Sept. 7, 1926. 1,598,758

T. W. VARLEY ET AL

PNEUMATIC TRAIN CONTROL

Original Filed Jan. 30, 1919 2 Sheets-Sheet 1

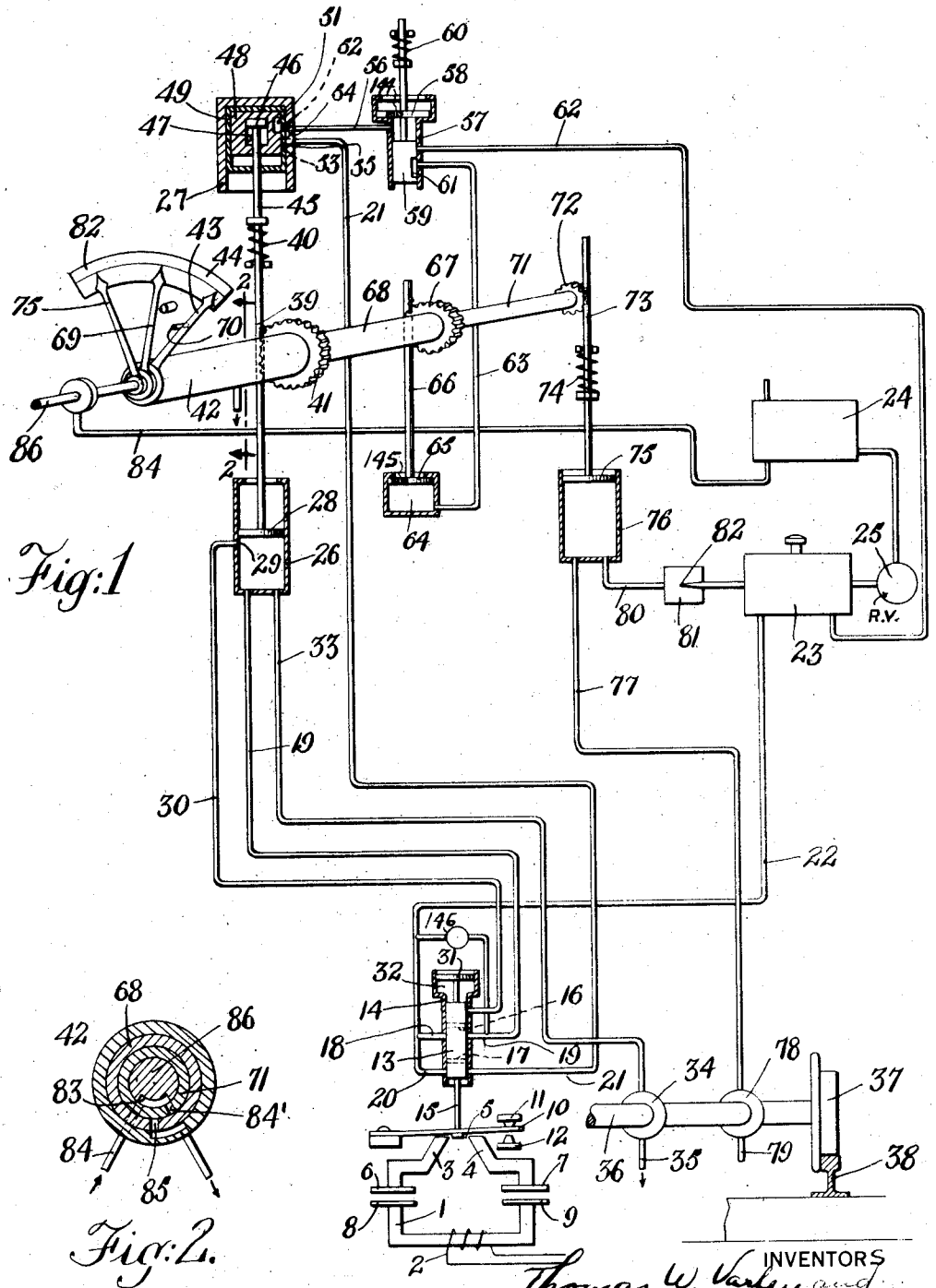

Fig:1

Fig:2.

