

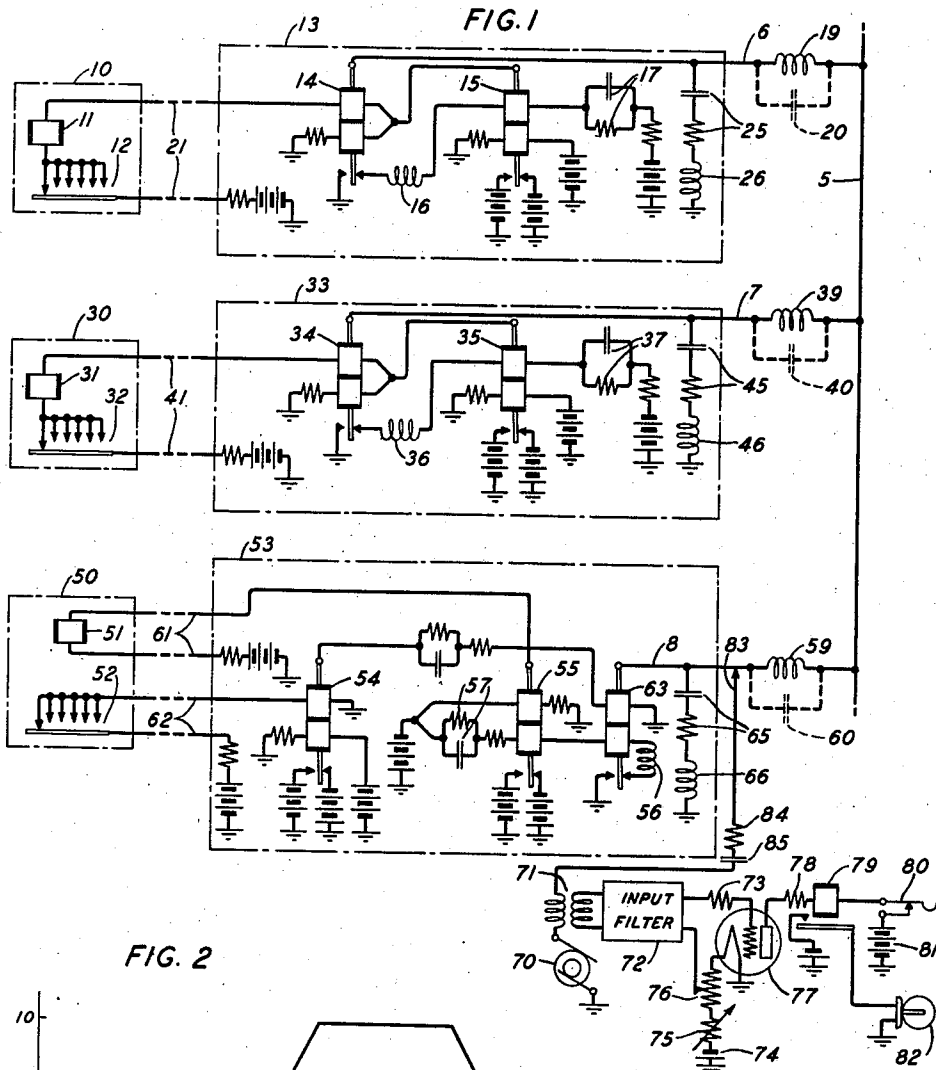
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TELEGRAPH SYSTEM

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TELEGRAPH SYSTEM

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This invention relates to telegraph systems and more particularly to observing transmission over telegraph systems having a plurality of interconnected lines.

Telegraph systems are subject to various types of disturbances which interfere with the transmission of telegraph signals over them such as, for example, stray currents caused by lightning which are frequently referred to as static, stray currents caused by earth potentials or differences in earth potentials between various points of an extended telegraph system, and also stray currents due to switching and interconnecting various lines or sections of a system. Stray currents due to these and other causes produce pulses of sufficient magnitude and duration, at times, to interfere with the transmission of telegraph signaling impulses over the system.

