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(54) **Apparatus for transporting materials along a guided path**

(57) Apparatus for transporting materials along a guided path, characterized in that it comprises:

- a guide structure (1) defined by one or more elements (11;60) modularly associable to each other, each of which is made up of two pillars (4) disposed parallel to the longitudinal development of the structure and along which there are provided a plurality

of engagement elements (3) equidistant from each other by a preset extent;

- a carriage (2) able to slide along said structure (1) and provided with motor means (8,80) connected, through means (5) for the transmission of motion, with means interacting with said engagement elements (3) of the structure (1), so as to move the carriage bidirectionally along said structure (1).

Fig. 1A

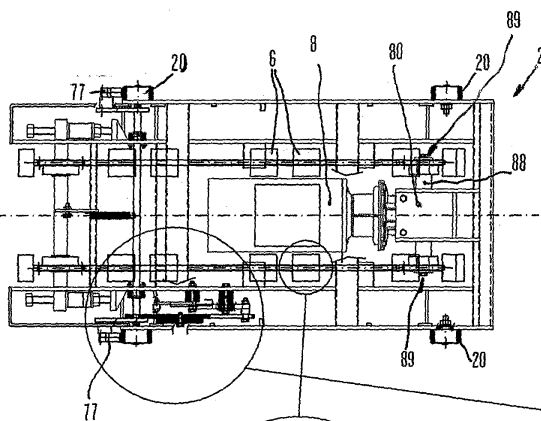


Fig. 1C

Fig. 1D

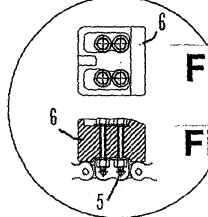
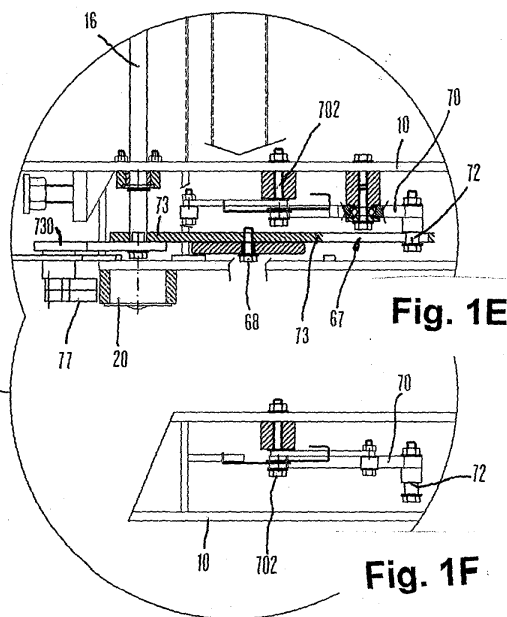


Fig. 1E

Fig. 1F



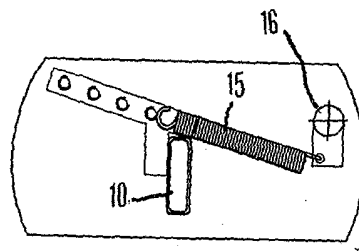


Fig. 1B

Description

[0001] The present invention refers to an apparatus for transporting materials along a guided path whatever its inclination and use, in particular but not exclusively for use in the building sector.

[0002] In the construction, as well as in the renovation of buildings, or upon removal operations for changing residence, it is often necessary to move materials of various nature vertically from the ground level to the upper floors and vice versa. To this end, besides capstans or winches, which have a limited field of application, there are used hoists, with more or less inclined paths, which provide for moving a carriage either along guides able to be joined by racks and pinions, or with the use of cables to be associated with relevant members, thereby forming devices so-called, respectively, of "self-propelled" and "pulled" carriage.

[0003] The known apparatus for the transport of materials exhibit some drawbacks.

[0004] As far the cable-operated hoists with pulled carriage are concerned, the following drawbacks can be indicated: with such elevators it is not easy to pass over difference of levels exceeding 20-25 meters; a variation of path length requires disengaging the pull cable; the descent occurs by gravity, with the possibility of having the carriage blocked because of dirt on the guides or of insufficiently accurate dimensional tolerances; the assembly times in the building yard are relatively long.

[0005] As far the hoists with self-propelled carriage are concerned, the following drawbacks can be indicated: the coupling between the various lengths of rack requires a high accuracy during the manufacturing and assembly, the whole pulling force is applied to one point only of the rack which may be disposed in correspondence of the guide's sides, with consequent considerable concentration and eccentricity of the stresses and the need of oversizing.

[0006] The object of the present invention is to overcome the said drawbacks.

[0007] This result has been achieved, according to the invention, by adopting the idea of making an apparatus having the features indicated in the claim 1. Further characteristics being set forth in the dependent claims.

[0008] One of the advantages of the present invention is that it is possible to transport materials safely and at considerable heights, that the apparatus is provided with attachments for a set of accessories allowing the transport of materials of various nature, also in the horizontal plane or with very low inclinations, that the apparatus is provided with an antidrop device, that the apparatus maintains its characteristics also after prolonged service times.

