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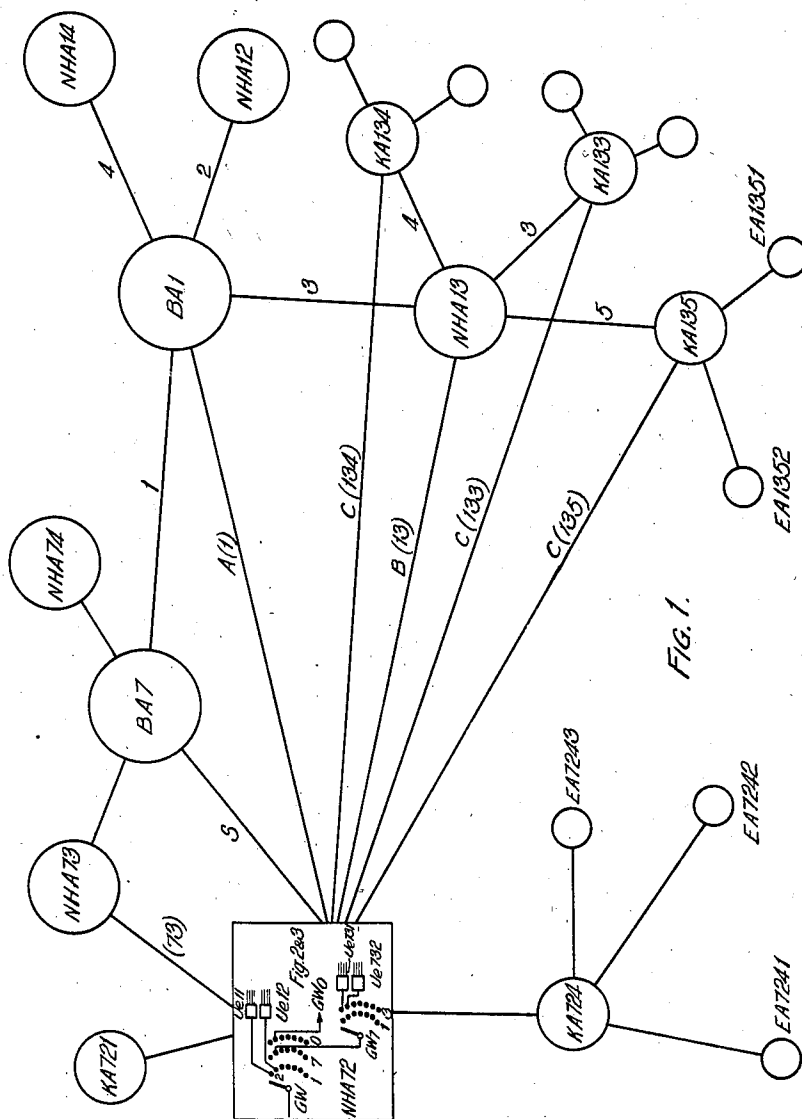
R. HOFERT ET AL

2,276,489

TELEPHONE SYSTEM

Filed June 13, 1940

5 Sheets-Sheet 1



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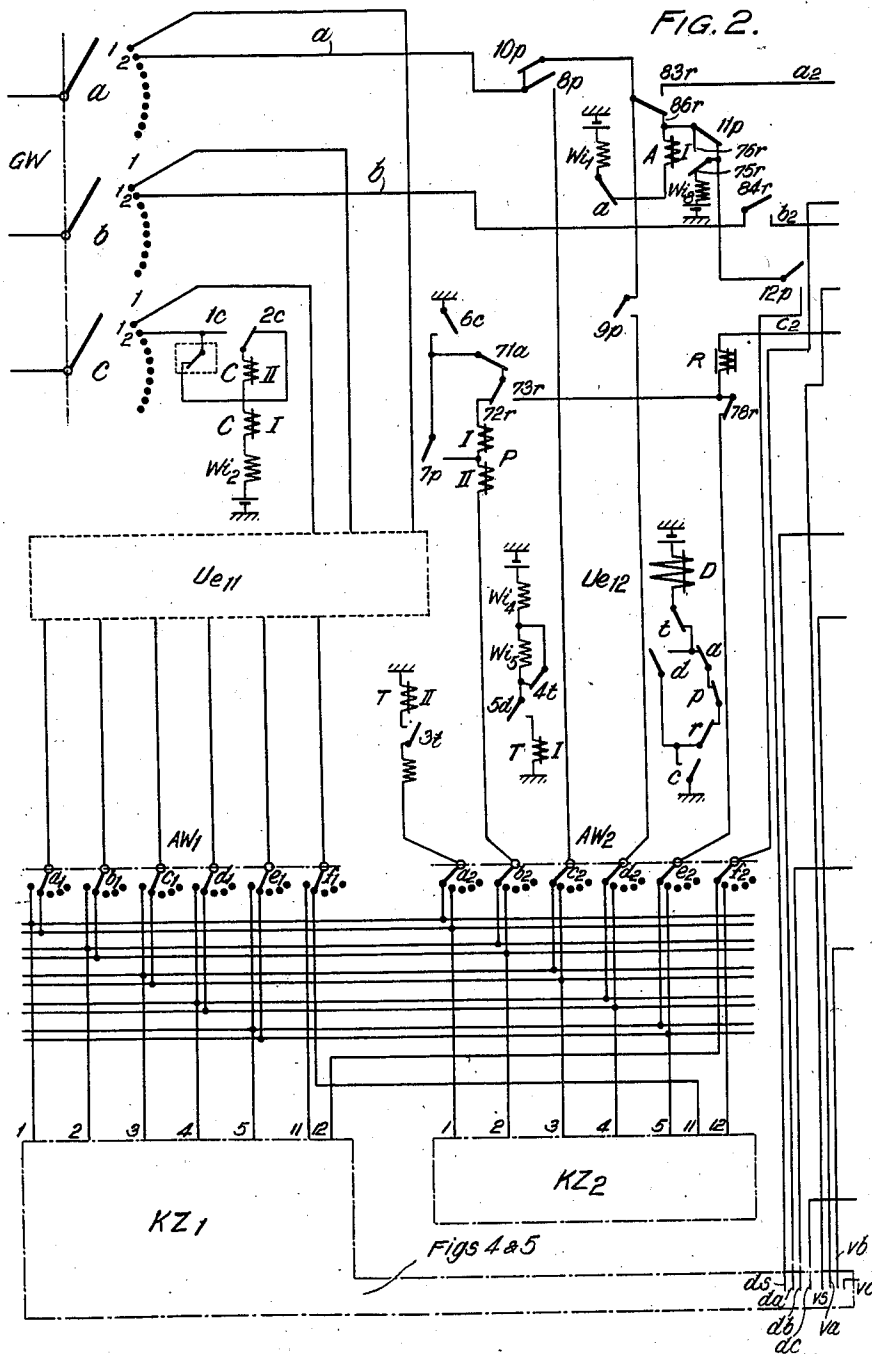
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5 Sheets-Sheet 2



