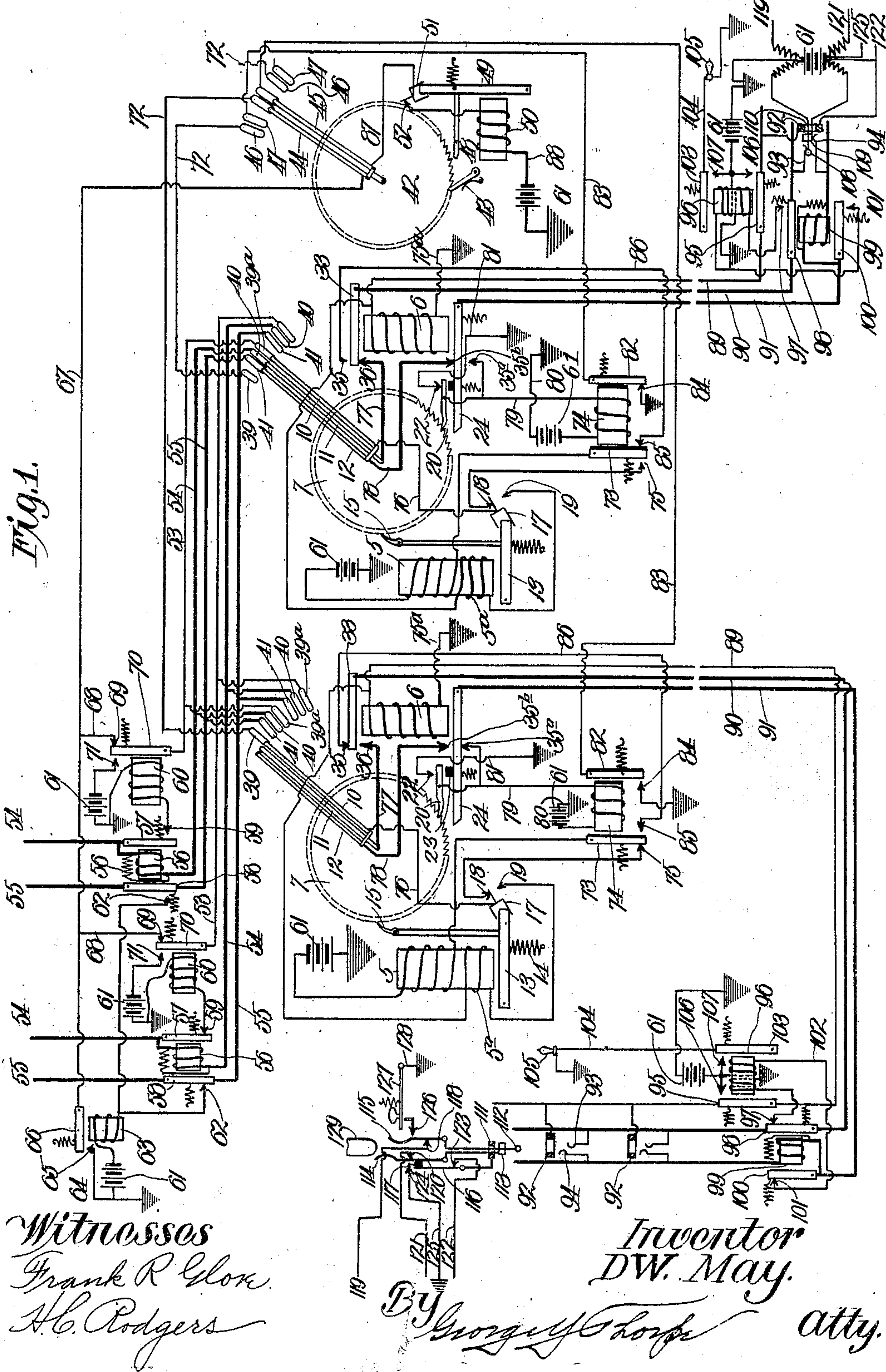


928,680.

D. W. MAY.  
TELEPHONE SYSTEM.  
APPLICATION FILED MAY 18, 1908.

Patented July 20, 1909.

