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LOCOMOTIVE SPEED CONTROL SYSTEM

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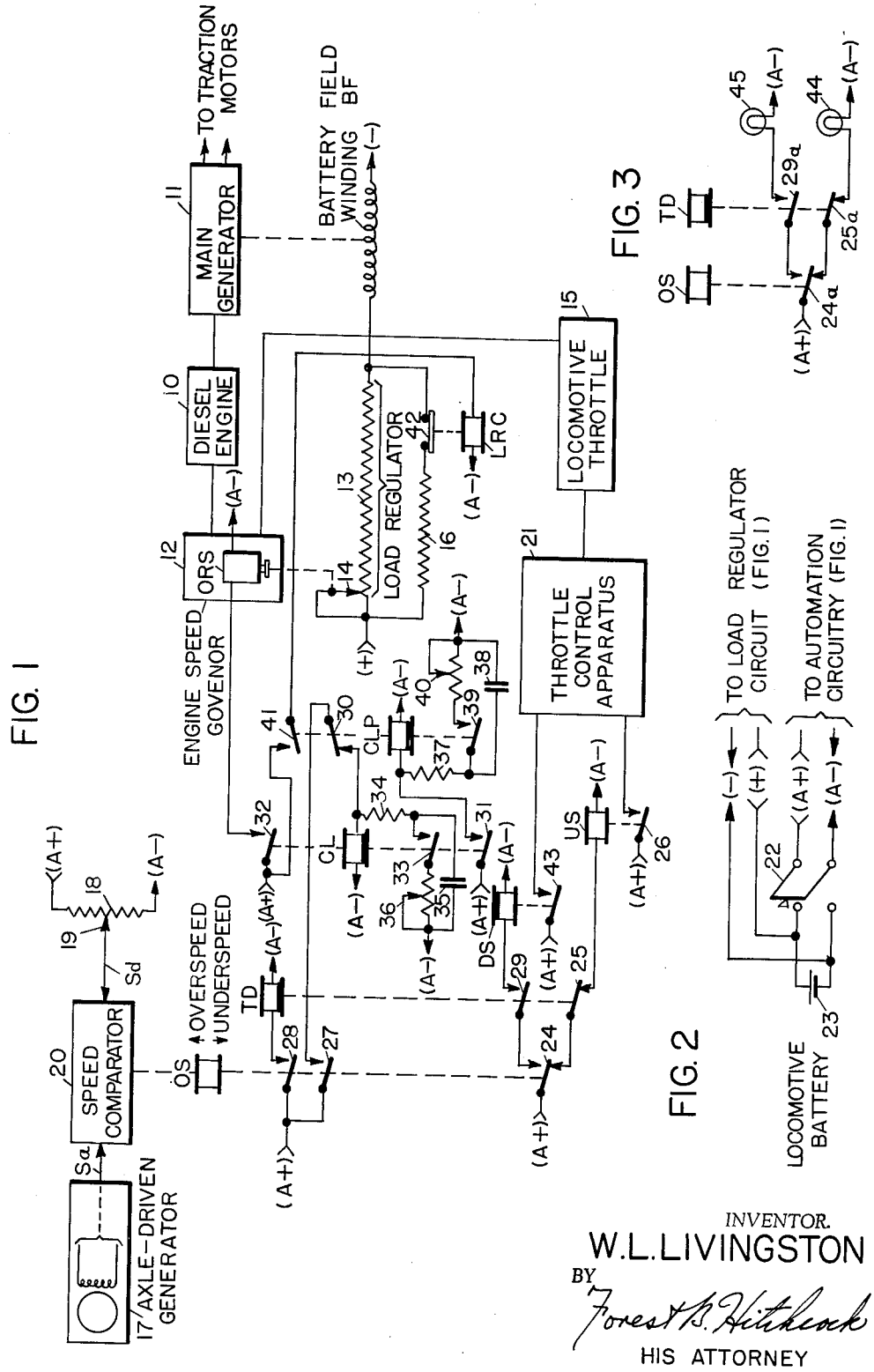


FIG. 1

FIG. 3

FIG. 2

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LOCOMOTIVE SPEED CONTROL SYSTEM

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This invention generally relates to vehicle control systems and more particularly pertains to a speed control organization for a hump locomotive in a railroad car classification yard.

