

(19)



(11)

EP 2 292 873 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
04.06.2014 Bulletin 2014/23

(51) Int Cl.:
E04G 11/06^(2006.01)

(21) Application number: **10380073.6**

(22) Date of filing: **27.05.2010**

(54) Adjustable panel for shuttering curved walls

Justierbares Paneel zum Umschalen von gewölbten Wänden

Panneau réglable pour le banchage de murs incurvés

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

(30) Priority: **15.07.2009 ES 200930463**

(43) Date of publication of application:
09.03.2011 Bulletin 2011/10

(73) Proprietor: **Sistemas Técnicos De Encofrados, S.A.**
08150 Parets Del Valles (Barcelona) (ES)

(72) Inventor: **Ubinana Felix, José Luis**
08150 Parets del Valles (Barcelona) (ES)

(74) Representative: **Durán Moya, Luis-Alfonso et al**
Durán-Corretjer
Còrsega, 329
08037 Barcelona (ES)

(56) References cited:
EP-A2- 1 884 608 DE-U1- 9 410 525
GB-A- 2 133 826 US-A1- 2002 139 917
US-A1- 2005 263 672 US-A1- 2007 108 367

EP 2 292 873 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

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 **cross-member** -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 (1) 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 (2) which have the structure of a substantially open trapezoidal box, the panel also having beams (3) at its edges for attachment to adjacent panels, **characterised by** the arrangement of shafts (5) for bringing about and synchronising the adjustment of the curvature of the laminar shuttering element between each of the panel beams (2) parallel thereto, each pair of adjacent shafts (5) being associated with a single operating mechanism associated with the intermediate beam between the said shafts (5), **which** mechanism can cause the two shafts (5) adjacent thereto to rotate, the said operating and synchronisation shafts (5) being connected to the respective adjacent beams (2,3) through articulated connecting rods (24) 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

- (2) bearing the operating mechanisms for the two adjacent shafts (2,3) have fixed transverse bars (17) 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 (17) also having slotted openings (18) for guiding the pivots fixed in extensions (19) integral with the adjacent beams (2,3).
3. An adjustable panel for shuttering curved walls according to Claim 2, **characterised by** the arrangement of two pivots in each integral extension (19) of the beams (2,3) which slide within the corresponding slots (18) 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 (18) lies on the internal face of the shuttering panel (1).
 5. An adjustable panel for shuttering curved walls according to Claim 1, **characterised in that** the shafts (5) synchronising adjustment of the curvature of the laminar shuttering element (1) take the form of crankshafts articulated at the top and bottom to wings (34) 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 (6) with the ability to adjust length mounted in one of the panel beams (2) and articulated to the two synchronisation shafts (5) adjacent to the said beam (2).
 7. An adjustable panel for shuttering curved walls according to Claim 6, **characterised in that** the shaft (6) 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 (10,11) articulated to the adjacent synchronisation shafts (5), so that rotation of the central body of the said shaft (6) 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 (18) 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 (3) of the panel have windows (46) in their top and bottom ends with internal **cross-members** (49) for the attachment of joining clamps (4) 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 (1) has beams (3) in the form of an open box with flat sides, one of which ends in a folded flange (41) which can be fitted to the internal face of the flat shuttering member and attached thereto by bolts (42) 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 (39) of an stepped plate (37) incorporated within the beam which forms the stepped portion supporting the coupling clamp (7) 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 (3) of a panel have an opening (46) on their front face opposite the laminar shuttering element (1) which is parallel to the shaft of the beam and an internal cross-member (49) which is firmly attached to the beam itself so that one of the jaws of a clamp (4) 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 (49) securing the clamp (4) comprises a pin joined to the beam by welding.
 13. An adjustable panel for shuttering curved walls according to Claim 10, **characterised in that** attachment between the beam (3) and the laminar shuttering element (1) is brought about by means of screws (42) supporting a lateral flange (41) on one of the two sides of the beam directly to the said laminar shuttering element (1), the head being accessible from the inside of the panel and also by means of a long pin (43) which passes through the laminar shuttering element (1) with its head (50) flush with the external surface thereof and secured by means of a nut on the front face of the beam (3) which can be accessed from the inside of the shuttering panel.
 14. An adjustable panel for shuttering curved walls according to Claim 13, **characterised in that** the flanges (38,39) of the reinforcing plate (37) are joined to the beam (3) by means of linear stitching using laser beams.

Patentansprüche

1. Verstellbare Platte zur Verschalung von gekrümmten Wänden in der Bauart, umfassend eine flächige Schaltafel (1), die gekrümmt werden kann, um die Oberfläche der Verschalung zu definieren, wobei diese flächige Tafel an einer ihrer Flächen mit mehreren vertikal angeordneten Trägern (2) verbunden ist, die die Struktur eines im Wesentlichen offenen trapezförmigen Gehäuses haben, wobei die Platte an ihren Kanten für die Befestigung an angrenzenden Platten auch Träger (3) aufweist, **dadurch gekennzeichnet, dass** die Anordnung von Schäften (5) zum Bewirken und Synchronisieren der Einstellung der Krümmung von dem flächigen Schalelement zwischen jedem der Plattenträger (2) parallel dazu ist, wobei jedes Paar benachbarter Schäfte (5) mit einem einzigen Betätigungsmechanismus verbunden ist, der mit dem Wischenträger zwischen den benachbarten Schäften (5) verbunden ist, wobei der Mechanismus die zwei Schäfte (5), die daran angrenzen, veranlassen kann zu rotieren, wobei die besagten Betätigungs- und Synchronisierungsschäfte (5) mit den entsprechenden angrenzenden Trägern (2,3) durch gelenkige Verbindungsstangen (24) verbunden sind, um ihre relative Position und dadurch die Krümmung der Platte zu verändern.
2. Verstellbare Platte zur Verschalung von gekrümmten Wänden nach Anspruch 1, **dadurch gekennzeichnet, dass** die Träger (2), die den Betätigungsmechanismus für die zwei angrenzenden Schäfte (2,3) tragen, oben und unten fixierte Querstäbe (17) aufweisen, welche Schäfte tragen, die in Bezug auf jene, die sie mit den Betätigungsschäften, die die Einstellung der Krümmung von den Platten synchronisieren, verbinden, exzentrisch sind, was durch Verbindungsarme erreicht wird, wobei die besagten Querstangen (17) auch schlitzförmige Öffnungen (18) aufweisen, um die Gelenke, die in Verlängerungen (19) fixiert sind, welche mit den angrenzenden Trägern (2,3) eine integrale Einheit bilden, zu führen.
3. Verstellbare Platte zur Verschalung von gekrümmten Wänden nach Anspruch 2, **gekennzeichnet durch** die Anordnung von zwei Gelenken in jeder integralen Verlängerung (19) der Träger (2,3), die innerhalb der entsprechenden Schlitze (18) gleiten und ferner das Ende der Schwenkpositionen bestimmen.
4. Verstellbare Platte zur Verschalung von gekrümmten Wänden nach Anspruch 2, **dadurch gekennzeichnet, dass** das Zentrum der Krümmung von den Schlitzen (18) auf der inneren Fläche der Schalplatte (1) liegt.
5. Verstellbare Platte zur Verschalung von gekrümmten Wänden nach Anspruch 1, **dadurch gekennzeichnet, dass** die Schäfte (5), die die Einstellung der Krümmung von dem flächigen Schalelement (1) synchronisieren, die Form von Kurbelwellen annehmen, die oben und unten gelenkig an Flügeln (34) angebracht sind, welche an den Trägern, an denen der Betätigungsmechanismus montiert ist, fixiert sind.
6. Verstellbare Platte zur Verschalung von gekrümmten Wänden nach Anspruch 1, **dadurch gekennzeichnet, dass** der einzige Betätigungsmechanismus für jeweils zwei der in Längsrichtung verlaufenden Synchronisierungsschäfte einen Querschafft (6) mit der Fähigkeit die Länge anzupassen umfasst, der in einem der Plattenträger (2) montiert ist und mit den zwei Synchronisierungsschäften (5), die an den besagten Träger (2) angrenzen, gelenkig verbunden ist.
7. Verstellbare Platte zur Verschalung von gekrümmten Wänden nach Anspruch 6, **dadurch gekennzeichnet, dass** der Schafft (6), der in der Länge angepasst werden kann, einen zentralen getreckten Körper umfasst, der an seiner äußeren Oberfläche mit flachen Flächen und Gewindeöffnungen versehen ist, die sich zu jedem seiner Enden hin öffnen, wobei die Gewinde in entgegengesetzter Richtung verlaufen, und mit Stangen (10,11) verbunden sind, die gelenkig mit den angrenzenden Synchronisierungsschäften (5) verbunden sind, sodass die Rotation des zentralen Körpers des besagten Schafts (6) in eine Verlängerung oder Verkürzung der Distanz zwischen den Punkten der gelenkigen Verbindung mit den Synchronisierungsschäften und die entsprechende Veränderung in eine Krümmung der Schalplatte umwandelt wird.
8. Verstellbare Platte zur Verschalung von gekrümmten Wänden nach Anspruch 2, **dadurch gekennzeichnet, dass** die Schlitzöffnungen (18) eine derartige Form haben, dass die Länge des Bogenumfangs zwischen zwei Generatrics über den gesamten Einstellbereich konstant gehalten wird.
9. Verstellbare Platte zur Verschalung von gekrümmten Wänden nach Anspruch 1, **dadurch gekennzeichnet, dass** die Träger (3) der Platte in ihren oberen und unteren Enden Fenster (46) mit innenliegenden Querstreben (49) für die Befestigung von Verbindungsklemmen (4) mit anderen Platten und Aufhängehaken zur Handhabung der Platten aufweisen.
10. Verstellbare Platte zur Verschalung von gekrümmten Wänden nach Anspruch 1, **dadurch gekennzeichnet, dass** die Platte (1) an jeder ihrer lateralen Kanten Träger (3) in der Form eines offenen Gehäuses

