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(54) **Adjustable panel for shuttering curved walls**

(57) The panel is of the type which comprises a laminar shuttering plate (1) which can be curved to determine the surface of the shuttering, this laminar plate (1) being associated on one of its sides with a plurality of vertically arranged beams (2) of substantially open trapezoidal box structure and characterised by the arrangement of shafts (5) operating and synchronising adjustment of the curvature of the laminar shuttering element between each

of two panel beams (2) and parallel thereto, each pair of adjacent shafts (5) being associated with a single operating mechanism associated with the intermediate beam between the said shafts, a mechanism which can cause the two shafts (5) adjacent thereto to rotate, the said operating and synchronisation shafts being joined by means of connecting rods (24) articulated to the corresponding adjacent beams to change their relative position and thereby the curvature of the panel.

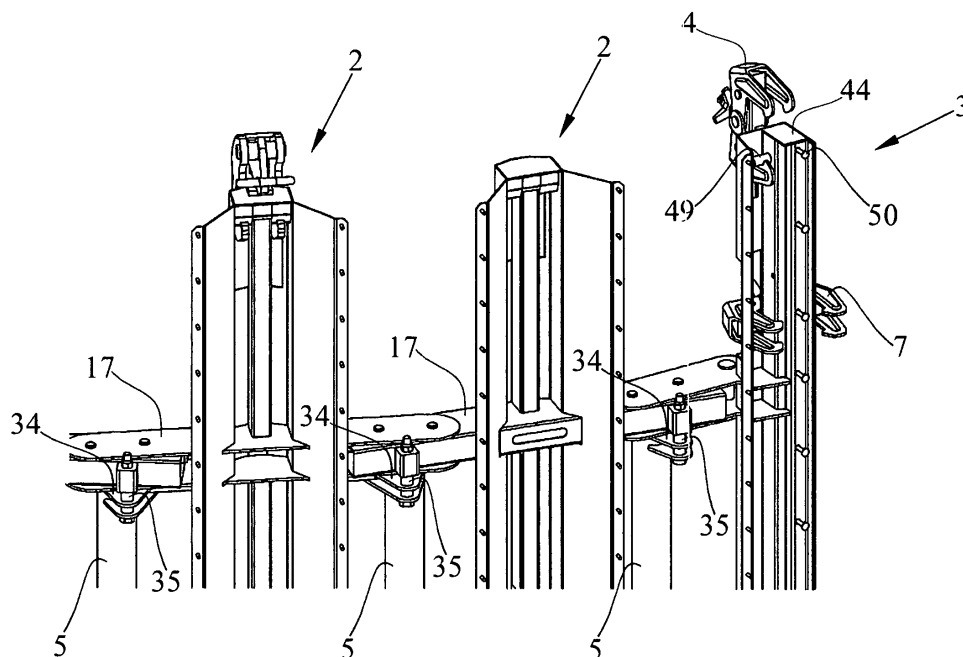


FIG.4

Description

[0001] This invention relates to an adjustable panel for shuttering curved walls which incorporates substantial novel and inventive features in comparison with what is presently known.

[0002] The adjustable panel for shuttering curved walls to which this invention relates is of the type comprising bodies of sheet steel or beams of substantially open trapezoidal cross-section located in the direction of the generatrices of the curved surfaces attached to the laminar member or shuttering plate which will adopt the curved shape required for the wall which is to be built and in which the trapezoidal bodies are connected together in an articulated way to permit adjustment of the mutual angular arrangement of the said bodies or trapezoidal beams in order to fit the desired curve.

[0003] U.S. Patent 7048249 discloses a shuttering of adjustable circular type in which adjustment of the angular arrangement of each pair of adjacent trapezoidal beams is brought about through intermediate tensioners articulated to the said beams and positioned along the same. For this, multiple points of connection positioned along the length of the beams are used in such a way that multiple tensioners are needed in order to bring about individual adjustment of each length of each beam. This is very cumbersome and somewhat unsatisfactory work given that there is no mechanical link between the various devices for adjusting each individual beam.

[0004] In other systems known in the state of the art there are different types of adjusting elements which are also characterised by being difficult to use and by little accuracy in the curve which is imparted to the laminar element of the shuttering, which is able to warp.

[0005] In order to overcome the problems indicated, following tests and experiments, the inventor has conceived an adjustable panel for shuttering curved walls in which the shuttering can be quickly adjusted to the desired curve by working on a very small number of adjustment points in a synchronised way along each beam in the form of a generatrix for the shuttering, in such a way that adjustment can be achieved quickly with great uniformity of curvature in the direction of the height of the shuttering panel, avoiding warping of the latter as a result of loss of parallelism between generatrices.

[0006] In order to achieve its object this invention provides synchronising shafts which act on the top and bottom parts between two curved shuttering panel beams parallel thereto in such a way that through the action of a single transverse shaft of hexagonal structure two longitudinal parallel shafts are brought into action simultaneously and through articulations act on a number of adjacent beams, with the result that for example from a single adjustment point it is possible to adjust the position of the two adjacent beams, that is to say the curvature of two segments or panels of the laminar shuttering element each lying between two successive beams can be adjusted simultaneously. In this way it is possible to bring

about quick and effective adjustment of the shuttering and avoid deformation due to warping of the surface of the curved shuttering by synchronising the top and bottom parts of the panel.

[0007] The synchronising shafts may be shafts which rotate about their own geometrical axes or preferably may be in the form of crankshafts rotating on an eccentric axis determined by their upper and lower pivots, which provides more favourable construction as regards resistance to the forces generated.

[0008] For a better understanding explanatory drawings of an embodiment of the adjustable panel for shuttering according to this invention are provided by way of example. The embodiment explained on the basis of these drawings is merely of an explanatory nature and not restrictive.

[0009] The invention is defined by Claim 1. The dependent claims define additional developments of the invention.

Figure 1 shows a perspective view of a curved shuttering element incorporating this invention.

Figure 2 shows a view of the frame for the adjustable shuttering panel, that is to say without the laminar shuttering element itself, corresponding to the bottom part of the shuttering element in Figure 1.

Figure 3 shows a view similar to that in Figure 2 corresponding to the central part of the adjustable shuttering panel illustrated in Figure 1.

Figure 4 shows a view similar to those in Figures 2 and 3 corresponding to the top part of the adjustable shuttering panel in Figure 1.

Figure 5 shows an elevation of the top part of the adjustable shuttering panel without the curved laminar element.

Figure 6 shows a cross-section through the section plane indicated in Figure 5.

Figure 7 shows a cross-section through the section plane likewise indicated in Figure 5.

Figure 8 shows another transverse cross-section likewise indicated in Figure 5.

Figure 9 shows a detail of the device operating the lefthand part in Figure 7 on a larger scale.

Figure 10 shows a detail in cross-section of the attachment of a clamp to a beam on one of the edges of the adjustable shuttering panel for curved walls which is designed for attachment to another lateral panel.

Figure 11 shows an arrangement of fixing clamps on two shuttering panels for curved walls according to this invention, at its upper edge.

Figure 12 shows a perspective view showing the articulation of a synchronisation shaft with a lateral edge beam in greater detail.

Figure 13 shows a perspective detail of the top end of a lateral edge beam with a housing for the laminar shuttering element.

Figure 14 shows a transverse cross-section of the lateral edge beam in Figure 13.

Figure 15 shows a view in elevation of a shuttering panel without the laminar shuttering element in which section plane G-G in Figure 16 will be seen.

Figure 16 shows a detail in cross-section of the synchronisation shaft of the crankshaft type.

Figure 17 shows a view similar to that in Figure 15, showing the cross-section of a synchronised shaft articulation with its terminal connecting rod.

Figure 18 shows a detail in cross-section along the section plane indicated in Figure 17.

Figure 19 shows a perspective view of the top part of a lateral beam of a shuttering panel according to this invention in which the position of a supporting clamp in a crossbeam of the beam itself will be seen.

[0010] As will be seen in the figures, the shuttering curved walls to which this invention relates comprises multiple panels joined together by means of clamps each of which can be curved as shown in Figure 1, comprising the laminar element which can be shaped into a curve -1- and various beams -2- of special cross-section which will be described below attached equidistantly to laminar element -1-, with the arrangement being supplemented by beams -3- for each of the edges located to the left and right of the panel illustrated respectively.

[0011] The various panels -1- may be connected vertically through clamps -4- and horizontally through clamps -7- as will be explained in greater detail below. There are also suspension hooks for raising and lowering them, such as hook -16- in Figure 1.

[0012] An essential feature of the adjustable panel for shuttering according to this invention is synchronisation of the adjustment of the radius of curvature of element -1- through aligning the adjustment elements along the generatrices of the panel in order to avoid warping of the latter with loss of parallelism between generatrices. This is achieved through the provision of shafts -5- parallel to the panel beams with one located between each two beams as illustrated in Figure 1. These longitudinal shafts

-5- can be rotated through the action of adjustable length arms -6- which are housed in one of beams -2- and act directly on two adjacent longitudinal shafts -5-, and through the articulations which will be explained the latter act on the side walls of the adjacent beams. As will be seen in Figures 3 and 9, each arm -6- which is adjustable for length has an external structure that is preferably hexagonal prismatic as this corresponds to a commercially-available section and has internal openings -8- and -9- threaded in opposite directions in which threaded rods -10- and -11- are respectively housed in such a way that rotation of arm -6-, for example by means of a spanner from the exterior, brings about inward or outward movement of the respective housings for threaded rods -10- and -11- in mutually opposing directions. These rods are articulated through their ends -12- and -13- to corresponding extensions of shafts -5- which are indicated by number -14- and which may be double or single. In this respect it should be noted that the embodiment involving arm -6- with an internal thread and movable rods -10- and -11- with articulations at ends -12- and -13- is only one preferred example of construction, and it should be understood that the connection between a central control and adjustment shafts -5- may be brought about by any conventional mechanical device.

