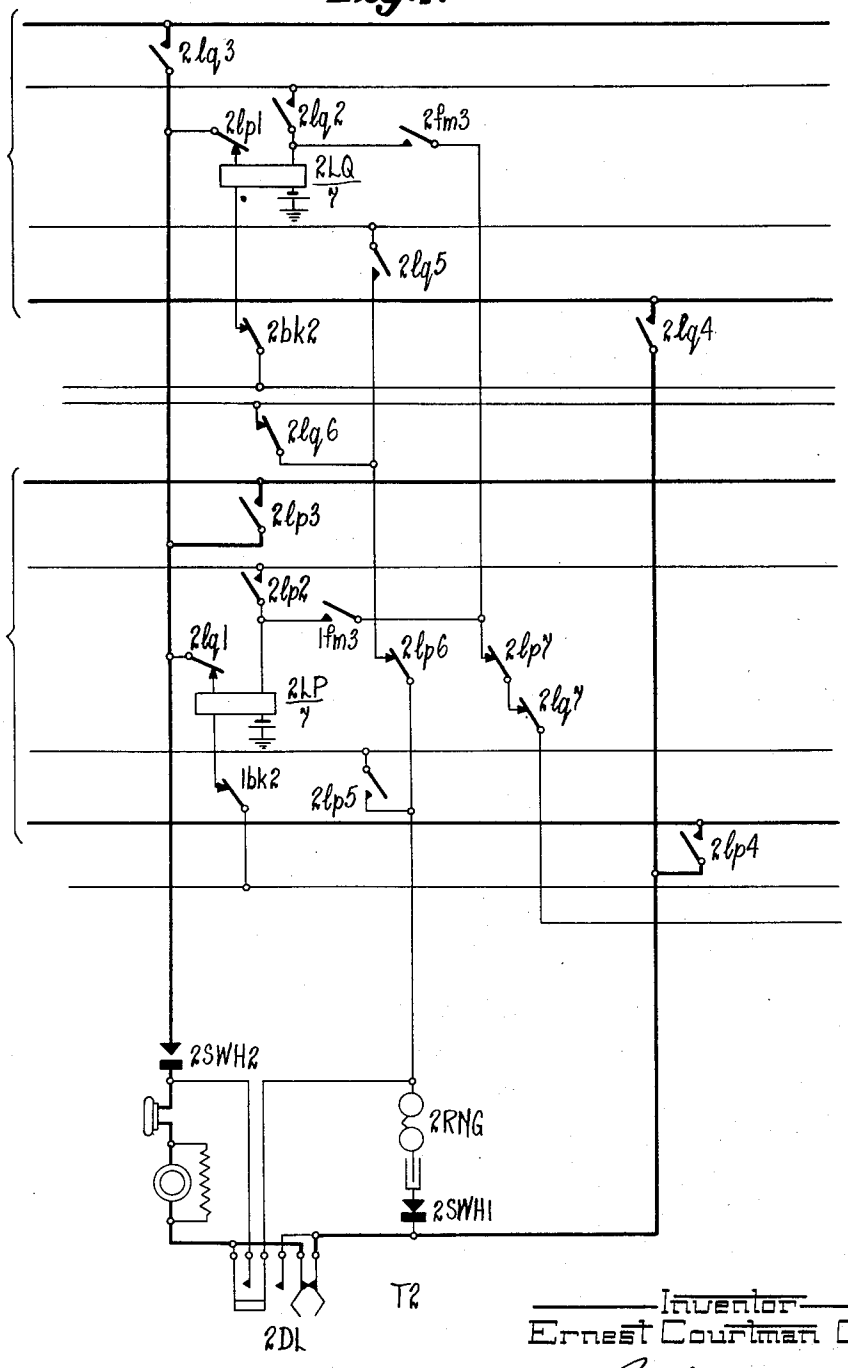
Jan. 23, 1934. E. C. OLIVER 1,944,693

TELEPHONE SYSTEM

Filed Dec. 7, 1931 5 Sheets-Sheet 1

Fig. 1.



