June 30, 1936. J. W. LIVINGSTON 2,045,989

SPEED CONTROL SYSTEM FOR CAR RETARDERS

Filed May 5, 1934 2 Sheets-Sheet 1

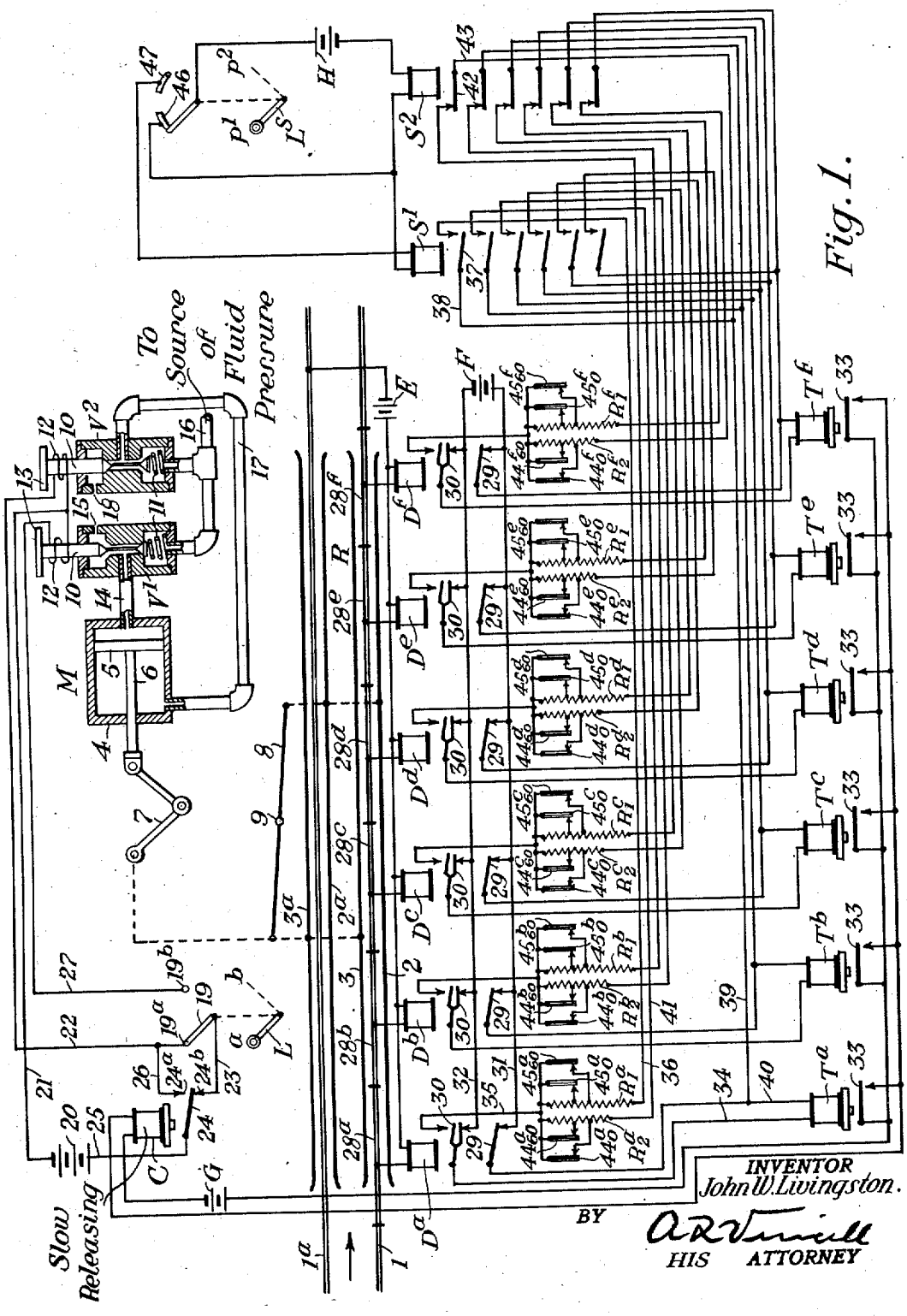

Fig. 1.

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Filed May 5, 1934 2 Sheets-Sheet 2