[0013] Arm -6- is fixed with the ability to rotate in one of beams -2-, for example, through the arrangement illustrated in Figures 3, 7 and 9 through collar -15- and the corresponding groove, although it should be understood that this could be achieved through any other type of assembly incorporating an enclosing bushing, bearing, etc.

[0014] Longitudinal shafts -5- parallel to the beams are linked to the adjacent beams through connecting rods -24-, as will be seen in the same Figures 3 and 9.

[0015] At the top of shafts -5- there are likewise operating members which act on the shafts through connecting rods and through the arrangement of transverse bars -17- which have slotted openings -18- connected by means of two pivots passing through extensions -19- which are lateral extensions of the adjacent beams.

[0016] The slotted openings are in the form of an arc of a circle centered on the inside face of the shuttering panel, so that the length of the arc of circumference between two generatrices is maintained constant throughout the range of adjustment.

[0017] At the bottom the connection between shafts -5- and beams -2- is similar to that described for the top through connecting rods -20- which are not shown at the top, together with wings -19- and transverse bars -17-.

[0018] As indicated previously, the synchronisation shafts can rotate about their own geometrical axes or preferably they may be arranged as crankshafts as illustrated in the figures, preferably in Figures 4, 9 and 12. In fact it will be seen from these figures that, in a way which is fixed to one of beams -2- bearing operating shaft -6- and through top and bottom bars -17-, shafts -5- are mounted in the form of a crankshaft through wings -34-

articulated through vertical pivots -35- which give rise to an eccentrically rotating shaft. Mounting a shaft -5- in the form of a crankshaft is also illustrated in Figure 15 and in the cross-section in Figure 16, and it will be seen that the arrangement is the same at the top and the bottom.

[0019] Figures 17 and 18 show the articulation between one of synchronisation shafts -5- and adjacent beam -2- through intermediate connecting rods -36- in such a way that rotation of the said synchronisation shafts is transmitted to said adjacent beams -2-.

[0020] Beams -2- have a special structure which can be seen especially in Figures 6 to 9 and 12. In Figure 12 in particular it will be seen that the said beams have a central column with a prismatic or similar structure which imparts great rigidity to the beam and that in the situation illustrated in the figures they comprise a pentagonal prismatic structure with side faces -25- and -26- substantially perpendicular to laminar shuttering element -1- and another two faces -27- and -28- which are inclined with respect to side faces -25- and -26- and a further face -29- perpendicular to said side faces -25- and -26- and substantially parallel to laminar element -1-. The beam is supplemented by two oblique wings -30- and -31- secured to laminar shuttering element -1- by means of flanges and bolts. The said columns strengthening the beams are provided with openings for clamps or other types of access such as upper longitudinal openings -32- and "tightening eye" openings -33- and others of the like.

[0021] Figures 13 and 14 show details of the construction of side beam -3- of the open type which has straight faces, giving rise to a general prismatic structure which on its front face has a longitudinal opening -46- for the insertion of one of the jaws of a clamp providing a vertical joint between an adjustable wall panel and another located at the top as will be seen in the detail in Figure 11. The front face of beam -3- has a longitudinal abutment -45- designed to limit the transverse position of the clamp so that the arms thereof do not interfere internally with beam -3-. Internally, the beam has a stepped plate -37- joined by flanges -38- and -39- on its edges, preferably by laser welding, to the front face of beam -3- and the edge -40- of side face -47- of beam -3- respectively. On the edge of the other side -48- of the beam there is a second flange -41- of structure similar to that of flange -39-, and through this arrangement laminar shuttering element -1- is attached by means of bolts -42- as will be seen in Figure 14. The beam is attached to laminar shuttering element -1- partly through bolts -42- mentioned which attach flange -41- and partly through long transverse bolts -43- which pass through the beam and are incorporated in the front face of shuttering element -1- through a widening head -50- which is flush with the said panel. Bolts -43- are fixed by nuts -49- which like bolts -42- can be accessed from the interior of the shuttering, allowing easy access to the said bolts for the purposes of maintaining the panel, dismantling laminar element -1- after use one or more times in construction, replacing it by a new laminar element, or for other tasks. It should

also be borne in mind that the fact that the bolts are accessible from the rear face of the shuttering panel doubly eases the work of dismantling, because the fouling brought about by pouring of the concrete is very much reduced on this side.

[0022] A top plug -44- seals off the column comprising doubly stepped internal plate -37- and the walls of beam -3- directly opposite the same.

[0023] Figure 10 shows the arrangement of a clamp for coupling two shuttering panels by their lateral edges, only one of these corresponding to beam -3- being shown in Figures 13 and 14. As will be seen in those figures the clamp fixes a panel to the adjacent panel by bringing together its jaws on the stepped internal plates -37- incorporated within beams -3-.

[0024] Vertical attachment of one panel to another upper panel by means of a clamp is to be seen in Figure 11, one of those arms is attached to a transverse rod -49- fixed in beam -3- transversely by conventional means through which each shuttering element can be attached to another element located above it in a very firm way.

[0025] Although the invention has been illustrated and described on the basis of a preferred embodiment with the help of the appended figures, it will be understood that after they have become aware of this invention those skilled in the art may incorporate many variations and changes which will be included within the scope of this invention as defined by the following claims and their equivalents.

Claims

1. An adjustable panel for shuttering curved walls of the type comprising a laminar shuttering plate which can be curved to determine the surface of the shuttering, this laminar plate being associated on one of its faces with multiple vertically arranged beams which have the structure of a substantially open trapezoidal box, the panel also having beams at its edges for attachment to adjacent panels, **characterised by** the arrangement of shafts for bringing about and synchronising adjustment of the curvature of the laminar shuttering element between each of the panel beams parallel thereto, each pair of adjacent shafts being associated with a single operating mechanism associated with the intermediate beam between the said shafts, the mechanism of which can cause the two shafts adjacent thereto to rotate, the said operating and synchronisation shafts being connected to the respective adjacent beams through articulated connecting rods in order to change their relative position and thereby the curvature of the panel.
2. An adjustable panel for shuttering curved walls according to Claim 1, **characterised in that** the beams bearing the operating mechanisms for the two adjacent shafts have fixed transverse bars at the top and

bottom bearing shafts which are eccentric with respect to those joining them to the operating shafts synchronising adjustment of the curvature of the panel, by means of connecting arms, the said transverse bars also having slotted openings for guiding the pivots fixed in extensions integral with the adjacent beams.

3. An adjustable panel for shuttering curved walls according to Claim 2, **characterised by** the arrangement of two pivots in each integral extension of the beams which slide within the corresponding slots and further determine the end of travel positions.
4. An adjustable panel for shuttering curved walls according to Claim 2, **characterised in that** the centre of curvature of the slots lies on the internal face of the shuttering panel.
5. An adjustable panel for shuttering curved walls according to Claim 1, **characterised in that** the shafts synchronising adjustment of the curvature of the laminar shuttering element take the form of crankshafts articulated at the top and bottom to wings fixed to the beams on which the operating mechanism is mounted.
6. An adjustable panel for shuttering curved walls according to Claim 1, **characterised in that** the single operating mechanism for each two of the longitudinal synchronising shafts comprises a transverse shaft with the ability to adjust length mounted in one of the panel beams and articulated to the two synchronisation shafts adjacent to the said beam.
7. An adjustable panel for shuttering curved walls according to Claim 6, **characterised in that** the shaft which can be adjusted in length comprises a central elongated body provided with flat faces on its outer surface and threaded openings which open in each of its ends, with threads in opposite directions, connected to rods articulated to the adjacent synchronisation shafts, so that rotation of the central body of the said shaft is translated into lengthening or shortening of the distance between the points of articulation with the synchronisation shafts and the corresponding change in curvature of the shuttering panel.
8. An adjustable panel for shuttering curved walls according to Claim 2, **characterised in that** the slot openings have a shape such that the length of the arc of circumference between two generatrices is maintained constant over the entire adjustment range.
9. An adjustable panel for shuttering curved walls according to Claim 1, **characterised in that** the beams

of the panel have windows in their top and bottom ends with internal sections for the attachment of joining clamps to other panels and suspension hooks for handling of the panel.

