

Aug. 19, 1941.

F. LUBBERGER

2,252,856

TELEPHONE SYSTEM

Filed Feb. 17, 1939

17 Sheets-Sheet 1

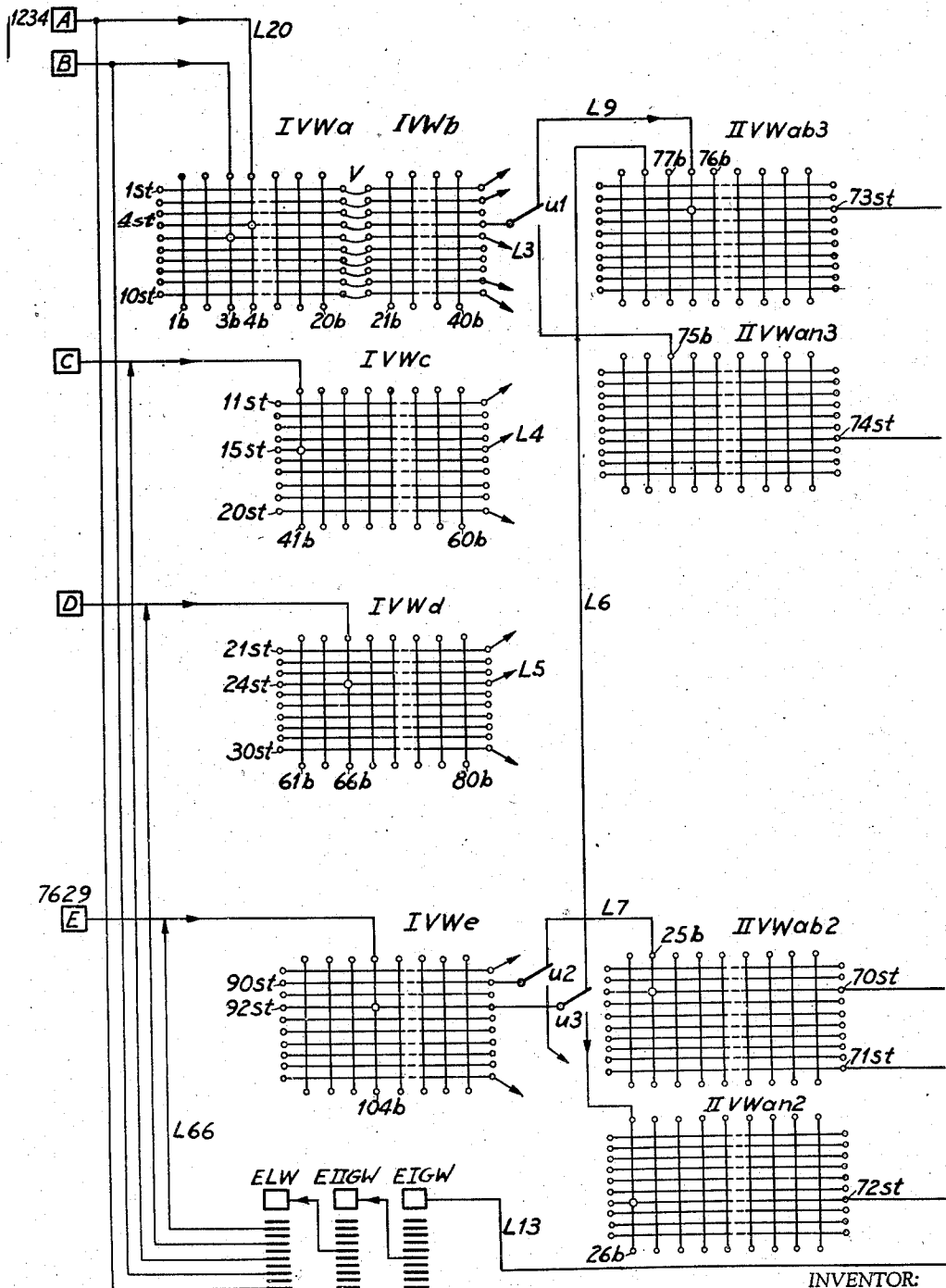


FIG. 1

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Aug. 19, 1941.

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17 Sheets-Sheet 2

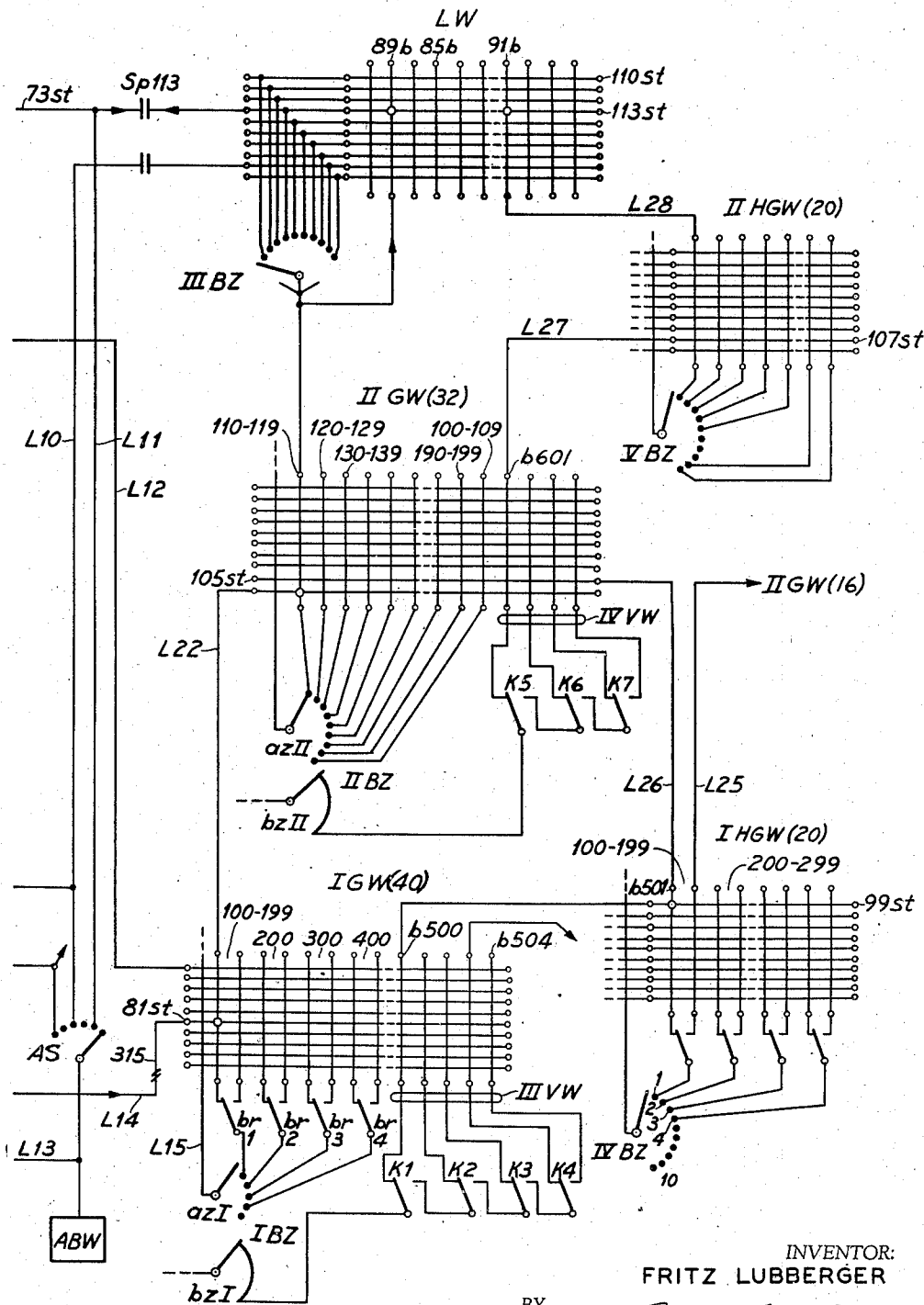


FIG. 2

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INVENTOR:
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2,252,856

