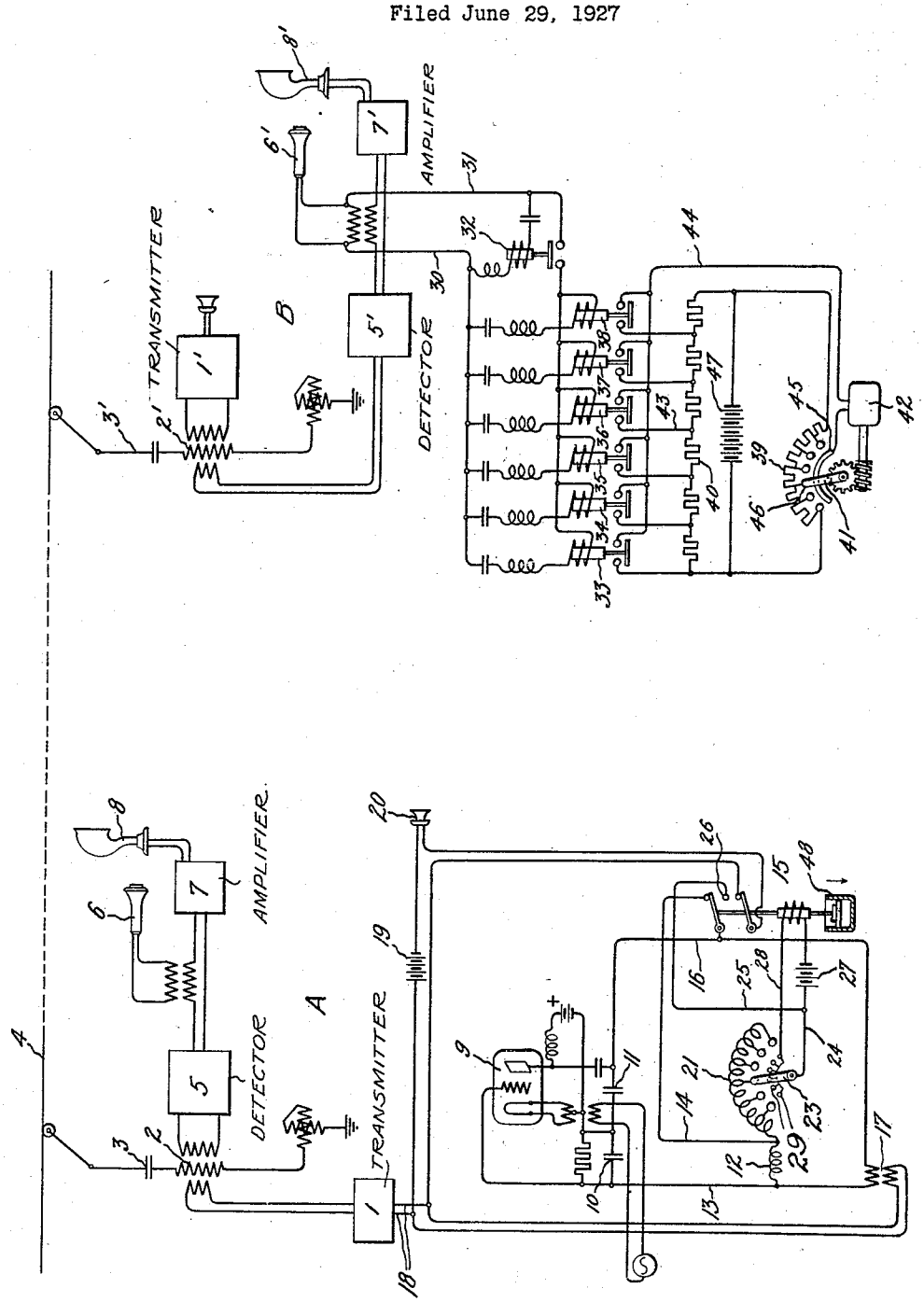
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SIGNAL AND CONTROL SYSTEM

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SIGNAL AND CONTROL SYSTEM

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My invention relates to signal and control systems and more particularly to such systems as applied to communication and control between different train units of a single train, or between different trains, or between a stationary point and a moving vehicle. Still more particularly my invention is primarily concerned with signal and control systems for operation between a leading, or master locomotive of a train and other locomotives of the same train.

