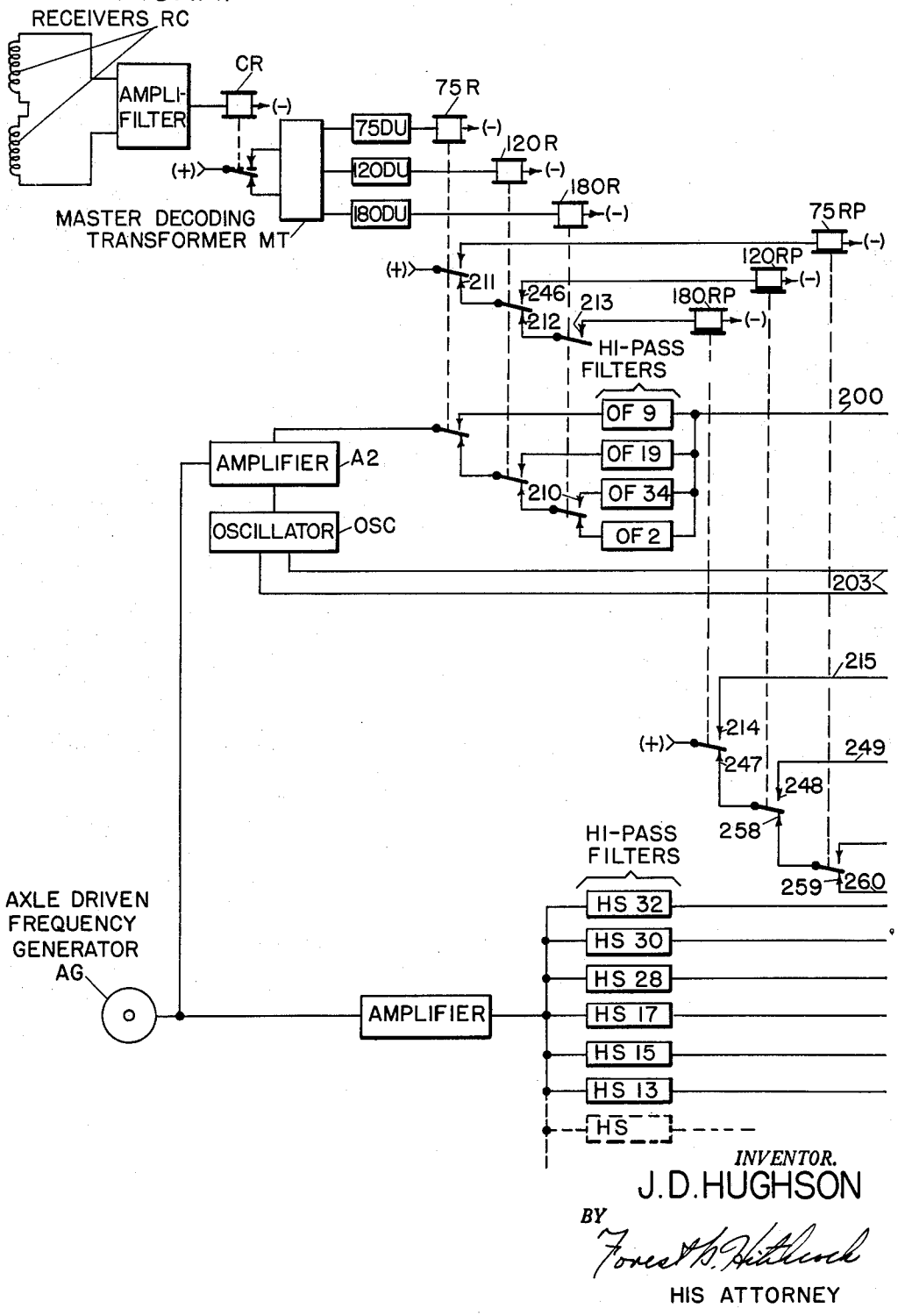
May 24, 1966 J. D. HUGHSON 3,253,143

LOCOMOTIVE CONTROL SYSTEM

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FIG. IA.



