S. B. WILLIAMS, Jr.
TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED MAY 22, 1915.

1,200,788.

Patented Oct. 10, 1916.

6 SHEETS—SHEET 1.

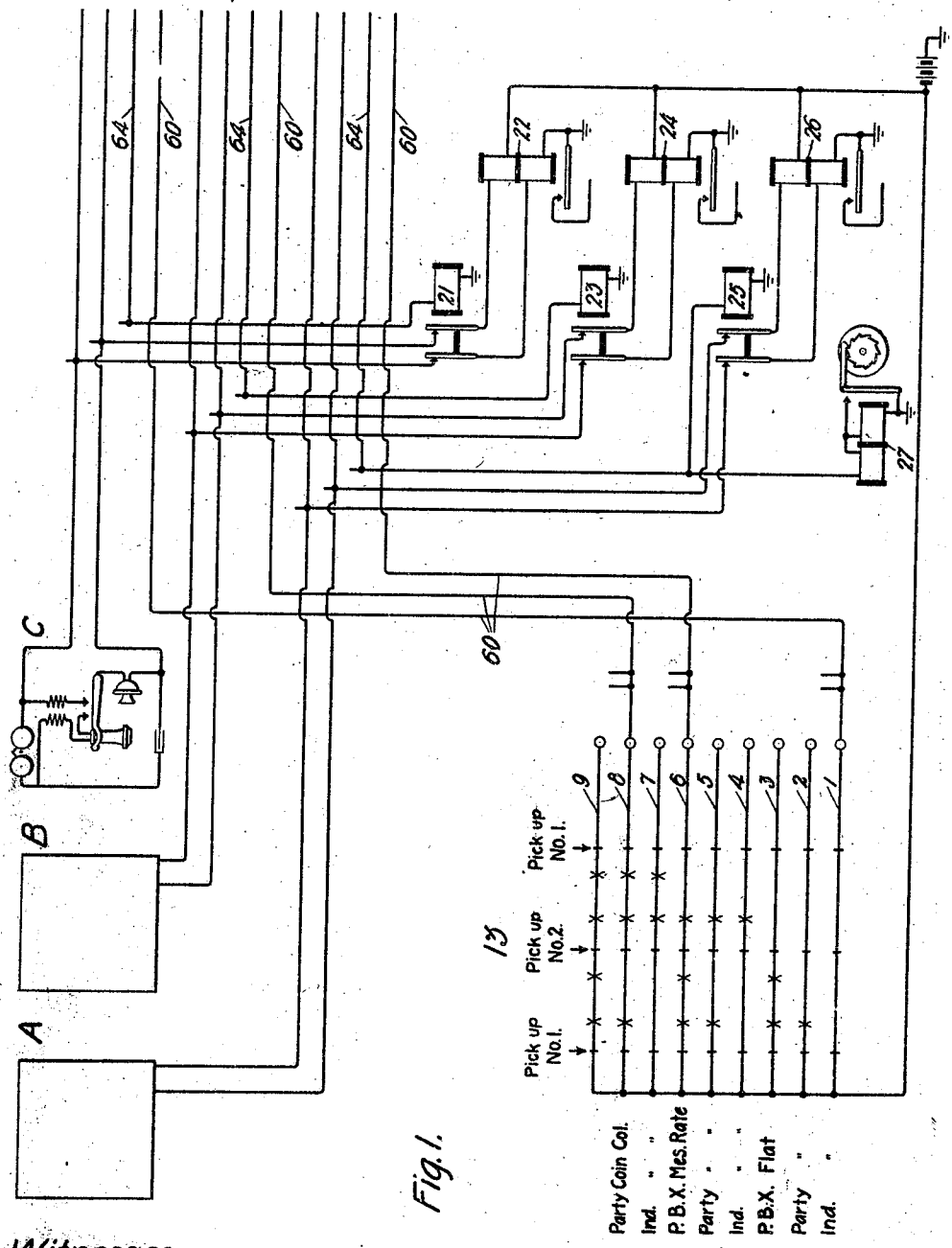


Fig. 1.

Witnesses:
O. E. Parmenter
C. M. Luthe.

Inventor:
Samuel B. Williams Jr.
by A. C. Manuel, Atty

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6 SHEETS—SHEET 2.

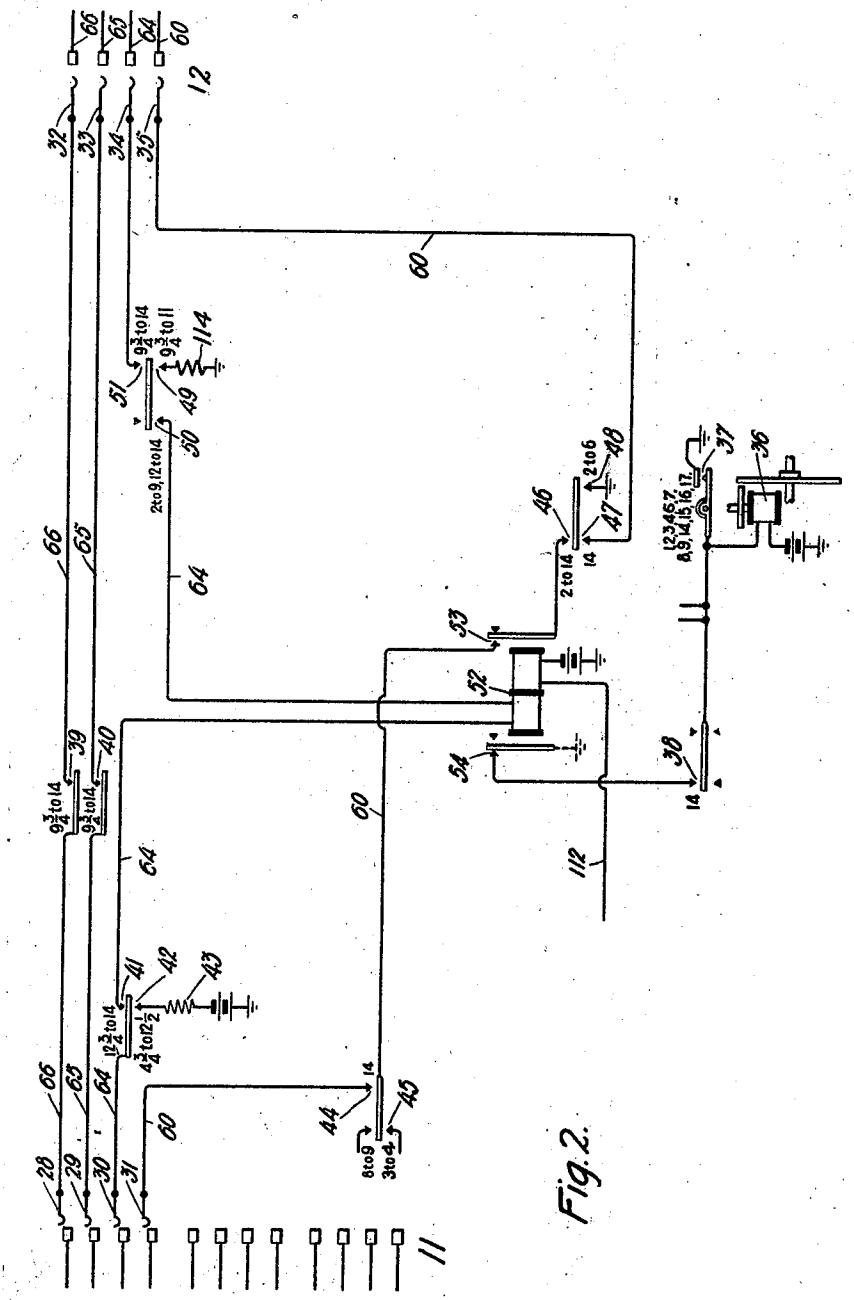


Fig. 2.

Witnesses:
D. C. Lacunnen
O. M. Gulke.

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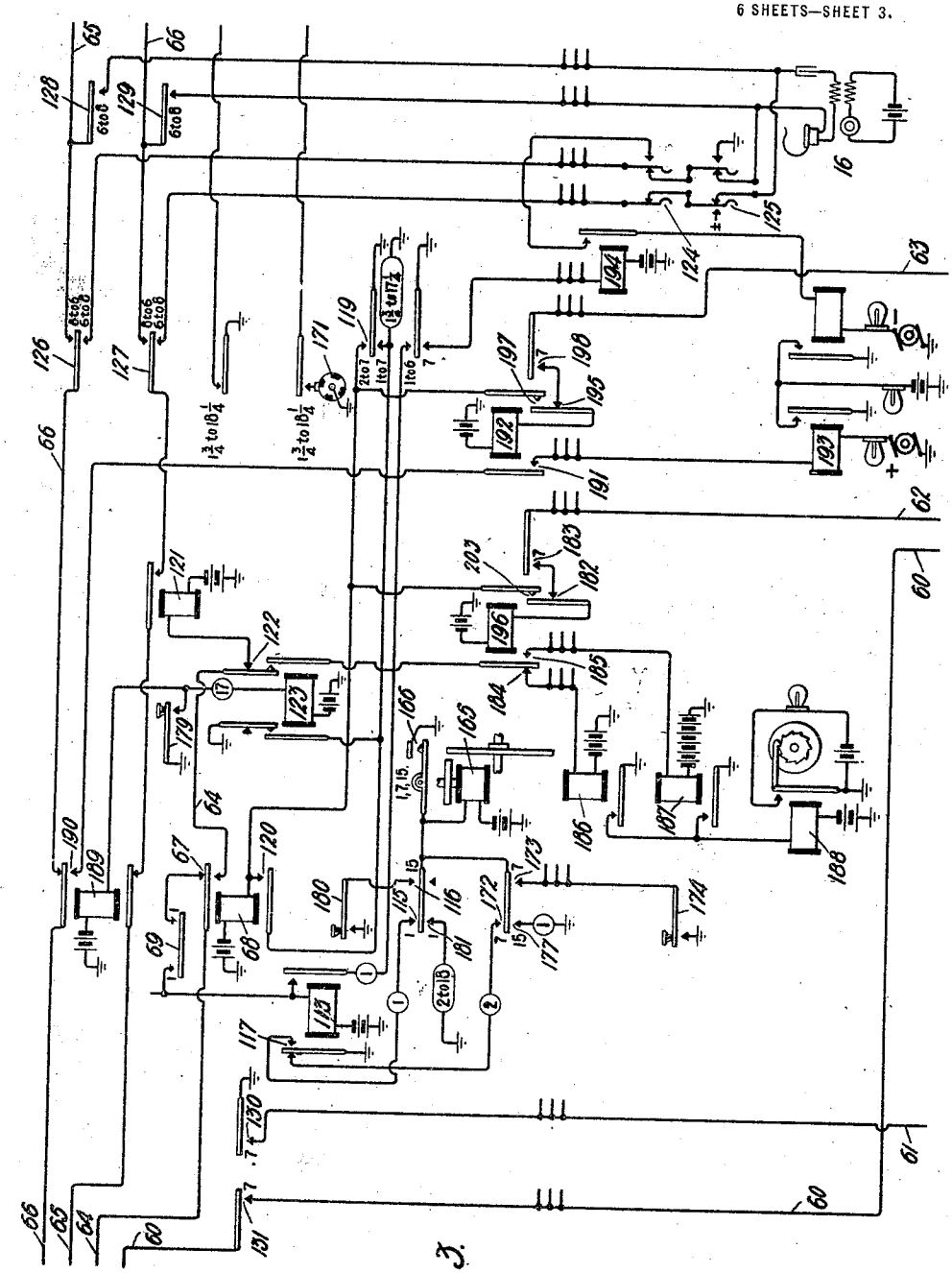


Fig. 3.