[0009] These and other advantages and characteristics of the invention will be best understood by anyone skilled in the art from a reading of the following description in conjunction with the attached drawings given as

a practical exemplification of the invention, but not to be considered in a limitative sense, wherein:

- Fig. 1A is a schematic plan view of a possible embodiment of a carriage comprising the apparatus according to the invention;
- Fig. 1B is a partial side view of a detail of the carriage in Fig. 1A, relating to some elements of a braking device;
- Figs. 1C and 1D show, respectively in top view and partial side view, a detail of the carriage in Fig. 1A, relating to a hold member;
- Figs. 1E and 1F show respectively in two top views with parts taken away, a detail of the carriage in Fig. 1A relating to further elements of the braking device;
- Fig. 2 is a schematic side view of the assembly made up of the carriage in Fig. 1A and a portion of the guide structure according to the invention;
- Figs. 3A, 3B and 3C show schematically in corresponding side views, a detail of the carriage in Fig. 1 in different operating configurations;
- Figs. 4A, 4B, 4C show an element of the guide structure respectively in front view, in side view and in plan view with parts partially omitted;
- Figs. 4D, 4E and 4F show schematically a detail relating to a base portion of the guide structure, in front view (Fig. 4D), in side view without the wheel (Fig. 4E), and in side view with the wheel (Fig. 4F);
- Figs. 5A and 5B show the detail of a connection element of the elements making up the carriage-guiding structure, in side view (Fig. 5A) and in a cross-section taken on line A-A in Fig. 5A;
- Fig. 6 shows in a schematic side view a further element of the guide structure 60 able to change the inclination of the same guide structure.

[0010] With reference to the figures of the accompanying drawings, the apparatus in question, intended for transporting the materials along a guided path to be inclined through an angle ranging from 0° to 90°, is essentially made up of a guide structure 1 defined by one or more elements 11, 60 modularly associable with each other, each of which consists of two pillars 4 disposed parallel to the longitudinal development of the structure, and along which there are provided a plurality of engagement elements (3) equidistant from each other by a preset extent; and of a carriage (2) able to slide along said structure (1) and provided with motor means (8, 80) which are connected, through means (5) for the transmission of motion, to means interacting with said engagement elements (3) of the structure (1) so as to move the carriage bidirectionally along said structure (1).

[0011] In particular, each element 11 of the structure 1 comprises two parallel pillars formed by C-shaped section bars and whose opening defines a guide 40. The openings of the two section bars 4 are disposed facing each other and inwardly of the structure 1.

The two pillars 4 are united by a plurality of cross-pieces 3 which make up, in the illustrated example, the said engagement elements.

The cross-pieces 3 have a tubular hollow shape with square cross-section and are all disposed on one side only with respect to pillars 4; this expedient bringing about several advantages.

[0012] For example, on the side opposite to that of crosspieces 3, the regions of the guides 40 are made accessible for sliding the carriage 2 along the two pillars 4, as will be described later on; besides, it is possible to use the lateral holes 30 of the crosspieces 3 as fixing points in order to engage the guide structure 1 or to install accessories such as pulleys, for example, for guiding the motor's power cable.

[0013] The elements 11 of the guide structure 1 (such as the adjustable angle element 60 to be described below) are connected to each other by means of pairs of rigid connections (e.g. made from steel) which are able to be bolted and easily assemblable. Shown in Figs. 5A and 5B is an embodiment of a connection 39. This has two pairs of holes 37 which define corresponding seats for bolts 38 to be inserted into as many through-holes 36, respectively, on the upper and lower end of the pillars 4 of two elements 11 to be connected. In Fig. 5B, numeral 38 designates the axis of the bolt, while the holes 36 are indicated in Fig. 4C. The distance between the holes 37 provided on the connection 39 is equal to the sum of the distances between the holes 36 plus their distance from the respective pillar 4.

[0014] Shown in Fig. 6 is the adjustable angle guide element 60 which allows changing the inclination by 25° - 45° between two elements 11 of the guide structure. The illustrated guide element 60, which can be associated at its ends with two modular elements 11, is made up of two portions 90 and 91 able to rotate relative to each other about a pivot 69 going through connecting brackets 92 and 93 exhibited by the two portions 90 and 91. Provision is also made for a rigid rod 62 whose ends 94 have their respective fulcrum on other two brackets 95 and 96 presented by the portions 90 and 91.

The positioning on variable inclinations (e.g., between 25° and 45°) is achieved by rotating the two portions 90 and 91 about the above mentioned pivots and fixing the same portions to each other by means of an adjusting and fixing flat element 97. The flat element 97 is pivoted in one end 98 thereof to the portion 90, and is provided with a plurality of holes 99 disposed spaced from each other by such an extent as to result, one at a time, in alignment with a hole 61 of portion 91 to allow fixing it at a predetermined angle by means of a bolt going through said hole 61 and one of holes 99.

[0015] The rod 62 is provided with a movable cross-piece 63 which, in correspondence of the various inclinations taken up, will be able to result positioned tangent to the drive chains 5, as will be described later on, and to relevant teeth or notches 6. Also provided at the ends of rod 62 are two fixed crosspieces 64 and 65 which

have a rectangular (not square) cross-section suited for not interfering with said notches when changing the inclinations.

[0016] Shown in Figs. 4D-F is an embodiment of modular element 11' suitable for making up the base of structure 1, that is, suitable for use as a support in contact with the ground or in association with one or more bottom elements 11 connected to each other. The element 11' is provided with two feet 48, each of which is hinged via a pivot 47 to a corresponding support 49. Said support 49 is, in turn, hinged to the base of a pillar 4 via a pivot 45. The pivot 47 is disposed orthogonally to the crosspieces 3 while the pivot 45 is parallel to them. In this way, it is possible to incline the structure 1 at an angle of about 50° in the direction orthogonal to the crosspieces 3, and of about 30° in the direction parallel to the same crosspieces, thereby adapting the supports also to irregular and unlevelled grounds. Fixed on the lower end of pillars 4 of element 11' are two wheels 43 rotating about relevant shafts 46 to ease the transport thereof. Each of the wheels 46 is fixed by a shaft to said support 49.

[0017] The carriage 2 consists of a frame 10 (for example, made of steel) on which a motor 8 is fixed in association with a relevant reducer 80. Also present on the frame 10 are four attachments 13 for the accessories intended to transport materials used in the building yards and for renovations, removals, and similar operations.

