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(71) Applicant: **Kemac S.p.A.**
41042 Fiorano Modenese MO (IT)

(72) Inventor: **Laroma Iezzi, Mario**
42013 Casalgrande (Reggio Emilia) (IT)

(74) Representative: **Gotra, Stefano**
BUGNION S.p.A.
Via Emilia Est 25
41100 Modena (IT)

(54) A translatable truck apparatus for positioning and unloading workpieces in water-jet machine tools

(57) In water jet machine tools, especially for cutting stone materials, loading and unloading operations of workpieces are done using an apparatus comprising workpiece-supporting trucks (12,13) which are translatable alternatingly from the work position to an external position of the machine tool in which the products to be subjected to a work operation are loaded and unloaded. Thanks to the special configuration and structure of the translation system, the trucks (12,13) are in the same loading and unloading position with respect to the machine tool, though starting from positions which are distinct or coincidental, and advantageously located on a same side of the machine tool.

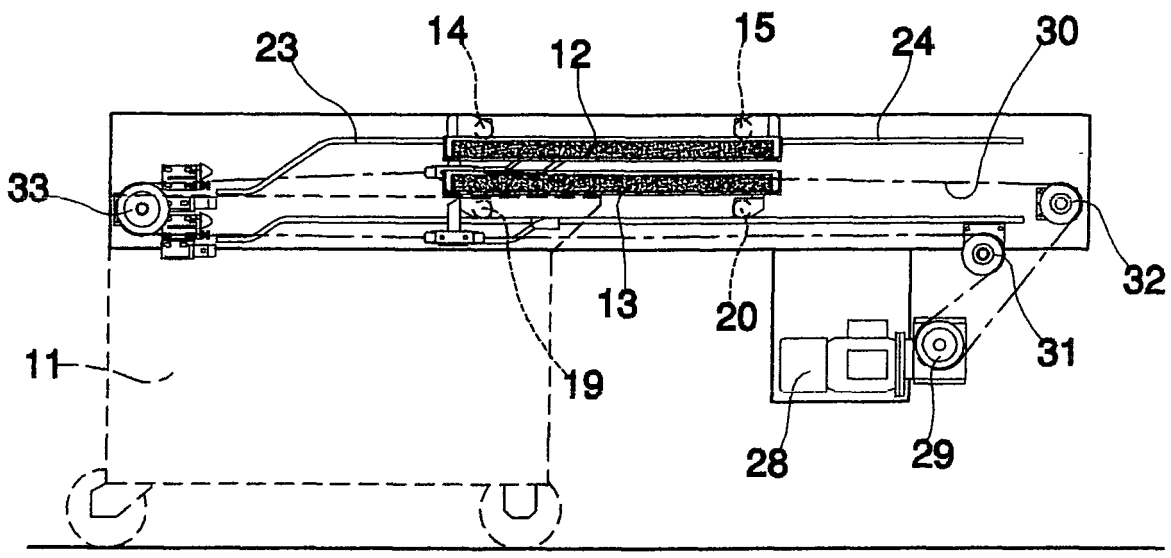

Fig. 1

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Description

[0001] Specifically, though not exclusively, the invention is usefully applied for loading and unloading materials, especially stone materials, onto or from water-jet cutting machines.

[0002] At present, as is known, marble and stone-cutting operations in general are done using machines comprising a work support plane of adequate proportions for slabs of various sizes and thicknesses, above which is located at least a turret bearing a pressurised-water-jet tool able to translate in height and according to two coplanar perpendicular directions, x, y, in order to execute the desired cutting path. A reservoir for collecting the water is located below the work support plane.

[0003] The operation of the above-mentioned machines includes an initial stage, quite laborious, in which the workpiece materials are positioned on the support plane, a cutting stage, and a final stage, also laborious, in which the workpieces are removed from the support plane.

[0004] The complexity of the initial and final stages, i.e. position and removal, is because of the considerable dimensions and weights of the products, which require the use of special equipment, such as bridges or the like, often located above the cutting machines. Among other things this requires the tool-bearing turret to be distanced from the work area.

[0005] The simplification of these procedures, and the consequent better use of the cutting machine, are therefore to be sought after, but the possible solutions must satisfy the need, a general one in the sector, to contain the spaces required and the associated costs.

[0006] The main aim of the present invention is to provide an apparatus which enables a positioning and discharge of the materials worked on by tool machines using water jets, reliably and in a simplified way in comparison to the prior art, while at the same time increasing the working capacity of the machines.

[0007] A further aim of the invention is to provide an apparatus for positioning and unloading of especially stony materials being worked on water-cutting machines, which offers overall spaces which are relatively limited and means for activating which are simple and reliable.

[0008] The above-mentioned aims and others besides are attained by an apparatus for positioning and unloading workpieces in water-jet machine tools, characterised in that it comprises at least two trucks, each of which constitutes a support plane for the workpiece materials and each of which is horizontally translatable from the normal work stage of the machine to a position external of the machine in which the materials to be worked are loaded on the truck or the same materials are unloaded therefrom, the trucks, in the normal work station position, being positioned in the same station with respect to the machine tool, starting from respective positions, distinct and coincidental, located advantageous on a same side of the machine.

