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104, RAILWAYS,

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CROSS REFERENCE

A 8006 N / X 310/13 Search Room

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May 19, 1936. W. O. HOPKINS 2,041,607

ELECTRIC RAILWAY

Filed Sept. 28, 1932 2 Sheets-Sheet 1

Fig. 1.

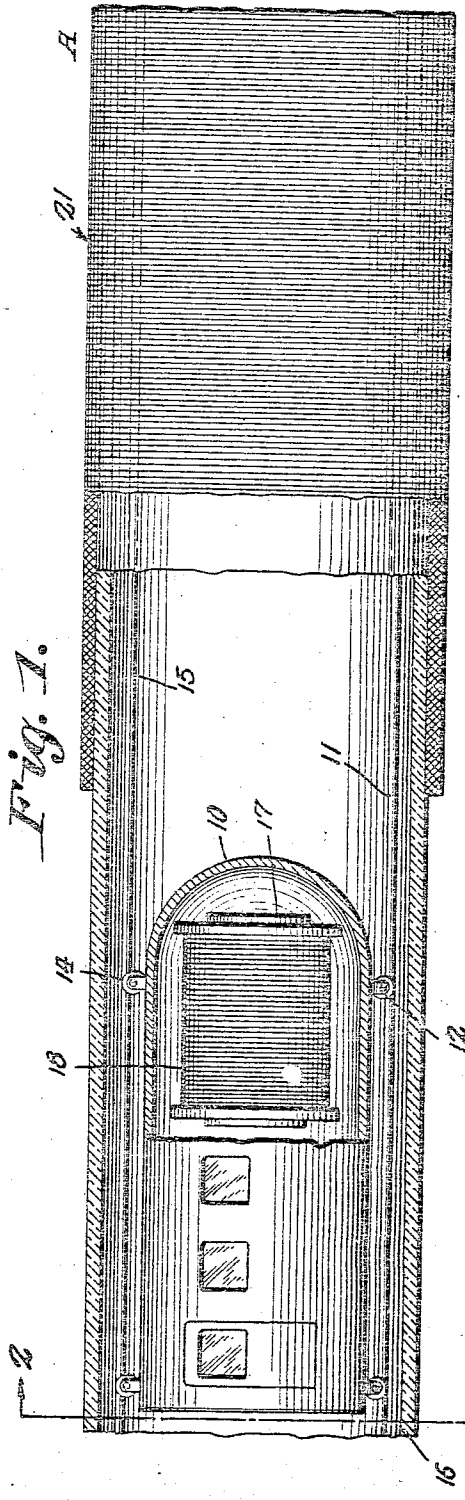



Fig. 3.

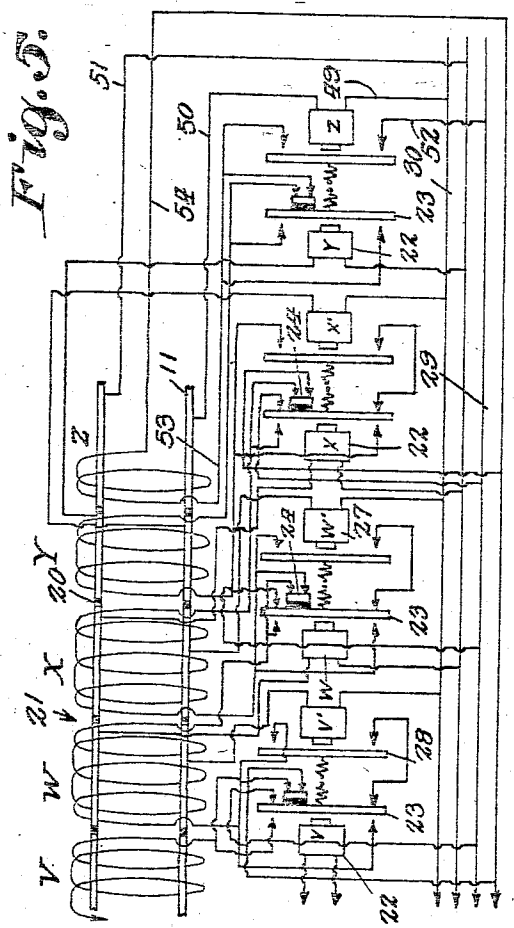
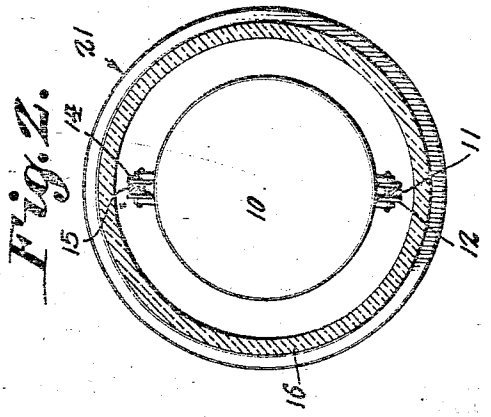



Fig. 2.




