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(54) **A SHUTTERING PANEL**

(57) The present group of inventions is related to civil  
engineering and can be used in erection of multi-storey  
buildings/constructions.

Technological equipment includes travelling form-  
work comprising lifting jacks with props enclosed in  
shells, where U-shaped jack frames are installed on.  
In the base of the jack frame posts, holders of vertical shut-  
tering panels and extendible supports are installed move-  
ably. In the process of work performance, formwork is  
laid resting upon previously erected structures by means  
of lifting jack props, while shells enclosing said props are  
driven with rotating motion. Further on, extendible sup-  
ports of jack frames are installed on the newly erected  
structures, props of lifting jacks together with shell are  
extracted and concrete is poured into the formed cavities.  
Formwork is re-installed on the already erected struc-  
tures by means of lifting jack and the cycle is repeated.  
Methods for erecting both single- and multilayer vertical  
structures, as well as methods for erecting "floor structure  
- single-/multilayer wall" segment of building are dis-  
closed.

Result - reduction of consumption of materials for  
formwork and power costs for its relocation; reduction of  
time for construction.

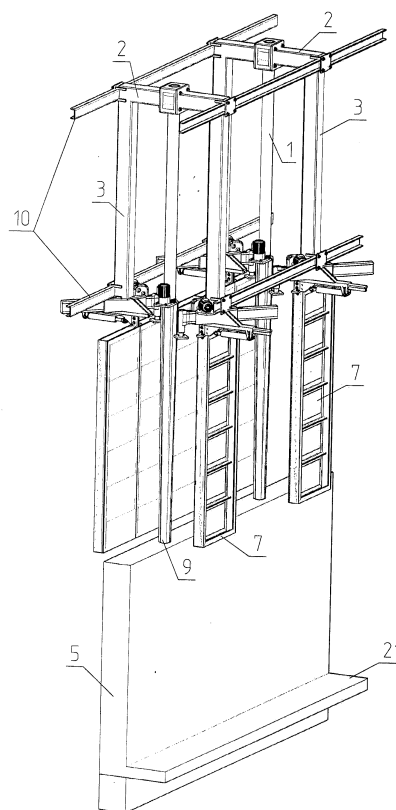


Fig. 1

## Description

**[0001]** The present group of inventions is related to civil engineering and can be used in erection of multi-storey buildings/constructions.

**[0002]** Method for erecting monolithic buildings and technological equipment for its implementation is known (group of inventions, 1)

**[0003]** Method under the preferred embodiment includes erection of the building monolithic segment consisting of floor structure of the whole building and vertical structures of the upper tier/storey of the whole building. Main principle of the method: erecting the tier/storey floor structure of the whole building; following setting of concrete of said floor structure, pouring concrete of vertical structures of the next tier/storey of the whole building; curing the poured concrete until the design strength is achieved; erecting subsequent floor structure, etc. During performance of works, formwork rests on the already poured vertical structures of building. Technological equipment comprises, without limitation, travelling formwork and vertical shuttering panels. Travelling formwork includes lifting jacks with props, where U-shaped jack frames are installed. Posts of said jack frames are equipped with bearing plates. Frames located on both sides of the being erected vertical structures are connected together by rigid links. On bearing plates of said jack frame posts, carriages are mounted with possibility of travelling across said being erected vertical structures with vertical shuttering panels installed on them. During concreting, jack frames rest on vertical shuttering panels installed on the underlying vertical structures. Following the required strength of concrete is attained, jack frames are relocated to rest upon props of lifting jacks, and formwork is lifted to the next tier/storey.

**[0004]** The fact that jack frames during performance of works rest upon vertical shuttering panels imposes increased requirements to the strength properties of panels. It results in excessive consumption of metal during manufacturing of the panel frames, increased power consumption for relocation of formwork. Erection of multilayer vertical structures using known travelling formwork requires some time for the poured concrete to attain necessary strength in order to make it possible to re-rest jack frames on lifting jacks, which are installed on the already erected vertical structures, and to mold a cavity for the new layer. It extends the time of construction.

**[0005]** The present group of inventions is directed toward solution of following tasks: reduction of time for erection of buildings/constructions of monolithic reinforced concrete; reduction of material and labor costs.

**[0006]** The set task is resolved by the method for erecting vertical structures of building/construction of monolithic reinforced concrete including process steps of:

- installing lifting jacks containing props enclosed in shells on the already erected structures; installing U-shaped jack frames equipped with posts and ex-

tensible supports on said jack props; connecting posts of said jack frames located adjacently on both sides of the being erected vertical structures by rigid links;

- 5 - installing reinforcement cages of vertical structures for the whole height of tier/storey with their connection to protruding reinforcement of previously erected structures;
- 10 - installing formwork panels for erection of vertical structures on the posts of jack frames; securing rigidly said panels located in single plane; adjusting the width of molding cavity; and connecting said panels located in parallel on the opposite side of reinforcement cage of the being erected vertical structures by means of tightening devices;
- 15 - pouring concrete into molding cavities of the being erected vertical structures; imparting reciprocating and rotating or only rotating motion to shells enclosing props of lifting jacks; resting U-shaped jack frames upon the poured vertical structures by means of extendible supports following 30-40% design strength of molded structures is attained; extracting lifting jack props with their enclosing shells from said molded structures with subsequent filling cavities formed in vertical structures with concrete; and moving formwork panels away from the molded surface;
- 20 - resting props of lifting jacks upon the already erected structures; lifting U-shaped jack frames with formwork on the next tier/storey; and repeating the cycle for erecting vertical structures. Vertical structures can be erected simultaneously for the whole building/construction.

35 **[0007]** The set task is resolved by the method for erecting multilayer vertical structures of building/construction of monolithic reinforced concrete including process steps of:

- 40 - installing lifting jacks containing props enclosed in shells on the already erected structures; installing U-shaped jack frames equipped with posts and extendible supports on said jack props; connecting posts of said jack frames located adjacently on both sides of the being erected vertical structures by rigid links;
- 45 - installing reinforcement cages of vertical structures for the whole height of tier/storey with their connection to protruding reinforcement of previously erected structures;
- 50 - installing formwork panels for erection of vertical structures on the posts of jack frames; securing rigidly said panels located in single plane; adjusting the width of molding cavity; and connecting said panels located in parallel on the opposite side of reinforcement cage of the being erected vertical structures by means of tightening devices;
- 55 - pouring concrete into molding cavities of the being

- erected vertical structures; imparting reciprocating and rotating or only rotating motion to shells enclosing props of lifting jacks; moving formwork panels away from the molded surface on one or both sides following stripping strength of the molded structures is attained; adjusting the width of molding cavity of the new layer and its filling with molding material;
- resting U-shaped jack frames upon the poured vertical structures by means of extendible supports following 30-40% design strength of the base (constructional) layer is attained; extracting lifting jack props with their enclosing shells from said molded structures with subsequent filling cavities formed in vertical structures with concrete;
  - moving formwork panels away from the molded multilayer surface; resting props of lifting jacks upon the already erected base (constructional) layer of vertical structure; lifting U-shaped jack frames with formwork on the next tier/storey; and repeating the cycle for erecting multilayer vertical structures.

**[0008]** Prior to fill molding cavity of the base (constructional) layer with concrete, removable recess-forming cages can be hanged on the inner surface of formwork panels. Prior molding of the last (outer) layer, these cages shall be removed.

**[0009]** On posts of jack frames, panels can be installed with holes performed in their decks, where sleeves of elastic material are inserted. Following adjustment of width of molding cavity of the base (constructional) layer, reinforcing rods are inserted in holes with protruding ends located on both sides of the plane of panels. Following removal of panels and prior molding the next layer, a mesh cage is secured on the inserted reinforcing rods.

**[0010]** Vertical multilayer structures can be erected simultaneously for the whole building/construction.

**[0011]** The set task is resolved by the method for erecting the "floor structure - wall" segment of building/construction of monolithic reinforced concrete including process steps of:

- installing lifting jacks containing props enclosed in shells on the already erected vertical structures; installing U-shaped jack frames equipped with posts and extendible supports on said jack props; connecting posts of said jack frames located adjacently on both sides of the being erected vertical structures by rigid links;
- installing the floor structure formwork with reinforcement cages and installing reinforcement cages of vertical structures for the whole height of tier/storey with their connection to protruding reinforcement of previously erected structures and reinforcement of floor structure;
- installing formwork panels for erection of vertical structures on the posts of jack frames; securing rigidly said panels located in single plane; adjusting the width of molding cavity; and connecting said panels

located in parallel on the opposite side of reinforcement cage of the being erected vertical structures by means of tightening devices; locating bottom part of vertical shuttering panels at the level of the top part of floor structure formwork;

- pouring concrete of the floor structure; pouring concrete into molding cavities of the being erected vertical structures at the final stage of setting of said floor structure concrete; imparting reciprocating and rotating or only rotating motion to shells enclosing props of lifting jacks; resting U-shaped jack frames upon the poured vertical structures by means of extendible supports following 30-40% design strength of molded structures is attained; extracting lifting jack props with their enclosing shells from said molded structures with subsequent filling cavities formed in vertical structures with concrete; and moving formwork panels away from the molded surface;
- resting props of lifting jacks upon the already erected vertical structures; lifting U-shaped jack frames with formwork on the next tier/storey; and repeating the cycle for erecting vertical structures.

**[0012]** Floor structure and vertical structures of the whole building/construction can be erected simultaneously.

**[0013]** The set task is resolved by the method for erecting the "floor structure-multilayer wall" segment of building/construction of monolithic reinforced concrete including process steps of:

- installing lifting jacks containing props enclosed in shells on the already erected vertical structures; installing U-shaped jack frames equipped with posts and extendible supports on said jack props; connecting posts of said jack frames located adjacently on both sides of the being erected vertical structures by rigid links;
- installing the floor structure formwork with reinforcement cages and installing reinforcement cages of vertical structures for the whole height of tier/storey with their connection to protruding reinforcement of previously erected structures and reinforcement of floor structure;
- installing formwork panels for erection of vertical structures on the posts of jack frames; securing rigidly said panels located in single plane; adjusting the width of molding cavity; and connecting said panels located in parallel on the opposite side of reinforcement cage of the being erected vertical structures by means of tightening devices; locating bottom part of vertical shuttering panels at the level of the top part of floor structure formwork;
- pouring concrete of the floor structure; pouring concrete into molding cavities of being the erected vertical structures at the final stage of setting of said floor structure concrete; imparting reciprocating and rotating or only rotating motion to shells enclosing

props of lifting jacks; moving formwork panels away from the molded surface on one or both sides following stripping strength of the molded structures is attained; adjusting the width of molding cavity of the new layer and filling said cavity with molding material;

- resting U-shaped jack frames upon the poured vertical structures by means of extendible supports following 30-40% design strength of the base (constructional) layer of vertical structures is attained; extracting lifting jack props with their enclosing shells from said molded vertical structures with subsequent filling cavities formed in vertical structures with concrete;
- moving formwork panels away from the molded multilayer surface; resting props of lifting jacks upon the already erected base (constructional) layer of vertical structure; lifting U-shaped jack frames with formwork on the next tier/storey; and repeating the cycle for erecting the building/construction segment.

