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REMOTE CONTROLS FOR PLURAL LOCOMOTIVE UNITS

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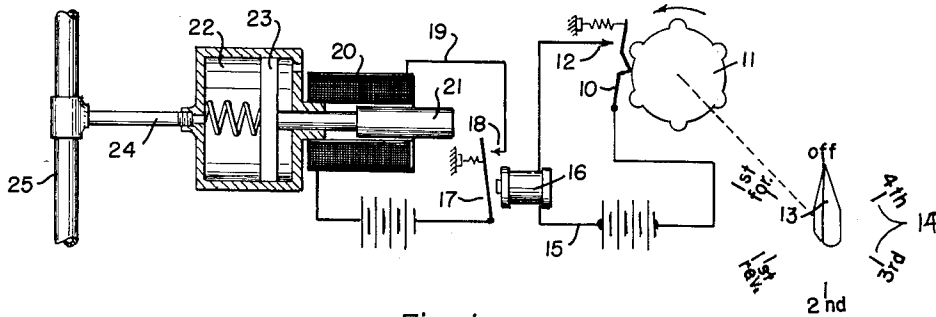


Fig. 1

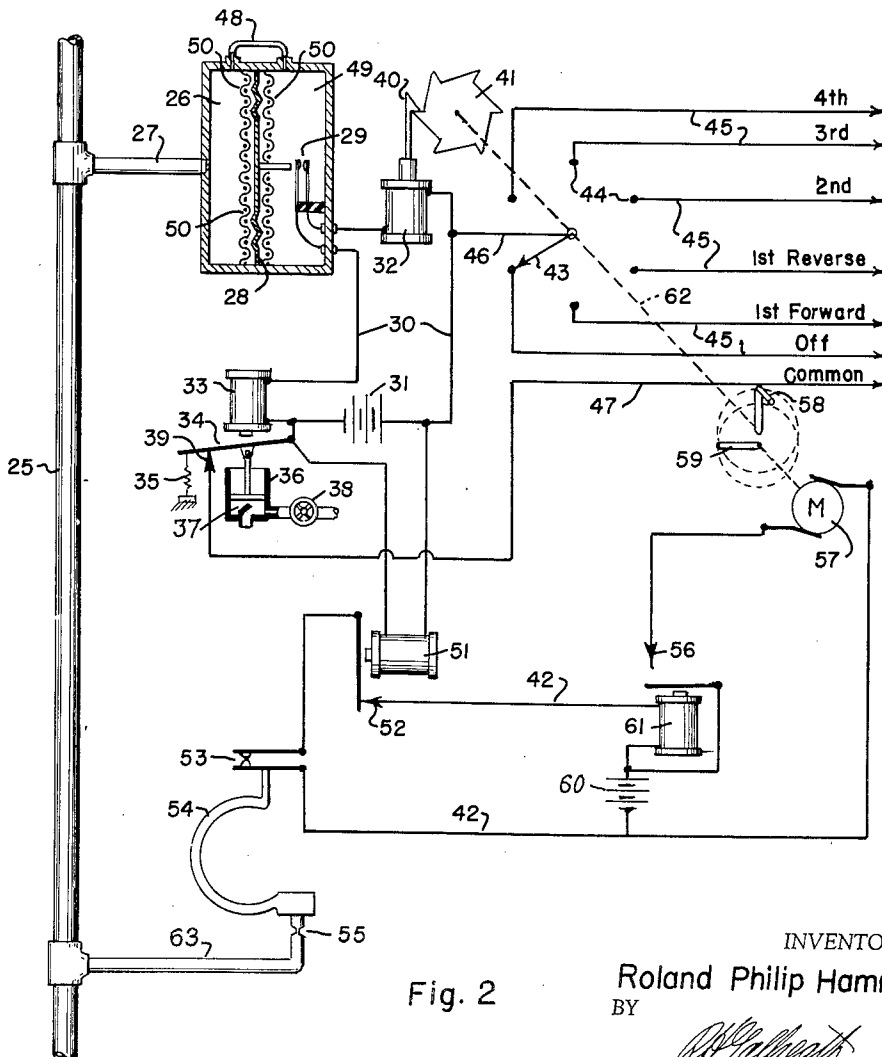


Fig. 2

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REMOTE CONTROLS FOR PLURAL LOCOMOTIVE UNITS

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This invention relates to a method and means for simultaneously controlling a plurality of diesel-electric locomotives in multiple car railway trains.