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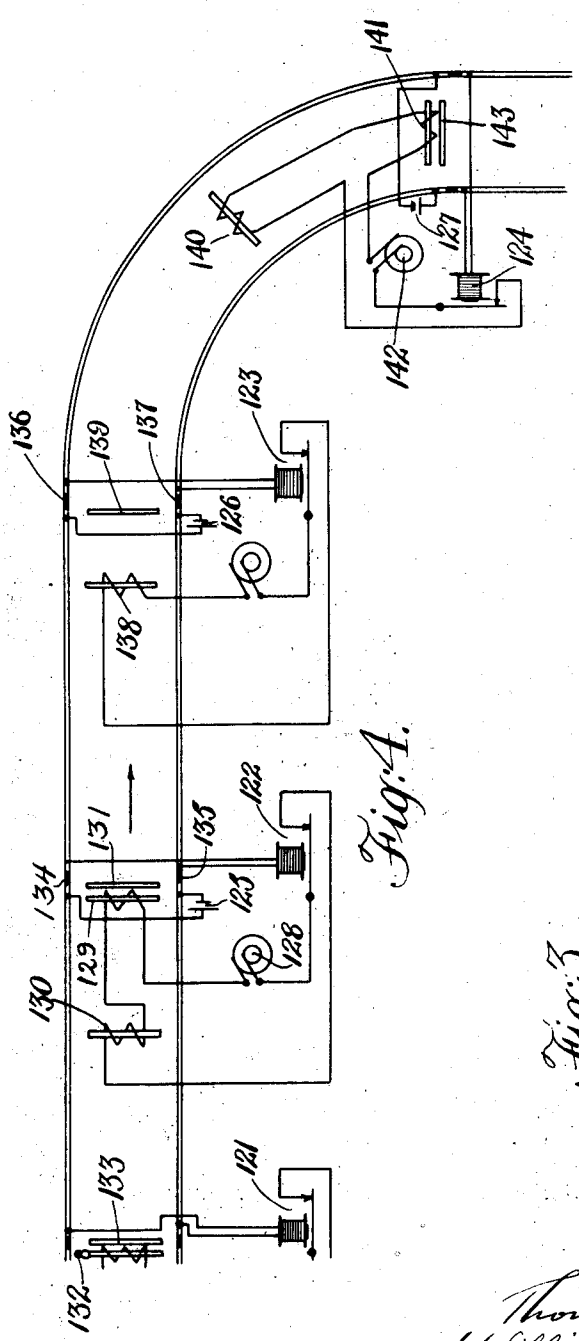

Fig. 4.

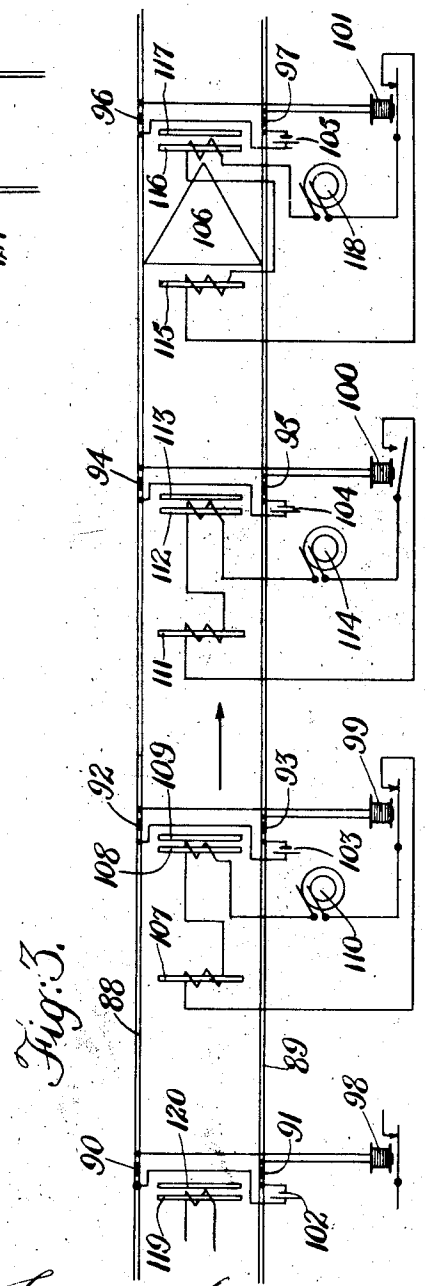

Fig. 5.

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Patented Sept. 7, 1926. 1,598,758

UNITED STATES PATENT OFFICE.

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PNEUMATIC TRAIN CONTROL.

Application filed January 30, 1919, Serial No. 273,959. Renewed February 3, 1926.

This invention relates to train control systems wherein the train or vehicle in the absence of "clear" conditions is compelled to be slowed down to a predetermined maximum speed or stop. Suitable signals may also be included in the equipment to indicate existing conditions to the driver of the vehicle.

The present invention is an improvement upon that of our application Serial No. 144,836, filed January 27th, 1917, now Patent No. 1,397,024, dated Nov. 15, 1921, the control devices in the present case being operated by fluid pressure controlled by instruments distributed along the right of way or track.

Other and ancillary objects of the invention will appear hereinafter.

In the accompanying drawings which illustrate the invention:—

Figure 1 is a diagrammatic view showing the arrangement of pneumatically operated apparatus upon the vehicle and its relation to the track instruments;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a diagrammatic view showing the arrangement of track magnets and circuits; and

Fig. 4 is a diagrammatic view of track magnets and circuits as applied to the control of the speed of the vehicle on a curve.