[0009] In a first embodiment of the invention, in the external loading and unloading station, the trucks take on parallel positions, located on superposed planes. Each of the trucks is guided by guide pairs in which wheels anchored to two opposite sides of the trucks engage; the guide pairs run parallel at a distance corresponding to the distance between the superposed planes, and include, at the work station, inclined ramps of different width. The wheels of a first of the trucks are located below the plane of the truck itself, while the wheels of the second truck are located above the work plane of the second truck, so that the guides of one truck can run parallel to the guides of the other truck without interference. The trucks are activated contemporaneously, in opposite directions, by a first gear reducer acting on a traction-resistant element set in rotation in both directions about a pair of drawing wheels, one of the trucks being constrained to one of the branches of the element running between the wheels, while the other truck is constrained to the other branch.

[0010] In a second preferred embodiment of the invention, the two trucks assume a same work position and a same loading and unloading position. The two trucks are separately activated, by means of separate actuators acting or pairs of cogged belts arranged coplanarly at two sides of the truck, in the displacement direction thereof, and set in rotation in both directions, and synchronised. One of the trucks is connected to a first of the pair of belts arranged, which first belt is arranged more internally, while the other truck is connected to a second of the belts, which second belt is arranged more externally, there being, between the trucks and belts, respective means for lifting for moving the trucks in different runs, so that the trucks can translate in directions lying on parallel but different planes which do not interfere with one another.

[0011] The above-described structural characteristics clearly provide advantages with respect to traditional machine tools used in the stone-working field.

[0012] The operative capacity of each single machine is improved, eliminating all dead times at present necessary, both for position the materials on the work plane and for the removal of the workpiece at end of working. This is obtained while using an additional area equivalent to only one work station, and using actuators which are simple and reliable.

[0013] Other advantages of the present invention will better emerge from the detailed description that follows, of some preferred but not exclusive embodiments of the invention, illustrated purely by way of non-limiting example in the accompanying figures of the drawings, in which:

Figure 1 is a schematic side view of an apparatus according to the invention in an intermediate operative configuration of work, either of loading or unloading;

Figures 2 and 3 show two further lateral views of the apparatus of figure 1, relating to two alternative work configurations;

Figure 4 is a view from above of one of the configurations of figures 2 and 3;

Figure 5 is a further view from above, similar to the view of figure 4 but relating to a different embodiment of the invention;

Figures 6 and 7 are two schematic side views of the apparatus of figure 5, relating respectively to a work configuration and to an intermediate translation configuration.

[0014] With reference to figure 1, 10 denotes in its entirety an apparatus for loading and unloading workpiece materials onto and from water-jet tool machines; for one of the tool machines a reservoir 11 for collecting the water is shown in a broken line.

[0015] The apparatus 10 comprises, in this embodiment of the invention, two flat trucks 12, 13, horizontally translatable between a work position, located close to the reservoir 11, and an external position where the slabs of stone material can be positioned on the truck, or where the worked slabs can be unloaded therefrom.

[0016] A salient point is that the total area used for the loading and unloading operations, i.e. the external station of the machine, is comprised on a same side of the machine, in order to keep the total area occupied for the whole operation, including the work operations on the slabs, within opportune limits.

[0017] A further embodiment might include the two trucks' displacing together in both directions on a same plane, once in one direction and once more in the opposite direction. In this case there would certainly be the same result with regard to the use of the tool machine, though the total area occupied would be much greater and there would also be an increase in management costs of the means for loading and unloading.

[0018] In the embodiment illustrated in figures from 1 to 4, the two trucks 12, 13 assume, in the work position, exactly the same position both vertically and horizontally with respect to the machine tool, as illustrated in figures 2 and 3, starting from respectively different external positions arranged on superposed planes, but belonging to a same loading and unloading position.

[0019] Each of the trucks 12, 13 is provided with pairs of wheels anchored at two opposite sides of the truck and arranged in a displacement direction thereof.

[0020] The wheels are freely rotatable about axes thereof and engage on guides arranged between the work position and the loading and unloading position. In more detail, as can be seen in figures 3 and 4, the second truck 12, superiorly located, is provided with a pair of wheels 14, 15 anchored on one side 16 and a like pair of wheels 14', 15' anchored on the other side 18.

[0021] Likewise, the first truck 13, inferiorly located, is provided with a pair of wheels 19, 20 anchored on one side 21 and a like pair of wheels 19', 20' anchored on the other side 22.

[0022] In each of the trucks 12, 13 the two wheels on one side are not aligned but positioned at different distances from the edge of the truck and run, therefore, on guides or tracts of guides which are separate, or specific. For example, in the case of wheels 14 and 15, we note that the more external wheel 14 is engaged on the guide 23, while the more internal wheel 15 is engaged on the guide 24, the guides being distinct from one another in the tract at the work position, where they exhibit two inclined ramps 23', 24', but being made on a same flat element 25 in the tract where loading and unloading is performed, where the guide 23 is constituted by the more external portion of the element 25, while the guide 24 is constituted by the more internal portion.

