March 10, 1931. R. F. STEHLIK 1,795,350

SERVICE OBSERVATION IN TELEPHONE SYSTEMS USING CALL INDICATORS

Filed Aug. 29, 1927 5 Sheets-Sheet 1

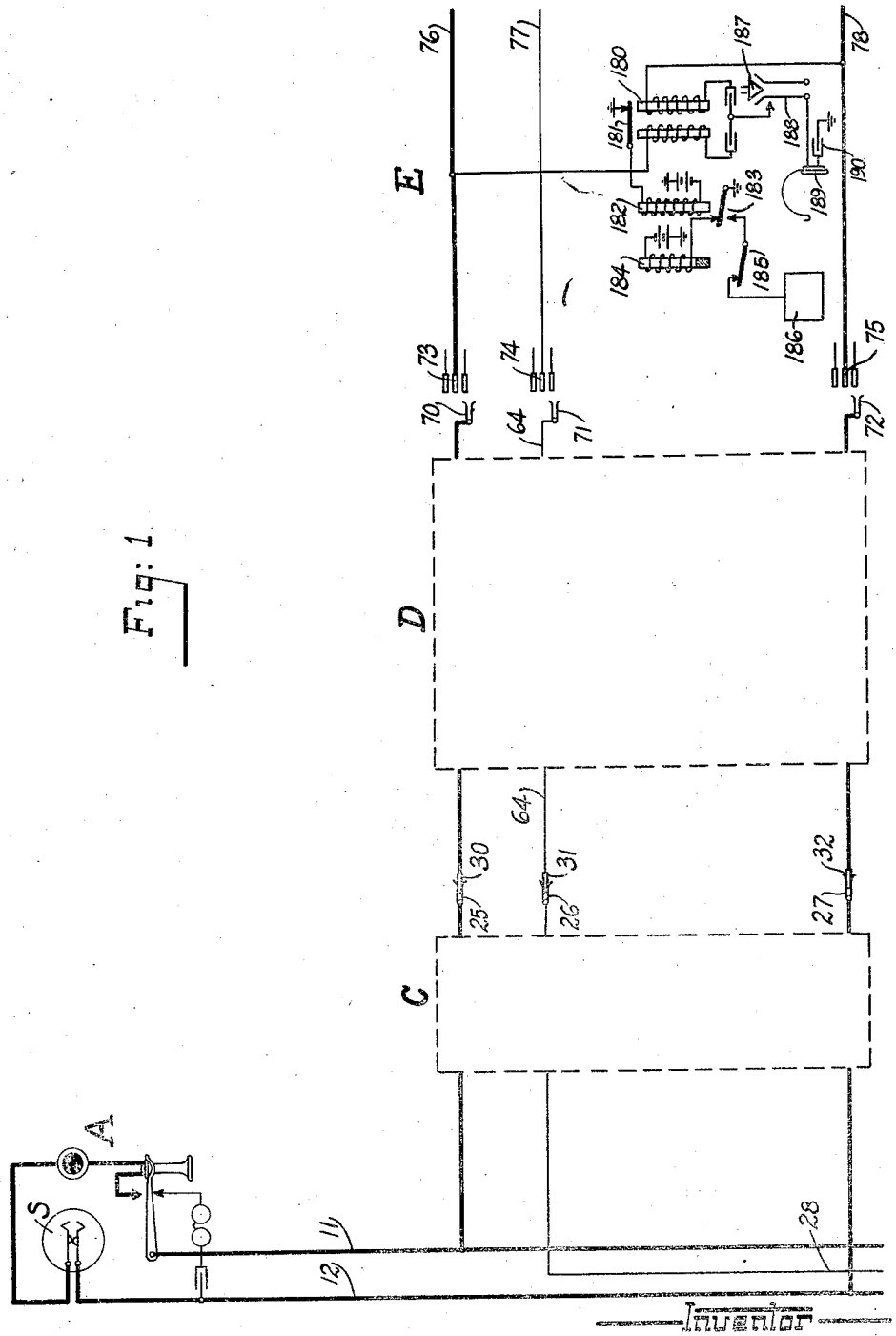

Fig. 1

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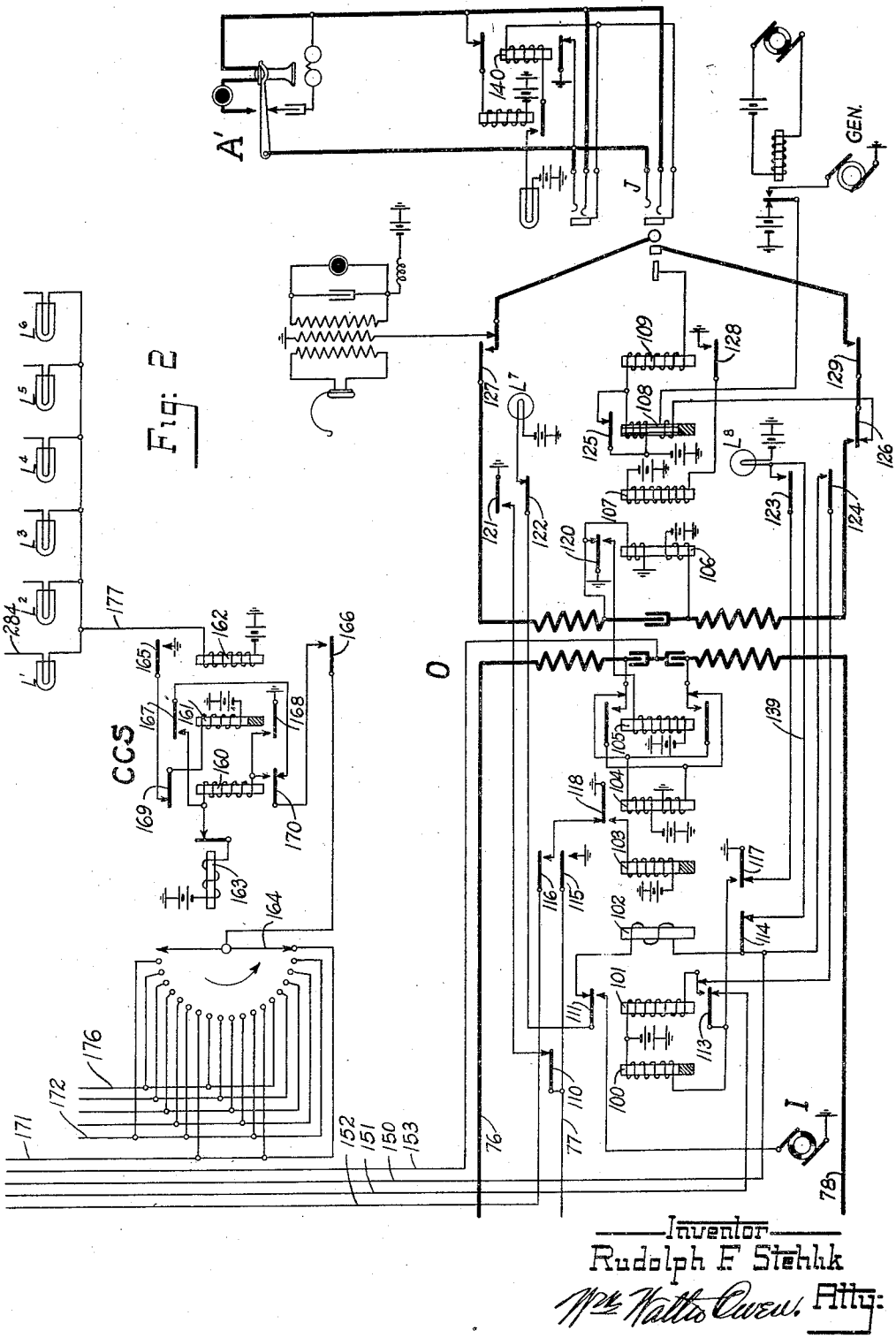
Filed Aug. 29, 1927 5 Sheets-Sheet 2



