Feb. 23, 1926. 1,574,195

L. F. HOWARD

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed May 26, 1924 2 Sheets-Sheet 1

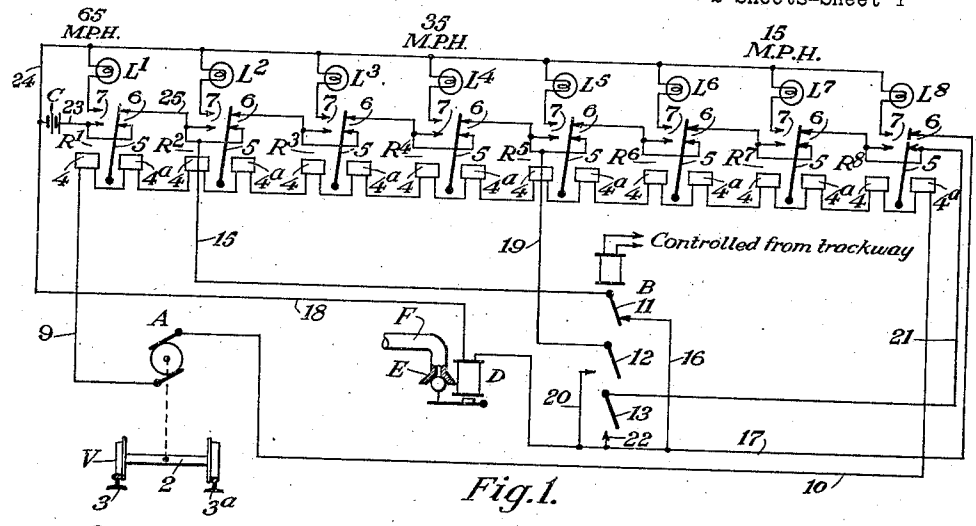


Fig. 1.

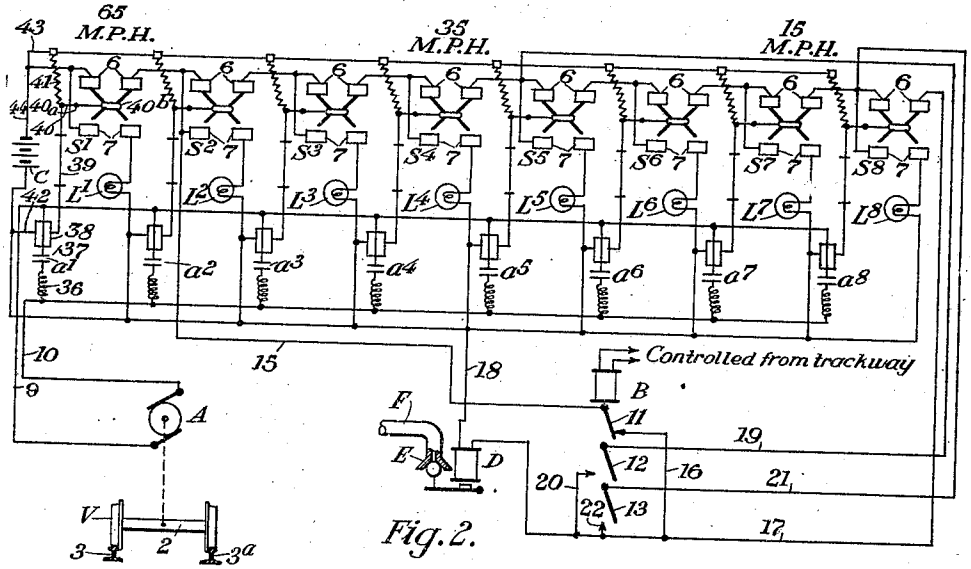


Fig. 2.

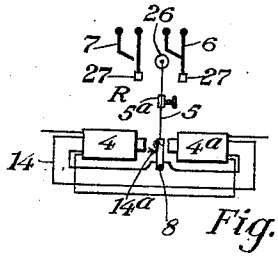


Fig. 3.

INVENTOR:
L. F. Howard,
BY A. E. Terrell
His ATTORNEY

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L. F. HOWARD

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed May 26, 1924 2 Sheets-Sheet 2

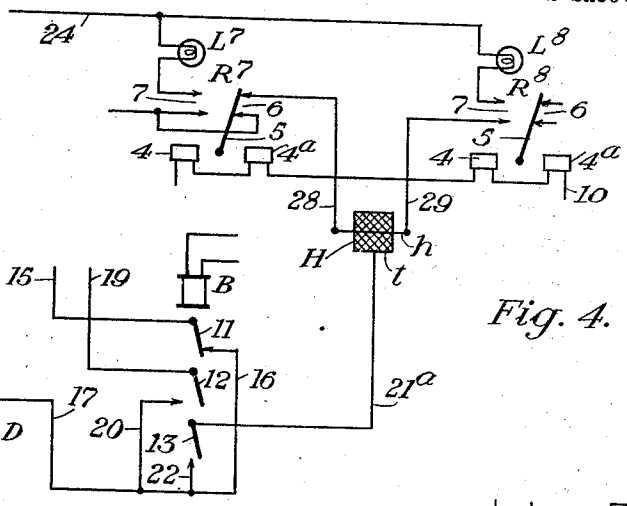


Fig. 4.