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Filed Feb. 17, 1939

17 Sheets-Sheet 3

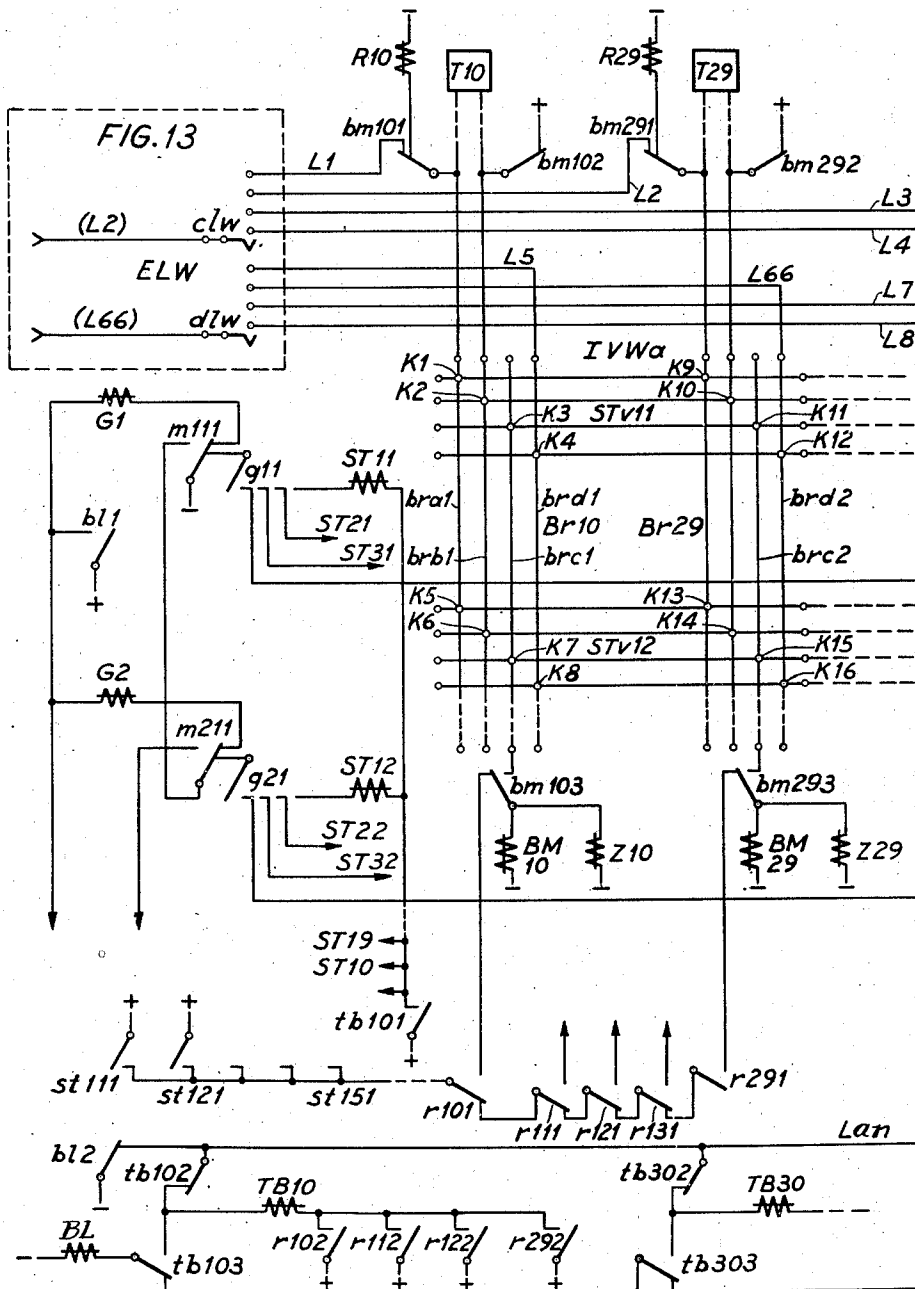


FIG. 3

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2,252,856

TELEPHONE SYSTEM

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17 Sheets-Sheet 4

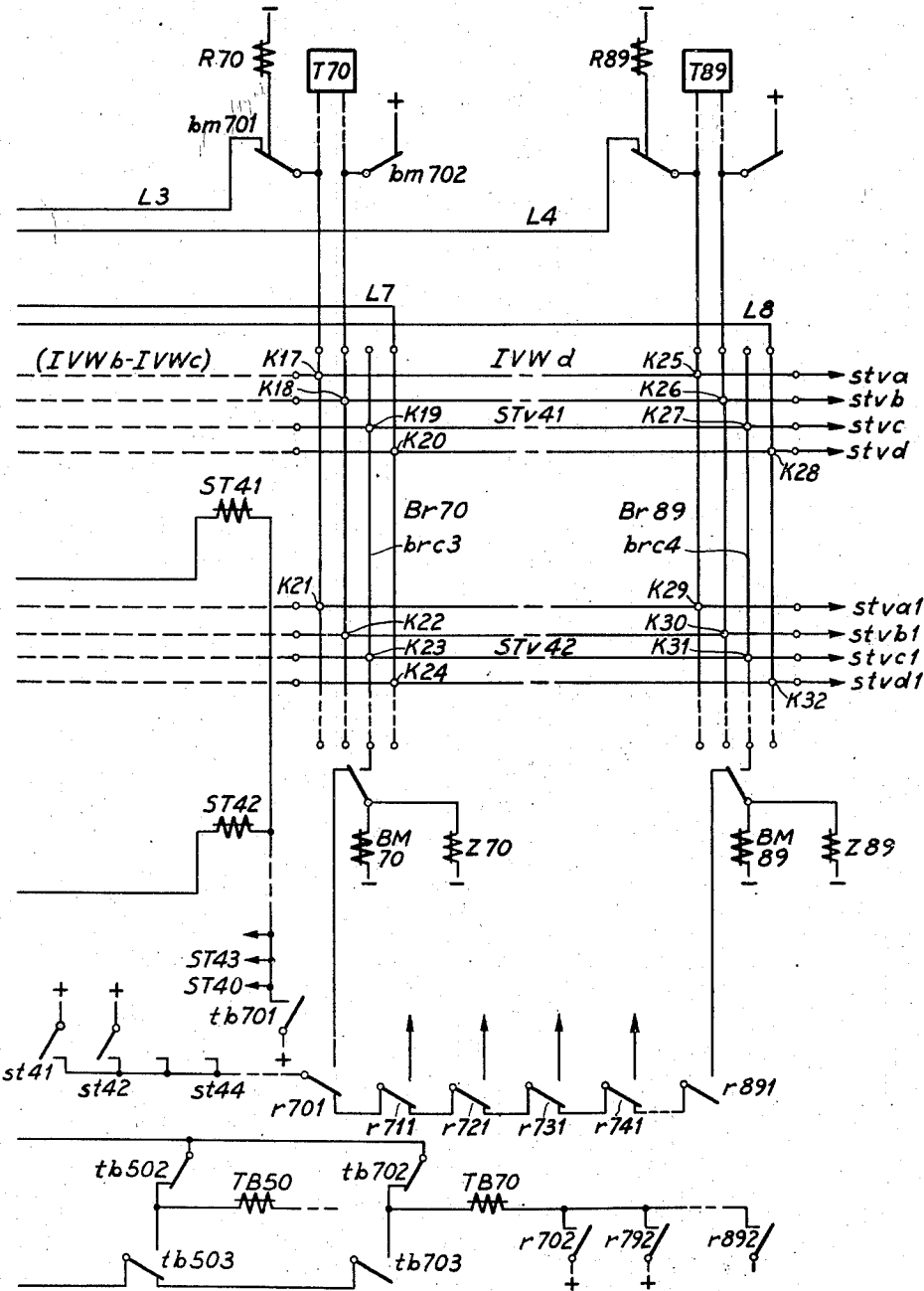


FIG. 4

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2,252,856

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17 Sheets-Sheet 5

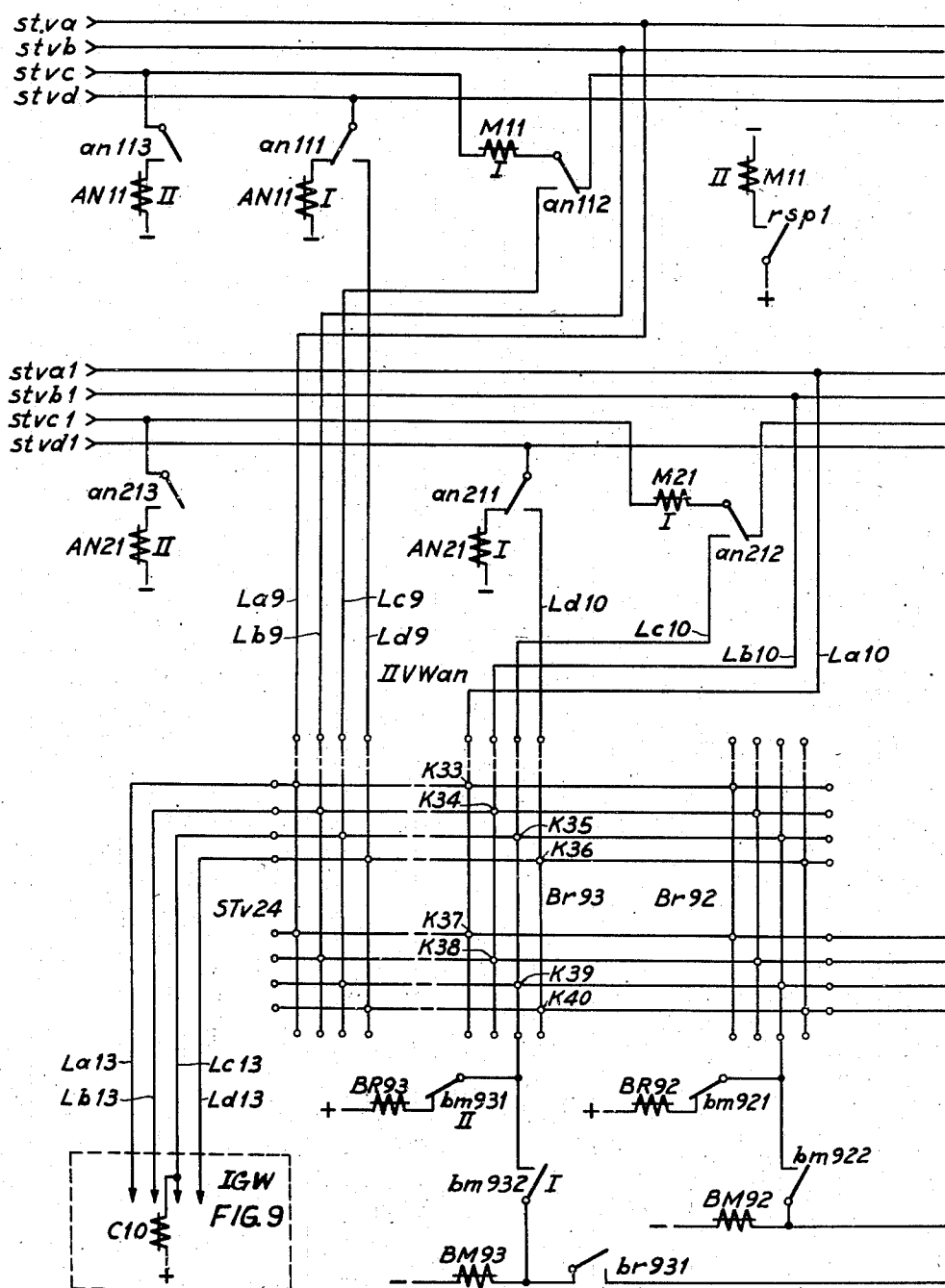


FIG. 5

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2,252,856

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Filed Feb. 17, 1939

17 Sheets-Sheet 6

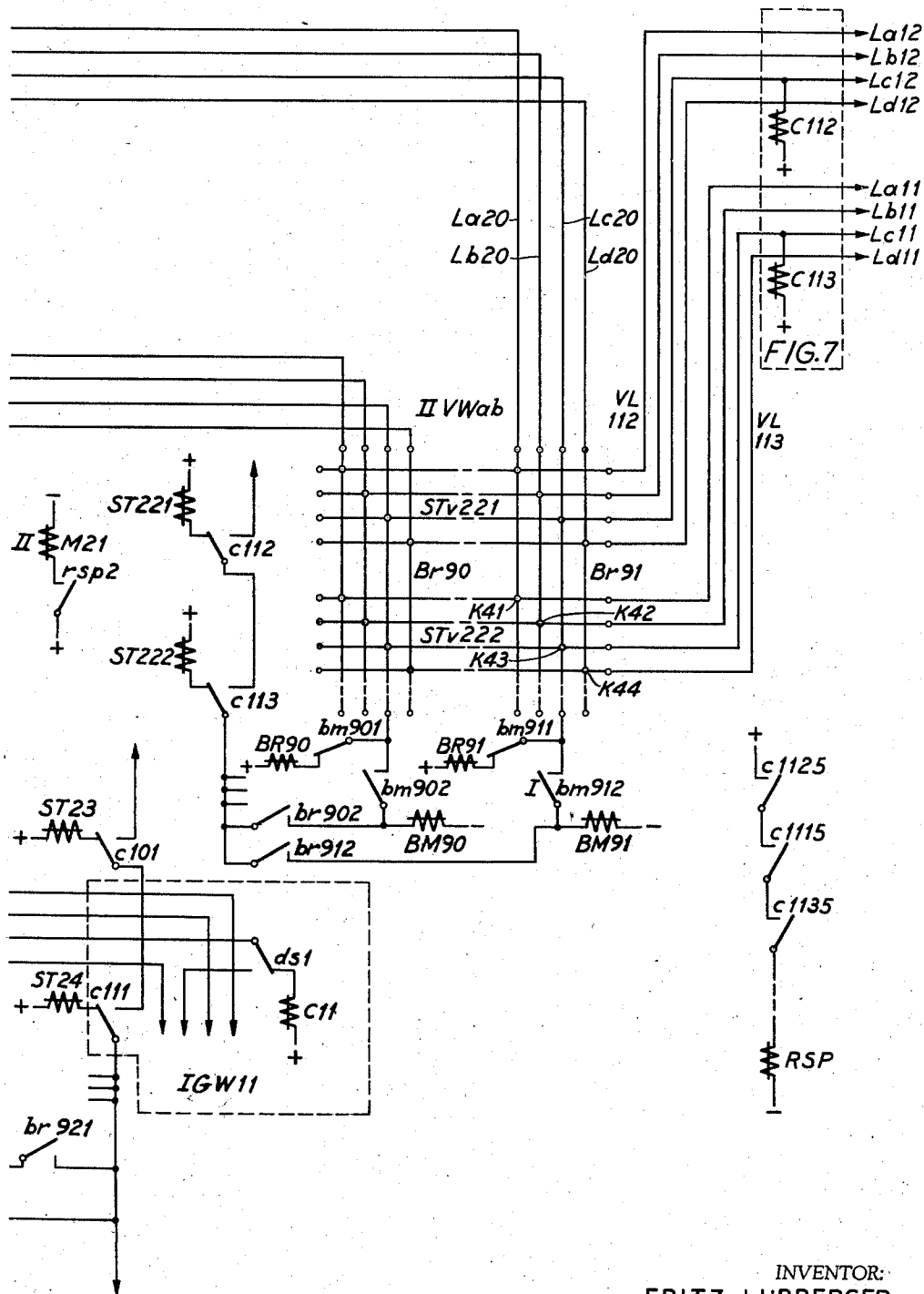


FIG. 6

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INVENTOR:
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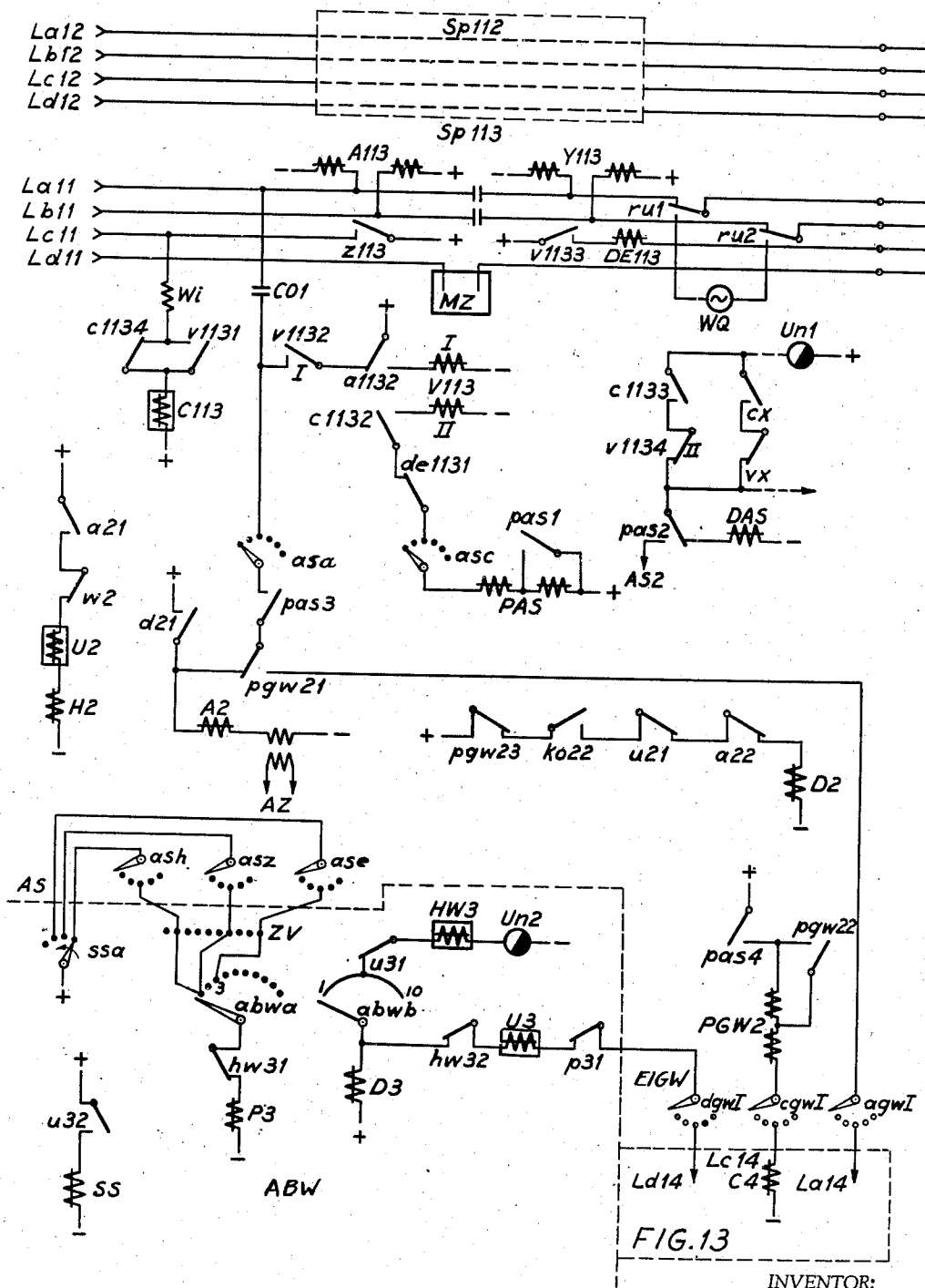
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17 Sheets-Sheet 7



INVENTOR:
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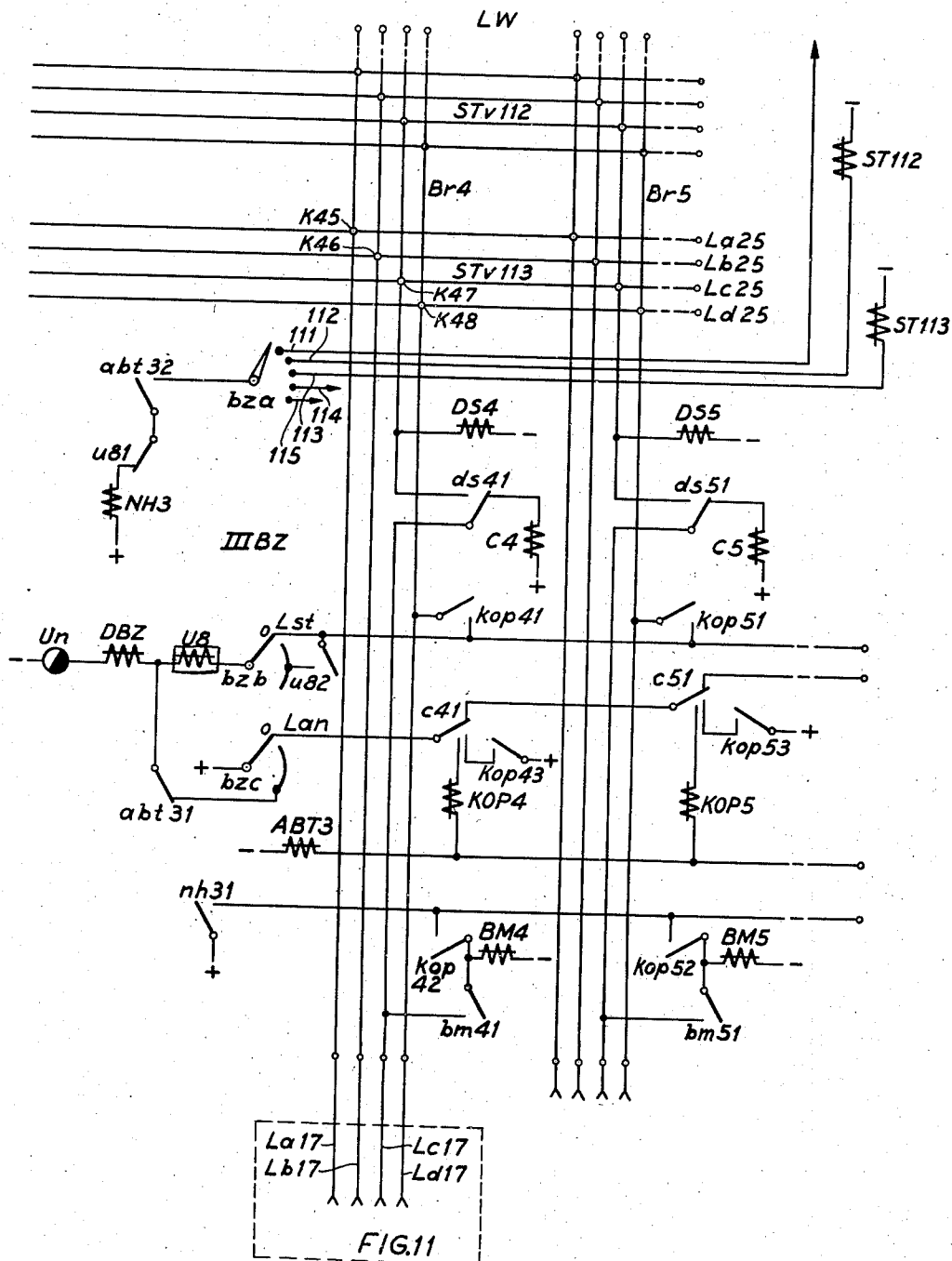
F. LUBBERGER

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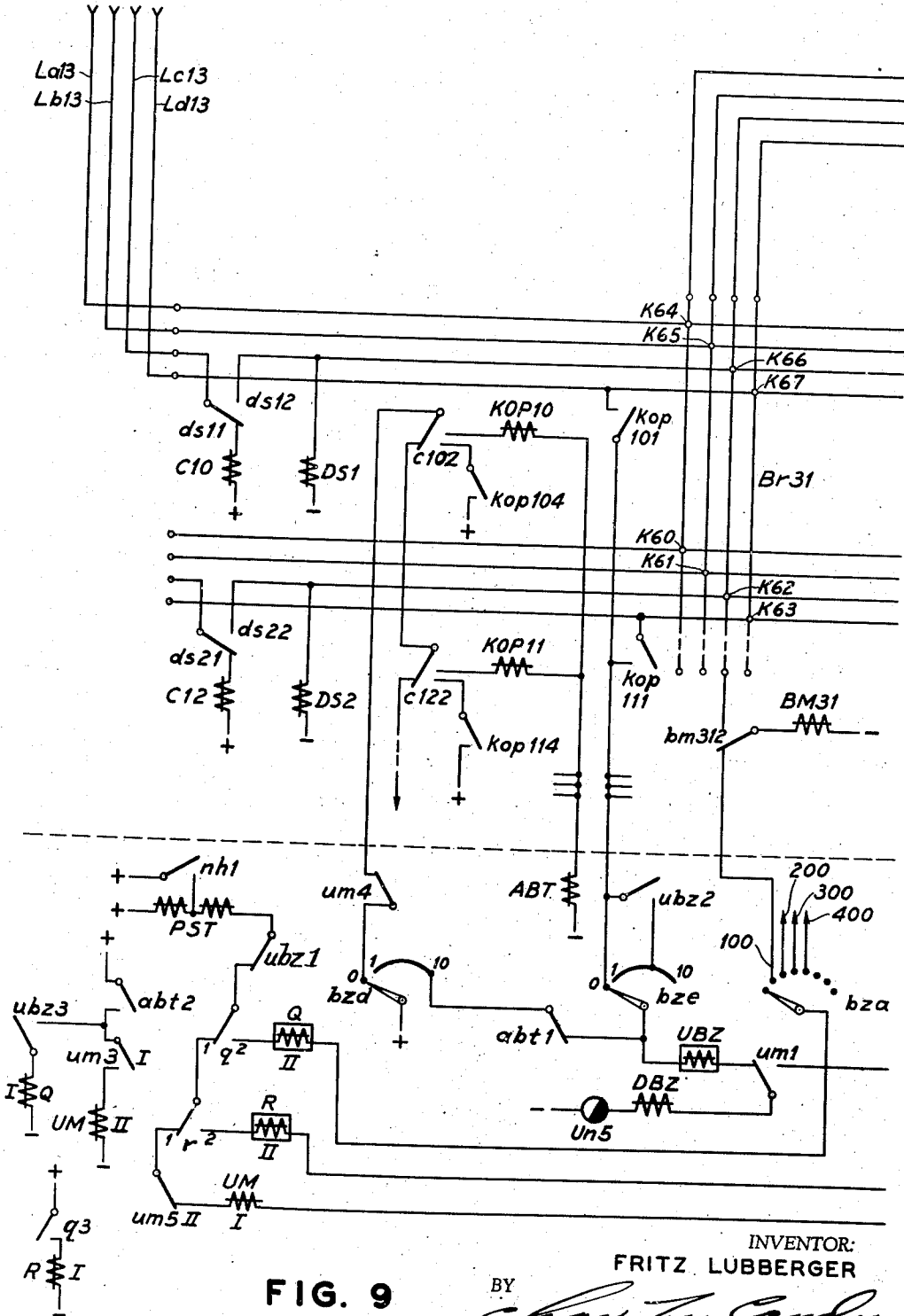


FIG. 9

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17 Sheets-Sheet 10

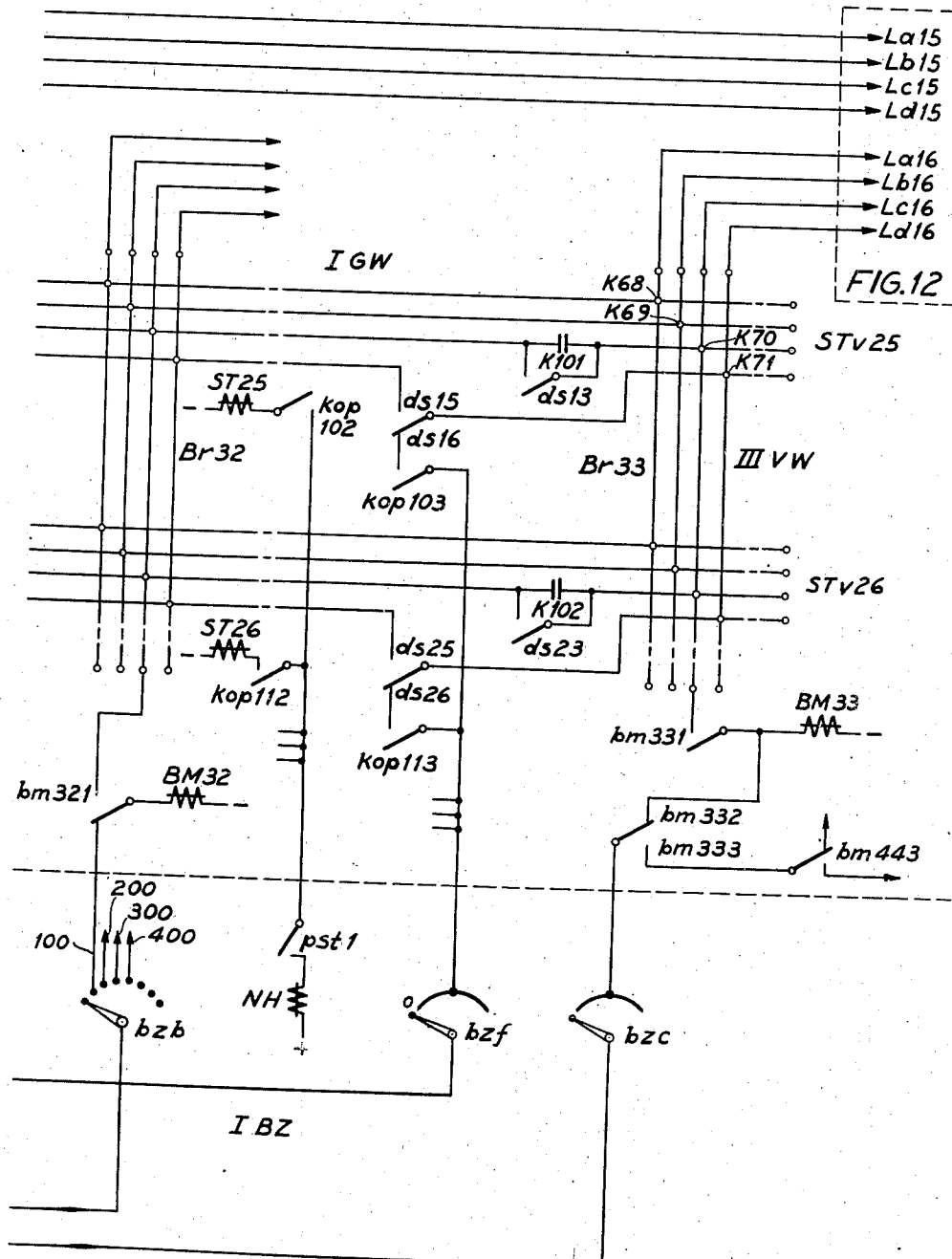


FIG. 10

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Filed Feb. 17, 1939

17 Sheets-Sheet 11

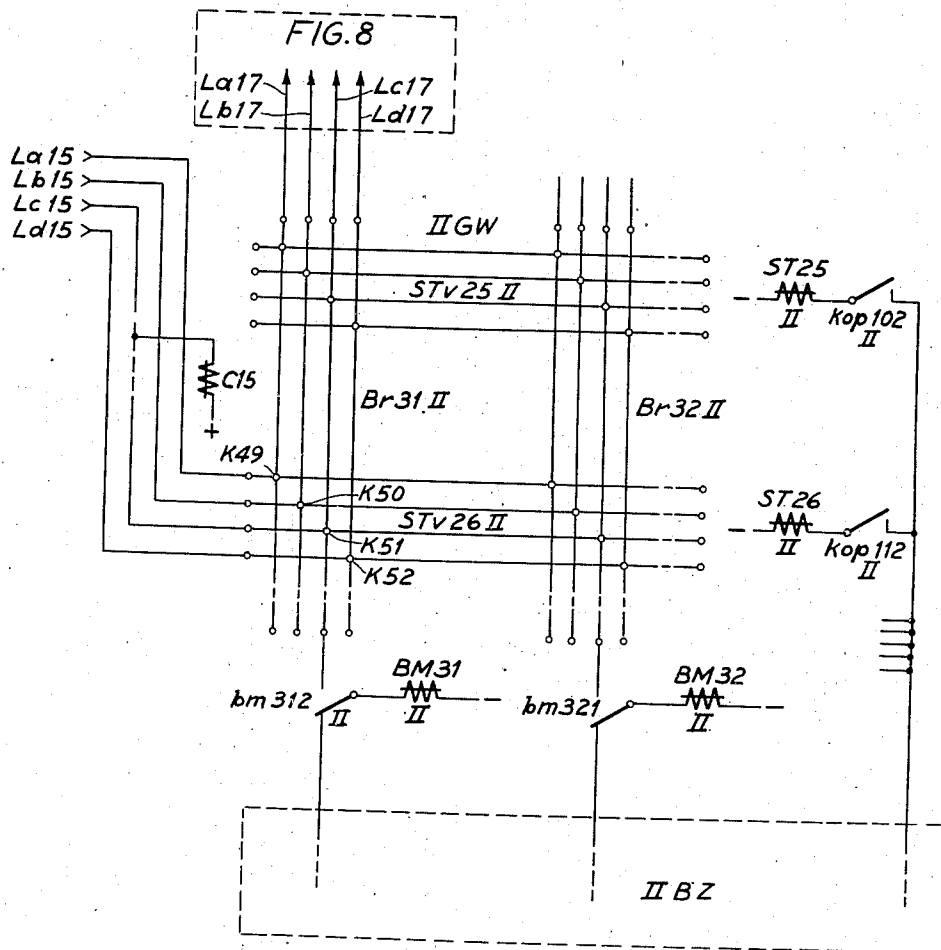


FIG. II

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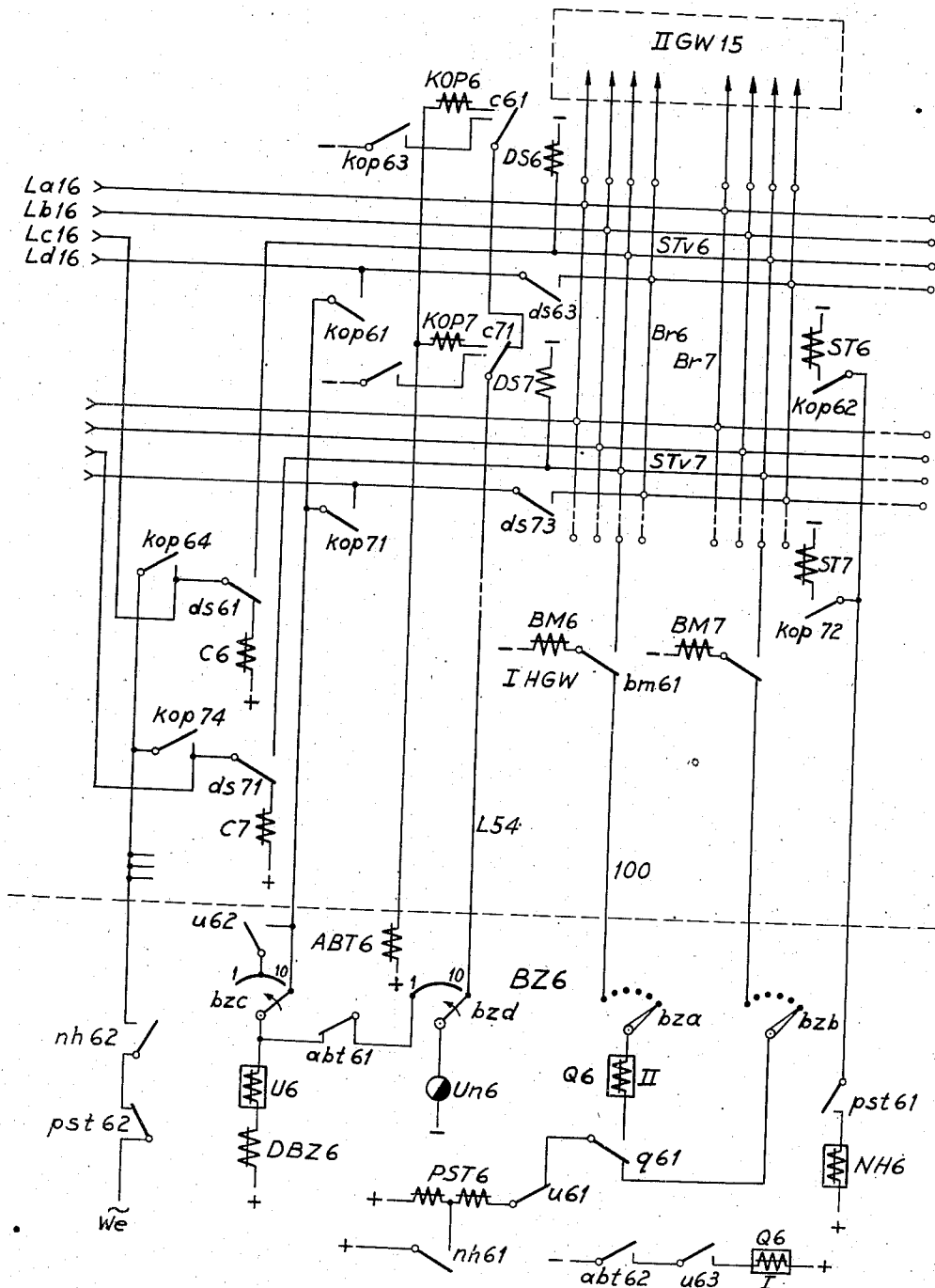
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TELEPHONE SYSTEM

