

Feb. 16, 1932.

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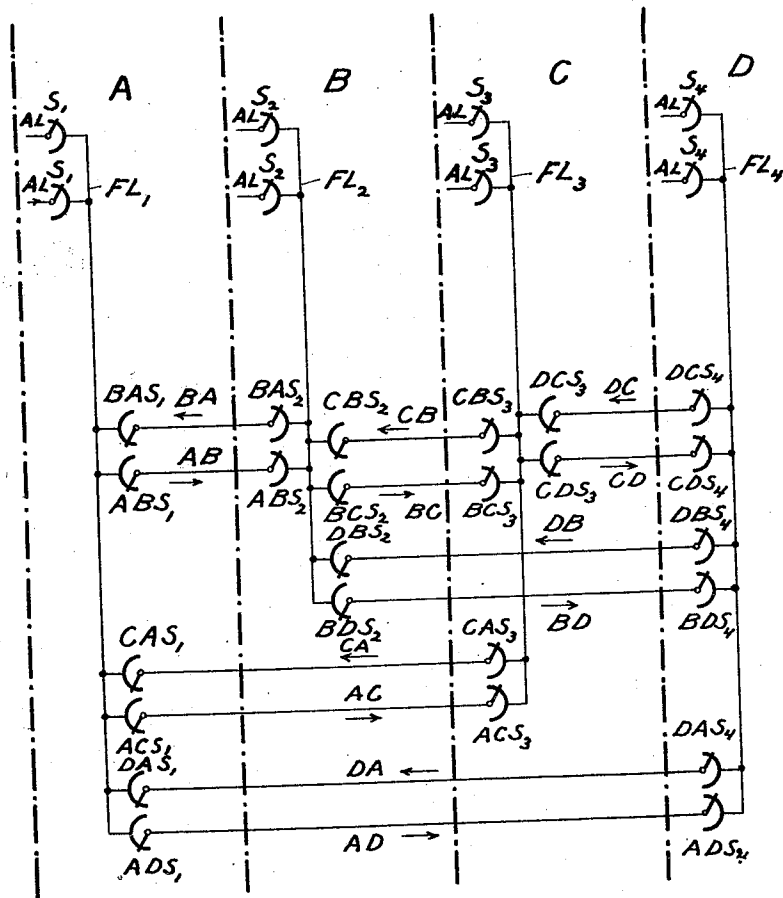
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SWITCHING ARRANGEMENT FOR AUTOMATIC TELEPHONE SYSTEMS

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4 Sheets-Sheet 1

Fig. 1.