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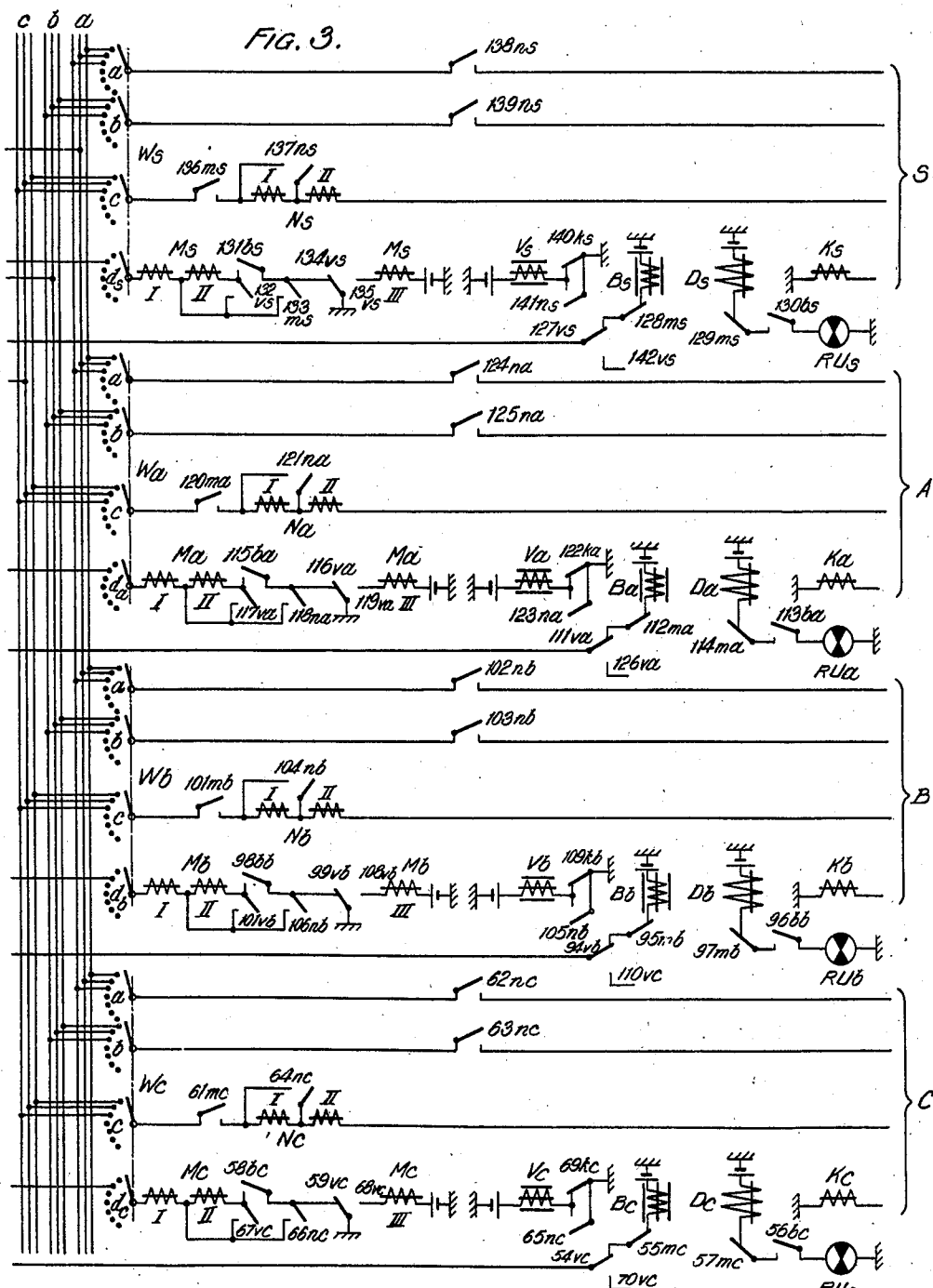
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TELEPHONE SYSTEM

