Feb. 14, 1933. D. L. LINDQUIST 1,897,493

ELEVATOR CONTROL APPARATUS

Filed Aug. 31, 1929

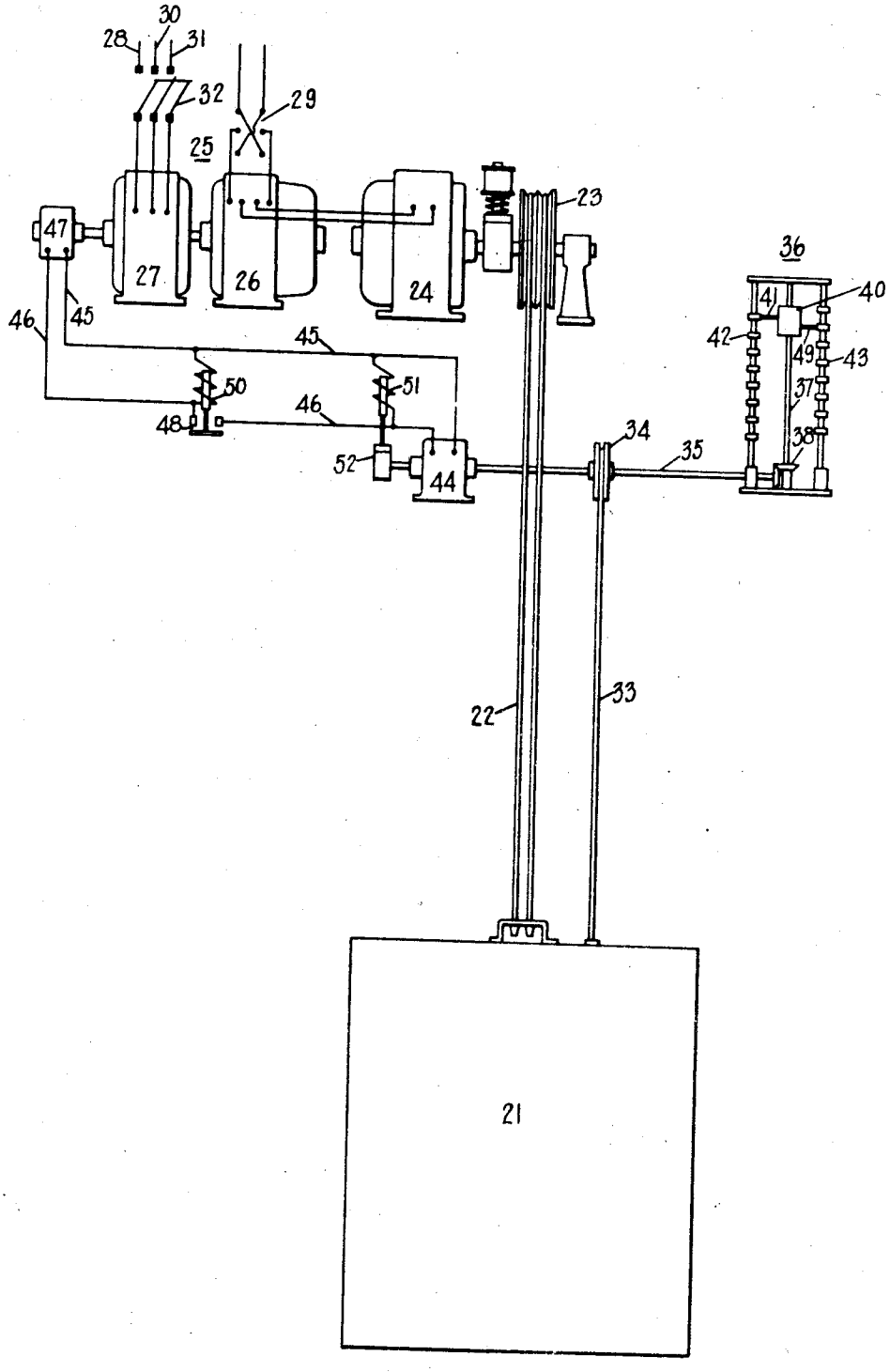

FIG. 1

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Patented Feb. 14, 1933

1,897,493

UNITED STATES PATENT OFFICE

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ELEVATOR CONTROL APPARATUS

Application filed August 31, 1929. Serial No. 389,664.

