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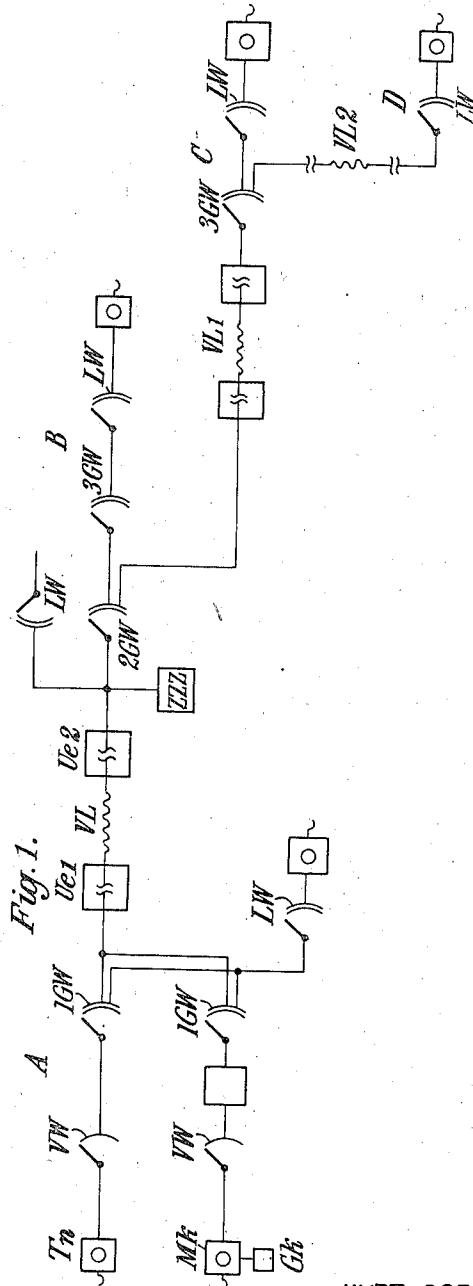
K. SOBOTTA ET AL

2,251,301

TELEPHONE SYSTEM

Filed Dec. 29, 1939

5 Sheets-Sheet 1



Inventor

KURT SOBOTTA & HANS J. LURK

Chas. ^{by} Lee. Candy.
Attorney

Aug 5, 1941.

K. SOBOTTA ET AL

2,251,301

TELEPHONE SYSTEM

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5 Sheets-Sheet 2

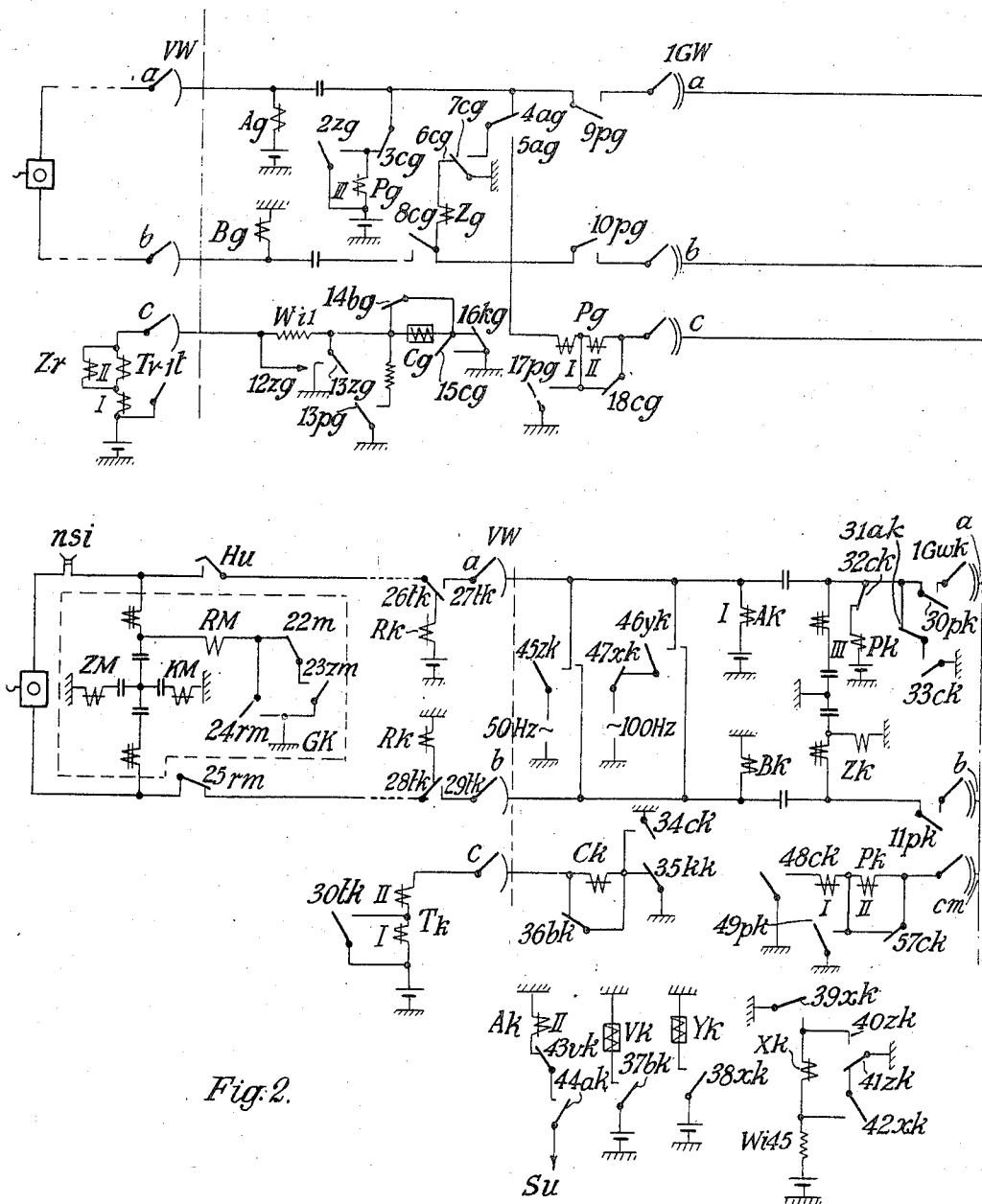


Fig. 2.

Inventor
KURT SOBOTTA & HANS J. LURK

Chas. ^{by} H. Hardy
Attorney

2,251,301

5 Sheets-Sheet 3



by
Chas. W. Condy.
Attorney

Attorney

Aug 5, 1941.

K. SOBOTTA ET AL

2,251,301

TELEPHONE SYSTEM

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5 Sheets-Sheet 4

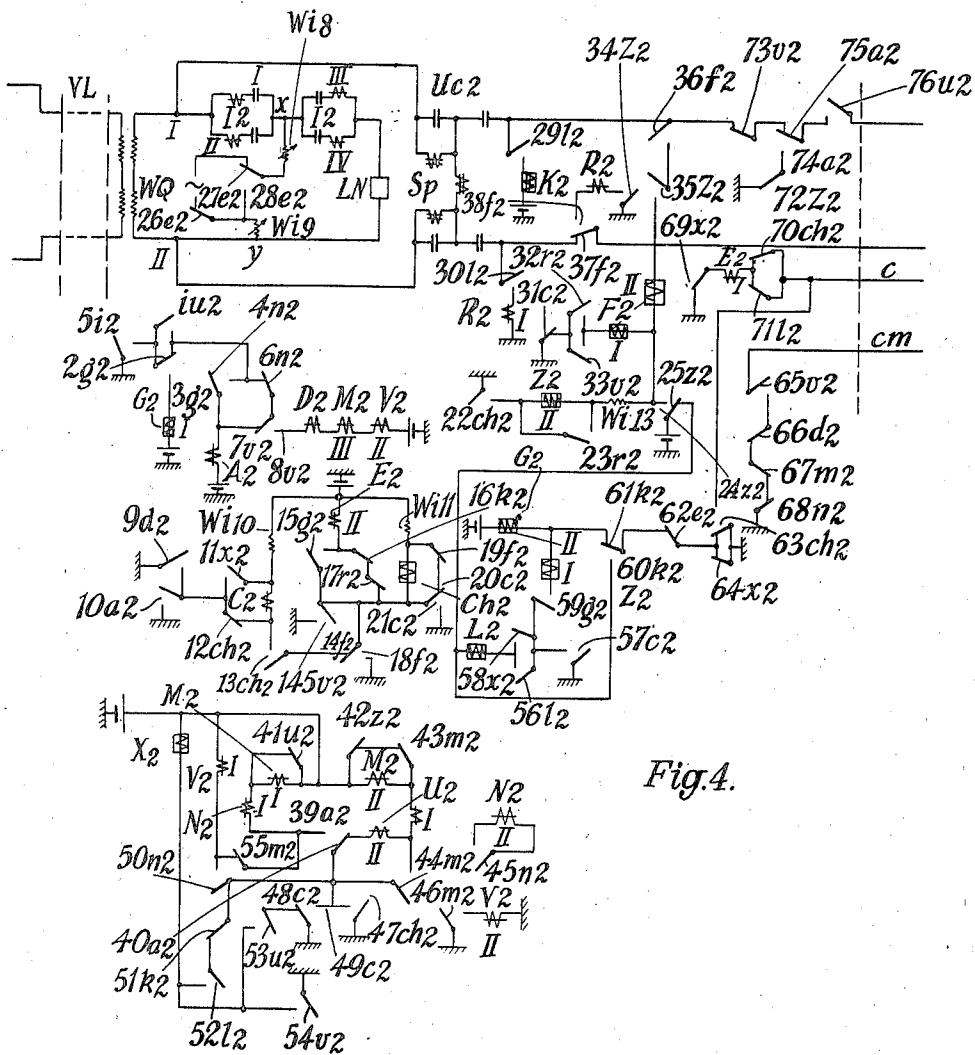


Fig. 4.