In extended telegraph systems having a plurality of lines or sections extending to widely separated points such disturbances arising in any one of the lines or extensions connected to the system are transmitted to all of the other lines of the system and interfere with transmission of telegraph signals over the entire system. This makes it extremely difficult and highly desirable to locate first the line or section of the system upon which the trouble originates and then locate the source of the interference.

It is an object of this invention to provide an improved arrangement for observing transmission over an extended telegraph system so that the source of extraneous currents may be more readily located.

In previous systems designed for a similar purpose it has been necessary to either provide a special repeater for the lines upon which the source of trouble is believed to originate as, for example, the system disclosed in U. S. Patent 2,104,426. F. S. Kinkead, January 4, 1938, or else to provide an impedance in series with the signaling path or in shunt thereto, or both, to secure sufficient energy to operate certain indicating devices. Certain other systems have been designed which are adapted for use with specific types of telegraph systems, apparatus, and repeaters, as, for example, the system shown in Patent 1,982,022, granted to Reeve, November 27, 1934, but are not adapted for observing transmission over improved interconnecting systems in which each of a plurality of lines is connected to a common line or signaling point to which all or a part of the lines of the system are connected.

It is an object of this invention to provide an

improved telegraph observing system in which the foregoing disadvantages are largely overcome.

Furthermore, the systems described in the prior art such as referred to above, for example, are capable of indicating the origin of extraneous signaling impulses with certainty only during the time the entire system, or at least the portion of the system to which the indicator is connected, is in one of the two possible signaling conditions, usually the marking condition.

A further object of this invention is to provide a transmission observing system for observing the transmission of signaling impulses over an extended communication system which is capable of indicating the origin of false or extraneous signaling impulses during the time either signaling condition is being transmitted over or applied to at least a portion of the transmission network.

A further object of this invention is to provide a transmission observing system which is capable of observing stray or extraneous impulses of the type usually encountered in telegraph systems and which may be of very short duration.

Briefly, in accordance with the preferred embodiment of this invention a source of relatively high frequency as, for example, 10,000 cycles is connected through an indicating device to the particular section or sections of the telegraph system the transmission over which it is desired to observe. Impedance elements are connected in this branch of the system as well as all of the other branches connected to the same electrical point at the central interconnecting station to which the line under observation is connected. These impedance elements are designed to provide sufficient impedance to the high frequency (10,000 cycles in a specific embodiment) to properly control the high frequency currents but they do not have appreciable impedance to the frequencies of the signaling currents which comprise the signaling pulses transmitted over the system so that they do not interfere with the transmission over the system.

A filter circuit is connected between the source of high frequency current and the indicating device to prevent false operation of the indicating device due to the high frequency components of the signaling frequencies which may be generated by the interconnecting and repeating apparatus at the central station.

The foregoing and other objects and features of this invention, the novel features of which are specifically set forth in the claims appended

hereto, may be more readily understood by reference to the following description of one specific embodiment of the invention when read with reference to the attached drawing, in which:

Fig. 1 illustrates a typical multi-line telegraph system to which the invention is connected; and

Fig. 2 shows the general form of the desirable characteristic of the input filter of the indicating device. No attempt, however, has been made to show the exact form or limits of this filter which may be required in any given case.

Fig. 1 shows in detail the features of this invention applied to a typical telegraph system. The line or conductor 5 represents a common point or terminal at a central switching station to which a plurality of lines are connected through their individual repeaters. Three distant telegraph stations 10, 30 and 50 are shown in Fig. 1 connected over lines 21, 41, and 61 and 62, respectively, to a central interconnecting station. At the central station each of these lines is terminated in a repeater equipment 13, 33 and 53 individual to the lines connecting stations 10, 30 and 50 to the central station. Transmitting and receiving equipment is shown at each of the stations 10, 30 and 50; for example, the receiving device is represented by the receiving relay or magnet 11 and the transmitting device is represented by contacts 12 at station 10. Similarly, the receiving device is represented at station 30 by magnet 31 and at station 50 by magnet 51. The transmitting contacts are represented at station 30 by contacts 32 and at station 50 by contacts 52.