Witnesses:
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6 SHEETS—SHEET 4.

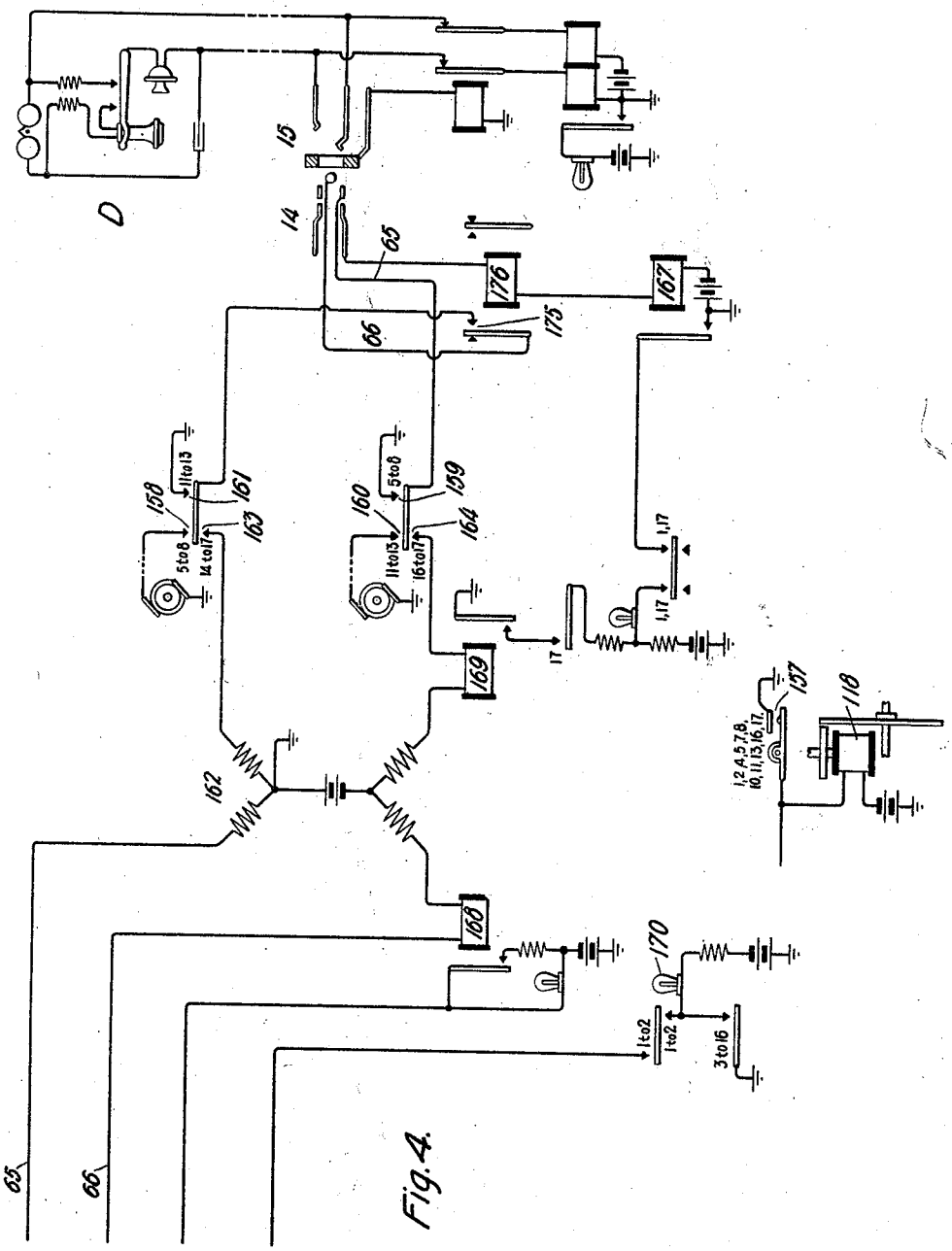


Fig. 4.

Witnesses:
O. E. Rasmussen
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Inventor:
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S. B. WILLIAMS, JR.

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6 SHEETS—SHEET 5.

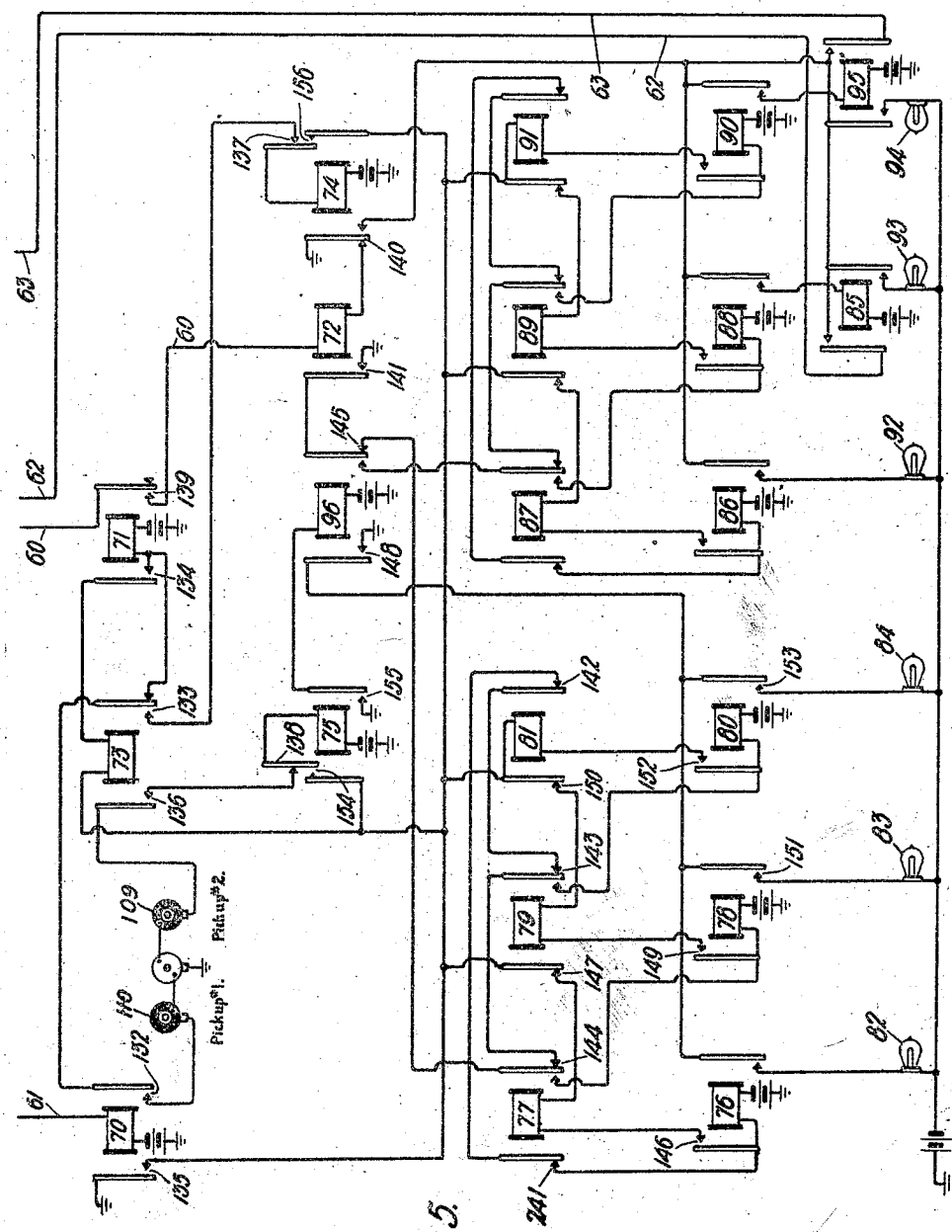


Fig. 5.

Witnesses:
J. E. Ramsey
J. M. Guthe.

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6 SHEETS—SHEET 6.

Fig. 6.

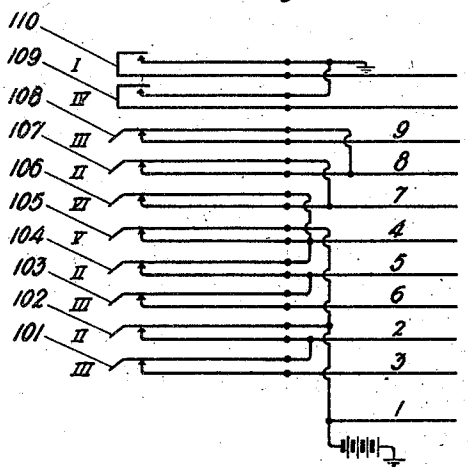


Fig. 7.

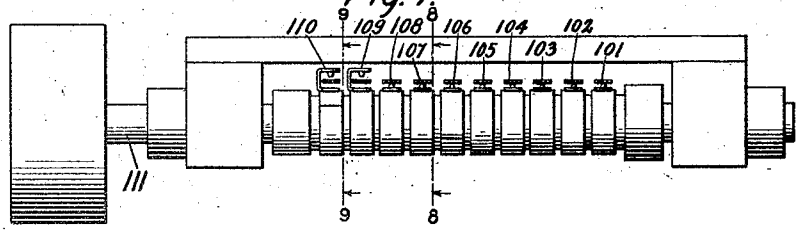


Fig. 8.

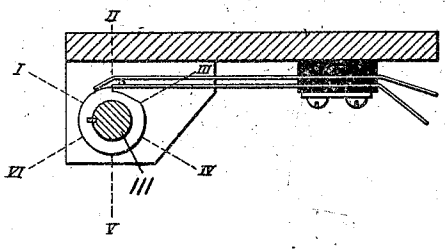
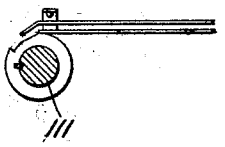


Fig. 9.