This invention relates to elevators and particularly to control apparatus therefor.

It is frequently desirable in elevator systems to drive various mechanisms in synchronism with the car. It may be desired to reproduce the elevator hatchway and the movement of the car therein on a conveniently reduced scale and then to control certain functions of the elevator system by the operation of this scalar reproduction. One form of these scalar reproductions is the so-called selector machine embodying an element movable in simulation of the movement of the car in the hatchway. One manner of simulating the movement of the car is to operate such a selector machine by means of a flexible transmission member, such as a cable or tape, connected to the elevator car and suitable reduction gearing, thereby causing the movable element of the selector machine to reproduce the movement of the car on a reduced scale. The movable element of the selector machine should accurately reproduce the movement of the elevator car and to this end it is desirable that the cable or tape connected to the car be kept under tension to avoid inaccurate operation of the selector machine arising from slack in the cable or tape or stretching thereof. It is also desirable that the tape drive for the selector machine and the tensioning devices for the tape shall not unduly encumber the elevator hatchway.

A feature of the invention is the provision of a drive for control mechanisms in which the moving elements are accurately synchronized with the movement of the car over long periods of time without the necessity of adjustment or correction.

A second feature of the invention is the provision of a tape drive for a selector machine, or other control mechanism, in which a minimum amount of tape is required.

A third feature of the invention is the provision of a tensioning device for the selector drive which is economical of space in the elevator hatchway and which is of simple construction and reliable in operation.

The invention contemplates the provision of a reel located at one end of the hatchway on which reel a metallic tape, attached at one end to the car, is wound and unwound as the car moves up and down the hatchway. The tape is wound on the reel by an electric motor when the car moves in one direction and is unwound against the torque of the electric motor by the car as it moves in the opposite direction. The reel drives a selector machine, or other control mechanism, through appropriate gearing.

The single figure is a schematic view of a portion of an elevator system embodying the invention.

Referring to the drawing, an elevator car designated 21 is raised and lowered in the elevator hatchway by means of hoisting roping 22 passing over a sheave 23 driven by an electric motor 24. Current is supplied to the elevator motor 24 by a motor-generator set designated as a whole by 25. The generator 26 of motor-generator set 25 supplies current to the elevator motor 24 and is driven by a motor 27 whose windings are connected to the wires 28, 30 and 31 of suitable power source by means of a line switch 32. A reversing switch 29 is provided to control the operation of motor 24 to raise or lower the car.

For the sake of simplicity of illustration and description, the counterweight and the devices for controlling the starting and stopping of the elevator car are not shown. However, it is to be understood that suitable devices are provided for controlling the operation of motor 24 through switch 29 to raise and lower the car in the hatchway.

A flexible cable or tape 33 is connected at one end to the elevator car and at its other end is connected to a reel 34 secured to a shaft 35. In the arrangement shown the tape 33 is adapted to be spirally coiled in a circumferential groove on reel 34.

A suitable motor 44 connected to shaft 35 is provided to maintain tape 33 under tension to insure proper operation of the selector 36 as the elevator car is operated, motor 44 being also adapted to wind the tape upon reel 34 as the car is raised by motor 24. Current to operate motor 44 is supplied through wires 45 and 46 connected to the terminals of an

exciter 47 driven by the motor 27 of motor-generator set 25. Exciter 47 may also be employed to supply current for other purposes, such as energizing the field windings of generator 26 and motor 24. An electromagnetically operated switch 48 is provided in the wire 46 supplying current to motor 44. The operating coil 50 for switch 48 is connected across wires 45 and 46 and is so designed that energization of the coil will not be effective to close switch 48 until the terminal voltage of exciter 47 is adequate to insure proper energization of motor 44. A brake release coil 51 is also connected across wires 45 and 46 and is adapted upon energization to release a brake 52 to permit operation of motor 44.

Shaft 35 is adapted to drive a selector machine, designated as a whole by 36, in response to the movement of the elevator car. The selector machine illustrated is provided with a vertically arranged threaded shaft 37 driven from shaft 35 through bevel gearing 38. A traveller 40 is mounted on threaded shaft 37 and upon rotation thereof is moved upwardly or downwardly therealong in simulation of the movement of the elevator car. A contact 41 carried by traveller 40 is adapted to engage a series of contacts 42 in succession as the tape is unwound from reel 34 as car 21 descends and a similar contact 49 on traveller 40 is adapted to engage a series of contacts 43 in succession as the tape 33 is wound upon reel 34 as the car ascends. As the selector machine 36 is driven to reproduce the movement of the elevator car on a reduced scale, it may be employed to control any function of the elevator system which is dependent upon the position or movement of the elevator car in the hatchway, such as the operation of signals, the automatic stopping of the car or the levelling of the car.

