Dec. 16, 1941. U. KESTEN 2,266,215

TELEPHONE SYSTEM

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*Fig. 1.*

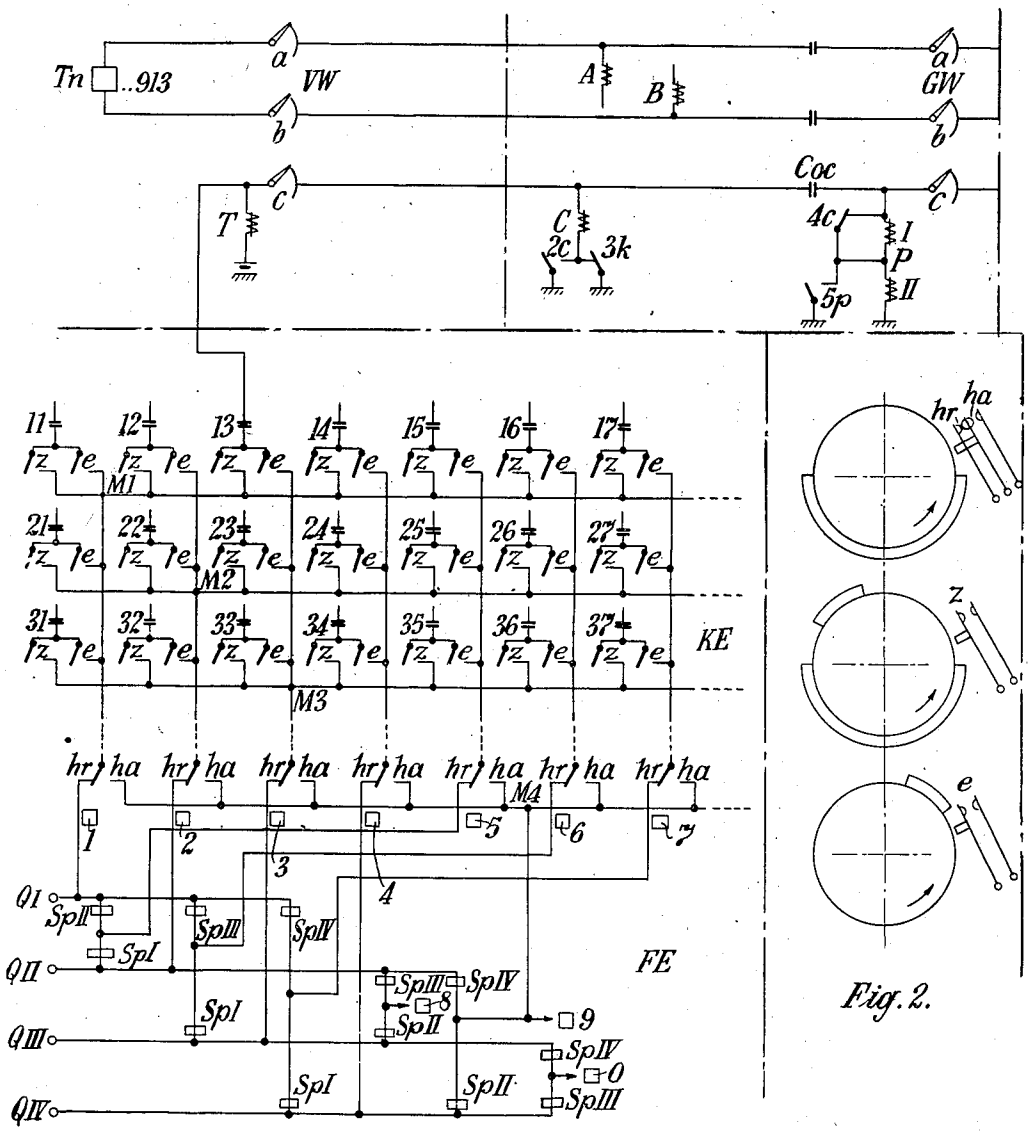





*Fig. 2.*

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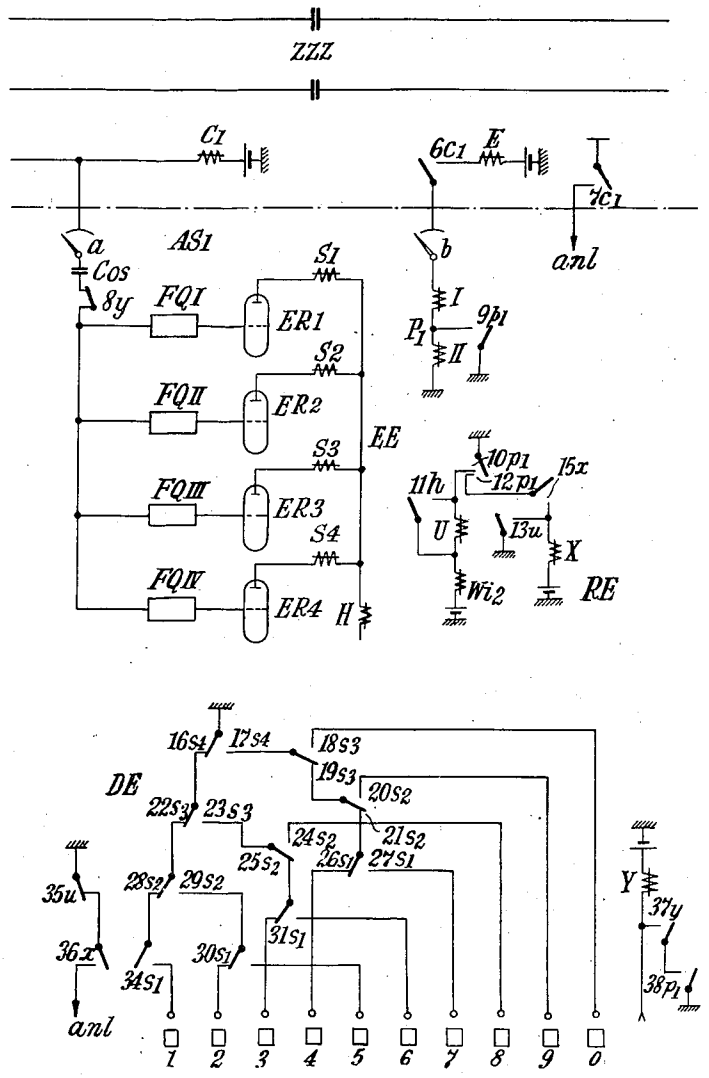
*Fig. 3.*

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# UNITED STATES PATENT OFFICE

2,266,215

## TELEPHONE SYSTEM

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13 Claims. (Cl. 179—27)

The present invention concerns circuit arrangements for remote signalling systems, especially telephone systems, for marking the calling subscriber's station.

Such marking is necessary, for example, if it is desired to produce automatically an account ticket by means of a central recording device at the exchange recording the number of the calling subscriber in addition to other data (number of called party, value of the connection, time, date etc.)

It is possible in known apparatus of this kind, when the time for recording the number of the calling subscriber occurs to identify the calling subscriber by a test device and then to transmit to the central recording device by an adjoining impulse sending apparatus suitable series of impulses corresponding to the individual digits of the calling number.

This operation besides being complicated by inherent difficulties also takes a comparatively long time to carry out, during which time the device in question cannot be used for determining other calling numbers.

The object of the present application is to cut short, as far as possible, the time required for repeating the number of the calling subscriber and at the same time to make possible the determination of several calling numbers, for which end different A. C. frequencies or combinations of frequencies individual to each subscriber are connected for marking purposes to each subscriber's connecting device by which the subsequent recording device in the connecting arrangement is so operated that the recording element is set corresponding to the number of the calling subscriber concerned.

The drawings illustrate a particular embodiment of the invention in Figs. 1, 2 and 3. All switch apparatus and circuit arrangements which are not necessary for the complete explanation of the invention are omitted on the grounds of simplicity and clarity.

