

Aug. 9, 1932.

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RADIOCONTROL SYSTEM
Filed May 20, 1926

1,870,832

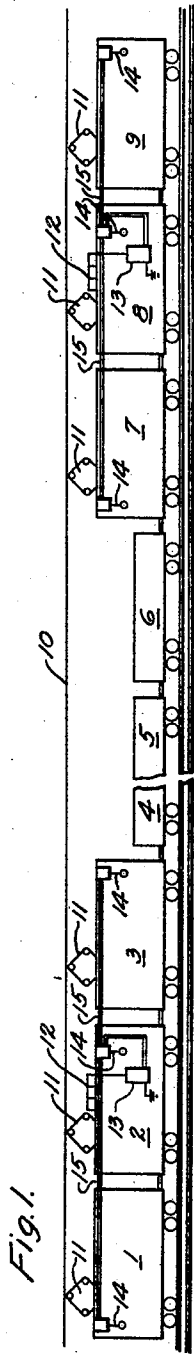


Fig. 1.

WITNESSES:

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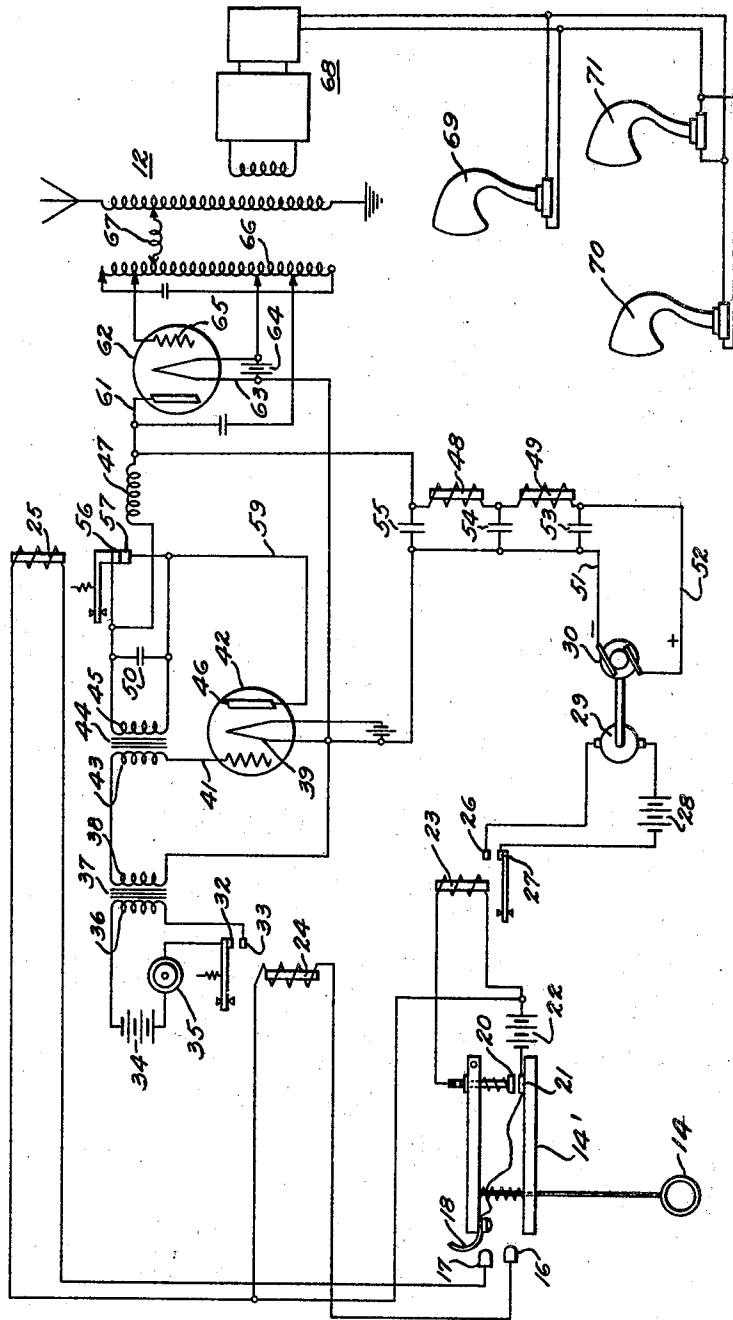


Fig. 2.

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RADIOCONTROL SYSTEM

Application filed May 20, 1926. Serial No. 110,363.

