R. S. WILBUR.

SIGNALING SYSTEM.

APPLICATION FILED JAN. 14, 1918.

1,386,748

Patented Aug. 9, 1921.

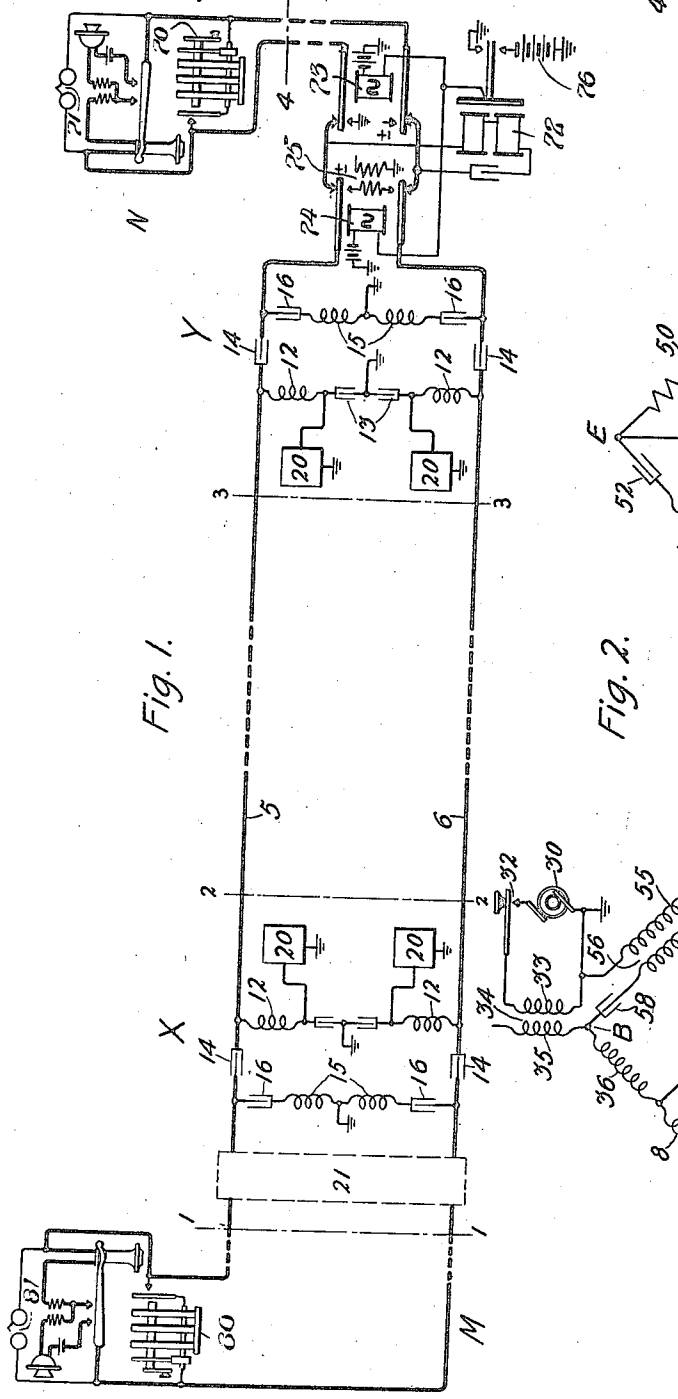


Fig. 1.

