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(54) **Title:** METHOD OF LOADING AND UNLOADING A MOLD ON A FOAM PLASTICS MOLDING MACHINE

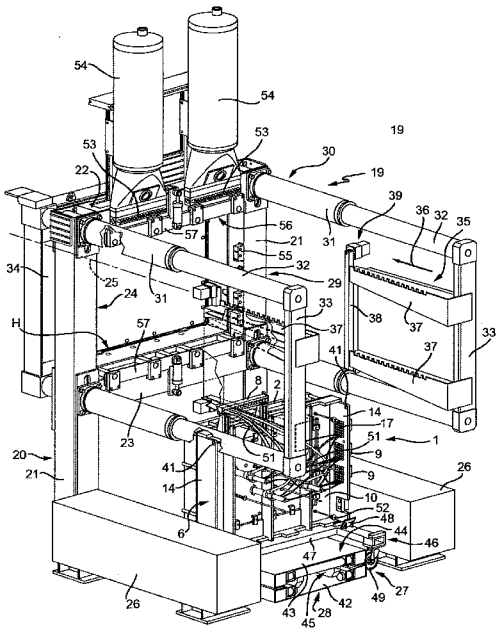

FIG. 1

(57) **Abstract:** On a foam plastics molding machine (19), a molding unit (1), defined by a mold (2) and an interface frame (6) equipped with a number of plastic molding material and operating fluid inlets (8, 9), is loaded into a raised window (24) in a fixed frame (29) of the machine (19) by positioning the molding unit (1) in a fixed position on a trolley (46); positioning the trolley (46) astride a fixed platform (28); raising the platform (28) so that vertical ribs (14) on the interface frame (6) slidably engage corresponding vertical guides (38) forming part of the machine (19) and on a level (H) with the window (24); connecting the guides (38) to the ribs (14); and moving the guides (38) towards the window (24).

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METHOD OF LOADING AND UNLOADING A MOLD ON A FOAM PLASTICS MOLDING MACHINE

TECHNICAL FIELD

The present invention relates to a method of loading and unloading a mold on a foam plastics molding machine .

BACKGROUND ART

In foam plastics molding, a machine, as described for example in the Applicant's EP-A-0 968 805 , is known comprising a fixed frame with a window, higher than the machine supporting surface, for receiving the mold; and the mold, comprising two interlocked half-molds, is loaded onto the machine in a loading sequence comprising:

- a first step of setting up and connecting a machine-mold interface frame to the mold to form a molding unit, which comprises the mold and interface frame, and has a number of plastic molding material and operating fluid inlets;

– a second step of advancing the molding unit towards the fixed frame;

- a third step of lifting the molding unit to window level; and

- a fourth step of loading the molding unit into a work position physically and functionally engaging the fixed frame at the window, and in which the molding unit is locked to the fixed frame.

In the work position, the mold is connected automatically to feed lines supplying granular plastic material and operating fluids, such as compressed air and steam.

In the work position, the half-molds are made movable with respect to each other by locking a first half-mold, connected to the feed lines, to a fixed frame of the machine at the window; locking a second half-mold to a movable frame of the machine facing the window; making the two half-molds free to move with respect to each other; and moving the movable frame to and from the fixed frame in a given operating sequence.

One of the main problems of known molding machines of the above type is loading the molding unit accurately onto a lift movable vertically on the machine to perform the third step described above.

In this connection, it is important to bear in mind that a molding unit can weigh several tons, is always off-balanced (when suspended, is always tilted with respect to the vertical), and, when attached to the lift, assumes with respect to the machine a precise final work position which, except for the movements of the molding unit on the machine at the third and fourth steps, remains substantially unchanged throughout the operating cycle of the machine. Attaching the molding unit to the lift therefore involves an indefinite number (varying from one unit to another) of setting and balancing operations, which are not only time-consuming,

but must be performed with the machine off, and, in the case of medium production runs, may cut the output capacity of the machine by as much as half.

DISCLOSURE OF INVENTION

It is an object of the present invention to provide a method of loading and unloading a mold on a foam plastics molding machine, designed to eliminate the above drawbacks .

According to the present invention, there is provided a method of loading and unloading a mold on a foam plastics molding machine, as claimed in Claim 1 and preferably in any one of the following Claims depending directly or indirectly on Claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which :

Figure 1 shows a view in perspective, with parts removed for clarity, of a foam plastics molding machine implementing the method according to the present invention;

Figures 2 and 3 show two, respectively front and rear, views in perspective, with parts removed for clarity, of the Figure 1 machine in a different operating configuration;

Figure 4 shows a larger-scale first detail of Figure 1;

Figure 5 shows an exploded view in perspective of a

second detail of Figure 1;

Figures 6 and 7 show respective larger-scale details of the Figure 1 machine.

BEST MODE FOR CARRYING OUT THE INVENTION

Number 1 in Figure 5 indicates as a whole a molding unit comprising a mold 2, in turn comprising two facing half-molds 3 and 4 defining a chamber 5 for molding foam plastic material. Molding unit 1 also comprises a frame 6 connected integrally to half-mold 3 by a number of tubular stays 7, and in turn comprising a first number of top front connectors 8 connected to molding chamber 5 by part of tubular stays 7 to feed plastic molding material into molding chamber 5; and a second number of lateral front connectors 9 connected to molding chamber 5 by a further part of tubular stays 7 to feed operating fluids (compressed air, water, etc.) into molding chamber 5.

Frame 6 comprises a plate 10, which faces half-mold 3, is connected to half-mold 3 by tubular stays 7, is perpendicular to a longitudinal axis 11 of mold 2, and comprises, on the opposite side to that facing half-mold 3, a number of reinforcing cross members 12 positioned, like axis 11, substantially horizontally in use; a number of reinforcing wings 13 perpendicular to cross members 12 and to axis 11, and positioned substantially vertically in use; and two ribs 14 parallel to wings 13 and extending along respective lateral edges of plate 10.