Referring to the drawings, and first to Fig. 1, a track instrument is indicated as comprising an iron yoke 1 energized by means of an electric coil 2 controlled according to track conditions as will be hereinafter more fully referred to. Arranged upon the vehicle is a magnetic yoke comprising horns 3 and 4 between which is an air gap 5 and magnetizable members connected with each of these horns have plates 6 and 7 adapted to be presented to, and spaced away by an air gap from, plates 8 and 9 on the track instrument. Bridging the gap 5 is a magnetic member 10 which is biased by its inherent spring to a position away from the horns 3 and 4, against a back stop 11, while a forward stop 12 prevents the member 10 from being drawn so closely against the horns 3 and 4 as to freeze thereto. When the coil 2 of the track instrument is energized, and the vehicle is so positioned that the plates 6 and 7 are passing over the plates 8 and 9, the magnetic circuit of the yoke 1 will be completed through the horns 3 and 4 and the member 10. This will result in the attraction of the member 10 and a drawing down of the piston 13 in the cylinder 14. Normally the piston is elevated independently of the member 10, the rod 15 sliding in a hole in the member 10 and having a knob at its bottom for engaging the member 10 to draw the piston downwardly. Within the piston 13 are two ports or passages 16 and 17, the passage 16 being normally out of register with the pipes 18 and 19 and the passage 17 being normally out of register with the pipes 20 and 21. When, however, the piston is drawn downwardly by the member 10 as before referred to, the port 16 will connect the pipes 18 and 19 and the port 17 will connect the pipes 20 and 21. The pipes 18 and 20 are connected by a common pipe 22 with a low pressure reservoir 23 of compressed air, the reservoir 23 receiving its supply from a reservoir 24 through a suitable reducing valve 25. The reservoir 24 may be directly connected with the fluid supply for operating the air brakes. On the other hand the pipe 19 leads to the lower portion of a cylinder 26, while the pipe 21 leads to a cylinder 27. When, therefore, the vehicle passes over an energized track instrument, compressed air will be admitted to the cylinder 26 beneath its piston 28. This piston will be forced upwardly until it uncovers the port 29 communicating with the pipe 30 leading to the cylinder 14. It will therefore be seen that the piston 28 always moves upwardly the same distance and therefore includes the same cubic contents in the cylinder beneath it so that a fixed amount of air is taken into the cylinder at each upward movement of the piston. The piston 13 has secured to it, but spaced from it, a second piston 31. With the pistons in the elevated positions, as shown in the drawings, the port through which the pipe 30 communicates with the interior of the cylinder 14, is closed by the piston 13. When, however, the piston is depressed, the pipe 30 opens into the space 32 between the two pistons. The area of the piston 31 exposed to that pressure being larger than that of the piston 13, the two pistons 31 and 13 will be forced upwardly so that the pipes 19 and 21 will be cut off from the source of pressure.

The piston 28, however, will rise until its rod 39 comes against a stop as when it comes against the pistons 48 and 49 when both are at the upward limit of their movement in the cylinder 27. Communicating with the lower end of the cylinder 26 is a pipe 33 which communicates through a suitable rotating or measuring valve 34 with the exhaust 35 to the atmosphere. The rotating valve 34 is mounted on the axle 36 of the vehicle, one of the wheels as 37 resting upon the track 38. It will be apparent that a given amount of compressed air will be exhausted from the cylinder 26 by a certain number of revolutions of the valve 34 and the revolution of the valve bearing a fixed relation to the revolution of the vehicle wheel 37, the vehicle will have to travel a certain distance in order to exhaust the compressed air from the cylinder 26. It follows therefore, that the exhaustion of the air from the cylinder 26 is proportional to the distance traveled by the vehicle and consequently the piston 28 will occupy a position in the cylinder according to the distance of the vehicle from a given point. As we have seen, the action is initiated by the passing of the vehicle instrument over the track instrument and consequently the piston 28 occupies a position proportional to the distance which the vehicle has traveled from an energized track instrument. As the piston 28 rises it pushes up the rack-rod 39 against the tension of the spring 40. The rack of the rod meshes with the gear 41 fixed to the sleeve 42. Fixed upon the sleeve 42 is a pointer 43 adapted to move over the scale 44. When the piston 28 is forced upwardly the pointer 43 is moved into its initial or zero position and as the piston 28 drops with the distance traveled by the vehicle, the pointer 43 will move over the scale 44 so as to indicate the distance traveled by the vehicle.

