

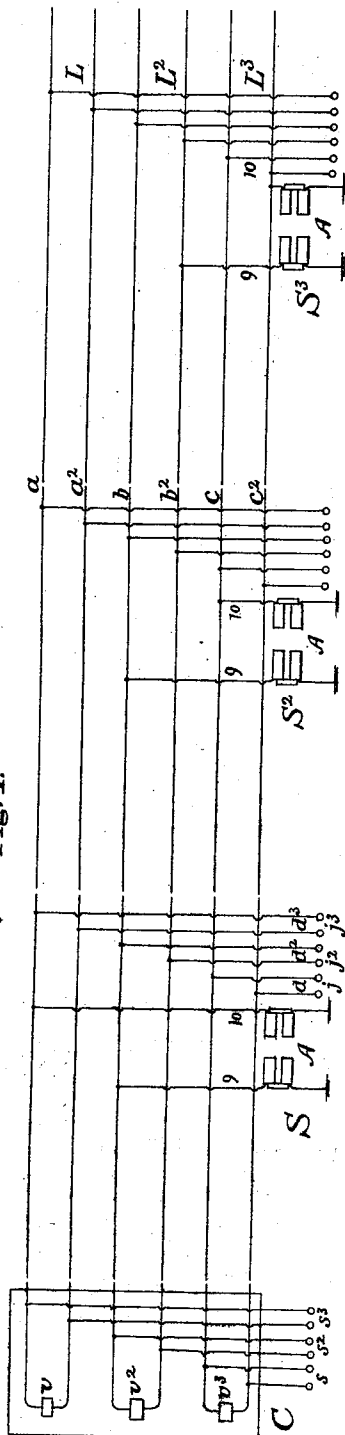
T. D. LOCKWOOD & S. J. LARNED.

ELECTRIC SIGNALING.

No. 501,087.

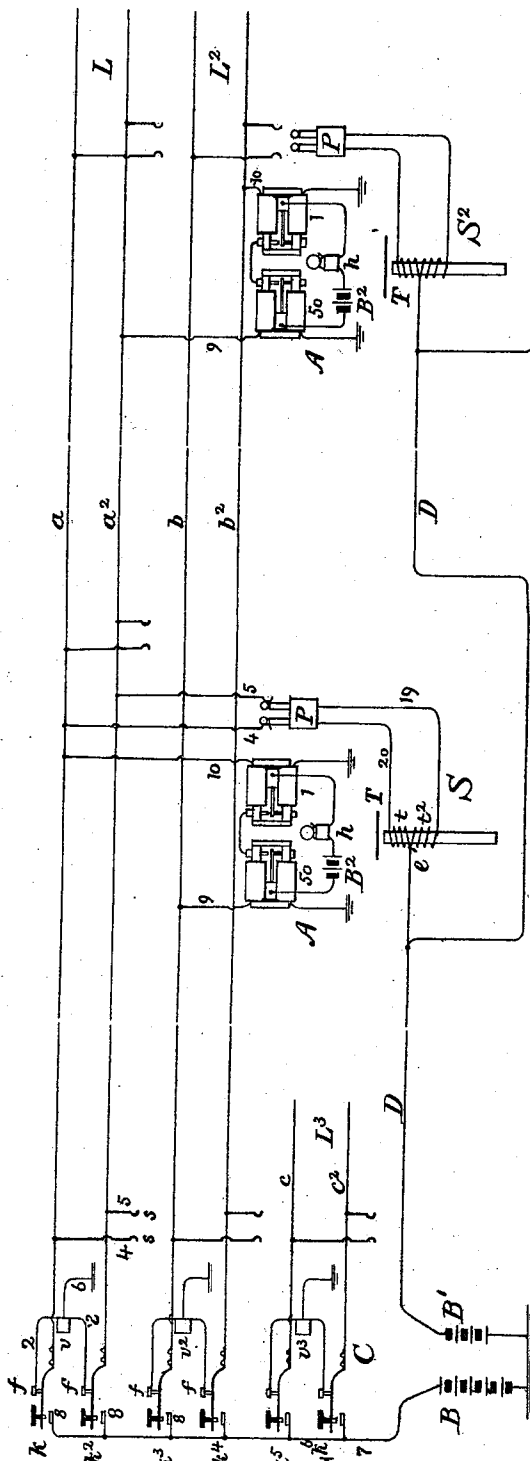
Patented July 11, 1893.

Fig. 1.



Witnesses.
Geo. T. Smallwood.

Fig. 2.



