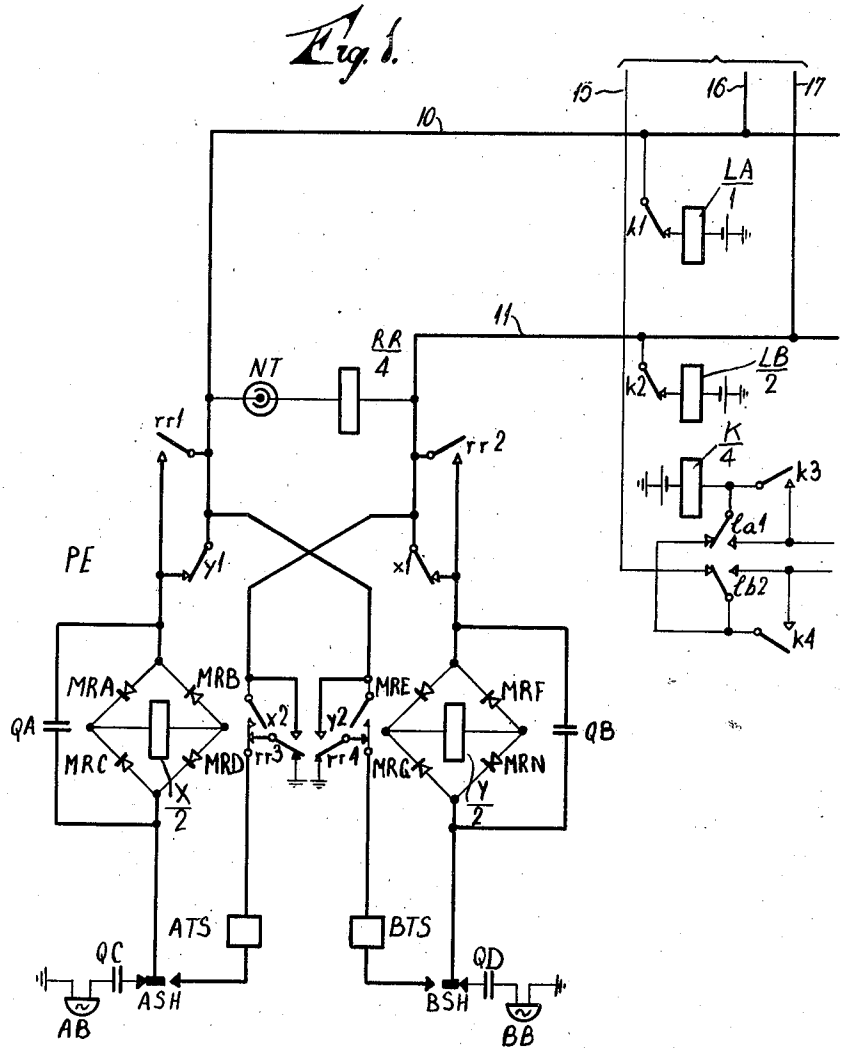
June 17, 1941. J. W. McCLEW ET AL 2,245,799

TELEPHONE SYSTEM

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Fig. 1.



