

PATENT SPECIFICATION

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DRAWINGS ATTACHED.

Inventor: —NORMAN CAROL SMART.

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COMPLETE SPECIFICATION.

Improvements in or relating to Automatic Telephone Systems.

We, GENERAL ELECTRIC COMPANY LIMITED, of Magnet House, Kingsway, London, W.C.2, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to automatic telephone systems.

The invention is particularly concerned with automatic telephone exchanges having arrangements for identifying the telephone stations of calling subscribers.

It is an object of the present invention to provide an automatic telephone exchange with an improved arrangement for identifying the telephone stations of calling subscribers.

According to the present invention, in an automatic telephone exchange there are provided a number of conductors which are associated with a plurality of subscriber's line circuits of the exchange, pulse generating means which is operable to supply electric pulses to said conductors so that each conductor receives a predetermined number of pulses that is characteristic of that conductor, a plurality of control leads which are associated with said line circuits and a plurality of electric pulse counting means which are each arranged to count electric pulses supplied to a different one of said control leads, and each of said line circuits is provided with individual switching means which is operable to connect said control leads to predetermined ones of said conductors, said pulse generating means being arranged to operate after any one of said switching means is operated and the arrangement being such that the number of pulses registered by any particular one of said

counting means subsequent to the operation of the said switching means of any said line circuit characterises the value of a numerical digit in the directory number of the subscriber's line served by that line circuit and this particular one of said counting means characterises the position of this numerical digit in said directory number.

In a preferred arrangement, there are ten said conductors and said pulse generating means is arranged to supply one, two, three, four, five, six, seven, eight, nine and ten electric pulses to those ten conductors respectively upon the operation thereof. Each said pulse counting means has a normal condition and ten off-normal conditions and is arranged to attain these eleven conditions in sequence, one at a time, in response to the supply thereto of electric pulses, the arrangement being such that any particular one of these conditions is re-attained every eleven pulses. Each said pulse counting means is provided with an output circuit and off-normal contacts which are arranged to be closed in every said condition thereof excepting said normal condition, and after any said registration of pulses by said pulse counting means further electric pulses are arranged to be supplied to each said pulse counting means and to its associated output circuit by way of its said off-normal contacts, the arrangement being such that in response to said further pulses each said counting means is restored to its said normal condition and each said output circuit receives a number of those further pulses that is the complement with respect to eleven of the number of pulses originally registered by its associated pulse counting means. There is a separate control lead for each numerical digit of the exchange numbering scheme and

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the said switching means of any said line circuit is arranged so that upon its operation, it connects the control lead corresponding to any particular numerical digit to that one of said conductors which is arranged to be supplied with "N" electric pulses by said pulse generating means where "N" is either equal to or is the complement with respect to eleven of that particular numerical digit in the directory number of the subscriber's line served by that line circuit.

Each of said pulse counting means may comprise an electromagnetic step-by-step switch.

Preferably said switching means comprises an electromagnetic relay which is arranged to be operated in response to the supply of a predetermined signal to a supervisory conductor, for example, the private wire, of its subscriber's line circuit and which is adapted through contacts thereof to connect said control leads to the appropriate ones of said conductors upon its operation.

The said pulse counting means may be associated with recording means which is arranged to produce a record of the values of the numerical digits characterised by the numbers of pulses registered by those counting means subsequent to the operation of the said switching means of any one of said line circuits. This recording means may include perforating means which is arranged to punch holes in a tape or card according to a predetermined pattern which represents the values of said numerical digits.

The said pulse counting means may be associated with a number of indicator means which are each arranged to provide a visual indication of the value of the numerical digit characterised by the number of pulses registered by the associated one of said counting means subsequent to the operation of the said switching means of any one of said line circuits.

An automatic telephone exchange in accordance with the present invention will now be described by way of example with reference to the three figures of the drawings accompanying the Provisional Specification in which:—

Figure 1 shows part of the exchange schematically;

Figure 2 shows part of the electric circuit of a junction relay set that is represented in block form in Figure 1; and

Figure 3 shows the electric circuit of control apparatus that is represented in block form in Figure 1.

