F. W. DUNBAR.

TELEPHONE SYSTEM.

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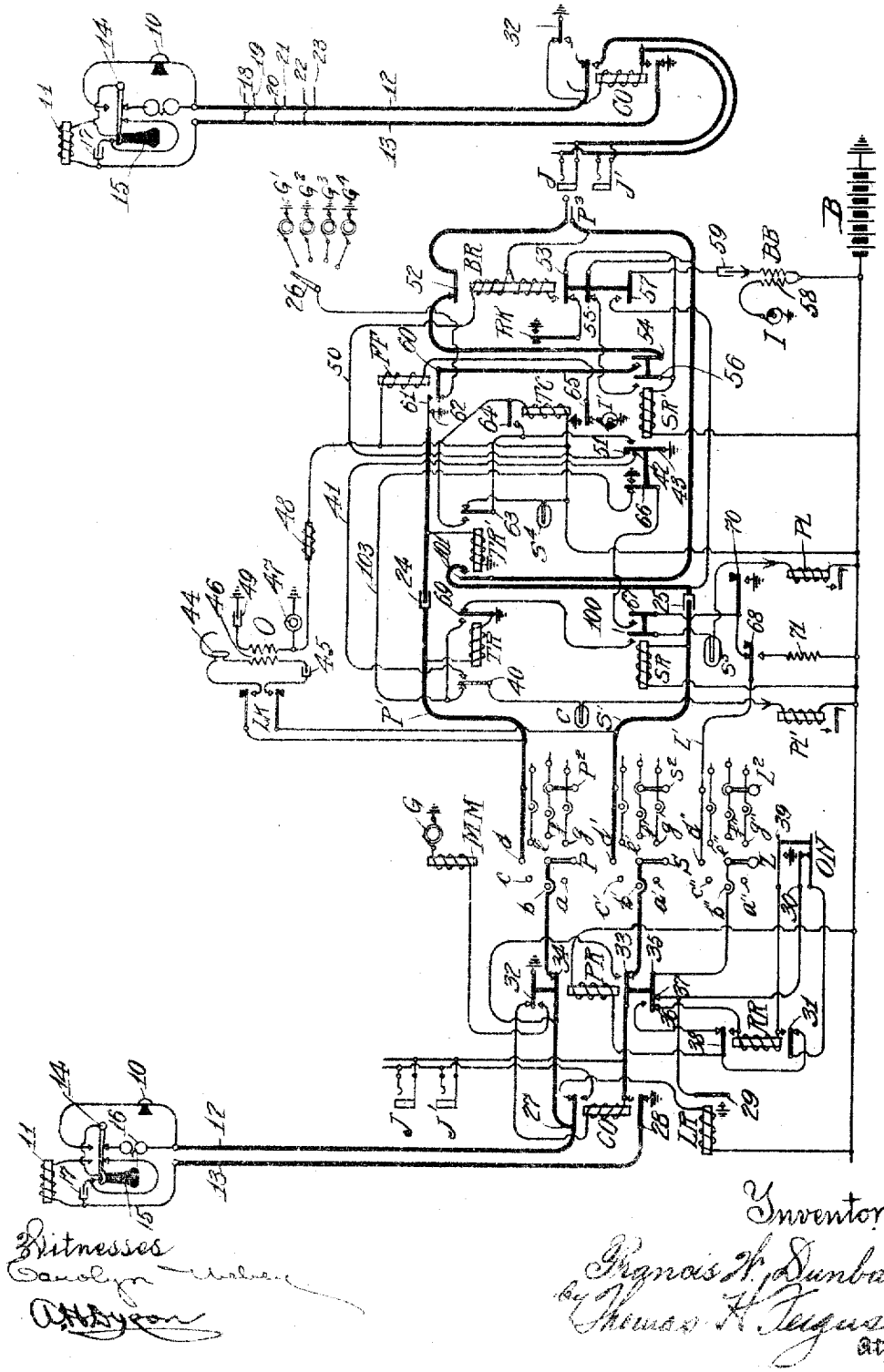

Witnesses

Carolyn Wilson

O. H. Bryson

Inventor

Francis F. Dunbar

by Thomas H. Ferguson

Atty.

UNITED STATES PATENT OFFICE.

FRANCIS W. DUNBAR, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO KELLOGG SWITCHBOARD & SUPPLY COMPANY, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, FRANCIS W. DUNBAR, a citizen of the United States, residing at Chicago, county of Cook, State of Illinois, have invented new and useful Improvements in Telephone Systems, of which the following is a specification.

The present invention relates to telephone systems generally and more particularly to the circuits and apparatus by which the busy and idle conditions of a telephone line are established and tested and ringing current applied to the called-for line.