Filed Feb. 17, 1939

17 Sheets-Sheet 12



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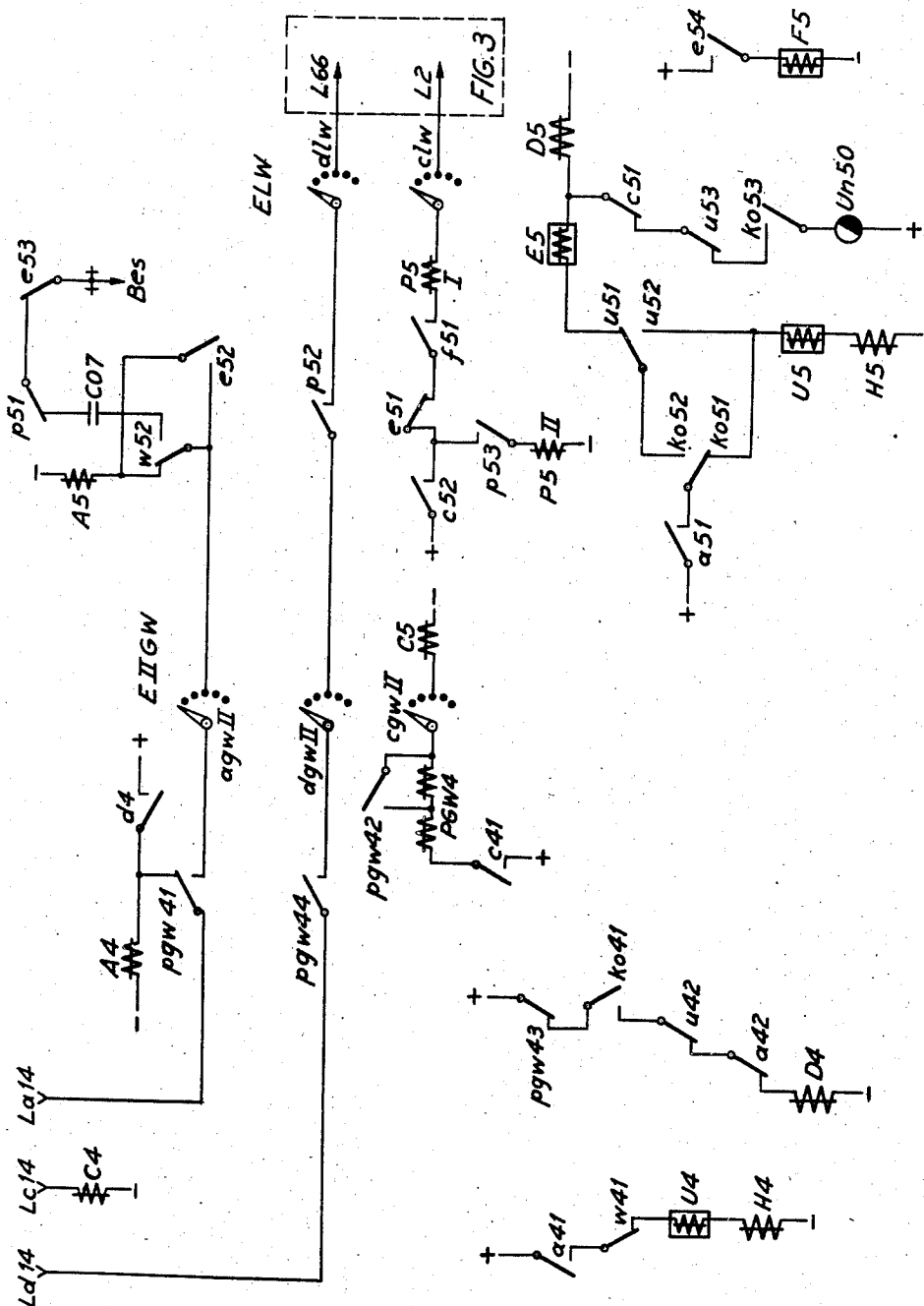
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TELEPHONE SYSTEM

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2,252,856



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TELEPHONE SYSTEM

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17 Sheets-Sheet 14

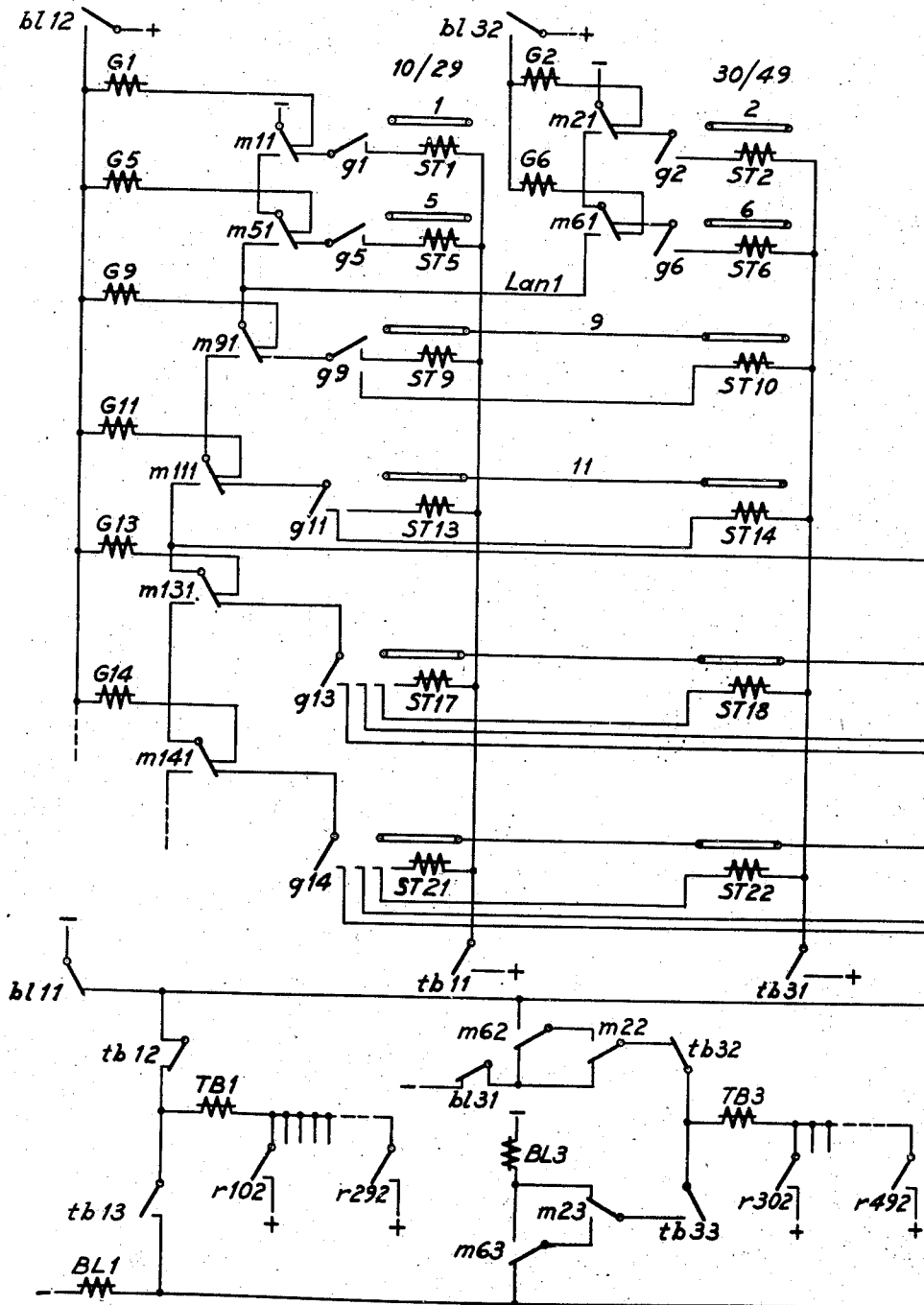


FIG. 14

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TELEPHONE SYSTEM

Filed Feb. 17, 1939

17 Sheets-Sheet 15

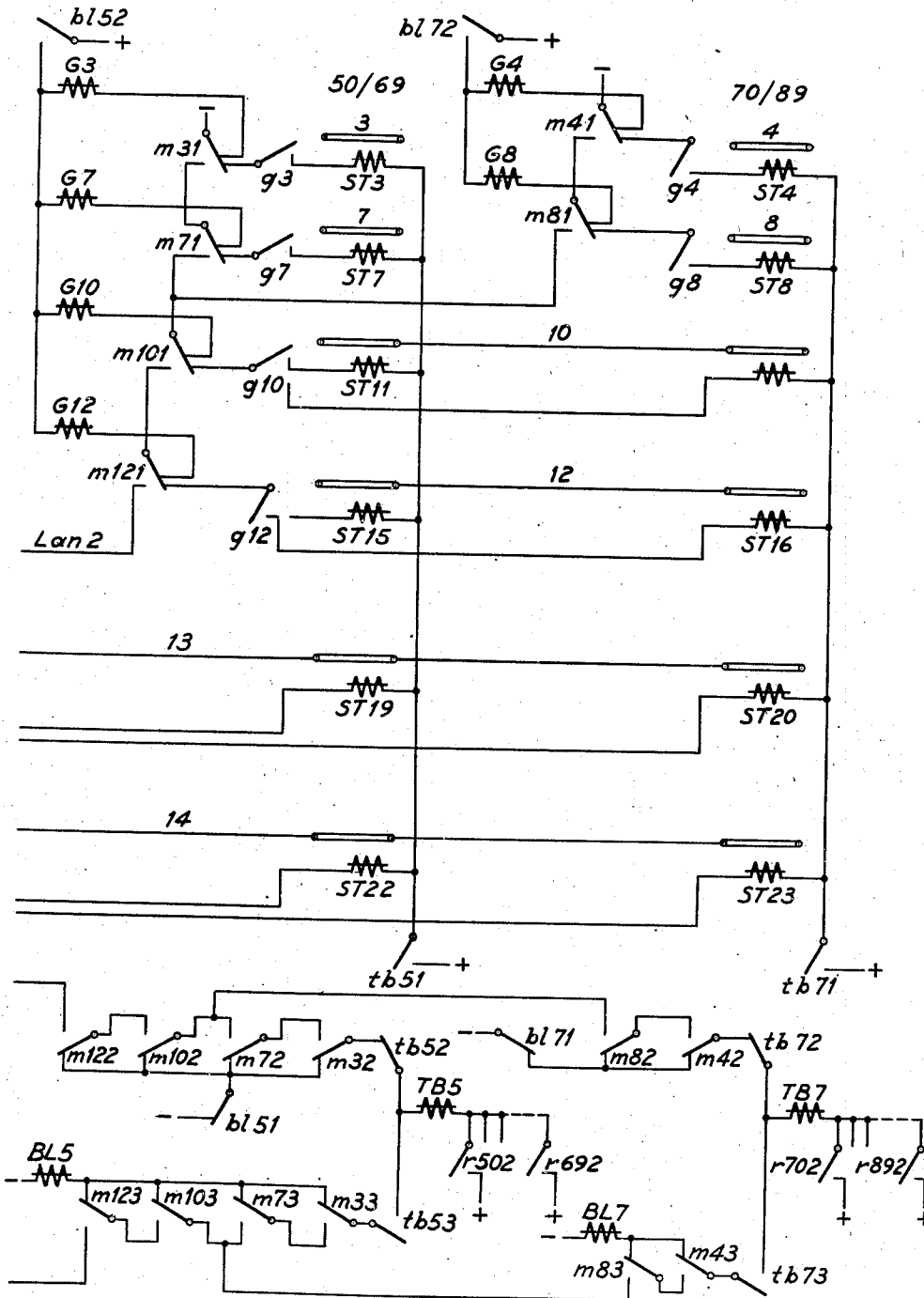


FIG. 15

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Filed Feb. 17, 1939

17 Sheets-Sheet 16

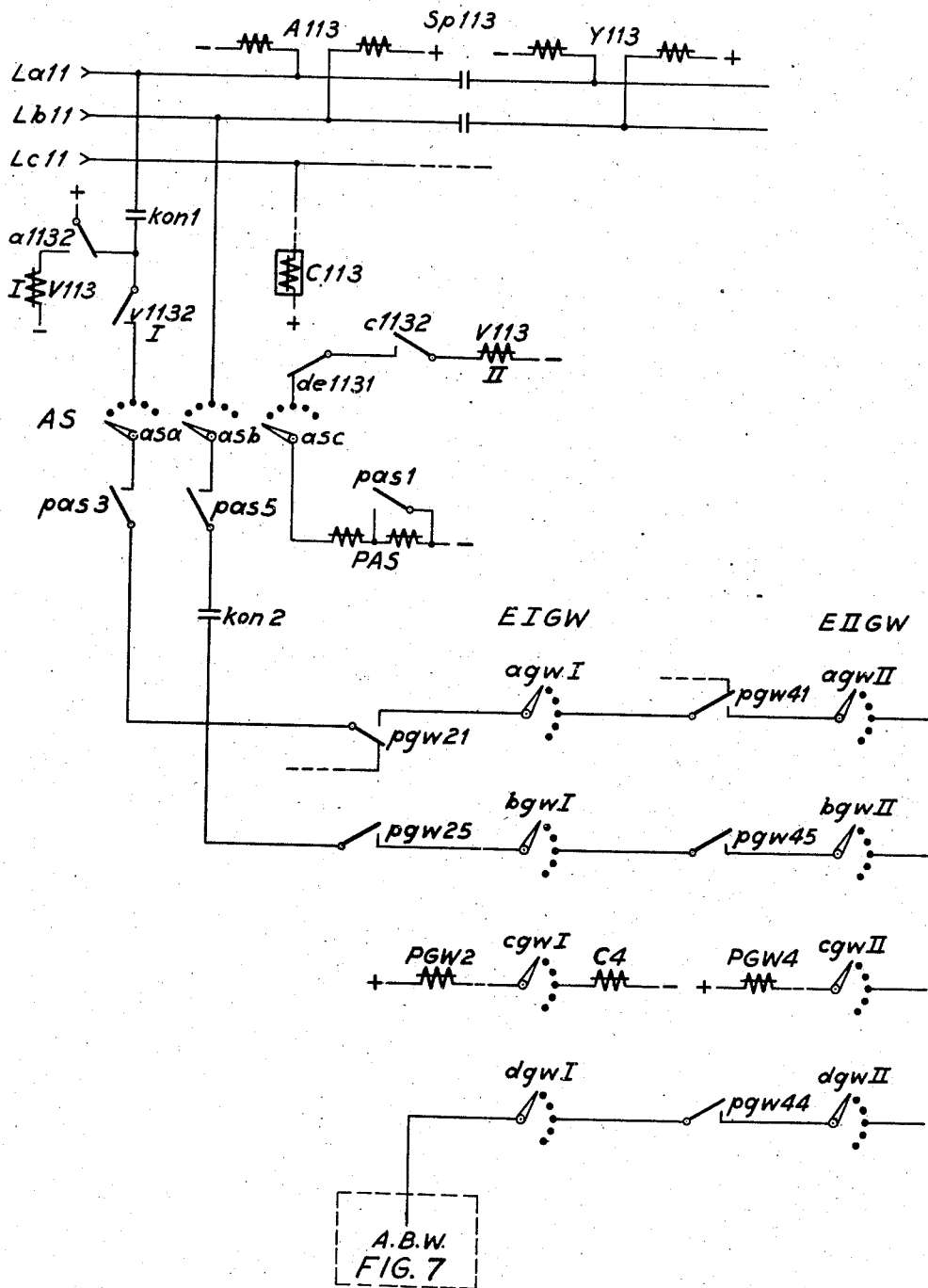


FIG. 16

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2,252,856

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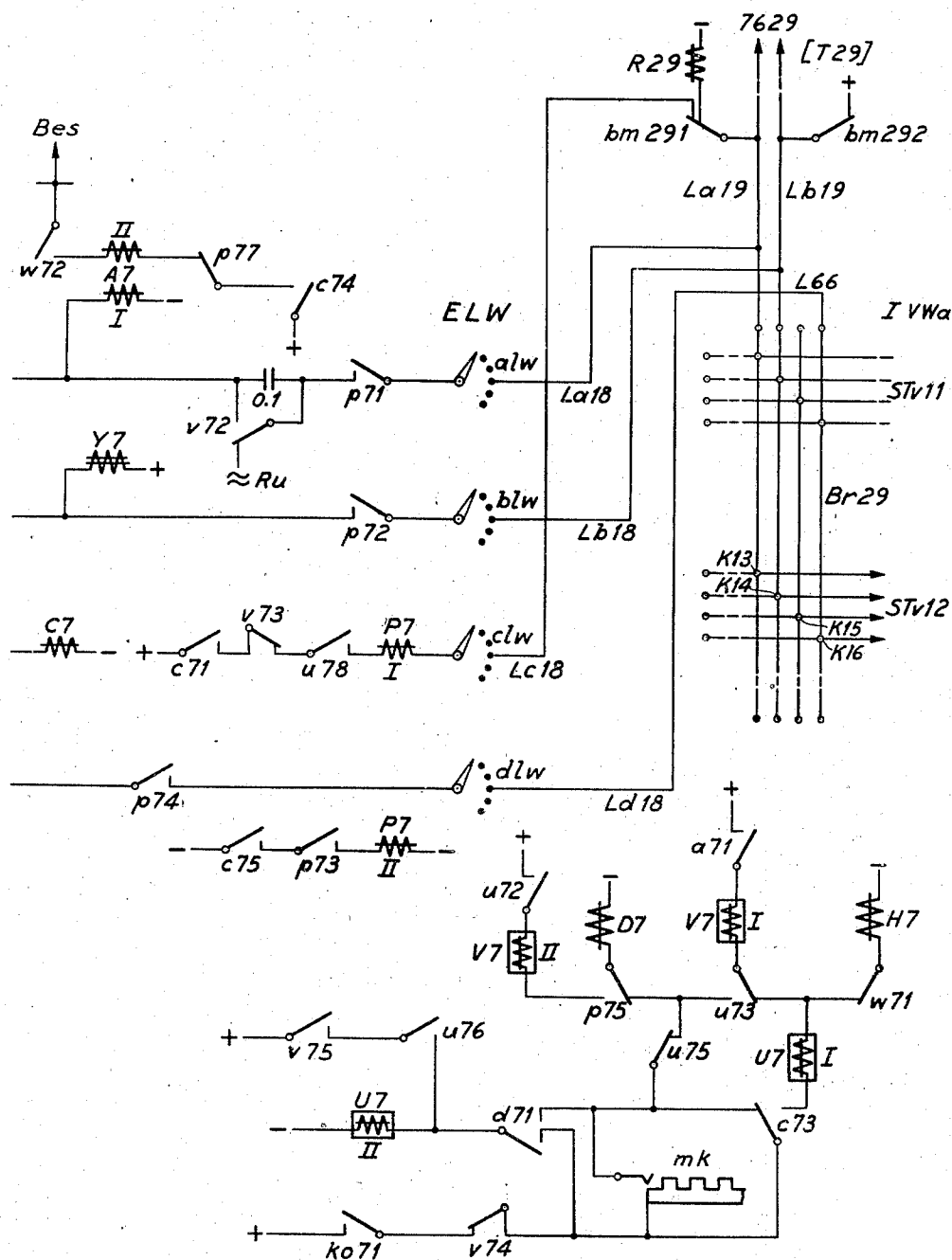


FIG. 17

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UNITED STATES PATENT OFFICE

2,252,856

TELEPHONE SYSTEM

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Application February 17, 1939, Serial No. 256,979
In Germany February 18, 1938

18 Claims. (Cl. 179-18)

The present invention relates to a system having separate setting and talking paths in which in spite of reduction in expense on switch means a considerable number of alternative connecting paths are available and the number of possible simultaneous conversations is large. Further, the system can deal with a very large number of simultaneous conversations without requiring the provision of complex switching devices for this purpose.

