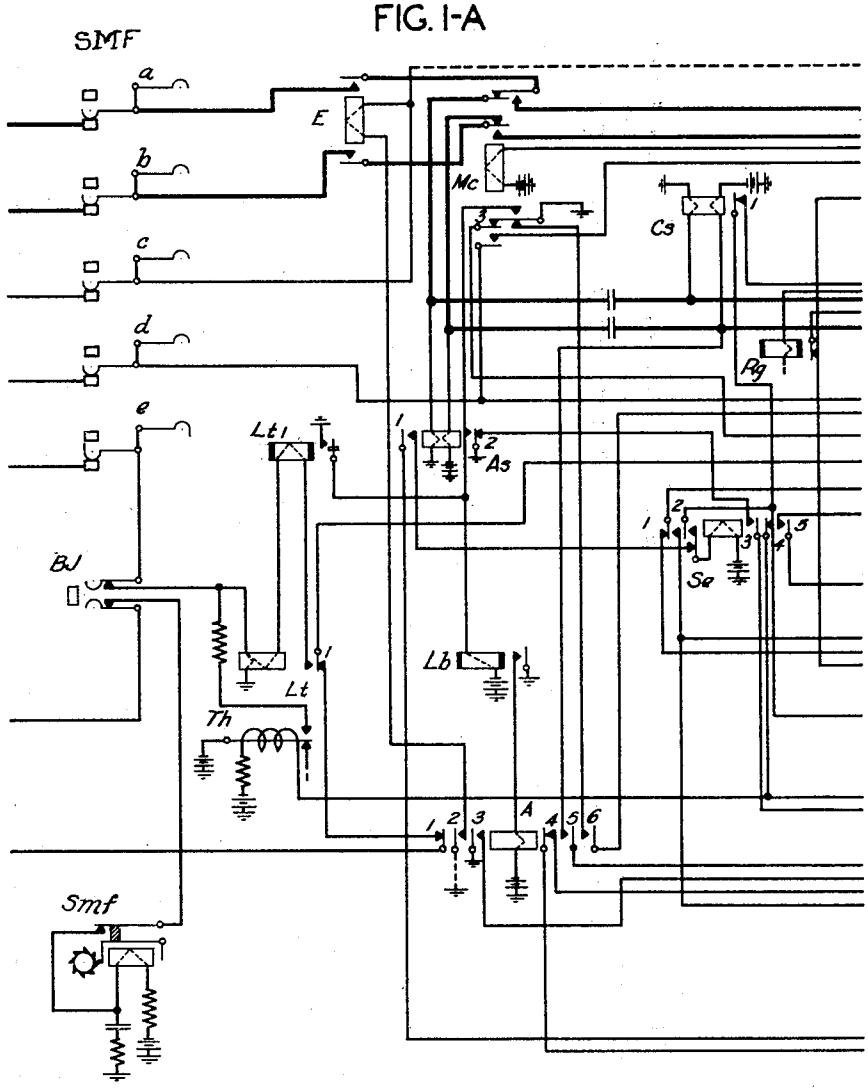
Jan. 12, 1932. W. HATTON ET AL 1,840,950

