Sept. 8, 1931. W. D. HAILES 1,822,088

CONTINUOUS INDUCTIVE TRAIN CONTROL SYSTEM

Filed May 29, 1929

FIG. 1.

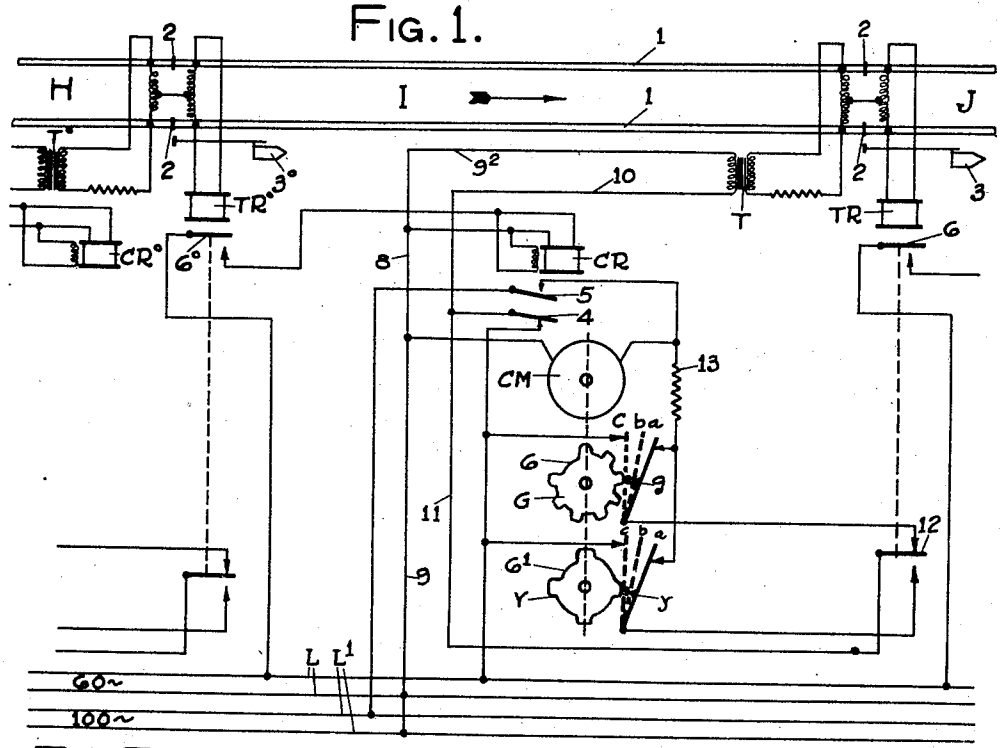
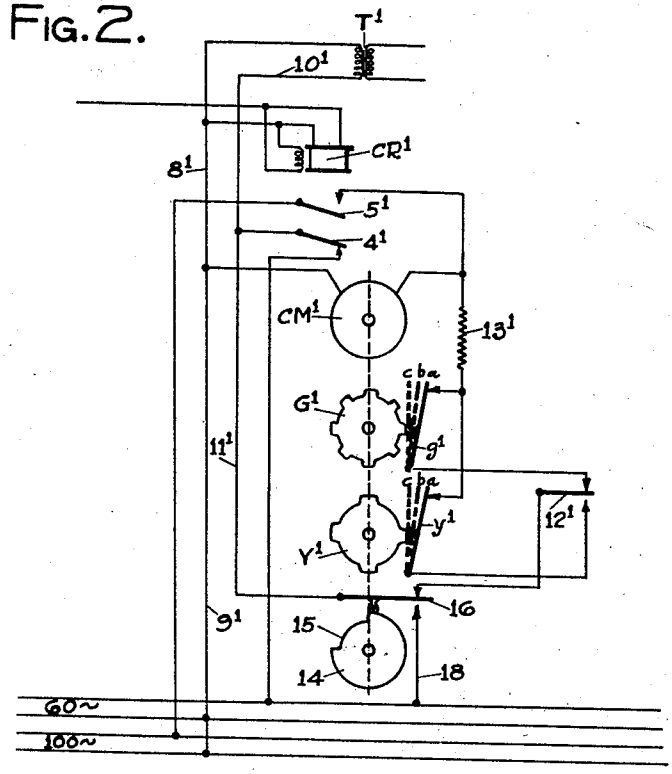


FIG. 2.



