Dec. 19, 1939. E. JAUCH ET AL 2,183,839

AUTOMATIC TELEPHONE SYSTEM

Filed Oct. 21, 1937 3 Sheets-Sheet 1

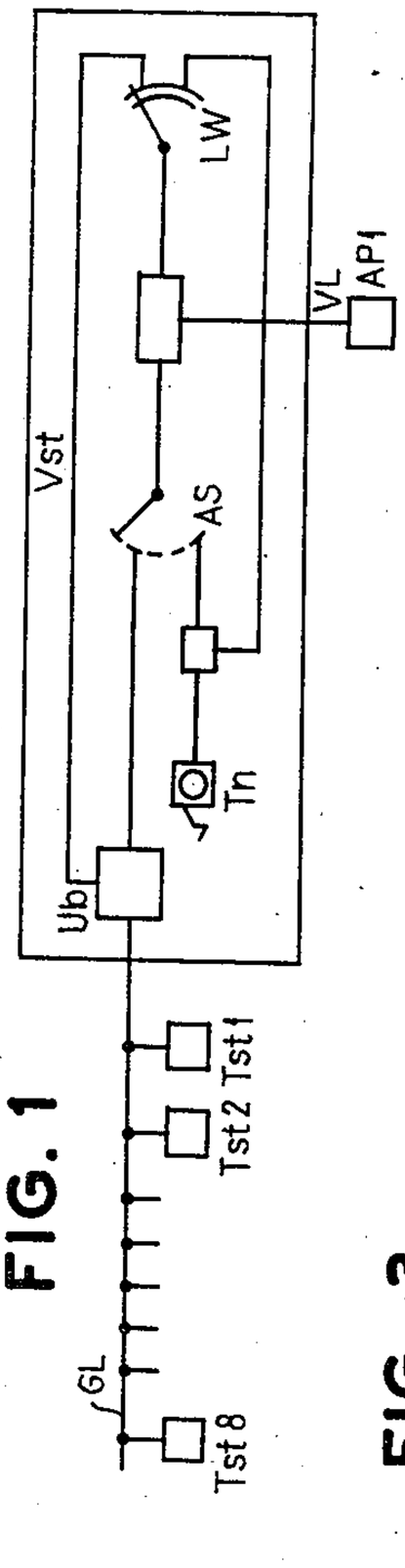


FIG. 1

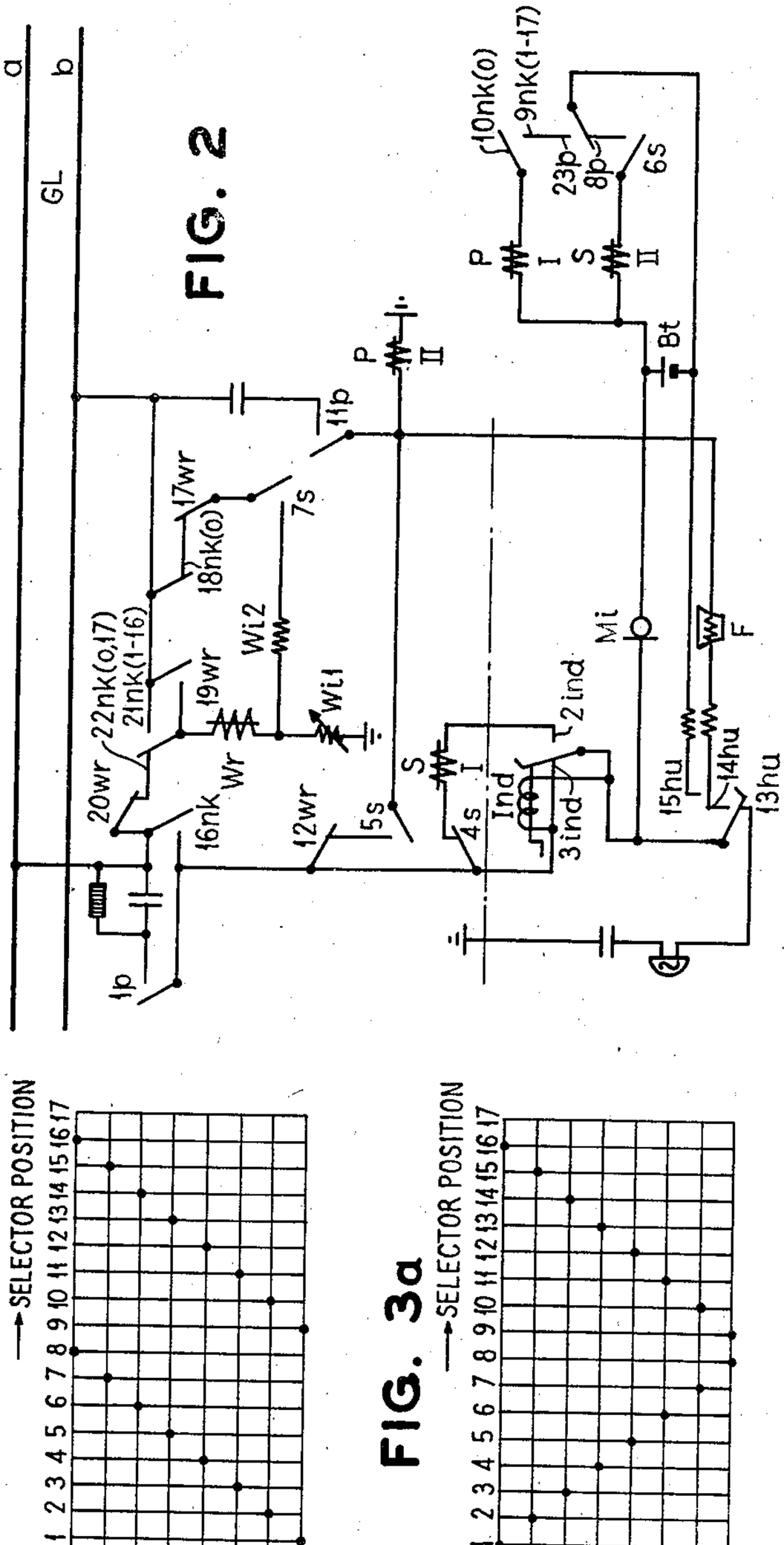


FIG. 2




FIG. 3




FIG. 3a

