

April 23, 1929.

L. V. LEWIS

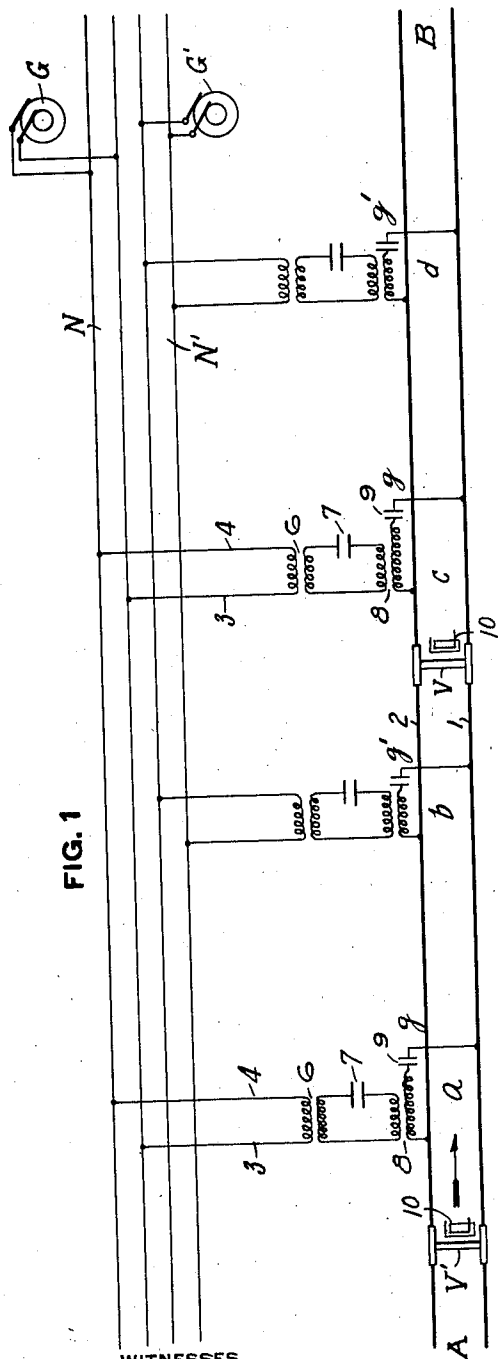
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RAILWAY SIGNALING

Original Filed Oct. 3, 1916

4 Sheets-Sheet 1

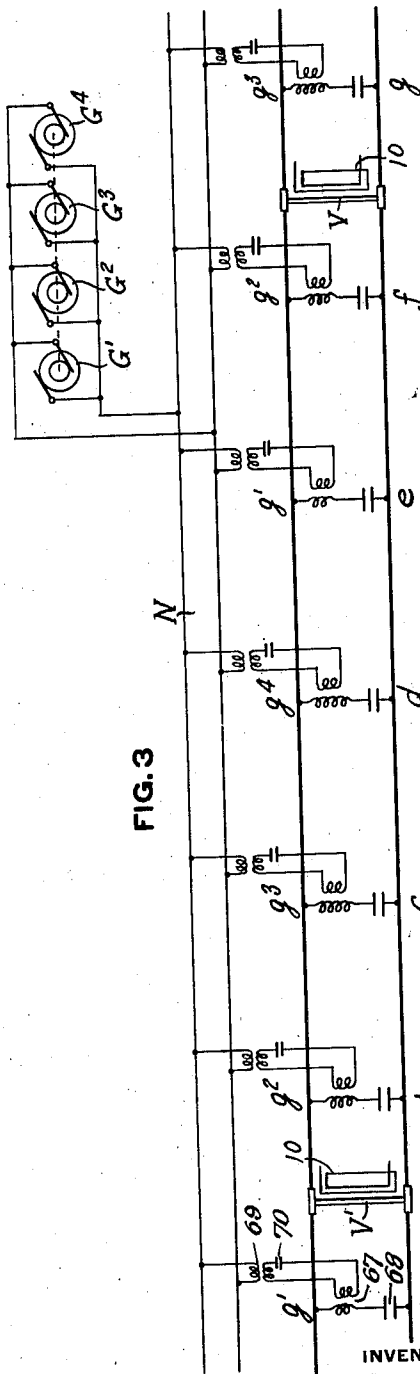
FIG. 1



WITNESSES

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FIG. 3



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April 23, 1929.