The rising of the rack 39 and the rod 45 connected thereto, also performs another operation as will now be described. The rod 45 carries a knob 46 slidable in a recess 47 in the piston 48 which is slidable in the hollow piston 49 which in turn slides in the cylinder 27. When the rod 45 is pushed to its uppermost position as shown in the drawings, the pistons 48 and 49 are pushed to their upper positions in the cylinder 27 by reason of the head 46 coming against the upper end of the recess 47. As the rod 45 drops with the piston 28, the head 46 will move for a short distance while the pistons 48 and 49 remain in their upper positions. When, however, the head 46 comes against the bottom of the recess 47, it will carry along with it the piston 48. After a small movement of the piston 48, the port 51 in that piston, will connect the two ports 52 and 53 in the cylinder 49, these ports 52 and 53 in the uppermost position of the piston 49 as shown, being in registry with the ports 54 and 55 in the cylinder 27. When, therefore, the head 46 in its downward movement, causes the port 51 to connect the ports 52 and 53, the piston 49 remaining at the uppermost portion of its movement, the ports 52 and 53 are in registry with the ports 54 and 55 so that, the ports 52 and 53 being placed in communication as described, the pipes 56 and 21, connecting with the ports 54 and 55, are placed in communication. Consequently when these ports 52 and 53 are in communication and the piston 13 is in its lowermost position as before referred to, so that the pipe 22 is connected with the pipe 21 by the passage 17 in the piston 13, the pipe 56 will be placed in communication with the compressed air reservoir 23. The pipe 56 communicates with the cylinder 57 at a point between the pistons 58 and 59 and, the piston 58 being of larger area than the piston 59, the compressed air admitted into the space between the pistons forces them upwardly against the pressure of the spring 60. The piston 58 is provided with a vent 144 to permit the escape of air to the atmosphere so that the piston may move downwardly when the supply of compressed air is cut off, while when this air is applied beneath the piston it will be raised. In their uppermost positions the port 61 in the piston 59 connects the pipe 62 leading to the compressed air reservoir 23 into communication with the pipe 63 leading to the bottom of the cylinder 64. The air pressure thus applied beneath the piston 65 forces it upwardly and with it the rack-rod 66 engaging with the pinion 67. The piston 65 is provided with a vent 145 which permits the escape of the compressed air to the atmosphere so that when the supply of compressed air is cut off from beneath the piston it will descend under the weight of itself and its carried parts, the vent being so proportioned, however, that when the source of compressed air is in communication with the under side of the piston, sufficient pressure will be accumulated to cause the piston to rise. The rising of the rack-rod 66 turns the pinion 67 and with it the sleeve 68 to which is also fixed the stop arm 69. The relation of the rack-rod and pinion 66 and 67 is such that when the piston 65 rises as described, the arm 69 is turned to its zero position, that is, the right hand limit of its movement. The arm 69 is pushed to the left by means of a pin 70 upon the distance arm 43 which extends into engagement with the arm 69. It will now appear that a depression of the piston 13 due to the passage of the plates 6 and 7 over an energized track magnet will cause the piston 28 to be moved to its upward limit of movement and in lifting the rack 39 will

move the distance hand 43 to its zero position. It will further raise the knob 46 and the pistons 48 and 49 to their upper position. As the piston 28 descends and with it the knob 46, the knob will move a short distance without producing any result because of the lost motion connection between it and the piston 48. When, however, it engages the lower end of the recess in that piston, the piston will be moved with it so that the port 51 will be brought into registry with the ports 52 and 53. The object of the lost motion connection between the rod 45 and the piston 48 is to bring the ports 52 and 53 into registry in the first part of the travel of the rod 45 for reasons as will be pointed out later. With the ports 52 and 53 connected as described, if the piston 13 is drawn downwardly by the plates 6 and 7 passing over an energized track instrument, the stop arm is restored to zero as before referred to. It thus appears that with the drawing down of the piston 13, the distance arm 43 is restored to zero and if another magnet in the track which is placed a predetermined distance from the magnet which has just acted to restore the distance hand, is energized at the instant the pipes 21 and 56 are connected as described, then the stop arm 69 will also be restored to zero. If, however, there is not such a succeeding magnet so energized, the fluid pressure will be cut off at the pipe 20, the piston 48 will continue its downward course, and coming against the lower end of the piston 49 will move that piston downwardly, thus moving the ports 52 and 53 in that piston out of registry with the ports 54 and 55. The pistons 48 and 49 will then continue their downward course with the piston 28 and any subsequent depression of the piston 13 by attraction of the armature 10 will not operate to affect the stop arm. Such subsequent energization will, however, act to elevate the piston 28 and restore the distance hand. In restoring the distance hand the pistons 48 and 49 will be pushed upwardly, but the port 51 will be thrown out of registry with the ports 52 and 53 so that there can be no communication between the pipes 21 and 56 in this movement.

Within the sleeves 42 and 68 turns a sleeve 71 having fixed upon it a pinion 72 engaging with a rack 73 tending to be forced downwardly by a spring 74. Secured to the shaft 71 is a speed indicating hand 75 which moves to the right with increase of speed. The rack 73 is connected at its lower end with a piston 75 sliding in the cylinder 76. An exhaust pipe 77 communicates with the lower end of the cylinder 76 and through a rotating valve on the vehicle axle, this valve 78 being similar to the valve 34, with an exhaust pipe 79 opening into the atmosphere. Also connecting with the lower end of the cylinder 76 is a pipe 80 leading to a receptacle 81 which is fed with compressed air at a predetermined rate through the nozzle of orifice 82 from the reservoir 23. It will be apparent that since the chamber 81 is fed at a predetermined rate, its pressure, and consequently the pressure within the cylinder 76, will depend upon the rate at which the air is exhausted from this receptacle. Since the valve 78 is fixed to the axle of the vehicle, the rate of exhaustion will be proportional to the speed of the vehicle, consequently the pressure in the cylinder 76 will be proportional to the vehicle speed, the position of the piston 75 will therefore correspond to the vehicle speed and this piston being connected as before described with the hand 75, that hand will take up a position in accordance with the speed of the vehicle. The speed may therefore, be noted by observing the position of the hand 75 upon a scale 82 which may be calibrated in miles per hour.