3 SHEETS—SHEET 1.



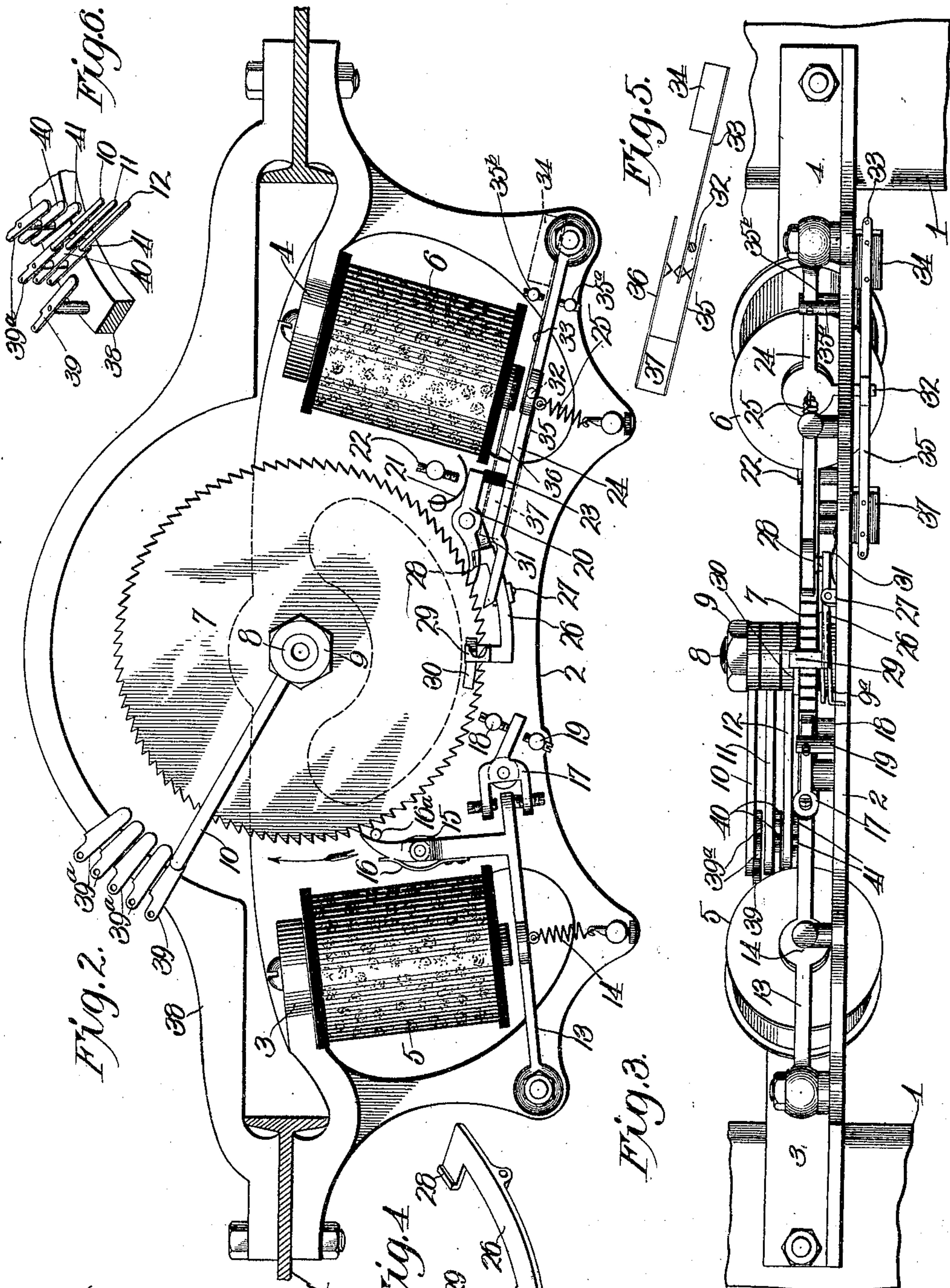


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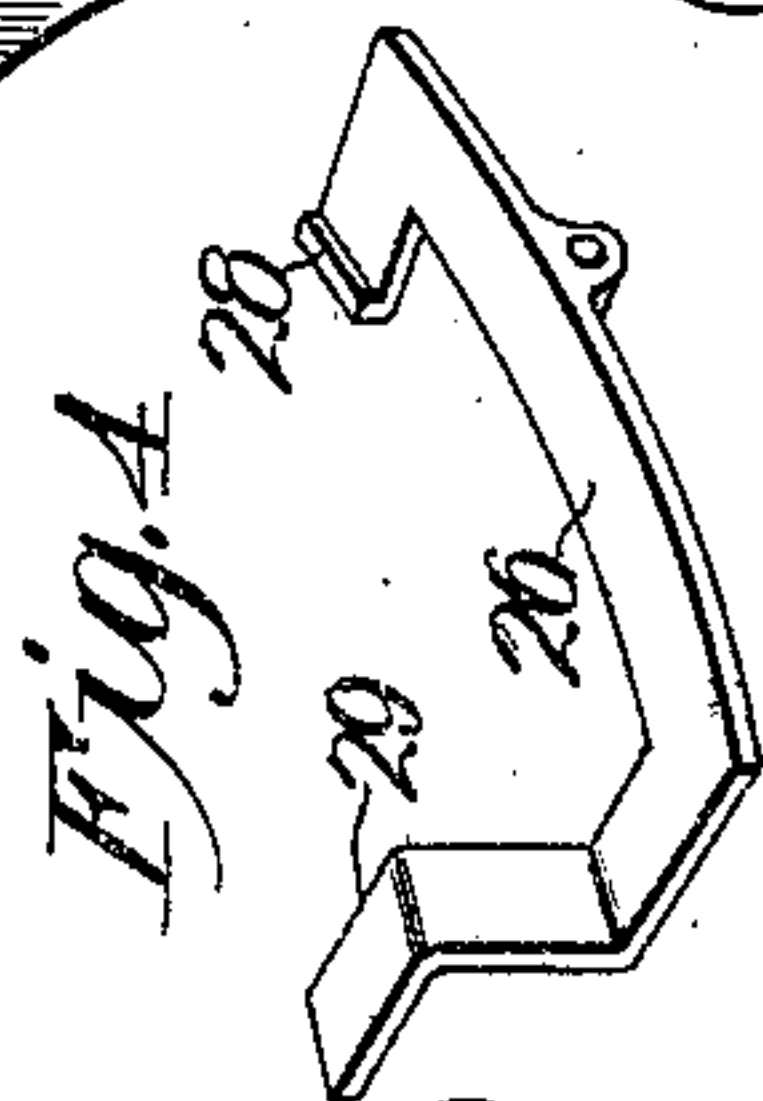
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3 SHEETS—SHEET 2.



Witnesses  
Frank R. Gore  
H. C. Rodgers

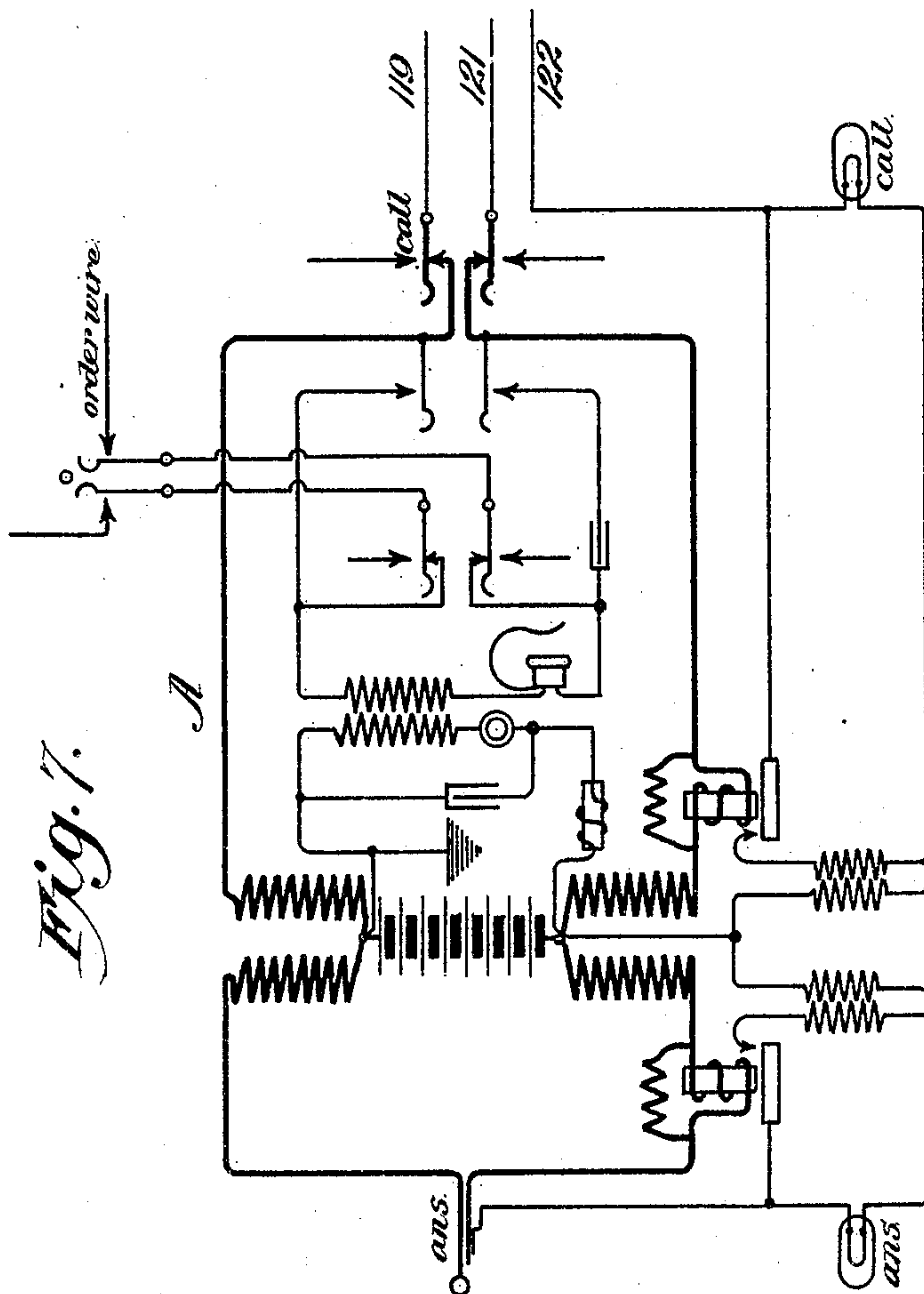


Inventor  
D. W. May.  
By George Thorpe Atty.