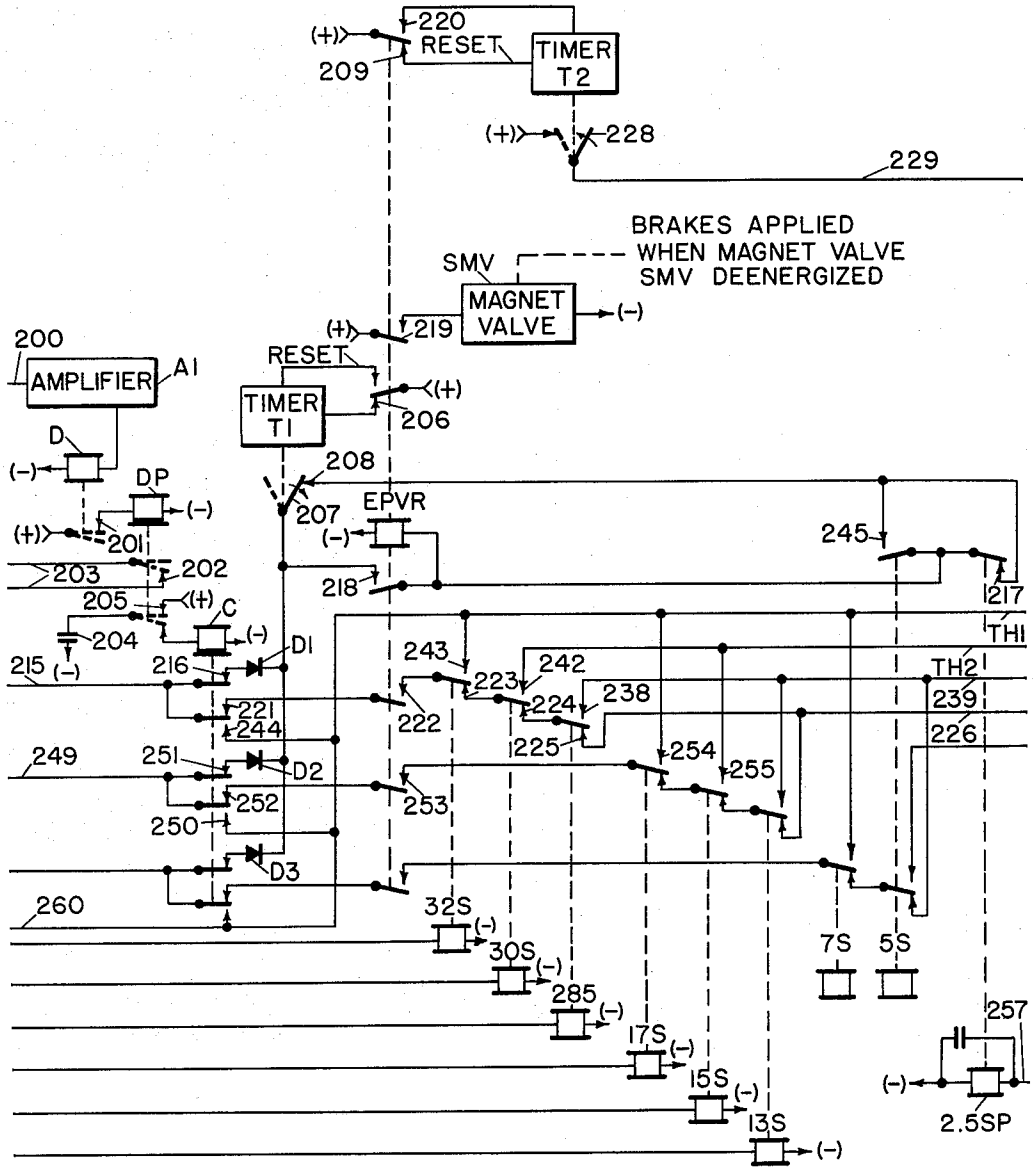
INVENTOR.
J. D. HUGHSON
BY
Forrest S. Hitchcock
HIS ATTORNEY

May 24, 1966 J. D. HUGHSON 3,253,143

LOCOMOTIVE CONTROL SYSTEM

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FIG. IB.



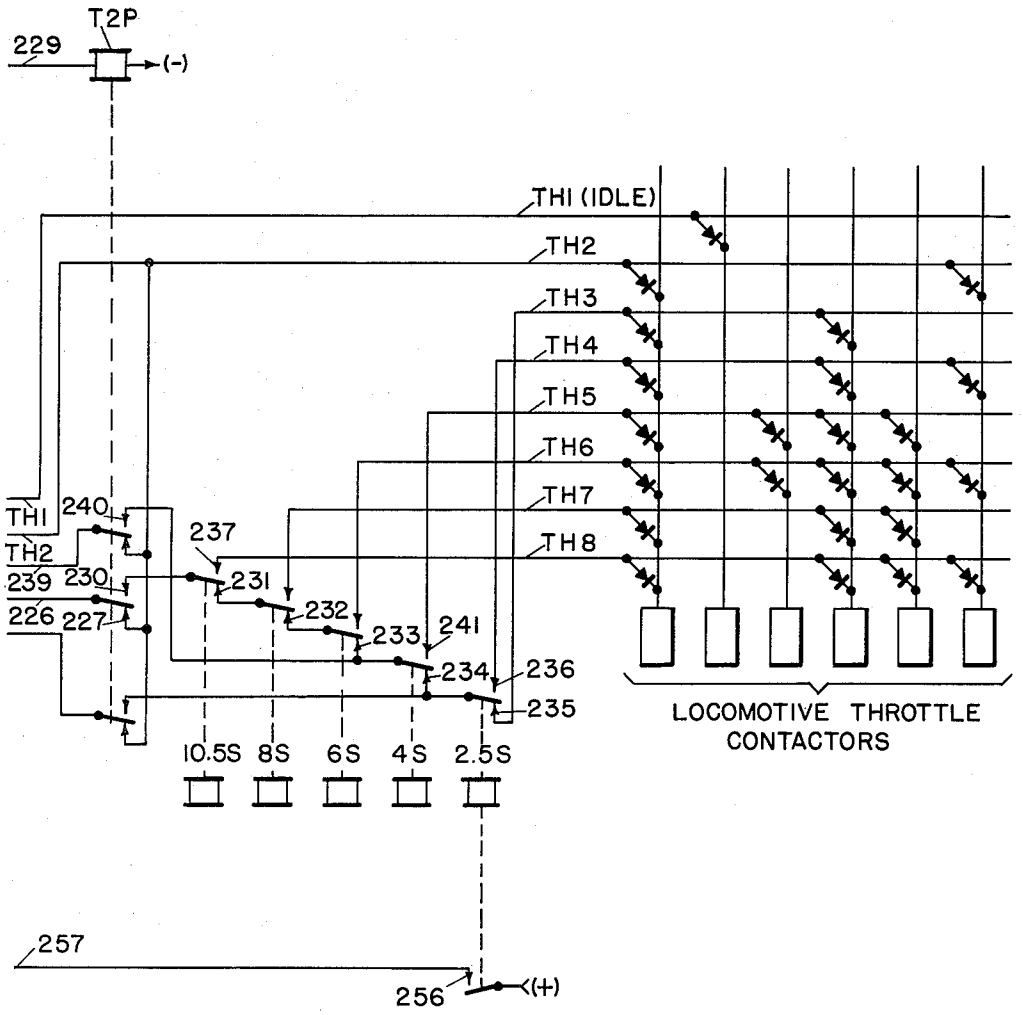
INVENTOR.
J. D. HUGHSON
BY Forest B. Hitchcock
HIS ATTORNEY