Inventor

Ernest Courtman Oliver

R. S. Richardson

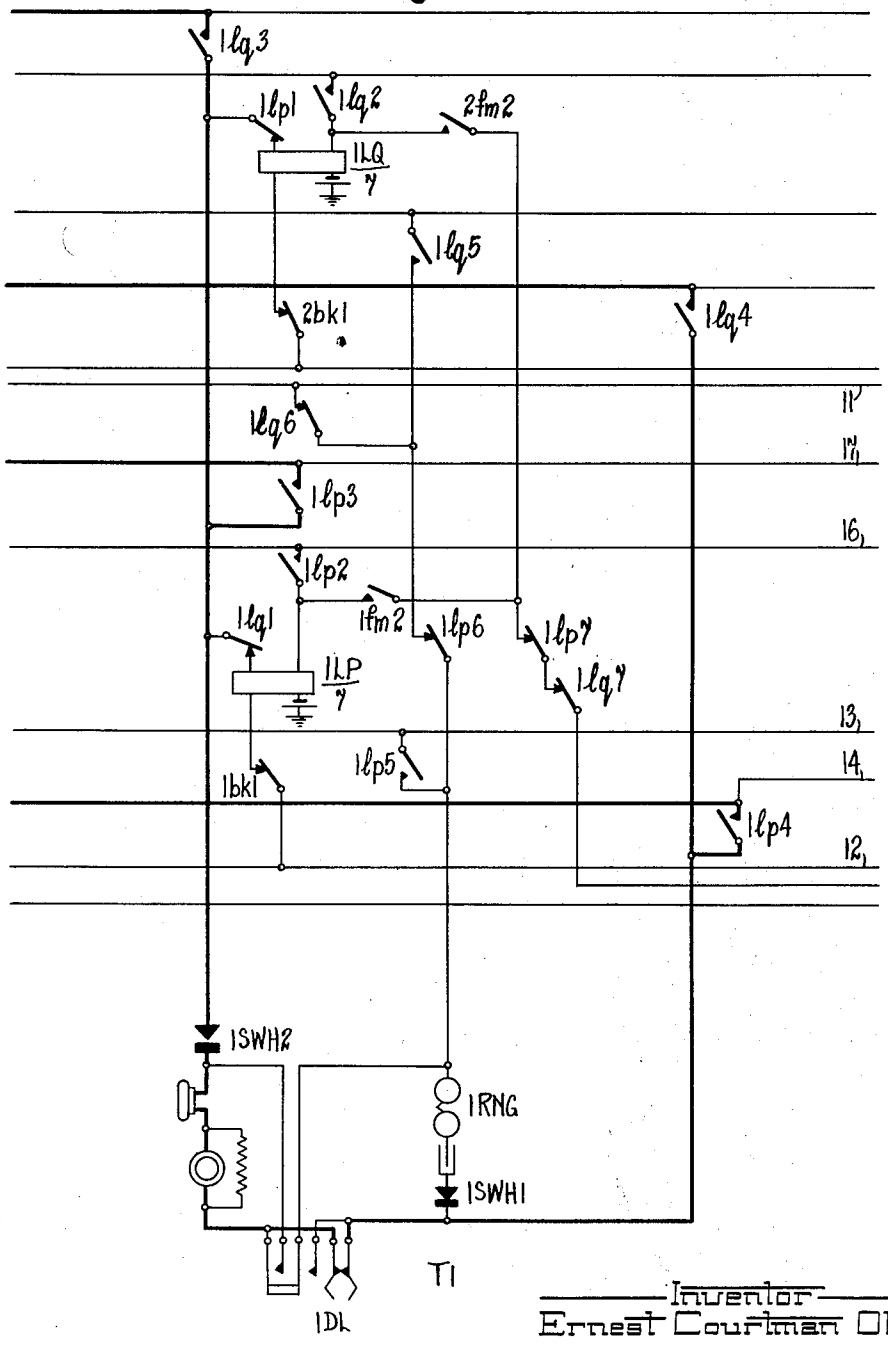
Atty.

Jan. 23, 1934. E. C. OLIVER 1,944,693

TELEPHONE SYSTEM

Filed Dec. 7, 1931 5 Sheets-Sheet 2

Fig. 2.



Inventor

Ernest Courtman Oliver

Atty.

Jan. 23, 1934. E. C. OLIVER 1,944,693

TELEPHONE SYSTEM

Filed Dec. 7, 1931 5 Sheets-Sheet 3

Fig. 3.