In carrying out my invention, I have devised a system in which the busy test connection to the multiple contacts of a calling telephone line is established, where an automatic switch is employed, as soon as the switch is set in motion, and in which, upon establishing connection with the called-for line, either a busy back signal will be transmitted over the calling circuit, if the called-for line be busy at the time connection is established with it; or if the called line be idle, calling current will not be applied to the called-for line without the intervention of the operator. This arrangement requires, first, the insertion of the link-circuit plug into a jack of the called-for line, and then, if the said line be idle, the pressing of a ringing key or other manually controlled device to project ringing current out over the called line to signal the called-for party. In commercial operation, this sequence of operation is also preferred and it is to meet this preference of practice that I have devised the present system.

The specific nature of the invention will be best understood by reference to the accompanying drawing and the following detailed description, while the scope of the invention will be particularly pointed out in the appended claims.

In the drawing, I have illustrated an individual calling line at the left, adapted to be connected by an intervening link-circuit to a party line at the right, the connection between the calling line and the link-circuit being established by an automatic switch, and that between the opposite end of the link-circuit and the called line being established manually. At the substation, the usual equipment may be provided. A transmitter 10 and induction coil 11 are included in a normally open conductive bridge of the line limbs 12, 13, which is adapted to be closed by the switch-hook 14 upon the removal of the receiver 15. A normally closed bridge includes the call-bell 16 and the condenser 17. In the case of party lines, the call-bells are tuned in accordance with the well-known harmonic principle to respond only to current of definite frequencies supplied from proper generators at the central office. In the case of the called line, the second, third and fourth substation outfits are indicated by the leads 18—19, 20—21, 22—23.

At the central office, each line 12, 13 has access to switch mechanism, here illustrated as a traveling switch individual to the line and arranged to select the first idle link-circuit of a number of link-circuits whose calling ends are controlled by operators. In the present instance, P, S, L, designate the primary, secondary and local wipers of a switch individual to the calling line, and contacts a, b, c, d, e, f, g, a', b', c', d', e', f', g', and a'', b'', c'', d'', e'', f'', g'', designate the coöperating fixed contacts which form terminals of the primary, secondary and local strands of the associated link-circuits. In the present instance, the primary, secondary and local strands P′, S′, L′, of the contacts d, d' and d'', are the only strands illustrated. It will of course be understood that in practice, each of the fixed contacts a, b, c, e, f, g, and their companions, would be similarly connected. In the present instance also, just to the right of the switch having the wipers P, S and L, is a switch having wipers P^2, S^2, L^2, having associated bank contacts. It will be noted that the strands P′, S′, L″ of the link-circuit illustrated are also connected to contacts of this switch. Although the link-circuit here illustrated is connected to but two switches, it will be understood that in practice the same may be connected to any desired number, according to the number of lines which it is desired to give access to this link-circuit. Each switch is provided with a motor magnet MM and appropriate mechanism (not illustrated) for moving the wipers over their associated fixed contacts. Each switch is also provided with off-normal contacts ON, which are operated upon the first movement of the switch from normal. A line

relay LR, a cut-off relay CO, a private relay PR, and a release relay RR is provided for each line and its associated switch. In the present instance, jacks J, J', forming alternate connection terminals for the line 12, 13, are provided, so that the line may be connected to manually.

In the link-circuit, the tip strand P' is provided with the usual tip relays TR, TR', and the interposed condenser 24, while the sleeve strand S' is provided with sleeve relays SR, SR', and an interposed condenser 25. In addition, the link-circuit is provided with a busy relay BR, a flip-flop relay FF, and a tip control relay TC. A call lamp C, answering supervisory lamp S^3 and calling supervisory lamp S^4 are also provided. Busy back signal transmitting means are illustrated at BB and an operator's outfit is illustrated at O. Generators G', G^2, G^3, G^4 are adapted to be brought into circuit with the called line through the agency of the manual switch 26 and the contacts of the flip-flop relay FF. These generators, as before indicated, are arranged to supply current of differing frequencies to selectively operate bells at the substations of each party line.