The operation is as follows: When line line switch 32 is closed, current is supplied to motor 27 of the motor-generator set to effect operation thereof to drive generator 26 and exciter 47. Generator 26 when driven is adapted to supply current to the windings of elevator motor 24 when suitable controls are operated to cause the car 21 to ascend or descend in the hatchway. When exciter 47 is set in operation, its terminal voltage builds up. When this voltage is sufficient to effect the operation of switch 48 through coil 50, switch 48 closes completing a circuit from exciter 47 through wire 46, switch 48, coil 51 and wire 45 to the exciter to effect the energization of coil 51 to release the brake 52 of motor 44. Current is also supplied to the windings of motor 44 upon the closing of switch 48.

When motor 44 is energized the movable element thereof tends to turn shaft 35 and reel 34 to wind tape 33 spirally in the groove on the reel. Thus, tape 33 is put under tension. When the elevator car descends in the hatchway, tape 33 will be unwound from reel 34 against the torque of motor 44 thereby turning shaft 35. The energization of the windings of motor 44 tends to turn the movable element thereof and consequently reel 34 in the direction opposed to the movement of the reel by car 21 through tape 33, thereby maintaining tape 33 taut. Thus, slack cannot develop in tape 33 during the operation of the car nor by continued rotation of drum 34 as a result of momentum when the car stops. Motor 44 tending to winding tape 33 on reel 34 also prevents the weight of the tape depending from reel 34 unwinding the remaining portion and causing inaccurate operation of selector 36 when car 21 is near the lower end of the hatchway. When shaft 35 is driven, threaded shaft 37 of selector 36 will be rotated moving traveller 40 therealong, causing contact 41 to engage contacts 42 in succession as above set forth.

When the car is raised in the hatchway by motor 24, motor 44 drives reel 34 to wind tape 33 thereon preventing slack developing in tape 33 between the reel and the car. Rotation of reel 34 by motor 44 results in the operation of selector 36 to move contact 49 into engagement with contacts 43 in succession. The rate of operation of selector 36 by motor 44 is determined by the rate at which the movement of the car permits motor 44 to wind tape 33 on reel 34 thereby insuring that the operation of selector 36 will accurately reproduce the movement of car 21.

Motor 44 is so designed that it may be continuously energized during the operating period of the elevator car and yet permit the movable element thereof to be held stationary when the elevator car is at rest, or the movable element may be turned by tape 33, in the direction opposed to that in which energization of the motor windings tends to rotate the movable element, without deleterious results to the motor. Motor 44 is preferably a series wound or torque motor but other types of motors either direct or alternating current may be employed if desired.

In the event that the power fails while the car is in operation, motor 44 will be maintained in operation by the dying out voltage of exciter 47 while the voltage across coil 50 is sufficient to keep switch 48 closed. Thus, motor 44 will be maintained in operation for an interval after the power fails and the car stops to prevent slack developing in tape 33. When the exciter terminal voltage is no longer sufficient to keep switch 48 closed, the switch opens deenergizing motor 44 and brake release coil 51. As coil 51 is deenergized brake 52 becomes effective to stop the rotation of motor 44 and reel 34 and hold them stationary.

It is to be noted that in accordance with the invention the portion of the selector driv-

ing tape extending between the car and the reel is always maintained under tension, thereby insuring that the selector or other mechanism will be operated to accurately reproduce the movement of the car.

It is to be further noted that as but a single tape is employed to effect the operation of the selector, a minimum amount of tape is required.

It is also noted that as but a single tape is employed and as this tape may be arranged to extend from the top of the car to the top of the hatchway, the portion of the hatchway below the car is completely unobstructed by any apparatus connected with the drive for the selector machine.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In an elevator system, a hatchway; a car movable therein; a selector operable to simulate the movement of said car in said hatchway; a shaft for operating said selector; a reversible reel on said shaft; a tape connected at one end to said car adapted to be wound and unwound on said reel, said tape being unwound from said reel upon movement of said car in one direction in said hatchway to drive said reel in one direction; an electric motor operatively connected to said reel to oppose the unwinding of said tape from said reel and to drive said reel in the opposite direction to wind said tape thereon upon movement of said car in the other direction in said hatchway; means for energizing said electric motor continuously during operation of the car; a brake for preventing unwinding of said tape; and means for causing the application of said brake upon deenergization of said motor.