ses mit flachen Seiten aufweist, wobei eine davon in einem gefalteten Flansch (41) mündet, der an die innenliegende Fläche des flachen Schalbauteils angepasst und daran mit Bolzen (42) befestigt werden kann, die von der Innenseite der Platte zugänglich sind, während die gegenüberliegende laterale Fläche des Trägers durch seine Kante an einen Flansch (39) von einer Stufenplatte (37) fixiert ist, die innen in dem Träger enthalten ist, wobei er den gestuften Teil bildet, der die Kupplungsklemme (7) für zwei angrenzende Schalplatten über ihre lateralen Kanten hält.

11. Verstellbare Platte zur Verschalung von gekrümmten Wänden nach Anspruch 10, **dadurch gekennzeichnet, dass** jeder der lateralen Endträger (3) einer Platte eine Öffnung (46) auf seiner vorderen Fläche gegenüber dem flächigen Schalelement (1), das parallel zu dem Schaft des Trägers ist, und eine innenliegende Querstrebe (49) aufweist, die fest mit dem Träger selbst verbunden ist, sodass einer der Backen einer Klemme (4), die dazu gedacht ist, die Schalplatte an einer weiteren, darüber liegenden Schalplatte zu fixieren, eingeführt und gesichert werden kann.
12. Verstellbare Platte zur Verschalung von gekrümmten Wänden nach Anspruch 11, **dadurch gekennzeichnet, dass** die Querstrebe (49), die die Klemme (4) sichert, einen Stift umfasst, der mit dem Träger durch Verschweißen verbunden ist.
13. Verstellbare Platte zur Verschalung von gekrümmten Wänden nach Anspruch 10, **dadurch gekennzeichnet, dass** die Verbindung zwischen dem Träger (3) und dem flächigen Schalelement (1) mittels Schrauben (42) bewirkt wird, die einen lateralen Flansch (41), der an einer der beiden Seiten des Trägers ist, direkt an dem besagten flächigen Schalelement (1) halten, wobei der Kopf von der Innenseite der Platte und auch mittels eines langen Stifts (43) zugänglich ist, der durch das laterale Schalelement (1) hindurch läuft, wobei sein Kopf (50) mit der äußeren Oberfläche davon bündig ist, und mittels einer Mutter auf der vorderen Fläche des Trägers (3) gesichert wird, die von der Innenseite der Schalplatte zugänglich ist.
14. Verstellbare Platte zur Verschalung von gekrümmten Wänden nach Anspruch 13, **dadurch gekennzeichnet, dass** die Flansche (38,39) der Verstärkungsplatte (37) mit dem Träger (3) mittels Linearstitching unter Verwendung von Laserstrahlen verbunden sind.

Revendications

1. Panneau ajustable pour le coffrage de parois incurvées du type comprenant une plaque de coffrage laminaire (1) qui peut être incurvée pour déterminer la surface du coffrage, ladite plaque laminaire étant associée, sur l'une de ses faces, à plusieurs poutres agencées verticalement (2) qui ont la structure d'un boîtier trapézoïdal sensiblement ouvert, le panneau comportant également des poutres (3) à ses bords pour l'attacher à des panneaux adjacents, **caractérisé par** l'agencement d'arbres (5) pour générer et synchroniser l'ajustement de la courbure de l'élément de coffrage laminaire entre chacune des poutres de panneau (2) parallèle à celui-ci, chaque paire d'arbres adjacents (5) étant associée à un mécanisme d'actionnement unique associé à la poutre intermédiaire entre lesdits arbres (5), ledit mécanisme pouvant amener les deux arbres (5) adjacents à celui-ci à tourner, lesdits arbres d'actionnement et de synchronisation (5) étant reliés aux poutres adjacentes respectives (2, 3) par l'intermédiaire de bielles articulées (24) afin de changer leur position relative et de ce fait la courbure du panneau.
2. Panneau ajustable pour le coffrage de parois incurvées selon la revendication 1, **caractérisé en ce que** les poutres (2) portant les mécanismes d'actionnement pour les deux arbres adjacents (2, 3) ont des barres transversales fixes (17) au niveau des arbres porteurs supérieur et inférieur qui sont excentrées par rapport à celles les assemblant aux arbres d'actionnement en synchronisant l'ajustement de la courbure du panneau, au moyen de bras de liaison, lesdites barres transversales (17) comportant également des ouvertures à fentes (18) pour guider les pivots fixés dans des extensions (19) faisant partie intégrante des poutres adjacentes (2, 3).
3. Panneau ajustable pour le coffrage de parois incurvées selon la revendication 2, **caractérisé par** l'agencement de deux pivots dans chaque extension (19) faisant partie intégrante des poutres (2, 3) qui coulissent à l'intérieur des fentes correspondantes (18) et qui déterminent en outre l'extrémité de positions de déplacement.
4. Panneau ajustable pour le coffrage de parois incurvées selon la revendication 2, **caractérisé en ce que** le centre de courbure des fentes (18) se trouve sur la face interne du panneau de coffrage (1).
5. Panneau ajustable pour le coffrage de parois incurvées selon la revendication 1, **caractérisé en ce que** les arbres (5) synchronisant l'ajustement de la courbure de l'élément de coffrage laminaire (1) prennent la forme de vilebrequins articulés en haut et en bas avec des ailes (34) fixées aux poutres sur lesquelles

le mécanisme d'actionnement est monté.

6. Panneau ajustable pour le coffrage de parois incurvées selon la revendication 1, **caractérisé en ce que** le mécanisme d'actionnement unique pour chaque paire d'arbres de synchronisation longitudinaux comprend un arbre transversal (6) avec la possibilité d'ajuster la longueur de montage dans l'une des poutres de panneau (2) et articulé avec les deux arbres de synchronisation (5) adjacents à ladite poutre (2).
7. Panneau ajustable pour le coffrage de parois incurvées selon la revendication 6, **caractérisé en ce que** l'arbre (6) dont la longueur peut être ajustée comprend un corps central allongé pourvu de faces plates sur sa surface extérieure et d'ouvertures filetées qui s'ouvrent à chacune de ses extrémités, avec des filetages dans des sens opposés, reliées à des bielles (10, 11) articulées avec les arbres de synchronisation adjacents (5), de sorte qu'une rotation du corps central dudit arbre (6) soit convertie en un allongement ou un raccourcissement de la distance entre les points d'articulation avec les arbres de synchronisation et le changement correspondant de courbure du panneau de coffrage.
8. Panneau ajustable pour le coffrage de parois incurvées selon la revendication 2, **caractérisé en ce que** les ouvertures à fentes (18) ont une forme telle que la longueur de l'arc de circonférence entre deux génératrices soit maintenue constante sur toute la plage d'ajustement.
9. Panneau ajustable pour le coffrage de parois incurvées selon la revendication 1, **caractérisé en ce que** les poutres (3) du panneau ont des fenêtres (46) à leur extrémité supérieure et à leur extrémité inférieure avec des traverses internes (49) pour l'attachement de pinces d'assemblage (4) à d'autres panneaux et des crochets de suspension pour la manipulation du panneau.
10. Panneau ajustable pour le coffrage de parois incurvées selon la revendication 1, **caractérisé en ce que**, sur chacun de ses bords latéraux, le panneau (1) comporte des poutres (3) sous la forme d'un boîtier ouvert avec des côtés plats, dont l'une se termine par une bride repliée (41) qui peut être entrée dans la face interne de l'organe de coffrage plat et être attachée à celle-ci par des boulons (42) qui sont accessibles à partir de l'intérieur du panneau, alors que la face latérale opposée de la poutre est fixée à travers son bord à une bride (39) d'une plaque en escalier (37) incorporée à l'intérieur de la poutre qui forme la portion en escalier supportant la pince de couplage (7) pour les deux panneaux de coffrage adjacents à travers leurs bords latéraux.
11. Panneau ajustable pour le coffrage de parois incurvées selon la revendication 10, **caractérisé en ce que** chacune des poutres latérales d'extrémité (3) d'un panneau comporte une ouverture (46) sur sa face avant opposée à l'élément de coffrage laminaire (1) qui est parallèle à l'arbre de la poutre et une traverse interne (49) qui est fermement attachée à la poutre afin que l'une des mâchoires d'une pince (4) destinée à fixer le panneau de coffrage sur un autre panneau de coffrage situé au-dessus de celui-ci puisse être insérée et fixée.
12. Panneau ajustable pour le coffrage de parois incurvées selon la revendication 11, **caractérisé en ce que** la traverse (49) fixant la pince (4) comprend une broche assemblée à la poutre par soudage.
13. Panneau ajustable pour le coffrage de parois incurvées selon la revendication 10, **caractérisé en ce que** l'attachement entre la poutre (3) et l'élément de coffrage laminaire (1) est généré au moyen de vis (42) supportant une bride latérale (41) sur l'un des deux côtés de la poutre directement sur ledit élément de coffrage laminaire (1), la tête étant accessible à partir de l'intérieur du panneau et également au moyen d'une longue broche (43) passant à travers l'élément de coffrage laminaire (1) avec sa tête (50) arasée avec la surface externe de celui-ci et fixée au moyen d'un écrou sur la face avant de la poutre (3) qui est accessible à partir de l'intérieur du panneau de coffrage.
14. Panneau ajustable pour le coffrage de parois incurvées selon la revendication 13, **caractérisé en ce que** les brides (38, 39) de la plaque de renforcement (37) sont assemblées à la poutre (3) au moyen d'une couture linéaire en utilisant des faisceaux laser.

