

1,298,589.

F. M. SLOUGH.
TELEPHONE SYSTEM.
APPLICATION FILED JAN. 19, 1915.

Patented Mar. 25, 1919.
3 SHEETS—SHEET 1.

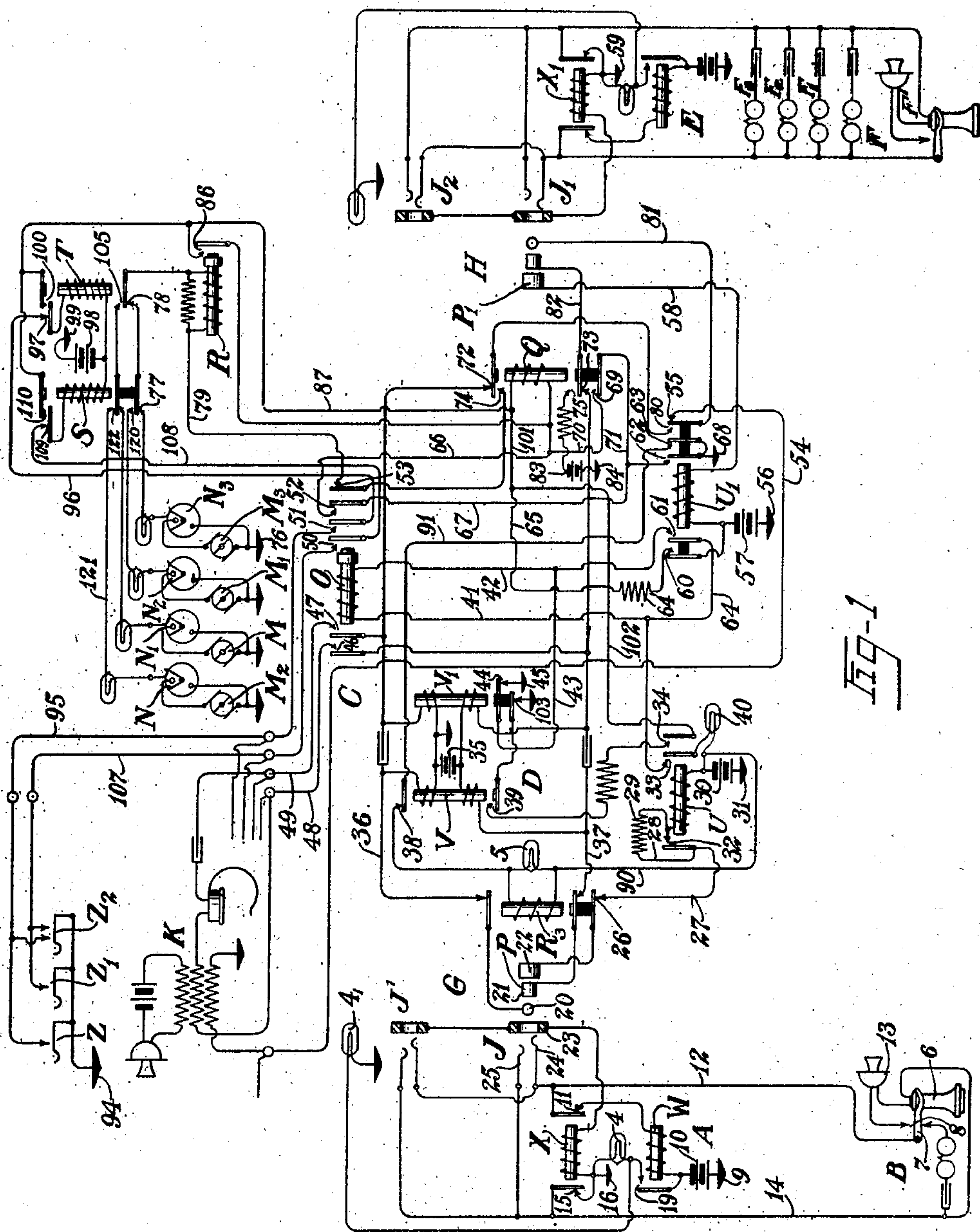


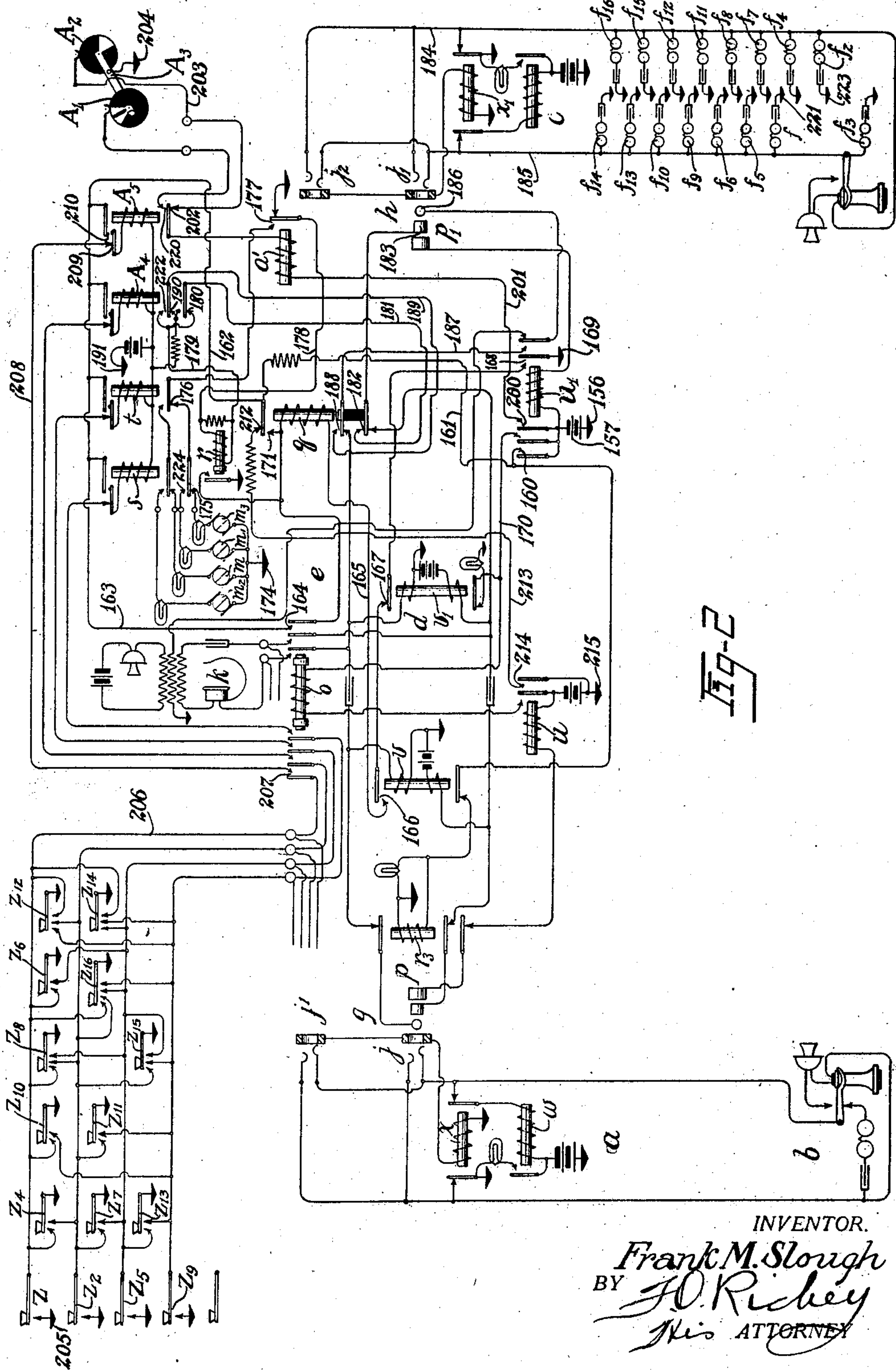
FIG-1

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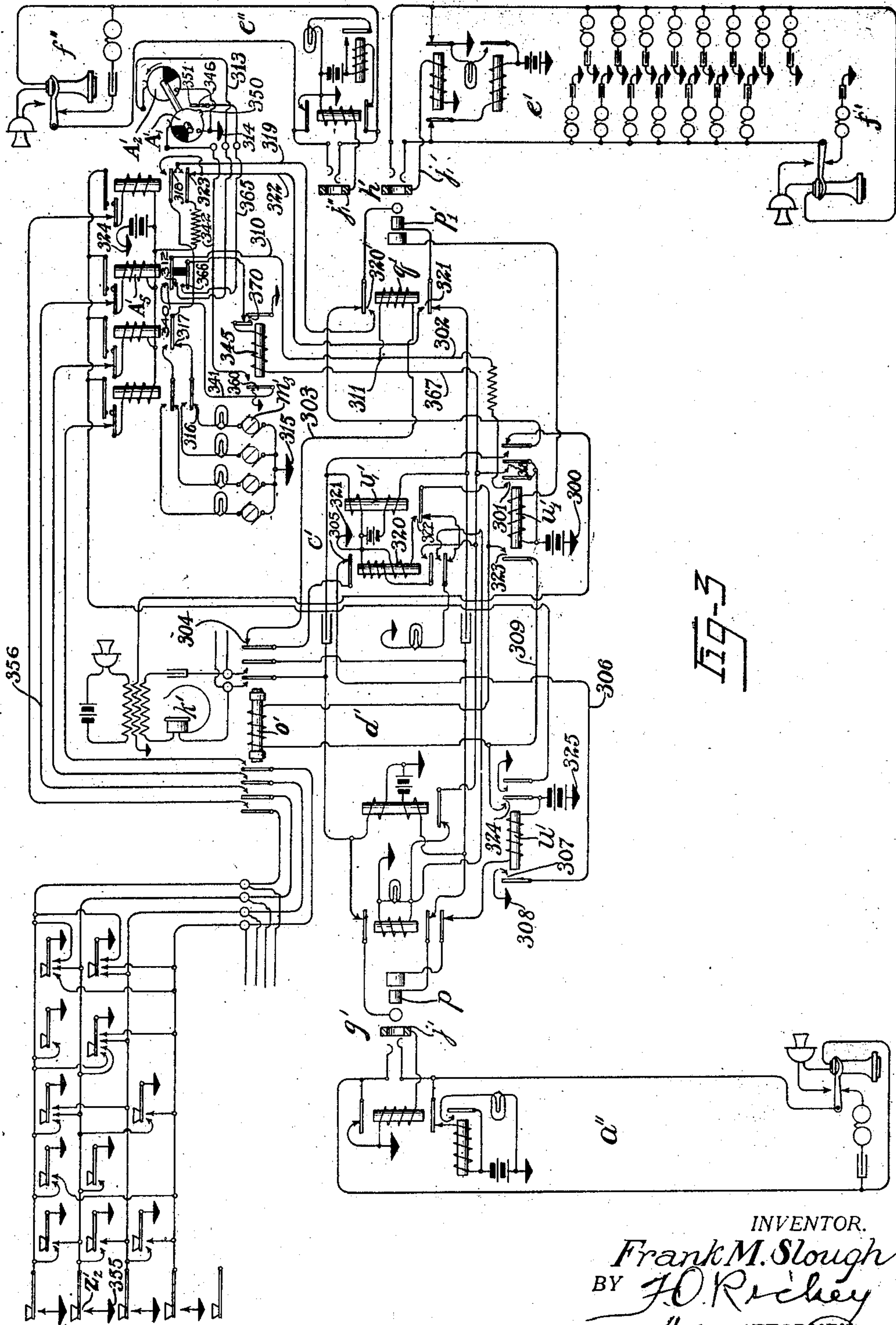
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3 SHEETS—SHEET 3.



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Frank M. Slough
BY *J. O. Richey*
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UNITED STATES PATENT OFFICE.

FRANK M. SLOUGH, OF ELYRIA, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO
STROMBERG-CARLSON TELEPHONE MFG. CO., OF ROCHESTER, NEW YORK, A
CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

1,298,589.

Specification of Letters Patent.

Patented Mar. 25, 1919.

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To all whom it may concern:

Be it known that I, FRANK M. SLOUGH, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Telephone Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable other skilled in the art to which it appertains to make and use the same.

My invention relates to telephone systems; and the object of the same is to make certain improvements in telephone systems.

In the telephone systems now in use, the substations are provided with signals and means are provided at the main station for causing the actuation of said signals. There is also provided a substation mechanism through which the operator controls the actuation of such signals.

One of the objects of my invention is to provide a system in which but a single set of controlling mechanism is employed at each operator's position. With this object in view, I have provided at each position a single controlling mechanism for controlling the actuation of all of the signals of the particular character in the system. I have also, with this object in view, provided means for placing the controlling mechanism into association with the particular connecting means with which it is to be employed, and for breaking such association as soon as the controlling mechanism has performed its function.

Another object of my invention is to provide means whereby certain signals may be operated without the operation of the controlling mechanism, the operation of the switching mechanism at the main station of the system being sufficient to place the signal actuating means in a position to cause the actuation of the substation signal, and at the same time, I associate the apparatus for accomplishing both of these objects together, in a manner which will be described.

I also aim to provide a system which will reduce the time necessary to make a connection, and in which work hitherto done by the operator is done by the electrical and mechanical apparatus in the system. In other words, I aim to "speed up" the work so as to reduce the number of operators required.

Another object of my invention is to provide a system in which a plurality of systems of selective signaling are superposed and whose operations are determined by a system of keys or switches. I also aim to do this, and at the same time provide automatic ringing for the telephone system.

Another object of my invention is to provide means to prevent the application of the signaling current during a ringing period. For example, suppose the signal of the party desired to be aroused was three short rings, and the apparatus was cut in after the code determining mechanism had passed one of these short rings, then the first signal would be two short rings, which would be false and call the wrong party. I provide means whereby it is impossible to cut in on the signaling except before the beginning of a ringing period.

