F. M. SLOUGH.

TELEPHONE SYSTEM.

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1,298,588. Patented Mar. 25, 1919.

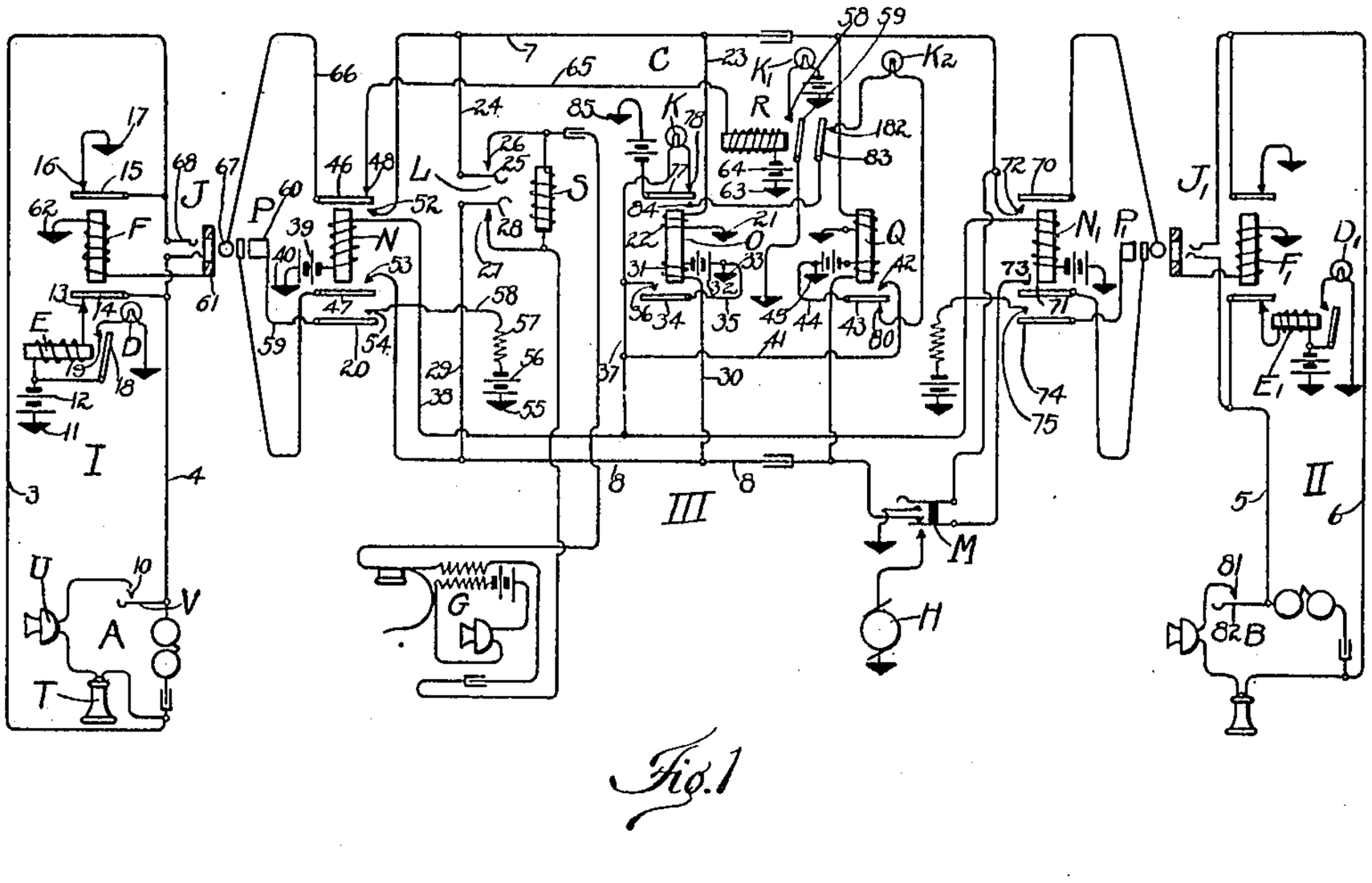

Fig. 1

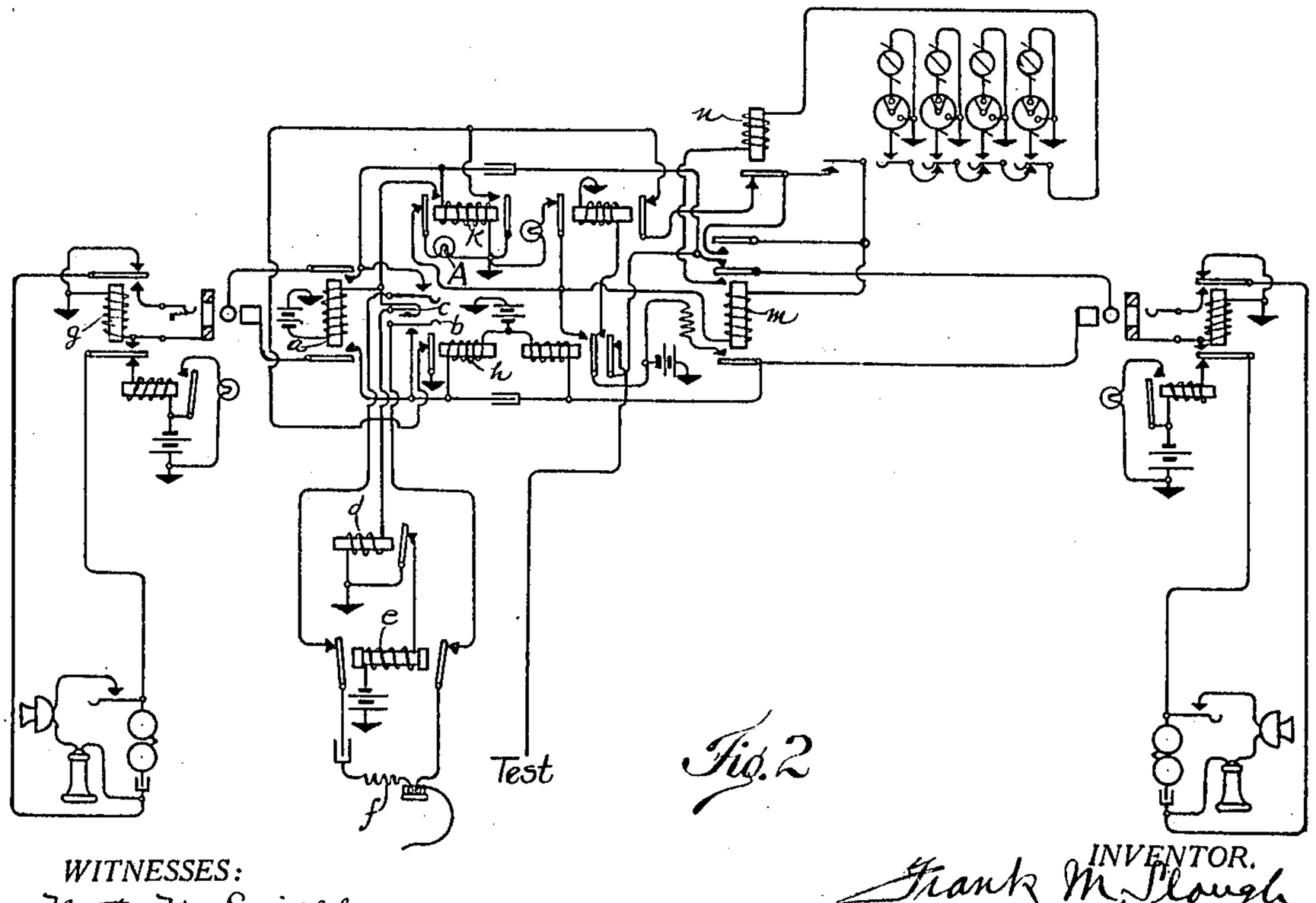

Fig. 2

WITNESSES:

Meta M. Smithberger.

John S. Richey

INVENTOR.

Frank M. Slough

BY F. O. Richey

ATTORNEY

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.

1,298,588. 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 others skilled in the art to which it appertains to make and use the same.

The object of my invention is to improve telephone systems by providing means for releasing the line circuit and other apparatus at the termination of a call, independently of the operator, so as to enable the line to be used for other purposes during the interval between the termination of the conversation and the taking down of the connection by the operator. I aim to place the apparatus for accomplishing this first named object under the control of the operator.

Another object of my invention is to provide a new system of supervisory signaling and a third object is to enable the operator to restore the connection of the cord circuit to the line without taking down and setting up the connections again in order to enable her to answer a recall immediately.

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

Figure 1 is a diagrammatic illustration of an embodiment of my invention.

Fig. 2 is a diagrammatic illustration of a second embodiment of my invention.