Any suitable type of transmitting and receiving equipment may be employed at these stations including all of the local control circuits, apparatus, motors, rectifiers, etc., associated with the telegraph stations of the various types. As shown in Fig. 1, lines 21 and 41 are represented as two conductor lines connecting stations 10 and 30 to the central station and operate in a manner such that signaling impulses may be transmitted in either direction over the line but not in both directions simultaneously. The line or lines connecting station 50 to the repeater 53 at the central station comprises two separate and independent transmission paths comprising lines 61 and 62. Line 61 is employed to transmit impulses from the central station to station 50 while line 62 is employed to transmit impulses from station 50 to the central station. Repeater 53, to which lines or channels 61 and 62 are connected is arranged so that signals can be transmitted through it in only one direction at a time. It is to be understood that the stations and lines shown in Fig. 1 merely represent the typical telegraph stations which it may be desired to interconnect so that messages transmitted from any one of these stations may be received at all of the other stations.

Both the stations and the lines may be of any type suitable for transmitting and receiving telegraph signaling impulses. It is also within the scope of this invention to provide only receiving equipment at certain of the stations and only transmitting equipment at certain other of the stations. These stations may be connected over any of the types of telegraph channels available. For example, the lines may be of the type in which a single conductor is employed with a ground return. They may be of a full metallic telegraph line or a channel in a voice frequency or high frequency carrier telegraph system or they may be a radio channel. Furthermore,

the lines may extend from the switching point for a considerable distance and include more than one type of transmission line or channel. These lines also may include suitable repeating equipment as well as composite sets or filters for enabling the signals to be transmitted over telegraph channels of composited telephone and telegraph lines. The composite lines may be of any type usually employed for the combined transmission of telephone and telegraph signaling currents including so-called composite systems, simplex systems and phantom channels or systems.

Transmission over the various types of lines may be of any of the well-known types of transmission as, for example, transmission of signaling impulses by means of applying impulses of current and no current to the line, impulses of positive current and negative current as well as impulses of varying magnitude of current. The polarities and magnitudes of the impulses may be so related to each other and to the electrical characteristics of the line that variation of the leakage resistance of the line does not add appreciable distortion to the signals or so that variation of conductor resistance of the line does not add appreciable distortion to the signals. The polarities and magnitudes of the impulses transmitted over the line may be also related to each other in any suitable manner. The lines from the outlying stations terminate in repeater equipment at the central station. These repeaters are adapted to both transmit and receive the type of impulses suitable for transmission over the respective lines to which they are connected. These repeaters are also arranged to be connected to a common point.

Repeater 13 is provided with a conductor 6 which extends to the common line or point 5. Repeater 33 has a similar conductor 7 and repeater 53 provided with line 8 extending to the line or terminal 5. In repeater 13 line 6 extends through the contacts of relay 14 which responds to signals received from station 10 and repeats these signals to the common conductor or line 5. Line 6 also extends through the winding of relay 15 and network 17. Relay 15 responds to signals received from line 5 over line 6 and causes them to be repeated to the outlying station 10 over line 21. Similar relays are shown in repeaters 33 and 53. An impedance element 19 is connected in line 6 between line 5 and repeater 13. This impedance element may be of any suitable type to furnish a high impedance to high frequency currents employed in the indicating device as described hereinafter but has negligible impedance to the frequencies of the signaling currents transmitted to and from repeater 13. In the preferred embodiment of this invention an inductance element 19 may be designed to provide these characteristics. If it is desirable, a more complicated network may be provided. For example, if the frequency of the observing device is closer to the frequencies transmitted over the system it may be desirable to connect a condenser, such as condenser 20, in parallel with the impedance element 19 to provide a higher impedance for the frequencies of the observing device. An additional impedance network is usually connected to the transmission circuit to protect the transmitting contacts and to improve the transmission. This network frequently comprises a condenser and resistance illustrated at 25. When such a network is provided it may be necessary to increase the im-

pedance of this network to the high frequency currents as for example by inductance 26. This inductance should not, however, be sufficient to interfere with the effect of the network upon the signaling currents. The impedance of the relay winding and wiring to ground should be considered and included in this impedance. A further impedance element 16 is connected between the contacts of relay 14 and the winding of relay 15. The impedance element 16 tends to impede the flow of the high frequency current without materially affecting the signaling currents similar to the action of element 19 and may assume any of the forms assumed by the element 19. The element 16 should include the impedance in the winding of relay 15 and the impedance network 17 connected thereto. Certain relays may have sufficient impedance in their windings so that a separate element 16 will not be required. However, it is essential that the path from the right-hand contacts of relay 14 to either battery or ground present a high impedance to the current from the indicating device, while providing at telegraphic frequencies the proper impedance for transmission of the signaling impulses.