During the classification of cars in a railway classification yard, the cars of an incoming train are normally pushed up an elevated portion, referred to as the hump of the classification yard, by a so-called hump locomotive. Normally, the cars of this incoming train are then uncoupled either individually or in groups (called cuts) and roll down the hump for routing, by a suitable track switching system, to various classification yard storage tracks dependent upon the future destinations for these incoming cars. As is well known in the art, it is advisable to have each of the incoming cars being classified couple onto the cars already standing on the storage tracks at a proper coupling speed which should not be too high in order to avoid damage to the cars and contents; whereas, on the other hand the speed of the cars being classified should not be too low in order to prevent the cars from stopping short of their desired coupling point. Thus, in the modern railway classification yard, various automatically controlled car retarders are disposed strategically throughout the yard to provide predetermined amounts of braking to each car being classified so that each car reaches its coupling point at the proper coupling speed.

In order that all the cars of an incoming train be classified in the shortest time, and, to permit all of the cars to start from the hump at the same speed, it is desirable that the locomotive utilized in pushing the incoming cars over the crest of the hump be controlled to operate at a substantially uniform speed. Accordingly, the present invention proposes to provide a speed control organization particularly adapted, for example, to automatically cause a hump locomotive to travel at a predetermined desired speed.

In the hump locomotive control organization heretofore proposed, the engineman aboard the locomotive was provided with means whereby he could manually vary the power output of the locomotive power unit in each position of the locomotive throttle, in order to maintain the desired locomotive speed, as the loading on the locomotive was continually changing due to the uncoupling of the cars or cuts of cars when they reached the crest of the yard hump. On such locomotives equipped with this previously proposed manual humping control, the engineman was furthermore required to observe whether or not the locomotive was performing as desired, so that he could then manually change the position of the locomotive throttle as required to maintain the desired locomotive speed. However, such previously proposed hump locomotive control apparatus relies quite heavily upon manual operations by the engineman, and, the need therefor exists for a control organization capable of more or less automatically controlling a hump locomotive so that the locomotive can be made to accurately maintain a predetermined desired speed.

In accordance with the present invention, the power output of the locomotive power unit is thus automatically varied as the cars or cuts of cars are uncoupled from the locomotive, and, the position of the locomotive throttle is automatically adjusted when necessary in order to provide fully automatic speed control aboard the hump locomotive effective to substantially maintain the locomotive at the desired speed.

Although the system of the present invention may be utilized, as previously discussed, to completely automate the speed control operations aboard the locomotive, it is also contemplated that the present invention may be utilized, if desired, to automatically adjust the power unit output in each throttle position, in order to maintain constant locomotive speed as the cars are uncoupled, together with apparatus for providing a distinct indication to an operator or engineman aboard the locomotive concerning whether the throttle position must be increased or decreased in order to maintain the desired locomotive speed; i.e. the control organization provided in accordance with the present invention may be utilized in either an automatic or semi-automatic nature depending upon whether or not an operator is provided on the locomotive.

In view of the above discussion, one object of the present invention is to provide a control organization for maintaining the actual speed of a vehicle in substantial agreement with a desired vehicle speed.

A further object of the present invention is to provide for causing a vehicle to operate at a desired vehicle speed while minimizing hunting of the actual speed around the desired speed.

A more specific object of the present invention is to provide a speed control organization for a hump locomotive effective to vary the power output of the locomotive power unit as the power requirements to maintain a predetermined desired speed decrease by providing an indication to the engineman on the hump locomotive concerning any adjustment in the throttle positioning necessary to maintain the desired speed.

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

FIG. 1 illustrates partially in block diagram form, the apparatus according to one embodiment of the present invention for automatically causing a hump locomotive to travel at a predetermined desired speed;

FIG. 2 of the accompanying drawings illustrates how a suitable locomotive carried power source such as the locomotive battery could be controlled to provide energization to the automation circuit apparatus illustrated in FIG. 1 dependent upon whether the locomotive is to be manually or automatically operated; and

FIG. 3 illustrates a modification for the apparatus of FIG. 1 which would be utilized on the locomotive if an engineman were provided, whereby the engineman is kept continually informed as to any throttle position change necessary to maintain a desired locomotive speed.