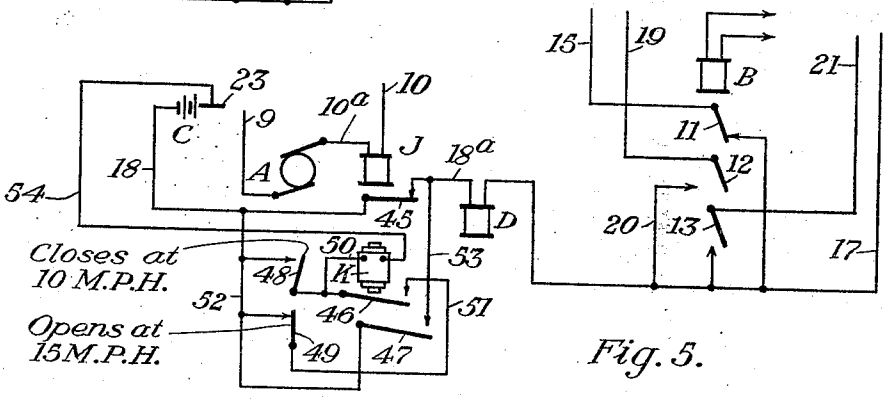


Fig. 5.

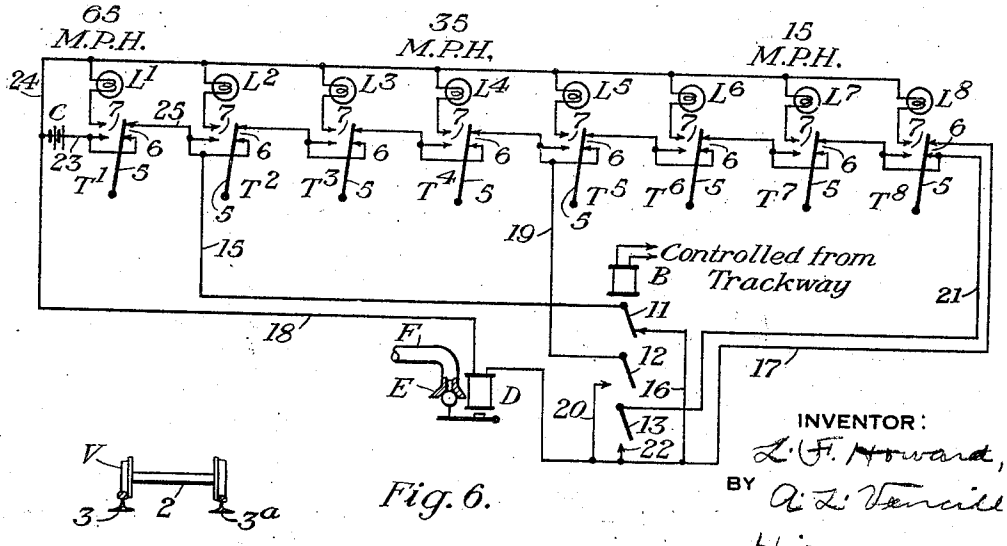


Fig. 6.

INVENTOR:
L. F. Howard,
BY A. L. Vencill
His ATTORNEY

Patented Feb. 23, 1926. 1,574,195

UNITED STATES PATENT OFFICE.

LEMUEL F. HOWARD, OF EDGEWOOD BOROUGH, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

RAILWAY-TRAFFIC-CONTROLLING APPARATUS.

Application filed May 26, 1924. Serial No. 715,870.

To all whom it may concern:

Be it known that I, LEMUEL F. HOWARD, a citizen of the United States, residing at Edgewood Borough, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Railway-Traffic-Controlling Apparatus, of which the following is a specification.

My invention relates to railway traffic controlling apparatus, and particularly to apparatus of the type which involves means for automatically indicating or governing the speed of a train.

In apparatus of this character it has heretofore been proposed to use a centrifugal device to perform certain functions dependent on the speed of the train, the centrifugal device being in turn operated in such manner that its speed corresponds to the actual speed of the train. One object of the present invention is to accomplish the same results without the use of a centrifugal device.

