FIG. 10

FIG. 11
SCREW-DRIVEN ELEVATOR
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ABSTRACT OF THE DISCLOSURE

An elevator comprising an elevator shaft means defining a vertical elevator shaft, a cabin including at least one vertical wall position to move up and down said elevator shaft, a plurality of guide rails fixed vertically on said elevator shaft means, guide rollers arranged perpendicularly fixed to said cabin and riding on said guide rails, a screw vertically mounted on said elevator shaft means adjacent the center of the vertical wall of said cabin, beam means mounted to the exterior of said vertical wall in the plane of said screw and provided with an opening through which the screw passes, a nut fixed on said beam means and threadedly engaging said screw, and a motor rigidly fixed relative to said nut and operatively connected to drive said nut up and down said screw.

This invention relates to a lift or elevator, which comprises a nut which is axially fixed to the car and moveable up and down along an axially stationary screw, and an electric motor for driving the nut or screw.

During the last two decades of the preceding century, various screw-driven lifts or elevators have been disclosed in the literature. Such lifts or elevators have been used in practice only for the handling of goods. In most present-time lifts or elevators, particularly in residential buildings, the car is suspended by means of block and tackle mechanisms from cables and is controlled by means of electric hoists, or the car is moved up and down by hydraulic means. Owing to their high initial expenditure, these known lifts or elevators cannot be economically used in buildings having less than five floors. It has not been possible before to fill this gap by a screw-driven lift or elevator because the known lifts or elevators of this kind do not meet the requirement that the space required above the uppermost car position and below the lowest car position should be as small as possible. In this respect, all those known designs have failed in which the driving and power transmitting means are disposed below the car. Those designs in which a screw is centrally disposed in the shaft for the lift or elevator cannot be used in residential buildings.

The above requirements have been met by a known lift or elevator of the kind described hereinbefore, in which the freight compartment and the drive means are arranged one beside the other on a common platform, which is guided along a self-supporting, vertical column, which guides also the top end of the screw. With this design, a space of considerable depth is required for the accommodation of the lift or elevator and this space is not available in most residential buildings. For this reason, the last described known design is satisfactory only as a goods lift or freight elevator. Another disadvantage of the known design resides in that the screw is firmly anchored to the floor because this anchoring may cause buckling. As this design is applied to goods lift or freight elevator, there are no safety features, which are essential for a passenger lift or elevator.

In view of this state of the art, it is an object of the invention to provide a lift or elevator which is suitable for relatively low residential buildings as it can be installed along a wall and comprises a frame which can be made from prefabricated elements.

This object is accomplished according to the invention in a lift or elevator of the kind described first hereinbefore in that a longitudinal wall of the car is provided on its outside, preferably along its center line, with a cross-beam, to which the nut is secured, and the car is guided by rollers on laterally disposed tracks, which are preferably connected to the wall of the shaft for the lift or elevator. As a result, the car of the lift or elevator according to the invention can be moved up and down like a motor-driven, wheeled car. All parts which may require servicing may be secured to the cross-beam, which extends preferably along the center line of a longitudinal wall of the car. In the known design, the area required for the driving and power transmitting means is approximately as large as the useful area of the car. The space required for the cross-beam and the elements secured to it is only a fraction of the useful area of the car.

In a development of the invention, the elements which are carried by the cross-beam are accessible through a door from the interior of the car so that the servicing is facilitated.

The safety of the passenger in case of a failure of the motor is ensured according to the invention in that a hand-wheel is carried by the nut or by the shaft or driving pulley of the motor, which is mounted on the cross-beam. The passenger can lower the car with the aid of the hand-wheel even when the motor is inoperative.

The lift or elevator according to the invention is particularly suitable for residential buildings having two or three floors as well as for workshops in which loads must be lifted to a height of about 6 or 8 meters.