May 24, 1966 J. D. HUGHSON 3,253,143

LOCOMOTIVE CONTROL SYSTEM

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FIG. IC.



INVENTOR.
J.D.HUGHSON
BY Forest B. Whitlock
HIS ATTORNEY

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LOCOMOTIVE CONTROL SYSTEM

J. Donald Hughson, Rochester, N.Y., assignor to General Signal Corporation

Filed Dec. 9, 1960, Ser. No. 74,901
11 Claims. (Cl. 246—187)

This invention generally relates to control systems for railway locomotives and more particularly pertains to control systems for controlling the operation of unmanned locomotives in accordance with coded information transmitted to the locomotives.

The general organization of the train carried system according to the present invention is disclosed, but not claimed, in my copending application Ser. No. 70,477, filed November 21, 1960, and the present application may be considered a continuation-in-part of such parent application Ser. No. 70,477.

It is intended here that the present invention may be employed in conjunction with any suitable type of centralized traffic control system whereby code information distinctive of the desired locomotive speed along a right of way, may be transmitted to the locomotive either directly from the control office of the controlling system or transmitted to the locomotive from the wayside, said wayside transmission being controlled either from the main control office, or automatically in response to traffic conditions and the like.

It is generally proposed then, in accordance with the present invention, to provide for selectively controlling the throttle application on unmanner railway locomotives in accordance with distinctive code information transmitted to the locomotives regarding the desired speed of such locomotives along a right of way. As used herein, the term "throttle" is intended to include any conventional means employed on locomotives for controlling the amount of driving power developed by such locomotives.

It is more specifically proposed in the present invention to provide decoding means, on each unmanned railway locomotive, for decoding the coded information transmitted to the locomotive and to further provide that the condition of such decoding means be distinctive of the desired running speed for the unmanned locomotive.

It is further proposed that such unmanned locomotives be equipped with means for measuring the actual speed of the locomotive for selectively energizing speed registering means in accordance with the actual speed at which the locomotive is travelling. In the selected embodiment of the present invention, such speed registering means are in the form of a plurality of speed relays, selectively energized in accordance with the actual locomotive speed.

These speed relays are then divided into a plurality of speed range groups, each of which encompass one of the designated running speeds at which the locomotive should move in accordance with each distinctive received code. It is then provided, in the present invention that the above mentioned decoding means properly select the correct speed range group, in accordance with the distinctive code information received on the locomotive. Each speed range group, thus provided with a plurality of speed relays, selectively controls the setting of the locomotive throttle whereby the actual locomotive speed is maintained substantially at the designated locomotive running speed, as called for by the received code.

It is also proposed, in the selected embodiment, to provide that the decoding means further select certain over-speed detecting means for detecting if the locomotive exceeds the maximum permissive speed limit associated with each desired locomotive running speed and to cause such over-speed detection means to initiate a timed application

of the locomotive brakes if such an over-speed condition is detected.

In addition to the above mentioned timed brake application, it is furthermore proposed that certain received coding conditions will initiate a full brake application to completely stop the locomotive.

From the above considerations, a general object of the present invention is to provide locomotive control apparatus for selectively setting a locomotive throttle in accordance with received coded information.

A further object of the present invention is to provide for controlling the setting of a locomotive throttle in accordance with whether the locomotive is running over or below the desired running speed, as called for by the received coded information.

A still further object of the present invention is to provide over-speed control for detecting when a locomotive exceeds a predetermined maximum permissive speed limit associated with each desired running speed and to provide that such an over-speed condition will initiate a timed application of the locomotive brakes.

A still further object of the present invention is to provide means on an unmanned locomotive which prevents full throttle application to a locomotive getting under way and to cause such throttle to be successively increased to its full throttle setting as the locomotive picks up speed.

Other objects, purposes and characteristic features of the present invention will be in part obvious from the accompanying drawings, and in part pointed out as the description of the invention progresses.

In describing the invention in detail, reference will be made to the accompanying drawings, in which like reference characters designate corresponding parts and in which:

FIGS. 1A through 1C, when placed side by side, illustrate certain locomotive carried apparatus in accordance with one embodiment of the present invention.

In order to simplify the illustrations in the drawings and facilitate in the explanation of the fundamental characteristics of the present invention, various parts and circuits have been shown diagrammatically in accordance with conventional symbols. Arrows with associated symbols (+) and (−) are employed to indicate connections of the circuits of the various relays to the opposite terminals of a suitable source of current for energization of such relays; and the source of current may be of any suitable characteristic for the purpose intended. The various contacts of the relays involved in the illustrations are shown conventionally as being a lower or inclined position when the coil or winding of the associated relay is deenergized, and in a raised or horizontal position when the relay is energized; the contacts belonging to any given relay are shown connected to its coil or winding by dotted lines, and these contacts may be either below or above the illustration of the relay winding. The front and back contacts between which the movable contacts are operated by the different relays are shown conventionally as arrowheads and the movable contacts are ordinarily of the type which have their contacts pulled downwardly by gravity or spring action.