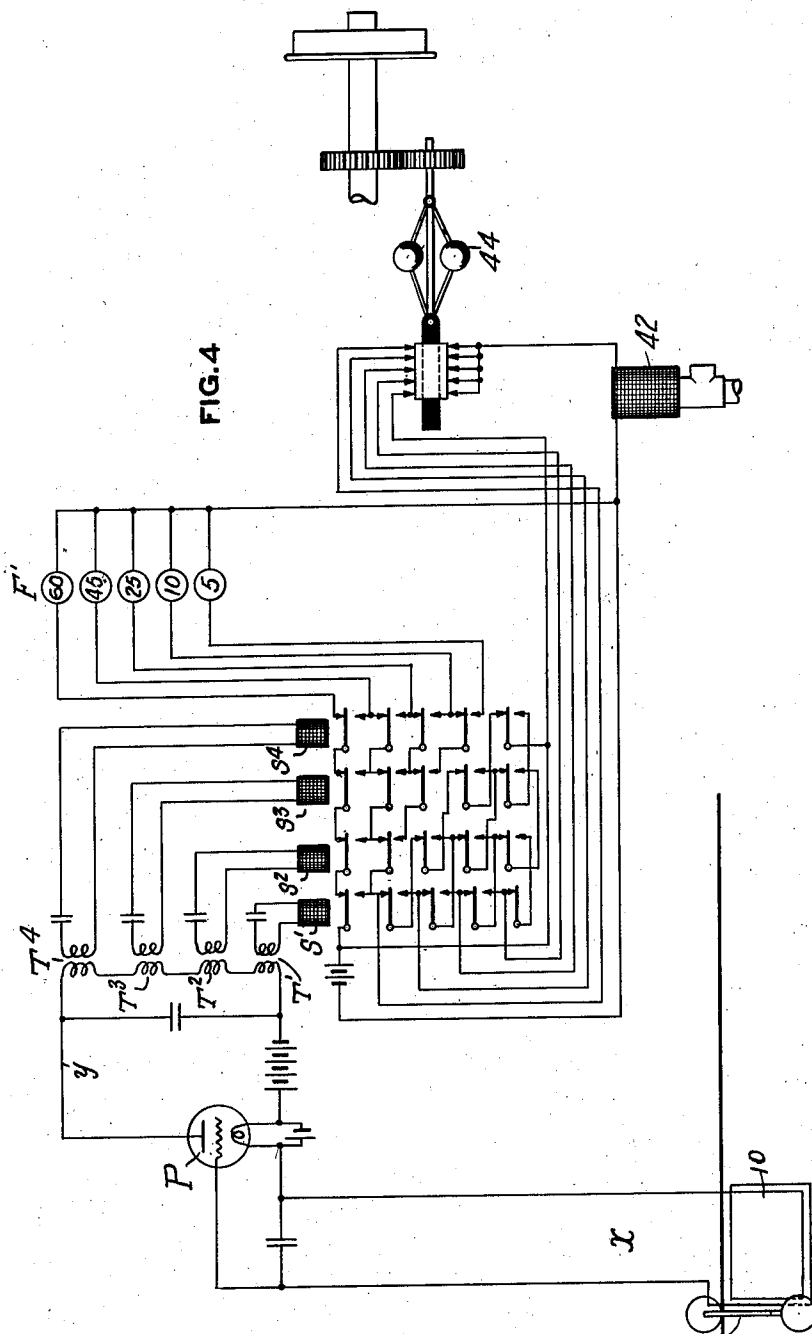
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RAILWAY SIGNALING

