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SELF ACTING TELEPHONIC LINE CONNECTING SYSTEM.
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Patented Oct. 18, 1910.

2 SHEETS-SHEET 1.

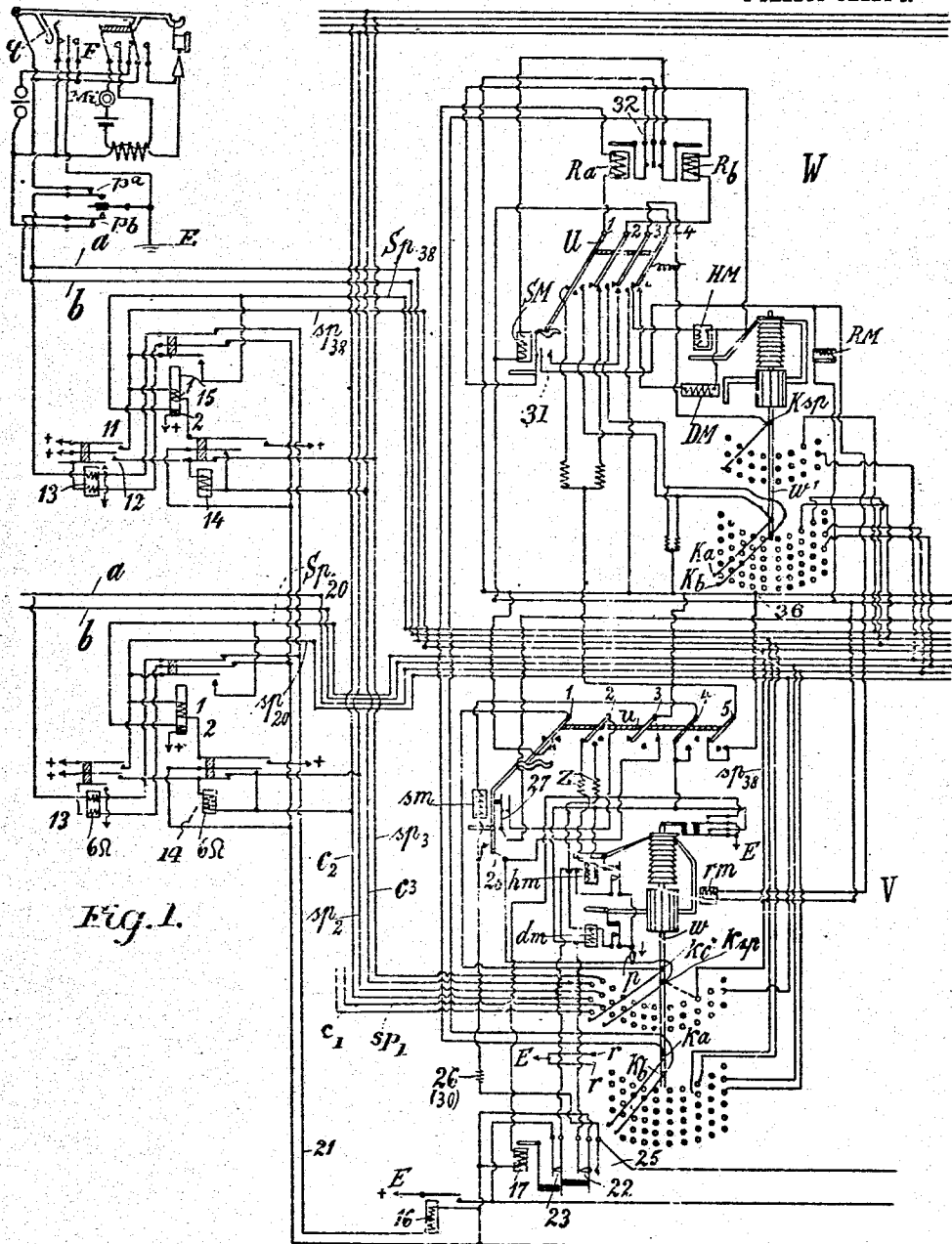


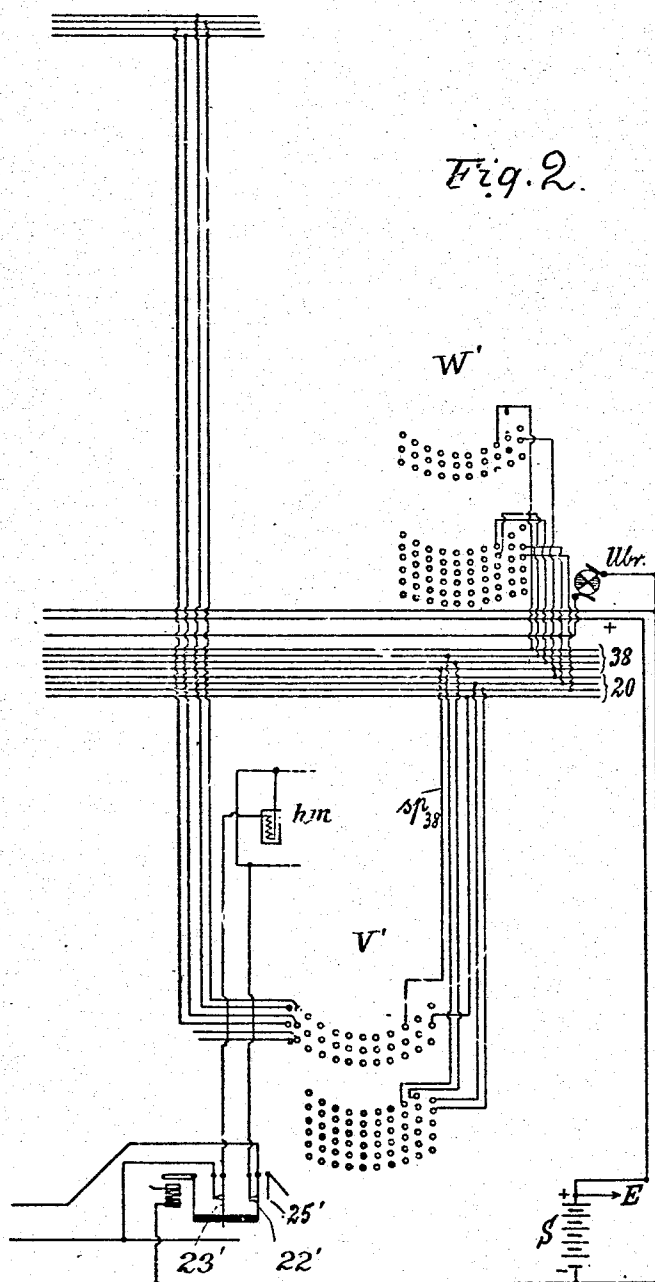
Fig. 1.

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972,874.

2 SHEETS—SHEET 2.



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UNITED STATES PATENT OFFICE.

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SELF-ACTING TELEPHONIC LINE-CONNECTING SYSTEM.

972,874.

Specification of Letters Patent.

Patented Oct. 18, 1910.

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To all whom it may concern:

Be it known that I, BERNHARD KUGELMANN, a civil engineer, and a subject of the King of Bavaria, a resident of 3 Theresienstrasse, in Bad Kissingen, Kingdom of Bavaria, part of the German Empire, have invented a certain new and useful Self-Acting Telephonic Line-Connecting System, of which the following is a specification.

10 This invention refers to an arrangement in connection with telephonic connecting or transmitting systems of that kind, in which in the central station for a particular group of subscribers only so many line selector devices are to be used, as are required for the largest number of simultaneous connections for conversation occurring according to experience.

15 In the system about to be described, there are for instance provided for a group of 100 subscribers, say 10 to 15 line selecting devices or for a group of 200 subscribers there are provided about 20 line selecting devices. To each of these line selecting devices belongs a corresponding pre-selector in the well known manner. There are accordingly provided for a group of 100 subscribers with ten line selecting devices, 10 pre-selectors. Every subscriber of the group is furnished in each pre-selector with a contact arrangement, which consists of blocking contacts and line contacts, with which contact arms of one of the pre-selectors are made to register automatically, as soon as the subscriber calls up. On the other hand the contact arms are connected to the line selecting apparatus, corresponding or belonging to this pre-selector, so that the calling-up subscriber is connected to this line selecting device, thereby being enabled to effect the desired connection.

