



Description

POSITIONING AND SYNCHRONIZATION SYSTEM FOR ELEVATOR CAR DOORS

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Cross-Reference to Related Applications

This application is related to commonly owned co-pending applications filed on the same day herewith having Serial Numbers:

_____ (OT-2654), _____ (OT-2662), _____
10 (OT-2676), _____ (OT-2679) and _____
(OT-2680).

Technical Field

The present invention relates to elevator systems and, more
15 particularly, to movement and positioning of elevator car doors
therefor.

Background of the Invention

In conventional elevator systems, elevator car doors are
20 opened and closed by door operators which are electromechanical
assemblies that use a rotary electric motor, mechanical drive linkages,
and a control box. The rotary electric motor drives one of the elevator
car doors through the mechanical linkage that is attached onto that
door. The other door is physically pulled by a relating cable extended
25 over two pulleys with one end of the cable attaching onto one elevator
car door and the other end attaching onto the second door. The
speed and direction of the door movement is usually monitored by

cams and switches disposed at the motor that provide door position and direction data to the elevator door controller. One disadvantage of the conventional systems is that the linear position and movement of the elevator car door is translated by means of calculations to the rotary position of the motor, since the monitoring of the position and direction of the door movement occurs at the rotary motor. Such translation of the linear position of the door into rotary position of the motor inevitably introduces inefficiencies.

Another disadvantage of the existing scheme is that the accuracy of the position and direction data may become compromised when drive linkages become misaligned or loosened with time. In order to monitor accurately the direction and position data, the switches must be recalibrated periodically and the drive linkages readjusted. The process of recalibration and readjustment is time consuming and expensive. Therefore, a more precise method for monitoring the speed, position, and direction of the elevator car doors is desirable.

Disclosure of the Invention

It is an object of the present invention to improve a positioning and synchronization system for elevator car doors.

According to the present invention, a positioning and synchronization system for elevator car doors includes a relating cable attaching onto a first and a second elevator doors and extending over an encoder pulley and an idler pulley, and an encoder coupled directly onto the encoder pulley for interpreting the position and direction of

the elevator car doors. The idler pulley and the encoder pulley include high friction polymer liners to provide positive traction between the pulleys and the relating cable, thereby avoiding slippage therebetween. As the doors travel between the open and closed
5 positions, the relating cable ensures that both doors open and close simultaneously. The encoder interprets the linear position and direction of the doors throughout the travel.

Direct coupling of the encoder onto the pulley eliminates intermediate linkages that potentially introduce inaccuracies. The
10 present invention also eliminates the need to translate the linear position of the door into a rotary position, thereby reducing the associated inefficiencies. The synchronization system of the present invention insures that both doors in a two door center opening bi-parting configuration open and close substantially simultaneously.

.15 One advantage of the present invention is that if travel of one of the doors is interrupted, the other door is also stopped. Another advantage of the present invention is that only one encoder is used to interpret the positions of both doors. Use of a single encoder represents a significant cost saving.

20 The foregoing and other advantages of the present invention become more apparent in light of the following detailed description of the exemplary embodiments thereof, as illustrated in the accompanying drawings.

Brief Description of the Drawings

FIG. 1 is a schematic, perspective view of an elevator door system including a positioning and synchronization system, according to the present invention;

5 FIG. 2 is a cut-away, schematic, perspective view of the elevator door system including the positioning and synchronization system of FIG. 1; and

FIG. 3 is an enlarged, cut-away, schematic, perspective view of the synchronization link system of FIG. 2.

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Best Mode for Carrying Out the Invention

Referring to FIG. 1, an elevator car door system 10 for selectively opening and closing elevator car doors 12, 14 includes a header bracket 16 which supports a first and a second door hangers 18, 20 that have the first and second elevator car doors 12, 14, 15 suspended therefrom, respectively. A linear motor driving the elevator car doors 12, 14 includes a motor secondary 22 attached onto the header bracket 16 and a pair of motor primaries 24, each attaching onto the door hangers 18, 20.

20 A positioning and synchronization system 30 includes an idler pulley 32 secured to the header bracket on the outside of the travel of the door hanger 20, and an encoder pulley 34 also secured to the header bracket and disposed on the outside of the travel of the door hanger 18. A relating cable 36 extends over both pulleys 32, 34 to 25 form a closed loop with a first loop portion 38 and a second loop portion 42, as best seen in FIG. 2. The second loop portion 42 of the

relating cable 36 is continuous and is fixedly attached onto the first door hanger 18 by means of a first hitch 44. The first loop portion 38 of the relating cable 36 includes two ends 46,48 of the cable with each end attaching onto the second door hanger 20 by means of a second hitch 50. The attachment of the ends 46,48 of the cable 36 to the second hitch 50 is adjustable for periodic calibration of tension within the cable.

The pulleys 32,34 include high friction polymer liners that the relating cable 36 comes into contact with. The most effective type of high friction polymer for this invention is urethane.