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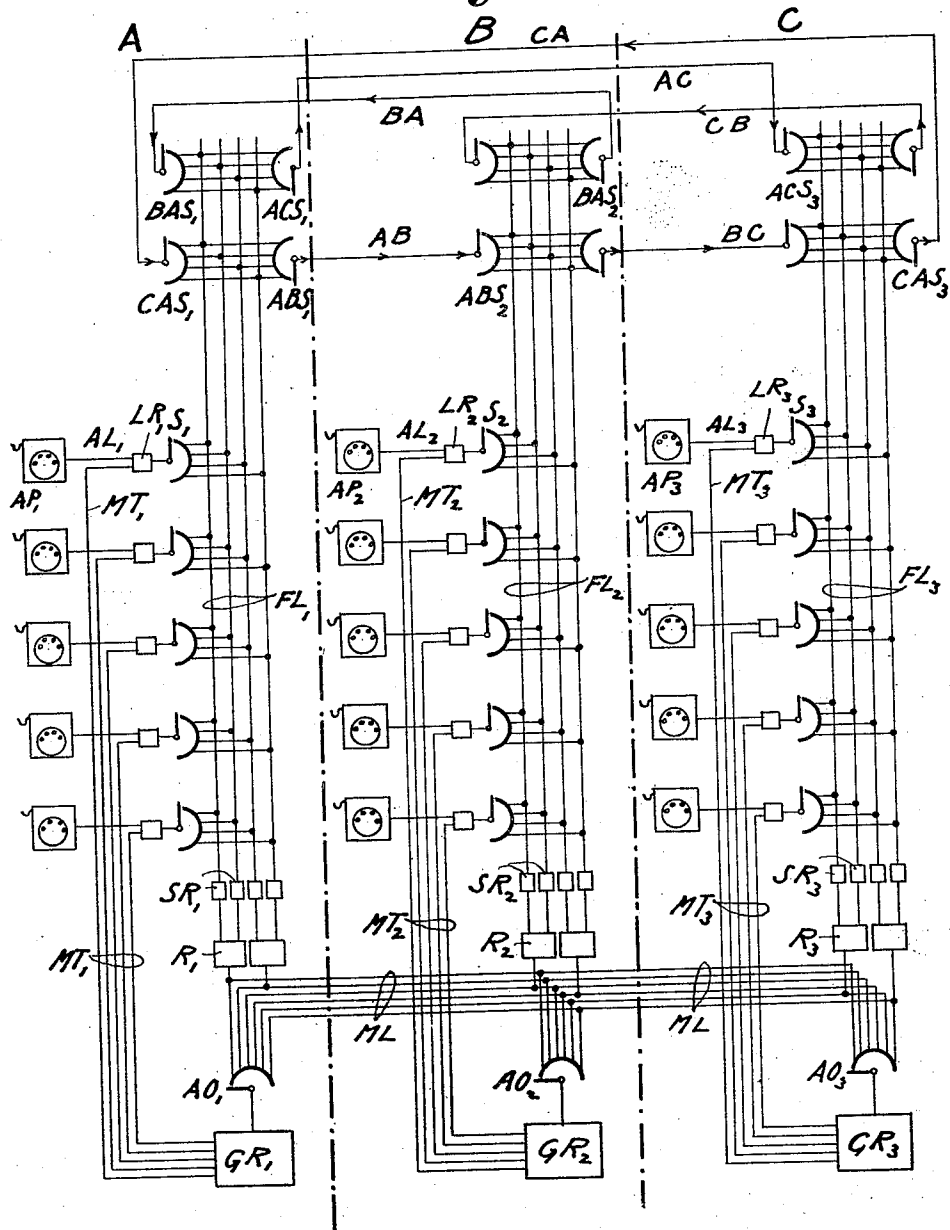
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Fig. 2.



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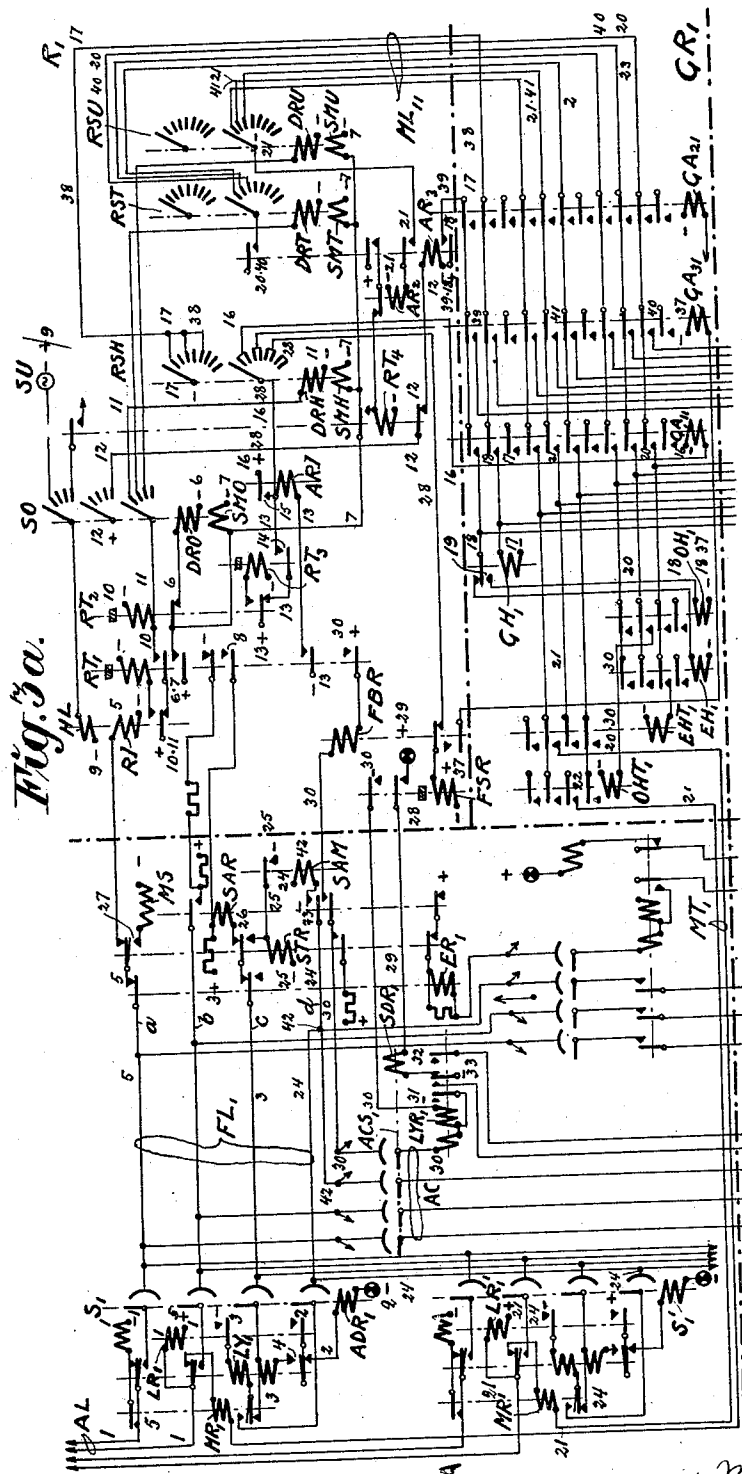
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SWITCHING ARRANGEMENT FOR AUTOMATIC TELEPHONE SYSTEMS