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3 SHEETS—SHEET 3.



Witnesses  
Frank R. Gore  
H. C. Rodgers

Inventor  
D. W. May  
By George F. Hooper Atty.



# UNITED STATES PATENT OFFICE.

DAVID W. MAY, OF KANSAS CITY, MISSOURI.

## TELEPHONE SYSTEM.

No. 928,680.

Specification of Letters Patent.

Patented July 20, 1909.

Application filed May 18, 1908. Serial No. 433,575.

*To all whom it may concern:*

Be it known that I, DAVID W. MAY, a citizen of the United States, residing at Kansas City, in the county of Jackson and State of Missouri, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

This invention relates to telephone systems and more especially to what are generally known as common battery systems, and my prime object is to produce equipment for enlarging the capacity of the central office of such systems; a second important object being to reduce the cost of outside construction of such systems.

With these general objects in view, the invention consists in certain novel and peculiar features of construction and organization as hereinafter described and claimed and in order that it may be fully understood, reference is to be had to the accompanying drawings, in which:—

Figure 1, is a diagrammatic view of a telephone system embodying my invention. Fig. 2, is a plan view of one of the switches of such system. Fig. 3, is an edge view of such switch. Fig. 4, is a detail perspective view of a part of the switch. Fig. 5, is a detail plan view of a part of the switch. Fig. 6 is a detail perspective view of part of the contacts of such switch. Fig. 7, is a diagrammatic view of an operator's talking set and the connections between the same and the cord circuit.

Before proceeding with a detail description it is desirable to state that in accomplishing the objects above-named, the telephones of any common battery system, are divided into groups, according to locality by preference. Each group is connected to the central office by as many trunk lines as are necessary to properly handle the business of such group, and each trunk line appears at the central office as and occupies the space ordinarily occupied by the exchange equipment of a single subscriber or of an ordinary trunk line, and thus enlarges the capacity of the central office by omitting therefrom individual representation for all the telephones in excess of the number of trunk lines for the group, that is to say, if there are one hundred telephones in the group and ten trunk lines connecting such group to the central office, the space of ninety per cent. of the telephones is saved at the

central office and the capacity of the exchange increased to that extent.

Each trunk line is equipped with a line-selecting switch mechanism located by preference in the neighborhood of the group of telephones associated with such trunk line, as such arrangement materially reduces the cost of outside construction by effecting a large saving of copper wire. Each switch of trunk lines is provided with a sleeve finger, a tip finger and a ring finger, and with a starting contact normally engaged by the sleeve finger, and with a set of sleeve, tip, and ring contacts for each telephone in the group, the sleeve, tip and ring contacts for each switch being respectively connected in multiple with the corresponding contacts of all of the other switches to permit the fingers of any switch in the group to engage the set of contacts of such switch, connected to any telephone in the group.

The invention also comprises a selecting switch adapted to be caused by the operation of any line-selecting switch which happens to be in use, to move and make electrical connection with an idle line-selecting switch, so that when another call comes in, such line-selecting switch is prepared to select the line on which such call originates.

The invention also consists in certain co-operating instrumentalities whereby the removal of a telephone receiver from its hook, causes the line-selecting switch electrically connected to the selecting switch to electrically connect the telephone from whose hook the receiver has been removed, to the central office by means of the associated trunk-line.

The invention also embraces the usual exchange or central office instrumentalities for effecting the completion of the talking circuit, and instrumentalities whereby the exchange or central operator is enabled to call any subscriber desired whether located in the same group as the calling subscriber or in some other group.

Referring now to the drawings in detail, 1—1 indicate preferably vertical beams on which all of the switches of a group are preferably banked in superposed relation, each of said switches except the switch-selecting switch hereinafter described, being constructed as follows:—

2 is a frame, of fiber or other insulating material, if desired, supporting relay coils 5 and 6, respectively, at opposite sides of a



ratchet wheel 7 journaled on shaft 8 projecting upward from the frame, and held on such shaft by a retaining nut 9, a torsion spring 9<sup>a</sup> secured to wheel 7 and frame 2 5 being employed to return the wheel to its original position when permitted, as hereinafter explained.

10, 11 and 12 indicate sleeve, tip and ring fingers arranged in superposed relation, and 10 rotatable with wheel 7, being insulated from said wheel and from each other in any suitable or preferred manner.

13 indicates the armature of relay coil 5, and 14 a retractile spring therefor.

15 15 is a pawl pivotally carried by the armature and held by a spring 16 in position to engage the ratchet wheel and turn it one step each time the armature is attracted by said coil, a pin 16<sup>a</sup> projecting from the frame 20 compelling the pawl to move out of the path of the ratchet wheel each time the armature is withdrawn by its spring 14.

17 is a switch pivoted to the frame and having one end bifurcated and receiving the 25 free end of armature 13 and held by the latter when withdrawn from the coil as shown in Fig. 2, in engagement with contact 18, and adapted when the armature is attracted by its coil, to be forced by said armature out of engagement with contact 18 and 30 into engagement with contact 19.

20 is a detent pivoted to frame 2 to prevent premature back rotation of the ratchet wheel and its arms 10, 11 and 12, except 35 under certain conditions as hereinafter explained, and 22 is a contact carried by the frame to be engaged by detent 20, when the latter is forced out of engagement with the ratchet wheel by the pin 23, of the armature 40 24, of coil 6, said armature when attracted by said coil against the resistance of its retractile spring 25, not only effecting the stated operation of the detent but also engaging ratchet wheel 7 and locking it against 45 movement as long as the coil 6 remains energized.