20 The essential feature of this invention resides in the fact, that it is distinguished from the well known systems of this kind by the absence of any rotatable or stepwise actuated devices which are provided for the purpose of placing one of the pre-selectors in contact with the line of the calling-up subscriber, aside from the ordinary line selecting devices and pre-selectors. In this invention however, every pre-selector is provided with some contacts 22, 23, 25, whereby the effect is produced, that of all the pre-selectors, it is only the next unoccupied pre-

selector, which can be moved by the calling-up subscriber within actuating distance of an interrupter, provided in the central station, so as to be operated by this means. On the other hand every subscriber is provided with special relay-contacts (11, 12). By the influence of the interrupter, the pre-selector, which happens to be in operating position, several pre-selectors, as will be set forth hereinafter, being operated, even, when the subscriber calls up, moves over the line contacts and the blocking contacts, which latter are connected to the relay contacts (11, 12) of the subscribers. The calling-up subscriber will then have influenced his relay contacts in such a manner,—thus for instance by closing the contacts,—that the pre-selector, or, in case several pre-selectors are moving, one of them with its contact arms is arrested upon the system of contacts (blocking contacts and line contacts) corresponding to this subscriber in the pre-selector, and to which the lines of the subscriber are connected. Inasmuch as on the other hand the contact arms of the pre-selector are connected to a line selecting apparatus, the calling-up subscriber is now in position, to effect the desired connection by means of the line selecting apparatus.

25 In the drawings is illustrated diagrammatically a telephone system constructed in accordance with the present invention, two subscribers' stations, having the calling numbers 38 and 20, and the corresponding pre-selectors and selecting apparatus, being shown.

Figure 1 represents a portion of such system; and Fig. 2 the remaining parts thereof.

30 In the interest of clearness of illustration and with a view of a better comprehension of the various parts, the one pre-selector with corresponding line selecting apparatus is only represented by its sets of contacts (blocking contacts and line contacts). In all line selectors W the usual form with rotatable and displaceable shaft is shown, while of course the invention is also applicable to any other form or type of selectors.

35 In the upper left-hand corner of Fig. 1 is shown the wiring of a subscriber's apparatus which is similar to that of the "Strower system."

In Fig. 1, being the left hand part of the

drawing, three relays are shown for each subscriber, that is to say a calling-up relay 13 with the above mentioned relay contacts 11 and 12, a relay 14, the purpose of which will appear from the following description, and a separating relay 15. Besides, a calling-up relay 16, which is common to the entire group (Fig. 1 of the drawing, lower portion) is provided.

Every pre-selector V consists of a rotatable and displaceable shaft on which a double contact arm k_a , k_b and a double locking arm k_{sp} , k_c , are mounted. The arms k_a , k_b , k_{sp} control the contact arrangements of the subscribers in the pre-selecting device, k_a , k_b controlling a field containing double contact pins (hereinbefore called line contacts), and k_{sp} controls a field of contact blocking pins (hereinbefore called blocking contacts). To each double contact pin corresponds a contact blocking pin. Hence, when k_a , k_b are placed on a double contact pin, k_{sp} will be placed upon the corresponding blocking pin. The blocking pins are permanently and securely connected to the lines sp_{20} and sp_{38} of the subscribers. In the drawing three series of double contact pins and of contact blocking pins are represented, that is to say all in all the contacts for 30 subscribers. There is the peculiarity however, that to each row of blocking pins a separate double blocking pin is furnished. To each of these double blocking pins a double line sp_1 , c^1 , sp_2 , c^2 , sp_3 , c^3 is securely connected. In the inoperative position of the pre-selector, the arms k_{sp} , k_c , k_a , k_b do not make connection with any contact. As soon as the shaft has been raised one step, k_{sp} is placed upon sp_1 , k_c on c^1 ; on the second step k_c is placed on c^2 , k_{sp} on sp_2 and so on; k_a and k_b do not make connection with contacts while the shaft is raised; only during the rotating movement k_a and k_b are moved over the double pins of the subscribers. The relay contact 12 of every subscriber makes contact with one of the lines sp^1 , sp^2 , sp^3 and the relay 14 of this subscriber is in contact with the corresponding line c^1 , c^2 , c^3 , in such a manner, that a subscriber, whose calling number is for instance 38, is connected to the line sp^3 by his relay contact 12, while by his relay 14 he is connected to c^3 , that is to say, in the representation of the invention, shown, the switching parts (12, 14) of a group of ten subscribers are included in each double line (sp_1 , c^1 , sp^2 , c^2 . . .), thus for instance sp^1 , c^1 includes the switching parts of the subscribers with the calling numbers 10 to 19. The relay contact 11 of each subscriber is included in his blocking line sp_{38} , sp_{20} , which, as already mentioned, is connected to the blocking pins of this subscriber in the pre-selectors. In the form of carrying the invention into effect, here shown by way of example, the relay contacts 11 of the sub-

