and may be provided with suitable guide-marks indicating time, so that the time of making any record

can be estimated from the relative place on the tape where the number appears, or the recording apparatus may be arranged so as to print the exact time when the number is printed, in which case the paper would be advanced only step-by-step as the records were made, as in ordinary writing-machines. The levers of the recording apparatus are arranged in three distinct groups d^1 d^2 d^3 , (see Fig. 3,) of which the group d^1 would represent units, d^2 tens, and d^3 hundreds. Recording-levers or type-bars of any group should be arranged to mark the paper at the place reserved thereon for units, tens, or hundreds, according to the group in question. Thus the actuation of any one of the ten type-bars 0 to 9 of the group d^1 marks upon the paper tape the figure occupying the place of units. Similarly, the actuation of one of the ten type-bars 00 to 90 of the group d^2 marks a corresponding figure in the tens place, and so the actuation of any one of the nine type-bars of the hundreds, 100 to 900 of the group d^3 , marks a corresponding figure in the hundreds place. The simultaneous actuation of one type-bar of each group produces the registration of a number of three figures corresponding to the particular type-bars of the three groups which are selected for actuation.

The mechanism of a recording apparatus adapted for control in accordance with my invention is illustrated diagrammatically in Fig. 4. A single drum e , which may be rotated by any suitable means, carries a paper tape n , upon which the figures are to be marked by the type-bars j . If the electromagnets of Figs. 1 and 2 are arranged to act directly upon these type-bars, the arrangement should be such as to reduce to the minimum the mechanical effort required to be produced by these electromagnets. The electrical and mechanical means for realizing this end are well known, and Fig. 4 is intended merely to suggest these means in a diagrammatic way. The type-bar j is shown in Fig. 4 as arranged to be actuated by a lever h , pivoted at h' and held against the tension of a spring i , by a detent g^2 , carried by the armature-lever g^1 of an electromagnet g . When the magnet g is energized, the exertion of a very slight attractive force upon its armature will serve to trip the lever h , which is thereupon rocked on its pivot by the spring i to actuate the type-bar j . The mechanism may be arranged to be automatically restored to its normal position by a magnet l , included in a local circuit controlled at contact k' , which is closed through the agency of the type-bar when said type-bar has struck the paper to make its mark. The type-bar j in the same movement which makes its mark actuates the lever k , which closes the contact k' . The magnet l being thus excited attracts its armature, which is carried by lever h , so restoring said lever to its normal position, in which it is held by the detent g^2 . As the type-

bar is retracted the contact k' is opened. The mechanism for advancing the cylinder e and the paper n step-by-step as each record is made is too well-known to require description. If the armatures of the electromagnets of Figs. 1 and 2 are arranged to control local circuits containing more powerful magnets, which act directly upon the recording-bars of the recorder, the dimensions of the controlling-magnets may be greatly reduced and they may be made sufficiently sensitive to respond to a very feeble current. Recording apparatus of very many different types may be arranged to be controlled by electromagnets connected as herein set forth.

Fig. 5 shows a modified form of recorder worked by clockwork mechanism. Three drums e may be provided similar to the drum e shown in Fig. 5, each drum including a controlling-wheel p of ten teeth (0 to 9, inclusive) and a type-wheel q , mounted to rotate therewith, having ten characters corresponding to and diametrically opposite the teeth of wheel p . The nine teeth of wheel p are in different vertical planes, each tooth being in position to be stopped by an electromagnetically-controlled detent r arranged in the same vertical plane. Thus the lever r actuated by the units-magnet is arranged to stop the tooth p marked "0," as shown in said Fig. 5. Each of the detent-levers may be arranged to be actuated by an electromagnet g , which may either be one of the magnets illustrated in Figs. 1 and 2 or a subsidiary magnet controlled thereby. The actuation of the electromagnet g results in interposing the detent in the path of the corresponding tooth p . At the same time the mechanism of the drum e may be released to permit the same to turn until it is stopped by the detent r which has been actuated. The type-wheel q is thus rotated until the character corresponding to the tooth so stopped is brought into position to mark the paper n , which may be arranged to be struck at a point immediately behind the type character. The three drums e should be released at the same time, so that the three figures of any number between "100" and "999" will be simultaneously printed. In this apparatus only a very slight force is necessary to actuate the levers r ; the whole force necessary for printing being furnished by the mechanism of the recorder.