Referring to the Figure 1, the telephone exchange includes an arrangement to enable any subscriber's station (not shown) served by the exchange to be identified, for call accounting purposes, during a telephone trunk call originated from that station. In this arrangement, ten conductors 1 to 10

and a number of control leads 11, 12 and 13 equal to the number of numerical digits employed in the exchange numbering scheme are associated with the subscriber's line circuits of the exchange of which only the line circuit 14 is shown. The conductors 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 correspond to the values '1', '2', '3', '4', '5', '6', '7', '8', '9' and '0' respectively for these numerical digits.

The subscriber's line circuit 14, like each of the other line circuits (not shown) of the exchange, has positive and negative wires 15 and 16 which are connected to the two line wires respectively of its associated subscriber's line 17, and a private wire 18, the so-called P-wire. This P-wire is arranged to be connected to earth potential by way of a rectifier element 19 in series with the winding 20 of an electro-magnetic relay ND when the line circuit is taken into use. The rectifier element 19 is poled to conduct only when the voltage of the P-wire 18 is positive to earth potential.

The relay ND has three sets of contacts ND1, ND2 and ND3 which are arranged to close when the relay is operated. These contacts ND1, ND2 and ND3 are connected between the control leads 11, 12 and 13 and the particular ones of the conductors 1 to 10 that correspond to the values of the units, tens and hundreds digits respectively of the telephone number allocated to the subscriber's station (not shown) which is connected to the line 17. It has been assumed that the numerical digit portion of this telephone number is five hundred and thirty-seven. Thus the contacts ND1, ND2 and ND3 are connected to the conductors 7, 3 and 5 respectively.

The conductors 1 to 10 are connected to control apparatus 21 which forms part of the said arrangement. The control leads 11, 12 and 13 are each multiplied to a plurality of junction relay sets of the exchange of which only the junction relay set 22 is shown. These junction relays sets 22 and the like provide access to junction circuits (not shown) of the exchange for trunk traffic originating from the subscriber's stations of the exchange. The connection of any subscriber's line 17 or the like to a junction relay set 22 or the like is facilitated by first selectors of the exchange which, it will be assumed, are two-motion selectors and of which only the selector 23 is shown.

Each junction relay set of the exchange, for example the relay set 22, is connected to the control apparatus 21 by four conductors 24, 25, 26 and 27 and is also connected over further conductors 28, 29, 30, 31, 32 and 33 to tape perforating apparatus (not shown) which is associated with all the junction relay sets 22 and the like. The conductors 25, 26, 31 and 33 are individual

to the relay set 22 while the conductors 24, 27, 28, 29, 30 and 32 are multiplied to all the relay sets 22 and the like.

As will be hereinafter described, the conductors 24 to 27 are employed for signalling between the junction relay set 22 and the control apparatus 21 when, during a telephone trunk call set up by way of that relay set, it is required to establish the identity of the calling subscriber's station. The conductors 28 to 33 are thereafter employed for signalling between the junction relay set 22 and the said perforating apparatus so that a record of the identity of that subscriber's station is produced by that perforating apparatus.

The part of the electric circuit of each of the junction relay sets 22 and the like that is associated with the control leads 11, 12 and 13 and is included in the said arrangement is as shown for the relay set 22 in Figure 2. Referring to this figure, three electromagnetic step-by-step switches, U, D and C are associated with the control leads 11, 12 and 13 respectively. The windings 34, 35 and 36 of these switches U, D and C normally are connected between earth potential and the conductors 30, 29 and 28 respectively by contacts ID2, ID3 and ID4 of an electromagnetic relay ID. These contacts ID2, ID3 and ID4 are arranged to connect the windings 34, 35 and 36 between earth potential and the control leads, 11, 12 and 13 respectively when the relay ID is operated.

Each of the switches U, D and C has a normal condition and ten off-normal conditions and is arranged so that, commencing at said normal condition, a different one of said off-normal conditions is attained for each number of electric current pulses up to ten that is supplied to its windings 34, 35 or 36 and said normal condition is re-attained as the result of the supply of eleven electric current pulses to that winding. Each switch U, D or C has off-normal contacts U1, D1 or C1 which are arranged to be open only when that switch is in its normal condition. These contacts U1, D1 and C1 are connected between the conductor 31 and the conductors 30, 29 and 28 respectively.

The junction relay set 22 has a private wire (P-wire) 37 which is arranged to be connected to earth potential by contacts B of an electromagnetic relay (not shown) which is operated when the relay set is taken into use. The connection between this P-wire 37 and earth potential also includes contacts ID1 or the relay ID that are arranged to apply a positive potential to earth to this P-wire in place of earth potential when this relay is operated.

