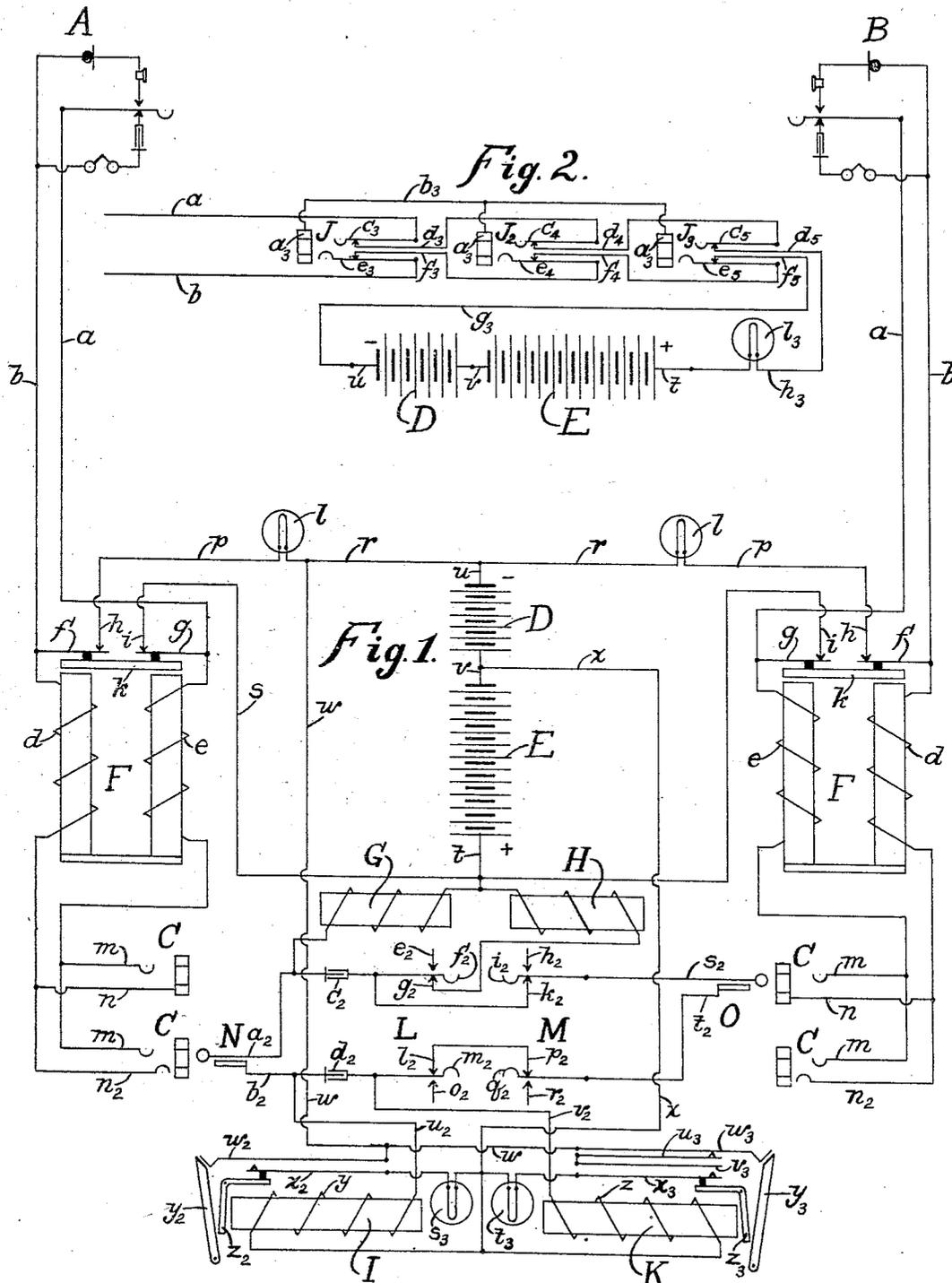


F. R. PARKER.
 TELEPHONE SIGNALING SYSTEM.
 APPLICATION FILED AUG. 24, 1904.

1,103,909.

Patented July 14, 1914.



WITNESSES:

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UNITED STATES PATENT OFFICE.

FREDERICK R. PARKER, OF CHICAGO, ILLINOIS.

TELEPHONE SIGNALING SYSTEM.

1,103,909.

Specification of Letters Patent.

Patented July 14, 1914.

Application filed August 24, 1904. Serial No. 221,994.

To all whom it may concern:

Be it known that I, FREDERICK R. PARKER, a citizen of the United States of America, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Telephone Signaling System, of which the following is a specification, reference being had to the accompanying drawings, illustrating same.

My invention relates to electrical signaling systems, the form herein shown and described being particularly adapted for signaling in connection with telephone systems.

The principal objects of my invention are, to provide improved means for operating signals in electrical transmitting systems; to provide improved means for operating the supervisory or disconnect signals in such systems; to provide improved apparatus to be used in such systems for various purposes and in connection with such signals for operating or manipulating same; to provide improved circuit arrangements in such systems; to provide a suitable highly-efficient electric signal lamp adapted to be operated or manipulated in series with both long and short telephone lines, and improved line-signaling systems embodying such lamps.

Other objects will be apparent from the following specification.

In this present invention I have shown the telephone line circuit described and claimed in my application for United States Letters Patent on telephone system, filed June 20, 1904, Serial No. 213,284, but do not wish to be limited in this invention to this particular line circuit. In connection with this line circuit I have shown my special signal lamp.

The double-armature relay illustrated in this present invention forms the subject matter of my co-pending application for United States patent on electromagnet, filed February 19, 1904, Serial No. 194,392.

I have shown the central source of electricity and the special signal lamp connected in series with the telephone line, and I desire it to be understood that it is one of the objects of this invention to thus connect the said signal lamp. If the said lamp is of a voltage approximately the same as the battery voltage, other apparatus, such as impedance coils, resistance coils, relays, etc., may be excluded from this signaling circuit at the central station. The operation of the line cut-off relay in the line circuit shown,

disconnects the signal lamp and central source of electricity from the telephone line.

I have also shown a modified form of line circuit in which any one of a number of jacks is adapted to disconnect the line signaling device and central source of current from the telephone line when a connecting plug is inserted therein.

The special line signal lamp which I employ is designed to be lighted to candle power on a very small current, and preferably on a rather high voltage. With such a lamp (and the consequent relative high-resistance thereof in relation to its voltage) a variation in the line resistance, which is in series with the lamp, from zero to a maximum, say to several hundred ohms, will not be sufficient to materially change the small current through the lamp, and will therefore not materially affect the luminosity thereof.

Heretofore it has not been practical to light a signal lamp in series with a reasonably long telephone line, for the reason that signal lamps heretofore required such a large current, and were consequently of such low resistance in relation to their voltage, that with a high-resistance line the lamp would not receive sufficient current to cause it to light, or else if the lamp did receive sufficient current over a long line, on a short-circuit of the line near the central station the lamp would burn out; the variation in the current, caused by such a variation in the line resistance, being too great for the lamp. With such a lamp and sufficient resistance in series therewith at the central station to protect the lamp from burning out on a short-circuit of the line at the central station, the voltage required to give sufficient current to light the lamp over the long line would be so high as to be prohibitive in telephone systems.

In this present invention I employ a lamp which I have perfected to be lighted in series with both long and short lines on a reasonable voltage without requiring any resistance in the circuit for regulating the flow of current (provided the voltage of the lamp is approximately that of the battery), and have found that lamps taking from .05 of an ampere to .04 of an ampere, and having a resistance of from 750 ohms to 1200 ohms, depending on the voltage used, give very satisfactory results. I use a lamp taking this small current, and of the consequent relative high-resistance, so as to enable me to

signal over long lines, and at the same time protect the lamp from burning out on a short-circuit of the line at the central station, as with a reasonably high voltage, say 52 volts, the variation of the line resistance from zero to several hundred ohms, is small compared with the resistance of the lamp for this voltage, and therefore does not reduce the current through the lamp sufficiently to extinguish its signal. The 1200 ohm lamp gives a good signal with more than 1000 ohms resistance in the line circuit, and will not burn out when the line is short-circuited at the central station. The reason for this is, that the resistance of a long line is such a small proportion of the total resistance of the circuit that the voltage on the lamp is not decreased to any great extent by the introduction of this long line resistance into the circuit. The lamp used in my present invention is a distinct improvement over an electromagnet, both in simplicity and cheapness, and it gives good signals through variations of line resistance through which electromagnets are required to operate. It is obvious that lamps taking a still smaller current will also give good results, and such lamps are contemplated in this invention. I also wish it to be understood that lamps taking a small current and also a small voltage, may be used in series with a resistance, where the battery voltage used is considerably higher than the lamp voltage. In such an arrangement it is clear that the small current (which is a feature of this invention) is still maintained. In short, any lamp taking a small amount of current, may be used with success in circuit with either long or short lines.