Close to its lateral edge positioned at the top and horizontally in use, plate **10** is fitted with a wing **15**, which extends between ribs **14**, is perpendicular to plate **10** and ribs **14**, and supports top front connectors **8** on a bracket **16**. A variation not shown has two or more brackets **16**, each fitted with a respective number of top front connectors **8**. Lateral front connectors **9** (Figure **3**) on the other hand are located on the outer surface of one of ribs **14**, and communicate with a number of through holes **17** formed in rib **14**, at a minimum distance D from the free edge of rib **14**.

Finally, molding unit **1** comprises a number of lock pins **18** projecting, parallel to axis **11**, from the opposite side of half-mold **4** to that facing half-mold **3**.

Frame **6** forms an interface connecting mold **2** to a molding machine **19**. In other words, mold **2** is totally generic, and frame **6** is specially designed for machine **19** to connect mold **2** to machine **19**.

As shown in Figure **1**, machine **19** comprises an intermediate portal **20** arranged vertically and comprising two uprights **21** connected by a top cross member **22** and an intermediate cross member **23**. Together with top portions of uprights **21**, cross members **22** and **23** define a substantially rectangular window **24**, which has a horizontal axis **25** perpendicular to portal **20**, and is located a given height H above a supporting surface of machine **19**, hereinafter referred to as the floor.

Machine **19** also comprises two boxes **26**, each of

which rests on the floor, projects rearwards from a respective upright **21** in a direction perpendicular to portal **20** and parallel to axis **25**, and defines, with the other box **26** and the floor, a passage **27** housing, in a fixed position, a platform **28** for lifting molding unit **1** from a lowered position on the floor to a raised position at height H. Platform **28** is narrower than passage **27** so as to define, between itself and boxes **26**, two aisles of given width on the floor.

Portal **20** and boxes **26** define a fixed frame **29** of machine **19**, which also comprises a movable frame **30**, in turn comprising two pairs of double-acting hydraulic cylinders **31** fitted to portal **20** and arranged at the four edges of a parallelogram coaxial with axis **25**. More specifically, at the intersections with top cross member **22** and intermediate cross member **23**, each upright **21** is fitted through with the fixed intermediate sleeves of a respective pair of hydraulic cylinders **31**; and each hydraulic cylinder **31** in each pair has a through piston **32**, the rear end of which, located over relative box **26**, is connected to the rear end of the other piston **32** by a substantially vertical rod **33** parallel to upright **21**. The front ends of all four pistons **32** are connected to respective corners of a rectangular plate **34** coaxial with axis **25**, and which in use is connected releasably in known manner (not shown) to half-mold 4 by means of pins **18**.

Movable frame **30** also comprises a transfer device

35 movable with pistons 32, in a work direction 36 parallel to axis 25, between a withdrawn position, in which transfer device 35 receives and supports molding unit 1, and a forward position, in which transfer device 35 releases molding unit 1 onto fixed frame 29 at window 24.

For each rod 33, transfer device 35 comprises two brackets 37 connected rigidly to rod 33, between and parallel to relative pistons 32, and extending from rod 33 towards portal 20; and a vertical guide 38, which is integral with the free ends of relative brackets 37, is parallel to rod 33, and has a U-shaped cross section defining a longitudinal groove with its concavity facing portal 20, of a depth at most equal to distance D, and of a width approximating but no less than the thickness of ribs 14. Guides 38 are arranged symmetrically with respect to axis 25 and are at least the same length as ribs 14; and the longitudinal axes of their grooves are spaced apart by the same distance as that between the intermediate planes of ribs 14.

Each guide 38 is fitted at each end with an electromechanical locking device 39 comprising a conical bolt 40 crosswise to axis 25 and which moves through the longitudinal groove of relative guide 38 to engage a respective through hole 41 in relative rib 14 and lock molding unit 1 to relative guide 38.

As shown in Figures 2 and 3, platform 28 comprises a flat base resting on and fixed to the floor; a top

plate 43 with a top supporting surface 44; and a hydraulically extendible accordion frame 45 for moving plate 43 between a lowered position resting on base 42, and a raised position substantially on a level with the bottom ends of guides 38, and for keeping supporting surface 44 perpendicular to guides 38, i.e. horizontal, at all times.

As shown in Figures 2 and 3, molding machine 19 also comprises a trolley 46 comprising a bed 47 of constant thickness, fitted on top with lateral and longitudinal locators 48, which cooperate with and define the position of a specific molding unit 1 on trolley 46. Bed 47 is fitted underneath with at least four wheels 49 - at least two of which are castors - high enough so that the top surface of bed 47 is higher than supporting surface 44 when plate 43 is in the lowered position.

Bed 47 is wider than platform 28 and narrower than passage 27, and is designed to straddle platform 28, with wheels 49 resting on the floor inside the lateral aisles defined by platform 28 inside passage 27.

Molding machine 19 can be loaded selectively with a number of molds similar to mold 2 described, provided each is fitted with a respective interface frame 6. Frames 6 obviously vary from one mold to another as regards the number and arrangement of tubular stays 7, but are identical in terms of overall size, the location and size of ribs 14, and the location of top and lateral

front connectors 8 and 9, to ensure correct fitment of molding unit 1 to molding machine 19.

When not in use, each molding unit 1 is stored on a respective trolley 46 specific to and forming an integral part of molding unit 1. Trolley 46 in fact virtually defines a locating and loading dock for respective molding unit 1, and its locators are positioned with respect to bed 47 so that, by simply positioning trolley 46 astride platform 28, with its front edge contacting a fixed locator 50 (Figure 3) on top plate 43 of platform 28, ribs 14 can be positioned directly beneath and perfectly aligned with respective guides 38.