INVENTOR
W. D. Hailes
BY Neil D. Preston
his ATTORNEY

Patented Sept. 8, 1931

1,822,088

UNITED STATES PATENT OFFICE

WILLIAM D. HAILES, OF ROCHESTER, NEW YORK, ASSIGNOR TO GENERAL RAILWAY SIGNAL COMPANY, OF ROCHESTER, NEW YORK

CONTINUOUS INDUCTIVE TRAIN CONTROL SYSTEM

Application filed May 29, 1929. Serial No. 366,879.

This invention relates in general to automatic train control systems, and has more particular reference to means in coded continuous types of train control systems for assuring the picking up of track relays immediately after their blocks have been vacated.

It is the practice in train control systems such as shown, for example, in the W. D. Hailes application Ser. No. 249,457 filed January 25, 1928, to provide means for automatically initiating the coding motor for placing coded energy onto the track rails and for simultaneously cutting the usual track circuit energy off of the track rails. In such circumstances, if a track relay is of such a character as to not respond to the coding energy, on any particular block being vacated, the track relay for that block may very well remain down to thus hold up traffic unnecessarily. In the particular application referred to, a direct current track relay is employed, and coded direct current energy is used, so that the track relay is responsive to the coded energy and hence picks up as soon as its block is vacated.

In the W. D. Hailes application, Ser. No. 228,059, filed October 22, 1927, a direct current track relay is employed in connection with a direct current track circuit, while coded alternating current is applied to the track rails of a block during its occupancy. In this case there is no necessity for cutting the track circuit energy off of the track rails during the application of coded current, so that the track relay is operated by its normal track circuit energy as soon as its block is vacated.

In case of the above referred to application Ser. No. 249,457 in which coded direct current is employed, if an alternating current type of relay be used for a track relay in connection with an alternating current track circuit, such a track relay would release on its block being occupied, and would not pick up again on its block being vacated.

Likewise in connection with application Ser. No. 228,059, above referred to, in which coded alternating current is employed, if alternating current relays be used for track relays in connection with alternating current track circuits supplied with alternating current of possibly the same, but preferably different, frequency alternating current, then it would be necessary to disconnect the track circuit energy from the tracks during coding. In this case, on a track circuit being vacated its track relay would not pick up, or at least would be very likely not to pick up, since it would be energized only by coded alternating current, and possibly coded current of a different frequency from that for which the track relay is designed.

From the above it may be stated, in general, that in coded continuous train control systems, where track circuit current is disconnected from the track rails during the application of coded current, and where the track relays used in connection with the track circuits are not certainly responsive to the coded current, then, to assure that the track relays pick up on vacancy of their respective blocks, some special means must be provided.

With the above and other objects in view, it is proposed, in accordance with this invention, to provide means assuring the picking up of track relays immediately their blocks become vacated. More specifically, it is proposed to provide, in a coded continuous system, means for intermittently applying to the track rails, for a sufficient length of time, a steadily applied track circuit current, whereby to assure the picking up of a track relay immediately its block is vacated.

Further objects, purposes and characteristic features will appear as the description progresses, reference being made to the accompanying drawings, showing, solely by way of example, and in no manner in a limiting sense, two forms which the invention can assume. In the drawings:—

Fig. 1 is a diagrammatic view of one form of applicant's invention.

Fig. 2 is a diagrammatic view of a second form of applicant's invention.

Referring now to the drawings, and first to Fig. 1, there is here shown a stretch of track constituted by track rails 1, furnished

with insulating joints 2 for separating it into usual section blocks such as H, I and J. At the entrance end of each block, travel being in the direction of the arrow, is positioned a wayside signal 3, operated by any usual or desired means (not shown), by means of a track relay TR connected across the entrance end of each block.

Paralleling the rails 1 is a 60 cycle, and a 100 cycle, transmission line L and L^1 respectively.

At each signal location is a control relay CR, a coding motor CM having code wheels G and Y for operating respective code fingers *g* and *y* to various of their indicated positions *a*, *b* and *c*, and a transformer T for supplying track circuit, and also train control, current to the track rails 1.