I will describe certain forms of apparatus embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a diagrammatic view showing one form of railway traffic controlling apparatus embodying my invention, and Fig. 2 is a similar view showing a modification of the apparatus shown in Fig. 1 and also embodying my invention. Fig. 3 is a view showing one form of tuned relay which may be used in the apparatus shown in Fig. 1. Fig. 4 is a view showing a modification of a portion of the apparatus shown in Figs. 1 and 2, and embodying my invention. Fig. 5 is a view showing another modification of a portion of the apparatus shown in Figs. 1 and 2 and also embodying my invention. Fig. 6 is a diagrammatic view showing another form of traffic controlling apparatus embodying my invention.

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

Referring first to Fig. 1, the reference character V designates an axle and a pair of wheels, which parts represent a vehicle traveling on track rails 3 and 3^a. Mounted on the vehicle V is an alternating current generator A which is operated in such manner that its speed, and consequently its frequency, are proportional to the speed at which the vehicle is traveling. As here shown this generator is driven by the axle 2.

The vehicle V is provided with a plurality of receiving devices R′, R^2 * * * R^8, tuned to respond to currents of different frequencies. As shown in Fig. 1, and also in Fig. 3, each of these receiving devices is in the form of a reed relay, comprising a pair of operating magnets 4, 4^a, a tuned reed 5, a normally closed contact 6 which is opened when the reed responds to the frequency for which it is tuned, and a normally open contact 7 which is closed when the reed responds to the frequency for which it is tuned. The magnets of the several relays R are connected in series and are constantly supplied with current from the generator A, the circuit being from this generator through wire 9, magnets 4 and 4^a of relay R′, magnets 4 and 4^a of each of the succeeding relays, and wire 10 to generator A. Each relay R vibrates when supplied with current of a certain frequency, and these frequencies are so chosen that they fall within the range of frequencies of the current supplied by generator A. This range of frequencies is further so chosen as to correspond approximately with the range of speed of the vehicle V. For example, relay R^8 may be designed to respond at 10 miles an hour, relay R^7 at 15 miles an hour, relay R^6 at 20 miles per hour, relay R^5 at 30 miles per hour, relay R^4 at 35 miles per hour, and so on up to relay R′ which responds at 65 miles per hour. Each relay preferably responds to frequencies corresponding to a range of a few miles per hour in each direction from the critical frequency, so that as the speed of the vehicle increases or decreases each relay will begin to respond just as the preceding relay ceases responding.

Associated with each relay R is a lamp designated by the reference character L with the same exponent as that of the corresponding relay. Each lamp is controlled by the normally open contact of the associated relay so that these lamps are all extinguished except when the vehicle is in motion and then only one lamp is lighted at a time. For example, the circuit for lamp L′ is from a battery C, through wire 23, contact 7, lamp L′, and wire 24 to battery C. The circuit for lamp L^2 is from battery C,

through wire 23, contact 6 of relay R′, wire 25, contact 7 of relay R^2, lamp L^2, and wire 24 to battery C. Similarly, the circuit for each of the succeeding lamps passes through the normally open contact of the associated relay R and the normally closed contact of each relay R corresponding to higher speeds. It will be seen, therefore, that as the speed of the train increases one lamp will be lighted at a time and that the next lamp will be lighted as the first lamp is extinguished. In other words, there will be a progressive lighting of the lamps from right to left as the speed of the vehicle increases, and a progressive lighting of the lamps from left to right as the speed of the vehicle decreases.

The reference character B designates a relay which is controlled from the trackway in such manner as to assume different positions in accordance with different traffic conditions in advance. As here shown, this relay comprises three contacts 11, 12 and 13, which contacts are closed respectively under proceed, caution and stop traffic conditions in advance. I will assume for purposes of the present disclosure that when the proceed or high speed contact 11 is closed it is permissible for the vehicle to travel at 60 miles per hour; when the caution or medium speed contact 12 is closed it is permissible to travel at 30 miles per hour but no faster, and when the stop or low speed contact 13 is closed it is permissible for the vehicle to travel at 10 miles per hour but no faster.

The reference character E designates a valve which is controlled by a magnet D in such manner that the valve is closed when the magnet is energized and is permitted to open when the magnet becomes de-energized. This valve E is utilized to govern the vehicle in any suitable manner, and preferably operates to retard the vehicle when the valve is open but not when it is closed. For example, the valve E may control an orifice in the pipe F, which may be the brake pipe of the vehicle or may be a pipe leading to apparatus designed to cause a brake application when valve E opens.

The valve magnet D is controlled jointly by the normally closed contacts 6 of the relays R and by the contacts 11, 12 and 13 of relay B. As here shown, magnet D is provided with a circuit which is supplied with current from battery C and which includes in series the contact 6 of each relay R′ to R^8. This circuit is provided with a shunt around contact 6 of relay R^8, which shunt includes the low speed contact 13 of relay B. The circuit for magnet D is provided with a second shunt around contact 6 of each relay R^5, R^6, R^7 and R^8, which shunt includes the medium speed contact 12 of relay B. The circuit for magnet D is further provided with a third shunt around contact 6 of each relay R^2 to R^8, inclusive, which shunt includes the high speed contact 11 of relay B.