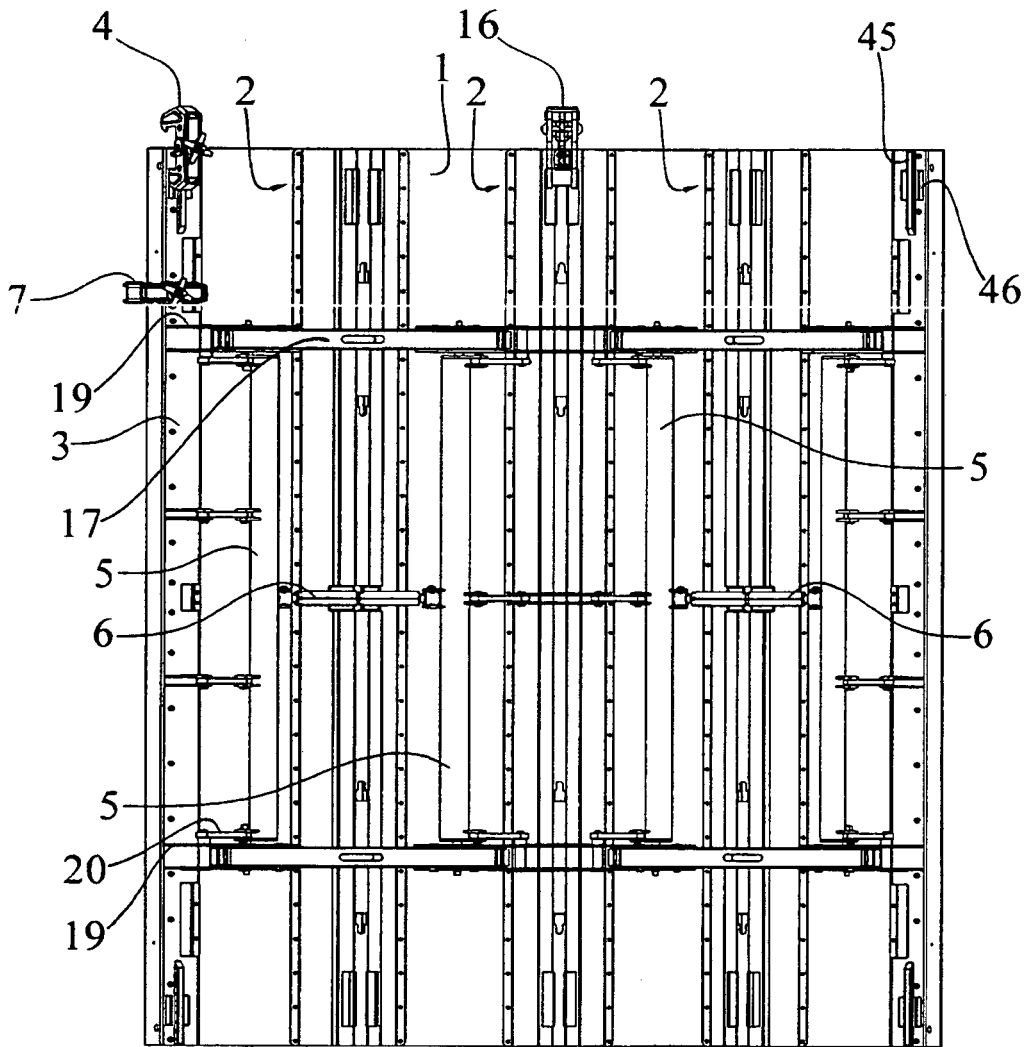


FIG.1

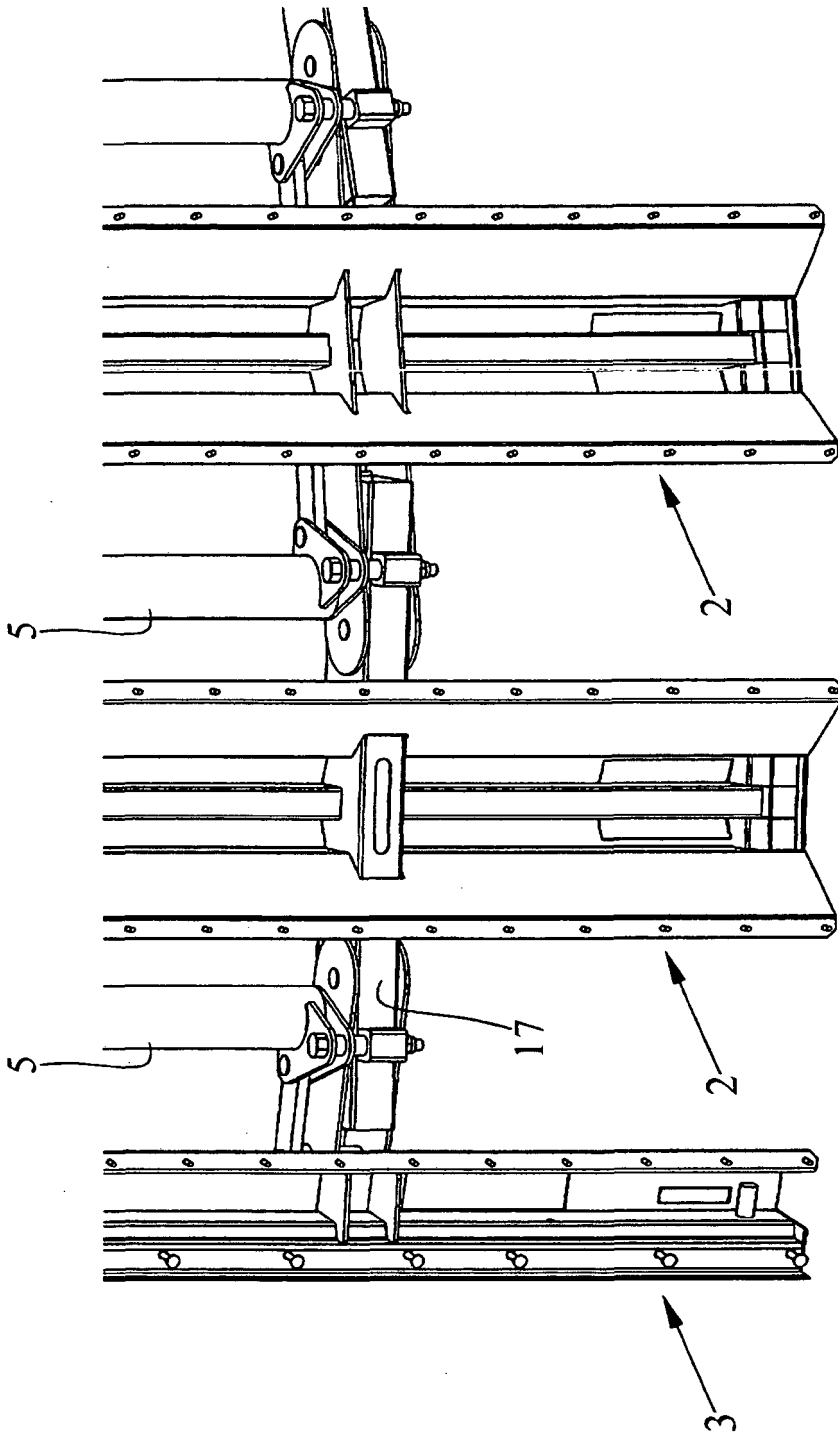


FIG.2

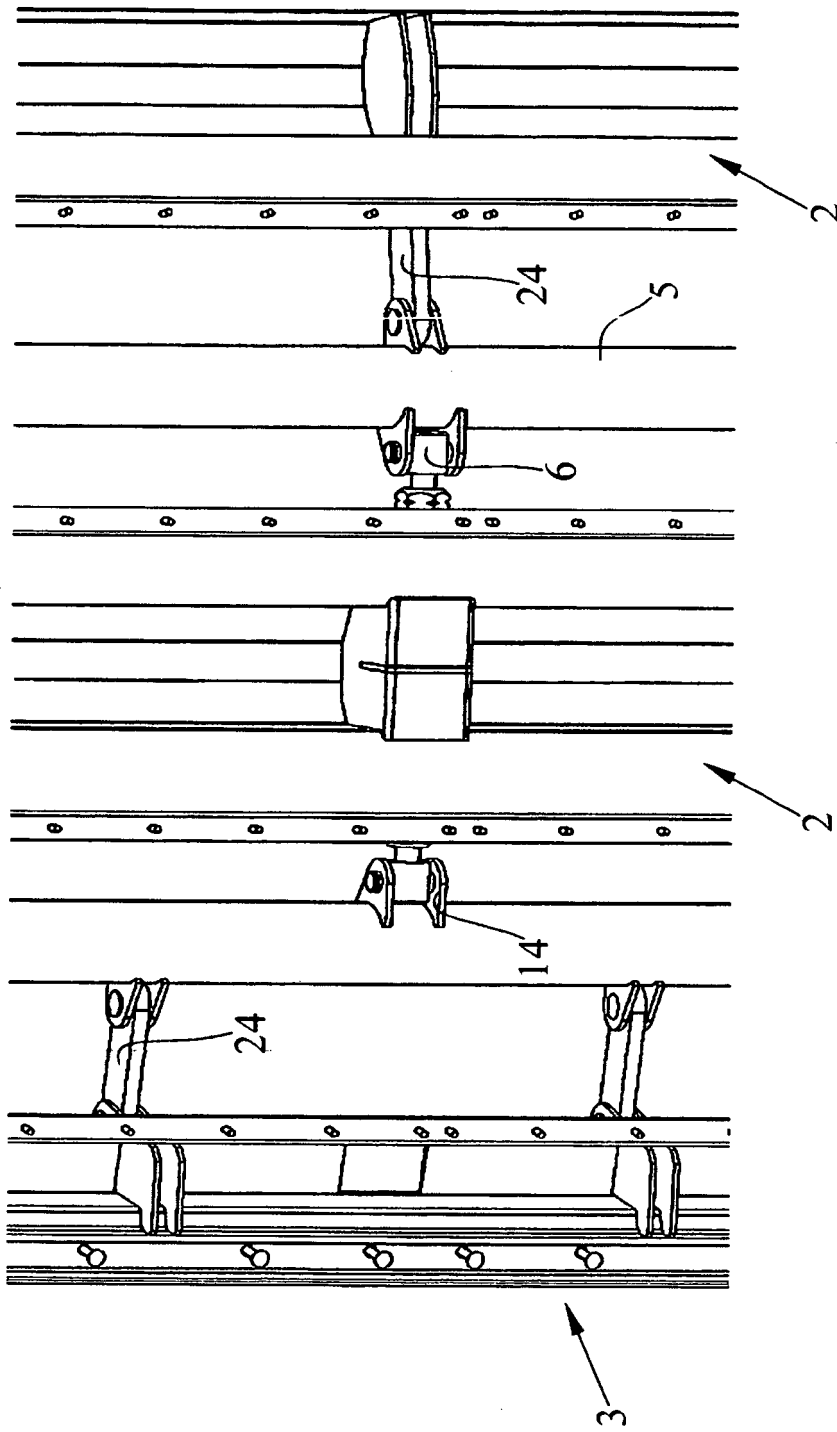


FIG.3

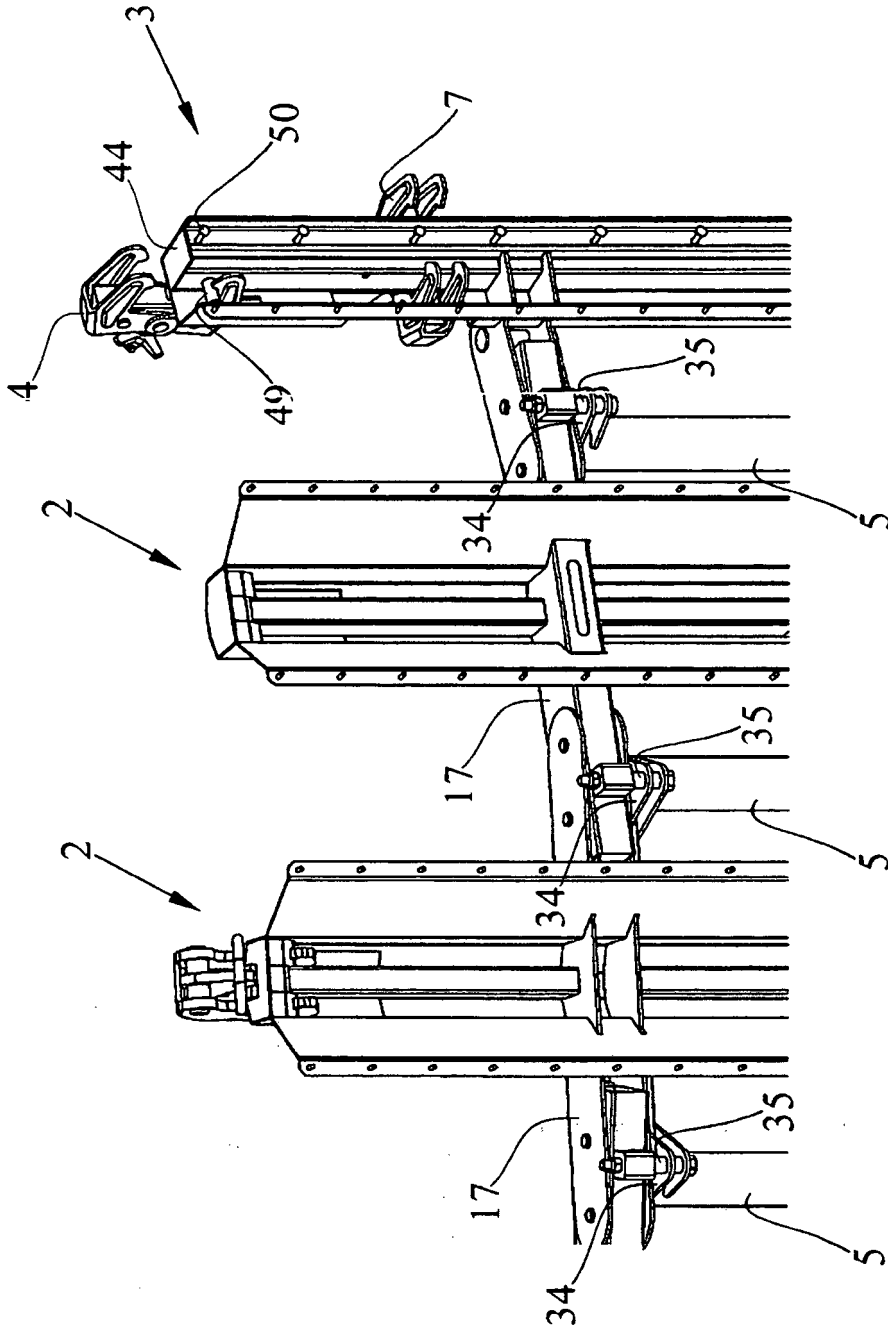