The transformer T has its primary connected across the 60 cycle transmission line through a contact finger 4 and back point of relay CR, relay CR having a second contact finger 5 for controlling flow of energy, through a front point, to the coding motor CM from the 100 cycle line.

Since the various instrumentalities employed at each signal location are the same, like reference characters with distinctive exponents are employed to identify like parts at different locations.

The code wheels G and Y are toothed for vibrating their fingers *g* and *y* when they are rotated, to move the fingers between the positions *a* and *b*. On the wheel G is a relatively long and deep cut out portion 6 extending inwardly of the wheel further than the roots of the teeth, and comprising a relay pick up depression, with a like pick up depression 6^1 in the wheel Y. These pick up depressions are deep enough to permit the respective fingers *g* and *y* to move to the positions *c*, for a purpose to be explained below.

On a train passing over track rails 1 and entering block I, track relay TR^0 releases to drop its contact finger 6^0 and thus complete a pick up circuit for relay CR which includes, one wire of the 60 cycle transmission line, contact finger 6^0 and back point of relay TR^0, the two windings of the two element relay CR and wires 8 and 9 to the other side of the 60 cycle transmission line.

On relay CR picking up, contact finger 4 disconnects the 60 cycle line from the primary of transformer T, which is normally supplied with 60 cycle energy through a circuit including one wire of the 60 cycle line, wires 9, 8 and 9^2, the transformer primary, wire 10, contact finger 4 and back point of relay CR, and back to the other side of the 60 cycle source.

It should be here explained that the track relays TR etc., are designed to respond to 60 cycle current, and that it is desirable to use train control current of a different, and preferably higher, frequency than the track circuit current to avoid any interference between the two currents.

The picking up of relay CR places the primary of transformer T across the 100 cycle line L^1 through a circuit including one side of the transmission line L^1, wires 9, 8 and 9^2, the primary of transformer T, wires 10 and 11, contact finger 12 and either front or back point of track relay TR, code finger *g* or *y* when in the "*a*" position, current limiting resistance 13, contact finger 5 and front point of relay CR, and back to the other side of the 100 cycle line. From this circuit it can be seen that 100 cycle energy is placed on the track rails through the transformer T, and is controlled by one of the other of the coding fingers *g* or *y*, depending on whether the block J, in advance of block I, is unoccupied, or is occupied, respectively.

The coding motor CM, is cut into operation by the picking up of relay CR, through a circuit which includes one side of the 100 cycle line, wire 9, the motor CM, contact finger 5 and front point of relay CR, and back to the other side of the 100 cycle line.

Thus it is seen that, in a manner very similar to that set forth in the above referred to Hailes applications, upon a block being occupied, its track relay releases to energize a coding motor, which latter operates to disconnect the track circuit energy from the track rails and to substitute for it the train control energy through a circuit including code fingers which are selected in accordance with traffic conditions ahead, (as by means of the track relay finger 12 in the present case).

Thus coded energy is applied to the track rails, and in the absence of such cut-out portions as 6 and 6^1 on the wheels G and Y, there would be no means of reapplying track circuit energy to the track rails after the block I was vacated. That is, the dropping of track relay TR^0 places coded train control energy on the track rails, and removes track circuit energy therefrom, and to get track circuit energy back onto the rails, it is necessary that the track relay be re-energized.

From the above considerations it is easily seen that the cut-out portion 6, for example, on code wheel G, operates once during each rotation of wheel G to allow coding finger *g* to move over to position "*c*", whereby to complete a circuit for placing 60 cycle, or track circuit energy onto the track rails, such circuit including one wire of the 60 cycle line, wires 9, 8 and 9^2, primary of transformer T, wires 10 and 11, contact finger 12 and (in the present case) front point of relay TR, coding finger *g* in its "*c*" position, and back to the other side of the 60 cycle line.

In this manner the track circuit energy of 60 cycles is applied intermittently to the track rails during occupancy. That is, during coding, for a short period of time on each rotation of the code wheels, the track circuit energy is steadily applied, whereby, as soon as the block in question is vacated, its track relay being supplied with the energy for which it is designed, picks up so as to drop the control relay CR, to thus de-energize the code motor CM and cut in the 60 cycle line the same as before occupancy.