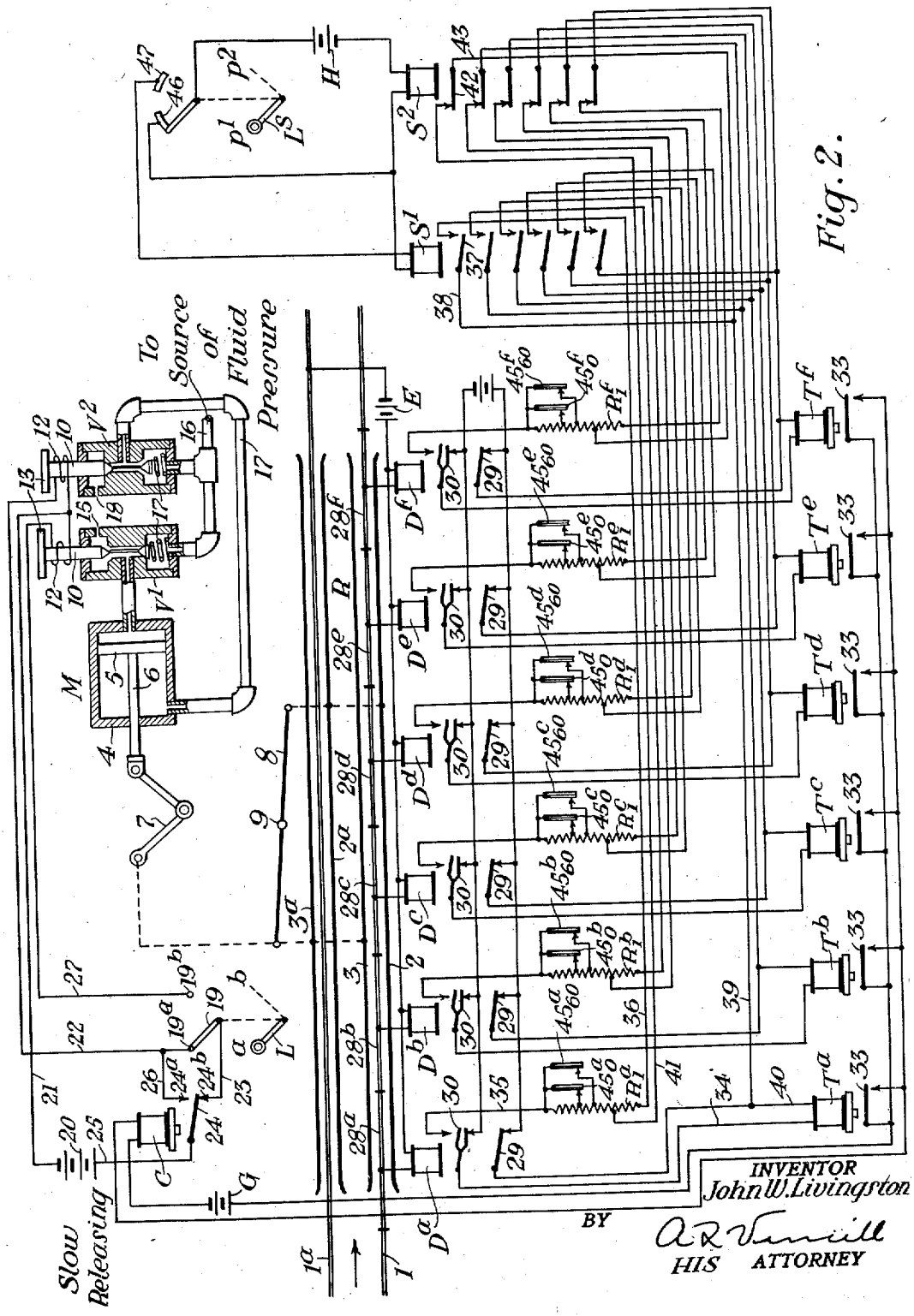

Fig. 2.

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SPEED CONTROL SYSTEM FOR CAR RETARDERS

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26 Claims. (Cl. 303—20)

My invention relates to speed control systems for car retarders, and particularly to speed control systems in which the braking action of a car retarder depends in part upon the release time of a slow releasing relay which is connected in a shunt circuit upon becoming deenergized.

One object of my invention is to provide means for automatically cutting into said shunt circuit additional resistance as the resistance of the circuit and of the relay winding decreases due to decreases in ambient temperature in a manner to maintain the release time of the relay within certain predetermined limits.

Specifically, my present invention relates to improvements in speed control apparatus of the type described and claimed in Letters Patent of the United States, No. 1,958,293, granted to Herbert L. Bone and John W. Livingston.

I will describe two forms of speed control systems embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a diagrammatic view illustrating one form of speed control system embodying my invention. Fig. 2 is a diagrammatic view showing a modified form of the speed control system illustrated in Fig. 1.

Similar reference characters refer to similar parts in each of the several views.

Referring first to Fig. 1, the reference characters 1 and 1ª designate the track rails of a stretch of railway track over which cars normally move in the direction indicated by the arrow under such conditions that it is desirable to at times control the speed of the cars automatically. For example, the stretch of track here shown might be in a classification yard of the "hump" type through which cars move under the influence of gravity. It is obvious that in service of this kind, the speed of individual cars or strings of cars will vary through wide limits depending, among other things, upon the speed at which they go over the hump, the temperature, the weight of the car and contents, and the condition of the car as to whether it is a free running car, or otherwise.

In order to control the speed of the cars, the stretch of track illustrated in the drawings is provided with a car retarder R which, in the form here shown, comprises two braking bars 2 and 3 extending parallel with, and located on opposite sides of, rail 1, and two similar braking bars 2ª and 3ª extending parallel with, and located on opposite sides of rail 1ª.

The braking bars 2, 3, 2ª, and 3ª are operated by a fluid pressure motor M comprising a cylinder 4 containing a reciprocable piston 5 attached to one end of a piston rod 6. The braking bars 2, 3, 2ª, and 3ª are operatively connected with the piston rod 6 through suitable linkwork including a bell crank 7 and a lever 8 pivotally supported at point 9. When piston 5 occupies its extreme right-hand position in which position it is illustrated in the drawings, the braking bars occupy their non-braking or ineffective positions in which they are out of engagement with the wheels of a car traversing the rails 1 and 1ª. When piston 5 is moved to its left-hand position, however, as when fluid pressure is admitted to the right-hand end of cylinder 4, the braking bars 2, 3, 2ª, and 3ª are moved toward the associated rail to their effective or braking positions in which they will engage the wheels of a car traversing the rails 1 and 1ª, to retard the speed of the car.