Within the sleeve 71 is a stationary shaft 86 wherein is cut a port 83 which is in communication with the train line or the air brake system of the vehicle as by means of a pipe 84 (see Fig. 2).

In the sleeve 71 is a port 84′, this sleeve being the one upon which the speed hand 75 is mounted and the port 83 is so proportioned that the port 84′ is always in communication with it. In the sleeve 68 upon which the stop hand is mounted is cut a port 85 which communicates with the atmosphere. It will now appear that when the ports 84′ and 85 are in registry, the port 83 will be connected with the atmosphere and, the last mentioned port being connected with the air brake system, the registry of the ports 84′ and 85 will cause the brakes to be applied, it being well understood how air brakes are applied by causing the exhaust of the air pressure. The stop hand 69 and the speed hand 75 are so placed on their respective sleeves, that when they are together (or one over the other) the ports 84′ and 85 will be in registry. Whenever, therefore, the speed hand which occupies its position according to the speed of the vehicle, is in registry with the stop hand 69, the brakes will be applied. The stop hand will take up its various positions according to different conditions as will be hereinafter referred to. The distance hand serves to operate the stop arm through the instrumentality of the pin 70 and both the distance hand and stop arm are restored to their initial or zero positions under conditions which can be best set forth in tracing the operation of the apparatus as the vehicle passes along a track.

In Fig. 3 is shown a straight stretch of railway track wherein the rails 88 and 89

are insulated into block sections by means of the sections of insulation 90 and 91, 92 and 93, 94 and 95 and 96 and 97. As is customary in block signal work, track magnets 98, 99, 100 and 101 are connected across the track rails near the ends of the respective circuits, while batteries 102, 103, 104 and 105 are respectively connected across the rails at the other ends of the circuits. When a vehicle, as is represented in this figure at 106, is in a block, it connects the rails by a short circuit thereby depriving the track magnet of that section of current.

Mounted in the road bed between the rails, each block section has three magnets, thus the block between the insulated sections 90 and 92, has the electro-magnets 107 and 108 and the permanent magnet 109. Each of these magnets may be of the form of the track instrument shown in Fig. 1 so as to co-operate with the magnetic instrument on the vehicle of which plates 6 and 7 are the pole pieces. As shown, the coils of the electro-magnets 107 and 108 are connected in series with each other and with a suitable source of current such as a dynamo 110, through the contacts of the track magnet 99, the circuit of these magnets being closed when the track magnet is energized. Similarly the next block to the right is provided with electro-magnets 111 and 112 and permanent magnet 113, and a dynamo 114, while the block still further to the right is similarly provided with electro-magnets 115 and 116 and a permanent magnet 117 and a dynamo 118 and so a uniform equipment of the blocks may be carried on indefinitely.

To trace the operation of the apparatus on the vehicle as it passes along the track as just described, as the magnetic instrument on the vehicle of Fig. 1 passes the electro-magnet 119, that magnet is energized because the succeeding block is empty and consequently the track magnet 98 is energized and holds its contacts closed. The piston 13 will therefore be depressed, and the piston 28 elevated. This operates to restore the distance arm 43 to its zero position and also throws the knob 46 and the pistons 48 and 49 to their uppermost position. The vehicle then passes on, the piston 28 meanwhile dropping according to the distance traveled by the vehicle. When the vehicle has traveled a certain distance, the various ports will be in such relation, as before described, that the pipe 21 will be in communication with the interior of the cylinder 57. If at this instant the magnetic structure on the vehicle comes within the influence of a magnet in the track so that the piston 13 is depressed, pressure will be supplied to the cylinder 57 so that the stop arm will be reset to its zero position, the piston 28 being also again forced up, distance arm 43 is again set back to zero and the piston 13 restored to its uppermost position as the port 29 is uncovered. The permanent magnet 120 is set in the trackway at the ending of a block and the magnet 119 is at such a distance preceding it that the depression of the piston 13 will occur at the proper moment to re-set the stop hand. This occurs at the ending of the block, there being no vehicle in the next block. In starting on this next block, therefore, both the distance and stop arm start from zero. The distance arm 43 moves in unison with the piston 28 as it descends, and at a certain point in its travel engages the stop arm and pushes it toward the left (see Fig. 1). We have already seen that in order to effect an application of the brakes, the speed arm 75 and the stop arm 69 must be in registry. The zero or initial position of the stop arm is that corresponding to the maximum running speed of the train desired as, say, eighty miles per hour. This speed can then not be exceeded as the speed and stop arms will come into registry at this point. The engineer or motorman can readily see the stop and speed arms and by suitable regulation of the speed keep it within such limits that the speed arm which moves to the right with increase of speed will not come into registry with the stop arm.