Another object of my invention is to combine such means with apparatus realizing other objects which I have set forth above.

Other objects of my invention and the invention itself will be better understood from a description of embodiments of the same.

Figure 1 is a diagram of a system embodying my invention.

Fig. 2 is a second diagram of a second system embodying my invention.

Fig. 3 is a third diagram of a third system embodying my invention.

Referring now to the drawings and first to Fig. 1, in which there is illustrated a common battery telephone system embodying my invention, at A and E are shown telephone lines. The telephone line A, hereinafter spoken of as the calling line, leads from a substation shown at B to a main or central station, shown at C. But one substation is shown on the line A, though any suitable number may be connected to this line. The line E, which will hereinafter be spoken of as the called line, leads from a plurality of substations F, F₁, F₂ and F₃ to the main station C. Four substations have been shown upon the line E, though any suitable number may be connected thereto. The talking apparatus at the substation F has been illustrated at F', the talking apparatus at the other substations having been omitted from the drawing for convenience, it being well understood from the apparatus

shown at F' that talking apparatus is connected to the line E at the other substations.

Means are provided at the main station for connecting telephone lines together. In the embodiment shown in Fig. 1 this consists of a cord circuit D. Mechanism is provided for connecting the connecting means D to telephone lines, here shown as switching means G and H. The switching means G, hereinafter spoken of as the answering switch, in the form shown comprises a plug P, hereinafter spoken of as the answering plug and a jack J. The switching means H, hereinafter spoken of as the calling switch, in the form shown comprises a plug P₁, hereinafter spoken of as the calling plug and a jack J₁. The jack J, as well as a second or multiple jack J', are at the main station and connected to the telephone line A. The jacks J₁ and J₂ are likewise at the main station and are connected to the line E. The central station operator's set is shown at K. The sources of current for actuating the substation signals are shown at M, M₁, M₂ and M₃. Controlling means for the substation signaling is here shown at Z, Z₁ and Z₂.

When the hook-switch at the station B is operated, the line lamp 4 will be actuated in the usual manner, and the operator, observing its actuation, will operate the switch G by inserting the plug P into the jack J. The relays U, V and X will be operated, the relay U closing a circuit through the relay O, which will be actuated, connecting the operator's set K to the cord. The relay O also connects the keys Z, Z₁ and Z₂ to the relays S and T. The operator having learned the station desired, will proceed to signal the subscriber thereat.

In the embodiment shown, the operations for setting up the signaling arrangement will be different with respect to each of the four stations upon the called line. For the character of signal shown at F₃, which may be a harmonic ringer of a certain frequency, or any ringer responsive to any frequency, the operation will be as follows: The operator simply closes the switch H by inserting the plug P₁ into the jack J₁, which will cause the actuation of the relay U₁. The relay U₁ will short-circuit the relay O and complete a circuit for the relay Q. The relay O being a slow acting relay will maintain the circuit of the relay Q long enough for the relay Q to be energized, and to complete an alternate or locking circuit for itself. The relay Q completes the ringing connections from the device M₃, and the operation of the signal at F₃ takes place.