In the connecting circuit I employ a double-armature relay or electrically-operable device for operating or controlling a supervisory or disconnect signal. The armatures of this relay device may be operated separately for controlling the signal, preferably on different strengths of magnetism in the relay, one armature preferably closing a contact in the supervisory signal circuit and the other armature preferably opening a contact in the same circuit. I preferably close and open the same contact in the supervisory signal circuit, with the respective armatures, but it is obvious that separate contacts may be used with the same result. The armatures of this relay may control any suitable combinations of circuits as desired. The divided battery herein shown, provides means for sending a large or small current through the supervisory relay to produce different strengths of magnetism therein, as will be hereinafter described, but do not wish to be limited to this arrangement alone, as other systems may be employed for operating the supervisory relay device. As will be hereinafter shown, the

current that operates one of the armatures of the supervisory relay, in the system illustrated, traverses the winding of the relay in the direction opposite to which the current which operates the other armature traverses the said winding. This reversal of current through the supervisory relay enables me to use a double-acting armature thereon, if desired, as set forth in my above mentioned application for Letters Patent on telephone system, Serial No: 213,284.

I have preferably shown the talking battery to be a part of the signaling-in battery, but it is to be understood that the talking source of electricity may be entirely separate from the signaling source.

I will now more particularly describe my invention by reference to the accompanying drawings illustrating the preferred form thereof, in which,—

Figure 1 is a diagram showing two subscribers' lines and the central station signaling and connecting apparatus; and Fig. 2 is a diagram showing the line-signal lamp and the central source of current adapted to be cut from the talking telephone line by a connecting plug, instead of by a cut-off relay, at any one of a number of spring jacks.

Like characters refer to like parts in the several figures.

The line of subscriber A extends in two limbs *a* and *b* from a substation to a central station where the said limbs pass through the respective windings *c* and *d* of relay F and terminate in the respective connection terminals *m* and *n* (or *m*² and *n*²) of the several spring jacks C C of a multiple switchboard. Spring members *g* and *f* of relay F are permanently connected to the limbs *a* and *b*, respectively, of the line, and normally engage the respective contacts *i* and *h*. Contact *i* is connected through conductor *s* to pole *t* of battery E, and contact *h* is connected through conductor *p*, line-signal lamp L, and conductor *r*, to pole *u* of battery D. Batteries E and D are connected in series and it is immaterial which is the positive or negative end pole of battery E D. When armature *k* of relay F is attracted to the cores thereof, springs *g* and *f* are disengaged from contacts *i* and *h*, respectively. In case of a grounded-return or common-return line, the ground or common conductor constitutes one limb of the telephone line.

At the subscriber's station I have shown one of a number of circuit arrangements in which the operation of the switch-hook connects either the talking apparatus or signaling apparatus for use over the line, in a manner so well understood that it need not be described here.

The line of subscriber B, shown upon the right of the drawing, is similar to line A,

and like characters have been employed to indicate like parts.

In the plug-cord connecting circuit the main strands of the connecting cords N and O are connected together through the respective condensers c_2 and d_2 , listening key L and ringing key M. Tip strand a_2 of answering plug N is connected through impedance coil G to pole t of battery E. Tip strand s_2 of calling plug O is normally connected through spring i_2 , contact h_2 , spring f_2 , contact g_2 , and impedance coil H, to pole t of battery E. Sleeve strand b_2 of answering plug N is connected through conductor u_2 , winding y of supervisory relay I, and conductor x , to the middle pole v of battery E D. Sleeve strand t_2 of calling plug O is normally connected through spring q_2 , contact p_2 , contact l_2 , spring m_2 , conductor v_2 , winding z of supervisory relay K, and conductor x , to the middle pole v of battery E D. Supervisory lamp s_3 is connected from conductor x to spring x_2 of relay I, and spring w_2 of this relay is connected through conductors w and r to pole u of battery D. Thus it will be seen that signaling device s_3 is connected in a closed circuit across battery D when the contact is made between springs x_2 and w_2 . Supervisory lamp t_3 is connected from conductor x to spring x_3 of relay K, and contact v_3 of this relay is normally connected through contact u_3 , spring w_3 , and conductors w and r to pole u of battery D. Thus it will be seen that signaling device t_3 is connected in a closed circuit across battery D when the contact is made between spring x_3 and contact v_3 .

Armature z_2 of relay I, when attracted to the core of I, moves spring x_2 into contact with spring w_2 , and armature y_2 of this relay, when attracted to the core thereof, moves spring w_2 out of contact with spring x_2 , if armature z_2 was previously attracted, or, if armature z_2 was not previously attracted, armature y_2 simply maintains an open contact between springs w_2 and x_2 . Armature z_2 is adapted to "pull up" with a small current in winding y of the relay, and armature y_2 with a larger current in the said winding. I have preferably shown armature z_2 as being interposed between armature y_2 and the core of the relay, but other arrangements of the armatures may be used with good results.

A special feature of this invention is to operate and control a supervisory signal by a relay device having two armatures adapted to "pull up" on different strengths of magnetism in the relay device, or different energizations thereof, whatever may be the arrangement of the armatures.

Armature z_3 of relay K, when attracted to the core of the relay, operates spring w_3 and thereby brings it into contact with spring v_3 . Armature y_3 of relay K, when

attracted to the core of the relay, operates spring w_3 and thereby breaks the normally closed contact between springs w_3 and u_3 . Armature z_3 is adapted to "pull up" with a small current in winding z of relay K, and armature y_3 with a larger current in the said winding. It will be seen that the armatures of relay K open and close respective contacts in its supervisory signal circuit, while the armatures of relay I both open and close the same contact in its supervisory signal circuit. This simply illustrates two ways of accomplishing the same result.

The operator's telephone set is to be connected from contact e_2 to contact o_2 of the listening key L, in a manner well understood but not shown in the drawings. When the listening key L is depressed, springs f_2 and m_2 are disengaged from contacts g_2 and l_2 , respectively, and engaged with contacts e_2 and o_2 , respectively.

A suitable ringing generator is to be connected to contacts h_2 and r_2 of ringing key M, in a manner well understood. When the ringing key M is depressed, springs i_2 and q_2 are disengaged from contacts h_2 and p_2 , respectively, and engaged with contacts h_2 and r_2 , respectively.

The operation of the system is as follows:—If subscriber A desires to talk with subscriber B, he lifts his telephone receiver from the switch-hook and thereby closes the circuit of battery E D through conductor s , contact i , spring g , limb a of the telephone line, sub-station A, limb b of the line, spring f , contact h , conductor p , lamp l , and conductor r , thus allowing current from battery E D to flow through lamp l and light same, and thereby convey to the operator the signal for connection. The operator thereupon lifts answering plug N and inserts same into a spring jack C of line A, which closes the circuit of battery E through impedance coil G, tip strand a_2 , jack spring m , winding e of cut-off relay F, limb a of the telephone line, substation A, limb b of the line, winding d of relay F, jack spring n_2 , sleeve strand b_2 , conductor u_2 , winding y of supervisory relay I, and conductor x , thereby energizing relay F and causing its armature k to be attracted and thus disengage springs f and g from contacts h and i , respectively, and also energizing relay I with sufficient current to attract armature y_2 thereof and thus maintain an open contact in the circuit of supervisory signal s_3 . When armature k of relay F is attracted, it cuts the central source of current and the line signal lamp l from the talking telephone line, thus opening the circuit of its signal at contact h and thereby extinguishing lamp l . It is immaterial whether armature z_2 of relay I is now attracted or not, as it cannot close the contact

between springs x_2 and w_2 while armature y_2 is attracted, but I have preferably shown a relay in which armature z_2 is at this time attracted with armature y_2 , by the current now traversing winding y of relay I.

The operator then depresses her listening key L, thereby bridging her telephone set across the main strands of the cord circuit, from contact e_2 to contact o_2 , in a manner well understood, and after learning that subscriber B is the subscriber called for, and after testing the line B in any suitable manner and finding it to be not in use, she inserts the calling plug O into a spring jack C of line B. She then depresses the ringing key M, in the usual manner, and at the same time restores the listening key L to its normal position. In depressing the ringing key M, the operator closes the circuit of the ringing generator (not shown) through contact h_2 , spring i_2 , tip strand s_2 , jack spring m of line B, winding e of relay F, limb a of the telephone line, substation B including a ringer, limb b of the line, winding d of relay F, jack spring n , sleeve strand t_2 , spring q_2 , and contact r_2 , thus ringing the said ringer which signals subscriber B. After subscriber B is signaled the ringing key M returns to its normal position. Relay F is constructed to respond to the said ringing current and thereby disengage springs g and f from contacts i and h , respectively, during the sending of the said ringing current over the line of subscriber B, which disconnects the central source of current and the line signaling apparatus from the telephone line. When the ringing key is restored to its normal position, relay F of line B is deenergized and springs g and f again engage contacts i and h , respectively. Before subscriber B responds to his call, the circuit of the central source of current E D is not closed over his telephone line, but the circuit of battery D is closed through conductor x , winding z of supervisory relay K, conductor v_2 , spring m_2 , contact l_2 , contact p_2 , spring q_2 , sleeve strand t_2 , jack spring n of line B, winding d of relay F, spring f , contact h , conductor p , line signal lamp l , and conductor r , which does not allow sufficient current to flow through relay F to actuate its armature, nor sufficient current to flow through lamp l to light same, but which does allow sufficient current to flow through supervisory relay K to actuate armature z_3 , only, thereof, and thereby close the contact between springs x_3 and v_3 , thus closing the circuit of battery D through the supervisory signaling device t_3 and causing same to display a signal. When subscriber B answers his call, he closes the circuit of battery E through impedance coil H, contact g_2 , spring f_2 , contact k_2 , spring i_2 , tip strand s_2 , jack spring m of line B, winding e of relay F, limb a of the telephone line, substation B,