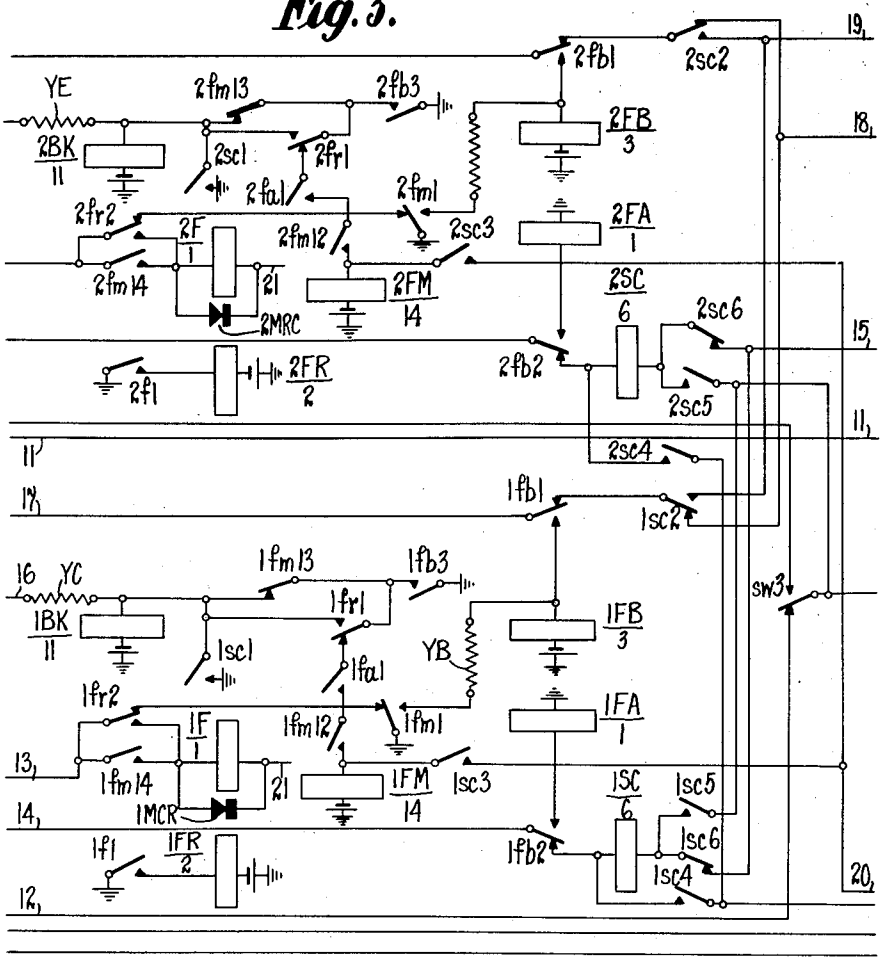


FIG. 1.	FIG. 2.	FIG. 3.	FIG. 4.
		FIG. 5.	

Fig. 6.

Inventor
Ernest Courtman Oliver

Atty.

Jan. 23, 1934. E. C. OLIVER 1,944,693

TELEPHONE SYSTEM

Filed Dec. 7, 1931 5 Sheets-Sheet 4

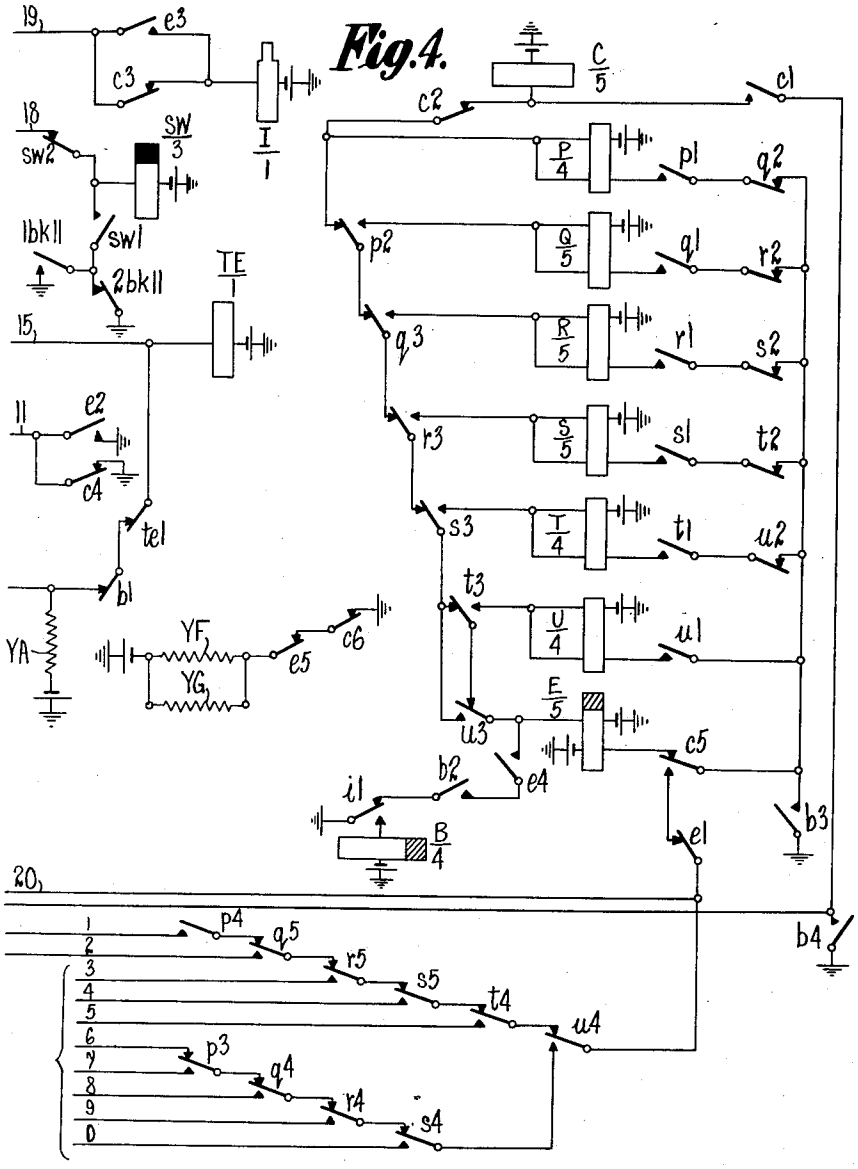


Fig.4.

Inventor
Ernest Courtman Oliver

Atty.

