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(54) Machine for forming overlap elements on the sides of rectangular flat slabs.

(57) The machine comprises a frame (30) carrying two wires (31) and two wires (32) able to cut a semifinished block (2), said wires (31) and (32) being maintained in a fixed geometrical position relative to the frame (30); said frame (30) is arranged to move relative to the block (2), both vertically, and horizontally in a direction substantially parallel to a diagonal of the horizontal faces (2''') of the parallelepiped; during the cutting of the semifinished block (2) the wires (31) are maintained parallel to a first vertical face (2') and the wires (32) are maintained parallel to a second vertical face (2''); said frame (30) is made to move relative to the semifinished block (2) in accordance with a cyclic sequence of vertical steps in the same direction and horizontal diagonal steps alternately in one direction and in the opposite direction, in such a manner as to form the required overlap elements (20); the vertical movements of the wires (31) and (32) determine the vertical faces of the overlap elements (20) and the horizontal movements of the wires (31) and (32) determine the horizontal faces of the same elements (20).

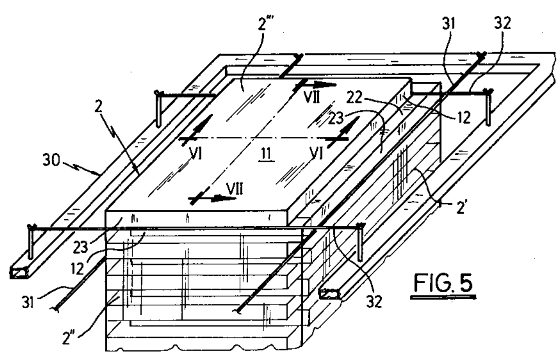

FIG. 5

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This invention relates to the manufacture of overlap elements on the sides of rectangular flat slabs, particularly of foamed polystyrene and more generally of analogous materials which can be cut with wires. The cutting can be by hot wires or by axially slidable wires.

In particular, the invention relates to the formation of flat slabs having the shape shown by way of example in the accompanying Figures 1A, 1B and 1C.

In these and the other figures and in the ensuing description and claims, said slabs are illustrated and described with reference to the geometrical position in which their major faces are horizontal.

The slab concerned is composed geometrically of a central parallelepiped portion 10 having two major parallel faces 11 (horizontal) and four minor side faces 12 (vertical), plus four overlap elements 20 projecting from respective side faces 12 of the central portion 10 and each comprising:

- a first horizontal face 21, coplanar with a major face 11,
- a second horizontal face 22, in an intermediate position between the planes in which the faces 11 lie, and
- an outer vertical face 23, parallel to and spaced outwards from the respective side face 12.

In addition, the elements 20 lying on two parallel side faces 12 have their first horizontal face 21 coplanar, in one element 20, with a major face 11 and, in the other element 20, with the other major face 11.

In other words, two overlap elements 20 positioned on two consecutive sides are coplanar with one major face 11, and a further two elements 20 positioned on the two consecutive sides opposite the former are coplanar with the other major face 11.

The slabs concerned are generally of square shape in plan view.

Flat slabs of the described form are used especially as wall lining panels, the overlap elements being used for improved thermal/acoustic insulation in the regions in which the slabs are joined together.

These overlap elements are currently obtained by milling starting from parallelepiped slabs, to create on each side face a right dihedral groove which forms a corresponding overlap element.

This procedure has however the drawback of creating a considerable quantity of material particles which disperse into the environment, so creating both cleaning and environmental pollution problems; in addition there is a substantial material wastage as the removed particles are no longer recoverable. Moreover the machines required to implement the procedure are very costly.

Theoretically, it is possible to form such panels with overlap elements starting from a semifinished block of wire-cuttable material in the form of a parallelepiped, the horizontal faces of which have dimensions not less than the total dimensions of the major faces of the slabs to be formed; a geometrical shape reproducing the required overlap elements can be cut on the vertical side faces of this block, which can then be cut along horizontal planes to produce the required slabs.

However the known machines for cutting blocks of polystyrene or like material are not only relatively costly and complicated but are also inefficient in forming the required overlap elements as they are able to operate on one vertical face of the semifinished block at a time; consequently the complete processing of the block would result in times and costs unacceptable in practice.