The motor M is controlled by two magnet valves V^1 and V^2, each comprising a valve stem 10 biased to an upper position by means of a spring 11, and provided with a winding 12 and an armature 13. When winding 12 of valve V^1 is deenergized, as shown in the drawings, valve stem 10 of this valve is moved to its upper position by the spring 11, and under these conditions, the right-hand end of cylinder 4 is connected with atmosphere through a pipe 14 and a port 15. When winding 12 of this valve is energized, however, valve stem 10 is moved downwardly against the bias of spring 11 to disconnect pipe 14 from atmosphere, and to connect this pipe with a suitable source of fluid pressure, usually air, through a pipe 16. When winding 12 of valve V^1 is energized, therefore, the fluid pressure supplied to the right-hand end of cylinder 4 moves piston 5 toward the left, thereby moving the braking bars to their effective or braking positions.

When the winding of valve V^2 is energized, valve stem 10 of this valve is moved to its upper position, and the left-hand end of cylinder 4 is then connected with atmosphere through a pipe 17 and a port 18. When winding 12 of valve V^2 is energized, however, as shown in the drawings, valve stem 10 is moved downwardly, disconnecting pipe 17 from port 18 and connecting pipe 17 with pipe 16. It will be apparent, therefore, that when valve V^2 is energized, piston 5 of motor M is urged toward the right, thus holding the braking bars in their ineffective or non-braking positions.

The magnet valves V^1 and V^2 are controlled by means of a normally energized slow releasing control relay C, and by a manually operable lever L. The lever L in the form here shown is capable of assuming a left-hand position *a*, in which posi-

tion it is illustrated in the drawings, and a right-hand position *b* indicated by a dotted line in the drawings. Operatively connected with the lever L is a contact arm **19** which engages a fixed contact **19ᵃ**, or a fixed contact **19ᵇ**, to close a contact **19—19ᵃ** or **19—19ᵇ**, according as lever L occupies its *a* or its *b* position.

Winding **12** of valve V^2 is provided with a circuit which passes from a suitable source of current here shown as a battery **20** through wire **21**, winding **12** of valve V^2, wire **22**, contact **19—19ᵃ** of lever L, wire **23**, back contact **24—24ᵇ** of relay C, and wire **25** back to battery **20**. Winding **12** of valve V^2 is also provided with another circuit which is similar to the circuit just described with the exception that this circuit includes a wire **26** and a front contact **24—24ᵃ** of relay C, instead of contact **19—19ᵃ** of lever L, wire **23**, and back contact **24—24ᵇ** of relay C. It will be apparent, therefore, that winding **12** of valve V^2 will become energized when relay C is deenergized and lever L occupies its *a* position, or when relay C is energized regardless of the position of lever L.

Winding **12** of valve V^1 is provided with a circuit which passes from battery **20** through wire **21**, winding **12** of valve V^1, wire **27**, contact **19—19ᵇ** of lever L, wire **23**, back contact **24—24ᵇ** of relay C, and wire **25** back to battery **20**. It will be apparent, therefore, that winding **12** of valve V^1 will be energized when and only when lever L occupies its *b* position and relay C is energized.

It follows from the foregoing that when relay C is deenergized, the braking bars will occupy their non-braking or braking positions according as lever L occupies its *a* or its *b* position, but that when relay C becomes energized, if the braking bars do not already occupy their non-braking positions, they will automatically be moved to their non-braking positions.

The apparatus also includes a series of relatively short insulated control sections **28ᵃ**, **28ᵇ**, **28ᶜ**, etc., which are formed in the rail **1**, a series of track relays D^a, D^b, D^c, etc., one of which is associated with each control section, and a series of timing relays T^a, T^b, T^c, etc., one of which is controlled by each track relay. The control sections **28ᵃ**, **28ᵇ**, **28ᶜ**, etc., will usually be of uniform lengths, and their lengths may be varied as conditions require, but the lengths of these sections will preferably be such that there will be an appreciable interval of time between occupancy of the same section by successive wheels of the car.

The track relays D^a, D^b, D^c, etc., are similar relays, and, as here shown, each of these relays is provided with a back contact **29**, and with a continuity transfer contact **30**, the front point of which becomes closed before the back point opens when the relay becomes energized. Each track relay is connected in a track circuit which includes the associated control section **28**, the rail **1ᵃ**, and a suitable source of current here shown as a battery E. It will be apparent, therefore, that when none of the sections **28** is occupied, as is the case when no car is traversing the stretch of track shown in the drawings, all of the track relays D will be deenergized, but that when a car is traversing the stretch of track shown in the drawings, each time a car wheel moves onto one of the sections **28**, the associated track relay D will become energized. It will also be apparent that the length of time a track relay remains energized after it becomes energized will depend upon the time required for the car which caused it to become energized to traverse a distance which is equal to the length of the associated control section, and hence upon the speed of the car.

The timing relays T^a, T^b, T^c, etc., are likewise similar relays, and, as here shown, have slow releasing characteristics. Each timing relay T is connected with a pair of line wires **31** and **32** over the back contact **29**, and the back point of the continuity transfer contact **30**, of the associated track relay D, as will be apparent from an inspection of the drawings, and the line wires **31** and **32**, in turn, are constantly connected with a suitable source of electromotive force, here shown as a battery F. It will be seen, therefore, that when none of the track relays D is energized, as is the case when no car is traversing the stretch of track shown in the drawings, all of the timing relays T will be energized, but that, when a car is traversing the stretch of track shown in the drawings, each time a car wheel moves onto one of the control sections **28** and causes the associated track relay D to become energized, the timing relay T controlled by such track relay will become deenergized, and will remain deenergized for a time interval which depends on the speed of the car. If the speed of the car is sufficiently slow so that this time interval is longer than the release time of such timing relay, this timing relay will close its back contact **33**, but if the speed of the car is not sufficiently slow so that this time interval is longer than the release time of this relay, this timing relay will not close its back contact **33**.

