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(54) **Linear motor driven elevator and its guide rail.**

(57) The guide rail of an elevator driven by a linear motor also constitutes the secondary circuit of the linear motor. The guide rail of the elevator car or counterweight is made of a conducting metal and extends substantially through the whole length of the shaft. The guide rail (22) is provided with reinforcements (23), which can be connected together by means of fasteners (26) going through the rail. The reinforcements receive the thrust of the guides (30) of the car or counterweight. Alternatively, the guide rail is coated e.g. with teflon, in which case the coated portion receives the thrust of the sliding guides.

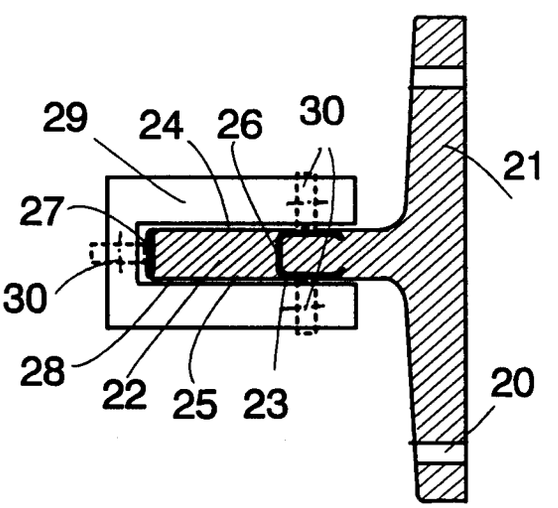

Fig. 2

EP 0 626 335 A1

The present invention relates to a linear motor driven elevator according to the preamble of claim 1 and to a guide rail according to the preamble of claim 6.

In recent times, linear motors have aroused great interest as elevator drive motors. The driving power of the motor is converted into linear motion in the elevator shaft without a transmission, a rotating drive machinery or a gear system changing the speed. In the solutions employed, the linear motor has been placed in the counterweight or the elevator car. The control unit of the elevator motor as well as the power supply equipment can be placed completely in the elevator shaft or in the elevator car and counterweight moving in it.

In elevator drive applications using a linear motor, the stationary secondary circuit of the motor is normally mounted in the elevator shaft, extending through its whole length. The movable primary circuit of the motor is placed in the counterweight or in the elevator car. In high-rise buildings, the secondary circuit has to be very long, constituting a considerable item of expenditure. To remedy this disadvantage, numerous solutions aiming at improving the perfomance of the magnetic circuit of the motor have been suggested. Systems have also been proposed where the secondary circuit or part of the secondary circuit of the motor consists of the guide rails guiding the movement of the elevator car and counterweight in the elevator shaft.

Application publication DE 2 002 081 (B66B 11/04) presents a solution in which the guide rails of the elevator car or counterweight are utilized by generating a sinusoidal magnetic field in them by means of inductance coils placed in the counterweight or elevator car. The guide rails are made of metal. The secondary circuit of the motor must have optimal electrical properties and, on the other hand, as it acts as a guide rail, it has to be able to receive the forces applied to it. The metals available do not have this combination of properties, which is why the performance of the elevator remains low.

Patent publication US 5 062 501 presents a linear motor driven elevator in which the counterweight guide rail is coated with a conducting layer which forms the secondary winding of the linear motor. The forces applied to the guide rail are received by the rail body which is made of steel. In this solution, two metals having different characteristics, steel and aluminium, have to be joined together to form a guide rail extending through the whole length of the shaft, involving high expenses and technical problems.

The object of the invention is to achieve a new linear motor which is economical to manufacture and install and meets the requirements applying to on an elevator drive. The invention is characterized by the features presented in the characterization part of claim 1. The guide rail of the invention is characterized by the features presented in the characterization part of claim 6.

With the solution of the invention, the number of parts to be installed in the elvator shaft is reduced dramatically. The manufacture of guide rails by the method of the invention can be easily implemented. The different effects of thermal expansion of different materials comprised in the guide rail can be easily managed and the hoisting height is virtually unlimited.

In the following, the invention is described in detail by the aid of some of its embodiments by referring to the attached drawings, in which

- Fig. 1 presents a counterweight constructed according to the invention,
- Fig. 2 presents a guide rail structure according to the invention,
- Fig. 3 presents another guide rail structure according to the invention, and
- Fig. 4 presents a guide rail reinforcement.

As shown in Fig. 1, an elevator car and its counterweight 5, connected together by a hoisting rope 6 or ropes, are installed in an elevator shaft 1 so that they can move in the vertical direction. The hoisting ropes 6 run over a diverting pulley 7 mounted in the upper part of the shaft. Mounted in the shaft are the guide rails 2 for the elevator car and counterweight. The guide rails are fixed to the shaft walls or alternatively to guide rail supporters (not shown) mounted in the shaft. Mounted in the counterweight in a manner known in itself are the iron components 8 forming the magnetic circuit of the primary part of the linear motor, as well as the primary winding, which is fitted in grooves provided in the iron components.