Inventor

KURT SOBOTTA & HANS J. LURK

by

Chas. L. Conky

Attorney

Aug 5, 1941.

K. SOBOTTA ET AL

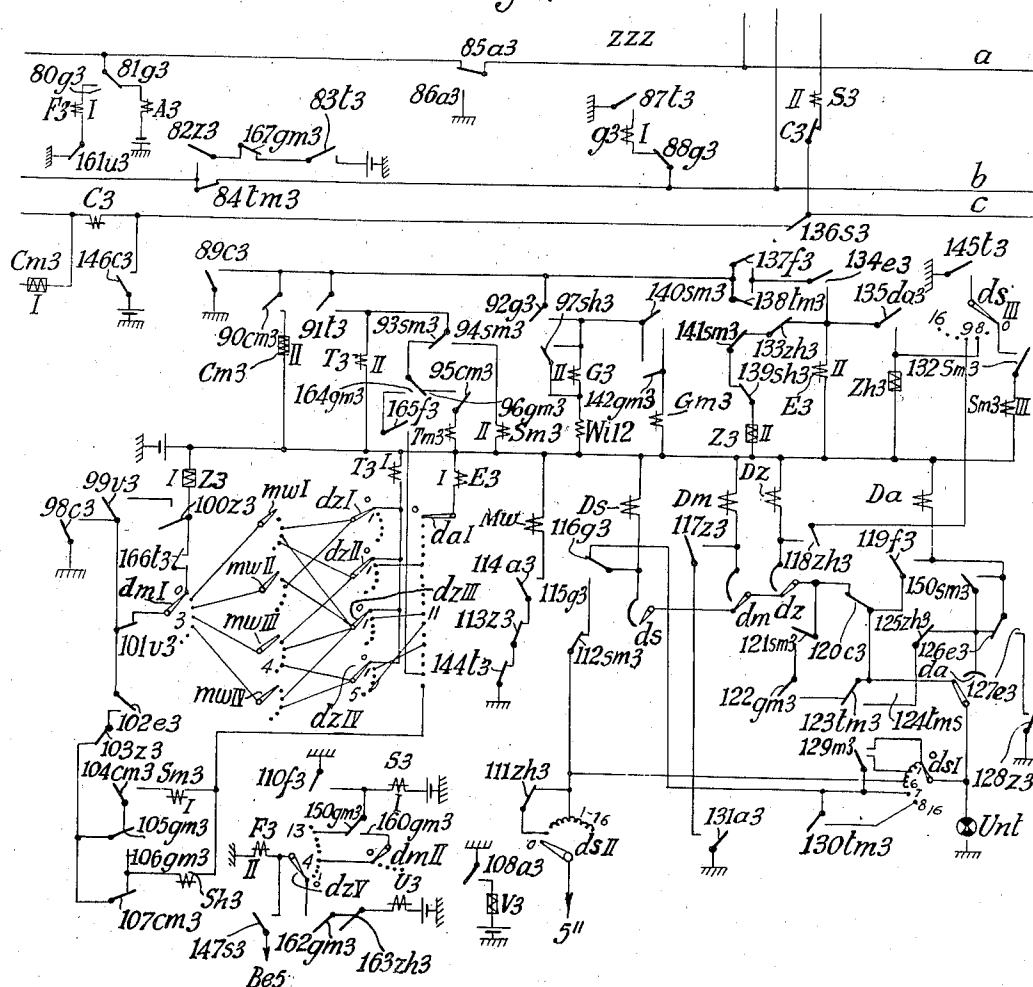
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TELEPHONE SYSTEM

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5 Sheets-Sheet 5

Fig. 5.



Inventor

KURT SOBOTTA & HANS J. LURK

by

Chas. L. Candy

Attorney

UNITED STATES PATENT OFFICE

2,251,301

TELEPHONE SYSTEM

Kurt Sobotta and Hans J. Lurk, Berlin-Siemensstadt, Germany, assignors to Fides Gesellschaft für Verwaltung und Verwertung von gewerblichen Schutzrechten mit beschränkter Haftung, Berlin, Germany, a corporation of Germany

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In Germany November 4, 1938

6 Claims. (Cl. 179—6.31)

The present invention relates to a circuit arrangement for telephone installations in which the calling subscriber at the termination of the conversation is charged an amount corresponding to the value and duration of the call by means of a time-zone switch operated by metering impulses.

When connections from telephone pay stations are set up the time zone switch takes over the function of determining the correctness of the fee inserted by the subscriber according to the value of the required connection. Metering impulses are transmitted for this purpose, representing by their number the value of the connection, and are received by a fee-control device operated according to the inserted amount. If the fee inserted is correct the connection is maintained and the amount is collected. If the inserted amount does not correspond to the selected zone the connection is interrupted and the fee is returned.

In previously known arrangements of this kind the transmission of the control impulses by the time zone switch occurs at the earliest after the end of the numerical selection. Therefore frequently all the connecting arrangements are held unnecessarily and moreover when a call from the required subscriber is to be prevented until availability of the required amount is tested precautions must be taken to delay the ringing of the required subscriber. In order to avoid these disadvantages, according to the invention when the time-zone switch is seized by a telephone pay station the time-zone switch is automatically converted for use in an operation which is different from the normal operation occurring when it is seized by a normal telephone station, so as to bring about the transmission of the metering impulses for supervising the fee control device directly after the marking digit, actually while the connection is being set up.

Fig. 1 is a lay-out showing in schematic form the connections from two different lines.

Figs. 2, 3, 4 and 5, when placed side by side, with Fig. 2 at the left and the other sheets placed in order consecutively to the right thereof, disclose the detailed circuits for extending connections from any of the subscribers shown in Fig. 1 through the repeater Ue1 in Fig. 3 over the line VL and repeater Ue2 in Fig. 4 to the equipment in Fig. 5 including the zone switch ZZZ.

Fig. 1 shows by means of a circuit diagram some possible connections in a telephone network. In the exchange A are included a subscribers station Tn and pay station Mk. For the sake of

simplicity it is assumed that the stations Tn and Mk in addition to their preselectors are also provided with separate first group selectors. The stations Tn and Mk can set up connections in the same exchange over first preselectors, first group selectors and final selectors LW. Within the same exchange further subscribers of the exchange A have access over the first group selectors to junction lines VL and hence to the exchange B. The junction line VL is provided at its ends with repeaters Ue1 and Ue2. In the exchange B over second group selector 2GW, the third group selector 3GW and final selector LW connections can be set up with subscribers of the exchange B or also over second group selector 2GW junction line VL1, third group selector 3GW and final selector LW with subscribers of the exchange C. Finally over the second group selector 2GW junction line VL1, third group selector 3GW, junction line VL2, and final selector LW, connections are possible to the subscribers of the exchange D. The setting up of connections from the exchange A is effected in known manner by selecting various marking digits which are operative on the time zone switch ZZZ at the incoming end of the junction line. According to the invention the time zone switch operates differently according to whether it is seized by a subscribers station Tn or a telephone pay station Mk. When it is seized by a subscribers station the discriminator of the time zone switch is positioned, in known manner, by the marking of the zone after the reply of the required subscriber. The time switching arrangements in the time zone switch are started in order to determine the period of the conversation. At the end of the conversation following the hanging up of the receiver by the calling subscriber or automatically after a certain time, for example 12 minutes, the assessor in the time zone switch is operated and brings about the transmission of a number of impulses to the meter of the calling subscriber according to the zone and duration of the conversation.

If the time zone switch is seized by a telephone pay-station Mk, the discriminator is seized by the first impulse trains. In such a connection a special signal is given after each impulse train, switching over the time zone set so that this set immediately after receipt of the marking digit begins to transmit metering impulses reveritely over the junction line without affecting the further impulse trains incoming from exchange A which serve to position the remaining selectors. These metering impulse trains are transmitted

to the fee control device Gk which is a mechanical device and is arranged within the pay station. These metering impulses are taken up by the fee control device which determines whether the amount inserted corresponds to the selected zone. If this is the case the connection is maintained and the inserted amount is collected, otherwise the connection is interrupted and the inserted amount is returned, the subscriber receiving the engaged signal.

According to a further feature of the invention on the switching over to the time zone switch ZZZ when it is seized by a telephone pay station there is an alteration in the maximum conversation period; a conversation in connections from subscribers stations is limited to 12 minutes and this is automatically cut down in connections from pay stations to 3 minutes.

Finally according to another feature of the invention metering impulses are transmitted in one direction simultaneously with dial impulses in the reverse direction over junction lines by using a differentially connected alternating current relay.

With reference to Figs. 2, 3, 4 and 5 the connection of a subscriber Tn of the exchange A with a subscriber of the exchange B will first be described. Then the setting up of a connection from the pay station Mk of the exchange A also with a subscriber of the exchange B will be described. Only those details necessary for the understanding of the invention are represented and described.