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5 Sheets-Sheet 3



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**March 17, 1942.**

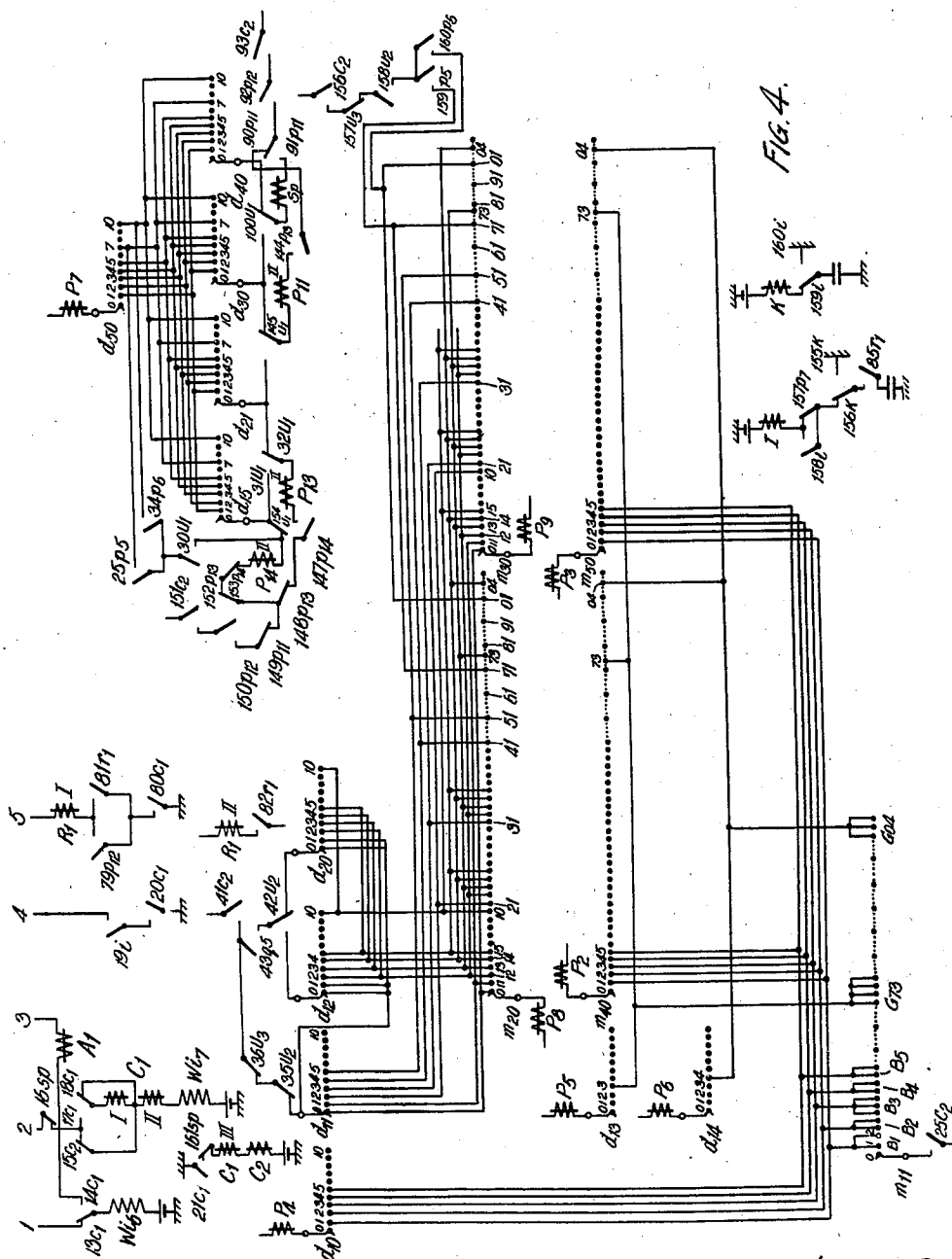
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**2,276,489**

TELEPHONE SYSTEM

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5 Sheets-Sheet 4



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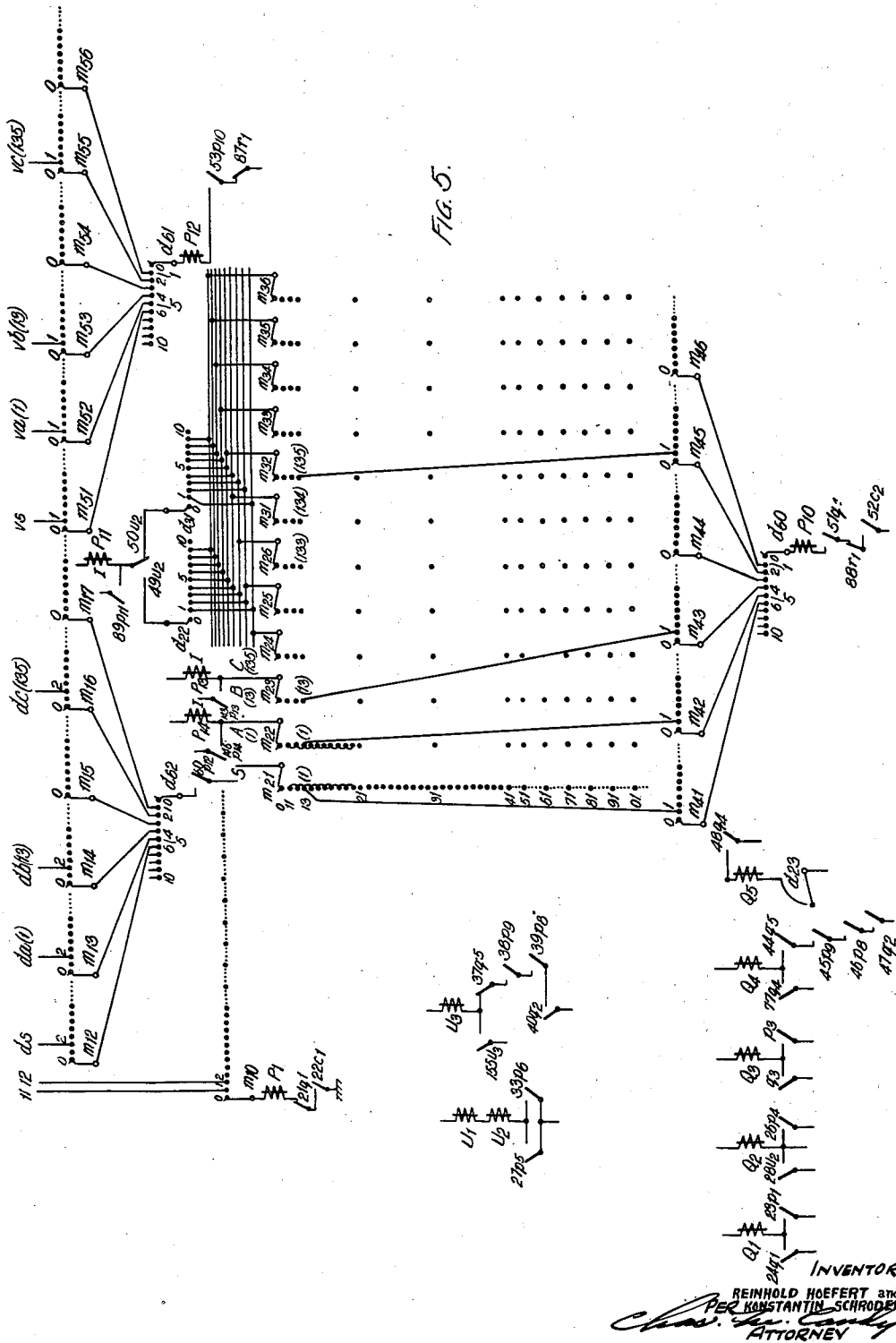
R. HOEFERT ET AL