Inventors
Thos. D. Lockwood & S. J. Larned.
by *John M. Munn*
attorney

(No Model.)

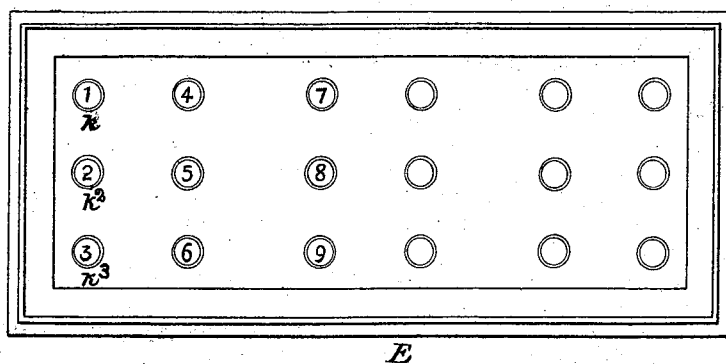
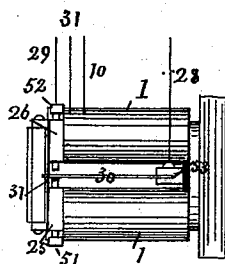
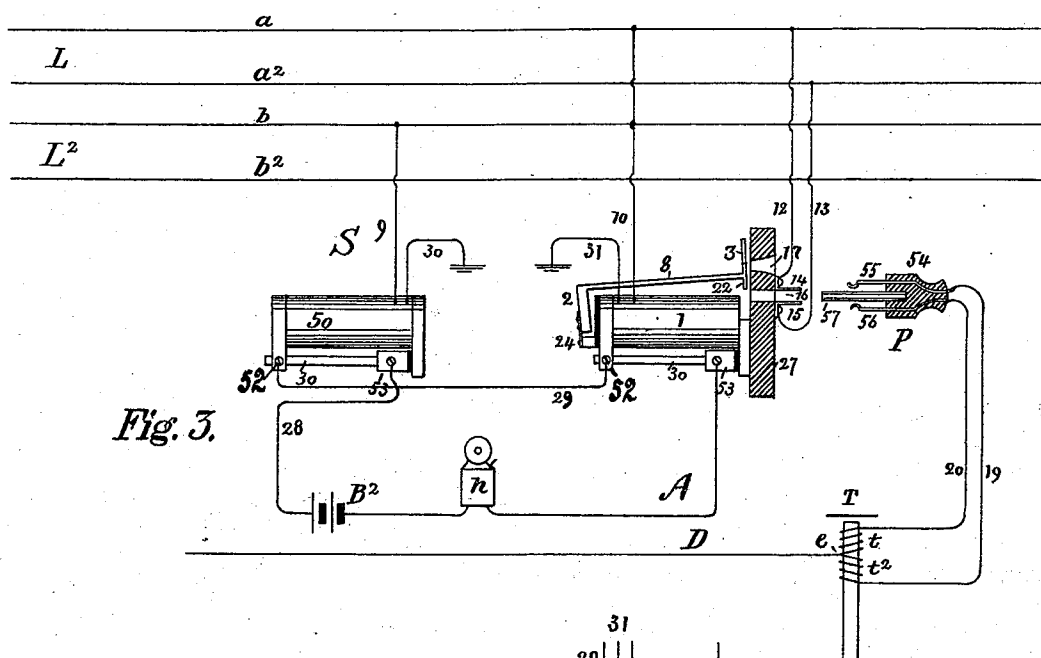
2 Sheets—Sheet 2.

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Witnesses.

Geo. Lewis.
Geo. T. Smallwood.

Inventors.

Inventors.
Thos. D. Lockwood
and S. J. Larned
by Paul Mauro
their attorney

UNITED STATES PATENT OFFICE.

THOMAS D. LOCKWOOD, OF MELROSE, MASSACHUSETTS, AND SHERWOOD J. LARNED, OF EVANSTON, ILLINOIS, ASSIGNORS TO THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY, OF NEW YORK, AND THE AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS.

ELECTRIC SIGNALING.

SPECIFICATION forming part of Letters Patent No. 501,087, dated July 11, 1893.

Application filed March 27, 1893. Serial No. 467,912. (No model.)

To all whom it may concern:

Be it known that we, THOMAS D. LOCKWOOD, residing at Melrose, in the county of Middlesex and State of Massachusetts, and SHERWOOD J. LARNED, residing at Evanston, in the county of Cook and State of Illinois, have invented certain Improvements in Selective Signaling, of which the following is a specification.