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SERVICE OBSERVATION IN TELEPHONE SYSTEMS USING CALL INDICATORS

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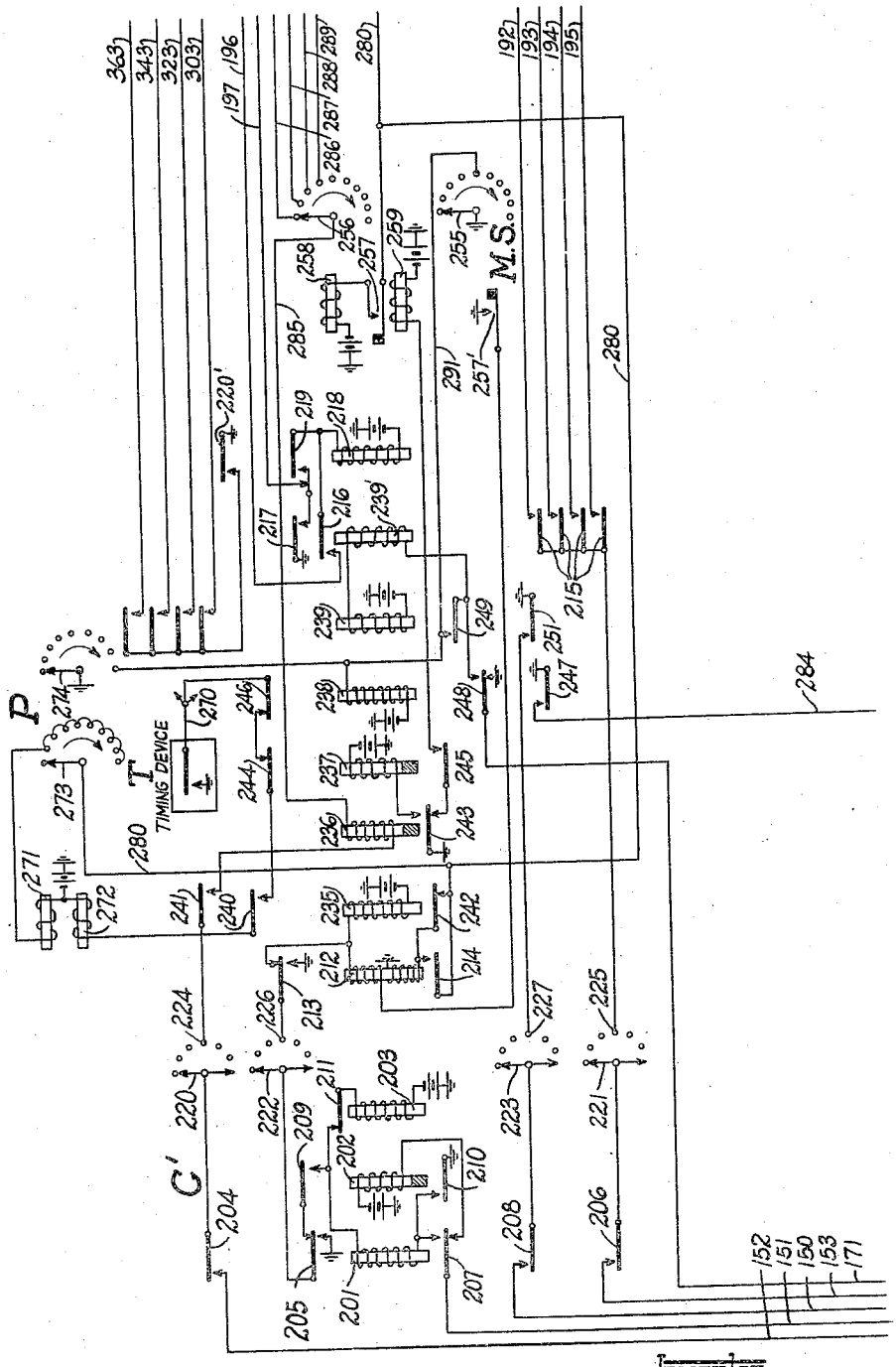
Fig. 3



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SERVICE OBSERVATION IN TELEPHONE SYSTEMS USING CALL INDICATORS

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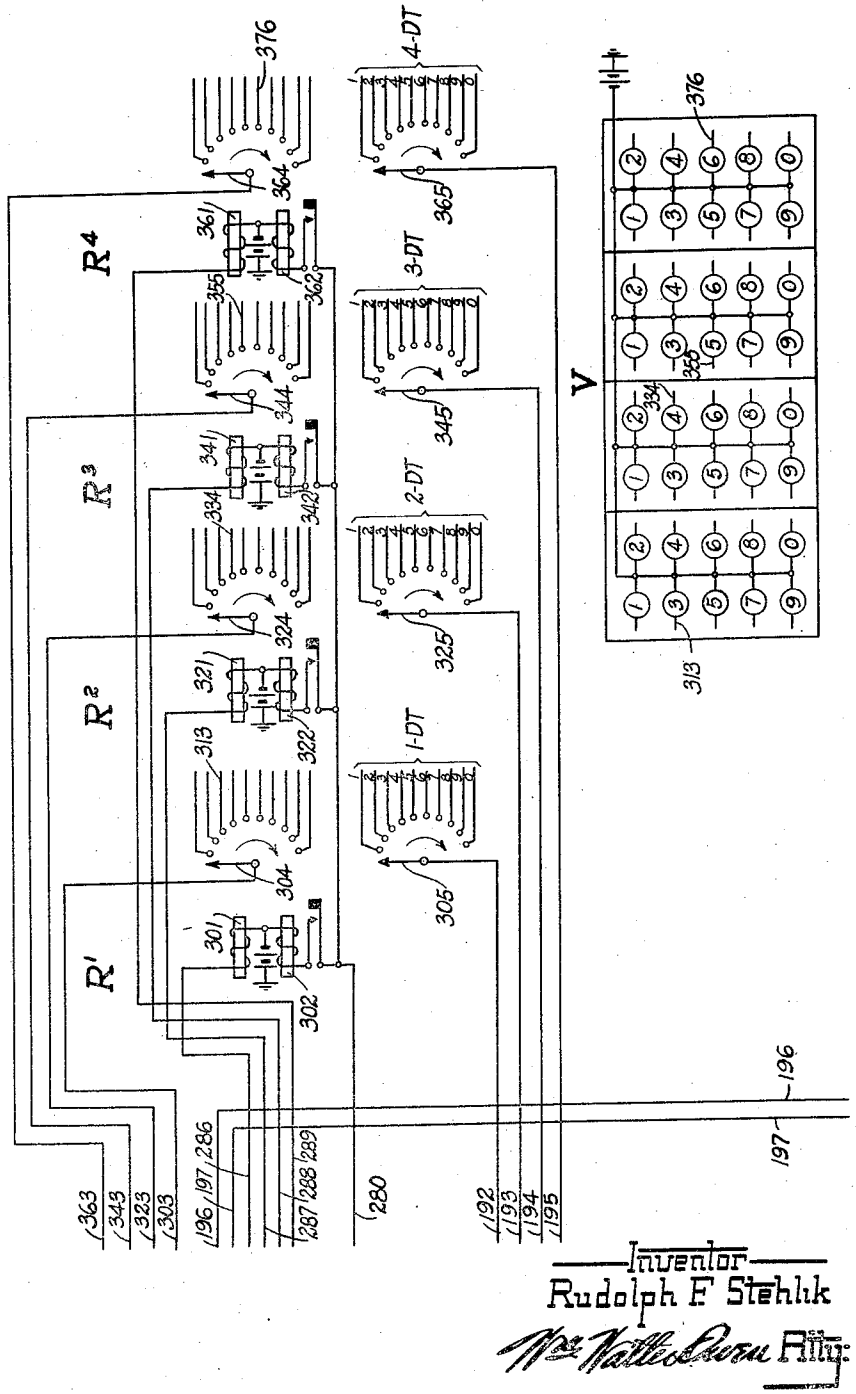
Fig. 4