AUTOMATIC TELEPHONE SYSTEM

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FIG. 1-A



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AUTOMATIC TELEPHONE SYSTEM

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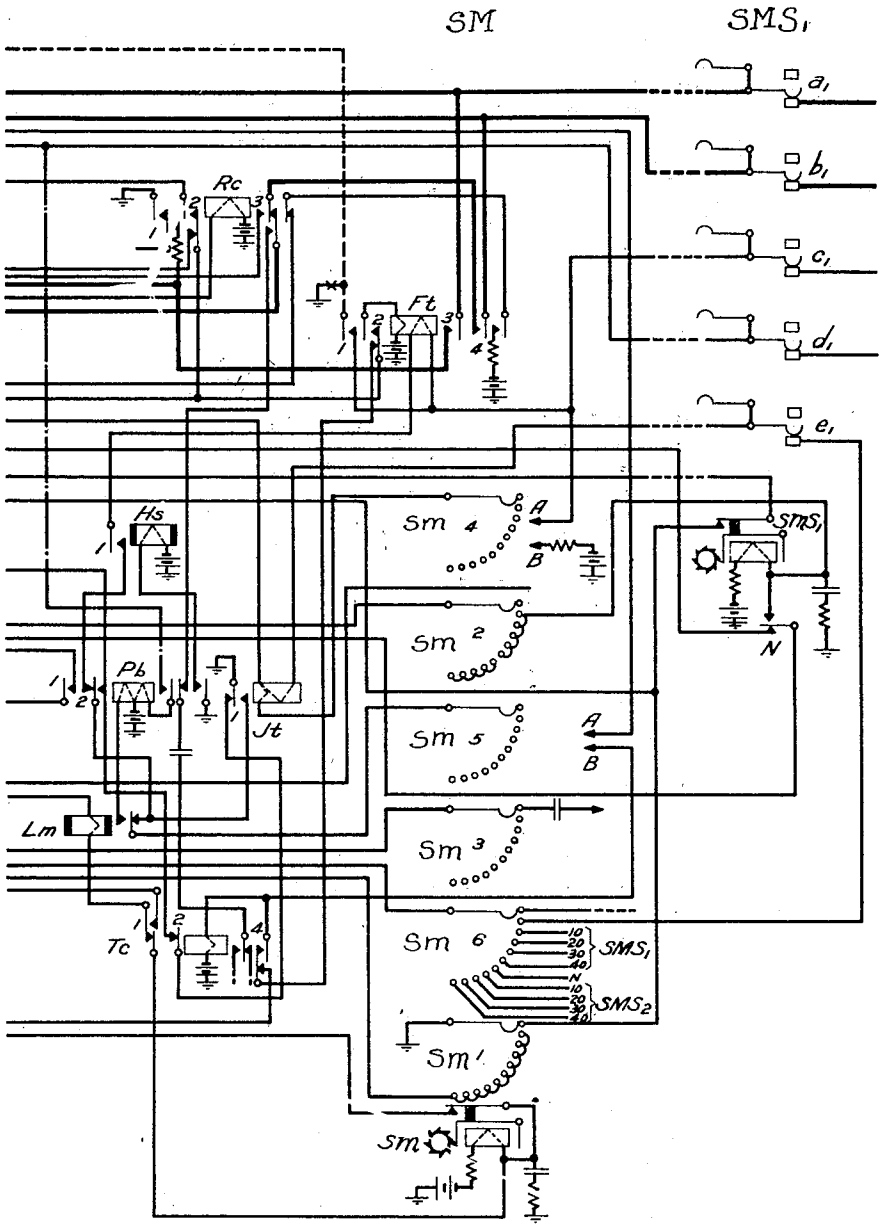


