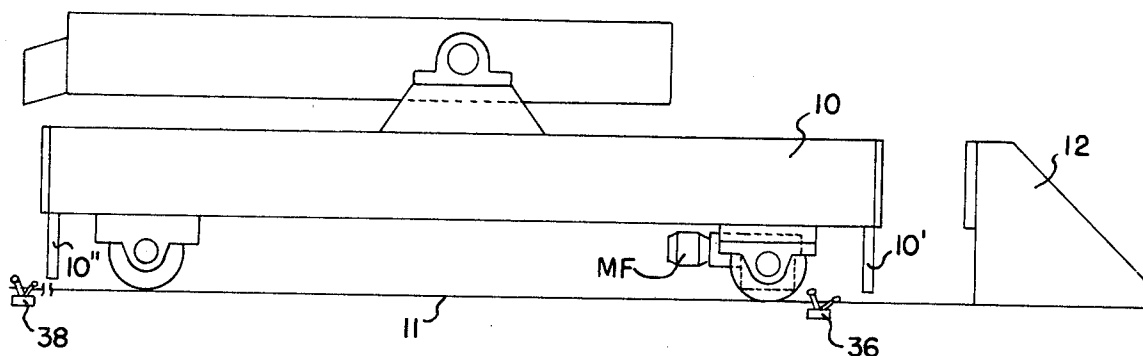


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[21] Appl. No. 817,347
[22] Filed Apr. 18, 1969
[45] Patented June 8, 1971
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[54] ALIGNMENT OF MOTOR-DRIVEN MACHINES
2 Claims, 3 Drawing Figs.
[52] U.S. Cl. 104/151,
104/38, 187/29
[51] Int. Cl. G05d 1/02
[50] Field of Search 104/38,
149, 151, 152; 187/29

ABSTRACT: A vehicle, such as a railroad car or a turntable, is moved by an electrical drive motor along a path toward a fixed bumper at full speed until it approaches close to the bumper. At this point the vehicle is stopped, a voltage reduction is provided in the motor power supply and the vehicle is restarted with limited torque. After the vehicle engages the bumper, it is stopped in position tight against the bumper. This secures exact positioning but prevents damage to the vehicle or the motor which has only a limited torque when it strikes the bumper.