Although the accompanying drawings fail to illustrate any means for establishing the various code rates utilized in the selected embodiment, it is intended here that such coding apparatus may be part of any suitable control system wherein distinctive code rates may be transmitted to the locomotive for controlling such locomotive to various running speeds. Referring to the accompanying drawings, 75, 120 and 180 track code rates are intended to call for low, medium and fast running speeds respectively when received on the locomotive. Furthermore, in the

selected embodiment, it will be arbitrarily assumed that the slow running speed of a locomotive is seven miles per hour, the medium running speed is fifteen miles per hour, and fast running speed is thirty miles per hour. It should of course be understood that the above mentioned track code rates (75, 120 and 180) are selected only for simplicity of disclosure and it should be further understood that various other types of coded transmission may be employed for transmitting speed control information to the locomotive, without in any manner departing from the spirit or scope of the present invention.

Referring now to FIG. 1A of the accompanying drawings, the various transmitted code rates are picked up on the locomotive by means of receivers RC which are effective to energize code repeater relay CR at a rate determined by the received coded transmission. By employing conventional decoding apparatus, including master decoding transformer MT and various decoding units DU, a plurality of code relays R are selectively energized in accordance with the code rate of the received coded transmission.

An exle driven frequency generator AG, of FIG. 1A, is also carried on the locomotive whose output is a frequency proportional to the actual speed of the locomotive. This frequency generator AG then is effective, by means of hi-pass filters HS, to energize a plurality of speed relays S, in FIGS. 1B and 1C, in accordance with the actual speed of the locomotive; i.e. a speed relay is picked up as long as the locomotive exceeds the speed, corresponding to the numerical designation for the speed relay. For example, speed relay **28S**, of FIG. 1B, is picked up as long as the locomotive exceeds 28 miles per hour.

This plurality of speed relays S is then divided into a plurality of speed range groups, each of which encompasses one of the desired running speeds associated with each distinctive code rate of the received coded transmission.

The selective energization of the plurality of code relays R then causes the proper speed range group to be effective to selectively energize a plurality of throttle control wires TH, in FIG. 1C, for properly setting the locomotive throttle as the desired running speed is approached, and for automatically increasing or decreasing the throttle setting on the locomotive depending upon whether track grade conditions and the like cause the actual speed of the locomotive to move below or above the desired running speed respectively. Referring to FIG. 1C, it is intended here that the energization of throttle wires TH1 through TH8 respectively shall cause increasing application of the locomotive throttle by selective energization of a plurality of throttle contactors (see FIG. 1C) through the use of the illustrated diode matrix.

The selective energization of the various code relays R also connects the proper over-speed filter OF, of FIG. 1A, to the axle driven frequency generator AG. Each of the various over-speed filters OF, shown in FIG. 1A, is of the high-pass type which provides a continuous output to amplifier A1 in FIG. 1B as long as the locomotive speed is greater than the designated over-speed limit for the existing code rate condition. As soon as such over-speed conditions exist, over-speed relay C, in FIG. 1B is deenergized to initiate a timed application of the locomotive brakes, such application being timed by timer T1 in FIG. 1B.

It will be noted in FIG. 1A that the reception of a no-code condition, causes over-speed filter OF2 to be connected to the axle driven frequency generator AG, and therefore over-speed relays C, in FIG. 1B, is deenergized, as will be described in detail hereinafter, to initiate a full application of the locomotive brakes which will bring the locomotive to a complete stop.

Timer T2, in FIG. 1B, is provided to prevent full throttle application to a locomotive getting under way and, for reasons presently to be explained, to furthermore prevent full throttle application after a timed brake application has been applied due to an over-speed condition, as mentioned above.

Before discussing the operation of the selected embodiment, the initial conditions will be discussed for forming a basis for such an operational discussion. Referring now to FIG. 1A of the accompanying drawings, and assuming that the locomotive is standing still, oscillator OSC normally provides an output frequency which is high enough to be passed through any of the over-speed filters OF and thus causes an output from such over-speed filters OF to be fed along wire **200**, between FIGS. 1A and 1B, to amplifier A1 and to thus cause energization of relay D. Such energization of relay D causes a subsequent energization of its repeater relay DP by a circuit extending from (+) in FIG. 1B, through front contact **201** of relay D, and to (—). As soon as repeater relay DP picks up, oscillator OSC, in FIG. 1A, is shut off by the opening of back contact **202** of relay DP which opens wires **203** extending from FIG. 1B to the oscillator OSC in FIG. 1A. This then causes relay D, in FIG. 1B, to be deenergized, which in turn deenergizes repeater relay DP and causes oscillator OSC, in FIG. 1A, to again provide output along wire **200**, between FIGS. 1A and 1B, to amplifier A1. Thus, in the initial conditions, relays D and DP act to dependently pulse one another.

The pulsing of repeater relay DP causes capacitor **204**, in FIG. 1B, to be intermittently charged through front contact **205** of relay DP and results in the retainment of slow drop away over-speed relay C in a picked up position.