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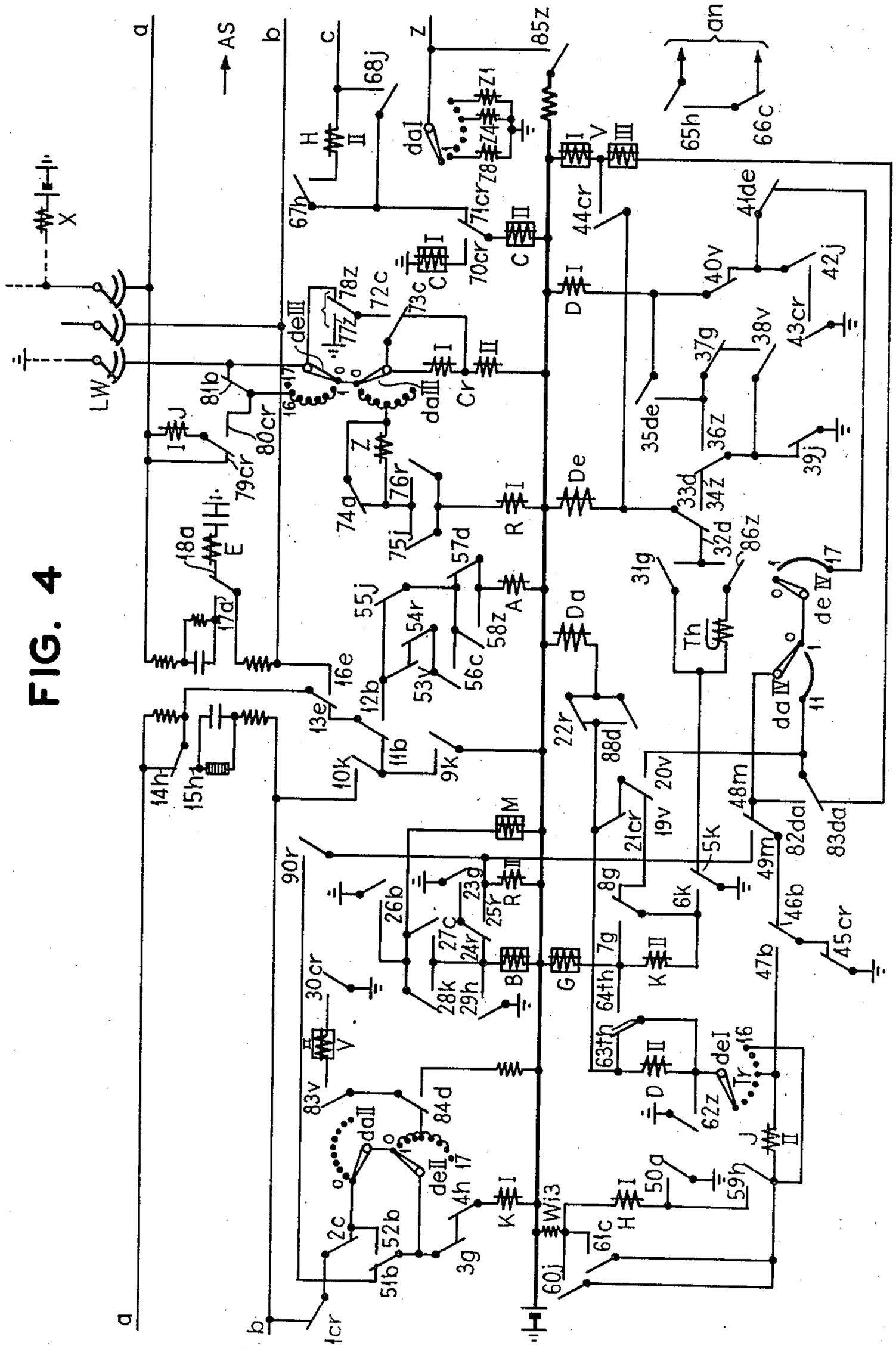
FIG. 4

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AUTOMATIC TELEPHONE SYSTEM

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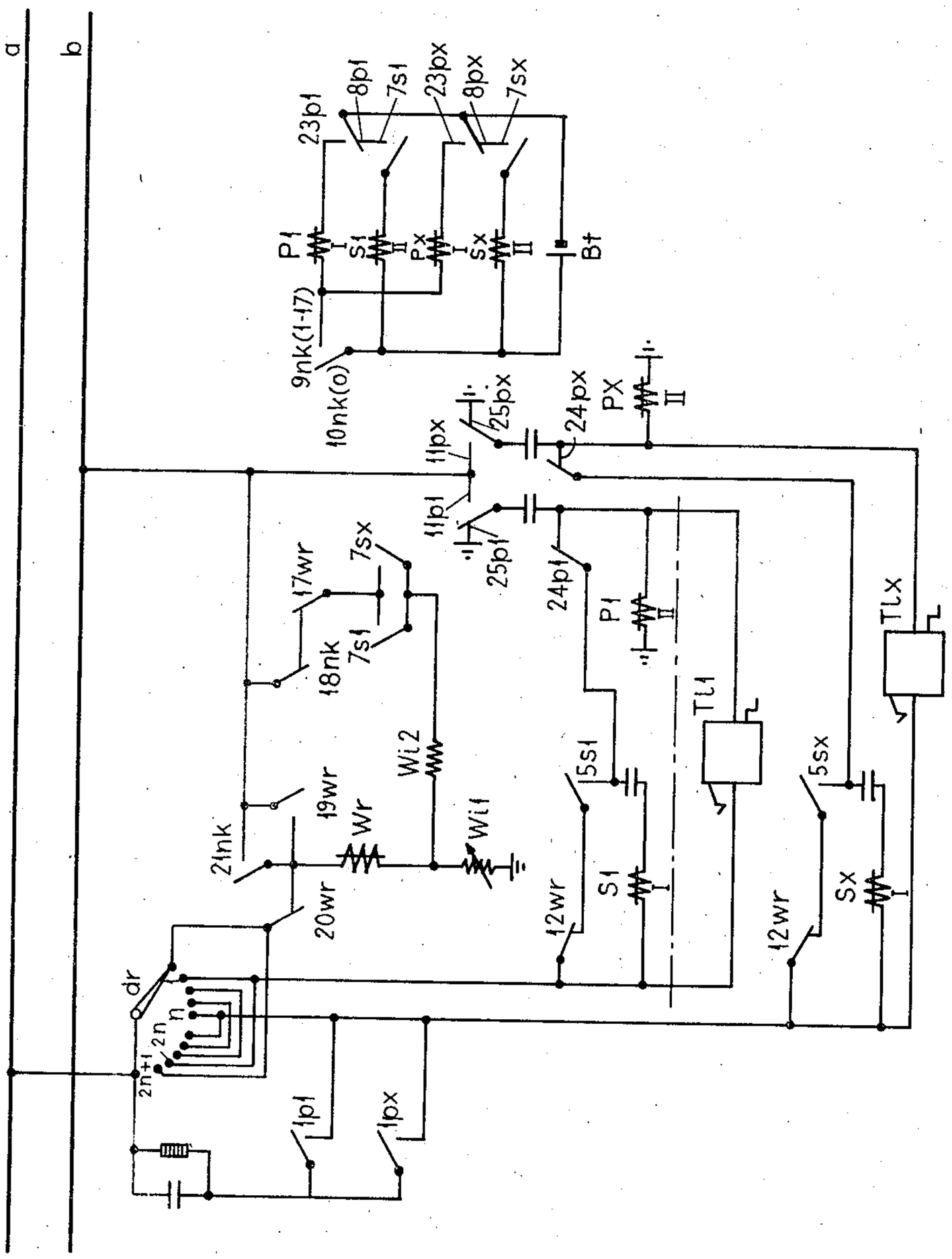
FIG. 5