[0018] The accessories to be installed on the apparatus in question will be provided with four base pivots to be inserted into respective slots 13 and tightened by suitable spring latches, the said pivots being so shaped as to allow the accessory to be snap-fitted without requiring any operation on the latch which, instead, will shall be released by hand for disassembling the same accessory.

The accessory's assembly and disassembly operations will thus be performed by a single operator.

The accessories will thus be differentiated according to the different types of materials. For example, provision may be made for a basket for heavy materials of small dimensions such as, tiles, bricks, tiling, etc.; platforms can be used for bulky materials, with relevant devices for blocking the load, such as slabs, boards, casings, rolls of sheeth, etc.; tanks and buckets will be preferred for loose, castable or powdery materials. Such accessories can be turned over or rotated so as to ease loading and unloading operations.

[0019] The carriage 2 is provided with four wheels (20) fitted for idly pivoting into openings 40 of the guiding elements 11 mentioned above. In practice, the wheels 20 slide with close fit inside the opening of the C-shaped section bar of pillars 4 thereby ensuring, as the wheels are fully protected, safety conditions for the operator.

[0020] The reducer 80 with orthogonal axes has on its output two driving shafts on which relevant pinions 88 are mounted; each pinion 88 is engaged in a respec-

tive chain 5; the two chains 5 are alike, loop-closed, parallel to each other, and make up the means for transmitting the motion. Provided on the outer side of said chains 5 are pairs of teeth or notches 6, made for example from plastics material such as polyamide, and spaced from each other by an extent corresponding to the width of crosspieces 3, so as to contain one crosspiece. Each pair of teeth 6 is spaced from the adjacent pair by an extent corresponding to the distance between two consecutive crosspieces. Each pair of teeth 6 of a chain 6 results juxtaposed to a corresponding pair of teeth 6 of the other chain 5, so that the two pairs of teeth 6 of the two chains can engage one crosspiece at the same time.

[0021] Once activated, the motor-reducer 8, 80 drives into motion the two chains whose teeth 6, by becoming inserted in succession around the various crosspieces 3 of structure 1, move the carriage 2.

[0022] Each of the two chains 5 is kept in tension by a spring 9 which acts between a shoulder 58 of frame 10 of carriage 2 and a support of a shaft 57, the latter having a gear 56 mounted thereon and around which gear the chain 5 is made to run. In case of normal extension of the chain, the spring 59 maintains the tension constant; otherwise it is possible to intervene manually by means of an adjustment member which includes a threaded bolt 590.

The carriage 2 is advantageously covered by a safety guard (not shown in the drawings) so that the various parts, especially those in motion, will result protected against falling foreign bodies such as water, sand, deposits, etc., as well as against any accidental contact with the operator's limbs.

[0023] As best visible in Figs. 3A, 3B, 3C, 1A and 1B, the apparatus in question is also provided with automatic braking means, disposed on the carriage 2 and able to engage the structure 1 upon exceeding a predetermined speed.

These automatic braking means, designated by numeral 7 in their entirety, in conjunction with the means for the activation thereof, will be described in relation to only one side of the carriage 2, that is, as they act on one of wheels 20.

[0024] In a preferred embodiment of the invention, the braking means 77 and 730, to be described below, are provided on both sides of the carriage, with braking action on both wheels of the two sides, while the means for activating said braking means are provided on one side only. The said means 7 comprise a disc 79 idly rotating on a pivot 68 of an arm 73, one end of which is fixed on top of a shaft 16, thereby oscillating vertically sideway of the frame 10 of carriage 2 and in such a way that the disc 79 will intercept the crosspieces 3 of the guide structure during the carriage's travel. On top of said shaft 16 and solid to arm 73 there is also fixed an extension arm 730 whose free end 77 is wedge-shaped and in such a position as to result able to be inserted under the wheel 20 of carriage 2.

[0025] The other end of arm 73 is provided with a slot 67, inside which a pivot 72 disposed on an appendix of a small disc 70 can slide, said small disc exhibiting a tooth 701 and a hook 71. The small disc 70 is able to rotate about a pivot 702.

Moreover, a spike 74 is hinged to the frame of the carriage, the free end of said spike interacting with the tooth 701 which projects from the profile 700 of the element 70.

Every time that the disc 79, during the travel of carriage 2, abuts against a crosspiece 3, it is caused to lift with respect to the latter; however, in normal conditions, that is, when the carriage is not traveling at an excessive speed, the disc 79 is recalled to its natural starting position by a suitably calibrated spring 15 which acts on the shaft 16 so that the latter moves the arm 73 bringing back the disc 79 downwards and maintaining the small disc 70 in neutral position, that is, with the hook 71 lifted up with respect to the crosspieces 3 (as can be viewed in Fig. 3A). This is due to the fact that the arm 73, when pushed downwards, keeps in a low position also the pivot 72 housed in the slot 67 of arm 73.

[0026] In case of a carriage's excessive downward speed, possibly caused, for example, by a failure of the motor shaft, or of the relevant brake or the reducer, the disc 79, by knocking the crosspiece 3 at a higher speed, as induced by the moving masses, is made to jump higher than normal (as illustrated in Fig. 3B) so that the spring 15 is unable to timely recall the small disc 70 via the pivot 72, and the same small disc 70 is made to rotate in anticlockwise direction up to the position in which the free end of the spike 74 results beyond the tooth 701 of the small disc 70; accordingly, as illustrated in Fig. 3B, the hook 71 results moved to the level of the crosspiece 3 so that the hook 71 hits a crosspiece 3 and then releases itself from it by rotating further the small disc 70 anticlockwise until the latter pushes (as shown in Fig. 3C) the wedge-like tip 77 of the extension arm 730 under the wheel of carriage 2 thus causing the latter to brake suddenly. The braking means described above for one side of the carriage 2 are also provided for the other side, as well as for the two wheels 20 disposed in correspondence thereof. In this regard, Fig. 1A shows a second wedge 77.