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OR IN 310/13

104, RAILWAYS,
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Cross Reference

Search Room

May 19, 1936. W. O. HOPKINS 2,041,607

ELECTRIC RAILWAY

Filed Sept. 28, 1932. 2 Sheets-Sheet 2

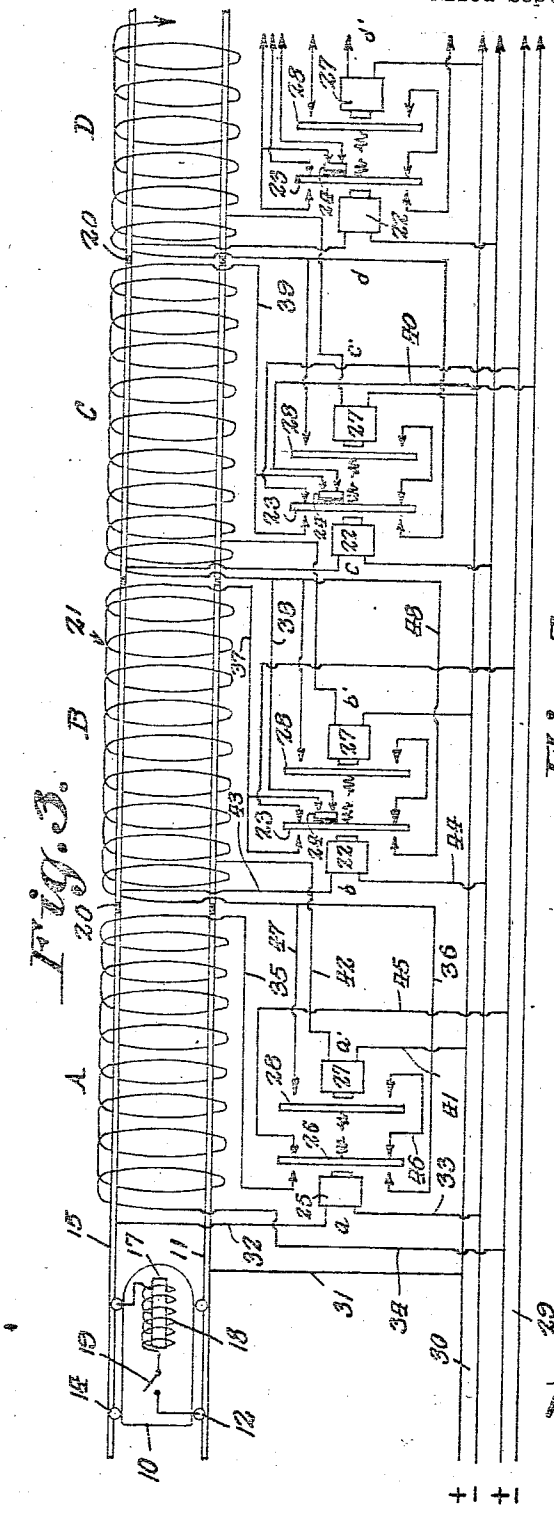


Fig. 3.