Original Filed Oct. 3, 1916

4 Sheets-Sheet 3



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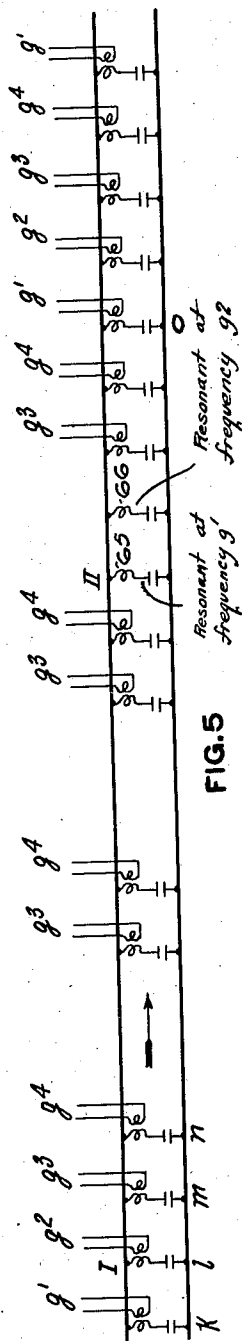
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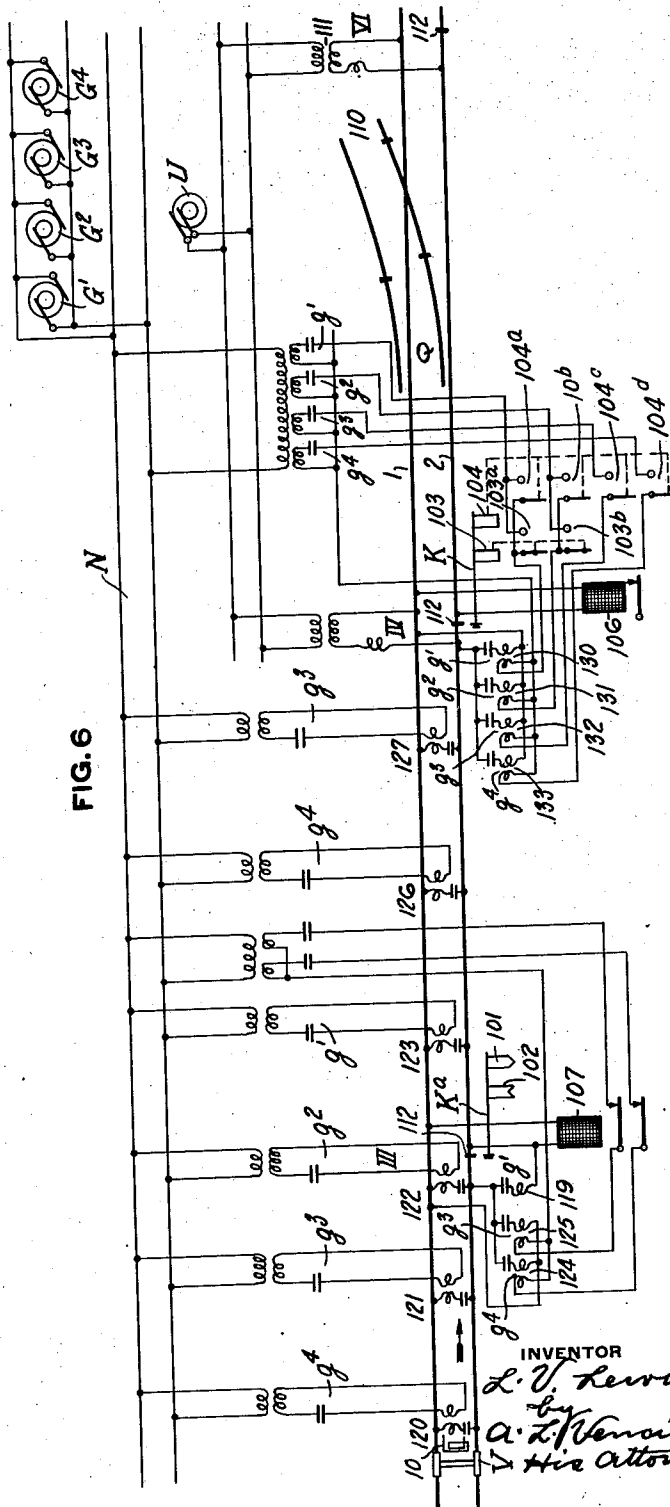
RAILWAY SIGNALING

Original Filed Oct. 3, 1916 4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE.

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RAILWAY SIGNALING.

Application filed October 3, 1916, Serial No. 123,498. Renewed October 12, 1928.

My invention relates to railway signaling.

I shall describe several forms of apparatus and circuits embodying my invention and then point out the novel features thereof in claims.

In the accompanying drawings Fig. 1 is a diagrammatic view showing one form and arrangement of trackway apparatus and circuits embodying my invention. Fig. 2 is a diagrammatic view showing one form and arrangement of vehicle carried circuits and apparatus embodying my invention and adapted for use in connection with the trackway circuits shown in Fig. 1. Fig. 3 is a diagrammatic view showing a modification of the trackway apparatus and circuits shown in Fig. 1. Fig. 4 is a diagrammatic view showing a modification of the vehicle-carried apparatus and circuits shown in Fig. 2, the apparatus and circuits being adapted for use in connection with the circuits shown in Fig. 3. Figs. 5 and 6 are diagrammatic views showing modifications of the trackway apparatus and circuits shown in Figs. 1 and 3 and also embodying my invention.

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

Referring first to Fig. 1, reference characters 1 and 2 designate the track rails of a stretch of railway track A—B, which rails are electrically continuous throughout the length of the stretch. G and G' are generators of alternating signaling currents of frequencies which I shall designate g and g' , respectively. These frequencies are preferably higher than those now in commercial use, but lower than the order of frequencies now in general use in wireless telegraph practice. The generators G and G' are connected respectively to transmission lines N and N' parallel to the railway track. Current from line N is fed to the track rails at a by means of a transformer 6 connected to the line N by wires 3 and 4. The secondary circuit of this transformer comprises a condenser 7, and the primary coil of a track transformer 8, this circuit being adjusted to resonance for current of frequency g . The secondary coil of transformer 8 is connected in series with a condenser 9 to the track rails 1 and 2, the condenser 9 having such capacity that when the rails are bridged by a car or train a considerable distance from point a the secondary circuit of transformer

8 is resonant at frequency g . The above described connection between transmission line N and the track rails offers but little impedance to the flow of current from generator G to the track rails and through the axles of a vehicle, because of the resonant conditions described. These resonant conditions, of course, do not exist for current of another frequency, such as is supplied by the generator G' so that if this current accidentally enters transformer 6 it cannot reach the track rails at a in appreciable quantity. The connection from line N to the track rails at c comprises similar apparatus, similarly adjusted to resonance for current of the same frequency g . Line N' is connected in similar manner to the track rails at points b and d , the connecting apparatus being adjusted to resonance for the current from generator G'. The points at which line N is connected to the track rails alternate with the points at which the line N' is connected to the rails, as shown on the drawing, so that adjacent points of connection with the track rails are supplied with currents differing in frequency.