[0027] What has been previously described clearly demonstrates the advantages of the present invention, especially in comparison with the prior art. Among the advantages of the proposed solution, some relate to the novel characteristics set forth below.

[0028] The apparatus is provided with a carriage of self-propelled type which moves along the guide structure 1 without requiring additional components such as wire ropes, racks or other components.

The crosspieces 3 are disposed on one side with respect to the structure's profile; such solution offers various and cost-effective possibilities as far as the connection between crosspieces and additional elements of the structure, and the propping/fixing systems

through the free side holes of the crosspieces, are concerned.

The lower portions of the base element 11' are made to pivot in the direction of the inclination of the ladder (for example, 50°) and in the direction orthogonal to the inclination (for example, 30°); this makes the guide structure 1 for a safe use thereof even on irregular grounds. Besides, two wheel are provided on the base element 11' which makes the transport thereof easier.

[0029] In particular, with respect to the elevators with carriage pulled by cable, the following advantages will result most evident:

- possibility of changing the inclination of the guide from 0° to 90° relative to the ground; the horizontal disposition, as a limit, is made possible by the fact that the motor is on board of the carriage and is able to exert a torque for both a lifting and lowering motion: the descent of the load does not, in fact, occur by gravity only;
- possibility of changing the length of the path by simply adding one or more modular guide elements 11, without disengaging the pulling cable and then re-engaging it, as necessary, instead, when using the traditional systems with a pulled carriage;
- the present solution prevents the carriage from getting stuck and blocked when moving down (especially, with no load, owing to the presence of dirt on the guides or to inaccurate dimensional tolerances) as a torque is operated both upon the lifting and lowering motion;
- the assembly at the building yard is made easier especially because there is no need of driving out the pulling rope over the top pulley and any other pulley possible present in correspondence of a curve in the path; in short, the proposed apparatus is easier and the installation time is reduced by more than 50%;
- even if the machine in question is one that has been designed with mechanical solutions, it does not require any adjustment, as both the chains 5 and the automatic braking means require no intervention; as for the chains, for example, the automatic tensioning system allows the chains to resume their natural elongation with the passing of time;
- the braking means 7 act concurrently on both the pillars of the guide structure 1 and, moreover, they do not result affected by the accumulation of foreign materials, nor by the action of weather agents;

only a yearly replacement is necessary for the cable or other components.

[0030] In comparison with the elevators with self-propelled or rack-operated carriage, the following advantages can be pointed out:

- the proposed solution is simpler since the guide structure is constructed with no elements added for

moving the carriage through the rack;

- the type of proposed drive system acts on rougher members (the crosspieces 3) than the rack-and-pinion couplings which requires higher accuracy in the connection of the various rack length; accordingly, the proposed system is more economical and requires less accuracy during the manufacturing and the in situ assembly;
- in the proposed solution, during the transport, symmetrical forces (2 for each crosspiece) are applied to the guide structure 1 and on at least two successive crosspieces; on the contrary, in the rack-operated solution, the pulling force is normally applied to one point only of the rack, the latter being possibly located along one of the sides of the guide; accordingly, there is a considerable concentration and eccentricity of stresses with consequent need of over-sizing.

Claims

1. Apparatus for transporting materials along a guided path, **characterized in that** it comprises:

- a guide structure (1) defined by one or more elements (11; 60) modularly associable to each other, each of which is made up of two pillars (4) disposed parallel to the longitudinal development of the structure and along which there are provided a plurality of engagement elements (2) equidistant from each other by a preset extent;
- a carriage (2) able to slide along said structure (1) and provided with motor means (8, 80) connected, through means (5) for the transmission of motion, with means interacting with said engagement elements (3) of the structure (1), so as to move the carriage bidirectionally along said structure (1).

2. Apparatus according to claim 1, **characterized in that** the said engagement elements (3) are made up of a plurality of parallel crosspieces disposed equidistant along said pillars (4) and **in that** the said transmission means (5) comprise at least a chain (5), driven by said motor means (8, 80) along a path parallel to the longitudinal development of the structure (1), and provided either with hold or insertion means (6) spaced apart by an extent corresponding to said preset value, so as to engage said crosspieces (3) to move the carriage (2) along the structure (1).

3. Apparatus according to claim 2, **characterized in that** the said hold means (6) consist of pairs (6) of teeth, the teeth of each pair being spaced apart by an extent corresponding to the thickness of cross-

pieces (3).

4. Apparatus according to claim 3, **characterized in that** the teeth of said pairs (6) are made of plastics material. 5
5. Apparatus according to claim 1, **characterized in that** the said pillars (1) are C-shaped section bars whose opening defines a guide (40) and **in that** said carriage (2) is provided with wheels (20) idly pivoting inside the guides (40) of the C-shaped section bars. 10
6. Apparatus according to claim 5, **characterized in that** the openings (40) of section bars (4) are disposed facing each other and inwardly of the structure (1). 15
7. Apparatus according to claim 1, **characterized in that** it comprises connection means (39) able to stably connect more removable modular elements (11, 60) to each other to form the guide structure (1). 20
8. Apparatus according to claim 1, **characterized in that** it comprises a guiding element (1) angle-shaped so as to be connected interposed between two subsequent elements (11) of said structure in order to form a non straight angle. 25
9. Apparatus according to claim 8, **characterized in that** the said angle element (60) is made up of two portions (90, 91), which can rotate relative to each other about a pivot (69) passing through two connecting brackets (92, 93) formed on said portions (90, 91), of a rigid rod (62) whose ends (94) are hinged on other two brackets (95, 96) respectively exhibited by said portions (90, 91), and of an adjusting and fixing element (97) hinged at one end thereof (98) onto one (90) of said portions (90, 91) and provided with a plurality of holes (99) disposed spaced apart and in such a way as to result, one at a time, in alignment with a hole 61 of portion 91 to allow fixing it at a predetermined angle by means of a bolt going through said hole 61 and one of holes 99. 30
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10. Apparatus according to claims 2 to 9, **characterized in that** said rod (62) is provided with a crosspiece (63) which can be moved to make it tangent to said chain (5) and to relevant hold means (6), in correspondence of the various inclinations taken up; two fixed crosspieces (64, 65) being provided at the two ends of rod (62). 50
11. Apparatus according to claim 2, **characterized in that** the said crosspieces (3) are all disposed on one side with respect of the pillars (4). 55

