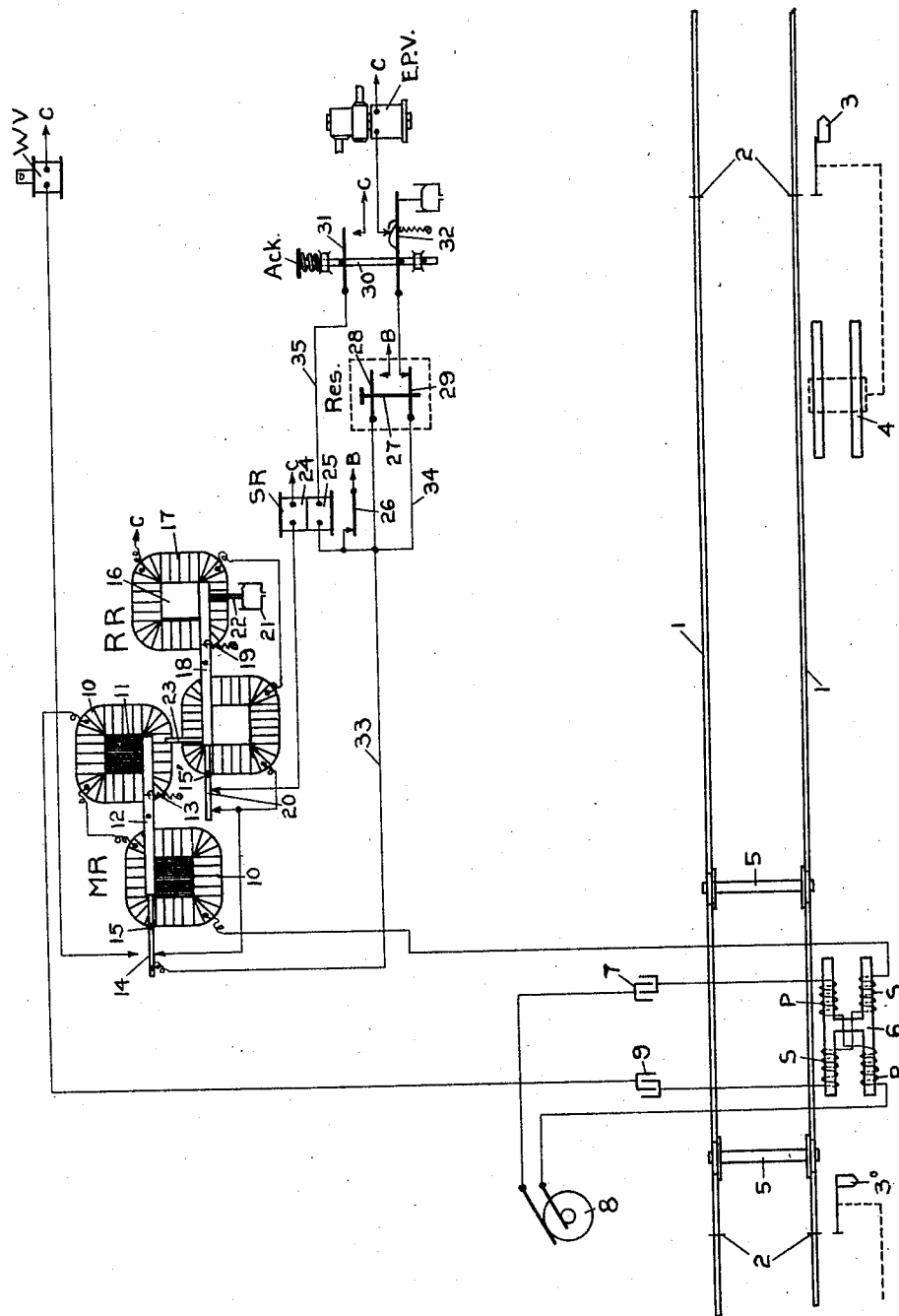


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C. S. BUSHNELL
TRAIN CONTROL SYSTEM
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TRAIN-CONTROL SYSTEM

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This invention relates in general to automatic train control systems of the intermittent inductive type employing alternating current, and refers more particularly to such a system wherein an acknowledging whistle is utilized in combination with acknowledging and reset means.