In the upper parts of Figs. 1 and 3 a schematic connecting path is shown. A subscriber T*n* on lifting his receiver is connected through the preselector VW associated with the subscriber to a free group selector GW. After the group selector has been set by the required numbers of impulses series being sent out by the subscriber a repeater for time zone metering is connected. The subsequent connecting steps, by which the calling subscriber obtains the required station are not shown. The calling subscriber is supplied with current in the usual manner over relays A and B in the group selector. The cut-off relay T is energised, and initiates known operations which are not further shown. Relay C is energised in the group selector over wiper *c* of the pre-selector and an off-normal contact 3*k* which is closed as long as the group selector is in its zero position, and holds over its own contact 2*c* during the connection independently of the off-normal contact. At contact 4*c* the short circuit of winding I of the test relay P is removed.

The test and locking conductors between the pre-selector and group-selector and group selector and repeater are, for the purpose of the following invention, connected together by the condenser C*oc*.

When the group selectors are set on a free repeater ZZZ a test circuit is established over wiper *c* of the group selector, in which both windings of test relay P in the group selector and seizing relay C*l* in the repeater are energised. Contact 5*p* closes and short circuits the high resistance winding II of relay P so that, in known manner, the free repeater selected is locked against further seizing. At contact 7*cl*, a start circuit for the finder switch AS*l* is completed so that the finder switch is stepped-on, until it has found the line in which relay C is energised. The following circuit is then completed: earth, battery, winding of relay E, contact 6*cl*, wiper *b* of the finder switch AS*l*, windings I and II of relay P*l*, earth. Contact 9*pl* closes and short circuits the high resistance winding II of relay P*l*. The following circuit is completed by contact 10*pl*: earth, contact 10*pl*, winding of relay U, resistance W*i*2, battery, earth. Relay U is energised in this circuit and at contact 13*u* switches in relay X. At contact 35*u* earth potential is disconnected, in the marking device DE, from a start conductor leading to an assessor switch.

The recording device is now ready to receive the marking signal corresponding to the number of the calling subscriber and, in known manner, to operate the type-wheel of the printing apparatus.

The apparatus for marking the calling subscriber is indicated in Fig. 1. It is assumed that a marking device is provided for each of 100 subscribers. It consists of a transmitting or contact device KE and a frequency generator FE, which is able to generate frequencies singly and in different combinations. This frequency generator may naturally be connected in common for all transmitting devices. With each subscriber are associated two contacts of the contact device KE, a contact *z* for marking the

tens position and a contact *e* for marking the units position. The contacts associated with the subscriber are connected over a condenser to the wiper *c* of the preselector of the subscriber concerned. It is assumed that the subscriber Tn concerned has a number the last three digits of which are "913." The wiper *c* of the preselector of this subscriber is accordingly connected to the condenser associated with the digits "13."

The frequency generator is so arranged that four different frequencies QI to QIV may be generated by it, singly or combined one with the other.

For marking the digit 1 frequency QI is used,
For marking the digit 2 frequency QII is used,
For marking the digit 3 frequency QIII is used,
For marking the digit 4 frequency QIV is used,
For marking the digit 5 a mixture of frequencies QI+QII is used,
For marking the digit 6 a mixture of frequencies QI+QIII is used,
For marking the digit 7 a mixture of frequencies QI+QIV is used,
For marking the digit 8 a mixture of frequencies QII+QIII is used,
For marking the digit 9 a mixture of frequencies QII+QIV is used.
For marking the digit 0 a mixture of frequencies QIII+QIV is used.

Separate blocking circuits are provided (SpI, SpII, SpIII and SpIV) in the frequency generator to separate the frequencies from each other. This means that the blocking circuit SpI blocks the frequency QI. In similar manner the blocking circuits SpII, SpIII and SpIV block the frequencies QII, QIII and QIV.

The frequency QI is connected over contact *hr* and the connection M1 to the contacts *z* of the subscribers with the tens position "1," i. e. subscribers 11, 12, 13 . . . 10. Further, frequency QI is connected over the same contact *hr* to the contacts *e* of the subscribers who have the digit "1" in the last position i. e. subscribers 11, 21, 31 . . . 01.