Jan. 23, 1934. E. C. OLIVER 1,944,693

TELEPHONE SYSTEM

Filed Dec. 7, 1931 5 Sheets-Sheet 5

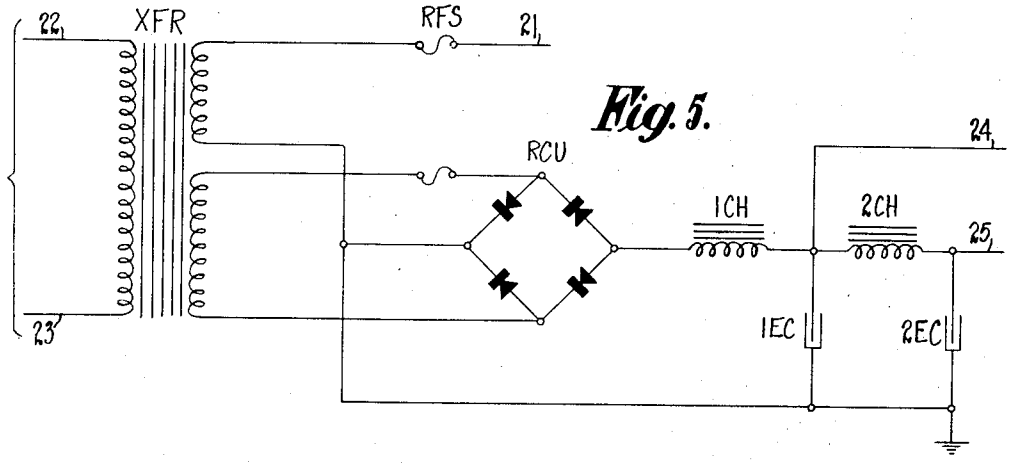


Fig. 5.

Inventor
Ernest Courtman Oliver

R. S. Richardson
Atty.

Patented Jan. 23, 1934 1,944,693

UNITED STATES PATENT OFFICE

1,944,693

TELEPHONE SYSTEM

Ernest Courtman Oliver, Cheshire, England, assignor to Associated Telephone and Telegraph Company, Chicago, Ill., a corporation of Delaware

Application December 7, 1931, Serial No. 579,505, and in Great Britain December 12, 1930

16 Claims. (Cl. 179—16)

The present invention relates to telephone systems and as regards certain of its features is more particularly concerned with small automatic exchanges of the type which do not provide facilities for connection with the public exchange system and are commonly used in offices, factories and the like. The chief object of the invention is to provide an installation of this type which shall employ a minimum of apparatus and hence will require a minimum of space and which shall also be cheap to manufacture and to maintain.

According to one feature of the invention the amount of equipment required is reduced by arranging that the apparatus which responds to the impulses dialled by the calling party is common to a large number of lines the holding time of this apparatus being reduced, however, by arranging that it is not taken into use until the calling party actually moves his dial off-normal in the process of dialling. With this object in view it is preferably arranged that the circuit for seizing the impulse responding equipment is completed over shunt springs of the dial as soon as it is moved from its normal position.

Another feature of the invention relates to the use of a special ringing circuit in which ringing current is fed through the winding of a relay which is operated thereby and in consequence of its operation maintains closed a point in the ringing circuit. When the calling party removes his receiver, the switchhook springs open the ringing circuit so that the ringing relay is de-energized and therefore opens a further point in the ringing circuit so as to produce a tripping action. Preferably ringing current is supplied over a special lead individual to each substation and this lead may conveniently form part of the circuit for effecting the seizure of the impulse responding equipment. There is no serious objection to this additional lead in installations of this type since the lines are almost without exception very short.

The advantage of simplicity of maintenance and economy of space is also obtained by the use of an arrangement whereby the current for operating purposes is taken from alternating current mains by means of a suitable rectifier arrangement and the rectified current is smoothed by means of a smoothing circuit employing electrolytic condensers. Since these condensers operate most efficiently if the applied voltage remains substantially constant, it is arranged that the rectifier output circuit normally includes an artificial load which is removed during the selecting operation when a comparatively heavy current drain is produced by the operation of the counting relays.

When the installation is of small size, for instance 10 lines, the apparatus is preferably assembled into two units, one consisting of the power equipment comprising the transformer, rectifier and chokes and condensers forming the smoothing circuit and the other consisting of the various control relays by means of which the proper connections are set up.

The invention will be better understood from the following description of one method of carrying it into effect reference being had to the accompanying drawings comprising Figs. 1 to 5 which should be arranged as shown in the key sheet located in Fig. 6 to form a complete circuit of the invention.

Referring now to the separate figures, Fig. 1 shows a subscriber's instrument circuit and connecting relays by means of which the telephone may be connected to either connecting circuit, Fig. 2 shows a further subscriber's instrument circuit also possessing two connecting relays which serve a similar function, Fig. 3 shows the connecting circuits arranged to supply speaking battery to the calling and called subscribers, Fig. 4 shows the selector equipment containing the counting relay chain responsive to the dialled impulses, while Fig. 5 shows a battery eliminator circuit and ringing feed which is of substantially conventional form.

Referring now to the detailed circuit operation, it will be assumed that the subscriber on telephone T1, Fig. 2, wishes to make a call to another subscriber on the system when the switch-board apparatus is idle. Upon the removal of the receiver from the switchhook, the contacts 1SWH1 and 2 will be operated, the former opening the circuit to the ringer 1RNG and the latter closing a point in the left-hand speaking conductor which is without effect as regards the operation of the switchboard apparatus until the dial 1DL is operated preparatory to the sending of the routing digit. When this is done the shunt springs located to the left-hand side of the main impulsing springs of the dial are operated to complete the following circuit to the line connecting relay associated with this instrument and designated 1LP: earth at the resting armature *c4*, Fig. 4, conductor 11, resting armature 1*lq*6, Fig. 2, resting armature 1*lp*6, third conductor extending to the telephone instrument T1, operated shunt springs of dial 1DL, resting impulse springs, switchhook spring SWH2, left-hand speaking conductor, resting armature 1*lq*1, left-hand wind-

