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(54) SET OF DISCS FOR GRINDING THE EDGES OF GLASS PLATES

(57) A set of discs for grinding the edges of a glass plate (5) has the form of round grinding discs, where in a set of diamond discs individual discs are provided in pairs and in each pair of the discs, each of the two discs cooperates with the opposite one of the two parallel edges of the glass plate (5), carried between said discs, where in the order of carrying the glass plate (5), the discs grinding the surfaces of the side edges of the glass plate comprise segment peripheral oscillating discs (1), discs chamfering the side edges of the glass plate (5) comprise cup discs (2.1,2.2), where the set of diamond discs comprises in the order of carrying the glass plate (5) to the set of discs: one pair of the segment peripheral oscillating discs (1) with an angle of cooperation of 0° with two surfaces of the side surface (5.1,5.2) of the plate (5), one pair of the rough cup discs (2.1) for chamfering both bottom edges of the glass plate (5), and one pair of the rough cup discs (2.2) for chamfering both upper edges of the glass plate (5). The set also comprises one pair of rough peripheral profile discs (3.1) for the rough profiling of the side surfaces (5.1,5.2) of the plate (5), one pair of finishing profile discs (3.2) for the finishing profiling of the side surfaces (5.1,5.2) of the plate (5), one pair of rough peripheral polishing discs (4.1) for the rough polishing of the side surfaces, one pair of finishing peripheral polishing discs (4.2) for the finishing polishing of the side surfaces (5.1,5.2) of the glass plate (5).

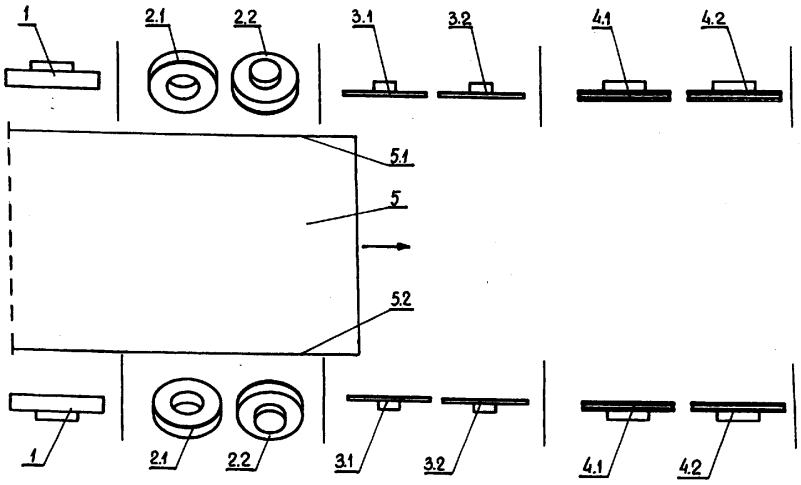

Fig. 1

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Description

[0001] The invention relates to a set of discs for grinding the edges of glass plates used in the construction industry, in the furnishing of flats and in the furniture industry.

[0002] In the furniture and construction industries and in the furnishing of flats, the use of transparent, frosted and coloured glass plates of various thicknesses and made of various types of glass plates are becoming more and more popular. In every case, when cutting glass plates to the desired size, in particular glass plates used as unframed, there is a problem of grinding off edges for the safe use of such plates, for example used as furniture doors. Usually, the edge grinding operation is performed in a machine provided with a glass plate guide and with, arranged near the edges of a plate, rotating s that are grinding discs mounted on drive units. Grinding disc rotation drive units contain motors from which the drive is transferred to round grinding discs. The grinding discs comprise cylindrical or flat working surfaces and are mounted on rotation axes at various angles to the surface of the glass plate. The setting angles of said rotation axes of grinding discs are usually adjustable. In some machines, the pressure of grinding discs on the edge of the plate being ground is also measured. There are many known solutions of this type of machines.

[0003] The solution known from patent description EP 0547995 presents a machine for grinding and bevelling any type of ceramic material, stone, granite, marbles and the like, comprising a tie-up system of the material between two belts, the workpiece access and continuous advance being allowed without relative movement of the workpieces during their transport. The grinding system comprises several grinders with mutually opposed bevelling and in this way the grinders concurrently operate and control parallel grinding.

[0004] In another solution known from patent description EP 1468784, a grinding machine for glass slabs containing a grinding head is disclosed. The grinding head comprises a supporting structure, round grinding discs for grinding and laterally polishing the slabs and grinding discs for grinding and/or polishing the edges of the slabs. The grinding discs for grinding or polishing contain rotation mechanisms, independently one from another, around an axis that is perpendicular to the rotation axis of the grinding discs. In this machine, the grinding discs for grinding or laterally polishing are adapted to perform, when working, axial movements, that can be actuated independently one from another, along the slabs.