It is desirable in systems of the character in question to have properly protected acknowledging and reset means whereby to prevent improper use of the same while permitting running past danger and caution signals under proper conditions, and to retain an acknowledging whistle or other signal in the cab for checking the proper operation of the entire system and apprising the engineman, upon acknowledgment, when he is passing a signal set at danger or caution, and when it is safe to release the acknowledging contactor.

With the above and other objects in view, it is proposed, in accordance with this invention, to provide a system satisfying the above requirements.

Further objects, purposes, and characteristic features of the invention will appear as the description progresses, reference being had to the accompanying drawing, showing solely by way of example, one physical form which the invention can assume.

The single figure of drawing represents, in a wholly schematic manner, one form of the present invention.

Referring to the drawing, there is shown a track comprising rails 1, divided in a usual manner into signal blocks by means of insulating joints 2, each block having a wayside signal 3 associated therewith at its entrance end, and such signal being of any desired type, although shown in the present case as a semaphore signal.

Each signal 3 is arranged to control an inductor 4 positioned along the side of the track a suitable distance in front of the entrance to the corresponding block, and the control of the inductor by the signal is such that the inductor is active when the signal is at stop or at caution, while it is inactive when the signal is at clear.

The structure so far described, and also certain other structure to be described in this

application, is substantially identical with that in applicant's copending application Ser. No. 171,820 of C. S. Bushnell, filed March 1, 1927. A railway vehicle, represented by wheels and axles 5, is equipped with car carried apparatus comprising a receiver 6, of a general H shape, having primary coils P, and secondary coils S, the two sets of coils being electrically insulated but inductively associated. The receiver 6 is positioned to pass over the inductor 4 so as to be inductively coupled therewith through a small air gap.

The primary coils P are connected in series with each other, with a condenser 7, and a source of alternating current energy 8, represented as an alternator, the condenser 7 in connection with the other parts of the circuit being so selected as to tune this circuit to oscillate most freely at the frequency of the current supplied by the alternator 8, which preferably is higher than the usual commercial frequencies, as, for example, 360 cycles per second.

The secondary coils S are connected in series with each other and included in a circuit comprising a condenser 9 and coils 10 carried on a core 11 of a main relay MR. As in the case of the circuit including the primary coils, this circuit of the secondary coils is tuned to oscillate most freely at the frequency of the current delivered by the alternator 8.

The particular coaction between the inductor 4 and the receiver 6 need not be described in detail as it is quite unnecessary for a complete understanding of the present invention. In the reference, when the receiver 6 passes over the inductor 4, the flux distribution in the receiver 6 is so changed as to sufficiently diminish, or reduce to zero, the current flowing in the secondary circuit including the coils 10 of relay MR, to thus de-energize such relay. This effect is produced only when the inductor 4 is active: when the signal 3 is at clear, the inductor 4 is inactive, and hence does not cause de-energization of relay MR.

The main relay MR has a pivoted armature 12 biased in a clockwise direction by a spring 13 and normally held in the position shown by the attraction of its core 11. Carried by

the armature 12, is a contact finger 14, suitably insulated from the armature by an insulating joint 15, as shown.

A restoring relay RR for the main relay, is very similar to the relay just described, and includes a core 16 carrying coils 17 and having a pivoted armature 18 biased in a clockwise direction by a spring 19 and equipped with a contact finger 20 insulated from the body of the armature 18 by an insulating joint 15'. The armature 18 is slow to drop away due to its connection to a dash pot or the like 21, by means of a rod 22. Carried by the armature 18, and positioned in the path of movement of armature 12 of relay MR, is an upstanding pin 23 which operates, on movement of armature 18 to attracted position, to mechanically move armature 12 back to its attracted position if it be in retracted position. Armature 12 of relay MR detunes the normally tuned energizing circuit for MR when it is in retracted position, whereby reapplication of normal voltage across said energizing circuit will not cause the armature to pick up. Relay MR is thus a stick relay and must be separately restored, as, for example, by the armature of reset relay RR.