The hoisting ropes 6 are attached to the overhead beam 9 of the counterweight. Mounted in the upper and lower parts of the counterweight are guides 10, whose thrust is received by the guide rails 2 and which keep the counterweight straight and maintain a correct distance between the primary circuit of the linear motor and the guide rails 2. The guides 10 are either roller guides or sliding guides as is known in elevator technology. The counterweight also comprises normal supporting structures and a weight forming a sufficient mass. According to the invention, in addition to guiding the movement of the counterweight, the counterweight guide rails 2 also act as the secondary circuit of the linear motor. The guide rails of the elevator car can be manufactured in the same way, in which case the linear motor is placed in the elevator car. In the following, the guide rail structures according to the invention are described by the aid of Fig. 2 - 3.

Fig. 2 presents a T-section guide rail consisting of a rail back or fixing part 21 formed by the cap of the T and a guiding part 22 formed by the shank of the T. The guide rail is fixed by its back to the shaft wall by means of bolts fitted in holes 20. The material of the back and the guiding part of the guide rail is mainly aluminium. The guiding part is provided with reinforcements 23 having a length equal to that of the rail and consisting e.g. of steel strips placed on opposite sides 24 and 25 of the guiding part. The reinforcements 23 are connected to each other at suitable distances by means of fasteners 26 going through the guiding part 22 of the guide rail. The end 27 of the guiding part 22 is provided with a stop face for a lateral guide. Especially when sliding guides are used, the aluminium surfaces of the guiding part 22 of the guide rail are provided with a coating 28 consisting of a slick material such as teflon. In this case, the thrust of the sliding guide may be received by a coated portion of the rail.

The primary part 29 of the linear motor mounted in the counterweight moves in the direction of the rail, surrounding its guiding part 22 on both sides and on the side facing the central part of the shaft. Using rollers 30 provided in the guides 10, an air gap of a certain width is maintained between the primary circuit 29 and the guiding part 22 of the guide rail forming the secondary circuit of the motor.

Fig. 3 illustrates another guide rail implemented according to the invention. In this case, the guide rail is an H or I-profile rail which is fixed to the wall by one end 31 of the profile, which forms the fixing part. The other end 32 of the guide rail profile constitutes the secondary circuit of the motor, the primary circuit 33 being fitted around it. In this case, the primary circuit of the motor consists of two parts which can also be connected together. Fitted on the sides 34 and 35 of the second end 32 are reinforcements 23, which are attached to each other by means of fasteners 26. Similar reinforcements are also mounted on both sides of the shank of the I profile. The reinforcements 23 receive the thrust of the guide rollers 38 as in Fig. 2.

Fig. 4 presents an example of a structure used as a reinforcement, which is formed by punching holes 40 in a steel fillet. The portions 44 remaining between the holes 40 form the fasteners while the portions 41 and 42 remaining on the sides of the fillet form the reinforcements. When the guide rail is being manufactured, the fillet is bent lengthwise to an angle of 90° along the edges 45 and 46 of the holes. The edges of the fillet are further bent to form additional spurs 47 which in a finished guide rail are turned inwards. The guide rail is formed e.g. by extruding aluminium around the framework formed by the steel fillet, producing a guide rail profile as illustrated in Fig. 2 and 3.

According to the invention, other guide rail profiles can also be used. Similarly, the reinforcements may be produced in numerous alternative ways and they may extend to the fixing part of the rail. Instead of roller guides it is possible to use sliding guides mounted so that their thrust is received by the reinforcements or a coated portion of the guiding part of the guide rail.

In the above, the invention has been described by way of an example with reference to some of its embodiments. However, the presentation is not to be regarded as limiting the sphere of patent protection, but the embodiments of the invention may vary within the limits defined by the following claims.

Advantageously the reinforcements or parts thereof are located at the surfaces of the guide rails in the runway of the rolling or sliding guides 10,30 so as to receive the thrust of the guides. The reinforcements may be coated with a slick material such as teflon.

Claims

1. Elevator driven by a linear motor, comprising an elevator car and counterweight (5) travelling in a shaft (1) and suspended from a hoisting rope (6), and a diverting pulley (7) over which the hoisting rope (6) runs, in which elevator the primary circuit (8,29,33) of the linear motor is fitted in the counterweight (5) so that it travels at a distance formed by an air gap from the guide rail (2) of the counterweight (5), said guide rail forming the secondary circuit of the motor, **characterized** in that the guide rail (2) of the counterweight is made of a conducting metal and extends substantially through the whole length of the shaft (1) and that the guide rail (2) is equipped with reinforcements (23) provided with fasteners (26).