10. An adjustable panel for shuttering curved walls according to Claim 1, **characterised in that** on each of its lateral edges the panel has beams in the form of an open box with flat sides, one of which ends in a folded flange which can be fitted to the internal face of the flat shuttering member and attached thereto by bolts which are accessible from the inside of the panel, while the opposing lateral face of the beam is fixed through its edge to a flange of an stepped plate incorporated within the beam which forms the stepped portion supporting the coupling clamp for two adjacent shuttering panels through their lateral edges.
11. An adjustable panel for shuttering curved walls according to Claim 10, **characterised in that** each of the end lateral beams of a panel have an opening on their front face opposite the laminar shuttering element which is parallel to the shaft of the beam and an internal cross-member which is firmly attached to the beam itself so that one of the jaws of a clamp intended to fix the shuttering panel to another shuttering panel located above it can be inserted and secured.
12. An adjustable panel for shuttering curved walls according to Claim 11, **characterised in that** the cross member securing the clamp comprises a pin joined to the beam by welding.
13. An adjustable panel for shuttering curved walls according to Claim 10, **characterised in that** each of the side beams for a panel has at its top end an elongated top member parallel to its longitudinal shaft which is intended to receive the fixing clamp to an upper panel at the top.
14. An adjustable panel for shuttering curved walls according to Claim 10, **characterised in that** attachment between the beam and the laminar shuttering element is brought about by means of screws supporting a lateral flange on one of the two sides of the beam directly to the said laminar shuttering element, the head being accessible from the inside of the panel and also by means of a long pin which passes through the laminar shuttering element with its head flush with the external surface thereof and secured by means of a nut on the front face of the beam which can be accessed from the inside of the shuttering panel.
15. An adjustable panel for shuttering curved walls according to Claim 14, **characterised in that** the flang-

es of the reinforcing plate are joined to the beam plate by means of linear stitching using laser beams.

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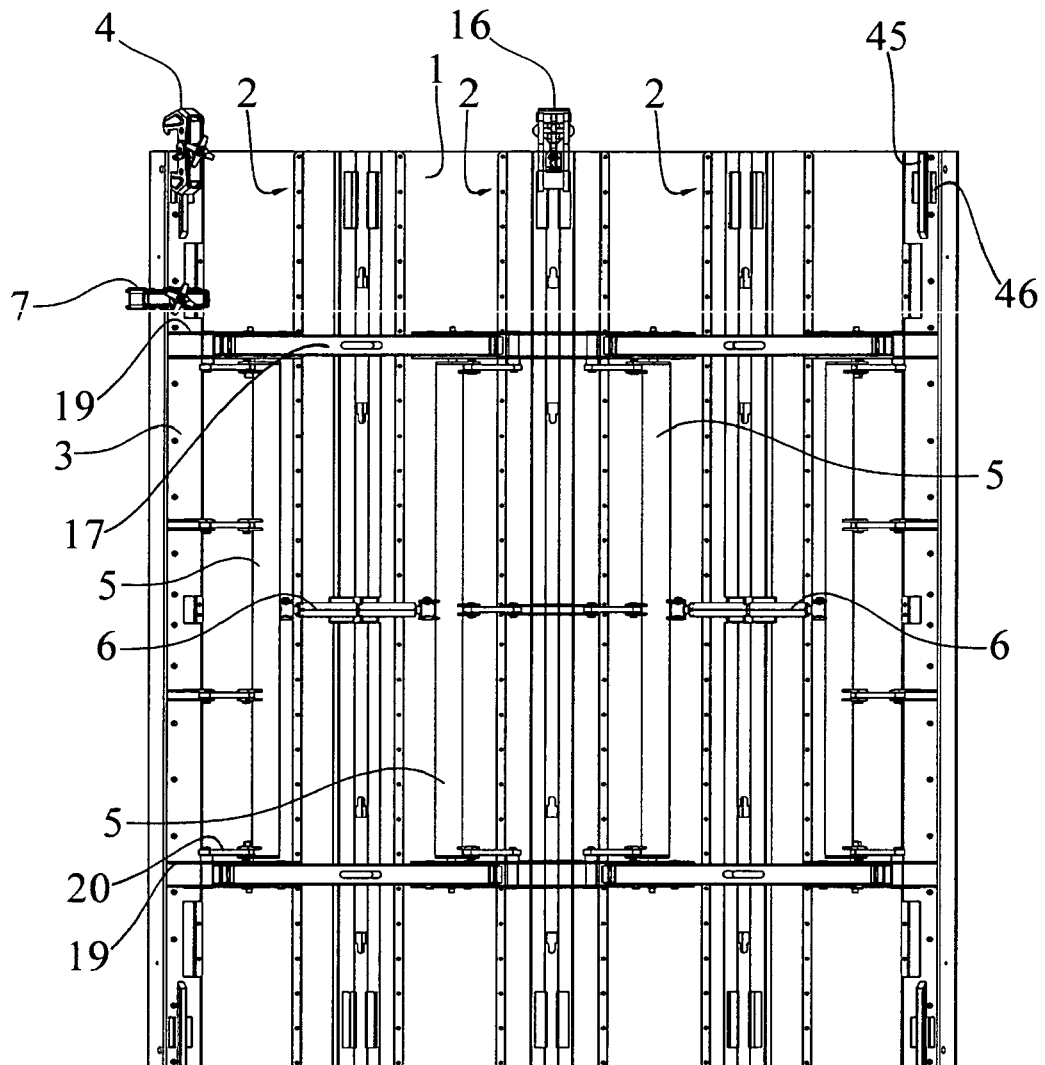