With the locomotive standing still and furthermore assuming that no code rates are being received, relay EPVR in FIG. 1B, is deenergized to thus deenergize magnet valve SMV (to apply locomotive brakes) and is furthermore effective to operate timer T1 by a circuit extending from (+), through back contact **206** of relay EPVR, and to timer T1. In the accompanying drawings, movable contact **207** of timer T1 is thus assumed to have completed its timing operation; i.e. has completed its movement from the dotted left-hand position, in the direction of the small arrow, and now makes contact with the right-hand contact **208** of timer T1.

Referring to the accompanying drawings, all other relays are in their normal deenergized positions and timer T2, in FIG. 1B is in its right-hand or reset position in accordance with the energization of the reset wire for this timer by a circuit extending from (+) through back contact **209** of relay EPVR.

To further explain the operation of the selected embodiment of the present invention, it will now be assumed that a 180 code rate, calling for a train speed of 30 miles per hour, is received by receivers RC of FIG. 1A. This 180 code rate is then effective, by means of code repeater relay CR, master decoding transformer MT and decoding unit **180**DU, to energize code relay **180**R in FIG. 1A. This energization of code relay **180**R causes over-speed filter OF**34** to be connected to the output of amplifier A2 through front contact **210** of code relay **180**R. At the same time, repeater relay **180**RP is energized by a circuit extending from (+) in FIG. 1A, through back contacts **211** and **212** of code relays **75**R and **120**R respectively, front contact **213** of code relay **180**R, and to (—). These various repeating relays RP, are made slow releasing to prevent a stop control from being initiated when changing from one code rate to another.

With the locomotive at a standstill, relay EPVR, in FIG. 1B, is now energized by a circuit extending from (+) in FIG. 1A, through front contact **214** of repeater relay **180**RP, along wire **215** between FIGS. 1A and 1B, front contact **216** of over-speed relay C, diode D1, right-hand contact **208** of timer T1, back contact **27** of speed repeater relay **2.5**SP, and to (—). It should be mentioned at this time that diodes D1 through D3, in FIG. 1B, are provided to isolate the throttle controls provided

by one code rate from those controls delegated to different code rates.

As soon as relay EPVR becomes energized, a stick circuit is provided for this relay including its own front contact **218**, which maintains relay EPVR picked up as long as over-speed relay C is picked up and a code is being received.

This picking up of relay EPRV also causes release of the locomotive brakes by completing the energizing circuit for magnet valve SMV, of FIG. 1B, this circuit extending from (+), through front contact **219** of relay EPVR, and to (−). As previously mentioned, it is intended here that the locomotive brakes will be selectively applied or released depending upon whether magnet valve SMV is deenergized or energized respectively.

With magnet valve SMV energized, and the locomotive brakes thus released, the setting of the locomotive throttle is successively increased to start the locomotive in motion. As mentioned previously, timer **T2**, in FIG. 1B, is provided to prevent full throttle application to a locomotive getting under way and such control is provided by initiating the timing operation of timer **T2** dependent upon the picking up of relay EPRV; i.e. timer **T2** is energized through front contact **220** of this relay.

Assuming now that timer **T2** has not as yet completed its timing operating, throttle wire **TH2** in FIG. 1C, is energized to provide a certain minimum forward throttle application, by a circuit extending from (+) in FIG. 1A, through front contact **214** of relay **180RP**, along wire **215** between FIGS. 1A and 1B, through front contact **221** of over-speed relay C, front contact **222** of relay EPVR, back contacts **223**, **224** and **225** of relays **32S**, **30S** and **28S** respectively, along wire **226** between FIGS. 1B and 1C, and through back contact **227** of relay **T2P**.

Assuming now that timer **T2** has completed its timing operation, so that movable contact **228** now connects (+), in FIG. 1B, to wire **229**, relay **T2P** is now energized by a circuit extending from (+) in FIG. 1B, along wire **229** between FIGS. 1B and 1C, and to (−). Wire **226** in FIG. 1C, is now connected to front contact **230** of relay **T2P** and causes throttle wire **TH3** to be energized (to increase the locomotive throttle setting) through back contacts **231** through **235** of relays **10.5S**, **8S**, **6S**, **4S** and **2.5S** respectively.

As the speed of the locomotive now increases, a point is reached where speed relay **2.5S** picks up and causes throttle wire **TH4** to be energized, through front contact **236** of relay **2.5S**, which further increases the speed of the locomotive. Similarly, as the remaining relays in this group pick up, the locomotive throttle setting is successively increased until throttle wire **TH8** is energized through front contact **237** of relay **10.5S**. Full throttle application is now applied to the locomotive and causes rapid increase in the locomotive speed.

As soon as the output from the axle driven frequency generator AG in FIG. 1A, indicates that the locomotive has passed 28 miles per hour, relay **28S** is energized, by means of hi-pass filter **HS28**, and lowers the throttle setting by energizing throttle wire **TH5** in FIG. 1C, instead of wire **TH8**, by a circuit extending from (+) in FIG. 1A through front contact **214** of repeater relay **180RP**, along wire **215** between FIGS. 1A and 1B, through front contact **221** of over-speed relay C, front contact **222** of relay EPVR, back contacts **223** and **224** of relays **32S** and **30S** respectively, front contact **238** of speed relay **28S**, along wire **239** between FIGS. 1B and 1C, through front contact **240** of relay **T2P**, and through front contact **241** of speed relay **4S**. Similarly, as soon as the actual locomotive speed exceeds thirty miles per hour, speed relay **30S** is energized and causes energization of throttle wire **TH2**, in FIG. 1B, through front contact **242** of relay **30S**, to further reduce the throttle application for the locomotive. It is expected that such energization of throttle wire **TH2** will maintain the locomotive speed at a constant thirty miles per hour in keeping with the desired speed designated by the received 180 code rate.