scriber 20 are therefore connected to sp_{20} and those of the subscriber 38 to sp_{38} . The other parts of the pre-selector V are well known as they are those of the well known "Strowger system" described, for example, at pages 724 to 734 of the *Electrotechnische Zeitschrift*, Berlin, 1903; they consist of the raising and rotating magnets hm , dm , an interrupter u , which is operated by means of the blocking magnet sm and which is turned one step toward the right every time, the blocking magnet is operated; and it further consists of a releasing magnet rm , the armature of which is formed, so as to constitute a checking pawl and which retains the shaft in its operative position, until rm is excited.

A peculiar feature of the invention resides in the blocking pins rr , the function of which is explained in the arrangement given as an instance of the application of the invention.

Below each of the pre-selectors, the switching device is shown, which comprises a relay 17 and the contacts 22, 23, 25 and which produces the effect, that when a subscriber is calling, only the next unoccupied pre-selectors can be operated every time. The selecting apparatus W, which corresponds to each of the pre-selectors V, differs but slightly from the latter one. The separate double blocking pins are not a part of the selecting apparatus. The double contact pins are connected to the a , b -lines while the contact blocking pins are connected to the blocking lines Sp of the subscriber. Hence, every subscriber is provided with two blocking lines sp and Sp .

Supposing, subscriber 38 desires connection with subscriber 20. Then, subscriber 38 will ground his a -line temporarily-preferably by taking off his receiver and thereby causes arm q to actuate the contact F and connect the same with the ground E—and he thereby produces a current impulse from the station battery S, the positive pole of which is grounded, the current passing as follows:—negative pole, universal calling-up relay 16, line 21, upper contact of the separating relay 15, upper winding of the calling-up relay 13, a , earth at the calling-up subscriber station. The relay 16 closes its contact and produces,—supposing that the first pre-selector is unoccupied,—a local current by way of the raising magnet hm of this pre-selector, which passes as follows:—negative pole of S, contact 22 on relay 17, hm , contact 23 on relay 17, contact on relay 16, positive pole. In consequence thereof hm raises the shaft w one step, so that the head contacts above the shaft are closed.

The closing of the head or top contacts produces in its turn a local current, which flows during the operative position of the shaft as follows:—negative pole, relay 17, 130

top contact, earth, so that the contacts 23 and 22 are opened and the contact 25 is closed by the responding of the relay 17. When the contact 25 is closed, a local current flows

- 5 by way of the blocking magnet sm as follows:—negative pole, contact 25, resistance 26, sm , fourth arm of the switch u , head contact, earth. This results in the closing of the contacts 27 and 28.
- 10 The contact 28, is arranged in such a manner, as indicated by the dart line,—that it remains closed only in the extreme operative position and during the return movement of the magnet sm . The closing of the contact
- 15 27 produces interrupting currents by way of the raising magnet hm , which pass as follows:—negative pole, interrupter, Ubr , contact 27, second arm of the switch u , resistance Z , (left hand part of Fig. 1 of the drawing), hm head-contact, earth. This results in the raising of the shaft on each impulse by means of hm . One of the poles of the raising magnet (and of the rotating magnet) is connected to the arm k_{sp} by way
- 20 of one closed circuit contact each and by way of a polarization battery p . The battery p prevents unintentional branching off of the current from the negative pole by way of 25, 26, 28, p , hm or by way of dm , head contact and earth. After each operation of hm the closed circuit contact is opened.