The operation of the apparatus shown in Fig. 1, is as follows:

Assuming that contact 11 of relay B is closed and that the speed of the train is 60 miles per hour or less, it will be observed that the circuit for magnet D is closed through contact 6 of relay R′, wire 25, wire 15, contact 11 of relay B and wire 16, so that magnet D is energized, valve E is closed, and so the speed of the train is not retarded. If the speed should approach 65 miles per hour, however, relay R′ will respond by opening its contact 6 with the result that magnet D will become de-energized and the speed of the train will be retarded by the opening of valve E. Similarly, if relay B is energized in such direction that contact 12 is closed, the train may proceed at 30 miles per hour or less but if the speed approaches 35 miles per hour contact 6 of relay R^4 will open, so that magnet D will become de-energized and the speed of the train will be automatically retarded. If relay B is de-energized so that contact 13 of this relay is closed the train may proceed at 10 miles per hour or less without affecting valve E, but if the train approaches 15 miles per hour, relay R^7 will respond by opening contact 6 so that magnet D will become de-energized and the speed will be automatically retarded.

I have stated in the foregoing discussion that when any relay R responds to the frequency for which it is tuned, it causes contact 6 to open and contact 7 to close. This does not necessarily mean that contact 6 remains open and contact 7 remains closed while the relay is responding; on the other hand, it may be that contact 6 will be opened and closed intermittently, whereas contact 7 will be closed and opened intermittently. When this is so, the circuit for magnet D is so designed that the intermittent opening of contact 6 of any of the relays R will increase the impedance of this circuit to such extent that magnet D will release its armature and so permit the valve E to open. Similarly, the intermittent closing and opening of contact 7 will cause an intermittent lighting of the associated lamp L, such lighting being sufficient, however, to constitute an indication to the driver of the vehicle.

Each relay R may be constructed in any suitable manner. As shown in Fig. 3, for example, the tuned reed 5 is attached to an armature 14^a which is pivotally mounted at 8 on a core 14 carrying the operating magnets 4 and 4^a. Armature 14^a is polarized so that it is drawn in one direction when the alternating current is positive, and in the opposite direction when the current is nega-

tive. The reed 5 is provided with a sliding inertia member 5^a, whereby the reed may be tuned to respond to the desired frequency. The upper end of the reed 5 carries a hammer 26 which operates to open contact 6 and closes contact 7 when the reed is vibrating. The movable member of contact 6 is provided with an inertia member 27 and this member is so designed that its natural period is greater than the natural period of the reed 5, so that while the reed is vibrating contact 6 will remain open. The movable member of contact 7 is similarly provided with an inertia member 27 to keep the contact closed.

Referring now to Fig. 2, the apparatus here shown is similar to that illustrated in Fig. 1, with the exception of the structure of the tuned receivers which are supplied with current from generator A. In Fig. 2 this generator is provided with a circuit having a plurality of branches a', a^2 * * * a^3, each tuned to resonance at a different frequency, this tuning being accomplished by a reactance 36 and a condenser 37. Each branch also includes the heating element of a thermo-sensitive cell 38. Each tuned receiver comprises the circuit branch a, a pair of contacts 6 and 7, and means interposed between the associated thermo-sensitive cell 38 and the contacts for controlling these contacts. Each tuned receiver is designated as a whole by the reference character S with a suitable exponent. Referring to receiver S′, the thermo-sensitive element of the cell 38 is included in a circuit which passes from battery C through wire 42, cell 38, a wire 39, a spring 41, and wires 43 and 44 to battery C. Wire 39 is formed of a material having a high coefficient of expansion, so that the length of this wire is highly sensitive to variations in temperature and so to variations in the strength of current flowing through the wire. The spring 41 and the wire 39 are both connected with a lever 40 pivoted at point 40^a and carrying a block 40^b which controls the contacts 6 and 7. When wire 39 is cold it holds the lever 40 in the position shown against the action of spring 41 so that contact 6 is closed and contact 7 is open. When the current in the circuit branch a' is of the frequency for which this branch is tuned, cell 38 is heated so that the current flow through this cell and wire 39 is considerably increased. Wire 39 responds to this increased current by increasing in length, whereupon the spring 41 shifts the lever 40 in clockwise direction so that the block 40^b operates to open contact 6 and close contact 7.

Contact 7 of each receiver S controls the associated lamp L in the same manner as in Fig. 1. Furthermore, the contacts 6 of the several receivers, together with the contacts of relay B, operate to control the valve magnet D in the same manner as in Fig. 1. The operation of the apparatus shown in Fig. 2 will therefore be understood without further detailed explanation.