When not in use, each molding unit 1 is stored, not only on its own trolley 46, but also ready for use, i.e. with top and lateral front connectors 8 and 9 connected by lines 51 (Figure 1) to molding chamber 5.

When not in use and, as explained below, also during part of the step of loading molding unit 1 onto molding machine 19, half-molds 3 and 4 are locked integrally to each other by screw fasteners 52 (Figure 1) fitted through plate 10 and removable from the outside .

To prepare molding machine 19 to produce a given part, the corresponding molding unit 1 is withdrawn, on respective trolley 46, from the store; and trolley 46, still resting on the floor, is positioned astride the lowered platform 28 and resting against locator 50.

As stated, when trolley 46 is in this position and transfer device 35 is in the withdrawn position, ribs 14 of frame 6 are positioned directly beneath and aligned with respective guides 38.

On molding machine 19, all the time-consuming work to balance and set molding unit 1 (which accounts for roughly 9/10 of mold changeover time) is therefore performed 'off the machine', i.e. while molding machine 19 is operating with another mold.

Platform 28 is then activated to vertically lift top plate 43 together with molding unit 1 and trolley 46, so the free rear edges of ribs 14 slide along guides 38. Because top plate 43 keeps ribs 14 perfectly parallel to guides 38, and remains parallel to itself and perpendicular to guides 38 throughout the whole of its upward movement, ribs 14 slide accurately along guides 38 up to height H, i.e. until they are stopped, based on a position signal from position sensors not shown, in a position in which holes 41 in ribs 14 are aligned with bolts 40 of relative locking devices 39, which are then activated to lock molding unit 1 to transfer device 35. At this point, platform 28 can be lowered to release molding unit 1 onto transfer device 35, and to lower trolley 46 onto the floor.

At this point, hydraulic cylinders 31 are activated to move movable frame 30 in work direction 36, and so move transfer device 35 into the forward position and at the same time detach plate 34 from portal 20. When

transfer device 35 is in the forward position, molding unit 1, with mold 2 still closed and locked by fasteners 52, is in an intermediate position, in which it is not yet physically and functionally connected to molding machine 19, but simply extends through window 24, with top front connectors 8 positioned facing and substantially contacting outlets 53 of granular plastic material tanks 54 fitted to top cross member 22 of portal 20, and with lateral front connectors 9 positioned facing and substantially contacting operating fluid outlets 55 on one of uprights 21 of portal 20. In this intermediate position, molding unit 1 can safely be released by transfer device 35 onto fixed frame 29 by withdrawing bolts 40.

Molding unit 1 is moved in work direction 36 into its final position, connected physically and functionally to molding machine 19, by activating a locking device 56 fitted to portal 20 and comprising two horizontal bars 57. These are fitted to top and intermediate cross members 22 and 23, along the top and bottom edges of window 24 respectively, are moved to and from each other by hydraulic jacks, and each have a bevelled lateral edge 58 (Figure 6) which, when bar 57 is moved towards the other bar 57 into a closed position and molding unit 1 is in the intermediate position, cooperates with a respective bevelled surface 59 on frame 6 to move molding unit 1 into its final forward position, and at the same time lock molding unit 1 to

portal 20 and connect top front connectors 8 to outlets 53, and lateral front connectors 9 to outlets 55.

Next, hydraulic cylinders 31 are activated to restore transfer device 35 to the withdrawn position, by detaching guides 38 transversely from ribs 14, and moving plate 34 towards mold 2 to connect plate 34 in known manner to half-mold 4 by means of pins 18.

At this point, fasteners 52 are removed, and molding machine 19 is ready to operate.

Molding unit 1 is unloaded off molding machine 19 by performing the above operations in reverse, the only difference being that, in this case, molding unit 1 is moved from its final position, connected to molding machine 19, to its intermediate position by bolts 40, which, being conical, can engage holes 41 in ribs 14 even when molding unit 1 is in the final forward position, and, as they advance inside holes 41, restore molding unit 1 to is intermediate position connected to transfer device 35.

Molding unit 1 is connected and disconnected in two stages, as described above, to ensure smooth, accurate connection and disconnection to and from molding machine 19.

The advantages of the method of loading and unloading a mold 2 on a machine such as molding machine 19 will be clear from the above description.

Firstly, mold 2 is loaded and unloaded fully automatically, with no adjustment needed to the position

or balance of mold 2 as it moves to and from molding machine 19, and above all as it moves vertically inside molding machine 19.

Secondly, trolley 46, together with frame 6, forms an integral part of mold 2, and, except when mold 2 is handed over to transfer device 35, supports it safely at all times, thus safeguarding against damage to mold 2 by shock or stress as it is being handled. It is molding machine 19 itself which simultaneously receives mold 2 and trolley 46, unloads mold 2 off trolley 46, loads mold 2 onto trolley 46, maintains trolley 46 in a precise position throughout the time mold 2 is detached from trolley 46, and provides for simultaneously unloading mold 2 and trolley 46.

Besides improving safety, the above advantages also drastically reduce mold changeover time, which normally takes at least one work shift using conventional methods, but can be done is less than half an hour using the method described by way of example. For a relatively high-speed machine, such as molding machine 19, operating on average two work days with no mold changeover, this substantially amounts to doubling output .

Close analysis of the loading and unloading method described shows the above advantages all originate from:

- using trolley 46 - with molding unit 1 set beforehand in a fixed position on it - to roll molding unit 1, on the floor, into a predetermined position with

respect to molding machine 19; and

- using platform 28 to lift and lower molding unit 1 between the floor and height H.

In fact, it is trolley 46 that allows molding unit 1 to be fully set off the machine; and it is platform 28 which, once trolley 46 is set to hold molding unit 1 in the set position on bed 47, with axis 11 positioned parallel to the bottom surface of bed 47, provides for :

- eliminating any errors, and the time taken to adjust them, in the position of mold 2 caused by defects on the floor or trolley 46, by simply detaching trolley 46 from the floor together with molding unit 1; and

- lifting and lowering trolley 46 and molding unit 1 simultaneously.