Witnesses:
O. E. Rasmussen
O. M. Guthe.

Inventor:
Samuel B. Williams, Jr.
by A. C. Stanwood, Atty

UNITED STATES PATENT OFFICE.

SAMUEL BYRON WILLIAMS, JR., OF BROOKLYN, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO WESTERN ELECTRIC COMPANY, INCORPORATED, A CORPORATION OF NEW YORK.

TELEPHONE-EXCHANGE SYSTEM.

1,200,788. Specification of Letters Patent. Patented Oct. 10, 1916.

Application filed May 22, 1915. Serial No. 29,875.

To all whom it may concern:

Be it known that I, SAMUEL B. WILLIAMS, JR., a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to an improved system of telephone exchange operation, and particularly to improvements especially useful in connection with call distributing systems. Its object is primarily to provide means for furnishing an automatic identification of each line with respect to its class of service, so that the treatment the line is to receive with respect to the manner in which it is handled or extended may automatically be indicated or determined.

In the ordinary manual practice of telephone exchange operation, it is customary to associate with the answering jack and lamp of each telephone line certain characters, letters or colors which convey to the answering operator information with respect to the character of the line, such information being necessary as a guide to the operator in handling the calls from the particular line. These distinguishing marks associated with the incoming terminal of the line inform the operator whether the line is an individual line, a party line or a private branch exchange line, and whether the line receives a flat rate or message rate charge, or whether it is a line equipped with coin-box or coin-collector mechanism. There is also associated with each line a number plate upon which appears the number of the line. There is thus available to the operator all the information that it is necessary for her to have in the manipulation of her message register and coin collector or return keys, and in writing such tickets and records as may be required in connection with the handling of the calls.

In a call distributing system, the operator who receives the call and extends it to the called line does not have access to the incoming terminals of the lines, and, therefore, is not in position to know the characteristics of the calling line which determine the treatment that the call must receive. The call comes to the answering operator over a trunk circuit, instead of through the medium of answering jacks, and is thus extended to the operator without any identification of the line or of the class of service which it is adapted and intended to receive.

By the application of the invention to a call distributing system, when a call comes to an operator, it comes accompanied by such identification of the calling line as is necessary to determine the manner in which the call is to be handled.

Generally speaking, the invention contemplates the association with all of the lines adapted by certain classes of service of means which impress upon such lines peculiar and characteristic electrical conditions, different for the different classes of service, which conditions are translated into indications at the operator's position that inform the operator of the identity with respect to its class of service of any line that is originating a call. Or this characteristic electrical condition impressed upon a line may bring about the operation of apparatus adapted to automatically determine the character of the circuits with which the calling line is to be associated in the process of extending the call, and thus automatically adapt the connecting circuits to the character of service for which the call originating line is intended.

In the specific embodiment of the invention that is here disclosed, there is at the central office a device for producing as many sorts of characteristic electrical conditions as are necessary for the identification of the various classes of lines that are served at the central office, and each of the lines has such connection with this device as to impress upon the line the characteristic condition appropriate to the class in which the particular line falls.

In the specific embodiment disclosed, the characteristic condition is impressed upon a conductor of the telephone line which is local to the central office. At the operator's position there is a device that is selectively responsive to the various electrical conditions that are impressed upon the lines. In the extension of the line to the operator's position, this device is brought into operative association with that conductor of the extended line upon which the characteristic condition is impressed, and is operated to furnish an indication that identifies the ex-

tended line with respect to the service which it is to have. This responsive device at the operator's position, furthermore, has control over certain circuits that are completed by the operator to supply current to the calling line for various purposes, such as for operating the message register that may be associated with the line, or for operating the mechanism of the coin-box, if the line be provided with such—so that the circuits which the operator controls may automatically be adapted to the class of service for which the line is intended.

A specific embodiment of the invention is shown in detail in the accompanying drawings, in which—

Figure 1 illustrates three telephone lines with their central office terminal connections and identifying circuits; Fig. 2 illustrates a line finder and cord finder circuit for extending a calling line; Figs. 3 and 4 illustrate a cord circuit terminating in a plug, a called line into a spring jack of which the plug may be inserted, and a part of the operator's circuit; Fig. 5 illustrates the part of the operator's circuit that has to do with determining the identity of a calling line with respect to its class of service; and Figs. 6, 7, 8 and 9 show details of the common identifying device or commutator and its connections.

In the particular embodiment of the invention illustrated in the accompanying drawings, I have shown three lines adapted for different classes of service extending from their respective stations A, B and C to switch terminals at the central office. A may be assumed to be a private-branch-exchange message-rate station, B a party line coin-collector station, and C an individual flat rate station. The character and arrangement of apparatus at such stations is well known, and I have not thought it necessary to illustrate it specifically. Cutoff relays 21, 23, 25 and line relays 22, 24, 26 are associated with the three lines in the usual way. The line from station A, being a message rate line, also has associated with it at the central office a message register 27.

Each of the lines has four conductors, two being the ordinary line conductors, and the other two, 64, and 60, being conductors local to the exchange. The local conductor 64 of each line has included in it a winding of the associated cutoff relay, while the conductor 60 in each case extends to the common identifying device or apparatus for producing the characteristic electrical conditions which serve to identify the various lines. This device is represented diagrammatically at 13 in the drawing, and is illustrated as comprising nine paths extending from the free pole of the central battery to nine terminals which are common to the lines of the exchange, and to one or another of which the conductor 60 of each line circuit is extended depending upon its class of service. I shall hereinafter particularly describe the type of identifying apparatus which I have found it convenient to employ. For the present, it is sufficient to say that this apparatus is arranged continuously to modify current that may flow in each of the paths so as to produce trains of impulses, the impulses of each train being divided into groups and subgroups and the number of impulses in each group and subgroup being varied so as to produce different and characteristic combinations. The duration of the groups and subgroups in each train is determined and limited by pick-up impulses. Each of the subgroups consists of one or more impulses of current, as determined by the action of circuit changing contacts in the various paths. A single interruption in one of the subgroup periods divides the current flow in that period into two impulses, and two interruptions in the subgroup period divides the current flow in that period into three current impulses. To meet the requirements of the present embodiment of my invention, I have found it only necessary to provide a maximum of three impulses in each subgroup period, the various combinations of one, two or three impulses in each subgroup of a group affording nine different characteristic combinations of current impulses.

As diagrammatically illustrated at 13 in the drawing, path 1 has one impulse in each subgroup period; path 2 has two impulses in the first period and one in the second period; path 3 has three impulses in the first period and one in the second; path 4 has one impulse in the first and two in the second; path 5 has two in the first and two in the second; path 6 has three in the first and two in the second; path 7 has one in the first and three in the second; path 8 has two in the first and three in the second; and path 9 has three in the first period and three in the second. The marks X placed upon the nine conductor paths indicate interruptions, and the broken lines extending transversely of the paths indicate the division of the resulting impulses into groups and subgroups by the pick-up impulses. The classification which I have found it desirable to provide for in this embodiment of my invention is a division of the lines into three classes with respect to the character of the line, and into three classes with respect to the nature of the charge that is made for the use of the line. The lines are thus classified as individual, party line and private branch exchange or P. B. X. lines, and the classification of the lines with respect to the charge vides them into flat rate, message rate and in collector lines. There are nine possible combinations in this classification, for each

of which combinations there is a path through the identifying device which provides a characteristic identification for that class of line and service. Thus, path 1 may have branches to and identify all the individual flat rate lines; path 2 in like manner may identify all of the party flat rate lines; path 3 may identify the private branch exchange flat rate lines; path 4, the individual message rate lines; path 5, the party message rate lines; path 6, the private branch exchange message rate lines; path 7, the individual coin collector lines; and path 8 the party coin collector lines. Path 9 would identify private branch exchange coin collector lines, if there were any such; but as it is not the practice to provide this class of service, path 9 is spare, in the present embodiment, and may be used for identifying some other class of service if desired.

Of course it will be understood that the scheme of identification outlined above is purely arbitrary and may be altered as desired to identify any other classes of service that may be provided. It will also be understood that by merely increasing the number of subgroups, or the number of impulses in each subgroup, or both, identification may be furnished for as many classes of service or as many line characteristics as may be desired.

When any line calls, it is extended, as shown in the present embodiment, by means of a line finder switch 11 and a cord finder switch 12, to a connecting cord circuit which terminates in a connecting plug 14 that is adapted to be inserted by the operator into any spring-jack 15 in order to complete the connection between the calling and the called telephone lines. When the cord finder switch 12 finds the connecting cord circuit that is to be used in completing the connection, the calling line is automatically extended by way of the connecting cord circuit to the telephone set and controlling switches of the operator at whose position the selected connecting cord circuit is located.

Among the conductors of the connecting cord circuit that are extended to the associated operators' circuits when the connecting cord is selected, there are four—60, 61, 62 and 63—which are particularly concerned with the operation of the apparatus that has to do with the identification of the line with respect to its class of service. All four conductors lead to the class-of-service indicating device with which the operator is provided, conductor 60 being the fourth or identifying wire of the line that is calling, conductor 61 being the wire over which the class-of-service responsive apparatus is brought into or out of action as the operators' circuits are connected with or disconnected from the connecting cord circuit, and conductors 62 and 63 being the wires through which the class-of-service responsive device exercises control over the sort of current that is applied to the calling line by means of the operator's charge key.

The class-of-service responsive device to which the conductors 60, 61, 62 and 43 lead, comprises, in the present instance, six lamps arranged in two groups of three lamps each, and groups of relays for controlling the identifications of these lamps, and for controlling the two conductors 62 and 63 which have to do with the control of the operator's charge circuit. Before describing the circuits in detail, I shall outline briefly the manner in which the identifying device and the class-of-service responsive device cooperate to identify the extended line with respect to its class of service.

The extension of a calling line to a connecting cord, and thus to the associated operator, operates a relay 70, associated with the class-of-service responsive mechanism, which relay in its operation makes this mechanism responsive to subsequent identifying impulses. The identifying device continuously operates switch contacts which produce pick-up impulses, these impulses being of two sorts and having a definite time relation to the identifying impulses produced by the device. Pick-up impulse #1 is transmitted at the beginning of each cycle or train of identifying impulses, and pick up impulse #2 is produced in the middle of each cycle to divide the group determined by consecutive pick-up impulses #1 into subgroups. For convenience and clearness in illustration, the commutator parts of the identifying device which produce the pick up impulses are diagrammatically shown as 109 and 110 in Fig. 5 in connection with the class-of-service responsive mechanism and the operator's position.