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TELEPHONE SYSTEM

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5 Sheets-Sheet 5



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## UNITED STATES PATENT OFFICE

2,276,489

## TELEPHONE SYSTEM

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4 Claims. (Cl. 179—18)

The present invention relates to improvements in telephone systems and more particularly to a circuit arrangement for multi-exchange telephone systems the exchanges of which are interconnected in different ways. Thus a call can be set up over the various junction lines provided or over different exchange stations. The latter is, for example, the case if as well as junction lines between the toll exchanges or between the rural main exchanges and the associated toll exchanges so-called tie lines are provided between rural main exchanges and other exchanges of the same or of another toll area over which traffic may be developed. The required exchange station can then be reached from the rural main exchange for example over the junction lines leading to the toll exchange or over tie lines.

In order to maintain the junction lines to the toll area exchange free, especially if traffic to distant exchanges is concerned, in the event of connections which may be made over tie lines precautions are taken that the seizing of a high-valued junction line is only possible if no tie line is available for building up the required connection. For this purpose code repeaters are provided at the connecting means available to the calling subscriber which receive the numerical impulse series transmitted for marking the required direction and determine according to the said signals whether the lines are available in the required direction in order that, if necessary, a free line of this kind should be switched to the connecting device seized by the calling subscriber. According to whether this line leads directly to the required exchange station or at first to another exchange station over which the required connection can then be set up, a certain number of the stored numerical impulse series are sent out from the code repeater. If it is desired to prevent the code repeater being taken into use when connections are set up within the rural main exchange connecting means must be provided the seizing of which is only undertaken after the selection of one or more numerical impulse series by the calling subscriber so that the code repeater must determine the numerical impulse series sent out before its seizure in order to determine the path to be used and, if necessary, to be able to transmit the impulses according to the path which is chosen for the connection. The code repeater must, therefore determine which toll exchange or which part of the toll exchange has already been marked by the calling subscriber. Further, since the code re-

peater is not at the sole disposal of any one connecting device in the exchange in question but is provided in common for several connecting devices, it must determine by which of these connecting devices it has been seized in order that the selected free line should be connected with that connecting device seized by the corresponding calling subscriber.

To this end it has been proposed to mark the toll exchange or part of the toll exchange marked by the calling subscriber's initial numerical selection in the code repeater by means of a relay and to determine the connecting means used thereby by by-path testing in dependence on the access seized by the code repeater. Since the code repeater is adapted for common use by several connecting devices, hunting has very often to be carried out by several code repeaters simultaneously and precautions must be taken to prevent cross-connections in the by-path testing. This is attained therein that a step-by-step switch mechanism closes the test circuits for the individual code repeaters one after the other so that at one time one testing operation only can take place. This switch mechanism can, however, only operate with a limited speed since the selector of the code repeater determining the seized connecting device must traverse a large number of contacts during each operation of the switch device.

According to the following invention the determination of the toll area selected by the calling subscriber and the connecting means seized for this purpose is simplified and false operation is prevented. This is attained therein that switch devices are associated with the code repeaters, to the contacts of which are connected the connecting devices used by the code repeater in groups according to their traffic directions and also singly so that by the setting of the switch device simultaneously the signal selection and setting up of the connecting path to be reproduced by the code repeater according to the direction of the seized connecting device is determined and the connecting device connected with the selected connecting path is also determined.

An embodiment of the invention is illustrated in Figs. 1-5. Fig. 1 is a schematic network layout of a multi-exchange area with a number of connecting paths, while in Figs. 2 and 3 a section of the rural main exchange (NHAT2) is shown attainable by a calling subscriber over a connecting means Uel2 to which a code repeater (e. g. KZ1) common to several connecting devices may be connected over a connection selec-

tor (for example AW2). The selectors (Ws, Wa, Wb, Wc) are shown for connecting the connecting lines (S, A, B, C) to the connecting means. In Figs. 4 and 5 a code repeater (e. g. KZ1) is shown with the selectors necessary for its different functions and the signal control relay. Battery and earth are omitted where they are not necessary in order that the invention be explained to simplify the drawings. The setting magnets for the selector with the associated re-vertive relay are not shown in order to explain more simply the operation in question. The contact banks of each signal selector are shown schematically in order to keep the circumference of the selector within a reasonable space; and a limited number of wipers are shown in the given embodiment. For the selectors in Figs. 4 and 5 with the reference "d" step-by-step selectors are used and for those with the reference "m" motor selectors are used; naturally other types of selectors may be used.

In Fig. 1, two toll area exchanges are shown, BA1 and BA7, to which rural main exchanges, for example NHA72, 73, 74 or NHA12, 13, 14 are connected. To some of the rural main exchanges are connected junction centres, for example KA721, 724, or KA133, 134, 135 from which final exchanges, e. g. EA7241, 7242, 7243 or EA1351, 1352 branch off.

The connecting means Ue12 shown in Figs. 2 and 3 with the associated selectors Ws, Wa, Wb, Wc, is like the code repeater KZ1 shown in Figs. 4 and 5, provided in the following example in the rural main exchange NHA72. From this exchange are connected so-called S-lines to the associated toll area exchange BA7, which is connected over junction lines with the toll area exchange BA1. Also between the rural main exchange NHA72 and the toll area exchange BA1 A-lines are connected, between the rural main exchanges NHA72 and NHA13 B-lines, and between the rural exchange NHA72 and the junction centres KA133, 134, 135 C-lines. Between the other exchanges likewise different junction lines can be connected in any preferred manner.