The signaling currents thus supplied to the rails flow along the rails to a railway car or train at which point these currents are shunted from one rail to the other through the wheels and axles of the car or train. If there is a car or train V on the track between b and c , as shown on Fig. 1, all currents that are supplied to the rails at points to the right of the car or train are short-circuited by the car axles, whereby they are prevented from flowing beyond the car or train into the rails to the left thereof. Similarly, the currents in the rails to the left of the car or train are short-circuited by the car axles so that they cannot flow into the rails on the right of the car or train.

Each car or train is provided with control apparatus responsive to the currents in the track rails immediately in advance of the car or train, which apparatus I shall now describe. Referring to Fig. 2, this control apparatus comprises a coil 10 fixed to the vehicle V' in front of the front axle and in inductive relation to the front axle and to the track rails 1 and 2 immediately in advance of such axle. A condenser 11 is connected in series with coil 10, the inductance of the coil and the capacity of the condenser

being of such relative values that the circuit x formed by the condenser and the coil is resonant for the mean of the frequencies g and g' . When, therefore, current of either frequency is present in the track rails it will induce in circuit x alternating current of the corresponding frequency. Circuit x is connected by wires 14 and 15 to the grid 16 and the filament 17 of a vacuum tube amplifier P, a device now well known in the art. Briefly, described this amplifier comprises a vacuum bulb 18 enclosing a plate 20, the grid 16 and the filament 17 above referred to, which filament is constantly heated to incandescence by current from a battery 19. A continuous current is sent through the amplifier by means of a battery 21, the negative terminal of which is connected to the filament 17 and the positive terminal of which is connected to the plate 20, the circuit, which I shall designate y being in detail: from battery 21, through transformers T and T', wire 23, plate 20, filament 17, to battery 21. The grid 16 is interposed between plate 20 and filament 17, and when the voltage between the grid and the filament is caused to vary, the current in the circuit just traced fluctuates in accordance with the variations in the voltage. When an alternating voltage is impressed between grid 16 and filament 17, as for example, by current in circuit x , the current from battery 21 is caused to pulsate in harmony with the frequency of the alternating voltage in circuit x , the variations of the current in circuit y being of much greater magnitude than the amplitude of the current in circuit x . The inductance of the transformers T and T' is balanced by a condenser 25 which has such capacity that the local circuit comprising the two transformers and the condenser in series is resonant at the mean of the frequencies g and g' .

The secondary circuits of transformers T and T' comprise, respectively, relays S and S' connected in series with condensers 26 and 26', the capacities of which condensers are such that the circuits comprising relays S and S' are respectively resonant at frequencies g and g' . When, therefore, there is current of frequency g in circuit y the relay S is energized, and when there is current of frequency g' in circuit y the relay S' is energized. As explained hereinbefore, the current in circuit y depends upon the currents induced in circuit x by the signaling currents in track rails 1 and 2 in front of the car or train, hence it is clear that current in the track rails of frequency g causes energization of relay S and that current in the rails of frequency g' causes energization of relay S'. Relay S will not respond however to current of frequency g' , and likewise relay S' will not respond to current of frequency g ; and to insure this selection the

two relays may be so constructed as to be selectively responsive to the currents to which they are intended to respond.

Relays S and S' may govern suitable signaling apparatus, or speed controlling apparatus, or both, on the vehicle, as I shall now describe. Reference characters L^a, L^x, and L^r designate signal lamps comprised in a cab signal F, which lamps indicate respectively, when illuminated, "proceed", "proceed with caution", and "stop". The green lamp L^a is illuminated only when both relays S and S' are energized, the circuit being: from battery 30, through wire 31, front contact 32 of relay S, wire 33, front contact 34 of relay S', wire 35, green lamp G, wires 36 and 37 to battery 30. The yellow lamp L^x is illuminated when only one of the relays S or S' is energized and the other is de-energized; when relay S is the one which is energized, the circuit for lamp L^x is from battery 30, through wire 31, front contact 32 of relay S, wire 33, back contact 34 of relay S', wire 40, lamp L^x, wires 36 and 37 to battery 30; when on the other hand relay S' is the one which is energized, the circuit for lamp L^x is from battery 30, through wire 31, back contact 32 of relay S, wire 38, front contact 39 of relay S', wire 40, lamp L^x, wires 36 and 37 to battery 30. When both relays S and S' are de-energized, lamp L^r is illuminated by current in the following circuit: from battery 30, through wire 31, back contact 32 of relay S, wire 38, back contact 39 of relay S', wire 41, lamp L^r, wires 36 and 37 to battery 30. It is clear from the foregoing, that when both relays S and S' are energized, the cab signal gives the "proceed" indication; when only one relay is energized, the signal gives the "caution" indication, and when both relays are de-energized, the signal gives the "stop" indication.

