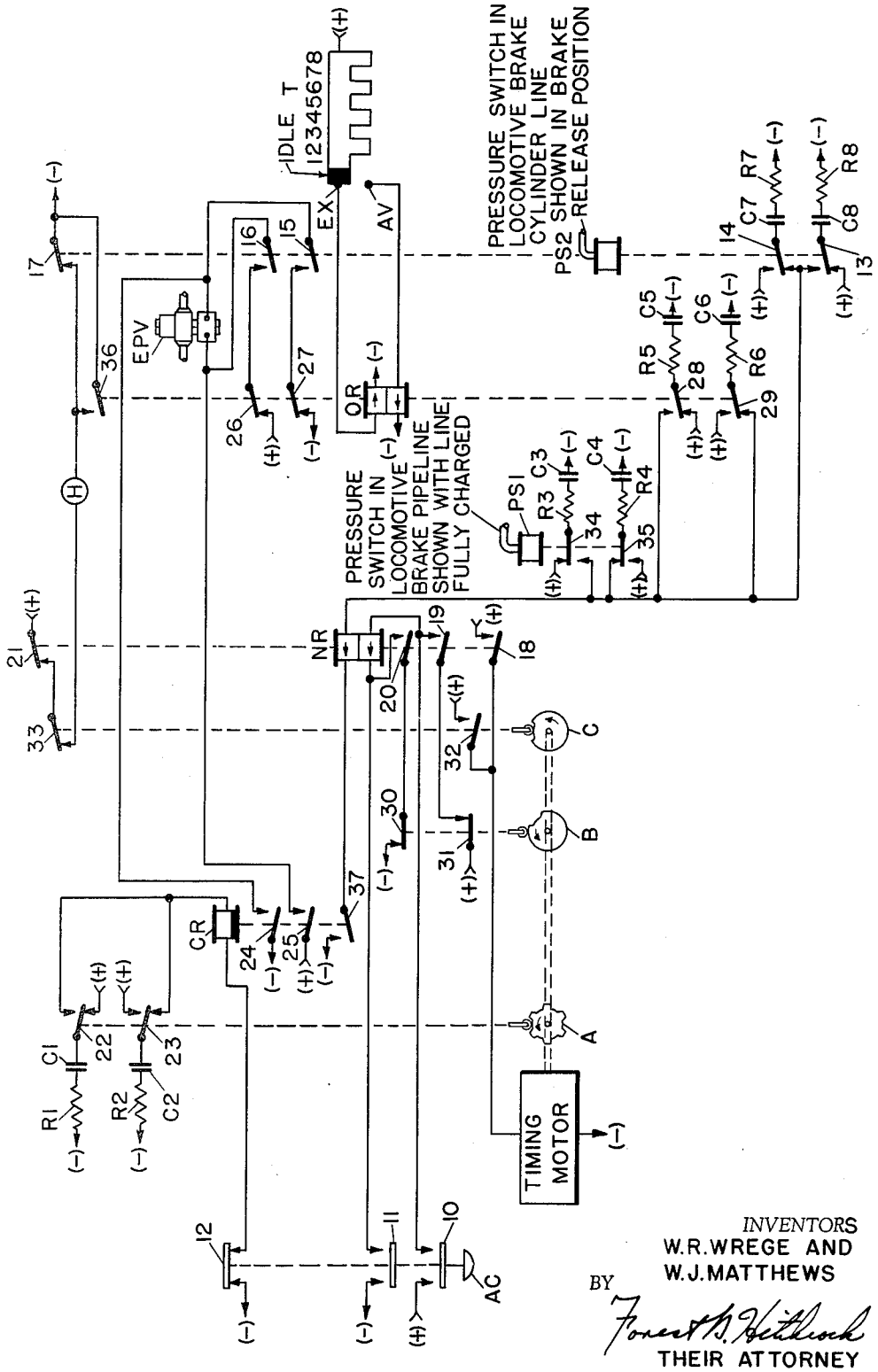
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VIGILANCE MONITORING SYSTEM FOR LOCOMOTIVE ENGINEER

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VIGILANCE MONITORING SYSTEM FOR LOCOMOTIVE ENGINEER

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This invention relates to a system for monitoring the vigilance of a locomotive engineer in performing his duties, and more specifically relates to a vigilance monitoring system which requires an intermittent positive action by the engineer in order to avoid an automatic brake application to the train being operated.

