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SYSTEM OF TRAIN CONTROL

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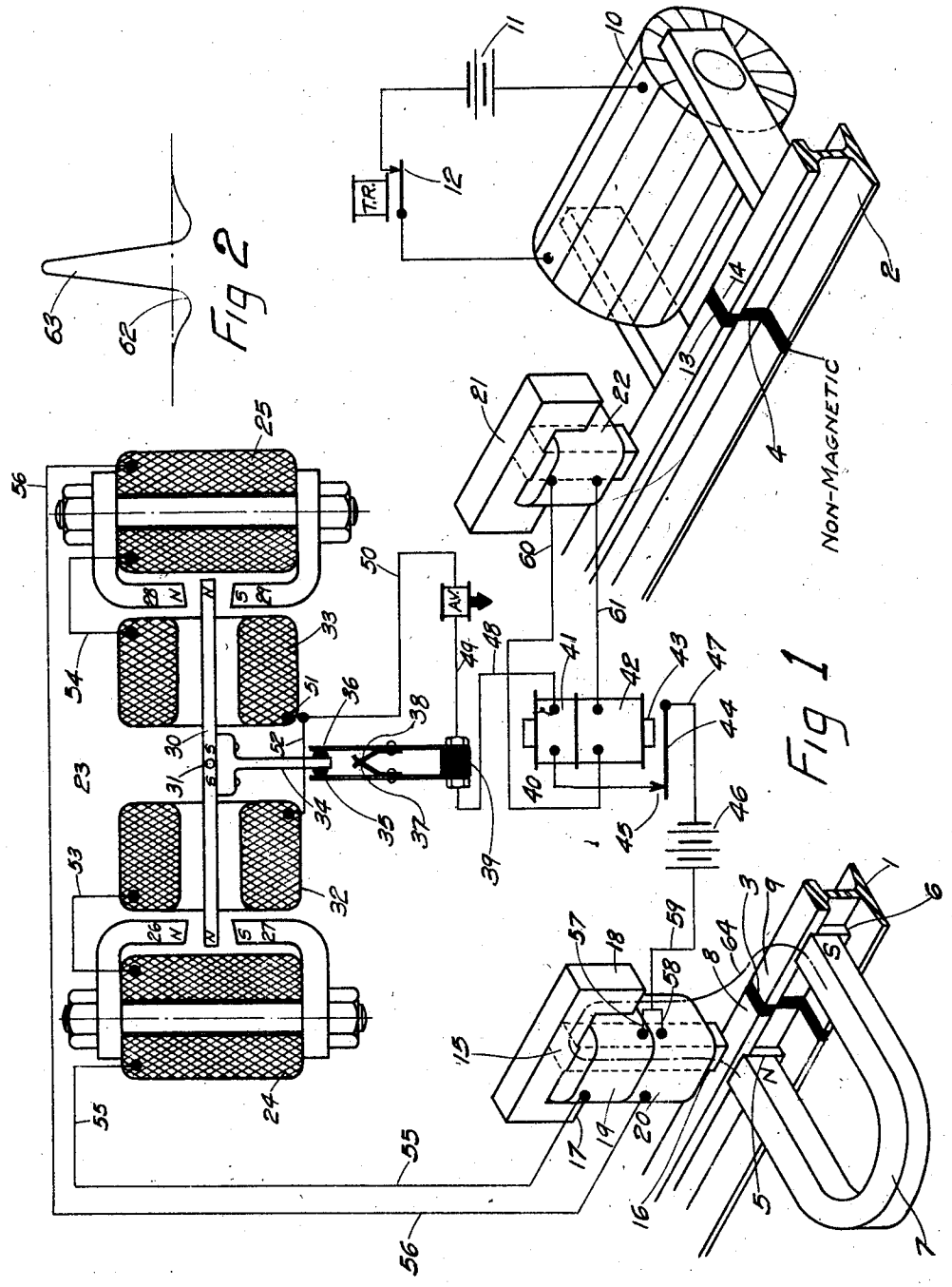

Fig 1

Fig 2

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SYSTEM OF TRAIN CONTROL

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This invention relates to a system of train control of that type known as intermittent control and has as an object the provision of a system of this character whereby the control may be maintained inductively without the use of roadside contacting devices and also the provision of a system of such a character that normal railroad clearances will not be interfered with. A further object is to provide a system, the integrity of which is automatically checked, and still further to provide in the system, a relay adapted to work on the minute current impulses available in this type of apparatus and which is so constructed that it will have maximum sensitivity and will control a substantial contact with a minimum input of control energy. These objects and further objects will become apparent from the following description and appended drawings and claims.