The conductors 24 and 25 are arranged to be connected to earth potential upon the actuation of contacts X1 and X2 of an electromagnetic relay X (not shown) in the

relay set 22. The conductor 26 is connected to the negative terminal of a battery 38 by way of the winding 39 of the relay ID. The positive terminal of this battery 38 is connected to earth potential. A circuit comprising the winding 40 of an electromagnetic relay RS in series with normally open contacts ID5 of the relay ID is connected between the conductor 27 and the negative terminal of the battery 38. An electromagnetic relay Y (not shown) has normally open contacts Y1 and Y2 connected between earth potential and the conductors 32 and 33 respectively.

Referring now to Figure 3, the circuit of the control apparatus 21 includes an electric pulse generator 41 to which the conductors 1 to 10 are connected. This pulse generator 41 has a start lead 42 and an output lead 43 and is arranged so that in response to the earthing of its start lead 42 it supplies one, two, three, four, five, six, seven, eight, nine and ten electric current pulses to the conductors 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 respectively whereafter it supplies a negative potential to earth to its output lead 43. This output lead 43 is connected to earth potential by way of the winding 44 of an electromagnetic relay PC and normally is also connected to earth potential by way of a resistor 45 and contacts TA1 of an electromagnetic relay TA. These contacts TA1 are arranged to break this latter connection and to connect earth potential to the start lead 42 upon the operation of the relay TA.

The control apparatus 21 also includes a uniselector switch AL having two wipers AL1 and AL2. The bank contacts 46 and the like of this switch AL that are associated with the wiper AL1 are individually connected to the conductors 25 and the like while the bank contacts 47 and the like of this switch that are associated with the wiper AL2 are individually connected to the conductors 26 and the like. It is arranged that the particular ones of the conductors 25 and the like and the conductors 26 and the like that are selected at any time by the wipers AL1 and AL2 are associated with the same one of the junction relay sets 22 and the like.

The wiper AL1 is connected to the negative terminal of a battery 48 by way of the winding 49 of a fast operating electromagnetic relay T. This terminal of the battery 48 is also connected to the conductor 24 by way of the winding 50 of an electromagnetic relay ST. The positive terminal of the battery 48 is connected to earth potential. Normally open contacts T2 of the relay T are connected between the wiper AL2 and earth potential. Normally open contacts PC1 of the relay PC are connected between the conductor 27 and earth potential.

Interrupter contacts 51 of the switch AL are connected in a series circuit which also

comprises the winding 52 of this switch, normally closed contacts TA2 of the relay TA, changeover contacts T1 of the relay T and normally open contacts ST1 of the relay ST. This series circuit extends between the negative terminal of a battery 53 which has its positive terminal earthed and earth potential, and is arranged so that the winding 52 is energised when the relay ST operates. The negative terminal of the battery 53 is also connected to the contacts T1 by way of the winding 54 of the relay TA which thus is arranged to be energised when the relays ST and T are both operated. A capacitor 55 is connected across the winding 54 of the relay TA which thus is arranged to be both slow to operate and to release.

The said tape perforating apparatus (not shown) has three groups of five tape perforating devices (not shown) that are associated with the conductors 28, 29 and 30 respectively. The perforating devices of each group are arranged to be operated in different combinations of two out of five for each number of electric current pulses up to ten that is supplied over the associated one of the conductors 28, 29 and 30. This perforating apparatus also includes an electric pulse generator (not shown) which is associated with the conductors 31 and the like that are individual to the junction relay sets 22 and the like and which is operable to supply a series of ten electric current pulses to any predetermined one of these conductors.

When a telephone trunk call is set up from any one of the subscriber's stations (not shown) of the exchange, the P-wire of the appropriate line circuit, for example the P-wire 18 (Figure 1) of the line circuit 14 is both connected to earth potential by way of the rectifier element 19 and the winding 20 of the relay ND and is extended through a first selector 23 or the like to the P-wire of the junction relay set 22 or the like that is employed for that call. Let it be assumed that this is the junction relay set 22. The contacts B (Figure 2) are actuated and since at this time the relay ID is not operated, the P-wire 37 and hence the P-wire 18 are connected to earth potential by the contacts ID1. The requirements to identify the calling subscriber's station is signalled in any suitable manner to the relay set 22 which is arranged so that the relay X (not shown) then operates.