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Patented Dec. 19, 1939

2,183,839

# UNITED STATES PATENT OFFICE

2,183,839

## AUTOMATIC TELEPHONE SYSTEM

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Application October 21, 1937, Serial No. 170,188
In Germany October 27, 1936

14 Claims. (Cl. 179—17)

The invention relates to a circuit arrangement for the establishment of calls between party line stations provided with selectors in automatic telephone systems. In such systems when a call is initiated the selector at the branch station of the party line is set on the contact of the calling station in order to characterize the calling station in the exchange. Now in the case of revertive calls i. e., calls between two subscribers of the same party line the difficulty arises of maintaining the connection of the calling subscriber when the switch is set on the contact of the called subscriber. This difficulty arises in particular when the switches at the branch stations have to pass over the zero position in order to be set in the position corresponding to the desired subscriber.

In order to avoid this difficulty the known arrangements require complicated circuits and a considerable amount of switching means both in the exchange and at the branch stations. The invention aims at avoiding this difficulty in that it avoids the necessity of the branch station switches passing over the zero position. This is realized in that two separate switching positions for connecting to the party line are associated with each branch station, in which positions the switches at the branch stations are so set that when a branch station makes a call the switches are brought to rest in the first of these associated switch positions and thereupon, on the further stepping of the switch under the influence of a numerical selection characterizing the desired branch station, are brought to rest in the second switching position associated with the wanted party.

Fig. 1 represents a circuit layout with reference to which the various connections will first be described on general lines.

To the common party line GL is connected a plurality of branch stations, in the present example eight in number, indicated by the references T*st*1 to T*st*8. The party line terminates in the exchange V*st* in a repeater Ü*b* which can also be reached over a finder-connector link AS/LW. Over the link AS/LW other subscribers indicated here by T*n* can be reached. Calls can be established between the subscribers of the party line (internal or revertive calls) and between subscribers of the party line and a subscriber of the exchange both in incoming and outgoing directions.

The establishment of calls takes place fundamentally in the following manner in that in response to a call initiating impulse on the part of the calling station the call finder AS is set on the calling line whereupon a call signal is transmitted to an operator's position AP*l* over the connecting line VL. The operator then enters the connection and makes her inquiry. By the aid of her dial switch she then sets up the call to the desired subscriber over the final selector LW, rings the subscriber and then disconnects from the connection. The release of the call takes place in dependence upon the calling subscriber.

Fig. 2 shows a branch station of the party line GL. The branch stations are all identical as regards their circuits. They are arranged as local battery stations and are provided with magnetos. Each branch station is provided with a switch which closes a contact in two particular positions of the switch whereby the branch station is connected to the party line. The switches operate these two contacts over a cam disc.

Figs. 3 and 3*a* show in which positions of the switch the two switch positions associated with the individual branch stations are reached. According to Fig. 3 the branch station 1 is connected up on step 8 and on step 16 while station 2 is connected up on step 7 and step 15 of the switch and so on. Station No. 8 is associated with the switch positions 1 and 9.

Fig. 3*a* represents a modification of Figure 3 but which does not depart from the fundamental idea of the invention and in particular involves no alteration of the repeater circuit in the exchange. According to this arrangement the branch station 1 is associated with contacts 1 and 16, station 2 with contacts 2 and 15 and so on, station 8 being associated with contacts 8 and 9. This arrangement merely requires a different construction of the cam disc at the individual branch stations. In Fig. 3 the cam disc of the switches can all be of the same shape.

Fig. 4 shows the circuit of the repeater Ü*b* in the exchange. This repeater is provided with two switches of which the one D*a* serves to select the meter of the calling station, while the other D*e* serves as an impulse sender for setting the switches at the branch stations and after it has carried out this function serves automatically to disconnect the call after a given time in cooperation with a thermo-relay.

The switches at the branch stations and also the impulse sender D*e* are constructed as 18 point switches with positions 0 and 1–17, assuming eight branch stations on the party line. If there are a larger number of branch stations, for example, *n*, the switches must be provided with $2n+2$ contacts.

Fig. 5 shows an application of the invention

to a branch station in which, as distinct from Fig. 2 in which one subscriber is connected, a group of subscribers are connected. The subscribers in this case are not connected to the party line by cam contacts but over a wiper *dr* of the switch W*r* and over two contacts in a contact bank traversed by the wiper *dr*.

The subscribers of the group are indicated in the figure by the references T*l*1 to T*l*×. As may be seen from the figure two contacts are provided for each of the subscribers in accordance with the scheme shown in Fig. 3*a*. Accordingly if there are *n* subscribers of the party line positions 1 and 2*n* are associated with the subscriber 1 and positions 2 and 2*n*—1 with subscriber 2 and so on.