[0023] The same thing is true for the other pair of wheels 14', 15', belonging to the second truck 12, and for the pairs 19, 20 and 19', 20' belonging to the first truck 13.

[0024] Thanks to this arrangement of the wheels, and the respective guides, the trucks are kept in an exactly horizontal position at all times in their translating movements.

[0025] The guides 26, 27 of the first truck 13 run parallel to the guides of the second truck 12 and while the wheels of the first truck 13 are located inferiorly of the lie plane of the first truck 13, the wheels of the second truck 12 are located superiorly of the plane identified by the second truck 12.

[0026] The lower guides 26, 27 are also provided, in the work position, with inclined ramps 26', 27'. The result of this arrangement is that the two trucks, starting from distinct and superposed respective loading and unloading positions, nevertheless reach a same work position, as shown in figure 2 for the second truck 12 and figure 3 for the first truck 13.

[0027] The means for translating the two trucks 12, 13, are constituted by a single gear reducer 28 activating a drawing wheel 29, to which a traction resistant element 30 is connected, which, via two transmission gears 31, 32, in a ring around a further wheel 33, located at the opposite end of the apparatus 10. The two trucks 12, 13, are respectively connected to the two branches of the element 30.

[0028] In the preferred embodiment of the invention illustrated in figures from 5 to 7, the apparatus 10' comprises, as before, two trucks 41, 42 which are horizontally translatable between a work position, by the reservoir 11', and an external position where the stone materials are loaded or unloaded.

[0029] In this case, though, both the work position and the loading and unloading positions coincide for both trucks, as shown in figure 6, where the work position is illustrated in the left side of the figure, at the position of the tool-bearing turret 43, while the loading and unloading position is illustrated on the right side. The loading and unloading position is exactly the same for both trucks.

[0030] The two trucks 41, 42, are separately activated by respective actuators 44, 45 acting on pairs of cogged belts arranged laterally of the trucks 41, 42, in the displacement direction; a more internal first pair of cogged

belts 46, 46', is destined to displace a first truck 41, while a more external second pair of cogged belts 47, 47', is destined to displace the second truck 42.

[0031] Means for lifting, constituted by hydraulic or pneumatic cylinders (see in particular figures 6 and 7) are interpositioned between the respective cogged belts. In particular, the means for lifting are two for each truck and are interpositioned between lateral appendages of the truck perimeter frame and special support plates anchored to the relative drawing elements. In the second truck 42, the lateral appendages are denoted by 48 and 48', while the means for lifting are denoted by 49 and 49'; one of the support plates is denoted by 50 and can be seen in figure 6. For the first truck 41, the lateral appendages are denoted by 51 and 51', the means for lifting are denoted by 52 and 52', and one of the support plates is denoted by 53 and can also be seen in figure 6.

[0032] The apparatus of the invention operates as now described; it is simple to deduce from the description given above.

[0033] In the illustrated embodiment in figures from 1 to 4, the two trucks are alternatingly moved by the gear reducer 28 between the two positions illustrated in figures 2 and 3. For example, starting from the situation of figure 2, the gear reducer, once the work operations have been performed on the materials supported on the second truck 12, causes a clockwise rotation, with reference to the figure, of the various drawing and turning wheels 29, 31, 32, 33, in such a way that the second truck 12, connected to the upper branch of the traction resistant element 30, displaces from the work position towards the external position and, at the same time, the first truck 13, connected to the lower branch of the element 30, displaces in an opposite direction, from the external position to the work position. When the first truck 13 reaches the position illustrated in figure 3, endrun sensors reduce the gear on the gear reducer 28 so that the truck presses against a left-located stop, then to stop in position, halted by the gear reducer 28 brake. At this point the worked materials on the truck can be unloaded and a following, unworked load can be loaded, while in the work position, the water-jet cutting of the stone materials supported on the first truck 13 can be performed.

[0034] At the end of the work operation the gear reducer 28 is reversed to bring the trucks 12 and 13 into the positions illustrated in figure 2, so that the next working of the materials on the second truck 12 can be performed, while the worked materials on the first truck 13 can be unloaded and the first truck 13 re-loaded if the machine work cycle so demands.

[0035] In the embodiment illustrated in figures from 5 to 7, the two trucks 41, 42, are alternatingly moved between the two positions illustrated in figure 6, by synchronisingly commanding the two respective actuators 44, 45. The control panel of the actuators 44, 45 must take into account the fact that the first truck 41, which is anchored to the more internal pair of drawing elements 46, 46', must move, during the contemporaneous translation of the two trucks 41, 42 in a lower horizontal plane than the displacement plane of the second truck 42 anchored to the pair of more external drawing elements 47, 47'.