12. Apparatus according to claim 1, **characterized in that** it comprises a base modular element (11') provided with teeth (48) pivoting in the direction of inclination of the guide structure (1) with respect to the ground and in the direction orthogonal to said inclination.

13. Apparatus according to claim 1, **characterized in that** it comprises a base modular element (11') provided with wheels (43).

14. Apparatus according to claim 1, **characterized in that** it is provided with automatic braking means (7), disposed on the carriage (2), able to engage the structure (1) upon exceeding a predetermined speed.

15. Apparatus according to claims 2, 5 and 14, **characterized in that** the said braking means (7) comprise a disc (79) idly rotating on a pivot (68) of an arm (73), one end of which is fixed on top of a shaft (16) thereby oscillating vertically sideways of the frame (10) of carriage (2) and in such a way that the disc (79) will intercept said crosspieces (3) of structure (1) during the carriage's travel; an arm (73) being provided solid to an extension arm (730) whose free end (77) is wedge-shaped and in such a position as to result insertable under the wheel (20) of the carriage (2).

Fig. 1B

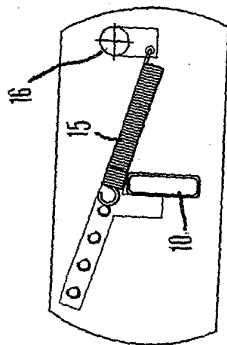


Fig. 1A

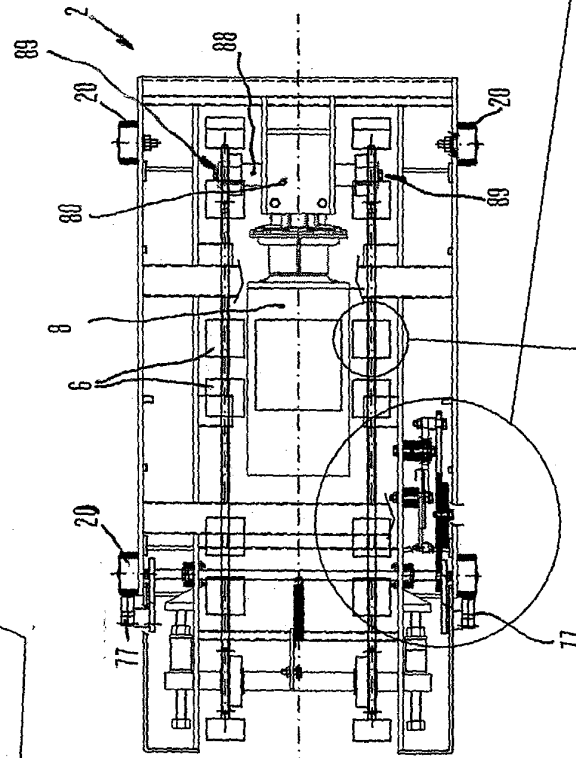


Fig. 1E

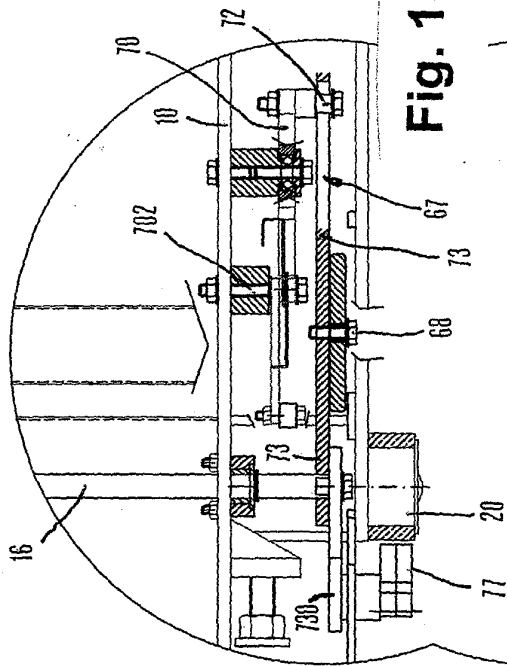


Fig. 1F

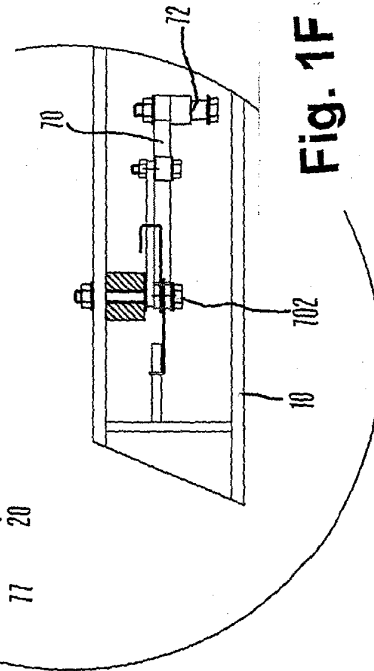


Fig. 1C

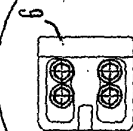
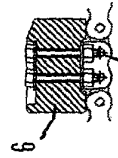