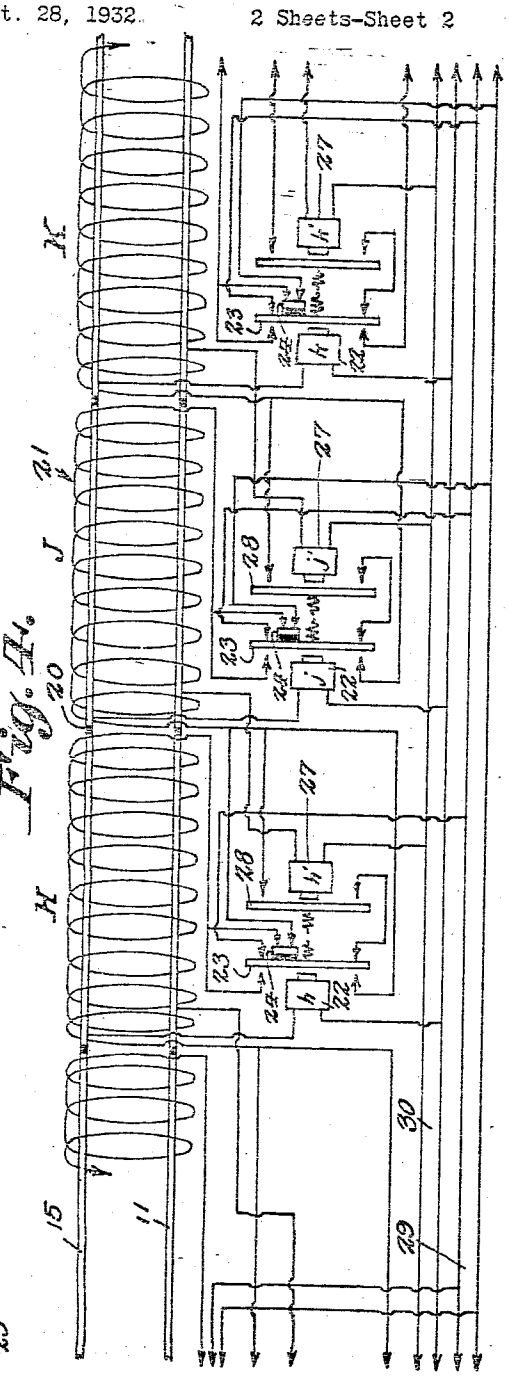


Fig. 4.

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Patented May 19, 1936

2,041,607

# UNITED STATES PATENT OFFICE

2,041,607

## ELECTRIC RAILWAY

Wiley O. Hopkins, Primghar, Iowa

Application September 28, 1932, Serial No. 635,288

2 Claims. (Cl. 172—290) 246-13

The object of the invention is to provide an electric railway in which the propulsion means is of such form as to exert a constant pull on the car just in advance of the latter; to provide a propulsion means which omits any mechanically movable parts other than the car itself, so that the latter may be advanced at a great rate of speed; to provide a construction of the kind indicated in which the propelling force is automatically regulated to vary its relation to the car, in order that the latter may be brought to a stop at a predetermined station or point; and generally to provide a construction which is composed of a minimum number of moving parts, thus reducing to a minimum the number of elements subject to wear by reason of relative movement.

With this object in view, the invention consists in a construction and combination of parts of which a preferred embodiment is illustrated in the accompanying drawings but to which embodiment the invention is not to be restricted. Continued use in practice may dictate certain changes or alterations and the right is claimed to make any which fall within the scope of the annexed claims.

In the drawings:

Figure 1 is a view partly in elevation and partly in section of a railway constructed in accordance with the invention.

Figure 2 is a sectional view on the plane indicated by the line 2—2 of Figure 1.

Figures 3, 4 and 5 are diagrammatic views illustrating respectively the starting, intermediate and terminal sections of the system embodying the invention.

In carrying out the invention, the car 10 employed is of the monorail form, traversing a single traction rail 11 which is engaged by the double flange supporting rollers 12 mounted on the under side of the body of the car. Upright position of the car is maintained by reason of its top rollers 14 engaging the guide rail 15. Practical operation of the system calls for the mounting of the rails 11 and 15 in a tube or conduit 16, which may be above or below ground but which throughout its length, is surrounded with a magnetizing coil 21 which, when energized, creates a pull on the car to advance the latter along its rails.

Interiorly the car is provided with a propulsion magnet 17, the winding 18 of which is electrically connected with the upper and lower rollers 14 and 12, a control switch 19 being interposed in the propulsion magnet circuit.

The track is divided into a plurality of isolated blocks, by reason of the insulating joints 23 which are included both in the guide and traction rails, these blocks being indicated on the drawings by the reference characters A, B, C, D . . . H, J, K . . . V, W, X, Y, Z. The winding 21 is divided into zones, each corresponding to a block, the zone A being coupled to the zone B through the circuit control devices *a*—*a'*, the B zone being coupled to the C zone similarly through the circuit control devices *b*—*b'*, and so on through similarly identified circuit control devices down to the final or terminal zone Z. Each of the circuit control devices *b*, *c*, *d*, *h*, *j*, *k*, *v*, *w*, *x* and *y* comprises a magnet 22 and a spring retracted armature 23 adapted to bridge a pair of spaced contacts when the armature is attracted and similarly to bridge a corresponding pair of spaced contacts when it is retracted by its spring. Each armature 23 embodies a bridging member 24 closing a pair of spaced contacts when the armature is retracted, the bridging or circuit closing element 24 being insulated from the armature 23 on which it is carried. The circuit control device *a* comprises a magnet 25 and associated spring retracted armature 26, the latter bridging a pair of spaced contacts when it is attracted by the magnet and another pair of oppositely disposed spaced contacts when it is retracted. This armature differs from the armatures 23 in omitting the bridging plate or circuit closing element 24. The circuit control devices *a'*, *b'*, *c'*, *d'*, *h'*, *j'*, *k'*, *v'*, *w'*, *x'* and *z* comprise magnets 27 and spring retracted armatures 28, the latter bridging spaced contacts when attracted but being inactive insofar as any circuit closing function is concerned when retracted by their associated springs.