For reasons which will be made clear as the description proceeds, it is desirable to be able to vary the release times of the timing relays T to cause them to close their back contacts **33** at different car speeds, and for this purpose each timing relay, as here shown, is provided with two shunt circuits, one or the other of which becomes closed when the associated track relay becomes energized according as a speed selector relay S^1 or a speed selector relay S^2 is then energized. The two shunt circuits for each timing relay are similar in all respects to the corresponding circuits for all of the other timing relays, and it is believed, therefore, that a description of the circuits for one timing relay will suffice for all. Referring particularly to the timing relay T^a, for example, the one shunt circuit for this relay may be traced from the left-hand terminal of the relay through wire **34**, front point of continuity transfer contact **30** of track relay D^a, wire **35**, a resistor R^{a}_{1}, wire **36**, a front contact **37** of speed selector relay S^1, and wires **38**, **39** and **40** to the other terminal of relay T^a. The other shunt circuit for the timing relay T^a may be traced from the left-hand terminal of this relay through wire **34**, front point of continuity transfer contact **30** of relay D^a, wire **35**, a resistor R^{a}_{2}, wire **41**, front contact **42** of speed selector relay S^2, and wires **43**, **39** and **40** back to the other terminal of relay T^a. The resistances of the two resistors R^{a}_{1} and R^{a}_{2} will, of course, be different and may have any suitable values which will give the desired release times. As here shown, the resistor R^{a}_{1} has a higher resistance than the resistor R^{a}_{2}, and it follows that when speed selector relay S^1 is energized, the timing relay T^a will release at a higher car speed than when the selector relay S^2 is energized.

Associated with the resistor R^{a}_{1} in the circuit just described are a plurality of contacts 44^{a}_{60} and 44^{a}_{0} which are adapted to become successively opened as the ambient temperature decreases and which when closed, short-circuit dif-

ferent portions of the resistor R^{a}_{2} for a purpose to be described hereinafter; and associated with the resistor R^{a}_{1} in the circuit just described are a plurality of other contacts 45^{a}_{60} and 45^{a}_{0} which are similar to the contacts 44^{a}_{60} and 45^{a}_{0}, respectively, and which when closed, short-circuit different portions of the latter resistor. The contacts 44 and 45 may be controlled in any suitable manner, but, as here shown, these contacts are controlled by means of bimetallic strips which constitute the movable element of the contacts. Furthermore, the contacts 44 and 45 may be made to close at any desired temperatures, the particular temperatures which I have chosen for purposes of illustration being 60° Fahrenheit and 0° Fahrenheit, as indicated by the subscripts associated with the reference character for each particular contact.

It will be understood, of course, that the resistors which are included in the shunt circuits not specifically described are similar to those included in the corresponding circuits for timing relay T^{a}, and have associated therewith temperature responsive contacts which are similar to those associated with the resistors R^{a}_{1} and R^{a}_{2}.

It will also be understood that if more than two release times are desired for each timing relay, these relays may be provided with additional shunt circuits, each similar to the shunt circuits shown, but each having a different resistance and each being controlled by a different selector relay S.

The timing relays T control relay C by virtue of a plurality of parallel pickup circuits, each of which includes a suitable source of current, here shown as a battery G, and the front contact 33 of a different one of the timing relays T. It will be seen, therefore, that when all of the timing relays T are energized, relay C will be deenergized, but that when any one of the timing relays T becomes deenergized, and remains deenergized for a sufficient interval of time to cause it to close its back contact 33, relay C will become energized.

Relay C is made sufficiently slow releasing so that when a car is traversing the stretch of track shown in the drawings at a speed which is just slow enough to cause the timing relays T to successively close their back contacts 33, this relay will bridge the interval of time which will elapse under these conditions between the opening of the back contact 33 of one timing relay due to a wheel of a car having departed from the associated control section 28, and the closing of the back contact 33 of the timing relay next in advance due to the same wheel of a car having moved onto the section 28 associated with this latter timing relay.

The speed selector relays S^{1} and S^{2} are controlled by a speed selector lever L^{s} capable of assuming two positions indicated by the reference characters p^{1} and p^{2}, respectively, and provided with a contact 46 which is closed only in the p^{1} position of the lever, and with a contact 47 which is closed only in the p^{2} position of the lever. When contact 46 of lever L^{s} is closed, relay S^{2} is energized by virtue of a circuit which includes contact 46 and a suitable source of current here shown as a battery H, and when contact 47 is closed, relay S^{1} is then energized over a circuit which includes contact 47 and battery H. These circuits are obvious from the drawings and do not, therefore, require detailed description.

As shown in the drawings, all parts of the apparatus are in the positions which they normally occupy when no car is traversing the stretch of track shown in the drawings. That is to say, the track relays D are all deenergized, and the timing relays are all energized. Speed control lever L^{s} occupies its p^{1}, or slow speed position. Lever L occupies its a or "off" positions, and relay C is deenergized, with the result that the braking bars occupy their non-braking positions.