Having described the recording apparatus and the means for controlling the same, I will proceed to indicate how it may be practically utilized in connection with the circuits of a telephone-exchange to count the number of connections established in the exchange.

Fig. 6 shows a line 1 2, connected with the spring-jack A at the central office. A key B is associated with each spring-jack and is adapted when actuated to connect the poles of a battery C in circuit with conductors 3 4

leading to the controlling apparatus of the recorder in the manner described in connection with Figs. 1 and 2—that is to say, the conductors 3 4 will be the incoming and outgoing wires referred to in the description and will be connected to a given pair of terminals in such a way as to control a given number corresponding to the number of the line. With this arrangement the operator can register a connection for any line by simply depressing the key B which corresponds to that line. A signal D is shown included in the circuit 3 4 to indicate the completion of the circuit and the proper actuation of the recorder when the key is depressed. Fig. 7 shows a similar arrangement adapted for use with a central-battery system. The parts such as the cut-off relay E and the line-relay F are well known. In this case when the key B is depressed the circuit 3 4 is completed through the windings of the line-relay, so as to cause a display of the line-signal D if the recorder-circuit is complete, as it should be.

In Fig. 8 I have shown a line 1 2 connected to a spring-jack A, the thimble whereof is connected to earth through the windings of a relay G, controlling the register-circuit 3 4. The third contact of the operator's plug H, which registers with the thimble of the jack when the plug is inserted to make connection with the line, forms the terminal of a circuit 5 6 from battery C, including a resistance H^2 . A key H' is adapted when depressed by the operator to complete a short circuit of the resistance H^2 , whereby increased current is permitted to flow in the circuit 5 6 7 8 to excite the magnet G. With this arrangement the operator registers a connection with any line by pressing the key H' , associated with the plug H, with which connection is made. The circuit 3 4 shown in this figure leads to the controlling-magnets of the recorder in the manner heretofore described.

Fig. 9 shows another modification, wherein the line 1 2 is connected at the central office through the normally closed contacts of a cut-off relay E to the poles of a central battery. When the plug H is inserted in the spring-jack A, the circuit from battery C is closed through the cut-off relay in a manner well known in the art. This cut-off relay E is arranged to act in two steps, according to the strength of the current applied, the first step serving simply to break the normal contacts, and the second step, taken when a stronger current is applied, serving to complete the circuit from battery C to conductors 3 4 at the front contacts of said cut-off relay. A resistance H^2 is included in the conductor 5 6 of the operator's plug-circuit, said resistance being adapted to cut down the current so that the relay E will only pull up its armatures through the first step, while said resistance

remains in the circuit. The operator is provided with a key H' , by which the resistance may be shunted to cause increased current to flow through the relay E, whereby the same is caused to close the recorder-circuit 3 4. In the arrangement of Fig. 9, as well as in that of Fig. 7, the circuit 3 4 is arranged to be completed through the line-relay, so that the line signal-lamp D will indicate the actuation of the recorder.

Fig. 10 shows how the key H' of Figs. 8 and 9 may be replaced by a relay K, interposed in the circuit from the ringing-generator controlled at the ringing-key L of an operator's plug-circuit and further controlled by the subscriber's telephone-switch in the usual way. Such a ringing-circuit associated with the connecting-plug H^3 and containing a relay responsive to the telephone-switch at the substation of the called line is well known in the art. In the arrangement shown the relay K attracts its armature K' when the called subscriber takes his telephone-receiver from its hook. The number of the calling subscriber is thus automatically recorded by the recorder upon the response of the called party. With this arrangement it is not necessary for the operator to actuate a special key H' to record the connection, but such record is made automatically upon the response of the called subscriber, no record being made, however, unless the two subscribers are actually placed in communication. The armature K' of the relay K controls a detent which is adapted to hold the ringing-key L in its depressed position, and when said relay K is excited it releases the ringing-key and at the same time closes at its front contact the short circuit about the resistance H^2 .