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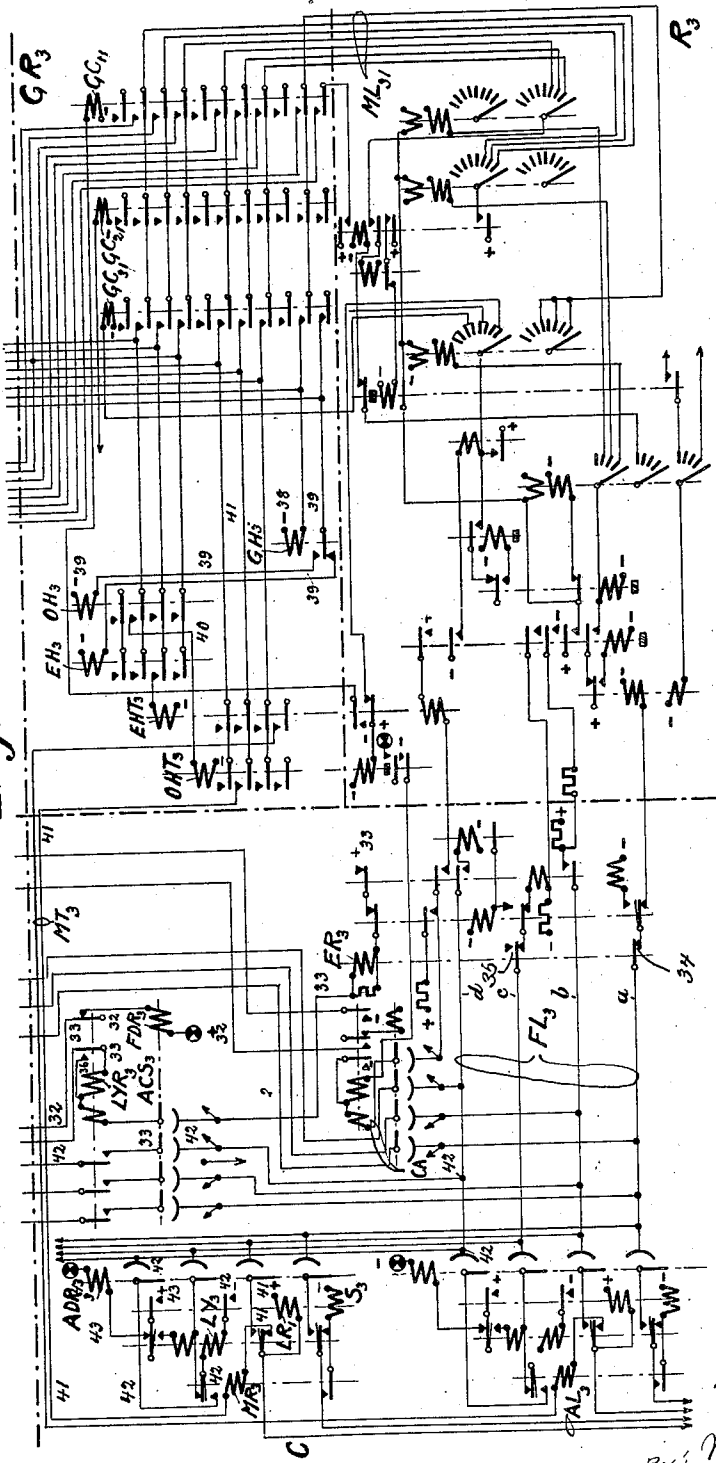
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SWITCHING ARRANGEMENT FOR AUTOMATIC TELEPHONE SYSTEMS