Similar impedance elements 36, 39, 45, and 46 are connected in line 7 between repeater 33 and line 5 while impedance elements 56, 59, 65, and 66 are connected in line 8 between repeater 53 and line 5 and operate in the same manner and have characteristics similar to impedance elements 16, 19, 25, and 26, respectively, connected in line 6 between line 5 and repeater 13 as described above.

The indicating device comprises a source of high frequency current 70 which is connected through transformer 71 to the line or lines the transmission of which it is desired to observe. The indicator may be connected to any of the wires 6, 7, 8, or any similar wire extending from other channels and connected to conductor 5 or indicators may be connected to two or more channels to observe the transmission over each of them. In this case each indicator responds to only the signaling and interference currents originating on the channel to which it is connected. In the system shown in Fig. 1 source 70 is connected through transformer 71 and conductor 83 to line 8 adjacent repeater 53. A network is connected in series with the primary winding of transformer 71 having a high impedance to the signaling frequency currents but a relatively low impedance to the high frequency currents. Thus the signaling currents are not materially affected by connecting the indicating device and source of high frequency current to any channel of the system. In the embodiment shown in the drawing this network comprises resistance 84 and condenser 85.

The secondary winding of transformer 71 is connected through an input filter 72 to the input circuit of an electron discharge device 77. Curve 90 of Fig. 2 shows the general characteristics of a suitable input filter. Curve 90 is not intended to show the exact form or limits of the filter. It is merely intended to show graphically the three general requirements viz., (1) a voltage step up of about ten for the high frequency current; (2) no material voltage step up for currents of other frequencies outside the pass band; and (3) a relatively narrow frequency pass band.

In the preferred embodiment of this invention the electron discharge device 77 is a gas-filled tube having a control element. As shown in

Fig. 1, tube 77 is provided with three elements. It is to be understood, however, that tube 77 may be provided with additional elements, such as additional grids employed as screens to improve its operation, in a manner well understood in the art.

Tube 77, however, need not be a gas discharge tube of the Thyatron type but may be any suitable three-element high vacuum tube or it may be a multielement high vacuum tube which has four or more elements including screens, suppressor, collector or deflecting elements to improve its operation. In case a high vacuum tube is employed it may be desirable to prolong the discharge through the tube upon the reception of short impulses to insure that the indicating device in the output circuit will have sufficient time to function. Tube 77 shown in Fig. 1 is shown as a filament type of tube. It is to be understood, however, that a heater type of tube may be employed equally well without departing from the scope of this invention.

As shown in Fig. 1 the input circuit of tube 77 comprises the input filter 72, resistance 73 to limit the grid current after a discharge has been initiated through the tube, and a portion of the resistance of potentiometer 76. Grid bias for the tube is obtained by the potential drop caused by the filament current flowing through a portion of the resistance of potentiometer 76 included in the grid circuit. Variable resistance 75 is included in the filament circuit of tube 77 to control the filament current. The output or plate circuit of tube 77 is connected through resistance element 78, winding of relay 79 and key 80 to battery 81. When a discharge is initiated through tube 77 by the application of proper potential to the grid, relay 79 operates and completes an obvious circuit for lighting lamp 82. Since tube 77 will continue to discharge after discharge is once initiated until stopped in some manner other than the removal of the starting potential from the control element, relay 79 will remain operated and cause lamp 82 to remain lighted. When it is desired to extinguish lamp 82, key 80 is operated. This interrupts the output circuit of tube 77 through the winding of relay 79 and thus causes the discharge through tube 77 to be extinguished and relay 79 to release. This in turn extinguishes the lamp 82.