With the apparatus shown in Fig. 1 or Fig. 2, it will be apparent that in the event of failure of any part of the speed responsive apparatus, such for example as failure of the supply of current from generator A, all of the tuned relays R of Fig. 1 will be at rest, and all of the receivers S of Fig. 2 will be in normal positions, so that the valve magnet D will be energized independently of the contacts of relay B. The driver would then not have his attention forced to the fact that his speed responsive apparatus is inoperative, although if he were alert and observant this fact would be indicated to him because all of the lamps L would be extinguished. The modification shown in Fig. 4 is so arranged as to de-energize magnet D under unsafe traffic conditions in the event of a failure such as that just mentioned. Referring to this view, it will be seen that the direct connection between contact 6 of relay R^7 and contact 7 of relay R^8 is broken and that the heating element h of a thermo-sensitive cell H is inserted in this connection, the path between these two relays then being from contact 6 of relay R^7, through wire 28, the heating element h of cell H, and wire 29 to contact 7 of relay R^8. Contact 6 of relay R^8 is omitted from the circuit of magnet D, and wire 21 leading from contact 6 of relay R^8 to contact 13 of relay B is replaced by a wire 21^a leading from the thermo-sensitive element t of cell H to contact 13 of relay B. The cell H is so designed that the heating element h and the thermo-sensitive element t are in mutual electrical contact, but this cell is furthermore so designed that when the heating element h is cold the amount of current which passes from wire 28, through the thermo-sensitive element t to the wire 21^a is not sufficient to energize magnet D. When, however, the heating element h is heated by current through contact 7 of relay R^8 and lamp L^8, the resistance of the thermo-sensitive element t is reduced to such value that the current which will then pass from wire 28, through element t to wire 21^a is sufficient to energize magnet D, assuming that contact 13 of relay B is closed. Under normal operation, if relay B is de-energized so that its back contact 13 is closed and the speed of the train drops below 15 miles per hour, contact 7 of relay R^8 will close after contact 6 of relay R^7 becomes closed and the current which then passes through contact 6 of relay R^7, element h of cell H, contact 7 of relay R^8 and lamp L^8, serves to heat the thermo-sensitive element t of cell H, so that current of sufficient value is supplied to magnet D and the brakes are not applied. If, however,

the supply of current to the operating magnets 4 and 4ª should fail while the train is running at a speed above 15 miles per hour, relays R⁷ and R⁸ will, of course, both be de-energized, so that contact 7 of relay R⁸ is open. If now relay B should become de-energized, the current which is supplied to magnet D through back contact 13 and the thermo-sensitive cell H will not be sufficient to keep this magnet energized, and, consequently, the brakes will be applied and the train will be brought to a stop. If the failure of operating current to the magnets 4 and 4ª should occur while the train is running at less than 15 miles per hour, it will not cause de-energization of magnet D provided the low speed limit is already in effect; but if the high or mechanism speed limit is in effect at the time of the failure, then when the low limit becomes effective magnet D will become de-energized even though the actual speed has not exceeded 15 miles per hour. If the failure occurs while the low limit is in effect and the actual speed is below 15 miles per hour, the train can continue without incurring an automatic application of the brakes, but if the speed should be increased above this value, the engineer will be aware of the system being out of order by reason of the speed indicator lamps not lighting.

It will, of course, be understood that the modification shown in Fig. 4 can be applied to the apparatus illustrated in Fig. 2 as well as to the apparatus illustrated in Fig. 1.