In present day railway practice it is very frequent that freight trains are a mile or more in length, thereby necessitating the use of a number of locomotives. For practical reasons it is desirable that the tractive effort of these locomotives be distributed along the length of the train as evenly as possible, i. e. that a plurality of small locomotives distributed along the length of the train be used in contra-distinction to the use of locomotives of large capacity located at the ends of the train or in a manner such that their effort is concentrated at a comparatively few points in the train. It is likewise desirable, in the interest of efficiency and safety, where a plurality of locomotives are used, that the functioning of all the different locomotives should be suitably coordinated, or that all of the various locomotives be controlled by a single operator.

One of the purposes of my invention is to provide means whereby the functioning of a number of locomotives may be controlled from a single master, or leading, locomotive of the train by means of high frequency currents, such as are employed in the usual high frequency communication system. Another purpose of my invention is to provide means such that a single high frequency channel may be employed for communication between different units, or different locomotives of a train and for control of either signal or power functions on the various units or locomotives. A further purpose is to provide means whereby these objects may be accomplished in a reliable and satisfactory manner and with a minimum of equipment.

I contemplate by my invention the use, between different units of a train, or between different trains, of a high frequency communication system, such as that employed either in radio communication or in connection with communication by means of carrier currents transmitted over the lines of the usual power distribution system. In connection therewith I contemplate means whereby the high frequency currents of such a system may be modulated by means of currents, the frequencies of which are determined in accordance with the power or signaling function which is to be performed upon a remote locomotive, or train unit, and means upon the different locomotives or train units operable responsively to the frequency of said modulating currents to perform the desired signal or power function.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawing, which represents one embodiment of my invention.

With reference to the drawing, at A is illustrated the equipment which is provided upon the master locomotive of a train and at B the equipment which is provided upon any of the subsidiary or "pusher" locomotives which may be distributed uniformly throughout the length of the train. This equipment may likewise be located upon any part of the train, or on a separate train or at any point where signal or power functions are to be controlled. The equipment located upon the master locomotive A includes a transmitter 1 of high frequency current such as is employed in the usual radio or carrier current communication system. This transmitter is adapted to supply high frequency currents through the transformer 2 and appropriate coupling circuit 3 to a suitable conductor 4 leading to the other locomotives of the train. In the case of electric railways the conductor 4 may comprise the usual trolley wire located above the train, or in the case of steam railways it may comprise the rails, or special

wires provided for the purpose either upon the train or located upon poles along the track. If desired the conductor 4 may be replaced by suitable antennæ located upon each of the various train units whereby the contemplated communication and control may be effected by space radio. Associated with the transformer 2, which may be of the usual three winding type, is an appropriate detector or demodulator 5, which is adapted to respond to received high frequency currents and to supply audio currents to a receiver 6, or if desired, through audio amplifiers 7 to either a visible or audible signaling device 8.

Likewise the equipment of the locomotive B includes a transformer 1′ which is adapted to supply high frequency currents through the output transformer 2′ and coupling circuit 3′ to the conductor 4 for communication from unit B to unit A. Associated with the transformer 2′ is a detector 5′ which serves to demodulate the received high frequency waves and supply audio currents to the telephone receiver 6′ and through audio amplifiers 7′ to the visible or audible signaling device 8′. The devices 8 and 8′ may be used for calling purposes and may be adapted to be disconnected from circuit when the operator lifts his receiver in response to a call.

As thus far described the system comprises substantially the apparatus used in connection with the usual high frequency radio or carrier current communication system. In connection with the apparatus on the locomotive A, I contemplate a source of alternating current having frequencies which are variable within the voice range and means whereby the output from the transmitter 1 may be modulated by means of these currents having definite frequencies determined in accordance with the operation which is to be performed upon a remote train unit. Likewise I contemplate means whereby the usual voice modulating means which comprises a part of the usual high frequency communication system may be rendered inoperative during periods when control frequencies are being transmitted and is again rendered operative after these currents have been transmitted during a time interval sufficient to permit the operation of the apparatus on the remote train units to perform the desired function. As a source of such alternating currents an electron discharge device 9 is provided having the usual oscillation circuit comprising the condensers 10 and 11 which are connected in series between the anode and the grid of the discharge device 9 and in parallel with an inductance 12 through a conductor 13, inductance 12, conductor 14, upper movable contact of the relay 15 and conductor 16. Connected to this oscillatory circuit through the conductors 13 and 16 is the primary winding of the output transformer 17, the secondary winding of which is connected to the modulating circuit 18 of the transmitter 1. In parallel with the secondary winding of the transformer 17 is a voice modulating circuit including a source of direct current potential 19, a transmitter 20 and the lower movable contact of the relay 15.