The frequency QII is connected over another contact *hr* and connection M2 to the contacts *z* of all subscribers whose penultimate digit is "2", i. e. subscribers 21, 22, 23 . . . 20. Further frequency QII is connected over the same contact *hr* to the contacts *e* of all the subscribers who have the digit "2" as a last figure.

Similar connections obtain for frequencies QIII and QIV.

The contacts *z* of all subscribers of the fifth series of tens, subscribers 51, 52, 53 . . . 50 (not shown) are connected to the frequency mixture QI+QII over another contact *hr* which, as already mentioned, characterises the digit "5". The same frequency is connected to the contacts *e* of all subscribers whose units number is the digit "5"; subscribers 15, 25, 35 . . . 05. The contacts of the other subscribers are wired to the different frequencies or mixtures of frequencies in a manner which is apparent without further explanation.

While contact *z* marks the tens position and contact *e* the units position of the calling number, marking for the hundreds position of the calling number takes place over the working contact *ha*. The connection for all the contacts *ha* is connected, in the embodiment, over junction point M4 to the marking device for the digit "9", i. e. with the frequencies mixture QII+QIV.

All contacts *z*, *e*, *hr* and *ha* are controlled in the necessary timing by a machine which is permanently running or is set in motion on a connection being set up. The contacts are operated separately as Fig. 2 shows. By tappet-discs or cylinders mounted on an axis and turning in an anti-clockwise sense all contacts *hr* are opened simultaneously and then all contacts *ha* together with all contacts *z* are closed. The frequency or mixture of frequencies required for the marking of the hundreds position of the calling number is connected over one of the contacts *ha* and one of the contacts *z* to the wiper *c* of the subscriber's preselector. After a half turn (e. g. about 250 milli-secs) of the plate or cylinder the contacts *ha* and *z* are again opened. A pause of about 20 ms. follows. Then contacts *z* alone are closed for about 50 ms. The frequency or mixture of frequencies necessary for marking the tens position of the calling subscriber's number is connected over the operated contacts *z* and the next contacts *hr* to the single preselector wiper *c*. A pause of about 50 ms. again follows and thereupon likewise for about 50 ms. all contacts *e* are closed. The frequency or mixture of frequencies for marking the units position of the calling subscriber's number is connected over the operated contacts *e* and rest contacts *hr* to the preselector wiper *c*.

The first impulse for marking the hundreds position is made longer (about five times as long) than the tens and units impulse to ensure a trouble-free recording of the calling number. The long impulse serves, as will be explained subsequently, to make the recording device ready to receive the frequency or mixture of frequencies associated with the calling number. Thus the recording of the separate positions of the calling number in the right order is ensured.

In the following example it is assumed that the subscriber's (Tn) number has its last three positions given by the digits "913". The wiper *c* of the preselector of the subscriber shown is connected to the condenser characterized by the digits "13".

When the initial impulse begins, i. e. when the contacts *ha* and *z* are closed, the frequency mixture QII+QIV is connected to the wiper *c* of the preselector for marking the digit "9": wiper *c* of the preselector, condenser 13, contact *z*, connection M1, first contact *ha*, connection M4, mixture of frequencies QII and QIV. After an interval contact *z* alone is operated. Frequency QI is then connected to the wiper *c* of the preselector of the subscriber: wiper *c* of the preselector, condenser 13, contact *z*, connection M1, first contact *hr*, frequency QI. The tens position is marked thereby by the digit "1". After a further interval contact *c* is closed. Thereby, frequency QIII is connected to the wiper *c* of the preselector: wiper *c* of the preselector, condenser 13, contact *e*, connection M3, contact *hr*, frequency QIII. The units position of the calling number is thereby marked by the digit "3".