As shown in the drawing, the core for relay MR is laminated, as likewise is the case with the inductor and receiver 4 and 6, for the well known purpose of reducing, as far as possible, various losses due to the use of alternating current. The core 16 of relay RR is shown as solid, since it is contemplated to energize this relay with direct current, it being understood, however, that under certain conditions alternating and direct currents could be interchanged without disadvantage.

Included in the system is a stick relay SR furnished with separate coils 24 and 25, and having a contact finger 26.

Shown in the drawing is a reset device Res, comprising a push rod 27 connected to a normally open contact finger 28, and a normally closed contact finger 29, for simultaneous operation of such contact fingers. This reset device, in order to prevent misuse of the same, is so positioned that it can be operated only when the train is at rest, and this is accomplished, for example, by making it accessible only from the ground, it being desired that the reset device should not be operated until after the train has been brought to a full stop.

An acknowledging contactor Ack, is employed, and includes a spring biased push rod 30, connected to operate a normally open contact finger 31, and a normally closed contact finger 32, the contact finger 32, due to a spring and dash pot arrangement as shown not breaking contact upon operation of rod 30, until after the lapse of a predetermined time interval, in the present case approximately 15 seconds.

The system in question also includes a whistle valve WV, for giving an audible signal, although any other desired type of signal could be used, and also an electro-pneumatic device EPV, normally energized, and arranged when de-energized to give either an automatic brake application, or to impose some other desired restrictive control on the vehicle in question.

In order to simplify the wiring diagram, positive and negative terminals of sources of electrical energy have been indicated by the letters B and C, and while the electrical energy under consideration is assumed to be direct current, it might however be alternating current.

The energizing circuit for the relay RR can be traced from a source C, windings 17, contact finger 14 and front contact of relay MR, wire 33, contact finger 26 and front contact of relay SR, to a source B. From this it is obvious that energization of relay RR requires the armature of relay MR to be in attracted position, and relay SR energized.

The normal energizing circuit for relay SR runs from a source C, winding 24 of relay SR, contact finger 20 and front contacts of relay RR, contact finger 14 and front contact of relay MR, wire 33, contact finger 26 and front contact of the relay SR in question, to a source B. This it will be seen, is a stick circuit for the relay SR which for closure requires the armature of relay RR to be in attracted position and also requires the armature of relay MR to be in attracted position.

The pick-up circuit, however, for relay SR can only be completed by depressing the reset device Res, upon operation of which a pick-up circuit is completed through the relay SR which can be traced from a source B, reset finger 28 and back contact thereof, wire 33, contact finger 14 and front contact of relay MR, contact finger 20 and front contacts of relay RR, the winding 24 of relay SR, to a source C. Thus in order to pick up this stick relay SR, it is necessary to depress reset rod 28 which, it is to be remembered, is only accessible when the train is at a standstill, and this operation must be effected at the time that both of the armatures of the relays MR and RR are in attracted position.

The normal energizing circuit for the brake applying or influence giving device EPV can be traced from a source C, winding of EPV, contact finger 32 and front contact of Ack, contact finger 29 and front contact of Res, wire 34, contact finger 26 and front contact of relay SR, to a source B. In other words, the normal energization of EPV requires stick relay SR to be energized, reset rod 27 to be in its normal position, and the acknowledging contact finger 32 in its normal position.

An auxiliary, or acknowledging, circuit for stick relay SR can be completed for a limited period of time, by depressing the ac-

knowledging rod 30, such circuit being traced from a source C, contact finger 31 and back contact of *Ack*, wire 35, winding 25 of relay SR, contact finger 26 and front contact of relay SR, to a source B. With this alternative energizing circuit for stick relay SR, its contact finger 26 is held up even though one or both of the armatures of the relays MR and RR be retracted. Protection by operation of contactor *Ack*, however, can be maintained only until the acknowledging contact finger 32 is moved downwardly in an automatic manner to break contact, and thereby open the energizing circuit for EPV at contact finger 32 and front contact of acknowledging device *Ack*.

The energizing circuit for the whistle valve WV is traceable from a source C, the whistle valve WV, contact finger 14 and back contact of relay MR, wire 33, contact finger 26 and front contact of relay SR, to a source B. From this it is seen that energization, and resultant sounding, of the whistle valve requires the armature of relay MR to be in retracted position and stick relay SR to be energized.