ing of the connecting relay 1LP, resting armature 1*bk*1, conductor 12, resting armature *sw*3 to battery by way of the low resistance YA in parallel with the comparatively high resistance relay TE which is short-circuited under these circumstances. Relay 1LP is therefore operated over the circuit described and at its armature 1*lp*1 opens the circuit to a similar connecting relay 1LQ associated with the second connecting circuit, at armature 1*lp*2 prepares a locking circuit to its right-hand locking winding, at armatures 1*lp*3 and 1*lp*4 connects up the speaking leads from telephone T1 to the first connecting circuit, at armature 1*lp*5 completes a circuit for operating relay 1SC, Fig. 3, which will be described later, at armature 1*lp*6 opens its own initial energizing circuit and at armature 1*lp*7 opens the incoming switch circuit to the connecting relays 1LP and 1LQ of the calling telephone T1.

It should be mentioned that the armatures 1*lp*5 and 1*lp*6 are arranged by adjustment to fulfil a make-before-break function so that a locking circuit may be completed to relay 1LP before the opening of its initial energizing circuit. The operating circuit previously mentioned for relay 1SC may now be traced from: earth at the resting armature 1*fm*1, Fig. 3, resting armature 1*fr*2, conductor 13, operated armature 1*lp*5, third telephone conductor, operated shunt springs of dial, right-hand speaking conductor, operated armature 1*lp*4, conductor 14, resting armature 1*fb*2, winding of relay 1SC, resting armature 1*sc*6, conductor 15 to battery in a parallel circuit which is formed by way of the comparatively high resistance relay TE and also by way of the resting armatures *te*1 and *b*1 to battery via the resistance YA which is sufficiently low to short-circuit relay TE against its operation under these conditions. Relay 1SC in operating, at its light armature 1*sc*1 completes an operating circuit for relay 1BK whose function will be described later, and also extends earth by way of the comparatively low resistance YC to conductor 16, to provide a locking circuit to the right-hand winding of relay 1LP. A parallel circuit may also be traced from earth connected to the left-hand winding of relay 1LP, resting armature 1*lq*1, operated armature 1*lp*3, conductor 17, resting armatures 1*fb*1 and 1*sc*2, conductor 18, resting armature *sw*2, winding of relay SW to battery. It will be seen therefore, that operating circuits to relays 1SC and SW are completed at substantially the same instant and in order to ensure that relay 1SC will always operate before relay SW, the latter is equipped with a copper slug so as to render the relay very slightly slow to operate. This arrangement is desirable in order to make quite sure that the locking circuit to the right-hand winding of the connecting relay 1LP is completed before the initial energizing circuit to the left-hand winding can be opened at the armature *sw*^{3} when relay SW is operated and locked to earth by way of the armatures 1*bk*11 and 2*bk*11. Relay SW is therefore locked until a further call is made and since the operating battery by way of the resistance YA is transferred to the second connecting group then a subsequent call must be made by way of this group although the first group may have been released meanwhile. Such arrangement therefore ensures the even distribution of the calls over the two connecting circuits.

Returning again to the operation of relay 1SC, at armature 1*sc*2 the initial energizing circuit to the distributing relay SW is transferred by way of conductor 19 and the resting armature *c*3 to the impulsing relay I of the selector equipment which is immediately operated and at its armature *i*1 operates relay B, at armature 1*sc*3 an operating circuit is completed to the marking relay 1FM, at armature 1*sc*4 an alternative locking circuit is completed to relay 1SC, at armature 1*sc*5 the winding of relay 1SC is connected direct to resistance battery by way of YA, and at armature 1*sc*6 a point is opened in the initial battery circuit which included relay TE. It should be explained that armatures 1*sc*5 and 1*sc*6 are arranged by adjustment to fulfil a make-before-break function so as not to interrupt the locking circuit to relay 1SC during the changeover of the battery circuit.

Considering now the operation of relay 1BK, it should be mentioned that this relay is provided with a plurality of armatures arranged to open the initial energizing circuits to all the connecting relays LP associated with all the telephone circuits such as T1, while at a further armature 1*bk*11 an alternative locking circuit is provided to the distributing relay SW. Relay B in operating, at its armature *b*1 opens the short-circuiting path to relay TE, at its armature *b*2 prepares a point in the impulsing circuit to the counting relays P to U, at armature *b*3 completes an operating circuit for relay E on its lower winding and prepares a locking circuit for the counting relays when operated, and at armature *b*4 completes a locking circuit to relay 1SC and prepares a locking circuit to relay C, Fig. 4. Upon the operation of relay E over the circuit described, at armature *e*1 a point is opened in the circuit of the marking relay 1FM so as to prevent its operation until the end of the impulsing period, at armature *e*2 earth is connected to conductor 11 which extends to the third telephone conductor, at armature *e*3 an alternative operating circuit is provided to the impulsing relay I, at armature *e*4 a further point is prepared in the impulsing circuit to the counting relays, and at armature *e*5 a point is opened in an artificial load circuit which is normally connected to the battery eliminator equipment shown in Fig. 5 the function of which will be fully described later. No further circuit operations will now take place until the calling subscriber allows his dial to return to normal under the influence of the restoring spring. When this is done impulses corresponding to the displacement of the finger plate of the dial will be delivered over the circuit previously traced to effect the operation of the impulsing relay I, Fig. 4. Upon the first de-energization of the impulsing relay I the following circuit may be traced to the counting relays: earth at the resting armature *i*1, operated armatures *b*2 and *e*4, resting armatures of all counting relays, upper winding of relay P to battery and in parallel by way of the resting armature *c*2 and winding of relay C to battery. Relays C and P will therefore operate their light armatures in this circuit, the former relay completing a locking circuit to earth at the operated armature *b*4, whilst the latter relay prepares a circuit for its full operation on both windings in series at the cessation of the impulse. It should be mentioned that a straightforward numbering scheme is employed for the system namely 1 to 0 and assuming for example that in this particular instance the digit 7 is dialled in order to establish connection with the telephone bearing that number, the following counting operation will be performed on the counting relays