Without attempting to limit the spirit or scope of the present invention, the drawings illustrate the present invention adapted to control a hump locomotive of the diesel-electric type during humping operation wherein the locomotive is desired to operate at a constant speed while pushing the cars of an incoming train up the hump of a railroad classification yard. Thus, and with reference to the accompanying drawings, the power unit on the diesel-electric type locomotive normally includes a diesel engine **10** which drives a main generator **11** to in turn produce electrical power output to the driving traction motors of the vehicle. As on most diesel-electric type locomotives, an engine speed governor **12** is employed to control the diesel engine **10** to predetermined speed and to automatically adjust the generator loading on the diesel engine to a proper value for each position of the locomotive throttle, as is well known to a person skilled in the art. This control of the engine loading is accomplished by a load regulator which includes a resistor **13**

and a movable arm 14 hydraulically operated along resistor 14 to adjust the curent supplied to the battery field winding BF of the main generator 11. By adjusting the generator loading on the diesel engine the position load regulator therefore also controls the power output from the locomotive power unit for each setting of the locomotive throttle 15.

Included in the engine speed governor 12 provided on the diesel-electric type locomotive, is a so-called overriding solenoid ORS which is controlled, in accordance with the present invention, to provide vernier adjustment of the driving power output from the locomotive power unit and thus the locomotive speed, so as to maintain the actual locomotive speed in substantial agreement with the desired locomotive speed. A so-called load regulator contactor LRC is also provided to selectively connect resistor 16 in multiple with the load regulator resistor 13, as will be described, to permit the actual speed of the locomotive to be adjusted, in accordance with the present invention, into substantial agreement with the desired locomotive speed with a minimum of hunting.

It should be of course understood at this time that this load regulator contactor LRC and the overriding solenoid ORS are normally provided on this type of railway locomotive for purposes other than those proposed in accordance with the present invention. Thus, it is to be understood that the control of the overriding solenoid ORS and the load regulator contactor LRC, as provided in accordance with the present invention, to form part of an automatic speed control organization for the locomotive is assumed hereto be in addition to the normal energizing control circuits for such devices which are well-known to persons skilled in the art.

In accordance with the illustrated embodiment of the present invention, the hump locomotive being controlled is provided with an axle-driven generator which produces an output signal S*a* whose frequency is proportional to (is an analog of) the actual locomotive speed, in a manner well known to those skilled in the art. Also included in the locomotive is a potentiometer including resistor 18 and movable arm 19 which is positioned to pick off a voltage signal S*d* proportional to (or the analog of) the desired speed for the locomotive.

A suitable speed comparator unit 20 is then employed to compare the actual and desired speed analog signals S*a* and S*d* from the axle-driven generator 17 and movable arm 19 respectively, and controls relay OS accordingly to selectively register whether or not the actual locomotive speed is above or below the desired locomotive speed. Although not shown in detail, this speed comparator unit 20 may be of any suitable form effective to cause relay OS to be picked up as long as the actual locomotive speed is above the desired speed, and dropped away when the actual locomotive speed is below the desired speed. This relay OS controls a pair of slow dropaway relays CL and CLP which are employed, in the illustrated embodiment of the present invention, to form a pulsing circuit for the overrriding solenoid ORS and the load regulator contactor LRC, for purposes to be described hereinafter.

Also controlled by the relay OS is a time delay relay TD which is also made slow releasing for purposes to be described hereinafter, and which, in combination with relay OS, selectively controls energization of downstep relay DS and upstep relay US, dependent upon whether the position of the locomotive throttle 15 must be decreased or increased respectively to maintain the desired locomotive speed. More specifically, the position of the locomotive throttle 15 is increased whenever upstep relay US is energized, and, is decreased whenever downstep relay DS is energized, by means of suitable throttle control apparatus 21 responsive to relays DS and US. Although not shown in detail, this throttle control apparatus 21 may take any suitable form such as, for example, a stepper switch selectively actuated in one direction or the other dependent upon whether relay DS or relay US is energized.

As is well known to those skilled in the art, the position of the locomotive throttle 15 causes the engine speed governor 12 to call for a predetermined speed at the diesel engine 10, and, the engine speed governor 12 is furthermore effective to operate the load regulator (by adjusting movable arm 14 on resistor 13) and thereby call for a predetermined power output from the locomotive power unit for each distinct setting of the locomotive throttle 15. However, since during humping operations, the load on the diesel-electric type locomotive is continually varying as the cars or cuts of cars are uncoupled from the locomotive, the power output from the locomotive power unit must be accurately controlled if automatic operation of the hump locomotive, substantially at the desired speed, is to be realized.