The object of the present invention is to provide a machine able to form the required overlap elements on a parallelepiped block to be then divided into slabs, the machine being in addition of very simple and low-cost construction and having a relatively very high operating rate.

This and further objects are attained by the machine according to the invention as characterised in the claims.

The invention is described in detail hereinafter with reference to the accompanying figures, which illustrate one embodiment thereof.

Figure 1A is a plan view of a slab with overlap elements, for example of a panel to be formed by the invention;

Figures 1B and 1C are sections through the slab of Figure 1A on the planes 1B-1B and 1C-1C respectively;

Figure 2 is a plan view from above of the machine according to the invention;

Figure 3 is a vertical elevation in the direction of the arrow III of Figure 2;

Figure 4 is a section on the vertical plane IV-IV of Figure 2, in which the block 2 and the station 50 are not shown;

Figure 5 is a perspective schematic view of the cutting wires 31 and 32 operating on a semifinished block;

Figures 6 and 7 are sections on the vertical planes 6 and 7 of Figure 5 respectively.

Figure 8 represents an alternative arrangement of the cutting wires, with the relative electrical schematic.

The machine according to the invention is arranged to operate conveniently on parallelepiped blocks 2 to obtain therefrom, by cutting with wires, several rectangular flat slabs 1 of a shape similar or analogous to that illustrated in Figures 1A, 1B and 1C, and described heretofore.

The constituent material of the block 2 is foamed polystyrene or another analogous material able to be cut by wires.

The block 2 is in the form of a parallelepiped with two mutually parallel first vertical faces 2' and two second vertical faces 2'' perpendicular to the first faces 2'; it also has two horizontal faces 2''' the dimensions of which are not less than the total dimensions (ie the dimensions of the central portion 10 added to the dimensions of the overlap elements 20) of the major faces of the slab 1 to be formed; conveniently the dimensions of the faces 2''' are equal to said total dimensions of the slab 1.

The machine according to the invention comprises a frame 30 carrying at least one first wire 31 and at least one second wire 32, said wires being able to cut the block 2 and being maintained in a fixed geometrical position relative to the frame 30.

In particular, said wires 31 and 32 are of the type heated by the Joule effect using electrical energy, and are able to cut the material of the block 2 by virtue of their temperature.

Alternatively the wires 31 and 32 can be driven so that they slide reciprocatingly in an axial direction.

The frame 30 is arranged to move, relative to the block 2, both vertically and horizontally in a direction substantially parallel to a diagonal of the horizontal faces 2''' of the parallelepiped defined by the block 2. During the cutting of the block 2 the first wire 31 is maintained parallel to a corresponding face 2' of the parallelepiped, whereas the second wire 32 is maintained parallel to a corresponding face 2''.

According to the invention, during its operation, the frame 30 is made to move relative to the block 2 in a cyclic sequence of vertical steps in the same direction, and a cyclic sequence of diagonal horizontal steps alternately in one direction and the other, in order to form the required overlap elements 20; in this, the vertical movements of the wires 31 and 32 form the vertical faces 23, and the horizontal movements form the horizontal faces 21 and 22.

In a preferred embodiment, relating to the most usual case in which four overlap elements 20 are to be formed, ie one on each side face of the slab 1, the frame 30 is provided with two first wires 31 parallel to each other, and with two second wires 32 also parallel to each other. The distance between the two wires 31 and the distance between the two wires 32 is equal to the corresponding horizontal dimension of the major face 11 of the central portion 10 plus the width of a corresponding overlap element 20. In Figures 1B and 1C, L1 and L2 indicate the dimensions of the major faces 11 of the central portion 10 relative (ie perpendicular) to the wires 31 and 32 respectively, and L3 and L4 represent the widths of the corresponding overlap elements 20. Said distances between the wires 31 and between the wires 32 are hence equal to L1 + L3 and L2 + L4 respectively.

In addition the wires 31 lie in one ideal horizontal plane and the wires 32 lie in another ideal horizontal plane, the distance between these planes being equal to the thickness S of the slabs 1 to be obtained (or equal to a multiple of S).

Alternatively, as shown in Figure 8, the wires 31 and 32 can be coplanar, as described hereinafter.

