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(54) Linear motor driven elevator and its guide rail

Mittels Linearmotor angetriebener Aufzug und dessen Führungsschiene

Ascenseur actionné par un moteur électrique linéaire et le rail-guide de cet ascenseur

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(73) Proprietor: **Kone Corporation
00330 Helsinki (FI)**

(72) Inventor: **Hakala, Harri
SF-05830 Hyvinkää (FI)**

(74) Representative:
**Zipse + Habersack
Wotanstrasse 64
80639 München (DE)**

(56) References cited:
US-A- 4 832 210 **US-A- 5 062 501**

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Description

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 performance 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 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 elevator shaft is reduced dramatically. The manufacture of guide rails according to 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 run-way 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, being made of a conducting metal and extending substantially through the whole length of the shaft (1), **characterized** in that at least the guiding part of 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 counterweight 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, said guide rail (2) being manufactured from a conducting material, **characterized** in 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.

Patentansprüche

1. Mittels Linearmotor angetriebener Aufzug umfassend eine Aufzugskabine und ein Gegengewicht (5), die in einem Schacht (1) laufen und an Zugseilen (6) aufgehängt sind, und ein Umlenkrad (7), über welches das Zugseil (6) läuft, in welchem Aufzug die Primärschaltung (28,29,33) des Linearmotors in dem Gegengewicht (5) befestigt ist, so daß dieses in einem durch einen Luftspalt gebildeten Abstand von der Führungsschiene (2) des Gegengewichts (5) läuft, wobei diese Führungsschiene den Sekundärteil des Motors bildet, aus einem leitfähigen Metall hergestellt ist und sich im wesentlichen über die gesamte Länge des Schachtes (1) erstreckt, dadurch **gekennzeichnet**, daß zumindest der Führungsteil der Führungsschiene (2) mit Verstärkungen (23) ausgebildet ist, die mit Verbindungselementen (26) versehen sind.
2. Aufzug nach Anspruch 1, dadurch **gekennzeichnet**, daß die Führungsschiene (2) des Gegengewichts als T-förmiges Aluminiumprofil ausgebildet ist, welches mit seiner Basis (21) an der Schachtwand (1)

befestigt ist, und daß die Verstärkungen (23) in dem Schenkel (22) des T-Profiles angeordnet sind.

3. Aufzug nach Anspruch 1, dadurch **gekennzeichnet**, daß die Führungsschiene (2) des Gegengewichts als I-förmiges Aluminiumprofil ausgebildet ist, welches mit seiner einen Stirnseite (31) an der Wand des Schachtes (1) befestigt ist, und daß die Verstärkungen (23) an der anderen Stirnseite (32) des I-Profiles angeordnet sind.
4. Aufzug nach einem der Ansprüche 1 bis 3, dadurch **gekennzeichnet**, daß die Kraft der Gegengewichtsführungen (10,38) durch die Verstärkungen (23) der Führungsschiene aufgenommen werden.
5. Aufzug nach einem der Ansprüche 1 bis 4, dadurch **gekennzeichnet**, daß der Abschnitt der Führungsschiene (2), der aus einem leitfähigen Material besteht, zumindest teilweise mit einem selbstschmierenden Material (28) beschichtet ist, und daß der Aufzug eine Gleitführung hat, deren Kraft durch den beschichteten Abschnitt der Führungsschiene (2) aufgenommen wird.
6. Führungsschiene (2), die die Bewegung einer Aufzugskabine oder des Gegengewichts in einem Aufzugschacht führt, welche Führungsschiene durch ihr Befestigungsteil (21,31) an den Schachtwänden oder anderen Trägerstrukturen befestigt ist und einen Führungsteil (22,32) aufweist, der in die an dem Gegengewicht (5) oder der Aufzugskabine angeordnete Primärschaltung (8,29,33) eines Linearmotors hineinragt, wobei der Führungsteil als Sekundärschaltung des Motors fungiert und die Führungsschiene (2) aus einem leitfähigen Material hergestellt ist, dadurch **gekennzeichnet**, daß zumindest der Führungsteil (22,32) mit Verstärkungen (23) versehen ist, die an dem leitfähigen Material befestigt sind.
7. Führungsschiene nach Anspruch 6, dadurch **gekennzeichnet**, daß die Führungsschiene (2) durch Extrudieren von Aluminium in Form eines T-Profiles (21,22) hergestellt ist, bei welcher der Basisteil (21) den Befestigungsteil bildet, während der Schenkel (22) den Führungsteil bildet.
8. Führungsschiene nach Anspruch 7, dadurch **gekennzeichnet**, daß die Führungsschiene (2) durch Extrudieren von Aluminium in Form eines I-Profiles (31,32) hergestellt ist, wobei die erste Stirnseite (31) den Befesti-