Referring now to Fig. 5, the apparatus shown in this view is the same as that shown in Fig. 1, except that the wire 18 connecting battery C with magnet D is divided into wires 18 and 18ª which are connected by a front contact 45 of a relay J. The winding of relay J is interposed in wire 10 of Fig. 1, this wire being divided into two wires 10 and 10ª in Fig. 5 for the purpose of interposing the winding of relay J. It follows that relay J is included in series in the circuit for the alternating current generator A, so that if this circuit fails for any reason relay J will become de-energized, and in so far as the apparatus thus far referred to is concerned, the de-energization of relay J will open the circuit for magnet D and so will cause an application of the brakes. To permit the train to proceed with relay J open, the circuit for magnet D is provided with a shunt around contact 45 of relay J, which shunt includes wire 52, contact 47 of a slow releasing relay K and wire 53. Relay K is normally de-energized, so that this shunt is normally open. Relay K is controlled by two contacts 48 and 49, which are preferably of the vibrating reed type and are mechanically responsive to the speed of the train. That is to say, contact 48 is so adjusted that it is normally open but that it responds mechanically to close when the train is traveling at 10 miles per hour; whereas contact 49 is normally closed but is so adjusted that it responds mechanically to open at 15 miles per hour. Assuming that relay J has opened, due to a failure of the alternating current circuit supplied by generator A, the brakes will, of course, be applied and the train will either be stopped or reduced to a very low speed. When the speed is reduced to 10 miles per hour contact 48 will close, whereupon relay K will be energized due to a pick-up circuit which passes from battery C, through wires 23 and 54, winding of relay K, wire 50, contact 48, and wires 52 and 18 to battery C. The energization of relay K closes the shunt around contact 45 of relay J so that the brakes will be released and the train may proceed. If the speed increases above 10 miles per hour, the pick-up circuit just traced for relay K will be opened at contact 48, but this relay will remain closed due to a stick circuit which passes from battery C, through wires 23 and 54, relay K, wire 50, contact 46 of relay K, wire 51, contact 49, and wires 52 and 18 to battery C. As long as the speed of the train does not reach 15 miles per hour, contact 49 will remain closed and so the stick circuit just traced for relay K will remain closed. If, however, the speed reaches or exceeds 15 miles per hour, contact 49 will open, and since contact 48 has already been opened, relay K will become de-energized, so that the shunt comprising contact 47 of this relay will open and the brakes will be applied. It follows that in the event of failure of current in the alternating current circuit supplied by generator A, the train may proceed at speeds less than 15 miles per hour without incurring an automatic application of the brakes.

Obviously the modification shown in Fig. 5 may be applied to the apparatus shown in Fig. 2 as well as to the apparatus shown in Fig. 1.

In Fig. 5 it will be observed that when the vehicle stops, relay J will be open due to the cessation of current from generator A. This will not cause magnet D to become de-energized, however, because relay K closes when the vehicle speed is reduced to 10 miles per hour and remains closed while the vehicle is at rest and until the speed is again increased to 15 miles per hour.

Referring now to Fig. 6, the apparatus shown in this view is the same as that shown in Fig. 1 except as to the means for causing operation of the tuned receivers which are here designated T. Each receiver T comprises a reed 5 which responds to the mechanical vibration of the vehicle, that is, each reed is so designed and mounted that it is mechanically resonant at the rate of vibration of the vehicle due to a given speed

or given small range of speeds, so that at such speed or range of speeds the reed vibrates freely and thus operates to open its associated contact 6 and close its associated contact 7. The several receivers may be designed to selectively respond to the same speeds as the corresponding receivers R in Fig. 1 and S in Fig. 2. It follows that the generator A, operating magnets 4 and 4ª, and the circuit including these elements, are omitted from Fig. 6, but in all other respects the apparatus is diagrammatically the same as Fig. 1. The operation of the apparatus shown in Fig. 6 will be apparent from the foregoing explanation of the operation of the apparatus shown in Fig. 1. Of course the apparatus of Fig. 6 does not require the protective schemes shown in Figs. 4 and 6.

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

Having thus described my invention, what I claim is:

1. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, and governing means on the vehicle controlled by said receivers.

2. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, apparatus on the vehicle controlled from the trackway and arranged to assume different conditions in accordance with different traffic conditions in advance of the vehicle, and governing means on the vehicle controlled jointly by said receivers and said apparatus.

3. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, and means controlled by said receivers for indicating the speed of the vehicle.

4. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, and a device associated with each receiver for indicating response of such receiver to the frequency for which it is tuned.

5. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, apparatus on the vehicle controlled from the trackway for imposing different permissive speed limits in accordance with different traffic conditions in advance, and means controlled jointly by said receivers and said apparatus for retarding the vehicle if the actual speed exceeds the permissive speed.

6. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, apparatus on the vehicle controlled from the trackway and arranged to assume different conditions in response to different traffic conditions in advance of the vehicle, mechanism controlled jointly by said receivers and said apparatus for governing the vehicle, and means for retarding the vehicle in the event of failure of response of the receiver corresponding to the actual speed of the vehicle.

7. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, and means associated with said receivers for retarding the vehicle in the event that the receiver corresponding to the actual speed ceases to respond.

8. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, and a safety deivce set into operation if the receiver corresponding to the actual speed of the vehicle ceases to respond.

9. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, a normally closed contact associated with each receiver and opened when the receiver is responding to the frequency for which it is tuned, a circuit including all of said contacts in series and a governing device for the vehicle, and means controlled from the trackway for shunting out certain of said contacts.

10. In combination, a railway vehicle, means thereon for generating a periodic

current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, a normally open contact associated with each receiver and arranged to be closed when the receiver is responding to the frequency for which it is tuned, and indicating means controlled by said contacts.

11. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, a normally open contact associated with each receiver and arranged to be closed when the receiver is responding to the frequency for which it is tuned, a lamp for each receiver, and a circuit for each lamp including the contact for the corresponding receiver and a source of current.

12. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, a normally closed contact associated with each receiver and arranged to open when the receiver responds to the frequency for which it is tuned, apparatus on the vehicle controlled from the trackway and arranged to assume different conditions corresponding to different speed limits according to different traffic conditions in advance, and means controlled by said contacts and said apparatus for retarding the vehicle in the event of an open contact representing a higher speed than the speed corresponding to the condition of said apparatus.

13. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, a normally closed contact associated with each receiver and arranged to open when the receiver responds to the frequency for which it is tuned, apparatus on the vehicle controlled from the trackway and arranged to assume different conditions corresponding to different speed limits according to different traffic conditions in advance, and governing means on the vehicle controlled jointly by said contacts and said apparatus.

14. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, a normally closed contact associated with each receiver and arranged to open when the receiver responds to the frequency for which it is tuned, apparatus on the vehicle controlled from the trackway and arranged to assume different conditions corresponding to different speed limits according to different traffic conditions in advance, said apparatus including contacts one or another of which is closed according to the condition assumed by the apparatus, a circuit including all of said normally closed contacts in series, and a vehicle retarding device, and a plurality of shunts for said circuit connected around different numbers of said normally closed contacts and each including one of said second mentioned contacts.

15. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of receivers supplied with said periodic current and tuned to respond to different frequencies, a normally closed contact associated with each receiver and arranged to open when the receiver responds to the frequency for which it is tuned, apparatus on the vehicle controlled from the trackway and comprising three traffic controlled contacts arranged to be closed according as traffic conditions in advance require a low speed, a medium speed or a high speed, a circuit on the vehicle including all of said normally closed contacts in series and a vehicle retarding device, a shunt for said circuit around the normally closed contacts corresponding to speeds below said low speed and including the traffic controlled contact which is closed under low speed conditions, a second shunt for said circuit around the normally closed contacts corresponding to speeds below said medium speed and including the traffic controlled contact which is closed under medium speed conditions, and a third shunt around all of said normally closed contacts corresponding to speeds below said high speed and including the traffic controlled contact corresponding to said high speed.

16. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of electro-magnets supplied with said periodic current, tuned reeds for said magnets adjusted to respond to different frequencies, and governing means on the vehicle controlled by said reeds.

17. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a plurality of electro-magnets supplied with said periodic

current, tuned reeds for said magnets adjusted to respond to different frequencies, apparatus on the vehicle controlled from the trackway and arranged to assume different conditions in response to different traffic conditions in advance, and governing means on the vehicle controlled jointly by said reeds and said apparatus.

18. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a circuit supplied with said periodic current and provided with a plurality of branches tuned to resonance at different frequencies, and governing means on the vehicle controlled by said tuned branches.

19. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, a circuit supplied with said periodic current and provided with a plurality of branches tuned to resonance at different frequencies, apparatus on the vehicle controlled from the trackway and arranged to assume different conditions in response to different traffic conditions in advance, and governing means on the vehicle controlled jointly by said circuit branches and said apparatus.

20. In combination, a railway vehicle, a plurality of tuned receivers thereon responding to different speeds of the vehicle, and governing means on the vehicle controlled by said receivers.

21. In combination, a railway vehicle, a plurality of tuned receivers thereon responding to different vehicle speeds, apparatus on the vehicle controlled from the trackway and arranged to assume different conditions in accordance with different traffic conditions in advance of the vehicle, and governing means on the vehicle controlled jointly by said receivers and said apparatus.

22. In combination, a railway vehicle, a plurality of tuned receivers thereon responding to different vehicle speeds, and means controlled by said receivers for indicating the speed of the vehicle.

23. In combination, a railway vehicle, a plurality of tuned receivers thereon responding to different vehicle speeds, and a device associated with each receiver for indicating response of such receiver to the vehicle speed for which it is tuned.

24. In combination, a railway vehicle, a plurality of tuned receivers thereon responding to different speeds of the vehicle, apparatus on the vehicle controlled from the trackway for imposing different permissive speed limits in accordance with different traffic conditions in advance, and means controlled jointly by said receivers and said apparatus for retarding the vehicle if the actual speed exceeds the permissive speed.

25. In combination, a railway vehicle, a plurality of tuned receivers thereon responding to different vehicle speeds, apparatus on the vehicle controlled from the trackway and arranged to assume different conditions in response to different traffic conditions in advance of the vehicle, mechanism controlled jointly by said receivers and said apparatus for governing the vehicle, and means for retarding the vehicle in the event of failure of response of the receiver corresponding to the actual speed of the vehicle.

26. In combination, a railway vehicle, a plurality of tuned receivers thereon responding to different vehicle speeds, and means associated with said receivers for retarding the vehicle in the event that the receiver corresponding to the actual speed ceases to respond.