limb b of the line, winding d of relay F, jack spring n , sleeve strand t_2 , spring q_2 , contact p_2 , contact l_2 , spring m_2 , conductor v_2 , winding z of relay K, and conductor x , which energizes relay F and causes its armature to be attracted and thereby disengage springs g and f from contacts i and h , respectively, and which also energizes relay K and causes armature y_3 thereof to be attracted and thereby disengage spring w_3 from contact u_3 , thus breaking the circuit through lamp t_3 and extinguishing its signal. Armature z_3 of relay K, may or may not be attracted, it being unable to affect the lamp t_3 when armature y_3 is attracted. The line lamp l of line B is now inoperative as the circuit through same is broken at contact h . Subscribers A and B are now connected for conversation with each other, all of the signals being inactive. When the conversation is completed and subscriber A hangs his telephone receiver upon its switch-hook, he breaks the circuit of battery E over his line, in a manner well understood, which stops the flow of current through relays F and I and allows their armatures to release. When armature k of relay F releases, it causes spring f to engage contact h and thereby close the circuit of battery D through conductor x , winding y of supervisory relay I, conductor u_2 , sleeve strand b_2 , jack spring n_2 of line A, winding d of relay F, spring f , contact h , conductor p , lamp l , and conductor r . The current from battery D now flowing through relay I is sufficient to cause armature z_2 thereof to be attracted and thereby close the contact between springs x_2 and w_2 , but this current is not sufficient to cause armature y_2 to be attracted. Armature z_2 therefore closes the circuit of battery D through conductor x , supervisory lamp s_3 , spring w_2 , spring w_2 , and conductors w and r , and thereby causes lamp s_3 to light and convey to the operator the signal for disconnection. The current now flowing through relay F is not sufficient to attract armature k thereof, nor sufficient to cause lamp l to light. It is obvious that if subscriber A should again take his telephone receiver from the switch-hook while connection is still made with his line, he would cause the supervisory lamp s_3 to be extinguished. By thus operating the switch-hook, the subscriber A may signal the operator for a second connection, through the agency of the supervisory signal. It will be noted that the current which attracts armature z_2 only, of relay I, traverses the winding y thereof in the direction opposite to which the current which attracts armature y_2 traverses the same winding. This reversal of current enables me to use opposite magnetic forces to operate the respective armatures of a supervisory relay device, if desired, or to operate other forms of electrically-operable devices.

When subscriber B hangs his telephone receiver upon the switch-hook, he causes his supervisory lamp t_3 to convey to the operator a signal for disconnection, as just described in connection with subscriber A, only that subscriber B causes armature z_3 of relay K to close the contact between springs w_3 and v_3 , in the supervisory signal circuit, whereas subscriber A caused armature z_2 of relay I to close the contact between springs w_2 and v_2 . It is obvious that if subscriber B should again raise his switchhook while connection is still made with his line, he would cause his supervisory signal t_3 to be extinguished. When the operator receives both disconnect signals from subscribers A and B, respectively, she withdraws the connecting plugs N and O from their respective spring jacks, thus breaking the battery circuits through supervisory relays I and K and allowing their armatures to release, thereby restoring both telephone lines and all central station circuits and apparatus to their normal condition.

It is obvious that subscriber B may be the calling subscriber, and subscriber A the called subscriber, but it is not thought to be necessary to give a detailed description of the different operations performed in thus connecting the system, as it would be practically the same as the above description wherein subscriber A is the calling subscriber and subscriber B is the called subscriber. With such connections, plug N would be connected with line B and plug O would be connected with line A, the operations with lines A and B being interchanged.

In Fig. 2 I have shown a series of spring jacks or connection terminals J, J_2 , J_3 , for a telephone line, each jack being adapted to disconnect the central station signaling apparatus and source of electricity from the telephone line when a connecting plug is inserted therein. The line circuit is, from limb a of the telephone line, through spring e_3 of jack J, conductor d_3 , spring e_2 of jack J_2 , conductor d_2 , spring e_1 of jack J_1 , conductor d_1 , line-signal lamp l_3 , battery E D, conductor g_3 , contact f_3 , spring e_3 of jack J_3 , conductor f_4 , spring e_4 of jack J_2 , conductor f_3 , spring e_3 of jack J and limb b of the telephone line. When a connecting plug is inserted into any one of the several spring jacks of the line, springs e_3 , e_2 , or e_1 , or e_4 , e_3 , etc., are caused to disengage their respective contact members and thereby cut the signaling device l_3 and source of current E D from the telephone line. The guide rings a_3 , a_2 , a_1 of the several jacks are connected together by conductor b_3 for a "busy-test" arrangement, in a manner well understood.

While I have illustrated this invention in connection with particular types of spring jacks, connecting plugs, keys, line cut-off relays, supervisory relays and signals,

sources of electric current, and auxiliary apparatus, I desire it to be understood that different types of these several pieces of apparatus may be used.

I have shown and described this invention in connection with multiple switchboard systems, but it is apparent that its features are also applicable to systems of the single, transfer, and divided board types.

I do not wish to limit this invention to the particular details nor to the particular arrangement of parts herein shown, as the principles involved may be carried out with numerous modifications thereof without departing from the scope of the appended claims. I also wish it to be understood that certain parts of the invention may be used apart from other parts thereof.

Having thus described my invention, what I claim is—

1. A telephone line-signaling system comprising a telephone line having a signal lamp connected in series therewith, the said lamp having a filament with a current-carrying capacity not exceeding approximately five-onehundredths of an ampere, and means for lighting the lamp over the line to give a signal.

2. A telephone line-signaling system comprising a telephone line having a signal lamp connected in series therewith, the said lamp having a filament with a current-carrying capacity not exceeding approximately five-onehundredths of an ampere whereby it may be lighted in series with a high-resistance line to give a signal and also through a short-circuit of the line resistance without burning out, and means for lighting the lamp over the line to give a signal.

3. A telephone line-signaling system comprising a telephone line having a signal lamp connected in series therewith, the said lamp having a filament with a current-carrying capacity not exceeding approximately five-onehundredths of an ampere whereby it may be lighted in series with a line having a resistance of at least five-hundred ohms to give a signal and also through a short-circuit of the line resistance without burning out, and means for lighting the lamp over the line to give a signal.

4. An electric lamp having a high-resistance filament constructed to carry a maximum current not greater than approximately five-onehundredths of an ampere, a telephone line, and means for lighting the lamp in a series circuit with the line to display a signal.

5. In a telephone system, the combination with a telephone line and connection terminals connected thereto, of a line-signal lamp connected to the said line, a cut-off relay associated with the said line and adapted to disconnect the said line-signal lamp from the telephone line when in an operated

condition, a plug-cord circuit adapted to be conductively connected with the said line, a supervisory signal-controlling relay connected to a talking strand of the said plug-cord circuit, the said supervisory relay being equipped with two armatures, one armature being adapted to close a contact in the supervisory signal circuit and the other armature being adapted to open a contact in the same circuit; a source of electricity associated with the said supervisory relay and with the said line-signal lamp, means for closing a circuit of the said source through the said supervisory relay and thereby actuating one of its armatures, when connection is made with the line, thus closing a contact in the said supervisory signal circuit, the said supervisory relay circuit including a talking strand of the plug-cord circuit, a terminal of the connecting plug, a main line terminal, and the said line-signal lamp and means on the line for operating the other armature of the supervisory relay and thereby extinguishing the supervisory signal, substantially as described.

6. In a telephone system, the combination with a metallic telephone line and connection terminals connected to the respective limbs thereof, of a line-signal lamp connected to one limb of the said line, a central source of electricity connected to the other limb of the said line, a cut-off relay associated with the said line and adapted to disconnect the said line-signal lamp and source of electricity from the respective limbs of the telephone line when in an operated condition, a plug-cord circuit adapted to be conductively connected with the respective limbs of the said line, the said source of electricity being associated with a talking strand of the plug-cord circuit, a supervisory, signal-controlling relay connected to a second talking strand of the said plug-cord circuit, the said relay being equipped with two armatures, one armature being adapted to close a contact in the supervisory signal circuit and the other armature being adapted to open a contact in the same circuit, a second source of electricity associated with the said supervisory relay and with the said line-signal lamp, means for closing a circuit of the said second source through the said supervisory relay and thereby actuating one of its armatures, when connection is made with the line, thus closing a contact in the said supervisory signal circuit, the said supervisory relay circuit including a talking strand of the plug-cord circuit, a main terminal of the connecting plug, a main line terminal, and the said line-signal lamp and means on the line for operating the other armature of the supervisory relay and thereby extinguishing the supervisory signal; substantially as described.

7. In a telephone system, the combination

with a telephone line and connection terminals connected thereto, of a line signal associated with the said line, a plug-cord circuit adapted to be connected with the said line, a supervisory relay associated with the said plug-cord circuit, the said relay being provided with an armature adapted to close a contact between two springs and also with a second armature adapted to open the same contact between the said springs, a supervisory-signal lamp connected to one of the said springs, a divided source of electricity a portion of which is connected to the said supervisory-signal lamp and to the other said spring, the said divided source of electricity being associated with the plug-cord circuit, with the supervisory relay and with the telephone line and line signal, means whereby, when the said plug-cord circuit is conductively connected to the said telephone line, the circuit of a portion of the said divided source of electricity is closed through the said supervisory relay, thus allowing a weak current to flow through the said relay and actuate one armature thereof, the said armature closing the circuit through the supervisory-signal lamp and its source of current and thereby lighting the said supervisory lamp, and means whereby, when the circuit of the telephone line is closed while connection is made therewith, the circuit of another portion of the said divided source is closed through the said supervisory relay, thus allowing a stronger current to flow through the said relay and actuate the said second armature thereof, this said second armature opening the circuit through the supervisory-signal lamp and thereby extinguishing same, substantially as described.