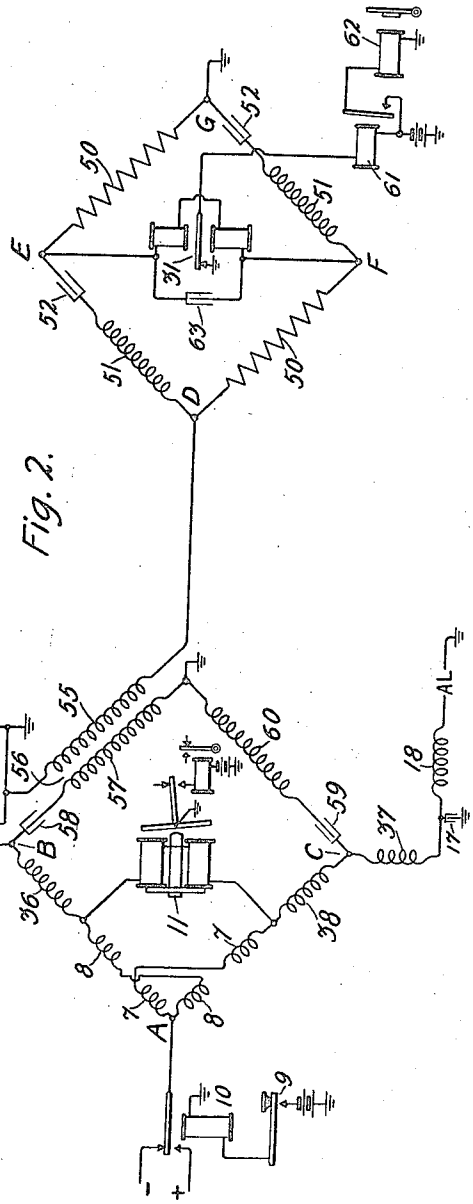


Fig. 2.

Inventor:
Ray S. Wilbur.
by J. E. Roberts
Atty.

UNITED STATES PATENT OFFICE.

RAY S. WILBUR, OF LYNDHURST, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

SIGNALING SYSTEM.

1,386,748. Specification of Letters Patent. Patented Aug. 9, 1921.

Application filed January 14, 1918. Serial No. 211,869.

To all whom it may concern:

Be it known that I, RAY SETH WILBUR, a citizen of the United States, residing at Lyndhurst, in the county of Bergen, State of New Jersey, have invented certain new and useful Improvements in Signaling Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to signaling systems, and more particularly to such systems in which a plurality of signal receiving devices are selectively operated over the same circuit.

The object of this invention is the provision of a system of this character in which the number of channels for the transmission of signal control currents over the same circuit is increased.

In accordance with this invention, a telephone line comprising two line conductors joining two telephone stations, and composited for the transmission of telegraphic messages between telegraph stations connected with the telephone line while telephone messages are being transmitted thereover, is equipped with apparatus for transferring over either of both line conductors alternating current impulses for the operation of signal receiving devices connected with the telephone line.

For a more complete understanding of this invention, reference should be had to the following description considered in connection with the accompanying drawing, wherein Figure 1 shows a composited telephone and telegraph line equipped for carrying into effect one embodiment of the invention; and Fig. 2 shows the equipment provided for each line conductor at each telegraph station.

As shown in Fig. 1, a telephone line comprising line conductors 5 and 6 joins two telephone stations M and N, at each of which is the usual telephone apparatus, composite ringer set, call bell and hand generator. Two telegraph stations X and Y are also connected with the telephone line, the former being illustrated between the dotted lines 1—1 and 2—2, and the latter between the dotted lines 3—3 and 4—4. Each telegraph station may be provided with two telegraph operators' sending and receiving equipments 20, one connected with the line conductor 5 and the other with the line conductor 6. The telegraph operators' equipments are all exactly alike; one of these is shown in detail in Fig. 2 and will be described later. At each telegraph station there is apparatus for preventing interference between the telephonic and telegraphic messages. This apparatus comprises retardation coils 12, 12, connected between the telegraph apparatus 20, 20, and the respective line conductors, in a manner well understood to prevent the short-circuiting of the telephonic currents through the telegraph apparatus connected between each line conductor and ground, and to graduate or round off the abruptness or sharpness of the direct current telegraph impulses, so that they may not interfere with the operation of the telephone apparatus; and condensers 14, 14, which tend to isolate the telephone apparatus from the direct current telegraph impulses. Condensers 13, 13, which are of relatively high capacity, six microfarads, each having proven suitable in the practical operation of this system, coöperate with the impedance coils 12, 12, to graduate the direct current telegraph impulses, while impedance coils 15, 15, and condensers 16, 16 connected between each line conductor and ground, provide drainage paths in shunt of the telephone apparatus, to prevent interference therewith from any direct current telegraph impulses which may pass the condensers 14, 14.

At each telegraph station there is provided a composite ringer set, diagrammatically shown at the station Y, while at the station X it may be considered that a similar set is correspondingly connected to the line conductors 5 and 6 at a point within the dotted rectangle 21. This ringer set may be of the type disclosed in the patent to Roy D. Conway, No. 1,265,751, May 14, 1918. This composite ringer set is responsive to alternating currents of relatively low frequency outgoing from the generator at the near telephone station, to connect with the line, alternating signaling current of a higher frequency suitable for transmitting over the line conductors independently of the direct current or the alternating current telegraphic channels and the set is in turn responsive to such high frequency alternating signaling current to connect with the line extending to the telephone station, alternating current of the lower frequency suitable for operating the call bell at the

telephone station. The alternating signaling currents transmitted over the line conductors 5 and 6, between the composite ringer sets, may be of a frequency of 133 cycles per second, while the frequency of the alternating currents for directly operating the telephone signals may be approximately sixteen cycles per second.