While a single energizing circuit for the coil 21 and circuit control devices may be provided, it is desirable to use two energizing circuits, as indicated at 29 and 30, the latter constituting the energizing circuit for the control devices and having its one side, for example, its positive side, connected to the traction rail in each separate block of the latter, the connection in the block A being direct and the connection in the remaining blocks being through the magnets 27 of the control devices *a'*, *b'*, *c'*, *d'* and so on. The magnet 25 of the control device *a* is connected across the guide rail and the negative side of the energizing circuit 30 but in the block A. The magnets 22 of the control devices *b*, *c*, *d* and so on are connected across the guide rail and the negative side of the circuit 30 and in the blocks B, C, D and so on. If the rails 11 and 15 are bridged by a metallic medium, as they will be by the car circuit when in any one block, the circuit

will be closed on the magnet 25 of the circuit control element *a* when the car is in the block A. When it is in the block B, the circuit will be closed on the magnets of the control devices *a'* and *b'* these two magnets being thrown in series across the control circuit 30. It is the same way with the remaining blocks.

The sections of the magnetizing coil corresponding to the zones A, B, C and D are cut into and out of circuit with the power energizing circuit 29, when the armatures of the control devices are attracted or released.

The operation of the car is based upon the principle of the solenoid or long-range magnet, the car corresponding to the movable core of such a magnet. Since a movable core will tend to center itself in a solenoid, any one of the zones A, B, C and so on will, if energized alone, tend to move the car to the longitudinal center of the coil, or if two or more zones be grouped in series will tend to center the car at the center of the combined lengths of the connected sections or zones. For the sake of clarity in explanation, the point to which there will be a tendency to move the car and retain it is arbitrarily referred to as the center of attraction.

Since closure of the circuit 30 is dependent on bridging the rails 15 and 11, there will be no activity of the system if the switch 19 be open, for then the magnets of the circuit control devices will all be deenergized and the attendant armatures will be retracted by their respective springs to inactive positions. If the switch 19 be closed, however, and the car be in the block A, current will flow from the positive line of the control circuit 30 over the conductor 31 to the traction rail in the block A, thence to the roller 12, through the winding of the propulsion magnet to the guide rail 15 and thence through the conductor 32, magnet 25 of circuit control element *a*, and conductor 33 to the negative side of the control circuit. But energizing the magnet 25 of the control element *a* will result in its armature 26 being attracted and activating the winding 21 in the zones A, B and C, current flowing from the positive side of the circuit 29 over the conductor 34 through the winding in the zone A, thence over the conductor 35 to the armature 26, thence over the conductor 36 to that section of the winding in the zone B, thence over the conductor 37 to the bridge plate 24 of the circuit control element *b*, since the armature 23 of the circuit control element *b* is retracted by its spring. Leaving the bridge plate 24, current will pass over the conductor 38 to that part of the winding comprised in the zone C, leaving which it passes over the conductor 39, the bridge plate 24 of the circuit control element *c* and the conductor 40 back to the negative side of the power circuit 29. The sections or zones A, B and C are those placed in series and the center of attraction will appear somewhere in the zone B with the result that the car will move toward this point. But before it reaches it, it will have passed from the block A into the block B and in leaving A, the circuit on the magnet 25 of the circuit control element *a* will be opened, so that its armature 26 will be retracted, thus opening the circuit on the zone A of the magnet 21. In passing into the block B, however, the car will bridge the two rails in this block and current will flow from the positive side of the control circuit over the conductor 41 through the magnet of the circuit control element *a'*, over the conductor 42 to the traction rail in the block B, thence through the appliances in the car to the guide rail 15 in the block B, thence over the conductor 43, through the magnet of the circuit control element *b* and over the conductor 44 to the negative side of the control circuit. The armature of the circuit control elements *a'* and *b* will thus be attracted, the former bridging its cooperating contacts and the latter bridging a different pair of contacts than formerly. The current from the coil energizing circuit will then be confined to the zones B and C, current flowing from the positive side of the power circuit 29 over the conductor 45, the armature 26 of the control device *a*, the conductor 46, the armature of the control device *a'*, the conductor 47, that portion of the winding 21 comprised in the zone B, thence over the conductor 37, the armature 23 of the control device *b*, the conductor 48 and thence through the section of the winding 21 comprised in the zone C and back to the negative side of the energizing circuit 29 as recited above. Since the zones B and C are at this instant the only energized zones, the center of attraction will appear approximately at the juncture of the blocks B and C. Whereas the car was formerly moving to reach a mid-point in the zone B, at which the center of attraction appeared when it occupied the zone A, this center of attraction has moved forward to the line of juncture between the zones B and C, because the car upon passing out of the zone A effected the cutting out of that zone.