With this outline of the apparatus employed in the system, the operation will be readily understood. Assuming that the party at the substation at the left desires to converse with the party at the completely illustrated substation at the right, he will remove his receiver 14 and thereby complete a circuit for his line relay LR which may be traced from the live or negative pole of battery B, through relay LR, normal contact 27 of relay CO, line limb 12, transmitter 10, switch-hook 14, induction coil 11, line limb 13, normal contact 28 of relay CO to ground, or the common return of the battery. The energization of relay LR grounds its contact 29 and thereby completes a circuit for private relay PR, which may be traced from ground at contact 29, through closed off-normal contact 30, normal contact 31 of release relay RR, relay PR to the opposite pole of battery B. Relay PR is thereby energized to place a busy test upon the test contacts of the jacks J, J', and start the switch wipers. Normally, the test contacts of the jacks are connected through cut-off relay CO and normal contact 32 of relay PR to ground. Upon the energization of this relay, however, this connection to the test contacts is changed from ground to battery via alternate contact 33 of relay PR, normal contact 27 of relay CO, and relay LR to the live pole of the battery B. Thus the busy test is placed upon the connection terminals of the calling line as soon as the relay PR is operated and the switch thereby started. The starting circuit for the switch extends from the live pole of the grounded generator G, which may be either an alternating or pulsating machine, through motor magnet MM and alternate contact 32 to ground. The opening of normal contacts 33 and 34 of relay PR disconnects the wipers P, S during their advance movement and thereby prevents interference with existing conversation through switch contacts over whose multiples said wipers may pass. Upon the first advance step of the switch, the contact 30 of the off-normal switch ON is opened, but in the meantime the local wiper L, which is preferably provided with an enlarged contacting end so as to engage one contact before disengaging the preceding, is moved into engagement with contact a''. As illustrated, this contact is not connected with the illustrated strand L', but if it be assumed that this contact is connected to a strand L' of some other link-circuit and that the link-circuit is idle, then the switch would not advance farther but would remain in this position, leaving the contacts P, S and L in engagement with contacts a, a' and a'' of the selected link-circuit. However, if it be assumed that the link-circuit, corresponding to contacts, a, a', a'', is busy, then strand L' of that link-circuit will be connected to ground over some one of several circuits, as will hereinafter more fully appear. Accordingly, the circuit of private relay PR will not be interrupted by the opening of off-normal contact 30, but will be continued through normal contact 38 of relay RR and alternate contact 35 of relay PR, wiper L, contact a'', strand L', to ground. Thus the wipers P, S and L will be advanced to the second set of contacts b, b', b''. This operation will continue until the wipers engage the contacts of an idle link-circuit. If it be assumed that the first idle link-circuit engaged is that illustrated, then the contacts P, S and L will be left in engagement with contacts d, d', d'' by reason of the interruption of the circuit of relay PR thus extended via strand L' and normal contact of key 68 to the normally open contact 67 of relay SR, as soon as such link-circuit is encountered. The deënergization of relay PR will complete the talking strands 12, 13 at contacts 33, 34, and will of course interrupt the circuit of motor magnet MM. It may also be noted that the first step of the switch closed off-normal contact 39 to ground. This is for the purpose of completing a circuit for release relay RR, as will more fully appear later.

As soon as the switch stops in engagement with the contacts d, d', d'', a circuit is completed through the sleeve supervisory relay SR and the cut-off relay CO of the calling line, which may be traced from the live pole of battery B, through relay SR, sleeve strand S', cut-off relay CO and normal contact 32 of relay PR to ground. The test or