To enforce observance of these signals, suitable automatic vehicle governing means may be provided for use in connection with relays S and S'. In the form here shown this means comprises a centrifugal device 44 operatively connected with an axle of the vehicle. This centrifugal device controls a magnet 42, which magnet governs a valve 43 in the fluid pressure brake system of the vehicle, in such manner that the brakes are applied when the magnet is de-energized. The arms of the centrifugal device are connected at one end to a shaft 45 bearing a contact sleeve 45^a, so that the spread of the fly balls due to movement of the car or train causes the contact sleeve 45^a to move to the right. The contact sleeve coacts with three pairs of contact fingers 46 and 46^a, 47 and 47^a, 48 and 48^a, in such manner that all three pairs of contact fingers are bridged by the contact sleeve when the speed of the car or train is low, as, for ex-

ample, 5 miles per hour and less. Above this speed the sleeve 45^a is drawn out of engagement with the first pair of fingers 46 and 46^a, remaining however, in engagement with the other two until the speed of the car or train reaches an intermediate value such as 30 miles per hour. Above this speed the second pair of contact fingers 47 and 47^a is opened so that only the third pair 10 48 and 48^a remain closed. The last pair of contact fingers is opened when the speed of the vehicle reaches a high value such as 60 miles per hour. When both relays S and S' are energized, the circuit for magnet 42 15 includes the right hand pair of contact fingers 48 and 48^a, the circuit being from battery 30, through front contact 50 of relay S, wire 51, front contact 52 of relay S', wire 53, contact finger 48, sleeve 45^a, contact finger 48^a, wire 54, magnet 42, wires 55 and 37 to battery 30. When only one of the magnets S or S' is energized, the circuit for magnet 42 includes the middle pair of contact fingers 47 and 47^a; when relay S is energized and relay S' de-energized, the circuit is from battery 30 through front contact 50 of relay S, wire 51, back contact 52 of relay S', wire 56, contact finger 47, contact sleeve 45^a, contact finger 47^a, wire 54, 20 brake magnet 42, wires 55 and 37 to battery 30; when relay S' is energized instead of relay S, the circuit is the same as traced above except that it passes through the back contact 50 of relay S, wire 57, and front contact 58 of relay S' to wire 56. When 35 neither relay S nor S' is energized, the circuit for magnet 42 includes the left hand pair of contact fingers 46 and 46^a, the circuit in detail being from battery 30 through 40 wire 59, contact finger 46, contact sleeve 45^a, contact finger 46^a, wire 54, magnet 42, wires 55 and 37 to battery 30. It is clear therefore, that when both relays S and S' are energized the speed of the car or train is limited only to 60 miles per hour. 45 When, however, only one of these relays is energized, the speed limit is reduced to 30 miles per hour, and when both relays S and S' are de-energized, the speed is limited to 5 miles per hour. It is understood, however, 50 that the apparatus herein shown for accomplishing this control of the speed of the car or train by relays S and S' is merely illustrative, and that any other suitable apparatus may be employed in the practice of my invention.

It will now be clear that when a car or train equipped with the apparatus shown in Fig. 2 proceeds over track rails in which 60 both signaling currents are flowing, the cab signal gives a "proceed" indication and the speed of the car or train is limited only to 60 miles per hour; when the car or train proceeds over track rails in which only one 65 of the signaling currents is flowing, the cab

signal indicates "proceed with caution" and the brake control apparatus limits the speed to 30 miles per hour; and when the car or train enters upon track rails in which neither of the signaling currents is flowing, 70 the cab signal changes to "stop" and the brake control apparatus limits the speed to 5 miles per hour or less.

From the above description of apparatus the operation of the signaling system will 75 be easily understood. For a brief explanation I shall assume that in Fig. 1 there is a car or train V on the track between points b and c and that another car or train V' is approaching from the left, the latter car 80 or train being equipped with the apparatus shown in Fig. 2. While vehicle V' is to the left of point a both signaling currents are present in the track rails in advance of the vehicle, so that the cab signal indicates 85 "proceed" and the speed of the vehicle is limited only to 60 miles per hour, as I have previously described. When the vehicle passes beyond point a, however, only one of the signaling currents is present in the track 90 rails, namely, current from generator G', consequently the cab signal changes its indication to "caution" and unless the speed has been reduced to 30 miles per hour or less, the brakes will be applied automatically and 95 will remain applied until the speed is reduced to this value. Thus the car or train proceeds under control from b to c. Beyond the last-mentioned point the track rails are not energized by signaling current of either frequency, so that the cab signal 100 changes to the "stop" indication as the car or train passes point b. In accordance with the usual railway practice the engineer should have brought the car or train to a complete stop and then proceeded slowly until the vehicle V is reached or the signal indication is changed. If the engineer fails to comply with this rule, the brakes will be applied automatically until the speed of the 105 train is less than 5 miles per hour. If now the first train V moves to the right beyond c, signaling current from generator G again flows in the track rails in advance of the car or train V' so that the engineer of the 110 latter train receives a "proceed with caution" signal in the cab. At the same time the speed limit imposed on the car or train is raised, allowing the car or train to proceed at a speed of 30 miles per hour. 115