With the various devices arranged and wired up in the manner above described, upon a train equipped with this system passing a signal set at clear, the inductor 4 controlled by such signal is in inactive condition and does not de-energize the main relay MR, so that nothing is changed, and no automatic brake application is incurred.

Let it be assumed now that a train passes a caution or stop signal under which conditions the inductor 4 controlled by such signal is in active condition. As a result of the influence of the inductor 4 on the receiver 6, if we first assume that no acknowledging act be performed, the relay MR becomes de-energized thus breaking the energizing circuit for the relay RR at contact finger 14 and front contact of relay MR, and also breaking the normal energizing circuit for stick relay SR at the same point. The relay RR, on de-energization, has its armature moved by the spring 19 to operate pin 23 to restore the armature of relay MR to its attracted position, but this does not operate to complete the normal energizing circuit for relay RR since the stick relay contact 26 has meantime dropped away so that the armature of relay RR remains retracted.

Upon dropping away of contact finger 26 of stick relay SR, the energizing circuit for the brake applying device EPV is broken and an automatic brake application is incurred. No sounding of the whistle valve WV is produced, however, since the various parts are so designed that before its energizing circuit is completed through contact finger 14 and back contact of relay MR, this energizing circuit is broken at contact finger 26 and front contact of relay SR.

Under the conditions set forth above the engineman is powerless to relieve the train from the automatic brake application until after the train has come to a standstill, whereupon he can operate the reset device *Res* to cause relay RR to pick up its armature to thereby complete the pick-up circuit for the stick relay SR, as traced above, the relay MR after having been restored by relay RR being maintained in attracted position by current induced in the secondary windings S of the receiver 6, such receiver having meanwhile passed beyond the inductor 4 in question. Pick up of contact finger 26 of relay SR permits re-energization of relay RR and this in turn completes the stick up circuit for relay SR through contact finger 20 and front contacts of relay RR as traced above, whereupon the normal energizing circuit for EPV is completed upon movement of the reset device *Res* to its normal position to thus relieve the train from the effect of the de-energization of EPV and restore all parts to their normal positions as shown.

Let it now be assumed that the engineman is alert and depresses the acknowledging contactor *Ack* just before passing the active inductor 4. In these circumstances the auxiliary circuit for maintaining the stick relay SR energized, is completed, through contact finger 31 and back contact of *Ack*, so that the drop away of relay MR, causing drop away of relay RR and subsequent restoration of relay MR as in the previous case, can take place without de-energizing the stick relay SR and hence without de-energizing EPV. Also restoral of armature 12 of relay MR, in this case, closes the energizing circuit for relay RR, since the stick relay SR has meanwhile been maintained energized.

Under the last conditions, as soon as contact finger 14 and back contact of relay MR make contact, the energizing circuit for whistle valve WV, is completed, as traced above, and the whistle sounds until armature 12 of relay MR is moved away from its back contact by pin 23, and this requires some few seconds, due to the slow drop away of armature 18 of relay RR. In other words, the duration of the whistle signal depends upon the time constant of the slow acting drop away of armature 18 of relay RR.

In the case just considered, if the acknowledging contactor *Ack* were depressed too soon, or held down for too long a period, the energizing circuit for EPV would be automatically broken at contact finger 32 and front contact of the acknowledging device, with a consequent automatic brake application, and thus misuse of the acknowledging device by tying it down, for example, is effectually prevented.

It should also be noted that operation of the reset device *Res*, opens the energizing circuit for EPV at contact finger 29 and its front contact, which thus insures that the re-

set device must be returned to normal position before the train can be put in motion.

The whistle valve WV, as explained above, becomes de-energized upon restoration of armature 12 of relay MR to attracted position, and thus this signal, after the engine-man has acknowledged, advise him that an active inductor 4 is being passed, and on termination of the signal, he is advised thereby that he can safely release the acknowledging contactor Ack, since he knows that relay MR is again in attracted position and that the normal energizing circuit for EPV is intact.

The above rather specific description of one form of the present invention has been given solely by way of illustration, and is not intended, in any manner whatsoever, in a limiting sense. Obviously, the invention can assume numerous different physical embodiments, and is susceptible of various modifications, and all such embodiments and modifications are intended to be covered by this invention, as some within the scope of the appended claims.

