G. P. THURBER.

TRAIN CONTROL SYSTEM.

APPLICATION FILED DEC. 20, 1915.

1,236,624.

Patented Aug. 14, 1917.

2 SHEETS—SHEET 1.

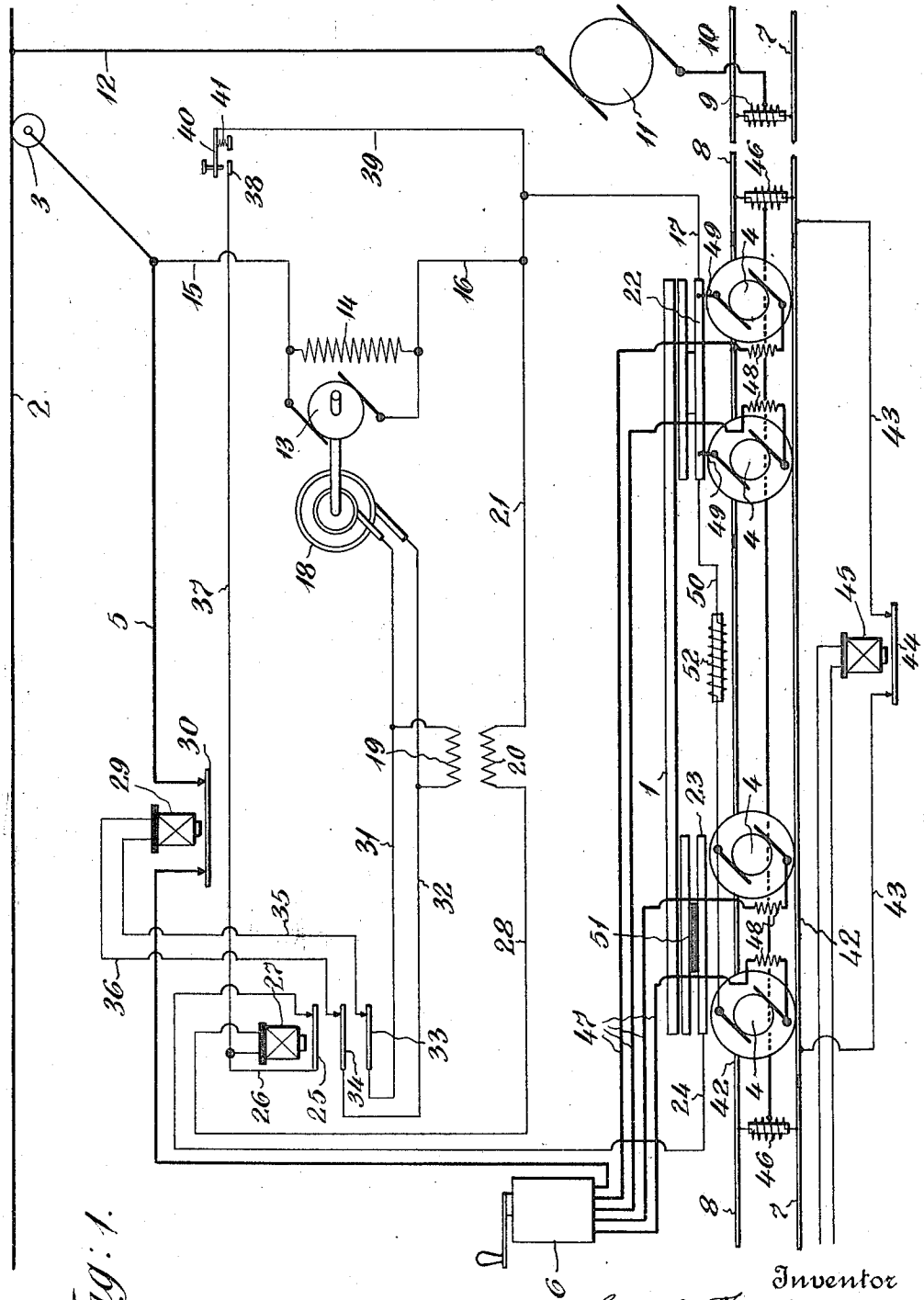

Fig. 1.