The safety requirements of modern railroad operations dictate the need for a monitoring system which insures that the engineer controlling a locomotive is alert mentally and is physically capable of performing his duties. Conventional systems generally employ some form of foot pedal or push button which must be continually depressed by the engineer while operating the locomotive. In the event that the engineer becomes unconscious or mentally or physically fatigued and pressure is removed from the foot pedal or push button, a penalty such as an automatic brake application or the like is enforced after a suitable warning has been given.

Such conventional systems contain certain defects. For example, it is quite possible that should the engineer lose consciousness, the position of his body may be such that pressure is maintained on the foot pedal or push button. Again, in order to circumvent the monitoring system, the foot pedal or push button may be continuously tied down. Under either of these circumstances the penalty can be avoided and a dangerous condition results.

In order to preclude the continuous actuation of the foot pedal or push button by the engineer as an effective response, refinements have been added to such conventional systems which require that the engineer perform certain acknowledging acts during a given period of time or distance travelled. Such systems place an additional burden on the engineer who must perform these acknowledging acts in addition to carrying out his normal duties.

In order to overcome the undesirable aspects of the aforementioned conventional systems but yet insure that the engineer is capable of performing his duties, the present invention proposes a monitoring system such that the engineer is required to intermittently perform a positive acknowledging act over a selected fixed time cycle in order to forestall a penalty brake application. However, the supervisory system is such that no undue strain is placed upon the engineer because a penalty brake application is forestalled for an additional time cycle whenever the engineer changes the throttle setting of the locomotive or the locomotive brakes are applied or released.

Under these circumstances it is only rarely that the engineer is required to perform an acknowledging response to the vigilance monitoring system because the system detects the operational responses of the engineer to road conditions and uses these responses as indications of his alertness. Moreover, additional means are provided which cause a penalty brake application should the engineer deliberately or unconsciously attempt to circumvent the monitoring system by continuously depressing the acknowledging contactor.

In view of the above, one object of the present invention is to provide a monitoring system of the type described wherein certain periodic responses are required on the part of the engineer of a locomotive during selected time cycles in order to prevent an automatic brake application.

Another object of the present invention is to provide a vigilance monitoring system for a locomotive engineer which provides for an automatic brake application if the engineer continuously depresses the acknowledging contactor.

Another object of the present invention is to provide a vigilance monitoring system of the type described wherein the automatic or manual application or release of the locomotive brakes or throttle setting changes constitute a response to the monitoring system sufficient to avoid a penalty.

A further object of the present invention is to provide a vigilance monitoring system for a locomotive engineer wherein acknowledgment is not necessary when the locomotive throttle is in the idle position and the locomotive brakes are applied.

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

In describing the invention in detail reference is made to the accompanying drawing wherein one embodiment of the present invention is illustrated partially in block diagrammatic and partially in schematic form.

For the purpose of simplifying the illustration and facilitating the explanation thereof, the various parts and circuits constituting this embodiment of the present invention have been shown diagrammatically and certain conventional illustrations and block diagrams have been employed. The drawing has been made more with the purpose of facilitating the disclosure of the present invention as to its principles and mode of operation rather than for the purpose of illustrating a specific construction and arrangement of parts that would be employed in practice. Thus, various relays and their contacts are illustrated in a conventional manner and symbols (+) and (—) are used to indicate the connections to terminals of batteries or other sources of direct current.

Referring to the drawing it can be seen that the vigilance monitoring system utilizes an acknowledging contactor A.C. which when depressed energizes a relay NR which provides a positive source of energy for driving a timing motor. The timing motor may be any suitable constant speed device which will provide the desired period of rotation for the cams A, B, and C which are controlled by the timing motor.