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4 Sheets-Sheet 4

Fig. 36.



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SWITCHING ARRANGEMENT FOR AUTOMATIC TELEPHONE SYSTEMS

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The present invention relates to a switching arrangement in automatic telephone systems. More especially it relates to medium sized telephone plants of said kind. In projecting such plants it has hitherto been necessary to design the system for a certain maximum capacity already from the beginning in view of the expected future developments of the telephone net. The erection costs per subscriber's line for such a system will then, however, be unproportionately high. Systems are known which allow a successive building out of an automatic telephone exchange having a small capacity by adding an arbitrary number of independent exchanges of substantially the same capacity. The traffic in both directions between the different exchanges may then be carried over external junction lines which by means of non-numerical selectors disposed at each end of the lines may be connected to internal junction lines in each one of the different exchanges. Thus the different telephone exchanges form only different sections of a larger telephone exchange in which case they need not necessarily be disposed in the same locality but may be disposed at suitable places.

The present invention relates to systems of the latter kind. More especially it relates to such systems in which the numerical selectors only are adapted to mark the wanted subscribers' lines and junction lines whereas the talking connections are established over separate connecting apparatus, preferably operating as searchers. Said numerical selectors together with the apparatus co-operating therewith will in the following, on account of their purpose to register the wanted number and to mark the lines corresponding thereto, be called marking registers. The invention has for its object to design such marking registers in such a manner that the telephone plant may be extended in above described manner by the addition of new exchange sections without then subjecting the marking register system to any considerable alterations. For this purpose the marking registers are, according to the invention, so designed that they may mark a

subscriber's line belonging to the own exchange section as well as a subscriber's line appertaining to another exchange section and an inter-exchange junction line extending to the latter exchange section. Those marking registers, which then are made use of, are preferably of the kind which comprise, on the one hand, an impulse receiver consisting of one or more marking selectors and, on the other, a marking relay set usually common to a plurality of impulse receivers and cooperating with the impulse receiver. Said relay set is adapted to control the marking circuits of the subscriber's lines. According to the invention the impulse receivers are individually allotted to the different exchange sections and are only accessible for the subscribers in the corresponding section whereas the marking relay sets are adapted to be connected to, and to co-operate with, an impulse receiver appertaining to any exchange section. Preferably a marking relay set is provided for each exchange section, each relay set then controlling only the marking circuits for the corresponding exchange section.

The invention will be more closely described with reference to the accompanying drawings. Figure 1 shows diagrammatically the mutual disposition of a number of exchange sections in a telephone plant of the kind in question. Figure 2 shows a principal diagram over a telephone plant according to the invention comprising three sections. Figures 3a and 3b taken together present a detailed circuit diagram of such a telephone plant, only two sections being however shown.