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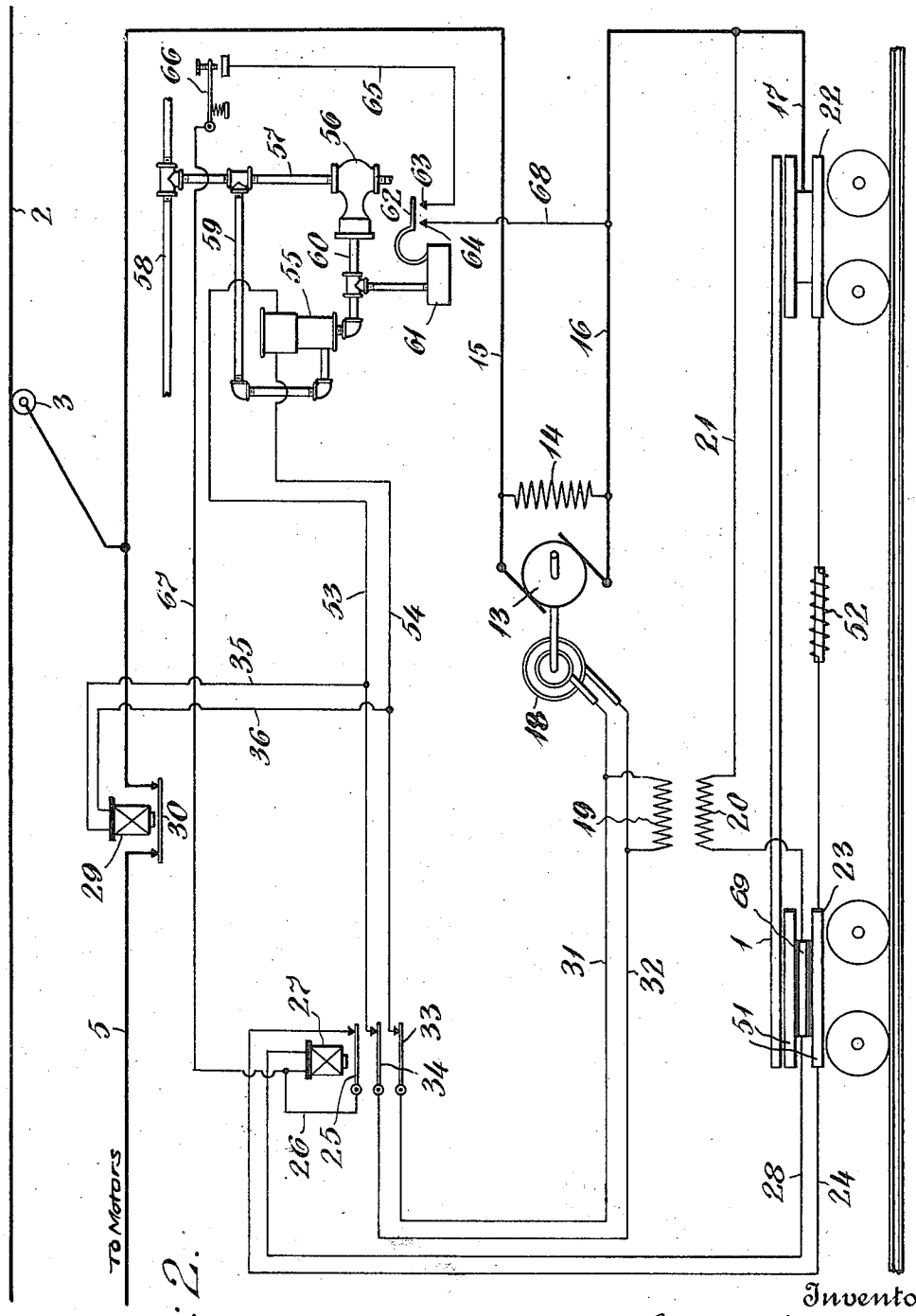

Fig. 2.

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TRAIN-CONTROL SYSTEM.

1,236,624. Specification of Letters Patent. Patented Aug. 14, 1917.

Application filed December 20, 1915. Serial No. 67,740.

To all whom it may concern:

Be it known that I, GUY P. THURBER, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Train-Control Systems, of which the following is a specification.

This invention relates to an electrically controlled railway system in which electric propulsion is employed, and has for an object to control the trains through an electric train controlling circuit, in such a manner that the currents of the propulsion and train controlling circuits will not interfere with each other.

A feature of the invention is to control the train by a system of normally closed train-carried circuits so arranged that any failure of the circuits will operate the train controlling mechanism. The degree of control exercised may vary under different conditions, but preferably any abnormal condition will take the control of the train out of the hands of the engineer and automatically stop the train.

This invention employs the system of train controlling circuits disclosed in Patent No. 1,195,534, Aug. 22, 1916, and this application is a continuation in part of the application which matured into Patent No. 1,195,534.