With reference to FIG. 2, the switch 22 is provided on the locomotive and is utilized to selectively connect the locomotive battery 23 (or some other suitable power source) to the illustrated apparatus of FIG. 1 dependent upon whether the hump locomotive is being automatically controlled in accordance with the present invention, during humping operations, or being manually operated during other locomotive operations in the classification yard. More specifically, the closing of switch 22 connects the locomotive battery 23 to the automation circuitry of FIG. 1, or represented by the symbols (A+) and (A−), and therefore, it should be understood at this time that until switch 22 is closed, the various circuits in FIG. 1 would be deenergized and the illustrated relays dropped away (as shown). However, it should be noted that the load regulator circuit in FIG. 1 is connected to the locomotive battery 23, is shown by symbols (+) and (−), irrespective of the position of switch 22.

Assuming now that the locomotive is to be thus automatically operated for humping operations (switch 22 is closed), the axle-driven frequency generator 17 produces an output analog signal S*a* indicative of the actual locomotive speed, while the movable arm 19 of the demand speed potentiometer produces an analog signal S*d* indicative of the desired locomotive speed, as inputs to the speed comparator 20. In the illustrated embodiment of the present invention, the desired locomotive speed is disclosed as being controlled, by way of example, in accordance with the position of the adjustable arm 19 so that the engineman on the hump locomotive or some other authorized person can manually select any desired humping speed for the locomotive.

With the actual speed of the locomotive below the desired speed, as the locomotive begins to push the cars of an incoming train up the yard hump, the relay OS will obviously be dropped away to close its back contact 24; whereas, the time delay relay TD will also be dropped away to close its back contact 25 and thereby complete an energizing circuit to the throttle-upstep relays US which, in turn, closes its front contact 26 and thereby causes the throttle control apparatus 21 to progressively increase the locomotive throttle setting so that the locomotive accelerates towards the desired humping speed. As is well known to those skilled in the art, during this increase in the locomotive throttle setting the engine speed governor 12 automatically causes the movable arm 14 to operate along the load regulator resistor 14 towards the so-called balance point for each throttle setting wherein a predetermined power output is produced by the locomotive's power unit.

Since the normal speed range for a locomotive during humping operations is relatively low; i.e. in the vicinity of one-half to three miles per hour, for example, the locomotive throtle 15 would initially be stepped to some predetermined throttle position dictated by the requirements of practice, wherein the actual speed of the locomotive would exceed the desired locomotive speed some time before the movable arm 14 reaches the so-called balance point on re-

sistor 13 for the particular predetermined position to which the locomotive throttle 15 has been actuated. Thus, during initial upstepping of the throttle control apparatus 21, the locomotive throttle 15 would be actuated to a throttle setting sufficient to permit the actual locomotive speed to exceed the desired speed at some point during the travel of the movable arm 14 along resistor 13 towards the so-called balance point for the particular throttle setting.

Consequently, when the actual locomotive speed exceeds the called for desired speed, the relay OS will become picked up to close its front contacts 24, 27 and 28. In accordance with closure of front contacts 28, time delay relay TD is energized and thereby closes its front contact 29 to complete an energizing circuit to the downstep relay DS, and furthermore, opens its back contact 25 in the energizing circuit to the upstep relay US. With the relay US now dropped away, the locomotive throttle position cannot be further increased, and, since the relay DS is slow in picking up, the locomotive throttle is not immediately decreased, but, remains in its predetermined, last operated position.

Upon closure of front contact 27 of relay OS, an energizing circuit is then completed to the relay CL, over back contact 30, of repeater relay CLP, so that the relay CL becomes picked up to operate its own front contacts 31, 32 and 33. With contacts 31 now closed, the repeater relay CLP subsequently becomes picked up and opens its back contact 30 to thereby deenergize the relay CL. However, relay CL is made slow dropaway by the adjustable timing circuit including fixed resistor 34, capacitor 35, front contact 33 and variable resistor 36, and thus, requires a predetermined time, after deenergization, before it will subsequently open its front contact 31 and thereby deenergize the repeater relay CLP which is also made slow releasing (by a similar timing circuit arrangement including fixed resistor 37, capacitor 38, front contact 39 and variable resistor 40) for a time interval substantially the same as the dropaway time of relay CL. From the above discussion and with reference to FIG. 1, it will thus be noted that the relays CL and CLP form a pulsing organization effective, whenever the relay OS is picked up, to momentarily pulse the overriding solenoid ORS (over front contact 32 of relay CL) and the load regulator contactor LRC (over front contact 41 of relay CLP).