**[0014]** Prior to fill molding cavity of the base (constructional) layer with concrete, removable recess-forming cages can be hanged on the inner surface of formwork panels. Prior molding of the last (outer) layer, these cages shall be removed.

**[0015]** On posts of jack frames, panels can be installed with holes performed in their decks, where sleeves of elastic material are inserted. Following adjustment of width of molding cavity of the base (constructional) layer, reinforcing rods are inserted in holes with protruding ends located on both sides of the plane of panels. Following removal of panels and prior molding of the next layer, mesh cage is secured on the inserted reinforcing rods.

**[0016]** Floor structure and vertical multilayer structures of the whole building/construction can be erected simultaneously.

**[0017]** The set task is resolved also by application of travelling formwork comprising lifting jacks having props with U-shaped jack frames installed on them. In the base of jack frame posts, guides are secured, where holders of formwork panels of vertical structures are installed with possibility of travelling across said being erected vertical structures by means of the motor drive for their motion. At least one of the jack frame posts is provided with extendible support installed on it. On props of lifting jacks, shells are installed freely with possibility of rotation and vertical motion. Lower end of each shell is located in the base of the lower (end side) arm of lifting jack. Posts of adjacent jack frames located on each side of the being erected vertical structures are connected with each other by rigid links. Travelling formwork includes also vertical shuttering panels connected rigidly with each other and secured on the jack frame holders. Each said panel contains bearing frame with an edge profile around the panel perimeter.

**[0018]** Extendible supports of jack frames can be provided with motion drive and can be installed on each post

of jack frames in guides located at an angle (preferably 45 degrees) to the being erected vertical structures. In addition, guides for motion of extendible supports located on posts of each U-shaped jack frame are arranged in opposite directions from posts along the being erected vertical structures.

**[0019]** Rotation drive of the shell can be installed on a pad located on its top end and contains a gear wheel engaging a gear ring secured on outer surface in the top part of the lifting jack prop.

**[0020]** The set task is resolved also by application of the vertical shuttering panel for erection of multilayer structures, which contains bearing frame with an edge profiles around the panel perimeter, a deck secured on said frame with holes performed in it, where sleeves of elastic material are inserted. On end face of the top edge profile of a panel, at least one bracket with holes for fixing elements to connect with the U-shaped jack frame can be secured.

**[0021]** In edge profiles of the vertical shuttering panels, holes for fixing elements to connect with other panels can be performed. In the panel deck and bearing frame elements, holes for tightening devices can be performed. Panel can be sized for the whole height of tier/storey.

**[0022]** The set of features of both every individual invention and the group of inventions, including structural elements (assemblies, parts, etc.), when they are used jointly, makes it possible to resolve the set task. Shells installed on the props of lifting jacks with possibility of rotation and vertical motion allow isolation of props in the process of structures concreting. In the process of implementation of methods for erecting structural elements of building/construction, load from the whole formwork is transferred to the previously erected vertical structures by means of jacks, unlike to panels as it follows from prior art. It makes it possible to decrease significantly amount of metal used to manufacture the frame of panels resulting in reduction of power consumed for relocation of formwork. Besides, it becomes possible to arrange additional layers of structures immediately following concrete of the erected base (constructional) layer achieves the stripping strength. Time to stripping of structures is less than time required for the poured concrete to set to a strength, when it becomes possible to transfer the formwork load on it by means of lifting jacks. As compared with prior art, it allows reduction of construction time. Installation of guides on the jack frame posts, where holders of the vertical shuttering panels are installed with possibility of motion across the being erected vertical structures, makes it possible, just as its provided by the prior art, to adjust the wall thickness, including reduction of the wall thickness of upper tiers/storeys, which contributes the decreased expenditure of construction materials. Extendible supports installed on posts of jack frames allow relocation of travelling formwork on the poured vertical structures and extraction of lifting jacks to continue performance of works. Application of removable recess-forming cages hanged prior concreting on the vertical shuttering

panels, as well as panels with holes in their decks for inserting reinforcing rods to secure mesh cage prior concreting of the next layer makes it possible to improve bonding of layers of vertical structures. It increases reliability and quality of construction works.

**[0023]** Inventions are explained by means of drawings, where:

Fig.1 - view of travelling formwork along the being erected single-layer wall with lifting jacks resting up-on the erected wall;

Fig.2 - the same as in Fig.1, where oppositely facing panels form the molding cavity;

Fig.3 - view of formwork and molded "floor structure - single-layer wall" segment of building; floor structure formwork is not shown;

Fig.4 - the same as in Fig.3 with partial section of the molded wall, where formwork panels are brought apart, formwork rests on extendible supports of jack frames, and props of lifting jacks are extracted (their bottom sections are raised);

Fig.5 - the same as in Fig.4, where lifting jacks rest upon the erected wall prior lifting the formwork on the next tier/storey;

Fig.6 - view of the jack frame post base with attached panels;

Fig.7 - view A in Fig.6;

Fig.8 - section view B-B in Fig.7;

Fig.9 - section view C-C in Fig.7;

Fig.10 - section view of the top and bottom parts of the travelling formwork lifting jack;

Fig.11 - the same as in Fig.2, where multilayer wall is erected by application of the recess-forming cages hanged on panels;

Fig.12 - view of formwork and molded "floor structure - multi-layer wall" segment of building with recesses in the wall; floor structure formwork is not shown;

Fig.13 - view of the vertical shuttering panel with holes in the deck for erection of multilayer walls;

Fig.14 - view of formwork along the erected multilayer wall with application of a panel with holes in the deck, where reinforcing rods are inserted;

Fig.15 - view of formwork and the "floor structure - wall constructional layer" segment of building molded using panel with holes in the deck, where mesh cage is secured on reinforcing rods protruding from the constructional layer; floor structure formwork is not shown.

**[0024]** In the specific embodiment as defined below, travelling formwork comprises lifting jacks with props 1, where U-shaped jack frames 2 are installed on. In the base of each post 3 of said jack frames, guides 4 are secured, where holders 6 of the vertical shuttering panels 7 are installed with motor drive providing possibility of their motion across the being erected vertical structures 5. Also, on posts 3 of the jack frame 2, extendible supports 8 are installed moveably. On props 1 of lifting jacks, shells

9 are installed freely with possibility of rotation and vertical motion. Lower end of each shell 9 is located in the base of the lower (end side) arm of lifting jack. Posts 3 of adjacent jack frames 2 located on each side of the being erected vertical structures 5 are connected with each other by rigid links 10. Travelling formwork includes also vertical shuttering panels 7 connected rigidly with each other and secured on holders 6 of jack frames 2. Each said panel 7 contains bearing frame with an edge profile around the panel perimeter. Extendible supports 8 of jack frames 2 are provided with motion drive and are installed on each post 3 of jack frames 2 in guides 11 located at an angle (preferably 45 degrees) to the being erected vertical structures 5. In addition, guides 11 are directed in opposite sides from posts 3 along the being erected vertical structures 5. It is evident that extendible supports 8 can be located only on the one of posts 3 of jack frames 2. In this case, extendible supports 8 on adjacent jack frames 2 will be located in the staggered order along the being erected vertical structures 5. Such an arrangement ensures reliable resting of the whole formwork on the being erected vertical structures following extraction of props 1 of lifting jacks from them. It is also evident that extendible supports 8 can be executed in the form of outriggers of the truck crane (supports of extendible, folding, pivotable and extendible, pivotable and folding types, etc.) and located on posts 3. Rotation drive of the shell 9 is installed on a pad located on its top end and contains gear wheel 12 engaging gear ring 13 secured on outer surface in the top part of the lifting jack prop 1. When props 1 are extracted from vertical structures 5, disengaging of gear wheel 12 and gear ring 13 occurs. Props 1 are lifted together with shells 9.

**[0025]** Travelling formwork comprises also vertical shuttering panels 7 containing bearing frame containing edge profiles around the panel perimeter. On end face of the top edge profile of panel 7, at least one bracket 14 with holes for fixing elements to connect with holders 6 of the U-shaped jack frames 2 can be secured. In edge profiles of the vertical shuttering panel, holes for fixing elements to connect with other panels can be performed. In the panel deck and bearing frame elements, holes for tightening devices can be performed. Panel can be sized for the whole height of tier/storey. For erection of multilayer structures, panels 15 can be used with holes 17 performed in their decks 16, where sleeves of elastic material are inserted. Also, for erection of multilayer structures, panels 7 can be used with removable recess-forming cages 18 hanged on them from the inner side.

**[0026]** Single-layer vertical structures are erected as follows.

**[0027]** Lifting jacks containing props 1 enclosed in shells 9 with U-shaped jack frames 2 provided with extendible supports 8 and installed on these props 1 are mounted on the already erected structures 5. Posts 3 of adjacent jack frames 2 located on each side of the being erected vertical structures are connected with each other by rigid links 10. Reinforcement cages of vertical struc-

tures are installed for the whole height of tier/storey and are secured to the protruding reinforcement of previously erected structures. Formwork panels 7 containing brackets 14 are secured to holders 6, and all panels 7 located in single plane are connected rigidly with each other. Width of molding cavity is adjusted by movement of holders 6 in guides 4. Panels located in parallel on the opposite side of reinforcement cage of the being erected vertical structures are connected by means of tightening devices. Concrete is poured in molding cavities of the being erected vertical structures 5. Reciprocating and rotational or only rotational motion is imparted to shells 9 enclosing props 1 of lifting jacks. When 30-40% design strength of erected structures is attained, U-shaped jack frames 2 are laid resting on the poured vertical structures 5 by means of extendible supports 8; props 1 of lifting jacks with their enclosing shells 9 are extracted from said vertical structures, while cavities formed in these structures are filled with concrete, and the formwork panels are moved away from the molded surface. Said cavities can be filled not for the whole height (not shown in figures). In this case, sockets are left for further installation of props 1 of lifting jacks. When the required strength of concrete is attained, props 1 of lifting jacks are placed resting upon the already erected structures 5, U-shaped jack frames 2 are raised with formwork on the next tier/storey and the cycle of erection of vertical structures is repeated. Vertical structures can be erected simultaneously for the whole building/construction.

**[0028]** Multilayer vertical structures are erected as follows.

**[0029]** First stages of erecting the base (constructional) layer are performed in just the same manner as described above.