FIG. 1-B

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AUTOMATIC TELEPHONE SYSTEM

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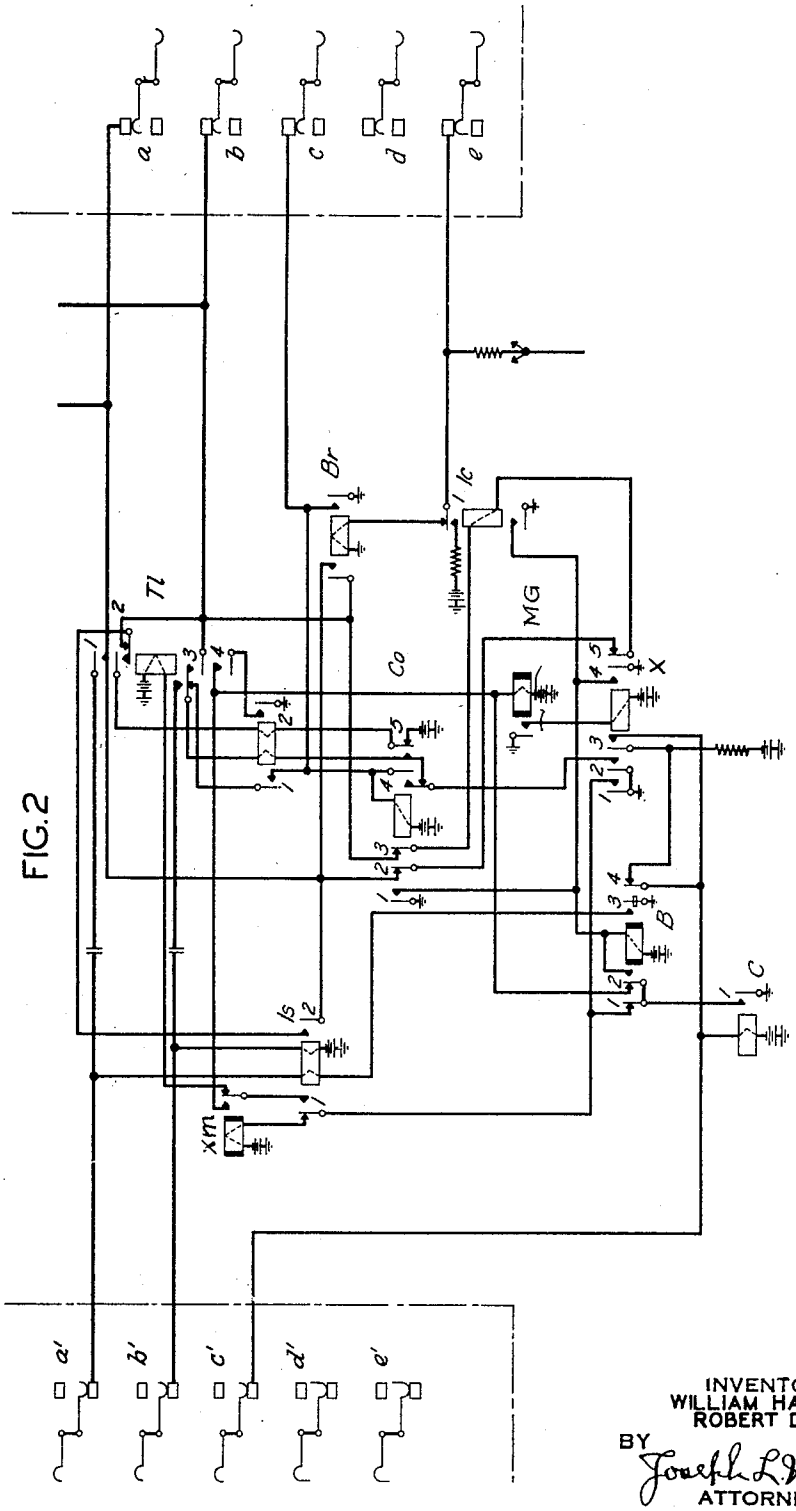


FIG. 2

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AUTOMATIC TELEPHONE SYSTEM

Application filed October 16, 1930, Serial No. 489,090, and in Great Britain November 15, 1929.

This invention relates to automatic or semi-automatic telephone systems.

One object of the invention is to provide an improved selector connector by means of which an idle outgoing junction can be taken into use or a wanted local line can be reached.

With this object in view, one feature of the invention comprises a selector switch or switches with which is or are associated a marking switch, and which is adapted to select a group of outlets marked by the marking switch in accordance with the value of a dialled digit characterized in this that in accordance with its setting, the selector switch either hunts for an idle outlet in the selected group or selects a particular outlet in the selected group in accordance with the value of a second digit.

The invention will be described by way of example with regard to two-way tie line working between small automatic exchanges comprising link circuits.