*Internal or revertive calls*

If a party line station, for example station T*st*2, wishes to call the branch station T*st*4 the calling station sends an impulse to the impulse sender in the repeater Ü*b* in the exchange which serves to transmit impulses to the party line, by operating his magneto. The switch D*e* also receives impulses so that the switch D*e* and the switches at all the branch stations are advanced in steps until the switch at the calling station has reached the first of the contact positions associated with it. The switches are brought to rest in this position. Referring to Fig. 3 the switches at the branch stations and the exchange will then stand on contact 7. The switch D*a* is also set on step 7 in synchronism with the switches at the branch stations. The call finder AS is then started up. It sets itself automatically on the repeater Ü*b* and thereby on the party line. After this has taken place a call signal is operated at the operator's position who thereupon enters the connection and makes her inquiry. As soon as she has been informed of the number of the wanted subscriber—in the present example number 4, she sets the final selector on the repeater Ü*b* and transmits an impulse train comprising four impulses over this switch. The final selector LW is accordingly switches over for the transmission of impulses. In the repeater Ü*b* the switch D*e* is advanced by the above-mentioned impulse train from the position 7 in which it has been assumed to be set to position 11. In this operation no impulses are transmitted to the party line. When the switch D*e* has reached position 11 it advances automatically in steps to position 17. While thus stepping from position 11 to position 17 six impulses are transmitted over the party line so that all the switches at the branch stations are advanced six contacts forward from their last position. They are thus stepped to position 13. After the switch has left the first contact position associated with the calling station the latter is held connected to the party line by the local holding circuit. As may be seen from Fig. 3 position 13 is the second switch position associated with the called branch station and over which this station is connected to the party line. The switches at the branch stations are brought to rest in position 13. The called subscriber is now rung from the final selector LW. As soon as he replies the operator receives the signal and disconnects from the call. The impulse sender D*e* proceeds to the zero position and then operates in co-operation with a thermo-relay as a time switch for automatically cutting off the call after a given time.

In the event of a branch station having a high call number calling a station with a low call number, for example in the event of station T*st*4 calling station T*st*2 the establishment of the call takes place in the same way as that described. The impulse sender in the exchange is started up by the call initiating impulse transmitted by the station T*st*4 and impulses are transmitted whereby all the switches at the branch stations are advanced in steps as also are the switches D*e* and D*a* in the repeater Ü*b*. The switches are brought to rest in the first contact position associated with subscriber 4 i. e., on step 5 assuming the arrangement shown in Fig. 3, or on step 4 in the case of the arrangement shown in Fig. 3*a*. When the operator transmits the impulse trains which characterize the wanted subscriber to the repeater Ü*b* the switch D*e* is advanced from the position which it has assumed either into position 7, assuming the arrangement shown in Fig. 3, or position 6, assuming the arrangement shown in Fig. 3*a*. From this position the switch D*e* which now operates as an impulse sender advances automatically to position 17 and transmits the complementary number of impulses to the party line thereby causing the switches to be set in the second contact position corresponding to the called branch station. Thus, in the example assumed 17—7=10 impulses (Fig. 3) or 17—6=11 impulses (Fig. 3*a*) are transmitted from the repeater Ü*b* to the party line. As may be seen from Fig. 3 the switches at the branch stations are advanced by ten impulses from position 5 to position 15 in which the called subscriber is connected to the party line. If the arrangement according to Fig. 3*a* is considered then the switches at the branch stations are advanced from position 4 by eleven impulses to position 15.

*Outgoing calls*

If a subscriber of the party line desires to call a subscriber T*n* of the exchange the switches at the branch stations are advanced to the first contact position associated with the calling subscriber in response to the calling impulse of the party line subscriber. If, for example, subscriber T*st*5 desires the call, the switches are advanced to position 4 (assuming the arrangement shown in Fig. 3). The switches D*a* and D*e* are also advanced by the same number of steps. The call finder AS is then started up and this sets itself on the party line. The further establishment of the call is effected by the operator at the position of AP*l* without any further displacement of the switches at the branch stations and in the repeater Ü*b* occurring. The switches are only advanced on release and then into the zero position.

*Incoming calls*

If subscriber T*n* of the exchange V*st* desires to call a subscriber of the party line, for example, subscriber T*st*7, the former first calls the operator's position AP*l*. The operator then completes the call by setting the final selector on the repeater Ü*b* to which the last impulse train characterizing the wanted subscriber is transmitted. In the present case this is an impulse train comprising seven impulses. By means of this impulse train the switch D*e* in the repeater Ü*b* is advanced seven steps without causing the transmission of impulses over the party line. The switch D*a* is not advanced in this case. From position 7 the impulse sender D*e* steps automatically to position 17 and transmits the com-

plementary number of impulses thereby setting the switches at all the branch stations. The switches are advanced from the zero position by 17—7=10 steps (Fig. 3), and are brought to rest in this position. As may be seen from Fig. 3 step 10 is the second position associated with the called station Tst7. The wanted party is then rung. After he has replied the operator withdraws from the connection. The switches are restored to normal on release.

The individual switching operations occurring in the case of a "revertive call" are as follows:

It will be assumed that station Tst4 wishes to call station Tst2. When the calling station (Fig. 2) operates the magneto Ind contact 2ind is closed and relay S is energized in the following circuit by the magneto current: magneto, contact 4s, winding I of relay S, contact 2ind, and the magneto. Relay S locks up in the following circuit: battery Bt, contacts 8p, 6s, winding II of relay S, battery Bt. Through the closing of contacts 7s, earth potential is connected to the b-lead of the party line and thereby the following circuit is closed for relay K in the repeater Üb (Fig. 4): earth, resistance Wi1, resistance Wi2, contacts 7s, 17wr and 18nk, the b-lead, contacts 1cr and 2c, wiper daII, wiper deII, contacts 3g and 4h, winding I of relay K, battery and earth.

In the repeater Üb (Fig. 4) relay K energizes. Relay K completes the following circuit for relay G: earth, contact 6k, winding II of relay K, the winding of relay G, battery and earth. Relay G energizes in this circuit and prepares a circuit for the magnet of the rotary selector De. The energizing of relay K closes the following circuit for the rotary magnet of the 11 point switch Da, which serves to operate the meter corresponding to the calling station: earth, contacts 6k, 8g, 19v, 21cr and 22r, winding of the rotary magnet Da, battery and earth. The switch Da takes a step forward. The circuit for the rotary magnet Da is broken by the opening of contact 8g. Relay K connects battery potential to the a and b leads of the party line over contacts 9k and 10k or 9k, 11b, 13e and 14h. All the rotary magnets of the switches at the branch stations receive an impulse on account of the potential connected to the a-lead which advances the switches from the zero position to position 1.

It may be mentioned at this point that the switches at the branch stations are small rotary switches which close contacts on each energization of the rotary magnets. These contacts are indicated in Fig. 2 by wr. In addition the switches operate so-called cam contacts by means of cams which contacts remain closed on a particular step or over a number of steps. These contacts are indicated in Fig. 2 by nk.