P to U. At the cessation of the first impulse, relay P will be fully operated on both windings in series to transfer the impulsing circuit to a relay Q, and at the cessation of the second impulse relay Q will be fully operated in a similar manner to transfer the impulsing circuit to relay R, while at the same time opening the holding circuit to the preceding relay P which then releases. This sequence of operations will be observed in respect of all relays P to U until the last relay U is operated at the cessation of the 6th impulse. Relay U it will be observed remains locked during the subsequent impulsing since its holding circuit does not include a resting armature of the following relay. Upon the reception of the 7th and last impulse, relay P will again be operated and locked for an indefinite period. It should be mentioned that relays B and E are equipped with copper slugs so as to enable them to hold operated continuously during the impulsing period. At the end of the impulsing period, relay I will hold and therefore after a suitable delay relay E will release to complete the following circuit to the marking relay 1FM: earth at the operated armature *b*3, operated armature *c*5, resting armature *e*1, conductor 20, operated armature 1*sc*3, winding of relay 1FM, Fig. 3, to battery. Relay 1FM in operating over the circuit described, at armature 1*fm*1 operates the upper battery feed relay 1FB in series with resistance YB, at armatures 1*fm*2 to 1*fm*11 prepares a point in the circuit of the right-hand windings of all connecting relays LP, at armature 1*fm*12 prepares an alternative locking circuit for itself which will become operative in case a busy condition is encountered, at armature 1*fm*13 opens a point in the locking circuit to the connecting relay 1LP and at armature 1*fm*14 prepares the circuit for ringing the called subscriber's bell.

Returning again to the counting relays in Fig. 4, it will be remembered that relays P and U are operated, and therefore upon the release of relay E which is followed by the operation of relay 1FM, a circuit may be traced to effect the operation of the connecting relay LP associated with the telephone No. 7 from earth at the operated armature *b*3, operated armature *c*5, resting armature *e*1, operated armature *u*4, resting armatures *s*4, *r*4 and *q*4, operated armature *p*3, marking conductor 7, resting armature 7*lq*7, resting armature 7*lp*7, operated armature 1*fm*8, right-hand winding of relay 7LP to battery. The relays with prefix 7 are not shown but are similar to the corresponding ones with prefix 2. 1*fm*8 corresponds to 1*fm*3. Since all telephone circuits are identical the following description instead of being directed to telephone No. 7 will be directed to telephone No. 2 which is shown in the drawings. Upon the assumed operation of the connecting relay 2LP over the marking circuit traced it will be seen that telephone No. 2 is connected to a calling circuit.

Considering now the operation of the battery feed relay 1FB, at armatures 1*fb*1 and 1*fb*2 the battery feed circuit to the speaking conductors is completed, and at armature 1*fb*3 a holding circuit is maintained to the connecting relays LP. The lower battery feed relay 1FA is also operated in series with relay 1FB over the speaking circuit and at armature 1*fa*1 a locking circuit is prepared to relay 1FM which is operative when the wanted line is busy. The called subscriber's bell will now be rung over the following circuit: ringing current supply over lead 21 from the eliminator equipment shown in Fig. 5, winding of ringing cut-off relay 1F, operated armature 1*fm*14, conductor 13, operated armature 2*lp*5, third telephone conductor, called subscriber's bell 2RNG, condenser, resting switchhook springs 2SWH1, right-hand speaking conductor, operated armature 2*lp*4, conductor 14, operated armature 1*fb*2, Fig. 3, to earth return by way of the winding of the battery feed relay 1FA. The calling subscriber's bell is of course not responsive to the ringing circuit owing to the opening of the bell circuit at the operated switchhook springs 1SWH1, but it should be mentioned that a distinctive tone indicative of the ringing condition is induced into the receiver of the calling instrument owing to the presence of alternating current in the common battery feed circuit formed by way of the winding of relay 1FA. It should be mentioned that the winding of the ringing cut-off relay 1F is connected in parallel with a metal rectifier 1MRC of a suitable well-known type so as to render the relay operable in the ringing circuit. Relay 1F in turn operates the relief relay 1FR, which at armature 1*fr*1 provides an alternating holding circuit to the connecting relays LP during the interval between the release of relays 1SC and 1FM, and at armature 1*fr*2 provides an alternative circuit to relay 1F. In this manner the called subscriber's bell is rung, and the foregoing conditions will obtain until the call is answered.

Returning again to the operation of relay 1FB, it will be seen that at armature 1*fb*1 the circuit is opened to the impulsing relay I, Fig. 4, which releases and in turn drops relay B after its slow period. Relay B in releasing drops the counting relays which were operated and also relay C, while at the same instant opening the holding circuit to relays 1FM and 1SC which also restore.

