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METHOD FOR AUTOMATICALLY SIGNALING AND CONTROLLING TRAINS ACCORDING TO THE POSITION OF TRACK SWITCHES

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Fig. 1.

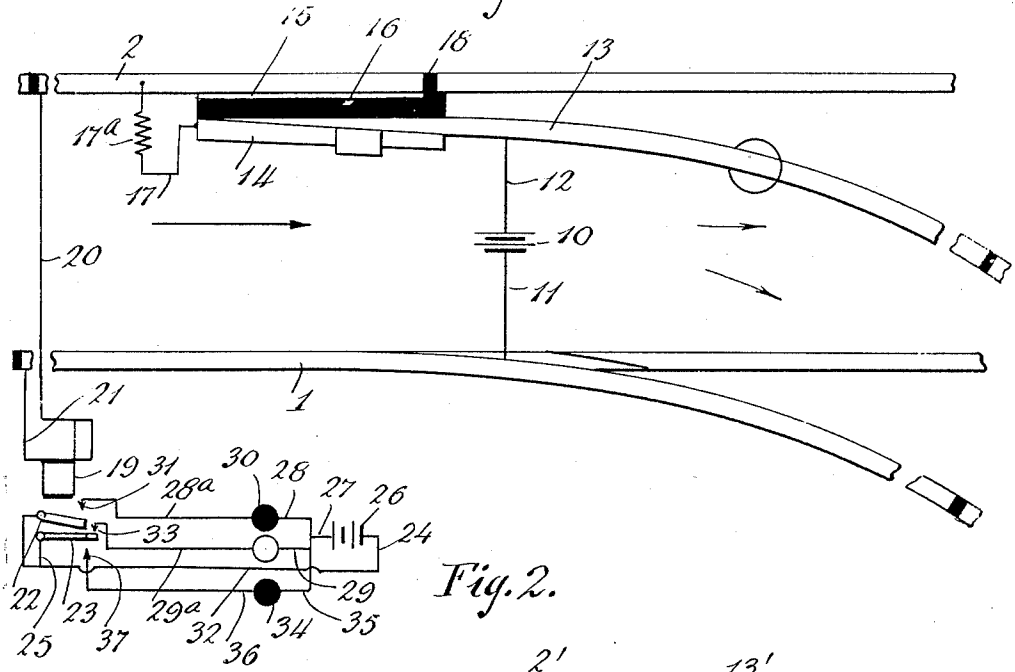
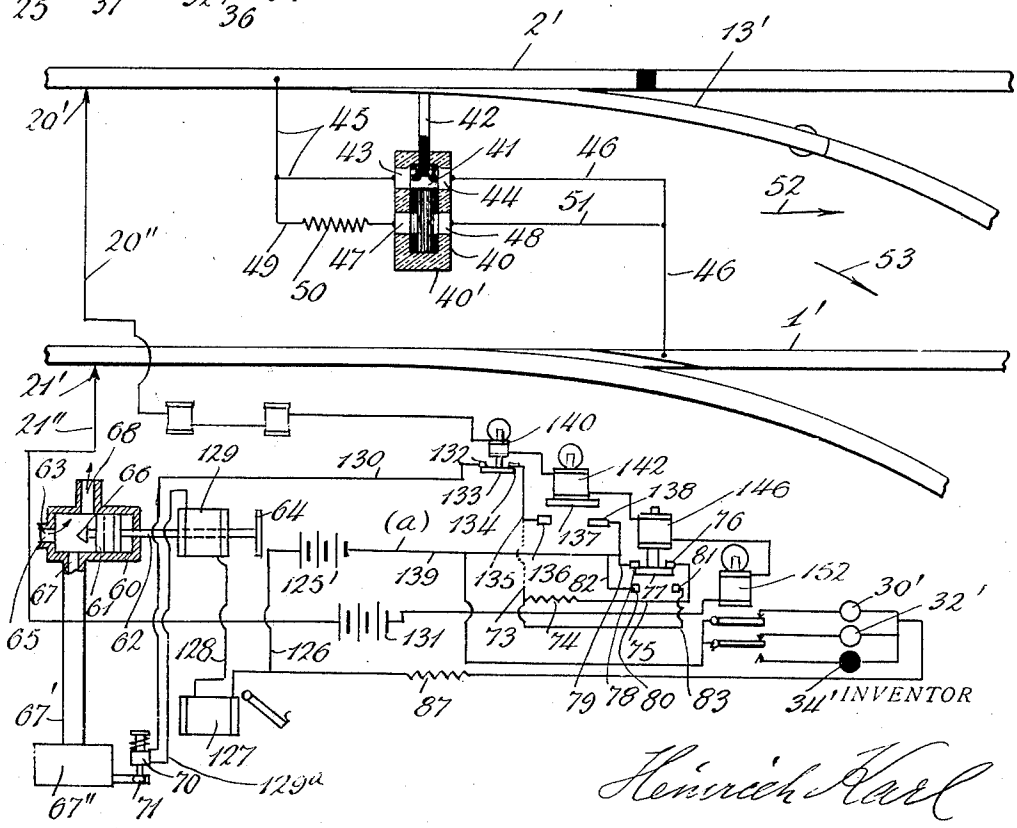