INVENTORS:
JOHN WILLIAM McCLEW
OWEN AVIS PEARCE

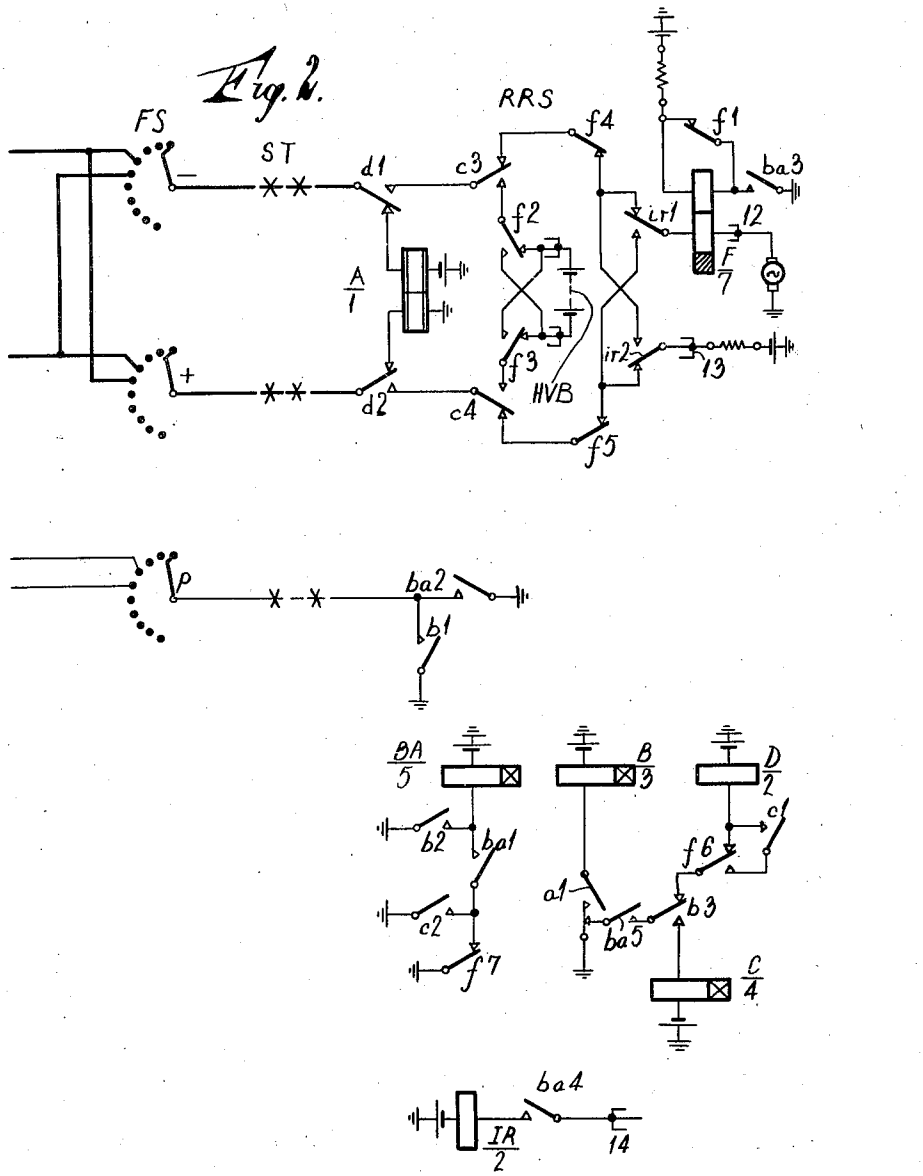
BY Chas. Tu. Candy
ATTORNEY.

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Fig. 2.



INVENTORS:
JOHN WILLIAM McCLEW
OWEN AVIS PEARCE

BY Chas. Le. Caudy
ATTORNEY.

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UNITED STATES PATENT OFFICE

2,245,799

TELEPHONE SYSTEM

John William McClew, West Derby, Liverpool, and Owen Avis Pearce, Barnston, England, assignors to Associated Telephone & Telegraph Company, Chicago, Ill., a corporation of Delaware

Application December 8, 1938, Serial No. 244,556
In Great Britain December 13, 1937

7 Claims. (Cl. 179—17)

The present invention relates to telephone systems and is more particularly concerned with systems including two-party lines which are arranged to give secret service and intercommunication facilities.

Hitherto in such systems it has only been possible to provide the above facilities satisfactorily by the use of numerical impulse responding mechanisms which are situated between the subscribers and the exchange line and serve to enable either or both of the parties to be associated with the line in accordance with the circumstances involved. The location of stepping mechanisms away from the exchange however provides an additional maintenance problem and moreover their initial cost is somewhat high. It is the chief object of the invention to provide a simpler and more economical system of the above type in which numerical impulse responding mechanisms outside the exchange are dispensed with.