In outline, the operation subsequent to the energization of the relay 70, is as follows: The first pick-up impulse #1 operates relay 71 and extends the identifying circuit over conductor 60 to the relay 72. The terminating pick-up impulse permits the relay 72 to operate, this relay acting to switch the pick-up #1 impulse to relay 74 and pick-up #1 circuit to relay 75. The impulse circuit to relay 75 flows by way of the identifying current which flows by way of conductor 60 as soon as relay 71 operates relay 72, and this relay in turn causes the operation of relay 76. The operation of relay 76 conducts an interruption in the identifying circuit, presuming that a second impulse is received in the first subgroup period, causing the energization of relay 72 and the operation of relay 77, relay 76 remaining energized. When the circuit of relay 76 is again closed in this same subgroup period, relay 72 operates and by the operation of relay 78, and the

terruption of the circuit leaves 78 up and operates 79 also, 79 in its operation deënergizing 76 and 77. If there is still another closure of the identifying conductor 60 in the first subgroup period, relay 72 is again operated, thus operating relay 80, and upon the subsequent termination of the impulse, relay 81 is operated, and relay 80 remains up, relay 81 in its operation deënergizing relays 78 and 79. Thus, depending upon the number of impulses of curent produced during the first subgroup period, relays 76 and 77, relays 78 and 79, or relays 80 and 81 of the group of impulse counting relays are left up, their locking circuits being by way of a conductor which is closed as long as relay 70 remains operated. Relay 76 of the first pair controls the circuit of lamp 82, which in the particular system of identification shown, is the individual line lamp; relay 78 of the second pair controls the circuit of lamp 83, which is the party line lamp; and relay 80 of the third pair controls lamp 84, which is the private branch exchange line lamp.

The first subgroup period is terminated by the production of pick-up impulse #2. Relay 73 having remained operated this impulse causes the operation of relay 75, which, in turn, causes the operation of relay 96. Relay 75 opens the path of pick-up impulse #2 and locks itself up, subject to the control of relay 70; while relay 96 completes a circuit of the particular lamp 82, 83 or 84 which has been selected in the first subgroup period, and also gives relay 72 control of the group of counting relays 86, 87, 88, 89 and 91. The impulses which are produced during the second subgroup period cause the operation of the second group of counting relays 86, 87, 88, 89, 90 in the same way described in connection with the operation of the first group of relays 76, 77, 78, 79, 80 and 81. This first impulse causes the first pair of relays 76 and 77 to be left operated; the second impulse leaves the second pair of relays 78 and 79 operated; and the third impulse leaves the third pair of relays 90 and 91 operated being controlled over the locking circuit for which relay 70. Relay 86 of the second group controls the circuit of lamp 93; and relay 88 of the second pair controls the circuit of lamp 94. In the particular embodiment that I am describing, the flat rate lamp, lamp 93 is the toll lamp, and lamp 94 as the coin lamp.

At the termination of the second subgroup, that is, at the termination of the cycle of the train of identifying impulses brought about by the production of another pick-up impulse #1. Inasmuch as relay 73 has remained energized, having a locking circuit by way of relay 70, the second pick-up impulse #1 flows through relay 74, and the resultant operation of that relay opens the circuit of conductor 60 through relay 72, thus removing the class-of-service responsive mechanism from further control by the class-of-service identifying device over conductor 60. Relay 74 in operating also closes a holding circuit for itself under the control of relay 70, and completes a circuit which causes the lighting of the particular lamp 92, 93 or 94 which has been selected by the impulses during the second subgroup period. Thus, the operation of the relay 70 causes the operator's class-of-service apparatus to be responsive to the identifying device during one cycle of its operation, during which cycle one of the lamps of the three in each group is lighted to apprise the operator of the class of service of the calling line. As long as relay 70 remains operated, the associated responsive mechanism is maintained in its operated condition, and the lamps that have been selected are kept lighted. When the relay 70 is deënergized, the responsive mechanism is restored to its normal condition, in readiness to register another indication whenever the relay 70 is again operated.

Associated with relays 88 and 90 of the second and third pairs, respectively, of the second group of relays, are two relays 85 and 95. These two relays control, through the medium of the conductors 62 and 63, the circuits that are completed by means of the operator's charge key. Whenever relay 88 is operated, relay 85 is also operated to close the circuit of conductor 62 and cause the locking up of relay 196, which relay controls alternative branches of the conductor through which the operator applies current to the third or sleeve conductor 64 of the line for the operation of the message register 27 of the line and the position register 188 of the operator's equipment. Whenever relay 90 is operated, it causes the actuation of relay 95 which closes the circuit of conductor 63 to operate relay 192, this relay acting to close a path over which coin collecting current is applied to the calling line, in case it be a line with a coin box, when the operator operates her charge key 179.

A type of device which I have found it convenient to employ for producing the identifying and pick-up impulses that serve to identify the various classes of lines is illustrated in Figs. 6, 7, 8 and 9. This device, in the form particularly illustrated, consists of ten cam-operated switches 101, 102, 103, 104, 105, 106, 107, 108, 109 and 110, each switch having an associated cam for

operating it, the ten associated cams being mounted upon a common shaft 111, which shaft is constantly driven by a suitable source of power. The shaft and associated cams may be driven to rotate at a rate of say 120 revolutions per minute. Switches 101 to 108 inclusive are normally closed, and are operated by their associated cams to be opened momentarily once in each revolution. Switches 109 and 110 are normally opened, and are arranged to be closed once in each revolution. The cams are cut away to produce the operation of their associated switches at any one of six points sixty degrees apart in the rotational cycle. I have indicated these point or positions by the Roman numerals I, II, III, IV, V and VI. The cams associated with switch springs 110 and 109 are cut away to produce the momentary closure of the switch contacts at positions I and IV, respectively, in the cycle of rotation of the cam shaft. These switch springs are those which determine the pick-up impulses switch 110 controlling pick-up impluse #1 and switch 109 controlling pick-up impulse #2. The cams associated with switch springs 102, 104 and 107 are cut away at position II of the cycle; the cams associated with switch springs 101, 103 and 108 are cut away at position III of the cycle; the cam associated with the switch 105 is cut away at position V of the cycle; and the cam associated with switch 106 is cut away at position VI of the cycle. Thus the complete rotation of the cam shaft with its cams involves the momentary closure of pick-up #1 switch at position I, the momentary opening of switches 102, 104 and 107 at position II, the momentary opening of switches 101, 103 and 108 at position III, the momentary closure of pick-up #2 switch 109 at position IV, the momentary opening of switch 105 at position V, and the momentary opening of switch 106 at position VI.

The eight switches 101 to 108 inclusive are connected in different combinations in the identifying paths 2 to 9 inclusive. Path 2 includes the contacts of switch 102; path 3 includes the contacts of switches 102 and 101; path 4 includes switch 105; path 5 includes switches 105 and 104; path 6 includes switches 105, 104 and 103; path 7 includes switches 105 and 106; path 8 includes switches 105, 106 and 107; and path 9 includes switches 105, 106, 107 and 108. Path 1 is adapted to remain closed in positions II, III, V and VI, and, therefore, does not include any of the switches that are operated in these positions.

The result of the above described arrangement of cam switches in the conducting paths of the identifying device is that these paths have produced in them the distinctive combinations of interruptions illustrated diagrammatically at 13 in Fig. 1 of the drawing, the impulses produced by the interruptions being divided through the medium of the pick-up impulses #1 and #2 into groups and subgroups. The various identifying device paths, thus adapted to produce trains of impulses divided into distinctive groups and subgroups, terminate upon connectors from which connection may be made with the fourth or identifying conductor 60 of any line that it may be desired to identify, the connector to which the identifying conductor of the line is led depending upon the classification of the line with respect to whether it is an individual line, a party line or a private branch exchange line, and whether it has a flat rate or a message rate, or is equipped with a coin box or collector.

Inasmuch as my invention is not particularly concerned with the character of the circuits over which the calling line is extended to the operator's position, and over which the calling line is extended to the called line after the operator has obtained such identification of the calling line and such information concerning the called line as may be necessary for her purpose, I shall describe these intermediate circuits and apparatus only to the extent that they are involved in the operation which has particularly to do with the disclosure of my invention. The organization which I have chosen for the purpose of showing a specific embodiment of my invention is one which utilizes automatic finder switches for finding a calling line and for extending the calling line to a connecting cord circuit that is at the time idle and available, and which utilizes a plug terminal for the connecting cord circuit, which plug terminal is inserted by the operator into the spring-jack of the wanted line. Such systems, with their automatic finder switches, sequence switches and control circuits are well known, and this specification need not be burdened with a particular and detailed description of such a system.

In the operation of the particular embodiment of my invention illustrated, when one of the lines calls, the associated line relay 22, 24 or 26, as the case may be, is energized, and in closing its contacts closes a circuit which is effective, through intermediate circuits and apparatus that need not here be particularly described, in permitting current to flow, by way of conductor 112, through one winding of the relay 52 associated with the line and cord finder circuit. This relay closes its contacts 53 and completes a circuit by way of contacts 48, 46 and 45 of sequence switch 36 to cause the line finder switch 11 to connect with the terminals of the calling line. The sequence switch 36 is adapted to rest in positions 1, 2,

3, 4, 6, 7, 8, 9, 14, 15, 16 and 17. Of these positions, the following are of interest in connection with this description:

Position 1—Normal.
Position 2—Awaiting starting circuit.
Position 4—Hunting calling line.
Position 9—Hunting cord circuit.
Position 14—Talking.

I do not consider it necessary to show the connection of the circuit last traced with the motor magnet of the line finder switch, nor the path over which the finding of the calling line results in the sequence switch 36 being advanced through the intermediate stages until it reaches position 9, which is the position in which the connecting cord circuit is hunted. The circuits for accomplishing this are well known in the art.

When the brush 30 of the line finder 11 comes into engagement with the corresponding terminal of the calling line, a circuit is completed that includes battery, resistance 43, sequence switch contacts 42, brush 30 and its coöperating line contact, and the cutoff relay 21, 23 or 25 of the calling line. This energizes the cutoff relay and causes it to disconnect the associated line relay branch from the line.