Fig. 2.



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METHOD FOR AUTOMATICALLY SIGNALING AND CONTROLLING TRAINS ACCORDING TO THE POSITION OF TRACK SWITCHES

Application filed February 15, 1928. Serial No. 254,502.

Part of this invention has been the subject of my co-pending application, Serial No. 59,917, filed October 1, 1925, of which division was required.

More particularly, this invention is created for preventing trains from derailing or being torn apart by signaling them and at the same time stopping them, or by reducing their excessive speed if such danger is at hand through an imperfectly closed or imperfectly opened track switch. These imperfect positions of the switch tongue may be caused by stones, mud or ice, etc. settling between the switch tongue and the rails etc. whereby the free movement of the switch tongue is obstructed. Another object of the invention is to signal the train of the position of the track switch, that is, if open or closed and to exert also a certain control upon the train entering the block in which the track switch is located. The control is performed through the electric current and therefore certain electric connections are brought in connection with the track switches. In this invention there are two forms or modifications shown of which one, which is shown in Figure 1 of the accompanying drawings, is so designed that the source of electric current is situated at the roadside, which arrangement serves especially when the control upon the train is a continuous one. The other arrangement which is shown in Figure 2 serves on such railroad lines where the source of the controlling current is situated on the train and as in this event the control is performed mostly on predetermined control points, such as on block entrances, etc., the electric connections differing somewhat from those shown in Figure 1. In Figure 2 there is also shown a device whereby the electric contacts are confined in a tube which serves for protecting them from weather and other influences etc.; this device which will be described later can be employed also in connection with the system of Figure 1.

Referring more particularly to Figure 1, the source of current is indicated by 10 and is represented as a track battery. However, any other source of current can be employed, such as the current of a generator conducted along the railroad line by means of a wire etc. and impressed upon the rails in a suitable manner; and this current may be A. C. if the control system on the trains is designed to respond to such current.

Connected to said battery 10 is a wire 11 which is also connected to the traffic rail 1 which might be a continuous rail as it is sometimes used in certain automatic control systems. To the negative side of the battery 10 is connected the wire 12 which is also connected to the switch tongue 13. This track battery 10, however, might be located at the end of the block to which the curved track rails lead to, and the wire 12 must then be connected to the left side traffic rail. See arrow for direction of traffic. This switch tongue is so arranged that it moves within certain bounds on the usual switch-bed which, however, according to Figure 1, is provided with certain electric contacts 14, 15 and an insulation 16 that is placed between these contacts. This insulation must be of such width that none of said contacts 14, 15 will be contacted by the switch tongue 13 when it is midway between these contacts in which position the wheel flanges of the train would ride on the crest of the switch tongue and thereby cause a derailment. The contact 15 may be formed by the track rail 2.

To the contact 14 is connected the wire 17 which includes a resistance 17^a of a predetermined amount of ohms, and this wire is also connected to rail 2. Rail 2 of the block is limited by the insulations 18 and at the entrance end of the block may be situated the usual block signal which, however, may be dispensed with if cab signals are employed on the trains. Such signals, either the track-side signals or the cab signals if they are designed on the safe side, will go to "danger" position if the track circuit is interrupted and as such interruption of the circuit would take place when the switch tongue 13 does not contact either with the contacts 14 or 15 the respective signal would then go to danger position. In this event, there would be also effected the stopping mechanism of the train entering this block so that the train would come to a stop before it reaches this

track switch. Although I have disclosed several train control systems which are pending patent applications, I do not limit myself by pointing to a certain system since there are many systems already known in the art which could serve in connection with the present invention. However, for fully comprehending the invention, reference is made to the disclosure in connection with Figure 2 of the present invention that will be described later.