8. The combination with a telephone line, of a plug-cord circuit adapted to be connected therewith, a double-armature relay associated with the plug-cord circuit, a supervisory signal circuit adapted to be controlled by the said armatures, one said armature being adapted to close a contact in the said supervisory circuit, the other said armature being adapted to open a contact in the same supervisory circuit, and means for actuating the said armatures separately and thereby controlling the operation of the supervisory signal.

9. The combination with a telephone line, of a plug-cord circuit adapted to be conductively connected therewith, a double-armature supervisory relay associated with a strand of the plug-cord circuit, a supervisory signal circuit under control of the said relay, means for actuating one armature of the said relay when connection is made with the telephone line and the circuit of the telephone line is open, and means for actuating the other armature of the said relay when connection is made with the tele-

phone line and the circuit of the telephone line is closed.

10. The combination with a telephone line, of a plug-cord circuit adapted to be connected with the said line, a double-armature supervisory relay connected to a connecting strand of the plug-cord circuit, a supervisory signal circuit under control of the said relay, a central source of electricity associated with the plug-cord circuit and with the telephone line, means for sending a weak current through the said relay when connection is made with the telephone line and the said line is not in use, and thereby actuating one of the armatures of the said relay, and means for sending a stronger current through the said relay when connection is made with the telephone line and the said line is in use, and thereby actuating the other armature of the said relay.

11. In a telephone system, the combination with a calling telephone line terminating in suitable connection terminals, of a line signal normally connected to the telephone line, a plug-cord circuit adapted to be connected to the said line, a supervisory signal circuit, a supervisory relay associated with a main strand of the said plug-cord circuit, the said relay being provided with two armatures, one of the said armatures being adapted to close a contact in the supervisory signal circuit, the other said armature being adapted to open a contact in the said supervisory signal circuit, a central source of electricity associated with the said relay and with the plug-cord circuit, means whereby when connection is made with the said calling line the circuit of the said source is closed through the said relay, thereby actuating its armatures and maintaining an open contact in the said supervisory signal circuit, the supervisory relay including a main strand of the plug-cord circuit and a limb of the telephone line, with a suitable return, and means on the line for operating one armature of the supervisory relay and thereby closing a contact in the supervisory signal circuit to display the supervisory signal, substantially as described.

12. In a telephone system, the combination with a metallic, calling, telephone line terminating in suitable connection terminals, of a line signal normally connected to a limb of the telephone line, a central source of electricity normally connected to the other limb of the telephone line, a plug-cord circuit adapted to be connected to the limbs of the said line, a supervisory signal circuit, a supervisory relay associated with a main strand of the said plug-cord circuit, the said relay being provided with two armatures, one of the said armatures being adapted to close a contact in the supervisory signal circuit, the other said armature being adapted to open a contact in the said supervisory sig-

nal circuit, the said central source of electricity being also associated with a main strand of the plug-cord circuit and with the said relay, means whereby, when connection is made with the said calling line, the circuit of the said source is closed through the said relay, thereby actuating its armatures and maintaining an open contact in the said supervisory signal circuit, the supervisory relay circuit including the main strands of the plug-cord circuit and the limbs of the telephone line, and means on the line for operating one armature of the supervisory relay and thereby closing a contact in the supervisory signal circuit to display the supervisory signal, substantially as described.

13. In a telephone system, the combination with a telephone line terminating in suitable connection terminals at the central station, of a high-resistance line-signal lamp normally connected to a limb of the said line, a cut-off relay included in a talking limb of the said line and adapted to disconnect the said line-signal lamp from the telephone line when in an operated condition, a subscriber's sub-station connected to the said telephone line, a plug-cord circuit adapted to be conductively connected with the telephone line, a supervisory signal lamp associated with the plug-cord circuit, a double armature supervisory relay connected to a main strand on the plug-cord circuit, one armature thereof being adapted to close a contact when actuated, the other armature thereof being adapted to open the same contact when actuated, a divided source of electricity associated with the line-signal lamp, the cord-circuit, the supervisory relay and the supervisory-signal lamp, the said supervisory-signal lamp being in circuit with the said contact of the supervisory relay, means for closing a circuit of the said source through the line-signal lamp and a limb of the telephone line, with a suitable return, at the said sub-station, and thereby lighting the said line-signal lamp, means for closing the circuit of a portion of the said source through the said supervisory relay, a talking strand of the plug-cord circuit, a main terminal of the connecting plug, a main line terminal, a winding of the said cut-off relay and a limb of the telephone line, with a suitable return, when connection is made with the line and the said line is connected through the sub-station, thereby actuating the said cut-off relay and thus disconnecting the line-signal lamp from the telephone line, and also actuating both armatures of the supervisory relay and thus maintaining an open contact in the said supervisory lamp circuit, and means for closing a circuit of another portion of the said source through the said supervisory relay, a talking strand of the plug-cord circuit, a main terminal of the connecting plug, a main line terminal, a winding

of the cut-off relay and the line-signal lamp, when the circuit of the telephone line is broken at the sub-station and connection is made with the said line, and thereby actuating one of the armatures of the supervisory relay and thus closing a contact in the supervisory lamp circuit and causing the said supervisory-signal lamp to light, substantially as described.

14. In a telephone system, the combination with a metallic telephone line terminating in suitable connection terminals at the central station, of a high-resistance line-signal lamp normally connected to one limb of the said line, a divided source of electricity normally connected to the other limb of the said line, a cut-off relay the windings of which are included in the respective talking limbs of the said line, the said cut-off relay being adapted to disconnect the said line-signal lamp and the said source from the respective limbs of the said line when in an operated condition, a subscriber's sub-station connected to the limbs of the telephone line, a plug-cord circuit adapted to be conductively connected with the respective limbs of the telephone line, a supervisory signal lamp associated with the plug-cord circuit, a double-armature supervisory relay connected to a main strand of the plug-cord circuit, one armature thereof being adapted to close a contact when actuated, the other armature thereof being adapted to open the same contact when actuated, an impedance coil connected to a second main strand of the plug-cord circuit, the said divided source of electricity being also associated with the line-signal lamp, the said impedance-coil, the supervisory relay and the supervisory-signal lamp, the said supervisory-signal lamp being in circuit with the said contact of the supervisory relay, means for closing a circuit of the said source through the line-signal lamp and the limbs of the telephone line, at the said sub-station, and thereby lighting the said line-signal lamp, means for closing a circuit of a portion of the said source through the said supervisory relay, the talking strands of the plug-cord circuit, the main terminals of the connecting plug, the main line terminals, the windings of the said cut-off relay, the limbs of the telephone line and the sub-station apparatus, when connection is made with the line and the said line is connected through the sub-station, thereby actuating the said cut-off relay and thus disconnecting the line-signal lamp and the said source from the respective limbs of the telephone line, and also actuating both armatures of the said supervisory relay and thus maintaining an open contact in the said supervisory lamp circuit, and means for closing a circuit of another portion of the said source through the said supervisory relay, a talking strand of the

plug-cord circuit, a main terminal of the connecting plug, a main line terminal, a winding of the cut-off relay and the line-signal lamp, when the circuit of the telephone line is open and connection is made with the said line, and thereby actuating only one of the armatures of the said supervisory relay, and thus closing a contact in the supervisory lamp circuit and causing the said supervisory-signal lamp to light, substantially as described.

15. In a telephone system, the combination with two telephone lines extending from respective subscribers' stations to the central station, of a line-signal lamp for each line and normally connected thereto, a cord-circuit terminating in two connecting plugs and adapted to be conductively connected with the said lines, supervisory signal circuits, a double-armature supervisory relay for each connecting plug and associated therewith, the said relays being adapted to control the respective supervisory signal circuits and thereby control the operation of the supervisory signals, a source of electricity associated with the said supervisory relays and signals and with the said lines and line signals, and means for operating the armatures of either supervisory relay separately or together, during the process of connecting and disconnecting the said telephone lines for conversation over the said lines, substantially as described.

16. In a telephone system, the combination with two telephone lines extending from respective subscribers' stations to the central station, of a line-signal lamp for each line and normally connected thereto, a cut-off relay for each line and associated therewith, the said relays being adapted to disconnect their respective line signals from the said respective telephone lines, when in an operated condition, a cord circuit terminating in two connecting plugs and adapted to be conductively connected with the said lines, supervisory signal circuits, a double-armature supervisory relay for each connecting plug the armatures of which are adapted to control the circuits of the corresponding supervisory signals and thereby control the operation of the said signals, a divided source of electricity associated with the said supervisory relays and signals and with the said lines and line signals, means for connecting the said telephone lines through the said cord circuit to facilitate conversation between the said lines, and means for operating the said line signals and supervisory signals by means of the said relays during the process of connecting and disconnecting the said telephone lines for conversation over the said lines, substantially as described.