When the sequence switch moves into position 9, the motor magnet of the cord finding switch 12 is made active, over circuits which need not be described, to cause the brushes 32, 33, 34 and 35 of the cord finder switch to engage corresponding contact terminals of an idle connecting cord. When the idle connecting cord is found, the sequence switch 36 is moved, by the closure of circuits that it is unnecessary to describe, into position 14, which is the talking position. In this position of the sequence switch, the two talking conductors 65 and 66 of the finder circuit are connected through from brushes 28 and 29 of the line finder switch to brushes 32 and 33 of the cord finder switch, by way of contacts 39 and 40 of the sequence switch, which contacts are closed in position 14. The third conductor 64 of the circuit is closed, in this position, from brush 30 of the line finder switch to brush 34 of the cord finder switch by way of contacts 41 of the sequence switch, one of the windings of relay 52, and contacts 50 and 51 of the sequence switch. The fourth or identifying conductor 60 is closed from brush 31 of the line finder switch to brush 35 of the cord finder switch by way of contacts 44 of the sequence switch, contacts 53 of relay 52, and contacts 46 and 47 of the sequence switch.

It will be noted that the motor magnet of the sequence switch, while the switch is resting in the talking position 14, is under the control of contacts 54 of the relay 52 by way of contacts 38 of the sequence switch closed in position 14; so that in the talking position relay 52 acts as a holding relay, the deënergization of which causes the sequence switch to move to its next position.

The circuits of the connecting cord are governed by a sequence switch 165 which has three resting positions, as determined by the master contact 166, these resting positions being as follows:

Position 1—Normal.
Position 7—Listening-in.
Position 15—Listening-out.

When the cord circuit is connected with by the cord finder switch 12, the sequence switch 165 is in its normal or No. 1 position. The engaging of brush 35 of the cord finder switch with the corresponding contact of the idle cord circuit, advances the sequence switch 36 of the finder circuit from its No. 9 or hunting position to its No. 14 or talking position by well-known circuits which need not be particularly illustrated or described and as soon as sequence switch 36 leaves its No. 9 position, it completes a circuit which may be traced from ground through resistance coil 114, sequence switch contacts 49 and 51, brush 34 and its corresponding cord circuit contact, conductor 64, contact 67 of relay 68, sequence switch contacts 69 and winding of relay 113 to battery. Relay 113 in operating closes a circuit for the energization of the motor magnet of sequence switch 165, by way of sequence switch contacts 115, contacts of calling plug sequence switch 118 closed in position No. 1 of that switch, and contacts 117 of relay 113, which moves the sequence switch to its No. 7 or listening-in position.

In order to avoid unnecessary confusion in the circuits, I have adopted the expedient of showing, by means of circles with appropriate numbers inclosed therein, the positions of the calling plug sequence switch 118 in which this switch acts to close the path upon which the numbered circles are placed. Otherwise, in order to indicate the control of the conductors by sequence switch 118, it would be necessary to extend them in each case to the vicinity of that switch, which is at a point somewhat remote in the drawing.

As soon as sequence switch 165 moves out of position 1, it closes an energizing circuit for relay 68 as follows: battery, winding of relay 68, contacts 119 of sequence switch 165 to ground. The operation of relay 68 closes a locking circuit for the relay as follows: battery, winding of relay 68, contacts 120 of that relay, and contacts 119 closed in position 1 to 7 of sequence switch 165 to ground. Subsequently there is an alternative path closed in positions $1\frac{3}{4}$ to $17\frac{1}{4}$ of the calling plug sequence switch 118 to ground. This locking circuit provides for the continued energization of relay 68 from the time the connecting plug 14 is inserted

in the spring jack of the called line until it is removed.

Relay 68 in operating disconnects the sleeve strand 64 from the relay 113 and connects it with the relay 121. This closes the path of the third strand 64 of the connecting circuit that remains normally completed during the period of extension of the calling line to the operator's circuit and to the called line. This path is as follows: battery, winding of relay 121, back contacts 122 of relay 123, front contacts 67 of relay 68, contact terminal and brush 34 of the cord finder switch 12, contacts 51 and 50 of sequence switch 36, winding of holding relay 52, sequence switch contacts 41, brush 30 of line finder switch 11 and the associated line contact, winding of cutoff relay 21, 23 or 25 to ground. The relay 121, the holding relay 52, and the cutoff relay are thus kept energized while the line is extended.

When sequence switch 165 moves into position 7, it breaks the direct talking path through conductors 65 and 66 of the connecting cord circuit, and substitutes a loop which passes through contacts of certain of the operators' control keys 124 and 125 and has connection with the operator's telephone set 16. This loop is controlled in the contacts 126, 127, 128 and 129 of sequence switch 165. The operator's key 124, thus brought into circuit in position 7 of sequence switch 165, is for the purpose of connecting high-voltage current of negative polarity with the calling line to bring about the return of a coin which may be held in the coin box of the line; while operator's key 125 is for the purpose of ringing back on the calling line circuit.

The movement of sequence switch 165 into position 7 brings the operator's telephone into circuit, as above described, and also brings the operator's class-of-service indicating mechanism into association with the circuit. The latter is accomplished by the closure in position 7 of the sequence switch contacts 130 and 131. The closure of contact 130 completes a path for the flow of current through conductor 61 including relay 70 of the class-of-service indicating apparatus, and the closure of sequence switch contacts 131 extends the fourth or identifying conductor 60 of the line circuit to the class-of-service indicating apparatus. This automatically causes the indicating apparatus to operate to apprise the operator of the characteristics of the calling line with which the apparatus has just acted to connect her. The manner in which the apparatus acts to effect this result is as follows: The closure of conductor 61 causes the energization of relay 70, which operates to close a path over which the next pick-up #1 impulse may operate the relay 71. This path is as follows: ground, commutator switch 110, contacts 132, back contacts 133 of relay 73, and winding of relay 71 to battery. When the first pick-up #1 impulse flows, after relay 70 is operated, relay 71 operates, and closes a locking circuit for itself in its contacts 134. When the contacts 134 close, a path is completed for the flow of current through the winding of relay 73 to ground by way of contacts 135 of relay 70. But as long as the pick-up #1 impulse persists, no current flows through the winding of relay 73, because this path is short-circuited by the direct path from the winding of relay 71 to ground by way of the pick-up commutator 110. But the termination of the pick-up #1 impulse and the opening of the direct path to ground at 110, permits the current through the winding of relay 71 to be diverted into the path including the winding of relay 73 and contacts 135 of relay 70. Thus, upon the termination of the first pick-up #1 impulse, relay 73 is operated, and thereafter relays 71 and 73 remain locked up as long as contacts 135 of relay 70 remain closed. Relay 73 in operating closes its front contacts 133 and 136. The opening of the back and closing of the front contact of 133 transfers the path through the pick-up #1 commutator 110 from relay 71 to the winding of relay 74 by way of normally closed contacts 137 of the last mentioned relay. The closing of contacts 136 of relay 73 connects the commutator switch 109 of pick-up #2 with the winding of relay 75 by way of normally closed contacts 138 of that relay. Relay 73 thus operates to make ready the paths over which the pick-up #2 impulse and the second pick-up #1 impulse subsequently operate to control the operation of the indicating device.

The actions described in the foregoing are those which follow immediately upon the extension of the calling line to the operator's circuit and the receipt of the first impulse from pick-up #1. The indicating apparatus is now in condition to receive the impulses of the first subgroup. The first impulse over conductor 60 after the operation of relay 71, flows by way of contacts 139 of relay 71, through the winding of relay 72, and through the back contacts 140 of relay 74 to ground. This impulse causes relay 72 to close its contacts 141 and complete a circuit for the operation of relay 76, which circuit may be traced from battery through the winding of relay 76, resting contacts 241 of relay 77, resting contacts 142, 143 and 144 of relays 81, 79 and 77, respectively, in series, resting contact 145 of relay 96 and contact 141 of relay 72 to ground. Relay 76 in operating closes its contacts 146 and completes a locking path for itself to ground by way of the winding of relay

77, resting contacts 147 of relay 79 and contacts 135 of relay 70. The previously traced path from the winding of relay 76 to ground closed in contacts 141 of relay 72, short-circuits the path last traced; but at the interruption in the flow of current which marks the end of the first impulse, relay 72 permits contacts 141 to open, thus breaking the short-circuit path about relay 77 and causing that relay to operate. Thereafter relays 76 and 77, constituting the first pair of the selected relays, are held operated, subject to the control of the resting contacts 147 of relay 79 and the contacts 135 of relay 70. Relay 76 in its operated position closes a path for the flow of current to the first lamp 82 of the first group of three lamps, subject to the control of normally open contacts 148 of relay 96, which contacts are closed at a later stage of the operation by the passage of the pick-up #2 impulse, as will hereinafter be described.

Relay 77 in operating, moves its contacts 144 to switch the circuit controlled by relay 72 from the winding of relay 76 to the winding of relay 78. Therefore, the second impulse of current that flows over conductor 60 in the first subgroup period and operates relay 72, closes a path for the energization of relay 78 that may be traced from battery through the winding of relay 78, front contacts 144 of relay 77, back contacts 145 of relay 96, and front contacts 141 of relay 72 to ground. The flow of current over this path operates relay 78, which relay closes a locking circuit for itself by way of its contacts 149, the winding of relay 79, resting contacts 150 of relay 81, and front contacts 135 of relay 70 to ground. Current is diverted from the path last traced by the short circuit path completed by way of contacts 145 of relay 96 and 141 of relay 72. Upon the termination of the impulse this short-circuit path is interrupted and relay 79 is operated. Thereafter relays 78 and 79 are both held up, subject to the control of resting contacts 150 of relay 81 and contacts 135 of relay 70. Relay 78 in operating closes, in its contacts 151, a path for the subsequent flow of current through the second lamp 83 of the first group, under the control of contacts 148 of relay 96, which are closed at a later stage of the operation. Relay 79 in operating opens its contacts 147, thus breaking the locking circuit for the previously operated pair of relays 76 and 77 and permitting those relays to fall back. The falling back of relay 76 opens the circuit of lamp 82, so that, that lamp will not be lighted when contacts 148 of relay 96 are subsequently closed; and relay 77 in falling back disconnects relay 78 from the controlling circuit and connects in its place relay 80 by way of the back contacts 144 of relay 77 and front contacts 143 of relay 79, which is one relay of the pair that is now energized.

The above described operation places relay 80 of the third pair in position to be energized by the closure of contacts 141 of relay 72 resulting from a third impulse of current over the conductor 60. When relay 72 closes its contacts 141 upon receipt of the third impulse, a path, like that previously traced for the operation of relays 76 and 78, is closed for relay 80 of the third pair; and relay 80 closes a locking circuit for itself in its contacts 152, which locking circuit includes the winding of relay 81 and contacts 135 of relay 70. Relay 81 is short-circuited and prevented from operating as long as the short-circuiting path by way of contacts 145 of relay 96 and contacts 141 of relay 72 is closed, in the manner previously described, and is operated as soon as the short-circuiting path is broken. Relay 80 in operating closes a path in its contacts 153 for the flow of current through the third lamp 84 of the first group, subject to the closure of contacts 148 of relay 96; and relay 81 in operating opens, in its contacts 150, the locking circuit for the previously operated pair of relays 78 and 79, and permits these relays to fall back and open the path prepared for the flow of current through the second lamp 83.