The accompanying drawings, in which like reference characters indicate like parts, show in Figure 1 a diagrammatic view of an electrically propelled and controlled railway car embodying the invention; Fig. 2 is a modified form of the invention.

In Fig. 1, 1 may represent an electric car receiving current from a trolley wire or third rail 2 through the trolley 3. This current may be of any suitable character and is conveyed to the traction motors 4 by way of the conductor 5 in which is interposed the usual controller 6. The traffic rails 7 and 8 form a return path for the current and are connected through the impedance bond 9 and conductor 10 to the generator 11. A conductor 12 connects the generator 11 to the trolley wire or third rail 2.

Carried on the train is a controlling circuit which may control the train, either by the operation of signals, or by controlling the brakes or power. This circuit is normally charged from a suitable source of supply furnishing a current having a different characteristic from that of the propulsion current. Thus, if the propulsion current is a single phase current of a certain frequency, the current of the train circuit may be a single phase current of a different frequency.

The source of supply for the train controlling circuit may be of any suitable nature. Preferably energy derived from a part of the propulsion current is utilized to produce a current having a different characteristic from that of the propulsion current itself. In the form shown a rotary transformer 13 having a shunt field winding 14 operates at a constant speed to furnish current having a constant value for the train controlling circuit. The rotary transformer 13 is supplied with current from the propulsion circuit by means of the conductor 15. Another conductor 16 leads from rotary transformer to a ground 17 on one of the trucks.

The modified current produced at the collector rings 18 feeds the primary 19 of a transformer. The secondary 20 of the transformer is connected by means of a conductor 21 to the ground connection 17 on the truck which has been already referred to. Current flowing from the conductor 21 into the truck 22 will flow from the truck into the rails 7 and 8 into truck 23 and from truck 23, to conductor 24, thence to armature 25, thence to conductor 26, thence through circuit controller 27 and back through conductor 28 to the secondary 20 of the transformer. The circuit just described may be fittingly termed the main train controlling circuit, since the automatic control of the car, or train, depends wholly upon the condition of this circuit.

The circuit controller or stick relay 27 controls in turn a subsidiary power controlling circuit and also controls the circuit in which it is placed since its own armature is in the same circuit. A circuit breaker 29 controls an armature 30 normally forming part of the propulsion conductor 5. The circuit breaker 29 is normally held in energized condition by means of current received from the collector rings 18 through the conductors 31 and 32, armatures 33 and 34 of circuit controller 27, and conductors 35 and 36 leading from the front contacts of the stick relay 27 to the circuit breaker 29.

The armatures 33 and 34 are, as shown, under the control of the circuit controller 27, and, when the latter is deënergized by the rupture of the main circuit, the armatures 33 and 34 drop and thereby break the subsidiary power controlling circuit just described thus deënergizing the circuit breaker 29. This causes the armature 30 to drop to open the propulsion circuit through the conductor 5, but it will be observed that the supply of current to the rotary transformer 13 is not disturbed and continues uninterruptedly.

Any suitable means may be provided for restoring the broken circuits, but in the present instance there is provided a conductor 37 connected to the conductor 26 at one end and terminating at its other end in the contact 38. Leading from the conductor 21 is a conductor 39 terminating in a circuit closer 40 normally held out of engagement with the contact 38 by means of the spring 41. When the circuit closer 40 is brought into engagement with the contact 38 the following restoring circuit is established. From the secondary 20 of the transformer, to conductor 21, to conductor 39, to circuit closer 40, to contact 38, to conductor 37, to circuit controller 27, to conductor 28 and back to secondary 20.

The establishing of this circuit will energize the circuit controller 27 and cause it to pick up armatures 25, 34 and 33 thereby reestablishing its own circuit and the circuit through the circuit breaker 29, unless there is a break down in the system, or unless other conditions prevent it, in which case the circuits will remain broken.

In order to control the main controlling circuit, insulated sections 42 such as are shown in the co-pending application already referred to, are provided in the track rails 7 and 8 which divide the track into block sections. By this means the train controlling circuit, which is normally completed through the track rails, may be broken to thereby control a car or train, passing over an insulated section.

In order to prevent the operation of the train controlling apparatus when a car passes over the insulated section under safety conditions a current path may be provided which is adapted to connect the insulated section to a rail of a block section in order to nullify the effect of the insulation in the rail. This path takes the form of a jumper circuit, or conductor 43 connected to the rail 7 at one end and to the insulated section 42 at the other. A circuit controller 44 is normally included in this conductor and is under the control of the track relay 45 responsive to conditions in the block ahead of the train. This relay is controlled by alternating signal current which is impressed on each block section and is prevented from passing from block to block by means of impedance bonds 46 which connect the block rails at each end of the insulated section and provide a path for the propulsion current around the insulated section.