Having described my invention, I now claim:—

1. In an automatic train control system, a normally energized traffic responsive device, a normally energized restoring member therefor, a normally energized brake applying device acting when de-energized to produce a brake application, a relay having an energizing circuit including a front point of both said traffic responsive device and said member, and a normal energizing circuit for the brake applying device broken upon de-energization of said relay.

2. In an automatic train control system, a normally energized traffic responsive device, a normally energized member for mechanically restoring said device, a normally energized brake applying device acting when de-energized to produce a brake application, a stick relay having a stick circuit including a front contact of both said traffic responsive device and said member, a normal energizing circuit for the brake applying device broken upon de-energization of said stick relay, and a normal energizing circuit for the restoring member broken upon de-energization of the traffic responsive device.

3. In an automatic train control system, a normally energized traffic responsive device, a normally energized member for mechanically restoring said device, a normally energized brake applying device acting when de-energized to produce a brake application, a stick relay having a stick circuit including a front contact of both said traffic responsive device and said member, a normal energizing circuit for the brake applying device broken upon de-energization of said stick relay, a normal energizing circuit for the restoring member broken upon de-energization of the traffic responsive device, and means opera-

tive upon de-energization of the restoring member to cause the traffic responsive device to assume its energized position.

4. In an automatic train control system, a normally energized traffic responsive device, a normally energized restoring member therefor, a normally energized brake applying device acting when de-energized to produce a brake application, a stick relay having a stick circuit including a front contact of both said traffic responsive device and said member, a normal energizing circuit for the brake applying device broken upon de-energization of said stick relay, a normal energizing circuit for the restoring member broken upon de-energization of the traffic responsive device, and means independent of train speed, including a front contact of the stick relay, for temporarily maintaining the energizing circuit for the brake applying device, unaffected by either the traffic responsive device or the restoring member.

5. In an automatic train control system, a normally energized traffic responsive device, a normally energized member for mechanically restoring said device, a normally energized brake applying device acting when de-energized to produce a brake application, a stick relay having a stick circuit including a front contact of both said traffic responsive device and said member, a normal energizing circuit for the brake applying device broken upon de-energization of said stick relay, a normal energizing circuit for the restoring member broken upon de-energization of the traffic responsive device, means, including a front contact of the stick relay, for temporarily maintaining the energizing circuit for the brake applying device, which means is unaffected by either the traffic responsive device or the restoring member, and means operative upon de-energization of the restoring member to mechanically return the traffic responsive device to energized position.

6. In an automatic train control system, a normally energized traffic responsive device, a normally energized member for mechanically restoring said device, a normally energized brake applying device acting when de-energized to produce a brake application, a stick relay having a stick circuit including a front contact of both said traffic responsive device and said member, a normal energizing circuit for the brake applying device broken upon de-energization of said stick relay, a normal energizing circuit for the restoring member broken upon de-energization of the traffic responsive device, and reset means operable to complete a pick-up circuit for the stick relay.

7. In an automatic train control system, a traffic responsive device, a restoring member therefor, a brake applying device acting when de-energized to produce a brake application, a stick relay controlled by the said

traffic responsive device and member, an energizing circuit for the brake applying device broken upon de-energization of said relay, an energizing circuit for the restoring member broken upon de-energization of the traffic responsive device, means operative upon de-energization of the restoring member to mechanically return the traffic responsive device to energized position, and reset means operable to complete a pick-up circuit for the said relay.

8. In an automatic train control system, a traffic responsive device, a restoring member therefor, a brake applying device acting when de-energized to produce a brake application, a stick relay controlled by the said traffic responsive device and member, an energizing circuit for the brake applying device broken upon de-energization of said relay, an energizing circuit for the restoring member broken upon de-energization of the traffic responsive device, means operative upon de-energization of the restoring member to return the traffic responsive device to energized position, and reset means operable to complete a pick-up circuit for the said relay which includes a front contact of the traffic responsive device and a front contact of the restoring member.