Figure 1 is schematic diagram partly in isometric projection and partly in section showing the system as a whole.

Figure 2 is a diagram of the approximate wave form of the impulses received by this class of apparatus.

Referring to Figure 1 it will be seen that the running rails 1 and 2 are provided with end posts of nonflux conductive material 3 and 4 respectively. These insulators serve to break the continuity of the flux conducting rails and may be made of any nonflux conducting material such as manganese steel, and are inserted at a regular rail joint in much the same manner that fibre end posts are inserted in insulated joints as is well known in the art. In the drawing I have not shown the necessary fish plates which would be used to tie the rails together as these are well known in the art, and would tend to complicate the disclosure if they were shown. It is apparent that these fish plates will also have to be of proper nonflux conducting material similar to the end posts 3 and 4, or else be spaced from the rail to obtain the same effect. The rail 1 is further provided with filler blocks 5 and 6 of iron or other suitable flux conducting material which act as a connection to convey flux from a permanent magnet 7 to the rail ends 8 and 9 respectively, thereby giving these rail ends dissimilar polarity characteristics. The rail 2 is equipped in similar manner except that instead of a permanent magnet, an electromagnet 10 is provided, which will, when energized by means of a source of energy 11 through relay contact 12, set up similar opposing poles in the rail ends 13 and 14. The contact 12 is controlled by the relay marked TR which may be a track relay or any other control relay well known in the signaling art. The equipment so far described is that which is installed in the track and it will be noted that the end post in rail 2 is in advance of the end post in rail 1.

I will now describe the equipment which is carried by the vehicle traveling over the rails 1 and 2. A T shaped inductor 15 is provided having an extended center core 16 arranged to pass along immediately over the top of the rail 1 and is further provided with short extended pole pieces 17 and 18, the function of which will be explained hereafter. The center core 16 is provided with two windings 19 and 20 respectively. A similar inductor 21 is provided and arranged to pass along over rail 2. This inductor is equipped with a single coil 22. The engine relay 23 is electrically connected to the coils 19 and 20 of inductor 15 and comprises field magnets 24 and 25 having pole pieces 26, 27, 28 and 29 respectively, with polarities as shown, when energized. An armature 30 pivoted at 31 is adapted to operate between the pole pieces 26, 27, 28 and 29 respectively, and is arranged to be magnetized by means of coils 32 and 33. Armature 30 is provided with a downwardly extending operating arm 34 which is adapted by means of insulators 35 and 36 to control the contacts 37 and 38 which are mounted on an insulating supporting block 39. These contacts are normally arranged to be in contact with one another and to have spring tension to maintain a definite contact pressure. A power failure and restoring relay 40 is used which is provided with two windings 41 and 42 respectively, both of which influence core 43 to control armature 44 for the operation of contact 45. The rectangle marked AV represents a brake application

valve of any well known make or any other cab signaling or brake controlling device which it may be found desirable to control.

Under normal conditions current from a suitable source of direct current such as a battery 46 flows through a circuit which passes from the battery, through wire 47, armature 44, contact 45, coil 41, wire 48, contacts 37 and 38, wire 49 through the air valve magnet to wire 50, thence through wires 51 and 52 respectively, through the coils 32 and 33 in opposite directions thereby setting up the poles in the armature 30 as indicated, through wires 53 and 54 respectively, through field magnets 24 and 25 in such a direction as to set up a polarity as indicated on these magnets, through wires 55 and 56 to coils 19 and 20 on the inductor 15, through these coils in opposite direction thereby setting up a substantially zero flux effect in inductor 16, through wires 57 and 58, through wire 59 back to source of energy 46. The coil 22 on inductor 21 is connected by means of wires 60 and 61 in series with the winding 42 on relay 40.