The principal object of the invention is to provide a plural locomotive control device whereby all of the locomotive units in a long train can be simultaneously controlled from the head locomotive, or other selected station in the train, so that the draw bar effort of all locomotives will be uniformly correlated to provide an even and continuous distribution of the load for more efficient operation and to reduce wear and tear upon the equipment.

Another object of the invention is to provide a simultaneous, plural locomotive control which will require no additions to or changes in the conventional train line air equipment or wiring and which will enable locomotives equipped with the improved equipment to be coupled into trains of conventional rolling stock without change in the latter or the couplings thereof.

Other objects and advantages will become apparent from the following discussion of the invention in which reference is had to the accompanying drawing which forms a part hereof. It is to be understood that all such objects and advantages are contemplated and within the scope of the present invention.

In the drawing:

Fig. 1 illustrates a circuit diagram of a typical master unit of the improved locomotive control system; and

Fig. 2 is a similar diagram of a controlled unit in the improved system.

Briefly, the invention contemplates transmitting control impulses to a plurality of electric locomotives in a single train through the train air line, with which all conventional trains are at present equipped, regardless of the position of the transmitting station and the controlled locomotives in the train.

The improved control system contemplates placing a master unit such as diagrammed in Fig. 1 in a unit of the train, preferably in the lead locomotive and a controlled unit such as diagrammed in Fig. 2 in the other locomotive units in the train such as in a mid-train locomotive and a rear end locomotive. The master unit may be mounted in the controller of the locomotive so as to operate simultaneously therewith or may be a separate unit if desired.

The master unit employs a normally open selector switch 10 actuated from spaced cams on a cam wheel 11 to intermittently close a signal circuit 15 through a contact 12. The cam wheel can be rotated from a mechanism similar to a conventional telephone dial to produce a sequence of spaced circuit closures. The cam wheel 11 may have any desired number of cams. As illustrated, six cams are provided and the wheel is arranged to be manually rotated from an index knob 13 indicating six positions upon a suitable circular index 14. For the purpose of description, the six positions will be designated in sequence as, Off, 1st Forward, 1st Reverse, Second, Third and Fourth.

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The signal circuit 15 includes a relay coil 16 having a relay armature 17 and a relay contact 18 arranged to close a solenoid circuit 19 to a solenoid 20. The relay coil 16 allows a relatively light current to be used in the signal circuit 15 and a relatively heavy current to be used in the solenoid circuit 19.

The armature of the solenoid 20, indicated at 21 is connected to a movable wall in a pneumatic pulsing chamber 22. The movable wall, as illustrated comprises a piston 23 arranged in pumping relation to the pulsing chamber 22. A flexible diaphragm could be used in place of the piston 23 if preferred.

The pulsing chamber 22 is connected, through the medium of an air pipe 24 with the conventional train air line pipe of the car or locomotive in which the master unit is positioned. Such a train air line is diagrammatically indicated at 25 in Fig. 1.

A controlled unit is placed in each of the locomotives of the train and is connected to the circuits of the standard controller (not shown) to function in parallel with the controller to automatically control the motor circuits of the locomotive when plural locomotive control is desired.