Each link circuit comprises a line finder, one or more selector switches and a marking switch, the selector switch or switches having access to local lines or outgoing junctions.

Certain of said junctions may lead to a manual exchange, while the others are two-way tie-lines to similar automatic exchanges.

Release for inter-exchange calls is in the hands of the calling subscriber. In order to prevent a "called subscriber held" condition, back release is provided after a certain time if the calling subscriber holds after the called subscriber has hung up. During the back release the incoming end of a tie line becomes freed before the outgoing end and it is therefore possible for a new call to be originated at the distant exchange over the said tie line before the other end of the tie line is released.

Another object of the present invention is to allow such a call to proceed and a new connection to be established without interfering with the release of the previous connection.

With this object in view another feature of the present invention consists of a both-way junction circuit, which is adapted to be seized at one end for setting up a call while the other end is still engaged.

The particular embodiment of the invention will now be described with reference to the accompanying drawings in which Figs. 1A and 1B show a link circuit for a 50 to 100 line automatic rural exchange comprising a call finder and a selector or selectors. A marking switch individual to the link circuit is also provided for controlling the selector. Only one selector will be used for up to 50 subscribers while for between 50 and 100 subscribers two selectors in parallel will be provided, both of which are adapted to be controlled by the same marking switch. The selectors have access to local lines or to groups of junctions.

Fig. 2 shows a two-wire tie line circuit to be provided at each end of a tie line. The two ends of the circuit appear respectively in the banks of the link circuit selectors and the link circuit finders for outgoing and incoming calls respectively.

The setting up of a call from one exchange to another over a tie line will now be described.

When a subscriber removes a receiver a circuit is closed for his line relay which energizes and in turn operates a starting relay to connect test potential to terminal *e* of the line finder SMF of the link circuit. The starting relay also completes a circuit for the magnet *smf* via its interrupter contacts causing the line finder to hunt: earth, wiper *sm*1, interrupter contacts of SMS1, *Se*1, normal contact N of SMS1, L*d*1, A1, front contact of starting relay, jack BJ, interrupter contacts and winding of SMF to battery. When the finder SMF reaches the calling line, relay L*t* operates via wiper *e* of SMF and locks in series with relay Lt_1, via normal contact N of SMS1 to earth over the circuit previously traced. Relays L*b* and A now operate in turn in obvious circuits. The dial tone starting circuit is now closed from earth at A3 over wiper *sm*6, dial tone being sent via *sm*3 and A5 to the *b* wire. Relay E operates in series with the calling subscriber's cut-off relay to earth at A2, and line relay A*s* then operates over the calling loop. Relay S*e* energizes: battery, winding of S*e*, make before break contacts of S*e*, A*s*1, make before break contacts of T*c*

and Ft, contacts A6, make before break contacts 3 of Mc, earth. Relay Se locks over its contacts 2, back contact of Cs and make before break contact 2 of Rc to earth as previously described.

The subscriber hearing dial tone, dials the first digit and the switch SM is stepped in the following circuit: earth, As2, Se3, winding of dialling relay Lm, Tc1, winding of SM battery. Immediately SM leaves normal switch SMS1 begins to hunt in the following circuit: earth Jt1, Tc2, Se5, interrupter contacts of SMS1, Se1, wiper sm2, SMS1, battery. It will be noted that two different connections may be made to the contacts in the banks of wipers sm4 and sm5. Lead A is to be connected to terminals corresponding to tie lines or junctions, while lead B is to be connected to the other terminals. Since the call is outgoing, SM will stop on contacts to which the leads A are connected. When SMS1 reaches a free junction in the group marked by SM, the relay Jt will operate in the following circuit: earth, A3, sm6, e1, both windings of Jt in series, sm4, C1, B4 in the tie line circuit, to battery via a resistance. Operation of Jt stops switch SM, and closes a circuit for relay Mc as follows: battery, Mc, sm5, back contact of Lm, Jt1 to earth. Relay Mc releases relay As and closes a metallic circuit through the link. This relay also connects earth at its contact 3 to the low resistance left-hand winding of Jt to busy the junction and closes a holding circuit for relay Lb. Relay Se is released by the operation of Mc.