I will now proceed to describe the operation of the device as the train passes by a section which is clear and in which it is not desired to cause the AV valve to operate. As the train passes along the track the inductor 15 will approach the end post 3 in rail 1. As the inductor approaches this end post a flux will be set up in leg 16 of the inductor and will reach its maximum at a point where the leg 16 is immediately adjacent to end post 3, but has not passed over it. The voltage thus set up in coils 19 and 20 will have a relatively low amplitude but a long time ordinate as shown at 62 in Figure 2. As the core 16 passes across the end post 3 there will be a complete reversal of the flux in the inductor 15 from a maximum in one direction to a maximum in the reverse direction setting up a voltage in the core of 19 and 20 of high amplitude and short duration as indicated by the portion 63 of the curve shown in Figure 2. This effect will be augmented by means of the extended pole pieces 17 and 18, the flux following the path shown by dot and dash line 64. The voltage thereby generated will be additive in the two coils 19 and 20, and will send current from coil 20 via wire 56, through magnet 25, wire 54, coil 33, wire 51, wire 52, coil 32, wire 53, magnet 24 and wire 55 back to coil 19. Of course, the common terminal of coils 19 and 20 is normally connected, through a path including battery 46, contact 45 of relay 40, coil 41, contacts 37—38 of relay 23, and the AV valve, with the common terminal of coils 32 and 33, but with relation to the voltage induced in coils 19 and 20 by the magnet 7 in the trackway, the common terminal of coils 19 and 20 and the common terminal of coils 32 and 33 are at the same potential, so that the voltages induced in coils 19 and 20 have no effect upon the current through the path just traced. But the current which flows through magnet 24, coils 32 and 33, and magnet 25, due to the voltages induced in coils 19 and 20 results in weakening magnet 25 and the effect of coil 33 on armature 30 and strengthening magnet 24 and the effect of coil 32 on armature 30. This will set up a torque in armature 30 due to unbalancing of the magnetic system, and will cause it to operate, thereby forcing the contacts 37 and 38 apart. This in its turn will open up the circuit first traced for current from battery 46, de-energizing the AV valve and opening contact 45. Immediately after the inductor 15 has passed the end post 3, contacts 37 and 38 will again close due to their initial spring tension. The local circuit, however, will remain open through the contact 45, and the AV valve will remain de-energized. The end post 4, however, in rail 2 is placed somewhat in advance of the joint 3 in rail 1. When the track is clear the track magnet 10 is energized and, therefore, a voltage will be set up in coil 22 on inductor 21 in a similar manner to that described in the case of coils 19 and 20 on inductor 15. This voltage will pass through coil 42 and will attract armature 44 again re-establishing front contact 45 and closing the local circuit, thereby re-energizing the AV valve and maintaining a clear or proceed condition. It is preferable to construct the AV valve with slow acting characteristics so that the valve will remain in its energized condition during the brief interval of time following the interruption of the circuit for the valve when the inductor 15 passes a joint 3 and prior to the resetting of the apparatus when the inductor 21 passes the adjacent joint 4. Should the stop indication be in order it will be apparent that the TR relay must be de-energized. The contact 12 will then open and the electromagnet 10 will be de-energized. In this event there will be no re-establishing impulse and the relay 40 will remain de-energized, leaving contact 45 open and leaving the AV valve de-energized to accomplish whatever functions are desired. The coil 22 on inductor 21 is so connected to coil 42 on relay 40 that if the permanent magnet 7 should become defective and fail to operate the relay 23 as intended, the inductor 21 will act as a tripping inductor. That is, the polarity of the main impulse as indicated in 63, Figure 2, will be such that it will neutralize the polarity set up in the local winding of the relay, thereby dropping the armature 44, opening contact 45 and setting up a stop or danger indication.

By referring to the drawing, it will be seen that should any coil in the local circuit become short circuited or open, or should the source of energy 46 become disconnected, in the one case, the relay 23 will operate to give a stop indication and in the latter case the

AV valve will become de-energized, thereby giving a stop indication. It is, therefore, apparent that with the circuit and apparatus as shown and described a system has been provided, the integrity of which is continually being checked and that in the event of failure of any of the vital parts in the system a stop indication will be received.

While I have shown and described one form of my invention, it will be understood that many modifications may be made in details of construction without departing from the spirit of the invention.