FIG.4

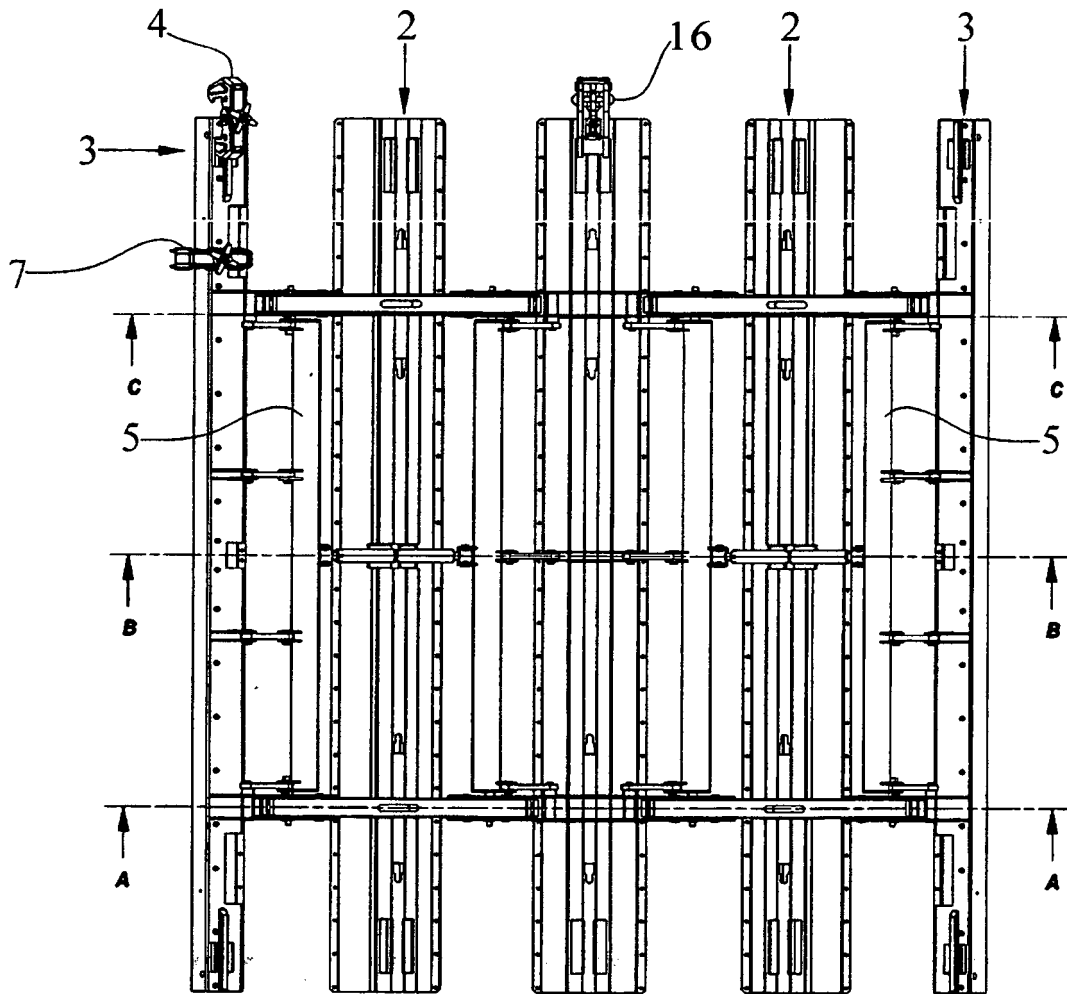


FIG. 5

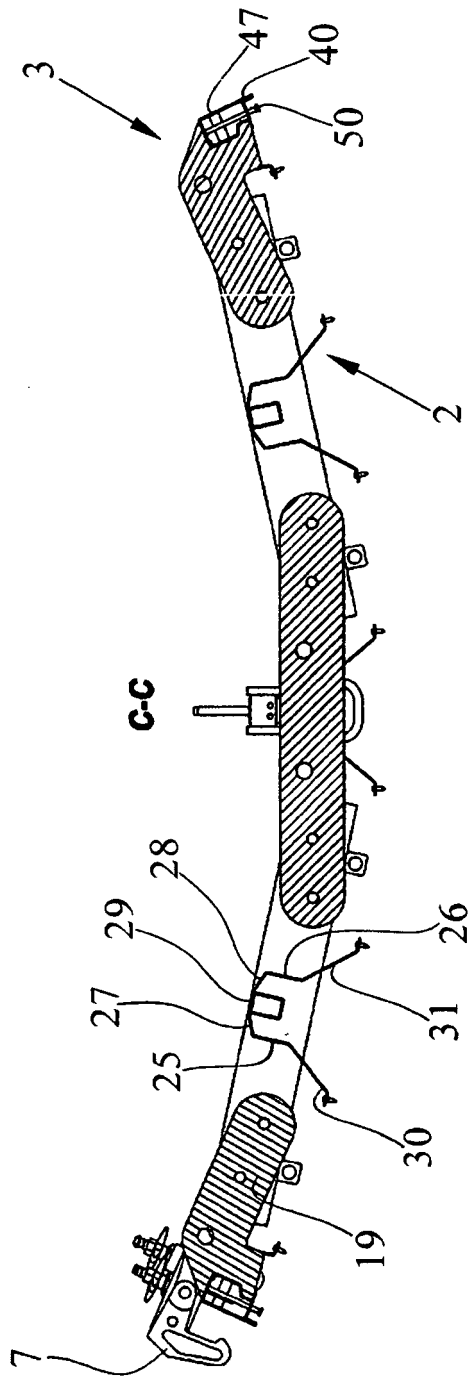


FIG.6

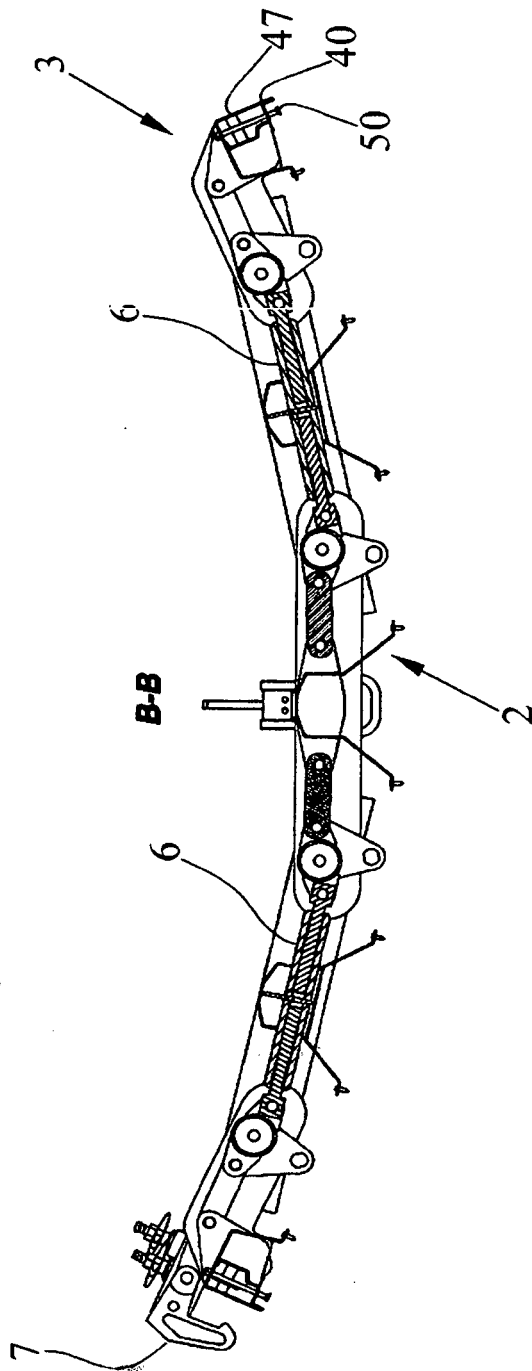