However, if the locomotive speed should increase to above thirty-two miles per hour, the throttle setting is reduced to "idle" by energization of throttle wire **TH1**, in FIG. 1B, upon closure of front contact **243** of speed relay **32S**. This then would cause the locomotive speed to be reduced to the desired thirty miles per hour. Obviously, if the actual speed of the locomotive dropped below thirty miles per hour, throttle wire **TH5** would again be energized as described above, to increase the throttle setting and thus increase the speed of the locomotive back up to thirty miles per hour.

If for some reason the locomotive exceeds its maximum permissive speed limit of thirty-four miles per hour, for the 180 code rate, the output from the axle driven frequency generator AG in FIG. 1A, is effective to produce an output from over-speed filter **OF34** to maintain relay D in FIG. 1B, steadily energized. This in turn causes repeater relay DP to be steadily energized and opens the energizing circuit between capacitor **204** and over-speed relay C, so as to drop this over-speed relay. It will be noted in FIG. 1B that the dropping away of over-speed relay C opens the above described stick circuit for relay EPVR, at front contact **216** of relay C, and relay EPVR is thus deenergized, to start timer **T1** and deenergize magnet valve SMV to initiate a timed application of the locomotive brakes. Furthermore, the locomotive throttle setting is now reduced to "idle" due to the energization of throttle wire **TH1** in FIG. 1B, through back contact **244** of over-speed relay C.

After timer **T1** has completed its timing operation, relay EPVR is once more energized, provided the speed of the locomotive has been reduced sufficiently to return relays D and DP to their normal pulsing condition (below the maximum permissive speed limit of 34 miles per hour), by a circuit extending from (+) in FIG. 1A, through front contact **214** of relay **180RP**, along wire **215** between FIGS. 1A and 1B, through front contact **216** of over-speed relay C, diode **D1**, contact **208** of timer **T1**, front contact **245** of speed relay **5S**, and to (−).

It will be noted in FIG. 1B that the previous dropping away of relay EPVR also causes timer **T2** to be reset to its normal position and relay **T2P** of FIG. 1C, to drop away, and upon the subsequent picking up of relay EPVR, the timing operation for timer **T2** is again initiated to insure that the throttle setting cannot now be increased past that value associated with the energization of throttle wire **TH2** (see FIG. 1C) until the brakes are fully released. From the drawings and the discussion above, it is thus seen that timer **T2** not only prevents full throttle application to a starting locomotive but also prevents high throttle application to a locomotive which has received an over-speed brake application.

With the locomotive now travelling at the desired thirty miles per hour, in response to the 180 code rate, assume that the received code rate is now changed from 180 to 120, thus calling for a speed reduction to 15 miles per hour. Relay **120R** in FIG. 1A, is now energized upon reception of this **120** code rate and is effective to energize its repeater relay **120RP** by a circuit extending from (+) in FIG. 1A, through back contact **211** of relay **75R**, front contact **246** of relay **120R**, and to (−).

Over-speed filter **OF19** is now connected to the output of amplifier **A2** by the obvious circuit in FIG. 1A, and because of the existing thirty miles per hour speed of the locomotive, the output of the axle driven frequency generator AG, applied to amplifier **A2**, is effective to steadily energize wire **200** between FIGS. 1A and 1B. As mentioned above, such energization of wire **200** causes relays D and DP to be steadily energized so as to drop over-speed relay C.

At this time, throttle wire **TH1** in FIG. 1B, is once more energized, to set the locomotive throttle to "idle," by a circuit extending from (+) in FIG. 1A, through back

contact 247 and front contact 248 of repeater relays 180RP and 120RP respectively, along wire 249 between FIGS. 1A and 1B, and through back contact 250 of over-speed relay C. Furthermore, the dropping away of over-speed relay C opens the existing stick circuit for relay EPVR, to drop this relay, and thus deenergize magnet valve SMV to apply the locomotive brakes.

This brake application is now continued (even though the timing operation of timer T1 may have ended) until the speed of the locomotive drops below 19 miles per hour, at which time relays D and DP are returned to their normal pulsing conditions to steadily maintain over-speed relay C in a picked up position.

As soon as over-speed relay C picks up, relay EPVR is once more energized, under the present conditions by a circuit extending from (+) in FIG. 1A, through back contact 247 and front contact 248 of relays 180RP and 120RP respectively, along wire 249 between FIGS. 1A and 1B, through front contact 251 of over-speed relay C, diode D2, contact 208 of timer T1 (assuming of course that this timer has completed its timing operation), through front contact 245 of speed relay 5S, and to (—). Thus, the locomotive brakes are now released.

Referring now to FIG. 1B, if at the end of this braking application, speed relay 17S is picked up, throttle wire TH1 will remain energized through front contacts 252 of over-speed relay C, 253 of relay EPVR and 254 of speed relay 17S, to further slow down the locomotive to its desired speed of fifteen miles per hour. The locomotive speed then continues to decrease such that speed relay 17S is also dropped away and the locomotive throttle setting is now increased, by energization of throttle wire TH2 in FIG. 1B, through front contact 255 of speed relay 15S, to hold the locomotive speed at its desired value of fifteen miles per hour.