The link circuit remains in this condition through conversation.

Turning now to the tie line circuit when the tie line was seized relay C operated, closing the circuit via C1, B2, for relay Mb. Relays X, B, Lm in turn pulled up in obvious circuits. The tie line is normally looped from conductor a, via Co2, A5, winding of Ic, Co3, to the b wire, relay Ic being pulled up over this loop for incoming calls: the operation of relay X breaks this circuit to prevent an incoming call taking place. Relay Is now operates over the calling loop, earth being supplied to its left hand winding at B3. Relay Lm is thereby released and the following circuit is formed for relay T1: battery, T1, back contact of Lm, Is1, X1, earth. Operation of T1 closes the calling loop to the distant exchange in which relay Ys operates as follows: battery, Co5, right hand windings of Ys, T12, Is2 to the a lead through winding of the Ic relay at the incoming end of the tie line, back over the b lead, T13, left hand winding of Ys, Co4, X2 to earth. Relay Mb holds via T14, Ys2. When the link circuit at distant exchange is connected to the tie line a dialling tone is transmitted to the calling party who then commences dialling the number of the wanted party.

On the reception of the first impulse relay T1 is released at Is1, disconnecting the calling and the transmitting circuit from the junction and completing a circuit for relay Co: battery, Co, Ys1, T13, left hand winding of Ys, Co4, X2, to earth. Relay Co operates and locks via its contact 4, disconnects the calling circuit and prepares the conversation circuit, at Co5. The slow releasing relay Lm also becomes energized during impulsing preventing the operation of T1 and forming a holding circuit for Mb via Is1, X1. The impulses are transmitted to the distant exchange by a metallic loop from the a lead over Is2, T12 to the b lead. After receiving each digit Lm de-energizes and T1 and Ys operate, the former closing the conversation circuit and the latter holding Mb. After completion of dialling, relay Ys is energized in the following circuit: earth, left hand winding of line relay As in the distant link circuit, a lead, Is2, T12, right hand winding of Ys, Co5, left hand windings of Ys, T13, b lead right hand winding of As in the distant link circuit, battery.

At the distant end seizure of the tie line operated relay Ic in the tie line circuit. Relay Ic operates relay B in an obvious circuit and at its contacts 1 energizes the starting relay (not shown) for the link circuit finders and puts test potential on the contacts of the wipers e. The link circuit operates as described before up to the reception of the tens digit. Relay Co in the tie line circuit becomes operated in series with the relay E of the link circuit releasing relay Ic. Relay B is, however, held at Co1.

In this case, wipers sm4, sm5, will stop on contacts connected to the B leads. Test relay Jt is connected via wiper sm4 to battery, via a resistance, and at its other side the test brush e1 of SMS1. Level e1 is the marking level as shown and the switch advances 10 terminals for each step made by SM. When the tens impulses are complete SM comes to rest and Lm de-energizes.

If the exchange has more than 50 lines the link circuit will contain 2 SMS switches, each of which is a 50 point switch. Switch SM is a 10 point switch, the first five contacts of which in level 6 mark switch SMS1, the other five marking the second selector switch. If the tens digit is greater than 5, as SM steps from its fifth to its sixth contacts the stepping circuit for SMS1 is immediately broken and a stepping circuit for the second selector is closed. The second selector therefore begins to hunt immediately it is determined that the wanted outlet is in its banks, and SMS1 is stopped in whatever position it has reached. In the present instance it will be taken that the wanted outlet is in the banks of SMS1, and when this switch reaches the marked terminal, relay Jt will operate

from battery, via wiper *sm*4, windings of *Jt* wipers *e*1 and *sm*6, A3 to earth.