The circuit for energizing the switch magnets at the branch stations is as follows: battery in the repeater Üb contacts 9k, 11b, 13e and 14h, the a-lead of the party line, contacts 20wr and 22nk, switch magnet Wr, resistance Wi1 and earth. When the switch magnet Wr operates, contact 17wr is temporarily opened and contact 18nk is opened when the switch leaves the zero position and remains open until the switch is restored to normal. Earth is thereby removed from the b-lead but is reconnected over the cam contact 21nk, and the switch magnet Wr. Cam contact 21nk is closed from position 1 to position 16. In the repeater Üb relay K is deenergized in that relay G breaks the circuit to winding I of relay K over the b-lead of the party line at contact 3g and at the same time short circuits winding II of relay K at contact 7g.

In the repeater Üb (Fig. 4) the following circuit is closed for the switch magnet De by the release of relay K: earth, contacts 5k, 31g, 32d, the winding De of the switch magnet, battery and earth. The switch De takes a step forward into position 1. On energizing, relay G closes the following circuit for relay B: earth, contacts 23g and 24r, the winding of relay B, battery and earth. Being slow-to-release relay B holds up during the impulse train in the following circuit: earth, contacts 26b and 28k, the winding of relay B, battery and earth. Relay B closes the following circuit for relay M: earth, contact 26b, the winding of relay M, battery and earth. When the wiper daII of the switch Da and wiper deII of the switch De have moved away from the zero position relay B closes once more the following circuit for relay K in the repeater Üb: earth, battery, winding I of relay K, contacts 4h, 3g, 52b, 2c, and 1cr, the b-lead, contact 21nk (closed from positions 1–16) rotary magnet Wr, resistance Wi1 and earth. Relay K energizes again in this circuit and energizes relay G. The current over the b-lead is so amplified over contacts 9k and 10k that the switch magnets Wr energize and the switches take another step forward. At its contact 3g relay G breaks the above described circuit so that the switch magnets at the branch stations and relay K release again. On the energizing of relay K the rotary magnet Da was energized again. When relay K released the rotary magnet De was energized again. These switches also take a step forward. After the release of relay K relay G releases. Relay G again closes the circuit for relay K and for the switch magnets at the branch stations. This sequence of operations is repeated until at the calling branch station Tst4 the switch has advanced to position 5—assuming the arrangement shown in Fig. 3. In this position the cam contact 16nk is closed, this contact being opened again as soon as the switch leaves this position. Contact 16nk is closed for the second time in position 13. This position is only operative in the case of incoming calls and not in the present case in which the branch station is calling. After the release of the switch magnet the following circuit is completed in the branch station Tst4: earth, winding II of relay P, contacts 5s, 12wr and 16nk, a-lead, contacts 14h, 13e, 12b, 55j and 57d, the winding of relay A, battery and earth. Relay P at the branch station Tst4 breaks the locking circuit for relay S by opening its contact 8p. Relay P holds up in the following circuit: battery Bt, contact 23p, cam contact 9nk (closed on steps 1–17 inclusive) the winding of relay P and battery Bt. Relay P connects the station to the party line at contacts 1p and 11p independently of the cam contact 16nk. If the calling branch station has not yet taken up his receiver, earth is removed again from the a-lead at the branch station Tst4 after a short time and relay S releases. The result of this is that relay A releases in the repeater Üb.

In the repeater Üb (Fig. 4) the following circuit was completed for relay H on the energizing of relay A: earth, contact 50a, winding I of relay H, resistance Wi3, battery and earth. The starting relay (not shown) of the call finder has been energized over contacts 65h and 66c. The call finder AS (Fig. 1) has set itself on the calling line, in this case on the repeater Üb, in the

known way. When the call finder finds the repeater the following test circuit is closed: earth, the testing relay in the call finder, the *c*-wiper of the call finder (not shown), *c*-lead, winding II of relay H, contact 67*h*, contact 71*cr*, winding II of relay C, battery and earth. Relay C energizes in this circuit and relay H holds up, winding I of relay H being short-circuited over contacts 59*h* and 61*c*. After the release of relay K relay B is held up over contacts 27*c* or 29*h*. When the call finder is seized a calling lamp is operated at the operator's position AP*l*. Through the closing of the loop over contact 17*a* and the two speaking leads a supervisory lamp is operated at the operator's position AP*l* in addition to the call indicating lamp. This supervisory lamp is extinguished again however, because relay A releases if the calling branch station has not taken up his receiver. The operator is therefore made aware that the calling station has not yet taken up his receiver and she accordingly transmits ringing current over the *b*-lead which energizes relay E over contact 18*a*. Relay E closes its contact 16*e*. The ringing current now passes over the *a*-lead of the party line, the cam contact 16*nk* contact 3*ind*, switchhook contact 13*hu* and through the bell at the calling station to earth. When the calling subscriber takes up his receiver the switchhook contacts 14*hu* and 15*hu* are closed. Earth is again connected to the *a*-lead over winding II of relay P and the switchhook contact 14*hu*. After the ringing current has died down relay A is therefore once more energized in the repeater Ü*b*. The loop to the operator's position AP*l* is closed over contact 17*a* thereby switching on the supervisory lamp.

The operator at the position AP*l* now receives the wanted subscriber's number from the calling station. The operator sets the final selector LW (Fig. 1) on the repeater Ü*b* by means of her dial switch. After the final selector has been set this is switched over to function as a group selector for the further selection. When the final selector LW has seized the repeater Ü*b* earth is connected to the testing lead in the final selector. The following circuit is consequently completed for relay C*r* in the repeater Ü*b* (Fig. 4) earth in the final selector LW, *c*-lead, contacts 78*z*, 72*c*, windings I and II of relay C*r*, battery and earth. Relay R is energized in parallel with relay C*r* over the *c*-lead from the final selector and contacts 78*z* and 72*c*, wiper *da*III, contacts 74*a* and 75*j*, winding I of relay R, battery and earth. This circuit is maintained independently of contact 75*j* by contact 76*r*. Relay C*r* connects relay C in a locking circuit over both windings I and II at contact 70*cr*. Since potential is applied to the *a*-lead from the final selector over relay X, relay J is energized as follows after the closing of contact 80*cr*: earth, battery, relay X, *a*-lead in the final selector, winding of relay J, contact 80*cr*, wiper *de*III, the C-lead and earth in the final selector. In this circuit relay X also is energized and switches over the final selector LW for the further selection. After relay J has energized, winding II of relay H is short-circuited over contact 68*j* and winding H releases. Relay B holds up over earth, contacts 26*b* and 27*c*, the winding of relay B and battery.