Referring to FIG. 3, the positioning and synchronization system 30 also includes a rotary encoder 60 coupled to the encoder pulley 34. The encoder 60 includes an encoder body 62 and a shaft 64 which is fixedly attached to the center of the encoder pulley 34 by means of a set screw (not shown). The encoder 60 and the encoder pulley 34 are fixedly secured onto the header bracket 16 by means of a mounting flange 66.

In operation, the linear motor drives the elevator car doors 12, 14 into open and closed positions. As the elevator car doors 12, 14 travel in opposite directions, the positioning and synchronization system 30 ensures that both doors travel simultaneously at the same speed. The relating cable 36 pulls both doors simultaneously as the doors are opened or closed. Since there is essentially no slippage between the urethane liners of the pulleys 32,34 and the relating cable 36, the encoder 60 readings are accurate. The "no slippage" condition is achieved by having urethane liners for the pulleys and by insuring

proper tension in the relating cable. As the doors 12, 14 travel between open and closed positions, the rotary encoder 60 generates incremental pulses which indicate changes in door position and direction. The encoder 60 sends signals to the controller box (not shown) which interprets the position and direction data and also
5 derives the speed of the doors.

A major advantage of the present invention over the prior art is that the encoder 60 is directly coupled to the movement of the doors without many intermediate parts, such as mechanical linkages and/or
10 motors. Such a direct connection between the encoder and the movement of the doors minimizes the opportunities for inaccuracies resulting from loosening of the mechanical linkages or misalignment of the mechanical parts. Another major advantage of the present invention is that translation of the linear position of the door into a
15 rotary movement of the rotor is eliminated. Therefore, the present invention not only ensures smooth operation of the elevator car doors, but also precisely locates the doors throughout the travel, eliminating inaccuracies and inefficiencies introduced by existing systems.

Another benefit of the present invention is that only one encoder
20 is used for both doors, thereby resulting in substantial cost savings.

A further benefit of the present invention is that when travel of one of the doors is interrupted, the other door also stops movement as a result of the relating configuration.

The rotary encoder can be a conventional encoder
25 manufactured by various vendors. For example, one type of such

product that is suitable for the current application is a rotary encoder fabricated by Danaher Controls of Gurnee, Illinois.

While the present invention has been illustrated and described with respect to a particular embodiment thereof, it should be appreciated by those of ordinary skill in the art, that various
5 modifications to this invention may be made without departing from the spirit and scope of the present invention. For example, although the best mode of the present invention was shown and described with respect to the elevator car having a two door configuration, the
10 synchronization and positioning system of the present invention can be used with other door configurations.



We claim:

1. A positioning and synchronization system for positioning and timing movement of elevator car doors in an elevator system, said elevator car doors being suspended from a first and a second door
5 hangers, said door hangers being movably supported by a header bracket, said positioning and synchronization system comprising:
an idler pulley attaching onto one side of said header bracket;
an encoder pulley attaching onto an opposite side of said header bracket;
10 a relating cable extending over said idler pulley and said encoder pulley forming a closed loop having a first loop portion and a second loop portion; and
a rotary encoder attaching to said encoder pulley for measuring position and direction of movement of said elevator car doors.
15
2. The positioning and synchronization system according to claim 1, wherein said idler pulley and said encoder pulley have a high friction polymer liner for minimizing slippage between said pulleys and said relating cable.
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3. The positioning and synchronization system according to claim 2, wherein said high friction polymer is urethane.



4. The positioning and synchronization system according to claim 1 wherein said first loop portion of said relating cable attaches onto said first door hanger and said second loop portion of said relating cable attaches onto said second door hanger.

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5. The positioning and synchronization system according to claim 1 wherein said rotary encoder generates incremental pulses which indicate changes in position and direction of said elevator car doors.

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6. An elevator car door operating system for opening and closing a first elevator car door and a second elevator car door, said elevator car doors being suspended from a first and a second door hangers, said door hangers being movably supported by a header bracket, said elevator car door operating system comprising:

a positioning and synchronization system for positioning and timing movement of said elevator car doors, said positioning and synchronization system including an idler pulley attaching onto one side of said header bracket and an encoder pulley attaching onto an opposite side of said header bracket with a relating cable extending over said idler pulley and said encoder pulley forming a closed loop having a first loop portion and a second loop portion, said positioning and synchronization system including a rotary encoder attaching to said encoder pulley for measuring position and direction of movement of said elevator car doors.

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7. An elevator car door operating system for opening and closing a first elevator car door and a second elevator car door, said elevator car doors being suspended from a first and a second door hangers, said door hangers being movably supported by a header bracket, said elevator car door operating system comprising:

a positioning and synchronization system for positioning and timing movement of said elevator car doors, said positioning and synchronization system including an idler pulley attaching onto one side of said header bracket and an encoder pulley attaching onto an opposite side of said header bracket with a relating cable extending over said idler pulley and said encoder pulley forming a closed loop having a first loop portion and a second loop portion, said positioning and synchronization system including a rotary encoder attaching to said encoder pulley for measuring a position and direction data of movement of said elevator car doors; and

a controller for interpreting said position and direction data received from said rotary encoder.