This invention is not limited to the type of output circuit for the discharge device 77 shown in Fig. 1. Any other suitable output circuit may be employed. For example, when desirable, relay 79 and lamp 82 may be dispensed with and the discharges through tube 77 observed.

Suitable switching circuits may be provided to interconnect the various lines and repeaters to the common transmitting point or line 5. In addition, switching equipment may be located out along any of the lines to connect them to any other lines or systems. Switching apparatus of the type suitable for use and systems of the kind set forth herein are well known and operate in their usual manner. Consequently, they need not be described in detail herein.

Normally, with the system and connections established but no signals being transmitted, the various relays are maintained in the position as shown in Fig. 1. The relays 14, 34 and 54, which receive impulses from the lines and repeat them to the common conductor or terminal 5, are maintained in the position shown. Similarly, relays 15, 25 and 55 are maintained in the position shown. The impedance elements 57, 58, re-

lay winding 55 and impedance elements 65 and 66 provide a high impedance to the high frequency current from source 70. Impedance element 59 also provides high impedance to current from the generator 70 into all other parts of the system connected to common conductor 5. The resultant high frequency current through the primary of transformer 71 is so small that the potential applied to the input circuit of the tube 77 through transformer 71 and filter 72 is insufficient to overcome the bias of the input circuit obtained from the potentiometer 76. Consequently, no discharge is initiated through tube 77 so relay 79 remains released and lamp 82 extinguished.

When the signaling impulses are transmitted from station 10, for example, relay 14 will follow these signaling impulses and repeat them to the common conductor or signaling terminal 5. When a spacing pulse is transmitted from station 10, relay 14 is operated to its left-hand position where it connects ground to the common conductor 5 through the impedance element 19. This completes a circuit for the operation of relays 35 and 55 from ground through the left-hand contact and armature of relay 14, lead 6, impedance 19, common point or conductor 5 to battery through the respective leads and relays of repeaters 33 and 53. In the case of repeater 33, the path extends from conductor 5, impedance element 39, lead 7, the armature and right-hand contact of relay 34, impedance 36, relay winding 35 to battery through network 37. A similar path may be traced through repeater 53 from conductor 5, impedance element 59, lead 8, armature and right-hand contacts of relay 63, impedance element 56, windings of relays 63 and 55 to battery through the network 57. Relays 35 and 55 thus follow the signals transmitted from station 10 and repeated by relay 14. These relays, in turn, repeat the signals to stations 30 and 50, respectively. During the transmission of these signals the impedance presented to the high frequency current from source 70 is not altered sufficiently to cause a discharge to be created through tube 77. The impedances of elements 19, 39, and 59 are sufficiently high to the frequency of the current from the source 70 so that the connection of lead 6 to ground due to the operation of relay 14 to its left-hand position does not sufficiently alter the impedance from the lead 8 to ground to cause a discharge to be created through tube 77 during the time transmission is from station 10 to stations 30 and 50.

The operation of indicating device, as well as the transmission, is substantially the same when the transmission is from station 30 to stations 10 and 50, with the exception that relay 34 now follows the signals transmitted from station 30 and repeats them to relays 15 and 55, which relays in turn, repeat the signals to stations 10 and 50, respectively.

During the transmission from stations 10 and 30, as described above, the operation of the respective relays 14 and 34 in response to signals transmitted to them tend to generate high frequency currents which are harmonics of the signaling currents. In order to prevent these higher frequency components of the signaling currents from interfering with the operation of the indicating device an input filter is connected in the input circuit of tube 77. This filter in the preferred embodiment of this invention has a characteristic similar to curve 90 shown in Fig. 2. When a filter having a characteristic of this type

is connected in the input circuit, it, together with the bias applied in the input circuit by potentiometer 76, prevents discharges through tube 77 due to the transmission from stations 10 and 30 but will permit or cause a discharge to be initiated when the transmission is from station 50 as described herein.

Transmission of the signaling impulses over the system is substantially the same when the transmission is from station 50 in that relay 54 follows the signals transmitted from station 50 and repeats them to relay 63 which relay in turn repeats them to relays 15 and 35, and relays 15 and 35 repeat the signals to stations 10 and 30.