The first subgroup period is terminated by the production of pick-up #2 impulse by the momentary closure of contacts 109 of the commutator. It will be remembered that relay 73 had previously been locked up to prepare a path for the flow of the pick-up #2 impulse by way of the winding of relay 75. Upon the passage of the pick-up #2 impulse, relay 75 operates, closes a locking circuit for itself by way of its make contacts 154, subject to the control of contacts 135 of relay 70, and also closes its contacts 155 to operate relay 96. Relay 96 in operating disconnects the circuit controlled by contacts 141 of relay 72 from the path leading to the relays 76, 77, 78, 79, 80 and 81 of the first group, and connects it to the path which leads to the relays 86, 87 88, 89, 90 and 91 of the second group. It also closes in contacts 148 the circuit for the flow of current over whichever of the lamps 82, 83 or 84 of the first group has its circuit left closed in the contacts of the associated relay 76, 78 or 80.

Assuming that three impulses of current are caused to pass to the second group of relays by way of the path controlled in the front contact 145 of relay 96, the selective operation of these relays by the successive impulses is the same as has been described in detail for the first group of relays, and needs no further description. The only point which needs to be noted in connection with the action in the second group of re-

lays, as distinguished from the action in the first group, is that relays 88 and 90 in operating do not prepare directly the circuits for the subsequent illumination of their associated lamps 93 and 94, respectively, but close the circuits of these lamps through the medium of the relays 85 and 95, which are operated when their associated relays 88 and 90, respectively, are operated, and which relays 85 and 95 also control circuits governing the operation of message rate and coin collector apparatus, which circuits will be traced hereinafter.

The second subgroup period and the cycle are terminated by the production of a second pick-up #1 impulse in switch contacts 110 of the commutator. This impulse flows by way of contacts 132 of relay 70, front contacts 133 of relay 73, resting contacts 137 of relay 74 and through the winding of the last mentioned relay. Relay 74 is thus operated, closes a locking circuit for itself in its contacts 156, and in its front contacts 140 completes a path for the illumination of whichever lamp 92, 93 or 94 of the second group is held in circuit by the energization of its associated relay 86, 88 or 90. Relay 74 in operating also, in opening its back contacts 140, opens the path for the flow of current through relay 72, so that that relay thereafter is unresponsive to the opening and closing of the identifying circuit 60 associated with the calling line. The completion of the cycle or group period of the identifying device thus leaves the circuit of the identifying conductor 60 open in contacts 140 of relay 74, the path of pick-up #1 impulse open in contacts 137 of relay 74, the path of pick-up #2 impulse open in contacts 138 of relay 75, and relays 71, 73, 74, 75 and 96 locked up subject to the control of contacts 135 of relay 70. If it be assumed that there were three impulses in each subgroup period, it also leaves relays 80 and 81 of the first group and relays 90 and 91 of the second group locked up over the locking circuit controlled in contacts 135 of relay 70, and the associated lamps 84 and 94 burning. It also, under the same assumption, leaves relay 95 held operated by the energization of relay 90, and the coin collector controlling path 63 closed to ground by way of contacts 140 of relay 74. This condition persists and lamps 84 and 94 continue burning as long as relay 70 remains energized. When that relay is deenergized, the opening of the holding contacts 135 opens the various locking circuits referred to and restores the apparatus to its normal position.

The actions described above were under the assumption that each of the two sets of counting relays received three impulses in its respective subgroup period. I shall now describe briefly the action that would take place if only one or two impulses were received in a subgroup period. In such a case, the flow of current through identifying conductor 60, following the passage of the first pick up #1 impulse acts, through the medium of the relay 72, to close the energizing circuit of the relay 76. But, assuming that there is but a single impulse in the first subgroup period, this flow of current continues and contacts 141 of relay 72 are held closed throughout the whole of the first subgroup period, and while this condition continues relay 77 is short-circuited and cannot pull up. The passage of the pick-up #2 impulse at the end of the first subgroup period actuates relays 75 and 96, as previously described, and relay 96 in operating opens its back contacts 145. This removes the short circuit from relay 77, and terminates the first subgroup period with relays 76 and 77 locked up and lamp 82 lighted. If there are assumed to be two impulses in the first subgroup period, the opening of contacts 141 of relay 72 marking the end of the first impulse removes the short-circuit from relay 77 and permits it to operate; and relay 77 in operating prepares the path for the energization of relay 78 by the second impulse. Relay 79 of the second pair is kept short circuited, as already described, during the passage of the second impulse; but the short circuit is removed and relay 79 operates when pick-up #2 impulse operates relay 96 to open its resting contacts 145 at the end of the first subgroup period. In operating, relay 79 opens the locking circuit of the first pair of relays 76 and 77, so that two impulses during the first subgroup period leave the second pair of relays 78 and 79 locked up and their associated lamp 83 illuminated, and the other two pairs of relays deënergized and their associated lamps dark.

The actions in the second group of counting relays, which follow the receipt of only one or two impulses in the second subgroup period, are exactly the same as the actions described above as taking place in the relays of the first group. The result is that the lamp which is left lighted in each of the two groups corresponds with the number of impulses which are received during that subgroup period, the operator being informed by the particular lamp lighted in the first group whether the calling line is an individual line, a party line or a private branch exchange line, and by the particular lamp lighted in the second group whether the line receives flat rate, message rate or coin collector service. Thus, when the operator's set 16 is automatically connected with the cord circuit to which the calling line is extended and the relay 70 is operated, the class-of-service indicating apparatus is made operative to cause the calling line to indi-

cate to the operator, by means of the particular lamps lighted, the class of service for which the calling line is adapted. Thus informed, the operator is enabled to write such tickets or memoranda or give such service as her instructions require for this sort of a line.

Having learned the number of the line that the calling line desires connection with, the operator completes the connection by inserting plug 14 into the spring-jack 15 of the desired line. The circuits of the calling plug end of the connecting cord circuit are controlled by a sequence switch 118, the principal resting positions of which, as determined by the master contact 157, are as follows:

Position 1—Normal.

Position 2—Awaiting listening key sequence switch.

Position 5—Ringing on tip conductor.

Position 8—Ringing on tip conductor.

Position 11—Ringing on ring conductor.

Position 13—Ringing on ring conductor.

Position 16—Awaiting supervisory relay.

Position 17—Talking.

The sequence switch 118 remains in position No. 1 until plug 14 is inserted, when it moves into position No. 2, and there waits upon certain actions in the associated connecting cord circuit, which are not particularly concerned with this invention and need not be described, and presently is moved into position 5. In this position, ringing current may be applied to the tip conductor of the cord by way of sequence switch contacts 158, the ring strand of the cord being connected to ground by way of contacts 159. In position 8 of the sequence switch, ringing current of a different sort may be applied to the tip strand and the ring strand grounded by way of the same sequence switch contacts. In positions Nos. 11 and 13, ringing current of different sorts may be applied to the ring strand and the tip strand grounded by way of sequence switch contacts 160 and 161 closed in these positions. Sequence switch 118 then moves to position 16 where it awaits the response of the called subscriber; and upon the subscriber taking his telephone from its hook, the sequence switch moves to position 17, which is the talking position.

In the talking position, the conversational circuit is completed between the calling and the called subscribers by way of the windings of the repeating coil 162 and contacts 163 and 164 of sequence switch 118. The tip strand of the talking circuit also passes through contacts 175 of relay 176, which relay, with relay 167, is included in a conductor extending from battery to the sleeve of connecting plug 14, and thence to ground through the cutoff relay of the called line. Answering supervisory relay 168 and calling supervisory relay 169 are included in the ring strands of the connecting cord circuit in the usual manner, and control the associated answering and calling supervisory lamps in the usual way when the sequence switch is in its talking position. A call lamp 170 is also provided, this lamp being caused to flash by a commutator 171 while sequence switch 118 is in its first and second positions, to designate to the operator the connecting cord to which the calling line has been extended, and being thereafter caused to glow steadily until the called subscriber has answered, and the sequence switch 118 has moved into its talking position 17.

When the sequence switch 118 moved to position 2, at the time the operator inserted the calling plug 14 into the spring-jack 15, it closed contacts which completed a circuit that moved the sequence switch 165 out of its listening-in position 7, in which it had been standing, and into its listening-out position 15. This circuit is as follows: battery, motor magnet of sequence switch 165, sequence switch contacts 172, contacts of sequence switch 118 closed in the second position, back contact 117 of relay 113 to ground. In moving out of its listening-in position 7, sequence switch 165 opens, in sequence switch contacts 131 and 130, the circuit of conductors 60 and 61 extending to the class-of-service responsive apparatus. The opening of conductor 61 allows relay 70 to fall back and open the locking and lamp circuits it controls. This extinguishes the lamps and restores the class-of-service apparatus to its normal condition.

When it is resting in its listening-in position 7, the sequence switch 165 may also be moved into its listening-out position over a circuit which passes from battery through the motor magnet of sequence switch 165, contacts 173 of the sequence switch and contacts of the master listening-out key 174. If the sequence switch 118 associated with the calling plug is in its first position when the master listening-out key 174 closes the circuit traced above, the sequence switch 165 finds a circuit to ground in its 15 position by way of contacts 177 of sequence switch 165, and contacts of the sequence switch 118 closed in the normal position of that switch. This condition causes the sequence switch 165 to pass through its 15 position and return to normal.

Assuming that the calling plug 14 has been inserted, and that the called subscriber has been signaled and has responded by taking this telephone from its hook, the conversational circuit between the calling and called subscribers' stations is completed by way of the talking conductors 65 and 66,—sequence switch 36 standing in its talking position 14, sequence switch 118 standing

in its talking position 17, and sequence switch 165 standing in its listening-out position 15, in which position the operator's telephone set and the class-of-service responsive apparatus are disconnected from the circuit.

When the subscribers have finished their conversation they hang up their telephones, as a result of which the answering supervisory relay 168 and the calling supervisory relay 169 of the connecting cord circuit are deënergized and cause the illumination of their associated supervisory lamps. Upon receiving this disconnect signal, the operator may listen-in on the circuit by pressing her listening-in key 180. The pressing of this key closes the following circuit: ground, contacts 116 of sequence switch 165, motor magnet of sequence switch 165, battery. This energizes the sequence switch and causes it to move out of its listening-out position 15. But instead of stopping in position 1, the sequence switch finds a circuit in that position as follows: battery, motor magnet of sequence switch 165, contacts 181, contacts closed in positions 2 to 18 of the calling plug sequence switch 118, ground. This circuit causes the sequence switch 165 to move through position 1 and come to rest in its listening-in position 7. As a result, by pressing her listening-in key 180, the operator reëstablishes the connection of her telephone set and of the class-of-service indicating apparatus with the connecting cord circuit, and the last mentioned apparatus thereupon operates, in the manner already described, to indicate again the class of service of the calling line.