As is well-known to those skilled in the art, the overriding solenoid ORS included in the engine speed governor 12 is effective, when energized, to override normal load regulating operation of the governor and draw the movable arm 14 towards its minimum field or left-hand position on the resistor 13 (as shown) wherein the battery field winding BF of the main generator 11 is supplied with minimum amount of current and a minimum power output is developed for the particular throttle setting. On the other hand, when the overriding solenoid ORS is deenergized, the load regulator arm 14 is permitted to operate along resistor 13 towards the so-called balance point for a given throttle position. It is also well known that, when the overriding solenoid ORS becomes energized, the movable arm 14 is caused to move to the left along resistor 13 at a relatively faster rate than that rate at which the arm 14 normally moves, either right of left along resistor 13, when the solenoid ORS is deenergized.

As is also familiar to those skilled in the art, the load regulator contactor LRC determines whether or not resistor 16 is connected in multiple with the load regulator resistor 14, in accordance with the opening and closing of the contacts 42 of contactor LRC. Without attempting to limit the spirit or scope of the present invention, the resistor 16 is assumed here to have a resistance value of the load regulator resistor 13; i.e. the resistor 16, for example, might have a resistance of four ohms, whereas the load regulator resistor 13 might have an overall resistance in the neighborhood of fifty ohms.

In view of the above, when the relay OS thus picks up to register overspeed and causes pulsing of the relays CL and CLP, as previously described, the overriding solenoid ORS momentarily becomes energized and starts to draw the movable arm 14 towards its minimum field or left-hand position on the load regulator resistor 13. Subsequently, when the relay CLP becomes picked up to close its front contact 41, the load regulator contactor LRC is operated and thereby opens contacts 42 to remove the shunt resistance 16 from around the load regulator resistor 13. As previously mentioned, when back contact 30 of relay CLP is opened, the relay CL opens its own front contact 32 after its predetermined dropaway time has elapsed and thereby deenergize the overriding solenoid ORS; and similarly, will open its front contact 31 and thus energize the relay CLP which will subsequently open its front contact 41 and thereby deenergize the load regulator LRC to again place the resistor 16 in multiple with the load regulator resistor 13. With both the overriding solenoid ORS and the load regulator contactor LRC deenergized, the engine speed governor 12 will again cause movable arm 14 to move to the right along resistor 13 in an attempt to increase the current to the battery field winding BF towards its predetermined value (balance point) for the existing throttle position.

Because of the previously discussed relative magnitudes of the resistors 13 and 16, the initial energization of the overriding solenoid ORS causes the movable arm 14 to begin moving to the left along resistor 13 and the current to the battery field winding is thus decreased at a relatively slow rate, until the load regulator contactor LRC is energized at which time resistor 16 is disconnected and the decrease in battery field current, as movable arm 14 moves to the left along resistor 13, will therefor be at a relatively faster rate. Subsequently, when the relay CL is dropped away and the overriding solenoid ORS deenergized, the movable arm 14 again moves to the right along resistor 13 in an attempt to reach the balance point for the existing throttle position; the rate of movement of arm 14 to the right along resistor 13 is the inherent speed of the load regulator which, as mentioned previously, is relatively slow compared to the speed at which the arm 14 moves to the left when the overriding solenoid ORS is energized. As soon as relay CLP becomes dropped away, as previously described, the resistor 16 is again connected in multiple with load regulator resistor 13, and after the initial current increase caused by again placing resistor 16 across the load regulator resistor 13, the current supplied to the battery field winding BF will then gradually increase at a relatively slow rate again determined by the relative magnitudes of the resistors 13 and 16. Obviously, the rate at which the battery field current will increase after the resistor 16 has been connected in multiple with load regulator resistor 13 is slow relative to the rate at which this current would increase if resistor 16 were disconnected.

In this manner, as soon as the relay OS becomes picked up to initiate pulsing operation of the relays CL and CLP, the current to the battery field winding BF is momentarily reduced (to reduce actual locomotive speed) and is subsequently permitted to gradually increase towards that value where the actual speed of the locomotive will once again exceed the desired speed. More specifically, since the resistor 16 is relatively small in magnitude compared to the load regulator resistor 13, the current to the battery field winding BF more gradually increases towards the critical value (at which relay OS becomes picked up) than could be accomplished if the resistor 16 were not connected in multiple with the resistor 13. Accordingly, the actual speed of the locomotive is maintained substantially at the desired speed of the locomotive with a minimum of so-called actual speed hunting.

With reference to the accompanying drawings it will be noted that if this momentary reduction in the power output of locomotive power unit (by the momentary

energization of the overriding solenoid ORS and the load regulator contactor LRC) fails to reduce the actual speed of the locomotive and therefore does not cause relay OS to be dropped away, repeated pulsing of relays CL and CLP will occur to draw the movable arm **14** closer and closer to its minimum field current position at the left-hand end of the load regulator resistor **13**.