According to the invention large-group selectors are provided having several access means each arranged common to the outgoing lines over which the normal speech traffic is extended thus using a simple method whereby several conversations can extend over this selector at the same time. The talking path selectors are arranged to be co-ordinate selectors such as are described for example, in the book entitled "Die Fernsprechanlagen mit Wählerbetrieb (Automatische Telephonie)" by Lubberger, published by R. Oldenbourg of Munich and Berlin, 1935 edition, Figs. 43 and 121. Instead of these co-ordinate selectors other selectors can of course be used which in their construction permit of the provision of a number of incoming and outgoing lines for one selector the incoming lines having access to all outgoing lines, and in which in the case of an existing connection between an incoming line and an outgoing line other incoming lines of the same selector can still be connected with outgoing lines selectively or by impulse selection.

The principal feature of the invention lies in the fact that two circuit arrangements are provided which operate together. The setting path of one arrangement impulses the desired junction line on the reception of impulse trains sent out from the calling station and the setting path of the second circuit arrangement seizes a talking path selector, in the impulse selecting section of the talking path to be completed, which is arranged to have a plurality of incoming lines and a plurality of outgoing lines accessible to these incoming lines. The second circuit arrangement also undertakes the switching through of a seized incoming line to an outgoing line of the selector in the direction necessary to set up the talking path between the calling station and the required station which has been obtained by means of impulses.

By providing the setting path for receiving the subscriber's number in order to select the desired station, special storage means to store the im-

pulse trains sent out from the calling station are dispensed with. By the provision of individual paths for by-passing each large-group selector of the talking path it is possible to use the talking selector for several connections in a simple manner since each individual setting path after the setting up of a connection between an outgoing line and an incoming line of the talking selector is ready for setting up a further connection over other incoming and outgoing lines of the same talking selector. These setting paths can be arranged to be very simple as in the present arrangement, since by dispensing with the storage of subscribers' numbers special impulse and preparing circuits extending from the storage device for each selecting stage of the talking or setting path need not be provided.

A further feature of the invention consists in the provision of numbered and unnumbered outgoing lines in connection with the large-group selectors in the group selecting section of the talking path. Free un-numbered outgoing lines are pre-arranged to be made available to the incoming lines to the selector when required numbered outgoing lines are engaged. These un-numbered outgoing lines are at the disposal of an incoming line to a selector when one or all of the various numbered outgoing lines are engaged.

The operating periods of the individual selectors by-passing the individual talking selectors are independent of the impulse transmission from the calling station insofar as their time sequences are concerned, since they are automatically set, corresponding to the marking of a general station serving to set up the talking connection at which the setting and talking paths separate.

In the embodiment described co-ordinate selectors of the kind shown in Fig. 43 of the previously mentioned book by Lubberger are used as the talking selectors. These selectors have a plurality of horizontal bare wire multiples and a plurality of vertical bare wire multiples which hereinafter will be referred to respectively as rod and bridge multiples. The rod multiples are controlled by rod magnets and the bridge multiples by bridge magnets, so that any rod multiple may be connected to any bridge multiple where the two cross by operating the rod magnet corresponding to that rod multiple and, at the same time, operating the bridge magnet corresponding to that bridge multiple. The selector itself can have 10 to 20 bridge multiples and a corresponding number of bridge magnets

since each bridge multiple has one bridge magnet. In the accompanying drawings the bridge multiples are indicated by vertical lines. The number of bridge multiples can be determined corresponding to the amount of traffic over the section in which the selector is used. Each of the bridge multiples is served by associated bridge magnets with a bridge by whose operation as many spring contacts of the bridge multiples are prepared and operated as there are rod multiples in the selector. The rod multiples of the selector are indicated by horizontal lines in the accompanying drawings. Each selector is provided with 10 rod multiples which are controlled by 5 rods with the aid of 10 rod magnets. Each rod is turned to one or the other side by one of two rod magnets so that by each rod up to 20 different multiples are prepared for use, corresponding to the number of bridges. Since each of the vertical bridges and each of the horizontal rods of the selector can be operated separate, it is possible to extend several connections over such a selector at the same time, and actually when there are 10 horizontal multiples and 10 vertical multiples, 10 connections can be set up at the same time. If a selector has 20 associated bridges then 10 incoming lines to the horizontal multiple field of the selector can be connected with 10 outgoing lines on the bridge multiples of the selector so that each rod multiple has a selection of 20 lines. The connection of the incoming and outgoing lines can take place in such a manner that the incoming lines are connected to the bridge multiple and the outgoing lines are connected to the rod multiples.

When the selector is taken into use a rod controlling a rod multiple is first turned and then a bridge magnet is energised. In this way the spring contacts at the intersection of the corresponding rods and bridges are operated and remain operated after the rod has been rotated back.

The present invention accordingly concerns the circuits for operating particular rod and bridge magnets.

Figs. 1 and 2 show a trunking scheme for the setting up of a particular connection according to the invention.

The remaining figures illustrate more fully the specific circuits outlined in the trunking scheme, as follows:

Figs. 3 and 4 show the subscribers' stations and the first preselectors of the system,

Fig. 5 shows the incoming second preselectors,

Fig. 6 shows the outgoing second preselectors,

Fig. 7 shows a feeding bridge, a seizing switch therefor and a first selector in the setting path,

Fig. 8 shows a final selector in the speaking path and the control switch therefor,

Figs. 9 and 10 show a first selector in the speaking path and the control switch therefor,

Fig. 11 shows a second selector in the speaking path,

Fig. 12 shows an auxiliary group selector in the speaking path and the control switch therefor,

Fig. 13 shows the second selector and final selector in the setting path,

Figs. 14 and 15 show a graded multiple arrangement for the first preselector stage, and

Figs. 16 and 17 show a setting path arranged for inter-exchange traffic.

It is assumed that there are 6000 subscribers or 7000 subscribers' connections and 1000 junction lines from other exchanges. These lines

all terminate at 8000 bridge multiples of the first preselectors.

The grouping of the individual selectors can now be arranged so that each selector is considered as a frame or several selectors together forming a frame. By connecting the rod multiples of the individual selector together, selector frames of up to 100 bridge multiples can be formed. Thus series or parallel circuits for the corresponding rod magnets can be obtained in known manner. If, however, the individual selector frames each comprise 80 bridges (80 subscribers' lines) then 4 preselectors must be arranged in the frame with the rod magnets of these four preselectors connected one with the other. In Fig. 1 such an arrangement of a pre-selector frame is indicated diagrammatically and the preselectors IVWa and IVWb represent two connected selectors of the kind whose rod multiples are connected by jumpers V. Selectors with a large number of bridges can also be connected together. In this case however, the control rods are increased in length since they must then extend over the space taken by 80 bridge multiples.

A connection between the subscriber's set A (No. 1234) and the subscriber's set E (No. 7629) extends as follows: when the subscriber at the set 1234 lifts up his receiver a free rod multiplying which extends over the selectors IVWa, IVWb is first prepared in that the rod magnet for the corresponding rods is energised. In this way a free access is determined extending to the line L9. There follows the energising of the bridge magnets of the subscriber's line L20 of the subscriber 1234. The contact springs of the bridge 4b, indicated in the selector IVWa by means of a small circle are closed. The bridge magnet remains energised so long as the rod magnets are not connected. It is not necessary to energise the rod magnets in both selectors but it suffices only to energise a single rod magnet of the selector IVWa since the calling line is connected to a bridge multiple in this selector. This is however, dependent on the arrangement of the impulse circuit.

The line outgoing from the rod multiple 4st of the selectors IVWa and IVWb has access to the two bridge multiples over contact u1 and actually to a bridge multiple (16b) in the outgoing second preselector IIVab3 and to a bridge multiple (15b) in the incoming second preselector IIVWan3. Since the present case concerns the setting up of an outgoing connection the connection over the contact u1 in its normal position is set up with the bridge 16b of the selector IIVWab3. The connection extends over the rod multiple 13st to the feeding bridge Sp113. The feeding bridge supplies the feeding current for the calling subscriber at the subscriber's station 1234. It has separate condensers and a feeding bridge for the incoming side (subscriber 7629). Further the calling apparatus for the calling subscriber is arranged in the feeding bridge, and the feeding bridge Sp113 also serves as an impulse bridge.

The 8000 bridge multiples of the subscriber are connected to 100 first preselectors or first pre-selector frames each having 10 outgoing lines, i. e. providing 1000 outgoing lines in all. These outgoing lines lead to 1000 outgoing and 1000 incoming bridge multiples in the second preselector. In the second preselector stage 40 incoming and 40 outgoing co-ordinate selectors are provided. Each of these selectors has 25 bridge multiples.

Accordingly since each selector has 10 rod multiples, 400 feeding bridges which are numbered 100, 101 to 499 are connected to the rod multiples of the outgoing second preselector. The rod multiples of the incoming second preselectors lead again to 40 first group selectors which in all have 400 incoming lines. The feeding bridge *Sp113* seized by the connection described is indicated by the number "113."

After the seizing of the feeding bridge the finder switch AS hunts for this and sets on the line L11. This setting of the finder switch is maintained in the switch mechanism ABW not shown in detail. The finder switch AS connects the setting path and consists of a normal up and around selector.

The calling subscriber obtains dial tone from the first group selector of the setting path. This is indicated by EIGW. The calling subscriber now sets the first group selector EIGW, the second group selector EIIGW and the final selector ELW in known manner, by dialling the number 7629 of the required set E in known manner. After setting the final selector ELW the impulsing of the bridge multiple indicated by 104b of the subscriber 7629 connected in the first preselector IVWe takes place. A free rod multiple of the preselector IVWe is prepared, for example the rod multiple which is indicated in Fig. 1 by 92st. The contact *u3* is operated and connects a bridge multiple in an incoming second preselector (IIVWan2). The seized bridge multiple is indicated in Fig. 1 in the preselector IIVWan2 by 26b. A free rod multiple is impulsed, for example rod multiple 72st which over line L14 has access to the rod multiple 81st of the group selector IGW. The number of this multiple, for example 315 is not of essential importance.

The talking path consists of three selector stages IGW, IIGW, LW each of which receive a digit. The 40 incoming second preselectors have access to 400 outgoing lines since each of these has 10 rod multiples, which outgoing lines lead to 400 rod multiples of the first group selectors. The rod multiple used in the described connection is indicated by 315. The system represented requires 40 first group selectors with from 13 to 15 bridge multiples.

In the first group selector the connection to a feeding bridge of the feeding bridge group 100 to 199, namely to the feeding bridge indicated by 113 is to be set up. A marking selector IBZ associated with the group selector IGW rotates after the seizing of the rod multiple *st81* of the group selector IGW. In this way impulses are passed over the setting path back to the seizing mechanism, ABW on the finder switch AS. On the first rotation the seizing switch finds the first digit namely the digit "1" of the feeding bridge characterising digit 113 and thus the marking selector IBZ is held in position 1. The setting 1 of the wiper *az1* of the marking selector IBZ leads to 2 bridge multiples of the group selector IGW which are connected to groups 100 to 199 of the feeding bridges. A connection between these bridges results at the contact *br1*. When the left bridge multiple is free the bridge magnet is operated so that the connection extends over the coupling point of the selector IGW indicated by means of a small circle. In this way the connection is switched through over the line L22 to a rod multiple of the second group selector IIGW. The marking selector IBZ is free to set up another connection. A connection

which is also connected from an incoming second preselector to a rod multiple of the first group selector must only wait until the marking selector IBZ which is associated with the group selector is freed from the previous connection. Since the marking selector after the switching through of the coupling point immediately travels back to its normal position and then is ready for setting up a connection immediately, only a very small waiting period is necessary. The sending out of impulses on the part of the seizing mechanism (ABW) only begins when it is set on a marking selector in its home position.

The arrangement of the second group selector is precisely the same as that of the first group selector. After the seizing of one of the rod multiples the marking selector IIBZ is connected when free and then together with the seizing switch ABW determines the second digit (1) of the number (113) of the feeding bridge *Sp113*. The left bridge multiple of the second group selector (IIGW) is connected to a line indicated by the numbers 110 to 119 over which the connection is extended to a bridge multiple in the final selector whose rod multiples are connected with the feeding bridges indicated by 110 to 119. In the final selector the marking selector (IIBZ) is connected. This in conjunction with the seizing switch ABW determines the third digit "3" of the number of the feeding bridge *Sp113*. The rod magnet of the rod multiple 113st and the bridge magnet of the seized bridge multiple to the bridge 89b are then energised, the selector IIBZ is freed and the rod magnet of the rod multiple 113st is released. The required line 7629 is connected to the feeding bridge *Sp113* seized by the subscriber's line 1234. Current then flows to the subscriber's station 7629 the setting path over the up-and-around selector is released.

Auxiliary group selectors IHGW and IIHGW shown in Fig. 2 are arranged as follows: Each of the 40 first group selectors can serve 10 connections as each of these selectors has 10 rod multiples associated with it. From each group selector of the first group selecting stage however only two paths lead to each 100's group of the feeding bridge as for example, two lines to the feeding group 100 to 199, two lines to the feeding bridging group 200 to 299, etc. In order however to increase the number of these paths assuming that the paths not sufficient to deal with the traffic present and that more than two paths are to be extended to a 100's group of the feeding bridge, each group selector can be provided with further bridge multiples which are not numbered in addition to the eight numbered bridge multiples. These are indicated on the selector IGW in Fig. 2 by 5500 to 5504. In the first group selector, not shown, five sets of unnumbered bridge multiples are included it being understood that there can be more or fewer than these.

When, for example, a third connection is extended to the bridge 100 to 199 the marking selector IBZ first determines that both bridge multiples indicated by 100 to 199 are seized. An impulse is then transmitted over the second arm *bz1* of the indicating selector IBZ to the contacts *k1*, *k2*, *k3*, *k4*. This contact chain is set on the first free bridge multiple of the multiple extension on the selector IGW. This extension field accordingly carries out the function of a third pre-selecting stage. In Fig. 2 this extension field is indicated by IIVW. Over a bridge multiple of this exten-

tion, for example, over the bridge multiple **b500** the incoming line **L14** is then connected with a rod multiple of an auxiliary group selector (**IHW**). When the connection has been switched through to the rod multiple **99st** in the selector **IHW** the connection of the marking selector **IVBZ** takes place. This marking selector takes up the desired number (1) from the marking selector **IBZ**, by the selector **IBZ** stepping on to its normal position and thus transmitting digit impulses to the marking selector **IVBZ**. The selector after 10 steps reaches the marked contact "1." Also from the auxiliary group selector **IHW** two paths proceed to the 100's group of the feeding bridge, actually two paths to the groups **100** to **199**, two paths to the groups **200** to **299** etc. The bridge multiples on the auxiliary group selector **IHW** are extended to the rod multiples of the second group selector provided for setting up of normal connections by which the connections can proceed in the normal manner. The lines outgoing from the auxiliary group selectors can however proceed to by-passing group selectors as, for example, indicated in the case of the line **L25**. When the connection extending from the first group selector **IGW** over the bridge multiple **b500** is connected over the rod multiple **99st** and bridge multiple **b501** is switched through over the line **L26** to the rod multiple **105st** of the second group selector **IIGW** the connection can be extended directly to a final selector if the bridge multiple which is connected to the groups **110** to **119** of the feeding bridge is free. If, however, the bridge multiple in the selector **IIGW** provided for the groups **110** to **119** is already engaged an auxiliary connecting path must be prepared which extends over the auxiliary multiple connections of the group selector **IIGW** which are indicated on the drawings by **IVVW**.

Over the second arm of the marking selector **IIBZ** the chain **k5, k6, k7** is connected when the bridge multiple **100—119** in the selector **IIGW** is engaged and a free bridge multiple is obtained. If the bridge indicated by **b601** is free the connection is extended over the line **L27** to the rod multiple **107st** and an auxiliary group selector **IIHW**. The marking selector **VBZ** is seized and receives the second digit from the marking selector **IIBZ** for marking the required feeding bridge. The selector **IIHW** thus connects the bridge multiple **91b** of the final selector **LW** over line over line **L28**. The marking selector **IIBZ** of the final selector **LW** receives the third necessary impulse train for determining the feeding bridge, from the seizing switch **ABW** and effects the switching through at the rod multiple **113st** of the final selector **LW**. The connection of the called subscriber's set **E** is thus carried out with the aid of the by-passing bridges **IIIVW** and **IVVW** and auxiliary group selectors **IHW** and **IIHW** to the feeding bridge **Sp113**.

With regard to the number of talking selectors used the following remarks are pertinent: Since the co-ordinate selectors in the talking path have 10 rod multiples, when 400 group selectors are provided there are 400 leading-in lines to the first group selecting stage. Each group selector has eight numbered bridge multiples so that the first group selector of the system shown has 320 outgoing numbered bridge multiples. These 320 outgoing lines of the 32 group selector are extended to 32 second group selectors. Further in connection with the rod multiples of each first group selector five auxiliary outgoing connections, for example, are provided (bridge multiples) (**III**, **75**

VW) so that the first group selecting stage has 200 unnumbered outgoing lines in addition to the 320 numbered outgoing lines. These 200 unnumbered outgoing lines can have access to 20 first auxiliary group selectors (**IHW**). Each first auxiliary group selector has eight numbered bridges so that by providing 20 first auxiliary group selectors 160 outgoing lines extend over the bridge multiples. These outgoing lines can be connected to 16 group selectors (**IIGW16**). According to the density of the traffic however instead of these 16 second group selectors which are reached from the first auxiliary group selector, second group selectors can be included which are active in the case of normal traffic. The group selector **IIGW** (32) in Fig. 2, for example is shown in such a circuit arrangement. The lines (**L26**) outgoing from the first auxiliary group (**IHW**) selector are mixed in some way with the line (**L22**) outgoing from the first group selector (**IGW**). The system accordingly has 48 selectors in the second group selecting stage with 10 rod multiples and therefore 480 incoming connecting paths.

Each second group selector has 10 numbered bridge multiples so that 480 bridges extend to the final selectors. Further each second group selector can be provided with four auxiliary bridge multiples (**IV VW**) for example over which 192 auxiliary lines **L27** can then be reached. These 192 lines are connected to 20 of the auxiliary group selectors each of which has 10 bridge multiples. The 200 bridge multiples of the second auxiliary group selected also extend to final selector bridge multiples so that in the whole system 680 bridge multiples can be provided in the final selector stage.

Each final selector occupies 10 feeding bridges with its rod multiples. The feeding bridges are accordingly connected to 40 final selectors so that the number of bridge multiples of each line selector must be fixed at 17. (40.17" 680.)

It is seen from the above that from the 400 incoming rod multiples to the first group selector 680 paths extend to 400 feeding bridges **Sp**. In this way very large overflow is possible in the connecting paths and jamming becomes improbable.

A group selector can be used for up to 10 connections over its 10 rod multiples. In this way each group selector with 2 bridge multiples has access to one of 4 feeding bridge groups. Since 400 groups of feeding bridges have been assumed 8 connections can be made to the feeding bridges. In addition 5 further unnumbered bridge multiples are present which extend over auxiliary group selectors to the feeding bridges. If certain unnumbered bridge multiples be connected to the individual group selectors auxiliary group selectors can be added should jamming occur.

Each group selector has only a single marking selector associated with it. From this it follows that a connection which leads to a rod multiple in the group selector must wait for a short while until the marking selector is free. Since 40 group selectors are provided up to 40 connections can be set up at the same time. For a system with 8000 subscribers this is a very high number.

In the second group selector stage 48 group selectors are present whereby 48 connections can be set up at the same time. In the final selector the possibility exists of 40 connections being set up at the same time.

This number of connections which can be

set up at the same time is unnecessarily high for the normal working of an 8000 line system. An exchange with 8000 connections has about 12,000 busy hour calls i. e., 3 to 4 calls per second. Since the marking selector is connected at the most for 2 seconds to a talking selector 8 connections occur in such a period. If accordingly devices for the simultaneous setting up of 20 connections are included the peak of simultaneous connections is provided for. Accordingly in practice two talking selectors can be associated with a single marking selector. The change as compared with the embodiments shown would be that the energising chain of relay KOP (e. g., Figs. 9 and 10) would be extended over the rod multiples of two selectors therefore over 20 rod multiples.

By the momentary association of the marking selector with the talking selector whereby the marking selector has merely to take up the impulse from the bridge or rod multiples it is arranged that each talking selector is served with several conversations at the same time.

A further advantage of the invention is that the desired feeding bridge to which a calling station is connected is always free for the selector at the final selector stage so that testing of the feeding bridge to be connected by the selector of the final selector stage need not be undertaken and time need not be wasted doing this testing.

There are a few further arrangements which may be added to the arrangement indicated above which will be indicated. Thus for example the second preselector has 25 means of access to only 10 outgoing lines. Accordingly if all 10 outgoing lines, are seized the remaining 15 means of access must be revertively guarded.