My invention relates to systems of communication, and it has particular reference to systems applicable to communication between the vehicles of a movable train.

5 Generally, when hauling heavy trains by electric locomotives it has been found necessary to use a plurality of propulsion units, placing one or more at the head of the train and one or more at the rear.

10 Some freight trains often attain a length of one mile or more, and it is apparent that reliable means of communication between the front locomotives and those at the rear is a matter of extreme importance in order to secure synchronous action in starting and stop-
15 ping. It has been the custom in steam railway work to signal by means of the steam whistles carried by the engines. This practice is fairly reliable if other noise does not interfere. The
20 air whistles used on electric locomotives, however, cannot be heard satisfactorily at any great distance, or through tunnels. It is, of course possible to provide a direct electrical connection between the front and rear and to
25 operate some type of a signalling system, either telephonic, telegraphic, or the like. These means of communication, however, fail when the train breaks into sections and it is at such times that uninterrupted communication between the various component parts of
30 the train is of vital importance.

It is, accordingly an object of my invention to provide a communication system, particularly adaptable for use on trains equipped
35 with electric locomotives.

Another object of my invention is to provide a simple and easily operated system of communication between the vehicles comprising a train.

40 Another object is to provide a system of communication which will not be hampered by reason of the train breaking into sections.

Still another object of my invention is to
45 provide a train signalling system which may be operated from any portion of the train and which will convey intelligence between the men in charge of each propulsion unit thereof.

50 I attain these objects, and others of a more

specific nature which will be clearly explained, in the following manner.

In each of the propulsion units, I install a radio transmitter and receiver. An antenna
55 fed by the transmitter is arranged on top of the cab at a distance approximately three or four feet below the trolley wire, which is used as a radiant energy guiding channel between the front and rear ends of the train. The transmitter and the receiver may be
60 mounted in steel boxes rigidly built to withstand vibrations. A motor generator, driven either from a storage battery or from the source of power operating the locomotive, furnishes the high voltage for the plate
65 supply to the transmitting tubes. Other current needs are supplied by suitable storage batteries.

The receiver may be the ordinary detector-amplifier system, the tuning of which is usually
70 set and remains fixed, but which may be variable.

I prefer to so arrange the equipment associated with the transmitter that either signals of the usual type may be sent, or the output of the transmitter may be modulated by
75 a microphone, enabling voice communication between various portions of the train. To accomplish this result, a small control box, which is attached to the ceiling of the locomotive cab, contains a switch device equipped with a plurality of contact members. These
80 contact members control relays adapted to close or open the circuits involved in either code signaling or voice transmission. To this
85 switch is attached a cord that hangs within easy reach of the engineer in charge of the locomotive and which takes the place of the whistle cord to which he has become accustomed.

90 When the engineer desires to signal, he pulls the signal rope half-way from the control box. This starts a motor-generator which energizes an oscillation generator, sending high-frequency current over the trolley
95 wires. He then pulls the signal rope further which closes contact members controlling an audio-frequency modulator coupled to the oscillation generator. By slightly lessening the pull on the rope, the modulator is
100

rendered inactive, and in this manner code signals may be radiated. In order to communicate by voice, the engineer first sends an agreed-upon code signal and then pulls the
 5 cord all the way down which breaks the audio-frequency modulator circuit and connects a microphone in circuit instead.

The microphone and attendant circuits may be dispensed with, if desired, signals in
 10 that case being sent by code only. The signal being sent by one engineer is also heard by him, inasmuch as his receiving set is at all times kept in an operative state and is coupled to the trolley wire in the same manner as is
 15 the receiving set of the engineer at the other end of the train. This is advantageous, as it enables each engineer to know exactly what signals he is sending out.

Referring now to the drawing and the following description, from which a more complete understanding of my invention may be
 20 had,

Figure 1 is a diagrammatic elevational view of a train equipped with apparatus according to my invention.

Fig. 2 is a diagrammatic view of the circuits and apparatus involved.

Referring specifically to Fig. 1, a plurality of electric locomotives 1, 2 and 3 are coupled together forming one propulsion unit which may be either at the front or rear end of a train, composed of a plurality of cars 4, 5 and 6. At the other end of the train is a similar propulsion unit comprising a plurality of
 35 electric locomotives 7, 8 and 9. Each of these locomotives draws current from the trolley wire 10 through a pantograph 11. One locomotive of each group of three is equipped with an antenna 12 and a transmitter 13.
 40 Each locomotive is equipped with a signaling cord and switch 14 and the control circuits between the locomotives are carried by a conduit 15.