This invention relates to that class of telephone exchange systems in which a series of stations are served by a smaller number of main circuits, which however are common to and accessible by all stations of the series, and which all extend from all substations to a central station. In such an exchange there is great economy in the main line conductors; while by reason of the fact that each substation has a number of main lines leading to the central office, there is a reasonable expectation though each line is capable of being used by any substation in the system that each substation desiring communication, will always find a conductor free and at its disposal.

In three other applications, filed of even date herewith, by Frank A. Pickernell, and by Frank A. Pickernell and S. J. Larned jointly, there has been described and claimed, in the first, apparatus and circuit arrangements whereby in such a system, the substation may at any time send a call signal to the central office indicating that communication is desired and whereby the said substation or its correspondent may be enabled at the close of said communication to apprise the central station of the fact and thus indicate the necessity of disconnection; and in the second, is described and claimed apparatus and circuits whereby in such a system the substation may be able to distinguish among the lines accessible thereto, the lines in use from the free lines or the lines not in use, and thus to prevent the connection of any second telephone to a line already in use; and in the third application, there is shown and claimed with apparatus and circuits in such a system, secrecy devices connected in each main line at the several substations, by means of which, when any main line is con-

nected for use at any substation, it is impossible for any other substation to connect with the same main line, thus insuring absolute secrecy to the connecting substation.

The present application has reference, in such a class of telephone exchange systems as has been herein outlined, to circuit arrangements and apparatus, whereby any one substation may be called from the central office or exchange without notifying any other substation in the group.

In carrying out the invention, a number of wires, say ten, connect a series or group of substations with the central station. In order to call any one substation, without attracting attention at any other, some combination or association of two of the ten wires is used as a circuit or circuits over which to send the signal to that substation, and as many such combinations are made as there are substations in the group, such combinations being preferably composed of one side or limb of one main circuit with one side or limb of another main circuit, in order that signals shall not be sent over the talking circuits, although the talking wires can be thus used, if necessary.

As there are $\frac{n^2-n}{2}$ possible combinations of " n " lines taken two at a time, $\frac{n^2-n}{2}$ separate stations can be signaled without interference by the use of " n " wires.

Preferably electro-magnetic devices are employed for the selective signal apparatus, and for simplicity and in order not to multiply apparatus the said selective signal devices are combined with the "line in use" and the "secrecy" apparatus forming the subject matter of the aforesaid second and third applications. By such a combination, the selective signal is operated in part by the electromagnets of the line in use and secrecy devices, which are legged to ground from one side of the main line at each substation, and in part by an electro-magnet legged to ground from the other side of the main line at each substation. In both electro-magnets a polarized

tongue is located between the two pole pieces thereof and plays between the two iron limiting screws projecting from the pole pieces; one of the screws has an insulating rubber tip 5 against which the tongue presses normally; the other screw has a contact tip. The switching tongue and polarizing magnets are insulated from the core of the electro magnet and therefore from the screws. The tongues of the two 10 electro magnets are connected together by a wire which includes a battery and a call bell or annunciator. The two contact limiting screws are connected through the core.

The current by which the substation calls 15 the central station operates the line in use or busy indicators and the secrecy devices, is always in one direction and has no tendency to move the polarized tongue from its insulated position. An overpowering current in the 20 opposite direction is used at the central station for ringing the substation, which moves the tongue to make connection with the contact screw; this current is sent over both sides of the signaling circuit at the same time and 25 operates the tongue of each electro-magnet closing the local bell or annunciator circuit, and giving the signal. There is used in the combinations of lines for signaling circuits, one line in connection with any one of the others *in seriatim i. e.* for example line one may 30 be used with line three to signal substation one; line one and line four to signal substation two; line one and line five to signal substation three, &c., or any other combination of 35 lines which does not conflict with another. It is thus necessary that the polarized tongues of two associated electro magnets be moved to close upon their contact screws in order to close the local circuit and produce a signal; 40 and one line which is combined with another to cause the polarized tongues to move at one station, may be combined with a third to move the two polarized tongues at another station.