- The above mentioned contact 28 on the blocking magnet sm produces the effect, that one end of the winding of the blocking
- 35 magnet sm is in connection with the contact arm k_{sp} during the extreme operating position of its armature and during the return movement of the same. Now, in case the shaft w in the example herein described, is
- 40 raised three steps, because a subscriber in the third group of tens has called up, k_{sp} is in engagement with sp^3 . Now inasmuch, as sp^3 has been directly grounded by the calling-up subscriber number 38 by way
- 45 of the contact 12 of this subscriber (as above described), both the raising magnet hm as well as the blocking magnet sm are short circuited by means of k_{sp} , sp^3 , earth and the head switch or by way of 28, k_{sp} ,
- 50 sp^3 , earth, head switch and u^1 , inasmuch as the current will now pass by way of negative pole S , Ubr , 27, u^2 , k_{sp} , sp^3 , earth, positive S or by way of negative S , 25, 26, 28, k_{sp} , sp^3 , earth, positive S , so that no further
- 55 interrupter current flows by way of hm , while on the other hand sm will not afford passage to the current and releases its armature. The return movement of this armature produces the well known effect, that the switch u is able to turn around to the second field of contacts. As soon as this is
- 60 done, a current impulse takes place by way of the relay 14 of the calling-up subscriber, passing through negative S , first arm of the switch u , k_s , c^3 , relay 14, contact 12, earth.

This current impulse excites the relay 14 and interrupts by this means the circuit sp^3 , earth, so that other moving pre-selectors are not arrested after the third step, unless sp^3 is grounded by the medium of another

70 calling-up subscriber (with a calling number between 30 and 39). The relay 14 will then remain excited for some time by the arresting current passing by way of its middle contact, which is connected to the

75 negative pole, by way of relay 14, middle contact 12 of relay 13, earth. When the switch is on the second field of contacts, the rotating movement of the shaft takes place under nearly the same conditions as during

80 the raising movement. First of all sm will again offer a path for the current (the current passing by way of negative pole, contact 25, resistance 26, fourth arm of the switch u , head contact, earth). Besides, in-

85 terrupter currents will pass into the rotating magnet dm , as soon as the blocking magnet sm has attracted its armature completely and has closed the contact 27. These interrupter currents pass as follows, from the

90 negative pole, to contact of the interrupter Ubr , contact 27, second arm of the switch u , resistance Z , (right hand or Fig. 2 of the drawing) dm , head contact, earth.

After eight such interrupter currents have

95 taken place, k_{sp} has been placed in contact with the blocking line sp_{38} of the calling-up subscriber. Inasmuch however, as sp_{38} has been grounded by the calling-up subscriber directly by way of the contact 11, both dm

100 as well as sm , are short circuited in the same manner as above explained with reference to hm and sm . No further interrupter currents can therefore pass by way of dm ; and on the other hand no current will pass

105 through sm , which releases its armature, so that the switch u can move upon the third field of contacts. No current or at least no current of any noticeable force will pass through the winding 1 of the relay 15, upper

110 contact of 14, earth. (The winding 1 of relay 15 has a resistance of nearly 750 ohms). When however the switch u is upon the third field of contacts, k_{sp} and sp_{38} in consequence are placed directly on the negative

115 pole, which is done by way of the third arm of u , see dotted line, so that now, especially when the contact 11 is grounded by way of a resistance, not shown in the drawing, a considerably stronger current will

120 also flow through the winding 1 of the relay 15 (negative pole, third arm of the switch u , k_{sp} , sp_{38} , winding 1 of 15, upper contact of 14, earth). Relay 15 opens and closes its contacts, whereby the current is prevented

125 from passing through the relay 13, whereby on the other hand the current is also cut off from the relay 14. As long as the pre-selector is placed on the lines of the calling-up subscriber 38, the current passes as fol-

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lows:—negative pole, third arm of the switch u , k_{sp} , sp_{38} , lower contact of 15, winding 2, earth, so that 15 remains excited and the relays 13 and 14 are separated off from the station battery. The pre-selector is now in engagement by means of its contact a ms k_a , k_b with the lines a and b of the calling-up subscriber, who is now enabled to operate the corresponding selecting apparatus by way of k_a , k_b .