Cam A actuates contactors which alternately charges one of two capacitors and discharges the other capacitor through the windings of a check relay CR. When the relay CR is energized it provides an energizing circuit for the electropneumatic valve EPV which may control a suitable pneumatic operating brake pipe venting device or the EPV may control a pneumatically operated brake valve actuator as desired. This device EPV represents suitable means to effect an automatic brake application of any degree or character desired upon the denergization of a circuit. Such a valve and its operation are well recognized in the art and this conventional representation is considered sufficient since the present invention is not directed to any particular type of brake control apparatus.

In view of the above, it can be seen that as long as cam A continues to rotate, energy will be provided for the windings of the relay CR and the EPV will remain in its normally controlled position, only provided the acknowledging contactor AC is released placing contact **12** of the acknowledging contactor in the closed back position. Cam B is employed to retain the nullification relay NR and, consequently, the timing motor momentarily energizes when the acknowledging contactor is released. When the cams begin to rotate, the structure of cam

B and C is such, that the contacts of cam B are opened deenergizing the nullification relay NR and energy is thereafter provided for the timing motor for the remainder of the timing cycle through closed front contacts 32 of cam C.

The timing period of the cams A, B and C in practice will, of course, be determined by the operating requirements of the railroad. However, for the purposes of this disclosure a timing period of 96 seconds has been selected as being suitable. Consequently, the RC discharge time of each capacitor must be on the order of eight seconds in view of the fact that the cam A is illustrated as having six protruding segments. Other suitable timing cycles may be provided by altering the structure of the cam A.

The vigilance monitoring system of the present invention may be used with a variety of locomotives subject to minor modifications readily made by those skilled in the art. However, in order to illustrate the required embodiment of the present invention, the Model E8 Diesel Locomotive of the Electromotive Division of General Motors Corportaion has been selected. This locomotive has two diesel engines which drive the main generators. The main generators produce direct current at a normal voltage for the armatures of four traction motors each of which rotates a power axle by means of a pinion gear meshing with an axle gear.

The throttle of the Model E8 locomotive, which is diagrammatically represented by T in the drawing, controls the speed of the diesel engines and the train speed in normal operation by controlling the fuel flow to the engines and by regulating the amount of resistance in the generator battery field circuits, thereby regulating the output current to the armatures of the traction motors which drive the locomotive.

The throttle has ten positions stop, idle, and eight running positions. Each running position increases the engine speed 75 r.p.m. from 275 r.p.m. at idle to 800 r.p.m. at full throttle. The EX contact shown in the drawing is used to provide positive energy for the generator battery field circuit. Such energy is made available through a resistance which is maximum in throttle Run 1 steadily decreases reaching a minimum in Run 8.

The AV connection associated with the throttle is incorporated in the fuel flow regulation means of the above mentioned locomotive. Fuel flow for the diesel engines is controlled by means of a governor which has associated therewith four solenoids or valves designated A, B, C and D which control the flow of fuel to the engines in accordance with the energization of the individual solenoids or various combinations of energized solenoids. Energy is provided through the AV connection, in conjunction with throttle, for the A solenoid with the throttle in either Run 2, 4, 6 or 8. This is indicated diagrammatically in the drawings.

Therefore, it can be seen that if the throttle is operated to Run 1 an energizing circuit is completed for the upper windings of the operational relay OR through the EX connection. As the throttle is moved to Run 2, the A valve connection AV in the diagram is placed in the energizing circuit completed by the throttle movement and current will flow in the opposite direction through the lower windings of the operational relay OR causing its contacts to drop away. Thus, movement of the throttle from one run to another by the engineer is manifested by the energization and deenergization of the relay OR and this fact is used in the present invention to initiate a new timing cycle for the monitoring system, in addition to the one currently in progress.

Specific details of the operation of the throttle may be obtained by referring to Operating Manual No. 2311 for Passenger Locomotive Model E8, Electromotive Division, General Motors Corporation, LaGrange, Illinois. For specific details of the operation and structure of the fuel flow governor, reference may be made to Bulletin PGR–2–51 of the Woodward Governor Co., Rockford, Illinois.