When the subscriber F₃ responds, the relay R is actuated and the source M₃ disconnected, the parts being restored to the condition shown in the drawing.

If it is desired to operate the bell at F,

the key Z is set, completing a circuit for the relay T, which immediately pulls up, locking itself and disconnecting the key from itself and from the apparatus associated with the cord D. A circuit will also be completed for the relay Q, which contains contacts of the relay T. The operation will be the same as previously described, the current now flowing from the source M.

When the station at F₁ is desired, the key Z₁ is operated, causing the energization of the relay S instead of T; otherwise, the operation will be the same as previously described.

When it is desired to operate the bell at F₂, the key Z₂ is operated, causing the energization of both relays S and T. These relays will, operating in substantially the same manner as previously described, connect the source M₂ to the called line.

After the ringing and the response of the called subscriber, conversation takes place over the telephone lines and the cord circuit. At the termination of the conversations, the circuits of the relay V and V₁, will be broken, completing a circuit for the relay R₃, which disconnects the switching device G from the cord circuit. At the same time, the lamp 5 is operated, signaling the operator, who withdraws the plugs from the jacks, and the system is restored to normal.

More specifically, the operation of the system is as follows: The operator at B initiates a call by removing the receiver 6 from the hook-switch 7, which closes a switch 8 in the circuit of the relay W, which will be operated from ground at 9—battery 10—W—switch 11—conductor 12—switch 8—transmitter 13—6—conductor 14—switch 15—to ground at 16. The magnet W will close a switch 19, completing a circuit through the lamp 4, as follows: 9—10—19—4—16. The lamp 4 is so located that its actuation can be observed by the operator at the station C, who controls the cord circuit D. The switch G is then operated by the operator by the insertion of the plug P into the jack J, the contacts 20, 21 and 22 of the plug registering respectively with the contacts 23, 24 and 25 of the jack. At the time the lamp 4 was actuated a lamp 4₁ was also actuated, associated with the jack J' at another position. The operation of the switching device G completed one circuit through the relays X and U and another circuit through the relay V. The first circuit is as follows: 16—X—23—22—switch 26—conductor 27—conductor 28—device 29—U—battery 30—to ground, 31. The magnet X opens the switches 11 and 15, interrupting the circuit of the magnet W, which opens the circuit of the lamps 4 and 4₁. The magnet U closes a switch 32, completing a shunt of the device 29. The object of this is to prevent the operator at

another position answering the call, as with the device 29 shunted in the cord D another operator with the device 29 in circuit with her magnet, corresponding to the magnet U, would not get sufficient current to operate her magnet U.

The magnet U also closes a switch 33 in the circuit of the relay O and a switch 34, for a purpose to be described. The circuit of the relay V includes the battery 35, the talking strands 36 and 37 of the cord, the contacts of the plug and jack, the limb of the line A and the substation apparatus thereon. This relay opens a switch 38 in the circuit of the relay R₃, preventing the operation of that relay during the ringing and talking. The relay V also closes a switch 39, for a purpose to be described. The relay O will now be energized over the following circuit: 31—30—lamp 40—switch 33—conductor 41—magnet O—conductor 42—conductor 43—switch 44—ground 45. The flow of current through this circuit will be sufficient to operate the magnet O, but insufficient to operate the lamp 40. The relay O closes the switches 46 and 47, connecting the operator's set K through the conductors 48 and 49 with the cord circuit, placing her in communication with the subscriber at B over the conductors 48 and 49—the strands of the cord circuit 36—37—the contacts of the switching device G—the line limbs 12 and 14 and the substation set at B, current being furnished from the battery 35 to both ends of the cord circuit, in the usual manner, through the relays V and V₁. When the relay O was energized, it closed the switches 50, 51 and 52 and opened the switch 53 all for purposes which will appear from a further description.

Assuming first that it is the subscriber at F₃ that is desired, after testing the line in the usual manner, the test circuit being shown at 54, including a switch 55, and after finding the line idle, which is the case here assumed, the plug P₁ is inserted into the jack J₁, completing a circuit through the relay U₁ as follows: ground 56—battery 57—U₁—conductor 58—switch H—device X₁—to ground 59. U₁ closes a switch 60 in the circuit of the relay Q, a switch 61 in a shunt of the relay O, and opens the switch 55, breaking the test circuit and closing switches 62 and 63, for purposes to be described. The closing of the switch 61 completed a shunt 64 of the relay O, causing the deenergization of the same. The relay O, when deenergized, opens switches in the circuit of the operator's telephone set K, disconnecting the same from the cord circuit, and also opens switches 50 and 51 in the circuit leading to the switching devices Z, Z₁ and Z₂, thus disconnecting them from the particular cord circuit and enabling these switches to be used in connection with any

other cord circuit of the operator's position. In this way I am enabled to use but one set of keys for a given operator's position. O, however, being slow acting, the switch 61 will be closed before the switch 52 is opened, so that for a short interval of time, the following circuit will be completed through the relay Q: 56—57—60—64'—conductor 65—Q—conductor 66—52—conductor 67—switch 62—ground 68. The relay Q will close a switch 69, completing a locking circuit for itself, as follows: 56—57—60—64'—65—Q—70—69—71—62—ground at 68. Relay Q will also interrupt the strands of the cord circuit, by opening the switches 72 and 73 and close the ringing circuit by closing the switches 74 and 75. The ringing will then take place over the following circuit: ground at 76—generator M₃—commutator N₃—switch 77—switch 78—R—conductor 79—switch 53—74—switch 80—conductor 81—through the switching device H—over the called line—through the bridge F₃—back through the switching device H—the conductor 82—switch 75—battery 83—to ground at 84. The bell at F₃ will be operated, and as soon as the subscriber responds, the completion of the talking set bridge at the substation will cause the character of current flowing through the circuit to be such as to cause the actuation of the relay R, which will close the switch 86, completing a shunt 87 about the magnet Q, which will become deenergized, restoring the ringing apparatus to the condition illustrated in the drawing.

At the time the called subscriber responded, the relay V₁ would also be actuated over a circuit very similar to that described in connection with the relay V, except that the limbs of the called line and the calling end of the cord are included therein. With the apparatus in this condition the conversation takes place, and at the termination of the conversation, the circuits of the relays V and V₁ will be interrupted when the receivers at the substations are restored. A circuit will be completed through the relay R₃ as follows: 31—30—90—R₃—and the lamp 5 in multiple—switch 38—conductor 91—switch 63—to ground 68. The relay R₃ will disconnect the plug P from the cord in a well known manner, and the actuation of the lamp 5 shows the operator that the conversation is terminated, whereupon she withdraws the plugs from the jacks and the system will be restored to normal.

Assuming that the operator learns that it is the subscriber at F that is desired, before the switch H is closed, the operator throws the key Z, whereupon the operation will be as follows: The relay T will be operated over a circuit as follows—ground 94—Z—conductor 95—51—96—switch 97—relay T—battery 98—to ground 99. The relay T will be ener-

gized, first closing a switch 100 and completing a circuit for itself independent of the key Z, as follows: 99—98—T—100—conductor 87—conductor 101—conductor 102—34—39—103—to ground. The generator M_3 will be disconnected from the conductor 79 by the opening of the switch 78 and the generator M will be connected to such conductor by the closing of the switch 105, both taking place when the relay T is operated.

The operator now operates the switch H, which completes a circuit for the relay U_1 , as described. U_1 will, as before, complete an initial circuit for the relay Q, but in this instance, this circuit will be as follows: 68—62—67—switch 52 of the slow acting relay O—66—Q—87—100—T—98—99. As soon as Q is energized, its locking circuit will be completed from ground 56—battery 57 in the same manner as previously described. The subsequent steps in the operation of the system will be the same as previously described in connection with the signaling of the substation at F_3 .

Assuming that it is the substation at F_1 that is desired, the operator upon learning this fact, actuates the key Z_1 which completes a circuit through the relay S, as follows: 94— Z_1 —107—50—108—switch 109—S—98 and 99. The relay S being energized, closes a switch 110 and completes a locking circuit for itself independent of the key Z_1 , as follows: 99—98—S—110—87—101—102—to ground through the switch 103, as previously described in connection with the relay T. Immediately after the closing of the switch 110, the switch 109 is opened, releasing the key Z_1 for use in connection with other cords. The operator then closes the switch H, whereupon the relay Q is energized over a circuit similar to that described in connection with the operation of the key Z, except it now includes the device S and the switch 110 instead of the relay T and the switch 100. The relay S will open a switch 77 and close a switch 120, connecting the generator M_1 to the called line. The subsequent operations of the system will be the same as previously described.