2. Elevator according to claim 1, **characterized** in that the guide rail (2) of the counterweight is a T-shaped aluminium profile which is fixed by its cap part (21) to the wall of the shaft (1) and that the reinforcements (23) are placed in the shank (22) of the T-profile.

3. Elevator according to claim 1, **characterized** in that the guide rail (2) of the counterweight is an I-shaped aluminium profile which is fixed by its one end (31) to the wall of the shaft (1) and that the reinforcements (23) are placed in the other end (32) of the I profile.

4. Elevator according to any one of claims 1 - 3, **characterized** in that the thrust of the coun-

terweight guides (10,38) is received by the reinforcements (23) of the guide rail.

5. Elevator according to any one of claims 1 - 4, **characterized** in that the portion of the guide rail (2) consisting of a conducting material is at least partially coated with a lubricous material (28) and that the elevator has a sliding guide whose thrust is received by the coated portion of the guide rail (2).

6. Guide rail (2) guiding the movement of an elevator car or counterweight in an elevator shaft, said guide rail being attached by its fixing part (21,31) to the shaft walls or other supporting structures and having a guiding part (22,32) which extends into the primary circuit (8,29,33) of a linear motor fitted in the counterweight (5) or elevator car and acts as the secondary circuit of the motor, **characterized** in that the guide rail (2) is manufactured from a conducting material and that at least the guiding part (22,32) is provided with reinforcements (23) attached to the conducting material.

7. Guide rail according to claim 7, **characterized** in that the guide rail (2) is manufactured by extruding aluminium into the shape of a T profile (21,22), in which the cap part (21) constitutes the fixing part while the shank (22) forms the guiding part.

8. Guide rail according to claim 7, **characterized** in that the guide rail (2) is manufactured by extruding aluminium into the shape of an I profile (31,32), in which the first end (31) forms the fixing part while the second end (32) forms the guiding part.

9. Guide rail according to any one of claims 6 - 8, **characterized** in that the reinforcements (23) consist of steel fillets having a length substantially equal to that of the guide rail (2) and fitted on opposite sides of it and that the fillets (23) are connected together by means of fasteners (26) going through the rail.

10. Guide rail according to any one of claims 6 - 9, **characterized** in that the conducting material of the guide rail (2) is provided with a lubricous coating (28), such as teflon.