The operation of the apparatus as a whole is as follows: When a car which is to be retarded approaches the retarder, the operator moves lever L from its a to its b position to move the braking bars to their braking positions and then moves speed control lever L^{s} to the position corresponding to the speed at which he wishes the car to leave the retarder. As the car moves through the retarder, each time a car wheel moves onto a control section 28, the resultant energization of the track relay D controlled thereby interrupts the energizing circuit for the associated timing relay, and completes one or the other of the shunt circuits for such relay, depending upon which position the speed control lever L^{s} then occupies; but, as long as the car speed remains above the speed at which the timing relays release their armatures with the speed control lever in the position which it then occupies, control relay C will remain deenergized, and the car retarder will therefore continue to slow down the car. As soon, however, as the car has been slowed down by the car retarder to a speed which is equal to, or less than, the speed at which the control relays release their armatures with the speed control lever in the position which it then occupies, and a wheel of the car traverses one of the control sections 28, the associated timing relay T will close its back contact 33, and relay C will then become energized. When relay C becomes energized, the braking bars will be moved to their non-braking positions in the manner previously described, and it will be apparent, therefore, that no further retardation of the car will take place unless relay C again becomes deenergized and remains deenergized for a sufficient interval of time to cause it to open its front contact $24—24^{a}$ and close its back contact $24—24^{b}$ while the car is still within the car retarder. Due to the slow releasing characteristic of relay C previously pointed out, this can only happen in the event that the car accelerates to a speed which is greater than the speed corresponding to the position which the lever then occupies. Assuming that the car does this, then as soon thereafter as the timing relay T which last became deenergized for a time interval of sufficient duration to close its back contact 33 again becomes energized, relay C will become deenergized and will subsequently remain deenergized, because, under these conditions, none of the other timing relays will now become deenergized long enough to close its back contact 33. Relay C will therefore open its front contact $24—24^{a}$ and will close its back contact $24—24^{b}$, thus restoring the braking bars to their braking positions in which they will again retard the speed of the car.

It will be readily understood that with the apparatus constructed in the manner described, since the release times of the timing relays depend upon the resistance of a shunt circuit, and since the speed at which the cars leave the car retarder depends upon the release times of the timing relays, any variation in the resistance of the shunt circuits will vary the speed at which the cars leave the car retarder. It will also be readily understood that as the ambient temperature decreases, the resistance of the shunt cir-

cuits will automatically decrease due to the decrease in resistance of the windings of the timing relays, of the resistors which are included in the shunt circuits, and of the circuit wires, and that, as the resistance of the shunt circuits decreases, the release times of the timing relays will increase, with the result that unless some means are provided to compensate for this change in resistance of the shunt circuits with changes in temperature, the cars, with the same setting of lever L^s, will leave the car retarder at slower speeds in cold weather than in warm weather. This is undesirable because car resistance increases with decreases in temperature, and it is for the purpose of automatically maintaining the resistance of the shunt circuits at values which will cause the timing relays to release at the most desirable car speeds at the different temperatures that the previously described temperature responsive contacts are provided. In this connection, it should be pointed out that by the most desirable car speed is meant the speed which will provide most satisfactory yard operation. For example, for those cars which are in the switching area of the classification yard, the most desirable speed will usually be the speed which will maintain a uniform spacing between cars, while for cars which are about to enter the classification track the most desirable speed will usually be that speed which will just cause a car to coast to its ultimate destination in the classification track. It should also be pointed out that the most desirable car speed under some conditions, might be the same at the lower temperatures as at the higher temperatures, while under other conditions, this speed may increase as the temperature decreases. It follows, therefore, that my invention contemplates the provision of means for partly compensating, fully compensating, or over-compensating for changes in resistance of the shunt circuits with changes in ambient temperature, and that while only two temperature responsive contacts are shown associated with each resistor in the drawings, any number of such contacts necessary to accomplish the desired degree of compensation may be provided.

With the temperature responsive contacts shown associated with each resistor in the drawings constructed to open at the temperatures described, it will be apparent that when the temperature decreases below 60° Fahrenheit the portions of the resistors R_1 and R_2 which were previously short circuited by the contacts 44_{60} and 45_{60} will become cut-in the associated shunt circuits, and that when the temperature decreases below 0° Fahrenheit, the portions of the associated resistors R_1 and R_2 which were previously short circuited by the contacts 44_0 and 45_0 will become cut-in the associated shunt circuits. The parts will normally be so proportioned that the portions of the resistors which become cut-in to the shunt circuits when the various contacts 44 and 45 open will be just sufficient to compensate for the decrease in resistance of the shunt circuits due to decrease in temperature; but as was previously pointed out the portions of the resistors which become cut-in, under these conditions, may have such resistances that the change in resistance of the shunt circuits will be only partially compensated for, or will be overcompensated for.