As already mentioned, more than one pre-selector is moved by one subscriber, because the current impulse, negative pole, 16, upper contact of 15, upper winding of 13, a , earth, may last any length of time at the calling-up subscriber station, so that the relay 16 is still excited, while the relay 17 has already caused its armature to be turned. This results in causing the current to pass through contact 25, contact 22' (Fig. 2) lifting magnet hm' , contact 23' and the contact of the relay 16 to the earth and in consequence the movement of the pre-selector V' . Suppose the case, that two subscribers (for instance 29 and 38) are calling-up simultaneously, several pre-selectors are operated which is done with a slight interval of time, inasmuch as the first local current by way of the raising magnet hm of a pre-selector can only take place anyhow, after the preceding pre-selector has been raised one step and after the relay 17, belonging to the latter pre-selector has caused the alteration of its field of contacts. This small interval of time produces the effect, that every subscriber is provided with a pre-selector V and consequently with a selector arm Z , inasmuch as the first operated pre-selector is arrested by the grounding of the conductor sp_2 and is caused to rotate, whereupon sp_2 is immediately cut out from earth again (in the lower contact of 14), so that the next pre-selector may move unimpededly as far as sp_3 . Since more pre-selectors can be operated, than it is possible to call up subscribers, the arrangement is such, that a pre-selector, which has been raised through eleven steps, is returned to its inoperative position automatically, because in this case, k_a , k_b will engage two contacts rr , which are legged to earth, so that the relays Ra , Rb of the corresponding selecting apparatus, which are connected to k_a , k_b are excited, the circuit being from the negative pole of the battery through arm 5 of the switch u and in one direction, through the arm 1 of the switch U and the parts R_a , k_a , r , to the positive side of the battery and on the other side through the arm 2 of the switch U and the parts R_b , k_b , r , to the positive side of the battery and the said preselector released. After taking the telephone off the hook, the calling up subscriber operates his so-called numbering switch which is designated in Fig. 1 by contact p_a , p_b and by this means he pro-

duces a number of impulses which correspond to the desired call number, in the selecting apparatus. The short interval of time from the moment of the first grounding (on the taking off of the telephone by the calling up subscriber) to the commencement of the series of current impulses, is sufficient for the above described switching operation, the interrupter-currents following each other very quickly. The subsequent switching operation is well known. Every impulse produced by the numbering switch by way of the a line conductor, excites the relay Ra of the selecting apparatus by way of a , k_a , Ra , U^1 , u^5 , S , earth, thereby producing local currents, as follows:—negative pole of the central battery S , operating contact at Ra , raising magnet HM , fourth arm of the switch U , positive pole. In consequence thereof HM raises the shaft two steps in the present instance. The current impulse produced by the numbering switch by way of the b line conductor, earth in the calling up subscriber station, b , k_b , Rb , second arm of U , fifth arm of u , negative pole, produces by the responding of Rb the following local current: positive pole, SM , contact at Rb , negative pole. SM is excited and when it is cut out of circuit, it moves the switch U upon the second field of contacts. In consequence thereof the next series of current impulses produces local currents by way of Ra and by way of the rotating magnet DM , the current passing as follows:—negative pole, contact at Ra , rotating magnet DM , fourth arm of the switch U , positive pole.

The shaft is rotated, which in the present instance takes place through ten steps, so that the arms Ka , Kb are placed on the line ab of the desired subscriber 20. The b current impulse causes, as above referred to, the turning around of the switch U onto the third field of contacts, so that the desired connection is now obtained (a of the subscriber 38), Ka , Ra , first arm of U (third field). Ka , a (of the subscriber 20), by way of his station, b , Kb , second arm of U (third field) Rb , Kb , b (of the subscriber 38)). It is well known, that the blocking line of a busy subscriber must be connected to one pole of the battery, in order that the connection may not be disturbed by third subscribers.