Further the arrangement indicated above only shows preselectors with up to 80 subscribers' bridges and complete bundles of 10 as outgoing lines. It is possible according to the invention to arrange the outgoing lines to be graded in connecting to the second preselector. At a later point (Figs. 14 and 15) the possibility of known grading principles is shown.

In place of the finder switch which serves to connect the setting path it is understood that preselectors can also be provided since by their setting it is possible to fix the selecting digit or marking digit of the feeding bridge to be connected. The number of setting paths which can be connected over these preselectors or over the finder switches shown for the selection of the calling subscribers' station is assumed to be 40 since the requirement previously set out is that 40 connections can be set up at the same time.

Figs. 3 to 17 show an embodiment of the circuits. In these the rod multiple connections are horizontal and the bridge multiple connections are vertical. At the intersection of the horizontal and vertical multiple connections a small circle indicates an operating contact which is closed by the rotation of a rod by means of rod magnet and the energising of a bridge magnet. All co-ordinate selectors are assumed to be 4 wire selectors.

Certain parts (e. g., relay C113, A113 on the feeding bridge Sp113) are represented in several drawings so that the interpretation of the drawings may be simplified. The current circuits themselves are simplified as compared with an actual embodiment as some details are not included, for example guarding of an access path

when its fuse is blown or the bridging over of some part on which there is a disturbance.

Figs. 3 and 4 show four first preselectors which have the references IVWa, IVWb, IVWc and IVWd, fitted in a single frame, each preselector having 10 rod multiples of which 2 are shown. Only the arrangements of the preselectors IVWa and IVWd are shown in detail since the preselectors IVWb and IVWc are similar to these. Each of the preselectors has 20 bridge multiples of which the bridge multiples Br10 and Br20 are shown in the preselector IVWa. For the preselector IVWd likewise two bridge multiples are shown which have the numbers Br70 and Br80. Since each of the preselectors has 20 bridge multiples, 80 bridge multiples and therefore 80 subscribers can be connected to 4 preselectors connected together. The inter-connection of the 4 preselectors in a single frame is performed by connecting the rod multiple system in the manner shown in the drawings. Rods which extend over 80 bridge multiples to control the rod multiples would be too long and mechanically heavy. However it is quite possible by a special construction and support of the rods to make selectors in which the rods cross more than 20 bridge multiples.

Of the 80 subscribers' stations connectible to the 4 first preselectors shown 4 subscribers are indicated by the numbers T10, T20 and T70, T80. The rod magnets serving the preselector IVWa are indicated by ST11, ST12 to ST10. The bridge magnets of the preselector IVWa are indicated by BM10 to BM20. Of the preselectors IVWb and IVWc only the rod multiples are shown. Of the preselector IVWd the bridge multiples Br70 and Br80 are indicated which are controlled by the bridge magnets BM70 and BM80. The rod multiples of the selector IVWd are operated by the rod multiples ST41, ST42 to ST40. STv11 and STv12 represent two rod multiples of the selector IVWa which are connected with the rod multiples STv41 and STv42 of the selector IVWd.

The preselectors of the subscribers T10 to T80 have, as is clear from Fig. 1, access to outgoing and incoming second preselectors over a switching point u1. On Figs. 5 and 6 such a switching point is shown with outgoing and incoming preselectors indicated by IIVWab and IIVWan. In these preselectors only two of the 10 rod multiples are shown. The two rod multiples of the selector IIVWab lead to the feeding bridges Sp113 and Sp112 (Fig. 7) of the 25 bridge multiples of the outgoing second preselector (IIVWab) only two are shown and in point of fact the bridge multiples which are operated by the bridge magnets BM90 and BM91. The rod magnet ST221 is associated with the rod multiple which extends to the feeding bridge Sp112 and the rod magnet ST222 with the rod multiple which extends to the feeding bridge Sp113.

Magnets M11 and M21 are chain magnets which prepare the next free rod multiple on the first preselector for use. The magnet M11 (Fig. 5) has a contact m111 (Fig. 3) and magnet M21 a contact m211 (Fig. 3).

It should be noted that in the contact reference numbers shown in the drawings in the case of a two-digit contact number the first digit indicates the corresponding relay or magnet and in the case of the 3-digit contacts the first two digits correspond to the relay. Single digit contacts correspond to unlettered relays. In the

case of 4-digit contacts the first three digits correspond to the associated relay.

On Figs. 3 and 4 each sub-group of 20 subscribers has an associated common relay which can be operated by means of the contacts of the individual call relays of the individual subscribers' stations in the sub-group. The common relay for the subscribers' sub-group T10 to T29 is indicated by TB10 for subscribers of the sub-group T30 to T49 by TB30, and for the subscribers of the subscribers' sub-group T50 to T69 by TB50 and for the subscribers of the sub-group T70 to T89 by TB70.

A further common relay BL is associated with the 4 sub-groups of the connecting line groups consisting of 80 subscribers' connections, the results of the coming into effect of which relay will be gone into in detail later.

In the following the setting up of a connection between a subscriber T10 and subscriber T29 will be described. The call number of the subscriber T29 is assumed to be 7629.

When the subscriber of the subscriber's station T10 (Fig. 3) lifts up his receiver the following circuit is completed: +, contact *bm102*, loop at the subscriber's station T10, contact *bm101*, relay R10, —. In this circuit the relay R10 energises. The relay R10 operates its contacts. Over the contact *r102* the following circuit is completed: +, contact *r102*, relay TB10, contacts *tb102*, *b12*, —. The relay TB10 can be energised in the same way by all subscribers of the sub-group T10 to T29 over corresponding contacts *r112*, *r122*, *R292*.

The relay TB10 locks up over contact *tb103* in a circuit which extends as follows: —, relay BL, contact *tb103*, relay TB10, contact *r102*, +. Relay BL opens the contact *b12* whereby negative potential is disconnected from the line *Lan* so that after the operations of the relay BL no subscriber T10 to T89 can make a call and double connections are avoided. The contact *tb102* is opened. The contact *tb101* has connected positive potential in preparation to the rod magnets ST11, ST12 of the first preselector. The contact *b11* of the relay BL connects positive potential to the relay G1 in the following circuit: +, contact *b11*, relay G1, contact *m111*, —. This circuit is completed when the upper rod multiple of the preselectors IVWa to IVWd is free and accordingly the magnet M11 (Fig. 5) is not energised. The contact *g11* is operated and connects the rod magnets ST11, ST21, ST31, and ST41 of the connected rod multiples STv11, STv21, STv31 and STv41. Of those multiples and rod magnets only the rod multiples STv11 and STv41 and rod magnets ST11 and ST41 are represented in detail. Only the rod magnet ST11 can operate however as only this magnet receives positive potential over *tb101*. By operation of the rod magnet ST11 the points of intersection of the rod multiples STv11 on the selector IVWa are prepared. The rod magnet ST11 operates its contact *st111* whereby the following circuit is completed for the bridge magnet BM10 of the bridge multiple Br10: +, contacts *st111*, *r101*, *bm103*, bridge magnet BM10, —. The meter Z10 connected in parallel to the bridge magnet BM10 receives current but this however is not sufficient to operate it. The bridge magnet BM10 connects through at the coupling point, provided on the multiple STv11 and the bridge multiple Br10, which is indicated by a small circle in the drawings so that connection of the subscriber's line of the subscriber T10 with the lines of the multiple

STv11 is brought about. Further the bridge magnet BM10 operates the contacts *bm101* to *bm103*. At the contacts *bm101* and *bm102* the call potential is disconnected from the subscriber's line of the subscriber T10. Further the incoming line L1 is disconnected from the final selector of the setting path so that the subscriber station T10 is also guarded against incoming connections. By means of contact *bm103* the bridge magnet BM10 locks up over the c-conductor *brcl*. The holding circuit extends over: —, bridge magnet BM10, contact *bm103*, coupling point K3, line *stvc* to the magnet M11 (Fig. 5) and from here over contact *an112*, line Lc20, contact *bm911*, relay BR91 to positive. The relay R10 (Fig. 3) restores at the opening of contacts *bm101* and *bm102* whereby the energising of the relay BL is discontinued by the opening of contact *r102*. The contacts *b11* and *b12* return to normal so that the starting line *Lan* is at the disposal of other calls. The rod magnet ST11 and the relay G1 are restored. At the contact *m111* the next free rod magnet, for example the rod magnet ST12, is prepared for receiving a calling impulse by the operation of the relay M11. The relay M11 has been energised in the circuit previously described for the bridge magnet BM10. By the opening of contact *r102* relay TB10 is also restored. After the release of the relay BL the release chain is at the disposal of any of the 80 subscribers of the subscribers' group represented. The relay AN11 connected to the conductor *stvd* is not energised by the switching through of the preselector IVWa since positive potential is not connected to the d conductor of the bridge multiple Br10. The relay AN11 is the switching relay for incoming connections.

In the outgoing second preselector IIVWab (Fig. 6) the relay BR91 is energised over the conductor Lc20. In this way the contact *br912* is closed and the following circuit is set up: —, bridge magnet BM91, contact *br912*, *c113*, rod magnet ST222, +. In this circuit the rod magnet ST222 operates but the magnet BM91 is however only partially energised in this circuit so that this magnet only operates contact *bm912*. The rod magnet ST222 prepared the coupling points for the rod multiple STv222. By the closing of contact *bm912* the following circuit for the bridge magnet BM91 is completed: bridge magnet BM91, contacts *bm912*, *bm911* (this contact is only operated by the impulse energising of magnet BM91) relay BR91, +. The magnet BM91 pulls up completely and closes the intersecting points of the bridge multiples Br91 with the rod multiples STv222 in the second preselector IIVWab. The magnet BM91 is maintained energised by means of the opposite potential connected over the relay C113 when by the opening of the contact *bm911* the relay BR91 is disconnected, and after its release by the opening of the contact *br912* positive potential is disconnected from the rod magnet ST222. The rod magnet ST222 is de-energised and at contacts *c113* the rod magnet ST221 is connected in preparation so that the rod multiple STv221 is ready for the following connection. In the feeding bridge Sp113 connected, the feeding bridge relay A113 operates (Fig. 7) over the subscriber's loop since after the closing of the coupling points *k41* to *k44* at the preselector IIVWab a metallic connection is set up with this.

The feeding bridge Sp113 to which the calling station is now connected has as is shown in the

plan according to Figs. 1 and 2, a connection with the incoming talking selector LW and finder switch AS over which the calling station is connected with the dial impulse acceptors of the setting path. The selectors of the setting path are indicated by EIGW, EIIGW, ELW. The finder switch AS, the assessor switch ABW and the first group selector EIGW of the setting path are shown in Figs. 7 and 8. The second group selector and the final selector of the setting path are shown in Fig. 13. The final selector ELW of the setting path impulses the desired connecting station as is seen from Figs. 1 and 2 whereupon the talking path is set up with the aid of the co-ordinate selector to the other side of the feeding bridge *Sp113* in Fig. 7. The incoming pre-selector IIVWan is shown (Fig. 5) which has access to the final selector LW (Fig. 8) over the first group selector IGW (Figs. 9 and 10) and the second group selector IIGW (Fig. 11).

As has already been indicated in the description of the arrangement of Figs. 3 to 6 the relay A113 (Fig. 7) operates, when the feeding bridge *Sp113* is seized, over the calling subscriber's station. By means of contact *a1132* the following circuit is completed for the two-step relay V113 (winding I): +, contact *a1132*, winding I of relay V113, —. The relay V113 is energised in the first step. In this way the contact *v11321* is closed whereby wiper *asa* of the finder switch AS is marked. Further by the seizing of the feeding bridge *Sp113* the relay C113 is operated over the negative potential connected to the conductor *Lc11*. The relay C113 closes a circuit for starting up a free finder switch by means of its contact *c1133*. This circuit extends as follows: +, interrupter device *Un1*, contacts *c1133*, *v1134II*, *pas2*, rotary magnet DAS of the finder switch AS, —. The finder switch rotates and steps on its wipers *asa*, *asc*, *ash*, *asz*, *ase*. The contacts *cx*, *vx* in parallel to the contacts *c1133* and *v1134II* belong to other feeding bridges which are served by the same finder switches.

When the finder switch AS reaches the feeding bridge *Sp113* marked by means of contact *c1132* of the relay C113 the following circuit is completed: —, winding II of relay V113, contacts *c1132*, *del131*, wiper *asc* of finder switch AS, relay PAS, +. The relay PAS operates and by closing the contact *pas1* guards the feeding bridge which has been found. The contact *pas2* disconnects the rotary magnet DAS of the finder switch so that this finder switch is stopped. Contact *pas3* connects the wiper *asa*. The relay V113 operates its winding II in the second step whereby the contact *v1134II* is opened and the interrupter *Un1* disconnected. The contact *pas3* connects dial tone in the following circuit to the calling line: —, tone generator AZ, relay A2 contacts *pgw21*, *pas3*, wiper *asa* of the finder switch, condenser CO1, a-conductor of the talking path.

When the subscriber begins the dial selection after receiving the dial tone then by the first digit 7 sent out from the calling station relay A113 is operated 7 times. In this way the relay A2 energised 7 times in the following circuit: +, contacts *a1132*, *v11321*, wiper *asa*, contacts *pas3*, *pgw21*, relay A2, upper winding of the tone generator AZ, —. The contact *a21* closes 7 successive times whereby the vertical magnet H2 of the first group selector EIGW of the setting path receives 7 impulses. The slow relay U2 in series with the vertical magnet H2 operates on the first impulse and remains energised during the im-

pulse train of 7 impulses. The relay U2 opens the contact *u21* on the first impulse so that the rotary magnet D2 of the first group selector EIGW of the setting path is not operated after the closing of the off-normal contact *ko22* during the first impulse train. When the first impulse train is ended the group selector rests with its wipers *agwI*, *cgwI*, *dgwI* on the 7th bank. The relay U2 is released since the contact *a21* has remained open for some time. On the closing of the contact *u21* the following circuit is completed: +, contacts *pgw23*, *ko22*, *u21*, *a22*, rotary magnet D2 of the group selector, —. The rotary magnet D2 is energised and the contact *d21* is closed. In this way the relay A2 is energised and contact *a22* opened. The rotary magnet D2 restores whereby the relay A2 is also released. On the first rotary step of the group selector the rotary off-normal contact *w2* is opened. The alternate play between the rotary magnet D2 and the relay A2 is continued until the selector EIGW has found a free line leading to the second group selector. If the line whose conductors are indicated by *La14*, *Lc14* and *Ld14* is free the following circuit is completed: +, contact *pas4*, test relay (PGW2) of the group selector EIGW, wiper *cgwI*, relay C4, —. The relay C4 is shown again in Fig. 13. The relay PGW2 operates and by opening contact *pgw23* stops the group selector. The contact *pgw22* is closed and in known manner guards the line which has been found. The contact *pgw21* is operated whereby the impulse line controlled by the contact *a1132* is switched through over the wiper *agwI* of the first group selector to the impulse receiving relay A4 (Fig. 13) of the second group selector EIIGW.

The second digit 6 sent out from the calling station causes the impulse accepting relay A113 in the feeding bridge *Sp113* (Fig. 2) to restore 6 times. In this way over contact *a1132* impulse accepting relay A4 of the group selector (Fig. 13) is energised 6 times. At the first energisation of the relay A4 slow relay U4 and the vertical magnet H4 of the second group selector EIIGW are energised by the closing of contact *a41* (Fig. 13). The following impulses operate the vertical magnet H4 only over *a41* while the relay U4 remains energised during the impulse train as a result of its slow response properties. The relay U4 opens the contact *u42* so that the rotary magnet D4 of the second group selector cannot be influenced after the closing of the off-normal contact *ko41* which is closed on the first vertical step of the group selector. When the second group selector has received 6 impulses the relay U4 restores. The rotary magnet D4 is energised in the following circuit: + contact *pgw43*, *ko41*, *u42*, *a42*, rotary magnet D4, —. The rotary magnet D4 operates the contact *d4* whereby positive potential is connected to the relay A4. Relay A4 operates and opens the contact *a42*. The rotary magnet D4 restores. This alternate play between the rotary magnet D4 and the relay A4 is continued until the wiper *cgwII* has found a free line. On the first rotary step of the second group selector the rotary off-normal contact *w41* is opened so that the vertical magnet H4 is not influenced by means of the oscillating contact *a41*. When the second group selector finds a free line for example a line leading to the final selector ELW the following circuit is completed: +, contact *c41*, test relay PGW4, wiper *cgwII*, relay C5, —. The test relay PGW4 operates and

switches through the lines to the wipers *agwII* and *dgwII* at the contacts *pgw41* and *pgw44*. The energising circuit for the rotary magnet D4 is interrupted at contact *pgw43*. Contact *pgw42* guards the line which has been found in known manner.

The next digit 2 sent out from the calling station operates the relay A5, which is reached over the wiper *agwII*, twice. The relay A5 operates contact *a51* whereby the vertical magnet H5 of the final selector ELW is operated. In this circuit the slow relay U5 is also energised. When the contact *a51* has been closed twice the wipers *clw* and *dlw* of the setting selector reach the contacts of the second bank. By means of the first impulse reaching the vertical magnet H5 contact *ko51* is opened and the contact *ko52* closed. Since however on the first impulse the relay U5 is energised the second impulse is extended over the closed contact *ko52* and the closed contact *u52* and the vertical magnet H5. The contact *ko53* which was operated by the first vertical step of the final selector does not influence the rotary magnet D5 since the contacts *c51* and *u53* are opened. When the first impulse train extending to the final selector is complete the relay U5 restores since the contact *a51* remains open for a sufficiently long period. In this way the contact *u51* is closed so that on the arrival of the first impulse of the second impulse train reaching the final selector the rotary magnet D5 and the relay E5 are energised in the following circuit: +, contacts *a51*, *ko52*, *u51*, relay E5, rotary magnet D5, -. The relay E5 operates the contacts *e51*, *e52*, *e53* and *e54*. By means of the contact *e51* test relay P5 of the final selector is disconnected. The contact *e52* sets up an energising circuit for the relay A5 which is independent of the operation of the rotary off-normal contact *u52* which takes place on the first rotary step of the final selector. Contact *e53* disconnects the engaged signal. The contact *e54* sets up an energising circuit for the relay F5. During the further impulses sent out from the calling station the rotary magnet D5 is operated intermittently over contact *a51* while the slow relay E5 remains energised. At contact *f51* the test circuit of the final selector is prepared. If the contact *a51* is held open from the calling station after the sending out of the 9th impulse relay E5 restores slowly. In this way previous to the release of the relay F5 the following circuit is completed for the subscribers' station T29: +, contact *c52*, *e51*, *f51*, winding I of relay P5, wiper *clw* of final selector ELW, line L2 (Fig. 3) contact *bm291*, relay R29, -. If the relay P5 (Fig. 13) operates previous to the release of relay F5 there follows the setting up of a holding circuit for the winding II of relay P5 by the closing of contact *p53*. Contact *p52* is closed and connects the wiper *dlw* over the final selector with the line L66 (Fig. 3) which is connected with the *d*-conductor of the bridge multiple Br29 of the pre-selector IVWa to which the required subscriber T29 is connected. The contact *p51* (Fig. 13) opens the circuit extending over the *a*-conductor which can be connected to the engaged signal.

If the subscriber's line 7629 is engaged the bridge magnet BM29 (Fig. 3) is energised. Accordingly the contact *bm291* is also opened. In this case there is no negative potential connected to the line L2 so that after the setting of the final selector (ELW) (Fig. 7) the relay P5 cannot operate. When after a few moments relay F5 restores, the test circuit prepared at contact

f51 is also opened. The calling subscriber receives the engaged signal which is transmitted over the contacts *e53*, *p51*, condenser CO7, rotary off-normal contact *u52*, to the wipers *agwII* and over contact *pgw21*, *pas3*, wiper *asa*, condenser CO1, *a*-conductor (Laf1), to the calling station. The release of the setting path brought about by the calling subscriber hanging up is described later.

If however the called party T29 is free he must be switched through to an outgoing second pre-selector over the preselector IVWa. In the testing circuit already described for the final selector ELW (Fig. 13) the relay R29 (Fig. 3) is energised. On the assumption that the calling subscriber T10 has seized the rod multiple STv11 the rod magnets ST12 and ST22, ST32 and ST42 are prepared by the operation of contact *m111*. The switching through of the bridge multiple Br29 of the subscriber T29 is exactly as was described for the bridge multiple Br10 for the subscriber T10. By the operation of the relay R29 the following circuit is set up for the relay TB10 by the closing of contact *r292*: -, contacts *b12*, *tb102*, relay TB10, contact *r292*, +. The relay TB10 operates and connects positive potential over contact *tb101* to the prepared rod magnet ST12. The contact *tb102* is opened and over contact *tb103* the holding circuit is set up for the relay TB10 and an energising circuit for the relay BL. The contact *b11* effects the energising of the relay G2, in the following circuit: +, contact *b11*, relay G2, contacts *m211* *m111* (operated), -. The contact *g21* is closed whereby the negative potential operates the rod magnet ST12 over contact *m111*. The contact *st121* of the magnet ST12 is closed whereby positive potential is connected over contacts *r101*, *r111*, *r121*, *r131*, *r291*, *bm293* to the bridge magnet BM29. Bridge magnet BM29 operates and opens the contacts *bm291* and *bm292*. Over contact *bm293* a holding circuit is set up which extends over a coupling point *k15* and line *stvc1* to the arrangements of Figs. 5 and 6 which follow as is described later. The relay R29 is released and in this way the relays BL and TB10 are restored. Also the rod magnet ST12 is released.