[0036] The actuator displacements have to be synchronised with the means for lifting associated thereto so that at the start of the translation operation there is first a positioning of the trucks at the heights of the respective movement planes, after which they are translated in opposite directions along the planes, and finally the trucks are positioned at the correct final height position. Starting, for example, with the configuration illustrated in figure 6, after arranging the work tool in the raised position of figure 7, first the cylinders 49 and 52 are activated, having runs of different entities, respectively to bring the second truck 42 into the completely raised position and the first truck 41 into the intermediate position, after which the two actuators 44 and 45 are activated to displace the first truck 41 towards the left and the second truck 42 towards the right; thus, when the trucks have completed the respective horizontal translations, the cylinder 52 is simply activated to move downwards to bring the first truck 41 into the final work position inside the reservoir 11, which position was previously occupied by the second truck 42.

[0037] The paths of the two trucks are illustrated in figure 7, by the broken lines 54 and 55.

[0038] The paths are completed by the trucks in opposite directions, to bring the trucks into the positions of figure 6 at the moment at which a new work cycle is to be performed or simply to unload the stone materials supported on the first truck 41. First the cylinder 52 is activated to move upwards, for half its total run, to bring the second truck 42 to the right height for translation. Then the two actuators 44, 45 are activated respectively to bring the first truck 41 towards the right and the second truck 42 towards the left, for the whole translation run, and finally the cylinders 49 and 52 are activated to move downwards for their full single runs, and upwards for the rest of their total runs, bringing the trucks back exactly into the configuration of figure 6.

[0039] Thanks to the apparatus described herein above the operativity of the cutting machines, or in any case machine tools working stone materials, can be optimised, while the total areas needed for the working operations can be minimised.

[0040] It is also clear that these advantages are maintained even if modifications and variations are made to the above-described embodiment.

[0041] The dimensions and conformation, for example, of the trucks could be varied according to the types of workpiece products to be supported thereon, and accordingly the size of the drawing elements and the types of means for actuation could be changed.

[0042] In the first embodiment herein described, the configuration of the sliding guides could be varied in relation to the arrangement of the trucks of the apparatus, including the arrangement which involves two translatable trucks moving in a same direction contemporaneous-

ly.

[0043] Other modifications could involve the arrangement of the actuators and the drawing and belt-returning wheels connected thereto.

[0044] In the second embodiment the type of the drawing elements could be changed, using instead of the cogged belts chains or other equivalent elements. The actuators could also be of various types and variously arranged, and there could indeed be a single actuator connected directly to one of the cogged belts and, via a pair of gearings to invert the motion, to the other belt.

Claims

1. An apparatus for positioning and unloading workpieces in water-jet machine tools, **characterised in that** it comprises at least a first truck and a second truck, each of which constitutes a support plane of materials being worked, the first and second trucks being translatable horizontally from a normal work position at the machine tool to a position, external of the machine tool, in which the first and second trucks are loaded with materials to be subjected to work operations and in which the first and second trucks are unloaded of the materials after working operations have finished, each of the first and second trucks assuming a same position with respect to the water-jet machine tool, starting from loading and unloading positions which can be distinct or coincidental.

2. The apparatus of claim 1, **characterised in that** the distinct loading and unloading positions are constituted by positions on superposed parallel planes located on a same side of the machine tool.

3. The apparatus of claim 2, **characterised in that** each of the first and second trucks (13, 12) is provided with pairs of wheels (14, 15, 14', 15') anchored to two opposite sides (16, 18) of each truck of the first and second trucks (13, 12) and arranged according to a displacement direction thereof, the pairs of wheels being freely rotatably about axes thereof and engaging in guides arranged between the work position and the loading and unloading position of the first and second trucks (13, 12).

4. The apparatus of claim 3, **characterised in that** two wheels (14, 15) of the pairs of wheels (14, 15, 14', 15') relating to a side (16) of a truck of the first and second trucks (13, 12) are positioned at different distances from an edge of the truck and run on guides or tracts of guides that are separate or specific (23, 24).

5. The apparatus of claim 3 or 4, **characterised in that** the guides of one of the first and second trucks (13, 12) run parallel to the guides of the other of the first and second trucks (13, 12), at a distance corresponding to a distance between the superposed parallel planes; the guides including inclined ramps of various inclinations at the work position.

6. The apparatus of claim 5, **characterised in that** the wheels of the first truck (13) of the first and second trucks (13, 12) are inferiorly located with respect to the plane of the first truck (13), and the wheels of the second truck (12) of the first and second trucks (13, 12) are located superiorly of the plane of the second truck (12).

7. The apparatus of any one of the preceding claims, **characterised in that** the first and second trucks (13, 12) are contemporaneously activated via a single gear reducer (28) acting on a traction resistant element (30) set in rotation in both directions about a pair of drawing wheels (29, 33).

8. The apparatus of claim 7, **characterised in that** the first and second trucks (13, 12) are contemporaneously activated in opposite directions, one of the first and second trucks (13, 12) being constrained to one of branches of the traction resistant element (30) running between the drawing wheels (29, 33), while the other of the first and second trucks (13, 12) is constrained to another branch of the traction resistant element (30).

9. The apparatus of claim 1, **characterised in that** the loading and unloading position of a first (41) of the trucks coincides exactly with the loading and unloading position of a second (42) of the trucks.