17. The combination with a telephone line and connection terminals therefor, of a line signal normally connected to the said line, a

plug-cord circuit adapted to be conductively connected with the said line, a double-armature relay associated with the plug-cord circuit, a supervisory signal, a source of electricity associated with the plug-cord circuit and with the said line, means for operating the said relay armatures separately or together and thereby operating and controlling a local circuit containing the supervisory signal, means whereby the said line signal is under control of the subscriber when no connection is made with the line, means whereby the said double-armature relay is under control of the said subscriber and means whereby the said line signal is rendered inactive, when connection is made with the telephone line, substantially as described.

18. The combination with a telephone line and connection terminals therefor, of a line signal normally connected to the said line, a cut-off relay associated with the said line and adapted to disconnect the said line signal from the said line, a plug-cord circuit adapted to be conductively connected with the said line, a double-armature relay associated with the plug-cord circuit, a supervisory signal, a source of electricity associated with the plug-cord circuit and with the said line, means for operating the armatures of the double-armature relay separately or together and thereby operating and controlling a local circuit containing the supervisory signal, means whereby the said line signal is under control of the subscriber when no connection is made with the line, and means whereby the said double-armature relay is under control of the said subscriber when connection is made with the telephone line, substantially as described.

19. The combination with a telephone line and suitable connection terminals therefor, of a line signal associated with the said line, a plug-cord circuit adapted to be conductively connected with the said line, a supervisory signal circuit, a double-armature supervisory relay adapted to operate and control the supervisory signal, a divided source of electricity associated with the said plug-cord circuit, the supervisory relay and the telephone line, means for closing a circuit of a portion of the divided source through the said supervisory relay and thereby sending a current through the said relay in one direction and thus actuating one of its armatures, and means for closing a circuit or another portion of the said divided source through the said supervisory relay and thereby sending a current through the said relay in the opposite direction and thus actuating the other armature thereof, the said armatures controlling a contact in the supervisory signal circuit, substantially as described.

20. The combination with a telephone line terminating in suitable connection terminals,

of a subscriber's station connected to the said line, a line signal normally connected to the said line, a cut-off relay associated with the said line and adapted to render the said line signal inoperative when in an actuated condition, a plug-cord circuit adapted to be conductively connected with the said line, a supervisory signal, a double-armature relay associated with the plug-cord circuit and adapted to operate and control the supervisory signal, a divided source of electricity associated with the plug-cord circuit and with the telephone line, and means whereby the subscriber reverses the current through the said supervisory relay by opening and closing the circuit of the telephone line while connection is made therewith, thus actuating and controlling the operation of the armatures of the supervisory relay, respectively, and thereby controlling the operation of the supervisory signal, substantially as described.

21. In a connecting circuit for telephone lines, an electrically-operable device normally associated therewith and provided with operable members for controlling a signal circuit, a signal circuit to be controlled, and means for operating the operable members separately.

22. In a connecting circuit for telephone lines, an electrically-operable device normally associated therewith and provided with operable members for controlling a signal circuit, a signal circuit to be controlled, and means for operating the operable members separately or together.

23. The combination with a plug-cord connecting circuit for telephone lines, of electrically-operable devices normally associated therewith, each device being provided with operable members for controlling a signal circuit, suitable signal circuits to be operated, and means for operating the operable members of either device, separately or together.

24. In a connecting circuit for telephone lines, a relay normally associated therewith and provided with armatures for controlling a signal circuit, a signal circuit to be controlled, and means for operating the said armatures separately.

25. The combination with a connecting circuit for telephone lines, of a relay normally associated therewith and provided with armatures for controlling a signal circuit, a signal circuit to be controlled, and means for operating the said armatures separately or together.

26. The combination with a plug-cord connecting circuit for telephone lines, of relays normally connected therewith, each relay being provided with armatures for controlling a signal circuit, suitable signal circuits to be controlled, and means for operating the armatures of either relay, separately or together.

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27. The combination with a connecting circuit for telephone lines, of an electromagnet normally connected therewith and provided with operable members for controlling a signal, a signal to be controlled, and means for operating the operable members separately or together.

28. The combination with a connecting circuit for electrical transmitting circuits, of electromagnets normally associated therewith, each electromagnet being provided with operable members for controlling a signal, suitable signals to be controlled, and means for operating the operable members of each magnet, separately or together.

29. The combination with a telephone line, of a plug-cord circuit adapted to be conductively connected therewith, a double-armature relay normally associated with the plug-cord circuit, circuit-controlling means adapted to be operated by either armature, a signal under control of the circuit controlling means, and means for operating the said armatures separately or together.

30. The combination with a telephone line, of a plug-cord circuit adapted to be connected with the line, a double-armature relay normally associated with the plug-cord circuit, a switch in a local circuit adapted to be opened or closed by either said armature, one armature closing the switch and the other armature opening it, or vice versa, a suitable local circuit for the switch, and means for operating the said armatures separately or together.

31. The combination with a telephone line, of a connecting circuit therefor, a double-armature relay associated with the connecting circuit, a local circuit adapted to be closed and opened by either armature of the relay, and means for operating the said armatures separately or together.

32. The combination with a connecting circuit for electrical transmitting lines, of an electrically-operable device normally associated therewith and provided with operable members, circuit controlling means adapted to be operated by the said operable members, a suitable circuit to be controlled by the circuit controlling means, and means for operating the said operable members separately or together.

33. The combination with a connecting circuit for telephone lines, of a double-armature relay normally associated therewith, a spring contact adapted to be opened or closed by either armature of the relay, a suitable circuit to be controlled by the spring contact, and means for operating the said armatures, one at a time or both together.

34. The combination with a connecting circuit for telephone lines, of a double-armature relay normally associated therewith, a contact in a signal circuit adapted to be opened or closed by either armature of the

relay, a suitable signal circuit to be controlled by the said contact, and means for operating the said armatures separately or together.

35. The combination with a connecting circuit for electrical transmitting lines, of an electrically-operable device normally associated therewith and provided with operable members, switching mechanism adapted to be operated by the said operable members, a signal adapted to be operated by the said switching mechanism, and means for operating the said operable members separately or together.

36. The combination with a connecting circuit for electrical transmitting lines, of an electromagnet normally associated therewith and provided with superposed armatures, circuit-controlling means adapted to be operated by either said armature, a signal circuit to be controlled by the circuit-controlling means, and means for operating the said armatures separately or together.

37. The combination with a connecting circuit for telephone lines, of a relay normally associated therewith and provided with superposed armatures, a switch adapted to be opened or closed by either said armature, a suitable signal circuit to be controlled by the switch, and means for operating the said armatures, one at a time or both together.

38. The combination with a telephone line and a subscriber's telephone connected thereto, of a plug-cord connecting circuit adapted to be connected with the line, a relay provided with superposed armatures and normally associated with a main strand of the plug-cord circuit, a source of electricity associated with the plug-cord circuit and with the telephone line, circuit-controlling springs adapted to be operated by the said armatures, a signaling device in circuit with the said springs, and means for operating the armatures of the said relay, one at a time or both together, and thereby controlling the operation of the said signaling device, one said armature being under control of the subscriber when connection is made with the line.

39. The combination with telephone lines, of a plug-cord connecting circuit terminating in connecting plugs and adapted to be connected with the said lines, a relay for each plug and normally associated therewith, each said relay being provided with a pair of superposed armatures, circuit controlling springs for each relay adapted to be operated by the armatures thereof, signal circuits controlled by the respective relays, a source of electricity associated with the said lines and relays, and means for operating the armatures of either said relay, one at a time or both together, and thereby controlling the respective said signal circuits, one said armature of each relay being under

control of respective line operating means when connection is made with the respective lines, substantially as described.

40. In a connecting circuit for electrical transmitting lines, an electrically-operable device provided with operable members for controlling a circuit, a signaling circuit adapted to be controlled by the said operable members, and means for operating the said operable members separately.

41. The combination with a connecting circuit for telephone lines, of a relay normally associated therewith and provided with superposed armatures, signaling means adapted to be controlled by the said armatures, and means whereby the said armatures may be operated separately or together.

42. The combination with a telephone line, of a connecting circuit therefor, an electrically-operable device normally associated with the connecting circuit and provided with operable members for controlling a signaling circuit, a signaling circuit to be controlled, and means on the line for controlling the operation of one of the said operable members while connection is made with the line, separately from the operation of another said operable member.

43. The combination with a telephone line, of a connecting circuit therefor, an electrically-operable device normally associated with the connecting circuit and provided with operable members for controlling a signaling circuit, a signaling circuit to be controlled, means whereby one said operable member is operated when connection is made with the line, and means on the line controlling the operation of another said operable member while connection is made with the line.

44. An electrical system having lines, a connecting circuit for the lines, an electrically-operable device normally associated with the connecting circuit and having operable members for controlling a signaling circuit, a signaling circuit to be controlled, and means for sending current through the said device from a plurality of circuits to operate the said operable members separately.

45. An electrical transmitting line, a connecting circuit therefor, an electrically operable device associated with the connecting circuit and having operable members for controlling a signaling circuit, a signaling circuit to be controlled, means whereby one of the said operable members is operated when connection is made with the line, and means whereby another said operable member is under control of the line while connection is made therewith.

46. The combination with a connecting circuit for electrical transmitting lines, of an electrically-operable switching device normally associated therewith and having

switch-controlling mechanism, suitable circuit portions to be controlled, and means whereby different degrees of energy in the said device control different portions of the switch-controlling mechanism.