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SERVICE OBSERVATION IN TELEPHONE SYSTEMS USING CALL INDICATORS

Filed Aug. 29, 1927 5 Sheets-Sheet 5

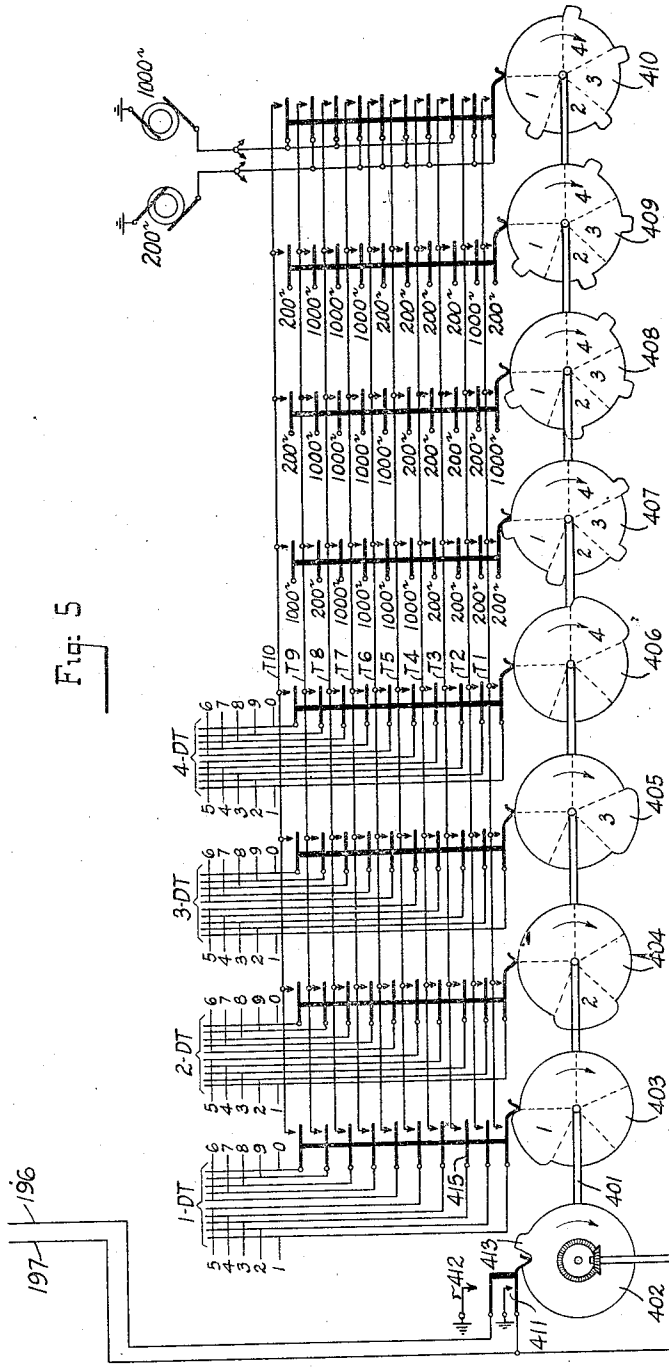

Fig. 5

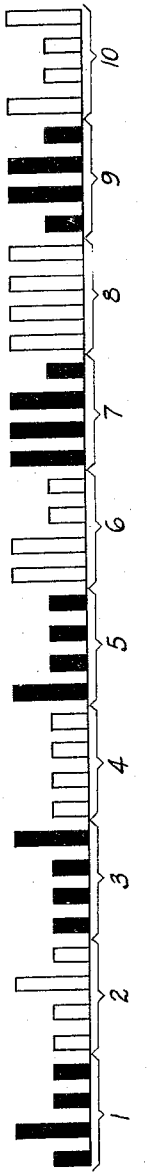

Fig. 6

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UNITED STATES PATENT OFFICE

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SERVICE OBSERVATION IN TELEPHONE SYSTEMS USING CALL INDICATORS

Application filed August 29, 1927. Serial No. 216,016.

This invention relates in general to service observation, but more particularly to service observation in multi-office telephone systems, such for example, as disclosed in the patent to Bernard D. Willis, filed May 3, 1921, Serial No. 466,446, Patent No. 1,542,649, issued June 16, 1925.

The system disclosed in the above patent comprises manual and automatic telephone exchanges. When a subscriber connected to an automatic exchange desires to extend a call to a subscriber in a manual exchange, he operates his calling device in correspondence with the desired subscriber's telephone number and gains access to an operator's position in the manual exchange. This operator is advised of the calling subscriber's wishes by means of a call indicator which records the desired subscriber's telephone number on a lamp indicator. The operator completes the desired connection by the usual manual means, consisting of a plug which terminates the trunk line taken into use by the calling subscriber, which plug is inserted into the jack of the wanted party's line. The presence of the operator does not concern the calling subscriber. As far as he is concerned, the connection is established entirely automatically.

The history, the purpose and the applicability of multi-telephone systems of this character are well known and shall not be discussed in the present application. The successive steps involved in the establishment of a connection and the operations incident thereto shall be explained in the detailed description which is to be presented later on.

Service observation, in the sense in which this term is used in the instant application, denotes means for following up the progress of a call from the moment the call is originated until the desired subscriber answers. The known means for service observation comprise apparatus which is manipulated by a person charged with the duties of observing the establishment of calls in an exchange and which permits the observer to connect with a trunk line which is provided for the extension of calls. The observation begins when the trunk line is taken into use by a calling subscriber. The trains of impulses transmitted over the trunk line by the calling party are utilized for operating suitable observation equipment which furnishes visual indications for the observer, informing him of the number dialled by the calling party. The observer listens-in until the called party replies, thereby checking-up whether or not the call has been successfully completed.

This type of observation equipment is entirely satisfactory in connection with standard switch trains, i. e., in systems in which a connection is completed exclusively by automatic switches. In call indicator systems, however, in which dialling of a certain number is utilized for informing an operator of the calling party's wishes, while the completion of the call is effected manually, other means must be devised for observing the progress of a call. This will be apparent when the possibilities are considered which may cause the loss of calls, or wrong connections, in call indicator systems. It is obvious that the causes for an improper connection may be a faulty manipulation of the calling device at the calling subscriber's station, or improper response of the register switches at the call indicator, or it may be incorrect plugging by the call indicator operator. It is the purpose of service observation to determine the causes of faulty connections, and the chief object of the present invention resides in the provision of suitable equipment for that purpose.

To achieve this object, the circuits disclosed in the patent cited in a previous paragraph have been changed somewhat to suit the purpose. A "tone machine unit" has been designed which may be made portable so that it may be used at whatever position it is desired. When the digits dialled by a calling party are registered by the register switches of the call indicator, and before these digits are displayed to the operator, the "tone machine unit" starts to operate, and goes through a cycle of operations during which tone combinations corresponding to the dialled digits are transmitted over a simplex circuit to the trunk line which is used in the connection. The service observer who is connected to this

trunk line hears the tone combination and is thereby informed of the number which is registered at the call indicator position. Should this number not agree with the number dialled by the calling subscriber, the observer knows that source of trouble. He remains in the connection until the called party replies. In case a wrong party answers while the dialled number has been properly transmitted and registered at the call indicator, the observer knows that the incorrect connection was due to faulty manipulation by the operator.

With the above introductory remarks in mind, the drawings, comprising Figs. 1 to 6, inclusive, will now be briefly explained, before the detailed description is proceeded with.

The drawings show, by means of the usual circuit diagrams, apparatus necessary for establishing a connection between a calling automatic subscriber A shown in Fig. 1, and a called manual subscriber A′ shown in Fig. 2.

Figs. 3 and 4, show the call indicator equipment for registering a call before the call indicator operator.

Fig. 5, shows the tone machine unit and circuit connections connecting the same with the rest of the equipment.

Fig. 6, shows the tone combinations produced by the tone machine unit in a graphic representation.

Inasmuch as the automatic switching equipment itself and the manual equipment are both well known and of the usual type, no detailed description of the mechanical features of this apparatus will be given except insofar as it is found convenient or necessary to do so in the explanation of the operation of the circuits.

Referring particularly to Fig. 1, the substation A is one of a plurality of ordinary automatic substations terminating in the automatic exchange previously referred to, and is provided with the usual talking equipment and ringer, and also with a calling device of well known type which is indicated by the reference character S, through the medium of which the subscriber controls the setting of the switches.

The line conductors 11 and 12 extend to the exchange where they terminate in the line switch C, which may be briefly described as a rotary line switch whose movable terminals or wipers have no normal position, and which have movements in a forward direction only. The construction of a line switch of this type is well known in the art, and its function, also well understood, is to extend its associated line when calling to an idle trunk line. In carrying out this object, a plurality of these individual line switches are given access to a group of trunk lines extending to first selector switches. One of the trunk lines to which the line switch C has access is indicated in the drawing as extending to the first selector D, which is a vertical and rotary selector of the well known Strowger type. In a multi office system of the kind herein contemplated the first selector switches are usually known as office selectors, and the selector D in common with a plurality of similar selectors has access to a plurality of groups of trunk lines, each of which group may extend to a different office or exchange in the system. Some of these groups of trunk lines may extend to automatic exchanges, while other groups may extend to manual exchanges. A trunk line in one of the latter groups is shown in the drawing and comprises conductors 76, 77, and 78, which extend to the manual exchange in question and terminate there in the plug ending cord circuit O Fig. 2. The cord circuit O is one of a plurality of similar cord circuits at a B operator's position in the manual exchange and constitutes the means whereby the trunk line may be connected by the operator with any one of the manual lines terminating in the manual exchange. One of these lines is the line of substation A′, with which is associated the line equipment shown at the right of Fig. 2.

From the foregoing it will be understood that the operation of an office selector, such as the selector D, in response to the calling of the first digit in the telephone number of a line in the manual exchange, will result in extending the connection from the line of the calling automatic subscriber to an idle plug ending cord circuit in the manual exchange. In order to take care of the remaining digits in the number, there is provided for each B operator position a plurality of register sets, as stated previously, each set being capable of registering all the digits in a telephone number with the exception, of course, of the first digit which controls the office selector in the automatic exchange.

In Figs. 3 and 4, there is shown one of these register sets complete. It comprises the master control switch MS, Fig. 3, and register switches R1, R2, R3, and R4, Fig. 4. The master control switch MS which may be described briefly, consists essentially of two wipers 255 and 256 and their associated sets of bank contacts, together with the stepping magnet 259 for advancing the switch wipers, and a release magnet 258 for restoring them to normal. A set of rotary off normal springs 257 are included in the circuit of the release magnet and are closed on the first movement of the switch. Another set of off normal springs 257′ are likewise closed when the switch moves from its normal position and serve a purpose which shall be explained later on. Since the switches are all alike mechanically, it will be unnecessary to describe the others.