As the vehicle moves from the beginning of the block between the insulated sections 90 and 92 and the distance arm is moved to the left starting from its zero position at the beginning of the block, the stop arm being moved only by the distance hand, the engineer is practically unlimited (within the maximum speed setting of the stop arm) in the speed which he may employ. As the vehicle progresses along the track, however, the stop arm is picked up and moved further and further toward the left so that the speed which may be employed without bringing the stop and speed arms into registry and applying the brakes, becomes less and less. The engineer must observe these conditions and hold his speed accordingly. At a certain distance from the ending of the block and from the magnets 119 and 120, the electro-magnetic device 107 upon the track, will operate to restore the distance arm to its zero position. The stop arm will, however, be left in a certain position depending upon the distance traveled by the vehicle from the beginning of the block or from the magnet 120, in other words, depending upon the distance of the magnet 107 from the magnet 120. The position at which the stop arm is left therefore, may be made any that is desired by suitably spacing the magnet 107 along the track from the magnet 120. The stop arm having been left in this position, the engineer must see to it that the speed of his vehicle does not become great enough to bring the speed arm 75 in registry

with the stop arm 69. Otherwise the brakes will be applied. This arrangement therefore affords a means, first of providing a gradual decreasing limit of speed during the first portion of the block and then a fixed limit for the remainder of the block.

As the vehicle then progresses beyond the magnet 107, the stop arm remains in the position to which it has been pushed, because, as will be seen, there is no other magnet suitably spaced from the magnet 107 to give the impulse at the right moment to restore the stop arm. When the magnetic yoke on the vehicle reaches the electro-magnet 108, the piston 13 is again depressed, again re-setting the distance arm to its zero position, and on passing further along it will encounter the permanent magnet 109 at the end of the block. As will be seen, the permanent magnet has spaced from it the magnet 108 by the same distance that the magnet 119 is spaced from the permanent magnet 120. Consequently the piston 13 will be depressed at the right moment to restore the stop arm and the stop and distance arms will start from their zero positions at the beginning of the next block, that is, the block between the insulating sections 92 and 94.

As the vehicle progresses to the right (see Fig. 3), the distance arm moves to the left (Fig. 1) and after a certain distance has been traversed the vehicle will pass over the electro-magnet 111. On account, however, of the fact that the next block (between the insulation sections 94 and 96) has a vehicle in it, the track magnet 100 is de-energized so that the circuit of the magnet 111 will produce no effect whatever upon the apparatus on the vehicle and therefore the distance hand, carrying with it the stop hand, will continue its movement and the speed of the vehicle must be kept below a limit which becomes less and less as the vehicle progresses. By the time the magnetic yoke on the vehicle arrives at the electro-magnet 112, the distance and stop arms will be well over to the left hand side of the scale (Fig. 1) so that the speed of the vehicle must be maintained very low in order to keep the speed hand out of the way of the stop arm. Then as the vehicle still progresses, if it reaches the permanent magnet 113 without stopping the vehicle, distance arm 43 will be re-set to its zero position, but the stop arm will be left so far over at the left hand side of the scale (Fig. 1) that the vehicle can progress only at a very slow speed and at this speed can enter the block containing the vehicle 106. If, however, it is desired to absolutely prevent the vehicle from entering the block containing the vehicle 106, the permanent magnet 113 would be omitted when the stop hand would certainly be carried over into registry with the speed hand and the brakes would be applied. In this way the train may be controlled as to its speed and stoppage in the blocks, and according to track conditions, throughout an indefinite number of blocks.

The space 32 in the cylinder 14 will be vented through the pipe 30 and port 29 to the atmosphere when the piston 28 has passed below that port, 13 being depressed.

A valve 146 is provided whereby a connection may be formed at will by the engineer, between the pressure supply pipe 22, and the pipe 19 leading to the distance hand controlling cylinder 26. By this means is provided whereby the engineer may if occasion arises, restore the distance hand and so prevent the stop arm from being moved into a position of lower speed or stop.

In Fig. 4 is shown an arrangement whereby the speed of the vehicle may be regulated, for instance, in slowing up the speed at which it may pass around a curve. In Fig. 4 is shown a track extending around a curve and divided into blocks by insulation dividing the track into sections as is apparent. Thus in the respective blocks are shown track magnets 121, 122, 123, and 124 and having at their ends furthest from these magnets, the batteries 125, 126 and 127. In the block at the left hand end of the figure is shown a circuit including the contacts of the magnet 122, a dynamo 128 and the electromagnets 129 and 130, the coils of the magnets 129 and 130 being connected in series. Also the block contains a permanent magnet 131. At the beginning of the block or just at the end of the preceding block are electromagnet 132 and a permanent magnet 133 arranged as the magnets 129 and 131. The arrangement thus far is the same as that indicated in the blocks of Fig. 3. Consequently the vehicle on entering the block between the insulation sections 134 and 135 on the one hand and 136 and 137 on the other, will, at the beginning of the block, have its stop and distance arms in their initial positions. As the vehicle progresses along this block the distance arm will move toward the left (Fig. 1) as before described, until the vehicle apparatus is operated upon by the electromagnet 138. It will be noted that this magnet 138 is much further from the beginning of the block than the magnet 130 is from the beginning of its block, consequently the distance and stop arms will have moved a greater distance to the left (Fig. 1) and when the distance arm is reset by the action of the magnet 138, the stop arm will be set for a much lower stopping speed and consequently the engineer will be held to a lower running speed. The vehicle then progressing from the magnet 138, will pass over the permanent magnet 139 at the end of the block. This magnet 139, being unaccompanied by an electromagnet, will