FIG.7

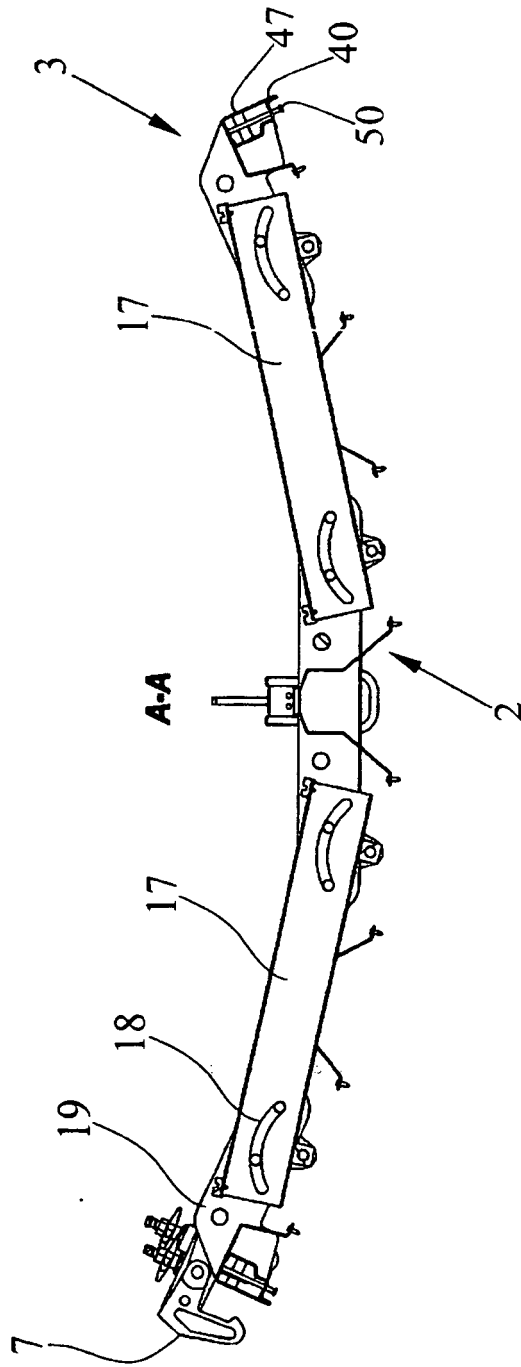


FIG.8

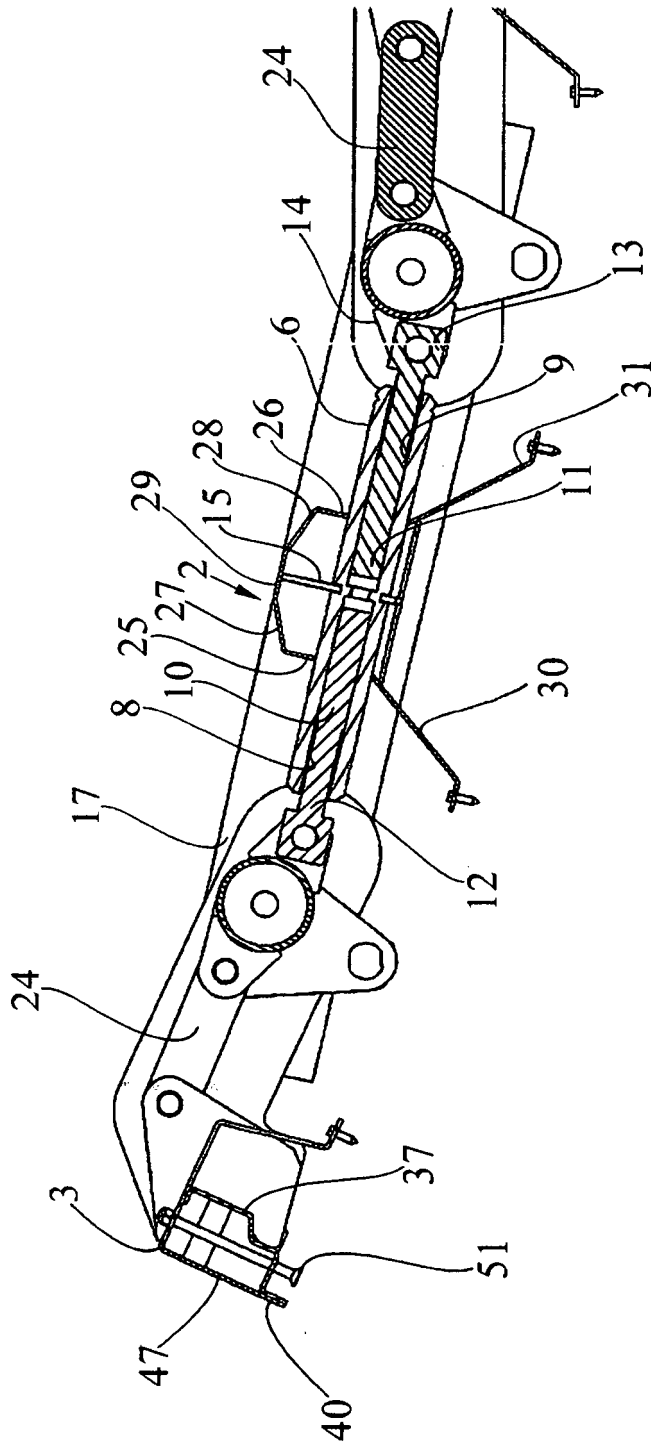


FIG.9

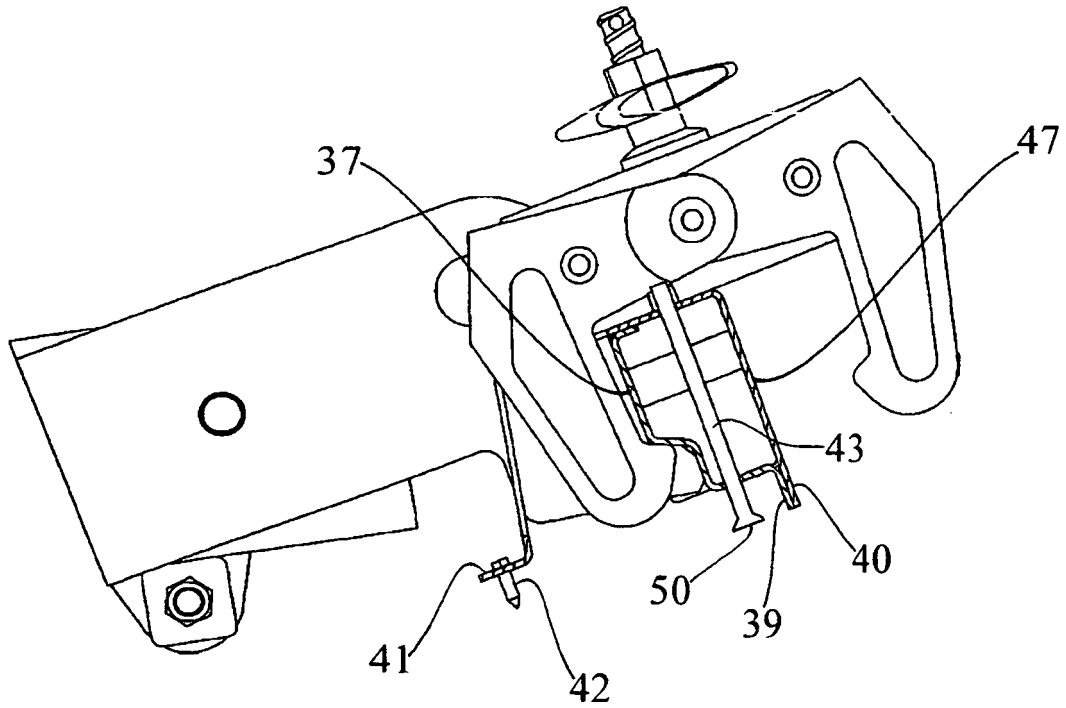


FIG.10