The indicating device by means of which

called telephone numbers are displayed to the operator is illustrated in Fig. 4, and indicated by the reference character V. It comprises, essentially, a plurality of banks of switchboard lamps, there being one bank of lamps for each register switch in a set. It will be understood that the lamps have the function of illuminating the digits of the called number. The digits are provided in black on the reverse side of a white semi-transparent surface and ordinarily not very conspicuous. But when the lamp immediately behind any character or figure is lighted, such character or figure will stand out very clearly and is recognized easily. The banks of the indicating device are wired to the bank contacts which are associated with wipers 304, 324, 344, and 364, of the several register switches shown. The lamps are, of course, also multipled to the corresponding bank contacts in the register switches of other register sets.

As stated already, there is a plurality of register sets provided for the registration of a plurality of calls simultaneously or one close after the other. These registered calls are displayed on the indicating device one after the other as fast as the operator can complete the connections by plugging into the multiple jacks which correspond to the numbers displayed. In order to switch a call over onto the next indicating device in succession the so-called consecution control switch is provided. This switch is shown in Fig. 2, where it is indicated by the reference character CCS. It comprises a single wiper and a bank of contacts. This switch is mechanically the same as the rotary line-switch C indicated in Fig. 1, that is, its wiper has no normal position and moves in a forward direction only. The circuit, however, is slightly different and will be described presently.

Each register set is provided with a time control switch, which, in the case of the register set illustrated in Figs. 3 and 4, is indicated by the reference character P, Fig. 3. This switch is similar in construction to the register switches but is operated by a timing mechanism instead, by means of impulses corresponding to the digits in a called subscriber's telephone number. The timing mechanism, which may be common to the exchange, is indicated by the reference character T, and may consist of any suitable kind of clock work controlled mechanism which is adapted to produce impulses at the rate of 1 per second.

In order to properly extend calls which are received at the manual exchange, to the register sets, each cord circuit is provided with an individual rotary line switch, and these line switches have common access to all the register sets. The reference character C′, in Fig. 3, indicates a rotary line switch which is individual to the cord circuit O, Fig. 2, and which has access to the register set shown in the drawing, and also to other register sets which are provided at the B operator's position in which the cord circuit O terminates. Line switch C′ is of the same construction as the line switch C, Fig. 1, but the circuits are modified somewhat in order to take care of the different requirements.

The above brief account of the system is concerned with the apparatus used in extending a call from a calling automatic substation to a called manual substation, as well as with the apparatus used for displaying the desired subscriber's number before the B operator's position. The equipment used for service observation of the type mentioned previously, will now be briefly outlined.

It will be seen that the register switches shown in Fig. 4, are provided with two wipers. The purpose of the upper wipers of these register switches is to establish connection with the corresponding display lamps in the indicating device V. The purpose of the wipers 305, 325, 345, and 365 is to establish connection with the tone machine unit shown in Fig. 5.

Referring now particularly to the equipment shown in Fig. 5, it will be seen that this equipment consists of a motor designated 400 which is adapted to rotate the shaft 401 in a direction indicated by the arrow on the cams 402 to 410. The cam 402 is adapted to operate the spring contacts 411 and 412 in such a manner that the contact 411 is closed when the cam 402 starts to rotate, while the contact 412 will only be closed through the medium of the projection 413. The cams 403, 404, 405, and 406, cooperate with sets of contact springs which will be closed in succession as is very obvious from the drawing.

The contact banks of the register switches shown in Fig. 4, and designated 1—DT, 2—DT, 3—DT and 4—DT are wired to the tone machine unit in Fig. 5, in a manner which can readily be seen from an inspection of the drawings, and which is indicated by corresponding designations on Fig. 4, and Fig. 5. There are ten common tone conductors shown in Fig. 5 and indicated by the reference character T1 to T10 respectively. When the cam 403 closes the corresponding contact set, the bank contacts accessible to the wiper 305 in Fig. 4, will be connected to the common tone conductors T1 to T10 in Fig. 5. The same is true of the cams 404, 405, and 406, with respect to the bank contacts accessible to the wipers 325, 345 and 365 shown in Fig. 4. In other words, the bank contacts of the registers R1 to R4, inclusive, shown in Fig. 4, will be connected in succession to the tone conductors T1 to T10. As will be seen later on, the register switch R1 receives the first digit to be displayed to the operator, and the rest of the registers receive the remaining digits.

The corresponding wipers of the various register switches are thereby advanced to bank contacts which correspond to the digits dialled. It will be apparent from the progressing description, that the wipers 305, 325, 345, and 365 are, at this stage of the operation, that is when a calling subscriber has finished dialling, connected through over a common signalling conductor to a simplex circuit which extends over the trunk line taken into use. The purpose of the tone machine unit shown in Fig. 5, is, as has been explained, to transmit to an observation operator a characteristic series of tone combinations indicating to him the setting of the register switches. These tone combinations are produced as follows:

During the time the cam 403 has connected the bank contacts of the register switch R1 to the common tone conductors T1 to T10, inclusive, the cams 407, 408, 409 and 410 which are also connected to the common shaft 401 successively close their corresponding set of spring contacts which are shown right above the various cams. A characteristic tone signal is thereby transmitted to the observation operator who happens to be connected to the trunk line for the purpose of observing the progress of the call. This tone combination designates the digit which has been received at the register switch R1. In the upper right-hand corner of Fig. 5, there are shown two generators which indicate tone machines, one producing a tone of two hundred cycles, and the other producing a tone of a thousand cycles. These tone machines are shown wired to the spring contacts adapted to be closed by the cam 410. The spring contacts which are closed by the cams 407, 408 and 409 are likewise wired to the generator as is indicated by the terminals at the springs. Since the spring contacts operated by the various cams 407 to 410, inclusive, are closed successively, it will be obvious that each of the common tone conductors T1 to T10 inclusive, will be connected in succession to the tone sources in certain combinations. Considering the tone conductor T1, for example, it will be seen, that it will be connected in succession to the tone sources as follows: When the cam 407 closes its contacts, the conductor will be connected to the two hundred cycle source; the cam 408 thereafter connects it to the thousand cycle source; cam 409 connects the conductor again to the two hundred cycle source, and, when cam 410 closes its corresponding contacts, the conductor will be again connected to the two hundred cycle source. This produces a characteristic tone combination. Should the register switch R1 in Fig. 4, have received digit 1, the wiper 305 will be connected with the conductor 1 leading to the common tone conductor T1 in Fig. 5. While the cam 403 keeps the spring contacts closed, and thereby the conductor 1 connected to the tone conductor T1, the aforementioned tone combination will be transmitted. If it is assumed that the register switch R1 in Fig. 4, has received five impulses, the wiper 305 will be in connection with the conductor 5 leading to the tone machine unit in Fig. 5. This conductor is connected by means of the cam 403 to the common tone conductor T5 and the tone combination which will be transmitted at this time over the conductor T5 consists of a short tone from the thousand cycle source followed by three short tones from the two hundred cycle source. The various tone combinations are shown graphically in Fig. 6.

When the characteristic tone combination for the first digit is transmitted, cam 403 opens its corresponding spring contacts and cam 404 connects the bank contacts of the second register switch, which are accessible to the wiper 325, to the common tone conductors. The characteristic tone combination designating the digit which has been registered on the register R2 will be transmitted to the observation operator. The tone combinations for the remaining digits registered on the register switches R3 and R4 will be transmitted in precisely the same manner as the tones for the first and second digit.

After all tone combinations for all digits registered are transmitted, which consumes about one second, the projection 413 on cam 402 will cause the closure of the contact springs 412 thereby completing a circuit which causes the display of the dialled digits to be B operator. This operator then completes the connection in the usual manner.

Having described in a general way the layout of the system, the operation of the circuits will now be described more in detail. It will be assumed for this purpose that an observation operator desires to know the progress of calls extended over the trunk line comprising conductors 76, 77 and 78. The observation equipment is shown diagrammatically in Fig. 1 and designated with E. It comprises relays 180, 182 and 184 for visually indicating on an observation indicator 186 digits dialled over the trunk line. The operation of this equipment is well known and shall not be discussed in detail in this specification. However, it may be said, that the relay 180 follows the impulses dialled over the trunk conductors 76 and 78, operating thereby the relay 182. As long as relay 180 is in normal position, a circuit is closed from ground, by way of armature 181, winding of relay 182 to battery. Relay 182 keeps its armature 183 closed, thereby providing a circuit for the slow acting relay 184. When impulses arrive over the trunk conductors 76 and 78, the relay 180, which follows the impulses, causes the relay 182 to operate correspondingly. Relay 184, however, does not follow the impulses and remains operated throughout the dialling period. Whenever relay 182 deenergizes, it

closes a circuit for the visual indicator indicated at 186, from ground, armature 183, and armature 185. The impulses transmitted over the trunk conductors 76 and 78 will thereby be registered in front of the observation operator. The present application is, however, not concerned with the visual indication of impulses dialled over the trunk conductor, and the equipment has merely been shown for the sake of completeness. It is chiefly used in observing the progress of calls to automatic exchanges.