[0005] In another solution known from patent description EP 1060833, a set of grinding discs for finishing the edges of glass sheets is described. Glass sheets are separated into desired sizes, after which the edges of the glass sheets are finished using first grinding discs to grind the edges, and then second grinding wheels for polishing the edges and to round off the edges by moving the edges of the glass sheet against rotating grinding and polishing discs.

[0006] In another solution known from patent description EP 2853343, another machine for grinding plate-shaped elements, particularly tiles and slabs of ceramic material, natural stones or glass plates is described. The machine comprises a base frame, forward movement means for a plate-shaped element having at least a first side to be ground and at least a second side transversal to the first side. The machine comprises the movement means being fitted on the base frame, being suitable for moving the plate-shaped element along a direction of forward movement and comprises two pairs of flexible elements, of which a first pair is fitted on a first support structure and a second pair is fitted on a second support structure. Grinding discs for the first side, which are arranged in proximity of the movement surface and are suitable for cooperation with the edges of the glass plate-shaped element in its movement along the direction of forward movement. The machining means comprise at least one side grinding disc and a chamfering disc. The machine comprises positioning means of a rectangular-shaped plate on the movement surface, with a first pusher and a second pusher moving alternately along the direction of forward movement.

[0007] In the solution known from patent description EP 3012066, a bilateral machine for machining the edges of plates made of glass or stone is described. The machine comprises at least one device for forming a radiused circular profile at one or more corners of the glass plate. Two devices are preferably provided on the two banks of the bilateral machine, outside of tool units in the form of round grinding discs for machining the side edges of the glass plate. The devices are configured and controlled for performing the smoothing operation of one or more corners of the plate while the plate advances through the work area of the machine.

[0008] Another solution known from the description of international application WO 2011/142159 presents a glass wafer chamfering device such that wafers are chamfered in parallel on a plurality of tables, that the throughput is improved. At the same time the total number of grindstones is restricted, resulting in the cost and the size of the entire device being reduced, and leading to maintenance and management being facilitated. The wafer chamfering device comprises a plurality of grindstones which have different processing characteristics corresponding to a plurality of processing steps for chamfering the peripheries of the wafers, and moving means for moving the grindstones among the processing tables. Each of the grindstones approaches one of the processing tables and chamfers one of the wafers, and then moves to another of the processing tables. These operations are repeated, with the result that the plurality of grindstones chamfer the plurality of wafers in parallel.

[0009] In the patent description known from international application WO 2013/065490, a different processing device for board-shaped objects is described. The device is provided with a surface plate that holds the

board-shaped object and a disc-shaped or cylindrical bevelling grindstone that grinds and bevels the edges of the board-shaped object held on the surface plate. The device also comprises a rotation means for rotating the bevelling grindstone, as well as a movement means for bringing the circumference of the bevelling grindstone into contact with the grinding surface on the peripheral surface of the board-shaped object and moving the bevelling grindstone along the object or the board-shaped object along the grindstone. The device may be additionally provided with a spraying means for spraying a cooling liquid on the point of contact between the surface of the bevelling grindstone and the ground edge of the board-shaped object. The spraying means sprays the cooling liquid in a direction to the rotation axis of the bevelling grindstone.

[0010] Another solution known from the patent description of international application WO 2013/072845 presents a machine for working edges of slabs comprising a frame and feeding members for moving a glass slab having an edge to be worked. The machine comprises at least one station for shaping the edges comprising at least one shaping member provided with a shaping tool. The shaping station comprises at least one member for detecting the position of the edge of the slab, operatively placed upstream of the shaping member. The machine also comprises a control unit designed to receive signal from the sensor and to send a command signal to the shaping member for determining the position of the shaping tool.

[0011] Another solution known from the description of international application WO 2013/100126 presents a glass plate working device which is provided with a holding base which holds a glass plate and a rail on which the holding base with the plate is moved along a conveyance path. The device comprises cutting devices which, on the conveyance path, cut the glass plate into a rectangular shape having a predetermined size. The glass plate is held on the holding base. The conveyance path contains devices which chamfer the edges of the glass plate. Working is started after the plate is cut to size by the cutting devices and the position of the chamfering devices is positioned relative to the holding base.

[0012] Another known solution of a machine for machining the edges of plates of glass, stone-like material and the like, is described in patent description US 6,416,382. The machine comprises a supporting frame which has a conveyor for glass plates. There are also provided an abutment shoulder and a movable shoulder for supporting abrasive grinding discs which act on the opposite edges of the plates. Therefore, the grinding discs are fixed in pairs and at the same time grind the opposite edges of the plate. The machine comprises, for each shoulder, downstream of the last grinding disc in the direction of advancement of the plates, a sensor for detecting the dimensions of the plates being machined which drives an advancement device for the advancement of the last grinding disc. Each grinding disc except for the first grinding disc along the advancement direction of the plates is provided with a detector for detecting the energy absorbed by the corresponding motor.