The functions of the various pieces of apparatus indicated in Fig. 1 will be more clearly brought out later in the description, this figure showing merely the relation between the locomotives, the train, the trolley wire, the antennae, and the radio transmitters.

50 Referring specifically to Fig. 2, a switching arrangement 14' having an actuating means 14 is provided with a plurality of contact members 16, 17, 18, 20 and 21. A battery 22 is provided, included in circuit with which
 55 are a plurality of relays 23, 24 and 25. The relay 23 has a plurality of contact members 26 and 27 which serve to open or close a circuit comprising a battery 28 and a motor 29. Mechanically coupled to this motor 29 is a
 60 direct-current generator 30 for supplying plate voltage to the thermionic tubes.

The relay 24 has two contact members 32 and 33 which serve to make and break a circuit through a battery 34, microphone 35 and
 65 a primary winding 36 of an input transformer

37. The secondary 38 of this input transformer is connected between the filament 39 and the grid 41 of a thermionic modulator tube 42. In series in this input circuit comprising the secondary 38 is a primary winding
 70 43 of a second transformer 44, the secondary 45 of which is connected in series between the plate 46 and the source of direct current 30, and may be shunted by condenser 50. Included in the circuit connections between the
 75 plate 46 and the source 30 is a radio frequency choke coil 47 and a plurality of choking inductances 48 and 49. Shunted across between the leads 51 and 52 from the source 30 are a plurality of by-pass condensers 53,
 80 54 and 55.

The relay 25 has contact members 56 and 57 which, in their normal position short circuit the winding 45. The plate 46 of the modulator tube is conductively coupled
 85 through a lead 59, the primary 45, and the choke coil 47 to the plate 61 of a thermionic oscillator tube 62. The oscillator tube 62 is provided with a filament 63, a source of filament potential 64, a grid 65, and a combined input-output inductor 66 so arranged
 90 that continuous oscillations may be maintained therein. Any well known thermionic oscillation generator may be substituted for the type I have illustrated, as this forms no part of my invention. The oscillation generator is coupled to the antenna 12 either by means of a choke 67, a condenser (not shown),
 95 or in some other well known manner.

Also coupled to the antenna 12 is a detector-amplifier system 68, the output of which may actuate a plurality of loud speakers 69,
 70 70 and 71, located wherever expedient, but usually in proximity to the signal cords 14.

Having now described the apparatus and circuits involved in my invention, the manner and sequence of its operation will be explained.

As shown in Fig. 1, the antennae of the various transmitters are placed in close proximity to the trolley wire or wires from which the locomotives derive current. Assuming that it is desired to send a signal from one end of the train to the other, the engineer or other person desiring to signal, first ascertains that the tube filaments in both transmitting and receiving sets are energized. He next grasps the signal cord 14 and pulls slightly thereon. This slight pull on the element 14 causes the contact members 20 and
 110 21 to close. Tracing the circuit from contact member 21 through battery 22 and relay 23 back to contact member 20, it is thus seen that the contact members 26 and 27 will be closed upon the energizing of the relay 23. The
 115 motor 29 is accordingly energized by the battery 28 and the generator 30 is set in motion to supply high potential current for the modulator and oscillator tubes. The supplying of this plate voltage causes oscillations to be
 120 125 130

set up in the output circuit of the tube 62, which oscillations are conveyed to the antenna 12.

The set is now in readiness for signalling, which is accomplished by a further pull on the cord 14, causing contact members 17 and 18 to close. The closing of these contacts energizes a circuit which may be traced through contact members 18 and 21, the battery 22, relay 25 and back to contact 17. The energizing of relay 25 causes contact members 56 and 57 to open, removing the short circuit from the winding 45. The removal of this short circuit causes the tube 42 to set up oscillations at an audio frequency determined by the inductance of the windings 38 and 43 and the stray capacity of the circuit between the grid 41 and the filament 39.

Inasmuch as the modulator tube 42 and the oscillator tube 62 are fed in parallel from the same source of plate potential 30, the audio-frequency oscillations in the tube 42 will modulate at an audio frequency the high frequency oscillations being supplied to the antenna 12, as is well known to those skilled in the art. The choke coil 47 prevents radio frequency from the tube 62 from traversing the circuits of the modulator tube.