According to one feature of the invention in a telephone system including a two-party line provided with a group of control equipment outside the exchange, the control equipment includes a relay individual to each party which is adapted to be operated on both incoming and outgoing calls to connect that party's instrument to the line.

According to another feature of the invention in a telephone system including a two-party line provided with a group of control equipment outside the exchange, the control equipment includes a relay which is operated on revertive calls to connect both parties to the line.

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 and 2. These when arranged side by side show a circuit diagram of a party line system including party line equipment PE which is assumed to connect with an automatic telephone exchange of line finder type. The equipment PE is conveniently located at the point where the lines to the two subscribers diverge and is mounted on a pole or in some other convenient location. It will be understood that the exchange equipment is shown only in sufficient detail to enable the principles underlying the invention to be appreciated.

For the purpose of the circuit description it will be assumed that of the two subscribers A and B sharing a two-conductor exchange line 10 and 11, the former originates a call. When he removes his receiver, earth is extended from the party line equipment PE by way of armatures *rr*3 and *x*2, telephone instrument ATS, the operated switchhook contacts ASH, rectifier MRC in a conductive direction, winding of relay X, rectifier MRB in a conductive direction, armature *y*1 and thence over conductor 10 to battery via armature *k*1 and relay LA in the exchange line circuit equipment. The resistance of relay LA is such that relay X is inoperative under these conditions but relay LA operates and effects marking and starting operations in the line finder switch FS in a manner not shown but well understood so that it thereupon hunts in search of the calling line circuit.

It will be seen that the line circuit is wired to two positions in the finder banks, the circuit arrangements being such that the upper one is marked by the operation of relay LA for a call originated by subscriber A and the lower one by relay LB in response to a call by subscriber B. It will be noticed also that the speaking conductors are reversed with respect to one another in the two positions. The utilisation of two positions in the finder bank corresponding to the party line subscribers' numbers enables metering discrimination or the like to be effected without difficulty.

When the calling line circuit is found, it is switched through over the finder switch wipers to a numerical selector which is not shown but which it will be understood is associated with the finder. The normal battery feed through the windings of the selector impulsing relay is now connected to the line conductors whereupon the battery potential applied to the negative line conductor operates relay X in the party line equipment. Relay X thereupon at armature *x*1 opens a point in the circuit for relay Y and telephone instrument BTS of the party B and at armature *x*2 loops the calling party's telephone instrument ATS in series with its winding across the exchange line so that it remains held. Dial tone is now received from the first numerical switch in the usual manner.

If any subscriber in the exchange other than party line subscriber B is required, the connection is effected by dialling his number and thus setting up a selector train in the usual manner. On the reply of the wanted party, a circuit is completed to operate the calling subscriber's meter in any known manner, the necessary discrimination between the A and B subscribers' meters being effected by the use of the two positions in the finder bank. Conversation may now pro-

ceed with absolute secrecy as subscriber B is completely disconnected from the line and cannot connect himself thereto.

At the end of the conversation when subscriber A hangs up, relay X de-energises and the exchange equipment is released in the usual manner.

Assuming now that a call is originated by the B subscriber, relays LB and Y are involved, the former marking the corresponding position in the finder banks while the latter cuts off the A subscriber's telephone. It will be noted that an operating circuit is provided for relay Y from the battery feeding bridge of the first numerical switch due to the reversal of the speech conductors in the corresponding banks of the line finder.

In case subscriber A should desire to communicate with subscriber B, he will dial suitable digits to route the call over the selector train ST to a revertive call relay set RRS. The battery feeding and impulsing relay A of the relay set is thereupon operated and causes the operation of relays B and BA in turn so that a guarding and holding earth is applied to the P lead at armatures *b1* and *ba1* and relay BA is locked up independently of relay B over armatures *ba1* and *f1*. In case any further trains of impulses are received, relay A responds and each time it releases it operates relay C from earth over armatures *a1*, *ba5* and *b3*. Relays B and C due to their slugs, hold operated however during each train received and as no other circuit operations are brought about, these trains of impulses are in effect absorbed.