As mentioned previously, the downstep relay DS requires a predetermined time interval of energization before it can be picked up to close its front contact **43** and thereby cause downstepping of the locomotive throttle **15**. Therefore, if the actual locomotive speed fails to be properly reduced below the desired speed within the predetermined time interval fixed by the slow pickup time of downstep relay DS; i.e. the relay OS fails to be dropped away due to the reductions in battery field current to the winding BF which occur during this overspeed condition, the downstep relay DS will become picked up, over front contacts **24** and **29** of relays OS and TD respectively, and therefore cause reduction in the locomotive throttle setting until the actual speed is properly lowered below the desired speed.

Conversely, if during operation of the locomotive, the relay OS remains in its dropped away position for a time sufficient to permit the time delay relay TD to drop away; i.e. the actual speed of the locomotive remains too low relative to the desired speed, the upstep relay US will become energized, over back contacts **24** and **25** of relays OS and TD respectively, to cause an increase in the locomotive throttle setting effective to return the actual locomotive speed back to the desired speed of the locomotive.

From the above discussion, it should be obvious that when the proper throttle position is reached, for the preselected desired humping speed of the locomotive, the actual speed of the vehicle will be controlled to gradually increase above the desired speed at which time the overspeed relay OS will become picked up and thereby initiate a pulsing operation of the relays CL and CLP to reduce the battery field current to the generator winding BF and thereby reduce the locomotive's actual speed. In this manner, as the actual speed of the locomotive is being held substantially constant around the desired speed, the relays CL and CLP are caused to complete one pulsing operation each time the actual speed of the locomotive gradually surpasses the desired speed, and therefore, if the actual speed of the locomotive is being held substantially constant, as desired, the downstep relay DS remains in its dropped away position along with the upstep relay US, and, the throttle position aboard the locomotive remains unchanged; i.e. the actual speed is maintained substantially at the desired speed in accordance with the momentary energization of the overriding solenoid ORS and the load regulator contactor LRC, when appropriate.

In view of the foregoing discussion, it will be seen that the illustrated embodiment of the present invention shown in FIG. 1 of the accompanying drawings serves to automatically control the speed of a hump locomotive so that such travels substantially at a constant desired speed irrespective of any variation in the amount of load being pulled or pushed by the locomotive, without any intervention being required on the part of an operator; i.e. the throttle is automatically upstepped or downstepped, as required, if the vernier control of the locomotive power output provided by relay CL and CLP fails to properly maintain the actual speed in substantial agreement with the desired speed.

In the foregoing operational description of the illustrated embodiment of the present invention shown in FIG. 1, the load regulator contactor LRC became energized (to remove the shunt resistance **16** from across the load regulator resistor **13**) each time the relay CLP picks up. However, it should be understood at this time that, if desired, the load regulator contactor LRC could be energized over a front contact of the speed relay OS in preference to the front contact **41** of relay CLP as shown in FIG. 1 and described hereinbefore. By so doing, the load regulator contactor LRC would remain energized as long as the actual speed of the hump locomotive is above the desired locomotive speed and only become deenergized, to re-connect resistor **16** in multiple with resistor **13** and thus permit the desired gradual increase in the current to the battery field winding BF, when relay OS releases. Depending upon the requirements of practical application, the above described manner of controlling the load regulator contactor LRC (by relay OS) may permit the actual locomotive speed to be held slightly better in agreement with the desired speed than if the contactor LRC is controlled over a front contact of the relay CLP (as shown in FIG. 1).

As previously mentioned, the speed control apparatus provided in accordance with the present invention may also be utilized, if desired, aboard a railway locomotive provided with an engineman to operate the locomotive throttle, for the purposes of aiding the engineman by providing him with an indication concerning whether or not the actual locomotive speed is being held substantially in agreement with the desired speed (by the operation of the CL and CLP relays), and furthermore, to provide indication to the engineman as to any required adjustment in the throttle setting aboard the locomotive necessary to maintain the desired locomotive speed.