The operator now transmits the impulse train for characterizing the desired branch station T*st*2. This impulse train comprises two impulses. Relay J responds to the impulsing. Since after the energizing of relay J, relay D has already energized, over earth, contacts 43*cr*, 42*j* and 40*v*, winding I of relay D, battery and earth, the following circuit is completed for the rotary magnet D*e* the first time relay J falls back: earth, contacts 39*j*, 34*z* and 33*d*, the winding of the rotary magnet D*e*, battery and earth. Relay D holds up during the dialling because it is made slow-to-release through its winding II being short-circuited at contact 63*th*. Relay V is energized in parallel with the switch magnet D*e* on the first impulse: earth, contacts 39*j*, 34*z*, 33*d* and 44*cr*, winding I of relay V, battery and earth. Relay D is impulsively energised in the following circuit after the opening of contact 40*v*: earth, contacts 39*j*, 38*v*, 37*g* and 35*de* (closed each time D*e* energizes) winding I of relay D, battery and earth. The magnet D*e* steps the switch forward in accordance with the incoming impulse train. At the end of the train the switch stands on contact 5+2=7. Further transmission of impulses from the final selector to the party line is prevented in that relay K cannot energize because contacts 1*cr* and 2*c* are open.

After the dialling, relay J energizes again permanently. Relay D releases in consequence. Relay K is now energized again in the following circuit: earth, contact 30*cr*, winding II of relay V, contacts 83*v* and 84*d*, wiper *de*II, contacts 3*g* and 4*h*, the winding I of relay K, battery and earth. Relay K operates relay G over contact 6*k* and the opening of contact 3*g* causes relay K to release again. After relay K has released relay G releases again. Relay K energizes once more over the *b*-lead and contact 3*g*. Relay V holds up as a slow relay during the interruptions in the circuit. Relays K and G operate alternately as an interrupter and advance the impulse sender D*e* into position 17. At the same time impulses are transmitted to the switch magnets at the branch stations by relay K over contacts 9*k* and 10*k* and the *b*-lead in accordance with the number of steps taken by the impulse sender. As has already been mentioned the switches are set by this impulse train in the second contact position corresponding to the called branch station. Contact 16*nk* is closed and over this contact the called branch station is connected to the party line.

The impulse sender D*e* in the repeater Ü*b* is brought to rest in position 17 in that wiper *de*II breaks the circuit for relay K on leaving position 16 and relay V releases. Relay J is also deenergized when the switch leaves position 16 since wiper *de*III breaks the circuit for relay J.

The called station is now rung automatically from the final selector LW in that relay X which is disposed in the final selector in series with the impulse receiving relay J deenergizes and connects up ringing current in the final selector. The ringing current pases over the *b*-lead to relay E in the repeater Ü*b*. Relay E by closing its contact 16*e* transmits the ringing current to the wanted branch station over the *a*-lead.

When the called subscriber takes up his receiver earth is connected to the *a*-lead, and relay P of the branch station and relay A in the repeater Ü*b* are energized: earth, winding II of relay P, contacts 14*hu*, 3*ind* and 16*nk*, the *a*-lead, contacts 14*h*, 13*e*, 12*b*, 55*j* and 57*d*, the winding relay A, battery and earth.

Relay P in the branch station, which switches through the speaking leads over contacts 1*p* and 11*p* holds up in a local circuit over its winding I. In the repeater Ü*b* relay A again closes the loop

extending over the two speaking leads to the call finder by means of contact 17*a*. The operator at the position AP*l* thereby receives the signal (supervisory lamp) to the effect that the called subscriber has replied. The operator now withdraws from the call and the two subscribers can converse together.

On the energizing of relay A in the repeater Ü*b* relay Z energizes in series with winding I of relay R because contact 74*a* opened and removed the short-circuit from relay Z. Relay Z closes the following circuit for the calling subscriber's meter: earth, meter Z4, wiper *da*I, contact 85*z*, battery and earth. Relay Z also connects up the thermo-relay T*h*, earth, contact 5*k*, the thermo relay T*h*, contacts 86*z*, and 32*d*, the rotary magnet D*e*, battery and earth. The rotary magnet does not energize in this circuit. After a short time the thermo-relay T*h* opens its contacts 63*th* and closes its contacts 64*th*. Relay G energizes over earth, contacts 62*z* and 64*th*. The thermo-relay T*h* is short-circuited at contact 31*g* and the rotary magnet D*e* energizes at the same time. The switch takes a step forward and proceeds from position 17 to position 0. The thermo-relay T*h* cools down slowly. On the energizing of the rotary magnet D*e* the following circuit is completed for relay D: earth, contacts 39*j*, 36*z* and 35*de*, winding I of relay D, battery and earth. Contact 32*d* breaks the circuit for magnet DE. Relay D holds up, after having energized, over its winding II until the thermo-contact 63*th* is again closed, in the following circuit: earth, contact 62*z*, winding II of relay D, contact 88*d*, the rotary magnet D*a*, battery and earth. Magnet D*a* does not energize in this circuit. When relay D is short-circuited at contact 63*th* and releases, the thermo-relay T*h* is switched on again. The sequence of operations is repeated. The rotary magnet D*e* advances the switch in steps until after a definite number of steps depending upon the cooling period of the thermo-relay, relay J is energized over wiper *de*I: earth, contact 62*z*, wiper *de*I, cut-off position T*r*, winding II of relay J, contact 61*c*, resistance W*i*3, battery and earth. Relay J opens its contact 55*j* and thereby interrupts the circuit of relay A which was previously held energized from earth at the calling branch station and the *a*-lead of the party line. Through the release of relay A relay Z is short-circuited at contact 74*a*. Relay Z releases. The opening of contact 77*z* brings down relay C*r*. At the same time relay R releases. Relay C*r* breaks the locking circuit for relay B at contact 37*c*. Relay B, however, holds up over contact 28*k* because after relays C and C*r* have released relay K continues to be energized over earth at the called branch station, the *c*-lead, contacts 1*cr*, 2*c*, 52*b*, 3*g* and 4*h*, winding I of relay K, battery and earth. Relay K switches on relay G again and the latter relay at contact 3*g* breaks the circuit for relay K so that the latter releases again.

Relay K at contacts 9*k* and 10*k* applies the full potential to the *b*-lead whereby the switches at the branch stations receive an impulse over the closed cam contact 21*nk* and take a step forward. The rotary magnet D*a* also receives an impulse over earth, contacts 6*k*, 8*g*, 10*v*, 21*cr* and 22*r*, rotary magnet D*a*, battery and earth. After relay K has released the magnet D*e* also receives an impulse. This switch too takes a step forward.