only restore the distance arm, leaving the stop arm at its setting as just referred to. Consequently the vehicle will enter the block to the right of the insulation sections 136 and 137 at this enforced low speed and will consequently enter upon the curve in that block at such low speed. In the block last referred to is an electro-magnet 140 in series with another electro-magnet 141 in the circuit of the dynamo 142 and the contacts of the track magnet 124. The magnet 140 is spaced from the beginning of its block by the same distance that the magnet 138 is spaced from the beginning of its block so that when the distance arm, which was reset at the beginning of the block, is reset by the magnet 140, the stop arm retaining its setting while the vehicle is passing around the curve in this block. Near the end of this block the permanent magnet 143 is placed, and adjacent thereto and spaced therefrom by a suitable distance to effect the resetting of both the distance and stop arms as the vehicle passes over them, is the electro-magnet 141. The vehicle will thus enter into the next block, provided it is clear, with both the stop and distance arms at zero when they will operate as described in connection with the straight stretch of track of Fig. 3 or the left hand block of Fig. 4. If danger conditions exist in any of the blocks of Fig. 4, it will be apparent that the track relay of that block will be dropped and, this being the case, there will be no resetting of the distance arm in the preceding block and the movement of the distance and speed arms will continue either to stoppage or a predetermined low speed of the train as before referred to.

While the invention has been illustrated in what are considered its best applications, it may have other embodiments without departing from its spirit and is not therefore, limited to the structures shown in the drawings.

What we claim is:—

1. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, a settable device for controlling said brake operating means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, the last mentioned means having an initial position and means for restoring the last mentioned means to said initial position independently of said settable device.

2. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, a settable device for controlling said brake operating means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, the last mentioned means having an initial position, means for restoring the last mentioned means to said initial position independently of said settable device, instruments along said right of way and means for controlling the setting of said settable device by the spacing of said instruments along said way.

3. The combination with a vehicle movable along a right of way, of brakes of the vehicle and means for operating the same, a settable device for controlling said brake operating means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, the last mentioned means having an initial position, means for restoring the last mentioned means to said initial position independently of said settable device and means operated by fluid pressure according to the speed of the vehicle, the said settable device and speed controlled means jointly controlling said brake operating means.

4. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, a settable device for controlling said brake operating means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, the last mentioned means having an initial position, means for restoring the last mentioned means to said initial position independently of said settable device, means operated by fluid pressure according to the speed of the vehicle for controlling said brake operating means, the last mentioned fluid pressure operated means and said settable device jointly controlling said brake operating means and instruments along said right of way and means for controlling the setting of said device by the spacing of said instruments along said way.

5. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, a settable device for controlling said brake operating means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, and fluid pressure operated means for restoring both said settable device and said fluid pressure operated means to their initial position.

6. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, a settable device for controlling said brake operating means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, and fluid pressure operated means for restoring both said settable device and said fluid pressure operated means to their initial position, said settable device and said fluid pressure operated means being restored independently.

7. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, a settable device for controlling said brake operating means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, fluid pressure operated means for restoring said settable device and the aforesaid fluid pressure operated means, and instruments along said right of way, the restoring of said settable device being controlled by one spacing of said instruments and the restoring of said fluid pressure operated means controlled by the distance traveled by the vehicle being controlled by a different spacing of said instruments.

8. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, a settable device for controlling said brake operating means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, the last mentioned means having an initial position, fluid pressure operated means for restoring both said settable device and said fluid pressure operated means to their initial positions, means operated by fluid pressure according to the speed of the vehicle for controlling said brake operating means, the last mentioned fluid pressure operated means and said settable device jointly controlling said brake operating means.

9. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, a settable device for controlling said brake operating means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, the last mentioned means having an initial position, fluid pressure operated means for restoring both said settable device and said fluid pressure operated means to their initial positions, said settable device and said fluid pressure operated means being restored independently, means operated by fluid pressure according to the speed of the vehicle for controlling said brake operating means, the last mentioned fluid pressure operated means and said settable device jointly controlling said brake operating means.

10. The combination with a vehicle movable along a right of way, of means for controlling the movement of the vehicle and means for operating the same, a settable device for controlling said vehicle controlling means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, the last mentioned means having an initial position, means for restoring the last mentioned means to said initial position independently of said settable device, instruments along said right of way and means for controlling the setting of said settable device by the spacing of said instruments along said right of way.

11. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, means operated by fluid pressure for controlling said brake operating means, means controlled by the distance traveled by the vehicle along said right of way independently of the time of travel for controlling said fluid pressure operated means, instruments distributed along said right of way and a magnetic device on said vehicle controlling said fluid pressure and operated inductively by said instruments as the vehicle passes along the right of way

12. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, means operated by fluid pressure for controlling said brake operating means, means controlled by the distance traveled by the vehicle along said right of way independently of the time of travel for controlling said fluid pressure operated means, instruments along said right of way having their condition governed by conditions along said right of way, a magnetic device on the vehicle controlling said fluid pressure and having its operation inductively governed by said instruments according to the conditions imposed upon them by the conditions along the right of way.

13. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, a settable device for controlling said brake operating means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, the last mentioned means having an initial position, means for restoring the last mentioned means to said initial position independently of said settable device, magnetic instruments along said right of way and means for controlling the setting of said settable device by the spacing of said instruments along said way.

14. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, a settable device for controlling said brake operating means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, the last mentioned means having an initial position, means for restoring the last mentioned means to said initial position independently of said settable device, means operated by fluid pressure according to the speed of the vehicle for controlling said brake operating means, the last mentioned

fluid pressure operated means and said settable device jointly controlling said brake operating means and magnetic instruments along said right of way and means for controlling the setting of said device by the spacing of said instruments along said way.

15. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, a settable device for controlling said brake operating means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, fluid pressure operated means for restoring said settable device and the aforesaid fluid pressure operated means, and magnetic instruments along said right of way, the restoring of said settable device being controlled by one spacing of said instruments and the restoring of said fluid pressure operated means controlled by the distance traveled by the vehicle being controlled by a different spacing of said instruments.

16. The combination with a vehicle movable along a right of way, of means for controlling the movement of the vehicle and means for operating the same, a settable device for controlling said vehicle controlling means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, the last mentioned means having an initial position, means for restoring the last mentioned means to said initial position independently of said settable device, magnetic instruments along said right of way and means for controlling the setting of said settable device by the spacing of said instruments along said right of way.

17. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, a settable device for controlling said brake operating means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, the last mentioned means having an initial position, means for restoring the last mentioned means to said initial position independently of said settable device, instruments along said right of way and means for controlling the setting of said settable device by the spacing of said instruments along said way, said settable device being restored by a predetermined spacing of said instruments and said fluid pressure operated means being variably restored by variable spacing of said instruments.

18. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, a settable device for controlling said brake operating means, fluid pressure operated means controlled by the distance traveled by the vehicle for operating said device, the last mentioned means having an initial position, means for restoring the last mentioned means to said initial position independently of said settable device, means operated by fluid pressure according to the speed of the vehicle for controlling said brake operating means, the last mentioned fluid pressure operated means and said settable device jointly controlling said brake operating means and instruments along said right of way and means for controlling the setting of said device by the spacing of said instruments along said way, said settable device being restored by a predetermined spacing of said instruments and said first mentioned fluid pressure operated means being variably restored by a variable spacing of said instruments.

19. The combination with a vehicle movable along a right of way, of brakes for the vehicle and means for operating the same, a receptacle on said vehicle, track instruments, means controlled by said track instruments for admitting a fixed amount of fluid to said receptacle, means for exhausting said fluid from said receptacle, proportionally to the distance traveled by the vehicle, means for controlling the brake operating means and means for operating said brake controlling means according to the fluid in said receptacle, a second receptacle on said vehicle, means for supplying fluid under pressure to said second receptacle, means for exhausting the fluid from said second receptacle proportionally to the speed of the vehicle and brake controlling means controlled by the pressure in said second receptacle, the two said brake controlling means operating jointly to control said brakes.

20. The combination with a vehicle of means for indicating the distance traveled by the vehicle from a given point comprising a pneumatic cylinder, means for admitting a definite amount of air to said cylinder, and means controlled by the movement of the vehicle for exhausting the air from said cylinder and an indicator controlled by the amount of air in said cylinder.

21. The combination with a vehicle of an indicator thereon for indicating the distance traveled by the vehicle and comprising a pneumatically operated means having an exhaust controlled according to the distance traveled by the vehicle.

22. The combination with a vehicle, of an indicator thereon for indicating the distance traveled by the vehicle and comprising a pneumatically operated means adapted to have the amount of its contained air varied, including a chamber and means for controlling the amount of air in said chamber according to the distance traveled by said vehicle.

23. In an automatic train control system, in combination with a vehicle air brake system, car-carried apparatus comprising a movable stop device for causing the operation of the vehicle brakes at increasingly restrictive speeds when moved from its initial position toward its ultimate position, a distance device, acting when moved from its initial position to move said stop device toward its ultimate position, traffic controlled trackway impulse transmitting apparatus acting to restore said distance device to its initial position independently of said stop device in response to a single impulse, and to restore said stop device to its initial position in response to two successive impulses spaced by a predetermined distance interval.

24. In a train control system in combination with a vehicle air brake system, car-carried apparatus comprising a movable stop device and a fluid pressure operated speed responsive device operating to cause a brake application at increasingly restrictive speed limits if said stop device is moved from its initial position to its ultimate position, a fluid pressure operated distance device acting until restored to move said stop device toward its ultimate position, trackway means comprising electro-magnets controlled in accordance with traffic conditions ahead for restoring said distance device, and further trackway means comprising a traffic controlled electro-magnet and a permanent magnet spaced a predetermined distance apart for restoring said stop device.

In testimony whereof I, THOMAS W. VARLEY, have signed this specification this 23rd day of January, 1919.

THOMAS W. VARLEY.

In testimony whereof I, WILLIAM C. NEIN have signed this specification this 23rd day of January, 1919.

WILLIAM C. NEIN.