It is thus seen that each time the contacts 17 and 18 close, the output of the antenna 12 will be subjected to modulation at an audible frequency. This modulated high frequency is guided along the trolley wires and is picked up by the detector-amplifier set at the other end of the train. Since each detector-amplifier portion of the apparatus is permanently coupled to each antenna, the signals being sent out are audible to the sender as well as to the engineer at the distant end of the train.

Should it be desired to communicate by voice, the cord 14 is pulled sufficiently to carry the contact member 18 past, and out of engagement with, the contact member 17 and to engage the contact member 16. As soon as contact between the elements 17 and 18 is broken, the relay 25 is released and the contact members 56 and 57 engage, thereby short-circuiting the transformer secondary 45, which prevents the tube 42 from oscillating.

A circuit may now be traced through contact members 16 and 18, battery 22 and relay 24 and back to contact member 16. The energizing of the relay 24 causes the contact members 32 and 33 to come together, placing the microphone 35, the battery 34 and the transformer primary 36 in series with each other. Upon speaking into the microphone 35, the modulator tube 42 is energized and serves to modulate the high-frequency output of the tube 62.

It is thus apparent that the engineer at one end of the train may gain the attention of the engineer at the opposite end by a pre-arranged code signal and may then talk to him directly, if desired. In some cases, how-

ever, the additional contact 16, with the attendant relay 24 and microphone 35, may be omitted without, in any way, changing the scope of my invention.

When being used with direct voice control modulation, it is desirable that there be no commutator ripple in the plate current supply to either the modulator or oscillator tubes and, for this reason, I employ a plurality of choking inductances 48 and 49 in the plate supply lead 52 and a plurality of by-pass condensers 53, 54 and 55 in order to smooth out the direct-current supply.

I have merely indicated diagrammatically the type of switch I may employ, but it is obvious that any known type may be substituted therefor, provided the proper sequence of operations is maintained. Upon return of the contact member 18 to its initial position, it is desirable and expedient that contact member 17 be missed during the upward travel. To secure this result, I may make use of a switch similar to that shown in the patent to S. W. Rushmore, No. 1,079,725 granted November 25, 1913. This patent discloses a type of switch in which a movable deflector is interposed between two contacts in one direction of travel and is not interposed therebetween when the relative movement is in the opposite sense.

A system constructed according to my invention has numerous advantages. The length of the train intervening between the two propulsion units is immaterial, and it is also apparent that even though the train break, communication will not be interrupted, and that one engineer can promptly apprise the other as to what steps to take. The passage of the train through tunnels has no effect upon the strength of signals. The presence of snow and ice on the trolley interferes in no way with satisfactory communication, and other weather conditions, which to some extent influence the travel of sound in air, have no effect on the high-frequency waves being guided by the trolley.

Another very decided advantage lies in the fact that if desirable, the transmitter might be of sufficient strength that a receiver at a central station could pick up the signals from any train along the route. In such cases, it would, of course, be necessary that each train employ a distinctive frequency. The various trains may also communicate with each other in cases of necessity, it being only necessary to vary the tuning of receiver and transmitter for this purpose.

The feature of signalling from one vehicle to another vehicle by means of radiant energy sent over a guiding channel is claimed in application S. N. 565,756, filed Sept. 29, 1931, which is a division of the present application.

Although I have illustrated and described herein certain specific embodiments of my

invention, I do not wish to be restricted thereto. I desire, therefore, that only such limitations shall be imposed as are indicated in the appended claims.

5 I claim as my invention:

1. In a radio system, energy radiating means, means comprising an oscillation generator for supplying energy to the radiating means, means for modulating the energy supplied and a single means for sequentially
10 causing the generation of oscillations and the modification thereof by said modulation means.

2. In a radio system, oscillation generating means, modulating means therefor, and a single operating means for successively causing the generation of oscillations and the modulation thereof.

3. In a signaling system, an antenna, means
20 associated therewith for supplying oscillatory energy thereto, modulating means for modifying said oscillatory energy, and a sequence switch, the operation of which first causes the supplying of said oscillatory energy to said antenna and then controls said
25 modulating means.

4. In a radio system, an oscillation generator, a plurality of modulating means, and a sequence switch having a plurality of positions, in one of which it effects the operation of the oscillation generator, a second position for effecting the operation of one modulating means, and a third position for effecting the operation of a second modulating means.

35 In testimony whereof, I have hereunto subscribed my name this 17th day of May, 1926.

WILLIAM E. BRINDLEY.

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