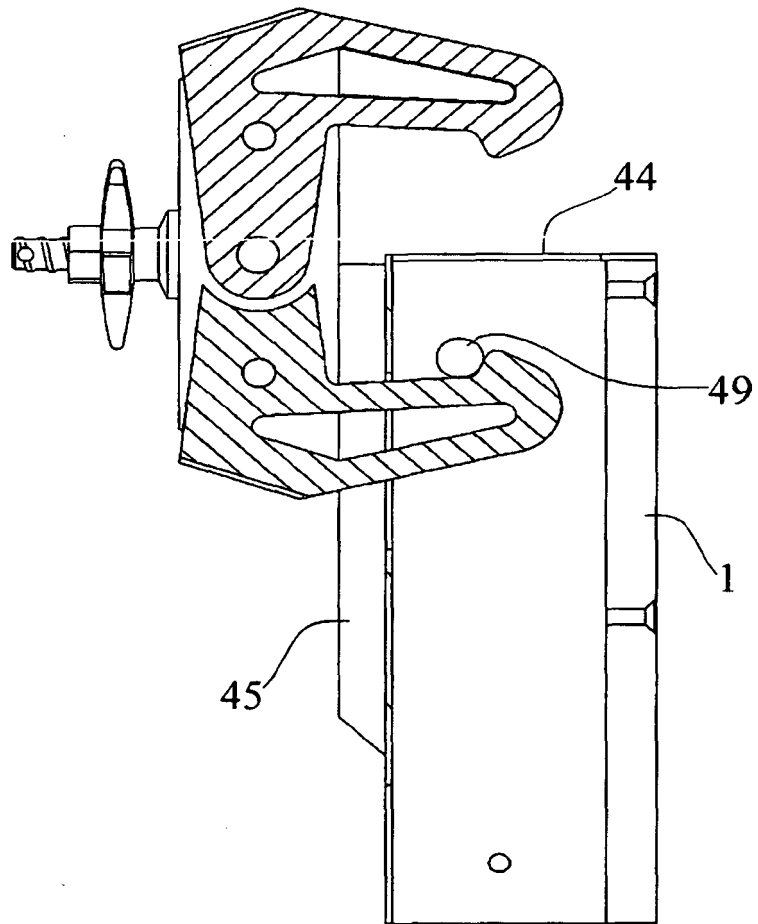


FIG. 11

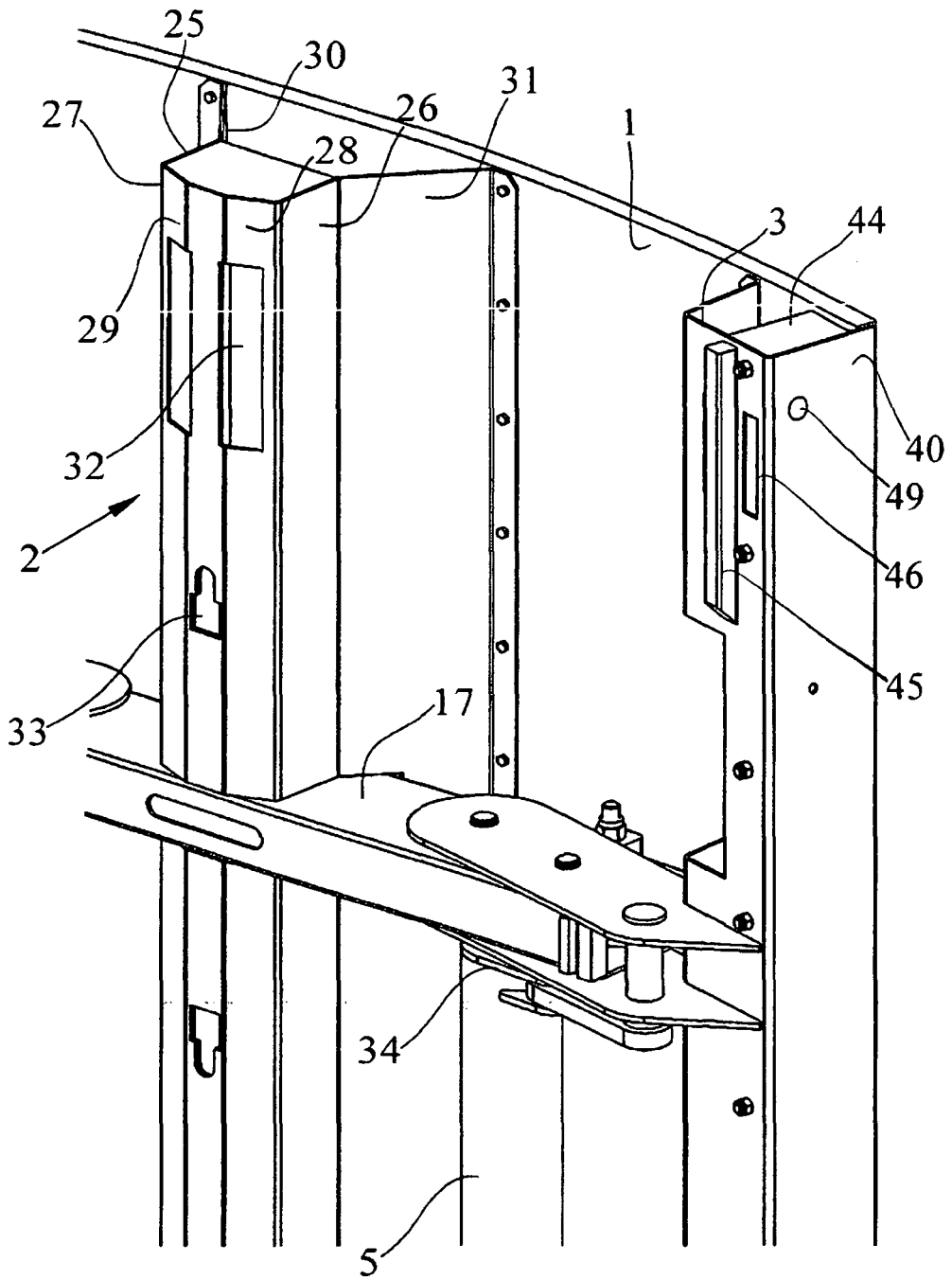


FIG.12

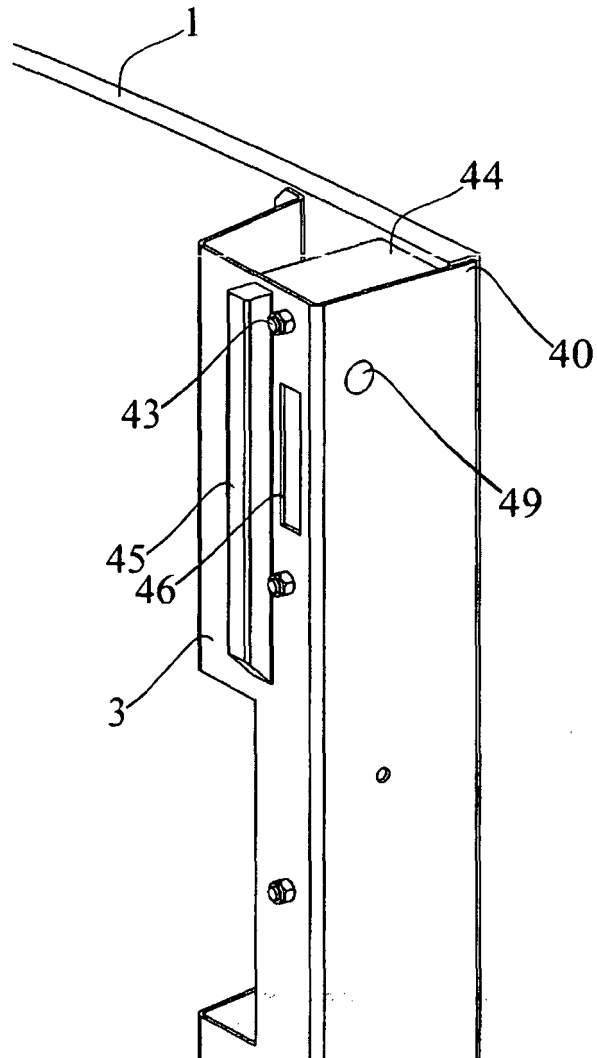


FIG. 13

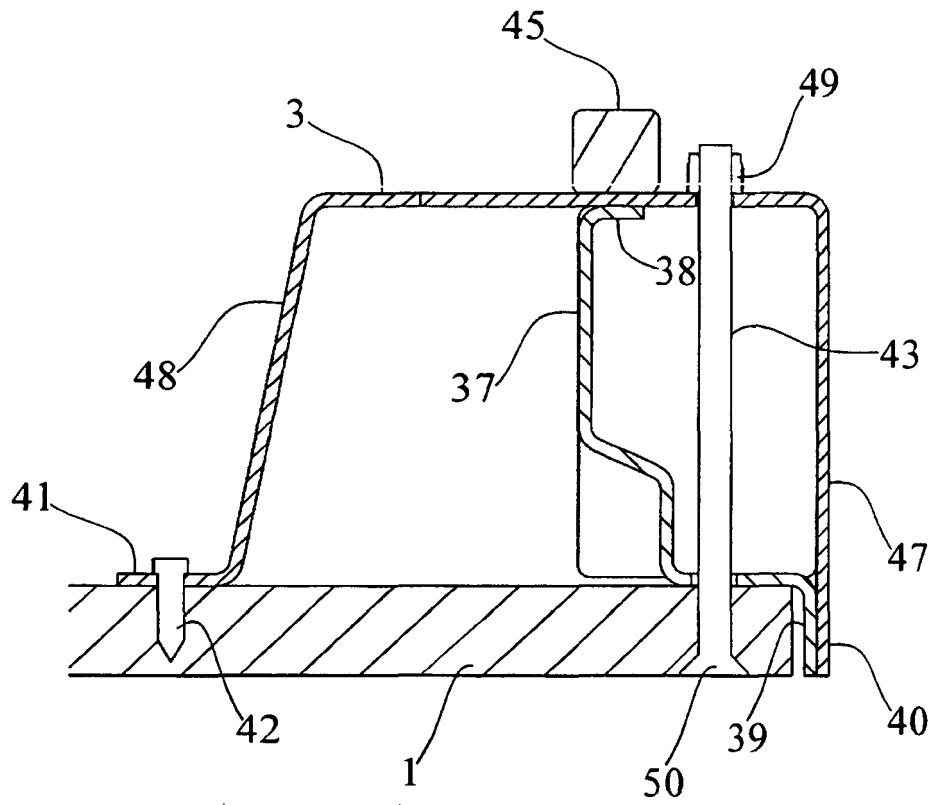