Referring now to Fig. 3, the signaling system here shown is similar to the system previously described, but it comprises four generators G', G², G³ and G⁴, generating currents of four distinct frequencies, which 125 frequencies I shall designate g', g², g³ and g⁴, respectively. In the arrangement here shown, all of the generators are connected to one transmission line N, which line is connected to the track rails at a, b, c, etc., 130

by means of intermediate circuits, each of which circuits is resonant for one of the frequencies of current in line N, so that only current of the one frequency can enter the track rails at each of the said points of connection. For example, at point *a* the rails are supplied with current by a transformer 67 whose secondary is connected with the rails and whose primary is connected with the secondary of another transformer 69, the primary of the latter being connected with the transmission line N. The circuit including the rails and the secondary of transformer 67 is tuned to resonance at frequency g' by a condenser 68, and the circuit including the secondary of 69 and the primary of 67 is similarly tuned to the same frequency by a condenser 70. In this manner the rails are furnished at *a* with current of frequency g' , at *b* with current of frequency g^2 , etc.; currents of the various frequencies being supplied to the track rails in rotation as indicated by letters g^1, g^2 , etc. on the drawing. When, therefore, in Fig. 4 the cars or trains V and V' are separated by four or more track connections, the track rails in front of car or train V' are energized by four signaling currents. When the second car or train V' approaches the first car or train V until they are separated by only three track connections, the rails between them are energized by only three signaling currents. It is clear, therefore, that, as the car or train V' approaches closer to car or train V, the track rails between the cars or trains carry fewer signaling currents, until the rails are completely de-energized as the second car or train V' passes the last track connection behind the first car or train V. It may be said, therefore, that the number of signaling currents in the track rails in front of a car or train depends upon the distance to the next car or train ahead.

Referring now to Fig. 4, the apparatus on the car or train for use in connection with the trackway circuits shown in Fig. 3 is similar to the apparatus shown in Fig. 2 previously described. The circuit *x* is tuned to resonance at the mean of the four frequencies g', g^2, g^3 and g^4 . The circuit *y*, however, comprises in series the primary windings of four transformers T', T², T³, T⁴, having secondary circuits comprising cab relays S', S², S³ and S⁴, respectively, which circuits are adjusted to resonance for frequencies g', g^2, g^3 and g^4 , respectively. From the description of Fig. 2 it is clear that the relays S', S², S³, and S⁴, respond respectively to signaling current in the track rails of the frequencies g', g^2, g^3 and g^4 .

These relays control, as in Fig. 2, a cab signal F', which as here shown comprises five lamps, the faces of which are marked respectively with numerals 60, 45, 25, 10 and 5, which numerals designate the permissible

speed of the car or train in miles per hour. When all of the cab relays are de-energized, the lowest lamp, marked 5, is illuminated, indicating that the speed of the car or train must not exceed 5 miles per hour. When any one of the cab relays is energized, this lamp is extinguished and the next higher lamp is illuminated, indicating that the speed may be raised to 10 miles per hour. In this manner, as the number of energized relays increases, the speed limit indicated by the lamps is raised in steps to the maximum of 60 miles per hour at which time all four relays are energized. These speed limits may be enforced, if desired, by a governor 44 controlling contacts in the circuits of the magnet 42, the control of these circuits being similar to the control shown in Fig. 2 and explained hereinbefore.

The operation of this signaling system is similar to the operation of the system shown in Figs. 1 and 2. Referring again to Fig. 3, it is apparent that the coil 10 on car or train V' receives signaling currents of four frequencies as it approaches car or train V, until train V' reaches the track connection designated *c*. With four signaling currents in the track rails the four cab relays S', S², S³ and S⁴ are energized so that the cab signal indicates the highest speed limit of 60 miles an hour and the governor limits the speed of the car or train accordingly. However, as the car or train V' passes point *c*, the track rails in front of the car or train are energized by only three of the signaling currents, namely, those currents having frequencies g^4, g' , and g^2 . As a result, the relay S³ in the cab is de-energized, leaving only three of the cab relays closed, so that the signal G changes its speed limit indication to 45 miles per hour and the governor 44 becomes effective to enforce this speed limit as explained hereinbefore. As the car or train V' proceeds still further and passes point *d*, signaling current of the frequency g^4 is also shunted from the track rails in front of the car or train so that relay S⁴ in the cab becomes de-energized. Only relays S' and S² are now closed, so that the cab signal indicates a speed limit of 25 miles per hour and the governor becomes effective to enforce this speed limit. As the car or train passes point *e*, signaling current of only one frequency, namely, g^2 energizes the track rails in front of the car or train so that only relay S² in the cab is energized, which results in a speed limit of 10 miles per hour. As the car or train passes point *f*, it enters upon de-energized track rails so that none of the relays in the cab are closed and the cab signal changes its speed limit indication to 5 miles per hour, which limit is enforced by the governor, as previously explained. It will be seen that this signaling system differs from the one previously described

in that it affords a less abruptly gradated change of speed limit.