In Fig. 2 is shown a slightly modified form of applicant's invention, wherein the code motor CM^1 has code wheels G^1 and Y^1 which do not include the deeply cut pick-up portions such as 6 and 6^1 in Fig. 1. The code motor CM^1, however, includes a pick up wheel 14 which has a deeply cut-out pick up portion 15, so as to permit a finger 16, controlled thereby, to contact with its back point for a limited time, during each rotation of the code wheels G^1 etc.

As in the form shown in Fig. 1, and described above, on occupancy of a block, its track relay releases to energize the control relay CR^1, to thereby pick up contact fingers 4^1 and 5^1. These operate in the same manner as in Fig. 1 to cut 60 cycle track circuit current off from the track rails, and to place 100 cycle train control current onto the track rails through a circuit including one side of the 100 cycle level, wires 9^1 and 8^1, the primary of transformer T^1, wires 10^1 and 11^1 contact finger 16 and front point of wheel 14, contact finger 12^1 of the track relay next in advance, one or the other of the coding fingers g^1 and y^1 depending on traffic conditions ahead, current limiting resistance 13^1, and contact finger 5^1 and front point of relay CR^1. This circuit, in addition to the corresponding one in Fig. 1, includes, contact finger 16 and front point of the pick-up wheel 14, whereby the circuit for applying coded 100 cycle current to the track rails is interrupted for a short period during each rotation of the code wheels G^1 and Y^1, by the cut-out portion 15 of wheel 14. During this interruption, 60 cycle track circuit current is reapplied to the track rails through a circuit including one side of the 60 cycle line, wire 18, contact finger 16 and back point of the pick up wheel 14, the primary of transformer T^1, etc.

Thus, in the form of invention shown in Fig. 2, the pick up wheel 14, which is mounted to rotate at the same speed as the code wheels G^1 and Y^1, and preferably is mounted on the same shaft with the code wheels, operates intermittently to place track circuit current onto the track rails for a sufficient period of time to pick up the track relay if the block be unoccupied.

It is, of course, understood that the intermittent application of track circuit energy during coding is such as not to interfere with the effect of the code on the car-carried receiving apparatus used in connection with the system. In the Hailes applications referred to above there is means provided in the car-carried apparatus for preventing a momentary interruption of code from affecting the indication set up by the receiving means, and thus the described intermittent reapplication of track circuit energy cannot affect the results given by receiving apparatus of this character.

It is to be understood, of course, that the coding motor can be equipped with any desired number of code wheels and can operate to place coded current onto the track rails by any usual or desirable means other than toothed wheels.

The above rather specific description of a device embodying this invention, is given solely by way of illustration, and is not intended, in any manner whatsoever, in a limiting sense. Obviously, this invention can assume many different physical forms, and is susceptible of various modifications, and all such forms and modifications are desired to be included by this invention, as come within the scope of the appended claims.

Having described my invention, I now claim:—

1. In a coded continuous train control system, in combination, a track circuit including a track relay, a source of track circuit energy, current coding means for placing coded current in the form of relatively short current impulses on the track circuit, a source of coding energy, and means to intermittently interrupt the application of coded energy, and apply track circuit energy for a relatively long period, to the track circuit.

2. In a coded continuous train control system, in combination, a track circuit including a track relay, a source of track circuit energy, current coding means, a source of coding energy, means to cut off track circuit energy from the track circuit during application of coded energy to the track circuit, and means to intermittently interrupt the application of coded energy, and apply track circuit energy, to the track circuit.

3. In a coded continuous train control system, in combination, a track circuit including a track relay, a source of track circuit energy, current coding means for supplying, at any one time, any one of a plurality of distinctive codes, a source of coding energy different from said track circuit energy and of a character incapable of operating the track relay, and means to intermittently interrupt the application of coded energy, and apply track circuit energy, to the track circuit.

4. In a coded continuous train control system, in combination, an insulated section of

track, a track relay connected across one end of the section, a coder, a source of track circuit energy and a source of train control energy, means controlled by the track relay for energizing the coder, cutting track circuit current off of the section, and cutting train control current onto the section under control of said coder, and means during operation of said coder for intermittently, for a limited time, replacing coded energy by track circuit energy.