[0013] Another known solution is described in patent description GB 2261433. According to this solution, a conveyor for quadrilateral glass plates supports their top and bottom surfaces. Limit switches are provided at corresponding positions at both sides of the conveyor. Corner cutting horizontal rotary grinders mounted on grinder tables are provided between the limit switches are detect the presence of the plate to be ground. Timers are operated in response to a glass-plate arrival and departure detection signals from the area between limit switches. The grinder tables are moved toward or away from each other. A control unit controls the speed of the movement of the grinder tables by step motors.

[0014] Known machines for grinding and chamfering the edges of glass plates cause that only some parts of diamond discs are excessively worn, which makes that a disc, used only in parts, is not suitable for further use as a whole. These parts comprise peripheral, almost linear contact zones between the edges of glass plates and a grinding disc. A grinding disc worn in a small part cannot be used again. Diamond grinding discs are also referred to as grinding discs. Diamond discs are the fastest-wearing part of a machine for grinding the edges of glass plates.

[0015] The object of the invention is to develop a new set of discs for grinding the edges of glass plates, arranged in a new way, to reduce the phenomenon described above and to slow down the wear of individual discs in the set. The rapid degradation of discs is, in particular, caused by the process of rough removal of the upper and lower edges of a glass plate using cup discs and the profiling process using profile discs.

[0016] In accordance with claim 1 and the subsequent claims, according to the invention, the process of removing excess glass after the cutting operation includes a roughing operation on peripheral oscillating discs and then a finishing operation on profile discs. The two operations, according to the invention, are separated by pre-profiling on cup discs by removing excess material at a specific angle, i.e. the operation of the initial shaping of the profile before peripheral profile discs. The introduction of this intermediate operation has made it possible to relieve peripheral profile discs, but has also relieved peripheral polishing discs and has enabled very fast grinding, while maintaining the quality and the full automation of the process of changing the size of the machined forms. As it turned out, the solution according to the invention has slowed down the wear of all the grinding discs in the set.

[0017] According to the invention, a set of discs for grinding the edges of glass plates is in the form of two rows of round grinding discs, where in a set of diamond discs individual discs are provided in pairs. From each pair of the discs, each of the two discs cooperates with the opposite one of the two parallel edges of the glass

plate. This means that a pair of discs simultaneously handles two opposite edges of the glass plate being ground, carried on a known belt conveyor between said discs. The discs grinding the surfaces of the side edges of the glass plate comprise segment peripheral oscillating discs, while the discs chamfering the side edges of these opposite surfaces perpendicular to the surface of the glass plate comprise cup discs. The set of discs comprises in the order in which the glass plate is inserted into the set of discs:

- one pair of the segment oscillating discs with an angle of cooperation of 0° with two surfaces of the side edges of the plate, perpendicular to the surface of the glass plate,
- one pair of the rough cup discs for chamfering both bottom edges of the glass plate, with an angle of cooperation from 0° to 45° with the peripheral side surface of the glass plate, and
- one pair of the rough cup discs for chamfering both upper edges of the glass plate, with an angle of cooperation from 0° to 45° with the peripheral side surface of the edge of the plate.

According to the invention, the set of discs is characterised in that it also comprises:

- one pair of rough profile discs with an angle of cooperation of 0° with the side surface of the edge of the glass plate, where the working surface of this pair of discs is perpendicular to the surface of this glass plate, and is therefore parallel to the side surface of the edge of the glass plate,
- one pair of finishing profile discs with an angle of cooperation of 0° with the side surface of the edge of the plate, where the working edge of the pair of discs is perpendicular to the surface of the glass plate,
- one pair of rough peripheral polishing discs with an angle of cooperation of 0° with the side surface of the edge of the glass plate, where the working planes of these discs are perpendicular to the side surface of the glass plate, and therefore parallel to the side surface of the edge of the plate,
- one pair of finishing peripheral polishing discs with an angle of cooperation of 0° with the side surface of the edge of the plate, perpendicular to the side surface of the glass plate, and thus the working surfaces of this pair of discs are parallel to the side surface of this edge of the glass plate.

According to the invention, the set of discs may preferably comprise two additional pairs of cup discs for chamfering the bottom edge and the upper edge of the glass plate with an angle of cooperation with the peripheral side surface of the plate from 0° to 45°.

[0018] In the set of discs according to the invention it is provided that the peripheral profile discs may preferably comprise slotted discs.

[0019] In accordance with claim 1 and the subsequent claims, a new set of discs for grinding the edges of a glass plate has been developed, where consecutive pairs of discs have been arranged in a new way to reduce and slow down the wear of individual discs in the set. In particular, the process of rough removal of the upper and lower edge of the glass plate using cup discs and the profiling process using profile discs led to the rapid degradation of discs, where only parts of the disc are used, while the remaining disc material is still an abrasive material. The process of removing excess glass after the cutting operation includes a roughing operation on oscillating discs and the roughing process followed by the finishing process on profile discs. These two operations, according to the invention, have been separated by pre-profiling on cup discs by removing excess material at a specific angle, i.e. a pre-chamfering operation with two pairs of discs. The introduction of this intermediate operation has made it possible to relieve both segment oscillating discs and peripheral profile discs, but has also relieved peripheral polishing discs. As it turned out, the solution according to the invention has slowed down the wear of all the grinding discs in the set.