Whenever the switch tongue 13 contacts with contact 15 then the full current of the track circuit flows through the track rails of the block and if no train should be situated in that block that, of course, would short circuit this circuit; this current will then energize the track relay 19 whose winding is electrically connected to rail 2 by means of the wire 20 and to rail 1 by the wire 21. Relay 19 may be of the usual construction but in the case where the position of a track switch is to be signaled a third indication is to be made by the signal and this is when the switch tongue contacts with the contact 14 which means that the switch is open. For this purpose, I arrange a second armature indicated by 23 which is much lighter than the armature 22. Armature 22 will be attracted only when the full current flows through the traffic rails and the winding of the relay 19, while only the armature 23 will be attracted when the current is forced to flow through the resistance 17^a because there will be a weaker energization of the track relay 19. A wire 24 is connected to the armature 22 or pivot thereof and by means of the wire 25 is also in electric connection with the armature 23. Wire 24 is connected to a battery 26 and at the opposite pole thereof is connected the wire 27. To wire 27 are connected two branch wires 28, 29, respectively. In connection with wire 28 there is the signal 30 that signals "switch closed". This signal is therefore connected by a wire 28^a that terminates at the contact 31 which will be contacted only by the armature 22 when it is fully attracted by the relay solenoid 19, in which event the circuit will be closed in which the signal 30 is included. In connection with wire 29 there is another signal, indicated by 32, and a wire 29^a is connected to this signal and to the contact 33 that will be contacted only be the armature 23 when it is fully attracted by the relay solenoid 19, and in this event the circuit will be closed that includes this signal 32. It is thus shown that signals 30 and 32 are lighted simultaneously when the switch is closed and that only the signal 32 is lighted when the switch is open. There is still another signal indicated by 34 which serves as the "danger signal". A wire 35 is therefore connected to this signal and to wire 29 or directly to wire 27, and a wire 36 is connected to this signal and to a contact 37 which will be contacted by the armature 23 when the latter is in its dropped position which will be the case when the switch tongue 13 neither contacts with contact 15 (or rail 2) nor with contact 14, or when the electric energy of the track battery 10 should be exhausted. The armature 23 then closes the circuit that lights the signal 34. In the drawing, the signals 30, 32 and 34 are simply represented as light signals and according to the code in the United States, signal 30 should be of green color, signal 32 of yellow or orange color and signal 34 of red color. Assuming that only cab signals are employed on that railroad for signaling the position of the track switches, a somewhat similar arrangement would be necessary, as that illustrated in Figure 2 of the present invention whereby however the battery 131 must be excluded from the circuit and referring to the other solenoids indicated by 140, 142, 146 they may be included in the circuit if there is a train control system arranged on the train. Instead of the relay 19 there would be the relay 152 (see Figure 2) and instead of the signals 30, 32 and 34 and electric connections thereof there will be the signals 30′, 32′ and 34′ on the locomotive or motor car, and instead of the wire 20 a contact will be in contact with the first left side wheel of that locomotive as simply indicated by the arrow 20′, and instead of the wire 21 there is a contact 21′ that will be in contact with the first right side wheel of that locomotive. To these contacts will then be connected the wires 20″ and 21″, respectively, which are then directly or indirectly electrically connected with the winding of the solenoid 152. In order to prevent short circuit of the track circuit, it will be necessary that an insulation be placed in the wheel axle of these first wheels of the locomotive or motor car and also in the axles of the other wheels of this first train unit, or that a very strong resistance be made between these first wheels of the train. Such resistance could be made by nickel-plating the axle of these wheels. In order to receive correct signals also when the locomotive or motor car should be turned in the inverse direction whereby the normally rear wheels of the locomotive or tender thereof, etc., would be the first wheels, a wire may be connected to a contact on the last left side wheel of the locomotive or tender or motor car and to wire 21″, and to a contact that contacts with the last right side wheel of that locomotive or tender or motor car a wire should be connected that must be connected also to the wire 20″ and besides this the axle of these last wheels of the locomotive or tender thereof or motor car should also be so insulated or should receive such resistance that it would not short circuit the track circuit current when the locomotive or motor car is turned

in the reverse direction in which then these normally last wheels of the locomotive, etc., would then be the first ones of the train.