Assuming that it is the subscriber at F_2 that is desired, the operator upon learning that fact, depresses the key Z_2 , completing circuits for both the relays S and T, as previously described. These relays operate, performing the functions previously described, the generator M_2 now being connected through the lead 121, the switches 122 and 105 to the conductor 79. Upon the operation of the switching device H, the source M_2 will be connected to the called line through the operations and connections previously referred to in describing the connection of the generators M and M_1 to such line. The subsequent steps in the operation will be the same as previously described.

I will now refer to the embodiment of my invention illustrated in Fig. 2. In addition to accomplishing the objects accomplished by the system shown in Fig. 1, the system in Fig. 2 enables me to control the operation of a large number of signals on a telephone line, at the same time realizing all of the advantages set forth in the system shown in Fig. 1. In so far as I have used letters for references in Fig. 1, duplicate parts have been referenced in Fig. 2 by the use of the same letters, except instead of using capital letters, as in Fig. 1, I have used small letters in Fig. 2. Except for the signaling of the sub-stations on the called line, the operation of the system shown in Fig. 2 is so much like that shown in Fig. 1 that I will not repeat that part of the description of the apparatus, limiting myself to the description of the signaling.

There is added in Fig. 2 a pair of commutators A_1 and A_2 , which may be connected by a shaft A_3 , so as to rotate in synchronism. When the ringing is controlled by the commutator A_2 , the ringing period will be continuous; that is, there will be recurring, continuous applications of the ringing current. When the ringing is controlled by the commutator A_1 , these recurring periods of ringing will be broken up into impulses. Perhaps this will be better understood if reference is made to the old code system of ringing. The commutator A_2 determines that the ringing shall be according to one signal of the code signaling, say one short ring, and that determined by A_1 will be according to a different signal in this cord, say two short rings, these rings it being understood, occurring at intervals, according to the relative size of the segments of the commutator. There have also been added two relays A_4 and A_5 . The relay A_4 controls the limb of the line to which the ringing current is applied and the relay A_5 determines which of the commutators A_1 or A_2 shall control the character of the ringing. An additional relay a' has been supplied for purposes which will be understood in the description of the operation.

For the purpose of illustrating the similarity between the systems shown in Figs. 1 and 2 and giving the reader the clue, I will describe the operation when straight line ringing is to be effected. For this purpose we will assume that an additional substation is bridged across the line e , as is done on the line b . In this case, the operator simply closes the switch h by inserting the plug p_1 into the jack j_1 . The relay u_1 will immediately be energized, completing a circuit for the relay q from ground 156—157—160—161—162—conductor 163—switch 164—relay q —conductor 165—now closed switch 166—switch 167—switch 168—ground at 169. At the same time, the relay u_1 will

shunt the relay o through the shunt 170 and the relay o will slowly release the switch 164 in the circuit of the relay q , which has been described. During this interval of time, the relay q will be actuated, completing a locking circuit for itself, as follows: 156—157—160—161—171— q —165—166—167—168—169. The relay q will be energized, completing the ringing circuit as follows: 10 ground at 174—ringing generator m_3 —switch 175—switch 176—now closed contact 177—178— r —conductor 179—switch 180—conductor 181—switch 182—to the contact 183 of the plug p_1 out over the limb 185 of the called line—through the substation bridge, 15 back over the other limb 184—through the plug p_1 to the contact 186—conductor 187—switch 188—conductor 189—switch 190—to ground at 191. This circuit will be opened 20 and closed at 177 by the relay a' over a circuit, as follows: 156—157—now closed switch 200—conductor 201—relay a' —switch 202—conductor 203—commutator A_2 to ground at 204.

25 It will be seen that if the relay A_3 were actuated the commutator A_1 would control the ringing periods through the relay a' . Suppose that it was the subscriber at station f that was desired. The operator depresses 30 the key z , completing a circuit, as follows: ground 205— z —conductor 206—now closed switch 207—conductor 208—relay A_5 —to ground 191. Relay A_5 would be energized, breaking the circuit just described at 209 35 and releasing the key z , as previously described. The relay A_5 would also close a switch 210, completing a locking circuit for itself, as follows: 191— A_5 —210—conductor 162—switch 212—conductor 213—now 40 closed switch 214—to ground at 215. The relay A_5 will open the switch 202, disconnecting the commutator A_2 and close a switch 220, connecting the commutator A_1 into the circuit of the relay a' . When the 45 switch h has operated, the relay a' will be operated at intervals, determined by the character of the segment A_1 which in the embodiment illustrated in Fig. 2 will at intervals place two short rings upon the line.

50 The relay q having also been energized, completes the ringing circuit, which in this case will be as follows: 174— m_3 —175—176—177—178— r —179—180—181—182—183—185—signal f —to ground 221 and through 55 ground back to 174. The generator m_3 is designed to produce a special kind of current, say current of a certain frequency to which respond only signals tuned to that frequency. The bell at f is tuned to respond 60 to the frequency of current generated by the generator m_3 . The bell at f_3 is also tuned to respond to this frequency, but the signal intended for the station f_3 is one ring only, such as is determined by the commutator A_2 , 65 and in fact, if the switch h was closed with-

out the operation of any of the keys, current would pass over the same ringing circuit as has been described, the commutator A_2 now determining the periods of ringing.

Assuming that it is the subscriber at f_2 70 that is desired, the key z_2 will be depressed, completing a circuit through the relay A_4 . The ringing circuit will be the same as described in connection with f_3 , except that the generator will be connected with the side 184 75 of the called line by the opening of the switch 190 and the closing of the switch 222. The circuit will then be as follows: 174— m_3 —175—176—177—178— r —222—189—188—186—184—through f_2 —to ground at 80 223. The signal for f_2 is one short ring, determined by the character of current produced by the generator m_3 . The signal of the subscriber at f_4 will be two 85 short rings of the same kind of current. The operation of the key z_4 will cause the signaling of the subscriber at f_4 , as it will be seen that the operation of this key will complete the circuits of both the relays A_4 and 90 A_5 , A_4 connecting the ringing to the side 184 of the called line and the relay A_5 cutting out the commutator A_2 and connecting in the commutator A_1 . There are thus on each side of the line e two bells which respond 95 to the frequency of the current produced by each of the generators. Each generator is adapted to be connected to either side of the line and each generator is adapted to be connected to either side of the line through 100 either of the commutators, so that currents of any of the frequencies producible by either of the generators can be connected to either side of the line to furnish either of the code signals. Thus, when the key z_5 is depressed, the relay t will be energized, connecting the generator m to the side 185 of 105 the line to operate the bell at f_5 , according to the signal determined by the commutator A_2 . The signal at f_6 will also respond to this frequency, but the signal intended for 110 the station f_6 is two rings instead of one. If it is desired to signal f_6 , both the relays A_5 and t must be operated. This is accomplished by the operation of the key z_6 . On the side 184 the signal at f_7 responds to the 115 frequency of current produced by the generator m and the subscriber at f_7 responds to a signal of one ring. This signal is operated by connecting the generator m to the side 184 of the called line when the commu- 120 tator A_2 controls the ringing circuit. This is accomplished by operating the relays t and A_4 . The key z_7 controls the circuit of these relays and its operation will cause the operation of the bell at f_7 . 125

The bell at f_8 responds to the same current, but the subscriber at f_8 knows that his signal is two rings instead of one. f_8 is, therefore, signaled when all three of the relays t , A_4 and A_5 are operated. This is ac- 130

complished by the actuation of the key z_8 . The bells at f_9 , f_{10} , f_{11} and f_{12} respond to the frequency of current produced by the generator m_1 . The subscribers at f_9 and f_{11} know that their signal is one ring, which is determined by A_2 and the subscribers at f_{10} and f_{12} know that their signal is two rings of the character produced by A_1 .

To ring f_9 the generator m must be connected to the side 185 of the called line with the commutator A_2 controlling the character of current. This is accomplished by the operation of the relay s through the key z_9 . The operation of z_9 completes a circuit through the relay s , which connects the generator m_1 through the switch 224 into the circuit previously described, including the limb 185.

To signal the subscriber at f_{10} it is necessary to complete the same circuit, except to shift the commutator by the actuation of the relay A_5 . This is accomplished through the agency of the key z_{10} , which controls the circuits of the relays s and A_5 . To signal f_{11} the relays s and A_4 must be operated, the relay s to connect the generator m_1 in the ringing circuit and the relay A_4 to connect the ringing circuit to the side 184. This is controlled through the agency of the key z_{11} , which completes the circuits of the relays t and S simultaneously.