CLAIMS

1) A method of loading and unloading a mold (2) on a foam plastics molding machine (19); the machine (19) comprising a fixed frame (29) having a window (24) for receiving the mold (2) and located at a higher level (H) than the supporting surface of the machine (19);

loading the mold (2) onto the machine (19) comprising :

- a first step of setting up and connecting to the mold (2) an interface frame (6) interfacing the machine (19) and the mold (2), to form a molding unit (1), which comprises the mold (2) and relative interface frame (6), and has a number of plastic molding material and operating fluid inlets (8, 9);

- a second step of advancing the molding unit (1) towards the fixed frame (29) ;

- a third step of lifting the molding unit (1) to the level (H) of the window (24) ; and

- a fourth step of loading the molding unit (1) into a work position physically and functionally engaging the fixed frame (29) at the window (24); and locking the molding unit (1) to the fixed frame (29) by first locking means (56) ;

and the method being characterized in that :

the second step comprises the substeps of :

- positioning the molding unit (1) in a given fixed first position on the bed (47) of a trolley (46) ; and

- moving the trolley (46) into a position astride a platform (28) defining a horizontal supporting surface (44) for the bed (47) of the trolley (46);

and the third step comprises lifting the molding unit (1) resting on the trolley (46), and comprises the substeps of :

- raising the platform (28), so that vertical ribs (14) on the interface frame (6), which is positioned in the given first position on the trolley (46), slidably engage corresponding vertical guides (38) on the machine (19) ;

- locking the ribs (14) to the relative guides (38) by means of second locking means (39), when the molding unit (1) is positioned coaxial with the window (24) ; and

- releasing the molding unit (1) on the guides (38) by lowering the platform (28) and the trolley (46) to detach the trolley (46) from the molding unit (1) .

2) A method as claimed in Claim 1, wherein the given said first position is defined by locators (48) on the trolley (46) and specific to the molding unit (1) .

3) A method as claimed in Claim 1 or 2, wherein the trolley (46), when positioned astride the platform (28), is positioned with respect to the platform (28) in a given second position defined by locating means (50) on the platform (28) ; said given first and second position combining to define, at all times, a predetermined position of the molding unit (1) with respect to the machine (19), as the mold (2) is loaded onto the machine

(19).

4) A method as claimed in one of the foregoing Claims, wherein the fourth step comprises two substeps, in a first of which, the molding unit (1) is locked to the guides (38), and in a second of which, the molding unit (1) is released from the guides (38) and supported by the fixed frame (29).

5) A method as claimed in Claim 4, wherein, at the first substep of the fourth step, the molding unit (1) is locked to the guides (38) by the second locking means (39), and the guides (38) are moved towards the window (24) in a horizontal work direction (36).

6) A method as claimed in Claim 5, wherein, at the second substep of the fourth step, the molding unit (1) is released from the guides (38) by releasing the second locking means (39), and undergoes a further forward movement in the work direction (36) into said work position.

7) A method as claimed in Claim 6, wherein said further forward movement is produced by activating the first locking means (56), and by them gradually engaging the molding unit (1).

8) A method as claimed in Claim 6 or 7, wherein unloading the mold (2) off the machine (19) comprises a step of detaching the molding unit (1) from the work position by releasing the first locking means (56), and by activating the second locking means (39), which gradually engage the molding unit (1) to lock the

molding unit (1) to the guides (38).

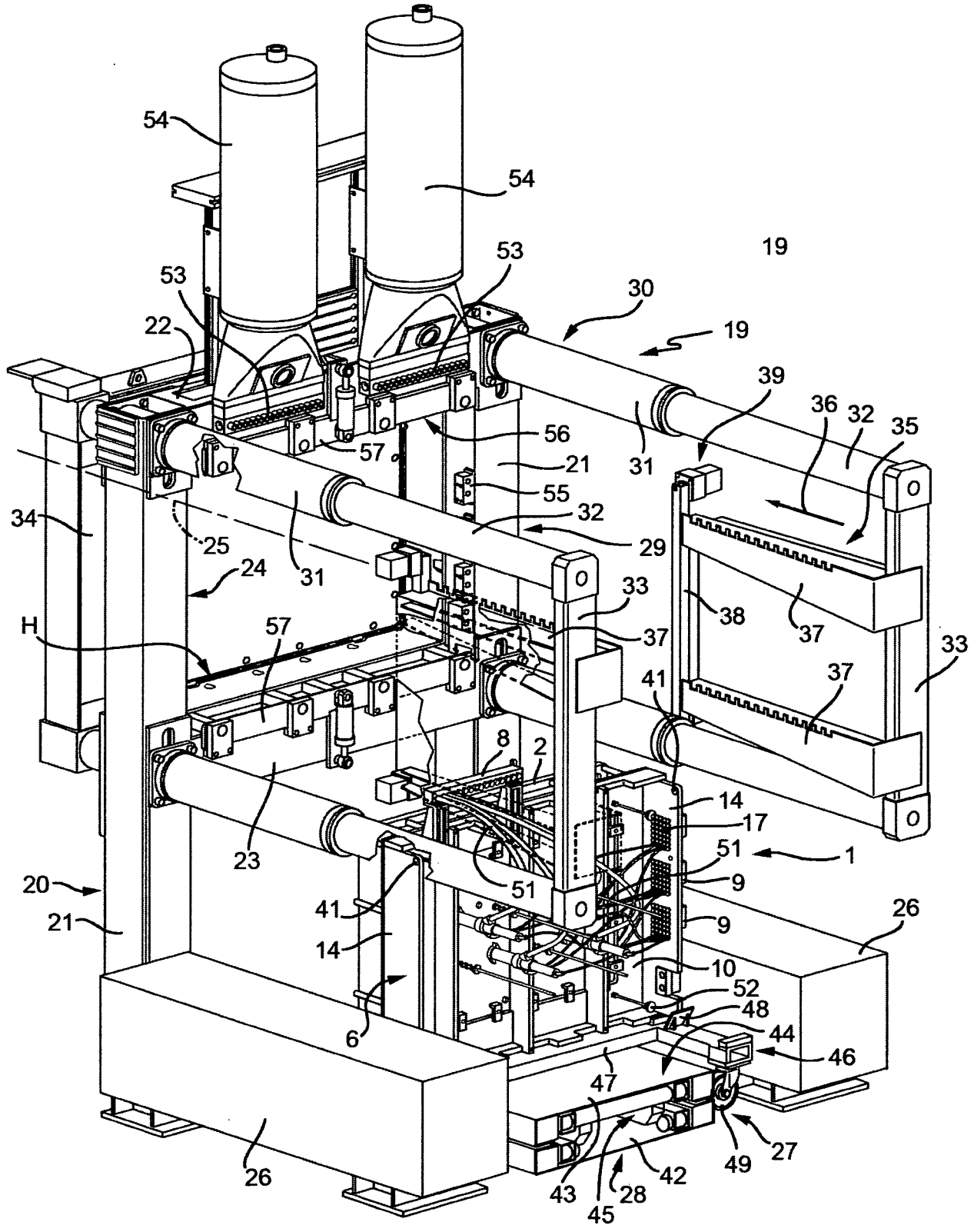
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FIG. 1