In this case, however, when relay 63 moves to its left-hand position it connects ground to lead 8 and thus also to lead 83 which is connected to lead 8. This causes considerable high frequency current to flow from source 70 through transformer 71, lead 83, lead 8, armature and left-hand contact of relay 63 to ground. This current causes a sufficient potential to be applied to the input circuit of tube 77 through the transformer 71 and filter 72 to overcome the bias supplied by the potentiometer 76 to tube 77 and thus initiates a discharge through this tube. When a discharge is initiated through tube 77, a circuit is completed for the operation of relay 79 which, in turn, completes the obvious circuit for lighting lamp 82. The attendant, upon observing lighted lamp 82, will operate key 80. The operation of key 80 interrupts the output circuit of tube 77 and thus extinguishes the tube. The attendant will then release key 80 and, if transmission is still from station 50, tube 77 will again be lighted. This will indicate that the transmission is from station 50 at this time.

Assume now that transmission is from, say, line 10, during which time no discharges are normally created through tube 77, as described above. If now any pulses are received over line 62 from station 50, relay 63 will be operated to its left-hand position, thus causing sufficient high frequency current to flow from source 70 to initiate a discharge through tube 77. When the attendant pushes key 80 and releases it under these circumstances, lamp 82 will remain extinguished, thus indicating that extraneous signals or pulses of some nature are being received from the line extended to station 50. It should be noted that the operation of tube 77 is controlled by the condition of relay 63 and is independent of the potentials applied to lead 5 at any other place. Hence, the system is capable of indicating the arrival of false or extraneous signaling impulses from station 50 when ground is connected to line 5 and any other point as well as when battery is connected to line 5 at other points.

In the specific embodiment of this invention shown in the drawing, only one indicating device has been shown and this device is shown connected to conductor 8. This device could be connected to either conductor 6 or 7 or other similar conductors connected to the common terminal 5. In this case the device would be responsive to only the signals and interference arising on the line or channel to which it is connected. Furthermore, additional indicators like or similar to the indicator shown connected to conductor 8 may be connected to conductors 6 and 7 if it is desired to observe the transmission over the associated channels.

In the embodiment shown in the drawing, high frequency impedances have been shown con-

nected in the circuit of each conductor connected to the common terminal 5. With this arrangement indicators may be readily connected to any channel of the system or switched from channel to channel. However, the indication device will work equally well if the high frequency impedances are connected in only to the conductor associated with the channel to which the indicator is connected.

What is claimed is:

1. In a telegraph system comprising a plurality of telegraph channels having an operative connection between them, an indicating device, a source of alternating current having a sustained high fundamental frequency connected to one of said channels, impedance elements connected in said operative connection for controlling said high frequency current in accordance with at least certain of the signaling conditions applied to said telegraph system, and means for controlling said indicating device by said high frequency current.

2. In a telegraph system comprising a plurality of telegraph channels, a single interconnecting terminal and an operative connection from each of said channels to said terminal for transmitting impulses to and receiving impulses therefrom, a transmission observing device comprising a source of alternating current having a sustained high fundamental frequency the frequency of which is independent of signalling currents, impedance elements for controlling said high frequency current in accordance with the signaling conditions applied to said telegraph channels connected in each of said operative connections from each of said channels to said terminal which present a high impedance to said high frequency current but substantially no impedance to telegraph currents, and means for controlling said indicating devices by said high frequency current.

3. An indicating device comprising a source of alternating current having a sustained high frequency component which frequency is independent of the signaling currents, impedance elements having a high impedance to said source connected thereto, means for connecting said impedance elements in at least one of a plurality of communication channels of a signaling system, and means for reducing the impedance to said high frequency component only when signals originate on one of said channels.

4. In a telegraph system comprising a line, an indicating device for indicating the origin of signals and stray interference currents on said line comprising a source of alternating current having a sustained high frequency component, an indicating device responsive to said high frequency component and an operative connection between said line, high frequency source, and said device for controlling said device in accordance with signals and interference received from said line.

5. An indicating device for indicating the origin of signaling and interference currents on a signaling line comprising a source of alternating current having a sustained high frequency component adapted to be connected to a signaling line, an indicating device including an electron discharge device, a signaling line, an impedance element having high impedance to said high frequency current but low impedance to signaling currents connected to said line, operative connections between said high frequency

current source, indicating device, signaling line, and impedance elements for controlling said indicating device in accordance with signals received over said line.