It will be seen that the observation equipment also includes an operator's head set designated 189 and a manually operable key 187 by means of which the head set may be connected to a middle point between the condensers joining the windings of relay 180. This latter equipment is provided for receiving the characteristic tone combinations designating the setting of the register switches at the call indicator position.

It was assumed that the observation operator desires to observe the progress of calls extended over the trunk conductors 76 and 78, and it is now further assumed that the subscriber at substation A desires to obtain a connection with the manual subscriber at substation A' in Fig. 2, whose telephone number, it will be assumed, is Number 23456.

When the receiver is removed at substation A, a circuit will be closed in the usual manner for operating the lineswitch C which rotates and seizes the office selector D. This selector is then operated in accordance with the first digit of the desired number and raises its wipers opposite a certain row or level in which trunk lines, such as the one comprising conductors 76, 77 and 78 are located. The selector rotates then to seize an idle one of the trunk lines and it will be assumed that the idle one is the trunk line comprising conductors 76, 77 and 78 and leading to the manual exchange shown in Fig. 2. The circuit of the line switch C and of the office selector D have not been shown in Fig. 1. For an explanation of the circuit operation of the switches, the Patent 1,542,649 mentioned in a previous paragraph may be consulted. When the office selector D seizes the trunk line, the incoming line conductors are disconnected from the windings of the line relay of the office selector and extended by way of the trunk conductors 76 and 78, left-hand windings of the repeating coil in the cord circuit O, Fig. 2, and normally closed contacts of the reversing relay 105 to the upper and lower windings of the line relay 104 in the cord circuit.

When the calling line is extended to the line relay 104 as above explained, the line relay 104 operates and completes an energizing circuit for the slow acting relay 103. Relay 103, upon energizing, at its armature 115, connects ground to the release trunk conductor 77 closing thereby a holding circuit for maintaining the switching relays of the selector D and of the lineswitch C in Fig. 1, energized during the call. In addition to the foregoing, relay 103 prepares at its armature 116 an operating circuit for the register sets, one of which is selected subsequently; and at its armature 117 closes an operating circuit for the individual line switch C', shown in Fig. 3, which circuit extends from ground, armature 117 and its make contact, armature 113 and its resting contact, conductor 151, armature 207 and its resting contact, and the winding of the line relay 202 to battery. Line relay 202 energizes and at its armature 210 closes a circuit for the switching relay 201 in series with the stepping magnet 203. At the same time, at its armature 209, the line relay connects the test wiper 222 with the above circuit at a point midway between the switching relay and the stepping magnet. The trunk selecting operation of the lineswitch C' takes place in the usual manner. For the sake of simplicity, it will be assumed that the wipers of the lineswitch C' are already in connection with the bank contact set associated with the register set shown in the drawings, and it shall further be assumed that this register set is idle. If this is the case, the test contact 226 is connected up as shown and the switching relay 201 of the lineswitch C' will operate immediately and establish a locking circuit for itself at its armature 207 in series with the stepping magnet 203. This latter magnet cannot energize on account of the high resistance of the switching relay 201. At its armature 204, the switching relay 201 connects the impulse conductor 152 through to the register switches; at armature 205, the wiper 222 is connected to direct ground thereby busying the seized register set; at armature 208 the conductor 150 is connected through to the register; and at armature 206 a circuit is prepared for transmitting to the observation operator the characteristic tone combinations mentioned previously.

Upon operation of the switching relay 201 and consequent attraction of armature 205, a circuit is completed for the relay 235, from ground, make contact and armature 205, wiper 222, bank contact 226, armature 213 and its resting contact, winding of relay 235, to battery. Relay 235 operates and closes at its armature 241 an impulsing circuit for the operation of the register switches; at its armature 240, it completes a circuit for the stepping magnet 272 of the time switch P, the operation of which will be described subsequently; and at its armature 242, the relay 235 disconnects the relay 212 from the common release conductor 280.

The apparatus is now ready for receiving the series of impulses corresponding to the second digit in the local number of the called line in the manual exchange. It is under-

stood, of course, that the first digit in the telephone number, which operates the selector D at the automatic exchange has to do with the office selection only, and does not appear in the multiple of the B operator's position. When the dial of the calling device S is operated in accordance with the next digit, another series of interruption, three in this case, will be produced in the line circuit and will bring about a like series of deenergizations of the line relay 104 in the cord circuit O. At each deenergization the line relay transmits an impulse of current to the stepping magnet 301 of the register switch R′ over the following path: ground, armature 118 and its resting contact, make contact and armature 116, conductor 152, make contact and armature 204, wiper 220, bank contact 224, armature 241 and its make contact, slow acting series relay 236, conductor 285, wiper 256 of the master control switch, conductor 286, winding of the stepping magnet 301 of the register switch R′, battery. By the operation of stepping magnet 301, wipers 304 and 305 of the register switch R′ are advanced three steps and are brought to rest in engagement with the third contact in their respective banks.

The slow-acting relay 236 energizes in series with the stepping magnet 301 and retains its armature 243 attracted while the stepping magnet is being operated. In operated position, relay 236 closes a circuit for the slow acting relay 237, which is thus held energized during the operation of the first register switch. After the last impulse is transmitted, the slow acting relay 236 deenergizes and opens the circuit of relay 237. Since this relay is slow acting, however, a circuit will be closed for an instant which extends from the grounded armature 243 by way of armature 245 and its make contact to the winding of the stepping magnet 259 of the master control switch MS and to battery. One impulse is thereby transmitted to the stepping magnet 259, and the wipers 255 and 256 are advanced one step into engagement with the second contact in their respective banks. The advance of wiper 255 does not produce any results at the present time, but when wiper 256 moves from its first contact to the second contact, the operating circuit is transferred to conductor 287 which extends to the stepping magnet 321 of the register switch R2.

The calling subscriber will now operate his calling device in accordance with the next digit in the desired number. As a result, the line relay 104 in the cord circuit operates in the same manner as before, but now sends four impulses over the operating circuit to the stepping magnet 321 of the register switch R2. The stepping magnet 321 advances the wipers 324 and 325 four steps and the wipers are brought to rest in engagement with the fourth contact in their respective bank. The slow acting relays 236 and 237 are energized during the transmission of the second series of impulses in the same manner as during the first, and when the impulse transmission seizes, another impulse of current is transmitted to the stepping magnet 259 of the master control switch, which advances the wipers 255 and 256 another step, and transfers the operating circuit by way of conductor 288 to the stepping magnet 341 of the register switch R3. It will not be necessary to consider in detail the manner in which register switches R3 and R4 are operated. When the digit 5 is called a series of five impulses is transmitted to the stepping magnet 341 of register switch R3 and wipers 344 and 345 are advanced into engagement with the fifth contact in their respective bank. At the end of the series of impulses the master control switch is operated one step and the operating circuit is transferred by way of conductor 289 to the stepping magnet 361 of register switch R4, and the wipers 364 and 365 are then advanced into engagement with the sixth contact in their respective bank. The stepping magnet 259 of the master control switch is then given another impulse of current at the end of the last series of impulses and the wipers 255 and 256 are advanced one more step.

The off normal contact 257 of the master control switch MS is connected to the common release conductor 280 immediately when the switch leaves its normal position. Likewise, the off normal contact of the register switches R1 to R4, shown in Fig. 4, which contact is shown below the release magnets 302, 322, 342 and 362, respectively, have connected the release magnets to the common release conductor 280. The wiper 273 of the timing switch P shown in Fig. 3 has left its normal position and made contact with one of the bank contacts, thereby connecting the release magnet 271 also to the common release conductor 280. Associated with the master control switch is a second off normal contact designated 257′. This off normal contact is also closed with the first step of the master control switch and connects ground to the upper winding of the relay 212. This connection is of no consequence at the present time. The only result produced consists in short circuiting the upper winding of relay 212 to ground by way of the armature 213, wiper 222, of the lineswitch C′, and the operated armature 205 of the switching relay 201. The operation of the various release magnates will be described presently in detail.

When the master control switch MS receives the fifth impulse, at the termination of the transmission of impulse series, the wiper 255 is brought into engagement with the fifth contact in its bank and ground is placed on conductor 291, resulting in the en-

ergization of relay 238. Upon attracting its armature 246 relay 238 stops the operation of the timing switch P, while at armature 247, the conductor 284 is connected to ground, thus closing a circuit through the lamp L', Fig. 2, and through the winding of relay 162 of the consecution control switch CCS. Relay 162 energizes and lamp L' lights to notify the operator that a call has been registered on the associated register set. In addition to the foregoing, relay 238 disconnects conductor 171 from ground at armature 248, and extends this conductor instead to the windings of relays 239 and 239' in series. Conductor 171 may be considered as a test conductor and extends to the first contact in the bank of the consecution control switch CCS, since the register set shown is assumed to be the first register set at the position. The other test conductors 172—176, inclusive, are of course associated with the other register sets at the same position.