Such a controlled unit is diagrammed in Fig. 2. It employs a pneumatic pulse-receiving cylinder which is divided into a pulse-receiving chamber 26 and a counter-balance chamber 49 by means of a flexible diaphragm 28. The pulse-receiving chamber 26 is connected to the train air line 25 through a suitable conduit 27 and to the counter-balance chamber 49 by means of a constricted duct 48. A suitable orifice in the diaphragm itself could take the place of the duct 48 if preferred. The diaphragm 28 is mounted between two spaced-apart rigid support structures, or screens 50, capable of preventing rupture of the diaphragm in case of a large pressure difference occurring between the chambers 26 and 49. The diaphragm 28 is provided with a switch-actuating device arranged to contact and close a contact switch 29 in the counter-balance chamber 49 when the diaphragm moves toward the latter chamber. The screens 50 are spaced-apart so that with no pressure difference across the diaphragm the latter is self-supporting, and with a very small increase of pressure in the pulse-receiving chamber 26, relative to the pressure in the counter-balance chamber 49, the diaphragm may move sufficiently to close the switch 29 before its movement is arrested by the screen. The constricted duct 48 insures that for any steady-state condition of the air-line pressure, or for any relatively slow change in air-line pressure, the chambers 26 and 49 are equalized in pressure and the diaphragm is at its intermediate or neutral position. A sudden increase in air-line pressure, however, will require a period of time for the pressure in the two chambers to be equalized through the restricted duct 48 so that the diaphragm will close the switch 29 before equalization can occur. By proper adjustment of the sizes and shapes of chambers 26 and 49 and the duct 48 and the resilient resistances of the diaphragm 28 and the switch 29, the system can be made to respond only to pressure pulses having a rate-of-rise greater than any normal train operating rate and to remain insensitive to lower or normal rates of rise.

The movement of the diaphragm 28 under the influence of rapidly increasing air pressure causes the contact switch 29 to close a circuit 30 from a power source 31 through a step-solenoid 32 and through a delay relay coil 33 of a time delay relay of any suitable conventional type. As diagrammatically illustrated in Fig. 2, the time delay relay comprises a switch armature 34 arranged to be magnetically attracted to the coil 33 when the latter is energized, to open a delay contact 39. The armature is biased by a spring 35. The switch armature 34 is connected to a dash pot 36 into which fluid is drawn through a check valve 37, when the armature is attracted and

from which fluid is discharged, through a controlled timing valve 38, under the influence of the spring 35.

The step-solenoid 32 actuates any suitable step relay designed to successively contact a plurality of contacts. As diagrammatically illustrated in Fig. 2, the solenoid 32 attracts a ratchet plunger 40 to a six-toothed ratchet wheel 41 in six successive steps.

The ratchet wheel actuates a rotating switch blade 43 into contact with an annular series of six contacts 44, each of which closes one of a plurality of control circuits 45. The control circuits 45 are designated to correspond to the designations on the index dial 14 and are individually connected to the "Off," "1st Forward," "1st Reverse," "2nd," "3rd," and "4th" motor control relays on the remote control board, with which most electrically controlled freight locomotives are provided, in parallel with the conventional leads from the standard locomotive controller. The exact function of these relays will depend upon the circuitry of the particular make and model of locomotive to be controlled.

Current is conducted to the rotatable switch blade 43 from one side of the power source 31 through a conductor 46. The common or ground conductor to the locomotive control relays, indicated at 47, is connected to the contact 39 of the delayed action switch 34.

Let us assume that the master unit of Fig. 1 is located in the lead locomotive of a long train; that one of the controlled units of Fig. 2 is positioned in an intermediate helper locomotive in the train; and that a second similar controlled unit is positioned in a rear helper locomotive at the rear of the train. Now let us assume that it is desired to start the train. The lead engineer turns his starter to the 1st forward position and simultaneously rotates the index knob 13 counterclockwise to the "1st Forward" indication on the index 14. This causes one cam on the cam wheel 11 to pass the selector switch 10 imparting a single impulse to the pulsing piston 23.