In Figure 1, a number of exchange sections A, B, C, D, are mutually separated by means of dot and dash lines. Each such section comprises an independent automatic telephone exchange of arbitrary size which may be placed anywhere within the telephone net. The different exchanges are of the kind which use separate setting and speaking current paths. In the figure, the speaking paths are diagrammatically shown by means of single lines. The selectors S allotted to the subscribers operate as preselectors or searchers

and may, upon calls in a section, establish communication between two subscribers' lines AL over a free one of a number of internal junction lines FL in the section. In traffic between two sections, by way of example from the section A to the section B, the internal junction line FL₁ of the section A is connected by means of the searcher ABS₁ to an inter-exchange junction line AB adapted to mediate the inter-exchange traffic between the sections which line, by means of a searcher ABS₂ disposed at the opposite end of the line, selects a free internal junction line FL₂ in the section B whereupon connection is obtained with the wanted subscriber's line over his selector S₂. In traffic in the opposite direction, the connection is instead preferably established over the junction line BA and the searchers BAS₂ and BAS₁ although also such inter-exchange junction lines may be provided, which each allow traffic in both directions. The four sections indicated in the figure are mutually connected together by means of inter-exchange junction lines AB and BA, AC and CA, AD and DA, BC and CB, BD and DB, and CD and DC in such a manner that a subscriber in any one section may call a subscriber in any other section of the plant.

All the subscribers' lines connected to the different sections are included in the same numerical series and it is, consequently, possible to obtain communication with one and the same line by calling the same number from any subscriber's line in the entire net. Although the plant thus technically is divided into a number of substations it constitutes, from the point of view of the subscribers, a unitary central which, as regards its operation, is identical with a central of a larger type.

Figure 2 shows principally how connections may be established between the sections A, B and C. The different sections may, by way of example, be made in accordance with the system described in the Swedish Patent No. 54.793. The subscriber's apparatus AP in each section may be connected over subscribers' lines AL with the appertaining relays LR and the selectors S, allotted to the subscribers' lines, to any one of a number of internal junction lines FL accessible in common for all the sections. Said internal junction lines are preferably brought together in groups, to each group being then allotted a marking register R which by means of relays SR may be connected to any one of the appertaining junction lines. Said marking registers are only adapted to select and, in a certain manner, to mark the wanted subscriber's line whereas the talking connection is established over the selectors S in such a manner that the selector S appertaining to the line marked by the register, is connected to the internal junction line FL to which the

calling subscriber has connected himself by means of his selector S. The marking registers are adapted to co-operate with the marking relay set GR common to the sections, which set controls the marking circuits MT and which may be connected to any one of the marking registers R in any of the sections A, B, C over connecting apparatus AO, which may be of any arbitrary kind such as searchers or relays, and over lines ML extending through all the sections and being connected in multiple to the apparatus AO.

For the traffic between the different sections, inter-exchange junction lines AB, BA, AC, CA, and BC, CB are disposed together with the appertaining searchers ABS₁, ABS₂, BAS₁, BAS₂, ACS₁, ACS₂, CAS₁, CAS₂.

In the following it may be assumed that each section has a capacity of two hundred lines, an arrangement according to Figure 1 having four sections and thus representing a capacity of eight hundred lines. The subscribers' numbers containing three digits, the first digit in the number indicating the section to which the subscriber belongs.

The establishment of a talking connection between two subscribers belonging to different sections takes place in the following manner.

After a subscriber in the one section, by way of example A, has lifted his micro-telephone from his set AP₁ and by his selector S₁ has been connected to a free internal junction line, the subscriber may, in case a free marking register R₁ is available, start to send the numerical impulses. As soon as the digit, by way of example designating the section C, has been dialled, the register actuates the starting relay of the searcher ACS₁. The searcher is started and begins hunting for the internal junction line engaged by the calling subscriber's set in the section A. As soon as the searcher has stopped on said line the other searcher ACS₂ of the inter-exchange junction line is started to hunt for a free internal junction line in the section C. When such a line is found the searcher stops and the calling subscriber's set AP₁ in the section A is connected to a free internal junction line FL₂ in the section C. After the subscriber has dialled the entire number the register R₁ is connected over the appertaining marking line ML and the connecting apparatus AO₂ to the marking relay set GR₂ of the section C if said set has not been previously engaged by any register. The number is then transferred in known manner to GR₂ which closes a marking circuit over the wanted subscriber's marking wire MT₂. Then the called subscriber's selector S₂ is started and hunts for the internal junction line FL₁ in the section A and over the inter-exchange junction line AC.