**[0030]** When molded structures (constructional layer) attain the stripping strength, formwork panels 7 on one or both sides are moved away from the molded surface (an example is shown in figures, where panels are moved away only on the one side to form the second layer 22). Width of molding cavity of the new layer is adjusted and this cavity is filled with molding material. When 30-40% design strength of the base (constructional) layer is attained, U-shaped jack frames 2 are laid resting on the poured vertical structures 5 (constructional layer) by means of extendible supports 8; props 1 of lifting jacks with their enclosing shells 9 are extracted from said vertical structures (constructional layer), while cavities formed in these structures are filled with concrete. The formwork panels 7 are moved away from the molded multilayer surface, props 1 of lifting jacks are placed resting on the already erected base (constructional) layer of vertical structure 5, U-shaped jack frames 2 are raised with formwork on the next tier/storey and the cycle of erection of the multilayer vertical structures is repeated. In one of possible embodiments (Figs. 11,12), prior to fill molding cavity of the base (constructional) layer with concrete, the removable recess-forming cages 18 are hanged on the inner surface of the formwork panels 7 and removed

prior molding of the last (outer) layer. Vertical structures can be erected simultaneously for the whole building/construction. Under another embodiment (Figs. 14,15), panels 15 (Fig.13) are installed on posts 3 of jack frames 2. The deck 16 of said panels 15 is provided with holes 17 performed in it, where sleeves of elastic material are inserted. Following adjustment of width of molding cavity of the base (constructional) layer, reinforcing rods 19 are inserted in holes 17 with their ends located on both sides of the plane of panels 15. Following panels are moved away prior molding of the next layer, mesh cage 20 is secured on the inserted reinforcing rods 19. Vertical multilayer structures can be erected simultaneously for the whole building/construction. It is evident that outside the constructional layer it is possible to erect simultaneously two - facing and insulating - layers at once. In this case, panels 7 or 15 are moved away from the molded constructional layer on both sides and works are performed as it is described above.

**[0031]** The "floor structure - wall" segment of building/constructions is erected of monolithic reinforced concrete as follows.

**[0032]** Lifting jacks containing props 1 enclosed in shells 9 with U-shaped jack frames 2 provided with extendible supports 8 and installed on said props 1 are mounted on the already erected structures 5. Posts 3 of adjacent jack frames 2 located on each side of the being erected vertical structures are connected with each other by rigid links 10. The floor structure formwork 21 with reinforcement cages is mounted and reinforcement cages of vertical structures for the whole height of tier/storey are installed. Said reinforcement cages are secured to protruding reinforcement of previously erected vertical structures and floor structure. Formwork panels 7 containing brackets 14 are secured to holders 6, and all panels 7 located in single plane are connected rigidly with each other with their bottom part located at the level of the top of the floor structure formwork. Width of molding cavity is adjusted by movement of holders 6 in guides 4. Panels 7 located in parallel on the opposite side of reinforcement cage of the being erected vertical structures are connected by means of tightening devices. Concrete of floor structure is poured and at the final stage of its setting concrete is poured in molding cavities of the being erected vertical structures. Reciprocating and rotational or only rotational motion is imparted to shells 9 enclosing props 1 of lifting jacks. When 30-40% design strength of erected structures is attained, U-shaped jack frames 2 are laid resting on the poured vertical structures 5 (constructional layer) by means of extendible supports 8; props 1 of lifting jacks with their enclosing shells 9 are extracted from said vertical structures, while cavities formed in these structures are filled with concrete, and the formwork panels are moved away from the molded surface. Props 1 of lifting jacks are placed resting on the already erected structures, U-shaped jack frames 2 are raised with formwork on the next tier/storey and the cycle of erection of the said building segment is repeated. Floor

structure and vertical structures can be erected simultaneously for the whole building/construction.

**[0033]** The "floor structure - multilayer wall" segment of building/construction of monolithic reinforced concrete is erected as follows.

**[0034]** First stages of works are performed in just the same manner as during erection of the "wall - floor structure" segment. When the base (constructional layer) attains the stripping strength, formwork panels on one or both sides are moved away from the molded vertical surface (an example is shown in figures, where panels are moved away only on the one side to form the second layer 22). Width of molding cavity of the new layer is adjusted and this cavity is filled with molding material. When 30-40% design strength of the base (constructional) layer of vertical structures is attained, U-shaped jack frames 2 are laid resting on the base layer by means of extendible supports 8; props 1 of lifting jacks with their enclosing shells 9 are extracted from said base layer, while cavities formed in vertical structures are filled with concrete. The formwork panels 7 are moved away from the molded multilayer surface, props 1 of lifting jacks are placed resting on the erected base (constructional) layer of vertical structure, U-shaped jack frames 2 are raised with formwork on the next tier/storey and the cycle of erection of the building/construction part is repeated. Possible embodiments of the method for erecting multilayer vertical structures are disclosed above in respective section of the present patent specification. Floor structure and multilayer vertical structures can be erected simultaneously for the whole building/construction.

**[0035]** Utilization of inventions makes it possible to reduce consumption of materials for technological equipment and power costs for this equipment relocation. Time required for erection of buildings/constructions with multilayer vertical structures is reduced. When works are carried out simultaneously at the whole building/construction, just as it is specified in the family patent, creation of the monolithic building segment including floor slab structure of building and vertical structures of the upper tier/storey is ensured. Furthermore, rigidity and strength properties of the erected buildings/constructions are improved, which makes it possible to utilize inventions efficiently during construction activities in seismic regions.

**[0036]** Further features and aspects of the invention may reside in the below clauses:

1. Method for erecting structural elements of building/construction of monolithic reinforced concrete including process steps of:

- installing lifting jacks containing props enclosed in shells on the already erected structures; installing U-shaped jack frames equipped with posts and extendible supports on said jack props; connecting posts of said jack frames located adjacently on both sides of the being erected vertical structures by rigid links;

- installing reinforcement cages of vertical structures for the whole height of tier/storey with their connection to protruding reinforcement of previously erected structures;
- installing formwork panels for erection of vertical structures on the posts of jack frames; securing rigidly said panels located in single plane; adjusting width of molding cavity; and connecting said panels located in parallel on the opposite side of reinforcement cage of the being erected vertical structures by means of tightening devices;
- pouring concrete into molding cavities of the being erected vertical structures; imparting reciprocating and rotating or only rotating motion to shells enclosing props of lifting jacks; resting U-shaped jack frames upon the poured vertical structures by means of extendible supports following 30-40% design strength of molded structures is attained; extracting lifting jack props with their enclosing shells from said molded structures with subsequent filling cavities formed in vertical structures with concrete; and moving formwork panels away from the molded surface;
- resting props of lifting jacks upon the already erected structures; lifting U-shaped jack frames with formwork on the next tier/storey; and repeating the cycle for erecting vertical structures.

2. The method according to clause 1, wherein vertical structures are erected simultaneously for the whole building/construction.

3. Method for erecting for erecting multilayer vertical structures of building/construction of monolithic reinforced concrete including process steps of:

- installing lifting jacks containing props enclosed in shells on the already erected structures; installing U-shaped jack frames equipped with posts and extendible supports on said jack props; connecting posts of said jack frames located adjacently on both sides of the being erected vertical structures by rigid links;
- installing reinforcement cages of vertical structures for the whole height of tier/storey with their connection to protruding reinforcement of previously erected structures;
- installing formwork panels for erection of vertical structures on the posts of jack frames; securing rigidly said panels located in single plane; adjusting the width of molding cavity; and connecting said panels located in parallel on the opposite side of reinforcement cage of the being erected vertical structures by means of tightening devices;
- pouring concrete into molding cavities of the being erected vertical structures; imparting recip-

- rotating and rotating or only rotating motion to shells enclosing props of lifting jacks; moving formwork panels away from the molded surface on one or both sides following stripping strength of the molded structures is attained; adjusting width of molding cavity of the new layer and filling said cavity with molding material;
- resting U-shaped jack frames upon the poured vertical structures by means of extendible supports following 30-40% design strength of the base (constructional) layer is attained; extracting lifting jack props with their enclosing shells from said molded structures with subsequent filling cavities formed in vertical structures with concrete;
  - moving formwork panels away from the molded multi-layer surface; resting props of lifting jacks upon the already erected base (constructional) layer of vertical structure; lifting U-shaped jack frames with formwork on the next tier/storey; and repeating the cycle for erecting multilayer vertical structures.
4. The method according to clause 3, wherein, prior filling molding cavity of the base (constructional) layer with concrete, removable recess-forming cages are hanged on the inner surface of formwork panels, and, prior molding of the last (outer) layer, said cages are removed.
5. The method according to clause 3, wherein panels with holes performed in their decks, where sleeves of elastic material are inserted, are installed on posts of jack frames; following adjustment of width of molding cavity of the base (constructional) layer, reinforcing rods are inserted in said holes with protruding ends located on both sides of the plane of panels; and following moving panels away and prior molding of the next layer, mesh cage is secured on the inserted reinforcing rods.
6. The method according to clauses 3, 4 or 3, 5, wherein vertical multilayer structures are erected simultaneously for the whole building/construction.
7. The method for erecting the "floor structure - wall" segment of building/construction of monolithic reinforced concrete including process steps of:
- installing lifting jacks containing props enclosed in shells on the already erected vertical structures; installing U-shaped jack frames equipped with posts and extendible supports on said jack props; connecting posts of said jack frames located adjacently on both sides of the being erected vertical structures by rigid links;
  - installing the floor structure formwork with reinforcement cages and installing reinforcement

- cages of vertical structures for the whole height of tier/storey with their connection to protruding reinforcement of previously erected structures and reinforcement of floor structure;
- installing formwork panels for erection of vertical structures on the posts of jack frames; securing rigidly said panels located in single plane; adjusting width of molding cavity; and connecting said panels located in parallel on the opposite side of reinforcement cage of the being erected vertical structures by means of tightening devices; locating bottom part of vertical shuttering panels at the level of the top part of floor structure formwork;
  - pouring concrete of the floor structure; pouring concrete into molding cavities of the being erected vertical structures at the final stage of setting of said floor structure concrete; imparting reciprocating and rotating or only rotating motion to shells enclosing props of lifting jacks; resting U-shaped jack frames upon the poured vertical structures by means of extendible supports following 30-40% design strength of molded structures is attained; extracting lifting jack props with their enclosing shells from said molded structures with subsequent filling cavities formed in vertical structures with concrete; and moving formwork panels away from the molded surface;
  - resting props of lifting jacks upon the already erected vertical structures; lifting U-shaped jack frames with formwork on the next tier/storey; and repeating the cycle for erecting vertical structures.
8. The method according to clause 7, wherein floor structure and vertical structures of the whole building/construction are erected simultaneously.
9. The method for erecting the "floor structure - multilayer wall" segment of building/construction of monolithic reinforced concrete including process steps of:
- installing lifting jacks containing props enclosed in shells on the already erected vertical structures; installing U-shaped jack frames equipped with posts and extendible supports on said jack props; connecting posts of said jack frames located adjacently on both sides of the being erected vertical structures by rigid links;
  - installing the floor structure formwork with reinforcement cages and installing reinforcement cages of vertical structures for the whole height of tier/storey with their connection to protruding reinforcement of previously erected structures and reinforcement of floor structure;
  - installing formwork panels for erection of vertical structures on the posts of jack frames; securing