To cause the signaling of the subscriber at f_{12} the relays s , A_4 and A_5 must be actuated, the relay s to connect the generator m_1 in the ringing circuit, the relay A_4 to connect the ringing generator to the side 184 of the called line and the relay A_5 to shift the control from the commutator A_2 to the commutator A_1 . This is accomplished through the agency of the key z_{12} .

A fourth generator m_2 is provided which furnishes current of a frequency calculated to operate the signals at f_{13} , f_{14} , f_{15} and f_{16} . To call the subscriber at f_{13} , it is necessary to connect the generator m_2 in the ringing circuit without any other changes, since the signal of the subscriber at f_{13} is one ring. This is accomplished by the operation of the relays s and t , which are controlled by the actuation of the key at z_{13} . However, to signal the subscriber at f_{14} , whose signal is two rings, the commutator A_1 must be connected in, and to do this, the relay A_5 must be actuated. This is accomplished through the agency of the key z_{14} . To signal f_{15} , whose signal is one ring, the relays s , t and A_4 must be operated, s and t to connect the generator m_2 to the ringing circuit and A_4 to connect the generator to the side 184 of the called line. This is accomplished by the operation of the key z_{15} . The subscriber at f_{16} , whose signal is two rings is called by the operation of all four of the relays, the relays s and t to connect m_2 to the ringing circuit, the relay A_4 to connect m_2 to the side 184 of

the line and the relay A_5 to shift the control from the commutator A_2 to the commutator A_1 . This is accomplished by the operation of the key z_{16} .

It will be seen that in each case, immediately after the actuation of the key, the same will be released for use in connection with other cord circuits, and that I am enabled to accomplish this in connection with automatic ringing for the signaling of subscribers upon lines on which the signaling is determined according to two different systems of selective ringing.

I will now refer to the embodiment of my invention illustrated in Fig. 3. The calling line is illustrated at a'' , the main station at c' , the connecting means, here shown as a cord circuit, at d' , the called line at e' , the connecting switches at g' and h' , the plugs at p' and p_1' , the jacks at j' and j_1' . At e'' I illustrate a second called line provided with a jack j_1'' . When the answering switch g' is operated, the relays u' and o' will be operated, o' connecting the operator's set k' to the calling line. The operator learns the subscriber desired, and after testing the called line, operates the switching device h' , assuming that it is the subscriber at f' that is desired. When h' is operated, the relay u_1' will be operated, completing a circuit for the relay q' , as follows: 300—switch 301—conductor 302— q' —conductor 303—now closed switch 304—switch 305—conductor 306—now closed switch 307—ground 308. The switch 307 was closed when the relay u' was energized and the switch 304 was closed when the relay o' was deenergized, owing to the closing of a shunt 309 about the same by the relay u_1' . The relay q' will be alternately energized and deenergized, owing to the operation of the commutator A_2' , which closes a shunt 310 about said relay. This shunt is as follows, beginning at the point 311—conductor 310—the switch 312—conductor 313—the commutator A_2' —to ground at 314. When this shunt is completed, the relay q' will be deenergized and there will be no sending of ringing current to the called line. This will be spoken of as the silent period. When, however, the shunt is broken, the relay q' will be operated and the ringing current will be applied to the line. This will be spoken of as the ringing period. It will be understood that the relative lengths of these periods will depend upon the relative sizes of the conducting and non-conducting segments on the commutator.

When the relay q' is energized, the ringing circuit will be as follows: ground 315—source of signaling current m_3' —switch 316—switch 317—switch 318—conductor 319—now closed switch 320'—through the switching device h' —over the called line, and assuming that one signal is bridged

across the line, as shown at f'' upon the line e'' , back over the line through the now closed switch 321—conductor 322—switch 323—to ground at 324. When the subscriber responds the relay v_1' will be operated, closing a circuit for the relay 320 as follows: 321—switch 322—now closed switch 323—conductor 309—now closed switch 324—to ground 325. The relay 320 will break the circuit of the relay q' and permanently interrupt the ringing circuit. At the termination of the conversation, the relay v_1' will be deenergized and the plugs withdrawn from the jacks, restoring the system to normal.

As in the system shown in Fig. 2, means are provided for modifying the ringing periods according to a predetermined code, here shown as a plurality of commutators A_2' and A_1' . A_1' is differently arranged from A_2' and in the form shown is calculated to break the ringing period up into a predetermined character and number of rings. The commutator illustrated at A_1' breaks this ringing period up into two short rings. As in Fig. 2, means are provided for determining which of these commutators should be employed, here shown as a relay A_5' .

Mechanism is provided for preventing the application of the ringing current at any intermediate point during the ringing period when the commutator A_1' is employed. This is done for the reason that the ringing current might come on during the ringing period determined by this commutator when one of the segments of the commutator has passed, so that it would cause but one short ring, thus resulting in a false signal. In the form shown, this commutator controls a shunt of the relay q' for the same purposes, as the shunt already described which is controlled by the commutator A_2' . The shunt controlled by A_1' is as follows: 310—switch 340—conductor 341—conductor 342—commutator A_1' —to ground at 314. This shunt is controlled by a relay 345 and in the form shown, the shunt cannot be made until the relay is energized. A circuit is provided for this relay controlled by the commutator in such a way that the circuit of 345 cannot be made except during a silent period. In the form shown, this is effected by a switch 346 in the circuit of 345, which is controlled by the commutator. This switch may be controlled by forming a projection 350 upon the commutator, which closes a switch when it engages the spring 351.

Assuming now that it is desired to call a subscriber who responds to a signal, the character of which is determined by the commutator A_1' , the operator depresses the key z_5' , completing a circuit for the relay A_5' as follows: ground 355—conductor 356—relay A_5' —to ground at 324. The relay A_5' operates, closing a locking circuit for itself

and breaking the circuit of the key, thus releasing the key. The relay also closes a switch 340, completing the shunt 310 about the relay q' at the switch 360 controlled by the relay 345. This switch will be closed until the relay is actuated, but the relay cannot be actuated until the switch 346 is closed, which can not take place during a ringing period, since the protuberance 350 upon the commutator only engages the spring 351 during the silent period. The switch 346 being thus closed during the silent period, the circuit of the relay 345 is closed. This circuit is as follows: ground at 314—switch 346—conductor 365—switch 366—relay 345—conductor 367—switch 368—to ground at 300. The relay 345 will be energized shifting the control of the shunt 310 to the commutator A_1' , breaking its own circuit and completing a locking circuit for itself through the switch 370. The commutator will continue to rotate, making and breaking the shunt, in accordance with a code predetermined by its construction.

The remainder of the operation will be understood from what was previously described. The operation for the calling of each of the subscribers shown upon the line e' will be understood from the description of Fig. 2. Each of the keys shown in the upper left-hand corner of the sheet, illustrated in Fig. 3, controls the application of a particular kind or character of signaling current to the called line, as described in connection with Fig. 2.

While I have illustrated these particular forms and the particular details employed in such forms, it has been done for the purpose of better describing my invention, and not that my invention is limited to such forms and details, it being understood by those skilled in the art that departures may be made from such forms and details without departing from the spirit of the invention.

I claim:—

1. In a telephone system, the combination of a calling telephone line, substation apparatus thereon, a called telephone line, a signal on said line, a main station, link conductors at the main station for connecting the telephone lines together, a switching device for connecting the link conductors to the called line, a signaling generator at the main station, means to connect said generator to said signal, including said called telephone line, a signaling key including key contacts controlling the connecting means and mechanism, operable independently of said switching device and substation apparatus for relieving such key contacts from the control of said connecting means.

2. In a telephone system, the combination of a main station, a telephone line leading to the main station, a signal on said line, a calling telephone line and substation ap-

apparatus thereon, link conductors for connecting telephone lines together, a signaling generator at the main station adapted to be connected to and to operate the signal on the telephone line, a relay associated with said link conductors controlling the connection of said generator to said signal, and means operable independently of the substation apparatus for disassociating said key from said link conductors immediately after said key has been operated.

3. In a telephone system, the combination of a main station, a telephone line leading to the main station, a signal on said line, link conductors at the main station for connecting telephone lines together, a signaling generator at the main station adapted to be connected to and to operate the signal on the telephone line, a key associated with said link conductors controlling the connection of said generator to said signal and manually controlled means for automatically disassociating said key from said link conductors after the generator has been connected to the signal.