10. The apparatus of claim 9, **characterised in that** the first and second trucks (41, 42) are connected to pairs of cogged belts (46, 46', 47, 47') which are coplanarly arranged at two sides of the first and second trucks (41, 42), in a direction of displacement of the trucks, and synchronisedly set in rotation in both directions, a first truck (41) being connected to a more internally-arranged first of the pairs of cogged belts (46, 46'), a second truck (42) being connected to a more externally-arranged second of the pairs of cogged belts (47, 47'); means for lifting (52, 49) being interpositioned between the first and second trucks (41, 42) and the pairs of cogged belts.

11. The apparatus of claim 10, **characterised in that** the means for lifting (52, 49) activate the first and second trucks (41, 42) in different runs, so that the first and second trucks (41, 42), on being translated, can be positioned at different heights and can be translated according to direction which lie on parallel but different planes which do not interfere with one another.

12. The apparatus of claim 10 or 11, **characterised in that** the first and second trucks (41, 42) are separately activated by means of respective actuators (44, 45) acting on the pairs of cogged belts (46, 46', 47, 47').

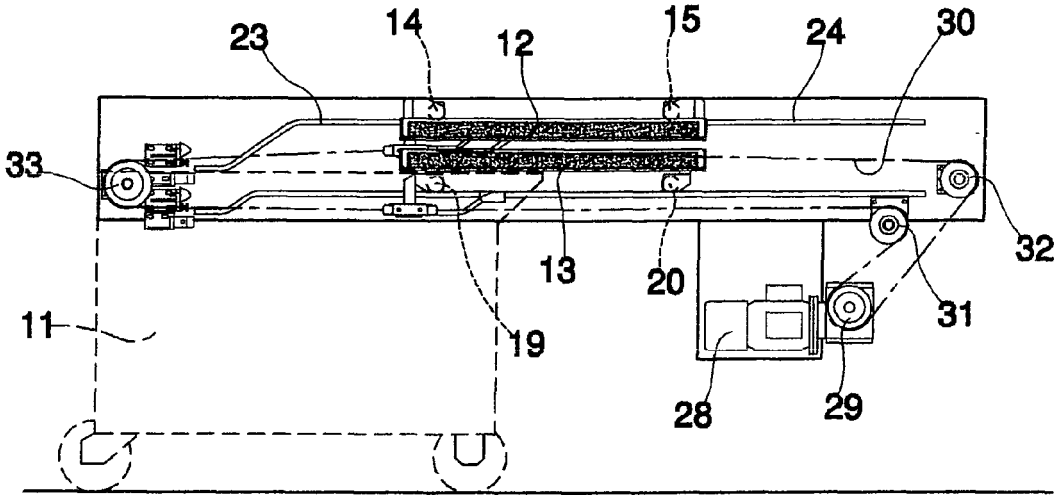
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Fig. 1

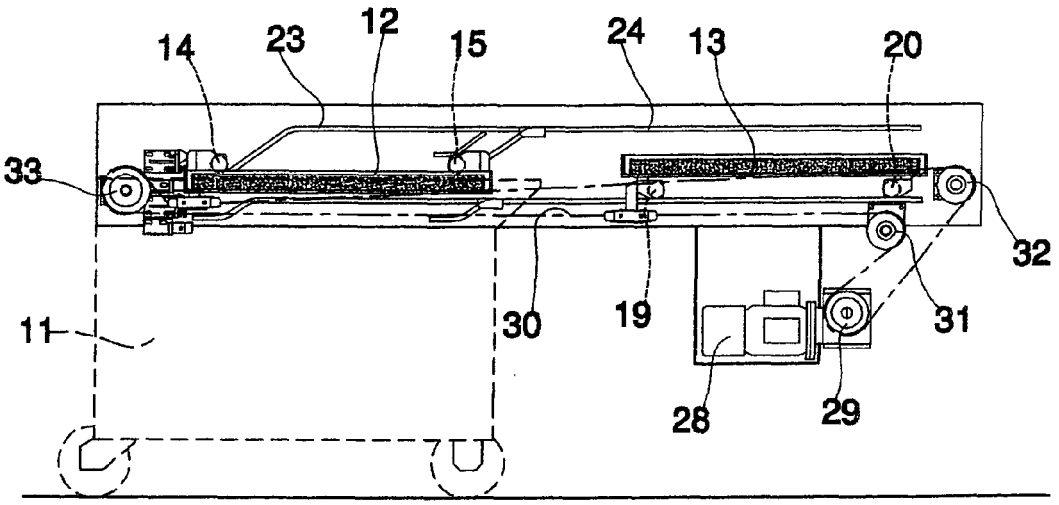
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Fig. 2