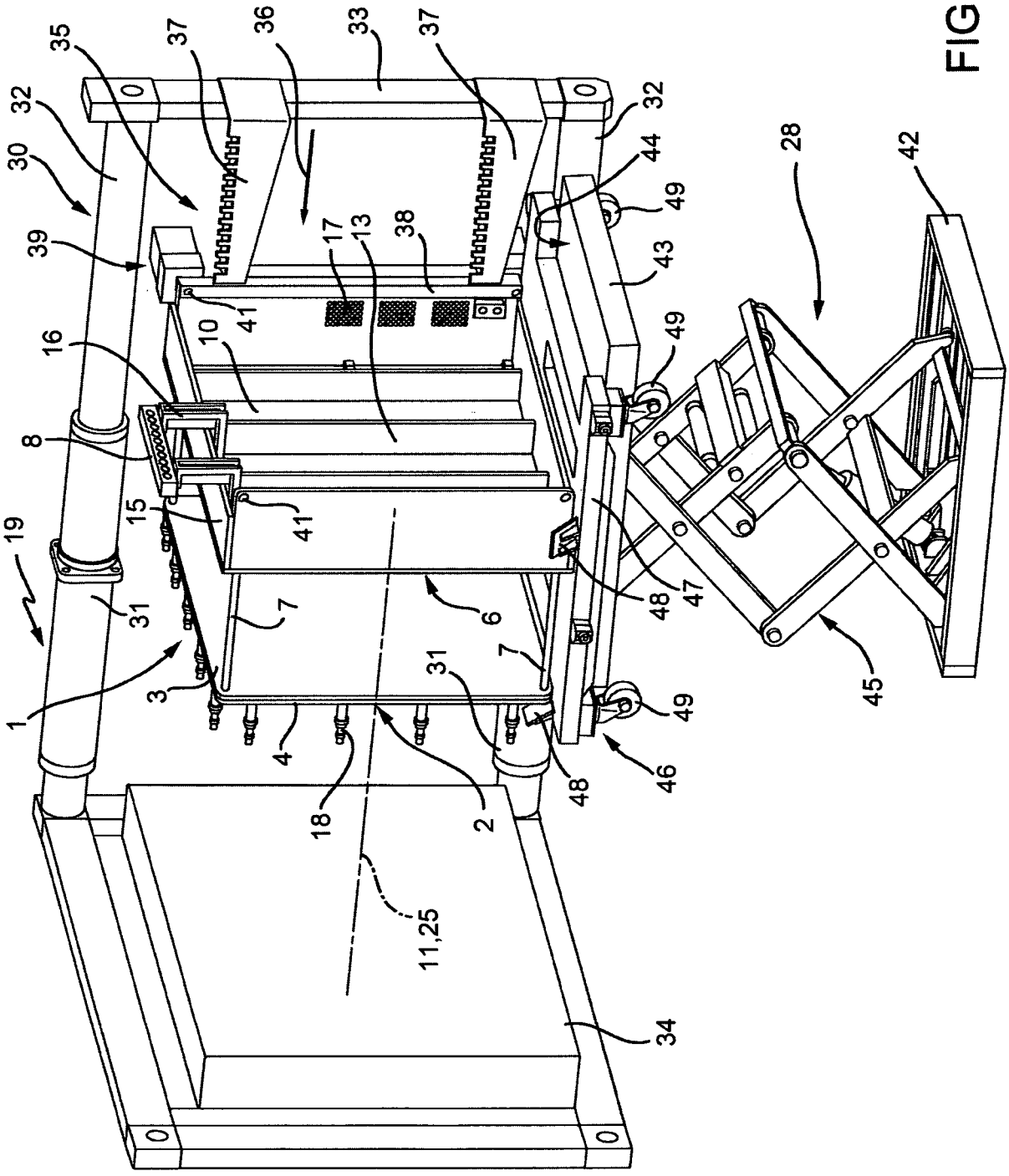
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FIG. 2