4. In a telephone system, the combination of a main station, a telephone line leading to the main station, a signal on the telephone line, link conductors at the main station for connecting telephone lines together, a ringing generator at the main station for actuating the signal at the substation, a ringing key controlling said generator normally disassociated from the link conductors, means for associating said key with said link conductors and mechanism for automatically disassociating the key from said conductors and releasing the same as soon as the signaling operation has been started.

5. In a telephone system, the combination of a main station, a telephone line leading to the main station, a signal on the telephone line, link conductors for connecting telephone lines together at the main station, a ringing generator at the main station adapted to actuate the signal on the telephone line, a ringing key at the main station controlling the connection of the generator to said signal, said key normally having no control over the connection of the generator to such signal, means at the main station for placing the control of the generator over said signal under said key and manually controlled means for automatically releasing the key for use with other cord circuits as soon as the ringing generator has been connected to such signal.

6. In a telephone system, the combination of a ringing circuit, a relay controlling the same, a circuit for said relay, a ringing key in said circuit, normally open contacts in said circuit, apparatus for closing the contacts in said circuit and placing said relay under the control of the ringing key, a second circuit for said relay, said relay when

operated opening its circuit containing the ringing key and closing said second circuit.

7. In a telephone system, the combination of a main station, a cord circuit at the main station for connecting telephone lines together, telephone lines leading to the main station, a signal on one of said telephone lines, a ringing generator at the main station, a ringing circuit including said generator, a portion of the cord circuit and the called telephone line, a relay controlling said circuit, a circuit for said relay, a ringing key in said circuit, normally open contacts in said circuit, a second relay controlling said normally open contacts adapted to close the same and place the control of said relay circuit under the ringing key, and a second circuit for said first relay, said first relay when actuated opening the first named circuit and closing the second named circuit.

8. In a telephone system, the combination of a calling and a called line leading from substations to a main station, a signal on the called line, link conductors at the main station for connecting telephone lines together, an answering and a calling switch for connecting the link conductors to the telephone line, a ringing generator at the main station, a signaling circuit including said generator, a portion of the link conductors and the called line, a relay controlling said circuit, a circuit for the relay including contacts of a ringing key, a second relay controlling normally open contacts in said circuit, said second named relay being controlled by the answering switch, and a second circuit for said first named relay, said first named relay when operated opening its first named circuit and closing its second named circuit, thereby releasing the key for use with other cords.

9. In a telephone system, the combination of a calling and a called line leading from substations to a main station, a cord circuit at the main station for connecting said lines together, an answering switch for connecting the cord to the calling line, a calling switch for connecting the cord to the called line, a signal on the called line, a source of current at the main station for operating said signal adapted to be connected to said signal, a ringing relay, a circuit for said ringing relay, a second relay controlling said ringing relay circuit, a circuit for said second relay, a ringing key controlling said second named circuit, a third relay controlling the circuit of said second relay, said third relay being controlled by the answering switch of the cord circuit, a second circuit for said second relay independent of said ringing key, said second relay when actuated opening its first named and closing its second named circuit.

10. In a telephone system, the combination of a calling telephone line and a called telephone line, a cord circuit for connecting said

calling and called lines together, a call bell on the called line, an answering plug and jack switch for connecting the cord to the calling line, a calling switch for connecting the cord to the called line, a ringing generator for ringing said bell, conductors for connecting said generator to the calling switch, a key normally having no control over said conductors, means including a relay controlled by the answering switch for assigning to said key control over said conductors and means including a relay caused to operate at the time the calling switch is operated whenever such calling switch is operated to establish a connection for removing said key from control of the said conductors.

11. In a telephone system, the combination of telephone lines, a subscriber's signal on one of said lines, link conductors for connecting the lines together, an answering switch and a calling switch for connecting the link conductors to telephone lines, a source of current for supplying current to operate said signal, conductors to connect said source to the line to which said signal is connected, a key switch common to a plurality of link conductors normally having no control over said conductors, wires normally connected to said keys and leading to a plurality of other link conductors, means controlled by the answering switch for assigning to said key control over said conductors and means for removing control over said conductors from said key.

12. In a telephone system, the combination of a plurality of telephone lines including a called line, a subscriber's signal on said called line, link conductors for connecting telephone lines together, a switch for connecting the link conductors to the called line, a source of current capable of supplying current to operate the signal on the called line, means for connecting said source to said switch and the called line and said signal, a key common to a plurality of cords adapted after said switch has been operated to control the connection of said source to said switch and mechanism controlled by said key for removing the control of the connection of said source to said switch from said key as soon as said source has been connected to said switch.

13. In a telephone system, the combination of a signaling circuit, a plurality of sources of current, each adapted to be connected in said circuit, one normally connected in said circuit, a relay controlling the connection of each of said sources in said circuit, another source of signaling current adapted to be connected in said circuit, all of said relays jointly controlling the connection of said last named source in said circuit and means controlling said relays.

14. In a telephone system, the combination of a signaling circuit, a plurality of

sources of current, each adapted to be connected in said circuit, one normally connected in said circuit, a relay controlling the connection of each of said sources in said circuit, a key controlling each of said relays, a third source of signaling current adapted to be connected in said circuit, means including all of said relays controlling the connection of a third source in said circuit and another ringing key controlling all of said relays.

15. In a telephone system, the combination of a signaling circuit, a normally open switch in said circuit, a source of signaling current, circuit conductors included in said circuit to connect said source to the contacts of said switch, a relay controlling said conductors and means controlled by said switch to remove the control of said conductors from said relay as soon as said ringing circuit is completed.

16. In a telephone system, the combination of a plurality of cord circuits, a ringing circuit, a key provided with a contact common to a plurality of cord circuits, said key controlling said ringing circuit, wires normally connected to said key and leading to a plurality of cord circuits, and a relay having contacts in the ringing circuit for disassociating said key from a cord circuit.

17. In a telephone system, the combination of a signaling circuit including a plurality of signals, a plurality of sources of signaling current for selectively operating said signals, mechanism for selecting and connecting said sources in said circuit, a plurality of devices for modifying the effect of the current from said sources on said signals and means for selectively causing said devices, each independently of the other, to modify the effect of the current from each source upon said signals.

18. In a telephone system, the combination of a signaling circuit including a plurality of signals, each signal constructed to respond to a particular one of a plurality of currents of different character, means for producing a number of currents of different character, means for determining which character of current shall be connected in said circuit and mechanism for modifying the current thus connected into the circuit according to a particular code.

19. In a telephone system, the combination of a signaling circuit, a plurality of tuned ringers connected in said circuit, a plurality of sources of current of different frequency adapted to be connected in said circuit, said sources producing current of a frequency to which said ringers are responsive, means for selecting each of said sources and connecting each in said circuit, and mechanism for breaking the current from said sources up into periods according to a certain code.

20. In a telephone system, the combination of a signaling circuit including a plurality of tuned ringers, a plurality of sources of current for operating said ringers, each source adapted to produce a current of a certain frequency calculated to operate a plurality of said signals, apparatus to selectively connect each of said sources in said circuit, a plurality of commutators differently arranged and means to cause each of said commutators to interrupt the current in said circuit from each of said sources.

21. In a telephone system, the combination of a signaling circuit, a plurality of signals in said circuit, a plurality of sources of signaling current each adapted to produce current of a character to which a plurality of said signals are responsive, mechanism to connect any of said sources of current in said circuit, a plurality of commutators having differently arranged contacts and means for causing either of said commutators to interrupt the current in said circuit from either of said sources.

22. In a telephone system, the combination of a signaling circuit, a plurality of tuned ringers connected in said circuit, a plurality of said ringers being responsive to the same frequency of current, a plurality of sources of alternating current each adapted to operate a plurality of said ringers, means to connect each of said ringers exclusive of the others in said circuit, a relay for interrupting said circuit, a plurality of commutators differently arranged, and means to connect each of said commutators in circuit with said relay.

23. In a telephone system, the combination of a ringing circuit, a plurality of tuned ringers connected to said circuit, a plurality of sources of signaling current each adapted to supply current to which a plurality of said ringers are responsive, apparatus to connect one of said sources in said circuit, a relay controlling said circuit, a plurality of commutators differently arranged, each adapted to be connected in the circuit of said relay, mechanism for selecting and connecting said commutators in the circuit of said relay and a common device controlling said apparatus and said mechanism.