Upon the relay X operating, the contacts X1 and X2 close to connect earth potential to the conductors 24 and 25. Assuming that at this time no other junction relay set (not shown) of the exchange is already causing earth potential to be connected to the conductor 24 then, in the control apparatus (Figure 3) the relay ST has its winding 50 energised.

The wipers AL1 and AL2 of the switch

AL occupy whatever position they attained when the control apparatus was last engaged by a junction relay set of the exchange. These wipers AL1 and AL2 may be positioned on their bank contacts 46 and 47 in which case the relay T has its winding 49 energised and operates before the relay ST operates. Assuming this not to be the case, then only the relay ST operates whereupon its contacts ST1 complete the series circuit whereby the winding 52 of the switch AL is energised by the battery 53. Because of the self-interruption of this circuit that is obtained by means of the interrupter contacts 51, the switch AL steps its wipers AL1 and AL2. When these wipers become positioned on their bank contacts 46 and 47 the relay T operates as the conductor 25 is earthed in the junction relay set 22.

Upon the relay T operating, its contacts T1 switch to disconnect the energising circuit of the winding 52 and to connect the winding 54 of the relay TA across the battery 53. Thus further stepping of the wipers AL1 and AL2 is prevented and the winding 54 is energised. The contacts T2 connect earth potential to the wiper AL2 and thence to the conductor 26.

After a predetermined delay obtained by means of the capacitor 55 the relay TA operates and its contacts TA1 switch to connect earth potential to the start lead 42 of the pulse generator 41. The contacts TA2 open to further disconnect the energising circuit of the winding 52 of the switch AL. The pulse generator 41 operates to supply electric current pulses as aforesaid to the conductors 1 to 10.

In the junction relay set 22 (Figure 2) the earthing of the conductor 26 causes the winding 39 to energise and the relay ID operates. The contacts ID1 switch to replace earth potential on the P-wire 37 by the positive potential to earth that is obtained by means of the battery 56. The contacts ID2, ID3 and ID4 switch to connect the windings 34, 35 and 36 of the switches U, D and C between the control leads 11, 12 and 13 respectively and earth potential. The contacts ID5 close to connect the winding 40 of the relay RS between the battery 38 and the conductor 27.

In the line circuit 14 (Figure 1) the application of the positive potential to earth to the P-wire 18 effects energisation of the winding 20 and the relay ND operates. The contacts ND1, ND2 and ND3 close to connect the conductors 7, 3 and 5 to the control leads 11, 12 and 13 respectively. It is after this that the relay TA (Figure 3) in the control apparatus 21 operates. Therefore the series of seven, three and five electric current pulses which are supplied by the pulse generator 41 (Figure 3) to the conductors 7, 3 and 5 respectively are supplied over the

contacts ND1, ND2 and ND3 and the control leads 11, 12 and 13 to the junction relay set 22. In the junction relay set 22 the switches U, D and C (Figure 2) register the said three series of pulses respectively and their off-normal contacts U1, D1 and C1 close.

When subsequent to the supply of electric pulses to the conductors 1 to 10, the pulse generator 41 (Figure 3) supplies a negative voltage to earth potential to its output lead 43, the winding 44 is energised and the relay PC operates. The contact PC1 close to connect earth potential to the conductor 27. Although this conductor 27 is connected to all the junction relay sets of the exchange the contacts in the relay set other than the relay set 22 that correspond to the contacts ID5 (Figure 2) are open. Therefore only the winding 40 of the relay RS (Figure 2) is energised. The relay RS has contacts (not shown) whereby it is arranged that the relay X (not shown) releases when the relay RS operates.

When the relay X in the junction relay set 22 (Figure 2) releases its contacts X1 and X2 open to disconnect earth potential from the conductors 24 and 25. Consequently, in the control apparatus (Figure 3) the relay T releases. The relay ST releases only if no other junction relay set of the exchange is awaiting access to the control apparatus. With the release of the relay T, the contacts T1 restore and disconnect the energising circuit for the winding 54 of the relay TA. The contacts T2 open to disconnect earth potential from the conductor 26.