When the subscriber Tn lifts his receiver the preselector VW is started up in known manner. After the setting of the preselector on a further first group selector IGW the test relay Tv of the preselector VW operates in the following circuit: earth, battery, windings I and II of the relay Tv, wiper c of the preselector VW, resistance W11, contact 14bg, off-normal contact 16kg, earth. The test relay Tv steps the preselector in known manner and guards the seized line against further seizing and switches through the talking conductors to the first group selector. After this switching through, the two battery supply bridge relays Ag and Bg operate over the subscribers loop closed in the first preselector. Relay Bg by means of its contact 14bg opens the short-circuit for the seizing relay Cg of the first group selector so that this relay operates over the test conductor, from the preselector. Relay Cg in known manner prepares a circuit for the stepping magnet of the selector. Further relay Cg locks up over contact 15cg independently of off-normal contact 16kg. By closing of contact 7cg the test circuit and the circuit for the transmission of the impulses over the a-conductor are prepared. By means of contact 8cg the b-conductor is switched through. At contact 18cg the short-circuit for the winding II of the test relay Pg is interrupted.

When dialling is carried out by subscriber Tn the subscribers loop is intermittently interrupted whereby the impulsing relay Ag alternately restores and operates again. Relay Ag repeats the impulses of the first impulse train to the vertical magnet of the first group selector. The wipers of the group selector are stepped up and perform the rotary hunting operation to seize the free repeater Ue1 and thus the free junction line VL. Thus the following circuit is completed: earth contacts 7cg, 5ag, winding I and II of the test relay Pg, wiper c of the first group selector, c-conductor, winding of the relay C1, resistance

W12, battery, earth. The test relay Pg stops the first group selector and by short circuiting its high resistance winding I at the contact 17pg guards the seized junction line against further seizing. At contacts 9pg and 10pg the two speaking conductors are switched through to the repeater Ue1.

In the repeater Ue1 the seizing relay C1 operates and closes the following circuit for relay A1: earth, contacts 78c1, 82u1, winding of the relay A1, battery, earth. Relay A1, by means of its contacts 113a1 and 114a1 connects the alternating current source WQ to the junction line VL. This alternating current flows over contact 113a1, regulating resistance W16 and then from the branching point x in two parallel directions over the windings I and II of an alternating current phase relay II, the windings having separate cores, the repeater winding back to the branching point y, in the opposite direction on the other hand the current flows over the two additional windings III and IV of the alternating current relay II, the artificial line L_N to the branch point y and from there over contact 114a1 back to the alternating current source. As indicated in the drawing, the winding III of the relay II is on the same core as the winding I and the winding IV on the same core as the winding II. The windings III and I as well as windings IV and II of the relay II are clearly of the same dimensions. The condensers connected in series with windings I and II are different in order to follow the phase displacement, but the condenser in series with winding III has the same value as condenser in series with winding I. The same is the case with the condensers in series with windings II and IV. Since the alternating current flows differentially over the two pairs of windings of the alternating current relay when the magnetic field in the relay cores diminishes the relay remains at rest. The relay A1 is again restored for a short interval and terminates the seizing impulse. Relay A1 on its energisation completes the following circuit for relay V1: earth, windings I and II of the relay V1, contact 75a1, resistance W13, battery, earth. The relay V1 operates whereby since the short-circuit for relays Z1 and U1 is interrupted at contacts 91c1, 92c1, these relays are energised in the following circuit: earth, winding of the relay Z1, contact 96r1, winding of the relay U1, resistance W14, contact 104v1, battery, earth. The relays Z1 and U1 are held energised when relay V1 releases and opens contact 104v1 over contact 103u1. Relay U1 interrupts at contact 82u1 the circuit for relay A1. Relay A1 restores and hence also relay V1. The seizing impulse is terminated. Relay Z1 completes the following circuit for relay G1: earth, contact 99z1, resistance W15, winding I of the relay G1, battery, earth. After the release of relay V1 the relay N1, hitherto short circuited over contacts 64u1 and 66v1 operates in the following circuit: earth, contacts 64u1, 65m1, winding II of relay N1, resistance W161, battery, earth. The winding II of the relay N1 is a high resistance winding so that relay N1 does not operate in the circuit now closed over contact 63n1.

In the repeater Ue2 at the incoming end of the junction line VL the relay E2 is normally energised over its high resistance winding I in the following circuit: earth, contact 69x2, winding I of the relay E2, contact 70ch2 and parallel contact 7112, c-conductor, winding of relay C3 in the time zone set ZZZ, contact 136s3, c-conductor of the

third group selector, seizing relay in the third group selector (not shown), battery, earth. The relay C3 in the time zone set and the seizing relay in the second group selector are not operated in this circuit. In view of the energising of relay E2, contacts 26e2 and 27e2 are opened and contact 28e2 is closed. The seizing impulses transmitted from the repeater Ue1 is therefore taken up by the alternating current relay I2 in the flowing circuit: windings of the ring repeater, branch point I, in parallel over the windings I and II of the relay I2 as well as the series condensers, branch point x, and then, on the one hand, over the regulating resistance Wi8, contact 28e2, regulating resistance Wi9, branch point y, and on the other hand over the parallel windings III and IV of the relay I2, the artificial line LN, branch point y, branch point II back to the ring transformer. The repetition of the incoming current impulses to the speaking conductors is prevented by means of the locking circuit Sp. Since the alternating current in this case flows in series and in the same sense over the two pairs of windings of the repeating relay I2 the relay operates. The following circuit is completed for the relay A2: earth contacts 5i2, 2g2, 6n2, 7v2, winding of the relay A2, battery, earth. Relay A2 closes the following circuit for the seizing relay C2: earth, contacts 10a2, 12ch2, winding of the relay C2, resistance Wi10, battery, earth. Relay C2 closes the following circuit for relay Ch2: earth, contact 21c2, winding of the relay Ch2, resistance Wi11, battery, earth. At the end of the alternating current impulses and the resulting release of relay I2 and A2, the relay C2 is maintained energised in the following circuit: earth, contacts 21c2, 14f2, 13ch2, winding of the relay C2, resistance Wi10, battery, earth. Relay Ch2 connects over contact 63ch2 direct earth to the c-conductor extending to the time zone switch and thereby seizes the latter. In the time zone set the seizing relay C3 and in the subsequent second group selector the seizing relay, not shown, operates. By the connection of direct earth to the c-conductor the winding I of relay E2 is short-circuited. The relay is maintained energised however, in the following circuit: earth, contacts 21c2, 17r2, 16k2, winding II of the relay E2, battery, earth. After the operation of relays C2 and A2 the following circuit is completed for the relays N2 and V2: earth, contacts 49c2, 39a2, winding I of the relay N2, contact 41u2, battery, earth. The circuit for the relay V2 is as follows: earth, contact 49c2, 39a2, 55m2, winding I of the relay V2, battery, earth. Relay V2 completes the following circuit for the relay X2: earth, contact 54v2, winding of the relay X2, battery, earth. Relay X2 closes the following circuit for the relay L2: earth, contact 57c2, 58x2, winding of the relay L2, contact 25z2, battery, earth. Relay L2 is maintained energised during this operation independently of relay X2 over its contact 56f2. Relay X2 is held energised during the operation of relay L2 independently of relay V2 in the following circuit: earth, contacts 49c2, 51k2, 52f2, winding of the relay X2, battery, earth. Relay L2 over contact 29f2 connects the relay K2 to the a-conductor and over contact 30f2 the relay R2 to the b-conductor.

At the end of the seizing impulses relays I2 and A2 restore. The relays N2 and V2 restore one after the other in a delayed manner. Relay N2 is short-circuited over contact 45n2 and its winding II. After relay A2 has deenergised the following circuit for relay U2 is closed: earth, contacts

49c2, 40a2, winding II and I of relay U2, contacts 43m2, 42z2, battery, earth. Relay U2 opens the short-circuit of the winding I of relay M2 at contact 41u2 and thereby prepares for its energisation by the following numerical selection.

In the time zone set ZZZ, as already explained, the relay C3 is energised on seizing. It holds itself energised over contact 146c3 in a holding circuit and further completes the following circuit for relay Z3: earth, contacts 98c3, 101v3, wiper dm1 of the discriminator Dm in its normal position, contact 166t3, winding I of relay Z3, battery, earth.

By the next impulse series the loop of the calling subscriber's station Tn is alternately interrupted and closed. Thereby the impulsing relay Ag of the first group selector oscillates and transmits the impulses in the following circuit to the impulsing relay A1 of the outgoing repeater Ue1: earth, contacts 7cg, 4ag, 9pg, wiper a of the first group selector, contacts 67h1, 84u1, 83u1, winding of relay A1, battery, earth. Relay V1 is again energised by the first impulse over the contact 75a1, and holds itself energised during the numerical selection since its winding I is short-circuited over contact 76n1. Over the contacts 113a1 and 114a1 the alternating current impulses are transmitted over the connecting line VL to the selected repeater. After relay V1 responds, winding II of relay N1 is short-circuited over contact 66v1. The relay is however held energised in the following circuit: earth, contact 66v1, winding I of relay N1, contact 63n1, winding II of relay M1, battery, earth. In this circuit relay M1 also responds. After the impulse series relays A1, V1, M1 and N1 restore, the latter slowly since its winding III is short-circuited over contact 89n1.

In the repeater Ue2 the impulses from the alternating current relay I2 are received and transmitted to relay A2, over contact 5i2. Relay A2 transmits the impulses in the following circuit to the impulsing relay A3 of the time zone set: earth, contacts 72z2, 74a2, 76u2, 81g3, winding of relay A3, battery, earth. After the first response of relay A2, the following circuit for relays N2 and M2 is closed: earth, contacts 49c2, 39a2, winding I of the relay N2, winding I of relay M2, battery, earth. Relay M2 breaks the short-circuit over its winding II at contact 43m2 and thereby prepares a holding circuit for itself. Further, relay M2 closes the following circuit independently of relay A2: earth, contacts 49c2, 44m2, winding I of relay U2, winding II of relay M2, battery, earth. In this circuit the relays U2 and M2 are held energised. After the response of relay N2, the following circuit for the relay V2 is closed: earth, contacts 49c2, 50n2, winding I of relay V2, battery, earth. Over contact 46m2 the winding II of relay V2 is short-circuited, so that the relay holds itself during the impulse trains. After the impulse trains, relays I2, A2, N2, V2 fall off, the latter slowly.