gungsteil bildet, während die zweite Stirnseite (32) den Führungsteil bildet.

9. Führungsschiene nach einem der Ansprüche 6 bis 8,
dadurch **gekennzeichnet**,
daß die Verstärkungen (23) aus Stahlleisten bestehen, deren Länge im wesentlichen der der Führungsschiene (2) entspricht und die an deren einander abgewandten Seiten befestigt sind, und daß die Leisten (23) miteinander durch Verbindungselemente (26) verbunden sind, die die Schiene durchsetzen.
10. Führungsschiene nach einem der Ansprüche 6 bis 9,
dadurch **gekennzeichnet**,
daß das leitfähige Material der Führungsschiene (2) mit einer selbstschmierenden Beschichtung (28), wie z.B. Teflon, beschichtet ist.

Revendications

1. Ascenseur entraîné par un moteur linéaire, comprenant une cabine d'ascenseur et un contrepoids (5) qui se déplacent dans une cage (1) et sont suspendus à un câble de levage (6), et une poulie de renvoi (7) sur laquelle passe le câble de levage (6), le circuit primaire (8,29,33) du moteur linéaire de cet ascenseur étant monté dans le contrepoids (5) de sorte qu'il se déplace à une distance définie par un intervalle d'air par rapport au rail de guidage (2) du contrepoids (5), ledit rail de guidage constituant le circuit secondaire du moteur, étant fabriqué en un métal conducteur et s'étendant sensiblement sur toute la longueur de la cage (1), caractérisé en ce qu'au moins la partie de guidage du rail de guidage (2) est pourvue de renforts (23) comportant des fixations (26).
2. Ascenseur suivant la revendication 1, caractérisé en ce que le rail de guidage (2) du contrepoids est un profilé en aluminium en forme de T qui est fixé par sa barre supérieure (21) à la paroi de la cage (1) et en ce que les renforts (23) sont placés dans la queue (22) du profilé en T.
3. Ascenseur suivant la revendication 1, caractérisé en ce que le rail de guidage (2) du contrepoids est un profilé en aluminium en forme de I qui est fixé par sa première extrémité (31) à la paroi de la cage (1) et en ce que les renforts (23) sont placés dans l'autre extrémité (32) du profilé en I.
4. Ascenseur suivant une quelconque des revendications 1 à 3, caractérisé en ce que la poussée des guidages de contrepoids (10,38) est reçue par les renforts (23) du rail de guidage.
5. Ascenseur suivant une quelconque des revendications 1 à 4, caractérisé en ce que la partie du rail de guidage (2) constituée d'une matière conductrice est au moins partiellement revêtue d'une matière lubrifiante (28) et en ce que l'ascenseur comporte un guidage glissant dont la poussée est reçue par la partie revêtue du rail de guidage (2).
6. Rail de guidage (2) pour guider le mouvement d'une cabine d'ascenseur ou d'un contrepoids dans une cage d'ascenseur, ledit rail de guidage étant attaché par sa partie de fixation (21,31) aux parois de la cage ou à d'autres structures de support et comportant une partie de guidage (22,32) qui s'étend dans le circuit primaire (8,29,33) d'un moteur linéaire monté dans le contrepoids (5) ou la cabine d'ascenseur et agit comme circuit secondaire du moteur, ledit rail de guidage (2) étant fabriqué en une matière conductrice, caractérisé en ce, qu'au moins la partie de guidage (22,32) est pourvue de renforts (23) attachés à la matière conductrice.
7. Rail de guidage suivant la revendication 7, caractérisé en ce que le rail de guidage (2) est fabriqué par extrusion d'aluminium sous la forme d'un profilé en T (21,22), dans lequel la barre (21) constitue la partie de fixation tandis que la queue (22) constitue la partie de guidage.
8. Rail de guidage suivant la revendication 7, caractérisé en ce que le rail de guidage (2) est fabriqué par extrusion d'aluminium sous la forme d'un profilé en I (31,32), dont la première extrémité (31) constitue la partie de fixation tandis que la deuxième extrémité (32) constitue la partie de guidage.
9. Rail de guidage suivant une quelconque des revendications 6 à 8, caractérisé en ce que les renforts (23) consistent en des feuilles d'acier ayant une longueur sensiblement égale à celle du rail de guidage (2) et placées sur des côtés opposés du rail, et en ce que les feuilles (23) sont reliées l'une à l'autre au moyen d'attaches (26) traversant le rail.
10. Rail de guidage suivant une quelconque des revendications 6 à 9, caractérisé en ce que la matière conductrice du rail de guidage (2) est pourvue d'un revêtement lubrifiant (28) tel que du téflon.