It will be noted that as shown in Fig. 1, a separate resistor having a separate set of temperature responsive contacts associated therewith is provided for each control speed. Under some conditions of operation the degree of temperature compensation required may not be sufficient to warrant the use of a separate resistor and separate temperature responsive contacts for each control speed, and when this is the case, the apparatus may be modified as shown in Fig. 2. Referring now to Fig. 2, as here shown, all parts of the apparatus are similar to that shown in Fig. 1 with the exception that each of the shunt circuits which are controlled by the speed selector relay S^2, instead of including a separate resistor having associated therewith separate temperature responsive contacts as shown in Fig. 1, includes a portion of the same resistor R_1 which is connected in the other shunt circuit for the associated timing relay. For example, referring particularly to the timing relay T^a, the shunt circuit for this relay which is controlled by the speed selector relay S^2 may be traced from the left-hand terminal of relay T^a through wire 34, front point of continuity transfer contact 30 of track relay D^a, wire 35, a portion of resistor $R^a{}_1$, wire 41, front contact 42 of speed selector relay S^2, and wires 43, 39 and 40 back to the other terminal of timing relay T^a. The other shunt circuits which are controlled by speed selector relay S^2 are similar in all respects to the circuit just traced for relay T^a, and it is believed, therefore, that these other circuits will be clear from an inspection of the drawings without tracing them in detail.

In operation, the apparatus shown in Fig. 2 is similar to that shown in Fig. 1 with the exception that since the same pair of contacts 44 control the resistance of both of the shunting circuits for the associated relay, and since the resistance of these circuits is different, the degree of compensation for one or the other of these circuits will not be as perfect as when the apparatus is constructed in the manner shown in Fig. 1.

Although I have herein shown and described only two forms of speed control systems embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In combination, a first relay which becomes energized for variable time intervals, said first relay being provided with a continuity transfer contact the front point of which closes before the back point opens when the relay becomes energized, a slow releasing timing relay provided with a pickup circuit which is closed when the back point of said continuity transfer contact is closed and with a shunt circuit which is closed when the front point of said continuity transfer contact is closed, said shunt circuit including a resistor, and temperature responsive means for short-circuiting part of said resistor when the ambient temperature increases above a predetermined temperature.

2. In combination, a first relay which becomes energized for variable time intervals, said first relay being provided with a continuity transfer contact the front point of which closes before the back point opens when the relay becomes energized, a slow releasing timing relay provided with a pickup circuit which is closed when the back point of said continuity transfer contact is closed and with a shunt circuit which is closed when the front point of said continuity transfer contact

is closed, said shunt circuit including a resistor, and means for successively short-circuiting additional parts of said resistor as the ambient temperature increases to maintain the release time of said relay within predetermined limits.

3. Car speed measuring means comprising a first relay which becomes energized while the car is traversing a fixed distance for a time interval which depends upon the speed of the car, a timing relay provided with a pickup circuit which is closed when said relay is deenergized and with a shunting circuit which becomes closed when said relay becomes energized, and means controlled by the ambient temperature for cutting into and cutting out of said shunt circuit resistance in a manner to maintain the release time of said timing relay within predetermined values.

4. The combination with a slow releasing relay which is connected in a shunt circuit substantially simultaneously with the cutting off of the supply of energy to the relay, of means controlled by the ambient temperature for maintaining the resistance of said shunt circuit within predetermined limits.

5. The combination with a slow releasing relay which is connected in a shunt circuit substantially simultaneously with the cutting off of the supply of energy to the relay, of means for automatically varying the resistance of said shunt circuit with variations in ambient temperature in such manner that the release time of said relay will increase somewhat as the ambient temperature decreases.

6. The combination with a slow releasing relay which is connected in a shunt circuit substantially simultaneously with the cutting off of the supply of energy to the relay, of means for automatically varying the resistance of said shunt circuit with variations in ambient temperature in a manner to substantially compensate for the changes in resistance of the circuit due to the changes in ambient temperature.

7. In combination, a stretch of railway track, a normally energized timing relay, means controlled by a car traversing said stretch for deenergizing said timing relay for a time interval which depends upon the speed of the car each time a wheel of the car traverses a predetermined part of said stretch and for substantially simultaneously connecting said relay in a shunt circuit, means associated with said shunt circuit for controlling the changes in the resistance of said circuit caused by changes in ambient temperature, and means controlled by said timing relay for controlling the speed of the car.

8. In combination, a stretch of railway track, a braking bar located in the trackway adjacent one of the rails of said stretch and movable toward and away from such one rail into braking and non-braking positions, a normally energized slow releasing timing relay, means effective each time a car wheel traverses a fixed portion of said stretch for deenergizing said timing relay and for simultaneously completing a shunt circuit for said timing relay, and means for controlling the changes in the resistance of said shunt circuit caused by variations in the ambient temperature, and means controlled by said timing relay for controlling said braking bar.

9. In combination, a stretch of railway track, a braking bar located in the trackway adjacent one of the rails of said stretch and movable toward and away from such one rail into braking and non-braking positions, a normally energized slow releasing timing relay, means set into operation by a car traversing said stretch for deenergizing said timing relay for a time interval which depends upon the speed of the car and for completing a shunting circuit for said timing relay while said timing relay is deenergized, temperature responsive means for controlling the resistance of said shunting circuit, and means controlled by said timing relay for controlling said braking bar.

10. In combination, a stretch of railway track, a braking bar located in the trackway adjacent one of the rails of said stretch and movable toward and away from such one rail into braking and non-braking positions, a first relay, means controlled by said first relay for controlling said braking bar, a series of relatively short insulated control sections formed in one rail of said stretch, a source of electromotive force; a plurality of track circuits each including a track relay, said source, a different one of said control sections, and the rail of said stretch opposite to the rail in which the control sections are formed, a plurality of timing relays one associated with each of said track relays, means effective when each track relay is deenergized for energizing the associated timing relay, means effective when each track relay becomes energized for shunting the associated timing relay with a shunt circuit the resistance of which is controlled in part by temperature responsive means, and means controlled by said timing relays for controlling said first relay.