[0020] In the present patent description, the expressions 'the edge of a glass plate' and 'the side of a glass plate' are used. These expressions should be understood to mean that the raw material for glass plates is a flat glass sheet of a certain thickness. After cutting out a plate of specific dimensions from a glass sheet, the plate has edges, i.e. sides with a certain thickness. These sides of the glass plate also comprise parts of the surface perpendicular to the main surface of the glass plate. These surfaces of the sides of the glass plate have their sharp edges in contact with the main surface of said plate. The solution according to the invention relates to a set of discs for grinding and polishing said sides of the glass plate, together with the chamfering or rounding of the sharp edges described above.

[0021] The object of the invention is shown in the examples in the accompanying drawings, in which the individual figures illustrate:

Fig. 1 - a set of rough discs with finishing discs on both sides of a glass plate according to the first example,

Fig. 2 - the set of discs, according to Fig. 1, arranged in pairs,

Fig. 3 - a set of rough discs with finishing discs on both sides of a glass plate according to the second example,

Fig. 4 - the set of discs, according to Fig. 3, arranged in pairs,

Fig. 5 - a segment oscillating disc in contact with the

edge of the glass plate,

Fig. 6 - a cup disc in contact with the edge of the glass plate,

Fig. 7 - a peripheral profile disc in contact with the edge of the glass plate,

Fig. 8 - a peripheral polishing disc in contact with the edge of the glass plate,

Fig. 9 - a peripheral polishing slotted disc in contact with the edge of the glass plate.

Example I

[0022] A set of discs for grinding the edges of a glass plate in the first example is shown in Fig. 1 and Fig. 2. In this example, the set is in the form of two rows of round discs in the form of grinding discs 1,2.1.,2.2.,3.1.,3.2.,4.1.,4.2 . In the set of discs, individual discs are provided in pairs. The object of the set of discs according to the invention is to work the side edge 5.1.,5.2 of the glass plate 5.

[0023] In the attached drawings, both discs from each pair have the same designation because they have the same technical characteristics and the same arrangement with respect to the edge of the glass plate 5. Only in each pair of discs from the pairs 2.1.,2.2.,2.3.,2.4 both discs are their own mirror image. In each pair of discs, each of the two discs cooperates with the opposite one of the two parallel edges 5.1.,5.2 of the glass plate 5. This means that two opposite discs from each pair of the discs simultaneously handle the two opposite, parallel edges 5.1.,5.2 of the glass plate 5 being ground. This is shown in Fig. 1 and Fig. 7.

[0024] The glass plate 5 is carried in this example on a known belt conveyor, not shown in Fig. 1 and Fig. 3, between said pairs of discs, in the direction indicated by the arrow in the figures.

[0025] The discs 1 grinding the surfaces of the side edges 5.1.,5.2 of the glass plate 5 comprise rough segment peripheral oscillating discs. Their purpose is to remove the excess material resulting from glass cutting, in relation to the assumed total excess, specified for the technological process or for a given thickness of glass. As a result of cutting out the plate 5 from a larger sheet, the excess remains over the excess assumed for the further working of the edges 5.1.,5.2. The working surface of said discs 1 cooperates with the surface of the side edge of the glass plate 5 at an angle of 0°. This is shown in Fig. 3 and Fig. 9.

[0026] Pairs of the cup discs 2.1 and 2.2 are tools for chamfering the side edges 5.1 and 5.2 of the glass plate 5 and they are shown in Fig. 1 and Fig. 2. These discs are diamond cup discs. The purpose of the pairs of the discs 2.1.,2.2 is the pre-profiling of the edges of the sides 5.1.,5.2 of the glass plate and the removal of the excess material at a specific angle. This type of operation is called in the engineering as chamfering. As shown in Fig. 6, in these examples, the discs are inclined at an angle of 45° with respect to the surface of the glass plate 5. Figs. 1-4 show that in each pair of the discs 2.1.,2.2.,2.3,2.4 two discs with the same degree of inclination are provided, but inclined in opposite directions to each other. One pair of the discs 2.1 is intended for working both bottom edges of the side of the glass plate 5, while the other pair of the discs 2.2 is intended for working the upper edges of the side of the glass plate 5.

[0027] To perform the grinding and/or polishing operations of the sides 5.1.,5.2 of the glass plate 5, the discs in said pairs of the discs are mounted in a known manner, each disc on the axis of a known drive motor, which is not shown in the attached drawings. The motors are mounted in a known manner, slidably on both sides of said known glass plate conveyor, and in this way the spacing of the discs mounted on the drive shafts of the motors, in each pair of the discs, is adjusted, according to the width of the glass plate being worked.