After relay K has released relay G releases. After relay G is released the circuit for winding I of relay K is closed once more over winding I and over the *b*-lead to earth. Relay K energizes relay G over contact 5*k*. Relay G at contact 3*g* breaks the circuit for winding I of relay K again. Relay K releases. Relays K and G interact together so that the former on energizing transmits impulses over the *b*-lead to the switch magnets at the branch stations and to the switch D*a* while on its release it transmits impulses to the switch magnet D*e*.

When the switches at the branch stations have left position 16 contact 21*nk* is opened at the various stations and in position 17 contact 22*nk* is closed. Earth is accordingly removed from the *b*-lead. In the repeater Ü*b* relay K then releases. The locking circuit of relay B is broken at contact 28*k*. The relay B releases and breaks the circuit at relay M. Through the release period of relay M relay R is energized over contact 59*m* and relay K is again energized over contacts 90*s* and 51*b*. Relay K applies potential to the *a*-lead over contacts 9*k*, 11*b*, 13*e* and 14*h* and the switch magnets at the various stations receive a further impulse over contact 22*nk* which drives them into the zero position. In the repeater Ü*b* relay K switches on relay B. Relay G holds relay R energized over contacts 23*g* and 28*r* so that when relay G releases relay B no longer remains energized. If the switches D*a* and D*e* are not yet in the zero position relay V is energized over earth, contact 45*cr*, 46*b* and 48*m*, wiper *da*IV, contact 83*da*, windings III and I of relay V, battery and earth. The rotary magnet D*a* now energizes: earth, contacts 45*cr*, 46*b* and 48*m*, wiper *da*IV, contacts 20*v*, 21*cr* and 22*r*, magnet D*a* battery and earth. When the magnet D*a* attracts its armature, contact 83*da* is opened and relay V releases. Contact 20*v* is consequently opened and the magnet D*a* releases. The interaction between relay V and magnet D*a* continues until the switch D*a* has reached the zero position in which the circuit for magnet D*a* is broken.

The following circuit is completed for relay D over the zero position of wiper *da*IV: earth, contacts 45*cr*, 46*b* and 48*m*, wiper *da*IV, wiper *de*IV, contacts 41*de* and 40*v*, winding I of relay D, battery and earth. The magnet D*e* is energized over earth, contacts 39*j*, 34*z* and 33*d*, magnet D*e*, battery and earth. When magnet D*e* energises contact 41*de* opens. Relay D releases and after it magnet D*e*. The circuit for relay D is closed afresh. Relay D and the magnet D*e* inter-act together until the switch D*e* is restored to normal in which position the circuit for magnet D*e* is finally broken.

The switches at the branch stations and in the repeater are now restored to normal. The party line is free for the establishment of a new call.

*Outgoing calls*

If a subscriber of the branch station wishes to call a subscriber of the exchange, for example, subscriber T*n*, relay S in the branch station and relay K in the repeater Ü*b* are energized by the call initiating impulses in the same way as in the case of internal calls. Relay S registers the call by way of its winding II which is held energized in a local circuit. In the repeater Ü*b* the impulse sender is started up by relay K. Relays K and G cause impulses to be transmitted over the *b*-lead to the switch magnets in the branch stations and to the magnets D*a* and D*e* in the repeater. As soon as the switches have reached the first contact position corresponding to the calling branch station relay P at the calling sta-

tion and relay A in the repeater Üb energizes. Relay P locks up locally and connects the subscriber's station to the party line.

In the repeater Üb relay H which is operated by relay A breaks the circuit for relay K and in consequence interrupts the impulse transmission to the party line and to the switches De and Da. The call finder AS is started up through the energizing of relay H. When the call finder tests on the repeater relay C is energized over winding II over the c-lead. Relay H is held energized in this circuit. The supervisory signal is operated at the operator's position APl through the closing of the loop at contact 17a. The operator thereupon inquires of the calling branch station subscriber the number of the wanted party. She thereupon sets up a connection to the wanted party via the final selector LW. After she has done this she withdraws from the connection. The two subscribers can now converse together. In this case neither the switch Da nor the switch De is advanced in the repeater.

The release of the connection is brought about by the calling branch line subscriber hanging up his receiver. Earth is consequently disconnected from the a-lead at the branch station. In the repeater Üb relay A releases. By opening its contact 17a relay A breaks the loop over the two speaking leads to the call finder AS. This promotes the release of the call finder and in consequence the breaking of the c-lead from the call finder so that relays H and C release in the repeater Üb. After relays H and C have released the locking circuit for relay B is maintained over contact 28k since relay K is energized over earth at the calling branch station, the b-lead of the party line, contacts 1cr, 2c, 52b, 3g and 4h, over contact 28k. Relay K switches on relay G again. On energizing relay K transmits impulses over b-lead to the switch magnets at the branch stations and to the switch magnet Da while on its release impulses are transmitted to the switch magnet De. The switches are thus stepped to normal as may be understood from the preceding description.

*Incoming calls*

If a subscriber Tn of the exchange Vst (Fig. 1) wishes to set up a call to a station of the party line earth is applied to the c-lead on the seizure of the repeater Üb by the selector LW after the operator at the position APl has replied to the calling party and has established the connection to the repeater Üb over the final selector LW by this application of earth. Relay Cr is energized over wipers deIII, daIII in the rest position, contact 13c and winding II of relay Cr. Relay Cr energizes relay C over its contact 10cr. In addition relay J is energized from potential on the c-lead in the final selector, relay X, winding I of relay J, contacts 80cr and 81b and earth on the c-lead of the final selector. Relay X in the final selector switches this selector over for the further selection. Relay J is influenced by the impulse transmission from the operator. As has already been described apropos of revertive calls relay D energizes in response to the energizing of relay J. When relay J releases the magnet De receives impulses. In parallel with the rotary magnet De the slow relay V is operated over contact 44cr and holds up during the impulsing. No transmission of this impulse train to the party line takes place. At the end of these impulses relay J energizes again permanently. Relay D releases. Relay V is held energized over its winding II, wiper deII, and winding I of relay K. Relay K energizes and in cooperation with relay G and the switch De transmits impulses to the party line over the b-lead, as already described, whereupon the switches at the branch stations are advanced from the zero position in steps to the second contact associated with the called branch station in which position the cam contact 16nk is closed. At the same time the switch De is advanced into position 17. In this position relay J releases because wiper deIII breaks the loop circuit to the final selector. Now, after the called party has taken up his receiver, both the testing relay P at the wanted branch station and also relay A in the repeater Üb can energize over the closed contact 55j and the a-lead of the party line. Relay A at contact 17a, completes a loop over the leads a and B and thereby transmits a signal to the operator indicating that the wanted branch station has been reached. Relay A in the repeater switches on relay H. Relay H breaks the circuit for relay K. Relay B holds up. The operator withdraws from the connection and the two subscribers can converse together.