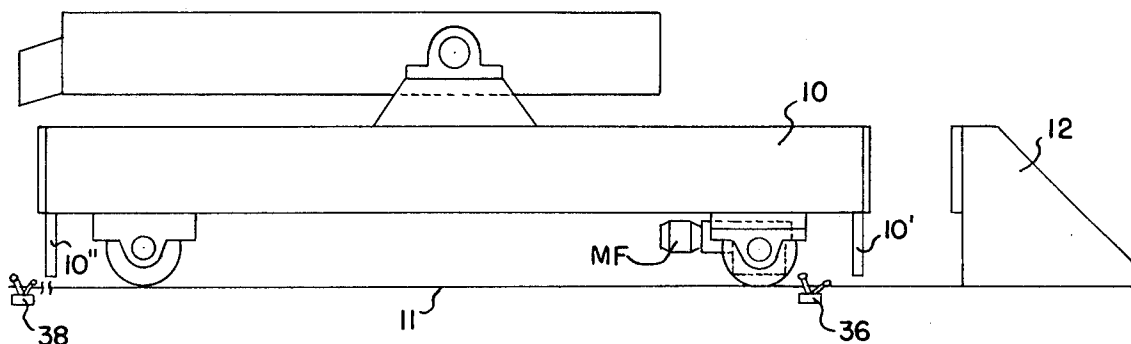


FIG. 1

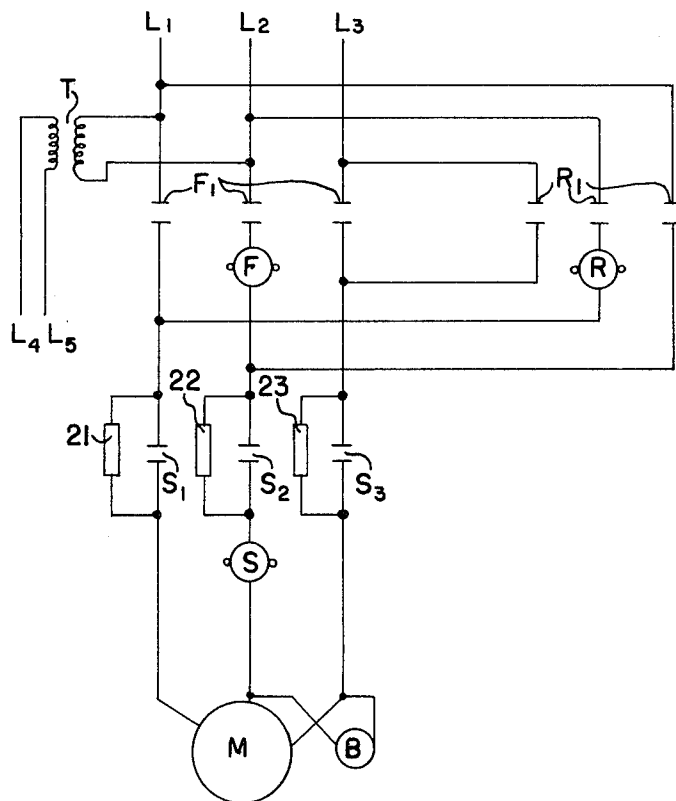


FIG. 2

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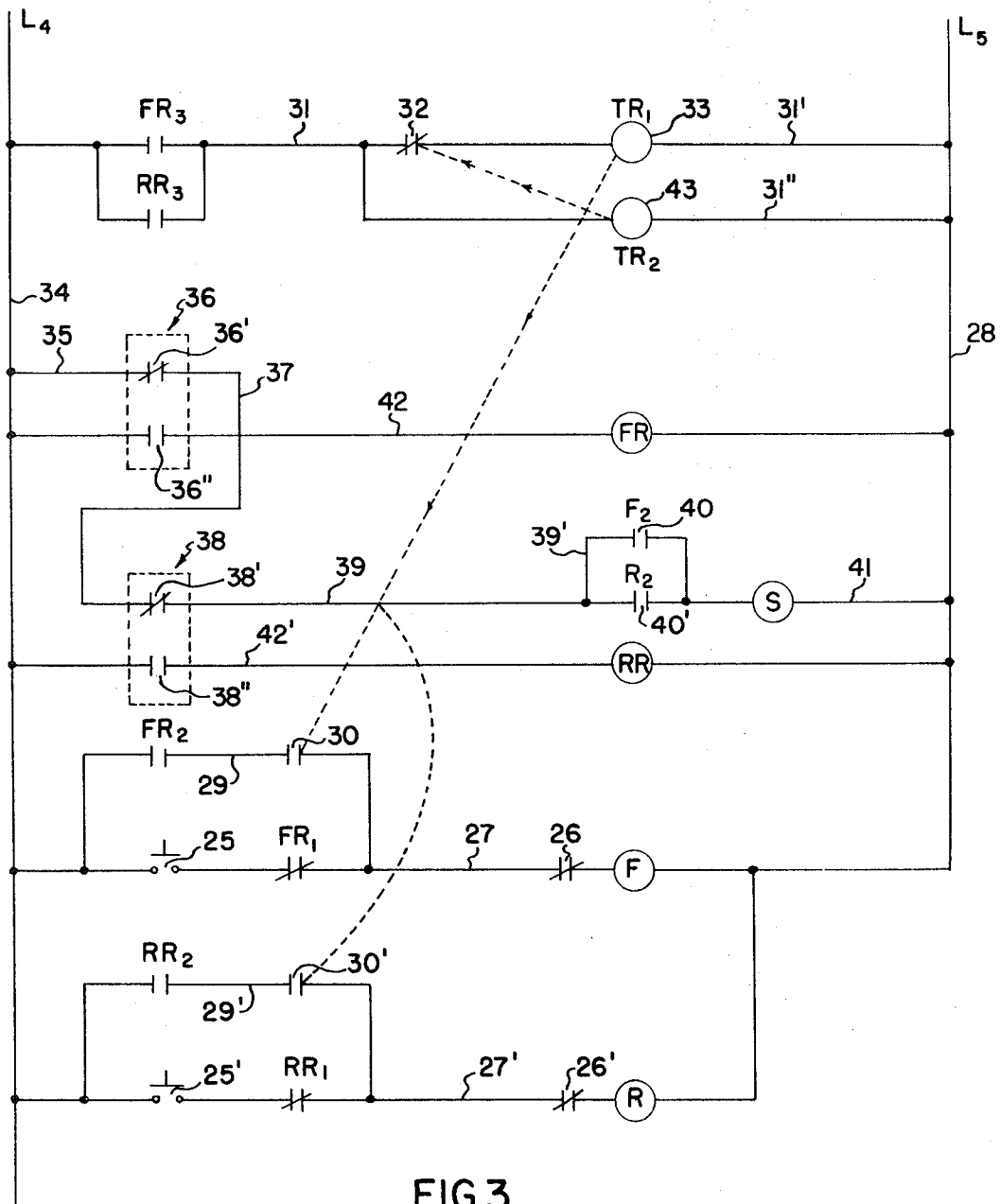