It will be obvious that a deënergization of the relay caused, for instance, by the presence of a train in the block ahead, will result in an interruption of the main train controlling circuit as a car passes over the insulated section.

The propulsion current is led from the controller 6 through conductors 47 to the field windings 48 of the motors 4. The armatures of the motors 4 of the rear truck 22, which is uninsulated from the car, are grounded on the truck itself through the conductors 49. The armatures of the motors of the forward truck which is insulated from the car body are also grounded on the frame of the rear truck through the conductor 50. It will be noted that the motors 4 of the insulated truck are below the insulated portion 51 thereof, and in order to prevent the train controlling circuit from passing around the insulation 51, it is necessary to use an impedance 52. This impedance connects the forward and rear trucks and is connected to the insulated truck 23 at a point below the insulation 51.

By this means the propulsion current returns freely to ground from the motors 4 on the insulated truck 23, while completion of the main train controlling circuit through this ground circuit is prevented. It will be obvious that, if the train controlling circuit should be able to pass around the insulation 51, or across from one truck to another, without going through the track there would be no way of rupturing said train controlling circuit when a broken jumper circuit is reached. The insulation 51 therefore constitutes means for forcing the train controlling circuit through the track rails and jumper circuit, and the impedance 52 constitutes a means for grounding the propulsion current on the truck 22 while at the same time preventing the completion of the train controlling circuit through the ground conductors for the motors. It is also to be noted that the field winding 48 and the armature windings of the motors 4 form an impedance that effectually prevents the train controlling circuit from passing up through a pair of the conductors 47 from one of the trucks 22 or 23, through the controller 6 and back through the remaining pair of conductors 47 to the other truck and thence to the rails thus forming a current path around the insulation 51.

In Fig. 2 is shown a modified form of train controlling circuit which differs from the device shown in Fig. 1 in the inclusion of a brake controlling device, and a timing

mechanism for preventing the closing of the ruptured controlling circuits until a definite time has elapsed. The arrangement of the propulsion and train controlling circuits is the same as in Fig. 1.

The train, or car 1 as in Fig. 1 has an insulated truck 23 and an uninsulated truck 22, and receives power from the conductor 2, through trolley 3 and conductor 5 which leads to a controller, not shown, as in Fig. 1. The rotary converter 13 receives current from the trolley 3 through conductor 15 and is grounded by means of conductor 16. The modified current is taken from the collector rings 18 and feeds the transformer primary 19, the secondary 20 of which furnishes current for the main controlling circuit which has included in it the circuit controller 27. As in Fig. 1 the main controlling circuit normally includes a portion of the track rails.

Controlled from the main controlling circuit just as in Fig. 1 is the circuit breaker 29. Branching off from the conductors 35 and 36 which lead to the circuit breaker 29, are the conductors 53 and 54, which lead to a magnet valve 55 arranged to control a valve 56 disposed in an exhaust pipe 57 leading from the train pipe 58. The magnet valve 55 is disposed in a branch pipe 59 leading from the pipe 57 and adapted to supply fluid under pressure to hold the exhaust valve 56 in closed condition while the magnet valve 55 is supplied with current. Upon the breaking of the circuit through the magnet valve 55 the fluid under pressure normally holding the valve 56 is exhausted from the pipe 60 whereupon the valve 56 opens the passage through the exhaust pipe 57 to vent the train pipe 58.

As in Fig. 1 means are provided whereby the engineer can restore the broken circuits but in the device shown in Fig. 2 this cannot be accomplished until a definite time has elapsed after the automatic application of the brakes.

The timing means employed preferably takes the form of a Bourdon tube 61 normally held in expanded condition by fluid under pressure supplied from the pipe 60. The Bourdon tube carries a bridging contact 62 adapted when there is no pressure in the Bourdon tube to make contact with the contact points 63 and 64. Contact 63 is disposed in a conductor 65 leading to a manually operable switch 66. Leading from the switch 66 is a conductor 67 which is connected to the conductor 26. Leading from the outer contact 64 is a conductor 68 which is grounded on the truck 22.

The Bourdon tube 61 can be adjusted to require a predetermined interval of time for its operation so that current through the restoring circuit cannot be supplied for a definite time interval after the automatic application of the brakes. When, however, this time interval has elapsed the engineer can by closing the switch 66, reënergize the circuit controller 27 through the following circuit; secondary 20, conductor 28, circuit controller 27, conductor 67, switch 66, conductor 65, contact 63, bridging contact 62, contact 64, conductor 68, and conductor 21 back to transformer 20. As will be obvious the closing of the circuit described will energize the magnet 27 to close the train controlling circuits.