Assuming that no other call is being shown on the indicating device at the present time, the consecution control switch CCS is now immediately operated to switch the registered call over onto the indicating device. However, before the registered number is displayed on the indicating device V shown in Fig. 4, characteristic tone combinations corresponding to the registered digits are transmitted to the observation operator who is connected to the trunk line as was described previously. This is done as follows:

When relay 162 of the consecution control switch CCS energizes, it connects the wiper 164, by means of armature 166, and at armature 165 it closes a circuit for the slow acting line relay 161. Upon energizing, the latter relay closes a circuit at its armature 168 which includes the switching relay 160 and the stepping magnet 163 in series, and at its armature 167 connects the wiper 164 to the above circuit at a point midway between the relay and the magnet. The latter operation provides for advancing the wiper 164 in case the contact with which it is in engagement is grounded, but it will be assumed in the present case, that the wiper is standing on the first contact of the bank as shown in the drawing, and since ground has been removed from this contact by the operation of relay 238, in Fig. 3, no rotation of the switch will take place. Instead, the switching relay 160, which is of high resistance, is at once energized in series with the stepping magnet 163, the latter remaining inoperative, and breaks the circuit of line relay at armature 169. The line relay is slow acting, however, and before it has time to deenergize, relays 239 and 239' in the master control switch are energized from ground, armature 168 and its make contact, make contact and armature 170, make contact and armature 166, wiper 164, conductor 171, armature 248 and its make contact, winding of relay 239', winding of relay 239, to battery. Upon energizing, relay 239 closes its armature 249, thereby providing a locking circuit for its own winding in series with the winding of relay 239' to the grounded conductor 291. This latter conductor is grounded over wiper 255 over the master control switch. This operation connects conductors 291 and 171 together and a circuit is thus completed for supplying ground to the switching relay 160 in the consecution control switch CCS in order to maintain this relay energized after the line relay 161 has deenergized. Relays 238, 239, and 239' are now energized, and the consecution control switch is in its operated position (switching relay energized) with its wiper in engagement with the bank contact corresponding to the first register set. Other calls may be registered on other register sets at any time now and when registration is completed the lamps L2, L3, etc., corresponding to the register sets used will be lighted, but this has no effect on the consecution control switch CCS, which makes no further movement until the call on the first register set is disposed of.

The disposal of the call may be considered in two distinct stages. First, characteristic tone combinations corresponding to the digit registered on the register switches R1 to R4, are transmitted over a simplex circuit to the trunk line shown in Fig. 1. The second stage consists in the switching operation which takes place in the register unit for the purpose of switching the registered number onto the display device V shown in Fig. 4.

It will be remembered that the relays 239 and 239' are in energized position. The four uppermost armatures of relay 239, which are adapted to complete the connection between the display conductors 363, 343, 323 and 303, are in attracted position. This operation serves to prepare the display circuit which will be completed when the relay 218 operates and closes its armature 220'. This relay operates after the characteristic tone combinations have been sent out by the tone machine unit shown in Fig. 5. Relay 239' operates its lowermost armatures, preparing thereby the signalling circuit over the common signalling conductor 153 by connecting the digit signalling conductors 192, 193, 194, and 195 through to the conductor 153 by way of the wiper 221 and armature 206 of the line switch C'. At armature 216, the relay 239' prepares a circuit for the operation of the relay 218 over the display conductor 196. At armature 217, the relay 239' connects ground to the start conductor 197 by way of the normally closed contacts controlled by armature 219. Following the start conductor 197 through Fig. 4, to Fig. 5, it will be seen that this conductor terminates in the winding of relay 420. This relay energizes now, attracts

its armature 421, and closes thereby a circuit for the motor 400.

The motor of the tone machine unit operates now, rotates the cams 402 to 410, inclusive, in the direction of the arrow shown on the cams. Cam 402 closes only the contact springs 411, thereby providing a holding circuit for the start relay 420. The springs 412 will be closed by the projection 413 shortly before the cam finishes one revolution. Cam 403 closes its associated contact springs, thereby establishing connection between all bank contacts of the lower bank of register switch R′ shown in Fig. 4, with the tone conductors T1 to T10. While the contacts of the lower bank of the register switch R1 are connected to the tone conductors, the cams 407, 408, 409, and 410 will successively operate their associated spring contacts and thereby connect characteristic tone signals to the tone conductors.

The register switch R′ was advanced, by the impulses transmitted by the calling subscriber, to the third bank contact. An inspection of the drawing Fig. 5 will reveal that the tone conductor T3 which is now in connection with the wiper 305 of the register switch R1, will be successively connected by the cams 407 to 410, to the tone sources as is indicated graphically in Fig. 6 above the numeral 3. The tone combination transmitted over the tone conductor T3 consists of three successively applied signals from the two hundred cycle source, followed by a signal from a thousand cycle source. The transmission path of this tone combination may be traced from the tone conductor T3, make contact and spring 415 closed by the cam 403, conductor 3, third contact in the signal bank of the register switch R′, wiper 305, conductor 192, upper armature 215 operated by relay 239′ in Fig. 3, bank contact 225 of the lineswitch C′, wiper 221, armature 206 and its make contact, conductor 153, middle point between the condensers on the left hand side of the repeating coil in the cord circuit O, Fig. 2, and then in a simplex circuit including the conductors 76 and 78, to Fig. 1, windings of the relay 180, condensers, key contacts 188, and to ground by way of the observation operator's head set 189.

The observation operator, who is informed of the numerical value of the various tone combinations, knows, that the tone combination received corresponds to the digit 3.

When this tone combination is transmitted, the cam 403 in Fig. 5, rotates past its associated contact springs, thereby disconnecting the signal bank of the register switch R1. The cam 404 operates now its associated contact springs and connects thereby the signal bank of the register switch R2 to the tone machine unit in the same manner as the signal bank of the register R1 was connected by the cam 403. During the time the signal bank of the second register is connected to the tone machine unit, the cams 407, 408, 409 and 410, will again connect the same tone sources to the tone conductors T1 to R10. The wiper 325 of the second register has been advanced to the fourth contact. Accordingly, the tone combination corresponding to digit 4 which consists of 4 successively applied tones from the two hundred cycle source will be connected over the wiper 325 and transmitted to the observation operator in the same manner as was described.

It will not be necessary to explain in detail the application of the tone combinations for the remaining two digits registered on the register set, since the operation is quite simple and will be easily understood from the foregoing remarks. Referring specifically to Fig. 4, the observation operator will receive four tone combinations, each combination corresponding to the digit which was set on the corresponding register switch. Since it was assumed that the register switches R1 to R4 have been operated by 3, 4, 5, and 6 impulses, respectively, the observation operator will receive the tone combination indicated in Fig. 6 by the numerals 3, 4, 5, and 6. In this graphic representation the low columns refer to signals from the two hundred cycle source and the high columns refer to signals from the thousand cycle source. The combinations have been shown alternately white and black in order to distinguish them easily. When the observer receives these combinations he knows by their numerical value that the register switches R1, R2, R3, and R4 have registered the digits 3, 4, 5 and 6, respectively.

The display of the registered digits may now take place on the indicator V shown in Fig. 4. This is done as follows: When the projection 413 on cam 402 reaches the associated spring combination at the end of a cycle, the springs 412 will be closed and ground will thereby be connected to the display conductor 196. Following this conductor through to Fig. 3, it will be seen that a circuit is closed for the relay 218, by way of a make contact at armature 216 of relay 239′ which, it will be remembered, is kept in energized position in series with the relay 239. Relay 218 operates and closes its armature 219 thereby connecting itself in a locking circuit including the armature 217 and disconnecting the start conductor 197 leading to the tone machine unit. When cam 402 of the tone machine reaches the position shown in the drawing, both spring contacts 412 and 411 are opened and the start relay 420 deenergizes since there is no ground on the conductor 197 for maintaining this relay energized.

At its armature 220′, the relay 218 connects ground to the four uppermost armatures operated by relay 239 which have established connections with the display conductors 303, 323, 343 and 363 leading to the wipers 304.

324, 344 and 364 of the register switches R1 to R4, respectively. The wiper 304 is in connection with the third contact; wiper 324 in connection with the fourth contact; wiper 344 with the fifth bank contact, and wiper 364 is in connection with the sixth bank contact. These bank contacts are wired to the corresponding lamps in the display device V and designated by the numerals 313, 334, 335, and 376. Accordingly, the corresponding lamps in the indicator will be lighted, and will indicate to the B operator that connection is wanted with subscriber number 3456 of the manual exchange.