FIG.1

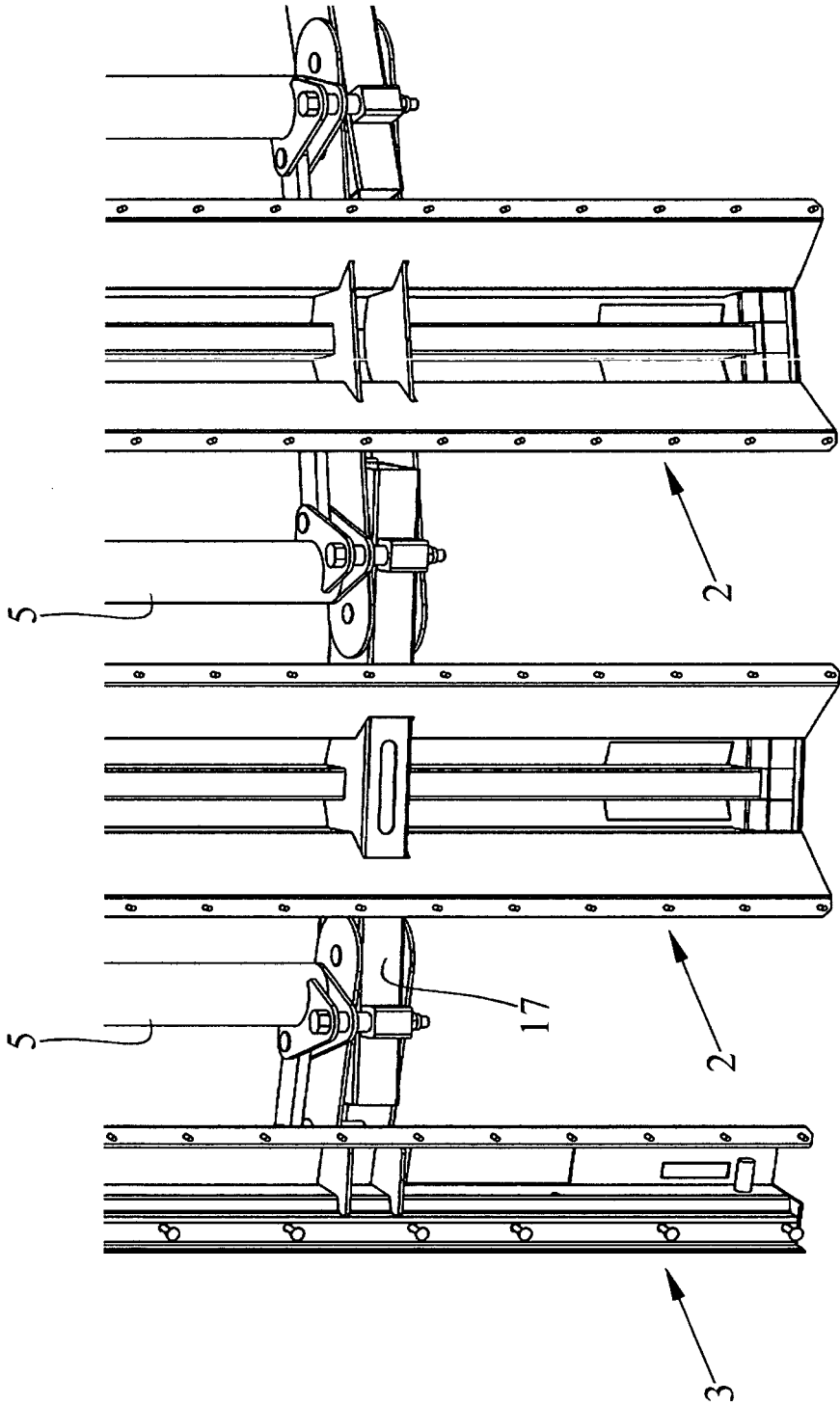


FIG.2

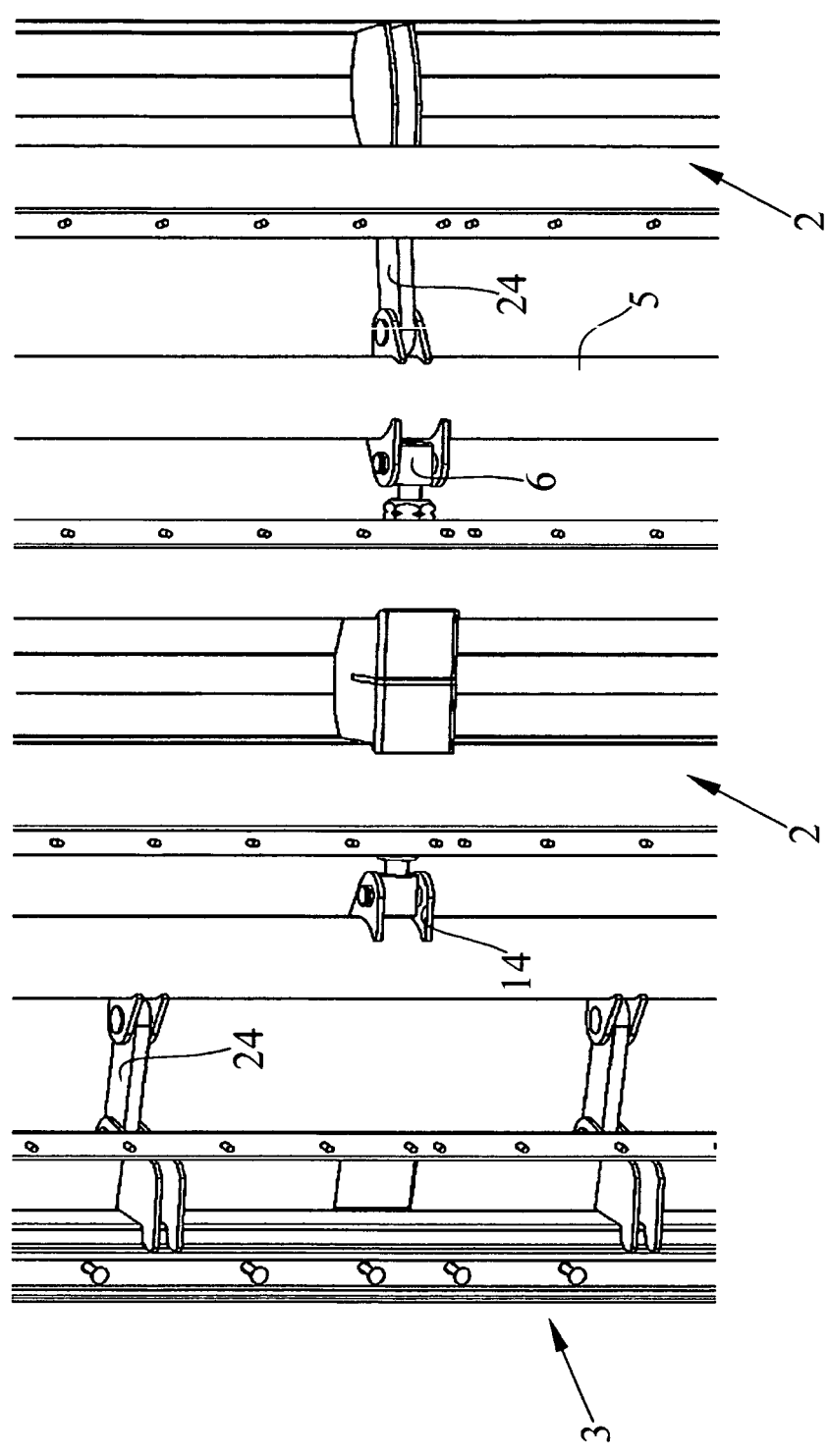


FIG.3

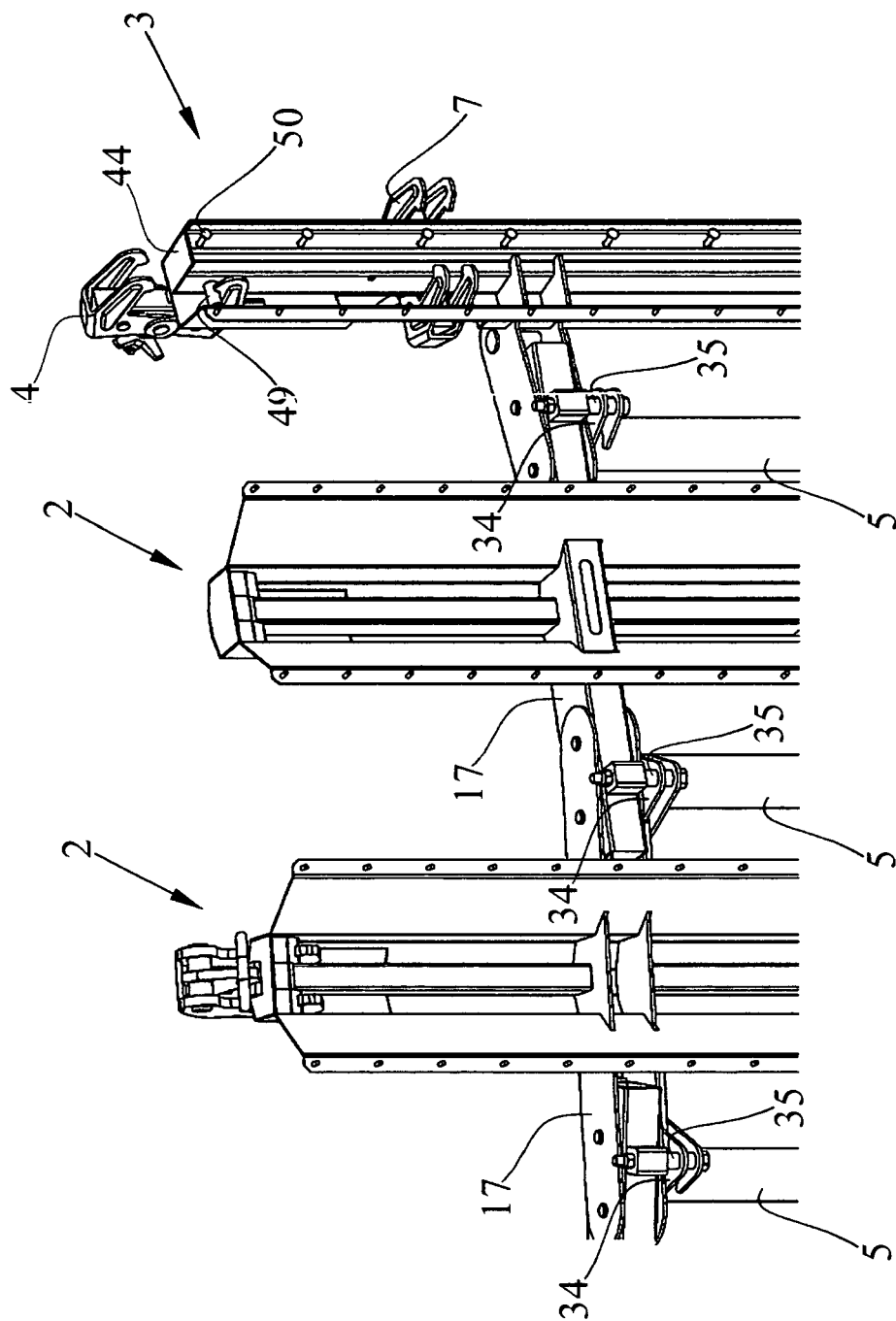


FIG.4

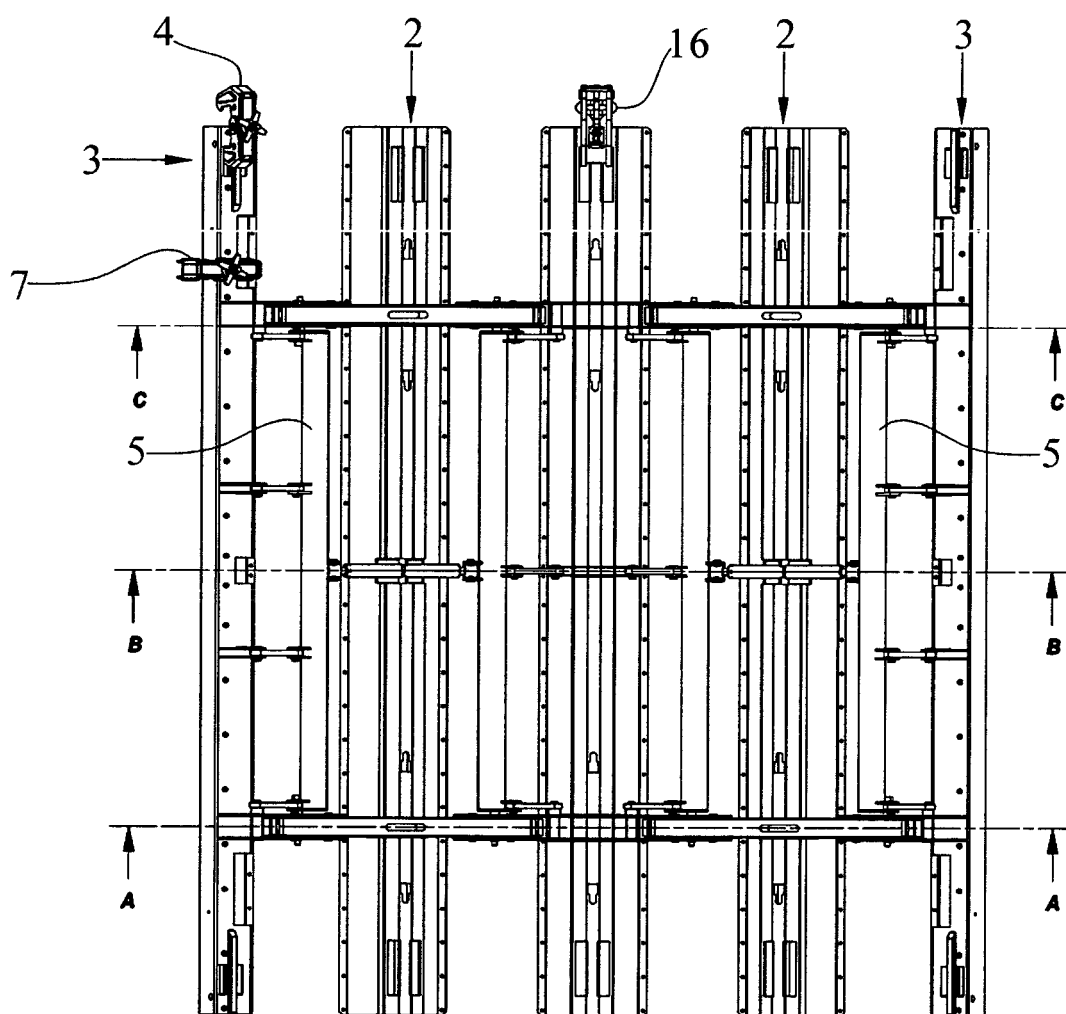


FIG.5

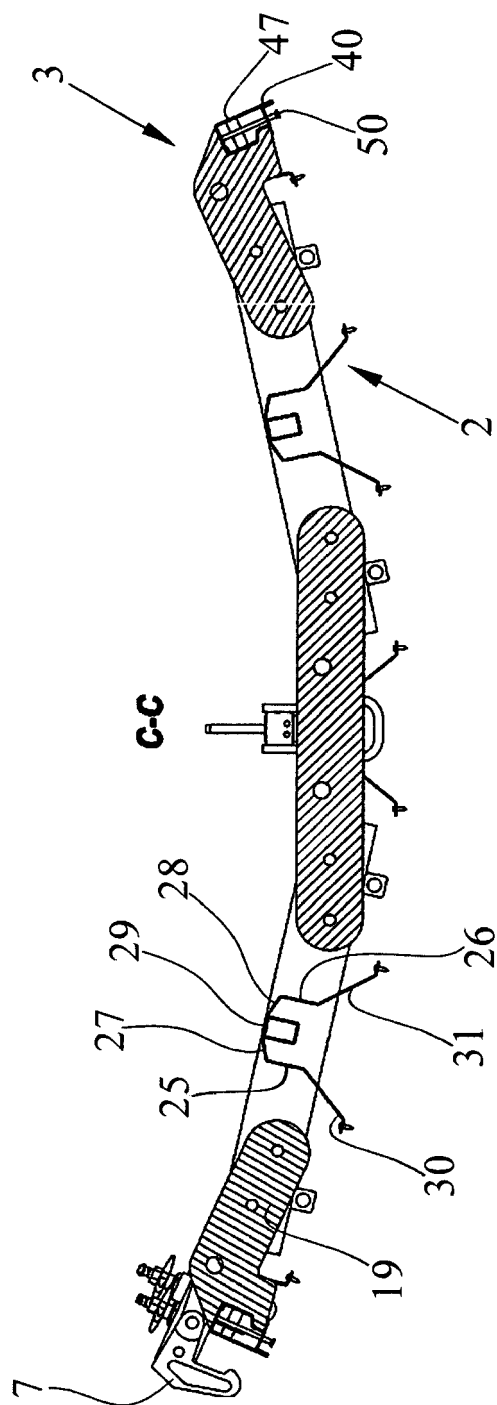


FIG.6