Referring now to the drawing and first to the embodiment illustrated in Fig. 1, at I I show a telephone line leading by its limbs 3 and 4 from a substation A to a main station at III. At II I show a second telephone line leading by its limbs 5 and 6 from a substation B to the main station at III. For convenience the line I will be spoken of as the calling line, the line II as the called line. At the main station III means are provided for connecting telephone lines together, here shown as a cord circuit C consisting of a plurality of strands, including the talking strands 7 and 8. Switching means are provided for connecting the connecting means to the line, here shown as plugs and jacks. The line I is provided with a jack J at which it may terminate at the main station and the called line likewise with a jack J_1. The cord circuit is provided with two plugs P and P_1 adapted to coöperate with the jacks to establish the connection. The plug P will be known here as the answering plug and the plug P_1 as the calling plug. The lines are provided respectively, with the line lamps D, D_1, line relays E, E_1 and cut-off relays F, F_1. There is at the main station an operator's set G, a ringing machine H, supervisory lamps K, K_1, K_2, a listening key L, a ringing key M, disconnect relays N and N_1, and supervisory relays O, Q and R. When a call is answered, the plug P is inserted into the jack J and the listening key L operated, which establishes a connection through the relay O and the coil S. The relay O is energized, closing a circuit through the relays N and N_1, which completes the connection through the cord circuit and which will be maintained by the subscriber whose line furnishes a circuit for the relay O and in a similar manner an energizing circuit for relay Q will be maintained by the called subscriber's line.

When the conversation is completed, the breaking of these circuits will deënergize the relays N and N_1, interrupting the cord circuit and releasing the lines. The lamp K is controlled by the calling subscriber, the lamp K_2 by both subscribers and the lamp K_1 will indicate the fact that both subscribers have hung up their receivers. When the conversation has been completed, and the disconnect apparatus operated, the operator may, by operating her listening key, restore the connection to immediately answer a recall.

The operation of the system is as follows:

Assuming that the subscriber at A desires to communicate with the subscriber at B, the receiver T is removed from the hook V, which rises, closing a switch V—10 in the circuit of the line relay E and closing the same, as follows: ground at 11—battery 12—E—13—14—4—V—10—transmitter U—T—3—15—16—ground 17. The relay E will attract its armature 18 and close a switch 18—19 in the circuit of the lamp D,

which will be energized. This lamp is placed in such a position that its illumination will be observed by the operator who will insert the plug P into the jack J, completing a circuit for the relay R from ground 63—through battery 64—R—65—48—46—66—tip 67—tip spring 68—15—16—to ground at 17. The relay R will be energized, closing a switch 58—59 in the circuit of the lamp K_1, which will be energized. The operator then operates the listening key L, which will complete a circuit for the relay O, as follows: ground 21—coil 22 of O—conductor 23—7—conductor 24—contacts 25 and 26—coil S—contact 27—28—29—8—30—coil 31 of relay O—battery 32—ground 33. The relay O will attract its armature 34, completing a circuit for the relay N, as follows: ground 33—35—34—36—37—38—N—battery 39—ground 40, and the relay N_1, as follows: 33—35—34—36—37—through N_1, battery and ground. The relay N will attract its armatures 46—47 and 20. A switch 46— 48 will be opened, breaking the circuit of the relay R, which will release its armature 59, opening the circuit of the lamp K_1 at 58—59. The strand 7 will be coupled up at 46—52 and the strand 8 at 47—53. The circuit of the relay F will be completed at 20—54 and the relay F energized over the following circuit: ground 55—battery 56—resistance 57—conductor 58—54—20—59—60—61—F—ground 52. The relay F will attract the armatures 14 and 15, cutting off the line lamp and relay from the ground. The relay N_1 will attract its armatures 70 and 71, completing the strands of the cord circuit 7 at 70—72 and 8 at 71—73 and the circuit of the cut-off relay F_1 at 74—75.