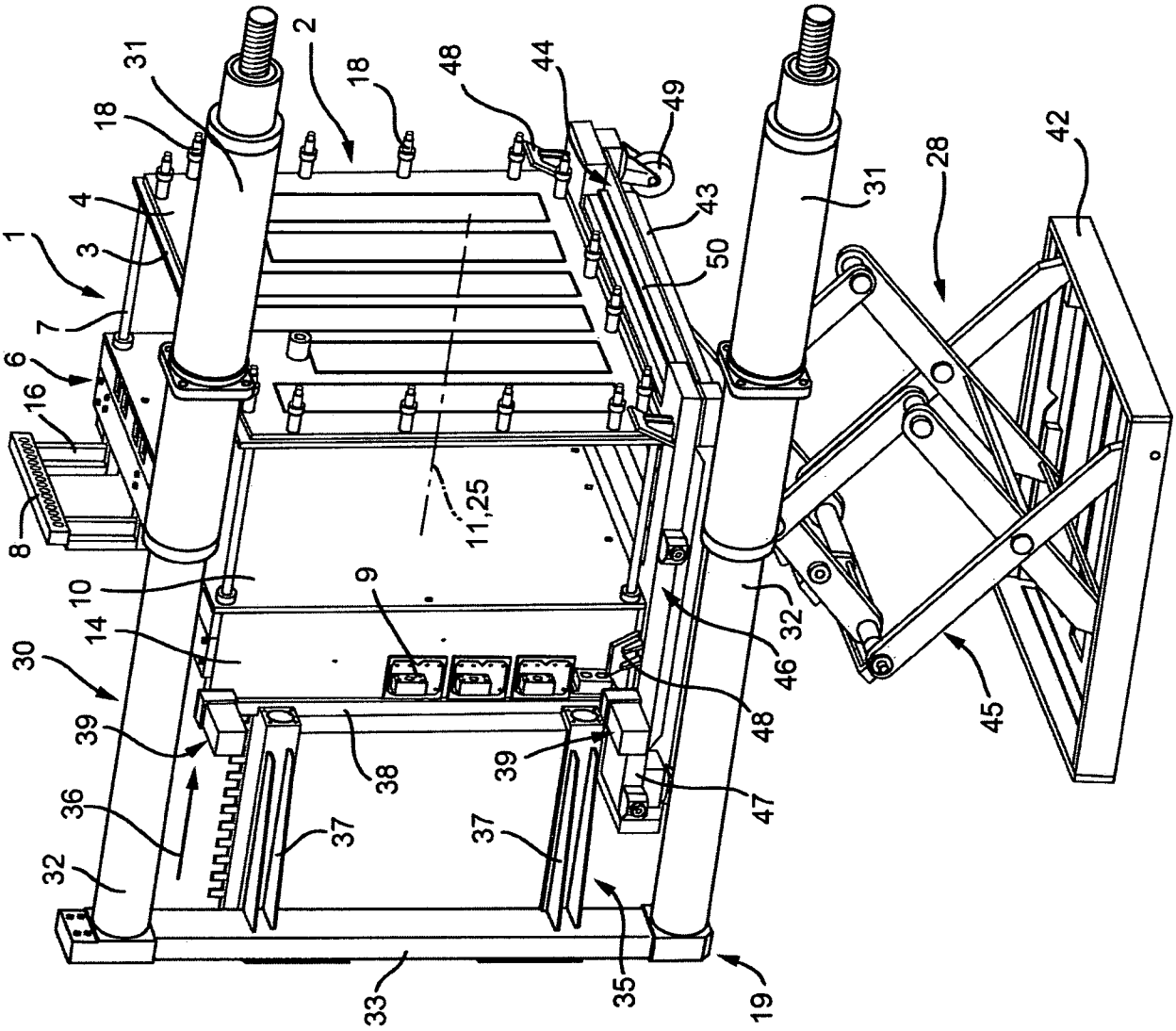
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FIG. 3

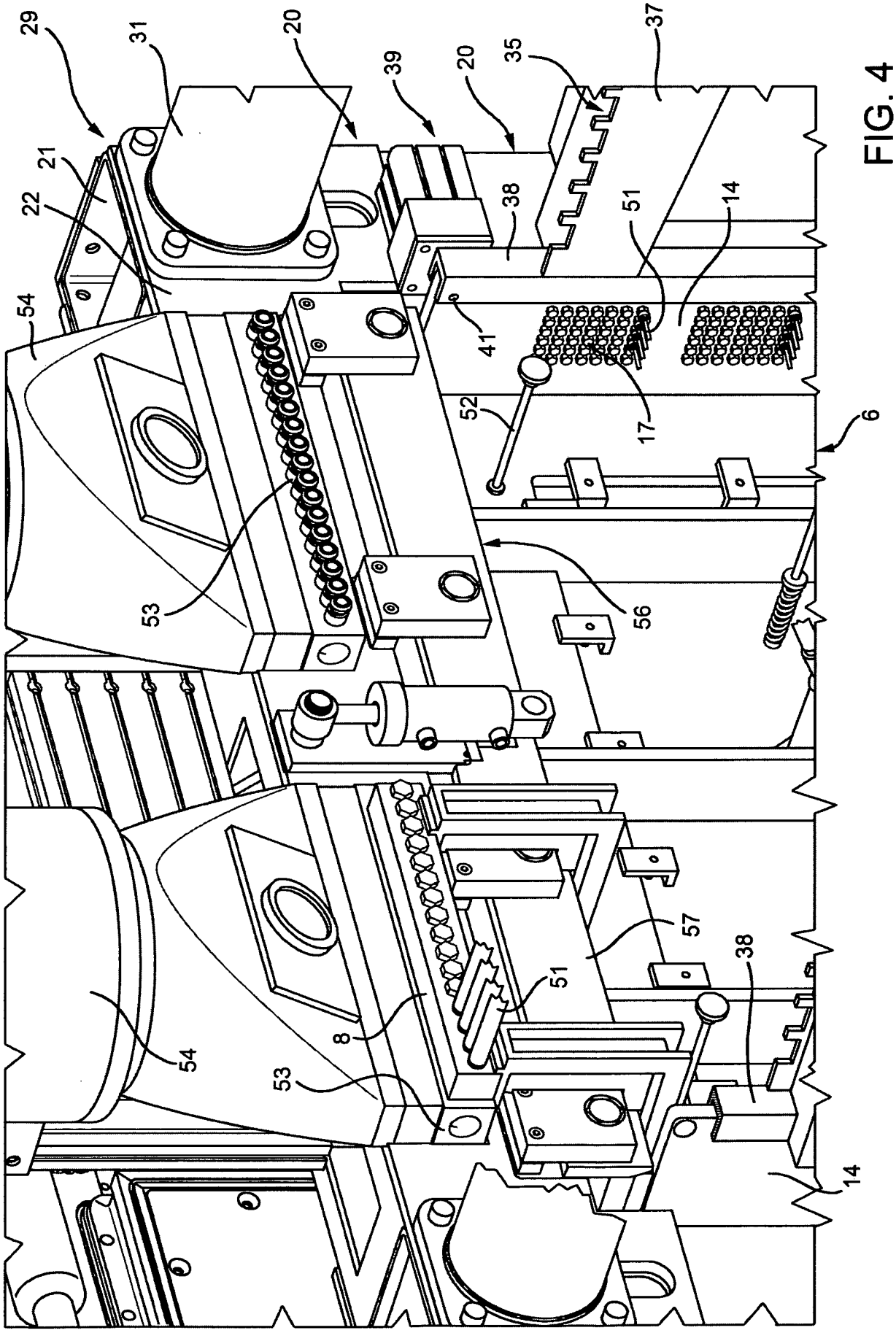
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FIG. 4