Throttle movements as detected by the OR relay are used to discharge capacitors through the windings of the NR relay. The energized NR then initiates a second timing cycle when the cycle currently in progress is completed.

Additionally, the present invention also provides structure for detecting braking operations on the part of the engineer as evidence of his ability to properly control the locomotive. For this reason, a pressure switch PS1 is located in the locomotive brake pipe.

The automatic brake valve is controlled by the engineer who manually operates it to provide a given brake application. This is accomplished by reducing the air pressure in the brake pipe line a selected amount and holding it at that level. The amount of the reduction of the pressure in the locomotive brake pipe controls the amount of air applied to the air brake cylinders. When the brakes are to be released, the engineer restores the brake pipe pressure to its normal value thereby reducing the amount of air applied to the air brake cylinders on the locomotive. Thus, the degree of a given brake application or release is reflected by a change in the air pressure in the locomotive brake pipe. As the pressure switch PS1 senses these changes in the locomotive brake pipe air pressure, these changes are used to open and close the contacts of the pressure switch PS1 which alternately charge and discharge capacitors through the windings of the nullification relay NR. Therefore, operation of the train brakes by the engineer in response to road conditions is used to initiate a new timing cycle of the vigilance monitoring system thereby alleviating the need for actuation of the acknowledging contactor.

The locomotive has two pneumatic braking systems. An independent braking system and a "so-called" automatic braking system. However, in addition to the automatic brake valve system, the engineer normally can control the locomotive brakes by means of an independent brake valve. The independent brake valve handle has two positions; release and full application with the application zone between the two positions. This system would be used, for example, when making a station stop. With the train halted and the throttle in the idle position, the engineer would allow the locomotive brake pipe line air pressure to be restored to its normal valve and hold the train in the station by means of the independent brake valve which maintains locomotive brake cylinder pressure at a value corresponding to the position of the brake valve handle in the application zone. The pressure switch PS2 is located in the locomotive brake cylinder line and is shown in the brake release position. Therefore, with the throttle in the idle position, the operations relay OR is deenergized and with the locomotive brake applied by means of the independent brake valve, an energizing circuit is completed for the EPV over front contacts 15 and 16 of the pressure switch PS2. Under these circumstances, acknowledgement is not necessary and the engineer is free to leave the cab. One pressure switch suitable for use as PS1 and PS2 is the Single Pole Heavy Duty Pressure Switch produced by Cutler-Hammer Inc. of Milwaukee, Wisconsin which is illustrated in their Bulletin 10,007 dated May 1958. This switch is operative in response to a minimum pressure differential on the order of 20 pounds per square inch.

An acknowledging horn H provides an audible warning to the engineer of an impending penalty brake application. When the warning horn sounds the locomotive engineer is provided time equal to the slow drop away time of the CR relay to depress the acknowledging contactor AC and initiate a new timing cycle.

A contact 37 of the CR relay is incorporated in the energization circuit for the relay NR. Consequently, whenever the CR relay is deenergized, the relay NR can only be thereafter energized by depressing and releasing the acknowledging contactor AC. Therefore, once a penalty brake application has been enforced, operation of

the PS1 or PS2 pressure switch in response to changes in the air pressure in the train brake pipe or the locomotive brake cylinder lines brought about by the penalty brake application will have no effect on the monitoring system. These same considerations apply to movement of the throttle.

It should also be noted that the system is fail safe in that should the relay CR become deenergized for any reason, energy will be removed from the EPV causing an automatic brake application and the engineer has notice that the system is malfunctioning. Under these circumstances, the engineer with the permission of the dispatcher, may break the seal on auxiliary means for retaining the EPV in the energized condition. Consequently, the dispatcher will be aware that the system is malfunctioning and may order the engineer to proceed under restricted speed orders.

More specifically, let us assume that the engineer is preparing to get underway having completed a station stop. Under these circumstances, the relay CR would be deenergized and the throttle T would be in the idle position. We will further assume that the engineer is using the independent brake valve to hold the train and air at a pressure governed by the independent brake valve is in the locomotive brake cylinders and, consequently, in the locomotive brake cylinder line.