In the time zone set ZZZ, the setting impulses, as already explained, are received by the receiving relay A3. They are transmitted over contact 86a3 as earth impulses over the a-conductor to the following selector. Further they are transmitted in the following circuit to the discriminator formed as a rotary selector: earth, contacts 131a3, 117z3, winding of the rotary magnet DM, battery, earth. At the first impulse relay V3 is also re-energized in the following circuit: earth, contact 108a3 winding of relay V3, battery, earth. Relay V3 holds up during an impulse

series. Relay Z3, which has been energized by seizing over wiper *dmI* in the zero position, holds itself energized until the discriminator has left the zero position during the impulse series in the following circuit: earth, contacts 98c3, 99v3, 100z3, winding of relay Z3, battery, earth. After the first impulse series has finished relays A3, V3 and Z3 de-energize.

At the second impulse series relay A3 in the time zone set is again impulsively energized. This impulse series is transmitted to a discriminator MW constructed, for example as a rotary selector in the following circuit: earth, contacts 144t3, 113z3, 114a3 winding of the rotary magnet MW, battery, earth. At the first impulse relay V3 again responds. The discriminator is switched on step-by-step. When the impulse series ends, relays A3 and V3 restore. Assuming that the discriminator DM is stepped three steps by the first impulse series and the discriminator MW is stepped four steps by the second impulse series, the following circuit for relay T3 is completed at the end of the second impulse series: earth, contacts 98c3, 101v3, wiper *dmI* in position 3, wiper *mwIII* in position 4, wiper *dsIV* of the time switch in its normal position, winding I of relay T3, battery, earth. The relay T3 responds and breaks the circuit for the discriminator MW at contact 144t3 so that no further impulses can be received from the discriminator mechanism. Relay T3 holds itself energized in the following circuit: earth, contacts 59c3, 91t3, winding II of relay T3, battery, earth. Over contact 87t3, relay T3 switches the winding I of relay G3 to the b-conductor.

After receiving the signals of the first two impulse series, the further impulse series are received in the time zone set by relay A3 and like the first two impulse series are transmitted to the final selector by connection of earth to the a-conductor over contact 86a3.

When the called subscriber replies potential is applied to the b-conductor in the line selector whereby the relay G3 in the time zone set responds in the following circuit: earth, battery connected to the b-conductor, contact 88g3, winding I of relay G3, contact 87t3, earth. Relay G3 responds and holds itself energized in the following circuit: earth, contacts 89c3, 92g3, winding II of relay G3, resistance *Wi12*, battery, earth. The winding I of relay G3 is disconnected from the b-conductor at contact 88g3. Relay A3 is disconnected from the a-conductor by contact 81g3 and at the same time prepares to connect relay F3 to the a-conductor over contact 80g3. When the called subscriber replies the time switch is disconnected. The following circuit for the rotary magnet Ds of a five-second switch is closed: earth, five-second switch, wiper *dsII* in its normal position, contacts 111zh3, 112sm3, 115g3, winding of the rotary magnet Ds, battery, earth. The selector Ds makes a step after five seconds and goes to position 1. From this position it is then switched on by the interrupter *Unt* to position 7 in the following circuit: earth, interrupter *Unt*, wiper *dsI*, bridged contacts 1 to 6, contacts 112sm3, 115g3, rotary magnet Ds, battery, earth. The selector Ds is set in position 7. It is switched on to position 8 over the five-second switch and the wiper *dsII*. In position 8 in which the selector Ds again remains for five minutes the following circuit for relay Zh3 is closed: earth, contact 145t3, wiper *dsIII* in position 8, winding of relay Zh3, battery, earth.

After the switch Ds is moved to position 9, 75

after five seconds of position 8, the following circuit for the minute switch Dz is closed: earth, contact 145t3, wiper *dsIII* in position 9, contact 118zh3, rotary magnet Dz, battery, earth. The minute switch goes from position 0 to position 1. The switch Ds makes a step further each five seconds driven by the five-second switch over wiper *dsII*. It travels over the positions 10 to 16, 0, 1 to 6, 7, 8. In between the relay Zh3 restores. In position 8 relay Zh3 is again energized and prepares for further switching of the minute switch. When the second switch *ds* comes to position 9, the minute switch Dz is again energized over contact 118zh3 and every minute in this manner a step forward is taken.

The time zone switch is provided with an installation for automatic conversation-limiting. If this comes into action the connection is broken after a definite time whereby the selected zone metering impulses are suitably sent to the calling subscriber. If the subscriber hangs up before this time depending upon the time and zone, metering impulses from the time zone set are sent back to the calling subscriber. The switch operations occurring are described in the following. Before that the description of the switch operations are recapitulated, which occur on the response of the called subscriber in the repeaters Ue2 and Ue1.

As already described, on the response of the called subscriber relay F3 is connected to the a-conductor over contact 80g3. Thereby in the repeater Ue2 the following circuit for the relay K2 connected to the a-conductor is formed: earth, contact 161u3, winding I of relay F3, contacts 80g3, 16u2, 75a2, 73v2, 2972, winding of relay K2, battery, earth. In this circuit the high resistance relay K2 responds but not the relay F3. Relay K2 breaks the holding circuit of winding II of relay E2 at contact 16k2, and at contact 51k2, the holding circuit of relay X2. The relays restore. Relay E2 connects the alternating current source WQ to the line VL at its contacts 26e2 and 27e2. The alternating current traverses the differential system of the two windings of relay I2 so that the relay does not respond. The connection of the alternating current is thereby ended, so that after the response of relay K2 and restoration of relays E2 and X2 the relay L2 is short-circuited over: earth, contacts 64x2, 62e2, 60k2; relay L2 again restores and at contact 2972 breaks the circuit for relay K2. Relay K2 restores, whereby relay E2 again responds over its winding II and the alternating current impulse ends. During the time relay E2 is energized, the following circuit is formed for relay G2: earth, contacts 64x2, 62e2, 61k2, winding II of relay G2, battery, earth. After relay E2 responds, relay G2 holds itself energized in the following circuit: earth, contacts 57c2, 59g2, winding I of relay Z2, winding II of relay G2, battery, earth. In this circuit relay Z2 also responds.

In the repeater Ue1 the alternating current impulse is received by relay I1. Relay I1 closes the following circuit for relays X1 and R1: earth, contact 111i1, winding of relay X1, winding of relay R1, battery, earth. The relay Z1 as this back impulse lasts a comparatively long time is short-circuited over contact 95r1, long enough for it to restore. By the opening of contact 99z1 the circuit for winding I of relay G1 is broken so that this relay also restores. After this happens the short circuit for the winding I of relay H1 is opened over contact 97g1. Relay H1 responds in

the following circuit: earth, contact 95r1, winding I of relay H1, winding of relay U1, resistance W14, contact 103u1, battery, earth. Relay H1 holds itself energised in the following circuit: earth, contacts 110c1, 109h1, winding II of relay H1, battery, earth. Relay F1 is connected to the a-conductor over contact 68h1. After the alternating current impulse concerned comes to an end, relays I1, R1, X1 restore one after the other. Relay Z1 energises again in series with relay U1 and switches relay G1 in again.

When the calling subscriber hangs up his receiver after the conversation, the relays Ag and Bg in the first group selector restore. Relay Bg short-circuits the seizing relay Cg over contact 14bg so that this restores. After relay Cg has restored the relay Zg is connected to the b-conductor over contact 6cg. Winding III of the test relay Pg is connected to the a-conductor by contact 3cg. Over contact 18cg the winding II of test relay Pg is short-circuited. Relay Pg however in spite of that does not restore since the following holding circuit for the winding III of relay Pg is completed: earth, battery, winding III of relay Pg, contacts 3cg, 9pg, wiper a of the first group selector, contact 68h1, winding I of relay F, earth. In this circuit relay F1 responds. Relay F1 completes the following circuit for relay A1: earth, contacts 81f1, 83u1, winding of relay A1, battery, earth. Relay A1 sends a long alternating current impulse over the line VL by means of its contacts 114a1 and 113a1. The relay F1 closes the following holding circuit for relay G1: earth, contact 100f1, resistance W15, winding I of relay G1, battery, earth. The alternating current impulse is thereby ended so that the relay C1 restores. This is caused by the seizing relay C1 of the repeater Ue1 being short-circuited over the contacts 51f1 and 58x1. Relay C1 restores slowly and short-circuits the relay Z1 over the contacts 91c1, 92c1, 94x1. Relay Z1 restores slowly. After relay Z1 has restored, relay U1 is short-circuited over the contacts 96z1 and 98x1 and likewise restores. The circuit for the relay G1 is broken after the restoration of relay Z1 at contact 99z1 but holds on over contact 100f1. After relay U1 restores, the circuit for the relay A1 is broken at contact 83u1. Relay H1 is held energized after relay C1 restores in the following circuit: earth, contacts 105f1, 109g1, winding II of relay H1, battery, earth.