After the predetermined delay obtained by means of the capacitor 55 the relay TA releases and its contacts TA1 disconnect earth potential from the start lead 42 of the pulse generator 41 and connect the resistor 45 across the winding 44 of the relay PC.

The contacts TA2 close and if the relay ST has been held operated or has been re-operated by another junction relay set the switch AL operates and its wipers AL1 and AL2 step to find this other relay set.

Upon the disconnection of earth potential from its start lead 42 the pulse generator 41 acts to disconnect the negative voltage to earth potential from its output lead 43. Therefore the relay PC releases and its contacts PC1 disconnect earth potential from the conductor 27.

In the junction relay set (Figure 2) the winding 39 is de-energised upon the disconnection of earth potential from the conductor 26 and the relay ID releases. The contacts ID1 reconnect earth potential to the P-wire 37. The contacts ID2, ID3 and ID4 reconnect the windings 34, 35 and 36 of the switches U, D and C between the conductors 30, 29 and 28 respectively and earth potential and the contacts ID5 disconnect the energising circuit of the winding 40 so that the relay

RS releases. It is arranged by means of contacts (not shown) of the relay RS that when this relay releases the relay Y (not shown) operates. The contacts Y1 and Y2 then close to connect earth potential to the conductors 32 and 33 and so signal to the said tape perforating apparatus (not shown) that the junction relay set 22 has information characterising the identity of the calling subscriber's station to be transferred to and recorded by that perforating apparatus. In this connection, the conductors 32 and 33 are connected to a similar circuit arrangement in the said perforating apparatus to that (Figure 3) which the conductors 24 and 25 are connected to in the control apparatus 21.

If the said tape perforating apparatus is not engaged by another of the junction relay sets (not shown) or when, having been so engaged, it is released, that perforating apparatus acts in response to the earth potential connected to the conductors 32 and 33 to connect its pulse generator (not shown) selectively to the conductor 31 and thereupon to operate that pulse generator. Of the ten electric pulses which are then supplied over the conductor 31 to the junction relay set (Figure 2) the first four are passed by the contacts U1 to the conductor 30 and to the winding 34 of the switch U which responds to those pulses. This switch U re-attains its normal condition in response to the fourth pulse so that the off-normal contacts U1 open to prevent the supply of the subsequent pulses to either the winding 34 or the conductor 30. Similarly the off-normal contacts D1 and C1 open after eight pulses and six pulses respectively. It is arranged by means of further off-normal contacts (not shown) of the switches U, D and C that the relay Y releases when all three of those switches re-attain the said normal condition so that the contacts Y1 and Y2 then open and enable the said tape perforating apparatus to be engaged by any other junction relay set requiring its services.

The series of four, eight and six pulses supplied over the conductors 30, 29 and 28 respectively to the said tape perforating apparatus (not shown) each effect the selection of a characteristic combination of two out of the associated group of five tape perforating devices (not shown). The selected perforating devices of each group then operate to punch holes at the appropriate two out of five positions across the width of a paper tape and so produce a record which characterises the numerical digits of the calling subscriber's station.

It will be appreciated that substantially the same result as is described above is obtained if the pulse generator 41 (Figure 3) in the control apparatus 21 is arranged to supply one, two, three, four, and so on electric pulses to the conductor 10, 9, 8, 7, 130

6, 5, 4, 3, 2 and 1 respectively. In these circumstances the number of electric pulses supplied to the said tape perforating apparatus (not shown) over any one of the conductors 28, 29 and 30 is then equal to the value of the numerical digit represented thereby whereas in the above example the number of pulses is the complement with respect to eleven of the value of this numerical digit.

In practice, each junction relay set 22 and the like will usually include further switches (not shown) which are arranged to register other information pertaining to a telephone trunk call such as the directory number, other than the first digit, of the called subscriber's station and the charge of the call. Usually this other information will be transferred to the said tape perforating apparatus at the same time as the information relating to the identity of the calling subscriber's station although this is not essential. When all information pertaining to a telephone trunk call set up by way of one of the junction relay sets 22 and the like is transferred simultaneously to the said tape perforating apparatus it is necessary to provide that apparatus with a separate group of tape punching devices for each item of that information.