In order to actuate the system after a stop, penalty or otherwise, the engineer must just depress the acknowledging contactor AC. This is necessary because with the relay CR deenergized, its front contact **37** will be open and the nullification relay NR cannot be energized through its upper windings by the actions of the engineer while operating the locomotive.

However, with a manually actuated timing cycle in progress and the energized relay CR causing its front contact **37** to close, the actions of the engineer in operating the locomotive will be effective responses to the vigilance monitoring system.

When the engineer releases the locomotive brake, the reduction of the air pressure in the locomotive brake cylinder line is reflected by the closure of back contacts **13** and **14** of the pressure switch PS2. It is to be understood that with the locomotive brakes applied, the contacts **13** and **14** of PS2 would be closed in their front position, thereby placing a charge on the capacitor C7. When the independent brakes are released, the pressure switch PS2 would sense the decrease in pressure in the line, thereby closing its back contacts. The charge placed on the capacitor C7 would then discharge through the upper windings of the nullification relay NR and front contact **37** of relay CR.

Energization of the nullification relay NR would close its front contact **18** providing an energizing circuit for the timing motor. Energization of the timing motor would initiate a timing cycle and the cams A, B and C would begin to rotate. Rotation of the cam A in the counterclockwise direction would cause its projected segments and depressions to alternately open and close its contacts **22** and **23**.

The closure of front contact **22** would cause the charge on the capacitor C1 to discharge through the windings of the check relay CR, providing an energizing circuit for the relay CR whenever contact **12** of the acknowledging contactor AC was in the normal closed position as shown indicating the acknowledging contactor was released by the engineer. Thereafter, relay CR would remain energized by the alternate discharge of capacitors C2 and C1. Energization of the relay CR completes an energizing circuit over its front contacts **24** and **25** for the EPV which retains the EPV in the closed position and normal air pressure in the brake pipe line. It should be remembered that with the throttle in the idle position and pressure in the locomotive brake cylinder line, the EPV would be energized by a circuit including (+), back contact **26** of relay OR, front contact **16** of PS2, the EPV, front contact **15** of PS2 and back contact **27** of relay OR. Therefore, when the air pressure is released from the locomotive brake cylinder line initiation of a timing cycle and energization of the relay CR merely retains the EPV in its normally energized position.

Assuming the engineer moves the throttle T to Run **1** in order to get the locomotive and the train underway, positive energy would be provided for the operations relay OR by means of (+), the exciter connection EX on the throttle, the upper winding of relay OR and (−). Energization of the relay OR would cause its front contacts **28** and **29** to close placing the capacitor C6 in circuit with a positive source charging potential over its front contact **29** and discharging the capacitor C5 over front contact **28** of relay OR through the windings of the nullification relay NR.

With a timing cycle in progress due to the release of air pressure in the locomotive brake cylinder line and contacts **30** and **31** of the cam B in their closed front position, energization of the relay NR would close its front contacts **19** and **20** completing a stick circuit for the relay NR. This circuit includes (+), front contact **31** of cam B, front contact **19** of relay NR, the bottom coil of relay NR, front contact **20** of relay NR, front contact **30** of cam B and (−). Energy for the timing motor is now being provided from two positive sources. The first source of positive energy is over front contact **32** of cam C which is rotating over the normal portion of its perimeter with a timing cycle in progress and the second source of positive energy is being provided over front contact **18** of relay NR.

Due to the structure of the cams B and C, the depression in the cam C will open its front contact **32** at the termination of each timing cycle. However, under the present circumstances the cam B will maintain its front contacts **30** and **31** in their closed position at the end of the timing cycle because at the termination of a timing cycle its normal perimeter is in contact with the contacts **30** and **31**. Therefore, the relay NR will remain momentarily energized at the end of the first timing cycle and will initiate a second timing cycle by means of the energy being provided for the timing motor over its front contact **18**.