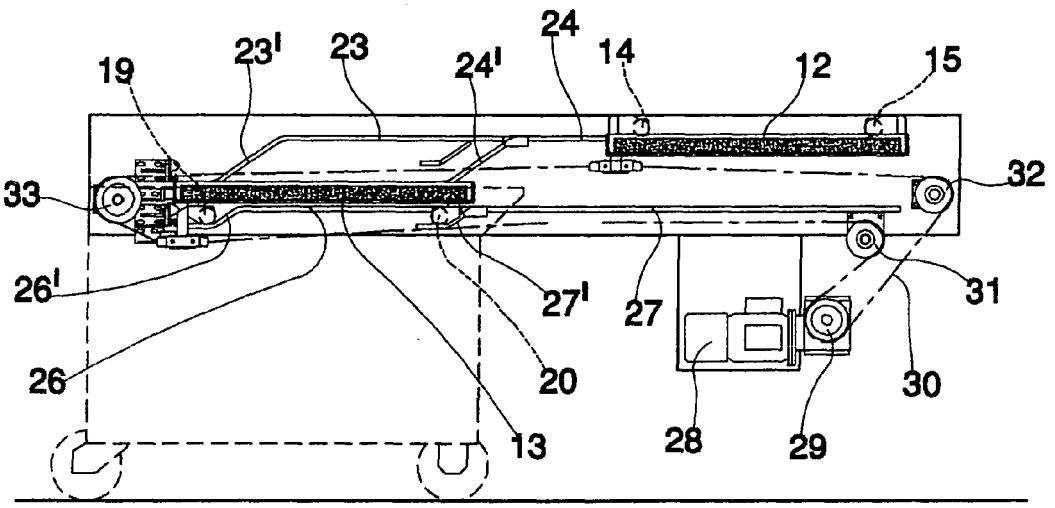
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Fig. 3

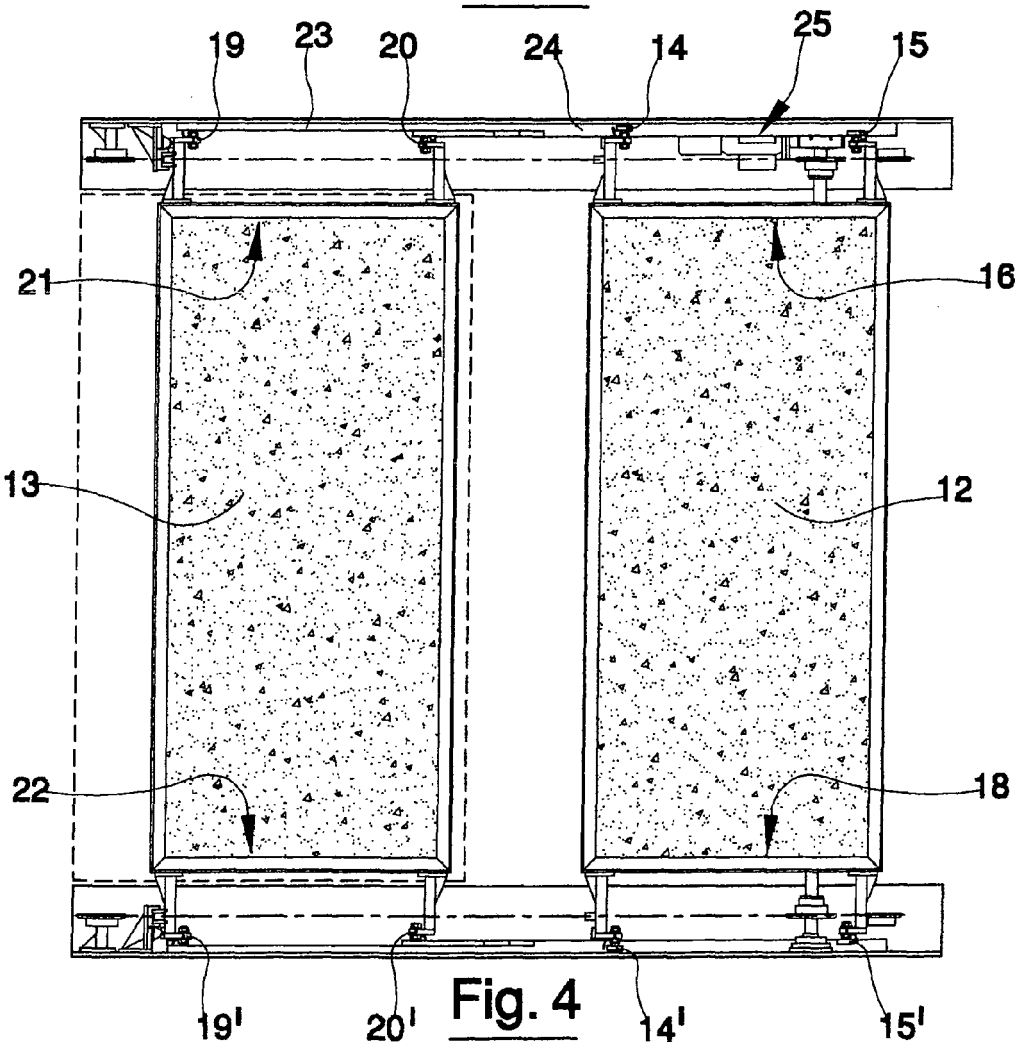
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Fig. 4