In this figure the main train controlling circuit has included in it an insulation break down detector 69 which will cause the circuit referred to to be affected by the leakage of current through the insulation between the truck 23 and the body of the car. This would result in the operation of the train controlling devices already described.

What is claimed, is:

1. An electric propulsion and controlling system comprising a car, propelling means therefor, a propulsion circuit, means for utilizing the energy of a portion of the current of the propulsion circuit to produce a current of a different characteristic, a normally closed train controlling circuit on the car supplied by said current, a circuit breaker for the propulsion circuit normally energized by the train controlling circuit which when deënergized ruptures the supply of propulsion current to the propelling means for the car without rupturing the supply to the current producing means, a circuit breaker for the train controlling circuit energized by the train controlling circuit and normally holding the said train controlling circuit closed, means for rupturing the train controlling circuit thereby deenergizing the said second circuit breaker, and means for restoring the train controlling circuit thereby energizing both circuit breakers and restoring the propulsion circuit.

2. A car, a metallic member on the car insulated both from the truck of the car and from the body thereof, a car circuit completed through said metallic member and through the track, a propulsion circuit having a current of a different characteristic from that of the car circuit using the track as a return, and a path for the propulsion circuit adapted to permit the flow of current having the characteristic possessed by the current in the propulsion circuit but preventing the flow of the current in the train control circuit and bridging both the metallic member and the insulation surrounding the same.

3. In an electrically propelled and controlled railway system, a train having an insulated and an uninsulated truck spaced apart in the direction of the length of the train, a source of current on the train, a normally closed train circuit charged from said

source and completed through the traffic track, a propulsion circuit, having a current of a different character from that of the train circuit utilizing the track as a return path, and means, bridging the insulated truck, forming a path for the propulsion circuit, and impermeable to the train circuit.

4. An electric propulsion and controlling system comprising a train propelling means therefor, a propulsion circuit, means for utilizing the energy of a portion of the current of the propulsion circuit to produce a current of a different characteristic, a circuit supplied by said current having included in it the primary of a transformer, a normally closed train controlling circuit on the train having included in it the secondary of the transformer, a circuit breaker for the propulsion circuit normally energized by the train controlling circuit which when deënergized ruptures the supply of propulsion current to the propelling means for the train without rupturing the supply to the current producing means, a circuit breaker for the train controlling circuit energized by the train controlling circuit and normally holding the said train controlling circuit closed, means for rupturing the train controlling circuit thereby deënergizing the said second circuit breaker, and means for restoring the train controlling circuit thereby energizing both circuit breakers and restoring the propulsion circuit.

5. An electric propulsion and controlling system comprising: a train, a propulsion circuit, means for utilizing the energy of a portion of the current of the propulsion circuit to produce a current of a different characteristic, a normally closed train controlling circuit on the car supplied by said current, train controlling means controlled by the train controlling circuit, means for affecting said train controlling circuit to operate said train controlling means, means for restoring the train controlling means to normal condition, and means for preventing the restoration of the controlling means to normal condition until after a predetermined interval of time.

6. An electric propulsion and controlling system comprising: a train, a propulsion circuit, means for utilizing the energy of a portion of the current of the propulsion circuit to produce a current of a different characteristic, a normally closed train controlling circuit on the train supplied by said current, braking means on the car controlled by the train controlling circuit, a circuit breaker for the propulsion circuit normally energized by the train controlling circuit, means for affecting said train controlling circuit to operate said braking means and said circuit breaker without affecting the supply of current to the modifying means, restoring means, and means for placing the restoring means in condition to be operated after a certain interval of time.

7. An electric propulsion and controlling system comprising: a train, a propulsion circuit, means for utilizing the energy of a portion of the current of the propulsion circuit to produce a current of a different characteristic, a circuit supplied by said current and having included in it the primary of a transformer, a normally closed train controlling circuit having included in it the secondary of the transformer, train controlling means controlled by said train controlling circuit, means for affecting said train controlling circuit to operate said train controlling means, means for restoring the train controlling means to normal condition, and means controlled by said train controlling means for preventing the restoration of the controlling means to normal condition until after a predetermined interval of time.

Signed at Pittsburgh, in the county of Allegheny and State of Pennsylvania this 11th day of December A. D. 1915.

GUY P. THURBER.

Witnesses:
MAX H. SROLVITZ,
CATHARINE LYNCH.