More specifically, if the actual speed of the locomotive remains below the desired speed for more than the predetermined time interval established by the slow drop-away time of the time delay relay TD, the indicator lamp **44** in FIG. 3, would become energized over back contacts **24***a* and **25***a* of relays OS and TD respectively, to indicate to the engineman that an increase in the throttle setting is necessary in order to maintain the desired speed. On the other hand, if the actual locomotive speed remains above the desired speed for more than a predetermined time interval, selected in accordance with the requirements of practice, indicator lamp **45** in FIG. 3 would be steadily illuminated over front contacts **24***a* and **29***a* of relays OS and TD respectively, to provide indication to the enginemen that the throttle setting must be decreased in order to maintain the desired speed. Obviously, during the times that the actual locomotive speed is being held substantially in agreement with the desired speed, by the momentary pulsing of the overriding solenoid ORS and the load regulator contactor LRC, the indicator lamp **45** in FIG. 3 would be intermittently turned on and off by relay OS to provide indication to the engineman that the speed of the locomotive is being held substantially constant as desired.

In view of the foregoing discussions, it will thus be seen that a locomotive speed control organization has been provided, in accordance with the present invention, which can be employed on a locomotive to maintain a desired locomotive speed with or without an engineman being provided on the locomotive to operate the locomotive throttle. As previously discussed, such a speed control organization has particular utility in that it will maintain a substantially constant desired locomotive speed during the humping of cars in a railway classification yard wherein the loading on the hump locomotive is continually being changed as each car or cut of cars is uncoupled from the locomotive.

Having thus described a locomotive speed control system and one modification thereof as specific embodiments of the present invention, it is desired to be understood that these forms are 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 other modifications, adaptations and alterations may be applied to the specific forms 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. In a speed control system for a locomotive equipped with a throttle controlled power unit and a regulating device for adjusting the driving power output of said power unit between predetermined limits for each position of said throttle, the combination of,

(a) means for comparatively registering the actual speed of said locomotive relative to a desired locomotive speed,

(b) means for advancing the throttle to a first position effective to cause said locomotive to accelerate towards said desired speed,

(c) means responsive to said speed registering means for operating said regulating device to reduce the power output of said power unit in predetermined timed step amounts whenever said actual speed is above said desired speed so as to reduce said actual speed, and

(d) means responsive to said speed registering means for registering whether said throttle position should be decreased or increased from said first throttle position dependent upon whether the actual speed of said locomotive is remaining respectively above or below said desired speed for more than predetermined time intervals while said throttle is in said first position.

2. In a speed control system for a locomotive equipped with a throttle controlled power unit and a regulating device for adjusting the driving power output of said power unit between predetermined limits for each position of said throttle, the combination of,

(a) means for comparatively registering the actual speed of said locomotive relative to a desired locomotive speed,

(b) means responsive to said speed registering means for progressively actuating the throttle on said locomotive from one position to the next higher position if said actual speed fails to attain said desired speed within a first predetermined time interval while said throttle is in said one position,

(c) means responsive to said registering means for operating said regulating device to reduce the power output of said power unit in predetermined timed step amounts whenever said actual locomotive speed is above said desired speed so as to reduce said actual speed, and

(d) means responsive to said speed registering means for decreasing the throttle position on said locomotive from one position to the next lower position if said power output step reductions fail to lower said actual speed below said desired speed within a second predetermined time interval while said throttle is in said one position.

3. In a speed control system for a locomotive equipped with a power unit controlled by a manually operated throttle and a regulator device for adjusting the driving power output of said power unit between predetermined limits for each position of said manually operated throttle, the combination of,

(a) means for comparatively registering the actual speed of said locomotive relative to a desired locomotive speed,

(b) means responsive to said speed registering means for operating said regulating device to reduce the power output of said power unit in predetermined timed step amounts whenever said actual locomotive speed is above said desired locomotive speed so as to reduce said actual speed, and

(c) indicating means responsive to said speed registering means for providing an indication to the operator of said throttle distinctive of whether said throttle should be decreased or increased from a predetermined position dependent upon whether the actual speed of said locomotive is remaining respectively above or below said desired locomotive speed for more than predetermined time intervals while said throttle is in said predetermined position.

4. The combination specified in claim 3 wherein said desired locomotive speed is manually adjustable.

5. The combination specified in claim 3 wherein said indication means are effective to indicate to said operator that said throttle position is proper as long as actual locomotive speed is being maintained in substantial agreement with said desired speed by said power output reductions.