In the repeater Ue2 the long release impulse is received by the relay I2. Relay I2 closes the following circuit for the relay A2: earth, contacts 51z, 1u2, 6n2, 1v2, winding of relay A2, battery, earth. Relay N2 is again energised over contact 39a2. After relay N2 responds relay V2 is energised over contact 50n2. Relay V2 switches in relay X2 over contact 54v2 whose holding circuit was broken by the response of relay K2 at contact 51k2 and after this relay restores at contact 5212. Now relay C2 is short-circuited for an appreciable time over: earth, contacts 10a2, 11z2, relay C2 restores and breaks the circuit for the relays Ch2 and E2 at contact 21c2. The relays however do not restore for after relay C2 restores the relay F2 is energised in the following circuit: earth, contacts 31c2, 33v2, winding I of relay F2, contact 24z2, battery, earth. The relay F2 holds itself energised further after the restoration of relays I2, A2, N2, V2 in the following circuit: earth, battery, contact 24z2, winding II of relay F2, contacts 35z2, 36f2, 73v2, 75a2, 76u2, 80g3, winding I of relay F3, contact 131u3, earth. In this circuit relay F3 of the time zone set also is energised. In

the repeater Ue2 relay F2 holds-on the circuit for the relays E2 and Ch2 at contact 18f2: earth, contacts 18f2, 17r2, 16k2, winding II of relay E2 and parallel thereto the winding of relay Ch2, resistance W11, battery, earth. Relay Z2 is held energised after the restoration of relay C2 in the following circuit: earth, contact 22ch2, winding II of relay Z2, resistance W13, contact 24z2, battery, earth. The relays N2 and M2 are also held energised over contacts 47ch2 and 44m2. Over the contacts 34z2 and 36f2 the winding II of relay R2 is connected to the b-conductor for receiving the metering impulses.

In the time zone set ZZZ, as already explained, the relay F3 is energised as a consequence of the release impulses transmitted from the calling subscriber. Relay F3 closes the following circuit for the assessor switch: earth, interrupter Unt, wiper da, contact 119/3, winding of the magnet Da, battery, earth. The selector makes one step and goes from position 0 to position 1. From position 1 the assessor switch is stepped on in the following circuit: earth, interrupter Unt, wiper da, contact 126e3, magnet Da, battery, earth. When the assessor switch reaches the zone selected by the discriminators Dm and Mw and the conversation time arrived at by a suitably marking contact, assuming that the conversation has lasted four minutes, the following circuit for relay E3 is closed: earth, contacts 98c3, 101v3, wiper dm1 in position 3, wiper mwIII in position 4, wiper dz IV in position 5, position 11 of the assessor switch, wiper da1, winding I of relay E3, battery, earth. The relay E3 responds and holds itself energised in the following holding circuit: earth, contacts 89c3, 137f3, 134e3, winding II of relay E3, battery, earth. Parallel to the winding II of relay E3 winding II of relay Z3 also responds over contacts 133zh3, 141sm3, 139sh3. The assessor switch Da is now no longer connected over the interrupter Unt but is energised step-by-step in the following circuit: earth, contacts 128z3, 127e3, rotary magnet Da, battery, earth. Each time the magnet Da is energised the contact 135da3 is closed and the relay Zh3 energised. Relay Zh3 breaks the circuit for relay Z3 at contact 133zh3. Relay Zh3 restores. Thereby the rotary magnet Da also restores. At contact 135da3 the circuit for relay Zh3 is opened. The relay restores and again closes at contact 133zh3 the circuit for the relay Z3. The assessor switch is thus stepped on simultaneously with the energizing of relays Z3 and Zh3. At each step relay Z3 transmits a metering impulse to the repeater Ue2 in the following circuit: earth, battery, contacts 83t3, 161gm3, 82z3, b-conductor, contact 36f2, winding II of relay R2, contact 34z2, earth. The relay R2 of the repeater Ue2 responds at each impulse and repeats, as we will show, the metering impulses back to the calling subscriber. If the assessor switch has reached its last position, then after relay Z3 restores the following circuit for the relay Sh3 is closed: earth, contacts 98c3, 102e3, 103z3, 101cm3, winding of relay Sh3, last position of the assessor switch, wiper da1, winding I of relay E3, battery, earth. In this circuit relay Sh3 responds, and finally interrupts the circuit for relay Z3 at contact 139sh3. Next the assessor switch ceases to function and the transmission of metering impulses is ended. The holding winding II of relay G3 is short-circuited over contact 97sh3, so that the relay restores. Relay G3 on restoring opens contact 80g3 whereby relay F3 in the time zone set and relay F2 in the repeater Ue2 restore.

When the relay F3 restores the circuit for winding II of relay E3 is broken at contact 137/3.

In the repeater Ue2 the metering impulses from the relay R2 connected to the *b*-conductor are received. Relay R2 interrupts the circuit for the winding II of relay E2 at contact 17/2 at each metering impulse. Relay E2 transmits the metering impulses on restoring by means of its contacts 26e2 and 27e2 as alternating current impulses backwards over the connecting line VL. The relay Z2 in the repeater is short-circuited at every impulse over contact 23r2 without however restoring.

In the repeater Ue1 the metering impulses are received by relay I1. Relay I1 energises the relays X1 and R1 in series over its contact 111/1. Thereby since relay X1 is a slow relay, after relay R1 restores, the following metering circuit is formed after each metering impulse connecting to the first group selector: earth, battery, contact 74u1, resistance W14, contacts 12x1, 71g1, 70r1, *b*-conductor, wiper *b* of the first group selector, contact 10pg, winding of relay Zg, contact 6cg, earth. In this circuit the relay Zg of the first group selector responds and transmits over the *c*-conductor by a current increased by means of the contacts 12zg and 13zg, which short-circuit resistance W14, the metering impulses to the metering relay Zr in the first preselector. When the metering impulse series comes to an end the continuous alternating current is connected over the connecting line finally energises the relay I1. The relays X1 and R1 are similarly energised for a period. Over contact 101/1 the winding I of relay G1 is short-circuited so that relay G1 restores. Further at contact 103g1 the holding circuit for the winding II of relay H1 is opened. The relay restores and breaks the circuit for the relay F1 in the repeater Ue1 at contact 63h1 and for the winding III of relay Pg in the first group selector. Relay Pg, which until now has held the connection to the first preselector at contact 13pg restores. Thereby the disconnection of the first group selector and the previous preselector occurs in known manner. In the repeater Ue1 after discontinuation of the blocking alternating current over the connecting line, the relays I1, R1, X1 restore. Then all the relays of the repeater are again in their rest positions.

In the repeater Ue2 when the metering impulse has been repeated as already explained the relay F2 restores. When relay F2 restores the relays Ch2 and E2 restore since their circuits are broken at contact 18/2. When relay E2 restores continuous alternating current is sent back over contacts 26e2 and 27e2 and connecting line VL which as already shown causes the beforementioned connecting apparatus to be disconnected. Since relay Ch2 restores the holding circuit for relay Z2 is broken at contact 22ch2 and at contact 47ch2 the holding circuit for relays U2 and M2 is opened. After relay U2 restores the holding circuit for relay X2 is opened at contact 53u2. Relay E2 again energises after relay X2 restores over contact 69x2, and its high resistance winding I as soon as the *c*-conductor to the second group selector is again switched through and the selector is released.

The direct earth is disconnected from the *c*-conductor leading to the time zone switch at contact 63ch2. Also seizing relay C3 in the time zone set restores. After relay C3 restores the holding circuit for relay T3 is opened. Besides this at contact 93c3 the circuit for relays Sh3 and E3, winding I, is opened. The relays restore. After

relay E3 restores the assessor switch is switched into its rest position in the following circuit: earth, interrupter Unt, wiper da, contact 126e3, rotary magnet Da, battery, earth. When the assessor switch is again in its rest position the time switch Dz is driven back to its rest position in the following circuit: earth, interrupter Unt, wiper da, contact 120c3, wiper dz, rotary magnet Dz, battery, earth. After the time switch Dz is set back, over wiper dm of the discriminator Dm in its rest position and, when this has reached its rest position, over wiper ds the time switch Ds is driven back to its rest position. Before this after relay T3 restored the discriminator MW has already connected to a path in its rest position (not shown). Thereby the time zone set is again in its rest position.

If the subscriber Tn has not hung up his receiver after 12 minutes in the time zone set ZZZ after minute switch Dz is set round 13 steps in position 13 the following circuit for relay S3 is closed: earth, winding II of relay F3, wiper dzV in position 13, contact 150gm3, winding of relay S3, battery, earth. Relay F3 does not respond in this circuit. Relay S3 breaks the *c*-conductor leading out at contact 136s3 so that the following selector is released. The calling subscriber receives an engaged signal over line Bes, contact 147s3, winding II of relay F3, earth. The engaged signal is transmitted back over the winding I of relay F3 connected to the *a*-conductor to the calling subscriber. The calling subscriber thereupon hangs up his receiver and causes thereby a long alternating current impulse to be sent out from the repeater Ue1 over connecting line to the repeater Ue2. As already described the long final impulse is transmitted in the repeater Ue2 such that in the time zone set is induced transmission of a metering impulse corresponding to the time and zone. The switch operations induced thereby have already been described.

When a connection is set up from a telephone paystation Mk of the exchange A with a subscriber of the exchange B the following switch operations take place: The subscriber using the telephone paystation lifts his receiver, inserts the amount corresponding to the required connection and begins dialling. When the receiver is lifted the call relay Rk of the first preselector VW associated with the telephone paystation is energised over the subscriber's loop. The call relay closes the start circuit of the preselector in known manner. The preselector rotates step by step until it finds a free line. As soon as this is the case the test relay Tk of the preselector is energised in the following circuit: earth, battery, windings I and II of relay Tk, wiper c of the preselector, contact 36bk, off-normal contact 35kk, earth. Relay Tk is energised, stops the preselector, locks the seized line over contact 30tk by short-circuiting its high resistance winding I and switches through the speech conductors to the first group selector 1GWk over contacts 27tk and 29tk. After this has been switched through both the battery supply bridge relays Ak and Bk respond over the subscriber's loop. The relay Bk breaks the short-circuit of relay Ck at contact 36bk which thereupon responds in series with the test relay Tk of the first preselector. Relay Bk causes the slow relay Vk to energise over contact 37bk.