When the selector finds said line it stops, the subscribers' lines AL_1 and AL_3 being then connected together over S_1 — FL_1 — ACS_1 — AC — ACS_3 — FL_3 — S_3 . At the same time the register and GR_3 are disconnected to be available for new connections.

The register in the section A is not connected to GR_3 before the internal junction lines FL_1 and FL_2 of the two sections have been united. The marking relay set GR_3 is thus not engaged by the register during the time when the two searchers of the junction line hunt for the internal junction lines in the sections A and C respectively.

Figures 3a and 3b taken together show a circuit diagram for a system of that kind which is described with reference to Figure 2. The marking registers R consist of a number of marking selectors RSH, RST and RSU. The successive connecting into circuit of the different marking selectors takes place under the control of a sequence switch SO of the same construction as the marking selectors. The latter are of the rotary type and adapted to be advanced stepwise by means of electromagnets DRH, DRT, DRU against the action of a spring by means of which the selector is restored to the starting position after a lock magnet SMH, SMT, SMU has been de-energized which magnet during the setting holds the selector in set position. The registers are adapted, by means of relays GA and GC respectively corresponding to the connecting devices AO in Figure 2, to be connected to marking relay set GR in the wanted section. If the wanted subscriber belongs to another section than the calling section the register is connected over a line ML to the marking relay set of the section in question. In Figures 3a and 3b there are only shown two sections A and C. It may be assumed that the subscriber's line AL_1 connected to the section A desires communication with a subscriber's line AL_3 connected to the section C.

When the calling subscriber lifts his micro-telephone the line circuit 1 is closed, the relay LR_1 then operating and closing an impulse circuit 2 for the driving magnet ADR_1 of the pre-selector S_1 , whereby the pre-selector is started and in known manner hunts for a free junction line FL_1 . In connecting to the latter line a current path 3 is formed over the third or private wire c through the test relay LY_1 and connecting relay SAR. The test relay connects itself into a holding circuit over its contact 4. The connecting relay SAR connects the junction line FL_1 to a register R_1 free for the time being, the microphone circuit 5 being then simultaneously closed through the impulse receiving relay RI of the register. When RI is energized a slow acting relay RT_1 is connected into circuit and closes in turn a circuit 6 through the driving magnet DRO of the sequence switch SO. Parallely with the said path a current path 7 is closed

through the lock magnets SMO, SMH, SMT and SMU in the marking selectors RS and the sequence switch SO. At the same time the register is marked busy by closing the contact 8 of RT_1 . When the sequence switch SO was actuated over the circuit 6 its contact arms were advanced to the second position of the sequence switch. In this position a current path 9 of a buzzer current source SU is closed through a winding HL of the impulse relay RI whereby the subscriber's attention is called to the fact that the register has been connected into circuit and is ready to receive the impulses. The subscriber then sends the impulses. Upon the first interruption in the line circuit, a circuit 10 is closed through the slow acting relay RT_2 and further a circuit 11 through the driving magnet DRH of the marking selector RSH. By said impulses said marking selector is now set in the position corresponding to the hundreds digit. If said digit is assumed to appertain to a line within the same section A, by way of example the numeral one, the marking relay stops thus in the second position if the selector is assumed normally to take up the first position. When the relay RT_2 is energized the circuit 6 of the driving magnet DRO of the sequence switch SO is interrupted which driving magnet is de-energized without, however, then bringing about any advance of the sequence switch. After the impulses in the first impulse series have been sent the relay RT_2 is de-energized the circuit 6 being then closed and bringing about a forward displacement of the sequence switch SO into the third position. Through the then succeeding impulse series corresponding to the tens digit in the subscriber's number, the marking selector RST is set whereupon the sequence switch SO in similar manner as before is advanced into the fourth position. In said position of the sequence switch the third series of impulses are sent which now actuate the marking selector RSU whereupon the sequence switch SO is advanced to its fifth position a circuit 12 being then closed over a relay AR_3 of the register. At the same time, when the relay RT_2 is deenergized, the circuit 13 is closed over the contact 14 of the slow acting relay RT_3 . The relay AR_1 is now energized and locks itself over its own contact 15 and closes a current path 16 over the hundreds selector RSH of the register through the marking relay GA_1 corresponding to section A in the common relay group GR_1 . The relay GA_1 is energized and closes a circuit 17 through the relay GH_1 adapted for selection, within the section, of even or odd hundreds and also a circuit 18 over the contact 19 of the relay GH_1 , through the relay OH_1 , and finally also the circuit 20 from the tens selector through the relay OH_1 and the circuit 21 from the units selector over the contact 22 of the relay OHT_1 and through the marking relay MR_1 of the