- rigidly said panels located in single plane; adjusting width of molding cavity; and connecting said panels located in parallel on the opposite side of reinforcement cage of the being erected vertical structures by means of tightening devices; locating bottom part of vertical shuttering panels at the level of the top part of floor structure formwork;
- pouring concrete of the floor structure; pouring concrete into molding cavities of the being erected vertical structures at the final stage of setting of said floor structure concrete; imparting reciprocating and rotating or only rotating motion to shells enclosing props of lifting jacks; moving formwork panels away from the molded surface on one or both sides following stripping strength of the molded structures is attained; adjusting width of molding cavity of the new layer and filling said cavity with molding material;
  - resting U-shaped jack frames upon the poured vertical structures by means of extendible supports following 30-40% design strength of the base (constructional) layer of vertical structures is attained; extracting lifting jack props with their enclosing shells from said molded vertical structures with subsequent filling cavities formed in vertical structures with concrete;
  - moving formwork panels away from the molded multilayer surface; resting props of lifting jacks upon the already erected base (constructional) layer of vertical structure; lifting U-shaped jack frames with formwork on the next tier/storey; and repeating the cycle for erecting the building/construction segment.
10. The method according to clause 9, wherein prior filling molding cavity of the base (constructional) layer with concrete, removable recess-forming cages are hanged on the inner surface of formwork panels, and, prior molding of the last (outer) layer, said cages are removed.
11. The method according to clause 9, wherein panels with holes performed in their decks, where sleeves of elastic material are inserted, are installed on posts of jack frames; following adjustment of the width of molding cavity of the base (constructional) layer, reinforcing rods are inserted in said holes with protruding ends located on both sides of the plane of panels; and following moving panels away and prior molding of the next layer, a mesh cage is secured on the inserted reinforcing rods.
12. The method according to clauses 9, 10 or 9, 11, wherein floor structure and vertical multilayer structures of the whole building/construction are erected simultaneously.

13. The travelling formwork to implement method according to clauses 1 or 3 or 7 or 9 comprising lifting jacks having props (1) with U-shaped jack frames (2) installed on them and containing posts (3); in the base of posts (3), guides (4) are secured, where holders (6) of formwork panels (7) of vertical structures (5) are installed with possibility of travelling across the said being erected vertical structures (5) by means of the motor drive for their motion; wherein at least one of posts (3) of jack frame (2) is provided with extendible support (8) installed on it; on props (1) of lifting jacks, shells (9) are installed freely with possibility of rotation and vertical motion; lower end of each shell (9) is located in the base of the lower (end side) arm of lifting jack; posts (3) of adjacent jack frames (2) located on each side of the being erected vertical structures (5) are connected with each other by rigid links (10); vertical shuttering panels (7) are connected rigidly with each other and are secured on holders (6); said panel (6) contains bearing frame with an edge profile around the panel perimeter.

14. The travelling formwork according to clause 13, wherein extendible supports (8) of jack frames (2) are provided with motion motor drive and are installed on each post (3) of said jack frames (2) in guides (11) located at an angle (preferably 45 degrees) to the being erected vertical structures (5); guides (11) for motion of extendible supports (8) located on posts (3) of each U-shaped jack frame (2) are arranged in opposite directions from posts (3) along the being erected vertical structures (5).

15. The travelling formwork according to clause 13, wherein rotation drive of shell (9) is installed on a pad located on the top end of said shell and contains gear wheel (12) engaging gear ring (13) secured on outer surface in the top part of the lifting jack prop (1).

16. The vertical shuttering panel (15) for erection of multilayer structures containing bearing frame with an edge profiles around the panel perimeter, a deck (16) secured on said frame with holes (17) performed in it, where sleeves of elastic material are inserted.

17. The vertical shuttering panel according to clause 16, wherein at least one bracket (14) with holes for fixing elements to connect with the U-shaped jack frame is secured on end face of the top edge profile of panel (15).

18. The vertical shuttering panel according to clause 16, wherein holes for fixing elements to connect with other panels are performed in edge profiles of the vertical shuttering panel (15).

19. The vertical shuttering panel to clause 16, where-

in holes for tightening devices are performed in deck (16) and in bearing frame elements.

20. The vertical shuttering panel according to clause 16, wherein panel (15) is sized for the whole height of tier/storey. 5

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#### Claims

1. The vertical shuttering panel (15) for erection of multilayer structures containing bearing frame with an edge profiles around the panel perimeter, a deck (16) secured on said frame with holes (17) performed in it, where sleeves of elastic material are inserted. 20
2. The vertical shuttering panel according to claim 1, wherein at least one bracket (14) with holes for fixing elements to connect with the U-shaped jack frame is secured on end face of the top edge profile of panel (15). 25
3. The vertical shuttering panel according to claim 1, wherein holes for fixing elements to connect with other panels are performed in edge profiles of the vertical shuttering panel (15). 30
4. The vertical shuttering panel to claim 1, wherein holes for tightening devices are performed in deck (16) and in bearing frame elements. 35
5. The vertical shuttering panel according to claim 1, wherein panel (15) is sized for the whole height of tier/storey. 40

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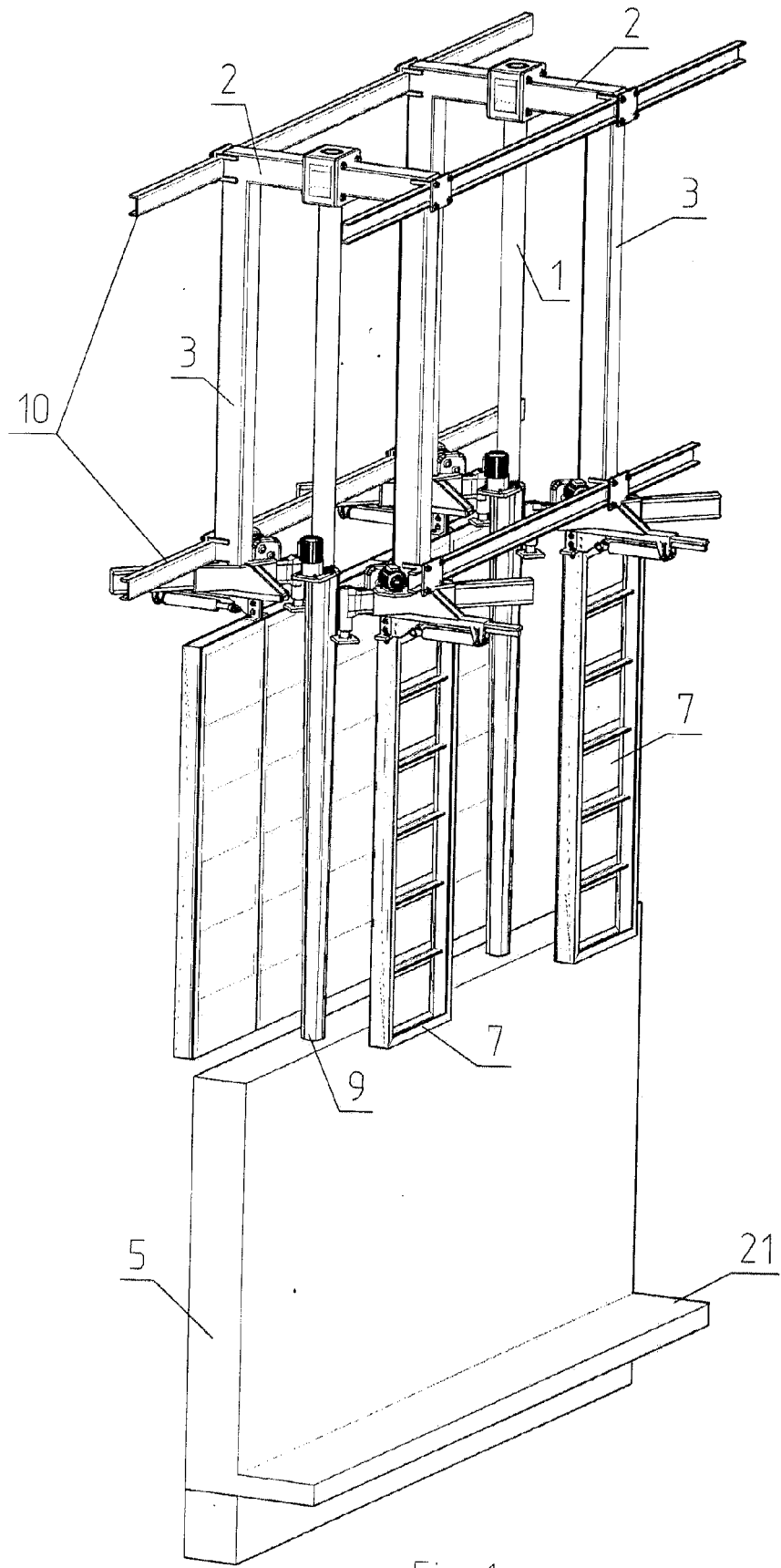