Whenever the record-circuit is closed in either of the ways heretofore described, the record is actuated to record the number of the calling subscriber upon the band of paper n , which thus shows a succession of numbers constituting a record of the lines over which calls have been transmitted. A single record and controlling mechanism will be sufficient for each operator's position. To count the number of calls chargeable to any one line, all that is necessary is to count the number of times that the number of the line in question appears upon the record. A record of this kind will also serve to show the work done by the operator during a given time.

Referring to Fig. 11, I have shown a complete telephone-exchange system comprising two telephone-lines 3 8 and 5, each extending in two limbs 1 2 from substations to the poles of a central battery. Each line has a spring-jack A at the central office, and a plug-circuit is provided for connecting said lines together through the medium of said spring-jacks, the central-office apparatus of each line being that illustrated in Fig. 9. The conduc-

tors 3 4 leading from the front contacts of the cut-off relay of line 38 are connected with the terminals of controlling-magnets 8 30, respectively, of the recorder. In a similar manner the conductors 3 4 leading from the front contacts of the cut-off relay of line 5 are connected with the terminals of magnet 5 of the recorder. Each cut-off relay is so arranged that when its circuit is closed by the insertion of a plug in the spring-jack of its line it will disconnect the line-signaling apparatus from the line, but owing to a resistance in such circuit will not receive sufficient current to bring its armatures into engagement with the contacts forming the terminals of conductors 3 4. The plug-circuit shown is similar to that already described in connection with Fig. 10 and is provided with a relay K responsive to the telephone-switch of the called subscriber and adapted when energized to close a shunt around the resistance in the circuit of the cut-off relay belonging to the calling-line, and so to complete the circuit of conductors 3 4 including the central battery and the controlling-magnets 30 and 8 to record the call.

I claim—

1. In a recording apparatus for telephone-exchanges, the combination with groups of electromagnets, each magnet corresponding to a particular figure, of a recording device controlled by each magnet to record the corresponding figure, a plurality of circuits, one for each telephone-line in the exchange, each including certain particular magnets which represent the figures of a distinctive number corresponding to the number of such line, the magnets in each circuit being selected from the several groups according to the respective digits in its number, and means for supplying current in any circuit to actuate the magnets thereof, whereby the corresponding number is recorded.

2. The combination with a group of telephone-lines, of a connection-recorder common to the group, comprising a number of electromagnets adapted for actuation singly or in sets or combinations, recording mechanism arranged to be actuated by said electromagnets, the record made being dependent upon the particular magnet or set of magnets selected, a circuit associated with each line adapted to determine the operation of a corresponding distinctive magnet or combination of magnets, and a switch for controlling said circuit to actuate said magnets, whereby each call from

any line is charged by recording the number of the line.

3. The combination with a group of telephone-lines terminating at a central switch-board, of switching devices for making connections, a connection-recorder common to the group, having electromagnets adapted to operate in different combinations to make corresponding distinctive records, a recorder-switch, a source of current, and a recorder-circuit for each line brought under the control of said switch in making connection with the line, each recorder-circuit including a distinctive combination of magnets, whereby a definite record distinguishing the connected line may be effected by the actuation of said switch during a connection.

4. The combination with a plurality of telephone-lines, of a recording device associated with and common to said lines, said device being adapted for selective actuation, electromagnetically-actuated mechanism for operating the recording device, and means associated with each line for applying current to said electromagnetic mechanism, whereby the recording device may be selectively actuated to effect a distinctive record for each of the lines with which it is associated.

5. The combination with a plurality of telephone-lines, of a circuit associated with each line and a switch for controlling the same, a group of electromagnets, each circuit including one or more of said magnets to form distinctive combinations, type-bars controlled by said magnets, and a tape upon which each type-bar when actuated by its controlling-magnet is adapted to imprint a characteristic indication, whereby the calls of a number of lines are selectively recorded upon a single recording device.

6. The combination with a plurality of telephone-lines, of an electromagnetic recording device permanently associated with and common to said lines, said device being adapted to be selectively actuated to make a distinctive record for each of the lines, and means associated with each line for bringing about the actuation of the recording device to effect the record peculiar to that line.

In witness whereof I hereunto subscribe my name this 10th day of June, A. D. 1903.

HENRI EMILE ALPHONSE ANDRÉ.

Witnesses:

J. ALLISON BOWEN,
H. PLANCHER.