FIG.3

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ALIGNMENT OF MOTOR-DRIVEN MACHINES

It is sometimes desirable to stop an electrically driven vehicle, moving along a fixed path, in an exact position at the end of the path of travel. It is an object of the present invention to stop such a vehicle in such an exact position and without damage to the vehicle or to the electrical motor which is driving the vehicle. The invention will be described in detail for positioning a tundish car, moving along a railroad track, in an exact position against a fixed bumper. The invention as described, however, has other uses such as the positioning of a turntable carrying a portion of railroad track, in an exact position so that the tracks on the turntable are in exact alignment with other mating tracks adapted to carry vehicles onto or off the turntable. In the specification and claims the word "vehicle" is intended to indicate a car or the like moving along a fixed path, or a turntable whose periphery moves in a circular path, or any equivalent use of this invention.

In the drawings,

FIG. 1 is a side elevational view of a tundish car on a track moving toward a fixed bumper;

FIG. 2 is an electrical diagram showing the power supply to one or more drive motors mounted in drive position on the tundish car; while

FIG. 3 is a control diagram associated with the power supply lines of FIG. 2 for carrying out the present invention.

In FIG. 2, the vehicle drive motor means is indicated as M for forward and reverse movement of the car. This motor has the usual magnetic brake B which automatically operates to stop the associated motor as soon as the power supply of the motor is cut off. This motor is of the crane and hoist type, preferably squirrel cage motor, having a maximum starting torque of about 300 percent of the normal torque at the motor rating. It is obvious that if this motor were brought to rest with the car against a fixed stop such as a bumper, that the torque would be three times what it would be considering just the rating of the motor. For this reason, the resistances 21, 22 and 23 inserted by this invention in the power supply to the motor are such as to limit the motor torque to 50 percent of the torque at the horsepower rating, which would be about 16-2/3 percent of the maximum torque which the motor could develop at a standstill. It should be understood that the torque limitation may have other values so long as it prevents damage to the vehicle and its drive motor as the vehicle comes to a stop against bumper 12.

The power supply for the drive motor at L1, L2 and L3 in this embodiment is three phase at 440 volts. In the power lines are normally open contacts F1 under the control of relay F for forward drive and similar contacts R1 controlled by relay R for reverse drive. The control of the drive motor according to this invention will now be described.