During the numerical selection the relay Ak in the first group selector 1GWk oscillates and thereby transmits the impulses of the first im-

pulse series in known manner to the vertical magnet of the group selector. After this impulse series is received the group selector hunts in the decade selected by the first impulse series. As soon as a free line is found the test relay *Pk* of the first group selector is energised in the following circuit: earth, contact *48ck*, windings I and II of the test relay *Pk*, wiper *cm* of the first group selector, winding of relay *C1*, resistance *W12*, battery, earth. In this circuit the seizing relay *C1* of the repeater *Ue1* operates. The test relay *Pk* of the first group selector stops the wiper in known manner, blocks the seized line by short-circuiting its high resistance winding I at contact *49pk* and switches through the speech conductors at the contacts *30pk* and *11pk*.

Relay *C1* in the repeater *Ue1* energises the relays *A1*, *V1*, *Z1*, *U1*, *G1*, as in a connection originated by the usual subscriber. Relay *A1* by means of its contacts *113a1* and *114a1* transmits a short alternating current impulse over the connecting line *VL*. The alternating current impulse is ended when relay *U1* is energised. Relay *U1* causes relay *A1* to de-energise. After relay *A1* is restored relay *V1* also restores. The relays *C1*, *Z1*, *U1*, *G1* are held energised. After relay *V1* has restored the short-circuit for winding II of relay *N1* is broken at contact *66v1*. The relay *N1* is energised over this winding. How- with the windings II and I of relay *N1* does not respond on account of the high resistance of the ever, relay *M1* whose winding II is now in series winding II of relay *N1*.

In the repeater *Ue2* the seizing impulse is received by the relay *I2*. Thereby relays *A2*, *C2*, *Ch2*, *N2*, *V2*, *X2*, *L2* are energised. The relay *L2* connects relay *K2* to the *a*-conductor over its contact *2912* and over contact *3012* connects relay *R2* to the *b*-conductor.

Relay *E2* which was held energised before the repeater was seized over its high resistance winding I by the continuous current is further energised after seizing the *c*-conductor leading to the time zone set over its winding II. The time zone set is locked by the direct earthing of the *c*-conductor over contact *63ch2*. After the seizing impulse ends the relays *I2*, *A2*, *N2*, *V2* in the repeater *Ue2* restore. The relays *C2*, *Ch2*, *X2*, *L2*, *E2* are held energised. Apart from this after relay *A2* restores relay *U2* is also energised.

In the time zone set *ZZZ* the relays *C3* and *Z3* respond after the seizing operation.

When the second impulse series is sent out by the telephone paystation the relay *Ag* again oscillates in the first group selector *IGWk*. The impulses are transmitted to the repeater *Ue1* over the following path: earth, contacts *33ck*, *31ak*, *30pk*, wiper *a* of the group selector *IGWk*, contacts *67h1*, *64u1*, *63u1*, winding of relay *A1*, battery, earth. Relay *A1* in the repeater *Ue1* transmits the impulses by means of its contacts *113a1* and *114a1* over connecting line *VL*. At the first impulse the relays *V1* and *M1* in the repeater *Ue1* also respond. After the impulse series is finished relays *A1* and *V1* restore. During the connection prepared by a telephone subscriber after relay *V1* restores relay *M1* immediately restores and relay *N1* after contact *65m1* is closed is held energised further over its high resistance winding II. For a connection set up from a telephone paystation relay *M1* does not de-energise. Since the short-circuit for winding I of this relay is broken at contact *61n1* the relay *M1* is held energised in the following circuit: earth, contact *49pk*, winding II of relay *Pk*,

wiper *cm* of the group selector *IGWk*, winding I of relay *M1*, contact *62m1*, winding of relay *C1*, resistance *W12*, battery, earth. Relay *N1* restores slowly since contact *65m1* of the circuit for both of its windings is broken. After relay *N1* restores the following circuit is again closed to short-circuit relay *A1*: earth, contacts *87m1*, *88n1*, *861*, winding of relay *A1*, battery, earth. Relay *A1* is energised and transmits in addition to the impulse series an alternating current impulse over connecting line *VL*. This impulse is ended when, after relay *N1* restores, the winding I of relay *M1* is also short-circuited over contact *61n1* whereby the relay is restored. After relay *M1* relay *A1* also restores. Apart from this relay *N1* is again energised over its high resistance winding II after relay *M1* restores.

In the repeater *Ue2* the number impulses are received by relay *I2* and are transmitted further over the *a*-conductor by the relay *A2*. At the first impulse the relays, *N2*, *M2*, *V2* are also energised. After the impulse series is finished the relays *I2* and *A2* restore. After this relay *N2* also restores. For a subscriber's connection relay *V2* also restores but in a connection originated by a telephone paystation the relay *V2* is held energised by the additional impulses transmitted together with the impulse series which occurs during the time this slow relay takes to restore: earth, contacts *512*, *1u2* or parallel contact *2g2*, *6n2*, *8v2*, winding of relay *D2*, winding III of relay *M2*, winding II of relay *V2*, battery, earth. In this circuit the relay *D2* is also energised. Further the differential winding III of relay *M2* is energised in this circuit and the relay restores. Relay *M2* is thus in this case not held energised as is the case in a usual connection. After the additional impulse is ended the relay *I2* restores together with relays *V2* and *D2*.

In the time zone set *ZZZ* the impulses received by relay *A3* during the impulse series are transmitted over contact *86a3* and the *a*-conductor on the one hand to the subsequent selectors and on the other hand over contact *131a3* to the rotary magnet *Dm* of the discriminator. During the impulse series relay *V3* is energised in the time zone set. After the impulse series is ended as a consequence of the additional impulses transmitted in connection with the setting impulse series the relay *Cm3* is energised in the following circuit: earth, contacts *68n2*, *67m2*, *66d2*, *65u2*, conductor *cm*, winding I of relay *Cm3*, winding of relay *C3*, contact *146c3*, battery, earth. Relay *Cm3* holds itself energised in the following holding circuit: earth, contacts *89c3*, *90cm3*, winding of relay *Cm3*, battery, earth. After relay *Cm3* is energized the following circuit for the rotary magnet *Ds* in the time switch is completed: earth, interrupter *Unt*, wiper *ds1* in zero position, contacts *129cm3*, *116g3*, winding of rotary magnet *Ds*, battery, earth. The selector *Ds* travels to position 1 and from this position is driven by the interrupter *Unt* without stopping until it reaches position 8. In this position the switch now is set.

At the next impulse the same switch operations occur in the connecting apparatus as in the case of the previous impulse series. In the time zone switch the impulse series is received by the discriminator *Mw*. When this marking impulse series comes to an end, the relay *T3* responds in the time zone set over the wipers *dm1* and *mw* which have been set as well as over the wiper *dz* in the rest position. This breaks the circuit for the magnet *Mw* at contact *144t3* so that the subsequent impulse series cannot be transmitted

further to the discriminator. Relay T3 holds itself energised over contact 91t3. Over this contact the relay Tm3 is further energised: earth, contacts 89c3, 91t3, 93sm3, 96gm3, 95cm3, winding of the relay Tm3, battery, earth. After relay T3 responds relay Zh3 is energised over the wiper dsIII in position 8. Relay Zh3 prepares at its contact 118zh3 the circuit for the minute switch Dz. The second switch Dz is stepped in the following circuit from position 8 to position 9: earth, interrupter Unt, wiper dsI, in position 8, contacts 130tm3, 116g3, winding of the rotary magnet Dz, battery, earth. In position 9 the following circuit for the magnet Dz is closed: earth, contact 145t3, wiper dsIII in position 9, contact 118zh3, winding of the magnet Dz, battery, earth. The minute switch Dz takes one step and goes from position 0 to position 1. After relay Tm responds the following circuit prepared for the assessor is completed: earth, interrupter Unt, wiper da, contacts 124tm3, 125zh3, 126e3, winding of the rotary magnet Da, battery, earth. The assessor goes from position 0 to position 1 then causes the interrupter Unt and the wiper da to be stepped on until it has reached the contact indicated by the selected marking number. At this point relay E3 responds over its winding I: earth, contacts 98c3, 10lv3, wiper dmI (e. g. in position 3), wiper mwIII (e. g. in position 2), wiper dzIII in position 1, wiper daI, winding I of the relay E3, battery, earth. Relay E3 holds itself energised in the following circuit: earth, contacts 89c3, 133tm3, 134c3, winding II of the relay E3, battery, earth. Parallel to the winding II of the relay E3 relay Z3 is held energised. Moreover the rotary magnet Da receives impulses over earth, contacts 128e3, 127e3, winding of the rotary magnet Da, battery, earth. At each impulse the relay Zh3 is also energised over contact 135da3 so that the relay Z3 is de-energised at contact 133zh3. The interaction of relay Z3 and Zh3 switches the assessor step by step until it reaches the rest position. Each time relay Z3 is energised an impulse is sent back over the b-conductor by a contact 82z3 which in the repeater Ue2 is received by the relay R2 in the following circuit: earth, winding I of relay R2, contacts 30t2, 31f2, 82z3, 167gm3, 83t3, battery, earth. During the repeating back of the metering impulses, the impulse series sent out further by the telephone paystation for setting the line selector are transmitted in the following circuit from the repeater Ue2 to the time zone set: earth, contacts 72z2, 74a2, 76u2, 81g3, winding of the relay A3, battery, earth. The impulses received over the a-conductor are transmitted further by the relay A3 by means of contact 86a3 as earth impulses.