The S-lines are lines which end at an S-group selector for selecting a toll exchange. The A-lines end in an A-group selector which provides for the selection of a rural main exchange. The B-lines lead to a B-group selector which provides for the selection of a junction centre while the C-lines lead to a C-group selector and are provided for the selection of a final exchange.

From the network layout shown in Fig. 1 it will be seen that a calling subscriber belonging to the rural main exchange NHA72 may reach, for example, the junction centre KA135 over the S-line to the toll area exchange BA7 and then over BA1—NHA13, or over A-line to the toll area exchange BA1 and then over NHA13 or over B-line to the rural main exchange NHA13, or directly over the C-line. The marking number for access to this junction centre is 135 and the first figure 1 serves for setting a group selector GW in the rural main exchange NHA72 on the first decade, in which a free connecting means is hunted e. g. the connecting means Ue12 connected to the contact 2. To this connecting device (of Figs. 2 or 3) a free code repeater e. g. KZ1 is connected over a hunting switch AW2. This code repeater which is shown in detail in Figs. 4 and 5 repeats the marking number already received from the group selector GW (the number 1) by setting the wipers d10—d15 according to setting of the wipers m10—m17; it receives

the further impulses transmitted from the calling subscriber consisting of three and five impulses by setting the wipers d20—d22 and d30—d31; if necessary then a further impulse series is received by setting the wiper d40. By a corresponding setting of the m20—m26, m31—m36, m40—m46, m50—m56, and d60—d62, the junction line available in the required direction is determined, the chosen line is connected with the connecting means Ue12 seized by the calling subscriber and, according to the line connected, determines how many impulse series are to be sent out from the code repeater KZ1, determined by the setting of the wiper d50, for reaching the required junction centre KA135.

The switch operations described above take place in detail in the following manner:

After the group selector GW in the rural main exchange NHA72 (Figs. 2 and 3) is set by the numeral 1 on the decade 1, it hunts for a free connecting means. If, for example, a connecting means Ue12 connected to the contact 2 is reached a circuit for the relay C is completed over the test conductor over the corresponding c-wiper which by connecting its high resistance winding II over the contact 1c holds the connecting means locked against further seizing by another group selector. The connecting selector AW2 associated with the connecting means Ue12 is prepared to be connected with a free code repeater e. g. KZ1 and the relay T of the hunting switch AW2 is energised over: earth, battery, W16 (Fig. 4), contact 13c1, conductor 1, wiper a2 of the hunting switch AW2 (Fig. 2), W13, contact 3t, winding II of relay T, earth. After the closing of the contact 6c, relay P (Fig. 2) and relay C1 (Fig. 4) are energised over: earth, battery, W17, winding II of relay C1, contacts 15c2, 16sp, conductor 2, wiper b2 of the hunting switch AW2, windings II and I of the relay P, contacts 17r, 11a, 6c, earth. The relay P, when its high resistance winding I is short-circuited over contact 7p, locks the code repeater KZ1 against seizing by another hunting switch. By closing the contact 8p the impulsing relay A1 of the code repeater KZ1 is connected over: wiper c2 of the hunting switch AW2, conductor 3, relay A1, contact 14c1, W16, battery, earth. By the closing of the contact 9p the circuit over which the code repeater KZ1 transmits numerical impulses is prepared over the wiper d2 of the hunting switch AW2 and the conductor 4.

In the code repeater KZ1 after relay C1 is energised the associated contacts are operated so that relay C2 is energised, contact 21c1 closed and relay C1 is held energised over its series winding III. Further, after the code repeater KZ1 is seized, the selector provided with wipers m10—m17 is set in motion, in a manner not of interest in this invention, in order to determine the seized connecting means Ue12. The selector is in motion until its wiper m10 reaches the conductor connected to the contact 2. Then the relay P1 is energised over: (Fig. 2), earth, battery, W18, contacts 15r, 12p, wiper f2, conductor 12 (Fig. 5), wiper m10 on contact 2, relay P1, contacts 21q1, 22c1, earth. The relay P1 is thus energised when the selector is stepped-on to the second contact; in a manner not shown here, further stepping by the selector is prevented. Wiper m11 set with the wiper m10 marks, in the contact bank which it traverses, the connecting means Ue12 by being set on the second contact. In this contact bank, however, contacts are multiplied according to the number of connecting

means required in the corresponding direction. To simplify matters two connecting means are provided in the direction 1 in the present embodiment.

After the relay P1 is energised, the relay Q1 is energised over the contact 23p1 and holds itself energised in a holding circuit over its contact 24q1. Moreover, depending on the control relay, not shown, the selectors with the wipers m40—m46 and m50—m56 are set in motion until the wipers m40 and m50 reach the contacts marked by the wiper m11. When the wipers m40 and m50 are resting on the contacts 1, the relays P2 and P3 are energised over: relay P2, wiper m40 on contact 1 or relay P3, wiper m50 on contact 1, wiper m11 on contact 2, contact 25c2.

Apart from the setting of these selectors, after relay Q1 is energised, in a manner not shown here, the selector with the wipers d10 to d15, is stepped-on until the relay P4 is energised over the wiper d10 and the contact marked by the wiper m11. This also takes place when the switch has taken one step. The next numeral is thus determined. The multiplying between the steps of the wipers d10 and m11 is so selected that the number to be transmitted is the first place of the marking number and is also the number of steps which the selector with the wipers d10—d15 is distant from its zero position. The first impulse series is subsequently routed over the wiper d15 set on the contact 1, and is transmitted by the selector with the wiper d53.

After relay P4 is energised, the relay Q2 is energised over the contact 26p4. The impulsing relay A1 of the code repeater KZ1 receives the further impulse series transmitted from the calling subscriber over the conductor 3. By the next impulse series the selector with the wipers d20—d23 is set and, since the next impulse series consists of three impulses, reaches the contact 3. Hereupon, in a manner which is not shown, switching over takes place so that the third impulse series (5) is transmitted from the relay A1 to the selector with the wipers d30 and d31. If necessary a 4th impulse series is subsequently transmitted to the selector of the wiper d40.