The recording apparatus RE is connected, as already explained, to the selected repeater by the seizing of the repeater ZZZ by the finder switch AS1. Thereby relays U and X are energised after relay P1 energises. Four frequency filters FQI, FQII, FQIII, FQIV are now connected to the test and locking conductors of the repeater, over which the frequencies are repeated. They are, since frequency filters are known, shown but schematically. The frequency filter FQI trans-

mits only frequency QI and blocks all other frequencies. Similarly frequency filter FQII transmits only the frequency QII, frequency filter FQIII transmits only the frequency QIII and frequency filter FQIV transmits only frequency QIV. Each frequency filter is connected to the grid of a valve ER1, ER2, ER3, ER4 while each anode of the valves is connected to one of the relays S1, S2, S3 and S4. All of these relays are connected to the winding of a relay H which has earth connected to the other end of its winding.

If a frequency or mixture of frequencies is sent from the marking device over the locking conductor, one or two of the relays S1 to S4 responds, simultaneously relay H is energised. Relay H closes its contact 11*h* and short circuits the winding of relay U. If the impulse sent from the marking apparatus over the locking conductor is only 50 ms. long, as long as the tens and units impulses, the short circuit of relay U is not sufficient to cause its de-energisation. If the long initial impulse arrives first relay U is de-energised on being short circuited. Contact 35*u* closes and a start impulse is sent, over contact 36*x* which is already closed, to an assessor switch which in known manner (not shown) is stepped over the contacts of its contact bank until it finds earth potential over the required contacts of the relays S1 to S4. Simultaneously with the assessor switch the type-wheel of a printing device is set, in a manner not shown here, on a required digit.

If the frequency QI is sent from the marking device and therewith relay S1 in the registering apparatus RE is energised, contact 1 in the assessor switch contact bank is connected to earth over contacts 16*s*4, 22*s*3, 28*s*2 and 34*s*1. After the first step the assessor switch comes to rest and the cypher "1" is recorded.

If the frequency QII is sent (relay S2 energised), contact 2 in the assesor switch contact bank is connected to earth potential over contacts 16*s*4, 22*s*3, 29*s*2 and 30*s*1. If the frequency QIII is sent (relay S3 energised) contact 3 is marked over contacts 16*s*4, 23*s*3, 25*s*2, 31*s*1, while if frequency QIV is sent and relay S4 responds, contact 4 in the assessor switch contact bank is marked over contacts 17*s*4, 19*s*3, 21*s*2 and 26*s*1. If the frequency mixture QI and QII is sent and relays S1 and S2 are energised, contact 5 of the assessor switch contact bank is marked over contacts 16*s*4, 22*s*3, 29*s*2 and 33*s*1. If the frequency mixture QI+QIII is sent (relays S1 and S3 energised) contact 6 of the assessor switch contact bank is connected with earth potential over contacts 16*s*4, 23*s*3, 25*s*2, and 32*s*1. The frequency mixture QI+QIV controls the two relays S1 and S4 so that contact 7 of the assessor switch contact bank is marked over contact 17*s*4, 19*s*3, 21*s*2, 27*s*1. If frequency mixture QII+QIII (relays S2 and S3 energised) is sent, contact 8 of the assessor switch contact bank is connected with earth potential over contacts 16*s*4, 23*s*3 and 24*s*2. The frequency mixture QII+QIV controls relays S2 and S4 so that contact 9 of the assessor switch contact bank is marked over contacts 17*s*4, 19*s*3 and 20*s*2, while, finally, if frequency mixture QIII+QIV is sent and relays S3 and S4 respond, the contact 0 in the assessor switch contact bank is connected with earth potential over contacts 17*s*4 and 18*s*3.

If the frequency mixture QII+QIV is now connected to the locking conductor, for the purpose of marking the number of the subscriber concerned, the digit 9 is marked in the recording device over contacts of the relays S2 and S4. It is repeated by the assessor switch to a type-wheel and, in known manner, printed. Thereupon the frequency QI which controls relay S1 in the recording device is connected for the tens digit, so that the digit "1" is set in the printing device by the assessor apparatus. Now the frequency QIII which energises the relay S3 in the recording apparatus RE is connected for marking the units digit so that the type-wheel is set on the digit "3" by the assessor switch.