Fig. 1

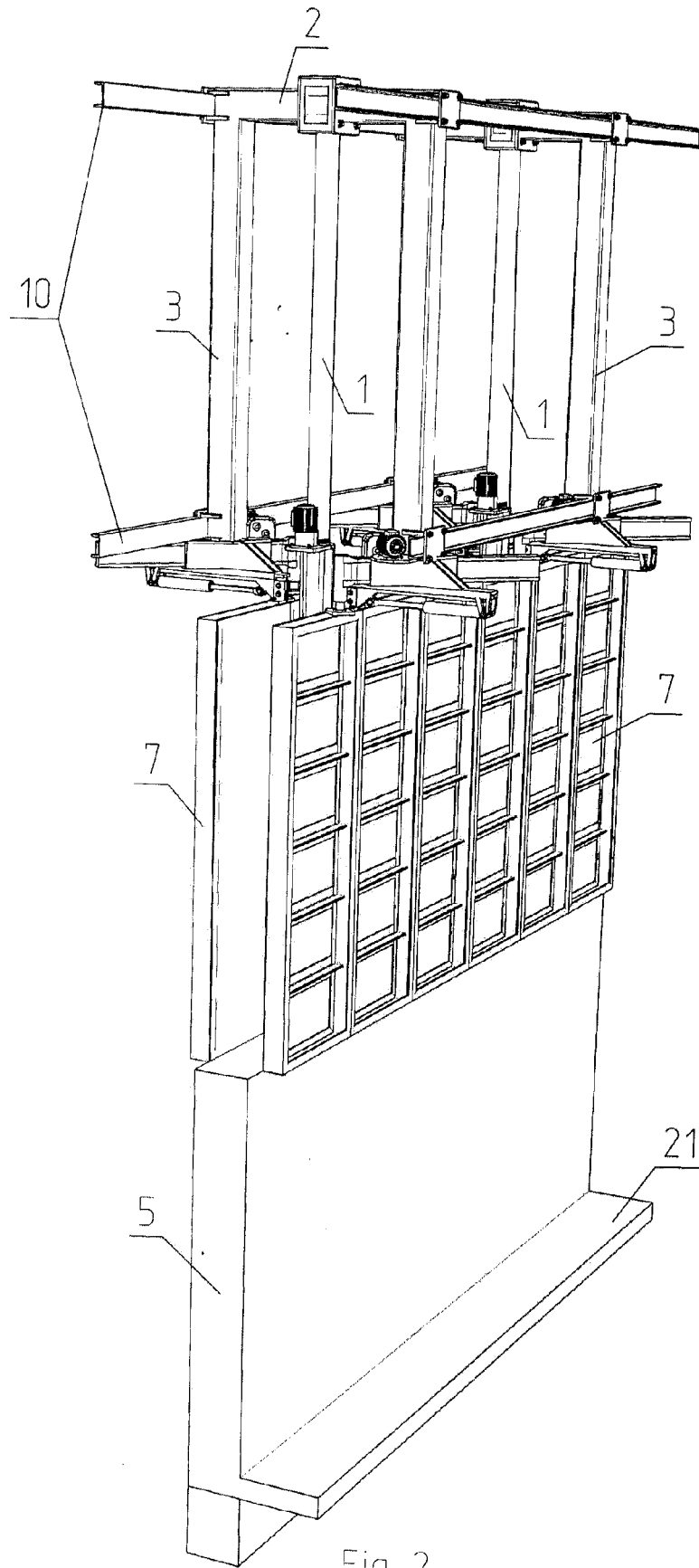


Fig. 2

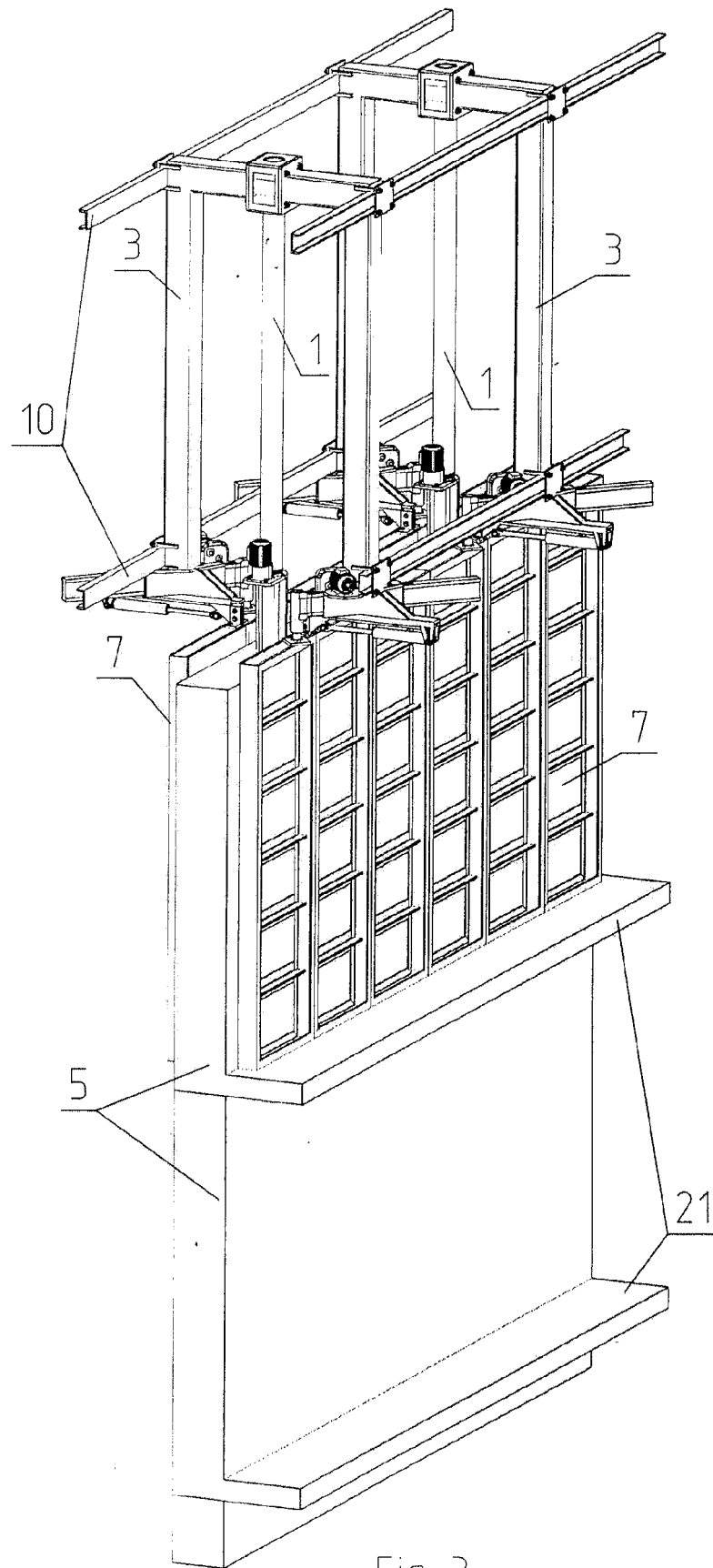


Fig. 3

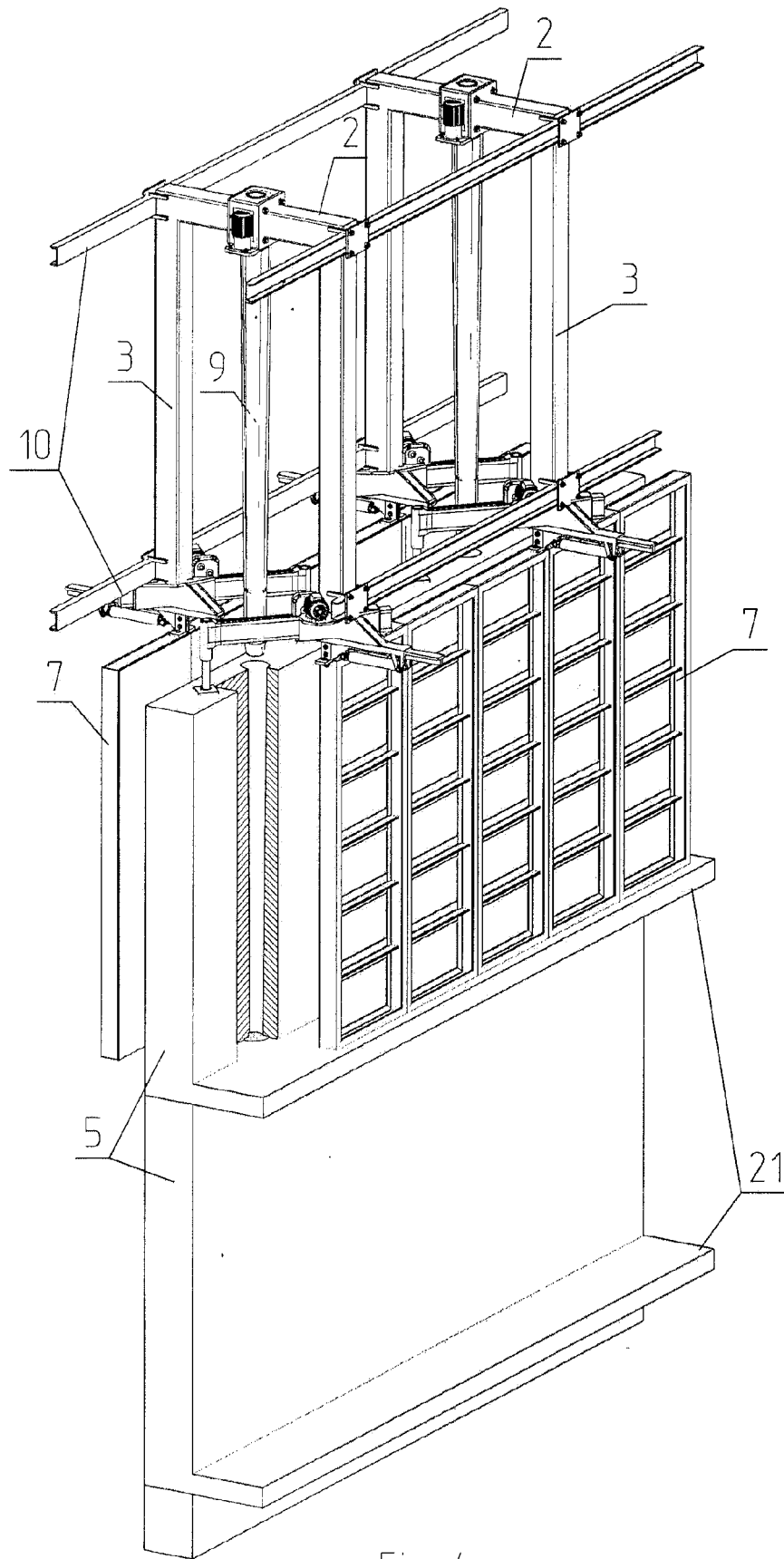


Fig. 4

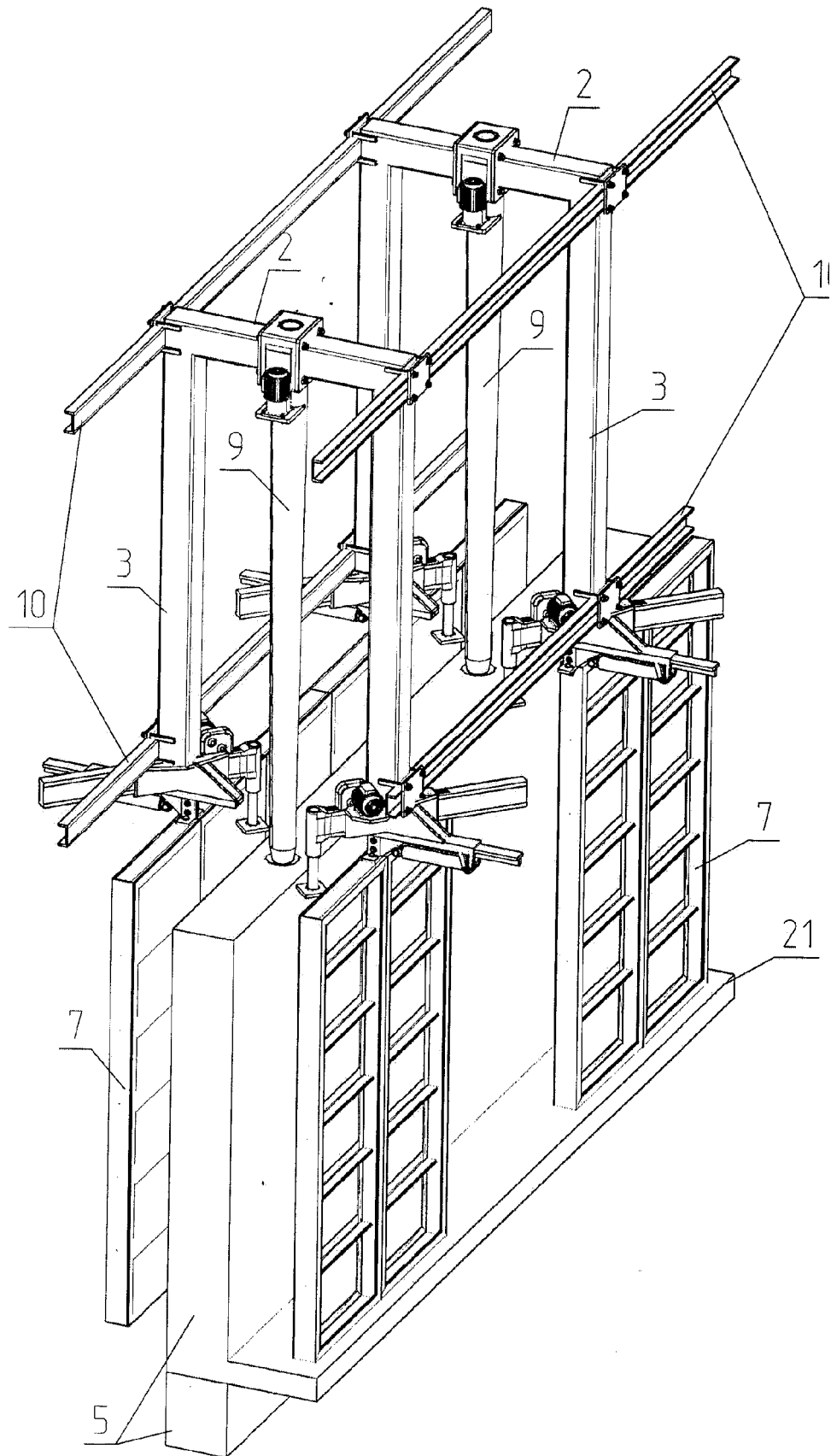