On the energising of the bridge magnet BM29 the *d*-conductor *brd2* of the bridge Br29 with which over the line L66 the wiper *dlw* of the final selector DLW is connected, is brought into connection with the *d*-conductor of the multiple STv12 over the coupling point *k16* so that at the moment of switching through of the bridge Br29 the following circuit is completed for the winding I of the relay AN21 (Fig. 5) over the line *stvd1*: -, relay AN21, winding I, contact *an211*, line *stvd1* (Fig. 4) of the multiple wiring STv42, coupling point *k16*, line *brd2*, of the bridge multiple Br29, line L66, wiper *dlw* of the final selector ELW (Fig. 13), contact *p52* in the final selector ELW (Fig. 13), wiper *dgwII* of the second group selector EIIGW, contact *pgw44*, line *Ld14*, wiper *dgwI* (Fig. 7), contact *p31*, relay U3, contact *hw32* in the assessing switch mechanism ABW, rotary magnet D3 of the assessor switch, +. The relay AN21 (Fig. 5) operates its contacts *an211*, *an212* and *an213*. Over contact *an213* the relay AN21 sets up a holding circuit for its winding II to which positive potential is connected in the incoming second preselector IIVWan over contact *an212*. Over this potential the bridge magnet BM29 (Fig. 3) is also maintained energised after the operation of contact *bm293*. The conductor *stvd1* of the multiple wiring STv42 (Fig. 4) is

connected over contact *an211* (Fig. 5) with the conductor *Ld10* which extends to the incoming second preselector *IIVWan*. A seizing of the bridge multiple in the second preselector *IIVWab* has not taken place since the energising of the relay *AN21* was already carried out previous to the final closing of contact *bm293* (Fig. 3). The relay *M21* (Fig. 5) operates whereby by the operation of contact *m211* (Fig. 3) the next rod multiple of the preselector *IVWa* is prepared for use. The energising of the relay *M21* (Fig. 5) of the relay *Br93* and the maintaining energised of the winding II of relay *AN21* and of the bridge magnet *BM29* (Fig. 3) is carried out in view of the following circuit: +, relay *Br93* (Fig. 5), contact *bm931*, line *Lc10* of the bridge multiple *Br93*, contact *an212*, relay *M21*, winding I, line *stvc1* (Fig. 4), coupling point *k15*, line *brc2* of the bridge multiple *br29*, contact *bm293*, bridge magnet *BM29*, —. The operation of the relay *Br93* (Fig. 5) closes its contact *br931*. The seized bridge multiple *Br93* must now be coupled with a free rod multiple of a second preselector *IIVWan*.

In the incoming second preselector *IIVWan* the rod multiple *STv24* which is controlled by the rod magnet *ST24* is seized. This rod multiple extends to a first group selector not described in detail which is indicated by *IGW11* in Fig. 6. In this group selector the relay *C11* is energised whereby the contact *c111* is also operated. Accordingly if the above-mentioned contact *br931* is closed by the seizing of the preselector *IIVWan* the following circuit is completed: —, bridge magnet *BM93*, contact *br931*, contact *c111* (operated) contact *c101*, rod magnet *ST23*, +. The rod magnet *ST23* operates. The bridge magnet *BM93* by its operation in the first place closes only a contact *bm932* and the coupling points *k37—k40*, whereby the bridge magnet *BM93* is completely energised in the following circuit: —, *BM93*, contact *bm932*, point *K35* of intersection in the second preselector *IIVWan*, line *Lc13*, contact *ds11*, relay *C10*, + in the first group selector *IGW* (Figs. 9 and 10). The relay *C10* operates. Contact *bm931* (Fig. 5) is opened whereby the relay *BR93* is disconnected. The positive potential on the relay *BR93* is replaced by positive potential on the relay *C10* (Fig. 9) so that the bridge magnet *BM93* (Fig. 5) does not restore.

By the release of the relay *BR93* (Fig. 5) the contact *br931* is opened so that the rod magnet *ST23* is released and the coupling rod is set back to its normal position. The contacts operated at the intersecting point of this rod with the bridge *Br93* remain operated however. The contact *c101* (Fig. 6) is operated by the energising of the relay *C10* (Fig. 9) whereby the next rod magnet on the selector *IIVWan* (Fig. 5) is prepared.

The group selector of which three bridge multiples are shown is indicated in Figs. 9 and 10 by *IGW*. Bridge multiples *Br31* and *Br32* are numbered bridge multiples which have access to second group selectors. *Br33* indicates a bridge multiple which corresponds to the bridge multiple *b500* in the general scheme of Figs. 1 and 2. This bridge multiple is connected to an auxiliary group selector as can be seen from Fig. 2. Of the ten rod multiples of the group selector *IGW* only two are shown and in point of fact the rod multiple *STv25* controlled by the rod magnet *ST25* and the rod multiple *STv26* controlled by the rod magnet *ST26*. According to Fig. 2 the first group selector of Figs. 9 and 10 has eight bridge multiples which are numbered in pairs.

The marking selector associated with the group

selector *IGW* is denoted in Fig. 2 by *IBZ*. It is a step-by-step rotary selector and has six wipers. These wipers have the references *bza* to *bzf*. The rotary magnet of the selector is indicated by *DBZ*.

When the relay *C10* is energised on the switching through of the preselector *IIVWan* the following circuit is set up over contact *c102*: —, relay *ABT* in the marking selector *IBZ*, coupling relay *KOP10* of the rod multiple *STv25*, contact *c102*, *um4*, contact 0 in the contact bank of the wiper *bzd* of the marking selector *IBZ*, +. When the marking selector *IBZ* is coupled with another rod multiple at the moment of operation of the relay *C10* the condition reached by the closing of the contact *c102* is maintained until the marking selector has travelled back to its normal position. When the marking selector has travelled back to its normal position the previously described circuits for the relays *ABT* and *KOP10* comes into effect whereby both relays are energised, the contact *kop104* is closed and over contact *c102* a holding circuit is completed for the relays *KOP10* and *ABT*. If during the coupling of a rod multiple another rod multiple is seized by the operation of relay *C12* the coupling relay *KOP11* is connected at contact *c112*. This relay can not however operate since the energising circuit is opened at the normal contact of the armature *c102*. The contact *kop101* closes the circuit for the marking selector to receive the first digit "1" (the first digit of the number of the feeding bridge). This circuit extends as follows: —, interrupter *Un5*, rotary magnet *DBZ* of the marking selector, contact *um1*, relay *UBZ*, wiper *bze*, contact *kop101*, line *Ld13* (also Fig. 5) intersecting point *k36* on selector *IIVWan* (Fig. 5), line *Ld10*, contact *an211*, d-conductor *stvd1*, rod multiple *STv42* (Fig. 4), coupling point *k16* of the bridge multiple *Br29*, line *L66*, wiper *dlw* of the line selector *ELW* (this wiper corresponds to the wiper *dlw* of Fig. 13) contact *p52* (Fig. 13) wiper *dguII*, contact *pgw44*, line *Ld14*, wiper *dguI* of the selector *EIGW* (Fig. 7), contact *p31*, relay *U3*, in the seizing switch mechanism *ABW*, contact *hw32*, rotary magnet *D3* of the seizing switch, +.

The first impulse of the interrupter *Un5* of Fig. 9 energises the rotary magnet *DBZ* of the marking selector *IBZ* of the group selector *IGW* (Figs. 9 and 10) and the rotary magnet *D3* of the seizing magnet *ABW* of Fig. 7. Furthermore in this circuit the relay *UBZ* (Fig. 9) and the relay *U3* in the seizing switch *ABW* (Fig. 7) are energised. The relays *UBZ* and *U3* are slow relays.

Since the first digit "1" of the feeding bridge *Sp113* (having the marking signal *113*) is to be transmitted, the relay *P3* operates after the first impulse reaches the assessor switch *ABW* in the following circuit: —, relay *P3*, contact *hw31*, wiper *abwa* in position 1, cross connections to the converting arrangement *ZV*, wiper *ash* of the finder switch *AS* (in position 3), contact 1 of the wiper *ssa* of the control switch *SS*, +. The contact *p31* opens the previously mentioned circuit to the assessor switch *ABW* so that the rotary magnet *D3* in the assessor mechanism *ABW* and the rotary magnet *DBZ* in the marking selector *IBZ* (Figs. 9 and 10) can receive no further impulses. After a short delay the relay *U3* (Fig. 7) and *UBZ* (Fig. 9) restore.

In the seizing switch mechanism *ABW* (Fig. 7) on the energising of the relay *U3* by the closing of the contact *u32* the stepping on magnet *SS* of the control switch *SS* has been energised. A further stepping on of the control wiper *ssa* takes place but only when the magnet *SS* is energised.

When accordingly the relay U3 restores after sending out an impulse over the impulse conducting line then, by the opening of the contact *u32* the magnet SS has been de-energised so that the wiper *ssa* of the finder switch AS which marks the 10's digit of the connecting bridge is connected to potential. Further the contact *u31* closes a circuit for setting the assessor switch in its zero position. This circuit extends from negative over the interrupter *Un2*, slow relay HW3, segments 1—10 of the wiper *abwb* of the assessor switch to the rotary magnet D3, +. The relay HW3 remains energised until the assessor switch reaches its normal position. Over contact *hw31* the circuit for the relay P3 is opened and this restores. The contact *p31* is closed but the impulse circuit is not completed again since the contact *hw32* has been opened during the release of the assessor switch ABW.

In the marking selector IBZ (Figs. 9 and 10) the relay UBZ restores on the opening of the impulse circuit.

The relay UBZ has energized the slow relay Q over its winding I on its first operation in the following circuit: +, contact *abt2*, *ubz3*, winding I of relay Q, —. (The relay ABT has been energised in series with the coupling magnet KOP10.) The contact *q2* prepares the energising circuit for a bridge magnet over the wiper *bza*. After the release of the relay UBZ the contact *ubz1* closes the following test circuit: +, test relay PST, contact *ubz1*, *q2*, holding winding II of the relay Q, wiper *bza* of the marking selector in position I, contact *bm312*, bridge magnet BM31, —. In this circuit only the test relay PST operates. The contact *pst1* closes the following energising circuit for the rod magnet ST25 and for the relay NH: +, relay NH, contact *pst1*, contact *kop102*, magnet ST25, —. After the energising of the magnet ST25 and the relay NH the contact *nh1* increases at relay PST the current in the energising circuit for the bridge magnet BM31 in that the contact *nh1* reduced the resistance in this circuit. The bridge magnet BM31 is now energised and opens the contact *bm312* and over the same contact locks up over line *Lc15* to a seizing relay (C15) in a second group selector IIGW (Fig. 11) reached over the bridge multiple Br31.

When the bridge magnet BM31 (Fig. 9) is energised there follows the energising of the switching through relay DS1, by the closing of the coupling point *k66* on the rod multiple ST25, which relay is arranged on the c-conductor (line *Lc13*) of the connecting multiple between the second pre-selector and the first group selector. Also the relay DS1 receives positive potential over the outgoing conductor *Lc15* which is connected to the second group selector IIGW (Fig. 11). The contact *ds11* of the relay DS1 (Fig. 5) opens the energising circuit for the relay C10 which restores. The contact *ds12* is closed and switches through the incoming c-conductor *Lc13* to the outgoing c-conductor *Lc15*. The contact *c102* of the relay C10 is restored to normal whereby the coupling relay KOP10 and the relay ABT in the indicating selector IBZ are restored. The contact *kop101* disconnects the marking selector IBZ from the impulse conductor *Ld13*. The contact *abt1* closes the homing circuit for the marking selector: —, interrupter *Un5*, magnet DBZ, contact *um1*, relay UBZ, contact *abt1*, segment 1 to 10 of the wiper *bzd*, +. During the restoration of the marking selector the contact *ubz1* is opened so that no further bridge magnet can be en-

ergised by the stepping on of the wiper *bza*. The closing of the contact *ubz2* has no effect since no coupling relay is energised. Another coupling relay can only operate again when the wiper *bzd* has reached its normal position.

When the bridge magnet BM31 to be connected over wiper *bza* is energised by the setting of the marking selector IBZ i. e., the bridge multiple Br31 is already seized, the energising circuit for the relay PST which extends over the second winding of the relay Q and the wiper *bza* cannot be completed since the contact *bm312* is opened. Accordingly after a few moments the relay Q restores and at contact *q1* switches over the test circuit to the wiper *bzb*. As long as the relay Q has been energised the winding I of slow relay R remains energised over contact *q3*. This relay R has connected the wiper *bzb* of the marking selector over its contact *2r* and its winding II in preparation. When accordingly relay Q restores owing to the bridge magnet BM31 being energised the following circuit is completed over the contact *2r* which is still closed: +, relay PST, contacts *ubz1*, *1q*, *2r*, winding II of relay R, wiper *bzb* in position I, contact *bm321*, bridge magnet BM32. When the bridge magnet BM32 operates after the energising of the relay NH and the rod magnet ST25 it switches through the bridge multiple Br32 on to a second group selector and actually in the same way as has been described previously for the bridge multiple Br31. If however the bridge multiple Br32 has also been seized already the connection is set up over a third preselector (IIIVW) and an auxiliary group selector (IHGW) as is described later.

The second group selector IIGW (Fig. 11) reached over the bridge multiple Br31 (Fig. 9) is connected in precisely the same way as the group selector IGW of Figs. 9 and 10. The second group selector is therefore only indicated in Fig. 11 in its essential parts. The relay C15 in this group selector, already mentioned several times, has the same position and effect as the relay C10 of the first group selector IGW of Fig. 9. Over this relay the bridge magnet BM31 of the first group selector receives positive potential. The only difference in the setting of the second group selector IIGW (Fig. 11) is the position of the control switch SS of Fig. 7 in its setting 2. The contact seized by the finder switch wiper *asz* is connected over the intermediate discriminator ZV (Fig. 7 lower left-hand corner) to the position I of the seizing contact bank of the wiper *abwa* of the assessor switch ABW for the transmission of a second digit "1" of the marking digits of the feeding bridge Sp113. After the transmission of the second digit "1" to the group selector IIGW shown in Fig. 11, the contact switch SS of Fig. 7, transfers to its position 3. The contact seized by the wiper *ase* of the finder switch AS is connected over the intermediate discriminator ZV to position 3 of contact bank of the wiper *abwa* of the seizing switch ABW so that as the third marking digit for the feeding bridge Sp113 a "3" is transmitted to the final selector.

In the group selector IIGW (Fig. 11) which as has already been mentioned is similar in construction to the first group selector IGW (Fig. 5), the switching elements which are the same are indicated by the same references as in the selector IGW (Figs. 9 and 10) but in the case of the group selector IIGW these have the index II. When after the setting of the group selector IIGW by means of the marking selector

IIBZ (not shown) the bridge magnet BM311I is operated, the connection is switched through, with the aid of the rod multiple STv261I and of the bridge multiple Br31 connected with this to the final selector LW of Fig. 8. The final selector LW shown in Fig. 8 is seized over contact *bm3121I* over the line *Lc17* of the bridge multiple Br311I of the second group selector IIGW by connection of negative potential. This circuit extends in Fig. 8 over the wire *Lc17* of the bridge multiple Br4, the contact *ds41*, relay C4 to positive potential. The positive potential on the relay C4 is the holding potential for all previously arranged bridge magnets and switching through relays in the incoming talking circuit. If it is assumed that the marking selector IIBZ of the final selector is free the relay C4 closes the following energising circuit: +, wiper *bzc* of the marking selector IIBZ, contact *c41*, (operated position) relay KOP4, relay ABT3, —. The contact *kop43* closes a holding circuit for the relay KOP4, which is independent of the operation of the wiper *bzc*. The contact *kop41* closes the following impulse circuit: —, interrupting device *Un*, rotary magnet DBZ of the marking selector IIBZ of the final selector LW, slow relay U8 (operated on completion of the circuit), wiper *bzb* in its home position, contact *kop41*, conductor *Ld17* of the bridge multiple Br4 of the line selector LW, line *Ld17* of bridge multiple Br311I of Fig. 11, coupling point *k52* of the rod multiple STv261I line *Ld15* (Figs. 9 and 10) coupling point *k67* of the first group selector IGW (Fig. 7), line *Ld13*, coupling point of the rod multiple STv23 of the second preselector IIVWan, line *Ld10* of the bridge multiple Br33, contact *an211*, line *std1*, coupling point *k16* of the bridge multiple Br29 (Fig. 3) of the subscriber set T29, line *L66*, wiper *dhw* of the setting final selector ELW, (the line *L66* and the wiper *dhw* are shown again in Fig. 13), contact *p52* (Fig. 13) wiper *dgw11*, contact *pgw44*, line *Ld14*, (Fig. 7), wiper *dgw1*, contact *p31*, relay U3 of the seizing switch mechanism ABW, contact *hw32*, rotary magnet D3 of the seizing switch mechanism, +. The transmission of the last marking digit "3" of the feeding bridge Sp113 takes place in the same way as the transmission of previous impulse trains in that on the coming into effect of the interrupting device *Un* (Fig. 8) in the marking selector IIBZ negative potential is connected to the previously mentioned impulse circuit whereby the rotary magnet DBZ of the relay U8 in the marking selector IIBZ and the relay U3 and the rotary magnet D3 in the seizing switch mechanism ABW (Fig. 7) are operated. The marking selector IIBZ advances by one step whereby the wipers *bza*, *bzb*, *bzc* are stepped on further. The previously described circuit to the seizing switch mechanism ABW is maintained in position 1 of the marking selector IIBZ over contact *u82* of the slow relay U8.

In the seizing switch mechanism ABW the opening of contact *u31* effects the energising of the relay U3 whereby the interrupter *Un2* is disconnected from the segment of the wiper *abwb*. The contact *u32* effects the energising of the magnet SS of the control switch but the wiper *ssa* is only stepped on when the circuit for the magnet SS is interrupted.

The second impulse sent out from the interrupting device *Un* of the marking selector IIBZ (Fig. 8) effects in the same manner as has been described in connection with the first impulse

the step-by-step movement of the wiper of the selector IIBZ and of the seizing switch mechanism ABW of Fig. 7. The relay U8 and the relay U3 remain energised respectively in the marking selector and in the seizing switch.

When the interrupting device *Un* sends out a third impulse the wipers of the selector IIBZ and ABW reach position 3. In this position the test magnet P3 of the seizing switch ABW is energised in the following circuit: —, test relay P3, contact *hw31*, wiper *abwa* of the seizing switch in position 3, intermediate discriminator ZV, wiper *ase*, of the finder switch AS, contact 3 in the contact bank of the control switch wiper *ssa*, +. Relay P3 operates and opens the circuit for the marking selector IIBZ at contact *p31*, which circuit extends over the selector EIGW (Fig. 7), ELW (Fig. 13), IVWa (Fig. 3), IIVWan (Fig. 5), IGW (Figs. 9 and 10), IIGW (Fig. 11) and LW (Fig. 8). The relays U3 (Fig. 7) and U8 (Fig. 8) restore. The relay U3 in the seizing switch mechanism effects the connection of the rotary magnet D3 to the interrupter *Un2* by the closing contact *u31* so that the rotary magnet D3 is operated intermittently and the wipers of the seizing switch ABW are returned to their normal positions. During the release movement of the seizing switch the relay HW3 is energised which is constructed as a slow relay or as an alternating current relay and accordingly contacts *hw31* and *hw32* are held open during the intermittent energising of the magnet D3. The relay P3 restores and opens its contacts. Control switch SS is stepped on again by one step when the contact *u32* is opened.

In the final selector the marking selector IIBZ has been stepped to position 3 by means of the three supervising impulses sent out from the seizing mechanism ABW (Fig. 7) so that the wiper *bza* of the marking selector IIBZ contacts the line 113. On this line the rod magnet ST113 is connected which controls the rod multiple STv113. When the relay U8 restores after the opening of the impulse circuit the contact *u81* is closed so that the following circuit is completed: +, relay NH3, contact *u81*, *abt32*, wiper *bza*, line 113, rod magnet ST113. The relay NH3 on its operation closes contact *nh31* whereby the following energising circuit is completed for the seized bridge multiple Br4: + contact *nh31*, *kop42*, bridge magnet BM4, —. The contact *bm41* closes the holding circuit for the bridge magnet BM4 which extends in the first place over the wire *Lc17* to positive potential on the relay C4. The closing of the coupling point *k47* of the c-line of the rod multiple STv113 effects an energising of the relay DS4 in the following circuit: —, relay DS4, coupling point *k47* of the rod multiple STv113, relay DE113, contact *v1133* of the feeding bridge Sp113, +. The relay DS4 switches over contact *ds41*. In this way the relay C4 is de-energised and the positive potential connected to the relay C4 is replaced by positive potential connected to the wire *Lc25* over contact *v1133*. This potential represents the holding potential for all the holding magnets lying ahead. Contact *c41* opens the holding circuit for the coupling relay KOP4 and the connecting relay ABT3. Contact *abt32* is opened and the rod magnet ST113 released. Further the contact *nh31* is opened. The bridge magnet BM4 is held over contact *bm41*. Contact *abt31* closes the following circuit for the rotary magnet DBZ of the marking selector IIBZ in which the marking selector takes up its normal position: —, in-

interrupting device *Un*, rotary magnet *DBZ*, contact *abt31*, wiper *bzc*, +. Over this circuit the marking selector is stepped on until it has reached its normal position. An impulsing of the rod magnet during the release of the marking selector is not possible since contact *abt32* holds the wiper *bza* disconnected. Also during the release of the marking selector one of the relays *KOP4*, *KOP5* cannot be energised since positive potential is connected to the wiper *bzc* only in the zero position at the conductor *Lan*. As contact *u82* is maintained open false impulse transmission over the line *Lst* on the release of the marking selector is prevented.