The operations for setting the assessor switch and type-wheels are not necessary for a full disclosure of the invention and are not described in detail. It is only mentioned, that it is necessary to provide an arrangement to match the operation of the assessor switch with the operation the contact device KE or the speed of the contact device with the mode of working of the assessor switch.

When the number of the calling subscriber is marked, a signal is sent from the printing device by which relay Y is energised. Relay Y holds itself energised for the duration of the connection in the circuit: earth, battery, winding of relay Y, contacts 37*y*, 38*p*1, earth. Contact 8*y* opens and the receiving apparatus EE is disconnected from the locking conductor of the repeater so that further closing of contacts in the marking device is without effect on the recording device shown.

The disconnection of the call and the apparatus illustrated is without significance to the invention and is therefore not shown.

Another embodiment may be shortly described. Instead of marking the single positions of the calling number one after the other by a contact device, by omission of the contact device, a different continuous combination of frequencies for each subscriber is connected to the preselector. For 100 subscribers however 20 different frequencies must be provided of which 10 must be thought of as ordinates and 10 as abscissae. The combination abscissae frequency and ordinate frequency is different for each subscriber. The receiving apparatus must then be so arranged, that the 20 frequencies are separate and for each subscriber individual marking is arranged. Having regard to the complication of the receiving and marking devices and the fact that several frequencies have to be provided it appears that the former arrangement is simpler and is preferable.

I claim:

1. In a telephone system, a group of lines, switching apparatus, a line switch for each of said lines, means for placing a calling condition on one of said lines to thereby operate the line switch therefor to seize said switching apparatus, means for thereafter controlling said switching apparatus to establish a connection, a predetermined number of sources of different alternating current frequencies, means for connecting certain of said sources individually or in combinations to said line switches to thereby transmit the telephone number of the line associated with each of said line switches, and means associated with said switching apparatus responsive to said connection and operative in response to the connection of said individual sources or combinations thereof to said line switch involved in said connection for registering the telephone number of said line having a calling condition thereon.

2. In a telephone system, a calling line, a called line, switching apparatus for setting up a connec-

tion between said lines, means associated with said switching apparatus for transmitting certain alternating current frequencies or combinations of frequencies indicative of said calling line telephone number, translating means associated with said switching apparatus operated in response to said transmission for producing a registration of said calling line telephone number.

3. In a telephone system, a group of lines, an individual switch terminating each of said lines, switching apparatus accessible to said switches, means responsive to a call on any one of said lines for operating the switch individual thereto to thereby seize said switching apparatus, means for thereafter operating said switching apparatus to extend a connection, means for transmitting coded alternating current pulses to each of said individual switches indicative of the individual telephone numbers of the lines connected thereto, and means temporarily associated with said switching apparatus responsive to the extension of said connection for translating the coded pulses received over the individual switch involved in said connection into numerical digits indicative of the telephone number of the calling line involved in said connection.

4. In a telephone system, a group of lines, an individual switch terminating each of said lines, switching apparatus accessible to said switches, means responsive to a call on any one of said lines for operating the switch individual thereto to thereby seize said switching apparatus, means for thereafter operating said switching apparatus to extend a connection, means for transmitting a predetermined number of pulses of alternating current to each of said individual switches, each pulse transmitted being indicative of a digit of the telephone number of a plurality of the lines connected to said individual switches, and means temporarily associated with said switching apparatus operated by said impulses for registering the telephone number of the calling line involved in said connection.

5. In a telephone system, a group of lines, an individual switch terminating each of said lines, switching apparatus accessible to said switches, means responsive to a call on any one of said lines for operating the switch individual thereto to thereby seize said switching apparatus, means for thereafter operating said switching apparatus to extend a connection, means for continuously transmitting alternating current pulses to said individual switch indicative of the telephone number of the line connected thereto, and means temporarily associated with said switching apparatus operative by said pulses in response to the extension of said connection for registering the telephone number of the calling line involved in said connection.