9. In an automatic train control system, a traffic responsive device normally energized with alternating current through a tuned circuit, a normally energized restoring member, a normally energized brake applying device acting when de-energized to produce a brake application, a relay controlled by said traffic responsive device and member, a normal energizing circuit for the brake applying device broken upon de-energization of said relay, a normal energizing circuit for the restoring member broken upon de-energization of the traffic responsive device, and means operative upon de-energization of the restoring member to mechanically cause the traffic responsive device to assume its energized position.

10. In a train control system, a normally energized alternating current main relay, a normally energized restoring relay, means operable on release of the main relay to cause the restoring relay to move the armature of the main relay to energized position, a stick relay controlled by the main relay, a brake applying device initiated upon de-energization of the stick relay, acknowledging means to only temporarily prevent initiation of the brake applying device, and an acknowledging whistle energized through a circuit including a front contact of the stick relay and a back contact of the main relay.

11. In a train control system, a normally energized alternating current main relay, a normally energized restoring relay, means operable on release of the armature of the main relay to cause the restoring relay to

move the armature of the main relay to energized position, a stick relay controlled by the main relay, a brake applying device initiated upon de-energization of the stick relay, acknowledging means to only temporarily prevent initiation of the brake applying device, an acknowledging whistle energized through a circuit including a contact of the stick relay and a back contact of the main relay and means causing slow release of the armature of the restoring relay.

12. In a train control system, a normally energized main relay, a normally energized restoring relay, means operable on release of the armature of the main relay to cause the restoring relay to mechanically move the armature of the main relay to energized position, a stick relay controlled by the main relay, a brake applying device initiated upon de-energization of the stick relay, acknowledging means to only temporarily prevent initiation of the brake applying device by completing a stick circuit for the stick relay, and an acknowledging whistle energized through a circuit including a front contact of the stick relay and a back contact of the main relay.

13. In a train control system, a main relay normally energized through a tuned circuit a normally energized restoring relay, means operable on release of the armature of the main relay to cause the restoring relay to mechanically restore the armature of the main relay to energized position, a stick relay energized through a stick circuit including, in series, front contacts of said two relays, a brake applying device initiated upon de-energization of the stick relay, reset means for the stick relay, acknowledging means to only temporarily prevent initiation of the brake applying device, and an acknowledging whistle energized through a circuit including a front contact of the stick relay and a back contact of the main relay.

14. In an automatic train control system, a first relay having a tuned energizing circuit responsive to traffic conditions, a second relay energized through a circuit including a front contact of the first relay, means, to mechanically move the armature of the first relay to attracted position, operated upon de-energization of the second relay, a brake relay controlled by each of said relays, a brake applying device initiated on de-energization of said brake relay, and a cab signal energized through a circuit including a back contact of the first relay.

15. In an automatic train control system, a first relay having an energizing circuit responsive to traffic conditions, a second relay energized through a circuit including a front contact of the first relay, means, operated upon de-energization of the second relay, to mechanically move the armature of the first relay to attracted position, a brake relay con-

trolled by said relays, a brake device initiated on de-energization of said brake relay, and a cab signal energized through a circuit including a back contact of the first relay, and a front contact of the brake relay.

16. In an automatic train control system, a first relay having an energizing circuit responsive to traffic conditions, a second relay energized through a circuit including a front contact of the first relay, means operated upon de-energization of the second relay to mechanically move the armature of the first relay to attracted position, a stick relay controlled by said first relay and said second relay, a brake device initiated on de-energization of said stick relay, a whistle valve energized through a circuit including a back contact of the first relay and a front contact of the stick relay, and means to cause a predetermined appreciable time interval between de-energization of the first relay, and restoration of the first relay armature to its attracted position.

17. In a train control system, a traffic responsive relay normally energized with alternating current through a tuned circuit, a restoring relay therefor normally energized to nonrestoring position, a brake applying device initiated on de-energization, a stick relay having a stick circuit including a front contact of both said traffic responsive and said restoring relay, an energizing circuit for said brake applying device including a front contact of said stick relay, an energizing circuit for said restoring relay broken on de-energization of said traffic responsive relay to cause mechanical restoration of the armature of said traffic responsive relay, and means unaffected by said traffic responsive relay or said restoring relay for only temporarily maintaining the energizing circuit for said brake applying device.

In testimony whereof I affix my signature.
CHARLES S. BUSHNELL.