[0028] In the example shown in Fig. 1 and Fig. 2, the set of discs contains two additional pairs of the discs 3.1 and 3.2, which are diamond peripheral profile discs. The pair of the discs 3.1 is a pair of rough profile discs with an angle of cooperation of 0° with the side surface of the edges 5.1,5.2 of the plate 5. The working surface of this pair of the rough discs 3.1 is perpendicular to the surface of the glass plate 5, and is therefore parallel to the side of the glass plate 5. The purpose of the pair of the rough discs 3.1 is to give the correct initial profile to the side of the plate 5 by removing the excess material. After this working, the side of the plate takes the correct profile, but it is still very rough. The pair of subsequent discs 3.2 are also diamond peripheral profile discs for finishing. The purpose of this pair of the discs 3.2 is to finally give the correct profile to the edges by further removing the assumed excess material, and after this working the sides 5.1,5.2 of the glass plate 5 are characterised by low roughness.

[0029] In the same example, the set of discs has been supplemented with two more pairs of discs designated as 4.1,4.2. These are pairs of peripheral polishing discs. One pair 4.1 of the discs is a pair of rough discs 4.1 with an angle of cooperation of 0° with the side 5.1,5.2 of the glass plate 5. The axes of rotation of the discs 4.1,4.2 lie in the planes perpendicular to the side surface of the glass plate 5, therefore they are parallel to the sides 5.1,5.2 of the glass plate 5. The second pair is a pair of finishing peripheral polishing discs 4.2 with an angle of cooperation of 0° with the sides 5.1,5.2 of the plate 5. It is a pair of finishing discs whose purpose is to polish the side of the glass plate.

Example II.

[0030] The second example of the set for grinding the edges of glass plates is illustrated in Fig. 3 and Fig. 4. In

this example, all of the components of example I were used, with the difference that to two pairs of the diamond cup discs 2.1,2.2 two further pairs of such discs 2.3,2.4 were added. However, in place of the single two pairs of the diamond peripheral profile discs 3.1,3.2 provided for in example I, slotted discs 3.3,3.4 were proposed. With this solution, after the periodical wear of one slot in the currently used pair of the discs 3.3,3.4, the discs can be moved axially and the grinding of the sides of the glass plate 5 in the new slot can be continued. An appropriate drawing illustrating this possibility is shown as Fig. 11.9.

[0031] The set of discs in this example contains two additional pairs of the cup discs 2.3,2.4 for chamfering the bottom edge and the upper edge of the glass plate 5 with an angle of cooperation of 45° with the peripheral side surface of the plate 5.

[0032] In the set of discs according to the invention, it is provided that the peripheral profile discs 3.3,3.4 may preferably be slotted discs.

List of designations in the figures

[0033]

1. Diamond segment peripheral oscillating disc.
2.1. Diamond cup disc.
2.2. Diamond cup disc.
2.3. Diamond cup disc.
2.4. Diamond cup disc.
3.1. Diamond peripheral profile disc.
3.2. Diamond peripheral profile disc.
3.3. Diamond peripheral profile slotted disc.
3.4. Diamond peripheral profile slotted disc.
4.1. Peripheral polishing disc.
4.2. Peripheral polishing disc.
5. Glass plate.
5.1. Side of the glass plate.
5.2. Side of the glass plate.

Claims

1. A set of discs for grinding the edges of a glass plate (5), in the form of round grinding discs, where in a set of diamond discs individual discs are provided in pairs and in each pair of the discs, each of the two discs cooperates with the opposite one of the two parallel edges of the glass plate (5), carried between said discs, where in the order of carrying the glass plate (5), the discs grinding the surfaces of the side edges of the glass plate comprise segment peripheral oscillating discs (1), discs chamfering the side edges of the glass plate (5) comprise cup discs (2.1,2.2), where the set of diamond discs comprises in the order of carrying the glass plate (5) to the set of discs:

- one pair of the segment peripheral oscillating discs (1) with an angle of cooperation of 0° with two surfaces of the side surface (5.1,5.2) of the plate (5),
- one pair of the rough cup discs (2.1) for chamfering both bottom edges of the glass plate (5), and
- one pair of the rough cup discs (2.2) for chamfering both upper edges of the glass plate (5),

characterised in that it also comprises:

- one pair of rough peripheral profile discs (3.1) for the rough profiling of the side surfaces (5.1,5.2) of the plate (5),
- one pair of finishing profile discs (3.2) for the finishing profiling of the side surfaces (5.1,5.2) of the plate (5),
- one pair of rough peripheral polishing discs (4.1) for the rough polishing of the side surfaces,
- one pair of finishing peripheral polishing discs (4.2) for the finishing polishing of the side surfaces (5.1,5.2) of the glass plate (5).

2. The set of discs, according to claim 1, **characterised in that** it comprises two additional pairs of cup discs (2.3,2.4) for chamfering the bottom edge and the upper edge of the side surfaces (5.1,5.2) of the glass plate (5).

3. The set of discs, according to claim 1, **characterised in that** the peripheral profile discs comprise slotted discs (3.3,3.4).