If a 75 code rate is now received on the locomotive, calling for a desired running speed of seven miles per hour, over-speed filter OF9 would be connected to amplifier A2, in FIG. 1A, to slow down the locomotive in substantially the same manner as described above for reception of a 120 code rate.

It has been observed, especially in the low speed operation of long trains, that a condition may arise where a reapplication of locomotive throttle, after a braking application, and in extreme cases merely releasing the brakes, might cause separation of the train. It is believed that such a condition results because of the propagation time required to release the brakes over the entire length of the train and furthermore due to the observed rapid increase in the co-efficient of braking friction at such low speeds. Thus, if forward throttle is applied to a train travelling at low speed, upon which the brakes towards the rear of the train have not had sufficient time to release, the heavy holding action of these rear brakes may cause separation of the train.

For protecting against such a condition, in the selected embodiment of the present invention, front contact 245 of speed relay 5S and back contact 217 of speed repeater relay 2.5SP are connected in multiple in the energizing circuit for relay EPVR. Thus, front contact 245 of speed relay 5S insures that the locomotive brakes cannot be released if, after an initial brake application, the train speed is too low (below five miles per hour) i.e.; the train speed has entered the critical region mentioned above wherein separation of the train may result from reapplication of the locomotive throttle, and back contact 217 of speed repeater relay 2.5SP furthermore insures that under such a condition, described above, the train will come to a complete stop before its brakes are released by energization of relay EPVR and magnet valve SMV. Referring now to FIGS. 1B and 1C, speed repeater relay 2.5SP is energized at train speeds above 2.5 miles per hour by a circuit including front contact 256 of speed relay 2.5S and wire 257 between FIGS. 1C and 1B.

Although five miles per hour was arbitrarily selected, in the above discussion, as defining the upper speed limit for the above mentioned critical speed region, it should be understood at this time that this choice was made merely for simplicity of disclosure and that some other train speed, such as fifteen miles per hour, may be preferred depending upon the requirements of practice.

Suppose now that with the locomotive travelling at one of its desired running speeds, a "no-code" condition arises, calling for full application of the locomotive brakes. Over-speed filter OF2 is thus connected to the axle driven frequency generator AG, through amplifier A2 in FIG. 1A. Since the locomotive speed is well above two miles per hour, the output of frequency generator AG is sufficient to maintain relays D and DP steadily energized. This, of course, causes over-speed relay C to drop away and initiate application of the locomotive brakes, as is fully described above.

When the speed of the locomotive is reduced below two miles per hour, oscillator OSC in FIG. 1A, is once again effective to start the normal dependent pulsing of relays D and DP, which returns over-speed relay C to its normal energized position. However, referring to FIGS. 1A and 1B, since a "no-coding" condition now exists, this picking up of over-speed relay C is ineffective to cause reenergization of relay EPVR, for releasing the locomotive brakes. Thus, the train is brought to a complete stop.

It should be noted in FIG. 1B that the "idle" throttle wire TH1 is energized, during this braking application, by a circuit extending from (+) in FIG. 1A, through back contacts 247, 258 and 259 of repeating relays 180RP, 120RP and 75RP respectively, and along wire 260 between FIGS. 1A and 1B.

Having thus described a locomotive control system, as one specific embodiment of the present invention, it is desired to be understood that this form is selected to facilitate in the disclosure of the invention rather than to limit the number of forms which it may assume; and, it is to be further understood that various modifications, adaptations and alterations may be applied to the specific form shown to meet the requirements of practice, without in any manner departing from the spirit or scope of the present invention.

What I claim is:

1. A locomotive control system for operating a locomotive at preselected running speeds in accordance with received coded speed control information distinctive of a designated one of the preselected speeds at which the locomotive is desired to operate comprising, in combination, a plurality of speed registering relays each selectively energized to register a different predetermined actual speed value of the locomotive, the speed registering relays being divided into a plurality of speed range groups, each of which encompasses one of the preselected running speeds, decoding means responsive to the received coded speed control information for selecting one group of the speed registering relays in accordance with the designated running speed for the locomotive, and throttle control means distinctively responsive to the condition of each of the relays of a selected group of speed registering relays for selectively activating corresponding throttle settings on the locomotive so as to maintain the designated running speed, said throttle control means including relay contacts of certain of the speed registering relays for progressively increasing the throttle settings on the locomotive when it is getting under way in accordance with the actual speed of the locomotive.

2. In a system for controlling the actual operation of a locomotive desired to be operated at a predetermined speed so as to cause the actual locomotive speed to conform with said desired locomotive speed, the combination of, throttle stepping means responsive to the actual and desired operating conditions of said locomotive for progressively increasing the throttle setting step-by-step

on said locomotive to acelerate said locomotive towards said desired speed when actual locomotive speed is below said desired speed, and control means responsive to the actual operating condition of said locomotive while in motion during acceleration effective to permit said throttle stepping means to increase said throttle setting from a first to a second higher setting only provided that said locomotive has attained an actual operating condition properly responsive to said first throttle setting.

3. In a system for controlling a vehicle equipped with brakes and desired to operate at a preselected speed, the combination of, speed control means responsive to the actual and desired speeds of said vehicle for adjusting the actual vehicle speed into substantial agreement with said desired speed, brake applying means responsive to said actual and desired vehicle speeds effective to initiate an application of the vehicle brakes if said actual speed exceeds said desired speed by more than a predetermined amount, timing means rendered effective to time out a predetermined time interval upon initiation of said brake application, and brake release means responsive to the actual and desired vehicle speeds and said timing means for releasing said brakes at the end of said time interval provided said actual speed does not then exceed said desired speed by more than said predetermined amount.