In carrying out the invention call sending 45 and receiving appliances are provided to be operated in conjunction with any member of a series of metallic main circuits and associated therewith are disconnecting signals; and with said main circuit or circuits is associated a common source of electric current, 50 for example a primary or storage battery which can be located either at the central station or at any suitable and convenient place. One of the poles of this source of electrical 55 energy may be connected to earth, and the other is extended by a supply conductor to the several substations, entering these by branches which when applied unite with the center of the telephone coil or helix. The 60 main circuit is normally open at the substations but has plug socket or spring jack branch terminals adapted to receive looping and connecting plugs which are respectively the terminals of the telephone loop extending from 65 its coil, and when thrust into their sockets, thereby close the said circuit through the telephone helix; the telephone is thus included

in the main circuit operatively, and in such a way as to be fully responsive to currents circulating therein. The main circuit is a double conductor or metallic circuit and at the 70 central station has a branch to earth including an electro-magnetic call annunciator common to all of the substations connected to the said main circuit.

Figure 1 is a diagram of a general system 75 with which the invention may be associated. Fig. 2 is a diagram of two main circuits illustrating the invention. Fig. 3 is a diagram of the apparatus located at one substation, illustrating the line-in-use indicator and secrecy 80 device, combined with the selective signal apparatus. Fig. 4 shows the under side of the selective electro magnetic apparatus, and Fig. 5 shows the face of the selective signal 85 key board, located at the central office.

In Fig. 1 is shown the general arrangement of a combination line system in association with which the invention may be conveniently operated. C represents a central or end station 90 for a number of metallic or double conductor circuits L, L^2 , and L^3 . S, S^2 and S^3 represent out or substations into which the said circuits enter by paired branches d, d^2 and d^3 ; the several pairs terminating respectively in spring-jack or other plug sockets j, j^2 and j^3 . Thus the 95 two conductors a, a^2 ; b, b^2 ; and c, c^2 of the several main circuits L, L^2 and L^3 lead into all of the substations normally connected with such circuits by multiple arc or parallel branches, 100 which so far as this invention is concerned, are normally open, or discontinuous while at the end station C, the two conductors of each main circuit are joined through the coils of suitable call receiving devices v, v^2 and v^3 105 and are furthermore provided with spring-jack connections s, s^2, s^3 whereby central station appliances may be connected by the use of intermediate or linking conducting devices of any ordinary or well known character. We have indicated in this figure the 110 selective signal apparatus at each substation S, S^2 and S^3 ; the signaling circuit for station S being the lines one and three combined; that of station S^2 the lines three and five; and that of station S^3 the lines four and 115 six.

Fig. 2 indicates the mode in which the invention will be preferably carried out. L represents one of the double conductor circuits, 120 and a and a^2 are the direct and return conductors thereof, provided at the central or end station C with connecting branches 4 and 5 leading to contacts in springjacks s . A differentially wound or connected annunciator 125 drop v is connected between the two main conductors and the earth branch 6; and at station S it is assumed that the telephone T has been connected with the circuit and that the metallic circuit by such a connection has 130 been closed through the telephone coils or helices t, t^2 . A source of electricity shown as a battery B' , is located at the central station C, or at any other and suitable and con-

venient place, and has one of its poles earthed, while the other connects with a call current supply conductor D which may form an extra member of the group of line conductors and passes to the several substations of the system, a branch being led from it into each, which branch is permanently united to the telephone helix at a point *e* at the center thereof or if the said telephones have two distinct helices, is serially connected at a point between them. A at the substation S in Figs. 2 and 3 represents the electro-magnetic selective device or apparatus composed of two electro magnets 1 and 50 legged or branched from the sides or conductors *a* and *b* of the main circuits L and L² by wire 10 and 9 respectively, to ground. The poles 25 and 26 of the electro-magnets are brought near to each other, as shown in Fig. 4, and have extending through them limit screws 51 and 52, the former having a button 31 of insulation at its extremity. 30 is a polarized switch or tongue attached at one end to a block 53 which is secured to but insulated from the yoke of the electro magnet; the free end of the tongue plays between the points of the screws 51 and 52 and normally rests against the button of the former. The blocks 53 of the two electro-magnets are connected by wire 28, which has included therein battery B² and bell or annunciator *h*. The tongue 30 is placed on the lower side of the electro-magnet. The screws 53 of the two electro magnets are connected by wire 29.