The manner in which the operator handles the call thus displayed before her will now be considered. When relay 239 energizes, it closes the circuit for starting the display of the registered number, and also at its armature 251 a circuit for the trunk or call signal lamp L7 in the cord circuit O which may be traced from ground, armature 251 and its make contact, bank contact 227, wiper 223, armature 208 and its make contact, conductor 150, winding of relay 102, resting contact and armature 111, armature 122 and its resting contact, lamp L7 to battery. By the closure of the above circuit, lamp L7, which is individual to the cord circuit O, is lighted simultaneously with the lamps in the indicating device V. Having observed the number 3456, and knowing by the lighting of the lamp L7 that the cord circuit O is the one in use, the operator will test the multiple jack of the line 3456 with the tip of her plug in the usual manner in order to find out whether or not the line is busy. If the line is found to be busy, the plug will be inserted in a "busy back" jack, of well known design and function, in order to give the calling subscriber a busy signal. Assuming, however, that the line is idle, the operator will at once insert the plug in the jack of the wanted line, which in the present case is the jack J.

As soon as the plug is inserted in the jack a circuit is completed for the sleeve relay 109 in series with the relay 140, of the calling line, and the latter relay is energized to clear the line of its normal battery and ground connections in the usual manner. Relay 109, at armature 127 disconnects the operator's head set. At the same time at its armatures 127, 129, the tip and ring conductors of the cord are connected through to the plug, and the ringing circuit is established over which ringing current from the generator GEN is projected intermittently to signal the called subscriber. In addition to the functions described, relay 109 also closes a circuit for relay 107 at its armature 128. Upon energizing, relay 107 opens the circuit of the call signal lamp L7 at armature 122, and at armature 124 it closes a circuit for relay 101, which includes the grounded conductor 150. Upon energizing, relay 101 establishes a locking circuit for itself at its armature 113, and at the back contact of the same armature disconnects ground from the holding conductor 151.

The last operation described above, causes the release of the switches in the register set, which served for the registration of the called number, and the release of these switches will now be explained. When ground is disconnected from conductor 151, the holding circuit for relay 201 of the lineswitch C' in Fig. 3 is open and this relay falls back to normal position. Ground is thereby disconnected from the bank contact 226, and relay 212, being no longer short circuited, will energize now in series with the relay 235. Upon energizing, the relay 212 operates its armature 213 connecting thereby ground to the bank contact 226 in order to mark the register set busy during the release operation. At its armature 214, the relay 212 connects its lower resistance winding, to the common release conductor 280.

Relay 201 upon deenergizing disconnects the wipers of the lineswitch which is thus restored to normal condition. When the relay 212 operates its armature 214, a circuit will be established for the release magnet 271 of the timing switch P by way of the wiper 273 and to ground in series with the low resistance winding of the relay 212. Another circuit may be traced over the conductor 280, off normal springs 257, winding of the release magnet 258 of the master switch MS to battery, and further release circuits may be traced over conductor 280 to Fig. 3 and over the off normal springs of the register switches to the release magnets 302, 322, 342 and 362. All of these magnets energize now and restore the respective switches to their normal position. The circuit of each release magnet, with the exception of the release magnet of the timing switch P, is taken through a pair of off normal springs, and, as each switch returns to normal position it separates its off normal springs in order to open the circuit of the associated release magnet. An equivalent arrangement is provided in the case of the timing switch P, consisting of the wiper 273 and its associated banks of contacts. The master control switch MS having been restored to normal position, ground is disconnected from conductor 291 at the wiper 255, and the relays 238, 239 and 239' are permitted to deenergize with the obvious result that the display and the signalling circuits are opened. The register is now completely restored to normal and in readiness for use in registering another telephone number.

When ground is disconnected from conductor 284 in Fig. 3, lamp L1 is extinguished and in case there is no other call waiting at this time, relay 162 of the consecution control switch CCS will be deenergized. If a call is

waiting, however, relay 162 will be held up in series with one of the other lamps shown, such as lamp L2 or lamp L3 for example, and when relay 160 falls back, the line relay 161 will again energize. Since the first test contact in the bank accessible to wiper 164 has just been grounded by the deenergization of relay 238, the operation of the line relay 161 causes the consecution control switch to advance its wiper into engagement with the test contact which is associated with the first register set upon which a registered call is waiting and this call is then switched onto the lamp of the indicating device in the same manner as has been described.

Returning now to the cord circuit O, it has been explained how the connection is completed to the line of the called substation A', and how ringing current is projected over the called line to signal the subscriber. During the ringing operation a tone is induced in the left hand winding of the repeating coil of the cord circuit O by reason of the fact that the ringing circuit includes the upper right hand winding of the repeating coil, and this tone is audible to the calling subscriber, who is thus advised that the signalling operation is proceeding satisfactorily. The ring cut-off relay 108 is included in the ringing circuit and when the called subscriber answers, this relay energizes and locks itself in energized position by attracting armature 125. This operation of armature 125 includes the upper winding of the ring cut-off relay in the circuit of the sleeve relay 109. Relay 108 also opens the ringing circuit at armature 126, and at the working contact of this armature finally completes the talking circuit.

The transmitter of the called station is now supplied with talking current through the right hand windings of the repeating coils and through the upper and lower windings of the battery feed relay 106. Relay 106 energizes first through its lower winding alone, since the upper winding is normally short circuited in order to keep it disconnected from the ringing circuit, but when the relay energizes, both of its windings will be included in the battery feed circuit. Relay 106 closes a circuit for reversing relay 105. Upon energizing, relay 105 reverses the trunk conductors 76 and 78 with regard to their connections with the windings of the line relay 104, and the direction of current flow in the calling line is reversed. This operation may be used for operating a meter, or for similar purposes, and is provided in accordance with standard practice, though it is of no particular utility in the present disclosure.

The desired connection has now been completed. The observation operator has followed the progress of the call, and, by means of the characteristic tone combinations transmitted in the manner described, is enabled to check up to determine if the call has been completed satisfactorily. Should a wrong subscriber reply to the call, the observation operator knows that the wrong connection is due to faulty manipulation of the B operator. Operations of switches and of other apparatus not specifically mentioned in this specification are contained in the Patent #1,542,649, referred to. All operations relating to the subject matter of the present disclosure have been described in detail and it will be appreciated that the present invention is concerned with novel means for enabling an observation operator to follow the progress of a call and to check and determine possible sources of faulty operation or other trouble.

Having described the invention, what is considered to be new and is desired to have protected by Letters Patent will be pointed out in the following claims:

What is claimed is:

1. In a semi-automatic telephone system, an automatic exchange, a subscriber's station thereat provided with a calling device for transmitting impulses, a manual exchange, an operator's position thereat, a trunk line inter-connecting said exchanges, a service observation operator's equipment bridged across said trunk line for checking the progress of connections extended thereover, register switches for receiving trains of impulses transmitted from a calling automatic station, a signal machine associated with said register switches, means operated by said signal machine for transmitting to said observation operator characteristic tone combinations corresponding to the trains of impulses received by said register switches, and means controlled by impulses transmitted by the calling device at the subscriber's station for visually indicating to the observation operator the number of impulses transmitted to said register switches.

2. In a semi-automatic telephone system, an automatic exchange, a subscriber's station thereat provided with a calling device for transmitting impulses, a manual exchange, an operator's position thereat, a trunk line inter-connecting said exchanges, a service observation operator's equipment bridged across said trunk line for checking the progress of connections extended thereover, register switches for receiving trains of impulses transmitted from a calling automatic station, a signal machine associated with said register switches, a simplex circuit extending from said observation equipment by way of said trunk line and said register switches to said signal machine, and means operated by said machine for transmitting over said simplex circuit a series of characteristic signal tone combinations corresponding to the trains of impulses received by said register switches.

3. In a semi-automatic telephone system,

an automatic exchange, a subscriber's station thereat provided with a calling device for transmitting impulses, a manual exchange, an operator's position thereat, a trunk line inter-connecting said exchanges, a service observation operator's equipment bridged across said trunk line for checking the progress of connections extended thereover, register switches for receiving trains of impulses transmitted from a calling automatic station, a signal machine associated with said register switches, means associated with said register switches for starting said machine, means operated by said machine for transmitting to said observation operator a series of characteristic signal tone combinations corresponding to the trains of impulses received by said register switches, an indicating device for visually displaying figures to said operator corresponding to the trains of impulses received by said register switches, and means operated by said signal machine for controlling the display of said figures after said tone combinations are transmitted.

4. In a semi-automatic telephone system, an automatic exchange, a subscriber's station thereat provided with a calling device for transmitting impulses, a manual exchange, an operator's position thereat, a trunk line inter-connecting said exchanges, a service observation operator's equipment bridged across said trunk line for checking the progress of connections extended thereover, register switches for receiving trains of impulses transmitted from a calling automatic station, a signal machine associated with said register switches, means operated by said signal machine for transmitting to said observation operator a series of characteristic tone combinations corresponding to the trains of impulses received by said register switches, each combination consisting of successively applied current sources of different frequency, and means controlled by impulses transmitted by the calling device at the subscriber's station for visually indicating to the observation operator the number of impulses transmitted to said register switches.