In the present case all three possible tie lines (A, B, C) are determined by the first three impulse series.

The relay Q2 energised over the contact 26p4 after relay P4 is energised during the determination of the first numeral (1) connects the selectors in a manner which is not shown, with the wipers m20—m26 and m30—m36 in an automatic stepping circuit. They are stepped-on until the wipers m20 and m30 reach that contact which is marked by the wiper d11 set on the contact 1. The test relays P8 and P9 of these two selectors are now energised and stop the selector. The energising circuit is completed over: relay P8, wiper m20 or relay P9, wiper m30 on contacts 11, multiplying wiper d11 on contact 1, contacts 35u2, 36u3, and 41c2. After contacts 39p8 and 38p9 are closed, relay U3 is energised over: contacts 37q5, 38p9, 39p8, 40q2. Relay U3 breaks the circuit for the relays P8 and P9 at 38u3 so that the two selectors are again switched in.

In the meantime, by the closing of contact 43q5 a new test circuit is prepared over the wiper d20, for, after the second impulse series from the calling subscriber setting this wiper the relay Q5 is energised over wiper d23.

Since in the above case this impulse series consists of three impulses the wiper d20 is set

on the contact 3, the two selectors with the wipers m20—m26 and m30—m36 are in motion until the wipers m20 and m30 reach the contact 13. The relays P8 and P9 are energised over: wiper m20 or m30 on contact 13, multiplying, wiper d20 on contact 3, contacts 42u2, 43q5, and 41c2. The relay Q4 is energised over the contacts 44q5, 45p9, 46p8 and 47q2 and is held energised over its contact 77q4. The relay Q5 is restored by the short-circuit over the contact 48q4. A further setting operation of the two selectors is prevented.

In the contact banks of the selectors which are swept over by the wipers m21—m26 and m31—m36 are contained all the possible connections in the main and tie directions. The contacts which may be reached by these wipers are multiplied in a definite manner with the contacts attainable by the wipers m41—m46. According to the above description, for example, the wipers m40—m46 corresponding to the groups of the seized connecting means Ue12 are set on the contact 1 while the wipers m20—m26 and m30—m36 are stepped corresponding to the first two impulse series (1 and 3) and are set on the contact 13.

In the circuit given in Figure 3 it is assumed that for the direction characterised by the three impulse series (1, 3, 5) the following possible connections may obtain:

C-direction according to the numerical selection 135  
B-direction according to the numerical selection 13  
A-direction according to the numerical selection 1  
S-direction according to the numerical selection 1

The corresponding contacts 13 are therefore connected with the contact 1 of the contact bank traversed by the wipers m41 to m46 in the manner shown.

The multiplying for the other directions is carried out according to all the connections which are possible.

As shown in Figure 1, three rural main exchanges NHA12, NHA13 and NHA14 may, for example, be connected to the toll area exchange BA1. In this case then the contacts 12 to 14 in the contact bank traversed by the wiper m21 are connected together and, since the toll area is associated with the group 1, one step is taken by the wipers m40 to m46 wired to the first contact of the contact bank traversed by the wiper m41. If other A-lines are provided, in the contact bank traversed by the wiper m22 the contacts 12 to 14 should be connected and multiplied with the first contact of the contact bank traversed by the wiper m42. This applies similarly for the B and C lines.

As shown above the relay Q4 is energised in the present circuit after the wipers m20 to m26 and m31 to m36 are set. The wipers d60 to d62 are stepped-on in any known manner. As soon as contact 2 of the wiper d60 is reached the relays P10 and P11 are energised in series over contacts 52c2, 83r1, 51q4, relay P10, wiper d60 on contact 2, wiper m45 on contact 1, wiper m32 on contact 13 (135), wiper d31 on contact 5, contact 50u2, relay P11. Over the contacts 87r1, 53p10, the relay P12 is connected to the wiper d61. Since the wiper d61 is set at contact 2 and the wiper m55 on the contact 1 (conductor vc) it can energise as long as a free C-line is available over the conductor vc. In this case the relay P12 is energised over: contacts 87r1, 53p10, relay P12, wiper d61 on contact 2, wiper m55 on contact 1, conductor vc, contacts 54vc, 55mc,



relay Bc, battery, earth. In this circuit relay Bc is also energised and by closing its contact 56bc the rotary magnet Dc of the selector Wc is connected over the contact 57mc. This selector is in motion until the relay Mc is energised over earth, contacts 59vc, 58bc, windings II and I of the relay Mc, wiper dc, conductor dc (Fig. 5), wiper m16 on contact 2, wiper d62 on contact 2, contact 60p12. In this case the connecting device Ue12 seized by the group selector GW to which the free C-line is connected is connected over the selector Wc. The relay Mc by opening contact 57mc prevents further operation of the rotary magnet Dc. Relay NC is connected to the wiper c of the selector Wc over contact 61mc so that the relay is energised over: C-line, windings II and I of the relay Nc, contact 61mc, wiper c of the selector Wc, relay R, contact 78r, wiper e2 of the connecting selector AW2, conductor 5 (Fig. 4) winding I of the relay R1, contacts 79p12, 80c1, earth. In this circuit the relays R and R1 are also energised. Conductor 5 is disconnected by the opening of the contact 78r. The holding circuit for the relays Nc and R is now extended over the contacts 73r, 71a and 6c, while relay R1 (Fig. 4) is connected in a holding circuit over its winding II and the contact 82r1. By the closing of the contact 64nc the connecting device Ue12 now connected to the selector Wc is locked, while by the closing of the contacts 62nc and 63nc the speaking conductors are switched through. By closing the contact 65nc the relay Vc is energised so that the relay Mc is also held energised over its winding III and the contact 68vc. When relay Vc is energised the seized C-line is disconnected from the conductor vc by the opening of the contact 54vc and this conductor is switched on to the next free C-line by the closing of the contact 70vc. By the closing of the contacts 83r and 84r the conductors a2 and b2 in the connecting device Ue12 are switched through and by the closing of the contact 85r1 (Fig. 4) impulse transmission is started as will be explained later.