sleeve rings of the jacks J, J′ are thus connected to battery B through the relay SR instead of relay LR, as they were before the release of relay PR, and relays SR and CO are both operated in series. At the same moment circuit was closed through the relays CO and SR, a circuit was provided for the operation of relay TR, via relay LR, normal contact 27 of relay CO, normal contact 34 of relay PR, switch contact P-*d*, strand P′, and said relay TR, to ground. Relay TR is thus initially energized at the same moment as is relay SR, thereby preventing even a momentary closing of the release circuit which will later be traced in detail. The operation of the relay CO provides a substitute path for the continued energization of relay TR, as follows: from battery B, through sleeve relay SR to the winding of relay CO, as previously traced, then in multiple circuit with the winding of relay CO via alternate contact 28, line limb 13, induction coil 11 at the substation, switch-hook 14, transmitter 10, line limb 12, wiper P, contact *d*, strand P′, and said tip relay TR to ground. The opening of normal contact 27 disconnects the line relay LR, and the closing of alternate contact 28 extends line limb 13 to the sleeve strand S′ of the link-circuit. The energization of both relays SR and TR prevents the operation of the answering supervisory signal S^3 and the associated pilot relay PL. On the other hand, however, pilot relay PL′ and calling lamp C are energized by the closing of a circuit extending from the live pole of battery B, through said relay PL′, and lamp C, alternate contact 40 of relay TR, conductor 41 and normal contact 42—43, to ground. The operator, upon observing the display of the call lamp C, will depress her listening key LK to include her head receiver 44, condenser 45 and winding of the induction coil 46 in bridge of the strands P′S′ to learn the order of the calling party. For such purpose, the transmitter 47 may be supplied from battery B, through impedance coil 48, and the local talking circuit for the transmitter will include the other winding of induction coil 46 and condenser 49. Upon learning the number of the desired substation, the operator will set the switch 26 so as to include the proper generator G′, G^2, G^3 or G^4 in circuit to actuate the bell of the called-for party in case his telephone be upon a party line, or in case the called-for party be on an individual line, the operator will leave the switch 26 in a position to include the generator for the bell of such line. She will then insert the calling plug P^3 into one of the jacks J, J′ of the called-for line. In case such line is in use, there will be a potential on the sleeve contact of the jack different from that of ground. In case the line is in service as a calling line, such potential will be supplied by one of the busy test connections heretofore traced in connection with the calling line. If such line is in service as a called line, such busy test connection will extend through the sleeve relay SR′ of that link-circuit which is used to establish connection to said line, alternate contact 56 and normal contact 55, to the sleeve contact of its plug P^3, and thence through the connection between the multiple jacks to the contact in question. If then the called line be busy, the insertion of the plug P^3 into the jack will cause a flow of current from the sleeve contact of the jack, through the upper winding of the busy relay BR, conductor 50 and normally closed contact 51—43 to ground. Relay BR will thus be immediately energized without further act on the part of the operator. The opening of its contact 52 will open the tip strand and thereby prevent all possible connection of ringing current to that side of the circuit. Alternate contact 53, closed by the energization of relay BR, will, however, bring the winding of sleeve relay SR′ and the lower winding of relay BR into a circuit which will extend from the live pole of the battery through said relay SR′, alternate contact 53, lower winding of relay BR, over the sleeve side of the circuit, through the already operated cut-off relay CO and normal contact 32 of the busy called line. This will cause the operation of sleeve relay SR′ and the continued operation of the busy relay BR.

In case the switch of the busy line was in process of selecting an idle link-circuit, its cut-off relay CO would not be operated, because its circuit is then open at normal contact 32 of its relay PR. Under these conditions, the sleeve relay SR′ would continue to vibrate until the busy line had selected a link-circuit, whereupon its cut-off relay CO would operate and provide a locking winding for the sleeve relay SR′ through it, as above described. The closing of contact 54 of relay SR′ does not bring the ringing generator into circuit, since, as before pointed out, such circuit is interrupted at contact 52. The opening of contact 55 of relay BR prevents the short-circuiting of the lower winding of relay BR, which would otherwise occur through closed contact 56. And the closing of contact 57 of relay BR connects the busy back mechanism in circuit so as to transmit a characteristic busy signal to the calling party as an indication to him that the line he wishes is in use. Such mechanism includes an interrupter I in circuit with one winding of an induction coil 58 and the battery B. The secondary portion of this circuit includes the other winding of induction coil 58, condenser 59, closed contact 57, the sleeve side of the link-circuit, the sleeve side of the line circuit, the receiver at the substation, the tip side of the

line circuit and ground at any grounded point along that side of the circuit, such as that at tip relay TR. The operation of the ringing key RK will be without effect because its circuit is now held open at alternate contact 53. The operation of relay SR′ has extinguished the calling lamp C by opening its circuit at normal contact 42—43, and has closed the circuit of the called supervisory lamp S^4 from battery, via said lamp, normal contact 63 of relay TR′, and alternate contact 43 of said relay SR′ to ground, thus lighting it. As soon as the calling subscriber, in response to the busy back signal, replaces his receiver, thus opening the circuit of the tip relay TR, the calling supervisory signal S^3 will light over the following circuit: battery B, supervisory pilot relay PL, said lamp S^3, closed contact 100 and normal contact 69 to ground. The operator is thus advised that the link-circuit plug may be removed.