FIG.14

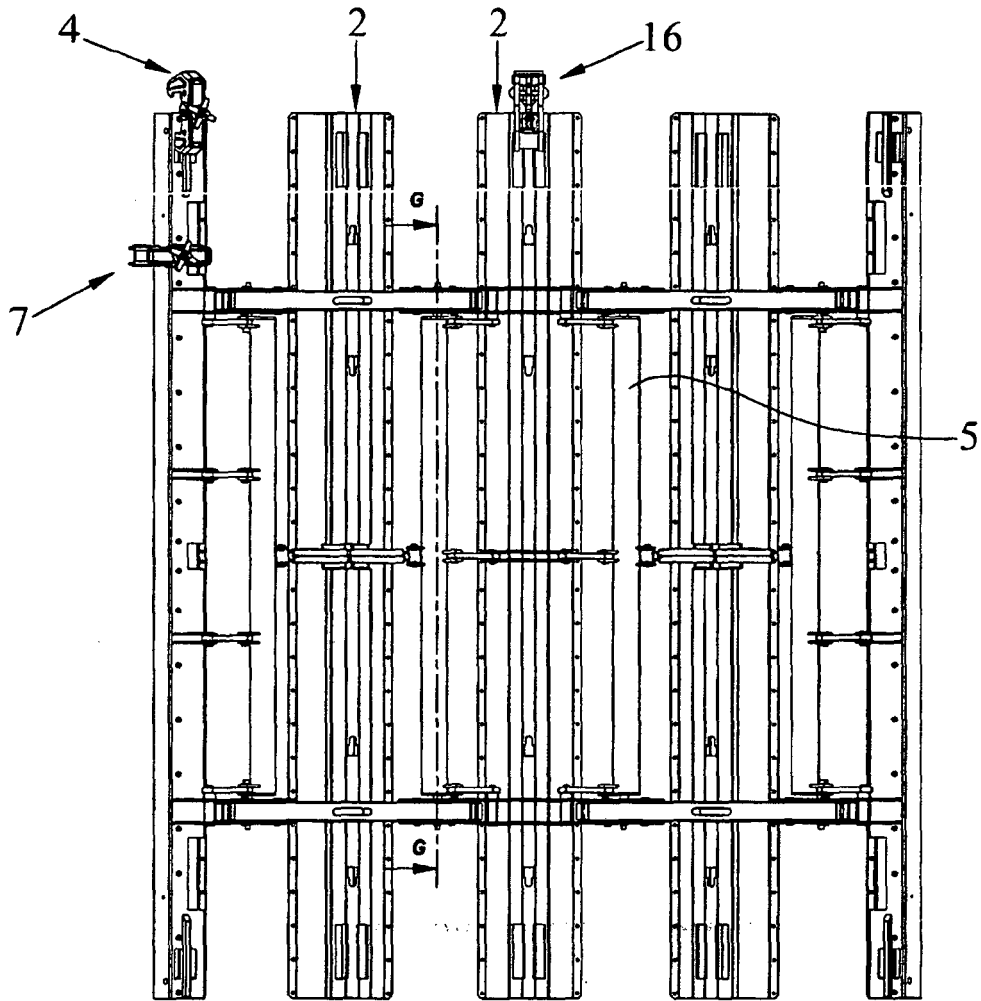


FIG. 15

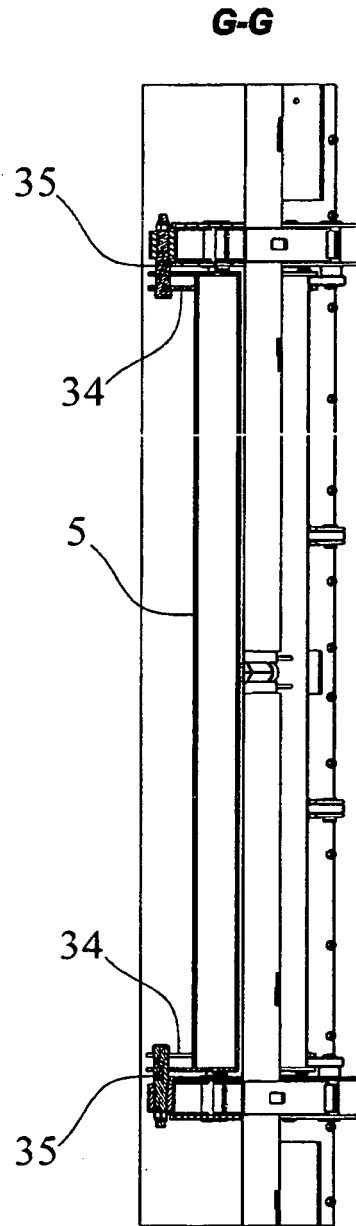


FIG. 16

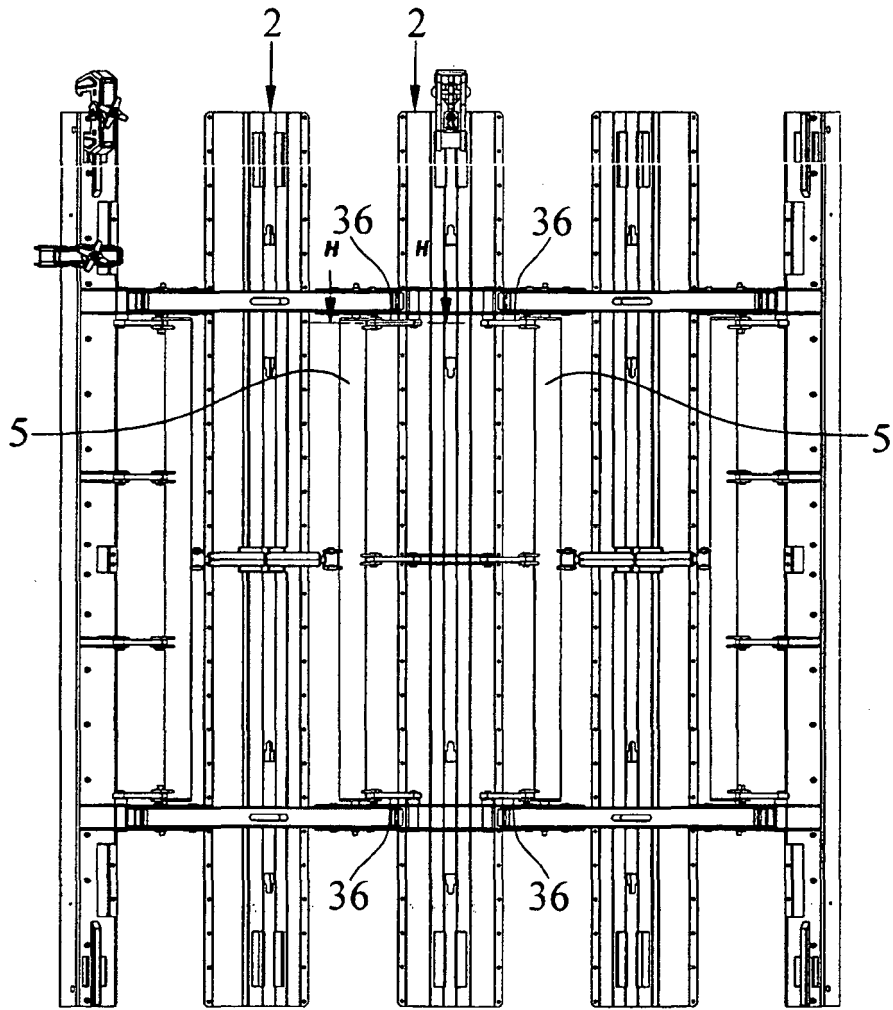


FIG.17