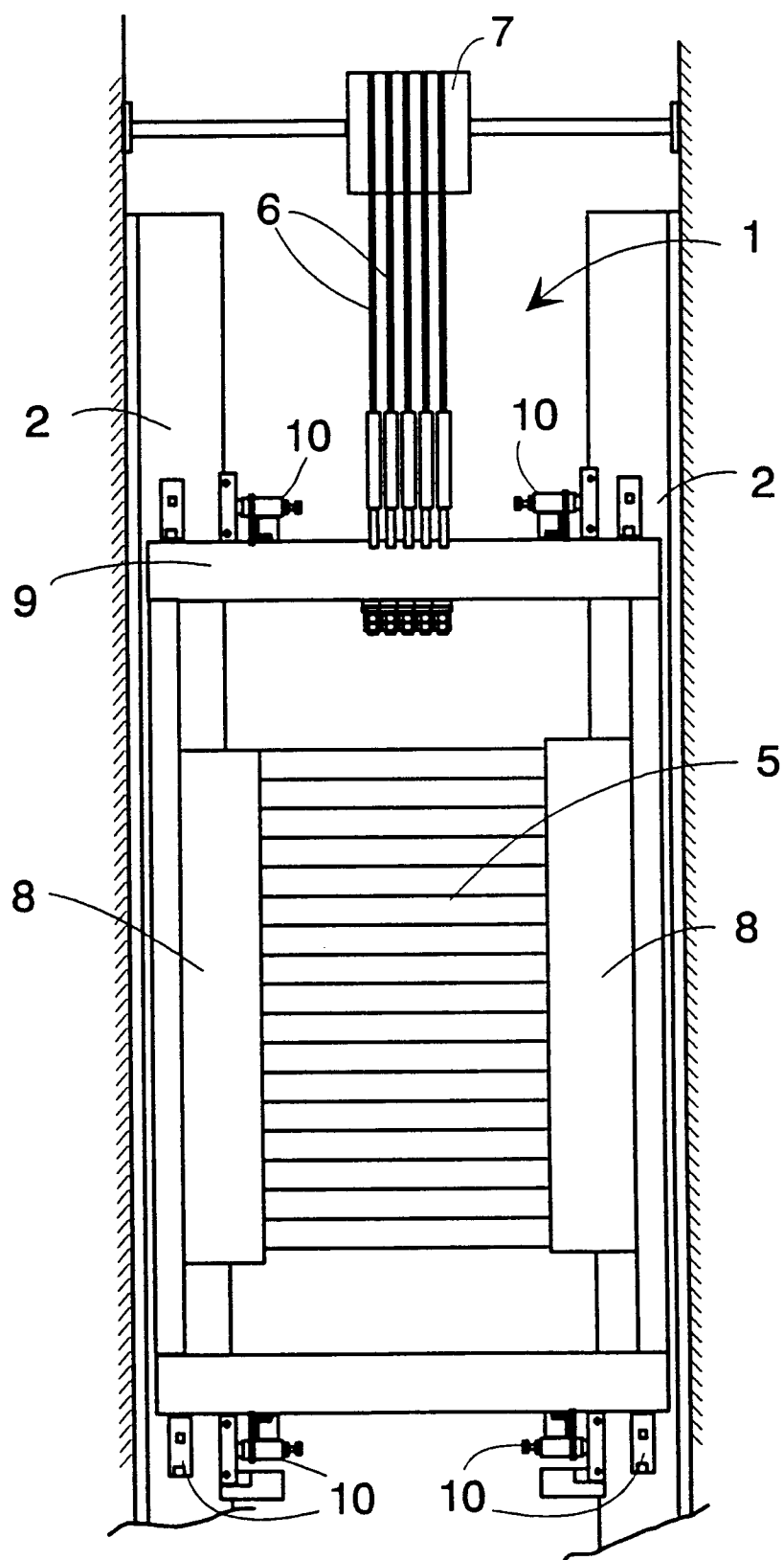


Fig.1

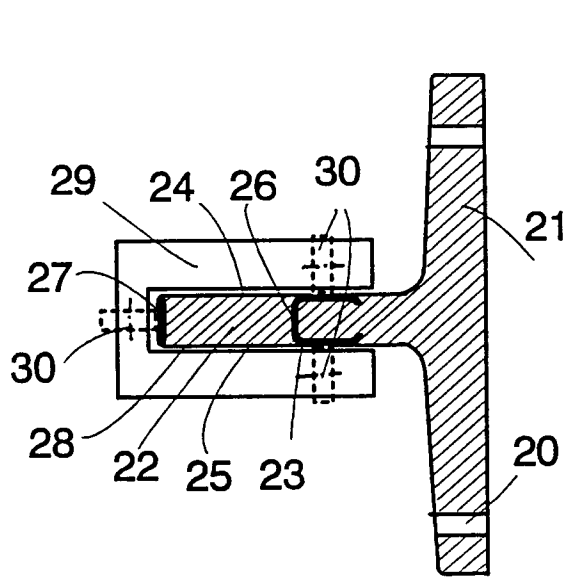


Fig. 2