26 indicates a lever pivoted to the frame at 27, for movement in a plane at right angles to the plane of the operation of the detent 50 and armature 24 and having one end underlying said detent and provided with an upwardly projecting lug or shoulder 28 and its other end 29 overlying the ratchet wheel and the path of movement of a cam lug 30 projecting upwardly from said wheel, a spring 55 31 secured to the frame engaging said lever and holding said lug or shoulder 28 pressed upwardly against the detent and its end 29 pressed downwardly toward the ratchet 60 wheel, it being desirable to state in this connection that the outward movement imparted to the detent by the rotation of the ratchet wheel in the direction indicated by the arrow Fig. 2, is insufficient to dispose the 65 detent outward of the lug or shoulder 28 of

lever 26, but that when the detent is operated by armature 24 as hereinbefore explained its movement is of sufficient range to permit the spring 31 to operate the lever and cause said 70 lug or shoulder to engage the inner edge of the detent and thus hold the latter out of engagement with the ratchet wheel, and the end 29 of said lever in the path of cam 30 of said wheel, so that when the spring 9<sup>a</sup> is permitted by the demagnetization of relay 6 and 75 the consequent withdrawal of its armature 24 from engagement with the ratchet wheel, to return the latter to its original position, cam 30 pivotally operates lever 26 to permit the detent to reengage the wheel. 80

32 is a pin projecting from armature 24 and engaging a spring contact 33 carried by projection 34 of the frame, said contact normally engaging a spring contact 35 and being adapted to be caused by pin 32 when armature 24 is attracted by coil 6, to move from 85 engagement with spring-contact 35 and into engagement with spring-contact 36, mounted upon projection 37 of frame 2. 35<sup>a</sup> is a contact carried by the frame and engaged by 90 armature 24 when the relay 6 is deenergized, the operation of said armature by the relay resulting in breaking the engagement of the armature with contact 35<sup>a</sup> and causing said armature to engage a contact 35<sup>b</sup> carried 95 by the frame.

38 is a frame of fiber, if desired, secured to beams 1 and equipped with a starting contact 39 for engagement by switch-finger 10, said finger being hereinafter referred to as a 100 sleeve finger. Frame 38 is also equipped with a set of sleeve, tip and ring contacts, each set being arranged for simultaneous-engagement by their respective sleeve, tip and ring fingers. Each of the switches constituted by 105 parts 7, 10, 11 and 12 and contacts 39, 39<sup>a</sup>, 40, and 41 are hereinafter referred to as line-selecting switches and each of said line-selecting switches has as many sets of contacts 39<sup>a</sup>, 40 and 41 as there are telephones in 110 the group with which said line-selecting switches are associated.

A switch for automatically selecting any idle line-selecting switch in a group is preferably arranged above the bank of line-selecting switches described and is constructed as follows:— 115

42 is a ratchet wheel adapted to be rotated backward by a spring (not shown) corresponding to spring 9<sup>a</sup> and held against 120 back rotation by a spring-actuated detent 43, and provided with a pair of contact fingers 44 and 45, rotatable with but insulated in any suitable manner, from said ratchet wheel and from each other, for simultaneous engagement with their respective contacts 46 125 and 47, of which there is a set for each line-selecting switch.

50 is a relay embodying a spring-retracted armature 49, provided with a spring-actu- 130



ated pawl 48, to engage and turn wheel 42, each time the armature is attracted. 51 is a pivoted forked-switch normally held by said armature, when retracted, in engagement with contact 52.

All of the metal parts of the line-selecting switch will be insulated in any suitable manner from frame 2, if such frame is made of metal. If made of fiber the frame itself will serve to insulate such parts from each other.

Referring now to the diagrammatic view, Fig. 1, which illustrates the complete system for two telephones (not shown) of a group, 53, 54, and 55 indicate the sleeve wire and tip and ring line-wires for one telephone, which wires are connected to the first set of sleeve, tip and ring contacts 39<sup>a</sup>, 40 and 41 respectively, of each line-selecting switch, the corresponding line-wires of the second telephone being connected to the second set of sleeve, tip and ring contacts of said line-selecting switches, it being noted in this connection that the talking-circuit wires, viz. the tip and ring wires, are indicated by heavy lines in the drawings as distinguished from the light lines indicating the sleeve wires.

The tip and ring wires are connected up to the telephones in the usual manner, and in circuit with the former are cut-off relays 56 with non-inductive current shunting resistances around them, each of said relays having an armature 57 and an armature 58, the former being electrically connected to the tip-wire and normally in engagement with the contact 59 in circuit with a grounded line-relay 60 and a grounded battery 61. Armature 58 forms a permanent part of the circuit through ring-wire 55 and normally engages contact 62, electrically connected with a relay 63 common to all the telephones in the group, and grounded as at 64. 65 is a contact in circuit with the ground and adapted when said relay is energized to be engaged by its armature 66, said armature being connected by the common grounding wire 67 to the contact finger 44 of the selecting switch. 68 are wires connecting said common ground wire 67 with contacts 69, normally engaged by the armature 70 of line-relays 60, which armatures are in permanent electrical connection with the sleeve-wires 53, and are normally withdrawn from contacts 71 grounded through battery 61, and 72 are wires electrically connecting the different contacts 46 of the selecting-switch to the starting-contacts 39 of the different line-selecting switches.

It will be well to state in this connection that the various batteries numbered 61, will in practice, preferably be one battery, but the latter is shown divided up in the drawings for convenience and simplification of illustration.

The switch-actuating relays, as relays 5

will be hereinafter termed, are grounded through the battery 61, and said relays are in circuit with the armatures 73 of relays 74, which armatures 73 are normally in circuit with contacts 75 electrically connected to contacts 18, the contacts 19 being in circuit with second windings of relays 5 and the locking relays 6, grounded as at 75<sup>a</sup>.

76 are wires connecting the sleeve-fingers of the line-selecting switches with the forked switches 17. 77 are wires connecting the tip-fingers of the line-selecting switches with contacts 36. 78 are wires connecting the ring-fingers of the line-selecting relays with contacts 35<sup>b</sup>. The contacts 35<sup>a</sup> normally engaged by armatures 24, and the detents 20, are electrically connected by wires 79 to the relays 74 which are grounded through battery 61 by conductor 80, the contacts 22 being grounded by wires 81.

The relays 74 are provided with spring-retracted armatures 82, connected by wires 83 with different contacts 47 of the switch-selecting switch.

84 are grounded contacts normally out of engagement with armatures 82 and adapted to be engaged thereby when relays 74 are energized.

85 are contacts normally out of engagement with armatures 73 of relays 74, and adapted to be engaged by said armatures 73 when said relays are energized, and 86 are wires connecting contacts 85 with contacts 35 normally engaged by spring-contacts 33.

87 is a wire electrically connecting contact finger 45 of the selecting-switch, with switch 51, and 88 is a wire in circuit with switch-actuating relay 50 and grounded through battery 61.

89, 90 and 91 are the trunk-line wires, leading respectively, from relays 6, contacts 33 and armatures 24 to the central office, the sleeve trunk-line wire being electrically connected at the exchange or central office to the sleeves 92, and the tip and ring wires to the tip-contacts 93 and the ring contacts 94 respectively, these sleeve contacts, ring contacts, and tip contacts constituting the ordinary spring-jacks.

95 is a spring retracted armature forming a part of the trunk-line sleeve-wire 89.

96 is a double-wound trunk-line relay connected to contact 97 normally engaged by the spring-retracted armature 98, forming a permanent part of the trunk-line tip-wire 90.

99 is a trunk-line relay with a non-inductive resistance shunted around it, said relay and resistance being in circuit with the trunk-line ring-wire 91. 100 is another spring-retracted armature for said relay, normally engaging a contact 101 connected by wire 102, through a second winding of relay 96 and battery 61 to ground, said armature 100 being permanently connected to ring-wire 91.