Referring now to Fig. 5, the stretch of track here shown comprises a down grade section extending from I to II, in which grade the maximum safe speed is, say 25 miles per hour. To enforce this speed limit while the car or train is running on this down grade I supply to the track rails of this section only two frequencies of signaling currents so that only two of the cab relays can be energized even when there is no other car or train ahead, whereby the car or train is automatically prevented from assuming a higher speed than 25 miles per hour in the manner explained hereinbefore. As shown in Fig. 5, the frequencies g' and g^2 are not supplied to the rails on the down grade, and they are prevented from flowing into this section of the rails by shunts 65 and 66 connected between the rails adjacent II. The shunt 65 comprises an inductance and a condenser resonant for frequency g' , so that current of this frequency in the rails to the right of the shunt is short-circuited and prevented from flowing into the rails extending to the left of the shunt. In the same manner the current of frequency g^2 is prevented from flowing past the shunt 66 which is resonant at frequency g^2 . When, therefore, a car or train equipped with signal and speed control apparatus, as shown and described in Fig. 4, approaches the down grade extending from I to II, traveling in the direction of the arrow, the coil 10 thereon receives all four signaling currents up to the point designated k so that the speed is limited only to 60 miles per hour. After passing this point, however, the car or train short-circuits the current of frequency g' supplied at k so that this current cannot flow into the track rails preceding the car or train. Current of frequency g' is not supplied to the track rails within the limits of the down grade section, as previously mentioned, and cannot flow into these rails from the rails beyond the lower end of the grade because of the resonant shunt 65. The track rails in front of the car or train are therefore energized only by signaling currents of frequencies g^2 , g^3 and g^4 , so that only three cab relays are energized and the speed limit is reduced to 45 miles per hour, as hereinbefore explained. As the car or train passes point 1, it shunts out current of frequency g^2 from the track rails ahead of the car or train so that the speed limit is automatically reduced to 25 miles per hour, as hereinbefore explained. Signaling currents of frequencies g^3 and g^4 are supplied to the track rails on the down grade, permitting the car or train to proceed down the grade at 25 miles per hour, unless there is another car or train in advance, in which case the first-mentioned car or train must slow down first to 10 miles

per hour and then to 5 miles per hour in the manner which I have explained hereinbefore. Assuming that the track is unoccupied, the car or train proceeds at 25 miles per hour to the point at which the shunt 65 is connected between the track rails. The rails beyond this point are energized by current of frequency g' supplied at o so that the speed limit is changed to 45 miles per hour. As the car or train passes shunt 66 it enters on track rails energized by signaling currents of all four frequencies, so that the speed limit is raised to 60 miles per hour permitting the car or train to resume normal speed.

In similar manner a reduced speed limit may be imposed on cars or trains when passing over curves, switches or tunnels.

Referring now to Fig. 6, reference character Q designates a railway switch in a section of track IV—VI. When the switch is in its normal position, traffic passing over the switch in the direction of the arrow continues on the straight or high speed route, whereas when the switch is in its reversed position, traffic passing over the switch is diverted into a branch track 110, which I will term a medium speed route. For purposes of description I shall assume that the maximum safe speed on the high speed route is 60 miles per hour, whereas on the medium speed route it is 25 miles per hour. Reference character K designates a signal stationed adjacent the trackway, which signal comprises two semaphore arms 103 and 104. These arms are normally in the horizontal position, indicating "stop". When arm 104 is raised to the vertical position it indicates that switch Q is normal, and when arm 103 is raised to the vertical position it indicates that switch Q is reversed.

I have omitted from the drawing the circuits for the control of signal K, these circuits being irrelevant to my invention. It need here be mentioned only that a track circuit comprising the track rails from IV and VI enters into the control of signal K through a track relay 106, the length of the track circuit being defined by insulated joints 112 in rail 2. The track circuit is supplied by a transformer 111 adjacent point VI with alternating current of a low frequency, say, 60 cycles, which current is generated by an alternator U. The indications of signal K are repeated by a distant signal K^a located in the rear of signal K, the arms 101 and 102 of signal K^a corresponding respectively to semaphores 104 and 103 of signal K. Signal K^a is also controlled by a track circuit extending from point III to point IV, which circuit comprises a track relay 107, energized also from the low frequency source U.