In a further development of the invention, the screw is suspended at its top end from a fixed mounting and is inserted at its lower end with freedom of axial movement in a sleeve so that the thermal expansion of the screw will not be obstructed.

Further safety features of the lift or elevator according to the invention will become apparent from the following description of several illustrative embodiments of the invention.

FIG. 1 is an elevation showing a lift or elevator according to the invention;
FIG. 2 is a fragmentary longitudinal sectional view taken on line II—II of FIG. 3 and showing the driving means;
FIG. 3 is a horizontal sectional view taken on line II—II of FIG. 2 and showing the driving means;
FIG. 4 is a perspective view showing the mounting of the upper and lower ends of the screw;
FIG. 5 is a transverse sectional view which is associated with FIG. 4 and shows also the car;
FIG. 6 shows the wheeled car of the lift or elevator;
FIG. 7 is a transverse sectional view taken through the cross-beam 6 in FIG. 6;
FIG. 8 shows the suspension means for the screw and a safety contact;
FIG. 9 shows a modification of FIG. 8 with a spring suspension and a bridging contact;
FIG. 10 is a longitudinal sectional view taken through the nut;
FIG. 11 is a diagrammatic sectional view showing the interengaging parts of the nut and screw; and
FIG. 12 shows the braking device.

A car 1 of a lift or elevator comprises a floor 2, vertical longitudinal walls 3 and a top 4. One of the vertical longitudinal walls 3 of the car 1 is provided with two vertical channels 5, the flanges of which are directed toward each other (see FIG. 3). The channels 5 are interconnected by two horizontal channels 6. One of the
latter channels is secured to the inside of that flange of each channel 5 which faces the car. The other channel 6 is secured to the outside of the other flange of each of the channels. The two channels 6 form a cross-beam, to which a plate 7 is secured, which has a central, circular opening. A stationary screw 8 extends, e.g., vertically through the opening in the plate 7. In workshops having no space restrictions, the screw might be movable. In the advantageous embodiment of the invention which is being described, the upper end of the screw 8 is suspended from a stationary mounting. This is shown in FIG. 4. The lower end of the screw 8 is inserted with an axial clearance in a stationary sleeve 23. Owing to this suspension, any thermal expansion of the screw in operation will not be obstructed.

The car 1 is vertically movable along the screw 8. For this purpose, a nut 9 is secured to the plate 7 and movable along the screw 8. The driving nut 9 is connected to the plate 7 by anti-friction bearings. In the embodiment shown in FIG. 2, a simple ball bearing 10 is provided adjacent to the plate 7, and a self-aligning ball bearing 11 is provided adjacent to the nut 9. These anti-friction bearings facilitate the displacement of the car with an adequate lateral clearance, as is usual in screw drive lifts or elevators.

The driving nut 9 is driven from an electric motor 12 by a belt 13 to move along to the screw 8. In the embodiment shown in FIGS. 1 to 3, the drive motor 12 is a brake motor, which is secured by a beam 14 to the outside of one of the vertical longitudinal walls 3 of the car 1 so that this motor does not require additional space below the car when the same is in its lower end position. With the described arrangement, the motor is accessible from the interior of the car.

The V-belts 15 are guided in grooves of a drive pulley 16, which is wedged to the shaft 16 of the motor 12, and in grooves formed in the cylindrical peripheral surface of the driving nut 9. The transmission of power by V-belts has the advantage that a blockage of any of the elements for driving the lift or elevator will not result in a sudden seizing of the transmitting systems as the V-belts can slip in the grooves.

The rotor of the drive motor 12 can be manually operated by means of a handwheel 17, which is keyed to the shaft 16, so that the driving pulley 15 and the driving nut 9 can also be rotated. The operation of the handwheel enables a lowering of the entire car 1 and the motor 12 to the lower end position. In this respect, the lift or elevator according to the invention is much superior to the known lifts or elevators, in which a stoppage of the car occupied by passengers between two floors cannot be reliably avoided.