47. In a connecting circuit for electrical transmitting lines, a relay normally associated therewith and provided with operable mechanism for controlling circuit arrangements, suitable circuit arrangements to be controlled, and means whereby the relay may operate different portions of the said mechanism separately.

48. The combination with a telephone line, of a connecting circuit therefor, a relay normally associated with the connecting circuit and provided with operable mechanism for controlling suitable circuit arrangements, suitable circuit arrangements to be controlled, and means on the line for causing the relay to operate a portion of the said mechanism while connection is made with the line, separately from another portion of the said mechanism.

49. The combination with a telephone line, of a connecting circuit therefor, a relay normally associated with the connecting circuit and provided with operable members for controlling suitable circuit arrangements, suitable circuit arrangements to be controlled, means whereby the relay operates one said operable member when connection is made with the line, and means on the line causing the relay to operate another said operable member while connection is made with the line.

50. An electrical system having lines, a connecting circuit for the lines, a relay normally associated with the connecting circuit and having operable members for controlling suitable circuit arrangements, suitable circuit arrangements to be controlled, and means whereby the circuit arrangement of the system may be changed to vary the current supply through the said relay to operate the said operable members separately.

51. A telephone line signaling circuit having a signal lamp in series with the line with a small enough current-carrying capacity whereby it may be lighted in series with a line resistance of at least five-hundred ohms to give a signal and also through a short-circuit of the line resistance without burning out.

52. The combination of an electrical circuit having a make and break contact therein, a relay having armatures, and means adapting each armature to open and close the said contact when the relay is properly energized.

53. The combination of an electrical circuit having an operable contact therein, a relay having a plurality of operable members, and means for causing the relay to operate the said operable members separately

whereby each opens and closes the said contact.

54. A telephone line signaling circuit comprising a line, signal lamp and source of electricity connected in series, the parts of the circuit being proportioned so that a current not exceeding approximately five-one-hundredths of an ampere may be used for causing the display of the signal.

55. A telephone line signaling circuit comprising a line, signal lamp and source of electricity connected in series, the parts of the circuit being proportioned so that the current through the lamp is kept at a value not to exceed approximately five-one-hundredths of an ampere, for signaling purposes.

56. The combination of a telephone line extending to a central station, connecting means for the line, a relay normally associated with the connecting means and provided with operable mechanism for controlling suitable circuit arrangements, suitable circuit arrangements to be controlled, and means on the line for causing the said relay to control the operation of a portion of the said mechanism while connection is made with the line, separately from another portion of the said mechanism.

57. The combination of an electrical transmitting line extending to a central station, connecting means for the line, a relay normally associated with the connecting means and provided with mechanism for controlling a signaling circuit, a suitable signaling circuit to be controlled, and means on the line for causing the said relay to control a portion of the said mechanism while connection is made with the line, separately from another portion of the said mechanism.

58. The combination of a telephone line extending to a central station, connecting means for the line at the central station, a relay normally associated with the connecting means and having a plurality of armatures for controlling suitable circuit arrangements, suitable circuit arrangements to be controlled, and means on the line for controlling the operation of one of the said armatures while connection is made with the line, separately from another of the said armatures.

59. The combination of a telephone line extending to a central station, connecting means for the line, a relay normally associated with the connecting means and having a plurality of armatures operable separately upon different degrees of energy in the relay, switching mechanism adapted to be operated by the armatures, signaling means adapted to be controlled by the switching mechanism, and means on the line for varying the energization of the relay while connection is made with the line, to control the operation of one of the said ar-

matrices separately from another of the said armatures, during such connection.

60. In a telephone line-signaling system, the combination with a telephone line having a resistance of at least five-hundred ohms, of a signal lamp connected in series with the line, and means for lighting the lamp over the line to give a signal, the said lamp having a filament with a current-carrying capacity not exceeding approximately five one-hundredths of an ampere whereby it is prevented from burning out upon a diminution of the line resistance of at least five-hundred ohms.

61. In a telephone line-signaling circuit comprising a telephone line and a lamp connected in series, a high-specific-resistance filament for the lamp whereby the latter may be lighted over the line, to give a signal, through various line resistances varying through a range of at least five hundred ohms, on a voltage suitable for such a line.

62. A telephone line-signaling system comprising a telephone line having a signal lamp connected in series therewith and means for lighting the lamp over the line to give a signal, the said lamp having a filament with a current-carrying capacity not exceeding approximately five one-hundredths of an ampere whereby it is prevented from burning out upon a short-circuit of the line resistance.

63. A telephone line extending to a central station and having a resistance of at least five hundred ohms, and a small current-carrying capacity signal lamp at the central station adapted and arranged to be lighted in series with the line and also through a short-circuit of the line resistance at the central station, on a source of current suitable for such systems.

64. In a connecting circuit for electrical transmitting lines, a switch, a translating device under control of the switch, a plurality of operable members each adapted and arranged to open and close the switch, and means for operating the said operable members separately.

65. In a connecting circuit for electrical transmitting lines, a switch adapted to be opened and closed, a signal-initiating device under control of the switch, a plurality of mechanisms each adapted for opening and closing the switch, and means for causing the operation of the said mechanisms separately.

66. In a connecting circuit for telephone lines, a relay having switching mechanism, suitable circuit portions to be controlled by the switching mechanism, and a plurality of mechanisms for controlling the switching mechanism, the said plurality of mechanisms being adapted for operation upon respective electrical energizations in the said relay.

67. In a telephone system having a supervisory signal, an electromagnetic device for controlling the signal, the said device having a switch connected with said signal and a plurality of armatures each adapted to open or close said switch, and means for operating the said armatures separately as desired.

68. A supervisory signaling circuit of the character specified having a make and break contact therein, an electrically-operable device having armatures, and means adapting one of the said armatures to close the said contact and another of the said armatures to open the said contact, upon the proper energization of the said device.

69. A supervisory signaling circuit of the character specified having an operable contact therein, an electroresponsive device having a plurality of operable members, and means adapting one of the said operable members to close the said contact and another of the said operable members to open the said contact, upon the proper energization of the said device.

70. The combination with a telephone line, of a connecting circuit therefor, an electroresponsive device having a plurality of armatures and associated with the connecting circuit, a supervisory signal circuit adapted to be controlled by the said armatures, one of the said armatures being adapted to close a contact affecting the said signal circuit and another of the said armatures being adapted to open a contact affecting the said signal circuit, and means for operating the said armatures separately.

71. The combination with a telephone line, of a connecting circuit therefor, a relay device having a plurality of armatures and associated with the connecting circuit, a supervisory signal circuit adapted to be controlled by the said armatures, one of the said armatures being adapted to close a contact in the said signal circuit and another of the said armatures being adapted to open a contact in the said signal circuit, and means for operating the said armatures separately.

72. In a connecting circuit for telephone lines, a supervisory signal, a relay for controlling the said signal, means for energizing the relay as desired, and means whereby different degrees of energization of the said relay cause the display of the said signal and render same inert, respectively.

73. In a connecting circuit for electrical transmitting lines, a translating device, a normally unenergized electroresponsive device having an energizable member, for controlling the said translating device, means for energizing the said electroresponsive device as desired, and means whereby different degrees of energization affecting the same energizable member of the said electroresponsive device, cause the actuation of the

said translating device and render same inactive, respectively.

74. In a telephone system having lines, a connecting circuit for the lines, a switch, a supervisory signaling device under control of the switch, electroresponsive mechanism having a plurality of armatures each adapted and arranged to open and close the switch, and means for causing the operation of the said armatures separately to suitably control the said signaling device.

75. In a connecting circuit for telephone systems, an electrically-operable device having a plurality of primary operating members, switching mechanism under control of the said members, signal-initiating means under control of the said switching mechanism and means for operating the said members separately to suitably control the said signal-initiating means.

76. In a connecting circuit for telephone systems, a relay having a plurality of armatures operable separately upon different degrees of energy in the relay, switching mechanism under control of the armatures, signal-initiating means under control of the switching mechanism, and means for energizing the relay to operate the armatures separately as desired.

77. The combination with a connecting circuit for electrical transmitting lines, of an electrically-operable device normally associated therewith and provided with superposed operable members, signaling mechanism adapted to be controlled by the said operable members, and means for operating the said operable members separately.

78. An electrical circuit having a contact therein, a unitary electromagnet having a plurality of operable members, and means for causing the magnet to operate the said operable members separately whereby each control the said contact.

79. The combination with a telephone line, of a connecting circuit therefor, an electroresponsive device having a plurality of armatures and associated with the connecting circuit, a supervisory signal circuit, each of the said armatures being adapted to control a contact affecting the said signal circuit, and means for operating the said armatures separately.

80. The combination with a connecting circuit for telephone lines, of a supervisory signal circuit, and a unitary supervisory magnet for exercising sole control over said supervisory signal circuit under proper circuit connections, said magnet having a plurality of armatures operable separately for controlling said signal circuit.

81. The combination with a connecting circuit for telephone lines, of a supervisory signal, and a unitary supervisory magnet for exercising sole control over said supervisory signal, said magnet having mechanisms

adapted to be given separate actuations upon respective energizations of the magnet, for controlling the said signal.

82. The combination in a telephone system, of a signal circuit, and a unitary magnet for exercising sole control over said signal circuit, said magnet having a plurality of armatures operable separately for controlling said signal circuit.