2. In an elevator system; a hatchway; a car therein; an electric elevator motor for moving said car in said hatchway; a motor-generator set comprising a generator for supplying energy to said elevator motor and a motor for driving said generator; a reversible reel; a flexible transmission member connected to said car and adapted to wind and unwind on said reel; a torque motor operatively connected to said reel adapted to keep said flexible transmission member under tension; a brake for said torque motor; a magnet for releasing said brake; a circuit for said torque motor and brake release magnet; a switch in said circuit; an exciter driven by said generator-driving motor for supplying energy to said circuit; and a magnet responsive to a predetermined terminal voltage of said exciter for closing said switch to energize said brake release magnet and torque motor only when the terminal voltage of said exciter is adequate to operate said torque motor to keep said flexible transmission member under tension during the operation of said motor-generator set.

3. In an elevator system; a hatchway; an elevator car therein; an elevator motor for moving said car in said hatchway; a motor-generator set comprising a generator for supplying energy to said elevator motor and a motor for driving said generator; a selector; a reversible reel for driving said selector; a tape connected to said car adapted to be wound and unwound on said reel; a torque motor operatively connected to said reel adapted to be energized to keep said tape under tension to insure accurate operation of said selector in simulation of the movement of said car; a brake for said torque motor; a magnet for releasing said brake; a circuit for said torque motor and brake release magnet; a switch in said circuit; an exciter driven by the motor of said motor-generator set for supplying energy to said circuit to energize said brake release magnet to release said brake and to energize said torque motor; and a magnet responsive to a predetermined terminal voltage of said exciter for closing said switch, said switch opening upon the terminal voltage of said exciter falling to a predetermined value when the supply of power to the generator-driving motor is discontinued to cause the application of the brake and deenergization of the torque motor.

4. In an elevator system; a hatchway; an elevator car therein; means for supplying power to raise and lower the car in the hatchway; control mechanism; a reversible reel operatively connected to said control mechanism; a single tape connected at one end to said car and at the other end to said reel and adapted to be wound and unwound on said reel, said reel being driven in one direction by movement of said car to unwind said tape from said reel; an electric motor operatively connected to said reel and adapted upon energization to oppose the unwinding of said tape from said reel and to drive said reel in the opposite direction to wind said tape thereon upon movement of the car in the other direction, whereby said reel is driven in accordance with the car movement to cause said control mechanism to operate in synchronism with the movement of the car; and means controlled by said power supply means for controlling the energization of said electric motor.

5. In an elevator installation; a hatchway; an elevator car therein; an elevator hoisting motor for raising and lowering said elevator car; a Ward-Leonard system of control for controlling said elevator hoisting motor, said

system comprising a generator for furnishing power to said elevator hoisting motor and a driving motor mechanically connected to said generator for operating said generator; power-connecting switching mechanism for connecting said driving motor to a source of supply to effect the operation of said driving motor, and thus the rotation of said generator, so that said elevator car may be operated and controlled by appropriate car operating switching mechanisms while said driving motor is in operation; a selector machine for said elevator car; a reversible reel operatively connected to the movable element of said selector machine; a single flexible transmission member connected at one end to said elevator car and at the other end to said reel and adapted to wind and unwind on said reel, said reel being rotated by movement of said car in one direction to unwind said flexible transmission member from said reel; an electric reel motor operatively connected to said reel and adapted, when energized, to keep said flexible transmission member under tension while said reel is being rotated by said car to unwind said flexible transmission member from said reel, and to rotate said reel in the opposite direction to wind said flexible transmission member thereon upon movement of the car in the other direction, whereby said reel is driven so as to cause said movable element of said selector machine to operate synchronously with the movement of said elevator car; a brake for preventing movement of said flexible transmission member; and means, responsive to said power-connecting switching mechanism when operated to shut down the Ward-Leonard motor-generator set, for effecting the deenergization of said electric reel motor and the application of the brake for said flexible transmission member.

In testimony whereof, I have signed my name to this specification.

DAVID LEONARD LINDQUIST.