Fig. 1D



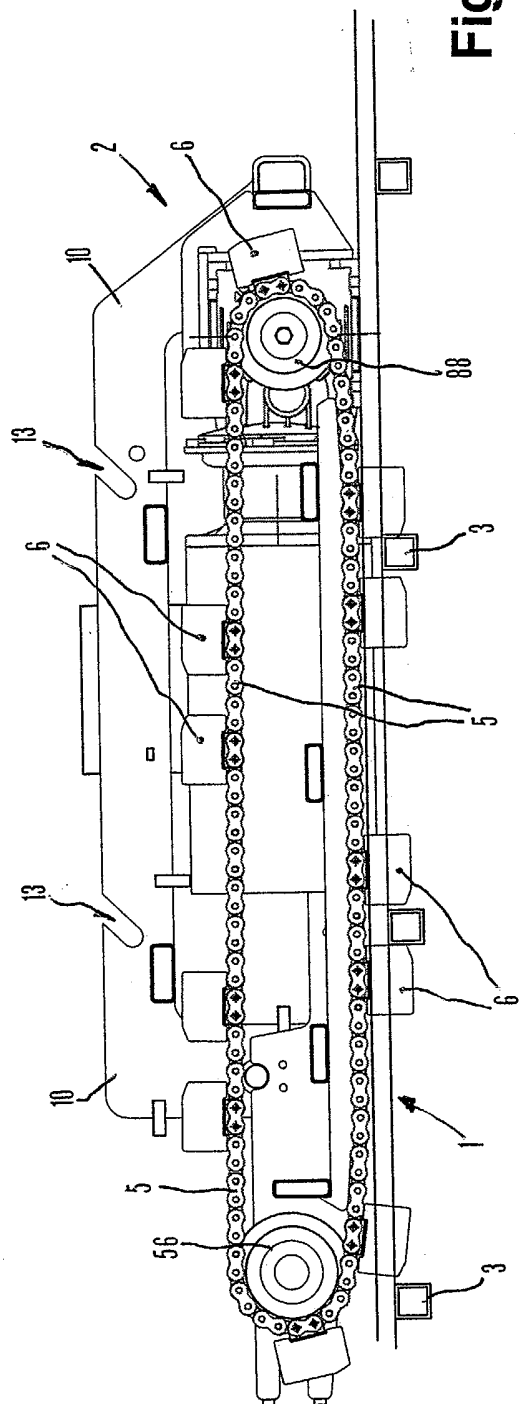


Fig. 2

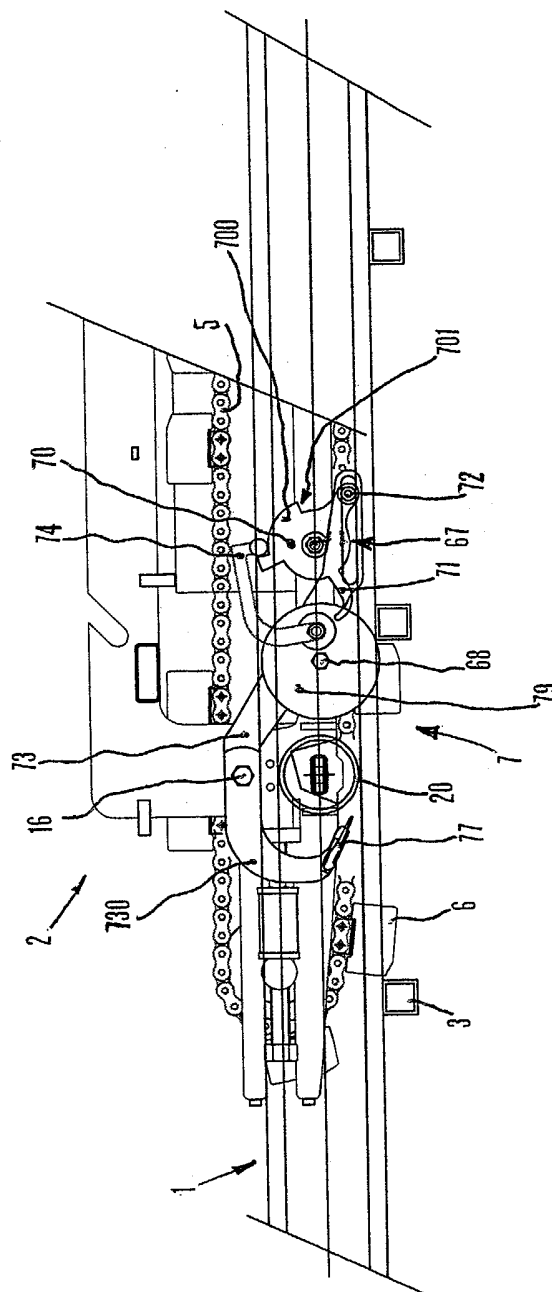