This impulse causes a high-rate-of-rise pulse to travel through the entire train air line 25 and to the controlled units in the two helper locomotives. At each controlled unit the pulse will act to impart a single pulsing vibration to the diaphragm 28 of that unit so as to close the circuits 30 in both units. The closing of the circuits 30 opens the delayed switch armatures 34 of both helper locomotives and rotates the rotating switch blades 43 of both helper locomotives to the first or "1st Forward" contact 44. The delayed action relays now return to their closed positions so that a circuit is closed through the ground or common conductor 47 and through to the "1st Forward" control relay in each locomotive causing all three locomotives to simultaneously start in the "First Forward" position.

Now let us assume that it is desired to shut off the power in all three locomotives simultaneously. The lead engineer shuts off his controller and simultaneously rotates the index knob 13, still counterclockwise, to the "Off" position on the index 14. This causes five of the cams on the cam wheel 11 to pass the selector switch 10 so as to give five separate and distinct pulses in the train air line as above described. The first pulse again opens the control circuit in the common conductor 47 and moves the rotatable switch blade 43 to the next control contact 44. The four following pulses successively rotate the selector switch into successive contact with the contacts 44 until it comes to rest on the "Off" contact. The delayed action relay then reestablishes the circuit to actuate the "Off" relays of the helper locomotives.

It can be seen from the above that any desired intermediate control position can be similarly obtained by simply rotating the index knob 13 to the desired control position. It will be noted that no controls are operative until all pulses have been received and the selector switch has come to rest upon the desired contact 44. The pulses in the train air line are of such slight magnitude and duration that they do not affect the normal functioning of the

air line in any way. The time delay is adjustable by means of the timing valve 38 so that the power application will take place in the desired sequence throughout the train.

Safety circuits may be provided to give protection against malfunction of the control device. As an example, means are illustrated for automatically resetting the rotatable switch blade 43 to the "Off" position, should the power source 31 fail or should the brakes be applied while the switch blade 43 is in an operating position. This is accomplished by means of a safety circuit 42 containing an independent power source 60 and a safety relay coil 61.

The head engineer will normally switch his controller and the index knob 13 to the "Off" position before applying the brakes, but to insure that brake application is accompanied by power shut off in all locomotives under all conditions a pressure switch 53 is provided in the safety circuit 42, actuated, for example, by a Bourdon tube 54 and connected to the train air line 25 through an air pipe 63 having a constricted orifice 55. The constricted orifice 55 insures that the tube 54 does not respond to pulses sufficiently to open the switch 53 except when there is a sustained loss of pressure in the brake pipe, as would be the case in brake application. Restoration of full pressure in the air line releases the brakes and recloses the switch 53. A relay coil 51 is bridged across the terminals of the power source 31 which acts to maintain a relay contact 52 in the safety circuit 42 closed as long as there is sufficient current to operate the ratchet system.

Interruption of the safety circuit 42 at either the pressure switch 53 or the relay contact 52, releases the armature of the relay coil 61 to close a contact 56 in a reset motor circuit furnishing power to a reset motor 57, which is arranged in any desired manner to reset the rotatable switch blade 43 in the "Off" position.

As illustrated, the axle of the ratchet wheel 41, indicated at 62, is provided with a return crank 58 and the motor 57 rotates a radial contact arm 59 about the axis of the motor. The motor axis is placed parallel to but eccentric of the axis of the ratchet axle 62. The radius of the crank 58 is less than the length of the arm 59, but greater than half its length, and is so placed as to be engaged by the arm 59 at all points of its revolution except at the "Off" position. Thus, any interruption of the safety circuit 42 will reset the ratchet wheel 41 and the switch blade 43 to the "Off" position and keep returning it there in spite of signals for power, until the safety circuit is reclosed.

While some forms of the invention have been herein illustrated and described in some detail, it is understood that the invention is not to be regarded limited to the precise construction described, except in so far as such limitations are included within the terms of the accompanying claims, in which it is intended to claim all novelty inherent in the invention as broadly as is permissible.