In case the called-for line is idle, the sleeve contacts of the jacks J, J′ will be free from potential and connected to ground through the cut-off relay CO; and upon inserting the plug P^3, there will be no flow of current through busy relay BR and consequently it will remain inert. In fact, this operation will not result in the operation of any of the relays of the link-circuit or of the called line. To apply ringing current to the idle called line, the operator momentarily depresses the manually controlled switch or ringing key RK. This will close a circuit for the sleeve relay SR′ from the live pole of the battery B, through said relay, normal contact 53 of relay BR, and closed contact of ringing key RK to ground. The energization of relay SR′ will at once close a locking circuit for itself which may be traced from the live pole of battery, through said relay SR′, closed contact 56, normal contact 55, plug and jack sleeve contacts and cut-off relay CO to ground at contact 32. The operation of cut-off relay CO will disconnect the line relay and the associated switch from the control of the parties on that line. The opening of normal contacts 43—42—51 of relay SR′ will open the circuit of call lamp C and cause its extinguishment, as before described, and will prevent the operation of relay BR by opening the circuit through its upper winding. As soon as contact 54 of relay SR′ is closed, the connected generator G′, G^2, G^3, or G^4, will be intermittently connected to the tip side of the circuit through the back contact 60 of the flip-flop relay FF, alternately with the calling supervisory tip relay TR′. Thus relay SR′ is in a sense a ringing relay since its operation applies ringing current to the line. Tracing the ringing circuit at the instant the flip-flop contact 60 is in the position illustrated, we find the circuit extends from the particular generator G′, G^2, G^3, or G^4, in service, through switch 26, back contact 60, closed contacts 54, 52 in the tip strand P′, thence out over the tip side of the circuit, through the call-bells and condensers upon the party line, or the single call-bell and condenser in case of an individual line, back over the sleeve side of the circuit to ground via the two paths, one through cut-off relay CO, and the other through sleeve relay SR′. If desired, the flip-flop relay FF may be, as shown, normally included in a closed circuit through the interrupter I′ and therefore continuously acting except when relay TC is energized.

As contact 60 of the flip-flop relay is attracted, it first disconnects the generator from the tip side of the circuit, then momentarily grounds the tip side of the circuit through contact 60—61—62, and finally connects the tip side of the circuit to ground through tip relay TR′. The momentary grounding of this side of the circuit through contact 62 permits the charged condensers upon the circuit to be partially discharged before the tip relay TR′ is brought into circuit. This avoids the possibility of the discharge of the condensers operating said relay TR′. As long as the receiver at the called station remains upon its hook, there is no conductive path for steady current between the line limbs and consequently relay TR′ will remain unenergized. As soon, however, as the called party removes his receiver and thereby completes such a conductive bridge, and as soon as flip-flop relay FF brings tip relay TR′ into circuit, said relay will be energized. The circuit by which this relay is energized is the battery supply circuit for the called station and extends from the live pole of the battery B, through relay SR′ to the sleeve side of the circuit, thence through the substation, back over the tip side of the circuit, through contact 60—61 of relay FF, and relay TR′ to ground. Prior to this operation of relay TR′, and subsequent to the operation of relay SR′, supervisory lamp S^4 remains lighted by reason of a circuit from the live pole of the battery, through said lamp, normal contact 63 of relay TR′ and alternate contact 43 of relay SR′ to ground. As soon as relay TR′ is energized, this lamp is extinguished and tip control relay TC is energized over a circuit extending from the live pole of the battery, through said relay, alternate contact 63 of relay TR′, and alternate contact 43 of relay SR′ to ground. The closing of contact 64 of relay TC completes a locking circuit for that relay through alternate contact 43 to ground, and the movement of its contact 65 to its alternate position disconnects the interrupter I′, thereby discontinuing the intermittent energization and deenergization of relay FF, and, by grounding the winding of

said relay, maintains it energized, thereby disconnecting the generators and completing the tip strand at contact 60—61. The operation of tip relay TR′ also completed, at contact 101, the sleeve strand of the link-circuit. The heavy lines indicate the talking circuit thus established between the two substations. During conversation, both supervisory lamps remain unlighted. Replacing the receiver at the calling substation releases the tip relay TR and lights the supervisory lamp S^3, as previously described. Replacing the receiver at the called substation releases the tip relay TR′ and lights the called supervisory lamp S^4 over the following circuit: battery, said lamp S^4, normal contact 63, alternate contact 43 and ground. The tip control relay TC remains locked up via the said alternate contact 43 of the sleeve relay SR′. Both supervisory lamps now being lighted, the operator will remove the plug P^3 to cause the release of the apparatus to normal position.