With the relay 15 in the position shown in the drawing the oscillation generator 9 is connected to supply currents having a frequency determined by the inductance 12 to the modulating circuit of the transmitter 1. These currents, for a purpose later to be set forth, are high in the audio range and are of a frequency which I term the base frequency of the oscillation generator. 21 represents an inductance which is divided into sections and which is adapted to be connected in series with the inductance 12 by a circuit including conductor 14, inductance 21, control arm 23, conductor 24, conductor 25, contact 26, upper movable contact of the relay 15, conductor 16, condensers 11 and 10 and conductor 13. The arrangement is such that when the relay 15 is in its upper position the inductance 12 determines the frequency of the oscillation generator, whereas with the relay 15 in the lower position the inductance 12 plus those sections of the inductance 21 between the conductor 14 and the movable arm 23 determine the frequency of the oscillation generator. The relay 15 is adapted to be operated responsively to adjustment of the control handle 23 upon the inductance 21 by means of an energizing circuit including the control handle 23, conductor 24, source of potential 27, actuating coil of the relay 15, conductor 28, and one of the contacts 29.

Associated with the output circuit of the demodulating device 5′ is a telephone receiver 6′, and through conductors 30 and 31, a tuned relay 32. When this relay is deenergized or in its closed position it connects a plurality of tuned relays 33, 34, 35, 36, 37, 38 in circuit with the conductors 30 and 31. Each of these relays is adapted to respond to currents of a frequency determined by the inductance 21 when the control handle 23 is in any of its various positions as, for example, when arm 23 is on the first contact at the left relay 33 will respond, when it is on the second contact relay 34 will respond, etc. These relays are adapted when operated to disturb the balance of a Wheatstone bridge comprising resistances 39, 40 and source of potential 47, the operation and details of which will later be described. The arm 41, which cooperates with the resistance 39 and which is driven into its various positions by means of an electro-responsive device 42 through suitable gearing mechanism, may be that of the usual locomotive controller situated upon the locomotive B, or that of any

suitable control device for effecting different signal or control operations in its different positions.

The operation of my device is as follows: With the arm 23 in the position shown in the drawing, it will be noted that the circuit of the actuating coil of the relay 15 is closed and that relay 15 is retained in its upper position thereby. In this position, by means of its lower movable contact, the voice modulating circuit including the microphone 20 is closed and operative, and by means of its upper movable contact the inductance 12 is connected into the oscillatory circuit of the oscillation generator 9 and the inductance 21 is disconnected. The oscillation generator 9 then operates at a base frequency which is caused to modulate the output currents of the transmitter 1, these currents in turn being transmitted to the demodulating device 5′ on the locomotive B. Simultaneously therewith voice currents may originate in the circuit including the source 19 and microphone 20 as caused by the operator speaking into the latter. These currents will likewise be impressed upon the modulation circuit of the transmitter 1 and will consequently be transmitted to the demodulating device 5′. Thus in the output circuit of the demodulating device 5′ will appear both voice currents and currents of the so-called base frequency. These currents of base frequency are sufficiently high in the audio range to prevent undue interference in the receiver 6′ with ordinary telephone conversation. If desired suitable low pass filters may be included in the circuits of devices 6′ and 8′ to further prevent interference from these currents. The relay 32 is adapted to respond to currents of this base frequency and to be retained thereby in its open position, thereby disconnecting the relays 33 to 38 from the output of the demodulating device 5′. Consequently voice frequencies may appear in the output circuit of the device 5′ without affecting any of the relays 33 to 38, and ordinary telephone communication may be carried on.