The selector equipment, Fig. 4, is therefore freed for use on other calls, and the control of the connections set up is transferred to the battery feed relay 1FB. When now the called subscriber removes his receiver to answer the call the associated switchhook contacts 2SWH1 will be operated to open the ringing circuit and connect up the speaking circuit, and under those conditions relay 1F will release and in turn release 1FR so as to disconnect the ringing current from the common conductor 13. Conversation may now take place between the calling and called subscribers and the necessary battery feed for speaking is supplied via the windings of the comparatively high impedance relays 1FA and 1FB which also serve the purpose of controlling the connection. In order to obviate the possibility of inductive interference in the speaking circuit a special battery feeder is provided for the eliminator equipment, Fig. 5, arranged to feed the relays 1FA, 1FB and 2FA, 2FB, and this feeder is quite separate and distinct from that arranged to supply the various controlling relays.

Considering now the possibility of the wanted subscriber being already engaged on a call, then the circuit operations previously described will obtain so far as the release of relay E at the end of the impulsing period, whereupon the relays 1FM, 1FB and 1FA will be operated in the manner explained, and since the ringing circuit to the wanted subscriber's bell is opened at the switchhook springs relays 1F and 1FR will not be operated so that under these conditions a holding circuit is established for relay 1FM by way of the resting armature 1*fr*1. Following upon the release of the impulsing relay I and in turn relays B and C, the holding circuit is opened

to relay 1SC which also releases, and owing to the continued operation of relay 1FM the holding circuit for the calling subscriber's connecting relay 1LP will not materialize via resting armature 1*fm*13 and the relay is therefore released. The release of the connecting relay 1LP is followed by the release of the feed relays 1FA and 1FB and also the marking relay 1FM, and it will therefore be realized that the apparatus is now freed for use on further calls. Absence of ringing tone in the calling subscriber's receiver is indicative that the call has not matured, and therefore further manipulation of the dial will be necessary to register a further attempt.

Although the selector equipment, Fig. 4, is only engaged for a very short period of time during each call, approximately equivalent to the time taken for the operation of the dial and its return to normal, it is conceivable, however, that the second caller may remove his receiver and operate the dial during this period, and therefore means must be provided to prevent the mutilation of the first caller's connection. This possibility is guarded against by the provision of a special relay TE which is only operable during the period when the selector equipment is already engaged.

Considering now the detailed circuit operation, it will be remembered from the previous description that upon seizure of the selector equipment, relay B is operated and therefore the short-circuiting path is disconnected from relay TE. Consequently in case a second caller should remove his receiver and operate the dial, the connecting relay LQ associated with the second circuit will operate, but since relay 2SC is adjusted not to operate in series with relay TE, the impulsing relay I is not connected to the second circuit and therefore the first caller's impulses will continue without interruption. It will be seen from the circuit that the second caller's impulses are without effect and consequently since relay TE is held operated under the control of the off-normal springs of the dial so as to absorb all the impulses, there is no possibility of the second caller establishing a mutilated connection in case the selector equipment should become free meanwhile.

Referring now particularly to the battery eliminator equipment shown in Fig. 5, it will be seen that this is of conventional form comprising a composite transformer XFR and a rectifying unit RCU arranged to provide full wave rectification. The conductors 22 and 23 connecting with the left-hand winding of the transformer XFR extend to the alternating current mains supply, while the right-hand winding is split and arranged so that the upper portion is stepped down to a pressure of conveniently 75 volts for supplying ringing current to the equipment at mains frequency by way of the fuse RFS and conductor 21. Conductor 21 extends to the windings of the ringing relays 1F and 2F of both connecting circuits. The lower winding of the transformer is stepped down to provide a pressure of conveniently 16 to 18 volts, and arranged to supply alternating current to the rectifying unit RCU where full wave rectification will take place in order that a continuous current may be delivered by way of suitable chokes 1CH and 2CH and conductors 24 and 25 to the control relays and battery feed relays respectively. Suitable values for the chokes may be for instance .3 of an ohm for 1CH and 1 ohm for 2CH, while large capacity electrolytic condensers of conveniently 2000 microfarads are also employed for smoothing the rectified current and are connected across the respective feeders in the positions indicated by 1EC and 2EC. Since, however, such condensers can only be guaranteed to function correctly over long periods where a substantially constant voltage is maintained, it will be appreciated that their presence in this particular circuit is not altogether desirable unless some special means of maintaining constant voltage is provided, since it will be remembered from the previous description that the rectifying unit on an open circuit will produce a pressure of from 16 to 18 volts, while under load it is quite conceivable that this pressure will drop as low as 12 volts. It will be seen therefore that the pressure is likely to vary between quite wide limits and therefore it is arranged that an artificial load shall be connected across the rectifying unit under normal conditions which is approximately equivalent to the load when the apparatus is in use. This load is provided in the form of two resistances YF and YG split in order to dissipate the head more readily and connected up in a circuit controlled by resting armatures of relays E and C, which it will be remembered are only operated when the low resistance counting relays which are responsible for the majority of the load are in use. In this manner therefore, a substantially constant voltage is maintained across the electrolytic condensers 1EC and 2EC so that their operating characteristics may be retained unimpaired for a long period.