It is obvious that by introducing electromagnetically operable train control devices in a circuit that is controlled by the electromagnets 140, 142, a completely safe automatic train control system will be created thereby. An automatic train control device that could serve in this case is disclosed in my United States Patent No. 1,649,597 of November 15, 1927.

Referring further to Figure 2 the scheme is somewhat similar to that shown in Figure 1, in so far as there is also the full current sent through the traffic rails of the block when the switch tongue 13′ contacts with the rail 2′ and that a current will flow through these traffic rails that is diminished in potential when the track switch is completely open and that no current will flow through the block traffic rails when the switch tongue does not resume the correct positions as defined as closed, or completely open.

In order to exclude any interference from external influences the electrical contacts in connection with the track switch are confined in a tube 40 that is made of an insulating material such as glass etc. A piston-like contact part 41 is arranged for moving within the hollow part thereof and to contact thereby with certan electric contacts or with the insulation of the tube in accordance with the position of the switch tongue. To this effect said contact part 41 (which may have as well a different shape) is connected to the rod 42 which must be insulated from the contact 41. Rod 42 is also connected to the switch tongue 13′ in such a manner that it cannot be deranged or broken by the train wheels, that is, by the flanges thereof. In the walls of the tube 40 that should be closed at the end 40′ two electric contacts 43, 44 are so arranged that they will be contacted simultaneously by the contact 41 when the switch tongue 13′ is completely closed, that is when the switch tongue contacts with the rail 2′. To contact 43 is connected the wire 45 which is again connected to rail 2′. To contact 44 is connected the wire 46 which is also connected to rail 1′. A certain distance from the contacts 43, 44 are arranged the contacts 47, 48 which are electrically separated by the insulating material of the tube 40 and which are electrically contacted by the contact part 41 when the track switch is completely open whereby the switch tongue by going to this position pushes the rod 42 and therewith the contact part 41 so far into the tube that this contact part comes out of contact with the contacts 43, 44 but comes into contact with the contacts 47, 48. To the contact 47 is connected the wire 49 which includes a resistance 50. Wire 49 is connected to wire 45 or directly to rail 2′. To the contact 48 is connected the wire 51 which is connected to wire 46 or directly to traffic rail 1′. By connecting wire 46 to a battery in a suitable manner and the other pole of the battery with the rail 1′, a control or signaling could be made in the sense as explained in connection with Figure 1. In Figure 2, however, it is assumed that the electric current that serves for operating the various signaling or automatic control devices is situated on the train and consequently is sent therefrom through the traffic rails of one or several blocks or sections ahead of the train. A minutely described system of this character is the subject of my automatic train control system, Serial No. 59,917, filed October 1, 1925, or of my patent application, Serial No. 149,659 that was filed November 20, 1926. In the latter application are described such systems that serve for continuously controlling the train.

In connection with Figure 2 of the present invention, however, only the general scheme will be indicated and the part of the train control very simplified.

On the train there are several electro-magnets (solenoids) of which 140 is very sensitive, that indicated by 142 is only responsive to a relatively strong current, as, for instance, the current of the track circuit that is not weakened by resistance. The solenoid 146 is already responsive to a current that may be weakened to a certain degree and the solenoid 152 may be responsive to all currents, because besides serving for the operation of cab signals as indicated previously, it may serve for operating a device that indicates the distances which another train may be apart from the train that carries these solenoids. This device is shown only in said application, Serial No. 59,917.

Assuming that the current of the battery 131 is sent through the windings of these solenoids, and impressed upon the traffic rails so that it must flow through those situated in advance of the train. The current will then flow through battery 131, wire 21″, contact 21′, the respective wheel therefor, rail 1, wire 46, and if the switch is completely closed, through contacts 44, 41 and 43, through wire 45, rail 2′, back to the train's first left side wheel, contact 20′, wire 20″, through the windings of the solenoids 140, 142, 146, 152 and connecting wires thereto and to the battery 131.