Fig. 5 represents the face of a keyboard, showing the keys *k*, which are lettered *k*, *k*², *k*³, &c., to represent the line conductors *a*, *a*², *b*, *b*², &c.; the circuits of which are shown at the central station C of Fig. 2; 7 being the grounded wire including the battery B, and extending by branches 8 to the anvils of the several keys *k*; connected to each line of the main circuits; *f*, *f* are back contacts of the keys *k*, connected by wires 2, 2 with the ground wires 6, 6 including the line call annunciators *v* *v*², &c. When the keys are in their normal position the line annunciators *v* are in circuit to receive calls from any substation. When any substation is to be called the two associated keys *k* connected to the two conductors forming the combination for that station are pressed to make contact with their anvils and the current of the proper polarity or direction passing over the two conductors from the same battery pole energizes the electromagnets there, and their respective polarized tongues are attracted to the contact screws thus closing the local circuit and ringing the bell or dropping the annunciator there. The current is of opposite polarity to that used by the substation in calling the central station, and is of sufficient strength to overpower the latter, should the latter be upon either conductor at the same time. For example to call station S (Figs. 2 and 3) the associated keys *k* and *k*³ are depressed to make contact with their anvils, the current flows from battery B,

over wire 7 to the keys *k* and *k*³ over the wires *a* and *b* through the electro magnets 1 and 50 energizing their coils and attracting the polarized tongues from their normal position to make contact with their respective screws 52, thus closing the local circuit and giving the signal. Upon releasing the keys, the battery is cut off and the electro-magnets are demagnetized, and the polarized tongues return to their normal position, opening the local circuit.

As shown in Fig. 3 one of the electro-magnets 1 serves to operate the busy or line in use indicating device and the secrecy device described specifically in the second and third applications referred to. 2 is an armature hung to the end of the electro-magnet and insulated therefrom by the flat spring 24; its arm 8 extends to the other end of the electro-magnet and bears upon its upper end a target 3, divided into two parts by different colors, or otherwise; opposite the target is an orifice 17 in the side of the inclosing case 27, through which the target is seen; this constitutes the line in use indicator. The same arm 8 bears upon the lower side of its end a projection 22 which, when the main line L to one side of which it is legged, is in use at some other station, closes the plug hole 16 and prevents the use of the connecting plug P, and this constitutes the secrecy device or apparatus; 14 and 15 are pin terminals of the branches 12 and 13 from the two sides *a* and *a*² of the main line L. The plug P is composed of an insulating base 54. Projecting from its center at one end is a metal spindle 57, and on either side thereof inserted in said handle are metal springs 55 and 56, connecting by wires 19 and 20 respectively to the coils *t*² and *t* of the telephone T. When the circuit is closed by the insertion of the plug P, the telephone is connected with the main circuit; the armatures 2 are attracted at all the substations, except the one at which the plug is inserted, and the lever terminals 7 at the said substations indicate busy or line in use, while the terminals 22 block the holes 16 to prevent a plug from being inserted or prevent the plug from making electrical contact with the said terminals and the said terminal sockets are rendered inoperative, acting as a line continuity controlling device; and simultaneously with the operation of the line in use and the secrecy apparatus the calling annunciator *v* at the central station, which is common to all the substations in the main line, is caused to indicate that a call has been made.

Having now fully described our invention, we claim—

1. The combination of a series of main double conductor telephone circuits extending between an end or central station and a series of substations, provided at the central station with calling keys one for each side or limb of the said main circuits, and an earth branch conductor including a source of electricity; a selective signal device or apparatus

at each substation, consisting of two electro magnets each in earth branches from different sides or limbs of the said main circuits; and means whereby a local circuit, including
 5 a source of electricity and a signal indicator is closed by said electro-magnets upon the connection of two associated calling keys at the central station with the said earth branch.

2. The combination of a series of main double conductor telephone circuits extending
 10 between an end or central station and a series of substations, provided at the central station with calling keys, one for each side or limb of the said main circuits; and an earth
 15 branch conductor including a source of electricity; a selective signal device or apparatus at each substation connected in earth branches from two separate sides or conductors of said main circuits and adapted to operate a signal
 20 indicator upon the union of the two calling keys associated with the said two conductors at the central station with the said earth branch.

3. The combination of two or more main double conductor telephone circuits, extending
 25 between an end or central station and a series of substations, provided at the said central station with calling keys, one for each side or limb of the said main circuits, and an earth
 30 branch conductor including a source of electricity; selective signal devices or apparatus one at each substation connected in earth branches from two separate sides or limbs of said main circuits, each signal device being
 35 in a different combination of earth branches from every other, and adapted to operate a signal indicator when the two main conductors concerned are simultaneously connected with the said earth branch including said
 40 source of electricity.