wanted subscriber and the line relay LR_1' . If the subscriber is free the latter relays cause in known manner the starting of the corresponding pre-selector S_1' . The pre-selector S_1' of the wanted subscriber hunts now in known manner for an internal junction line FL_1 , the fourth wire d of which is marked over the relay SAM and the contact 23 of the relay SAR. Then testing takes place over the circuit 24. As soon as the testing circuit 24 is closed, when the selector finds the junction line in question, the relay SAM is energized and closes the circuit 25 for the relay STR which disconnects the register and closes a holding circuit for itself over its contact 26. At the same time the microphone circuit is closed over the feed coil MS and the contact 27. The desired communication is thus completed with a subscriber within the same section and the register is restored to normal position in known manner.

If the subscriber desires communication with another subscriber with another section, by way of example the section C, whose number begins with, by way of example, the numeral 5, connection to the register and reception of the first impulse series take place in above described manner. The marking selector RSH then stops in its sixth position and when the selector RT_2 after the first impulse series is de-energized the relay AR_1 is energized over the circuit 13 and forms a current path 28 over the hundreds selector and the starting relay FSR of the inter-exchange junction line. The latter relay is energized and closes an impulse circuit 29 through the driving magnet FDR_1 of the inter-exchange junction line searcher ACS_1 . Further the relay FSR prepares a test circuit 30 through the relay LYR_1 . The latter circuit is closed when the searcher ACS_1 finds the junction line FL_1 to which the calling subscriber is connected. The circuit 30 includes a relay FBR which is energized and interrupts the impulse circuit 29 so that the selector ACS_1 stops. At the same time also the relay LYR_1 is also energized and receives holding current over its contact 31 and closes an impulse circuit 32 for the driving magnet FDR_3 of the inter-exchange junction line searcher ACS_3 . Further the relay LYR_1 prepares a test circuit 33 through the relay LYR_3 . The latter circuit is completed when the searcher ACS_3 finds a free internal junction line FL_3 in the section C. The circuit 33 is then extended through a busy marking relay ER_3 in the section C. The latter relay is energized and disconnects the register at its contact 34 of the a -wire of the internal junction line FL_3 and marks the line busy over the contact 35 of the c -wire. At the same time also the relay LYR_3 is energized and receives holding current over its contact 36. The calling subscriber in the

section A is thus connected to a free internal junction line in the section C.