If it be assumed that the arm 23 be moved to the right, for example to the next adjacent contact, the circuit of the actuating coil of the relay 15 will be interrupted during the time in which the arm 23 is disengaged from either of the two successive contacts 29. Upon being deenergized the relay 15 immediately drops to its lower position, thereby, by means of its lower movable contact, opening the voice modulation circuit and by means of its upper movable contact and its stationary contact 26 connecting four sections of the inductance 21 into the oscillatory circuit of the generator 9. As soon as the arm 23 reaches its next contact the output circuit of the transmitter 1 will be modulated by a frequency determined by the inductance 12 plus four sections of inductance 21 and the relay 15 will again be energized but will be retained in its lower position by the time delay device 48 until the equipment B has had time to operate responsively to the new frequency. Since this new frequency is below the base frequency, which is not at this time transmitted, the relay 32 will be deenergized and will, therefore, fall to its lower position completing the circuit of the tuned relays 32 to 38. The relay 36, for example, will operate responsively to this frequency to connect the electro-responsive device 42 in a circuit leading through conductor 43, contacts of the relay 36, conductor 44, electro-responsive device 42, contact 45, control arm 41, to the contact 46 on the resistance 39. It will be noticed that the resistances 40 and 39 are connected in parallel across a source of potential 47 and that each of these resistances is divided into a number of sections depending upon the number of different control frequencies which are to be transmitted. The electro-responsive device 42 is connected in a circuit which may extend from any contact on resistance 39 through the contacts of any relay 33 to 38 to a corresponding point on resistance 40, this constituting the galvanometer circuit of the Wheatstone bridge arrangement. Upon operation of relay 36 the balance of the bridge will be disturbed and currents will flow through the electro-responsive device 42 in a direction to cause it to operate the arm 41 to the right until it engages the next contact when the balance will again be restored leaving the arm 41 in its new position. Thus the arm 41 is automatically caused to assume a position corresponding to the position of the arm 23 in response to the different control frequencies transmitted thereto.

Thus, for example, if the arm 23 comprises the controller handle of the master, or leading, locomotive and the arm 41 that of the "pusher" locomotives, there being several, it will be seen that all of the controllers of the different locomotives will be operated responsively to the position of the controller in the master locomotive and that the functioning of these locomotives will be coordinated. As as consequence the complete control of all of the various locomotives will be in the hands of the operator of the master locomotive who merely operates the one controller handle as he would do were he controlling but the one locomotive.

While such operation is contemplated by my invention it will of course be understood that I do not wish to be limited thereto, since this controller may be operated entirely independently of the power functions of the locomotive as, for example, for signaling purposes only. In the latter case, if desired, the controller 41 may be dispensed with altogether and the individual signaling cir-

cuits may be caused to be energized directly in response to the relays 33 to 38.

Likewise while I have described my invention with particular reference to its use between different locomotives or different units of the same train it will, of course, be understood that it will be equally applicable between separate trains between stationary points, or between stationary points and moving trains or vehicles. In the latter connection an application particularly contemplated is the use of my invention for moving locomotives about in classification yards. The equipment A may then be located in a signal tower from which, by selective use of carrier frequencies, any locomotive within the transmitting range of the equipment may be moved as desired.

While I have shown and described a particular embodiment of the invention, it will of course be understood that I do not wish to be limited thereto since many modifications both in the circuit arrangement and in the instrumetalities employed may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In a signal and control system, the combination with a source of high frequency oscillations of means for modulating the output from said source with voice currents, means for selectively modulating the output from said source with control currents having any one of a plurality of frequencies determined in accordance with the operation to be controlled, means for detecting said voice and control currents, a receiver for said voice currents and means responsive to the frequency of said control currents for controlling said operation.

2. In a signal and control system, the combination with a high frequency transmitter, of means for modulating the output from said transmitter with voice currents, means for selectively modulating the output from said transmitter with control currents having any one of a plurality of frequencies determined in accordance with the operation to be controlled and for interruptig the operation of said voice modulating means, means for detecting said currents, means responsive to said voice currents and means responsive to the frequency of said control currents for controlling said operation.

3. In a signal and control system, the combiation with a high frequency transmitter, of means for modulating the output from said transmitter with either voice currents or control currents, said voice current modulating means being inoperative during periods of control current modulation, and said control current having any one of a plurality of frequencies determined in accordance with the operation to be controlled, means for demodulating the ouptut from said transmitter and means responsive to said control currents for controlling said operation.

4. In a signal and control system, the combination with a transmitter of high frequency currents of means for modulating the output from said transmitter with voice currents, means for modulating the output from said transmitter with control currents having any one of a plurality of frequencies determined in accordance with the operation to be controlled, means for rendering said voice modulating means inoperative during periods of control current modulation, demodulating means for said high frequency currents and means responsive to the frequency of said control currents for controlling said operation.

5. In a signal and control system, the combination with a transmitter of high frequency currents, of means for modulating the output from said transmitter with voice currents, means for modulating the output from said transmitter with control currents the frequency of said control currents being within the voice range and determined in accordance with the operation to be controlled, means for rendering said voice modulating means inoperative during periods of control current modulation, demodulating means for said high frequency currents, means responsive to the frequency of said control currents for controlling said operations, and means whereby said control current responsive means is rendered unresponsive to voice currents.