The connection is released by the calling subscriber Tn replacing his receiver. This has the effect of breaking the c-lead in the final selector and relays Cr and C in the repeater release. Relay B holds up for the present time since K is energized again after the relays Cr and C have released, over the c-lead of the party line and earth at the called branch station. Relay K energizes and in cooperation with relay G transmits impulses over the b-lead of the party line on the one hand and also the switch magnet De. The switches are thereby restored to normal.

Group stations as in Fig. 5 can be connected to the party line together with other similar group stations and also individual stations. It may be mentioned that such group station may however, be connected to a connecting line or a subscriber's line as a small terminal exchange. With this last arrangement there is the advantage that no small high tension batteries have to be provided for driving the switch at the group station.

The mode of operation of the group station both on the establishment of revertive calls and also on the establishment of outgoing and incoming calls, corresponds to the operation occurring at an individual branch station. Special reference may be made to the fact that revertive calls can be established not only between subscribers of the group station and subscribers of another group station or individual subscribers but also between two subscribers of one and the same group station. In this case the switch Wr of the group station is set first on the contact of the calling subscriber by a hunting operation after the manner of a call finder and then is set on the contact of the called subscriber by numerical selection over the party line in the manner of a final selector.

The switching operation occurring when a group station is used may be deduced directly by reference to Figs. 2 and 4 and the description of the individual calls.

Fig. 5 shows that the group station is provided with only one switch Wr common to all the subscribers just as in the case of an individual branch station, and that moreover a calling relay S and a testing relay P is provided for each subscriber. The relays S and P are pro-

vided with indices I and X. One difference between the group station circuit and the individual station circuit consists in the connection of winding I of the call relay S to the subscriber's line and in the circuit for the ringing current. When an operator actuates the magneto, the energizing circuit for winding I of the call relay is as follows: the subscriber's magneto, winding I of relay S, condenser, contact 24*p* and back to the magneto. Relay S is then held over its winding II and contact 7*s*.

The ringing current from the repeater Üb (Fig. 4) incoming over the *a*-lead proceed at the group station over a wiper *dr*, the connecting contact of the calling or called subscriber, the subscriber's station $Tl_x$, condenser, contact $11p_x$ and earth. After the testing relay $P_x$ has energized winding I of the calling relay $S_x$ is disconnected by contact $24p_x$, and the earth to which the ringing current passes is disconnected at contact $25p_x$. The advantage of this circuit is that the subscribers of the group station can be connected to the common equipment over a line comprising only two leads.

We claim:

1. In an automatic telephone system, a party line, a plurality of branch stations associated therewith, a selector switch at each of said party line stations having a plurality of contact positions including a first and a second position for each station, means for simultaneously operating said switches to one of said first positions to connect one of said stations to the line, and other means for causing the simultaneous operation of said switches to one of said second positions to permit the connection of one of said stations to the line.

2. In an automatic telephone system as claimed in claim 1, another line, means for extending a connection therefrom to one of said branch stations of the party line by rendering said first means ineffective and operating said other means.

3. In an automatic telephone system as claimed in claim 1, another line, means for extending a connection from one of said branch stations of the party line to said other line by rendering said other means ineffective and operating said first means.

4. In an automatic telephone system as claimed in claim 1, wherein said selector switches have a greater number of positions than the combined sum of said first and second positions for each station.

5. In an automatic telephone system as claimed in claim 1, wherein said first and second contact positions for a station are separated in the plurality of contact positions of its selector switch by a certain number of positions in accordance with said plurality of stations.

6. In an automatic telephone system as claimed in claim 1, wherein the first and second contact positions for each station are separated in the plurality of contact positions of a selector switch by a different number of positions.

7. In an automatic telephone system, a connecting device having an impulse sender, a party line terminating in said device, a plurality of branch stations associated with said line, a control device at each of the branch stations, each device responsive to a different number of impulses for permitting the connection of its station to said line, starting means effective when a call is initiated by a branch station for causing said impulse sender to operate and transmit impulses over said line to operate each of said control devices, and means operated at the calling station, when said control device is properly operated, for connecting said station to the line.

8. In an automatic telephone system as claimed in claim 7, wherein said party line comprises two conductors one of which is included in said starting means, the first of said impulses being transmitted over the other of said conductors while further impulses are transmitted over said one conductor.

9. In an automatic telephone system as claimed in claim 7, wherein said party line comprises two conductors one of which is included in said starting means while the other conductor forms a temporarily completed testing circuit for preventing the further operation of said impulse sender.

10. In an automatic telephone system, a connecting device having an impulse sender and a selector switch, a party line terminating in said device, a plurality of branch stations associated with said line, a sequence switch at each one of said branch stations, each sequence switch responsive to a different number of impulses for permitting the connection of its station to the line, means at a branch station operated when a call is initiated therefrom for causing said impulse sender to automatically operate and transmit impulses for controlling the operation of each one of said switches until the selector switch at the calling station permits the connection of said station to the line, and means operated thereafter for controlling the further operation of said selector switch in accordance with a branch station to be called.

11. In an automatic telephone system as claimed in claim 10, wherein each of said sequence switches are provided with two more positions than are necessary to furnish a first and second contact position for each of said stations.

12. In an automatic telephone system as claimed in claim 10, wherein after the operation of said last means said impulse sender again automatically operates and transmits impulses for controlling the further operation of each one of said switches until a certain position of said selector switch is reached.

13. In a telephone system, a line, a plurality of stations on said line, a switch for each station on the line and a common switch, means responsive to a call from one of said stations to operate all of the switches to a position corresponding to the calling line, means for thereafter further operating the common switch a number of steps corresponding to the number of a called station, and means for thereafter operating said common switch to cause a number of impulses to be transmitted to all of the other switches complementary to its setting.

14. In an automatic switching arrangement, a line, a plurality of stations associated therewith, a switch for each station, means responsive to the initiation of a call from one of said stations to operate all of said switches, means in each station operated to connect a calling station to the line and to render said first means ineffective when the switches are operated to a certain position in accordance with the calling station, said last means held operated locally and independently of further operations of said switches.

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