In as much as the charge for a telephone trunk call invariably is dependent upon the duration of that call it is clear that information pertaining to the total charge for such a call is not available for transfer to the said tape perforating apparatus until the call is terminated. Consequently a junction relay set 22 or the like storing particulars of a telephone trunk call usually will be arranged to seek access to the said tape perforating apparatus (not shown) upon the termination of that call.

If visual indications of the values of the numerical digits characterised by the numbers of pulses registered by the switches U, D and C are required, the conductors 28, 29 and 30 may be connected to indicator means (not shown) arranged to provide these indications in response to the electric pulses supplied over these conductors. Alternatively, the switches U, D and C may comprise the driving means of three indicators (not shown) of the kind in which a numeral bearing band is arranged for movement by driving means to any one of eleven positions in each of which a different section of the numeral bearing surface of the band is at a predetermined display position.

WHAT WE CLAIM IS:—

1. An automatic telephone exchange wherein there are provided a number of conductors which are associated with a plurality of subscriber's line circuits of the exchange, pulse generating means which is

operable to supply electric pulses to said conductors so that each conductor receives a predetermined number of pulses that is characteristic of that conductor, a plurality of control leads which are associated with said line circuits and a plurality of electric pulse counting means which are each arranged to count electric pulses supplied to a different one of said control leads, and wherein each of said line circuits is provided with individual switching means which is operable to connect said control leads to predetermined ones of said conductors, said pulse generating means being arranged to operate after any one of said switching means is operated and the arrangement being such that the number of pulses registered by any particular one of said counting means subsequent to the operation of said switching means of any said line circuit characterises the value of a numerical digit in the directory number of the subscriber's line served by that line circuit and this particular one of said counting means characterises the position of this numerical digit in said directory number.

2. An automatic telephone exchange according to Claim 1 wherein there is a separate control lead for each numerical digit of the exchange numbering scheme and wherein the said switching means of any said line circuit is arranged so that upon its operation, it connects the control lead corresponding to any particular numerical digit to that one of said conductors which is arranged to be supplied with "N" electric pulses by said pulse generating means wherein "N" is either equal to or is the complement with respect to eleven of that particular numerical digit in the directory number of the subscriber's line served by that line circuit.

3. An automatic telephone exchange according to Claim 1 or Claim 2 wherein there are ten said conductors and wherein said pulse generating means is arranged to supply one two, three, four, five, six, seven, eight, nine and ten electric pulses to those conductors respectively upon the operation thereof.

4. An automatic telephone exchange according to Claim 1, Claim 2 or Claim 3 wherein each of said pulse counting means has a normal condition and ten off-normal conditions and is arranged to attain these eleven conditions in sequence, one at a time, in response to the supply thereto of electric pulses, the arrangement being such that any particular one of these conditions is re-attained every eleven pulses.

5. An automatic telephone exchange according to Claim 4 wherein each of said pulse counting means is provided with an output circuit and off-normal contacts which are arranged to be closed in every said con-



respect

6, 5, 4, 3, 2 and 1 respectively. In these circumstances the number of electric pulses supplied to the said tape perforating apparatus (not shown) over any one of the conductors 28, 29 and 30 is then equal to the value of the numerical digit represented thereby whereas in the above example the number of pulses is the complement with respect to eleven of the value of this numerical digit.

In practice, each junction relay set 22 and the like will usually include further switches (not shown) which are arranged to register other information pertaining to a telephone trunk call such as the directory number, other than the first digit, of the called subscriber's station and the charge of the call. Usually this other information will be transferred to the said tape perforating apparatus at the same time as the information relating to the identity of the calling subscriber's station although this is not essential. When all information pertaining to a telephone trunk call set up by way of one of the junction relay sets 22 and the like is transferred simultaneously to the said tape perforating apparatus it is necessary to provide that apparatus with a separate group of tape punching devices for each item of that information.

In as much as the charge for a telephone trunk call invariably is dependent upon the duration of that call it is clear that information pertaining to the total charge for such a call is not available for transfer to the said tape perforating apparatus until the call is terminated. Consequently a junction relay set 22 or the like storing particulars of a telephone trunk call usually will be arranged to seek access to the said tape perforating apparatus (not shown) upon the termination of that call.

If visual indications of the values of the numerical digits characterised by the numbers of pulses registered by the switches U, D and C are required, the conductors 28, 29 and 30 may be connected to indicator means (not shown) arranged to provide these indications in response to the electric pulses supplied over these conductors. Alternatively, the switches U, D and C may comprise the driving means of three indicators (not shown) of the kind in which a numeral bearing band is arranged for movement by driving means to any one of eleven positions in each of which a different section of the numeral bearing surface of the band is at a predetermined display position.