What I claim is:—

1. A system of train control comprising, a running rail of magnetic material, a non-magnetic break in said running rail, means for setting up poles of opposite polarity on either side of said non-magnetic break, and a T shaped inductor adapted to be carried by a vehicle and to be responsive to the flux conditions set up about said non-magnetic break.

2. A system of train control comprising a train carried relay having a movable member, two magnets arranged when energized to move the member in opposite directions, a train carried inductor having two coils, a source of energy on the train normally supplying current to said coils in opposition and to said magnets so that their effects upon the movable member are balanced, and a source of magnetic flux located in the trackway for at times inducing additive voltages in the two coils to destroy the balance of the magnets and move the member.

3. A system of train control comprising a train carried relay having a movable member, two normally balanced magnets urging the member in opposite directions, a running rail of magnetic material, a non-magnetic break in said rail, means for setting up poles of opposite polarity on either side of the break, and a T-shaped inductor carried on the train and responsive to the magnetic conditions set up about said break to at times destroy the balance of said magnets and move the member.

4. A train control system comprising a train carried relay having two magnets, an armature urged in opposite directions by said magnets, an inductor having two coils, a circuit including the two magnets and the two coils in series, a source of energy, means controlled by the armature for connecting the source between a common terminal of the coils and a common terminal of the magnets, and means located in the trackway for at times inducing additive voltages in the two coils to send a current through the magnets thereby varying the current normally supplied to the magnets by the source.

5. A train control system comprising two train carried magnets, a movable member responsive to the relative strengths of said magnets, a train carried inductor provided with two coils, means for normally supplying current to the two magnets in series with the two coils, respectively, in such manner that the fluxes created by said coils are in opposition, and means located in the trackway for co-operating with said inductor to induce in the coils additive voltages which create current in the magnets to vary the relative strengths of the magnets.

6. Railway traffic controlling apparatus comprising a train carried relay having two electromagnets, a train carried inductor having two coils, means for connecting one terminal of one coil with a terminal of one said electromagnet, means for connecting a terminal of the other coil with a terminal of the remaining electromagnet, a source of current having one terminal connected with the free terminals of said coils, means for connecting the other terminal of said source with the remaining terminals of said electromagnets, governing means responsive to the relative magnitude of the currents in the electromagnets, and a source of magnetic flux located in the trackway for at times inducing additive electromotive forces in said coils to decrease the current in one said electromagnet while increasing the current in the other electromagnet.

7. Railway traffic controlling apparatus comprising a train carried relay having two electromagnets, an inductor comprising a core provided with two coils, a source of current, a circuit including one said electromagnet and one said coil, a branch for said circuit around said one coil and one electromagnet including the other coil and the other electromagnet, the two coils being arranged in such manner that the fluxes created in said core by current from said source are opposite in direction and substantially equal in magnitude, a source of unidirectional magnetic flux in the trackway for at times linking both said coils with a rapidly reversing flux to diminish the current through one said electromagnet while increasing the current through the other electromagnet, and governing means on the train responsive to the relative magnitude of the currents in said electromagnet.

8. A system of train control comprising a normally closed train carried contact, a train carried relay, a train governing device; a first train carried inductor, a plurality of devices located at intervals along the trackway each in turn cooperating with said first inductor to open said normally closed contact for a brief interval, means controlled by said normally closed contact and by a front contact of said relay for energizing said relay and said device, a second inductor on the train, and means located in the trackway in advance of each said trackway device for co-operating with said second inductor to de-

energize said relay if the relay is energized but to energize the relay if it is de-energized.

9. A system of train control comprising a normally closed train carried contact, a train carried relay, a train governing device; a permanent magnet located in the trackway, a first inductor on the train cooperating with said permanent magnet to briefly open said normally closed contact, an electromagnet in the trackway in advance of said permanent magnet and controlled by traffic conditions, a circuit for said device and a winding of said relay including said normally closed contact and a front contact of said relay as well as a source of energy, and a second inductor on the train having a winding connected with a second winding on said relay and cooperating with said electromagnet in such manner that the effect of the current created in said relay when the second inductor passes said electromagnet substantially neutralizes the current supplied to said one winding of the relay over said circuit but in such manner that said relay becomes energized if it is de-energized when the second inductor passes said electromagnet.

In testimony whereof, I have signed my name to this specification.

OSCAR S. FIELD.