Fig. 5

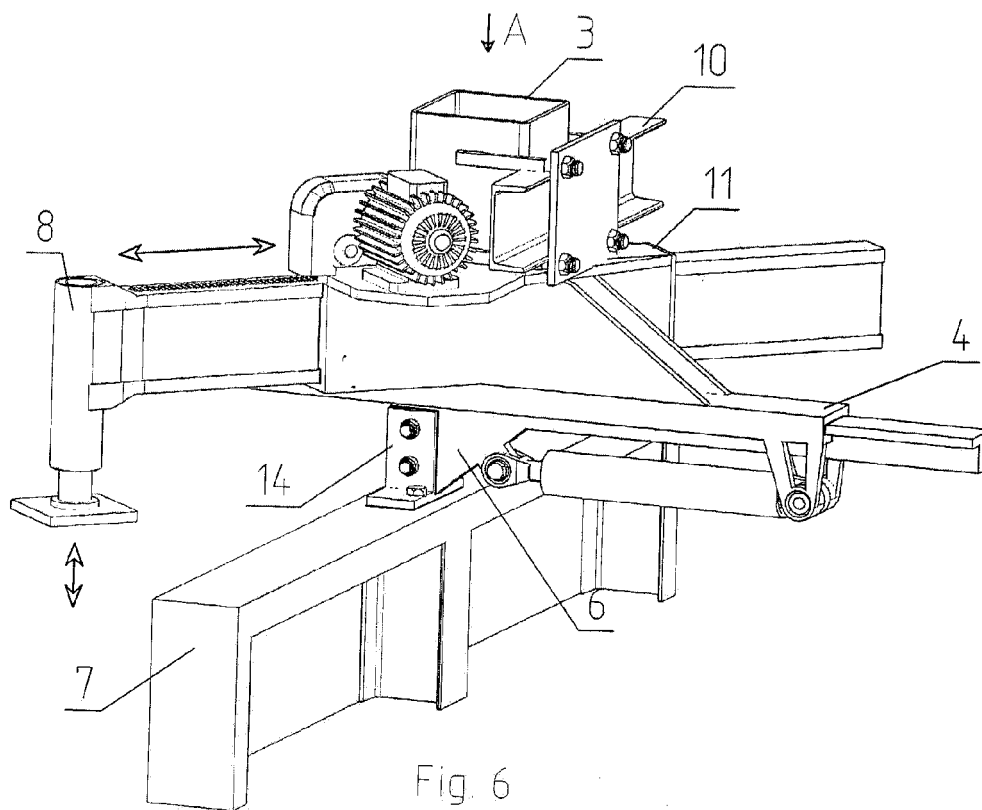


Fig. 6

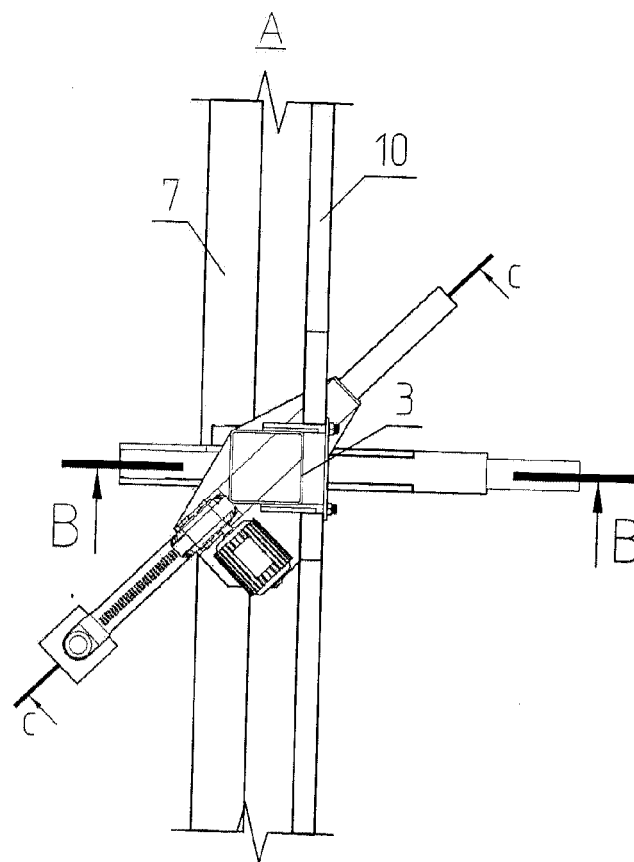
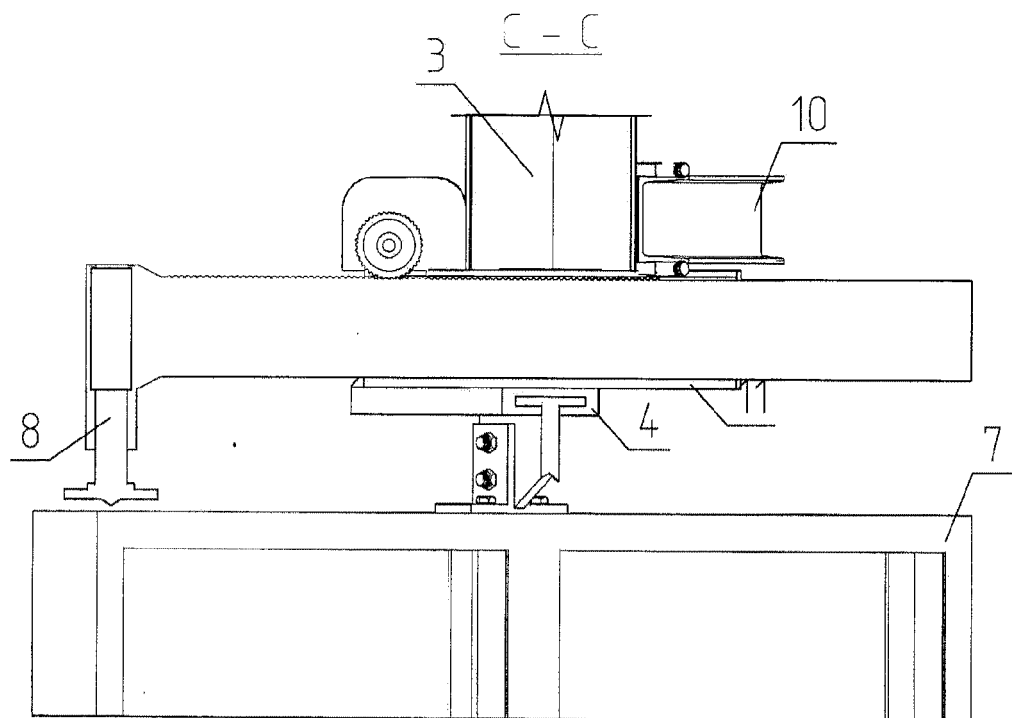
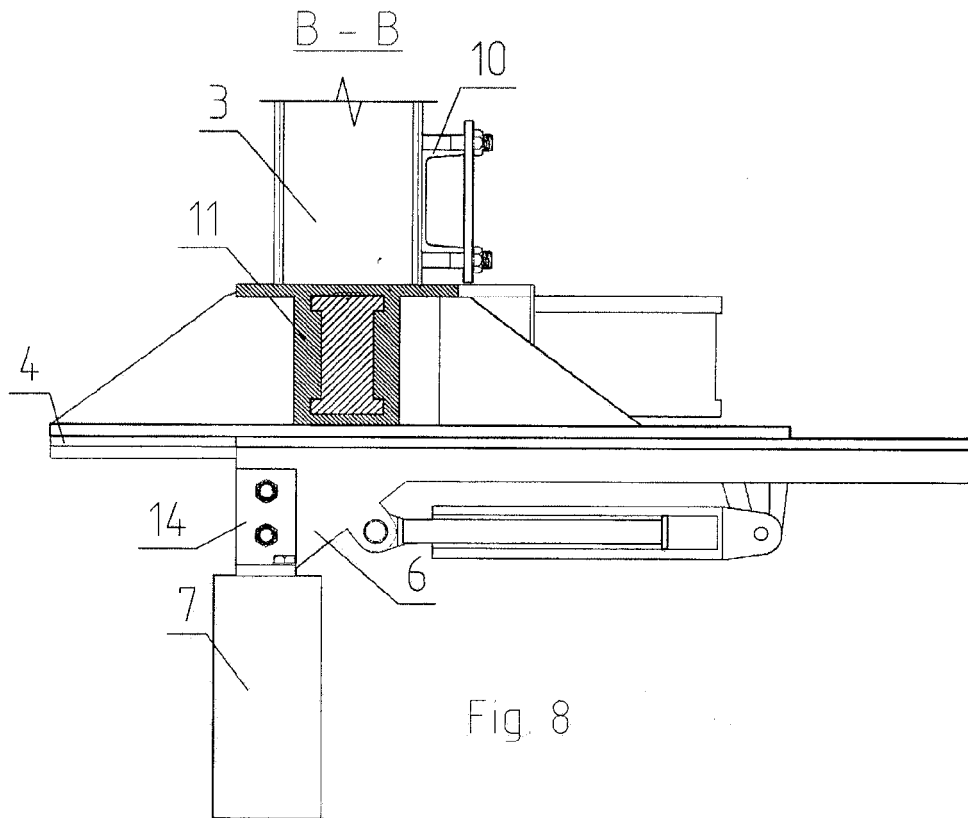