103 is a second spring-retracted armature for relay 96, grounded by wire 104 through lamp 105.

106 and 107 are contacts in circuit with battery 61 and the second winding of relay 96 and adapted when said relay is energized to be respectively engaged by armatures 95 and 103.

For the use of the central operator, any ordinary three-strand cord-set may be equipped with a make-and-break mechanism and a key for throwing said make-and-break mechanism in and out of circuit.

At the right-hand end of Fig. 1 is represented the answering-plug in operative position, that is, with the tip 108 engaging tip contact 93, the ring 109 in engagement with ring-contact 94, and the sleeve 110 in engagement with the sleeve contact 92, said ring and sleeve being grounded through battery 61 and the tip grounded around said battery. At the left-hand end of said figure, is shown the calling-plug comprising the sleeve 111, tip 112 and ring 113. A key consists of a spring-contact 114 electrically connected with the ring, a spring-contact 115 electrically connected to the tip and a spring-contact 116 normally connected to the sleeve, said spring-contact 116 being preferably provided with an insulating block 117 interposed between said contacts 116 and 114.

118 is a contact normally engaged by spring-contact 115 and grounded by cord-wire 119.

120 is a contact normally engaged by spring-contact 114 and grounded by wire 121 through battery 61.

122 is a wire grounding spring-contact 116 through said battery, when said contact is engaging contact 123.

124 is a contact normally out of engagement with spring-contact 114 and grounded by wire 125.

126 is a contact normally out of engagement with spring-contact 115 and adapted to be engaged by a spring-elevated key 127 grounded by wire 128, said contact 126 and key 127 constituting a make-and-break mechanism whereby the operator is enabled to send any desired number of pulsations of current over the tip of the trunk-line as a calling signal for any particular subscriber, it being necessary, however, to first operate the key-plunger 129, to force spring-contact 114 out of engagement with contact 120 and into engagement with contact 124 and incidentally force spring-contact 116 out of engagement with contact 123 the plunger immediately afterward engaging spring-contact 115 and forcing it out of engagement with contact 118 and into engagement with contact 126.

Before proceeding with a connected description of the operation it is desired to

state that the left-hand line-selecting switch and the left-hand telephone and central-office mechanism is in normal condition, the right-hand line-selecting switch, telephone and central-office mechanism showing the talking circuit completed. Now assuming that said right-hand mechanism is in the same position as the left-hand mechanism the operation will be described by which the parts attain the position shown in said right-hand mechanism. The subscriber of the telephone to which the right-hand mechanism is connected in the usual manner, removes the telephone receiver from the hook which operates and short-circuits the line through the transmitter as in all common battery telephones. The short-circuiting of the line permits the current to flow from battery 61 through ground, line-relay 60, contact 59, armature 57, and line 54 to the telephone, and back through line 55 and armature 58 to contact 62; thence through the common relay 63 back to battery 61. The completion of this circuit energizes line-relay 60 and common relay 63. The energization of line-relay 60 causes it to move its armature 70 from engagement with contact 69 into engagement with contact 71. The result of the said movement of armature 70 is to place negative battery on to the sleeve contact of the line calling in, that is to say, it electrically connects the negative pole of battery 61 through contact 71, armature 70, connected sleeve line wire 53 with contact 39<sup>a</sup> of the second line-selecting switch. The energization of the common relay results in the attraction of its armature 66 to contact 65 and thus completes the following circuit. From battery 61 through relay 5, 73, 75, 18, 17, 76, 10, contact 39 of said line-selecting switch, 72, contact 46, of the switch-selecting switch, 44, 67, 66, 65, and 64 to ground and back to battery 61. This energizes relay 5 which attracts its armature 13 and causes it through pawl 15, to rotate ratchet-wheel 7 one step and thus move its finger 10 from starting contact 39 to the first contact 39<sup>a</sup>, fingers 11 and 12 at the same time being brought into engagement with the first contacts 40 and 41, the detent 20 yielding to permit the ratchet-wheel to rotate as described and then reengaging said wheel to guard against back rotation of the same. The action of armature 13 results in operating the fork switch 17 and causing the same to move out of engagement with contact 18 and into engagement with contact 19 and thus complete the following circuit. From battery 61 through ground, 75<sup>a</sup>, locking relay 6, which is thus energized, the second winding 5<sup>a</sup> of relay 5, contact 19, fork switch 17, 76, 10, 39<sup>a</sup>, 53, 70, 71 back to battery 61.

The energization of relay 6 results in the



attraction of its armature 24 from engagement with contact 35<sup>a</sup> into engagement with contact 35<sup>b</sup> and also through the instrumentality of the armature, spring contact 33 to move out of engagement with contact 35 and into engagement with contact 36. The same movement of the armature also causes its engagement with ratchet wheel 7 and the tripping of detent 20, and the engagement of the latter with contact 22.

The engagement of 33 with 36 and 24 with 35<sup>b</sup> establishes electrical connection between the tip and ring fingers 11 and 12 with the tip and ring trunk lines 90 and 91 respectively. Such connections do not disturb the energization of relay 5 and thus fork-switch 17 is prevented from reengaging contact 18 until the circuit through 73 and 75 is broken, the continued energization of relay 5 being for the purpose of preventing the line-selecting switch referred to, from responding to other calls, it being noted in this connection that when the detent was tripped as explained, the spring actuated lever 26 operated and disposed its tooth 28 in a position hereinbefore described, to prevent the said detent from again engaging the ratchet wheel until the said lever is operated by the cam 30 of the ratchet wheel upon the return of the latter to normal position.

The engagement of armature 24 with contact 35<sup>b</sup>, spring contact 33 with contact 36 and fingers 11 and 12 with contacts 40 and 41 respectively, completes the following circuit. From battery 61 through ground, one winding of trunk-line relay 96, 97, 98, trunk-line tip wire 90, 33, 36, 77, 11, 40, tip-line wire 54, line cut-off relay 56 (which moves its armature 57 and 58 out of engagement with contacts 59 and 62 respectively), tip-line wire 54 to telephone and back through ring wire 55, armature 58, ring line-wire 55, 41, 12, 78, 35<sup>b</sup>, 24, ring wire 91 of trunk-line, 100, 101, 102 and the second winding of relay 96 back to the battery. This circuit energizes trunk-line relay 96 which attracts armatures 103 and 95 to contacts 106 and 107 respectively.

The engagement of 95 with 106 completes the following circuit. From battery 61 through ground, 75<sup>a</sup>, 6, 89, 95 and 106 back to the battery. This circuit continues the energization of relay 6 and thus maintains its armature 24 against contact 35<sup>b</sup>, and spring contact 33 against contact 36, and detent 20 against contact 22, so that when the negative battery is removed from the sleeve wire 53 of the calling-in telephone and thus opens the original circuit which energized relay 6 the latter remaining energized through the sleeve wire 89 of the trunk-line and holds the switch connected to the subscriber. The said negative current or battery being removed from the sleeve-

line wire 53 by the energization of line cut-off relay 56, as hereinbefore stated, breaks the engagement between armature 57 and contact 59 and opens the circuit through line relay 60, the deenergization of the latter permitting its armature 70 to move out of engagement with contact 71 and into engagement with contact 69. The opening of the circuit between 58 and 62 effects the deenergization of common relay 63 and as a result armature 66 withdraws from contact 65 and thus removes ground from all of the sleeve contacts.