Fig. 3A

Fig. 3B

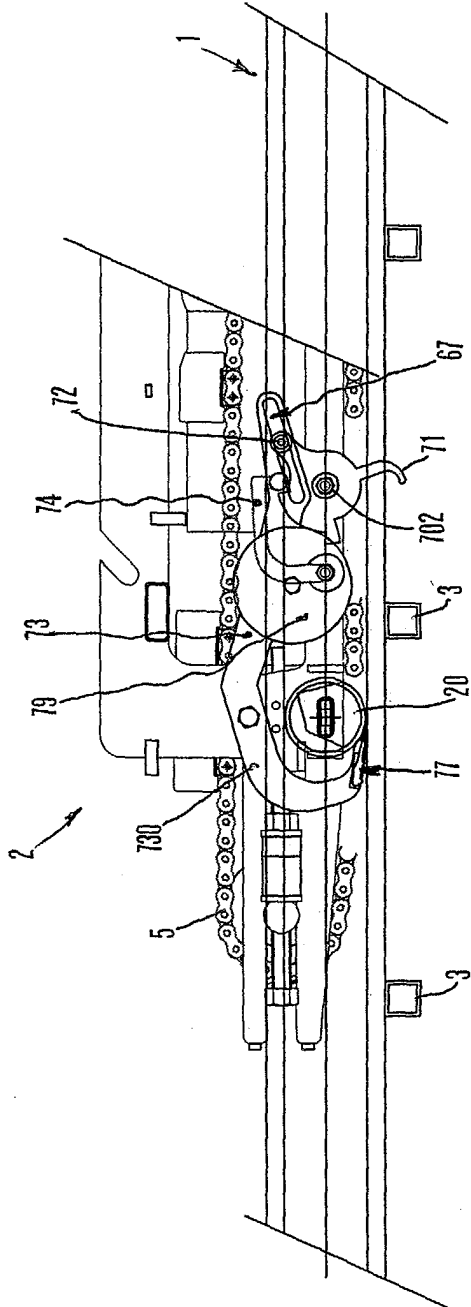
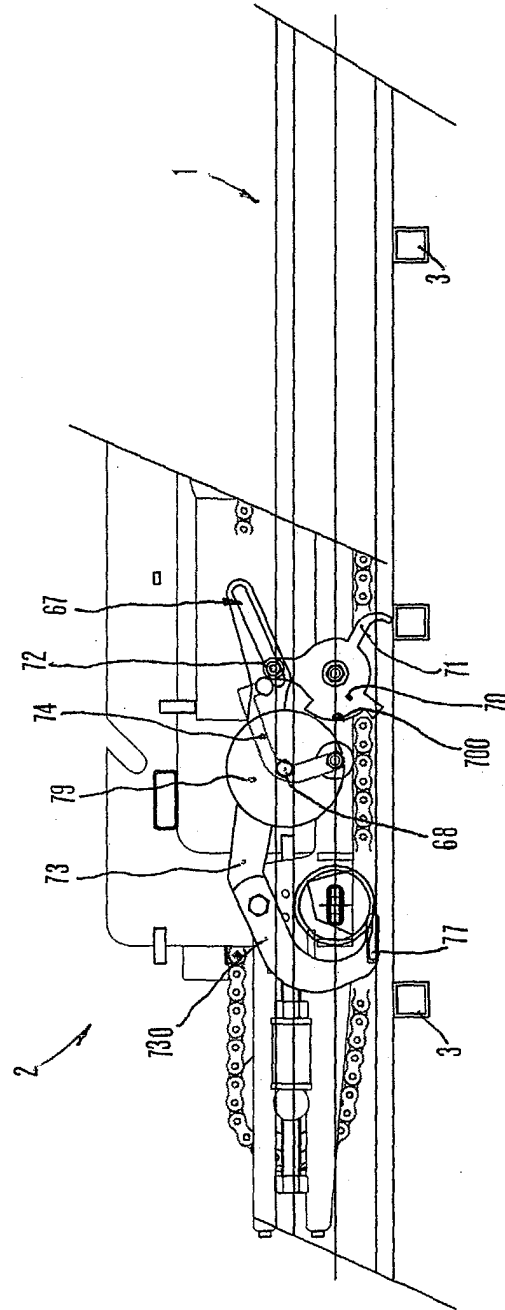