To move the railroad car 10 toward the right in FIG. 1, here called "forward", or to move a turntable in one direction, say clockwise, the operator closes the forward button 25 and holds his finger on the same causing the vehicle to move in a forward direction at full speed. Closing button 25 energizes relay F through line 27 and normally closed contacts 26. This closes three contacts F1 completing a circuit through line L1, L2 and L3 to motor M in a direction to cause forward movement of the vehicle or to the right in FIG. 1. When relay F was energized, a circuit was completed through line 34, line 35, contacts 36' of track limit switch 36, which at this time are in closed position, line 37, through contacts 38' of another track limit switch 38 which are in closed position, line 39 and 39', contacts F2 at 40, closed by relay F, and through lines 41 and 28 energizing relay S. Energization of this relay closes normally open contacts S1, S2 and S3, thus bypassing resistances 21, 22 and 23. This permits the motor M to run at full torque.

When the vehicle, moving toward the right in FIG. 3, strikes the track limit switch 36, this toggle switch is thrown to the position shown so as to open contacts 36' and to close contacts 36'' of that switch. This energizes relay FR through line 42 which opens normally closed contacts FR1 and closes normally open contacts FR2, but line 29 is still not energized. The opening of contacts 36' deenergizes relay S so as to permit

contacts S1, S2 and S3 to open, and to place resistances 21, 22 and 23 in circuit with the three phases of motor M so as to limit the current to this motor. The opening of contacts FR1 cuts off the power from motor M temporarily because contacts 30 in the bypass around button 25 are still open. When the movement of limit switch 36 energized relay FR, the closing of contacts of FR3 through line 31 and normally closed contacts 32 energized time delay relay TR1 at 33 through line 31'. It also energized, through line 31'', time delay relay TR2 at 43. Relay 33 being set for about 2 seconds then times out and operates to close contacts 30 which completes the circuit through line 29, bypassing button 25, and reenergizing relay F. Meanwhile the operator's hand on button 25 has, through contacts F2 and relay S, restarted motor M at low torque because resistances 21, 22 and 23 are in circuit. From this point to final stoppage the operation is automatic. Relay TR2 at 43 is set for a longer cycle of time, say in this case 6 seconds, during which the vehicle has come up against the fixed bumper 12 with power still applied to the motor M but this will do no damage because the electrical values and developed torque are held low through the resistances 21, 22 and 23. Upon timing out of the time delay relay 43, contacts 32 are opened which deenergizes relay 33 which permits normally open contacts 30 to open again, thus cutting off power to the motor M. Thereupon the magnetic brake B will hold the tundish car in exactly fixed position against the bumper 12.

To cause reverse movement of vehicle 10, for travel toward the left as viewed in FIG. 1, or to move a turntable in the reverse direction, say counterclockwise, the operator closes the reverse button 25' which energizes relay R through line 27' which closes three contacts R1 (FIG. 1) completing a circuit through lines L1, L2 and L3 to reverse motor M, causing reverse movement of the vehicle at low torque until projection 10' oscillates track switch 36 counterclockwise from the position of FIG. 1 so as to again close contacts 36' of that switch and to open contacts 36''. The closing of contacts 36' energizes relay S, closing contacts S1, S2 and S3 and bypassing resistances 21, 22 and 23 so that motor M runs at full torque.

When the vehicle has almost completed its reverse trip, and approaches a bumper (not shown) at the other limit of movement, like 12, a bar 10'' on vehicle 10 strikes limit switch 38 which is thrown counterclockwise from the position of FIG. 1 so as to open contacts 38' and to close contacts 38''. This energizes relay RR through line 42' which opens normally closed contacts RR1 and closes normally open contacts RR2, but contacts 30' are still open. The opening of contacts 38' deenergizes relay S, permitting contacts S1, S2 and S3 to open and placing resistances 21, 22 and 23 in circuit in lines L1, L2 and L3 so as to limit the current to motor M. The opening of contacts RR1 cuts off the power to motor M temporarily because contacts 30'' in the bypass around button 25' are still open. When relay RR closed contacts RR3, a circuit through line 31 and normally closed contacts 32 energized time delay relay TR1 and 33 through line 31'', and through line 31'' energized time delay relay TR2 at 43. Relay 33 is set for a time permitting the magnetic brake B of motor M to bring it to a stop, say about 2 seconds. This may be the end of the reverse travel if no bumper is provided at the left end of FIG. 1. When relay 33 times out it operates to close contacts 30' which completes a circuit through line 29', bypassing button 25'. Meanwhile, the operator's hand on button 25', through relay R and through contacts R2 and relay S, has restarted motor M at low torque, because resistances 21, 22 and 23 are in circuit in lines L1, L2 and L3. The balance of this reverse movement is under automatic control. Relay TR2 at 43 is set for a period of time sufficient to bring vehicle 10 to a stop against the fixed bumper at the reverse end of the track, say in this case about 6 seconds. Upon timing out of relay TR2, contacts 32 are opened which deenergizes relay TR1 which permits normally open contacts 30' to open, thus cutting off power to motor M, whereupon brake B holds the vehicle against the bumper.