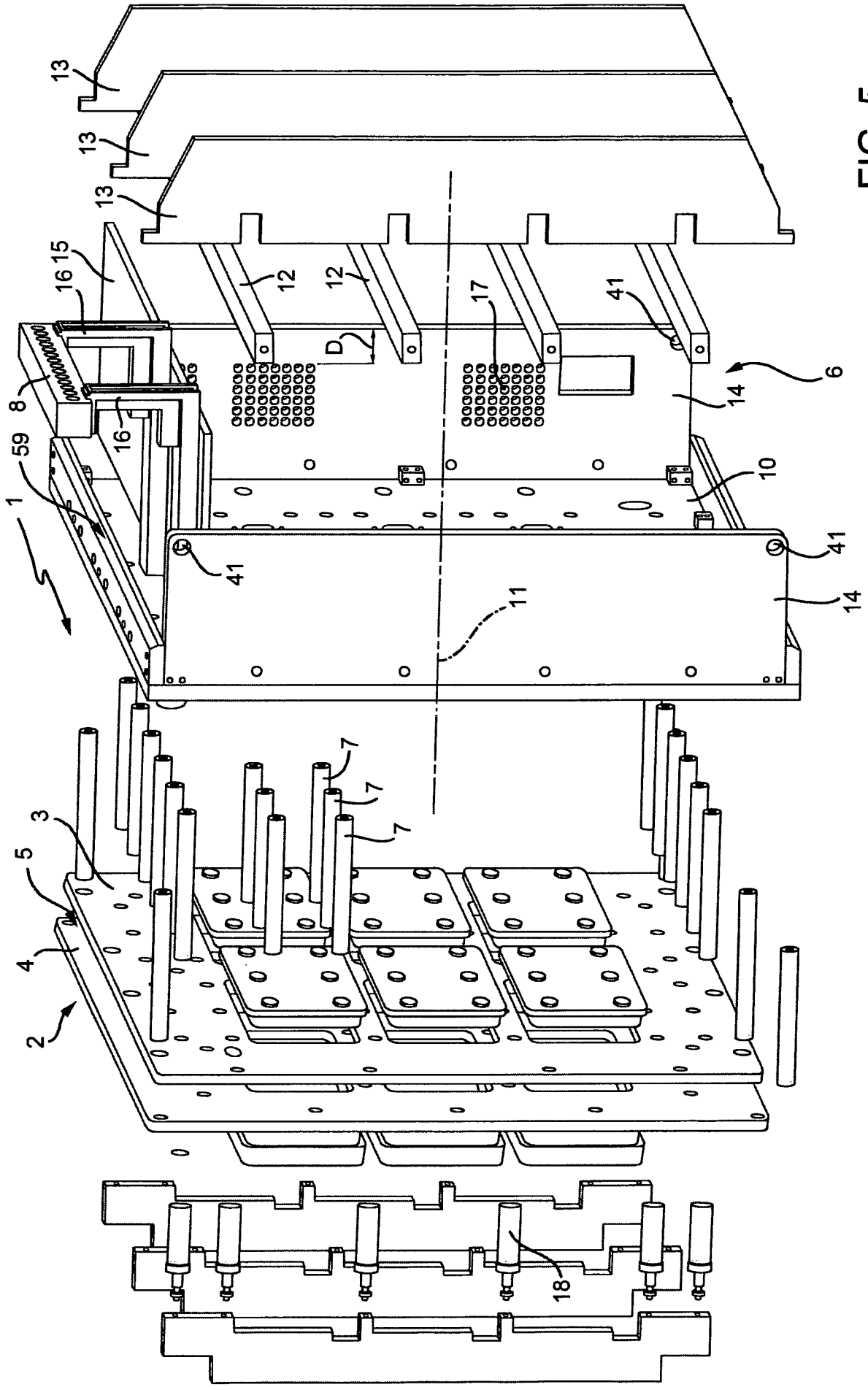

FIG. 5

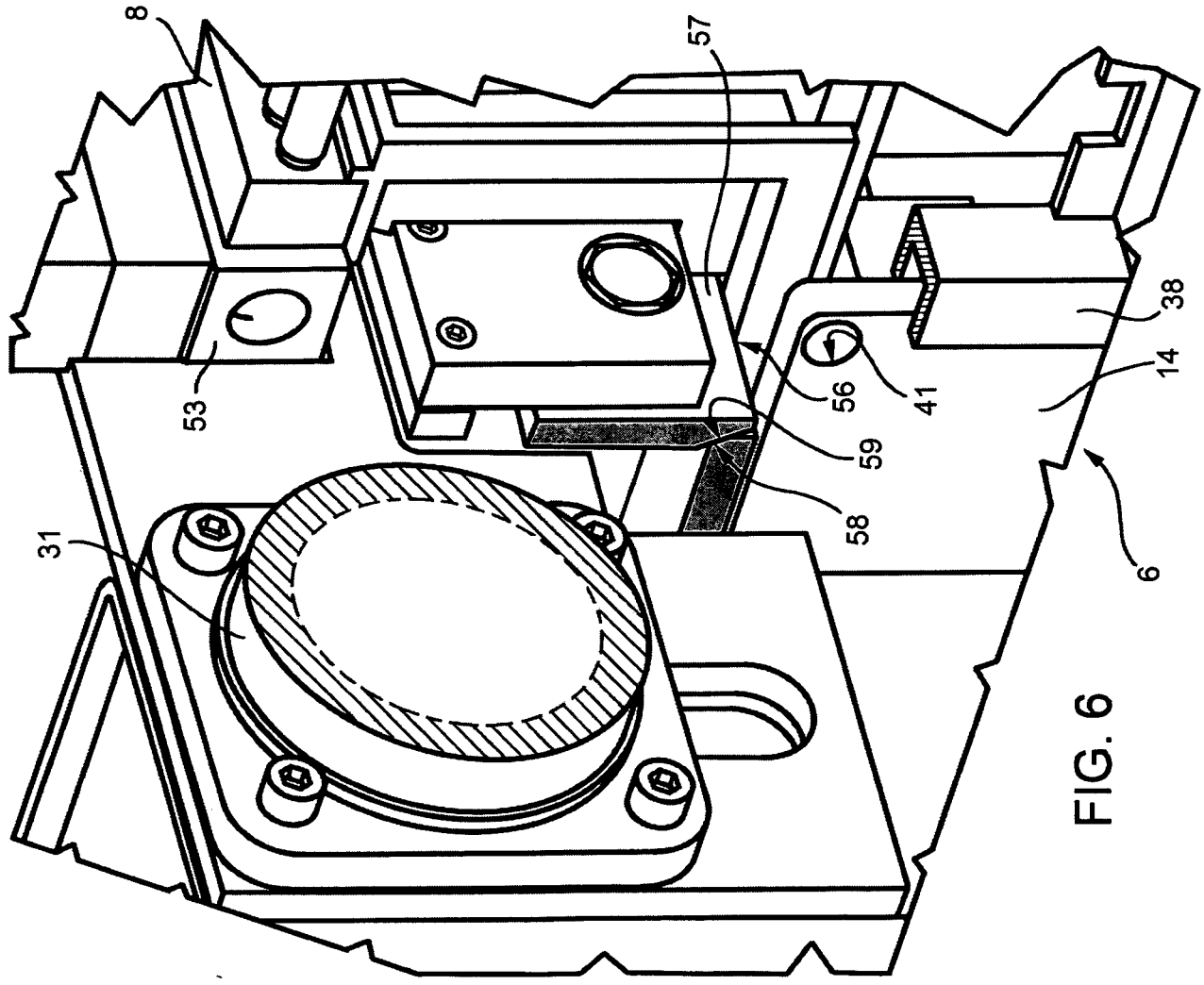

FIG. 6

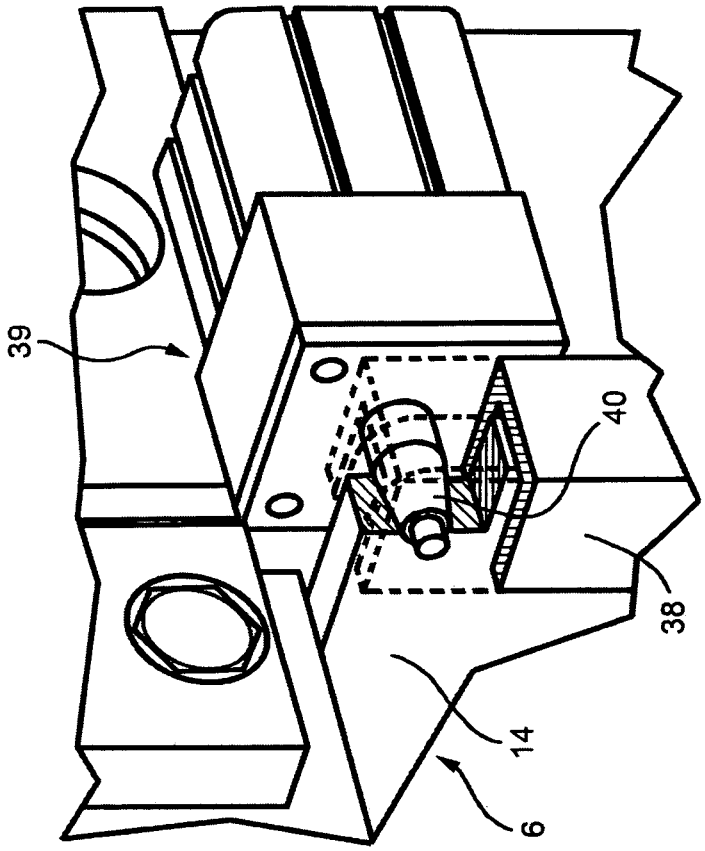

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2011/001584

A. CLASSIFICATION OF SUBJECT MATTER
INV. B29C31/00 B29C33/30 B29C44/42
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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☐ Further documents are listed in the continuation of Box C.

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Information on patent family members

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