6. In a speed control system for a locomotive equipped with a throttle controlled power unit and a regulating device for adjusting the driving power output from said power unit to a predetermined value for each position of said throttle, the combination of,

(a) means for comparatively registering the actual speed of said locomotive relative to a desired locomotive speed,

(b) means for advancing the throttle of said locomotive to a first position effective to cause said locomotive to accelerate towards said desired speed,

(c) an overriding solenoid which when energized, is effective to override said regulating device and reduce the power output of said power unit and the actual locomotive speed and which when deenergized permits said regulating device to adjust said power output to said predetermined value,

(d) circuit means responsive to said speed registration means for repeatedly energizing and deenergizing said overriding solenoid at predetermined times whenever the actual locomotive speed is above said desired locomotive speed, and

(e) means responsive to said speed registering means for registering whether said throttle should be decreased or increased from said first throttle position dependent upon whether the actual speed of said locomotive is remaining respectively above or below said desired speed for more than predetermined time intervals while said throttle is in said first position.

7. The combination specified in claim 6 wherein said circuit means include,

(a) first and second relays, the energizing circuit for picking up said first relay being completed when the actual locomotive speed is above said desired locomotive speed and said second relay is dropped away, and the energizing circuit for picking up said second relay being completed when said first relay is picked up, and

(b) an energizing circuit for said overriding solenoid completed only when said first relay is picked up.

8. The combination specified in claim 7 wherein the time interval between deenergization and dropaway for each of said first and second relays is adjustable.

9. In a speed control system for a locomotive equipped with a throttle controlled variable speed engine, an electric generator driven by said engine and at least one electric traction motor serving collectively as the power unit of said locomotive, said engine having governor means associated therewith effective to maintain said engine at substantially a constant predetermined speed for each setting of said throttle and furthermore effective to automatically increase the electric power output from said generator to said traction motor to a predetermined value for each of said throttle settings by increasing the amount of input current supplied to a field winding of said generator, the combination of,

(a) speed registering means for comparatively registering the actual speed of said locomotive relative to a predetermined desired locomotive speed,

(b) an overriding solenoid which when energized is effective to decrease the current supplied to said generator field winding so as to reduce the power output from said generator and the actual locomotive

speed and which when deenergized permits said governor means to increase said field current,

(c) an energizing circuit for said overriding solenoid controlled by said speed registering means to be alternately opened and closed for predetermined times whenever the actual locomotive speed is above said desired speed, and

(d) throttle positioning registration means responsive to said speed registering means for providing a registration indicative of whether the locomotive throttle setting should be decreased or increased relative to a predetermined setting dependent upon whether the actual locomotive speed is remaining respectively above or below said desired speed for more than predetermined time intervals while said throttle is in said predetermined setting and for providing a further registration indicating that said throttle setting should be maintained constant relative to said predetermined setting if said actual locomotive speed is being maintained substantially in agreement with said desired speed by said alternate energization and deenergization of said overriding solenoid.

10. The combination specified in claim **9** including throttle operating means responsive to said throttle positioning registration means effective to operate said locomotive throttle as indicated by the registrations of said throttle positioning registration means.

11. The combination specified in claim **9** including indication means responsive to said throttle positioning registration means effective to provide an indication to an operator aboard said locomotive concerning how the locomotive throttle should be operated to maintain said predetermined desired speed in accordance with the registrations of said throttle positioning registering means.

12. In a speed control system for a locomotive equipped with an electrical power generating device as part of the driving power producing unit thereof, said electric generator including a field winding supplied with a variable amount of current, over an input circuit including a variable first resistor and a second resistor connectable in multiple with said first resistor, to cause a corresponding variable amount of electrical power output to be produced by said electric generator and a corresponding variable locomotive speed, the combination of,

(a) speed registration means for comparatively registering the actual speed of said locomotive relative to a predetermined desired locomotive speed,

(b) current increasing means responsive to said speed registration means effective while said actual locomotive speed is below said desired locomotive speed to adjust said variable resistor so as to increase the amount of current supplied to said field winding,

(c) first energizable means effective when selectively energized or deenergized to either adjust said variable resistor so as to decrease the amount of current supplied to said field winding or to permit said current increasing means to increase the amount of current supplied to said field winding,

(d) first circuit means responsive to said speed registration means for repeatedly energizing and deenergizing said first energizable means at predetermined times when the actual locomotive speed is above said desired locomotive speed,

(e) second energizable means effective when energized and deenergized to selectively connect and disconnect said second resistor in multiple with said first variable resistor, and

(f) second circuit means responsive to said speed registration means effective to energize or deenergize said second energizable means in accordance with whether the actual locomotive speed is above or below said desired speed, whereby the current supplied to said field winding is controlled to vary at a relatively fast rate when the actual locomotive speed is above said desired locomotive speed and at a relatively slower rate when the actual speed is below said desired speed.

No references cited.

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