24. In a telephone system, the combination of a ringing circuit, a plurality of tuned ringers connected in said circuit, a plurality of sources of frequency current, each adapted to supply current to operate a plurality of said ringers, a relay for connecting one of said sources in said circuit, a second relay controlling said circuit and adapted to open and close the same, a plurality of commutators, each adapted to be connected in the circuit of the second named relay, a third relay controlling the connection of said commutators in the circuit of

the third relay and means including a single key controlling both said first and said third named relays.

25. In a telephone system, the combination of a signaling circuit, a plurality of signals connected in said circuit, a plurality of sources of current, each adapted to supply current of a character capable of operating a plurality of said signals, a relay controlling the connection of each of said sources to said circuit to the exclusion of the other sources, a second relay controlling said signaling circuit and adapted to open and close the same, a plurality of commutators differently arranged for interrupting the circuit of said second relay, a third relay controlling the connection of each of said commutators in said circuit to the exclusion of the others, and means including a single key controlling said first and third named relays.

26. In a telephone system, the combination of a signaling circuit including a plurality of signals, a plurality of sources of current each adapted to produce current capable of operating a plurality of said signals, means for selecting and connecting said sources in said circuit, a plurality of devices each adapted to interrupt the current from said sources according to a predetermined code, mechanism for determining which of said devices should act upon the current in the ringing circuit and means including a single key controlling both said means.

27. In a telephone system, the combination of a signaling circuit including a plurality of signals, a plurality of sources of current for simultaneously operating said signals, means for selecting and connecting said sources in said circuit, each of said sources adapted to supply current to operate a plurality of said signals simultaneously, a plurality of commutators for interrupting said current according to a predetermined code, each of the commutators interrupting the current in a manner different from the other, means to cause said commutators to effect the interruption of said current in a predetermined manner and mechanism including a single key controlling both said current source selecting means and said commutator selecting means.

28. In a telephone system, the combination of a ringing circuit, a plurality of ringers in said circuit, each connected between a limb of said circuit and ground, similar ringers connected from each of said limbs to ground, a plurality of sources of ringing current, each adapted to supply current to operate a plurality of said ringers, electromagnetic means for determining which of said sources shall be connected in said circuit, a relay for determining to which of

the limbs of said circuit the sources shall be connected, a plurality of commutators for interrupting the flow of current in said circuit, said commutators being differently arranged to interrupt said current according to a predetermined code, mechanism for determining which of said commutators shall interrupt the current in said circuit and means including a single key controlling said electromagnetic means, said relay and said mechanism.

29. In a telephone system, the combination of a signaling circuit, a plurality of signals in said circuit, each connected to a limb of said circuit, a plurality of sources of signaling current, each adapted to operate a plurality of said signals, devices for interrupting the flow of current in said circuit according to a predetermined code, said devices being differently arranged and interrupting said current in a different manner, apparatus for determining which of said sources of current shall be connected in said circuit, mechanism for determining to which of the limbs of said circuit said selected source shall be connected, means for determining which of said devices shall interrupt the flow of current through said circuit and means including a single key controlling said last named means, said apparatus and said mechanism.

30. In a telephone system, the combination of a signaling circuit, a plurality of signals, each connected to a limb of said circuit, a source of current for supplying current to operate said signals, means to connect said source in said circuit, mechanism for determining to which of the limbs of said circuit said source shall be connected, a plurality of devices for interrupting the flow of current in said circuit according to a predetermined code, each of said devices being differently arranged and acting upon the current in a different manner, apparatus for determining which of said devices shall act upon the current in said circuit and means including a single key for controlling said mechanism and said apparatus.

31. In a telephone system, the combination of a ringing circuit, a source of ringing current and means to connect said source in said circuit, mechanism for determining to which of the limbs of said circuit said source shall be connected, means including a plurality of commutators for interrupting the flow of current in said circuit according to a predetermined code, each of said commutators being differently arranged and influencing the current in the circuit in a different manner, apparatus for determining which of said commutators shall influence said current and means including a single key controlling both said mechanism and said apparatus.

32. In a telephone system, the combination of a signaling circuit, a plurality of signals, each connected to a limb of said circuit, a plurality of sources of signaling current, a relay for determining and controlling the connection of each of said sources in said circuit, a second relay for determining to which limb of said circuit a selected source shall be connected, means including a plurality of commutators for interrupting the flow of current in said circuit according to a predetermined code, each of said commutators being differently arranged and calculated to differently affect the flow of current in said circuit, a third relay determining which of said commutators shall affect the flow of current in said circuit, a plurality of keys, one controlling each of said relays, a plurality of keys, one controlling each pair of said relays and a key controlling all three of said relays, a source of current and suitable conductors connecting said keys and said relays.

33. In a telephone system, the combination of a signaling circuit, a plurality of signals, each connected to a limb of said circuit, a plurality of sources of signaling current, a relay for determining and controlling the connection of each of said sources in said circuit, a second relay for determining to which limb of said circuit a selected source shall be connected, means including a plurality of commutators for interrupting the flow of current in said circuit according to a predetermined code, each of said commutators being differently arranged and calculated to differently affect the flow of current in said circuit, a third relay determining which of said commutators shall affect the flow of current in said circuit, a key controlling said first named relay, a second key controlling said first and second named relays and a third relay controlling all of said relays, a source of current and circuit conductors associating said source, said relays and said keys.

34. In a telephone system, the combination of a signaling circuit, a plurality of signals, each connected to a limb of said circuit, a plurality of sources of signaling current, a relay for determining and controlling the connection of each of said sources in said circuit, a second relay for determining to which limb of said circuit a selected source shall be connected, means including a plurality of commutators for interrupting the flow of current in said circuit according to a predetermined code, each of said commutators being differently arranged and calculated to differently affect the flow of current in said circuit, a third relay determining which of said commutators shall affect the flow of current in said circuit, a set of keys, one controlling each of said relays, a

second set of keys, one controlling any two of said relays, another key controlling all three of said relays, a source of current and conductors associating said source, said re-

5 lays and said keys.

35. In a telephone system, the combination of a plurality of telephone lines, one of which includes a subscriber's signal, link conductors for connecting the lines together, 10 an answering switch and a calling switch for connecting the link conductors to telephone lines, a source of current for supplying current to operate said signal, said source adapted to be connected to the line 15 to which said signal is connected, a signaling key normally having no control over the connection of said source to said telephone lines, means controlled by the answering switch for assigning to said key the 20 connection of said source to said line, and means controlled by the calling switch for removing from said key control of the connection of said source to said line.

36. In a telephone system, the combination of a plurality of telephone lines, a subscriber's signal connected to one of said lines, a main station, a cord circuit at the main station for connecting lines together, an answering plug and jack switch for connecting 30 the cord to a calling line, a calling plug and jack switch for connecting the cord to a called line, a source of current for supplying current to operate said signal, conductors for connecting said source to terminals of the calling plug, a ringing key normally 35 exercising no control over said conductors, means operated when the answering plug is inserted into the jack of the calling line for assigning control over said conductors to said key, and mechanism operated when the 40 calling plug is inserted into the jack of the called line for discharging said key from control over said conductors.

37. In a telephone system, the combination of a main station, telephone lines leading to the main station, a signal on one of said lines, link conductors at the main station for connecting said lines together, an answering switch and a calling switch for 50 connecting said link conductors to telephone lines, a source of signaling current adapted to supply current to operate said signal, conductors for connecting said source to the terminals of the calling switch, a relay controlling said conductors, a signaling key normally having no control over said relay, 55 means controlled by the answering switch for placing said relay under the control of said key and mechanism controlled by the calling switch for discharging said relay from the control of said key.

38. In a telephone system, the combination of a plurality of telephone lines, a substation signal on one of said lines, a main

station, a cord circuit at the main station, 65 an answering switch for connecting the cord to one of said lines, a calling switch for connecting the cord to another of said lines, a source of signaling current adapted to supply current to operate the signal, con- 70 ductors for connecting said source to a terminal of the calling switch, a relay controlling said conductors, a signaling key, a normally open circuit including said relay and said key, means controlled by the answering switch for closing said circuit and 75 placing said relay under the control of said key, a second circuit for said relay and means controlled by the calling switch for opening the first named circuit and dis- 80 charging the control of the relay from the key and closing the second circuit for said relay independently of the first circuit.