Having thus described the invention, what is claimed and desired secured by Letters Patent is:

1. A system for simultaneously controlling the driving motor circuits in a helper locomotive from a lead locomotive in an electrically driven railway train through the medium of the train air line comprising: a pulsing chamber in said lead locomotive in communication with said air line; an electrically-actuated air compressing means arranged when actuated to momentarily reduce the capacity of said pulsing chamber so as to create a compression pulse in the air in said air line; an electric switching means interconnected with said electrically-actuated means for intermittently and momentarily closing a circuit to actuate said compressing means to produce a desired sequence of compression pulses in the air in said air line corresponding to the closures of said circuit; a pressure-responsive element in said helper locomotive in communication with said air line and operating in response to said compression pulses; a switch contact actu-

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ated by said pressure-responsive element; an electrical control circuit including said latter switch contact; a selective switch operable from said control circuit; locomotive control circuits selectively closed by said selective switch; and means for returning said selective switch to the "off" position should the pressure in the train air line drop below a predetermined value.

2. A system for simultaneously controlling the driving motor circuits of a plurality of electrically driven locomotives in a single train having a train air line running throughout the length of the train consisting of a master unit in the lead locomotive and a pneumatically actuated control unit in each remaining locomotive for controlling the driving motor circuits therein, said master unit comprising: a normally open manually-operated selector switch arranged to intermittently close a first electric circuit; a relay in said first electric circuit arranged to close a solenoid circuit in response to electrical impulses in said first circuit; a solenoid in said solenoid circuit; an armature in said solenoid; a pneumatic pulsing chamber in communication with said train line; a movable wall in said pulsing chamber acting to momentarily reduce the capacity of said pulsing chamber to create a compression pulse in said train line; means connecting said wall with the armature of said solenoid to convert an electrical pulse in said solenoid into a mechanical pulse of said wall so as to impart a momentary compression pulse in said air line for operating the pneumatically actuated control unit in each of the remaining locomotives, each control unit comprising: a pneumatic, pressure-responsive element in communication with said train air line; a circuit-closing-device actuable by said pressure-responsive element; a multiple-contact-switch the contacts of which are connected to the motor control circuits of the locomotive; electro-magnetic means actuating said multiple-contact-switch; a switch-actuating circuit including a power source and including said circuit-closing-device and said electro-magnetic means so that pulsation of said pressure responsive element will intermittently energize said switch-actuating-circuit to actuate said multiple-contact-switch from the "off" position into successive closure of its multiple contacts; an electrically-motivated resetting means for said multiple-contact-switch; a pressure-actuated-switch connected to said train air line; and a resetting circuit including said pressure-actuated switch and said latter means to reset said multiple-contact-

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switch to the "off" position when the pressure in the train line drops below a preset minimum.

3. A system as described in claim 2 having a safety circuit including said first power source and means for closing said resetting circuit when the voltage in said safety circuit drops below a preset minimum.

4. A system for selectively closing the electrical drive motor control circuits of an electrically driven locomotive in response to momentary compression pulses received from a train air line comprising: a rotary switch blade; a stepping relay arranged to advance said rotary-switch blade in steps so as to successively close said control circuits; a pneumatic compression pulse-receiving chamber in communication with said air line; a diaphragm in said chamber arranged to vibrate in response to the compression pulses in said air line; a stepping-relay circuit including a power source; a contact switch in said latter circuit, said contact switch being actuable by said diaphragm so that said stepping circuit will be intermittently closed in response to a series of increased-pressure-pulses on said diaphragm; a common ground circuit for all of said control circuits; means for closing said common ground circuit after said rotatable switch blade has completed the final step of the series of steps, said means for closing said common ground circuit including a relay coil in said stepping circuit; a relay armature in said common ground circuit attractable by said coil so as to open said common ground circuit when said stepping circuit is energized; means for delaying the return of said armature to the closed circuit position when said stepping circuit is deenergized; and means for resetting the rotary switch blade to an "off" position should the pneumatic pressure in the air line drop below a predetermined minimum.

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