The current energizes the solenoids 140, 142, 146 and 152 fully so that even the armature of solenoid 142 is attracted. This means that the circuit (*a*) that will be traced later is interrupted. This circuit is a normally closed one and thereby keeps the stopping mechanism normally ineffective. This stopping mechanism causes therefore the stopping of the train through the interruption of circuit (*a*) because it is assumed that the regular traffic should be in the direction of the arrow 52 while the switch would cause

the train to move in the direction of the arrow 53. Assuming, however, that the train had to go in the direction of the arrow 53, that is to say, that this direction is that of the regular traffic, the electric connections should then be changed somewhat and instead to place the resistance 50 in the wire 49 it should be placed in the wire 45 at a part that lays between the point of connection with wire 49 and the contact 43, or in the wire 46 between the point of connection with wire 51 and the contact 44.

Now it will be assumed that the regular traffic is in the direction of the arrow 52 and that the track switch is open, so that the contact 41 is in contact with the contacts 47, 48 and the current has to flow through the resistance 50, the solenoid 142 will then not be strongly energized and consequently will not attract its armature. Solenoid 140, however, will be sufficiently energized for attracting its armature despite the resistance 50 introduced in the circuit; the cab circuit (*a*) remains therefore closed. Circuit (*a*) includes the battery 125, wire 126, electro-magnet 127 of the electric brake, (which electromagnet may be any one of those employed for operating the brakes in the manner disclosed in my United States Patent No. 1,649,597 of November 15, 1927), wire 128, the solenoid 129 of the electro-magnetic air venting device, described later and employable in case where there is also the air brake employed on the train; then follows: the wire 129ª, electro-magnet 70, wire 130, contact 132, armature 133, contact 134 of the solenoid 140, wire 135, contact 136, armature 137 and contact 138 of the solenoid 142, wire 139 and battery 125. The electromagnetic air venting device consists of a cylindrical body 60 in which there is a piston 61 movably arranged therein. A rod 62 is secured to this piston and at the opposite end of this rod is secured the armature 64 of the solenoid 129 through the center of which the rod 62 is passed which therefore forms at the same time a core for this solenoid. At the left side end of the cylindrical body 60 there is an inlet port 63 for compressed air and a pipe 65 serves for conveying this compressed air from the train pipe to this inlet port 63. Secured to the piston 61 is a stopper 66 of the plug type which is so arranged that it normally closes the inlet port 63, that is to say, this stopper is pressed against the inlet port when the armature 64 is fully attracted by the solenoid 129 which takes place when the latter is fully energized by the current of circuit (*a*). In this event the armature pushes the rod 62 and piston 61 towards the left forcing the stopper 66 to cover the inlet port 63. In this position the piston 61 closes two exhaust ports or terminals of conduits that communicate with said cylinder 60. One of these ports, which is indicated by 67, communicates with a reservoir 67″ of a predetermined capacity and the other, indicated by 68, communicates with the atmosphere. Port 67 is nearer to the left side end of the cylinder 60 than the port 68. Assuming, now, that the solenoid 129 becomes completely de-energized, which happens when the armature 133 drops on account of the de-energization of solenoid 140 which takes place when the contact 41 neither contacts with the contacts 43, 44, nor with the contacts 47, 48 which shows that the switch tongue is in a position that endangers the train, the compressed air in pipe 65 exerting a strong pressure against the stopper 66 pushes it together with piston 61, rod 62 and armature 64 to the right whereby it passes through port 67 and pipe 67′ and enters the reservoir 67″ and remains there until circuit (*a*) is closed again, whereby the electro-magnet 70 which is included in the circuit (*a*) opens an air vent 71 that allows the compressed air in reservoir 67″ to escape to the atmosphere. The pressure of the compressed air in pipe 65 is such, however, that as soon as the reservoir 67″ is filled with compressed air the piston 61 will be moved still further to the right because there will not be any resistance from the part of the completely de-energized solenoid 129; the exhaust port 68 will then be opened by the piston whereby the compressed air rushes out to the atmosphere which means that the brakes will be strongly applied as it is known by those skilled in the art.