When the car passes out of the zone or block B, the control devices *a'* and *b* assume their former position because of the circuit being broken on their respective magnets. But on entering the zone C, the control devices *b'* and *c* are energized and their respective armatures actuated which cuts out the zone B and throws in circuit the zone D, in the same manner as described with reference to the zones A, B and C. The center of attraction therefore disappears from its position in the region of the point of connection between the zones B and C and reappears between the zones C and D, so that the car is advanced at this point and so on through the remaining zones to the terminal zone.

Where the speed is to be maintained uniform, the zones are of approximately uniform length, being increased in length where the speed is to be increased and reduced in length where the speed is to be reduced. In bringing the car to rest at the end of the run, it passes into the terminal zones V, W, X, Y and Z which are of progressively reduced lengths, so that the centers of attraction of the succeeding zones appear at progressively reduced distances from each other. In passing through these reduced lengths of zones, however, the control devices *v*, *v'*, *w*, *w'*, *x* and *x'* and *y* function in the same manner as cutting in approaching zones and cutting out past zones, just as described with reference to zones A, B and C. The car is finally brought into the zone Z, having passed into which, the control devices *x* and *y* are deenergized, thus leaving the zone Z the only energized zone and the center of attraction of which will be at approximately its longitudinal center. With the car in the final zone Z, the circuit on the magnet of the control device *z* will be energized, current flowing from the positive side of the control circuit 30 over the conductor 49, through the magnet and the conductor 50 to the traction rail. It passes thence through the car mechanism to the guide rail of the block Z and thence over the conductor 51 back to the negative side of the control circuit. But energizing

the magnet of the control device *z* attracts its armature and results in placing only the zone Z of the winding 21 across the power circuit 29, current flowing over the conductor 52, through the armature of the control device *z*, over the conductor 53 and thence back to the negative side of the power circuit over the conductor 54. The car will thus be retained in the zone Z, for any tendency to pass beyond this point will result in a backward pull on the car from the center of attraction and the car will center itself in the zone Z. This zone Z can be deenergized after the car has been brought to rest, by opening the switch 19 on the car, which, breaking the circuit between the guide and traction rails, will deenergize the magnet of the control device *z* thus permitting the retraction of its armature and the opening of the circuit on the winding comprising the zone by breaking connection between the contacts with which the conductors 52 and 53 are connected.

The invention having been described, what is claimed as new and useful is:

1. An electric railway comprising a track composed of spaced rails, a car spanning and traversing said rails, an energizing coil continuous throughout the length of and in surrounding relation to the track and in axial coincidence with the car, the track being divided into electrically isolated blocks, energizing means for the coil, circuit control elements interposed between the energizing means and the coil and dividing the latter into zones, supplemental circuit control elements electrically connected with said blocks, an electromagnetic propulsion coil carried by said car and placed in circuit with the supplemental circuit control elements as the car advances from one block to another, said supplemental circuit control elements controlling the first said circuit control elements to maintain the center of attraction in said coil immediately in advance of said car.

2. An electric railway comprising a track, a car traversing the track, a magnetizing coil in surrounding relation to the track and in axial coincidence with the car, energizing means for the coil, and a plurality of spaced circuit control elements interposed between the energizing means and the coil and dividing the latter into a plurality of magnetic zones of constant length from the starting point to a point adjacent the terminus and of progressively decreasing length from said point to the terminus, said constant length zones exceeding the length of the car and the remaining zones being of lengths less than that of the length of the car, the control elements being car actuated to maintain the center of attraction in each succeeding zone just ahead of the car, except in the final zone where the center of attraction is in the zone of the car.

WILEY O. HOPKINS.