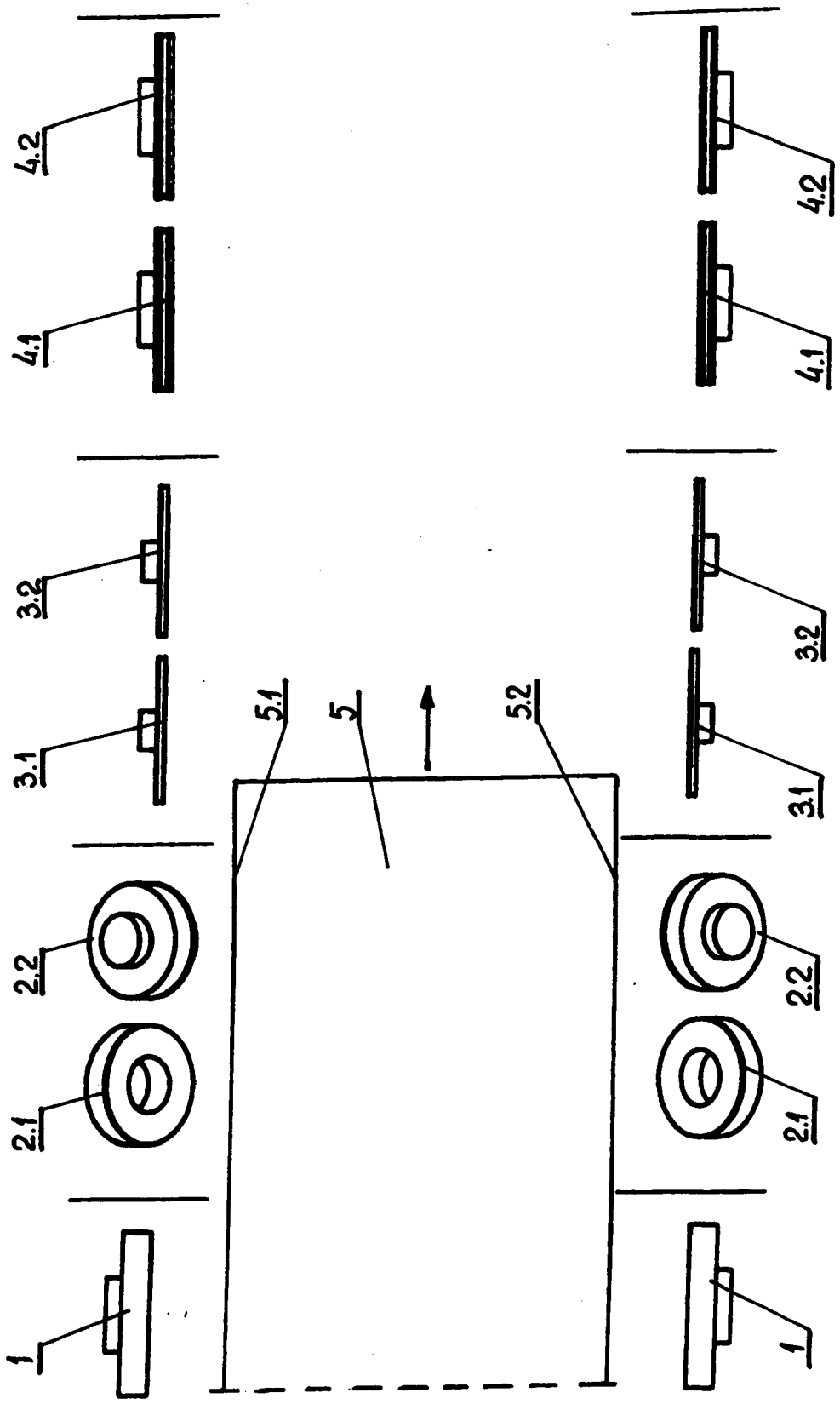

Fig. 1

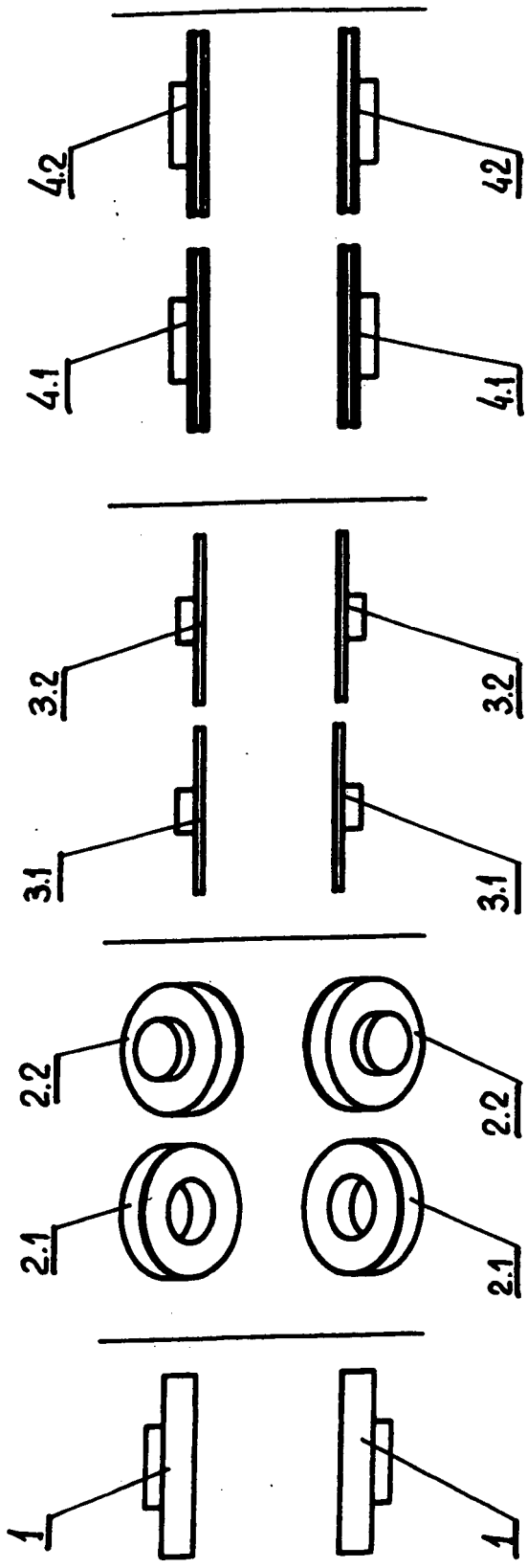

Fig. 2

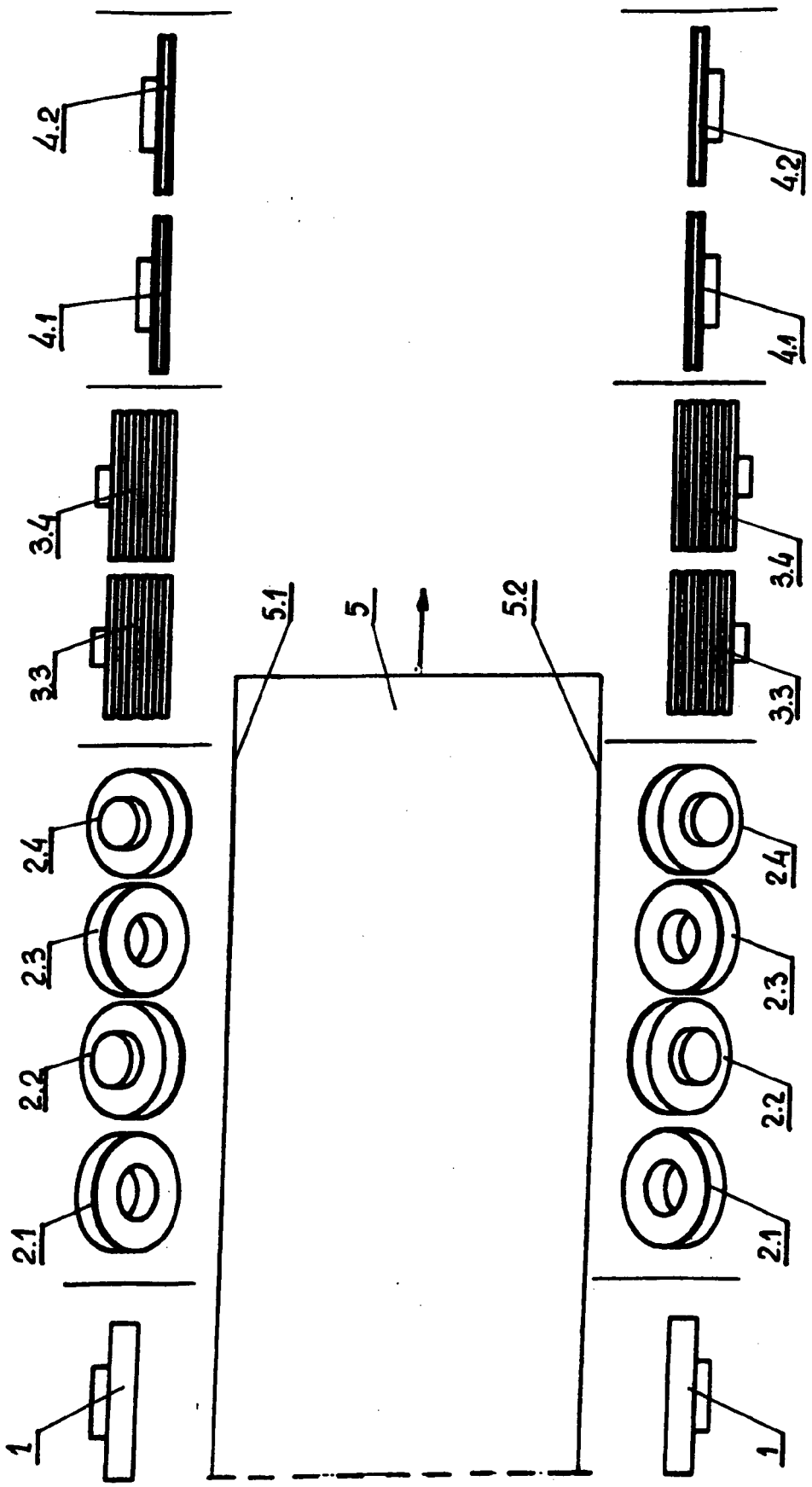

Fig. 3

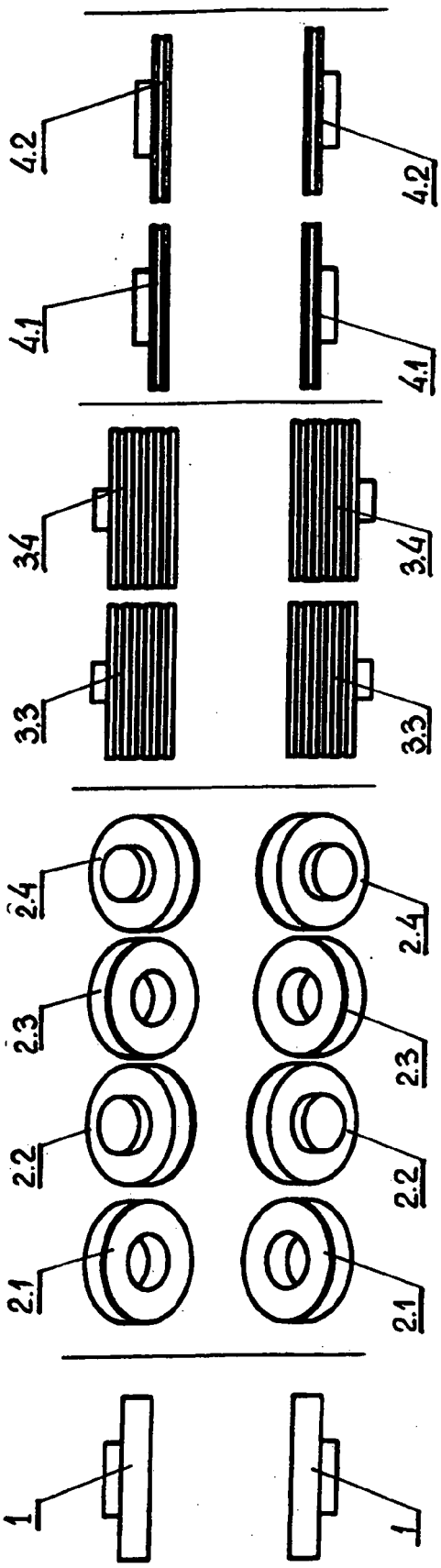

Fig. 4

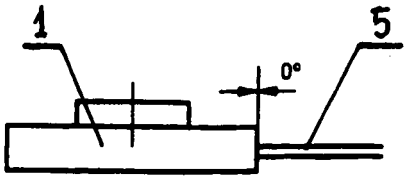

Fig. 5

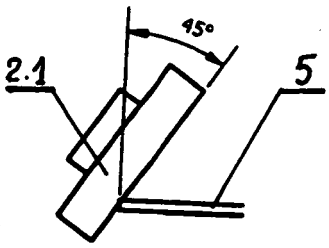

Fig. 6

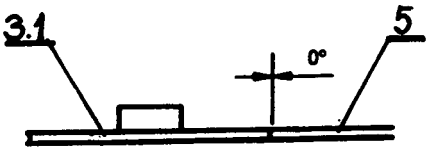

Fig. 7

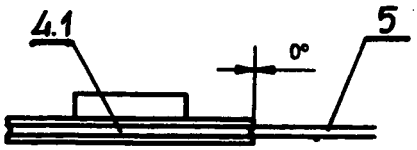

Fig. 8

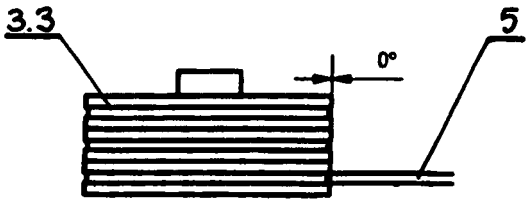

Fig. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 18 46 0034

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	WO 2009/034588 A1 (FORVET S R L [IT]; GARIGLIO DAVIDE [IT]) 19 March 2009 (2009-03-19) * page 2, line 15 - page 8, line 11; figures 1,4,5 *	1-3	INV. B24B9/10
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Y,D	EP 3 012 066 A1 (BIESSE SPA [IT]) 27 April 2016 (2016-04-27) * figure 1 *	2	
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Place of search	Date of completion of the search	Examiner
Munich	19 November 2018	Kornmeier, Martin

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