In the repeater Ue2 relay R2 breaks the circuit for the winding II of the relay E2 each time it is energised. Relay E2 repeats the metering impulse by means of its contacts 26e2 and 27e2 as alternating current impulses backwards over the connecting line. During this transmission back of alternating current impulses, since the alternating current relay I2 is not operated on account of its differential connection, the relay is energised by this simultaneous setting impulse occurring in the opposite direction since these flow through relay windings in series and thereby make the two windings III, IV of the relay operative. Relay I2 responds and the repeating relay A2 transmits the setting impulses, as already explained, to the impulse receiving relay A3 in the time zone set.

In the repeater Ue1 the metering impulses are received by the alternating current relay I1. Relay I1 responds in this circuit. Simultaneously the transmitted setting impulses are conducted over the relay in the opposite direction. The setting impulses transmitted from the group selector GWk are received in the repeater Ue1 by the receiving relay A1 which is connected to the a-conductor and these impulses are transmitted further by means of its contacts 113a1 and 114a1 as alternating current impulses. The metering impulses which are received in the repeater Ue1 via relay I1 cause relays X1 and R1 to be energised in series. At the end of each impulse the metering impulses are transmitted back by the aid of both these relays over the a-conductor to the group selector GWk. The relay Z1, temporarily short-circuited at each metering impulse by contact 95r1, does not restore during the short metering impulses.

In the group selector IGWk the relay Zk is energised by the metering impulse in the following circuit: earth, winding of the relay Zk, choke, contact 11pk, wiper b of the group selector IGWk, contacts 69v1, 73r1, 71g1, 72x1, resistance W14, contacts 73h1, battery, earth. Relay Zk connects alternating current of 50 cycles per second to both the speaking conductors in parallel over contact 45zk. These alternating current impulses are received by the magnet ZM of the fee control apparatus GK at the telephone paystation, tuned to this frequency. The circuit for this is as follows: earth, alternating current source, 50 cycles per second, contact 45zk parallel on the one hand over the a-conductor, a-wiper of the preselector, contact 27tk, hook switch contact Hu, choke, condenser, on the other hand over the b-conductor, b-wiper, of the preselector, contacts 29tk, 25rm, choke, condenser, winding of the magnet Zm, earth.

The numerical impulses are transmitted on the part of the telephone paystation simultaneously in the opposite direction by intermittent interruption of the subscriber's loop by which the relay Ak is temporarily restored. At each metering impulse the relay Xk in the group selector IGWk is also energised: earth, contact 40zk, winding of the relay Xk, resistance W15, battery, earth. Relay Xk switches in the slow relay Yk over contact 36zk. During the metering impulse the relay Xk is short-circuited impulsively over the contacts 41zk and 42zk. It holds itself energised over contact 39zk.

The fee control apparatus GK at the telephone paystation is so constructed that the magnet Zm transfers one of the coins inserted in the coin chute, each time metering impulse is received, to an intermediate container. Each time a coin is transferred from the coin chute the contact 22m is opened. On the other hand each time magnet Zm is energised contact 23zm is closed. The contacts are so adjusted that contact 23zm closes only if contact 22m is already open. If as many coins have been inserted as impulses are received from the magnet ZM the correspondence is so controlled that after the relay Zk in the group selector IGWk finally is restored, relay Xk is short-circuited for a time long enough to cause it to restore. Relay Xk breaks the circuit for the slow relay Yk. During the time relay Yk is restoring alternating current of 100 cycles per second is temporarily connected to both speech leads in parallel which, in the fee control apparatus, energises the pay magnet KM tuned to this frequency: earth, alternating current source 100

cycles per second, contact 47xK, 46xK, parallel over both speech leads, magnet KM, earth. As soon as the pay magnet KM has responded the coins are finally transferred to the cash box.

If the coins inserted in the fee control apparatus do not correspond with the metering impulses occurring, if for example a coin too little is inserted, at the last impulse the contact 23zm is closed, but contact 22m is not opened. Thereby relay RM is energised in the following circuit: earth, contacts 23zm, 22m, winding of relay RM, choke, hook switch contact Hu, contact 21tk, wiper a of the preselector winding I of the relay Ak, battery, earth. After magnet ZM restores a circuit for the relays RM and Ak is held on over contact 24rm. Relay RM breaks the b-conductor at contact 25rm and also the connection. In the group selector GWk the relay Bk restores. Relay Vk also restores at the same time. Also buzzer current is connected to the winding II of relay Ak: line Su, contacts 44ak, 43vk, winding II of the relay Ak, earth. The buzzer current is inductively transmitted to the winding I of relay Ak. The subscriber receiving engaged signal, replaces his receiver. When the receiver is replaced the money which has been inserted is returned from the intermediate container. The circuit for the relay RM and Ak is broken by the hook switch contact Hu. After relay Bk is restored relay Ck which is short-circuited over contact 36zk also restores. Thereby winding II of relay Pk is short-circuited over contact 57ck but the relay does not restore since winding III of relay Pk is held after contact 32ck is closed over the a-conductor and relay F1 in the repeater Ue1. The preselector and group selector now remain set. From the repeater Ue1 a long disconnecting impulse is sent over the connecting line VL which as a consequence causes the disconnection of the apparatus which is at the incoming end of the line which on its part, then causes disconnection to take place in a backward direction. The switch operations are described more particularly later on.

In the time zone set the transmission of the metering impulses is ended so that on the last step of the assessor the relay Sm3 is energised in the following circuit: earth, contacts 98c3, 102e3, 103e3, 105gm3, 104cm3, winding I of relay Sm3, wiper daI, winding I of relay E3, battery, earth. Relay Sm3 breaks the circuit for the relay Tm3, at contact 93sm3 so that it restores. At contact 14ism3 the circuit for winding II of relay Z3 is broken. Relay Sm3 holds itself energised in the following circuit: earth, contacts 89c3, 91f3, 94sm3, winding of relay Sm3, battery, earth. Further relay Sm3 closes the following circuit for the rotary magnet of the assessor: earth, interrupter Unt, wiper da, contact 159sm3, winding of the rotary magnet Da, battery, earth. The assessor returns to the position 0. The relay E3, the holding circuit of which has already been broken at contact 138tm3 finally restores after the assessor has travelled back to its rest position since the winding I is de-energised.

As soon as the called subscriber answers at the end of the selecting operation relay G3 is energised over its winding I by potential applied to the b-conductor. Relay G3 holds itself energised over its contact 92g3 and the winding II in a holding circuit. Parallel to this, relay Gm3 is energised: earth, contacts 89c3, 92g3, 140sm3, winding of relay Gm3, battery, earth. Relay Gm3 locks itself up over its contact 142gm3 in a holding circuit independent of relay Sm3. After relay Gm3 is energised the following circuit

for the rotary magnet Dz of the minute switch is closed: earth, interrupter Unt, wiper da in position 0, contact 123tm3, 122gm3, 12ism3, wiper dz, winding of the rotary magnet Dz, battery, earth. The minute switch is stepped on into its rest position by the interrupter Unt. As soon as it has reached this position the rotary magnet Dm of the discriminator is energised over the rest position of the wiper dz: earth, interrupter Unt, wiper da, contacts 123tm3, 122gm3, 12ism3, wiper dz in the rest position, wiper dm winding of the rotary magnet Dm, battery, earth. The discriminator is stepped on into the rest position. When it has arrived in this position the second switch Ds is switched into its rest position over the interrupter Unt. Finally the second discriminator MW is brought into its rest position in a manner which is not shown here. As soon as the second switch Ds returns to its zero position the following circuit for the differential winding II of relay Sm3 is closed: earth, contact 145t3, wiper dsIII in position 0, contact 132sm3, winding II of relay Sm3, battery, earth. The relay Sm3 restores. After relay Sm3 is restored the magnet Ds is energised again the following circuit: earth, 5 second switch, wiper dsII in position 0, contacts 112h3, 112sm3, 115g3, winding of the rotary magnet Ds, battery, earth. The switch steps from position 0 to position 1. Over the wiper dsI the switch is stepped on in the next 5 seconds by the interrupter Unt over the positions 1-5 to 7. In the position 7 the switch stays again for 5 seconds. Thereupon it is switched on over the wiper dsII to position 9. In position 9 the relay Zh3 is energised over the wiper dsIII. After a further 5 seconds the switch Ds reaches the position 9 in which the minute switch Dz receives the impulse over the wiper dsIII and contact 113zh3. The minute switch takes one step and travels from position 9 to position 1. The second switch Ds is now stepped on so that after a minute switch Dz is again energised. This action is repeated until the calling subscriber hangs up or, automatically at the end of 3 minutes, the disconnection of the connection occurs.