Relay T*c* will now operate; battery T*c*, *sm*5, back contact of L*m*, J*t*1, earth. The units impulses are received direct on SMS1, the change in the instepping circuit being effected by T*c*. The instepping circuit may be traced from ground, *as*2, *se*3, *Lm*, *tc*1, *sm*2, winding of SMS1, battery. Relay P*b* operates via front contact of L*m*, *sm*5, T*c*4, F*t*2, A6, M*c*3, earth. Relay H*s* now operates in an obvious circuit and relay R*c* energizes as follows: battery, R*c*, back contact of R*g*, P*b*1, C*s*1, R*c*2, A6, M*c*3, earth. Relay *Rc* locks via bank contact of R*g*, R*c*2, to earth, as before. When the last impulse is received L*m* de-energizes and opens the circuit for P*b*, which in turn opens the circuit for H*s*, which slowly releases. The wanted line is tested during release of H*s* and if it is free relay F*t* pulls up in the following circuit: battery, wanted subscribers cut off relay, wiper *c*1 of SMS1, right hand winding of F*t*, H*s*1, P*b*2, back contact of L*m*, *sm*5, T*c*4, F*t*2, A6, M*c*3, earth. F*t* locks over *ft*2, before H*s* releases. Ringing current is now connected to the wanted subscriber as follows: ringing current, winding of R*g*, R*c*3, F*t*4, wiper *b*1, wanted subscribers bell circuit, wiper *a*1, F*t*3, R*c*1 to earth. When the wanted party replies ringing trip relay R*g* energizes, opening the locking circuit for R*c*, which releases, disconnects the ringing current from the line, and completes the talking circuit.

When the calling subscriber hangs up relay I*s* in the outgoing tie line circuit releases followed by relays T1, Y*s*, M*b*, X, B and C*o*, the outgoing circuit thereby returns to normal. After relay X has released and before relay B has de-energized, the battery in shunt on the winding of relay C is removed. Relay *Jt* in the link circuit therefore de-energizes followed by relay M*c* and the link circuit returns to normal. The relay T1 breaks the circuit of relay A*s* in the local link circuit at the distant exchange. Relays M*b* and X thereupon release in turn, the latter removing locking ground from all the other relays. Switch *Sm* now homes in a circuit via contact A4, and wiper *sm*1. When SM reaches normal, SMS1 is homed; ground *sm*1, interrupter contacts of SMS1, S*e*1, off normal contacts and winding of SMS1, battery; when SMS1 has reached home, the test circuit for relay L*t* is again complete, making the link circuit available for a new connection.

If the calling subscriber holds on after the called subscriber has hung up, timed back release takes place.

When the called subscriber hangs up his feed relay C*s* de-energizes and a circuit is completed for thermostat relay TH: battery, T*h*, S*e*4, C*s*1, R*c*2, A6, M*c*3, earth. T*h* pulls up after thirty seconds, putting battery on the *e* wiper of SMF. Relay B*r* in the incoming tie-line circuit therefore energizes, putting a direct earth on the *c* wiper and holding relays C*o* and B. Relay E in the link circuit is short-circuited and disconnects relay A*s*, so that the link circuit releases. Relays B*r*, C*o* and B release when the thermostat falls back. Disconnection of A*s* in the incoming link circuit releases relay Y*s* in the outgoing tie-line circuit. Relays M*b*, X, T1, and C*o* in the said circuit also release in turn, but relays C and B remain operated. With X de-energized and B operated, the battery in shunt on relay C is disconnected so that relay J*t* in the originating link circuit is released, followed by M*c* and relay I*s* in the tie-line circuit. The calling loop is now connected to relay A*s* and since the loop is still closed, A*s* operates. A circuit is now formed for thermostat relay T*h*: battery T*h*, S*e*4, C*s*1, R*c*2, A6, M*c*3, earth. Relay T*h* operates after thirty seconds connects battery to wiper *e* to energize the subscriber's fault relay which grounds wiper *c* of SMF. Relay E is de-energized to release the link circuit as described above.