In the present case, given by way of example, every subscriber is provided with two blocking lines Sp and sp . If a subscriber's station is in use these blocking lines connect with the battery and prevent, as will be seen, any disturbance. When a subscriber has called, Sp is connected to the negative pole, thus for instance in the above instance, Sp_{38} of the subscriber 38 is connected by the lower contact of 15,—the said contact being closed in consequence of the excitement of

the winding 2, as has been shown above,— and by way of sp_{38} k_{sp} , third arm of the switch u , to the negative pole. If a subscriber is called his line S_p will also be in contact with the negative pole, for example, the line Sp_{20} in the illustration is over K_{sp} and the third arm of the switch U is in contact with the negative pole (in the selecting apparatus, occupied by the calling up subscriber 38). Inasmuch as on the other hand Sp_{20} of the called subscriber is connected to the winding 2 of relay 15 and to the positive pole, the relay 15 of the called up subscriber is also excited.

For the sake of a better comprehension of the blocking operation, it may be supposed in the above mentioned instance, in which the subscriber 38 calls up the subscriber 20, that the subscriber 20 has already been engaged by a third party by means of any kind of selector, thus for instance by the selector which is shown in the annexed drawing by its sets of contacts only. In this case, the blocking line Sp_{20} is connected to the negative pole, as has just been explained, by way of K_{sp} , and by way of the third arm of U of this selecting apparatus. Inasmuch as on the other hand however, the subscriber 38 excites Rb and consequently SM by the last current impulse and by way of his b line conductor (see above), a connection will be established between Sp_{20} and the positive pole in the moment, in which SM has attained its extreme working position (U being still maintained upon the second field of contacts), this connection being by way of K_{sp} , third arm of the switch U , contact at SM , releasing magnet RM , positive pole and also by way of releasing magnet rm , positive pole, so that the selecting apparatus with its pre-selectors, which are occupied by the calling up subscriber 38, are restored into inoperative position. It yet remains to point out, that by the simultaneous excitement of Ra and Rb of a selecting apparatus, the disengagement of the same and of the corresponding pre-selectors takes place, Rb exciting, as already mentioned, the magnet SM , by which means a local circuit is established by way of positive pole, RM , or rm respectively, contact 31 at SM , contact 32 at Ra , negative pole. Upon the release of the preliminary selector the head contacts of the same are opened, which results in 17 being cut out from the circuit, so that the contacts 22, 23, 25 are returned into inoperative position.

In the constructional details of the system described variations may occur.

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

1. In a telephone system, the combination, with the subscribers' lines divided into groups, of common lines and a number of pre-selectors for each group, each pre-selector comprising a traveling contact device, adapted to be moved successively in two directions, and to make contact by the movement in the first direction with said common lines, and each pre-selector arranged to engage with a subscriber's line.

2. In a telephone system, the combination with the subscribers' lines divided into groups, of common lines and a number of pre-selectors for each group, each pre-selector comprising a traveling contact device, adapted to make contact with each of the said common lines and each pre-selector arranged to engage with a subscriber's line, a switching apparatus for each pre-selector, the said switching apparatus arranged to set in action the next idle pre-selector, when a subscriber is calling up.

3. In a telephone system, the combination with the subscribers' lines divided into groups, or common lines and a number of pre-selectors for each group, each pre-selector comprising a traveling contact device, adapted to make contact with each of the said common lines and each pre-selector arranged to engage with a subscriber's line, a calling relay device for each subscriber, a common relay device, a switching apparatus for each pre-selector, arranged to set in action the next idle pre-selector.

4. In a telephone system, the combination with the subscribers' lines, divided into groups, of common lines and a number of pre-selectors for each group, each pre-selector comprising a traveling contact device, adapted to make contact with each of the said common lines, and each pre-selector arranged to engage with a subscriber's line, a calling relay device for each subscriber, a common relay device, a switching apparatus for each pre-selector, arranged to set in action the next idle preselector, a line selecting apparatus connected with each pre-selector, and means arranged to make the final connection with a desired subscriber's line.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

BERNHARD KUGELMANN.

Witnesses:

E. BARDEL,
H. BARDEL.