When the called subscriber answers the following circuit for relay K2 in the repeater Ue2 is closed: earth, contact 161u3, winding I of relay F3, contacts 81g3, 16u2, 15a2, 29f2, winding of relay K2, battery, earth. The relay F3, in the time zone set does not respond in this circuit. Relay K2 in the repeater Ue2 breaks the circuit for winding II of relay E2 at contact 15k2. Relay E2 restores and transmits a long alternating current impulse back over the connecting line. Each time relay K2 is energised the holding circuit for relay X2 is opened at contact 51k2. Relay X2 restores whereby relay L2 is short-circuited over earth, contacts 64x2, 62e2, 60k2. Relay L2 restores and thereby disconnects relay K2 from the a-conductor at contact 29f2. At contact 30f2 winding I of relay R2 is disconnected from the b-conductor. Relay K2 restores whereupon the relay E2 again responds. During the time the relay E2 is energised the following circuit for relay G2 is closed: earth, contacts 64x2, 62e2, 61k2, winding II of relay G2, battery, earth. After relay G2 responds it locks itself up in the following circuit: earth, contacts 51c2, 59g2, winding I of relay Z2, winding II of relay G2, battery, earth. In this circuit the relay Z2 is also energised.

In the repeater Ue1 the long alternating current impulse occurring when the called sub-

scriber replies, causes relay I1 to energise. Relay I1 again energises the relays X1 and R1 over its contact 111/1. Over contact 95r1 moreover, the relay Z1 is short-circuited for a time long enough for it to restore. Relay G1 also restores since contact 99z1 is opened. After relay G1 restores the short-circuit for the winding I of relay H1 is opened so that this relay is energised with the relay U1 over contact 95r1. Relay H1 holds itself energised after it responds over its winding II. Relay H1 connects relay F1 to earth from the a-conductor over its contact 68h1. At the end of the impulse, relays I1, R1, X1 restore one after the other. Thereupon the relay Z1 also responds in series with the relay U1 and again closes the circuit for the winding I of the relay G1.

When the calling subscriber replaces his receiver at the end of the conversation the two battery supply bridge relays Ak and Bk in the group selector 1GWk restores. Relay Bk short-circuits the seizing relay Ck over its contact 36bk so that this relay also restores. The test relay Pk the winding of which is short-circuited when the seizing relay restores over its contact 57ck, however, does not restore since it is held energised in the following circuit: earth, battery, winding III of relay Pk, contacts 32ck, 30pk, wiper a of the group selector 1GWk, contact 68h1, winding I of relay F1, earth. In this circuit the relay F1 of the repeater Ue1 also responds. The relay F1 short-circuits the seizing relay C1 over its contact 57f1 so that this restores. Relay F1 energises the relay A1 over contact 81f1. Relay A1 transmits a long disconnecting impulse over the connecting line VL which is ended when relay U1 restores. After relay C1 restores the relay Z1 is short-circuited over contacts 91c1, 92c1, 94x1, so that this restores. Over contact 90c1, 98x1, the relay U1 is short-circuited so that this relay also restores. After relay C1 has restored the relay H1 is already energised in the following circuit: earth, contacts 105f1, 103g1, winding II of relay H1, battery, earth. The relay G1 is held energised in the following circuit: earth, contact 100f1, resistance, w15, winding I of relay G1, battery, earth.

In the repeater Ue2 the relays I2, A2, N2, V2, X2 are energised by the long releasing impulse. The relay G2 is short-circuited for a time long enough for it to restore. After relay C2 has restored the relay G2 is also energised in the following circuit: earth, contacts 5i2, 3g2, winding I of relay G2, battery, earth. Relay Z2 is held energised after relay C2 restores in the following circuit: earth, contact 22ch2, winding II of relay Z2, resistance W13, contact 24z2, battery, earth. Relay Ch2 is held energised after relay C2 restores over contact 18f2. Relay F2 which is energised in the following circuit after relay C2 restores and relay V2 is energized: earth, contacts 31c2, 33v2, winding I of relay F2 contact 24z2, battery, earth, is held energised after relay V2 restores in the following circuit: earth, battery, contact 24z2, winding II of relay F2, contacts 35z2, 36f2, 73v2, 75a2, 76u2, 80g3, winding I of relay F3, contact 161u3, battery, earth.

In the time zone set relay F3 responds in this circuit. Relay F3 energises relay S3 over contact 110f3. Relay S3 causes the disconnection of the subsequent selector by breaking the c-conductor at contact 136s3. Moreover, the assessor again begins to operate: earth, interrupter Unt, wiper da, contact 119f3, winding of the rotary magnet Da, battery, earth. The assessor which after leaving the rest position is stepped on over wiper

da and the contact segment which is switched through is stepped on until it is in the penultimate position in which the relay E3 is energised: earth, contacts 89c3, 91f3, 93sm3, 164gm3, 165f3, wiper da1, winding of relay E3, battery, earth. Relay E3 responds and locks itself up over: earth, contacts 89c3, 173f3, 134e3, winding II of relay E3, battery, earth. Parallel to this the relay Z3 is energised. Metering impulses are sent back but not transmitted forward since the circuit is broken at contact 167gm3. The assessor moreover is stepped over contacts 127e3 and 128z3 to the last position in which the relay Sh3 is energised. Here the assessor is next stopped since at the contact 139sh3 the circuit for the relay Z3 is broken. Relay Sh3 short-circuits relay G3 over contact 97sh3 so that this restores. The restoration of relay G3 is followed also by the restoration of relay Gm3 and further at contact 80g3 the circuit for the relay F3 in the time zone set and relay F2 in the repeater Ue2 is broken. When relay F2 restores the guard on the c-conductor in the repeater Ue2 is lifted so that relay C3 in the time zone set also restores. When relay C3 restores the holding circuit of the relays Cm3, T3, Sh3 and E3 is broken. When relay E3 restores the assessor is returned to its rest position over contact 126e3. When the assessor has reached its rest position the time switches Dz and Ds are returned to their rest positions over contact 120c3.

As soon as the relay F2 connected to the a-conductor in the repeater Ue2 restores, the holding circuit of the relays Ch2 and E2 is opened. Relay E2 conducts alternating current back over the connecting line. After relay Ch2 restores the relays U2, M2, Z2, X2 also restore. Relay Ch2 disconnects the locking potential at contact 63ch2 from the c-conductor leading to the time zone set. This conductor is further interrupted during the time that relay X2 is restoring at contact 69x2 so that the seizing relay C3 in the time zone set restores. The transmission of the alternating current back to the connecting line is again interrupted as soon as relay E2 is energised over its high resistance winding I over the c-conductor leading to the time zone set and the subsequent group selector when relay X2 has restored.

In the repeater Ue1 the relays I1, X1, R1 are energised one after the other by the alternating current impulses transmitted back over the connecting line. Relay R1 short circuits the winding I of relay G1 over contact 101r1. Relay G1 restores whereby the holding circuit for the relay H1 is opened at contact 108g1. Relay H1 breaks the circuit for relays F1 and Pk at contact 68h1. Relay F1 restores whereby the repeater Ue1 is in its rest position.

In the group selector, the test relay Pk restores and causes the disconnection of the group selector and the previous preselector.

If the calling subscriber at the telephone pay station does not hang up his receiver in three minutes, after this time an automatic disconnection of the line ensues in the time zone set so that in position 4 of the minute switch Dz the following circuit for the relays S3 is completed: earth, winding II of relay F3, wiper dzv in position 4, wiper dmII in position 0, contact 160gm3, winding of relay S3, battery, earth.

Relay S3 breaks the outgoing c-conductor and initiates the disconnection of the subsequent selector. The calling subscriber receives the engaged signal over contact 147s3 and the winding

II of relay F3 and which is inductively transmitted to the winding I of relay F3.

If the calling subscriber thereupon hangs up his receiver the same switch operations take place as have been described above. A longer disconnecting impulse is transmitted from the repeater Ue1 to the repeater Ue2 so that the time zone set is restored to the rest position and simultaneously the connection is released revertively.

We claim:

1. In a telephone system, wherein calls are extended from paystation telephones and regular telephones in one exchange to called lines in other exchanges, a time zone switch in one exchange operated in accordance with the value of a connection to transmit impulses back to the calling subscriber varying in number in accordance with the connection extended to assess a charge for the connection, means for causing said switch to function in one manner when called from a regular telephone and in a different manner to transmit impulses to the calling telephone while the connection is being extended to automatically control the collection of a plurality of coins thereat when called from a paystation telephone.

2. In a telephone system, means for extending connections from two different types of telephone lines to lines in other exchanges, a toll assessing device accessible to both lines, said device operable during the extension of a connection from one type of line to transmit a number of impulses back to the calling telephone line after the connection is completed varying in number in accordance with the value of the connection, said assessing device operable during the extension of a connection from the other type of telephone line to transmit a particular number of impulses back to the calling telephone line during the extension of the connection varying in accordance with the value of the connection.

3. A telephone system as claimed in claim 2 wherein the impulses transmitted back to the calling telephone line can be transmitted at the same time the impulses for extending the connection are being transmitted in the other direction.

4. A telephone system as claimed in claim 1 wherein there are provisions for transmitting alternating current impulses in both directions over the connection simultaneously.

5. In a telephone system, automatic switches, means for operating said switches for extending connections of different value and for controlling the operation of said switches by transmitting alternating current impulses in one direction over the connections, an assessing device in each connection for returning impulses of alternating current thereover to automatically assess toll for the connection, an alternating current relay in each connection connected as a differential relay, the said alternating current impulses passing through said relay in both directions simultaneously over the connection without interference.

6. In a telephone system, means for extending toll connections from regular or paystation lines, an assessing switch included in all connections and variably operated during the extension of a connection, in accordance with the value thereof, to transmit a number of impulses to automatically assess charges therefor, means for transmitting the impulses for setting the connection over one conductor and the assessing impulses over the other conductor when a regular line extends a call, and means for transmitting the impulses for setting a connection extended from a paystation simultaneously with the transmission of the assessing impulses transmitted in the opposite direction.

KURT SOBOTTA.
HANS J. LURK.