When the notch or depressed area of the cam B comes in contact with contactors **30** and **31** they will open removing energy from the relay NR. However, at this point in the cycle the normal perimeter of the cam C will cause its front contact **32** to close providing an energizing source for the timing motor. Also, when the normal perimeter of the cam C is in contact with its contactors, it opens its contact **33** opening the energizing circuit for the horn H.

When the engineer advances the throttle to Run **2**, the AV connection is energized and an increased amount of fuel is provided for the engines. The AV connection also provides an energizing circuit for the windings of the operations relay OR in a direction opposite to that flowing through the upper windings of the relay OR. The consequent decrease in the magnetic field of the relay causes the relay OR to close its back contact **28** and discharging the capacitor C6 through the windings of the NR relay.

Energization of the relay NR closes its front contacts **19** and **20** and with the normal surface of the perimeter of the cam B maintaining its contacts **30** and **31** in the closed front position a stick circuit will again be developed for the relay NR. At the completion of the cycle in progress the depressed portion of the cam C will cause its contacts to drop away. However, as the nullification relay NR is providing positive energy for the timing motor over its front contact **18**, a new cycle will again be initiated and the alternate charging and discharging of the capacitors C1 and C2 by the cam A will retain the relay CR and the EPV energized. In the same manner each movement of the throttle to a new notch will

initiate a timing cycle preventing a penalty application of the brakes by maintaining energy on the EPV without requiring the locomotive engineer to depress the acknowledging contactor AC.

The engineer's actions with respect to the automatic braking system also alleviate the necessity of depressing the acknowledging contactor in the same manner as previously described for the independent brake system and the throttle. Should road conditions require that the engineer make a brake application of a specified degree, actuation of the brake lever will lower the pressure in the locomotive brake pipe line a fixed amount which, in turn, will permit air under pressure to flow from a reservoir on the locomotive and each car of the train into the air brake cylinder on the locomotive and each car of the train. The increase in air pressure in the brake cylinders is commensurate with the decrease in pressure in the train brake pipe line.

When the air pressure in the brake pipe line is reduced by the engineer, the pressure switch PS1 will close its back contacts **34** and **35**. This will cause the capacitor C3 to discharge over back contact **34** of PS1 through the winding of the nullification relay NR. With the cam B rotating with the normal surface of its perimeter maintaining its contacts **30** and **31** in the closed front position a stick circuit for relay NR will again be developed over contacts **19** and **20** of the relay NR. Also, a second energizing circuit for the motor will be developed by the closed front contact **18** of the relay NR. The first energizing circuit is, of course, developed by the normal surface perimeter of the cam C maintaining its front contact **32** closed. Under these conditions when the depressed portion of the perimeter of the cam C completes its current cycle, its front contact **32** will open removing this source of energy from the timing motor. However, as the eccentric portion of the cam B lags the eccentric portion of cam C over any individual cycle it can be seen that energy will be maintained on the NR relay by the closed front contacts **30** and **31** of cam B, thereby providing an energizing circuit for the timing motor through front contact **18** of the relay NR.

When the eccentric surface of the cam B allows its front contacts **30** and **31** to open, the relay NR becomes deenergized. However, at this instant, the normal surface of the cam C will be in contact with its front contact **32** providing energy for the timing motor and initiating a new timing cycle. Thus, it can be seen that although the relay NR opens its front contact **18**, the normal surface of the rotating cam C, being in contact with its contact **32**, provides positive energy for the timing motor.

When the brakes are subsequently released and the pressure in the train brake pipe line is restored to normal, the pressure switch PS1 will detect this increase, restoring its front contacts **34** and **35** to their normal front position as shown in the drawing. This will cause the discharge of the capacitor C4 through the windings of the relay NR which in the same manner as hereinbefore described will initiate a new timing cycle after the timing cycle in progress in completed. Moreover, as positive energy is provided for the warning horn H by a circuit including back contact **21** of the relay NR and back contact **33** of the cam C, it can be seen that once the cycle is initiated by energizing the relay NR causing the cam C to rotate one of these back contacts will be in the open position during the course of the cycle.