6. In a telephone system, a group of lines, switching apparatus, an individual switch for each of said lines operative in response to the initiation of a call by a subscriber thereon for connecting the said line with said switching apparatus, means for operating said apparatus to thereby establish a connection with a desired called line, means common to said group of lines for transmitting alternating current pulses to each of said individual switches indicative of the telephone number of the line connected thereto, each pulse transmitted being indicative of one of the digits of the telephone number of the line connected thereto, and means temporarily associated with said switching apparatus operative in response to said alternating current pulses transmitted to said individual switch involved in said connection for registering the digits of said calling line telephone number for the purpose of controlling a recorder to thereby record said calling line telephone number.

7. In a telephone system, a plurality of lines, switching apparatus for extending connections from said lines, means common to said lines for simultaneously connecting alternating current signals to each of said lines indicative of the telephone number therefor, and means temporarily associated with said switching apparatus responsive to a connection and operative in response to the signals transmitted to the line involved in said connection for registering said line telephone number.

8. In a telephone system, a plurality of subscribers' lines, an individual line switch terminating each of said lines, means for extending a call from any one of said lines over a connection including the lineswitch individual thereto, translating means temporarily associated with said connection, means associated with said line switches for transmitting alternating current pulses over said lineswitch involved in said connection to said translating means, the number of said pulses corresponding to the number of digits in the telephone number of the line associated with said lineswitch, and means controlled by said translating means for registering the digits of the telephone number of said line involved in said connection.

9. In a telephone system, a group of lines, an individual switch terminating each of said lines, switching apparatus accessible to said switches, means responsive to a call on any one of said lines for operating the switch individual thereto to thereby seize said switching apparatus, means for thereafter operating said switching apparatus to extend a connection, means for repeatedly transmitting a predetermined number of pulses to said individual switch corresponding to the telephone number of the line connected thereto, each pulse transmitted being indicative of one of the digits of the telephone number of the line connected thereto, and means temporarily associated with said switching apparatus operated by the transmitted pulses in response to the extension of said connection for registering the telephone number of the calling line involved in said connection.

10. In a telephone system, a group of lines, an individual switch terminating each of said lines, switching apparatus accessible to said switches, means responsive to a call on any one of said lines for operating the switch individual thereto to thereby seize said switching apparatus, means for thereafter operating said switching apparatus to extend a connection, means connected to each of said individual switches for repeatedly transmitting impulses of current corresponding to the individual telephone numbers of the lines connected thereto, said impulses being equal in number to the number of digits of a subscriber's telephone number, and means temporarily associated with said switching apparatus in response to the extension of said connection controlled by said impulses for registering the telephone number of the calling line involved in said connection.

11. In a telephone system, a group of lines, switching apparatus accessible to said lines, means for repeatedly transmitting signals indicative of the telephone number of each of said lines, said signals comprising a plurality of im-

pulses of current for each telephone number and only a single impulse of current for each digit of a number, means operative responsive to a call on any one of said lines for seizing said switching apparatus, means for thereafter operating said switching apparatus to extend a connection from said calling line, whereby the signals indicative of said calling line telephone number are repeatedly transmitted over said connection, a registering device, means operative in response to said connection for associating said registering device with said connection to thereby register the telephone number of said calling line, and means operated in response to a single registration of said telephone number for disassociating said registering device from said connection whereby the signals repeatedly transmitted over said connection are ineffective.

12. In a telephone system, subscribers' lines, means for extending a connection from a calling one of said lines, automatic means repeatedly transmitting impulses of current coded so that each impulse represents one of the digits of the telephone number of said calling subscriber's line, means associated with said connection for translating the coded impulses representing the digits of the telephone number of said calling line into numerical digits for recording purposes.

13. In a telephone system, a subscriber's line, means for extending a connection from said line, means for repeatedly transmitting impulses of current coded so that each impulse represents a digit of the telephone number of said line, and means associated with said connection for translating said coded impulses into a numerical telephone number for recording purposes.

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