4. The combination of two or more main double conductor telephone circuits extending
 45 between an end or central station and a series of substations, provided at the central station with calling keys one for each side or limb of the said main circuits, and an earth
 branch conductor including a source of electricity, and provided at the said substation with plug socket terminals; a second earth
 50 branch conductor including a source of electricity, provided with connecting plug terminals; an electro magnetic device at each substation connected in ground branches from two separate sides or limbs of said main circuits and adapted to first operate a signal
 55 indicator upon the closure of two associated calling keys at the central station with the said earth branch; and second to operate the "busy" or "line-in-use" indicators at all the
 60 other substations, when the said connecting plug terminals are inserted in the said plug sockets.

5. The combination of two or more main double conductor telephone circuits extending
 65 between an end or central station and a series of substations, provided at the central station with calling keys one for each side or

limb of the said main circuits, and an earth branch conductor including a source of electricity and provided at the said substations
 70 with plug socket terminals; a second earth branch conductor including a source of electricity, provided with connecting plug terminals; an electro magnetic device at each substation connected in earth branches from two
 75 separate sides or limbs of said main circuits, and adapted to first: operate a signal indicator upon the closure of two associated calling keys at the central station with the said earth branch; and second: to operate the
 80 "busy" or "line in use" indicator and the secrecy devices at all of the other substations simultaneously, upon the insertion in the said plug sockets of the said connecting plug terminals.

6. The combination of a series of main double conductor telephone circuits extending
 85 between an end or central station and a series of substations, provided at the central station with electro-magnetic annunciators in earth
 90 branches and calling keys one for each side or limb of the said main circuits, and an earth branch conductor including a source of electricity and provided at the said substations with plug socket terminals; a second earth
 95 branch conductor including a source of electricity, provided with connecting plug terminals; an electro-magnetic device at each substation connected in ground branches from two separate sides or limbs of said main circuits, and adapted to first operate a signal
 100 indicator upon the closure of two associated calling keys at the central station with the said earth branch; and second, to simultaneously operate the "busy" or "line-in-use" indicators, and the secrecy devices at all of the
 105 other substations, and to operate the electro magnetic calling annunciator at the central station upon the insertion in the said plug sockets of the said connecting plug terminals.

7. The combination of two or more main double conductor telephone circuits extending
 110 between an end or central station and two or more substations, provided at the central station with calling keys one for each side or
 115 limb of the said main circuits, and an earth branch conductor including a source of electricity; a selective signal device or apparatus at each substation, consisting of two electro magnets each in earth branches from different
 120 sides or limbs of the said main circuits, and each provided with switches operating to close a local circuit including a source of electricity and a signal annunciator upon the closure of two associated calling keys at the
 125 central station with the said earth branch.

8. The combination of a number of double conductor main circuits, extending from a
 130 central station to each of a number of substations; two relays at each substation connected in earth branches from two of the said main circuit conductors, differing for each station; a local circuit and alarm requiring for its operation the concurrent operation of

both of the said relays; a source of electricity at the central station having one pole to earth; and a key for each main circuit conductor at the central station, adapted to connect the said conductor with the remaining pole of said source of electricity, whereby the concurrent connection of any given pair of keys operates the alarm at the substation at which the two main conductors associated with said keys extend to earth through the branches from each conductor, including the relay in each branch.

9. The combination of a number of double conductor main circuits extending from a central station to each of a number of substations; two polarized relays at each substation connected in earth branches from two of the said main circuit conductors differing for each station; a local circuit and alarm requiring for its operation the concurrent operation of both of the said relays; a source of electricity at the central station having one pole to earth and a key for each main circuit conductor at the central station adapted to connect the said conductor with the remaining pole of said source of electricity, whereby the concurrent connection of any given pair of keys operates the alarm at the substation at which the two main conductors associated with said keys are grounded through the branches which include the polarized relays.

10. The combination of two or more main

double conductor telephone circuits, extending between an end or central station and two or more substations; provided at the central station with calling keys, one for each side or conductor of the said main circuits and a source of electricity in an earth branch conductor; a selective signal device or apparatus at each substation consisting of two electromagnets each in earth branches from different sides or conductors of the said main circuits, and each provided with polarized switches operating to close a local circuit including a source of electricity and a signal annunciator upon the connection of two associated calling keys at the central station with the same pole of the said source of electricity in the earth branch conductor.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 13th day of February, 1893.

THOMAS D. LOCKWOOD.

Witnesses:

GEO. WILLIS PIERCE,
FRANK C. LOCKWOOD.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 25th day of February, 1893.

SHERWOOD J. LARNED.

Witnesses:

FRED GERLACH,
ALBERTA ADAMICK.