11. In combination, a stretch of railway track, a plurality of circuits, means controlled by a car traversing said stretch for successively closing said circuits for time intervals which depend upon the speed of the car, means controlled by the resistance of said circuits for controlling the speed of the car, and means for automatically controlling the changes in the resistance of said circuits caused by changes in the ambient temperature in a manner to maintain the resistance of the circuits within predetermined limits.

12. In combination, a stretch of railway track, a plurality of circuits, means controlled by a car traversing said stretch for successively closing said circuits for time intervals which depend upon the speed of the car, means controlled by the resistance of said circuits for controlling the speed of the car, a plurality of contacts which become successively closed as the ambient temperature decreases, and means controlled by said contacts for cutting into and cutting out of said circuits resistance to control the changes in the resistance of said circuits caused by changes in the ambient temperature.

13. In combination, a stretch of railway track, a plurality of circuits, means controlled by a car traversing said stretch for successively closing said circuits for time intervals which depend upon the speed of the car, a plurality of resistors one included in each of said circuits, a plurality of contacts associated with each resistor and arranged to become successively opened as the ambient temperature decreases, means controlled by each contact and effective when the contact is closed for short-circuiting a different portion of the associated resistor, and means controlled by the resistance of said circuits for controlling the speed of the car.

14. In combination, a stretch of railway track, a braking bar located in the trackway adjacent a track rail and movable into engagement with a part of a car to retard the speed of the car, a first relay for controlling said braking bar, a series of relatively short insulated control sec-

tions formed in one rail of said stretch, a source of electromotive force, a plurality of track relays, a plurality of track circuits each including a different one of said track relays, a different one of said control sections, and the rail of said stretch opposite to the rail in which the control sections are formed, a plurality of timing relays one associated with each of said track relays, means effective when each track relay is deenergized for energizing the associated timing relay, a plurality of selector relays, a plurality of resistors, a plurality of shunt circuits for each timing relay each controlled by the associated track relay and a different one of said selector relays and each including a different one of said resistors, a plurality of temperature responsive contacts associated with each resistor and arranged to become successively opened as the ambient temperature decreases, means controlled by each of said temperature responsive contacts for short-circuiting different portions of the associated resistor, and means controlled by said timing relay for controlling said first relay.

15. In combination, a stretch of railway track, a braking bar located in the trackway adjacent one of the rails of said stretch and movable toward and away from such one rail into braking and non-braking positions, a plurality of insulated control sections formed in one rail of said stretch, a plurality of track relays, each said track relay being provided with a back contact and with a continuity transfer contact the front point of which closes before the back point opens when the relay becomes energized; a plurality of track circuits each including a different one of said rail sections, the opposite rail, a different one of said track relays, and a source of current; a plurality of slow releasing timing relays, a pair of line wires connected with a source of electromotive force; means for connecting one terminal of each of said timing relays with one of said line wires over the back contact of the associated track relay and for connecting the other terminal of each of said timing relays with the other line wire over the back point of the continuity transfer contact of the associated track relay, a plurality of selector relays, means for selectively controlling said selector relays, a plurality of shunt circuits for said timing relays selectively controlled by said selector relays and each including the front point of the continuity transfer contact of the associated track relay, and means controlled by said timing relays for controlling said braking bar.

16. In combination, a stretch of railway track, a braking bar located in the trackway adjacent one of the rails of said stretch and movable toward and away from such one rail into braking and non-braking positions, a plurality of insulated control sections formed in one rail of said stretch, a plurality of track relays, each said track relay being provided with a back contact and with a continuity transfer contact the front point of which closes before the back point opens when the relay becomes energized; a plurality of track circuits each including a different one of said rail sections, the opposite rail, a different one of said track relays, and a source of current; a plurality of slow releasing timing relays, a pair of line wires connected with a source of electromotive force; means for connecting one terminal of each of said timing relays with one of said line wires over the back contact of the associated track relay and for connecting the other terminal of each of said timing relays with the other line wire over the back point of the continuity transfer contact of the associated track relay, a plurality of selector relays, means for selectively controlling said selector relays, a plurality of shunt circuits for said timing relays selectively controlled by said selector relays and each including the front point of the continuity transfer contact of the associated relay, means for controlling the change in resistance in said shunt circuits due to change in ambient temperature, and means controlled by said timing relays for controlling said braking bar.

17. In combination, a stretch of railway track, a braking bar located in the trackway adjacent one of the rails of said stretch and movable toward and away from such one rail into braking and non-braking positions, a plurality of insulated control sections formed in one rail of said stretch, a plurality of track relays, each said track relay being provided with a back contact and with a continuity transfer contact the front point of which closes before the back point opens when the relay becomes energized; a plurality of track circuits each including a different one of said rail sections, the opposite rail, a different one of said track relays, and a source of current; a plurality of slow releasing timing relays, a pair of line wires connected with a source of electromotive force; means for connecting one terminal of each of said timing relays with one of said line wires over the back contact of the associated track relay and for connecting the other terminal of each of said timing relays with the other line wire over the back point of the continuity transfer contact of the associated track relay, two selector relays, means for selectively energizing said selector relays, a first and a second set of resistors; a first set of shunt circuits, one for each of said timing relays and each including the front point of the continuity transfer contact of the associated track relay, a front contact of a first one of said selector relays, and a different one of the resistors of said first set of resistors; a second set of shunt circuits, one for each of said timing relays and each including the front point of the continuity transfer contact of the associated track relay, a front contact of the other selector relay, and a different one of the resistors of said second set of resistors; and means for controlling the change in resistance in said shunt circuits due to change in ambient temperature.