If a free C-line in the marked direction (135) is not available the relay P12 cannot be energised over a corresponding vc-conductor; the wipers d60 to d62 are stepped-on until contact 4 is reached. When relay P10 is energised the testing of the availability of a free B-line, corresponding with the testing (C-line) described above, takes place over the conductor vb. If a free vb conductor is available, the corresponding relay is operated as for the seizing of the free C-line, the selector Wb is set on the connecting device Ue12 and the connecting path is switched through.

If also no B-line is free the wipers d60 to d62 are stepped-on until contact 5 is reached. When relay P10 is energised the relay P12 tests over the conductor va whether a free A-line is available and if this is the case causes the selector Wa to be set on the connecting device Ue12 in a manner corresponding to that described above for the C or B-lines.

If no free A-lines are available the wipers d60—d62 are stepped-on until they reach the contact 6 over which the availability of an S-line is tested. If a free S-line is available the selector Ws is correspondingly set on the connecting device Ue12 over the conductor vs and is set according to the conductor ds marked.

It is understood that over the wipers d61 and m51 the different groups of lines are tested to see if they are free so that over the correspond-

ing v-conductor (vc, vb, va, vs) a corresponding selector (Wc, Wb, Wa, Ws) is started. Over the wipers d62 and m12 to m17 the d-conductor (dc, db, da, ds) is marked corresponding to the connecting device on which the corresponding selector must test. As soon as this occurs the relays R and R1 are energised as shown. The test circuits for the relays P10 and P12 are broken at the contacts 87r1 and 88r1. Moreover, the transmission of the impulses by the code repeater (KZ1) may begin. According to the path (C, B, A, S) over which a connection is to be developed the marking number 135 is completely or partly absorbed or completely transmitted.

If for example a C-line is seized the complete marking number 135 is absorbed; only the 4th number which sets the wiper d40 is transmitted. As described above the relay P11 is energised after a C-line is determined; it holds itself energised further over the contact 89p11. By closing the contact 91p11, a contact is immediately marked in the contact bank traversed by the wiper d50 which corresponds to the setting of the wiper d40 so that the wiper d50 can take up this setting. When this is accomplished the relay P7 is energised over: wiper d50, multiplying, wiper d40, contact 100u1, relay Sp, contacts 91p11, 92p12, 93c2. Further switch operations are described further on.

If, instead of a C-line, a free B-line is seized, relay P13 is energised after this B-line is selected and a holding circuit is completed over the contact 143p13. Over the contact 144p13, contact 5 in the contact bank traversed by the wiper d50 corresponding to the setting of the wiper d30 (3rd dialling of the marking number) is marked so that the wiper d50 takes up this setting and thus, as will be explained later, can transmit 5 impulses. In this case the numbers 1 and 3 are absorbed.

If a free A-line is seized, instead of a B-line the relay P14 is energised and a holding circuit is completed over the contact 146p14. Over the contact 147p14 the wiper d21 is connected so that its setting (on contact 3) is taken up by the wiper s50. In this case only the number 1 of the marking number is absorbed.

If an S-line is seized, the wiper d15 set on the contact 1 is immediately connected since the contacts 151c2 and 150p12 are, as in the above cases, closed. The wiper d50 thereupon takes up the setting of this wiper d15 and no numbers are absorbed.

The actual stepping-on of the wiper d50 when taking up its position for the purpose of impulse transmission takes place by the well-known alternating reciprocal interaction of the relays I and K when the contact 85r1 is closed. The contact 19i transmits the impulses over the conductor 4 and the wiper d2 of the selector AW2 over the connecting device Ue12 while another i-contact operates the magnet, not shown, of the wiper d50.

If it is assumed that an S-line is connected with the connecting device Ue12 over the selector Ws the whole marking number 135 is transmitted as described above. The number 1 is marked by the setting of the wiper d15 on the contact 1, the number 3 by the setting of the wiper d21 on the contact 3 and the number 5 by the setting of the wiper d30 on the contact 5. Since now only the relay P12 is energised and not the relays P11, P13 and P14 only the wiper d15 is connected; by being set on the contact 1 in the contact bank traversed by the wiper d50 it marks the contact

1 so that after taking one step the wiper *d50* connected for transmitting an impulse, is stopped since the relay *P7* is energised and the relay *I* is disconnected at contact *157p1*. The wiper *d50* is thereupon returned to its resting position by an interrupter (not shown). Relay *P14* is energised over its winding *II* in series with the relay *P7* so that the wiper *d15* is disconnected at contact *153p14* and over contact *147p14* the wiper *d21* is connected. In the meantime relay *P7* restores so that the next impulse transmission takes place with the wiper *d50* again being stepped-on from its rest position. According to the setting of the wiper *d21* on contact *3*, three impulses are transmitted since the relay *P7* is energised after wiper *d50* is set on contact *3* over: wiper *d50* on contact *3*, wiper *d21* on contact *3*, contact *32u1*, winding *II* of the relay *P13*, contacts *147p14*, *148p13*, *149p11*, *150p12*, *151c2*. The relay *P13* is energised in this circuit in series with the relay *P7* and disconnects the wiper *d21* and connects the wiper *d30*. The wiper *d50* is, in the meantime, again restored to its rest position. By the third impulse train which is transmitted, as before, over the contact *19i* the wiper *d50* is stepped for the third time until the contact *5* marked by the wiper *d30* is reached. The relay *P7* is now energised in series with the relay *P11* over: wiper *d50* on contact *5*, wiper *d30* on contact *5*, contact *145u1*, winding *II* of the relay *P11*, contacts *144p13*, *99p11*, *92p12*, *93c2*. The wiper *d30* is disconnected and the wiper *d40* is connected. The 4th impulse series is then undertaken by a further operation of the wiper *d50* according to the setting of the wiper *d40*. When the corresponding contact is reached the relay *P7* is energised in series with the relay *Sp*. The contacts *16sp* and *161sp* give rise to the disconnection of the code repeater *KZ1*. In the connecting device *Ue12* relay *P* is de-energised, (Fig. 2) and the *a*-conductor is switched through to the conductor *a2* over the contact *10p*; the calling subscriber receives a signal from the exchange and dials the additional numbers required for reaching the required subscriber.