5. In a semi-automatic telephone system, an automatic exchange, a subscriber's station thereat provided with a calling device for transmitting impulses, a manual exchange, an operator's position thereat, a trunk line interconnecting said exchanges, a service observation operator's equipment bridged across said trunk line for checking the progress of connections extended thereover, register switches for receiving trains of impulses transmitted from a calling automatic station, a signal machine associated with said register switches, means operated by said signal machine for transmitting to said observation operator a series of characteristic tone combinations corresponding to the trains of impulses received by said register switches, each combination being predetermined and consisting of alternately and successively applied current sources of different frequency, and means controlled by impulses transmitted by the calling device at the subscriber's station for visually indicating to the observation operator the number of impulses transmitted to said register switches.

6. In a multi-office telephone system, a manual exchange, an operator's position thereat, an automatic exchange, a trunk line interconnecting said exchanges and terminating at said operator's position, a service observation operator's equipment adapted to be associated with said trunk line for checking the progress of calls extended thereover, a call indicator associated with said manual operator's position for displaying digits of a wanted manual subscriber's number to said operator, and means for transmitting audible signals to said observation equipment corresponding to the digits to be displayed on said indicator.

7. In a multi-office telephone system, a manual exchange, an operator's position thereat, an automatic exchange, a trunk line interconnecting said exchanges and terminating at said operator's position, a service observation operator's equipment adapted to be associated with said trunk line for checking the progress of calls extended thereover, a call indicator associated with said manual operator's position for displaying digits of a wanted manual subscriber's number to said operator, and means adapted to be associated with said indicator for transmitting a series of characteristic signals to said observation equipment audibly indicating the digits to be displayed on said indicator.

8. In a multi-office telephone system, two exchanges interconnected by a trunk line, calling and called stations, an operator's position at each exchange connected to said trunk line, means at a calling station for transmitting series of impulses over said trunk line corresponding to digits in a wanted station's telephone number, means for visually indicating said digits to one of said operators, and means for audibly indicating said digits to the other operator.

9. In a multi-office telephone system, a first and a second exchange, calling and called subscribers at said exchanges, a trunk line interconnecting said exchanges, an operator's position connected to said trunk line at each of said exchanges, means at a calling subscriber's station for transmitting series of impulses over said trunk line corresponding to digits in a called subscriber's telephone number, means for audibly indicating said digits to one of said operators, and means for thereafter visually indicating said digits to said other operator.

10. In a signalling system comprising a plurality of exchanges, calling and called

stations at said exchanges, two of said exchanges interconnected by a trunk line, an operator's position connected to said trunk line at each of said exchanges, means at a calling station for transmitting series of current impulses over said trunk line to extend a connection to a called station, means for audibly indicating said called station to one of said operators by a series of characteristic signal tones, and means for visibly indicating said called station to the other operator by a series of lamp signals, said signal tones and said lamp signals corresponding to the designation of said called station.

11. In a telephone system, two exchanges inter-connected by a trunk line, a calling and a called station, an operator's position at each exchange associated with said trunk line, means at the calling station for transmitting a series of impulses corresponding to digits in the called station's telephone number, and means for visually indicating said digits at both operator's positions but to one position in advance of the other.

12. In a signalling system comprising two exchanges, calling and called stations at said exchanges, an operator's position at each exchange, means at the calling station for transmitting series of impulses to extend a connection to the called station, means for operating a series of signals at each operator's position corresponding to the impulses transmitted at said calling station, the signals at one station being operated in advance of those at the other station.

13. In a signalling system, a calling and a called station, a central office provided with a connecting operator's position, indicating devices at said position, an observing operator's position provided with indicating devices, means at the calling station for transmitting a series of impulses to first cause the operation of the indicating devices at the observing position and then the operation of the indicating devices at the connecting position, means controlled after the operation of the devices at the observing position and before the operation of the devices at the connecting position to audibly indicate the number of impulses in the series transmitted from said calling station.

14. In a signalling system, a calling and a called station, a central office provided with two operator's positions each provided with indicating devices, means at the calling station for transmitting a series of impulses to cause the operation of the indicating devices at both positions, and additional means controlled by said impulses for causing an audible indication to be given at one position before the indicating devices are operated at the other position.

15. In a signalling system, a calling and a called station, a central office provided with a connecting operator's position and an observing operator's position, indicating devices at each position, registering devices for controlling the operation of indicating devices at the connecting position, means at the calling station for transmitting a series of impulses to first cause the operation of the indicating devices at the observing position and then the operation of said registering devices, means controlled after the operation of the registering devices for audibly indicating to the observing operator the number of impulses received by said registering devices, and means controlled by said registering devices for thereafter causing the operation of the indicating devices at the connecting position.

16. In a signalling system, mechanism for transmitting a number of impulses, two stations, a multiposition device at one station responsive to the number of impulses transmitted, means at the other station to indicate the number of impulses transmitted to said device and means at said other station to always indicate the position assumed by said device in response to said impulses.

17. In a signalling system, mechanism for transmitting a number of impulses, a multiposition device responsive to the impulses transmitted, means to indicate the number of impulses transmitted and means to always indicate the position assumed by said multiposition device in response to the impulses transmitted by said mechanism.

18. In a signalling system, mechanism for transmitting a number of impulses, two stations, a multiposition device at one station responsive to the number of impulses transmitted, means at the other station to indicate the number of impulses transmitted to said device, and means for transmitting to said other station coded signals indicative of the position assumed by said device in response to said impulses.

19. In a signalling system, mechanism for transmitting a number of impulses, two stations, a multiposition device at one station responsive to the number of impulses transmitted, a simplex circuit, means at the other station to indicate the number of impulses transmitted to said device, and means for transmitting to said other station over said simplex circuit coded signals indicative of the position assumed by said device in response to said impulses.

20. In a signalling system, mechanism for transmitting a number of impulses, two stations, a multiposition device at one station responsive to the number of impulses transmitted, said device having a plurality of sets of wipers, means at the other station for indicating the number of impulses transmitted to said device, and means for transmitting to said other station over one of said sets of wipers coded signals indicative of the

position assumed by said device in response to said impulses.

21. In a signalling system, mechanism for transmitting a number of impulses, two stations, a multiposition device at one station responsive to the number of impulses transmitted, said device having a plurality of sets of wipers, means at the other station for indicating the number of impulses transmitted to said device, a simplex circuit, and means for transmitting to said station over one of said wipers sets and said simplex circuit coded signals indicative of the position assumed by said device in response to said impulses.

22. In a signalling system, an operator's station, a multiposition switch having a set of wipers, means for operating said switch to position its wipers in one of the positions, and means responsive to said operation to transmit over said wipers to said operator's station a signal characteristic of the position of the wipers.

23. In a signalling system, an operator's station, a multiposition switch having a set of wipers, means for operating said switch to position said wipers in any of the positions, and means responsive to the operations of said switch for transmitting to said station over said wipers a different signal for each position of the wipers.

24. In a signalling system, an operator's station, means for transmitting impulses, a multiposition switch having a set of wipers and responsive to said impulses to advance its wipers in one of the positions, and means responsive to said advancement for transmitting to said station over said wipers a signal characteristic of the position to which said wipers were advanced in response to said impulses.

25. In a signalling system, an operator's station, means for transmitting impulses, a multiposition switch having a set of wipers and responsive to impulses transmitted to advance the wipers to one of the positions, and means responsive to said advancement for transmitting to said station over said wipers a tone signal characteristic of the position to which said wipers were advanced in response to said impulses.

26. In a signalling system, a first station, a second station, a third station, means at the first station for transmitting a signal to the second station, means at the third station responsive to such a transmission for indicating thereat the signal transmitted, and means at the second station for notifying the third station of the reception of the transmitted signal.

27. In a signalling system, a first station, a second station, a third station, means at the first station for transmitting a signal to the second station, means at the third station for registering the transmitted signal, and means at the second station for registering the signal and notifying the third station of the signal registered.

28. In a signalling system, a first station, a second station, a third station, means at the first station for transmitting a signal to the second station, means at the third station for registering the transmitted signal, and means at the second station for registering said signal and automatically notifying the third station of the signal registered.

29. In a signalling system, a first station, a second station, a third station, means at the first station for transmitting a number of impulses to the second station, means at the third station for registering the transmitted impulses, and means at the second station for registering said number of impulses, and means at the second station for notifying the third station of the number of impulses registered.

30. In a signalling system, a first station, a second station, a third station, means at the first station for transmitting impulses to the second station, a multiposition device at the second station responsive to said impulses, means at the third station for indicating the number of impulses transmitted to said device, and means at the second station for transmitting signals to the third station indicative of the position assumed by said device in response to said impulses.

31. In a signalling system, a first station, a second station, a third station, means at the first station for transmitting impulses to the second station, a multiposition device at the second station responsive to said impulses, means at the third station for indicating the number of impulses transmitted to said device, and means at the second station for transmitting signals comprising coded impulses to the third station indicative of the position assumed by said device in response to the impulses transmitted from the first station.

In witness whereof, I hereunto subscribe my name this 11th day of August, A. D. 1927.

RUDOLPH F. STEHLIK.