I claim:

1. In a telephone system, a plurality of lines each equipped with a dial, impulse responsive equipment for completing connections between said lines, said equipment being normally disconnected from all of said lines, and means responsive to the movement of one of said dials from its normal position for associating said equipment with the associated line.

2. In a telephone system, a plurality of subscribers' lines each equipped with a dial, impulse responsive apparatus common to said lines and normally disconnected therefrom, and means for connecting said apparatus to a calling line responsive only to the operation of the dial associated with the calling line.

3. In a telephone system, a plurality of subscribers' lines each equipped with an impulse sender, impulse responsive apparatus common to said lines and normally disconnected therefrom, and means for associating said apparatus with a calling line only during the time the impulse sender associated with the calling line is operated.

4. In a telephone system, a plurality of subscribers' lines each consisting of two talking conductors and a third conductor, impulse responsive apparatus common to said lines and normally disconnected therefrom, and means controlled over the third conductor of a calling line for connecting such line to said common apparatus.

5. In a telephone system, a plurality of subscribers' lines each equipped with a dial, impulse responsive apparatus common to said lines and normally disconnected therefrom, means for connecting said common apparatus to a calling line, and a circuit over which said means is controlled by the dial of the calling line.

6. In a telephone system, a plurality of subscribers' lines, impulse responsive apparatus common to said lines and normally disconnected therefrom, a plurality of relays for associating said common apparatus with calling lines, and

means responsive to the operation of one relay to connect the common apparatus with a calling line for rendering the remainder of said relays inoperative.

7. In a telephone system, a plurality of subscribers' lines, impulse responsive apparatus common to said lines and normally disconnected therefrom, two relays for associating said common apparatus with calling lines, a third relay, means responsive to the operation of one of said two relays for connecting said apparatus to a calling line and for preparing a circuit for said third relay, means responsive to an attempt by a second calling line to connect with said common apparatus for completing the circuit to said third relay, and means controlled by said third relay for preventing the operation of the other of said two relays.

8. In a telephone system, a plurality of substation telephone lines each consisting of two speaking conductors and an auxiliary conductor, automatic switching apparatus controlled over a calling line for establishing a connection to a called line, and means for transmitting ringing current over the auxiliary conductor of the called substation telephone line for signalling purposes.

9. In a telephone system, a plurality of subscribers' lines, automatic switching apparatus for completing telephone connections between said lines, means for transmitting ringing current to a called line, a relay included in the ringing circuit and operated by the ringing current, and a contact on said relay for opening the ringing circuit when said relay releases due to an interruption of the ringing current.

10. In a telephone system, a plurality of subscribers' lines, automatic switching apparatus for completing telephone connections between said lines, a ringing circuit over which ringing current is supplied to a called line including the winding of a relay, a rectifier connected in multiple with said relay so that the relay will be operated by ringing current, and a make contact on said relay included in the ringing circuit to open the circuit when said relay releases responsive to cessation of ringing current.

11. In a telephone system, a plurality of subscribers' lines, impulse responsive apparatus common to said lines and normally disconnected therefrom, means responsive to the initiation of a call over one of said lines for associating said commmon apparatus with the calling line, means in the common apparatus responsive to digit impulses transmitted from the calling line for establishing a connection, independent of said common apparatus, between the calling and called lines, and means for releasing said common apparatus in case the called line is busy.

12. In a telephone-system, a plurality of subscribers' lines, two common talking circuits over which telephone connections between said lines are established, impulse responsive apparatus common to said talking circuits and normally disconnected therefrom, means responsive to the initiation of a call over one of said lines for connecting the calling line to one of said talking circuits and for connecting the common apparatus to the seized talking circuit, and means for disconnecting said common apparatus from said talking circuit when the called line has been connected thereto and in case the called line is busy.

13. In a telephone system, subscribers' lines, two talking circuits over which connections are established between said lines, impulse responsive apparatus common to said talking circuits and normally disconnected therefrom, means responsive to the initiation of a call over one of said lines for connecting the calling line to one of said talking circuits and for connecting said common apparatus to the seized talking circuit, means responsive to the initiation of a second call for connecting the second talking circuit to said common apparatus, and means for rendering said last means inoperative until said common apparatus has been disconnected from said first talking circuit.

14. The combination with a telephone system including automatic switching apparatus for establishing talking connections between subscribers' lines of current supply means comprising a source of alternating current and a rectifying system, a conductor over which alternating current for ringing purposes is supplied to said apparatus, a second conductor over which direct current suitable for operating current is supplied, and a third conductor over which direct current suitable for talking current is supplied.

15. The combination with a telephone system including automatic switching apparatus for establishing talking connections between subscribers' lines of a source of commercial alternating current and means for converting said alternating current into three kinds of current for use in connection with said automatic switching apparatus, namely, alternating current suitable for ringing purposes, direct current suitable for operating said apparatus, and direct current suitable for talking current.

16. In combination, a telephone system including automatic switching apparatus operable to establish talking connections between subscribers' lines, a source of alternating current, a rectifying system for converting said alternating current into direct current suitable for use in operating said automatic switching apparatus, an artificial load normally connected to said rectifying system, and means for disconnecting said load during the operation of said automatic switching apparatus.

ERNEST COURTMAN OLIVER.