For the purpose of repeating the indications of signal K^a and K in the cab of a car or train, and in order to automatically en-

force observance of these signals, I provide my hereinbefore described high frequency signaling system suitably modified, as I shall now describe. The apparatus on the car or train may be the same as that shown in Fig. 4. The transmission line N energized by generators G' , G^2 , G^3 and G^4 , supplies signaling currents to the track rails, in somewhat the same manner as in Fig. 3, the frequency supplied to the track rails being indicated by the same letters as before at each point of connection. It should here be noted that the insulated joints 112 in rail 2 prevent the high frequency signaling currents supplied to the track rails within the insulated sections from flowing beyond the limits thereof. For example, with the arrangement of apparatus thus far described, current of frequency g' supplied at 123 to the track rails in section III—IV cannot flow to the rails extending to the left of point III because of joint 112 in rail 2. To pass this current around the said joint I provide a shunt 119 connected to the ends of rail 2 abutting said joint, which shunt is resonant for frequency g' , so that currents of the other frequencies cannot flow through this shunt in appreciable quantities.

A car or train V traveling in the direction of the arrow will receive at 120 current of frequency g' as well as currents of frequencies g^2 , g^3 and g^4 , so that the car or train may proceed at 60 miles per hour. When the car or train passes point 120 it will, however, receive only three of the said currents i. e. g' , g^2 and g^3 , unless the frequency g^4 is supplied to the rails through a transformer 124, whose connection to the line L is controlled by the relay 107, the control being such that current flows to the transformer only when the section III—IV is unoccupied. In similar manner current of frequency g^3 is supplied to the said rails by a transformer 125, similarly controlled by relay 107. In this manner the car or train may proceed at full speed to the entrance of section III—IV except when said section is occupied, in which case the speed of the car or train is reduced automatically.

Assuming now that the section III—IV is unoccupied and that signal K at the entrance to the next section is at stop, the car or train on entering section III—IV receives only three signaling currents g' , g^4 and g^3 supplied to the track rails at 123, 126 and 127, so that the speed of the car or train is reduced to 45 miles per hour. As the car or train passes point 123 its speed is reduced to 25 miles per hour, at point 126 it is limited to 10 miles per hour, and at 127 it is limited to 5 miles per hour, all in the manner hereinbefore explained.

When, on the other hand, signal K indicates "proceed at full speed", i. e. when semaphore arm 104 is in the vertical posi-

tion, all four signaling currents are supplied to the rails of section III—IV adjacent point IV through transformers 130, 131, 132 and 133, respectively, which transformers are controlled through contacts 104^a , 104^b , 104^c , 104^d , governed by arm 104 of signal K, the contacts being closed or open according as blade 104 is horizontal or vertical. In this manner the train receives all four signaling currents as it approaches signal K so that it may pass this signal at full speed, in accordance with the indication of the signal.

When, however, the signal K indicates "proceed at medium speed", blade 103 being vertical and blade 104 horizontal, only currents of frequencies g' and g^2 are supplied to the track rails at point IV through transformers 130 and 131 governed by contacts 103^a and 103^b , operated by signal blade 103. In this case the car or train receives all four frequencies of current only up to point 126 in the section III—IV. After passing this point only three currents are transmitted to the car or train and the speed is reduced to 45 miles per hour. At 127 the speed is reduced to 25 miles per hour, thus insuring a safe medium speed when the car or train passes signal K.

The control of the car or train after it passes signal K is the same as hereinbefore described; in connection with Fig. 3; I have omitted the circuits and apparatus for the control thereof to avoid unnecessary complication of the drawing.

Although I have herein shown and described but several forms of apparatus and circuits 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. A stretch of railway track, a plurality of sources of current differing in frequency connected to the rails of said track, and a shunt resonant at one of said frequencies connected between said rails for preventing flow of said current beyond said shunt.

2. In combination, a stretch of railway track supplied with a plurality of signaling currents, a portion of said stretch being supplied with a lesser number of signaling currents, means for preventing currents not directly supplied to the said portion from entering said portion at one end, and vehicle-carried controlling means responsive to said signaling currents.

3. In combination, a stretch of railway track comprising a portion necessitating a lower speed than the remainder of the stretch, means for supplying to said portion one or more signaling currents and for supplying to the remainder of the stretch a greater number of signaling currents, reso-

nant means for preventing the signaling currents not directly supplied to the said portion of the stretch from entering said portion, and vehicle-carried governing means responsive to the said signaling currents.

4. In combination, a stretch of railway track comprising a portion necessitating a lower speed than the remainder of the stretch, means for supplying to the track rails of said portion one or more signaling currents and for supplying a greater num-

ber of signaling currents to the track rails of the remainder of the stretch, resonant shunts connected between said track rails for preventing the flow of the signaling currents into said portion and vehicle-carried governing means responsive to the number of signaling currents supplied to the track rails in front of the vehicle.

In testimony whereof I affix my signature.

LLOYD V. LEWIS.