If it should be desirable that the so-called service application of the brakes be made automatically when the train has to proceed in the direction of the arrow 52 certain electric connections are made in connection with the electro-magnet 146 that serve for energizing the electro-magnet (solenoid) 129 to a degree in which the armature will be attracted sufficiently to exert as much counter-pressure to the air in pipe 63 that only the port 67 will be opened but the port 68 still kept closed by the piston 61. Said electric connections with the electro-magnet 146 are: the wire 73 that is connected to wire 135 of circuit (*a*), the resistance 74 that causes the reduced energization of solenoid 129, the wire 75, the contact 76, armature 77, and contact 78 of electro-magnet 146, and the wire 79 that is connected to the wire 139 of circuit (*a*). It is thus shown that a shunt is made in which the resistance 74 is included and that the circuit (*a*) with the exception of the contact 136, armature 137 and contact 138 and a part of the wires 135 and 139, is included in the circuit thus created. If it is not desired, however, that a service application of the brakes takes place automatically when the train has to proceed in the direction of the arrow 52 it will be simply necessary to increase the amount of ohms in the

resistance 50 to such a degree that the solenoid 146 will not be energized sufficiently for attracting its armature whereby, however, the solenoid 140 should be still sufficiently energized as to attract its armature. The armature 77 of solenoid 146 drops then upon the contacts 80, 81 which are connected by the wires 82, 83, respectively, which are connected to wires 73, 139, respectively, and a circuit will be closed that comprises all electric connections of that last mentioned circuit with the exception of resistance 74, wire 75, contact 76, contact 78, and wire 79. The solenoid 129 remains then fully energized.

Referring to the signals 30′, 32′ and 34′ that are operated through the armatures of the solenoid 152, it is scarcely necessary to explain the electric connections and function thereof, because they are practically of the same character as those described in connection with Figure 1. It may be mentioned only that instead of the battery 26 the battery 125 is included in the circuits and that a resistance 87 is used for reducing the strong current of battery 125 to a potential that will be more suitable for the light signals 30′, 32′ and 34′.

What is claimed is:

1. In an automatic signal and control system, a switch tongue of a track switch adapted to resume a completely normal open and a completely normal closed position, movable contacts adapted to make electric connection when the switch tongue is in normal closed position and when in completely normal open position but interrupting the electric connection when the switch tongue is in a position midway between these positions, a signaling device adapted to indicate said three positions of the track switch tongue, a relay including a relatively heavy armature and a light armature, a circuit including said relay and said movable contacts, a resistance included in said circuit when the track switch resumes one of said normal positions whereby only the light armature will be attracted, and no resistance included in said circuit when the switch tongue resumes the other of said normal positions whereby both armatures will be attracted by said relay, and the signal device indicating "danger" when the switch tongue resumes said position midway between said two normal positions whereby none of said armatures will be attracted by said relay.

2. In an automatic signal and control system, a switch tongue of a track switch adapted to resume a closed position and an open position, electric connections including contacts, said contacts confined in a tubular device for protection against exterior influences such as weather, water, dust, etc., another contact movably arranged within said tubular device and brought in connection with the switch tongue in such manner that the latter will bring this contact into contact with a pair of contacts within said tubular device when the switch tongue is close to the traffic rails and with another pair of electric contacts also within said tubular device when the switch tongue is in its normal completely open position, and said movable contact contacting only with insulating material when the switch tongue is in a position midway between said first mentioned positions, a resistance included in the electric connections of one of the pairs of electric contacts, a source of current and a signaling device adapted to indicate the position of the switch tongue through the current of said source, and a relay adapted to respond to current flowing through said contacts in the tubular device when they are contacted by said movable contact, one of said pairs of contacts having electric connection that includes a resistance.

3. In an automatic signal and control system, a track switch adapted to make a completely normally open and a completely normally closed position, a movable electric contact part in connection therewith, contacting with stationary electric contacts when the track switch is completely open for a given track, the same movable electric contact part contacting with other stationary electric contacts when the track switch is completely closed for said track, an insulating material interposed between all stationary electric contacts and so arranged that said movable electric contact will be disconnected and insulated from said stationary electric contacts when the track switch is neither fully closed nor fully open for said given track.

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