83. In a connecting circuit for electrical transmitting lines, a supervisory signal circuit and an electrically-operable device for controlling the said signal circuit, the said device having operable mechanism adapted to assume two operative positions, besides normal position, upon the proper energization of the said device, for properly controlling the said signal circuit.

84. In a connecting circuit for electrical transmitting lines, suitable circuit portions to be controlled, a supervisory signal associated with a said circuit portion, and a relay for controlling the said circuit portions, the said relay having operable mechanism adapted to assume two operative positions, besides normal position, upon the proper energization of the said relay, for properly controlling the said circuit portions and signal.

85. In a connecting circuit for electrical transmitting lines, a supervisory signal circuit, and an electrically-operable device for controlling the said signal circuit, the said device having contacts adapted to assume two operative positions, besides their normal position, upon the proper energization of the said device, for properly controlling the said signal circuit.

86. In a connecting circuit for electrical transmitting lines, suitable circuit portions to be controlled, a supervisory signal connected with a said circuit portion, and a relay for controlling the said circuit portions, the said relay having contacts adapted to assume two switching positions, besides their normal position, upon the proper energization of the said relay, for properly controlling the said circuit portions and signal.

87. In a connecting circuit for electrical transmitting lines, a supervisory signal circuit, and a relay device for controlling the said signal circuit, the relay device having contacts adapted to assume a plurality of positions besides their normal position, upon the proper energization of the said relay device, the latter also having a plurality of armatures operable separately for properly controlling the said contacts.

88. The combination with a connecting circuit for electrical transmitting lines, of a relay normally associated therewith and having switch-controlling mechanism, suitable circuit portions to be controlled, and means whereby different degrees of energy

in the relay control different portions of the said switch-controlling mechanism.

89. The combination with a unitary electromagnet included in an operating circuit therefor, of a local signaling circuit under control of the magnet, the latter having two armatures operable separately upon different degrees of energization of the magnet, and switching mechanism in series in the said local circuit and under control of the said armatures whereby each of the said armatures controls the said local circuit.

90. In a telephone system, a telephone line extending to a central station, a signal at the central station, a non-polarized electrically-operable device at the central station for controlling the said signal, the said device having a switch contact controlling the circuit of the said signal and mechanism controlling the said switch contact, and means for causing the said device to give the said mechanism a plurality of operations upon different degrees of energization of the said device, each operation of the said mechanism causing a different control of the said switch contact.

91. In a connecting circuit for telephone systems, a relay having a plurality of armatures and switching mechanism controlled by the said armatures, suitable circuit arrangements under control of the said switching mechanism, and means for causing the relay to operate the said armatures separately upon the proper energization thereof, whereby the said armatures properly control the said switching mechanism.

92. An electrical circuit having a make-and-break contact therein, a unitary electromagnet having armatures adapted to be operated separately, and means adapting one of the said armatures to close the said contact and another of the said armatures to open the said contact, upon the proper energization of the magnet.

93. The combination of a signal circuit, and a unitary magnet for exercising control over the said signal circuit, the said magnet having a plurality of armatures exterior of the said circuit and operable separately for controlling the said signal circuit.

94. In a connecting circuit for telephone systems, an electrically-operable device having a plurality of primary operating members and switching mechanism under control thereof, suitable circuit portions under control of the said switching mechanism, and means for operating the said primary operating members separately to suitably control the said circuit portions.

95. A signaling system comprising a line and a signal lamp connected in series therewith, the said lamp having a filament with a current-carrying capacity not exceeding approximately five-one hundredths of an am-

pere, and means for lighting the lamp over the line to give a signal.

96. In a telephone system, the combination with a telephone circuit at the central office of the system, of a relay connected with said circuit, said relay adapted to be partially actuated over said circuit at one time to affect telephone apparatus and completely actuated at another time to again affect said apparatus, substantially as described.

97. The combination in a telephone exchange system of a cord circuit adapted to make connection with a telephone line, a signal controlling electromagnet associated therewith responsive to current in a circuit established by the connection of said cord circuit to the line, means for securing a limited energization only of said electromagnet during the non-use of the line to cause the display of a signal, and means for securing a greater energization of said electromagnet when the line is in use whereby the said signal is again effaced, substantially as described.

98. In a telephone exchange system, the combination of a cord circuit adapted to make connection with a telephone line, a signal controlling electromagnet associated therewith adapted to display a signal only when partially energized and to efface said signal when energized to a greater extent, a switch controlled by the operator for securing a partial energization of said electromagnet, and a circuit controlled from a substation for securing a greater energization of said electromagnet, substantially as described.

99. The combination in a telephone exchange system of a telephone line uniting a substation with a central office, a cord circuit adapted to make connection with said line, and a signal controlling electromagnet associated therewith and adapted when energized to a limited extent to display its signal and when energized to a greater extent to efface said signal, substantially as described.

100. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections therewith for conversation, a supervisory relay associated with the cord circuit and having its circuit completed through a high-resistance path when connection is made with the line and the subscriber's telephone is not in use, to partially operate the relay, a supervisory signal displayed by said apparatus at this time, and means for completing a low-resistance path for said relay when connection is made with the line and the subscriber's telephone is in use to completely operate the said relay to thereby efface said supervisory signal.

101. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections with the line for

conversation, a cut-off relay for the line adapted to render the line signal inoperative when a connection is established, a supervisory relay associated with the cord circuit, means for establishing a path for current through said supervisory and cut-off relays when a connection is established with the line to partially operate the supervisory relay, a supervisory signal having its circuit closed during such period of partial operation of the supervisory relay, and means whereby when the subscriber's telephone is in use an increased flow of current through said supervisory relay completely operates the same and thereby renders the supervisory signal inoperative.

102. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections for conversation therewith, a supervisory relay associated with the cord circuit, a central source of current to furnish current over the telephone line for conversation, said relay being partially operated during the connection when the subscriber's telephone is not in use, to operate the supervisory signal, the said relay being in the path of current over the telephone line when the telephone is in use whereby the relay is then completely operated to render the supervisory signal inoperative.

103. In a telephone system, the combination with the connecting circuit at the central office of the system, of a relay connected with said circuit, said relay being adapted and arranged to be partially actuated over said circuit at one time to affect telephone apparatus and completely actuated at another time to again affect telephone apparatus.

104. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections therewith for conversation, an electromagnet associated with the cord circuit and having its circuit completed through a high resistance path when a connection is established by the cord circuit with the line and the subscriber's telephone is not in use, to partially energize the said magnet, supervisory apparatus controlled by said electromagnet, and means for completing a low resistance path through said electromagnet when the subscriber's telephone is in use to fully energize the said magnet to again affect said apparatus.

105. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections with the line for conversation, a cut-off device for the line adapted when operated to render the line signal inoperative, a supervisory signal-controlling magnet associated with the cord circuit, a suitable signal adapted to be controlled thereby, means for establishing a path for current through said magnet and

said cut-off device when a connection is established with the line for conversation, the current in said path when the subscriber's telephone is upon its hook being only sufficient to partially energize the said magnet whereby it is caused to disclose its signal, and means whereby when the subscriber's telephone is in use a low resistance path is provided for current through said magnet which is more completely energized thereby and serves in this condition to efface the supervisory signal.

106. The combination in a telephone exchange system, of a signal-controlling electromagnet normally associated with a cord circuit and responsive to current therein when said cord circuit is united to a telephone line, and a normally-effaced signal associated with said electromagnet, adapted to be displayed when the electromagnet is energized to a limited extent, and to be again effaced when the electromagnet is energized to a greater extent.

107. In a telephone exchange system, the combination of a cord circuit adapted to make connection with a telephone line and a signal-controlling electromagnet normally associated therewith, adapted to display a signal only when partially energized and to efface said signal when energized to a greater extent.

108. The combination in a telephone exchange system of a signal-controlling electromagnet associated with a cord circuit and responsive to current therein when said cord circuit is united with a telephone line, a normally effaced signal associated with said electromagnet, adapted to be displayed when the electromagnet is energized to a limited extent, and to be again effaced when the electromagnet is energized to a greater extent, means for securing a limited energization only of the electromagnet when the cord circuit is united with a line not in use and means for securing a greater energization of said electromagnet when the line is in use.

109. The combination in a telephone exchange system of a signal-controlling electromagnet associated with a cord circuit and responsive to current therein when said cord circuit is united with a telephone line, a normally effaced signal associated with said electromagnet, adapted to be displayed when the electromagnet is energized to a limited extent and to be again effaced when the electromagnet is energized to a greater extent, means controlled by the operator for securing the limited energization only of the electromagnet when the cord circuit is united with a line not in use and means controlled at the substation for securing the greater energization of said electromagnet when the line is in use.

110. In a telephone exchange system, the

combination of a cord circuit adapted to make connection with a telephone line, a signal-controlling electromagnet associated therewith, adapted to display a signal only when partially energized and to efface said signal when energized to a greater extent, means for securing a partial energization of said magnet when the line is not in use and the cord circuit is connected thereto, and means for securing a greater energization of said magnet during the use of the line.

111. In a telephone exchange system, the combination of a telephone line uniting a substation with the central office, a switch at the substation for controlling the flow of current over said line through the substation, a signal-controlling electromagnet, a cord circuit associated therewith, adapted to make connection with said line and to complete a circuit through an energizing winding of said signal-controlling electromagnet, means for securing a limited energization only of said electromagnet over a circuit controlled by the operator whereby the said magnet is caused to display its signal, and means controlled by the substation switch for securing a greater energization of said electromagnet whereby the said signal is effaced.