The engagement of armature 103 with contact 107 as hereinbefore described, completes the following circuit: from battery 61 through ground, lamp 105, 104, 103, 107 and back to the battery, the lighting of the lamp attracting the central operator's attention to the call. The operator then "plugs in" with grounded positive battery on the tip 108 of the answering plug and negative battery on the ring and sleeve of said plug and thus completes the following circuit. From battery 61 through ground, 75<sup>a</sup>, 6, trunk-line sleeve wire 89, 95, sleeve-contact 92 of the jack and sleeve 110 of the plug back to the battery, which circuit continues the energization of relay 6 when the circuit through 95 and 106 of the trunk-line is broken.

The insertion of the answering plug into the spring jack completes the talking circuit which is as follows: from battery 61 through tip 108 of the plug, tip-contact 93 of the jack, armature 98, 90, 33, 36, 77, 11, 40, 54, 56 to continue the energization of the same, 54, through the telephone and back through 55, 58, 55, 41, 12, 78, 35<sup>b</sup>, 24, 91, cut-off relay 99 energizing the same, ring-contact 94 of the jack and ring 109 of the plug and back to the battery. Conversation may now be held between central and the subscriber. The energization of cut-off relay 99, attracts armatures 98 and 100 and thus breaks their connection with contacts 97 and 101 respectively, to open the circuit through the trunk-line relay 96; the deenergization of the latter opening the circuit through the lamp and extinguishing light, and breaking the connection between 95 and 106, as the trunk-line relay circuit is no longer needed to continue the magnetization of relay 6 because the latter is now energized by the current which comes from the answering plug sleeve, as hereinbefore traced. It will thus be seen that the relay 6 is first energized through the completion of a circuit by the line relay 60 and before such circuit is broken is energized through a circuit completed by the trunk-line relay 96; a third circuit through the sleeve of the answering plug and said relay 6 being completed before the trunk-line relay circuit is broken.

When relay 6 is first energized and effects



the engagement of detent 20 with contact 22, a circuit is completed from battery 61, through 80, ground, 81, 22, 20, 79, relay 74 (which is thus energized) and back to the 5 battery.

The energization of relay 74 results in the attraction of its armatures 73 and 82 and causes the former to move from engagement with contact 75 and into engagement with 10 contact 85, the attraction of armature 82 causing it to engage contact 84. The breaking of the circuit through 73 and 75 opens the circuit through relay 5 to prevent further movement of the line-selecting switch 15 after fork-switch 17 reengages contact 18.

The engagement of armature 82 with contact 84 establishes the following circuit: from battery 61, through ground 84, 82, 83, 47, 45, 87, forked switch 51, contact 52, relay 20 50, and 88 back to battery 61. The energization of relay 50 effects the attraction of its spring-retracted armature 49 and through its pawl 48 rotates ratchet-wheel 42 one step and moves the fingers 44 and 45 into en- 25 gagement with the next set of contacts 46 and 47. The operation of the armature 49 also swings fork-switch 51 out of engagement with contact 52 to deenergize relay 50 and thus permit its armature to withdraw and 30 throw switch 51 again into engagement with contact 52 so that if ground is on contact 47 the same circuit will be completed again and effect the rotation of wheel 42 another step, this alternate making and breaking of the 35 circuit being repeated until finger 45 encounters a contact 47 that is not grounded, that is, which is connected to a relay 74 that is not energized, so that the switch-selecting switch has selected a line selecting switch, 40 and both are in a position to respond in the event of another subscriber removing his telephone receiver from the hook, it being understood in this connection that as many different conversations may be held simul- 45 taneously as there are trunk-lines represented on the switch-board at the central office, as hereinbefore suggested.

Central having received the number of the subscriber's telephone with which the call- 50 ing-in subscriber desires to be connected, inserts the calling plug in the spring-jack, after first selecting an idle trunk line electrically connected to the group in which the desired subscriber is located. The operator 55 determines whether or not the line desired is busy by touching the tip of the operator's plug to the sleeve of the jack of the line with which the calling subscriber wishes to be connected, this being the usual method of 60 making the busy test. If the line is busy the operator gets the busy call through her head set. If the test shows that the line is not busy, central operates key-plunger 129, which first engages spring-contact 114 and 65 moves it from engagement with contact 120

and into engagement with contact 124, and incidentally moves contact 116 out of engagement with contact 123. The continued movement of the plunger 129 results in moving contact 115 out of engagement with con- 70 tact 118 and into engagement with contact 126. The disengagement of the contacts mentioned removes the ordinary cord conditions as will be understood, and the engagement of contact 114 with contact 124 75 completes the following circuit: from battery 61 through 80 to the ground, then through 125, 124, 114, ring 113 of the calling-in plug, ring contact 94 of the jack, relay 99, 91, 24, 35<sup>a</sup>, 79, relay 74, and through the 80 part of conductor 80 back to the battery 61.

The energization of relay 74 results in the attraction of its armatures 73 and 82, the former moving from engagement with contact 75 and into engagement with contact 85 85 85. The movement of armature 82 results in its engagement with contact 84, the engagement of 82 and 84 effecting the operation of switch 42 as hereinbefore described to cause the same to operate and thus se- 90 lect an idle line-selecting switch, provided finger 45 of switch 42 is engaged with the contact 47 connected to the switch selected by the operator.

The disengagement of armature 73 and 95 contact 75 opens the sleeve-line circuit as hereinbefore described and thus prevents any further operation of relay 5 from any calling-in telephone by the removal of the receiver from the hook. 100

The engagement of armature 73 with contact 85, establishes an electrical connection whereby, when contact between 115 and 126 is made as hereinbefore referred to, the desired number of pulsations of current may be 105 sent over the tip of the trunk line by the operation of key 127, the circuit thus made and broken being as follows: from battery 61 through ground, 128, 127, 126, 115, tip 112 of the calling-plug, tip-contact 93 of the 110 jack, 98, tip wire 90 of the trunk line, 33, 35, 86, 85, 73 and relay 5 which is thus energized, back to the battery, this energization of relay 5 resulting in the operation of its as- 115 sociated line-selecting switch as many steps as there are impulses sent over tip of the trunk line by key 127, it being understood that a certain number of impulses will be necessary to cause the switch being operated to select 120 the telephone of the called subscriber. Central then withdraws key-plunger 129 which results in breaking the engagement between contacts 115 and 126 and the reengagement of contacts 115 and 118. It also results in the 125 breaking of the engagement between contacts 124 and 114 and the reengagement of contacts 120 and 114, and 116 and 123, the reengagement of contacts 116 and 123 permitting current to flow from battery 61 through ground, 75<sup>a</sup>, 6, 89, 95, sleeve-contact 92 of the jack, 130