WHAT WE CLAIM IS: —

1. An automatic telephone exchange wherein there are provided a number of conductors which are associated with a plurality of subscriber's line circuits of the exchange, pulse generating means which is

operable to supply electric pulses to said conductors so that each conductor receives a predetermined number of pulses that is characteristic of that conductor, a plurality of control leads which are associated with said line circuits and a plurality of electric pulse counting means which are each arranged to count electric pulses supplied to a different one of said control leads, and wherein each of said line circuits is provided with individual switching means which is operable to connect said control leads to predetermined ones of said conductors, said pulse generating means being arranged to operate after any one of said switching means is operated and the arrangement being such that the number of pulses registered by any particular one of said counting means subsequent to the operation of said switching means of any said line circuit characterises the value of a numerical digit in the directory number of the subscriber's line served by that line circuit and this particular one of said counting means characterises the position of this numerical digit in said directory number.

2. An automatic telephone exchange according to Claim 1 wherein there is a separate control lead for each numerical digit of the exchange numbering scheme and wherein the said switching means of any said line circuit is arranged so that upon its operation, it connects the control lead corresponding to any particular numerical digit to that one of said conductors which is arranged to be supplied with "N" electric pulses by said pulse generating means wherein "N" is either equal to or is the complement with respect to eleven of that particular numerical digit in the directory number of the subscriber's line served by that line circuit.

3. An automatic telephone exchange according to Claim 1 or Claim 2 wherein there are ten said conductors and wherein said pulse generating means is arranged to supply one two, three, four, five, six, seven, eight, nine and ten electric pulses to those conductors respectively upon the operation thereof.

4. An automatic telephone exchange according to Claim 1, Claim 2 or Claim 3 wherein each of said pulse counting means has a normal condition and ten off-normal conditions and is arranged to attain these eleven conditions in sequence, one at a time, in response to the supply thereto of electric pulses, the arrangement being such that any particular one of these conditions is re-attained every eleven pulses.

5. An automatic telephone exchange according to Claim 4 wherein each of said pulse counting means is provided with an output circuit and off-normal contacts which are arranged to be closed in every said con-



- dition thereof excepting said normal condition, and wherein, after any registration of the number of pulses by said pulse counting means as aforesaid, further electric pulses are arranged to be supplied to each of said pulse counting means and to its associated output circuit by way of its said off-normal contacts, the arrangement being such that in response to said further pulses each of said counting means is restored to its said normal condition and each of said output circuits receives a number of those further pulses that is the complement with respect to eleven of the number of pulses originally registered by its associated pulse counting means.
6. An automatic telephone exchange according to any one of the preceding claims wherein each of said pulse counting means comprises an electromagnetic step-by-step switch.
7. An automatic telephone exchange according to any one of the preceding claims wherein each of said switching means comprises an electromagnetic relay which is arranged to be operated in response to the supply of a predetermined signal to a supervisory conductor, for example, the private wire, of its subscriber's line circuit and which is adapted through contacts thereof to connect said control leads to the appropriate ones of said conductors upon its operation.
8. An automatic telephone exchange according to any one of the preceding claims wherein said pulse counting means are associated with recording means which is arranged to produce a record of the values of the numerical digits characterised by the numbers of pulses registered by these counting means subsequent to the operation of the said switching means of any one of said line circuits.
9. An automatic telephone exchange according to Claim 8 wherein said recording means includes perforating means which is arranged to punch holes in a tape or card according to a predetermined pattern which represents the values of said numerical digits.
10. An automatic telephone exchange according to any one of the preceding claims wherein said pulse counting means are associated with a number of indicator means which are arranged to provide a visual indication of the value of the numerical digit characterised by the number of pulses registered by the associated one of said counting means subsequent to the operation of the said switching means of any one of said line circuits.
11. An automatic telephone exchange having an arrangement for identifying the telephone stations of calling subscribers that is substantially as hereinbefore described with reference to Figures 1, 2 and 3 of the drawings accompanying the Provisional Specification.
- For the Applicants,
J. D. DOLWIN,
Chartered Patent Agent.