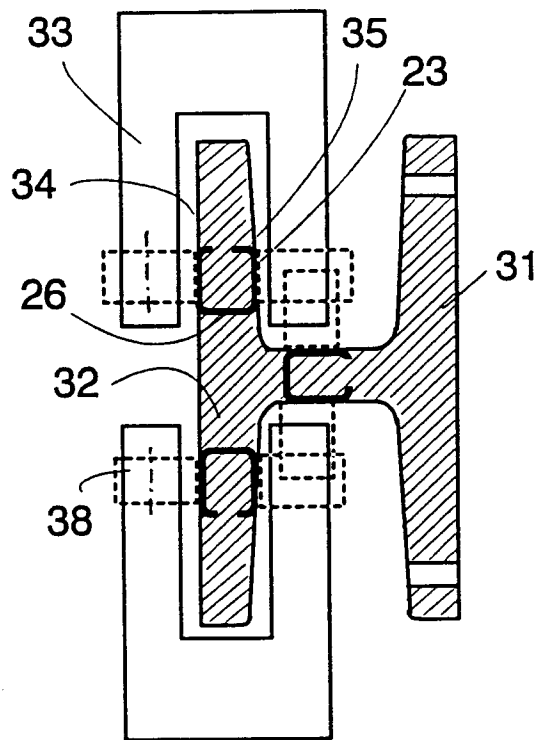


Fig. 3

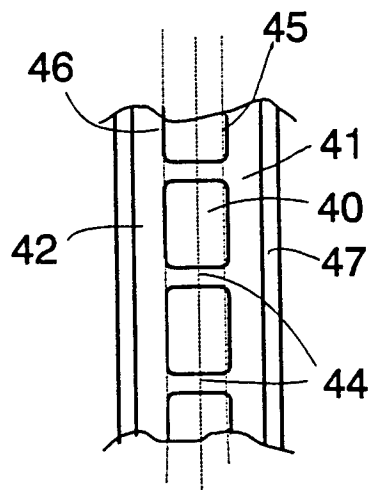


Fig. 4