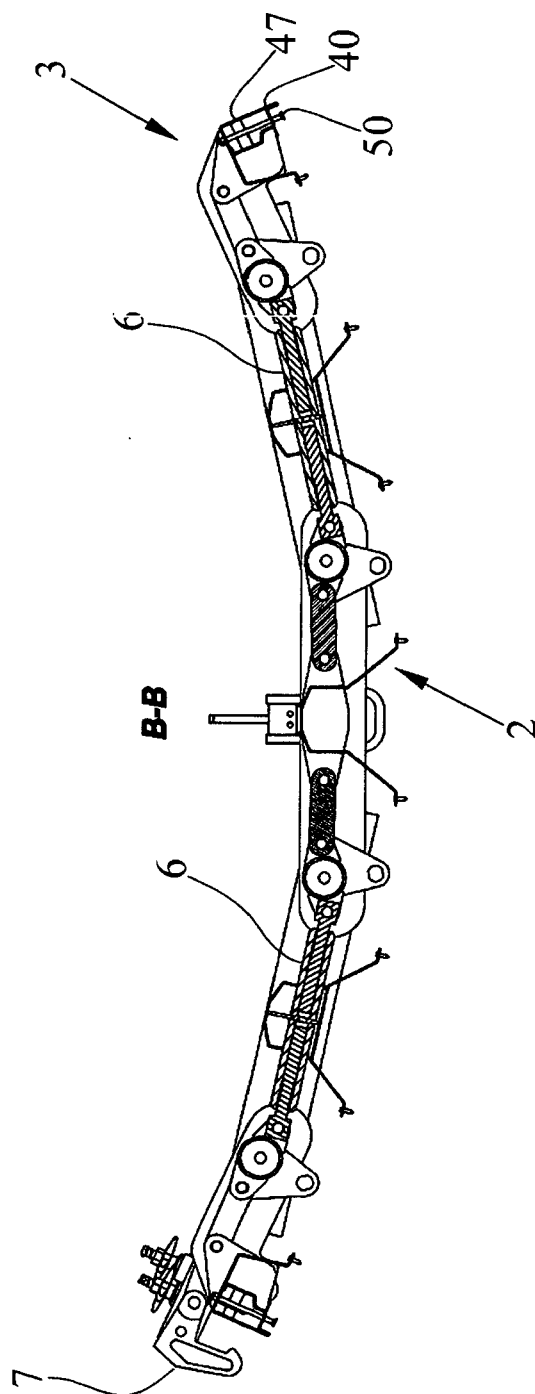


FIG. 7

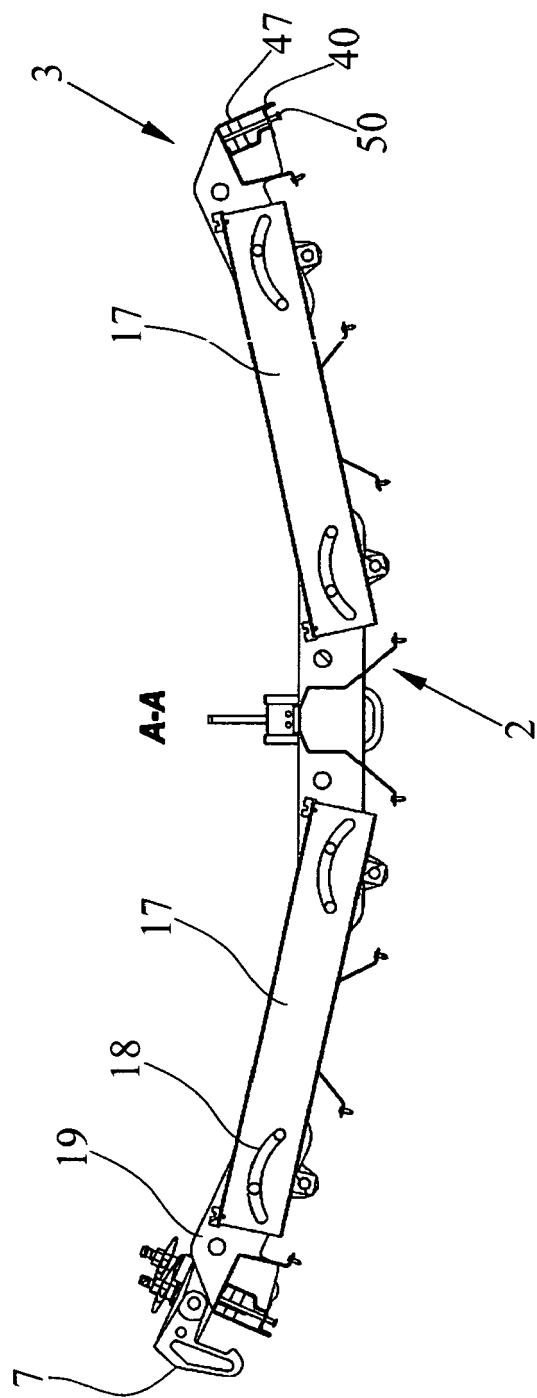


FIG.8

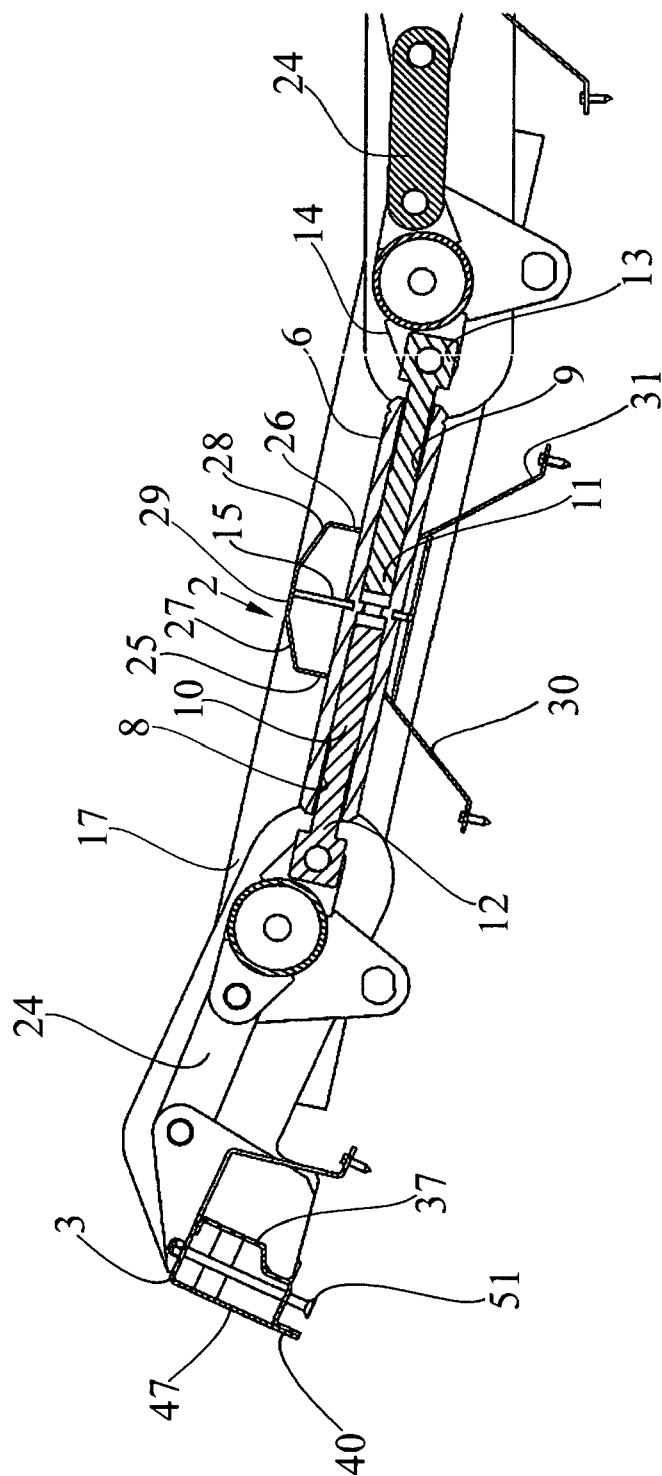


FIG. 9

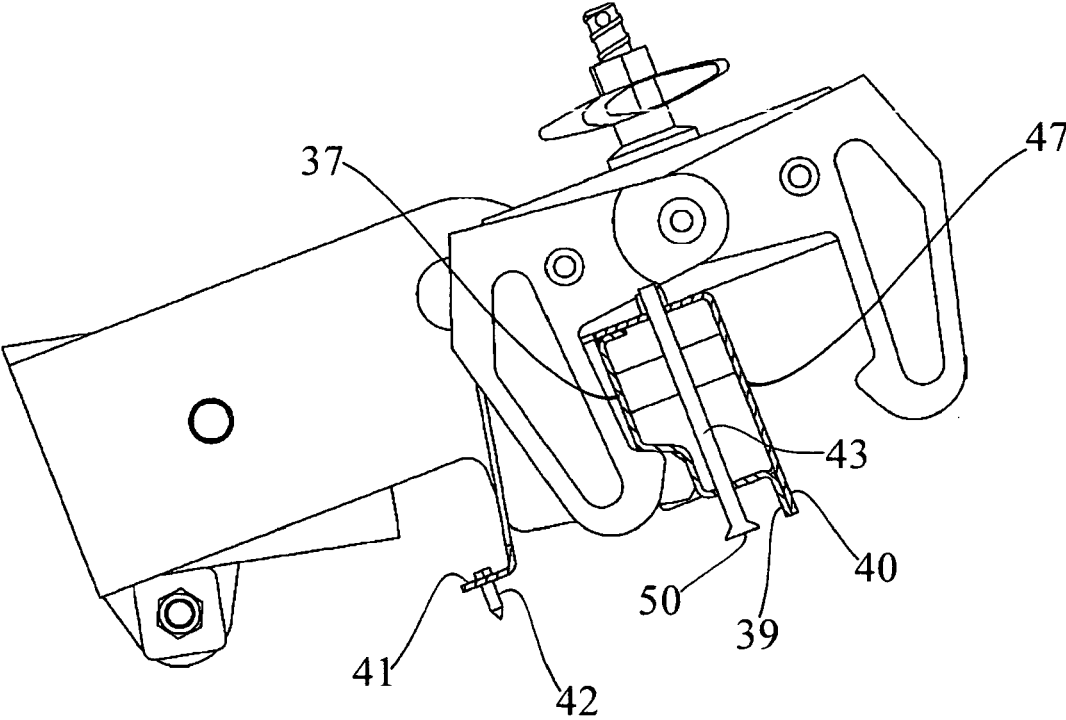


FIG.10

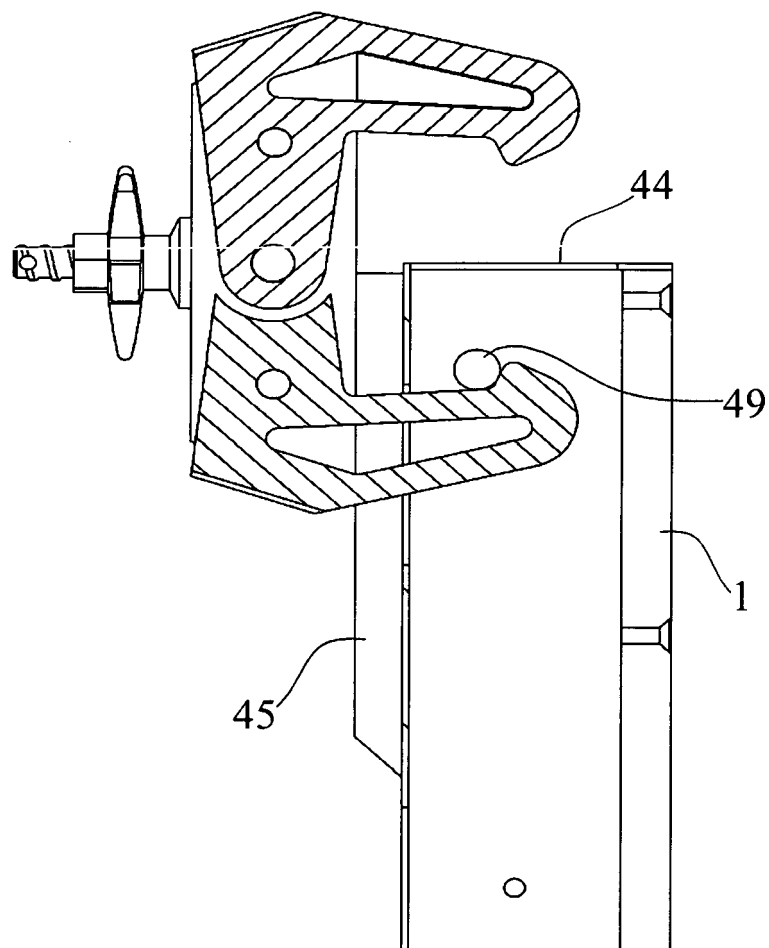


FIG.11