18. In combination, a stretch of railway track, a braking bar located in the trackway adjacent one of the rails of said stretch and movable toward and away from such one rail into braking and non-braking positions, a plurality of insulated control sections formed in one rail of said stretch, a plurality of track relays, each said track relay being provided with a back contact and with a continuity transfer contact the front point of which closes before the back point opens when the relay becomes energized; a plurality of track circuits each including a different one of said rail sections, the opposite rail, a different one of said track relays, and a source of current; a plurality of slow releasing timing relays, a pair of line wires connected with a source of electromotive force; means for connecting one terminal of each of said timing relays with one of said line wires over the back contact of the associated track relay and for connecting the other terminal of each said timing relays with the other line wire over the back point of the continuity transfer contact of the associated track relay, two selector relays, means for selectively energizing said

relays, a first and a second set of resistors; a first set of shunt circuits, one for each of said timing relays and each including the front point of the continuity transfer contact of the associated track relay, a front contact of a first one of said selector relays, and a different one of the resistors of said first set of resistors; a second set of shunt circuits, one for each of said timing relays and each including the front point of the continuity transfer contact of the associated track relay, a front contact of the other selector relay, and a different one of the resistors of said second set of resistors; a plurality of temperature responsive contacts associated with each resistor arranged to become successively opened as the ambient temperature decreases and each effective when closed for short-circuiting a different portion of the associated resistor, and means controlled by said timing relays for controlling said braking bar.

19. In combination, a stretch of railway track, a braking bar located in the trackway adjacent one of the rails of said stretch and movable toward and away from such one rail into braking and non-braking positions, a plurality of insulated control sections formed in one rail of said stretch, a plurality of track relays, each said track relay being provided with a back contact and with a continuity transfer contact the front point of which closes before the back point opens when the relay becomes energized; a plurality of track circuits each including a different one of said rail sections, the opposite rail, a different one of said track relays, and a source of current; a plurality of slow releasing timing relays, a pair of line wires connected with a source of electromotive force; means for connecting one terminal of each of said timing relays with one of said line wires over the back contact of the associated track relay and for connecting the other terminal of each of said timing relays with the other line wire over the back point of the continuity transfer contact of the associated track relay, a plurality of resistors; a first set of shunt circuits one for each of said timing relays and each including a front contact of the one selector relay, the front point of the continuity transfer contact of the associated track relay, and a different one of said resistors, a second set of shunt circuits one for each of said timing relays and each including a front contact of the other selector relay, the front point of the continuity transfer contact of the associated track relay and a portion of a different one of said resistors, means associated with the portions of said resistors which are common to the two sets of shunt circuits for controlling the changes in resistance of said shunt circuits caused by changes in ambient temperature, and means controlled by said timing relays for controlling said braking bar.

20. In combination, a slow releasing relay, an energizing circuit for said relay, a shunt circuit for said relay, means for controlling said two circuits in such manner that when said energizing circuit is opened by said means said shunt circuit will simultaneously become closed, and means controlled by the ambient temperature for controlling the resistance of said shunt circuit.

21. In combination, a slow releasing relay, an energizing circuit for said relay, a shunt circuit for said relay, means for controlling said two circuits in such manner that when said energizing circuit is opened by said means said shunt circuit will simultaneously become closed, and means controlled by the ambient temperature for controlling changes in the resistance of said circuit due to changes in ambient temperature in such manner that the release time of said relay will remain substantially constant.

22. In combination, a slow releasing relay, an energizing circuit for said relay, a shunt circuit for said relay, means for controlling said two circuits in such manner that when said energizing circuit is opened by said means said shunt circuit will simultaneously become closed, and thermally controlled means for controlling the changes in resistance of said circuit due to changes in ambient temperature in such manner that the resistance of said circuit will remain substantially constant at all temperatures within predetermined limits.

23. In combination, a slow releasing relay, an energizing circuit for said relay, a resistor, a shunt circuit for said relay including said resistor, means for controlling said two circuits in such manner that when said energizing circuit is opened by said means said shunt circuit will simultaneously become closed, and means for varying the amount of said resistor which is effective in said shunt circuit with variations in ambient temperature.

24. In combination, a slow releasing relay, an energizing circuit for said relay, a resistor, a shunt circuit for said relay including said resistor, means for controlling said two circuits in such manner that when said energizing circuit is opened by said means said shunt circuit will simultaneously become closed and means for automatically connecting in said shunt circuit different values of said resistor when the ambient temperature reaches different predetermined values.

25. In combination, a slow releasing relay, an energizing circuit for said relay, a resistor, a shunt circuit for said relay including said resistor, means for controlling said two circuits in such manner that when said energizing circuit is opened by said means said shunt circuit will simultaneously become closed, and thermally responsive means for short circuiting a part of said resistor when the ambient temperature is above a predetermined temperature.

26. In combination, a slow releasing relay, an energizing circuit for said relay, a resistor, a shunt circuit for said relay including said resistor, means for controlling said two circuits in such manner that when said energizing circuit is opened by said means said shunt circuit will simultaneously become closed, and means for varying the amount of said resistor which is effective in said shunt circuit with variations in ambient temperature in such manner that the resistance of said shunt circuit will remain substantially constant.

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