The rotation of the driving nut 9 is transmitted to a locknut 18, which is threaded to the screw 8 below the nut 9. The locknut 18 is connected to the driving nut 9 by a driving pin 19 so that the locknut moves up and down along the screw 8 in union with the driving nut 9. Whereas only one driving pin 19 is shown in FIG. 1, there are a plurality of driving pins, which are parallel to the screw 8. The locknut 18 rotates normally with the driving nut 9 under no load. When the driving nut 9 has become worn to such an extent that it is no longer self-locking, the locknut 18 takes up the function of the driving nut and prevents the car 1 from descending along the screw 8 merely under the action of gravity.

For the same purpose, namely, to prevent an unintended descent of the car 1 only under the action of gravity, the threads of the driving nut 9, the locknut 18 and the screw 8 are self-locking. These threads have relative to the normal on their common longitudinal axis an angle of lead which is preferably 6° or less.

The car 1 is moved up and down in the shaft for the lift or elevator in usual manner and is provided for this purpose near its top and bottom with rollers 20, 21, as is readily apparent from FIGS. 1 to 3, particularly from FIG. 1. These rollers serve to guide the car 1 along the flanges and in the interior of channel-shaped tracks.

In the embodiment shown by way of example in FIGS. 1, 2 to 3, the screw 8 is stationary and the driving nut 9 and the locknut 18 are moved. Alternatively, the screw may be driven by a drive motor about its stationary longitudinal axis so that the nuts are displaced along the screw but do not rotate.

In the design according to the invention, a single screw and a single driving nut may be sufficient for moving up and down the car. This is a special advantage of the lift or elevator according to the invention. The design according to the invention may also comprise a plurality of screws and associated driving screws.

The suspension of the screw 8 at its upper and lower ends is readily apparent from FIGS. 4 and 5 of the drawing and need not be described in more detail. It is apparent from FIGS. 6 and 7 how the car of the lift or elevator according to the invention can be moved like a wheeled car between the laterally disposed tracks. FIG. 8 shows an overload-preventing safety device for the lift or elevator according to the invention. Of the vertical channels of the suspension 42, a pivot channel is designated 42a and a fixed channel is designated 42b. The channels 42a and 42b are connected by a connecting pin 24, which constitutes a pivot under certain operating conditions. Both channels are also provided with a pressure pin 25 and a limiting stop 29. The pivot channel 42c carries a bracket arm 25, in which the screw 8 is mounted with the aid of preferably conical insulators (not shown), which serve to reduce the noise. The screw 8 is locked with the aid of a castle nut 27. A microswitch 30 is secured to the pivot channel 42a and a switch-actuating pin 31 is secured to the fixed channel 42b. When an excessive load is applied to the car suspended from the screw 8, the connecting pin 24 acts as a pivot so that the safety switch is actuated to de-energize the driving motor immediately.

FIG. 10 shows a modification of the bearing arrangement for controlling the engagement between the screw 8 and the nut 9. Two bearings 33, 34 are accommodated in a bearing chamber 32 and may alternatively consist of inclined conical roller bearings. This design has the advantage that the bearings are enclosed within a housing so that they are protected from being soiled.

FIG. 11 shows that the screw threads 35 of the screw 8 and the mating screw threads 36 of the nut 9 are designed so that the meshing portion of the nut 9 is much larger in section than the meshing portion of the screw 8. In the drawing, the two meshing portions to be compared have different hatchings. This feature contributes to the safety. Whereas the screw with a typical diameter of 70 mm. is highly over-dimensioned in view of its load, which is small owing to the relatively low speed of travel at the angle of lead which has been stated, the described feature further reduces the pressure transmitted per unit of area between the screw and the nut.