If for any reason the operator wishes to do so, she may listen-in and listen-out on the connection as many times as she cares to while the connection is established between the two subscribers' lines, by merely pressing her listening-in key 180 and her master listening-out key 174, the sequence switch 165 being thus correspondingly moved to its listening-in position 7 or its listening-out position 15; and each time the sequence switch moves to the listening-in position, the lamps of the class-of-service responsive device again indicate the class of service of the calling line. At the conclusion of the conversation between the subscribers, and before taking down the connection, the operator presses her charge key 179. This act causes the application of current to the connecting cord circuit in a manner which is automatically predetermined by the operation of the class-of-service responsive apparatus, this apparatus acting to adapt the circuits controlled by the charge key to the class of service of the calling line in a manner which I shall now describe. When the charge key 179 is pressed, it causes the operation of two relays, 189 and 123, the circuit of the last mentioned relay being further controlled in contacts that are closed in position 17 of the calling plug sequence switch 118, so that the charge key has control over the relay 123 only when the calling plug sequence switch is in its talking position, that is, only when a connection has been completed with the called line. Assuming that this is the condition, and that the relay 123 is operated, it moves its switch contacts 122 to disconnect the relay 121 from the third conductor 64 of the connecting cord circuit, and to extend the conductor 64, without interrupting it to a circuit having two branches controlled in the contacts 184 and 185 of relay 196. The branch normally closed is by way of contacts 184, and includes the winding of a relatively high-resistance and sensitive relay 186 and a battery of, say, twenty-four volts; while the other branch, by way of contacts 185, which is closed when the relay 196 is operated, includes a relatively low-resistance and insensitive relay 187 and a battery of, say, forty-eight volts. Each of the relays 186 and 187, when it operates, is adapted to operate a position register 188, and this position register, in operating, registers the connection and lights an associated pilot lamp. The conductor 64 with which one or the other of these branches is connected when the relay 123 is operated, is the third strand of the connecting cord circuit, and is an extension of the conductor of the calling line which includes the cutoff relay. If the calling line is a flat rate or coin collector line, its third conductor includes only the cutoff relay. If it is a message rate line, a message register 27 is also connected with the third conductor 64 in parallel with the cutoff relay. This message register 27 may be of a well-known type having two windings in series, one of which windings is short-circuited when the register operates to permit an increased flow of current over the circuit. When the line is a message rate line with the message register 27 connected, the branch that includes the winding of relay 187 and the forty-eight volt battery is included in the circuit. The relay 187 is of such low resistance that it is not operated by the current which flows when both windings of the message register 27 are included in the circuit. But when the message register acts and short-circuits one of its windings, the increased flow of current is sufficient to operate the relay 187. As a result, the relay 187 acts to operate the position register 188 and the associated pilot lamp only after the message register 27 has operated.

If the calling line is not a message rate line, the relatively high resistance and more sensitive relay 186 is included in the circuit of the third strand or conductor 64, so that when the relay 123 operates as a result of

the depression of the charge key 179, the relay 186 acts to operate the position register 188 and light the associated pilot lamp without waiting for the operation of some other device such as the message register 27. Thus one of the branches, that which includes the contacts 185, the winding of the relay 187 and the forty-eight volt battery, is adapted to the circuit conditions present in message rate lines; while the other branch, that which includes the contacts 184, the winding of relay 186 and the twenty-four volt battery, is adapted for the circuit conditions that are present in lines other than message rate. Which one of these branches is operatively associated with the circuit at the time the operator presses her charge key 179, is automatically determined by the class-of-service responsive device, through the medium of the relay 196, which controls the two branches. If the calling line is not a message rate line, the relay 196 is not energized. But if the calling line is a message rate line, when it is first brought into operative relation with the class-of-service indicating apparatus, that apparatus operates, as hereinbefore set forth, to leave the relay 85 energized at the end of the cycle of operation, and thus to complete the circuit of conductor 62 in which the relay 196 is included. This path for the operation of the relay 196 is as follows: battery, winding of relay 196, contacts 182 of said relay, contacts 183 of sequence switch 165, conductor 62, contacts of relay 85, front contacts 140 of relay 74, to ground. The closure of this circuit operates relay 196 to connect with the circuit the branch including the relay 187, and also closes a locking circuit for relay 196 by way of its contacts 203 and contacts 119 of sequence switch 165 to ground. This locking circuit also has a path to ground through locking contacts 120 of relay 68 and contacts of the calling plug sequence switch 118 that are held closed in positions $1\frac{3}{4}$ to $17\frac{1}{4}$ of that switch; that is, from the time the switch leaves its normal position until it moves out of its talking position. Thus the identification of the calling line as a measured service line causes the relay 196 to operate and remain operated thereafter until the connection is taken down, and in its operation to connect in circuit the particular apparatus that is adapted for coöperation with the charge mechanism of message rate lines. Returning now to the other relay 189 which is operated when the operator depresses her charge key 179, this relay, in its contacts 190, breaks the tip conductor 66 of the connecting cord circuit, and connects the portion that extends to the calling line with a branch which includes normally open contacts 191 of relay 192, the winding of a pilot relay 193, and a protective lamp, and extends to the positive pole of a high potential source of current. The current that flows by way of this path to the tip conductor of the calling line is for the purpose of operating the coin-box mechanism at the subscriber's station to collect the deposited coin. The mechanism at the subscriber's station involved in this operation, and in the operation of returning the coin when high potential current of the opposite polarity is applied to the calling line by way of the operator's key 124, under control of the relay 194 operated in the listening position of the sequence switch 165, is well known in the art, and need not be particularly shown or described.

Whether or not current for collecting the coin is applied by relay 189 when the operator presses her charge key 179, is determined by whether or not the relay 192 is operated; and this in turn is determined by whether or not the conductor 63 has been closed in the operation of the class-of-service indicating apparatus. The closure of conductor 63 is effected by the operation of the relay 95, and this in turn is brought about by the action of the class-of-service responsive apparatus hereinbefore described if the calling line is a coin collector line. If it is, a circuit is closed for the energization of the relay 192 as follows: battery, winding of relay 192, contacts 195 of that relay, contacts 198 of the sequence switch 165, conductor 63, front contacts of relay 95, front contacts 140 of relay 74, to ground. The operation of the relay 192 opens the path traced above, and closes a locking path by way of contacts 197 of the relay and contacts 119 of the sequence switch 165, to ground, an alternative path to ground being provided by way of locking contacts 120 of relay 68 and contacts closed in position $1\frac{3}{4}$ to $17\frac{1}{4}$ of the calling plug sequence switch 118. Thus, if the calling line is a coin collector line, the path for the application of the coin collecting current is automatically prepared by the action of the class-of-service responsive device, so that when the operator presses her charge key 179 and thus operates relay 189, the coin collecting current flows out to the calling subscriber's station and there operates the coin mechanism; whereas, if the calling line is not a coin collector line, the operation of the charge key does not apply the high potential coin collecting current. After the operator has pressed the charge key, which brings about in the manner described the application of the sort of charge current to the calling line for which the class of service of the line adapts it, she withdraws the plug 14 from the jack 15. This starts a train of operations governed by the sequence switches, in a manner which need not be described, that results in all of the apparatus involved in the connection being returned to its normal condition.

What is claimed is:

1. In a telephone system, the combination with a plurality of telephone lines, an identifying device, means for causing said device to produce a plurality of different characteristic groups of impulses, each of said groups of impulses being impressed upon the lines of a particular class to distinguish and identify them from the lines of another class, and an indicating device selectively responsive to the different groups of impulses and means for causing the temporary association of said indicating device with any of said lines.

2. In a telephone system, the combination with a plurality of lines divided into groups, of a device for producing different characteristic groups of impulses and to apply said groups to the different groups of lines to distinguish the lines of one group from the lines of another, an operator's position, means for extending any one of said lines to said operator's position, and an indicating device at said position arranged to display a different signal for each of said characteristic groups of impulses and means for causing said indicating device to be brought temporarily into association with any of said lines.

3. In a telephone system, the combination with a plurality of lines adapted for different classes of service, class-of-service identifying means associated with each of said lines, a class-of-service responsive device, means for bringing said class-of-service responsive device temporarily into association with any of said lines, and signal mechanism controlled in its operation by said class-of-service responsive device.

4. In a telephone system, the combination with a plurality of telephone lines, of an identifying device common to said lines for producing trains of impulses, each train consisting of a succession of characteristic groups of impulses, said trains of impulses being impressed upon the various lines to identify them, a responsive device, means for bringing said responsive device temporarily into association with any one of said lines, and means for making the responsive period of said responsive device coextensive with the period of production of a single group of a train.

5. In a telephone system, the combination with a telephone line, an operator's position, and a trunk for extending said line to said operator's position, of an identifying device for producing and applying to said line a train of characteristic groups of impulses, a responsive device at the operator's position, means for bringing said responsive device temporarily into association with the extension of said telephone line, and means for rendering said responsive device responsive at the start of a group of impulses.

6. In a telephone system, the combination with a telephone line, an operator's position and a trunk for extending said line to said operator's position, of an identifying device for producing and applying to said line a train of characteristic groups of impulses, a responsive device at the operator's position, means for bringing said responsive device temporarily into association with the trunk extension of said telephone line, and means to render said responsive device responsive during the period of production of a single group of impulses of said train.

7. In a telephone system, the combination with a telephone line adapted for temporary extension to an operator's position, of an identifying device for producing and applying to said line a train of characteristic groups of impulses, each of said groups being made up of subgroups of impulses, a responsive device at the operator's position, means for bringing said responsive device temporarily into association with said line, means for making the operative period of said responsive device coextensive with the period of production of a single group of impulses of said train, and means for rendering said device selectively responsive with respect to the subgroups of impulses.

8. In a telephone system, the combination with a plurality of telephone lines adapted for different classes of service, of a class-of service identifying device common to said lines for producing a plurality of characteristic trains of impulses, each of said trains being divided into groups and subgroups by pick-up impulses, and said different characteristic trains being applied to the different lines to identify them with respect to their class of service, a class-of-service responsive device, means for bringing said class-of-service responsive device temporarily into association with any line, and means controlled by said pick-up impulses for making the operative period of said responsive device coextensive with the period of production of a single group of said series, and for making said responsive device selectively responsive with respect to the subgroups of each group.