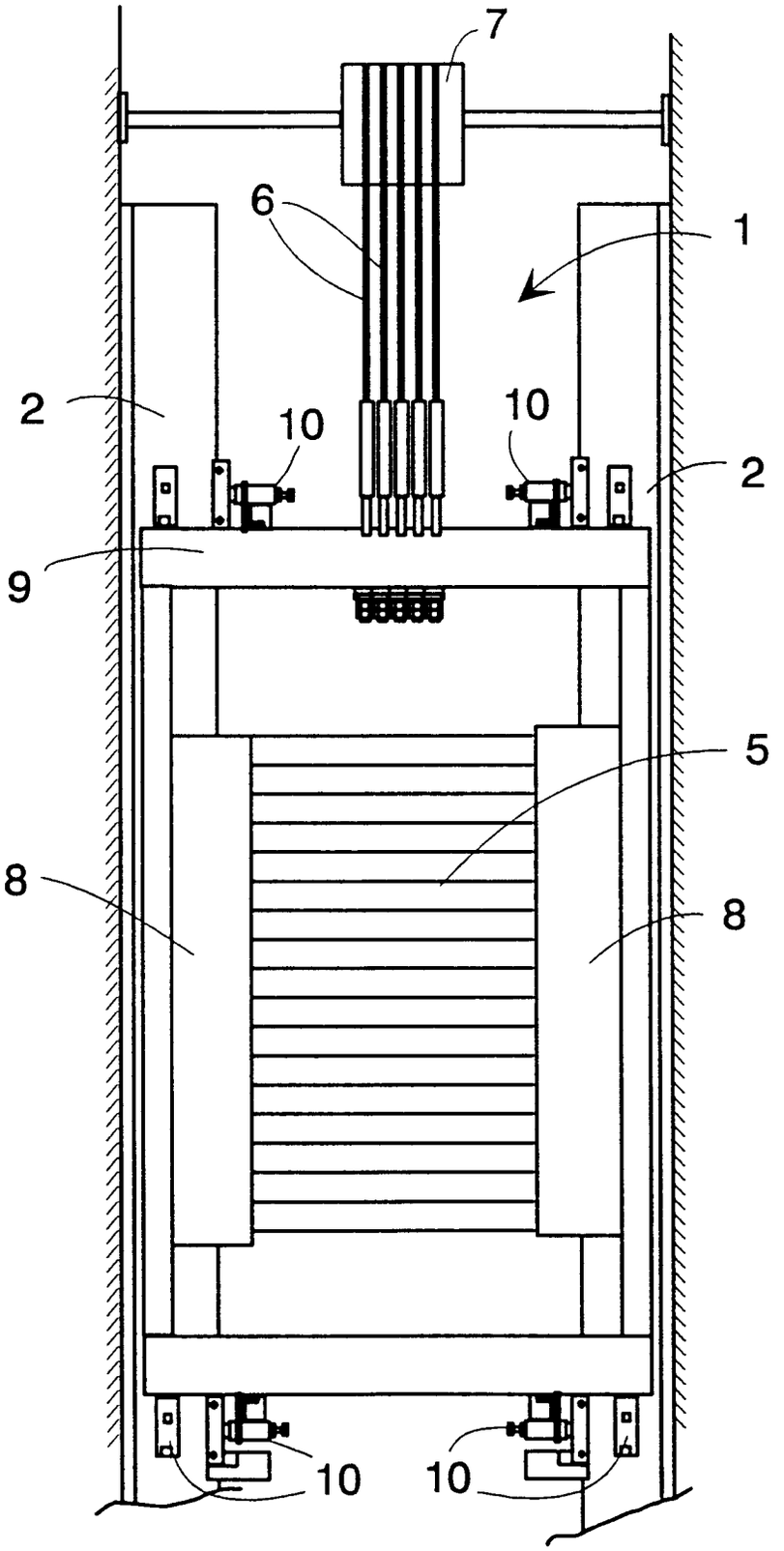

Fig.1

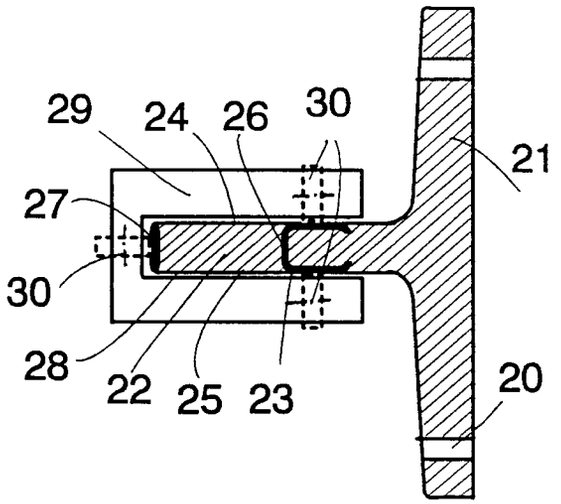

Fig. 2

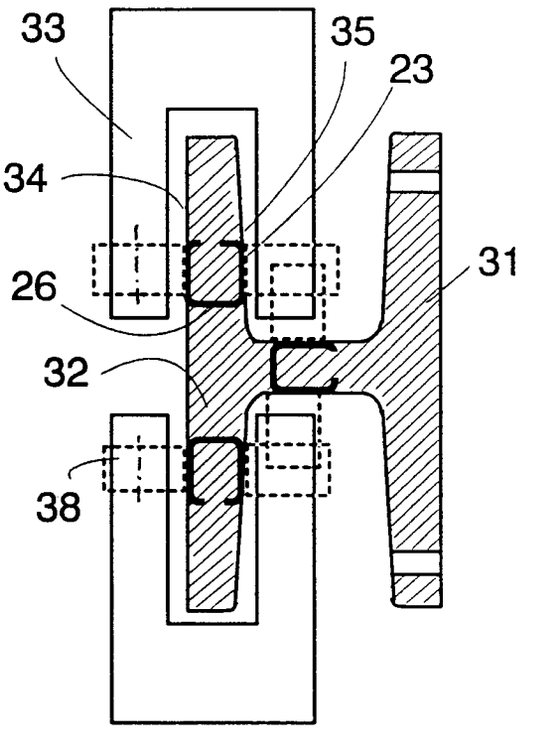

Fig. 3

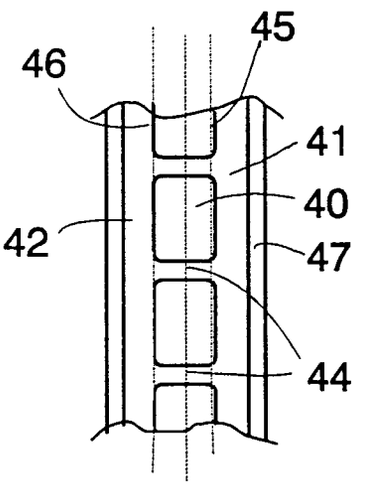

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number EP 94108142.4

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
D,A	US - A - 5 062 501 (PAVOZ) * Abstract * --	1,6	B 66 B 7/02 B 66 B 11/04
A	US - A - 4 832 210 (WOOD) * Abstract * ----	5,10	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 66 B 7/00
B 66 B 11/00
H 02 K 41/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	17-08-1994	NIMMERRICHTER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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