In briefly describing the operation of the composite ringer equipment, let it be assumed that it may be desired to send a call from the station Y to the station X. Accordingly, the magneto or hand generator 70 is operated to apply low frequency alternating currents through the winding of an alternating current relay 72. This relay is of such form that its movable contact member is normally at rest intermediate and in clearance with respect to its oppositely positioned contact stops. Under the influence of the alternating current from the generator 70, the armature of this relay will respond in phase with these currents to alternately connect with the battery 76 and to earth. The potential of the battery 76 is higher than the potential of the batteries at the relays 73 and 74, through which the windings of these relays are respectively connected to earth therefore, current from the battery 76 may flow through the relays 73 and 74 when the armature of the relay 72 is in contact with this battery, while for the opposite position of the armature of the relay 72 a ground is established whereby current from the batteries at the relays 73 and 74 may flow through the windings of these relays. It will be clear that in phase with the movements of the armature of the relay 72 reversals of current will take place through the relays 73 and 74. These relays, however, are so constructed or adjusted that the relay 73 will respond to high frequency currents only, while the relay 74 will only respond to currents of low frequency. Therefore, in the example assumed, low frequency current from the generator 70 will cause low frequency changes through the relay 74, and this relay will respond to switch the line circuits from the telephone instrument at the station Y to a circuit formed through the secondary winding of this transformer 75. Since the primary winding of this transformer may be energized from a source of high frequency alternating currents, as indicated by the conventional plus and minus signs in the drawing, corresponding currents will traverse the line conductors 5 and 6 in series to control the composite ringer set at the distant station, thereby effecting operation of a call signal 81 at that point.

In describing the manner in which high frequency alternating currents affect the ringer set, let it be assumed that in carrying out the operations of a call from the station X to the station Y, a low frequency generator 80 at the station X is operated to control a relay equipment which will be understood as present within the space 21 at the latter station whereby high frequency currents may traverse the line conductors 5 and 6 to the station Y, at which point these currents will complete circuit through the winding of the relay 72. The latter relay is of such type as will respond to either high or low frequency alternating currents, therefore, operation of this relay will establish high frequency current changes through the relays 73 and 74. The low frequency relay 74 will not be affected by these currents, however, but the high frequency relay 73 will be operated thereby to switch the circuit of the instrument at the station X from the main line conductors to a source of low frequency alternating current, thereby operating a call signal 71.

The circuits and the coördination of the apparatus in the present system with respect to the direct current telegraphing and the alternate current telegraphing is such that the alternate currents, just described as controlling the call signals 71 and 81, may be applied over the line without affecting and entirely independent of the telegraphic operations.

The telegraph operator's equipment shown in Fig. 2 comprises a polarized Morse telegraph relay 11 for receiving incoming direct current telegraph impulses, and a sending key 9 controlling a local circuit relay 10, which, in operating, reverses the polarity of the telegraph battery connected to line. The relay 11 is connected across a Wheatstone bridge, one arm of which comprises the connected line conductor balanced by an artificial line having electrical characteristics simulating those of the line conductor and forming a second arm of the bridge. The other two arms of the bridge comprise retardation coils 7 and 8, connected so as to be differential to outgoing direct current telegraph impulses, but in series to such currents incoming. The armature of relay 10 is connected to the point A of the bridge. Condenser 17 and retardation coil 18 connected in the artificial line arm of the bridge, are provided for balancing the condenser 13 and the retardation coil 12, respectively connected in the line arm of the bridge.

The hereinbefore described apparatus is that usually employed in a system where telephone and telegraph messages are simultaneously transmitted over the same line, and employing composite ringer sets for transmitting currents of proper frequency for controlling the operation of the call bells at the telephone stations. The apparatus about to be described is that employed in association with each telegraph operator's equipment to provide in a system of this

character additional channels over the same line through which alternating current impulses may be projected for the operation of additional signal receiving devices.