39. In a telephone system, the combination of a pair of telephone lines, a signal 85 on one of said lines, link conductors for connecting the lines together, an answering switch for connecting the link conductors to one of said lines, a calling switch for connecting the link conductors to the other 90 of said lines, a signaling circuit including one of said lines, said signal and a source of signaling current, a key for controlling said circuit normally having no control 95 thereof, means operated while the answering switch alone is operated for placing the ringing circuit under the control of said key and means actuated while both of said switches are operated to discharge said ringing circuit from the control of said key. 100

40. In a telephone system, the combination of a pair of telephone lines, link conductors for connecting the lines together, an answering switch and a calling switch each adapted when operated to connect the link 105 conductors to one of said lines, a ringing circuit including one of said lines, a signal on the line in the ringing circuit, a source of signal operating current adapted to be connected in said ringing circuit, a relay 110 controlling normally open contacts in said ringing circuit, means for energizing said relay when the answering switch is operated and means for deenergizing said relay when the calling switch is operated. 115

41. In a telephone system, the combination of a calling line and a called line, a signal on the called line, a cord circuit for connecting the lines together, an answering switch for connecting the cord to the call- 120 ing line, a calling switch for connecting the cord to the called line, a ringing circuit including a portion of the cord circuit and the called line, a source of signal operating current adapted to be connected in said circuit, a relay controlling the connection of 125 said source in said circuit, a circuit for said relay, a second relay controlling said

cuit and a circuit for the second relay controlled by the answering switch.

42. In a telephone system, a calling telephone line, a called telephone line, a plurality of connective circuits having answering and calling connective switches, a relay operated when connection is made by means of the answering switch of a connective circuit with a calling telephone line, a selective key common to a plurality of connective circuits and adapted to be associated with the particular connective circuit by said relay, and means operated by the closure of the calling connective switch to disassociate said selective key from the particular connective circuit.

43. In a telephone system, a plurality of lines leading thereto, one of which is a party line containing a plurality of substations, a connective circuit adapted to connect a calling line to said called party line, other connective circuits which likewise are adapted to connect calling and called telephone lines, a selective relay in each of all said cord circuits and adapted when actuated to select a particular character of ringing current, a control relay op-

erated when connection is made between the connective circuit and a calling line, said control relay causing the connection of a selective key to said connective circuit, circuit conductors permitting said selective key to then operate said selective relay, a calling switch adapted to connect said connective circuit to said party line, a ringing relay, said ringing relay adapted to apply said selected ringing current to the called party line, electromagnetic means operated when said calling switch is connected to said called line, said electromagnetic means being adapted to slowly release said control relay, circuit connections established during the interval while said control relay is being restored to normal to cause said ringing relay to operate, and a circuit independent of said control relay established upon this operation to maintain said ringing relay until the response of the called subscriber, and electromagnetic means operative upon said response to restore said ringing relay to normal.

I have hereunto affixed my signature this 7th day of June, 1915.

FRANK M. SLOUGH.

DISCLAIMER.

1,298,589.—*Frank M. Slough*, Elyria, Ohio. TELEPHONE SYSTEM. Patent dated March 25, 1919. Disclaimer filed March 13, 1923, by the assignee, *Stromberg-Carlson Telephone Mfg. Co.*

Hereby enters its disclaimer to the claims of the patent which read as follows, to wit:

"1. In a telephone system, the combination of a calling telephone line, substation apparatus thereon, a called telephone line, a signal on said line, a main station, link conductors at the main station for connecting the telephone lines together, a switching device for connecting the link conductors to the called line, a signaling generator at the main station, means to connect said generator to said signal, including said called telephone line, a signaling key including key contacts controlling the connecting means and mechanism, operable independently of said switching device and substation apparatus for relieving such key contacts from the control of said connecting means.

"2. In a telephone system, the combination of a main station, a telephone line leading to the main station, a signal on said line, a calling telephone line and substation apparatus thereon, link conductors for connecting telephone lines together, a signaling generator at the main station adapted to be connected to and to operate the signal on the telephone line, a relay associated with said link conductors controlling the connection of said generator to said signal, and means operable independently of the substation apparatus for disassociating said key from said link conductors immediately after said key has been operated.

"3. In a telephone system, the combination of a main station, a telephone line leading to the main station, a signal on said line, link conductors at the main station for connecting telephone lines together, a signaling generator at the main station adapted to be connected to and to operate the signal on the telephone line, a key associated with said link conductors controlling the connection of said generator to said signal and manually controlled means for automatically disassociating said key from said link conductors after the generator has been connected to the signal.

"5. In a telephone system, the combination of a main station, a telephone line leading to the main station, a signal on the telephone line, link conductors for connecting telephone lines together at the main station, a ringing generator at the main station adapted to actuate the signal on the telephone line, a ringing key at the main station controlling the connection of the generator to said signal, said key normally having no control over the connection of the generator to such signal, means at the main station for placing the control of the generator over said signal under said key and manually controlled means for automatically releasing the key for use with other cord circuits as soon as the ringing generator has been connected to such signal.

"11. In a telephone system, the combination of telephone lines, a subscriber's signal on one of said lines, link conductors for connecting the lines together, an answering switch and a calling switch for connecting the link conductors to telephone lines, a source of current for supplying current to operate said signal, conductors to connect said source to the line to which said signal is connected, a key switch common to a plurality of link conductors normally having no control over said conductors, wires normally connected to said keys and leading to a plurality of other link conductors, means controlled by the answering switch for assigning to said key control over said conductors and means for removing control over said conductors from said key.

"12. In a telephone system, the combination of a plurality of telephone lines including a called line, a subscriber's signal on said called line, link conductors for connecting telephone lines together, a switch for connecting the link conductors to the called line, a source of current capable of supplying current to operate the signal on the called line, means for connecting said source to said switch and the called line and said signal, a key common to a plurality of cords adapted after said switch has been operated to control the connection of said source to said switch and mechanism controlled by said key for removing the control of the connection of said source to said switch from said key as soon as said source has been connected to said switch.

"13. In a telephone system, the combination of a signaling circuit, a plurality of sources of current, each adapted to be connected in said circuit, one normally connected in said circuit, a relay controlling the connection of each of said sources in said circuit, another source of signaling current adapted to be connected in said circuit, all of said relays jointly controlling the connection of said last named source in said circuit and means controlling said relays.

"14. In a telephone system, the combination of a signaling circuit, a plurality of sources of current, each adapted to be connected in said circuit, one normally connected in said circuit, a relay controlling the connection of each of said sources in said circuit, a key controlling each of said relays a third source of signaling current adapted to be connected in said circuit, means including all of said relays controlling the connection of a third source in said circuit and another ringing key controlling all of said relays.

"17. In a telephone system, the combination of a signaling circuit including a plurality of signals, a plurality of sources of signaling current for selectively operating said signals, mechanism for selecting and connecting said sources in said circuit, a plurality of devices for modifying the effect of the current from said sources on said signals and means for selectively causing said devices, each independently of the other to modify the effect of current from each source upon said signals.

"18. In a telephone system, the combination of a signaling circuit including a plurality of signals, each signal constructed to respond to a particular one of a plurality of currents of different character, means for producing a number of currents of different character, means for determining which character of current shall be connected in said circuit and mechanism for modifying the current thus connected into the circuit according to a particular code.

"19. In a telephone system, the combination of a signaling circuit, a plurality of tuned ringers connected in said circuit, a plurality of sources of current of different frequency adapted to be connected in said circuit, said sources producing current of a frequency to which said ringers are responsive, means for selecting each of said sources and connecting each in said circuit, and mechanism for breaking the current from said sources up into periods according to a certain code.

"20. In a telephone system, the combination of a signaling circuit including a plurality of tuned ringers, a plurality of sources of current for operating said ringers, each source adapted to produce a current of a certain frequency calculated to operate a plurality of said signals, apparatus to selectively connect each of said sources in said circuit, a plurality of commutators differently arranged and means to cause each of said commutators to interrupt the current in said circuit from each of said sources.

"21. In a telephone system, the combination of a signaling circuit, a plurality of signals in said circuit, a plurality of sources of signaling current each adapted to produce current of a character to which a plurality of said signals are responsive, mechanism to connect any of said sources of current in said circuit, a plurality of commutators having differently arranged contacts and means for causing either of said commutators to interrupt the current in said circuit from either of said sources.

"41. In a telephone system, the combination of a calling line and a called line, a signal on the called line, a cord circuit for connecting the lines together, an answering switch for connecting the cord to the calling line, a calling switch for connecting the cord to the called line, a ringing circuit including a portion of the cord circuit and the called line, a source of signal operating current adapted to be connected in said circuit, a relay controlling the connection of said source in said circuit, a circuit for said relay, a second relay controlling said circuit and a circuit for the second relay controlled by the answering switch."

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