112. In a telephone exchange system, the combination of a telephone line uniting a substation with the central office, a switch at the substation for controlling the flow of current over said line through the substation, a signal-controlling magnet, a cord circuit adapted to make connection with said line and to complete a circuit associated therewith through an energizing winding of said signal-controlling magnet, means for securing a limited energization only of said magnet over a circuit controlled by the operator whereby the said magnet is caused to display its signal, and means controlled by the substation switch for causing a greater energization of said magnet when associated with the line.

113. The combination in a telephone exchange system, of a telephone line uniting a substation with a central office, a cord circuit adapted to make connection with said line, a signal-controlling electromagnet associated therewith and adapted when energized to a limited extent to display its signal and when energized to a greater extent to efface said signal, means whereby the operator may normally control the limited energization of said electromagnet, and means whereby the substation may secure either the limited or greater energization of said electromagnet when the line is switched for conversation.

114. The combination in a telephone exchange system of a telephone line uniting a substation with a central office, a cord circuit adapted to make connection with said

line, a signal-controlling electromagnet associated therewith and adapted when energized to a limited extent to display its signal and when energized to a greater extent to efface said signal, an energizing winding for said electromagnet in a circuit normally under control of the operator adapted to secure the limited energization of said electromagnet, and means whereby the substation may secure either the limited or greater energization of said electromagnet when the line is switched for conversation.

115. The combination in a telephone exchange system of a telephone line uniting a substation with a central office, a cord circuit adapted to make connection with said line, a signal-controlling electromagnet associated therewith and adapted when energized to a limited extent to display its signal and when energized to a greater extent to efface said signal, a circuit under control of the operator including an energizing winding of the electromagnet adapted to secure the limited energization of said electromagnet, and a switch at the substation for controlling an increased flow of current through said electromagnet when the line is switched for conversation.

116. In a telephone exchange system, the combination of a subscriber's line free from operative earth connections outside of the exchange, a link conductor associated therewith, a non-polarized electromagnet, a normally effaced supervisory signal and a source of current all associated with said link conductor, a path under the control of the operator for causing a flow of current through said magnet and to cause the display of said signal, and a branch path for current through said magnet for increasing the energization of the said magnet, directly controlled by the subscriber when said link conductor is connected with said line and adapted to cause the effacement of said signal.

117. In a telephone exchange system, the combination of a subscriber's line free from operative earth connections outside of the exchange, a link conductor associated therewith, a non-polarized electromagnet, a normally effaced supervisory signal and a source of current all associated with said link conductor, a path under the control of the operator for causing a flow of current through said magnet to cause the display of said signal, and a branch path for current directly controlled by the subscriber when said link conductor is connected with said line and adapted to cause the effacement of said signal by increasing the energization of the said magnet.

118. In a telephone exchange system, the combination of cord connecting apparatus adapted to make connection with a conversational circuit, a signal associated with said

cord connecting apparatus, an electromagnet also associated with said cord connecting apparatus, adapted to cause the display of said signal by the energization of said electromagnet when said apparatus is associated with an idle circuit and to prevent the display of the signal by an increased energization of said electromagnet while said circuit is in use.

119. The combination with a telephone line, of a connecting circuit therefor, an electrically-operable device associated with the connecting circuit and provided with operable members for controlling a signaling circuit, a supervisory signaling circuit to be controlled by the said operable members, means whereby one said operable member is attracted when connection is made with the line, and means on the line controlling the attraction of another said operable member while connection is made with the line, to control the said supervisory signaling circuit.

120. In a telephone system, the combination with a telephone circuit extending to the central office of the system, of a relay device at the central office adapted and arranged to be partially actuated over a local circuit at the central office at one time to affect telephone apparatus and completely actuated over another circuit at another time to affect telephone apparatus.

121. In a telephone system, the combination with a telephone line circuit extending to the central office of the system, of a relay device at the central office adapted and arranged to be connected with the line when connection is made therewith and to be partially actuated at one time to affect telephone apparatus and completely actuated at another time to again affect the said telephone apparatus.

122. In a telephone system having lines extending to a central station, a signal at the central station, relay mechanism at the central station for controlling the signal, and mechanism on a line for controlling the said relay mechanism at a certain time, the said relay mechanism having a plurality of armatures operable separately for controlling the said signal.

123. In a telephone system having lines extending to a central station, a signal at the central station, relay mechanism at the central station for controlling the signal, the said relay mechanism being adapted to be connected with a line when connection is made therewith, and mechanism on a line for controlling the said relay mechanism at a certain time, the said relay mechanism having a plurality of operable members operable separately for controlling the said signal.

124. In a telephone system having lines extending to a central station, a signal at the

central station, relay mechanism at the central station for controlling the signal, and mechanism on a line for controlling the said relay mechanism at a certain time, the said relay mechanism having a contact for controlling the said signal and a plurality of armatures operable separately for controlling the said contact.

125. In a telephone system having lines extending to a central station, a signal at the central station, relay mechanism at the central station for controlling the signal, and mechanism on a line for controlling the said relay mechanism at a certain time, the said relay mechanism having a contact for controlling the said signal and a plurality of operable members operable separately for controlling the said contact.

126. In a telephone system having lines extending to a central station, a signaling device at the central station, relay mechanism at the central station having a plurality of armatures operable separately for controlling the said signaling device, means at the central station for controlling one of the said armatures and mechanism on a line for controlling another of said armatures, whereby the said signaling device is properly controlled.

127. In a telephone system having lines extending to a central station, a signaling device at the central station, relay mechanism at the central station having a contact for controlling the said signaling device and a plurality of armatures operable separately for controlling the said contact, means at the central station for controlling one of the said armatures and mechanism on a line for controlling another of said armatures, whereby the said signaling device is properly controlled.

128. In a telephone system having lines extending to a central station, a signaling device at the central station, relay mechanism at the central station adapted to be connected with a line when connection is made therewith and having a plurality of operable members operable separately for controlling the said signaling device, means at the central station for controlling one of the said operable members and mechanism on a line for controlling another of said operable members, whereby the said signaling device is properly controlled.

129. In a telephone system having lines extending to a central station, a signaling device at the central station, relay mechanism at the central station having a contact for controlling the said signaling device and a plurality of operable members operable separately for controlling the said contact, means at the central station for controlling one of the said operable members and mechanism on a line for controlling another of

said operable members, whereby the said signaling device is properly controlled.

130. The combination with a telephone line extending to a central station, of a connecting circuit therefor, an electrically-operable device normally associated with the connecting circuit and having a certain degree of actuation at one time to affect telephone apparatus, and another degree of actuation at another time to again affect telephone apparatus.

131. In a telephone system, the combination with a telephone line circuit extending to the central office of the system, of an electrically-operable device at the central office adapted to be connected with the line when connection is made therewith and having a certain degree of actuation at one time to affect telephone apparatus and another degree of actuation at another time to again affect the said telephone apparatus.

132. In a telephone system having lines extending to a central station, relay mechanism at the central station having a contact exterior of the energizing circuit thereof for controlling telephone apparatus and a plurality of armatures operable separately for controlling the said contact, and means for operating the said armatures separately.

133. In a telephone system having lines extending to a central station, relay mechanism at the central station having a contact exterior of the energizing circuit thereof for controlling telephone apparatus and a plurality of operable members operable separately for controlling the said contact, and means for operating the said operable members separately.

134. In a telephone system having lines extending to a centralized station, a pair of switch members at the said station cooperating with each other to open and close a contact therebetween, suitable apparatus under control of the said contact, and relay mechanism at the said station arranged to be associated with various lines and having a plurality of armatures operable separately and acting conjointly to control the said contact, the said armatures being adapted to operate the respective said switch members and each to operate its respective switch member both when attracted and released.

135. In a telephone system having lines extending to a centralized station, a pair of switch members at the said station cooperating with each other to open and close a contact therebetween, suitable apparatus under control of the said contact, and electromagnetic mechanism at the said station arranged to be associated with various lines and having a plurality of operable members operable separately and acting conjointly to control the said contact, the said operable members being adapted to operate the re-

spective said switch members and each to operate its respective switch member both when operated by an energization of the electromagnetic mechanism and by a de-energization of same.

136. A signal circuit and a unitary magnet for exercising control over same, said magnet having a plurality of armatures adapted to be operated separately, one closing a contact in said signal circuit and one opening a contact in said signal circuit.

137. In a telephone line-signaling circuit comprising a telephone line and a lamp connected in series, a filament for the lamp having a small enough current-carrying capacity whereby the lamp may be lighted over the line to give a signal through various line resistances varying through a range of at least five-hundred ohms, on a voltage suitable for such a line.

138. In a telephone line-signaling system, the combination with a telephone line having a resistance of at least five-hundred ohms, of a signal lamp connected in series with the line, and means for lighting the lamp over the line to give a signal, the said lamp having a filament with a small enough current-carrying capacity whereby it is prevented from burning out upon a diminution of the line resistance of at least five-hundred ohms.

As inventor of the foregoing, I hereunto subscribe my name in the presence of two subscribing witnesses, this 19th day of July, 1904.

FREDERICK R. PARKER.

Witnesses:

ROBT. G. PARKER,
WM. F. VIOLETT.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."