Fig. 7





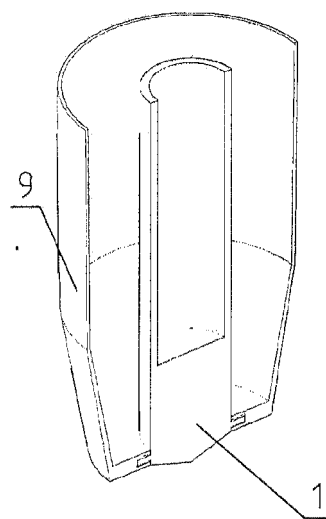
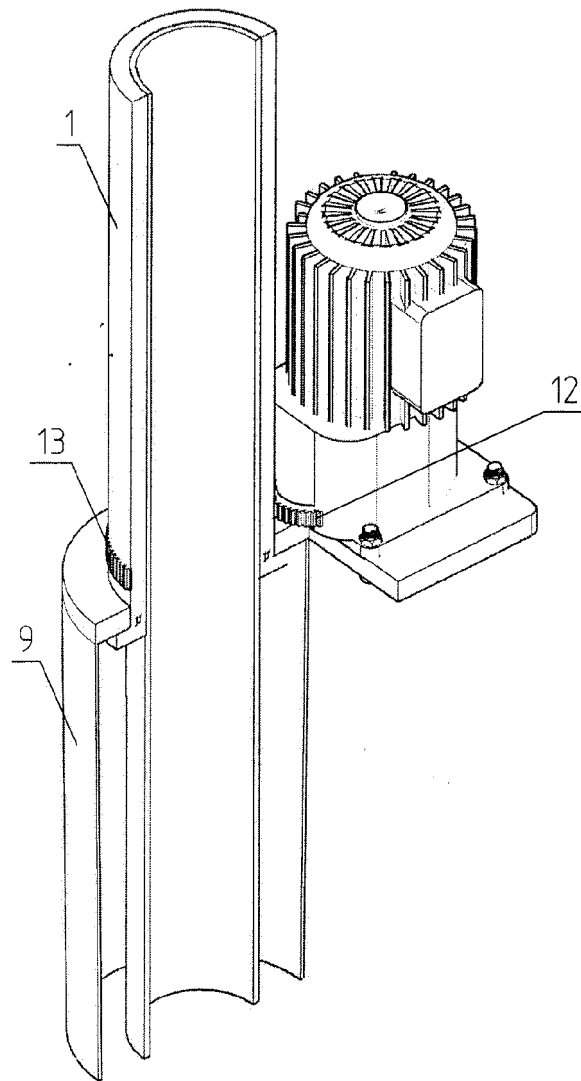