Having learned what subscriber is desired, the plug P_1 is inserted into the jack J_1, establishing the circuit of the relay F_1, which cuts off the line signal D_1 and relay E_1 from the line II. After the circuit of the relay O is once established by the operation of the key L, it will be maintained by the calling subscriber's substation set over the line and the talking strands of the cord, in a manner which will be clear from the diagram. The relay O also attracted its armature 77, opening the switch 77—78 in the circuit of the lamp K. To call the subscriber at B the ringing key M is operated, and ringing current placed upon the line over a circuit which will be clear from the drawing, and which is well known and understood. On the response of the subscriber at B, the relay Q will be energized over the talking strands of the cord and the called line in a manner well understood and clear from the drawing. A switch 43—80 will be opened in the circuit of the lamp K_2 and a switch 43—42 closed, completing a second circuit for the relays N and N_1 from the ground 45—44—43—42—41 to the conductor 37 and to and through the relays, in the manner already described. When the conversation is completed, either or both subscribers hang up their receivers. In case the subscriber at B hangs up, the relay Q will be deënergized by the breaking of its circuit at 81—82. The circuit of the relays N and N_1 passing through the switch 42—43 will be broken, but unless the calling subscriber hangs up, the other circuit of these relays will be maintained at 34—36. The circuit through the lamp K_2 will be energized over the following circuit: 45—44—43—80—K_2—182—83—84—77—to ground 85. If the calling subscriber alone hangs up, the relay O will be deënergized by the interruption of its circuit at 10—V, interrupting the branch of the circuit of the relays N and N_1 at 31—34. These relays, however, will not be deënergized unless the called subscriber hung up, since their circuits will be maintained at 42—43. The lamp K, however, will be lighted over the following circuit: ground at 85—77—78—K—37—41—42 to ground at 45. If both of the subscribers hang up then both the relays O and Q will be deënergized, opening both branches of the relays N and N_1, both of which will be deënergized, so that the talking strands of the cord circuit will be interrupted at each end and each plug will be disconnected from the talking strands, releasing the lines. The circuits of both the lamps K and K_2 will be opened, but the circuit of the lamp K_1 will be completed, owing to the reënergization of the relay R over its circuit, which has already been described.

Now in case there is a recall by either of the subscribers, the line lamp of his line will be flashed before the operator, who by simply operating the key L can, as previously described, reëstablish the connection without having to withdraw the plugs and restore them to the jacks.

In the form shown in Fig. 2 but one plug is disconnected. In this form I have shown the well known system of line signal and cut-off apparatus, the operation of which will be clear from the description of Fig. 1. I have shown a well known system of supervisory signaling, whose function will be clear from the drawing. I have also illustrated an automatic ringing system. In general, the function of the system shown in Fig. 2, is as follows: The cord circuits are normally interrupted at the contacts of the relay *a*. When the plug is inserted no connection is made until the listening key *b* is depressed, when the contact *c* will be closed, completing a circuit for the relay *a* and the relay *d*. The relay *e* is a slow acting relay, whose circuit is normally closed, and normally maintaining the operator's set *f* disconnected. When energized, the relay *d* opens the circuit of

the relay *e*, which, being slow acting, does not let go its armature and connect the operator's set for an appreciable period of time, during which the other apparatus is operating, so that the operator does not get the clicks in the circuit resulting from the operation of this apparatus. The relay *a* pulls up its armatures, connecting the cord circuit through and completing a circuit for the cut-off relay *g* and the supervisory relay *h*. A locking circuit will be completed for the relay *a* through the contacts of the relay *k*. This locking circuit includes the winding of relay *a*, the back contacts of the left-hand armature of relay *k* and the lamp A. The relay *h* will have been energized by the completion of its circuit through the talking strands and the line when the relay *a* was first energized. The operator being connected, learns the desire of the calling subscriber, plugs in on the called line and depresses one of the ringing keys which completes a circuit of the relay *m* in a well known manner. The relay *m* completes the ringing circuit and the ringing takes place until the called subscriber responds, when the relay *n* will be energized, owing to the fact that the substation bridge is of lower resistance than the bell circuit, and the increased flow of current is sufficient to energize the relay *n*, which failed to respond to the character of current produced by the ringing generator in its circuit, which included the bell bridge. When the conversation is completed and the circuit of the relay *k* broken by the retirement of the calling subscriber, the relay *a* will be deënergized, the cord interrupted and the system restored to normal, the interruption of the cord relieving the calling line, so that it will now be available either for a recall or for use as a called line in the multiple positions.

The test circuits will be understood from the drawings. In Fig. 1 when the tip of the plug P_1 is applied to the ring of the jack of a busy line, such ring will be at a higher potential than the tip of the plug and the talking strand connected thereto, due to the connection to a multiple jack of such line of the plug of another cord. In other words, the jack ring of the busy line will be "live" with electricity. Current will then course from the tip of P_1, through 70—72 calling end of 7—23—22 to ground at 21, inducing an influx of current in the circuit 21—22—23—7—24—25—26—G—27—28—29—30—31—32, which will be recognized by the operator as a busy signal.

In Fig. 2 current will flow from the tip of the calling plug through the calling end of the tip talking strand, the normal contacts of relay *m*, the normal contacts of the calling supervisory relay, and through the conductor terminating in the drawing at the word "Test," which, as is well understood, leads to a secondary (omitted to simplify the drawing) of the winding *f* and thence to ground.