5. In a coded continuous train control system, in combination, an insulated section of track, a track relay connected across one end of the section, a coder, a source of track circuit energy and a source of train control energy, means controlled by the track relay releasing upon occupancy of the section for energizing the coder, cutting track circuit energy off of the section, and cutting train control energy onto the section under control of said coder, said track relay being non-responsive to the coded energy, and means during operation of said coder for intermittently, and for a limited time, replacing coded energy by track circuit energy.

6. In a coded continuous train control system, in combination, an insulated section of track, a track relay connected across one end of the section, a coder, a source of alternating current track circuit energy and a source of train control energy of different frequencies, means controlled by the track relay for energizing the coder, cutting track circuit energy off of the section, and cutting train control energy onto the section under control of said coder, and means during operation of said coder for intermittently, and for a limited time, replacing coded energy by track circuit energy.

7. In a coded continuous train control system, in combination, an insulated stretch of track, a track relay connected across one end of said stretch, a first normally closed circuit for applying track circuit current to said stretch, and a second normally open circuit for applying train control current to said stretch, a normally de-energized coder, release of said track relay operating to energize the coder, break said first circuit and make said second circuit, said coder operating when energized to make and break said second circuit at relatively short intervals to apply coded current to said stretch, and to intermittently hold the second circuit open while holding the first circuit closed for a relatively long interval.

8. In a coded continuous train control system, in combination, an insulated stretch of track, a track relay connected across one end of said stretch, a first normally closed circuit for applying track circuit current to said stretch, a second normally open circuit for applying train control current to said stretch, of a character to which said relay will not respond, a normally de-energized coder, release of said track relay operating to energize the coder, break said first circuit and make said second circuit, said coder operating when energized to make and break said second circuit to apply coded current in the form of a plurality of current impulses separated by current-off periods, to said stretch, and to intermittently hold the second circuit open while holding the first circuit closed during said current-off periods.

9. In a coded continuous train control system, in combination, an insulated stretch of track, a track relay connected across one end of said stretch, a first normally closed circuit for applying track circuit current to said stretch, and a second normally open circuit for applying train control current to said stretch, a normally de-energized coder, release of said track relay operating to energize the coder, break said first circuit and make said second circuit, said coder operating when energized to make and break said second circuit to apply coded current to said stretch, and to intermittently hold the second circuit open while holding the first circuit closed, said coder including a member having cut-out and under-cut-out portions and a contact finger operated by said member to control the first and second circuit.

10. In a coded continuous train control system, in combination, an insulated stretch of track, a track relay connected across one end of said stretch, a first normally closed circuit for applying track circuit current to said stretch, a second normally open circuit for applying train control current, of a character to which said relay will not respond, to said stretch, and a normally de-energized coder, release of said track relay operating to energize the coder, break said first circuit and make said second circuit, said coder operating when energized to make and break said second circuit to apply coded current to said stretch, and to intermittently hold the second circuit open while holding the first circuit closed, said coder including a member having cut-out portions of varying depths and a contact finger operated by said member to control the first and second circuit.

11. In a continuous train control system, in which a track relay, responsive to track circuit current but non-responsive to coded train control current, releases on occupancy of its block to energize a coder and to cut normally applied track current off of the block and cut train control current, controlled by the coder, onto the block; the method for insuring pick-up of the track relay on unoccupancy of its block, comprising intermittently applying to the block, during the operation of the coder, track circuit current for a time sufficient to pick up

the track relay if its block be unoccupied, but for a time insufficient to interfere with the response of receiving means to the coded current.

12. In a coded continuous train control system, in combination, an insulated stretch of track, a track relay connected across one end of said stretch, a first normally closed circuit for applying track circuit current to said stretch, a second normally open circuit for applying train control current, of a character to which said relay will not respond, to said stretch, and a normally de-energized coder, release of said track relay operating to energize the coder, break said first circuit and make said second circuit, said coder operating when energized to make and break said second circuit to apply coded current to said stretch, and to intermittently hold the second circuit open while holding the first circuit closed, said coder including a code member incapable of making said first circuit, and a separate member capable of intermittently making said first circuit.

In testimony whereof I affix my signature.

WILLIAM D. HAILES.