This additional apparatus consists of an alternating current generator 30, provided for generating current having a frequency preferably of approximately 50 cycles per second, for operating an additional signal receiving device 31. Currents generated by the generator 30 are of a frequency differing from those employed for operating the call bells associated with the telephone stations. A telegraph sending key 32, when depressed, connects the generator 30 in circuit with the primary winding 33 of a repeating coil 34, the secondary winding 35 of which is connected in the conductor joining the point B of the bridge with the line conductor. The repeating coil 34 is provided with an additional winding 36, which is connected in the arm AB of the bridge, and the two windings 35 and 36 are connected in series opposing so that practically no lag in the direct current Morse telegraph impulses is introduced, due to the presence of these windings in the path of the direct current impulses. Retardation coil 37 in the artificial line arm of the bridge, and retardation coil 38 in arm AC of the bridge are wound on the same core, and are connected in series-opposing, and serve to balance the windings 35 and 36 of the repeating coil 34.

The signal receiving relay 31, responsive to alternating current impulses of approximately 50 cycles per second, is connected across points E and F of a Wheatstone bridge composed of balanced arms D—F and E—G, each comprising a resistance coil 50, and balanced arms D—E and F—G, each comprising a retardation coil 51 and a condenser 52. The arms D—E and F—G are resonant to the 133-cycle alternating current employed for operating the call bells associated with the telephone stations, so that these two arms D—E and F—G have the same effective resistance to such currents as do the arms D—F and E—G, but these arms D—E and F—G are of high impedance to the 50-cycle alternating current employed for operating the relay 31. The point D of the bridge for relay 31 is connected with the secondary winding 55 of a repeating coil 56 whose primary winding 57 has one terminal grounded, and the other connected through a condenser 58 to the point B of the bridge for relay 11. The repeating coil 56 is provided for transmitting alternating current impulses to the relay 31. The path including the primary winding 57 and the condenser 58 is resonant to alternating currents of approximately 50 cycles per second, but is of high impedance to alternating currents of 133 cycles. The repeating coil 56 is provided with a third winding 60, one terminal of which is grounded, and the other connected through a condenser 59 with the point C of the bridge. This path, including the condenser 59 and the winding 60, is likewise resonant to alternating currents of 50 cycles, but is of high impedance to alternating currents of 133 cycles. Alternating currents traversing the primary winding 57 are not only induced into the secondary winding 55, but also into the third winding 60, and in order that the currents induced into this winding 60 may not interfere with the telegraph apparatus operated by means of direct current impulses, the connections of the winding 60 are such that the direction of flow of current therethrough is the same as that through the primary winding 57. In this manner the points B and C of the bridge are maintained at substantially equal potentials of the same polarity. With the connections of the primary winding 57 and the third winding 60 of the repeating coil 56, such as above described, any direct current impulses which may find their way into the paths to ground from the points B and C of the bridge are balanced, so that no current is induced into the secondary winding 55.

The relay 31, which is responsive to 50-cycle alternating current impulses from generator 30, controls, through a normally energized relay 61, a sounder 62, which serves as a signaling device. The relay 31, while responsive to very small currents, is rendered fast-operating, due to the presence of a condenser 63 connected in parallel therewith.

Some of the 133-cycle alternating current connected with the line for operating the call bell at either telephone station, may find its way through the retardation coils 12, which, while of relatively high impedance to telephonic currents, are of relatively low impedance to alternating currents of 50 and 133 cycles. Since the retardation coils 7 and 8 and the relays 11 are of high impedance to alternating currents of 50 and 133 cycles, the relays 11 will not be affected by such current of 133 cycles as may find its way through the retardation coils 12, a portion of which will be shunted to ground through the condensers 13. Likewise, since the path including the condenser 58 and the primary winding 57 is of high impedance to such currents, very little current will be induced into the secondary 55. Even if some of this 133-cycle alternating current is induced into the secondary 55, the arms D—E and F—G of the bridge with which relay 31 is associated, are resonant to such currents, and balance the arms D—F and E—G so that there will be no difference of potential at the points E and F of the bridge, and the relay 31 will not therefore be affected.

When transmitting direct current Morse

telegraph impulses by the operation of the key 9, such currents as find their way into the paths, one of which includes the condenser 58 and the primary winding 57 and the other the condenser 59 and the winding 60, are equal; and since the flow of current through the primary winding 57 and the third winding 60 is equal and opposite, no current will be induced into the secondary winding 55. Therefore, the transmission of direct current Morse telegraph impulses does not cause the operation of the relay 31.