Although my invention is capable of being embodied in a number of different forms, I have illustrated only two of these forms which appear to me now to best serve to illustrate the invention. I do not wish, however, to be limited to these forms as many variations may be made from the forms and from the details thereof without departing from the spirit of the invention, which is more fully set forth in the appended claims.

I claim:—

1. In a telephone system, the combination of a plurality of telephone lines and a cord circuit, a listening key in the cord circuit and subscriber controlled switches on the telephone lines, and means without the talking strands of the cord circuit controlling the strands of the cord circuit governed by the listening key and the subscriber controlled switches.

2. In a telephone system, the combination of a main station, a plurality of substations, telephone lines connecting the substations to the main station, connecting means at the main station for connecting the telephone lines together, mechanism under control of the substation's apparatus for automatically interrupting the connecting means when the substation apparatus is retired, and means including a listening key controlled by the operator for restoring the connecting means.

3. In a telephone system, the combination of a main station, a plurality of substations, telephone lines leading from the substations to the main station, connecting means at the main station for connecting the telephone lines together, switching means for connecting the connecting means to the telephone lines, mechanism controlled by the substation apparatuses for automatically interrupting the connecting means when the conversation is terminated, and apparatus controlled by the operator for restoring the connecting means without operating said switching means.

4. In a telephone system, the combination of a plurality of supervisory signals, means to actuate one of said signals when one of said subscribers retires, means to actuate a second of said signals when the other of said subscribers retires, means to extinguish both said first and second signals when both said subscribers retire, and means to operate the third of said signals when both of said subscribers retire.

5. In a telephone system, the combination of a main station, a plurality of substations, telephone lines leading from the main station to the substations, a cord circuit at the main station, a plurality of supervisory signals in the cord circuit, means including one of said telephone lines for causing the ac-

tuation of one of said supervisory signals when a subscriber on said line retires, means including another of said lines for causing the actuation of another of said supervisory signals when a subscriber upon the second line retires and means for causing the retirement of said first and second supervisory signals including said lines when both said subscribers retire and for causing the actuation of a third of said signals.

6. In a telephone system, the combination of a calling telephone line and a called telephone line, a cord circuit for connecting said lines together, a listening key associated with the cord circuit, mechanism at each substation including a subscriber-controlled switch, and means controlling the strands of the cord circuit governed by the listening key and jointly by the switches of the calling and called subscriber.

7. In a telephone system, the combination of a calling and a called telephone line, subscribers' apparatus including a switch on each line, a main station, a cord circuit at the main station, a listening key, apparatus controlling the cord circuit, means including said key controlling said apparatus and means for transferring the control over said apparatus from said key to the joint control of the switches of the calling and called subscribers.

8. In a telephone system, the combination of a calling and a called telephone line, a cord circuit, apparatus controlling the strands of the cord circuit, an operator's listening key controlling said apparatus and means for transferring the control over said apparatus from the listening key to the joint control of the substation apparatus on the called and calling lines.

9. In a telephone system, the combination of a plurality of substations, telephone lines leading from the substations to the main station, a cord circuit at the main station, apparatus at the main station controlling the cord circuit, a listening key at the main station and means including the listening key controlling said cord circuit controlling apparatus, means to transfer the control of said cord circuit controlling apparatus from the listening key to the joint control of the apparatus at two of said substations and means for transferring said control back to the listening key when said substation apparatus is retired.

10. In a telephone system, the combination of a main station, a calling substation and a called substation, a telephone line leading from each substation to the main station, connecting means at the main station for connecting the telephone lines together, mechanism under control of the apparatus of the calling and called substations for automatically interrupting the connecting means when the substation apparatus is retired, and means including a listening key controlled by the operator for restoring the connecting means.

11. In a telephone system, the combination of a main station, a called substation and a calling substation, telephone lines leading from said substations to the main station, connecting means at the main station for connecting the telephone lines together, switching means for connecting the connecting means to the telephone lines, mechanism controlled by the apparatus of the calling and called substations for automatically interrupting the connecting means when the conversation is terminated and apparatus controlled by the operator for restoring the connecting means without operating said switching means.

12. In a telephone system, the combination of a main station, a plurality of telephone lines including a calling line and substation apparatus on the calling line, a cord circuit at the main station, apparatus controlling the strands of the cord circuit, a relay controlling said apparatus including a winding controlled by the substation apparatus on the calling line, and a listening key associated with the cord circuit controlling said relay winding independently of the substation apparatus.

In witness whereof, I have signed my name in the presence of two witnesses this 7th day of November, 1914.

FRANK M. SLOUGH.

Witnesses:
GEO. E. ROBERT,
JOHN PEHRSSON.