27. In combination, a railway vehicle, a plurality of tuned receivers thereon responding to different vehicle speeds, and a safety device set into operation if the receiver corresponding to the actual speed of the vehicle ceases to respond.

28. In combination, a railway vehicle, a plurality of tuned receivers thereon responding to different vehicle speeds, a normally closed contact associated with each receiver and opened when the receiver is responding to the vehicle speed for which it is tuned, a circuit including all of said contacts in series and a governing device for the vehicle, and means controlled from the trackway for shunting out certain of said contacts.

29. In combination, a railway vehicle, a plurality of tuned receivers thereon responding to different vehicle speeds, a normally open contact associated with each receiver and arranged to be closed when the receiver is responding to the vehicle speed for which it is tuned, and indicatinng means controlled by said contacts.

30. In combination, a railway vehicle, a plurality of tuned receivers thereon responding to different vehicle speeds, a normally closed contact associated with each receiver and arranged to open when the receiver responds to the speed for which it is tuned, apparatus on the vehicle controlled from the trackway and arranged to assume different conditions corresponding to different speed limits according to different track conditions in advance, and means controlled by said contacts and said apparatus for retarding the vehicle in the event of an open contact representing a higher speed than the speed corresponding to the condition of said apparatus.

31. In combination, a railway vehicle, a plurality of tuned receivers thereon responding to different vehicle speeds, a normally closed contact associated with each receiver and arranged to open when the re-

ceiver responds to the speed for which it is tuned, apparatus on the vehicle controlled from the trackway and arranged to assume different conditions corresponding to different speed limits according to different traffic conditions in advance, and governing means on the vehicle controlled jointly by said contacts and said apparatus.

32. In combination, a railway vehicle, a plurality of tuned receivers thereon responding to different vehicle speeds, a normally closed contact associated with each receiver and arranged to open when the receiver responds to the speed for which it is tuned, apparatus on the vehicle controlled from the trackway and comprising three traffic controlled contacts arranged to be closed according as traffic conditions in advance require a low speed, a medium speed or a high speed, a circuit on the vehicle including all of said normally closed contacts in series and a vehicle retarding device, a shunt for said circuit around the normally closed contacts corresponding to speeds below said low speed and including the traffic controlled contact which is closed under low speed conditions, a second shunt for said circuit around the normally closed contacts corresponding to speeds below said medium speed and including the traffic controlled contact which is closed under medium speed conditions, and a third shunt around all of said normally closed contacts corresponding to speeds below said high speed and including the traffic controlled contact corresponding to said high speed.

33. In combination, a railway vehicle, means thereon for generating a periodic current the frequency of which is proportional to the speed of the vehicle, governing means on the vehicle controlled by the frequency of said current, and protective means on the vehicle responsive to the failure of said current while the vehicle is moving.

34. In combination, a railway vehicle, means thereon for generating an electric current having a characteristic which varies in proportion to the speed of the vehicle, governing means on the vehicle controlled by the said characteristic of such current, and protective means on the vehicle responsive to the failure of said current while the vehicle is moving.

35. In combination, a railway vehicle, means thereon for generating an electric current having a characteristic which varies in proportion to the speed of the vehicle, governing means on the vehicle controlled by the said characteristic of such current, means for preventing operation of said governing means when said current fails due to stoppage of the vehicle, and means for causing operation of said governing means in the event of failure of said current while the vehicle is in motion.

36. In combination, a railway vehicle, means thereon for generating an electric current having a characteristic which varies in proportion to the speed of the vehicle, governing means on the vehicle controlled by the said characteristic of such current, and apparatus associated with said governing means for permitting the vehicle to travel at a speed not exceeding a given low value in the absence of said current.

37. In combination, a railway vehicle, means thereon for generating an electric current having a characteristic which varies in proportion to the speed of the vehicle, a relay included in the circuit for said current, governing mechanism on the vehicle provided with a governor circuit controlled by a front contact of said relay, a shunt for said governor circuit around the said front contact and including a front contact of an auxiliary relay, and apparatus including tuned reeds responsive to the vibration of said vehicle for energizing said auxiliary relay at relatively low speeds.

38. In combination, a railway vehicle, means thereon for generating an electric current having a characteristic which varies in proportion to the speed of the vehicle, a plurality of receivers on the vehicle controlled by said current and responsive selectively to different vehicle speeds, the receiver for one speed having a normally closed contact which opens at the speed for which the receiver is adjusted and the receiver for the next lower speed having a normally open contact which closes at the speed for which the receiver is adjusted, a circuit including said normally closed contact and a vehicle governing device and the thermo-sensitive element of a thermo-sensitive cell, and a second circuit including said normally closed contact and said normally open contact and the heating element of said thermo-sensitive cell.

In testimony whereof I affix my signature.

LEMUEL F. HOWARD.