When it is desired to operate the sounder 62 at the telegraph station Y, which is controlled over the line conductor 6, the key 32, included in the telegraph operator's equipment connected with line conductor 6 at the telegraph station X, is actuated, thereby causing a flow of current from the generator 30 through the primary winding 33 of the repeating coil 34. Current is thereupon induced into the secondary winding 35 and the third winding 36 thereof. The current induced into the secondary winding 35 finds a path which may be traced from ground through the primary winding 57 of the repeating coil 56, the condenser 58, the secondary winding 35, the retardation coil 12 at station X, line conductor 6, to station Y, and then through the secondary winding 35, the condenser 58 and the primary winding 57 (which path is resonant to currents of 50 cycles) to ground. Although a portion of this current finds its way to ground through the condensers 13, 13, connected with the line conductor 6, the amount of current which may traverse the line conductor will be sufficient to operate the relay 31 at the distant station Y, in a manner more fully hereinafter described. Also, a portion of such current finds its way through the third windings 36, the retardation coils 7 and 8 and the relays 11 at both stations, but since the retardation coils and the relays are of very high impedance to currents of 50 cycles, the amount of current so shunted is very small, and is not sufficient to cause the operation of the relays 11. Current of 50 cycles traversing the primary windings 57 of the repeating coils 56 at both stations, induces current into the secondaries 55 thereof. These repeating coils may be of the step-up type. Induced alternating current of 50 cycles therefore flows through a circuit at each station which may be traced from the grounded secondary 55 through resistance arm D—F of the bridge (for relay 31), windings of relay 31 and condenser 63 in parallel, and the resistance arm E—G of the bridge to the ground. Very little current finds its way through the arms D—E and F—G, since these are of high impedance to currents of 50 cycles. Each relay 31 operates, opening its contact and releasing relay 61, whereupon the sounder 62 attracts its armature, giving a signal. Each time that the key 32 is actuated, the relays 31 will be operated, thereby operating the sounders 62 controlled thereby. It will be seen, therefore, that these superimposed 50-cycle alternating current impulses may be employed for transmitting telegraph messages, separate and distinct from those transmitted by the direct current telegraph impulses. The retardation coils 15, 15 of relatively low impedance to alternating current of 50 cycles, but of high impedance to telephonic current, prevent such alternating current from interfering with the proper functioning of the telephone apparatus.

What is claimed is:

1. A signaling system comprising a pair of line conductors, means for connecting a source of signaling current thereto, signaling apparatus responsive to such current traversing the line conductors in series, means for connecting a source of direct current to one line conductor, a third conductor, a signal receiving device responsive to such direct current traversing the one line and the third conductor in series, a Wheatstone bridge composed of two balanced non-inductive arms and two balanced inductive arms resonant to signaling current, a signal receiving device connected across the bridge between the junction points of the inductive and non-inductive arms, a repeating coil inductively connecting the bridge with the one line conductor, and means for connecting a source of alternating current with the one line conductor for operating the bridged signal receiving device.

2. A signaling system comprising a pair of line conductors, means for connecting a source of signaling current thereto, signaling apparatus responsive to such current traversing the line conductors in series, means for connecting a cource of direct current to one line conductor, a third conductor, a signal receiving device responsive to such direct current traversing the one line and the third conductor in series, a Wheatstone bridge composed of two balanced non-inductive arms and two balanced inductive arms resonant to signaling current, a signal receiving device connected across the bridge between junction points of the inductive and non-inductive arms, a repeating coil inductively connecting the bridge with the one line conductor, means for inductively connecting a source of alternating current with the one line conductor for operating the bridged signal receiving device, and a condenser connected in parallel with the bridged receiving device for rendering this device quick in operating.

3. A signaling system comprising a pair of line conductors, means for connecting a source of signaling current thereto, signaling apparatus responsive to such current

traversing the line conductors in series, means for connecting a source of direct current to one line conductor, a third conductor, a signal receiving device responsive to such direct current traversing the one line and the third conductor in series, a Wheatstone bridge composed of two balanced non-inductive arms and two balanced inductive arms resonant to signaling current, a signal receiving device connected across the bridge between junction points of the inductive and non-inductive arms, a repeating coil inductively connecting the bridge with the one line conductor, means for connecting a source of alternating current with the one line conductor for operating the bridged signal receiving device, a third winding on the repeating coil, and condensers coöperating therewith and with the third and the primary windings of the repeating coil for preventing the direct current from interfering with the proper operation of the bridged signal receiving device.

In witness whereof I hereunto subscribe my name this 4th day of January A. D. 1918.

RAY S. WILBUR.