The talking connection of the two subscribers *T10* and *T29* to be connected is now completed. In the feeding bridge *Sp113* on the side connected to the subscribers set *T29* (call number 7629) only the circuit details necessary for the understanding of the invention are shown. This feeding bridge itself is arranged in known manner. By *WQ* a calling current source is indicated which comes into effect on the closing of the talking path. *Y113* is the feeding relay for the connected subscriber's set *T29*. The connection of the calling current *WQ* results on switching through, with the aid of contacts *ru1* and *ru2*.

The release of the setting path is initiated on the closing of the marking points *k45* to *k48* in the final selector *LW* in that the relay *DE113* operates on the switching through of the marking point *k47* (positive on contact *v1133* and negative on relay *DS4*).

The relay *DE113* opens the contact *de1131* when it is energised whereby the holding circuit for relay *PAS* of the finder switch *AS* is interrupted. The relay *PAS* restores and opens the test circuit of the group selector *EIGW* of the setting path by means of contact *pas4*. The relay *PGW2* restores and by means of contact *pgw23* closes the following release circuit for the group selector: +, contact *pgw23*, off normal contact *ko22*, contact *u21*, *a22*, rotary magnet *D2* of the group selector *EIGW*, -. The rotary magnet *D2* operates and closes contact *d21* over which the relay *A2* is energised. Relay *A2* opens contact *a22* whereon the rotary magnet *D2* restores. This interaction is repeated until at the end of the bank the off-normal contact *ko22* is opened whereupon from this rotary position the group selector *EIGW* reaches its normal position in known manner.

In the group selector *EIGW* (Fig. 13) relay *C4* restores. Contact *c41* opens the circuit for the test relay *PGW4* of the second group selector which releases. Contact *pgw43* closes a circuit for the rotary magnet *D4*. The rotary magnet *D4* operates and closes contact *d4*. In this way the relay *A4* is energised and over contact *a42* the rotary magnet *D4* is released. The rotary magnet restores and opens the circuit for the relay *A4* at contact *d4*. Over contact *a42* the rotary magnet *D4* is then energised. The interaction is continued until the wipers of the group selector have traversed the contact bank. The off-normal contact *ko41* is opened whereupon the group selector takes up its home position in normal manner. By the opening of contact *c41* the relay *C5* of the final selector *ELW* is also de-energised. In this way at contact *c52* the test relay *P5*, the winding *II* of the final selector is disconnected. The following circuit is completed for the rotary magnet *D5*: -, rotary

magnet *D5*, contact *c51*, *u53*, off-normal contact *ko53*, interrupter *Un50*, +. In this circuit the rotary magnet *D5* receives impulses until the opening of the off-normal contact *ko53*. Contact *ko53* is opened as soon as the wipers of the finder selector have traversed the contact bank whereupon the final selector takes up its normal position.

Metering of a connection which has been set up is undertaken by the operation of a feeding bridge *Y113* as soon as the called subscriber has hung up. The condition of the c-conductor to the calling side is as follows: On Fig. 3 the bridge magnet *BM10* and the meter *Z10* are connected in parallel to negative potential over contact *bm103* to the conductor *brcl* of the bridge multiple *Br10* of the subscriber *T10* of the pre-selector *IVWa*. The c-conductor of the bridge multiple *Br10* is connected over the coupling point *k3* with the c-conductor *stvc* of the rod multiple *STv11*. From this conductor the connection extends over the relay *M11* (Fig. 5) to conductor *Lc20* in the bridge multiple *Br91* of the second pre-selector *IIVWab* and from this over the coupling point *k43* to the relay *C113* of the feeding bridge *Sp113* (Fig. 7) over the conductor *Lc11*. Fig. 7 shows the relay *C113* with the necessary devices for metering, namely, with the resistance *W1*, contact *c1134* and the parallel contact *v1131*. Further the bridge magnet *BM91* (Fig. 6) holds over the same circuit (c-conductor of the calling connection) which is connected over contact *bm912*. At the moment of metering a metering relay not shown, in the feeding bridge *Sp113* (s. Fig. 7) connects earth momentarily to the c-conductor (*Lc11*) of the calling side at the contact *z113* by connecting contact *z113* to positive potential. In this way the current in the c-conductor is increased whereby at the calling set meter *Z10* (Fig. 3) is operated.

As already indicated the d-conductor of the incoming side of the talking path serves to transmit the impulse trains for setting the talking selector. The d-conductor is connected by the coupling relay *KOP* in the individual selecting stages to the indicating selector and disconnected therefrom as soon as the setting of the corresponding talking selector is completed. After the release of the setting path the d-conductor is switched through to the incoming side from the commencement of operation in the first pre-selector *IVWa* (Fig. 3) until the disconnection at the feeding bridge *113* (Fig. 7) without being locked.

When for example, the line to the subscriber *T29* is a trunk line, then between this line and its pre-selector a relay repeater is connected. The d-conductor can now be used for transmitting impulses to the feeding relay *A113* or a storing device connectable thereto can be used for the further selection over the line *T29*. Alternately the d-conductor can be used after the remote selection for transmitting a plurality of metering impulses from the relay transmitter to the line *T29* for the metering operations between the feeding bridge relay *A113* and the meter *Z10* of the calling line. A device which takes up the plurality of metering impulses is indicated in Fig. 7 on the feeding bridge *Sp113* by the reference *MZ*.

In the following the setting up of the talking path over an auxiliary group selector is described. When on the setting of the group selector *IGW* (Figs. 9 and 10) the two bridge multiples *Br31*

and Br32 connected to the feeding bridge Spl13 and indicated by 100—199 are engaged a connection is extended over one of the bridge multiples of the first group selector IGW that does not have a reference, for example of the bridge multiple Br33 of the third preselector IIIVW.

On Fig. 1 five such bridge multiples are shown in connection with the selector IGW.

From the description of the setting of the first group selector IGW (Figs. 9 and 10) it should be repeated that after the numerical setting of the selector IBZ by means of the relays Q and R in the marking selector IBZ (Figs. 9 and 10) an attempt is made to obtain one of the numbered bridge multiples Br31 or Br32. If however both bridge multiples are engaged it is indicated by the contacts *bm312* and *bm321* being open. The relay R (winding II) in the marking selector IBZ then restores whereby the contact *ri* closes the following energising circuit to impulse a free bridge multiple of the third preselector IIIVW: +, relay PST in the marking selector, contact *ubz1*, *q1*, *ri*, *um5II*, relay UM1, wiper *bzc* of the indicating selector IBZ in position 1, contact *bm332* of the bridge magnet BM33, bridge magnet BM33, —. This circuit is completed when the bridge multiple Br33 is free. If the bridge multiple Br33 is engaged this circuit extends however over the operated contact *bm333* to the bridge magnet of the next free bridge. In the impulse circuits described above the relays PST and UM (winding I) operate. The bridge magnet BM33 does not receive sufficient current however in order to pull up. The relay UM locks up over its winding II via: —, relay UM, winding II, contact *um3*, *abt2*, +. The contact *um1* prepares the circuit for the first auxiliary group selector which is reached over the bridge multiple Br33. The contact *pst1* closes the following energising circuit for the rod magnets ST25: —, magnet ST25, contact *kop102*, *pst1*, relay NH, +. The rod magnet ST25 prepares the coupling points of the bridge multiples Br33 with the rod multiples STv25. By the closing of contact *nh1* the current in the impulse circuit for the bridge magnet BM33 is increased so that this now operates. The contact *bm331* closes a holding circuit for the bridge magnet BM33 and for a relay C6 (Fig. 12) which is arranged in the auxiliary group selector IHGW on the conductor (Lc16 of the rod multiple STv6. The relay UM (Fig. 9) is a two step relay. It only pulls up in the strong energising circuit for the bridge magnet BM33 and thereby opens contact *um5II* and thus an impulsing of the following free bridge multiple of the third preselector does not occur at contact *bm333* after the operation of the chain of relays.

An auxiliary group selector is shown in Fig. 12 and it is assumed that the bridge multiple Br33 of the third preselector IIIVW (Fig. 10) the setting of which has been described above, has seized the upper right multiple STv6 of the auxiliary group selector IHGW of Fig. 12 on the energising of the relay C6 over the conductor Lc16. It is further assumed that the marking selector BZ6 associated with the auxiliary group selector IHGW is free. If this is the case the contact *c61* of the relay C6 closes the following circuit: —, interrupter Un6 in the marking selector BZ6, wiper *bzd* of the marking selector in its zero position, line L54, contact *c71*, *c61*, relay KOP6, ABT6, +. The relays KOP6 and ABT6 operate as soon as the interrupter Un6, has connected negative potential to the wiper *bzd*.

The auxiliary group selector IHGW must now

receive the digit "1" from the first group selector IGW (Figs. 9 and 10) since the selection of the digit "1" from seizing switch ABW (Fig. 7) is without effect on the group selector IGW (Figs. 9 and 10).

The condition of the c-conductor of the connecting path previously set up is at this moment as follows: In the first group selector (Figs. 9 and 10) the rod multiple STv25 has been seized and the relay C10 energised. The part of the c-conductor of the multiple STv25 extending to the third preselector IIIVW is guarded against direct current by means of the condenser K101. In spite of the closing of the coupling point in the c-conductor on the bridge Br33 the switching through relay DS1 (Fig. 9) cannot operate. Further on the seizing of the first group selector IGW by the incoming second preselector coupling relay KOP10 has been energised whereby the contact *kop103* which is connected with the contact bank of the wiper *bzf* of the marking selector IBZ (Figs. 9 and 10) has prepared the circuit. When now the relay UM operates when the marking selector IBZ steps on to the 3rd preselector IIIVW contact *um1* closes the following circuit: —, interrupter Un5, rotary magnet DBZ of the marking selector IBZ, contact *um1*, wiper *bzf* in position 1, contact *kop103*, *ds16*, d-conductor of the rod multiple STv25, coupling point *k71*, line Ld16, (Fig. 12), contact *kop61*, zero contact in the contact bank of the wiper *bzc* of the marking selector BZ6, wiper *bzc*, relay U6, rotary magnet DBZ6, +. The interrupter Un5 operates the rotary magnet DBZ in the marking selector IBZ as well as the rotary magnet DBZ6 in Fig. 12. Further this interrupter operates the relay U6 (Fig. 12) which remains energised during the individual impulses of the impulse train however. The marking selector in the first group selector IGW (Figs. 9 and 10) is stepped on by 10 impulses from its position 1 to position 0. The marking selector BZ6 of the auxiliary group selector is stepped on by these 10 impulses over positions 10, 9, 8, to position 1. Thus the digit "1" from the marking selector IBZ is transmitted to the marking selector BZ6. In the marking selector of the first group selector (Figs. 9 and 10) the wipers reach 0. In this position the previously mentioned circuit of a wiper *bzf* is interrupted so that both marking selectors are stopped in the positions which they have taken up. In the marking selector BZ6 (Fig. 12) the slow relay U6 restores. During the energising of relay U6 the contact *u63* has energised the slow relay Q6 over its winding I and over the contact *abt62* which has been closed. Relay ABT6 is maintained energised on the stepping on of the wiper *bzd* of the marking selector BZ6 in series with the coupling relay KOP6 over contacts *c61*, *kop61*.

When, after the transmission of the impulse train the relay U6 in the marking selector BZ6 restores, the following energising circuit is completed for the test relay PST6: +, relay PST6 (winding II and I, contact *u61*, *q61* still operated for a time), winding II of relay Q6 wiper *bza* of the marking selector BZ6, line 100, contact *bm61*, bridge magnet BM6, —. The bridge magnet BM6 does not yet operate. The relay PST6 closes the energising circuit for the relay NH6 and the rod magnet ST6 over contact *pst61* as follows: +, relay NH6, contact *pst61*, *kop62*, rod magnet ST6, —. The contact *nh61* of the relay NH6 is operated whereby the current in the energising circuit for the bridge magnet BM6 is

increased so that it operates. The contact *bm61* is operated and connects the holding circuit for the bridge magnet *BM6* to a positive potential on the rod multiple of a second group selector which is seized by the bridge multiple *BR6*.

If after the setting of the marking selector *BZ6* the bridge multiple *Br6* is found to be engaged then the relay *Q6* restores after a moment since a holding circuit is not completed for winding II. The contact *q61* operates the impulse circuit for the bridge magnet on the wiper *bzb* so that the bridge magnet *BM1*, should it be free, is energised. By the operation of one of the bridge magnets the rod multiple *STv6* is then connected through with the corresponding bridge multiple at the coupling points indicated by a small circle. The relay *DS6* is energised (over positive potential on a seized relay *C10*, Fig. 9). Contact *ds61* then effects the release of relay *C6* and this de-energises the relays *KOP6* and *ABT6*. Relay *ABT6* carries out the setting of the marking selector *BZ6* to its normal position in known manner as is described in the case of the relay *ABT* (Fig. 9) for the marking selector *JBZ*. The switching through of the *c* and *d* conductors in the group selector *IGW* (Figs. 9 and 10) takes place as follows: When the bridge magnet *BM6* in the auxiliary group selector *IHGW* operates, the contact *bm61* opens the energising circuit for the relay *PST6*, the relay *PST6* restores and opens at contact *pst61* the energising circuit for the relay *NH6* and the rod magnets *ST6*. The relay *NH6* restores slowly in view of its delayed release. Alternating current now flows over the following circuit to the relay *DS1* (Fig. 9): alternating current source *We* at contact *pst62* (Fig. 12) contact *nh62*, *kop64*, conductor *Lc16* (Fig. 5) *c*-conductor of the bridge multiple *Br33* of the third preselector *IIIVW* (Fig. 10), coupling point *k70*, condenser *K101*, relay *DS1*, —. The relay *DS1* operates whereby the contact *ds13* short-circuits the condenser *K101*. The relay *DS1* holds over positive potential connected to the seizing relay *C6* of the auxiliary group selector and later to a seizing relay of a second group selector (e. g., group selector *IIGW15*, Fig. 12) which for example is connected in a similar manner to the relay *C10* in the first group selector *IGW* (Figs. 9 and 10). Further contact *ds11* (Fig. 9) opens a circuit of the relay *C10*. The contact *ds12* switches through the *c*-conductor. The *d*-conductor is switched through over contact *ds15*. By the release of relay *C10* the contact *c102* is opened so that the marking selector *IBZ* of the first group selector *IGW* is made ready for seizing again in the manner already described.

In the following a special method of operating the contact *um4* in the marking selector *IBZ* of Fig. 9 will be described. When for example in the setting up of any connection the relay *C12* operates over an incoming second preselector (not shown) and the coupling relay *KOP11* and the relay *ABT* are operated over contact *c122*, then if it is assumed that the connection is to extend over one of the bridge multiples of the third preselector *IIIVW* the following switching operation is undertaken: As already described on the setting up of the connection of the auxiliary group selector the setting back of the marking selector of the first group selector to normal takes place although the relay *ABT* is still energised. During this operation of the marking selector a new connection can be made for example over the relay *C10* so that at the

contact *c102* the relay *KOP10* is energised as positive potential is connected over the wiper *bzd*. In order to prevent too early connection of the marking selector still operating together with the auxiliary group selector *IHGW* when it finds a new seizing over relay *C10*, the relay *UM* which has been energised at contacts *um4* opens the energising circuit for the coupling relay. Only when the above described switching through occurs does the relay *C12* restore and open the contact *c122* of the holding circuit for the relay *ABT*. In this way also the holding circuit for the winding II of the relay *UM* is opened at contact *abt2* so that contact *um4* closes the energising circuit for the coupling relay. It should be noticed that in Fig. 2 the five bridges of the third preselector in the group selector *IGW* (40) lead to various group selectors *IHGW* and second group selectors so that over the bridge multiple of the third preselector there is always a free path to the second group selector in the desired traffic direction.

When in the setting up of the connection described the bridge multiple *110—119* in the second group selector (Fig. 2) is engaged the connection is passed over a free bridge multiple of the fourth preselector *IVVW* to a second auxiliary group selector, e. g., auxiliary group selector *IIHGW*. This connection is set up in exactly the same manner as a connection over the first group selector *IHGW* so that a description of the switching operations are superfluous.

Since the second preselector as already described has 25 means of access and these means of access stand at the disposal of 10 outgoing lines only, it is necessary to guard the remaining 15 access means when the 10 outgoing lines have been seized. In Fig. 6 two seizing relays (*C112*, *C113*) for the outgoing lines to the second preselector *IIVWab* are shown. Altogether there are 10 sets of seizing relays for the feeding bridges *SP110* to *SP119*. When all seizing relays *C110* to *C119* are energised an energising circuit is closed for a locking relay *RSP* which is indicated to the right in Fig. 6. This has 25 contacts namely one for each bridge multiple in the preselector. As is shown in Figs. 5 and 6 both rod multiples of the first preselector are extended to the same outgoing second preselector *IIVWab*. The uppermost rod multiple of the first preselector *IVWa* and the bridge multiple *Br91* of the second preselector *IIVWab* have been seized for the connection previously described. If it is assumed that nine other connections are existent the other access means to the second preselector namely the access means over the bridge multiple *Br90* are guarded revertively.

The locking relay *RSP* for the second preselector is energised. Two of its 25 contacts are seen in Figs. 5 and 6, actually the contacts *rsp1* and *rsp2*. These contacts energise the second windings of the chain relays *M11* and *M21*. The relay *M11* has been already energised in the connection described but the relay *M21* has not yet been energised. When now the contact *rsp2* energises the winding II of relay *M21*, contact *m211* (Fig. 3) connects the chain for energising the rod magnets of the first preselector although the lower rod multiple *STv12—STv42* shown is for the time being not required. In this manner after the 10 bridge multiples of the second preselector *IIVWab* have been taken into use the other 15 bridge multiples of the preselector are guarded.

The release of a talking connection follows on

the hanging up of the receiver at the calling station. In Fig. 7 the relay A113 is energized during the conversation. The positive potential connected to the relay C113 is the holding potential for magnets on the calling side and the positive potential connected to contact v1133 is the positive potential for all the holding magnets at the called side. When the required subscriber has hung up the relay Y113 restores but this is without any further effect on the setting up of the connection. Only on the hanging up of the receiver at the calling station is winding I of the relay V113 restored on the release of relay A113. In this way by the opening of contact v11311 the c-conductor Lc11 is disconnected from the calling side of the feeding bridge Sp113. The holding magnets which are connected to the c-conductor are restored. The contact c1134 remains open for a short while so that the release of these magnets is ensured. By the opening of contact v1133 the c-conductor of the outgoing connecting side is opened whereby all holding magnets are also restored. When these magnets have restored all components take up their initial positions.

Another attempt to reach the subscriber T29 will meet with an engaged line. It has been described that the calling subscriber receives the engaged signal when the line selector ELW (Fig. 13) of the setting path does not find a seizing potential over the wiper clw. When now the calling subscriber hangs up, the setting path as well as the connection of his line to the feeding bridge is released. It has already been described that, on the release, the relay C113 (Fig. 7) restores, and in this way the talking path is released. The contact c1132 shown in Fig. 7 now opens so that the holding circuit for the relay PAS is opened. The relays V113 and PAS restore so that the setting circuit is released.

In Fig. 1 the rod multiples of the four first preselectors IVWa, IVWb, IVWc and IVWd connected together to a frame are shown as plain multiples. A better utilisation of the outgoing lines is obtained by grading them and the lines of the multiple arrangements in the free selecting stage can be increased while keeping the same number of hunting points on the selector when the multiples for each connection are hunted for over positions extending from a first to a last and when the lines hunted for later are multiplied over, more seizing selectors than the first lines hunted for.

The seizing chain which is indicated by contacts m111 and m211 of Fig. 3 which are controlled by means of the relays M11 and M21 (Fig. 5), is privileged as far as concerns the rod multiple connections Stv1, Stv12, etc., of the series so that the rod multiples of the four first group selectors connected to a frame are arranged as a complete panel.

In Figs. 14 and 15 a graded multiplying is shown for the first preselector stage. The digits 1, 2, 3, 4 to 14 indicate 4-conductor rod multiples for the first preselector stage the multiple connections 1 representing the multiple connections of a first preselector arranged with 20 bridge multiples, and for multiple connections 2 and the multiple connections 3—8 being arranged in the same way. The multiple connections 9, 10, 11 and 12 extend as plain multiples over two preselectors connected with one another while the multiple connections 13 and 14 represent the rod multiples of 4 first preselectors connected with one another each having 20 bridge multiples.

The rod multiple 1 is the first line hunted for in the bridge multiples of the subscribers 10 to 29, the multiple 2 is the same for the subscribers 30 to 49, multiple 3 for the subscribers 50 to 69, and the multiple 4 for the subscribers 70 to 89. The multiple arrangement 8 is the multiple line hunted for in the 3rd position which is however also accessible to the subscribers 10 to 49. The rod multiples 13 and 14 extend over all bridge multiples of the subscribers 10 to 89. The 80 subscribers which are indicated on Figs. 3 and 4 are according to Figs. 14 and 15 connected to 14 graded outgoing lines which are at their disposal. Since the remaining construction of the co-ordinating selector shows 10 rod multiples, it is easy to see that the 4 rod multiples not shown in Figs. 14 and 15 can be divided up in a similar manner. However by using the grading according to Figs. 14 and 15 with 8 rod multiples for each selector a sufficient number of outgoing lines (14) can be reached.

Each rod multiple 1 to 14 of Figs. 14 and 15 has a relay M (M1 to M14 not shown) each with a winding connected in the c-conductor and an auxiliary winding for the revertive guarding. These relays are connected in the same manner as the relays M11 and M21 shown in Fig. 5.