It will be understood that in applying this invention to a turntable, a projection on the turntable will engage a fixed

bumper when the tracks on the turntable are exactly aligned with the fixed tracks leading away from it. Also, limit switches performing the function of switches 36 and 38 described herein will be so placed as to be actuated by the turntable shortly before it reaches a final position against one of its limiting bumpers. In a turntable operation, the two bumpers may be diametrically opposite across the turntable so as to cause the turntable to move exactly 180° in a clockwise direction, and thereafter through 180° in a counterclockwise direction. However, the turntable may move through any desired angle.

It will be noted that in the operation of this invention, to move the vehicle in the forward direction the operator need only depress button 25 and hold the same until the automatic mechanism takes over. To move the car in the reverse direction, the operator places his finger on button 25' and holds it until the automatic mechanism takes over.

The purpose of this invention is to move a vehicle against a fixed bumper with a low torque which will not damage the vehicle or its contents or its motor, and the current applied to the motor when it is stalled against the bumper is insufficient to cause motor damage for the few seconds involved.

What I claim is:

1. Means for stopping a vehicle, driven by an electrical motor having a magnetic brake, exactly in position against a fixed bumper, without damage to said motor, wherein said vehicle has an electrical motor drivingly connected therewith and a power supply therefor, means is provided constraining said vehicle for travel in a fixed path and a fixed bumper is in a position limiting said path of travel; said stopping means comprising initial starting means for said motor, normally open voltage limiting means selectively insertable in circuit with said motor to limit the voltage supply thereto, means responsive to said starting means for bypassing said voltage-limiting means, whereby said vehicle will move at full torque along said path, a track switch adjacent said path at a short distance from said bumper and actuatable by passage of said vehicle, means responsive to actuation of said track switch to cause

deenergization of said motor for a short period sufficient for said magnetic brake to bring said vehicle substantially to a stop, said switch spaced from said bumper sufficiently to allow said magnetic brake time after deenergization of said motor to stop said vehicle before it engages said bumper, means responsive to actuation of said track switch for causing closing of said voltage limiting means to place it in circuit with said motor, first time delay means responsive to actuation of said track switch effective to cause reenergization of said motor after said short period, and second time delay means effective at a longer period after actuation of said track switch sufficient to permit said vehicle to engage said bumper and operative to cause reenergization of said motor.

2. A vehicle control system for a vehicle travelling along a predetermined path having a bumper at its terminal end, electric motor drive means of the type having a magnetic brake means for moving said vehicle along said path and including said magnetic brake means for stopping said vehicle in predetermined position in said path; said control system comprising a source of energy connected in circuit with said motor drive means effective to actuate the same and propel said vehicle along said path toward said terminal end at a higher torque level, means responsive to the vehicle moving to a predetermined position in said path and being operable to effect the application of said brake means and stop said vehicle in said path at a position near but spaced from said bumper, means in circuit with said drive means being actuatable when said vehicle is stopped to limit the voltage input to said motor drive means to a value which limits the torque of said motor to a level substantially below said higher level, means in circuit with said drive means being actuatable when said vehicle is stopped to reactuate said drive means and propel said vehicle toward said terminal end at said lower torque level, and means operable subsequent to the reactivation of said drive means for effectively disconnecting said drive means from said source of energy at said lower torque level to permit said brake means to stop said vehicle only after it has reached a position in engagement with said bumper at said terminal end of said path.