If the road conditions under which the locomotive is operating do not require that the engineer use his throttle or his brakes then the vigilance monitoring system requires that he depress and thereafter release the acknowledging contactor AC to avoid a penalty brake application. When the engineer depresses the acknowledging contactor AC, an energizing circuit for the relay NR is completed which includes front contacts **10** and **11** of the acknowledging contactor AC and the lower winding of the relay NR. It should be noted that both the windings of the relay NR have current flowing through them in the same direction in their energized condition. However, separate windings are shown in order to disassociate the manual acknowledging circuit and the automatic response circuit.

When the relay NR closes its front contacts **19** and **20**, a stick circuit is developed which includes closed front contacts **30** and **31** of the cam B which retains energy on the windings of relay NR when the acknowledging contactor is released. Energy is provided for the timing motor over closed front contact **18** of the relay NR until the normal surface of cam C again closes its front contact **32**.

Rotation of the cam A by the timing motor alternatively opens and closes front contacts **22** and **23** in accordance with whether the projecting segments or the normal surface of the cam A is in contact with the contacts **22** and **23**.

As the capacitor C1 discharges through the windings of the check relay CR this relay becomes energized closing its front contacts **24** and **25** maintaining the EPV in its energized condition only provided that the engineer has removed pressure from the acknowledging contactor allowing back contact **12** of the acknowledging contactor to close. With the timing cycle now initiated and the normal surface of cam C maintaining its back contact **33** in the open position energy is removed from the warning horn H circuit. The relay CR is made slow to drop away in order to allow the engineer sufficient time to depress the acknowledging contactor AC when the warning horn sounds, thereby preventing a penalty brake application.

The vigilance monitoring system is such that should the engineer stop the train for any reason, such as a station stop, he is relieved of the necessity of actuating the acknowledging contactor AC without invoking a penalty. Under normal conditions at a station stop, the engineer would place the throttle in the idle position and would hold the train at the station by using the independent brake system, thereby allowing the air pressure in the train brake pipe to restore itself to its normal fully charged condition. The train would be held in the stopped position by the application of air pressure to the locomotive brake cylinders. This would be reflected by an increase in the locomotive brake cylinder line pressure which would cause the pressure switch PS2 to maintain its front contacts **15** and **16**, in the closed position. With the throttle in the idle position, energy would be removed from the operations relay OR closing its back contacts **26** and **27**. Therefore, the EPV would be maintained in its energized closed condition by a circuit including (+), back contact **26** of relay OR, front contact **16** of PS2, front contact **15** of PS2 and back contact **27** of relay OR.

The open back contact **17** of pressure switch PS2 and the open back contact **36** of the deenergized relay OR would open circuit the warning horn H in spite of the fact that no energy was being provided for the timing motor and cam B and C were in their normal positions as shown in the drawing. Under these circumstances, the engineer is free to leave the locomotive cab.

Thus, it is readily apparent that an improved vigilance monitoring system has been provided for monitoring the physical and mental capacity of a locomotive engineer to perform his duties. The system is such that the operational responses of the engineer to road conditions are used to actuate the system, thereby alleviating a penalty and relieving the strain imposed on the engineer by conventional monitoring systems. It has furthermore been disclosed that the present invention is characterized by means wherein should the engineer consciously or unconsciously attempt to avoid the system by continually depressing the acknowledging contactor, a penalty is provided.

Although one embodiment of a system, according to the present invention, has been shown as applied to a specific locomotive, it is to be understood that various

additions and modifications may be made without departing from the spirit or scope of the present invention. For example, the present invention as disclosed is adaptable to other Electro-Motor Division and Fairbanks Morse locomotives. Also, it might be more advantageous with some locomotives to use other means such as current surges to detect movement of the throttle.

Similarly, the pressure switch in the brake pipe line could be replaced by a dependent front and back contact on the automatic brake valve which would have positive energy on the back contact in the "running," "service" and "emergency" positions used to charge a capacitor. Under these conditions, as the brake valve handle is moved from the "running" position to either the "service" position or "emergency" position, it passes through the "lap" position. Ordinary skill in this art could then provide that the front contact close in the "lap" position applying the energy on the charged capacitor to the windings of the NR relay.