In the machine illustrated in Figures 1 to 7, the frame 30 is of square flat form.

On two opposing sides of the frame 30 there are four adjustable elements 33 between which the two wires 31 extend, and four adjustable elements 34 between which the wires 32 extend.

Rectangular slabs of any dimensions can therefore be worked provided these can be contained within the frame 30.

The elements 34 each comprise a vertical extender the length of which can be varied to vary the distance between the plane defined by the wires 32 and the plane defined by the wires 31, in order to maintain the distance between the two planes equal to the thickness of the slab 1 when this thickness varies.

The wires 31 and 32 are arranged parallel to the sides of the frame 30.

The machine also comprises a second frame 36 of horizontal flat quadrangular shape and in particular square, positioned below the frame 30 and having its sides parallel in pairs to the sides of this latter.

Both the frames 30 and 36 have plan dimensions greater than the corresponding dimensions of the slab 1, and when viewed in plan the wires 31 and 32 intersect within the inner area bounded by the two superposed frames 30 and 36.

The frame 30 is secured to the frame 36 such that it can move horizontally to this in a direction substantially parallel to one of its diagonals.

For this purpose two rods 37 are provided fixed to two opposing sides of the frame 36 and slidable axially as an exact fit within two bushes 38 fixed on two opposing sides of the frame 30. The axes of the rod 37-bush 38 units are parallel to a diagonal of the frame 30.

Between the two frames 30 and 36 there is a linear actuator 39 acting in said diagonal direction to move the frame 30 relative to the frame 36 through diagonal steps of predetermined length, alternatively in one direction and in the opposite direction, equal to the dimension in the diagonal direction of the horizontal faces 21 and 22 of the elements 20 (this dimension being indicated by L5 in Figure 1A).

The frame 36 is secured to a fixed support frame 40 such that it can move vertically. Means are also provided for vertically moving the frame 36 relative to the fixed frame 40 through same-direction steps equal to the thickness of the overlap elements 20 (indicated by L6 in Figures 1B and 1C).

In detail, the fixed frame 40 comprises two vertically extending sidepieces 41, positioned to the side of and external to two opposing sides of the frame 36, and each possessing a vertical column 42. The frame 36 is fixed by two short vertical beams 43 to two respective bushes 44 slidable along a respective column 42. Close to the column 42 there are pivoted on the frame 40 two lead screws 45 arranged to rotate about their axis and each engaged with an internally threaded slider 46 rigidly fixed to a respective bush 44. Gear wheels 47 are keyed onto the upper ends of the screws 45 and are driven by a transmission chain 48 from a motor 49. The motor 49 simultaneously rotates the two screws 45 to vertically move the sliders 46 and hence the frame 36.

Within the area defined in plan by the frames 30 and 36 there is a station 50 for supporting the semifinished block 2 in a suitable position relative to the wires 31 and 32. In particular, the station 50 consists of a short conveyor belt resting on the ground via a frame 51 concentric with the frames 30 and 36.

Aligned with 50 and external to the frames 30 and 31 there are provided means 52 for loading the block 2 onto the conveyor 50 and means 53 for unloading it.

The described machine operates in the following manner. Initially, the frames 30 and 36 are arranged within the highest part of the frame 40 so as not to hinder the movement of the block 2, which is brought into a central position on the conveyor belt and halted thereat.

The frames 30 and 36 are then lowered in successive steps about the block 2 by the means 45-49, and at the same time the frame 30 is moved stepwise horizontally by the actuator 39 in a cyclic sequence which for each cycle comprises:

- a vertical step of length L6,
- a horizontal diagonal step of length L5,
- a second vertical step of length L6, and
- a second horizontal diagonal step of length L5 in the opposite direction to the first.

The vertical steps cut the block 2 along the vertical faces 23, while the horizontal steps cut along the faces 21 or 22.

The wires 32 operate after the wires 31, to cut in regions in which the wires 31 have already operated.

If the major faces of the block 2 are equal to the total dimensions of the major faces of the slabs 1 (L1 + L3 and L2 + L4), the vertical faces 23 are formed from portions of the same vertical faces 2' and 2'', and during the vertical movements the wires 31 and 32 only graze the faces 2' and 2'' in correspondence with the faces 23 to be formed, but without cutting the material. In contrast, the faces 12 are obtained by cutting the material.