sleeve 111 of the plug 116, 123 and 122 back to the battery. This circuit results in the energization of relay 6 which trips the associated detent 20 and at the same time locks the associated switch and closes the circuit as before described and completes the talking circuit, so that the subscribers may converse without any chance of interruption. After tip and ring of trunk line are in electrical connection with tip and ring of the subscriber's line, central "listens in" to ascertain if subscriber is busy. If not, she "rings" the subscriber in the usual manner, and when the latter takes his receiver off the hook the talking circuit is just the same as hereinbefore described and shown in the right-hand line-selecting switch and connections, current flowing through the line cut-off relay 56 and energizing same to cause it to attract its armatures 57 and 58, thereby breaking contacts 59 and 62 and preventing the line-relay 60 and common-relay 63 from operating. The energization of relay 99 attracts armature 100 from engagement with contact 101 and thus cuts out the trunk-line relay 96 to prevent the lighting of the lamp as long as such trunk line is busy.

When the subscriber's conversation is ended and they hang up their receivers, the cord lamps are lighted in the usual manner viz. by the reopening of the tip and ring of the line wires. The operator then withdraws the plugs and thus removes negative battery from sleeve-contact of jack and reopens the circuit through relays 6 which permit the withdrawal of armatures 24 by their springs and the consequent back rotation of the switches to their original positions, by the springs 9<sup>a</sup>, the cams 30 of the switch ratchet-wheels 7 as the latter attain their original positions, tripping the levers 26 as hereinbefore explained, and permitting the detents 20 to reengage such ratchet wheels.

The operator's talking set illustrated on Sheet 3 is of the ordinary and well known type and is therefore identified as a whole by the reference character A and it is believed that it is unnecessary to describe its structural characteristics and operation in view of the fact that it is claimed only as a whole in connection with the elements described and shown on Sheets 1 and 2.

From the above description it will be apparent that I have produced a telephone system embodying the features of advantage enumerated as desirable and which is obviously susceptible of change in various particulars without departing from the spirit and scope of the appended claims.

Having thus described the invention what I claim as new and desire to secure by Letters-Patent, is:—

1. In a common battery telephone system, the combination with a trunk-line and a group of telephone lines, of a telephone line-

selecting switch for the trunk-line, adapted for intermittent or step-by-step operation and embodying a set of contact-fingers and also sets of contacts for each telephone line, means whereby the removal of a telephone receiver shall complete a circuit through one of said fingers and the contact engaged thereby, means actuated by the completion of said circuit for causing said switch to operate and connect the telephone line from which the receiver has been removed, to the trunk-line through the remaining contact fingers, and means whereby central operator may also effect the operation of said switch and cause it to move said contact fingers until said remaining contact fingers engage contacts electrically connected to the line of the telephone with which communication is desired.

2. In a common battery telephone system, the combination with a trunk-line and a group of telephone lines, of a telephone line-selecting switch for the trunk-line, adapted for intermittent or step-by-step operation and embodying contact-fingers and also sets of contacts for each telephone line, means whereby the removal of the telephone receiver shall complete a circuit, through one of said fingers and the contact engaged thereby, means actuated by the completion of said circuit for causing said switch to operate and connect the telephone from which the receiver has been removed, to the trunk-line through the remaining fingers, instrumentalities whereby the central operator may be placed in talking-connection with the said telephone, and means whereby central operator may also effect the operation of said switch and cause it to move said contact fingers until said remaining contact fingers engage contacts electrically connected to the line of the telephone with which communication is desired.

3. In a common battery telephone system, the combination with a trunk-line and a group of telephone lines, of a telephone line-selecting switch for the trunk-line, adapted for intermittent or step-by-step operation and embodying contact-fingers and also sets of contacts for each telephone line, means whereby the removal of a telephone receiver shall complete a circuit, through one of said fingers and the contact engaged thereby, means actuated by the completion of said circuit for causing said switch to operate and connect the telephone from which the receiver has been removed, to the trunk-line through the remaining fingers, instrumentalities whereby the central operator may be placed in talking-connection with the said telephone, means whereby the central operator may signal the telephone of the called subscriber and place the latter's telephone in talking-connection with the first-named telephone, and means whereby central operator



ator may also effect the operation of said switch and cause it to move said contact-fingers until said remaining contact fingers engage contacts electrically connected to the line of the telephone with which communication is desired.

4. In a common battery telephone system, the combination with a number of trunk-lines and a greater number of individual telephone lines, of a telephone line-selecting switch for each trunk-line, adapted for intermittent or step-by-step operation and each embodying contact fingers and a starting contact and also sets of contacts for each telephone line, connected in multiple with the corresponding contacts of all of the other line-selecting switches, and a switch-selecting switch adapted for intermittent or step-by-step operation, having a contact-finger and contacts corresponding in number and each connected to one of the said starting contacts, and means whereby the removal of a telephone receiver shall complete a circuit through the said finger and contact engaged thereby of the switch-selecting switch, and cause the line-selecting switch connected to said contact to connect the telephone from which the receiver has been removed to the central office through the trunk-line associated with said line-selecting switch.

5. In a common battery telephone system, the combination with a number of trunk-lines and a greater number of individual telephone lines, of a telephone line-selecting switch for each trunk-line, adapted for intermittent or step-by-step operation and each embodying contact fingers and a starting contact and also sets of contacts for each telephone line, connected in multiple with the corresponding contacts of all of the other line-selecting switches, and a switch-selecting switch adapted for intermittent or step-by-step operation, having a contact-finger and contacts corresponding in number and each connected to one of the said starting contacts, and means whereby the removal of a telephone receiver shall complete a circuit through the said finger and contact engaged thereby of the switch-selecting switch, and cause the line-selecting switch connected to said contact to connect the telephone from which the receiver has been removed, to the central office through the trunk-line associated with said line-selecting switch, and instrumentalities whereby the central operator may be placed in talking-connection with the said telephone.

6. In a common battery telephone system, the combination with a number of trunk-lines and a greater number of individual telephone lines, of a telephone line-selecting switch for each trunk-line, adapted for intermittent or step-by-step operation and each embodying contact fingers and a starting

contact and also sets of contacts for each telephone line, connected in multiple with the corresponding contacts of all of the other line-selecting switches, and a switch-selecting switch adapted for intermittent or step-by-step operation, having a contact-finger and contacts corresponding in number and each connected to one of the said starting contacts, and means whereby the removal of a telephone receiver shall complete a circuit through the said finger and contact engaged thereby of the switch-selecting switch and cause the line-selecting switch connected to said contact to connect the telephone from which the receiver has been removed, to the central office through the trunk-line associated with said line-selecting switch, and instrumentalities whereby the central operator may be placed in talking-connection with the said telephone, and means whereby the central operator may signal the telephone of the called subscriber and place the latter's telephone in talking-connection with the first-named telephone.