For a call of this type the calling party is instructed to replace his receiver after dialling the necessary digits and when he does so relay Y releases and also relay A which operates relay C. Relay B commences to release and after its slow release period relay D is operated from earth over armatures *a1*, *ba5*, *b3* and *f6*. Relay C also commences to release slowly so that during the slow release period of this latter relay a high voltage battery HVB having a potential of the order of 120 volts is connected across the calling line by way of armatures *f2* and *f3*, *c3* and *c4*, and *d1* and *d2*. This potential is of such a value and polarity that the neon tube NT in the party line equipment will flash and allow a current to flow through the magnetically polarised relay RR in a direction which will bring about its operation. Relay RR thereupon at armatures *rr1*—*rr4* connects the circuits of both the party line subscribers A and B to the exchange line and since both their receivers are replaced, the corresponding earthed bells AB and BB will be connected to the exchange line conductors 10 and 11 respectively.

On the release of relay C in the revertive call relay set, the battery HVB is disconnected and an earthed ringing generator is connected over common lead 12 by way of the lower winding of the ring trip relay F and thence by way of contacts of an interrupter relay IR and of relays F, C and D to the two line conductors alternately. Relay IR is caused to pulse over lead 14 to which is connected an interrupted earth source giving say .75 seconds on, .75 seconds off. Ringing current is accordingly transmitted to the party line equipment and brings about the alternate ringing of the earthed bells AB and BB.

The calling party A on hearing his own bell ring under these conditions will not answer, but when the called party B responds by removing his receiver and operates the switchhook contacts BSH, the line will be looped via the low impedance telephone instrument BTS so that relay F will operate over the loop in a circuit including ring return battery connected over lead 13 and will thus cut off the ringing at armatures *f4* and *f5*. The calling party on noticing the cessation of the ringing knows that the called party has replied and he too now removes his receiver. Relays X and Y now operate but without any particular effect in view of the operated condition of relay RR. Relay F removes the short-circuit from its upper winding at armature *f1* and locks thereover while at armature *f6* it releases relay D which then replaces the battery feed on the line via the windings of relay A. This relay in turn re-operates relay B which holds relay BA and these relays are maintained in this condition throughout the conversation. Relay F also in a manner not shown completes circuit arrangements to meter the call against the calling party, for example by the connection in well-known manner of a booster battery potential to the P lead.

At the conclusion of the conversation when both parties A and B have restored their receivers, relay A releases and opens the circuit of relay B and operates relay C. On the release of relay B, relay C commences to release and since relay F is still locked, relay D is operated by way of armatures *f6* and *c1* for the duration of the release time of relay C. The high voltage battery HVB will now be connected over armatures *f2* and *f3* to the line conductors in the reverse manner to that obtaining before so that a reverse polarity high voltage pulse will be transmitted over the line conductors. As a result the neon tube NT in the party line equipment flashes again and this time the direction of the resulting current flow opposes the magnetic polarising field of relay RR which therefore restores to normal. On the release of relay C in the revertive call equipment, relay D releases and also relay BA which has been maintained from relay C over armatures *c2* and *ba1* during this time. On the release of relay BA the guard earth is removed at armature *ba2* from the P lead to release the switch train and relay F is also released at armature *ba3* so that the relay set is now available for further use.

If on a revertive call the called party should fail to answer, the calling party may release the connection by momentarily removing his receiver so as to trip relay F and then replacing it whereupon the connection will be cleared down. In order to prevent meter registration against the calling party due to the operation of relay F under these conditions, a suitable delay is preferably provided between the operation of this relay and the completion of an operating circuit for the meter.