6. In a signal and control system, the combination with a transmitter of high frequency current, of means for modulating the output from said transmitter with voice currents, control currents and currents of a base frequency, demodulating means for said high frequency currents, means responsive to said voice currents, means responsive to said control currents and means responsive to currents of said base frequency for rendering said control current responsive means unresponsive to said voice currents.

7. In a signal and control system the combination with a high frequency transmitter, of means for alternately modulating the output from said transmitter with control currents having frequencies within the voice range and with currents of a base frequency, means for modulating the output from said transmitter with voice currents simultaneously with said modulation with currents of said base frequency, detecting means for said currents, means responsive to said voice currents, means responsive to said control currents and means responsive to currents of said base frequency for rendering said control current responsive means unresponsive to voice currents.

8. In a signal and control system, the com-

bination with a high frequency transmitter, means for modulating the output from said transmitter with voice currents and with control currents having frequencies within the voice range, detecting means adapted to be supplied with currents from said transmitter, means responsive to said voice currents, means responsive to said control currents and additional means for rendering said control current responsive means unresponsive to said voice currents.

9. In a signal and control system, the combination with a transmitter of high frequency current, of means for modulating the output from said transmitter with voice currents, additional means for modulating the output from said transmitter including an oscillation generator adapted to be connected to generate a base frequency and a plurality of control frequencies, means whereby said voice modulating means is rendered inoperative when said generator is connected to generate control frequencies and operative when said generator is connected to generate currents of said base frequency, demodulating means for said high frequency currents, means responsive to said voice currents, means responsive to said control frequencies and means responsive to said base frequency for rendering said control frequency responsive means unresponsive to said voice currents.

10. In a signal and control system, the combination with a transmitter of high frequency currents, of means for modulating said high frequency currents with voice currents, additional means for modulating said high frequency currents including an oscillation generator normally connected to operate at a base frequency and adapted to be adjusted to operate at a plurality of control frequencies, switching means adapted in response to an adjustment of the frequency of said oscillation generator to render said voice modulating means inoperative and to connect said oscillation generator to operate at one of said control frequencies, demodulating means for said high frequency currents and means associated therewith operable responsively to said modulating currents.

11. In a signal and control system, the combination with a transmitter of high frequency currents, of means for modulating said high frequency currents with voice currents, additional means for modulating said high frequency currents including an oscillation generator adapted to be adjusted to operate at a base frequency and a plurality of control frequencies, switching means adapted to connect said generator to operate at said base frequency and to establish an operative connection for said voice modulating means, said switching means being adapted in response to an adjustment of the frequency of said oscillation generator to interrupt said connections and to connect said generator to operate at the adjusted frequency, means including a time element for restoring said switching means to its initial position, demodulating means for the output of said transmitter and control means associated therewith operable responsively to said modulating currents.

12. In a signal and control system, a transmitter of high frequency currents, means for modulating said high frequency currents with voice currents and with control currents of a plurality of frequencies, means for demodulating said high frequency currents, a plurality of tuned relays each of said relays being adapted to respond to control currents of a different frequency and means whereby said tuned relays are rendered unresponsive to voice currents.

13. In a signal and control system, a transmitter of high frequency currents, means for modulating said high frequency currents with voice currents, control currents of frequencies within the voice range and currents of a base frequency, means for detecting said modulating currents, a plurality of tuned relays each of said relays being adapted to respond to control currents of a certain frequency and means responsive to currents of said base frequency for rendering said relays unresponsive to said voice currents.

14. In combination, a high frequency transmitter, means for modulating the output currents produced by said transmitter with voice currents, means operable selectively to modulate currents produced by said transmitter with control currents having one of a plurality of frequencies, and means responsive to operation of said last means to select a frequency for rendering the voice modulating means inoperative for a predetermined interval and thereafter for automatically interrupting modulation of said output current by control current of said selected frequency.

15. In combination, a high frequency transmitter, means for modulating the output currents produced by said transmitter with voice currents, means operable selectively to modulate currents produced by said transmitter with control currents having one of a plurality of frequencies, and means responsive to operation of said last means to select a frequency for rendering the voice modulating means inoperative for a predetermined interval, for modulating said output currents during said interval with control current of selected frequency and for thereafter rendering said voice modulating means operative.

In witness whereof, I have hereunto set my hand this 27th day of June, 1927.

FELIX KONN.