7. In a common battery telephone system, the combination with a number of trunk-lines and a greater number of individual telephone lines, of a telephone line-selecting switch for each trunk-line, adapted for intermittent or step-by-step operation and each embodying sleeve, tip and ring contact-fingers and a starting contact and sets of sleeve, tip and ring contacts for each telephone line, connected in multiple with the corresponding contacts of all of the other line-selecting switches, a switch-selecting switch adapted for intermittent or step-by-step operation having a contact-finger and contacts corresponding in number and each connected to one of the said starting contacts, and means whereby the removal of a telephone receiver shall complete a circuit through the said finger and contact engaged thereby of the switch-selecting switch, and cause the line-selecting switch connected to said contact to connect the telephone from which the receiver has been removed, to the central office through the trunk-line associated with said line-selecting switch.

8. In a common battery telephone system, the combination with a number of trunk-lines and a greater number of individual telephone lines of a telephone-line-selecting switch for each trunk line, adapted for intermittent or step-by-step operation and each embodying sleeve, tip and ring fingers and a starting contact and sets of sleeve, tip and ring contacts for each telephone line, connected in multiple with the corresponding contacts of all of the other line-selecting switches, a switch-selecting switch adapted for intermittent or step-by-step operation, having a contact-finger and contacts corresponding in number and each connected to one of the said starting contacts, means



whereby the removal of a telephone receiver shall complete a circuit through the said finger and contact engaged thereby of the switch-selecting switch, and cause the line-selecting switch connected to said contact to connect the telephone from which the receiver has been removed, to the central office through the trunk-line associated with said line-selecting switch, and instrumentalities whereby the central operator may be placed in talking-connection with the said telephone.

9. In a common battery telephone system, the combination with a number of trunk-lines and a greater number of individual telephone lines of a telephone-line-selecting switch for each trunk line, adapted for intermittent or step-by-step operation and each embodying sleeve, tip and ring fingers and a starting contact and sets of sleeve, tip and ring contacts for each telephone line, connected in multiple with the corresponding contacts of all of the other line-selecting switches, a switch-selecting-switch adapted for intermittent or step-by-step operation having a contact-finger and contacts corresponding in number and each connected to one of the said starting contacts, means whereby the removal of a telephone receiver shall complete a circuit through the said finger and contact engaged thereby of the switch-selecting switch, and cause the line-selecting switch connected to said contact to connect the telephone from which the receiver has been removed, to the central office through the trunk-line associated with said line-selecting switch, instrumentalities whereby the central operator may be placed in talking-connection with the said telephone, and means whereby the central operator may signal the telephone of the called subscriber and place the latter's telephone in talking-connection with the first-named telephone.

10. In a telephone system, a switch comprising a ratchet-wheel provided with contact fingers movable therewith, a starting contact for engagement normally by one of said fingers and sets of other contacts for successive engagement by said fingers, respectively, a relay having a double winding and yieldingly-retracted armature having a pawl, a yieldingly-actuated detent normally engaging the ratchet-wheel to prevent accidental forward or backward rotation thereof, a pair of contacts, one in electrical connection with one winding and the other with the other winding of said relay, a switch electrically connected to the finger of the ratchet wheel normally engaging the starting contact, and held by the said armature when retracted, in engagement with one of said pair of contacts and adapted when said armature is attracted to be moved thereby from engagement with the said contact of said pair and into engagement with the other contact of said pair; a second relay in electrical con-

nection with the second winding of the first-named relay, a yieldingly-retracted armature therefor adapted when attracted to engage the ratchet-wheel and disengage the detent therefrom, a third relay having an armature electrically connected normally to the contact engaged by the switch actuated by the armature of the first-named relay, and means whereby the energization of the second relay shall cause its armature to complete a circuit through the third relay and thus break the circuit through one winding of the first-named relay.

11. In a telephone system, a switch comprising a ratchet-wheel provided with contact fingers movable therewith, a starting contact for engagement normally by one of said fingers and sets of other contacts for successive engagement by said fingers, respectively, a relay having a double winding and a yieldingly-retracted armature having a pawl, a yieldingly-actuated detent normally engaging the ratchet-wheel to prevent accidental forward or backward rotation thereof, a pair of contacts one in electrical connection with one winding and the other with the other winding of said relay, a switch electrically connected to the finger of the ratchet-wheel normally engaging the starting contact, and held by the said armature when retracted, in engagement with one of said pair of contacts and adapted when said armature is attracted to be moved thereby from engagement with the said contact of said pair and into engagement with the other contact of said pair, a second relay in electrical connection with the second winding of the first-named relay, a yieldingly-retracted armature therefor adapted when attracted to engage the ratchet-wheel and disengage the detent therefrom, a third relay having its armature electrically connected normally to the contact engaged by the switch actuated by the armature of the first-named relay, means whereby the energization of the second relay shall cause its armature to complete a circuit through the third relay and thus break the circuit through one winding of the first-named relay, a movable contact, a pair of contacts electrically connected to the remaining fingers of the ratchet-wheel, one of which is adapted to be engaged by the armature of the second relay when attracted by the latter, and means whereby said movement of said armature shall cause said movable contact to engage the contact connected to the other finger of said ratchet-wheel.

12. In a telephone system, a switch comprising a ratchet-wheel provided with contact fingers movable therewith, a starting contact for engagement normally by one of said fingers and sets of other contacts for successive engagement by said fingers, respectively, a relay having a double winding



and a yielding-retracted armature having  
a pawl, a yielding-actuated detent nor-  
mally engaging the ratchet-wheel to prevent  
accidental forward or backward rotation  
5 thereof, a pair of contacts one in electrical  
connection with one winding and the other  
with the other winding of said relay, a  
switch electrically connected to the finger of  
the ratchet-wheel normally engaging the  
10 starting contact, and held by the said arma-  
ture when retracted, in engagement with one  
of said pair of contacts and adapted when  
said armature is attracted to be moved  
thereby from engagement with the said con-  
15 tact of said pair and into engagement with  
the other contact of said pair; a second relay  
in electrical connection with the second wind-  
ing of the first-named relay, a yielding-  
retracted armature therefor adapted when  
20 attracted to engage the ratchet-wheel and  
disengage the detent therefrom, a third re-  
lay having its armature electrically con-  
nected normally to the contact engaged by  
the switch actuated by the armature of the

first-named relay, means whereby the ener- 25  
gization of the second relay shall cause its  
armature to complete a circuit through the  
third relay and thus break the circuit  
through one winding of the first-named re-  
lay; a movable contact, a pair of contacts 30  
electrically connected to the remaining  
fingers of the ratchet wheel, one of which is  
adapted to be engaged by the armature of  
second relay when attracted by the latter,  
means whereby said movement of said arma- 35  
ture shall cause said movable contact to en-  
gage the contact connected to the other  
finger of said ratchet-wheel, means for de-  
energizing said second relay, and means for  
returning the ratchet-wheel and its fingers 40  
to their original positions.

In testimony whereof I affix my signature,  
in the presence of two witnesses.

DAVID W. MAY.

Witnesses:

L. B. WHERRITT,  
G. Y. THORPE.