Incoming calls to the party line subscribers are extended over leads 15, 16 and 17, relay K being operated over the private lead 15 to disconnect relays LA and LB from the line. The subscribers A and B sharing the line have separate sets of contacts in the final selector bank and the speech conductors from them to the common line circuit are reversed with respect to one another so that on an incoming call to the A subscriber ringing current will extend over lead 16 and thence to the earthed bell AB and similarly in the case of a call to the B subscriber ringing current will extend over lead 17 and thence to the earthed bell BB.

The full wave rectifier arrangements MRA—

MRD and MRE—MRH in which relays X and Y are respectively connected enable these relays to operate or be maintained operated irrespective of any reversal in the line loop current. Hence if the system is such that on the reply of the called party the line current is reversed for supervisory purposes, relays X and Y will be unaffected since the current flow through them will remain in the same direction. The condensers QA and QB are connected in parallel with these relays so as to provide a low impedance path for speech currents during conversation. It will also be noted that although the relay RR and neon tube NT are permanently connected across the speaking conductors, the non-conducting state of the tube during speech conditions isolates relay RR so that the standard of speech transmission is unaffected.

Although in the foregoing description the party line equipment is assumed to be connected to an automatic exchange it will be appreciated that the principle of the invention is also applicable to a manual exchange, though naturally it will involve some slight modification of the circuits.

We claim:

1. In a telephone system, an exchange, a two-party line outgoing from said exchange, control equipment common to the stations served by said line and located at a point on said line intermediate the stations and the exchange, a relay in said equipment, and means for operating said relay on calls between said two stations to connect both of the stations to said line.

2. In a telephone system, an exchange, a two-party line outgoing from said exchange, control equipment common to the stations served by said line and located at a point on said line intermediate the stations and the exchange, a relay in said equipment operated at times to connect one of said stations to said line, a second relay in said equipment operated at other times to connect the other of said stations to said line, and a third relay in said equipment operated at still other times to connect both of said stations to said line.

3. In a telephone system, an exchange, a two-party line outgoing from said exchange, control equipment common to the stations served by said line and located at a point on said line intermediate the stations and the exchange, said common control equipment including a gaseous discharge device and a relay connected to said line through said device, means for impressing a high potential upon said line to operate said relay, said relay effective thereupon to connect both of said stations to said line.

4. In a telephone system, an exchange, a two-party line outgoing from said exchange, control equipment common to the stations served by said line and located at a point on said line intermediate the stations and the exchange, said common control equipment including a polarized relay connected to said line, means for transitorily impressing upon said line a potential of one polarity and subsequently impressing thereupon a potential of the opposite polarity, said relay responsive to the potential of said one polarity to connect both of said stations to said line and responsive to the potential of said opposite polarity to disconnect said stations therefrom.

5. In a telephone system, two subscribers' stations, a party line common to said stations, automatic switches, reverting call equipment, means at one of said stations for taking said line into use for a reverting call and controlling said switches to extend a connection from said line to said equipment, means in said equipment responsive to an operation at said one station for transmitting over said line a high potential impulse, a gaseous discharge device, and a relay connected to said line through said device and responsive to said impulse to connect both of said stations to said line.

6. A telephone system as claimed in claim 5, wherein upon completion of a call between said two stations said means in the reverting call equipment is controlled conjointly by said two stations to transmit over said line another high potential impulse to operate said relay to disconnect said stations from said line.

7. In a telephone system, two subscribers' stations, a party line common to said stations, automatic switches, reverting call equipment, means at one of said stations for taking said line into use for a reverting call and controlling said switches to extend a connection from said line to said equipment, means in said equipment responsive to an operation at said one station for transmitting over said line an impulse of one polarity and subsequently responsive to another operation at the same or the other station for transmitting over said line an impulse of another polarity, a relay common to said two stations and connected to said line, said relay responsive to the impulse of said one polarity to connect both of said stations to said line and responsive to the impulse of said other polarity to disconnect both of said stations therefrom.

JOHN WILLIAM McCLEW.
OWEN AVIS PEARCE.