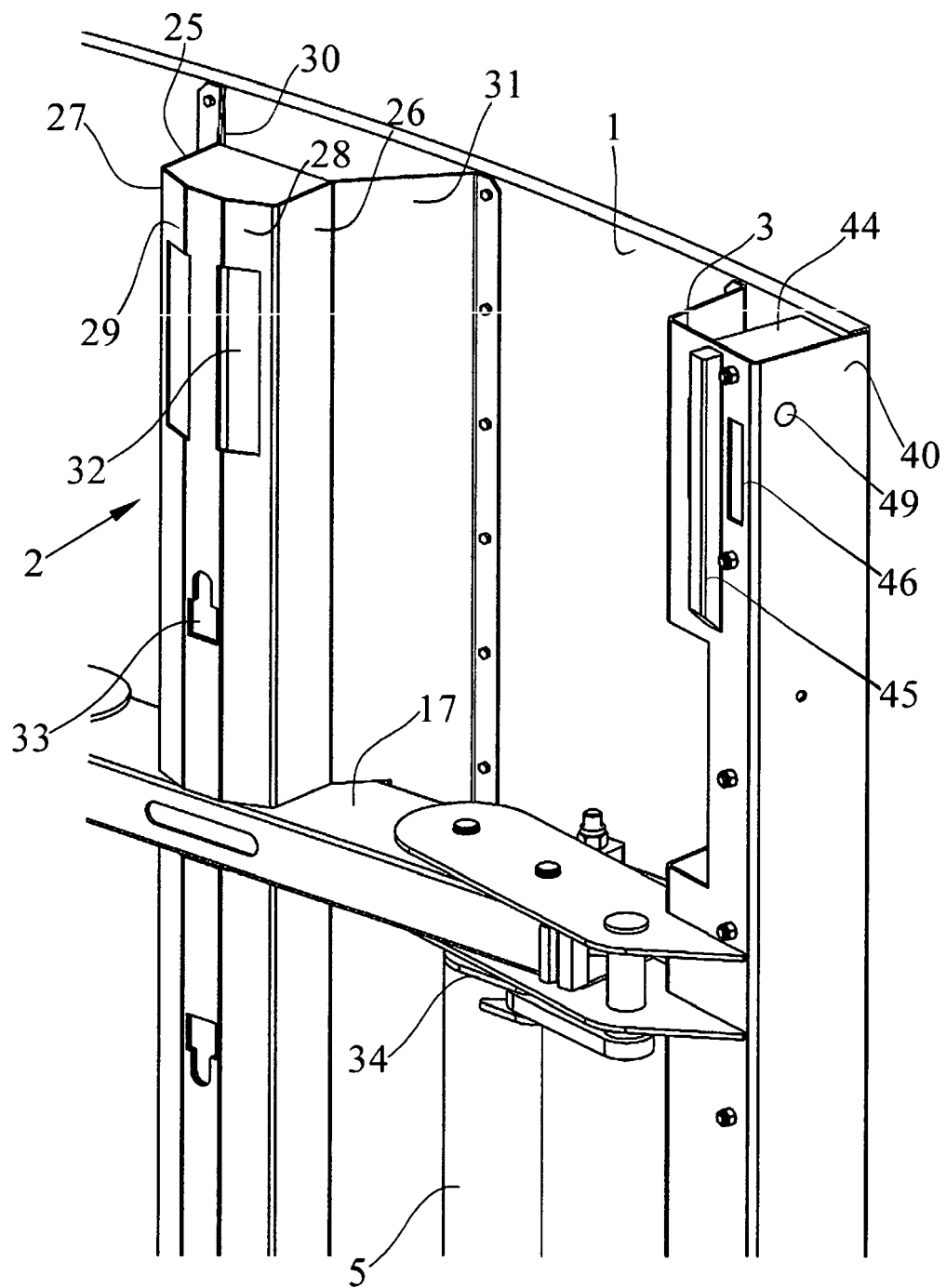


FIG.12

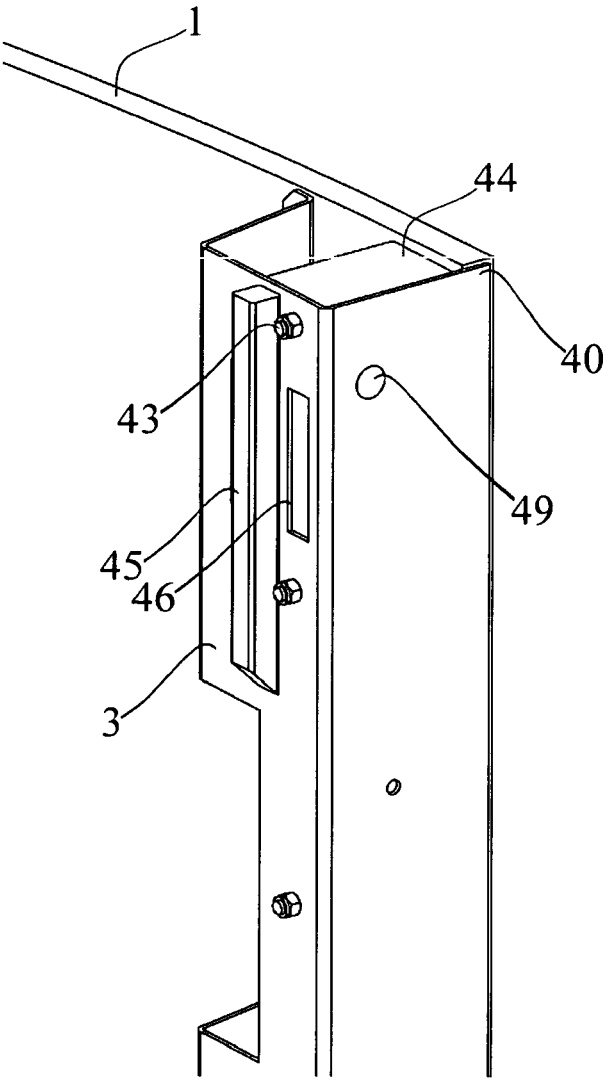


FIG.13

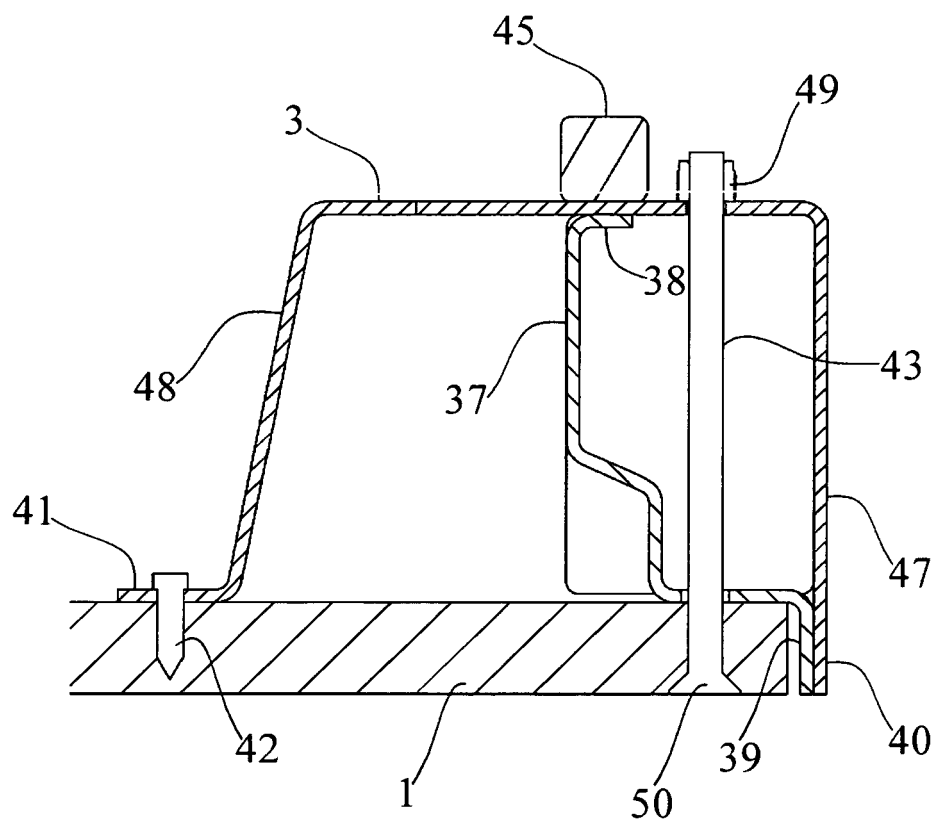


FIG.14

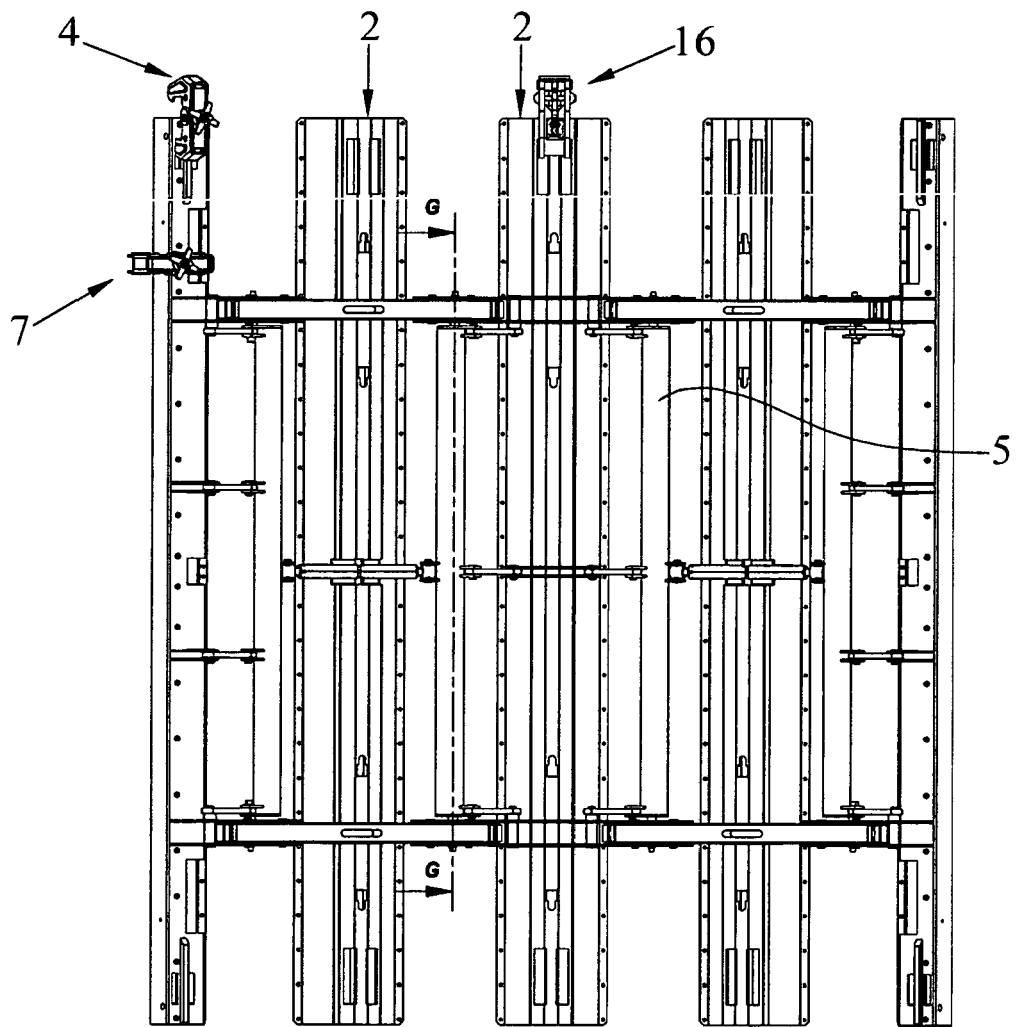


FIG.15

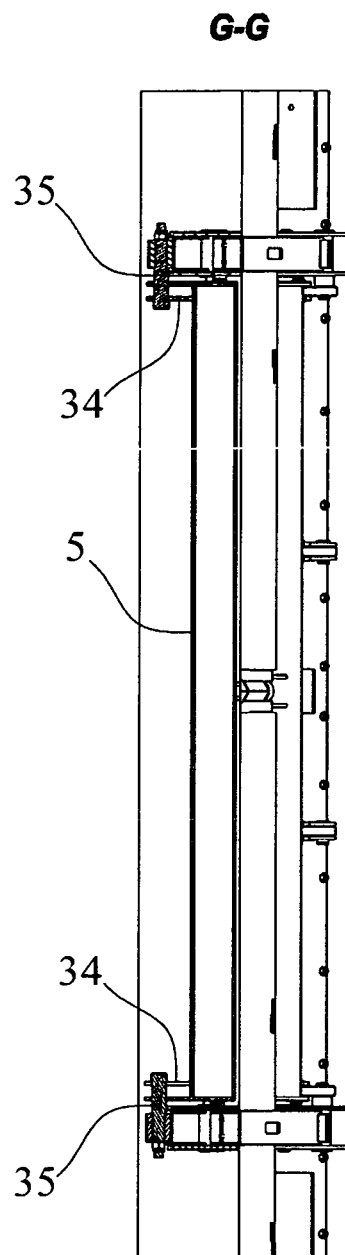


FIG.16

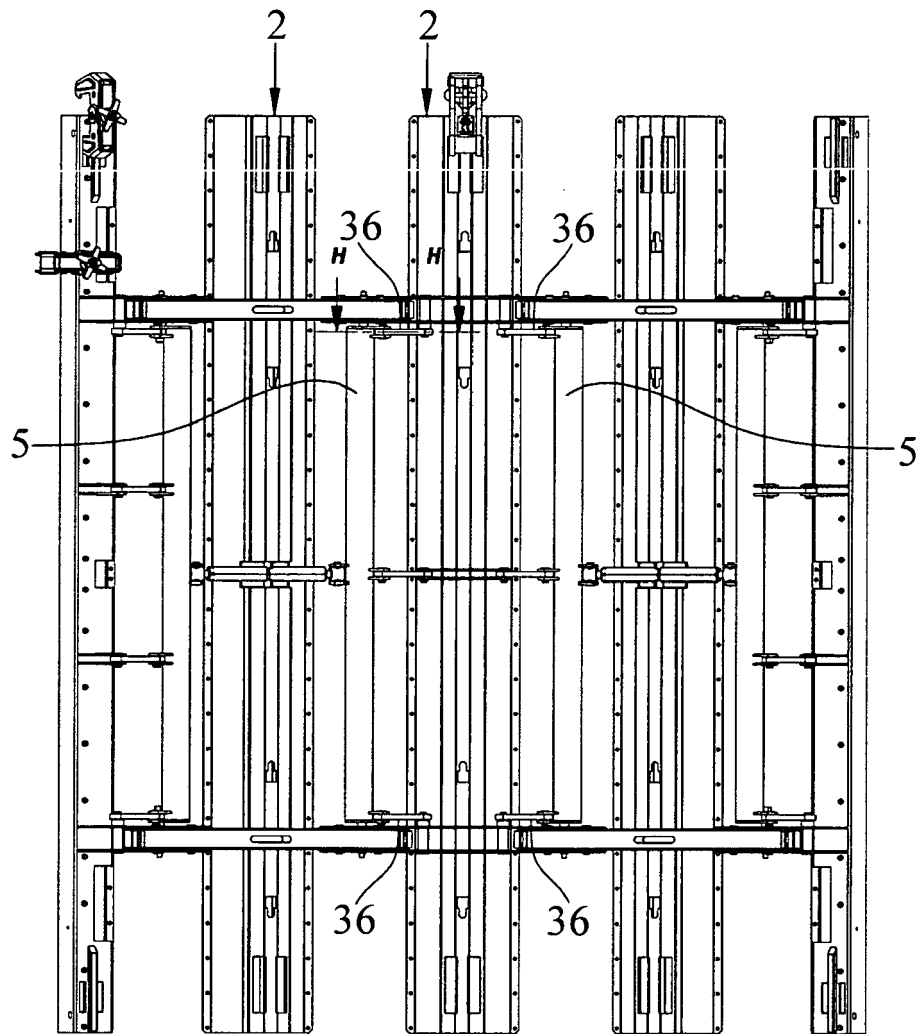