6. An indicating arrangement adapted to be connected to a signaling path for indicating the origination of signals and interference currents on the path to which the arrangement is connected independently of the signaling condition being applied to at least a portion of said path comprising a source of alternating current having a sustained high frequency component, the frequency of which is independent of signaling currents adapted to be connected to a signaling path, an indicating device, means for controlling said device by said high frequency current, and impedance elements connected in said path for controlling said high frequency current in accordance with the signals and interference received from said path.

7. In a signaling system comprising a plurality of channels, a single interconnecting terminal and an operative connection from each of said channels to said terminal for repeating pulses between the respective channels and said terminal, an indicating device comprising a source of alternating current having a sustained high frequency component connected to at least one of said connections, impedance elements connected in at least said one operative connection having high impedances to said high frequency currents and a low impedance to signaling pulses.

8. In a telegraph system comprising a plurality of telegraph channels, a single interconnecting terminal and an operative connection from each of said channels to said terminal for repeating pulses between the respective channels and said terminal, a plurality of transmission observing devices controlled by high frequency current each connected to one of said plurality of connections, a source of alternating current having a sustained high frequency component connected to said indicating devices, impedance elements connected in each of said operative connections which have a high impedance to said high frequency current and low impedance to telegraph pulses, and means responsive to the potential applied to any channel or said plurality of channels to increase the flow of said high frequency current through the respective indicating device.

9. In a telegraph system including a plurality of telegraph lines provided with a telegraph signaling transmission path between them, an indicating device for indicating the origin of signaling and interference currents, a source of alternating current having a sustained high frequency component, impedance elements having a high impedance to said high frequency current and a low impedance to signaling currents connected in said system, an operating connection extending from said high frequency source through said indicating device to one of said transmission paths, a signal responsive apparatus responsive solely to signals received over said path for changing the flow of high frequency current through said indicating device.

10. In a telegraph system comprising a plurality of telegraph lines subject to interfering currents provided with a common signaling path and transmission paths between said common signaling path and each of said lines, an indicating device connectable to any of said lines for indicating the origin of signals and interference currents thereupon including a source of alter-

nating current having a sustained high fundamental frequency component, an indicating device responsive to said high frequency current, impedance elements having a high impedance to said high frequency current and a low impedance to signaling currents connected in said transmission paths for normally preventing the flow of said high frequency current but permitting the flow of signaling currents, signal responsive apparatus connected with the path with which said indicating device is connected for increasing the flow of high frequency current from said source through said indicating device only in response to signals and interfering currents received from the line with which said indicating device is connected.

11. In a telegraph system, comprising a plurality of paths for the transmission of telegraph signaling currents subject to interfering currents and a common transmission path with transmission paths between said common path and each of said plurality of paths, an indicating device connectable to any of said plurality of paths for indicating the origin of signals and interference currents thereupon including a source of alternating current having a sustained high frequency component, an indicating device responsive to said high frequency component, impedance elements having a high impedance to said high frequency component and a low impedance to signaling currents connected in said paths for controlling the flow of said high frequency component without interfering with the signaling

currents, a control device responsive to signaling currents received from said path for transmitting signaling currents to said common path and simultaneously changing the flow of said high frequency component through said indicating device.

12. In combination, in a system in which transmission is accomplished by impulses of current traversing the system, said system having different sources for originating said impulses, a transmission path connected therebetween, one part of said path being separated from another part of said path by impedance means of low impedance to said impulses and of high impedance to current of a definite frequency range widely different from said impulses and harmonic components inherent therein, an indicating device connected to said path on one side of said impedance means in circuit relation to a source of alternating current having a frequency within said range by electrical transducing means whereby the potential of said alternating current is applied to said device, elements in said system limiting the application of said alternating voltage to said device to an ineffective value when impulses are proceeding into the section to which said device is connected but increasing the voltage applied to said device when impulses originate in the section to which said device is connected to a value effective to actuate said device to produce an indication.

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