For the 20 bridge multiples of the subscribers 10 to 29 the chain connections consisting of the relay contacts m11, m51, m91, m111, m131 and m141 are used. The bridge multiples of the subscribers 30 to 49 have only two access means of their own which are controlled by contacts m21 and m61. In the same way there are only two access means for the bridge multiples of the subscribers 70 to 89 and the access means are provided with contacts m41 and m81. For the bridge multiples of the subscribers 50 to 69 the access means m31, m71, m101 and m121 are used.

The chain connection beginning with contacts m21 and m61 is further connected with the chain consisting of the contacts m91 to m141. Also the chain connection beginning with the contacts m31 and m71 is connected with the contacts m41 and m81.

In addition to the control of the chain connections formed by the contacts m11 to m141 the appropriate rod magnets must be energized. In order to energize these the relay connections shown on the lower part of Figs. 14 and 15 are used. The relays TB1, TB3, TB5 and TB7 indicated here correspond to the relays indicated on Figs. 3 and 4 by TB10, TB30, TB50 and TB70. The relay BL1 corresponds to the relay BL of Fig. 3 but a locking relay so operating is provided in the arrangement of Figs. 14 and 15 for each subscriber sub-group and actually for the subscribers 10 to 29, the relay BL1 is provided, for the subscribers 30 to 49 the relay BL3, for subscribers of the sub-group 50 to 69 the relay BL5, and for the subscribers of the sub-group 70 to 89 the relay BL7. The contacts tb1, tb31, tb51 and tb71 operate in the same manner as the contacts tb101 and tb701 of Fig. 2. The relays BL1, BL3, BL5 and BL7 serve to prevent double connections in the same manner as the relay BL of Fig. 3. The relay BL5 however operates for example over contacts b152 only on the contacts of the chain m31, m71, m101, m121 while for the remaining rod multiples (13 and 14) which serves for the subscribers bridge multiples 50 to 69 the relay BL1 with control contact b112 is accessible.

This dependence is further controlled by other

m-contact chains. Thus for example the relay TB5 the subscribers group 50/69 operates together with the relay BL5 so long as one of the relays M3 to M12 (contact chain *m*31, *m*71, *m*101, *m*121 and the appropriate contacts *m*32 to *m*122 and *m*33 to *m*123) which are operated at the same time as the contacts *m*31 to *m*121 are in their normal position.

In order to describe the effect of this chain an example will be considered:

When the subscriber 30 makes a call the call relay R30 not shown is operated and corresponds in its effect to the relay R10 of Fig. 3. The subscribers relay 30 then closes the contacts indicated in Fig. 14 by *r*302. If it is assumed that the rod multiple 2 is already seized and the corresponding relay M2 which is reached over the rod multiple line is energised the contacts *m*21, *m*22 and *m*23 are operated. On the closing of the contact *r*302 the following circuit for the energising of the relay TB3 is completed: +, contact *r*302, relay TB3, contact *tb*32, *m*22 (operated) *m*62 (in normal position), *b*131, —. The relay TB3 operates and energises the relay BL3 in the following circuit: —, relay BL3, contact *m*63, *m*23 (operated) *tb*33, relay TB33, contact *r*302, +. The relay TB3 by closing the contact *tb*31 effects the energising of the rod magnet ST6 after the relay G6 has energised previously over the contact *b*132, the contact *m*61 (in normal position) and the operated contact *m*21. The release of the relays TB3 and BL3 takes place on the release of the relay R30 associated with the calling line in the same way as described in considering the effect of relay R10 in Fig. 3.

If the subscriber 30 makes a call at a certain point of time when only the rod multiples 13 and 14 are free the relay BL1 is energised. All contacts of the chain relays M2 to M11 are operated. On the closing of contact *r*302 the following circuit is then completed: +, contact *r*302, relay TB3, contacts *tb*32, *m*22, *m*62 (both operated), contact *b*111, —. The contact *tb*33 closes the energising circuit for the relay BL1. This extends as follows: +, contact *r*302, relay TB3, contacts *tb*33, *m*23, *m*63 (both operated), relay BL1, —. By the closing of contact *b*112 positive potential is connected to the relay G13 which is connected over the contact *m*131 (in its normal position), and the operated contacts *m*111, *m*91, *m*51, *m*11, with negative potential. Relay G13 by closing the contact *g*13 effects the energising of the rod multiple ST18. The energising of the bridge magnet associated with the subscriber 30 takes place in the same manner as was described in connection with the bridge magnet BM10 of Fig. 3.

The grading of the first preselector therefore features the use of a plurality of chains which work together in the manner indicated in Figs. 14 and 15.

Figs. 16 and 17 show a setting path which is suitable for traffic with other exchanges. As already described after the setting of the final selector of the setting path (ELW, Fig. 13) an impulse is transferred to the required station whereupon in a few seconds the talking path is set up over which current then flows to the required station. If it is assumed that the junction line extended to the subscriber T29 leads to another exchange it is advisable after the impulsing of the neighbouring line, immediately to send out calling current so that a line which has been impulsed in the neighbouring system is not seized over an outgoing connection.

The setting path shown in Figs. 16 and 17 is for the purpose of sending out calling current on the impulsing of a required junction line. Moreover up till the closing of the final talking path a momentary talking connection is completed by the impulsing of the final talking path over the setting path which is replaced by means of the usual talking path after the setting of the talking selector. Further the final setting selector ELW of Fig. 17 has the possibility of selecting several junctions.

In the upper left-hand corner of Fig. 16 the feeding bridge of Fig. 7 already described in detail is shown again. The setting group selectors EIGW and EIIGW are differentiated from the corresponding setting selectors on Figs. 7 and 13 by the additional talking conductor (*b*-conductor). The setting final selector ELW is shown more in detail with the devices for free selection of multiple junctions so that in the described arrangement the multiple junctions are connected to a particular 100's group (or 1000's group) so that the individual lines can be set out according to the representation of Fig. 13.

If the calling subscriber has sent out the first two digits for reaching a required line the selectors EIGW and EIIGW are set in the same manner as was described with reference to the corresponding selectors for Figs. 7 and 13. When the second group selector EIIGW, Fig. 16, seizes the final selector relay C7 of the final selector is operated. By the selection of the third digit which in the described embodiment is assumed to be "2" the contact *a*1132 is set back, twice to its normal position on the two-fold release of the relay A113. In this way the relay A7 in the final selector ELW is energised over the following circuit: +, contacts *a*1132, *v*111321, wiper *asa* of the finder switch AS, contact *pas*3, contact *pgw*21 of the test relay of the first group selector of the setting path, wiper *agw*1, contact *pgw*41 of the test relay of the second group selector in the setting path, wiper *agw*II, relay A7 (winding I), —. The relay A operates its contact *a*71 so that the vertical magnet H7 of the final selector is operated twice. In this circuit the slow relay V7 also operates in the following circuit: +, contact *a*71, relay V7, contact *u*73, *w*71, magnet H7, —. The final selector steps on its wipers by two steps and operates the rotary off-normal contact KO71 in making the first step. After the impulse train the relay V7 restores whereby the relay U7 is energised in the following circuit: —, vertical magnet H7 (H7 does not operate in this circuit), rotary off-normal contact W71, relay U7, winding I, contact *c*13, *v*14, closed vertical off-normal contact KO71 +. By the operation of the relay U7 a circuit is prepared over the contact *u*73 for the rotary magnet D7 over which this is operated by means of the last impulse train sent out from the calling station. This circuit extends from + over contact *a*71, relay V7, contacts *u*73, *p*75, rotary magnet D7, —. On the first rotary step of the final selector the rotary off-normal contact *w*71 is opened. The relay U7 remains energised however over its winding II in the following circuit: —, winding II of relay U7, contacts *u*76, *v*75, +. The relay V7 is maintained energised in the stepping circuit of the rotary magnet during the impulse train. The digit "9" is assumed to be the last impulse digit sent out from the calling station.

The final selector ELW after the selection of the digit "9" rests with its wipers on the first

connection of the local system which is marked by the digit 7629. This line is already engaged. Accordingly the test circuit extending over the wiper *clw* of the final selector over the line *Lc18* to relay *R29* is opened at contact *bm291*. The further stepping on of the final selector from the engaged line is performed with the aid of the multiple contact *mk*. Such contacts are known per se (e. g. in Lubberger's book, "Automatic Telephone Installations," vol. 5, Fig. 163). The last tooth of the multiple contact *mk* is cut away so that the last connection of the multiples is tested as an individual connection.

Since the test circuit for the relay *P1* is not closed for the first connection the rotary magnet *D1* operates again in the following circuit: —, rotary magnet *D1*, contacts *p15*, *u15* (relay *V1* has meanwhile restored) multiple contact *mk*, contact *v14*, *K011*, +. The rotary magnet *D1* operates and the contact *d11* controlled by it is closed. In this way the relay *U1* is energised over its winding II in the following circuit: —, winding II of relay *U1*, contacts *d11*, *v14*, *K011*, +. The contact *u15* opens the circuit for magnet *D1* whereby on the release of the rotary magnet the contact *d11* brings about the release of the relay *U1* (winding II). This reciprocal interaction is repeated until the relay *P1* operates by finding a free line. The following circuit is then completed: +, contacts *c11*, *v13*, *u18* (from the last rotary step still closed), relay *P1*, wiper *clw*, line *LC18*, *R* relay of the free junction line found. This *R* relay is connected in the same way as the relay *R29* shown. The bridge multiple appertaining to a multiple connection can be set up in any desired preselector so that heavy traffic to this junction can be divided up according to the requirements of the exchange. The bridge multiple impulsed over the final selector *ELW* now switches through on to an incoming second preselector in the manner previously described whereby over the switched through *d*-conductor (*Ld18*, *L66*) the conducting selector is positioned.

The corresponding relay *P1* opens the stepping on circuit for the rotary magnet *D1* at the contact *p15* and at the contacts *p11* and *p12* switches through a talking circuit. This extends over the conductors *la18*, *Lb18* to the conductors *la19*, and *Lb19*. The conductors *La18* and *Lb18* are switched through over the *a*- and *b*-conductors of the group selectors *ELIGW* and *EIGW* and of the wipers *asa* and *asb* of the finder switch *AS* to the lines *Lal1* and *Lbl1* leading to the calling station. These conductors are insulated from the feeding bridge *Sp113* for direct current by means of the condensers *Kon1* and *Kon2*.

Since the relay *U1* in the final selector *GLW* remains energised after energising relay *P1* for its release period the relay *U1* operates again over the following circuit: +, contact *u12*, winding II of relay *V1*, contact *p15*, rotary magnet *D1*, (which does not operate), —. The contact *v12* sends the first call impulse to the line 7629. This circuit extends from the alternating current source *Ru* over contacts *v12*, *p11*, wiper *clw*, conductor *La18*, loop at the called station line *Lb18*, wiper *blw*, contact *p12*, choke *Y1*, +. After the slow release of relay *U1* (winding II) this flow of current is terminated. The usual further call does not take place. In such a case the normal talking path over the talking selector back to the feeding bridge relay *Y113* of the feeding bridge *Sp113* may already be closed and the calling current from the setting final selector

ELW energises the feeding bridge *Y113* and so simulates a reply.

If the local operator has not replied up to the switching through to the feeding bridge *Y113* a further call takes place in the manner previously described from the feeding bridge *Y113*. When however she has already previously replied and has conversed over the talking path comprising the setting path then on the switching through of the normal talking path the feeding bridge relay *Y113* operates and immediately disconnects the call current. After the completion of the normal talking path the setting path is released as previously described.

When the setting final selector *ELW* (Fig. 17) finds the last multiple connection (*mk* tooth missing) the final selector does not rotate any further and the calling station receives the engaged signal over the following circuit: +, contacts *c14*, *p11*, winding II of relay *A1*, off-normal contact *w12*, engaged signal *BeS*. This signal is transmitted inductively to the calling station over the winding I of the relay *A1*.

On the release of the setting path there follows the opening of the *c*-conductor as described already in connection with the setting path of Figs. 14 and 15. Accordingly the relay *C1* restores in the final selector *ELW* and opens the circuit for the energising windings of the relay *P1*, at the contact *c11* and *c15*. The contact *c13* closes the following stepping on circuit for the rotary magnet *D1*: —, magnet *D1*, contacts *p15*, *u15*, *c13*, *v14*, vertical off-normal contact *k011*, +. The contact *d11* of the rotary magnet energises the relay *U1* over: —, winding II of relay *U1*, contacts *d11*, *v14*, *K011*, +. The rotary magnet *D1* and the relay *U1* remain up until the vertical off normal contact *K011* is opened whereupon the final selector *ELW* is restored to normal in known manner.

If the line 7629 is used as a trunk line for automatic trunk traffic the setting final selector *ELW* is used as an intermediate selector. The calling subscriber can then further select over the setting path without a pause after the selection of the marking digit (7629) of the trunk line, while the talking path is set up over the *d*-conductor which is not required for the numerical selection of the subscriber.

If the setting paths are also used for junctions between individual connections as talking paths to be used momentarily and arranged to call to a required line found to be free then both subscribers if the required subscriber replies immediately can carry on over the setting paths until after a few seconds the talking path is set up.

It should be pointed out that the talking path (Figs. 1 and 2) which is set up from the called station to the feeding bridge in the talking path can also be set up in the reverse order from the outgoing side to the incoming side. In such a case the rod multiples of the second incoming preselector (Fig. 1) must have references as is shown for example in the case of the first rod multiple *st81* extending to the first group selector *IGW* of Fig. 1, as the rod multiple *st81* has received the number 315. The first group selector must then be connected to a feeding bridge and the outgoing connection of the incoming second preselector to the rod multiples of the final selector. Then, as well as an incoming second preselector, an outgoing line, for example 315, seized, must be connected to an impulse transmitter or a seizing switch which sends the corre-

sponding digit train over setting paths to the marking selectors which are set according to the train from the feeding bridge side. The marking of the connected feeding bridge undertaken by the finder switch in the embodiment shown is then replaced by the marking from the device for determining the digit of the seized outgoing line (315).

I claim:

1. In an automatic telephone system having separate setting and speaking routes for extending connections between calling and called lines, a control point, automatic switches controlled over a calling line for extending connections to said control point, another series of automatic switches controlled one after another over the calling line to extend a setting connection progressively to the line of a called subscriber, each of said last switches operated in turn over the preceding switch in said series as said setting connection is extended, a third series of switches each having several incoming lines and several outgoing lines accessible thereto, and means controlled from said control point for operating said third series of switches to extend a speaking connection from the called line to the control point and release the setting connection.

2. A telephone system as claimed in claim 1 wherein there is a setting switch for each switch in said third series, means for controlling each of said last setting switches from the control point to complete a connection through its associated switch, and means for then releasing the controlled setting switch.

3. In an automatic telephone system, calling and called subscribers' lines, a plurality of feeding bridges, means controlled from a calling line for automatically extending a connection to one of said bridges, a common control mechanism, means responsive to the seizure of a bridge for associating said mechanism therewith, a series of automatic switches, means controlled by the calling subscriber for operating said switches to extend a connection to a called subscriber's line, a second series of automatic switches, and means controlled by said common mechanism for automatically controlling said second series of switches to then extend a talking connection from the called subscriber's line to said bridge to thereby complete a talking connection to the calling line.

4. A telephone system as claimed in claim 3 wherein each switch of said second series is a cross-bar switch having a plurality of incoming leads and a plurality of outgoing leads accessible thereto and a control switch and wherein the control mechanism controls the control switch of each cross-bar switch to extend a connection therethrough and then release the control switch.

5. In a telephone system having calling and called subscribers' lines, a plurality of common control devices, means including one of said devices controlled from a calling line for extending a connection to a called line, a series of cross-bar switches each having a setting switch, means automatically controlled by said one device for controlling the operation of the setting switches of a plurality of said cross-bar switches to extend a separate connection from the called line through the cross-bar switches to the calling line, said last means controlling each setting switch in turn over the previously operated cross-bar switch, and means for then releasing the first extended connection and all operated setting switches.

6. A telephone system such as claimed in claim 5 wherein each said setting switch normally has access to a particular outgoing trunk line when operated by a particular number of impulses from said control device.

7. A telephone system such as claimed in claim 5 wherein each setting switch has access to either of two outgoing lines when operated by impulses representing a particular digit, an auxiliary switch, and means controlled by the setting switch for extending the connection over the auxiliary switch whenever the two trunk lines are found busy.

8. In a telephone system, an automatic switch having a plurality of incoming lines and a plurality of outgoing lines each accessible to all of said incoming lines, a special outgoing line in said switch also accessible to all of said incoming lines and common to all of said first outgoing lines, an auxiliary switch for controlling said automatic switch, means for seizing one of said incoming lines at different times and operating said auxiliary switch directly to select particular different ones of said first outgoing lines, said auxiliary switch effective to test the particular selected outgoing line at each of said times and to cause said automatic switch to extend a connection thereover if the selected line is found idle, and means controlled by said auxiliary switch whenever any one of said first outgoing lines is selected and found busy to cause said automatic switch to extend a connection over said special outgoing line.

9. In a separate setting and speaking route system wherein connections are extended from a calling to a called subscriber's station by means of one set of automatic switches and later a talking connection is set up between said stations, primary and secondary switches accessible to all subscribers, there being one primary switch and first and second groups of secondary switches accessible to each line, means controlled in response to a call from a line to operate its primary switch and a secondary switch in the first of its associated groups, and means operated during the extension of a talking connection for operating the primary switch associated with the called line and a secondary switch in the second of its associated groups.

10. In a telephone system, subscriber lines, primary non-numerical switches associated with the lines, two groups of secondary non-numerical switches accessible to each line, means responsive to a call from a line to operate a primary non-numerical switch and a secondary switch in one group to extend a connection therefrom, means responsive to a call extended to a line for operating the primary non-numerical switch associated therewith and for operating a secondary non-numerical switch in the other group accessible thereto, to extend a connection thereto.

11. A telephone system as claimed in claim 10, wherein each of said connections extended includes two talking conductors, a third conductor for guarding the connection and a fourth conductor for determining whether the call is outgoing from or incoming to the subscriber's line.

12. In a telephone system wherein connections are extended between calling and called lines in accordance with the transmission of impulses corresponding to digits of called numbers, a cross-bar switch forming one switching stage and always operated in accordance with a particular order of digit, a plurality of lines incoming to the switch, a plurality of groups of outgoing lines

extending from the switch, each of said groups corresponding to a different digit value, other lines outgoing from the switch, each of said other lines common to all of said groups, means responsive to the transmission of any digit to the switch to connect with and test the outgoing lines corresponding to that digit, and means operated when the outgoing lines of any of said groups are tested and found busy to extend a connection over one of the other outgoing lines.

13. In a telephone system wherein connections are extended between calling and called lines in accordance with the transmission of impulses corresponding to digits of called numbers, a cross-bar switch forming one switching stage and always operated in accordance with a particular order of digit, another cross-bar switch, outgoing lines extending from said first switch corresponding to each digit value, outgoing lines extending from said other switch also corresponding to each digit value, other lines outgoing from said first switch to said other switch, means responsive to the transmission of any digit to said first switch to connect with and test the outgoing lines corresponding to that digit, means operated when those outgoing lines are busy to extend a connection over one of the other outgoing lines to said other switch and to automatically transmit over said connection impulses corresponding to said digit, and means controlled by said impulses for operating said other switch to extend a connection over one of the outgoing lines corresponding to said digit.

14. In a telephone system, an automatic switch, a plurality of groups of lines outgoing from said switch, the different groups of said lines corresponding to different digits, an overflow line outgoing from said switch, means for extending a connection to said switch and controlling said switch thereover in accordance with any digit, said switch thereupon effective either to extend said connection over an idle one of the lines in the group corresponding to said digit or, if none of the lines in that group are available, to extend said connection over said overflow line.

15. In a telephone system, two automatic switches, a plurality of groups of lines outgoing from one of said switches, the different groups of said lines corresponding to different digits, a plurality of groups of lines outgoing from the other of said switches, said last groups corresponding respectively to the groups outgoing from said one switch, a line outgoing from said one switch to said other switch, means for ex-

tending a connection to said one switch and controlling same thereover in accordance with any digit, said one switch thereupon effective either to extend said connection over an idle one of the outgoing lines in the group corresponding to said digit or, if none of the lines in that group are available, to seize the line outgoing to said other switch, and means associated with said one switch then effective to automatically control said other switch to extend a connection over an idle one of the outgoing lines in the group corresponding to the unavailable group in said one switch.

16. In a telephone system, an automatic switch, a connecting path outgoing from said switch over which connections may be extended in any of a plurality of different traffic directions, other connecting paths outgoing from said switch over each of which connections may be extended in but a particular one of said different traffic directions, means for seizing said switch and controlling same in accordance with the traffic direction in which it is desired that the switch shall extend a connection, said switch thereupon effective either to extend said connection over that one of said other paths over which connections may be extended only in the desired traffic direction or, if that path is not available, to extend said connection over said first connecting path.

17. In a telephone system, a plurality of lines, a connective link common to said lines, means for seizing said link over any calling one of said lines and controlling it to extend a connection to any desired other one of said lines, means common to said lines and associated with said link operated to identify said calling line, means controlled by said last means to transmit the identification of said calling line over said connection extended to the desired line, and means controlled over said desired line by said transmitted identification to extend another connection from said desired line to said calling line.

18. In a telephone system, a calling line and a called line, cross-bar switches and two-motion step-by-step switches, means for completing a connection from said calling line to said called line over a plurality of said step-by-step switches in series, means controlled over said connection after same has been extended to said called line to complete a by-path connection around said step-by-step switches over said cross-bar switches, and means for then releasing said step-by-step switches.

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