Meanwhile the subscriber has started sending of the other impulses whereby the marking selectors RST and RSU are set as before. All the wires ML_{11} , which are the object of the selecting operation of said selectors, may by means of relays GA_{31} be connected to the marking relay set GR_3 in the section C. In similar manner said wires may be connected through a relay GA_{21} to the marking relay set in a section B, Figure 2. The relays GA_{11} , GA_{21} , and GA_{31} correspond thus to parts of the connecting apparatus AO_1 and AO_2 and AO_3 respectively in Figure 2. The relay GA_{31} is controlled by the circuit 37 which was formed in energizing the relay FBR over the circuit 30 when the selector ACS_1 found the junction line FL_1 . Through the energization of the relay GA_{31} there is now formed the circuit 38 through the relay GH_3 which, upon its energization, closes the circuit 39 through the relay OH_3 and selects odd hundreds within the section C. Through the energization of the relay OH_3 the circuit 40 is closed for the tens relay OHT_3 and when said relay is energized the marking circuit 41 is completed through the wanted subscriber's marking relay MR_3 and the relay LR_1 . Said relays cause then, if the subscriber is free, in known manner the starting of the corresponding pre-selector S_3 . The latter selector hunts now in known manner by means of testing in the contact field of the fourth wire the internal junction line FL_3 engaged by the calling subscriber. The testing then takes place over the circuit 42 through the relay SAM in the section A. As soon as said testing circuit is closed when the selector finds the junction line in question the relay SAM is energized and closes the circuit 25 for the relay STR which disconnects the register and closes a holding circuit for itself over its contact 26. At the same time the microphone circuit is closed over the feed coil MS and the contact 27. The test relay LY_3 is energized at the same time as the relay SAM and interrupts the impulse circuit 43 of the driving magnet ADR_3 the selector then stopping. Then the wanted communication with a subscriber belonging to another section is completed and the register is restored to normal position in known manner.

The restoration of the talking connection takes place when the calling subscriber hooks up his microtelephone. Then the relay LR_1 is de-energized whereby the relay STR is de-energized. This results in that the relay LYR_1 is de-energized and then also the relays LYR_3 and ER_3 at the contact 35 of the latter relay the circuit of the holding winding of the relay LY_3 is then interrupted.

I claim:

1. In a telephone system comprising a num-

ber of automatic telephone exchanges or exchange sections mutually connected by means of inter-exchange junction lines, means to connect up the subscribers' lines over internal
 5 junction lines to marking registers, which only serve to mark the wanted subscriber's line or the junction line respectively, means to establish the talking connections over separate connecting apparatus preferably operating as searchers, and means to mark both a
 10 subscriber's line appertaining to the own exchange section, and a subscriber's line belonging to another exchange section and an inter-exchange junction line extending to the latter exchange section from the marking register belonging to the calling station.

2. A telephone system according to claim 1, in which the marking registers comprise on the one hand an impulse receiver with a number of marking selectors, said receiver being
 20 individually allotted to each separate exchange section and accessible only for the subscribers in the appertaining exchange section, and on the other a marking relay set cooperating with the impulse receiver to control the marking circuits of the subscribers' lines, which relay set is adapted to be connected to and cooperate with an impulse receiver appertaining to any one of the different exchange sections.

3. In a telephone system comprising a number of automatic telephone exchanges mutually connected by means of inter-exchange junction lines, means to connect up the subscribers'
 35 lines over internal junction lines to marking registers consisting of an impulse receiver and a marking relay set cooperating with said receiver and controlling the marking circuits of the own exchange only, means to mark both a
 40 subscriber's line appertaining to the own exchange and a subscriber's line belonging to another exchange and an inter-exchange junction line extending to the latter exchange from the marking register belonging to the calling station.

4. In a telephone system comprising a number of automatic telephone exchanges mutually connected by means of inter-exchange junction lines, means to connect up
 50 the subscribers' lines over internal junction lines to marking registers consisting of an impulse receiver and a marking relay set cooperating with said receiver and controlling the marking circuits of the own exchange only, means to mark both a subscriber's line appertaining to the own exchange and a subscriber's line belonging to another exchange and an inter-exchange junction line extending to the latter exchange from the marking register belonging to the calling station and means to engage the marking relay set of the own exchange upon calls to another exchange first after the calling subscriber's line has
 65 been connected over an inter-exchange junction line to an internal junction line in the latter exchange section.

tion line to an internal junction line in the latter exchange section.

5. In a telephone system comprising a number of automatic telephone exchanges mutually connected by means of inter-exchange
 70 junction lines, means to connect up the subscribers' lines over internal junction lines to impulse receiving marking registers, means to connect up the inter-change junction lines to the internal lines over searchers which are allotted to the different inter-exchange junction lines and which may be selected and started over circuits controlled by the impulse receivers.

In testimony whereof I affix my signature. 80
 KARL GEORG JOHNSON.

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