Fig. 3C



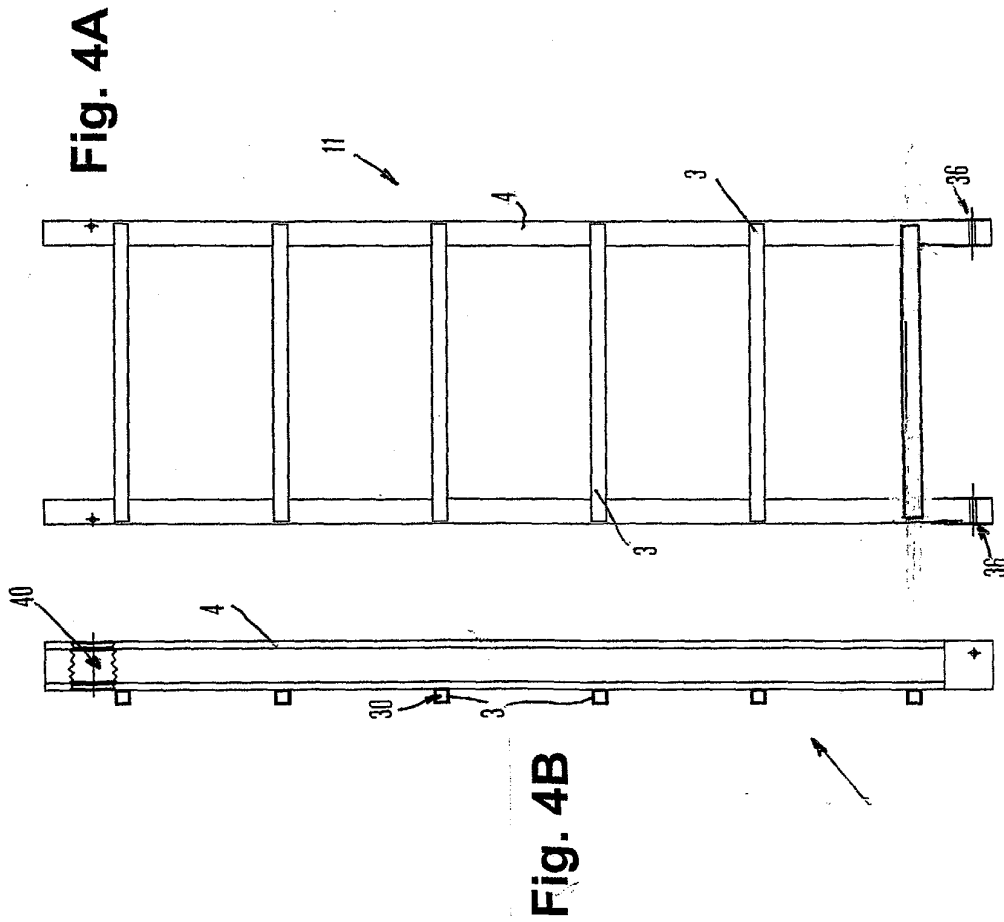


Fig. 4E

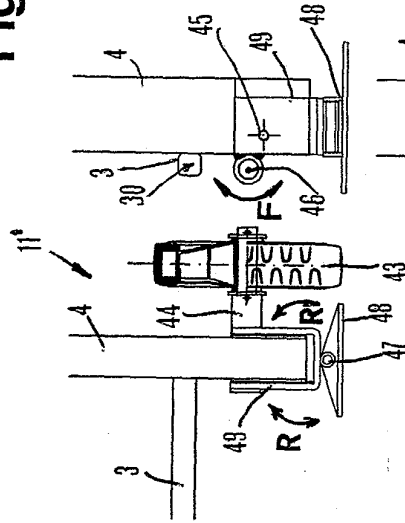


Fig. 4D

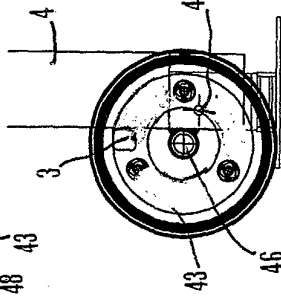
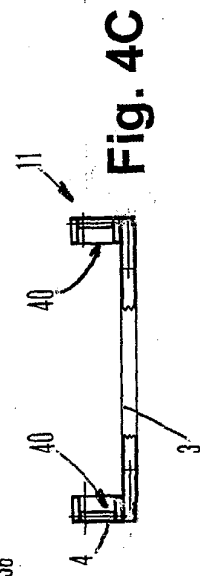


Fig. 4F



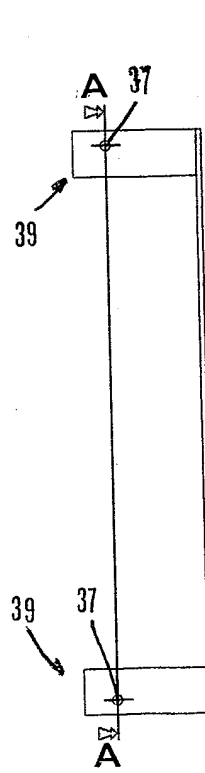
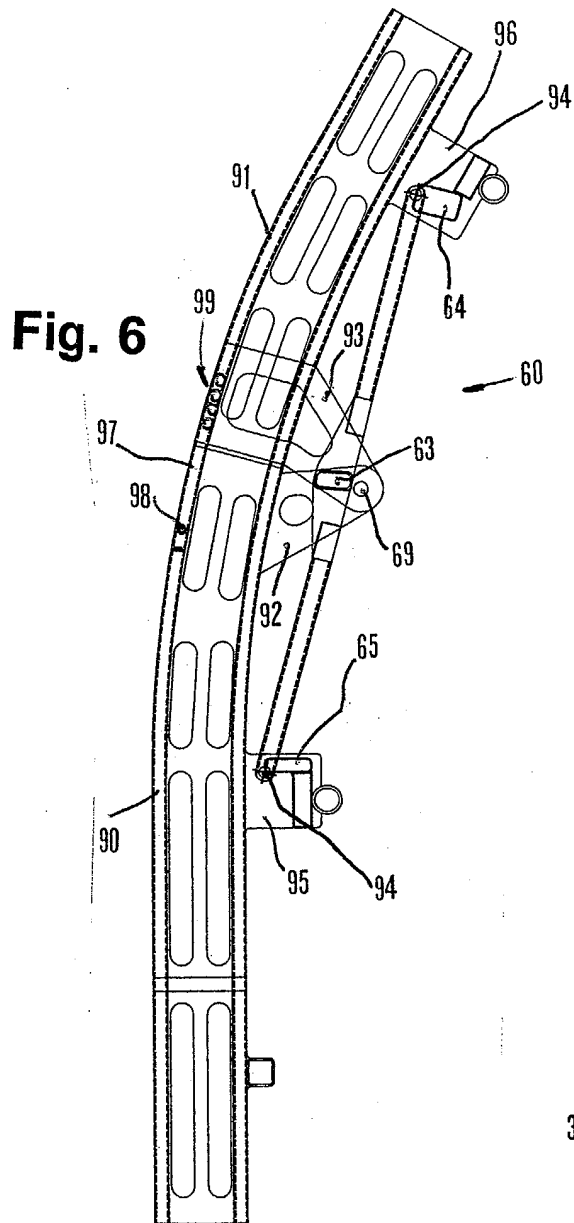


Fig. 5A

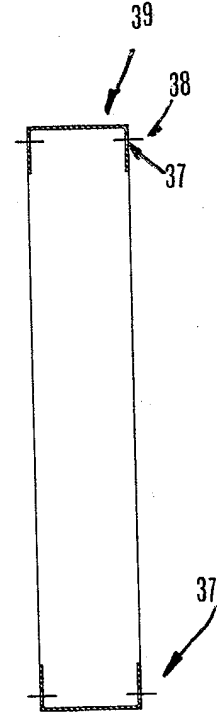


Fig. 5B



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 42 5502

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The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 8 December 2003	Examiner Eckenschwiller, A
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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