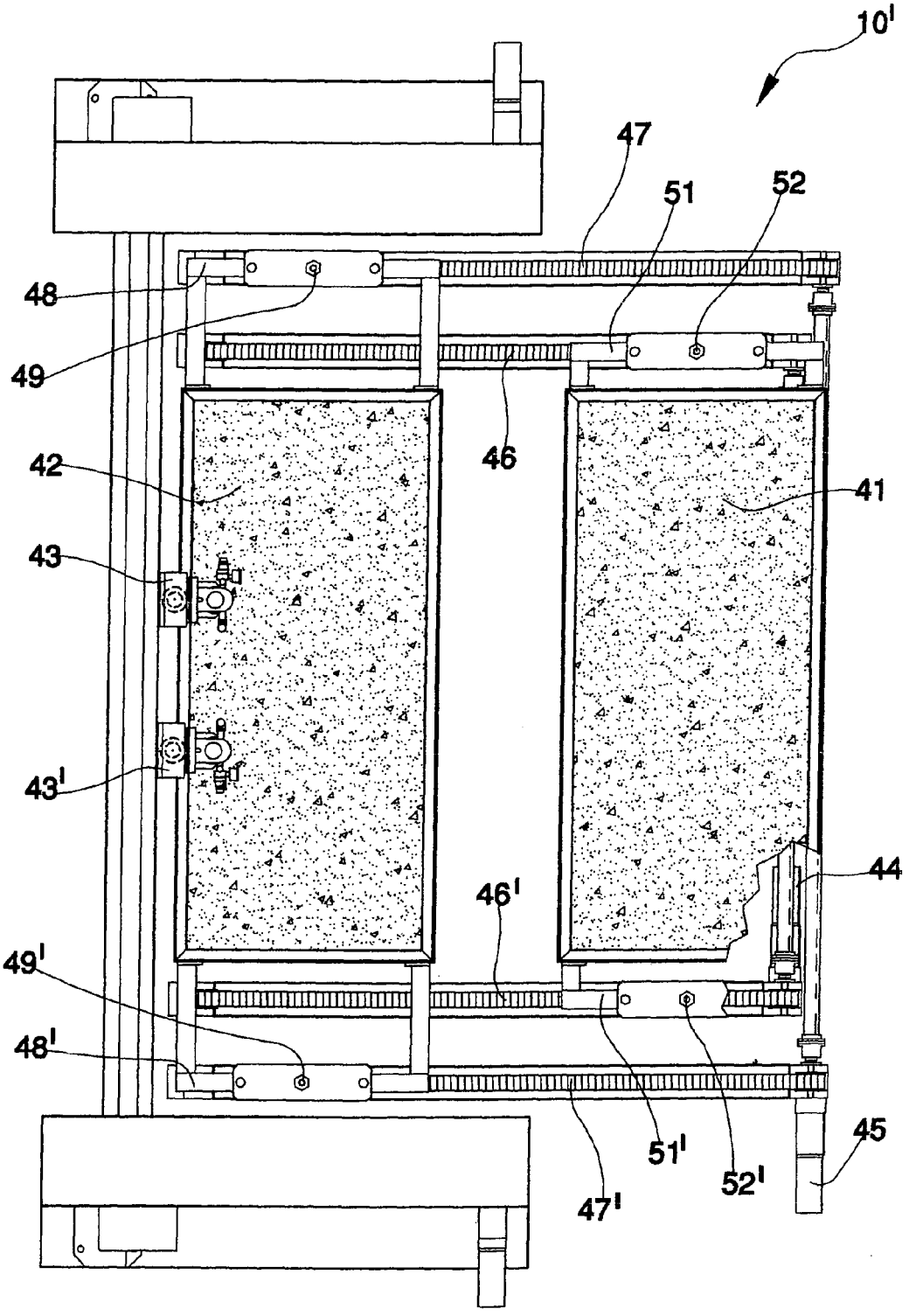


Fig. 5

Fig. 6

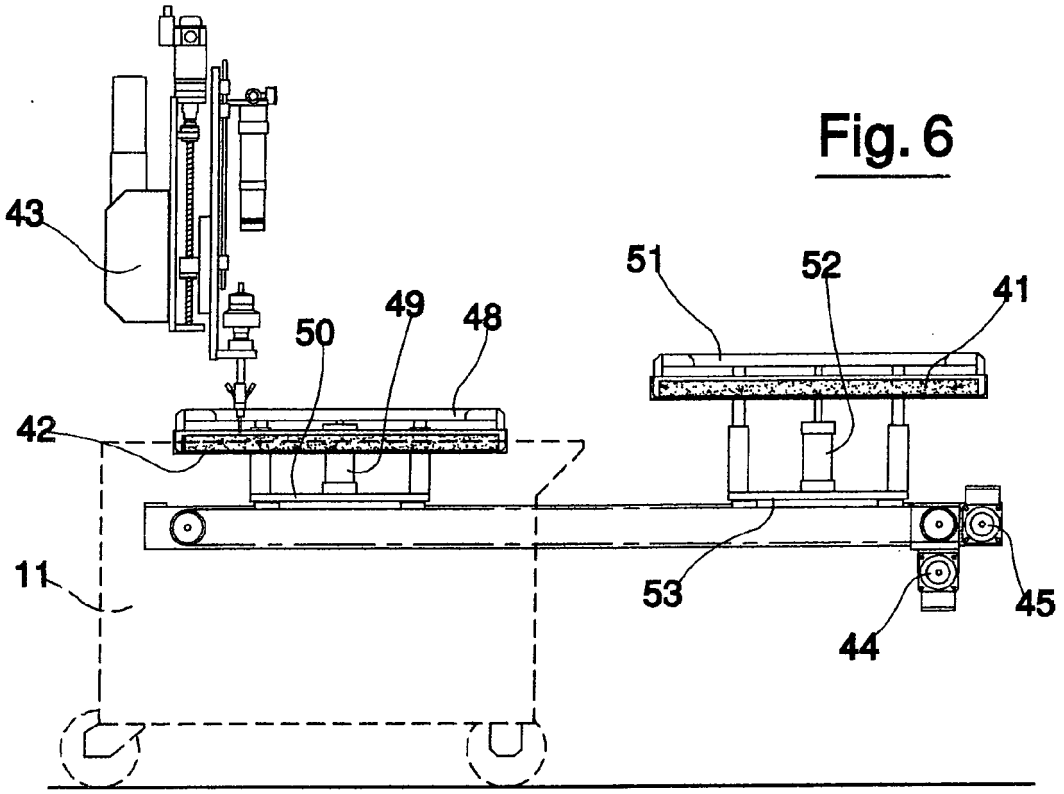
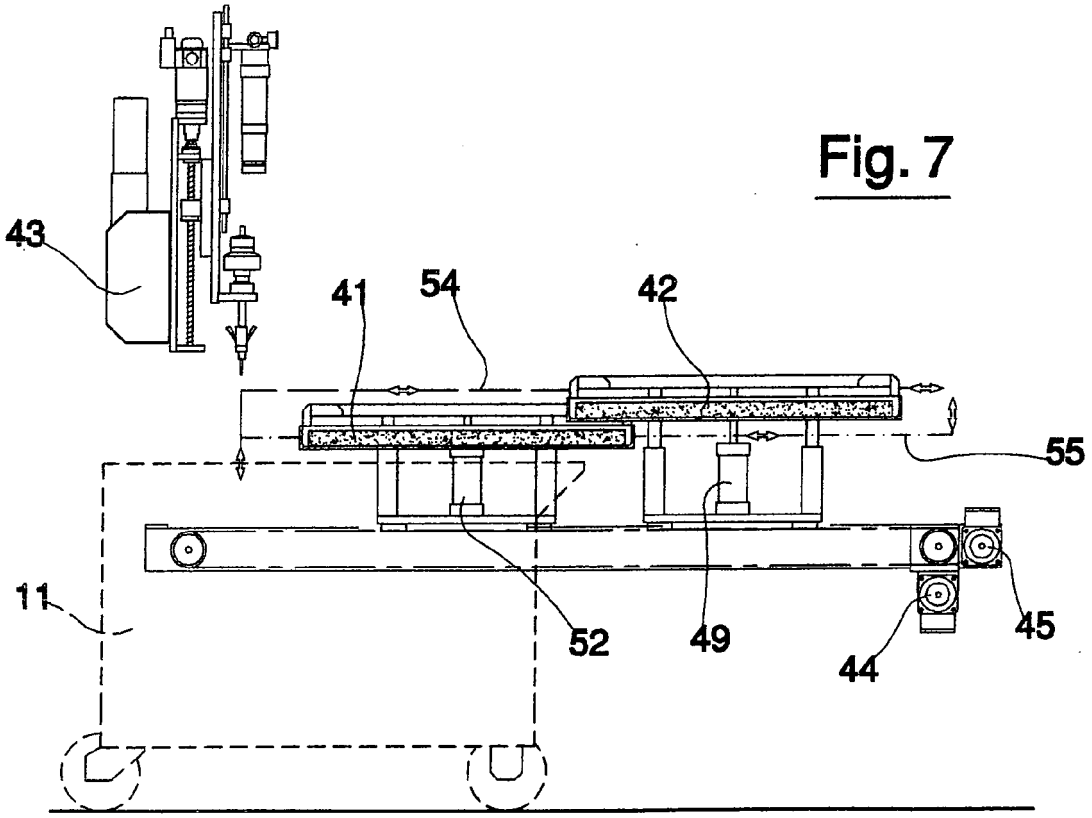


Fig. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 05 07 7724

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 978 748 A (LESLIE ET AL) 7 September 1976 (1976-09-07)	1-5	B26D7/06 B65G47/00
A	* column 5, line 65 - column 6, line 25; figure 3 *	6-12	B28D7/04
X	US 4 949 610 A (JONES ET AL) 21 August 1990 (1990-08-21)	1	
A	* the whole document *	2-12	
X	US 2005/079797 A1 (MARTI DANIEL ET AL) 14 April 2005 (2005-04-14)	1-4	
A	* figures 1-7 *	5-12	
A	EP 1 522 511 A (KEMAC S.P.A) 13 April 2005 (2005-04-13) * the whole document *	1-12	

TECHNICAL FIELDS SEARCHED (IPC)

B26D
B65G
B28D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 April 2006	Wimmer, M

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