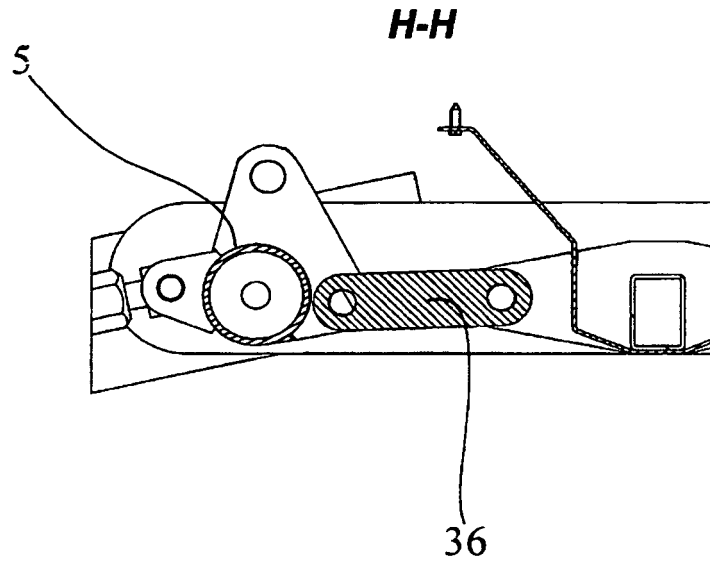


FIG. 18

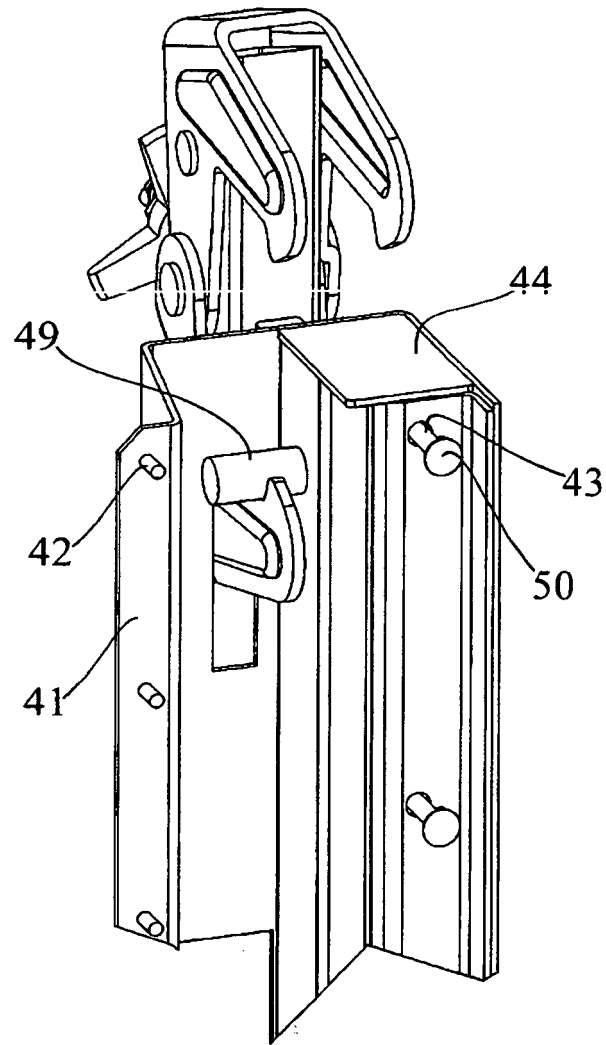


FIG.19

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 7048249 B [0003]