4. In a system for controlling the throttle and brakes on a vehicle desired to operate at a preselected speed, the combination of, means responsive to the actual and desired vehicle speeds for reducing the throttle setting and applying the vehicle brakes if the actual vehicle speed exceeds the desired speed by a predetermined amount, means responsive to the actual and desired vehicle speeds for subsequently initiating a release of said brakes when the actual vehicle speed no longer exceeds said desired speed by said predetermined amount, and throttle delaying means rendered effective when said brake release is initiated for preventing subsequent increase in the throttle setting until after said brakes are fully released.

5. The combination specified in claim 4 wherein said throttle delaying means include, timing means rendered effective to time out a predetermined time interval when said brake release is initiated, and means responsive to said timing means for preventing said subsequent increase in the throttle setting until after said predetermined time interval has elapsed.

6. A locomotive control system for operating a locomotive having a variable throttle at preselected running speeds in accordance with received coded speed control information comprising, in combination, speed registration means for registering the actual speed of the locomotive, said speed registration means being divided into a plurality of speed range groups, each of which encompasses one of said preselected running speeds, decoding means responsive to the received coded speed control information for selecting one group of said speed registration means in accordance with the designated running speed for the locomotive, throttle applying means responsive to the condition of said decoding means for increasing the throttle setting on to the locomotive so as to increase the speed thereof, throttle control means responsive to the condition of the selected group of speed registration means for varying the throttle setting on the locomotive so as to maintain the designated running speed, brake control means for causing a timed application of the locomotive brakes if the locomotive exceeds a preselected maximum permissive speed associated with the designated running speed, and means responsive to said speed registration means for preventing subsequent release of said locomotive brakes if the speed of said locomotive decreases below a preselected minimum value.

7. A locomotive control system for operating a locomotive with a variable throttle at preselected running speeds in accordance with received coded speed control information comprising, in combination, speed registration means for registering the actual speed of the locomotive, said speed registration means being divided into a plurality of speed range groups, each of which encompasses one of said preselected running speeds, decoding means responsive to the received coded speed control information for selecting one group of said speed registration means in accordance with the designated running speed for the locomotive, throttle applying means responsive to the condition of said decoding means for increasing the throttle setting on the locomotive so as to increase the speed thereof, throttle control means responsive to the condition of the selected group of speed registration means for adjusting the throttle setting the locomotive so as to maintain the designated running speed, maximum speed detecting means for detecting when the locomotive exceeds a preselected maximum permissive speed associated with the designated running speed, brake control means responsive to the condition of said maximum speed detecting means for causing a timed application of the locomotive brakes if the locomotive exceeds the maximum permissive speed associated with the designated running speed, and timing means responsive to the condition of said brake control means for delaying the operation of said throttle applying means after said timed application of the locomotive brakes so as to insure full brake release before the fuel application to the locomotive is increased.

8. In a control system for a vehicle equipped with brakes and desired to operate at a predetermined speed, the combination of, means for initiating an application of said vehicle brakes if the actual vehicle speed exceeds said desired vehicle speed, and means responsive to the actual vehicle speed for preventing subsequent release of said brakes if the actual vehicle speed decreases below a predetermined value during said brake application.

9. In a control system for a vehicle equipped with a throttle controlled power unit and brakes and desired to operate at a predetermined speed, the combination of, throttle control means responsive to the actual and desired vehicle speeds for adjusting the throttle setting on said vehicle to cause substantial agreement between said actual and desired vehicle speeds, brake control means responsive to said actual and desired vehicle speeds for causing an application of said vehicle brakes if said actual speed exceeds said desired speed by a predetermined amount, and means responsive to the actual vehicle speed for preventing subsequent release of the vehicle brakes if said actual speed decreases below a preselected value during said brake application.

10. In a control system for a throttle controlled locomotive desired to operate at a predetermined speed, the combination of, throttle applying means responsive to the actual and desired locomotive speeds for progressively increasing the throttle setting on said locomotive to accelerate said locomotive toward said desired speed when said actual speed is below said desired speed, and means responsive to the actual speed of said locomotive while in motion for permitting a given increase in throttle setting on said moving locomotive only provided that the actual locomotive speed is then above a predetermined value.

11. In a system for controlling the speed of a locomotive desired to be operated at a predetermined speed, the combination of, generator means on said locomotive effective to produce an output which varies proportionately with the actual locomotive speed, means responsive to the output of said generator means to register actual locomotive speeds in a range from substantially locomotive standstill to an actual speed above said desired speed, throttle control means responsive to said actual speed registering means and said desired speed for progressively increasing the throttle setting on said locomotive to accelerate said locomotive toward said desired speed and for subsequently adjusting said throttle setting to maintain said desired speed, and means responsive to said actual speed registering means after said locomotive is in motion for controlling the progressive increasing

of the locomotive throttle setting by said throttle control means in accordance with whether or not the actual locomotive speed is increasing in a predetermined manner.

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EUGENE G. BOTZ, *Primary Examiner.*

LEO QUACKENBUSH, JAMES S. SHANK, *Examiners.*

S. B. GREEN, E. SEAMAN, *Assistant Examiners.*