The release is secured by disconnecting conductor L′ from ground and connecting it to battery. Prior to release and subsequent to the selection of the link-circuit, the said conductor L′ has been maintained connected directly to ground for the purpose of rendering the link-circuit busy to other calling lines and for the purpose of preventing the premature operation of the release relay RR. Thus, at the moment of selection when relay PR releases its armature and closes normal contacts 35, 36, 37, and before the armature of the line relay LR, as a result of the operation of the cut-off relay CO, is released, the conductor L′ and all contacts *d*″ multiply connected thereto are grounded via normal contact 35—37 and closed contact 29. This short-circuits the release relay RR, now included in the closed branch extending from conductor L′, via contact 35—36 and off-normal contact 39 to ground, whereby it is prevented from operating, should, just at this moment, a wiper L of some other calling switch, seeking an idle link-circuit, wipe over one of the multiple contacts *d*″, or should the sleeve relay SR operate quicker than the tip relay TR, thus momentarily connecting battery to the conductor L′, via lamp C, normal contacts 40 and 66, alternate contact 67 and key 68. Immediately after selection, the ground is removed from conductor L′ at contact 29, but is provided instead at alternate contact 69, via key 68, alternate contact 67, normal contact 66, conductor 103 and said alternate contact 69. Upon inserting the plug P^3 into a jack of the called line, relay SR′ operates, as previously described, whether the line be busy or idle, and thus grounds conductor L′ at the alternate contact 66. As relay SR′ remains energized until the plug is removed, it will be seen that conductor L′ is maintained grounded and the release relay RR short-circuited during the entire busy period of the link-circuit, thus causing seeking switches to pass by busy link-circuits without releasing them.

Upon the withdrawal of the plug P^3, in response to the disconnecting signal, either from the jack of a busy line or from the jack of a line at the conclusion of conversation, the sleeve relay SR′ is released, thereby releasing busy relay BR in the case of a busy line, or the tip control relay TC, and consequently the flip-flop relay FF, in the case of an idle line. The release of the sleeve relay SR′ also extends battery B via pilot relay PL′, lamp C, normal contact 40 (now closed), conductor 103, normal contact 66, alternate contact 67, key 68, conductor L′, contact L—*d*″, and normal contact 35—36, through the release relay RR and thence to ground via off-normal contact 39, thus operating said release relay RR. The operation of relay RR closes circuit from battery B, through private relay PR to alternate contact 38, thus placing said relay PR in multiple circuit with the pilot relay PL′ and lamp C, and in series with the release relay RR. The resistance of the lamp C is sufficiently high to permit the operation of relay PR, whereby both it and relay RR are maintained operated via the off-normal contact 39, as above traced. The operation of relay PR opens the circuit of the wipers P, S and L, thus releasing relays SR and CO and restoring the link-circuit to its normal idle condition. It also closes the circuit of the motor magnet MM, as previously described, and the switch rotates its wipers to their normal position. During rotation, the wipers P, S are maintained open at contacts 34 and 33 for the purpose previously described, and wiper L is maintained open at normal contact 38 so as not to interfere with the circuits connected to contacts *a*″, *b*″, *c*″, *d*″, etc. On reaching the normal position, the circuit of relays PR and RR is opened at off-normal contact 39, whereby both release their armatures, thus leaving the switch and calling line in normal idle position.

In case the line limbs 12, 13 of an idle line should have been accidentally or purposely crossed, as by a falling wire or by permanently removing the receiver, an idle link-circuit would be selected as described, but the operator would secure no response and would then cause key 68 to be depressed, thus connecting conductor L′ to battery via resistance 71, whereby the switch would be released as above described. On reaching normal, however, the circuit of relays PR and RR, instead of being opened by the opening of off-normal contact 39 as previously described, would be continued via alternate contact 31, off-normal contact 30,

and contact 29 now maintained closed by the continued operation of line relay LR, due to the permanent cross on the line. The switch would therefore continue to rotate, the relays PR and RR finding a closed circuit through either contact 39 or 30 of the off-normal switch. This rotation of the switch continues until the trouble is corrected or located, but no link-circuits are interfered with after the first selection and release. By this means, such troubles are confined to the line itself.

Keys 68 and 70 may preferably be located before the traffic manager or chief operator. If key 70 be depressed, thus grounding the strand L', the corresponding link-circuit is made artificially busy. The chief operator may therefore, by means of the keys 70, throw out of use one or more link-circuits terminating before any operator, and can therefore regulate and proportion the business handled by each operator according to their respective abilities. Thus each operator's position may be equipped with ten link-circuits arranged in regular order with respect to the fixed contact points on the various selective switches. A skilled operator may be able to keep all ten in efficient service, while an operator of less skill may be able to handle efficiently the calls from but five or six. The wire chief will therefore render artificially busy, by means of one of the keys 70, the cords in excess of the number which can be efficiently handled by each operator.

Obviously, in carrying out my invention, certain alterations and modifications may be made in the circuits and apparatus without departing from the spirit and scope of my invention. I therefore do not wish to be limited to the specific matter illustrated, but aim to cover, by the terms of the appended claims, all such alterations and modifications.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines, means other than said link-circuit for rendering said called line busy, manually controlled means operative upon the connection of said link-circuit to said called line when idle to transmit ringing current over said called line, and means dependent upon the non-exercise of said manual control and upon the connection of said link-circuit to said called line when busy to transmit a busy signal from said link circuit back over said calling line.

2. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines, other terminals for said called line, other link-circuits for connecting through said terminals to said called line, manually controlled means for applying ringing current to said called line whenever said first link-circuit is connected to it while it stands disconnected from said other link-circuits, and a busy back device for transmitting a busy signal back over said first link-circuit and the calling line whenever said first link-circuit is connected to the calling line while it stands connected to one of said other link-circuits and before said manual control has been exercised.

3. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines, means for establishing other connections with said called line, a ringing relay, manually controlled means for operating said ringing relay, a ringing current source connected by the operation of said ringing relay and the connection of said link-circuit to said called line to supply ringing current to said called line, a busy relay operated in response to the connection of said link-circuit to said called line, when busy, before the operation of said manually controlled means, and a busy back device operated by said busy relay to send a busy signal from said link circuit over said calling line.

4. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines to establish a talking circuit, means for establishing other connections with said called line, means for supplying ringing current and a busy back signal, ringing and busy back connections extending to said link circuit, a pair of relays for controlling said connections, and an energizing circuit for one of said relays including a portion of the talking circuit.

5. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines to establish a talking circuit, means for establishing other connections with said called line, means for supplying ringing current and a busy back signal, ringing and busy back connections, a pair of relays for controlling said connections, and an energizing circuit for both of relays including a portion of the talking circuit.

6. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines to establish a talking circuit, means for establishing other connections with said called line, means for supplying ringing current and a busy back signal, ringing and busy back connections, a pair of relays jointly controlling one of said connections and one solely controlling the other connection, and an energizing circuit for one of said relays including a portion of the talking circuit.

7. A telephone system comprising calling

and called telephone lines, a link-circuit and connection terminals for uniting said lines to establish a talking circuit, means for establishing other connections with said called line, means for supplying ringing current and a busy back signal, ringing and busy back connections, a pair of relays jointly controlling one of said connections and one solely controlling the other connection, and an energizing circuit for both of said relays including a portion of the talking circuit.

8. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines to establish a talking circuit, means for establishing other connections with said called line, means for supplying ringing and a busy back signal, ringing and busy back connections, a busy relay solely controlling the busy back connections, a ringing relay controlling the ringing connections jointly with said busy relay, and an initial energizing circuit for said busy relay including a portion of the talking circuit.

9. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines to establish a talking circuit, means for establishing other connections with said called line, means for supplying ringing and a busy back signal, ringing and busy back connections, a busy relay solely controlling the busy back connections, a ringing relay controlling the ringing connections jointly with said busy relay, an initial energizing circuit for said busy relay including a portion of the talking circuit, and a maintaining circuit for both relays including a portion of the talking circuit.

10. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines to establish a talking circuit, means for establishing other connections with said called line, means for supplying ringing and a busy back signal, ringing and busy back connections, a busy relay solely controlling the busy back connections, a ringing relay controlling the ringing connections jointly with said busy relay, a local energizing circuit for said ringing relay and a manual switch for controlling said circuit.

11. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines to establish a talking circuit, means for establishing other connections with said called line, means for supplying ringing and a busy back signal, ringing and busy back connections, a busy relay solely controlling the busy back connections, a ringing relay controlling the ringing connections jointly with said busy relay, a local energizing circuit for said ringing relay, a manual switch for controlling said circuit, and a maintaining circuit for said ringing relay including a portion of the talking circuit.

12. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines to establish a talking circuit, means for establishing other connections with said called line, means for supplying ringing current and a busy back signal, ringing and busy back connections, a pair of relays for controlling said connections, a manual switch, and an energizing circuit for one of said relays including said switch and contacts of the other relay.

13. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines to establish a talking circuit, means for establishing other connections with said called line, means for supplying ringing current and a busy back signal, ringing and busy back connections, a pair of relays jointly controlling one of said connections and one solely controlling the other connection, a manual switch, and an energizing circuit for one of said relays including said switch and contacts of the other relay.

14. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines to establish a talking circuit, means for establishing other connections with said called line, means for supplying ringing current and a busy back signal, ringing and busy back connections, a busy relay solely controlling the busy back connections, a ringing relay controlling the ringing connections jointly with said busy relay, a manual switch and an energizing circuit for one of said relays including said switch and contacts of the other relay.

15. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines to establish a talking circuit, means for establishing other connections with said called line, means for supplying ringing current and a busy back signal, ringing and busy back connections, a busy relay solely controlling the busy back connections, a ringing relay controlling the ringing connections jointly with said busy relay, a manual switch, an energizing circuit for said ringing relay including said switch and contacts of said busy relay.

16. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines, means for establishing other connections with said called line, a source of ringing current, a relay for connecting said source to the called line, a busy back signal transmitter, a busy relay for connecting

said transmitter to the calling line and for breaking the ringing current connection to the called line, and a manual switch for energizing said first-mentioned relay when said busy relay is inert.

17. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines, means for establishing other connections with said called line, a source of ringing current, a relay for connecting said source to the called line, a busy back signal transmitter, a busy relay for connecting said transmitter to the calling line and at the same time operating said first-mentioned relay and interrupting the ringing current connection to the called line, and a manual switch for energizing said first-mentioned relay when said busy relay is inert.

18. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines, a call-bell and condenser in normal bridge of the called line, a source of ringing current, a control relay adapted to operate upon the response of the called party, a "flip-flop" relay for alternately connecting said source and said relay to one limb of said line, and means for providing a discharge path for said condenser upon each operation of said flip-flop relay to prevent the operation of said control relay by the discharge of said condenser.

19. A telephone system comprising calling and called telephone lines, a link-circuit and connection terminals for uniting said lines, a call-bell and condenser in normal bridge of the called line, a source of ringing current, a control relay adapted to operate upon the response of the called party, a "flip-flop" relay for alternately connecting said source and said relay to one limb of said line, and a ground connection closed by said flip-flop relay after each disconnection of said source and before the connection of said control relay to the line limb, whereby the operation of said control relay by the discharge from said condenser is prevented.

20. In a telephone system, the combination with a telephone line, of an operator's link-circuit having a normally open contact in the talking circuit and connected with said line, signal-actuating apparatus for said circuit in operative relation with said line, a relay adapted to be operated to terminate said relation, and a second relay adapted to be operated by current over said telephone line and controlled by said relay for closing said normally open contact.

21. In a telephone system, the combination with a telephone line, of an operator's link-circuit having a normally open contact in the talking circuit and connected with said line, signal-actuating apparatus for said circuit in operative relation with said lines, a relay adapted to be operated to terminate said relation, electromagnetic means adapted to be operated by current over the connected line and a switch contact directly controlled by said relay for rendering said means effective for closing said normally open contact.

22. A telephone system comprising telephone lines, a two conductor manually operable link circuit and a non-numerical switch for interconnecting said lines, and means included in said link circuit for applying the busy signal or ringing current from said link circuit to the terminals of the called line.

23. A telephone system comprising calling and called telephone lines, a link circuit for uniting said lines, automatic means for interconnecting a calling line and an idle link circuit, means for rendering a called line busy, manually controlled means for said link circuit effective when said link circuit is connected to said called line when idle to transmit ringing current over the called line, and means effective irrespective of the exercise or non-exercise of said manual control when connection is made to said called line when busy to transmit busy signal from said link circuit back over said calling line.

24. A telephone system comprising telephone lines, link circuits having manual terminals for connecting to said lines as called lines, automatic means for interconnecting a calling line and an idle one of said link circuits, a manual switch and circuit connections effective when said link circuit is connected to a called line when idle to transmit ringing current over said called line, and means effective without the operation of said manual switch responsive to connection of said link circuit to a called line when busy to transmit a busy signal from said link circuit back over said calling line.

25. A telephone system comprising telephone lines, link circuits having manually connected terminals for connecting to said lines when called, automatic switches individual to said lines for connecting a calling line to an idle link circuit, means controlled through an automatic switch or a manual terminal for rendering the connected line busy, a manual switch and means operative upon the connection of a link circuit to a called line when idle to transmit ringing current thereover, and means dependent upon the non-exercise of said manual control and upon the connection of said link circuit to said called line when busy to transmit a busy signal from said link circuit back over said calling line.

26. A telephone system comprising calling and called telephone lines, automatic means for connecting said calling lines with an idle link circuit, means other than said link circuit for rendering said called line busy, manually controlled means operative upon the connection of said link circuit to

a called line when idle to transmit ringing current over said called line, and means dependent upon the non-exercise of said manual control and upon the connection of said link circuit to said called line when busy to transmit a busy signal from said link circuit back over said calling line.

27. A telephone system comprising telephone lines, means including non-numerical metallically controlled automatic switches and two-conductor manual link circuits for interconnecting said lines, and means included in said link circuits for applying the busy signal or ringing current from said link circuits to the terminals of the called line.

In witness whereof, I hereunto sign my name this 25th day of May, 1909.

FRANCIS W. DUNBAR.

Witnesses:

CAROLYN WEBER,

H. G. WEBSTER.