9. In a telephone system, the combination with a plurality of telephone lines differing in their characteristics, identifying means associated with each line, and an indicating device responsive to said identifying means and means for bringing said indicating device into temporary association with any of said lines, said indicating device comprising a plurality of signals and electrically actuated mechanism for selectively displaying the same under the control of said identifying means.

10. In a telephone system, the combination with a plurality of lines adapted for different classes of service, of means for im-

pressing upon each line an electrical condition characteristic of the class of service for which said line is adapted, a class-of-service responsive device, means for bringing said class-of-service responsive device into temporary association with any of said lines, and signals controlled thereby, said responsive device being operated, under the control of the characteristic electrical current flow in the particular line with which it is associated, to selectively display signals corresponding to the class of service of said line.

11. In a telephone system, the combination with a plurality of lines having different characteristics and adapted for temporary extension to an operator's position, of a group of signals at the operator's position for indicating the characteristics of an extended line, an identifying device for impressing upon each line an electrical condition corresponding to the special characteristics of said line, and electrically actuated mechanism responsive to said electrical condition of an extended line for selectively controlling said signals.

12. In a telephone system, the combination with a calling line, class-of-service identifying means associated with said line, an operator's position, operator's equipment including a class-of-service indicating device at said operator's position, automatic means made operative in the calling of said line for extending the line to said operator's equipment to produce a class-of-service indication at said position, a called line, means under the control of the operator for extending said calling line to the called line, automatic means for disconnecting the operator's equipment and rendering the class-of service indicating device inoperative upon the extension of the calling line to the called line, and a switch under the control of the operator for reconnecting the class-of-service indicating device to the calling line to bring said indicating device again under the control of said identifying means.

13. In a telephone system, the combination with a plurality of telephone lines, an operator's position, and means for extending any one of said lines to said operator's position, of a class-of-service identifying device for producing and applying to said lines different trains of characteristic groups of impulses, each of said trains being divided into groups and subgroups by pick-up impulses produced by said device, a class-of-service indicating device, means for bringing said class-of-service indicating device temporarily into association with the extended line at the operator's position, said indicating means comprising a group of signal devices divided into subgroups corresponding with the subgroups of impulses in a train, an electrically actuated switch actuated by the first pick-up impulse received after the indicating device is brought into association with the line for rendering the first subgroup of signal devices selectively responsive to the first subgroup of impulses, an electrically actuated switch operated by the second pick-up impulse for rendering the second subgroup of signal devices selectively responsive to the second subgroup of impulses, and an electrically actuated switch operated by the pick-up impulse at the end of the group of impulses for rendering the signal devices unresponsive to further impulses in the train.

14. In a telephone system, the combination with a telephone line, an operator's position, and means for extending said line to said operator's position, of a class-of-service identifying device for producing and applying to said line a train of impulses divided by pick-up impulses into groups and subgroups, a switch operated as an incident to the connection of the operator's equipment with the extended line, and a class-of-service indicating device at the operator's position brought into operative association with said extended line in the operation of said switch, said class-of-service indicating device comprising a group of signal devices divided into subgroups corresponding with the subgroups of impulses in a train, an electrically actuated switch actuated by the first pick-up impulse received after the indicating device is brought into association with the line for rendering the first subgroup of signal devices selectively responsive to the first subgroup of impulses, an electrically actuated switch operated by the second pick-up impulses for rendering the second subgroup of signal devices selectively responsive to the second subgroup of impulses, and an electrically actuated switch operated by the pick-up impulse at the end of the group of impulses for rendering the signal devices unresponsive to further impulses in the train.

15. In a telephone system, the combination with a plurality of terminating telephone lines, means for extending the circuit of any one of said lines, a class-of-service identifying means associated with each line, a class-of-service responsive device, means for bringing said device into temporary association with the extended line and responsive to the identifying means associated with said line, and a switch for controlling the circuit of said line, said switch being controlled in its operation by said responsive device.

16. In a telephone system, the combination with an operator's position, of a telephone line temporarily extended thereto, class-of-service identifying means associated with said line, a class-of-service responsive device at the operator's position temporarily associated with said extended line and re-

sponsive to the class-of-service identifying means associated with said line, and a circuit for applying controlling current to said line, said circuit being under the control of said class-of-service responsive device.

17. In a telephone system, the combination with a telephone line, of class-of-service identifying means associated with said line, a class-of-service responsive device, means for bringing said device into temporary association with said line, and a switch for applying controlling current to said line, said switch being under the control of said responsive device.

18. In a telephone system, the combination with a telephone line, of class-of-service identifying means associated with said line, a class-of-service responsive device, means for bringing said device into temporary association with said line, and a switch controlled by said responsive device for controlling the circuit of said line.

19. In a telephone system, the combination with a connecting circuit, of a plurality of lines severally adapted to be extended thereto, identifying means associated with each line, a responsive device, means for bringing said device into operative relation with said connecting circuit, and responsive to the identifying means of the extended line, and a switch controlled by said responsive device for controlling the circuit of said line.

20. In a telephone system, the combination with a plurality of lines extending to a central office, identifying means associated with each line at the central office, a responsive device, means for bringing said device into temporary association with any of said lines, said device being responsive to the identifying means of the associated line, and a switch controlled by said responsive device for controlling the circuit of the associated line.

21. In a telephone system, the combination with a plurality of lines extending to a central office and divided into groups at the central office with respect to their class of service, class-of-service identifying means common to all of the lines of each group, a class of service registering device, means for bringing said device into temporary association with any of said lines and responsive to the identifying means of such line.

22. In a telephone system, the combination with a connecting circuit, of a plurality of lines severally adapted to be extended thereto, said lines being divided into groups with respect to their class of service, identifying means common to all of the lines of each group and different in character from the identifying means for the lines of another group, and a class-of-service indicating device associated with said connecting circuit and means for displaying a distinctive signal in response to the identifying means of each of said groups.

23. In a telephone system, the combination with a plurality of lines differing in their characteristics, a line identifying device for producing a plurality of trains of groups of impulses, each of said trains differing from the others in the number of impulses in its group, said trains being impressed upon the various lines to distinguish and identify them, an indicating device, and means for bringing said device into temporary association with any of said lines, said device comprising signals successively made responsive by said means to the successive impulses of a group, whereby the particular signal made operative corresponds with the number of impulses in the identifying group.

24. In a telephone system, the combination with two telephone lines, electromagnetic mechanism associated with one of said lines, a class-of-service identifying means associated with said lines for identifying them with respect to the presence or absence of said associated electromagnetic mechanism, a class-of-service responsive device, means for bringing said device into temporary association with either of said lines, a source of current for operating said electromagnetic mechanism, and a switch controlled by said responsive device for permitting the application of said operating current to the line having said associated electromagnetic mechanism and preventing its application to the line unprovided with said mechanism.

25. In a telephone system, the combination with an identifying mechanism for producing pick-up impulses and trains of counting impulses, each of said trains having a number of impulses in a given interval different from the number of impulses in each other train, a plurality of telephone lines to which said trains of counting impulses are variously applied for identifying the same, an electrically actuated counting device, an energizing circuit for the same, and electromagnetic mechanism controlled by said pick-up impulses for bringing said energizing circuit into operative relation with a particular one of said telephone lines during the interval between two successive pick-up impulses, whereby the number of counting impulses applied to the line during said interval is measured by said counting device.

26. In a telephone system, the combination with a circuit, and a plurality of telephone lines severally adapted to be extended thereto, of an identifying device common to said lines for applying to each line a predetermined number of impulses for its identification, and an electrically actuated counting mechanism associated with said connecting circuit with means for rendering said mechanism selectively responsive to the iden-

tifying impulses applied to the various lines which may be extended to said circuit.

27. In a telephone system, the combination with a connecting circuit and a plurality of telephone lines adapted severally to be extended thereto, of an identifying device for producing a plurality of trains of counting impulses, the impulses in each of said trains being different from those in the other trains with respect to their arrangement and timing, an indicating device associated with said connecting circuit, said indicating device comprising a plurality of electrically actuated counting mechanisms, an electrically actuated switch for controlling the operation of said counting mechanisms, said switch being responsive to the train of identifying impulses in the line to which said connecting circuit is connected, an electrically actuated switch for placing said counting mechanisms successively under the control of said first mentioned electrically actuated switch, and means controlled by said identifying device for causing the operation of said second mentioned electrically actuated switch, whereby different impulses in a train of counting impulses are caused to flow to different counting mechanisms.

28. In a telephone system, the combination with a plurality of lines, an extension circuit for said lines, and a group of signals associated with said extension circuit, of a circuit interrupter for selectively controlling the operation of said signals for the purpose of indicating the character of said lines incident to the extension thereof.

29. In a telephone system, the combination with a plurality of lines, and an extension circuit for said lines, of an indicating device associated with said extension circuit, said device comprising a plurality of groups of signals with apparatus for operating the same, and identifying means associated with each of said lines for bringing about the display of a particular signal in each group to identify an extended line.

30. In a telephone system, the combination with a plurality of lines, and an extension circuit for said lines, of an indicating device associated with said extension circuit said device comprising a plurality of groups of signals with apparatus for operating the same, identifying means associated with each of said lines and adapted to produce impulses for the operation of the signals of said groups, and an automatic switch for directing said identifying impulses to said groups in succession to cause the display of a signal in each of said groups.

31. In a telephone system, the combination with an operator's circuit and a plurality of lines severally arranged to be extended thereto, of a commutator device associated with said lines, indicating devices associated with said operator's circuit, and means controlled by said commutator device incident to the extension of a line to said operator's circuit to selectively actuate said devices to indicate the character of said extended line.

32. In a telephone system, the combination with an operator's circuit, and a plurality of lines arranged severally to be extended thereto, of a commutator device associated with said lines to supply to the same impulses of identifying current, said impulses differing for the different lines and being applied in a constant succession of cycles, indicating devices associated with said operator's circuit, and means controlled by said commutator device incident to the extension of a line to said operator's circuit to actuate one or more of said devices during the period of one of said cycles to indicate the character of said extended line.

33. In a telephone system, the combination with an operator's circuit, of a plurality of lines severally adapted to be extended thereto, a constantly operating commutator device common to said lines for producing a controlling impulse and a plurality of different identifying impulses in each cycle of its operation, said identifying impulses being applied to the different lines for their identification, an indicating device associated with said operator's circuit for giving different signal indications corresponding to said different identifying impulses, and means controlled by said controlling impulse to establish an operative relation between said indicating device and the identifying impulses of an extended line during one cycle of operation of said commutator.

In witness whereof, I hereunto subscribe my name this 21 day of May A. D., 1915.

SAMUEL BYRON WILLIAMS, JR.