FIG.17

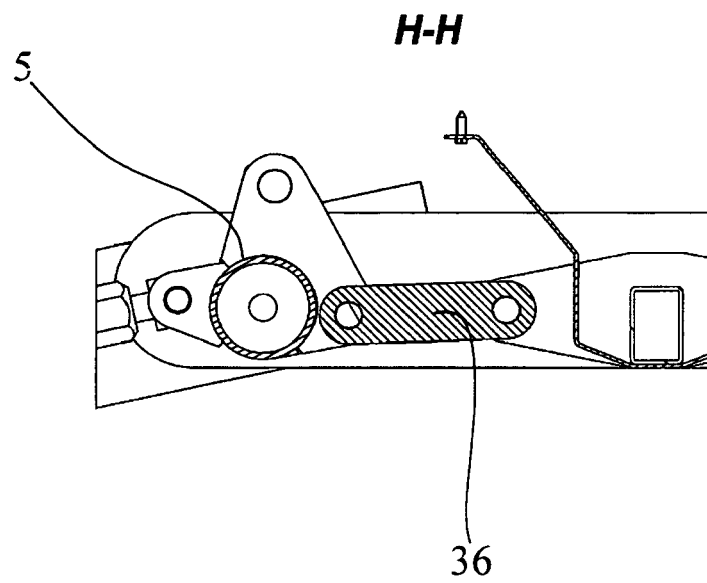


FIG.18

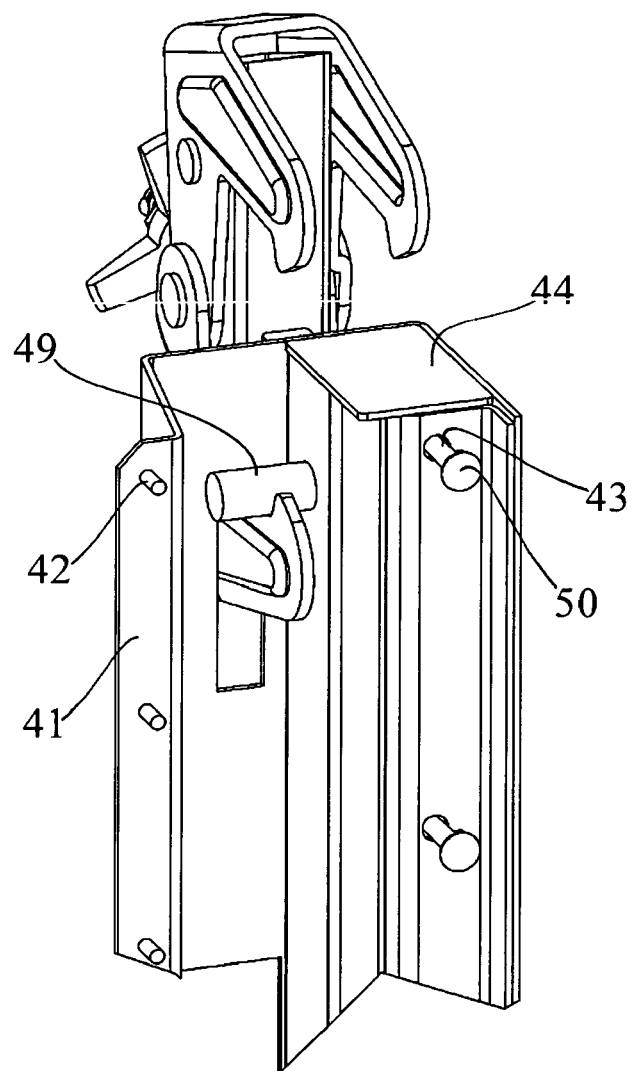


FIG.19



EUROPEAN SEARCH REPORT

Application Number
EP 10 38 0073

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The present search report has been drawn up for all claims			
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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 10 38 0073

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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