What we claim is:

1. A vigilance control system for a locomotive engineer, wherein the degree of locomotive braking is a function of the air pressure in the locomotive brake pipe and locomotive is controlled by means of a throttle, comprising,
   (a) a valve for maintaining air under pressure in the locomotive brake pipe,
   (b) timing means manually operable for actuating said valve means to maintain air pressure in said brake pipe for a preselected time cycle.
   (c) and means responsive to the movement of the locomotive throttle for actuating said timing means for a preselected cycle.

2. A vigilance control system for a locomotive engineer, wherein the degree of locomotive braking is a function of the air pressure in the locomotive brake pipe, comprising:
   (a) a throttle for controlling the speed of the locomotive,
   (b) a valve for maintaining air under pressure in the locomotive brake pipe,
   (c) timing means energized in response to a manual actuation for actuating said valve means to maintain air pressure in said brake pipe for a predetermined period of time,
   (d) means energized and deenergized in accordance with the successive movements of said throttle,
   (e) and storage means responsive to said last mentioned means for energizing said timing means for a preselected period of time whenever the throttle is moved.

3. A system in accordance with claim 2 wherein said storage means is a resistance capacitance network which is charged and discharged in accordance with the energization or deenergization of said last mentioned means.

4. In a system for monitoring the vigilance of the operator of a locomotive, wherein the degree of locomotive braking is a function of the air pressure in the locomotive brake pipe, comprising:
   (a) valve means located in said locomotive brake pipe,
   (b) timing means operable in response to throttle setting changes for actuating said valve means to maintain air under pressure in said brake pipe for a selected time cycle,
   (c) pressure means responsive to changes in said air pressure in said brake pipe,
   (d) and means responsive to said pressure means for actuating said timing means and valve means for a selected time cycle,
   (e) whereby said valve means maintains air pressure in said brake pipe as long as said timing means actuates said valve means in response to said throttle setting changes and said pressure means.

5. A vigilance control system for a locomotive engineer, wherein the degree of said locomotive braking is dependent on the air pressure in the locomotive brake pipe and the air pressure in the locomotive brake cylinder comprising:
   (a) valve means for maintaining air under pressure in said brake pipe,
   (b) throttle means for controlling the speed of the locomotive,
   (c) timing means for actuating said valve means to restrict air under pressure to said brake pipe for a predetermined timing cycle,
   (d) control means manually actuatable for energizing said timing means,
   (e) first sensing means responsive to the movements of said throttle means in the running positions for energizing said control means,
   (f) second sensing means responsive to changes in air pressure in said brake pipe for energizing said control means,
   (g) third sensing means responsive to changes in the air pressure in said locomotive brake cylinders for energizing said control means and for cooperating with said first sensing means whenever the throttle is in the idle position for directly energizing said valve means,
   (h) whereby said valve means is actuated to maintain air under pressure in said brake pipe for a predetermined timing cycle,
   (i) whenever said control means is manually actuated or actuated by said first sensing means or said second sensing means or said third sensing means whenever said third sensing means detects the presence of air under pressure in the locomotive brake cylinder and said throttle means is in the idle position.

6. A system for monitoring the vigilance of an operator of a vehicle having a manually operable control throttle and braking means operable to braking and nonbraking positions, resettable timing means on the vehicle operable from a reset condition to measure a predetermined time interval, means responsive to the actuation of the braking means for resetting said timing means, means responsive to the manual actuation of the throttle for resetting said timing means, and means rendered effective in response to the measurement of said predetermined time interval by said timing means for automatically operating said braking mechanism to its braking position, whereby the intermittent actuation of the braking means or the throttle by an operator forestalls automatic operation of the braking means to a braking position provided that such actuations are performed at a rate within said predetermined time interval.

7. A system according to claim 6 wherein audible indication means is provided for indicating when said timing means is near the end of said predetermined interval, whereby the operator is advised that action should be taken to reset the timing means.

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