The switch operations described above occur if, before the code repeater *KZ1* is seized, a single number (1) of the marking number (135) is sent out. If, for example, for setting up a connection within the same toll area (BA7) two numbers have already been selected—cf. Fig. 1, in which for reaching the main network *73* before a connecting device is seized the selectors *GW* and *GW1* are already set—the direction to be used is only developed by the use of a code repeater if the second number marks a different rural main exchange such as is the case, if in the present instance the number *73* is selected. These numbers selected before the code repeater is seized have to be reproduced subsequently. For this purpose a wiper *d13* is provided together with a relay *P5*. The contact bank traversed by the wiper *d13* is so multiplied with the contact bank traversed by the wiper *m11* that the relay *P5* is energised after the wiper has taken the number of steps which correspond to the second number (3) which is to be reproduced. The relay *P5* switches in the relays *U1*, *U2* over its contact *27p5* whereupon the relay *Q2* is energised over the contact *28u2*. The wipers *m20* to *m26* and *m30* to *m36*, stepped-on after relay *P5* is energised, stop when contact *71* is reached since then the relays *P8* and *P9* are momentarily energised over: wiper *m20* or *m30*, contacts *71*, *159p5*, *158u2*, *157u3*, *155c2*. The relay *U3* is energised,

however, so that the circuit described is broken at the contact *157u3*. The wipers *m20*—*m26* and *m30*—*m36* are operated until the contact *73* is reached, since this contact is marked by the wiper *d12* set by the wiper *d13*. The relays *P8* and *P9* are again energised. If, later, the numbers to be sent out by the wiper *d50* are determined the first number (7) is so formed that the relay *P7* is again energised after 7 steps by the switch over: wiper *d50* on contact *7*, contacts *25p5*, *30u1*, winding *II* of the relay *P14*, contacts *153p14*, *152p13*, *149p11*, *150p12*, *151c2*. In this circuit relay *P14* is also energised and completes a holding circuit for itself over contact *146p14*. When the wiper *d50* is operated a second time the relay *P7* is then energised in series with the relay *P13* over: the wiper *d50* on contact *3*, wiper *d15*, contact *31u1*, winding *II* of the relay *P13*, contacts *147p14*, *148p13*, *149p11*, *150p12*, *151c2*. Thus three impulses are transmitted, the two numbers already transmitted by the calling subscriber before the code repeater was seized are reproduced and are transmitted by the code repeater over an S-line. When using other lines the appropriate impulse series are suppressed.

Corresponding operations occur if a service call is to be made, for marking which, for example, the numbers 04 are dialled. In this case the relay *P6* is operated over the wiper *d14* the relays *U1*, *U2* and *Q2* are energised. The wipers *m20* to *m26* and *m30* to *m36* are first set on the contact *01* and then contact *04*. When the first number is transmitted the relay *P7* is energised over the contact *34p6* in series with the relay *P14* while the next number is transmitted in manner corresponding to that previously described. When using other lines a part of the impulse transmission is suppressed.

It should be noticed that for transmitting all the numbers of the marked number by means of the wiper *d50* if two numbers are to be reproduced afterwards, the first number is transmitted according to the direct marking over the contacts *25p5* or *34p6* the second number according to the setting of the wiper *d15*, the third according to the setting of wiper *d21* and so on, while for reproducing a number all numbers of the marking number are transmitted by the aid of the wiper *d50* so that the wiper *d15* determines the first number, *d21* the second, *d30* the third and so on.

We claim:

1. In a telephone system, a multi-exchange network, two groups of connecting devices in one of said exchanges, numerical switching apparatus in said one exchange operable to select either of said groups of devices at will and effective thereupon to seize one of the devices in the selected group, a code repeater common to all of said devices and having a plurality of contacts each corresponding to a different one of said devices, means operated upon the seizure of said device by said apparatus to mark the one of said contacts corresponding to the seized device, means in said repeater controlled by the marked contact for determining the one of said devices seized and, at the same time, registering a code depending upon the one of said groups selected, other means in said repeater operated variably to register a code indicative of any other exchange in said network, a direct and an indirect route over which connections may be established between said one exchange and said other exchange, both of said routes accessible to the seized connecting device, said repeater controlled by said registered codes to select one of said routes and to control the ex-

tension of a connection thereover from the seized connecting device to said other exchange.

2. In a telephone system, a multi-exchange network having alternative routes for setting up connections between exchanges, a repeater in a local one of said exchanges for controlling the extension of connections to the distant exchanges in said network, two groups of connecting devices in said local exchange, means operated to seize a device in one of said groups when it is desired to extend a connection to certain of said distant exchanges and to seize a device in the other of said groups when it is desired to extend a connection to other distant exchanges, means responsive to the seizure of any of said devices for identifying the seized device in said repeater and, at the same time, registering therein the identity of the group to which the seized device belongs, other means in said repeater operated to register the identity of the exchange to which it is desired to extend a connection, said repeater effective to select a route over which to extend the connection to said desired exchange and at times, in dependence upon the route selected, to repeat all or part of said registered information to control switching apparatus to set up the connection over the selected route.

3. A telephone system as claimed in claim 2, wherein said registration of the identity of the group to which said seized device belongs controls the selection, by said repeater, of the route over which said connection to the desired exchange shall be extended.

4. In a telephone system, wherein connections are set up by automatic equipment under control of the digits of the called station's number, two connecting devices, means for seizing one of said devices at times responsive to the receipt of a certain order of digit of the called station's number and for seizing the other of said devices at times responsive to the receipt of a different order of digit of the called station's number, a controller common to said devices, means for seizing said controller responsive to the seizure of either of said devices and for automatically registering therein the digit which caused that device to be seized, said controller thereafter effective to control said automatic equipment in accordance with said registered digit to extend a connection from the seized device.

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