It will be noted, however, that the incoming end of the tie-line falls free thirty seconds before the outgoing end is released. There is therefore the possibility that a subscriber at the incoming exchange may seize the tie-line for a call in the opposite direction before the other end of the tie-line is released. It is necessary therefore to ensure that the initiation as such a call may take place without interfering with and without hindrance from the release operations at the other end.

If the previously described connection is referred to, it will be found that for an incoming call, firstly relays I*c* and B, and later relays C*o* and B are operated. Both these conditions duplicate the forced release condition in an outgoing tie line circuit, that is, that relay X shall be released and relay B energized. Thus release is not interfered with.

Similarly the forced release conditions in an outgoing tie-line circuit consist of the energization of relays C and B only. Relay C does not interfere with the answering loop of the tie-line circuit and the operation of B is essential to an incoming call also, so that an incoming call may proceed unchecked.

If the calling subscriber hangs up after the thermostat at the incoming link circuit has operated, another call may be initiated in the same direction over the tie-line while relays B*r*, C*o* and B in the incoming tie-line circuit are operated. Since C*o* holds the normal answering loop open, the call cannot proceed, but in order that the distant end of the line shall not release, B*r* closes an alternative loop on the tie-line at its contacts 1. When T*h* in the link circuit releases, B*r* and C*o* release and the new call proceeds.

What is claimed is:

1. In an automatic telephone system, a

circuit arrangement for a two-way inter-exchange junction, means for causing the junction to be seized at one end for setting up a call, before the other end has been released from a previous connection in the same or opposite direction.

2. In an automatic telephone system, a circuit arrangement for a two-way inter-exchange junction in which one end of the junction may be made available for setting up calls while the other end is still connected up in a previous connection in the same or opposite direction.

3. In an automatic telephone system the combination of a calling and called subscriber at different exchanges, means for extending a connection between said subscribers over a two-way inter-exchange junction, the release of the connection normally under control of the calling subscriber, means for causing a forced release to take place if the calling subscriber delays hanging up.

4. In an automatic telephone system the combination of a calling and a called subscriber, means for extending a connection between said subscribers over a junction, the release of the connection is normally under the control of the calling party, and in which forced release of a connection is initiated at the called end if the called subscriber is unduly held, means whereby if the calling subscriber initiates a new call the calling end of a junction after forced release has been initiated at the called end, the junction may be seized for the new call in the same direction before the incoming end of the junction has been freed.

5. In an automatic telephone system the combination of a calling and called subscriber, means for extending a connection between said subscribers, means whereby the release of the connection is normally under control of the calling party, and in which forced release by a called subscriber is controlled by time delay means.

6. In a telephone exchange system the combination of a calling and called line, a selector switch having access to a group of outlets, a marking switch for marking said outlets to render them selectable by said selector switch to extend a connection from the calling to the called line, means for releasing said connection normally under control of the calling line, and a time delay means for releasing said connection independent of the normal releasing means.

7. In a telephone exchange system the combination of a plurality of exchanges connected by trunk lines, a selector and a marking switch, means controlled by said selector to engage an idle trunk to extend a connection to another exchange, means normally controlled by a calling line to control the release of said connection, a time delay means for releasing the connection and controlled at the other exchange independent of the normal releasing means, and means controlled by the time relay means to render the trunk line free for selection while the connection remains at one end.

8. A circuit arrangement as claimed in claim 4 comprising an alternative holding circuit characterized in this that the circuit of the incoming call answering relay at the called end of the junction is held open during forced release at the called exchange, but that the alternative holding circuit is meanwhile completed to prevent the breaking down of a further incoming call.

In witness whereof, we hereunto subscribe our names this 25th day of September, 1930.

WILLIAM HATTON.
ROBERT DAHL.