Fig. 10

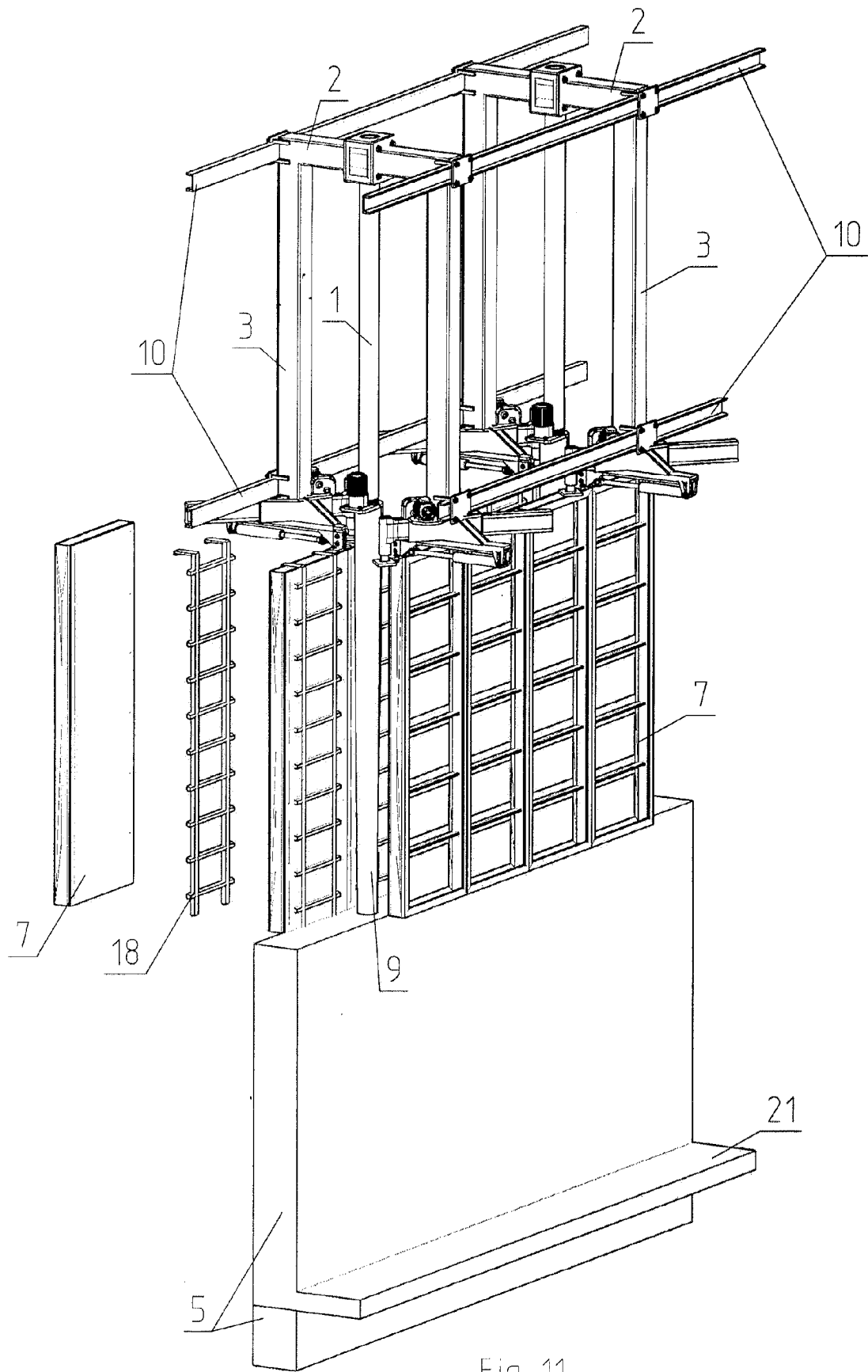


Fig. 11

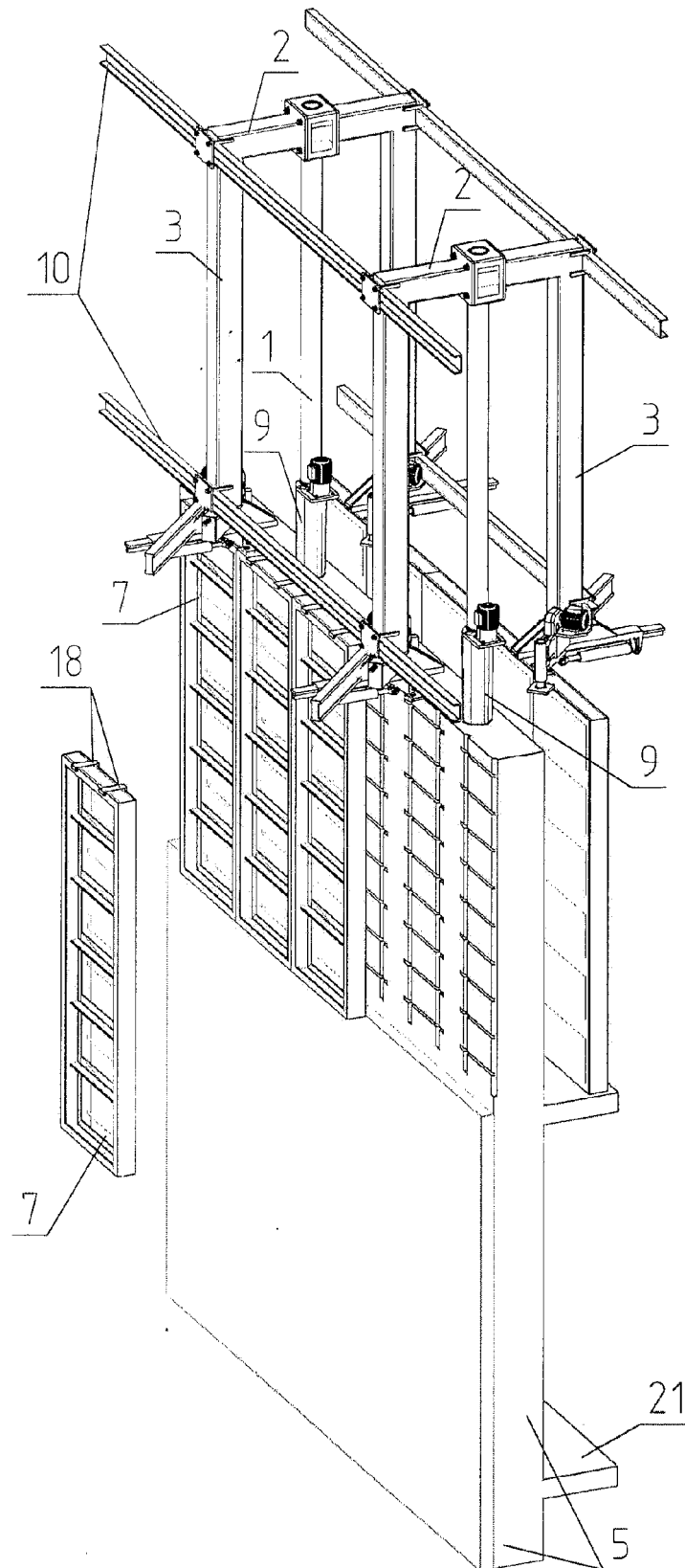


Fig. 12

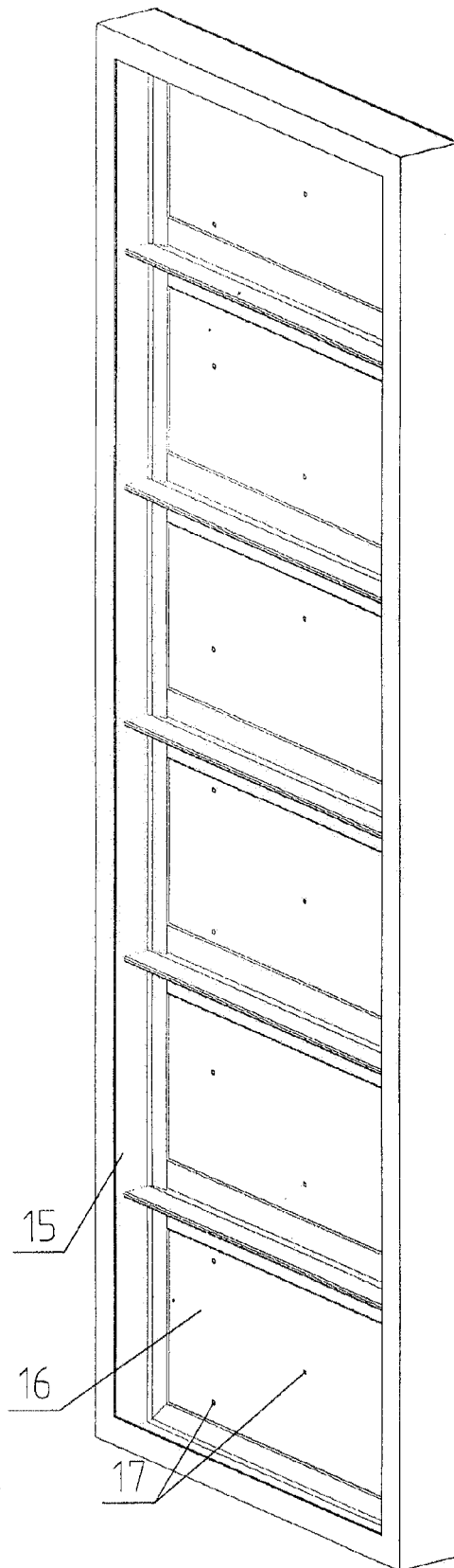


Fig. 13

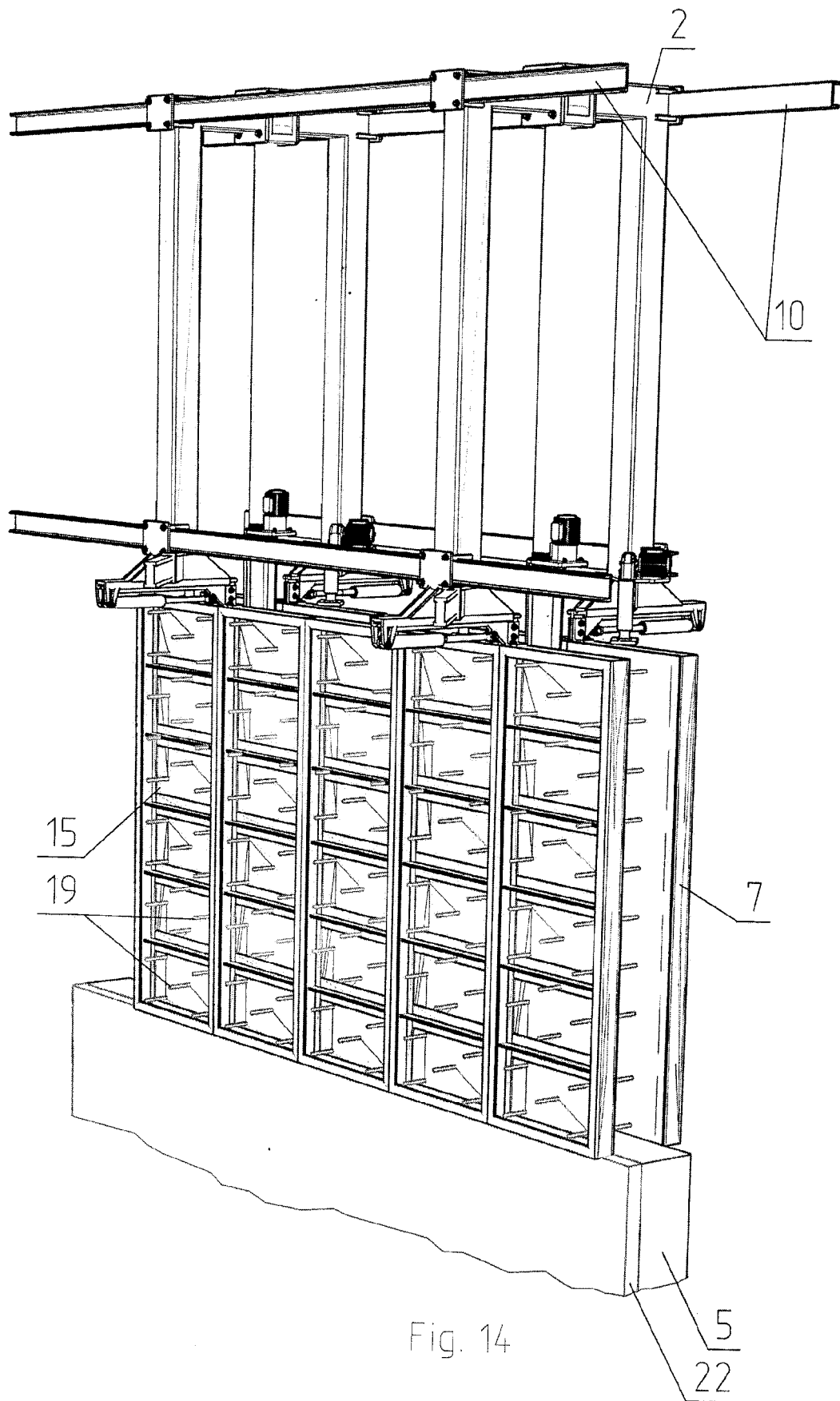


Fig. 14

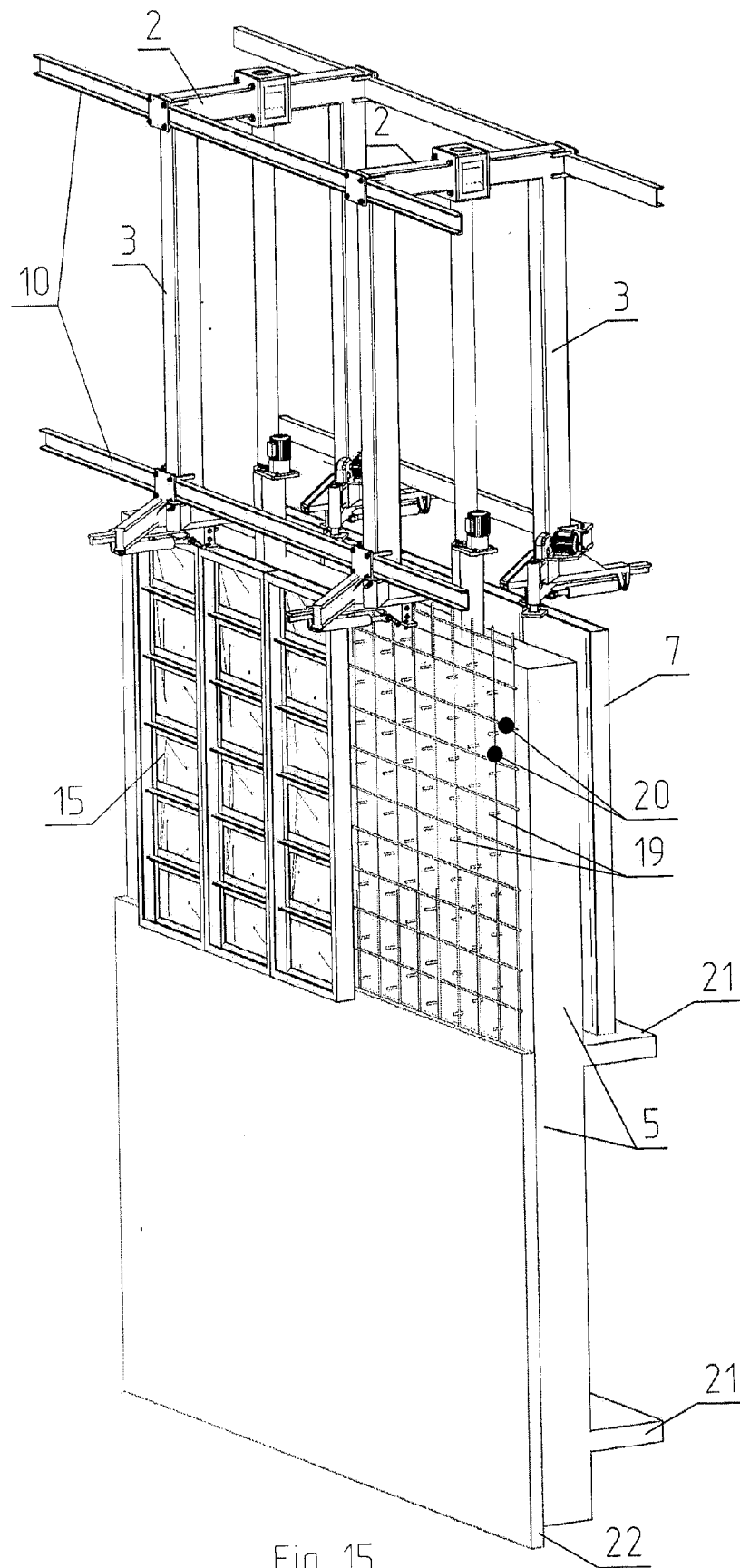


Fig. 15



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