FIG. 12 shows a lift or elevator according to the invention with an embodiment which can be operated without a brake motor so that its cost can be further reduced. The electromagnetically operateable brake which is used in this embodiment for the nut 9 consists of a braking strap 37, which is secured at one end and slung around a drum portion 38 of the nut 9. The free end 39 of the braking strap 37 is adapted to be attracted by means of a solenoid 40. The braking direction is indicated by the arrow 41. For a screw-driven lift or elevator, a brake acting in one direction is sufficient because only the descent of the nut must be frictionally braked.

FIG. 9 shows for the screw 8 a suspension which is simpler and comprises a bridging contact. A strong spring 45 is simply inserted between the retaining arm 44 and the castle nut 27. This spring is designed to maintain the contact closed unless the load on the lift exceeds a predetermined value. A higher load will compress the
spring so that the bridging contact is opened and the lift or elevator is stopped.

As is particularly apparent from FIGS. 1, 2 and 6, the car 1 of the lift or elevator is provided near its upper and lower end with guide rollers 20, 21, which are at right angles to each other. This arrangement prevents the occurrence of a canting moment at the car 1 under the action of the load.

In addition to lifts or elevators, the invention is applicable to other apparatus for transporting passengers or freight in a vertical or inclined direction.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An elevator comprising elevator shaft means defining a vertical elevator shaft, a cabin including a vertical wall positioned to move up and down said elevator shaft, a plurality of guide rails fixed vertically on said elevator shaft means, guide rollers arranged perpendicularly fixed to said cabin and riding on said guide rails, a screw vertically mounted on said elevator shaft means adjacent the center of the vertical wall of said cabin, a first vertical channel rigidly affixed to one extremity of said vertical wall, a second vertical channel rigidly affixed to the other extremity of said vertical wall, a first horizontal channel in juxtaposition to said vertical wall and rigidly affixed to said first vertical channel at its one end and to said second vertical channel at its other end, a second horizontal channel remote from said vertical wall and rigidly affixed to said first vertical channel at its one end and to said second vertical channel at its other end, said horizontal channels forming beam means mounted to the exterior of said vertical wall in the plane of said screw and provided with an opening through which the screw passes, a nut fixed on said beam means and threadedly engaging said screw, and a motor rigidly fixed relative to said nut and operatively connected to drive said nut up and down said screw.

2. Elevator according to claim 1 wherein said motor is mounted to the exterior of said wall laterally displaced from said nut.

3. Elevator according to claim 1 further provided with a handwheel drivingly connected to manually operate said nut and means to obtain convenient access to said handwheel from the cabin interior.

4. Elevator according to claim 1 wherein said screw is suspended at its upper end from a fixed support and has its lower end received in a sleeve with freedom of axial movement.

5. Elevator according to claim 1 wherein the upper end of said screw is fastened to a holding arm which upon overload of the cabin is swung about a connecting pin to actuate a safety contact.

6. Elevator according to claim 1 further including electromagnetically actuable brake means cooperating with said nut, said nut including a portion formed as a drum, and said brake means including a unilaterally fastened brake band wrapped around said drum with its free end attached to a spring acting in opposition to an electromagnet.

7. Elevator according to claim 1 wherein the thread of said screw and the mating thread of said nut are so developed that the profile cross section of the nut is substantially larger than the profile cross section of the screw.

8. An elevator comprising elevator shaft means defining a vertical elevator shaft, a cabin including at least one vertical wall positioned to move up and down said elevator shaft, a plurality of guide rails fixed vertically on said elevator shaft means, guide rollers arranged perpendicularly fixed to said cabin and riding on said guide rails, a screw vertically mounted on said elevator shaft means adjacent the center of the vertical wall of said cabin, the upper end of said screw being fastened to a holding arm which upon overloading of the cabin is swung about a connecting pin to actuate a safety contact, beam means mounted to the exterior of said vertical wall in the plane of said screw and provided with an opening through which the screw passes, a nut fixed on said beam means and threadedly engaging said screw, and a motor rigidly fixed relative to said nut and operatively connected to drive said nut up and down said screw.

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