The movements in the horizontal diagonal direction cause the wires 31 to cut along the faces 21 or 22 of the elements 20 on the vertical faces 2' of the block 2, and simultaneously cause the wires 32 to cut along the faces 21 or 22 of the elements 20 on the vertical faces 2''.

In Figures 5, 6 and 7 the wires 31 and 32 are shown cutting the block 2. The thicker lines indicate the surfaces already cut and the thinner lines indicate the surfaces still to be cut.

Figures 6 and 7 show the various positions which the wires 31 and 32 assume during any cycle of the described operating step sequence. The letters "a-e" associated with the wire reference numerals 31 and 32 indicate the various positions assumed by the wires, following the alphabetical order of these letters.

After the wires 31 and 32 have operated over the entire height of the block 2, they lie below the plane in which the lower face 2''' of the block 2 lies, and this can then be advanced onto the means 53 and removed. The frames 30 and 36 then return upwards and a further block 2 can be placed on the station 50 to be worked in the aforedescribed manner.

The block 2 which has already been worked over its entire faces 2' and 2'' is then suitably cut, by known means (not shown), along horizontal planes (indicated by dashed and dotted lines M in Figures 6 and 7) coplanar with the faces 21 of the elements 20, to divide the block into a plurality of finished slabs 1.

Alternatively, the block 2 with which the machine works can consist of a plurality of slabs already divided along horizontal planes, ie a plurality of superposed horizontal slabs.

If the horizontal movements of the frame 30 relative to the frame 36 are produced in a direction close to but different from the diagonal of the starting slab, the overlap elements L3 and L4 will be of different dimensions.

In addition, the relative vertical movement between the block 2 and the wires 31 and 32 can be achieved by maintaining the frame 36 at rest and vertically moving the station 50 on which the block 2 rests.

The machine according to the invention is therefore able to operate simultaneously on the four faces 2' and 2'' of the block 2 by moving in only two directions, namely a vertical direction and a horizontal direction. In this, the determining movement is that in the diagonal or nearly diagonal direction (as stated heretofore), by which cutting takes place simultaneously along horizontal faces 21 and 22 which extend both along the faces 2' and along the faces 2'' of the block 2.

The result is therefore a relatively high operating rate and a machine which is constructionally simple and economical.

As shown in Figure 8, the wires 31 and 32 can also be arranged coplanar on the frame 30.

This arrangement is particularly advantageous if it is required to form a slab provided with overlap elements 20, such as that shown in Figure 1A, starting from a block 2 having the same thickness as the central part 11 of the slab.

The arrangement of Figure 8 also enables several coplanar slabs to be obtained from the same block 2 having the same thickness as the slabs, by providing more than two wires 31 and 32.

Figure 8 shows an arrangement with N wires 31 and N' wires 32, which enables a number of slabs equal to (N-1) x (N'-1) to be obtained from a block 2.

To prevent short-circuiting, each series of wires 31 and 32 is powered, in accordance with the electrical schematic of Figure 8, by a 220 V alternating current line 101, via a transformer 102 which reduces the voltage to 50 V and a series of diodes 103 which feed a pulsating current always of the same sign to each series of wires.

In the case of coplanar wires such as in Figure 8, the vertical travel of the frame 30 is limited to the thickness of the slab, this latter resting on an anvil and kept at rest by an overlying presser table comprising grooves corresponding to the position of the wires. The anvil and table are not shown as they are of obvious implementation.

Claims

1. A machine for forming overlap elements on the sides of rectangular flat slabs of foamed polystyrene or analogous material which can be cut with wires, said slabs being obtained by cutting a semifinished block (2) of parallelepiped shape, the horizontal faces (2''') of which have dimensions not less than the total dimensions of the major faces of the slabs (1) to be obtained, said parallelepiped having two first vertical faces (2') parallel to each other and two second vertical faces (2'') perpendicular to the first faces (2'), characterised by comprising a frame (30) carrying at least one first wire (31) and at least one second wire (32) able to cut the semifinished block (2), said wires (31) and (32) being maintained in a fixed geometrical position relative to the frame (30); said frame (30) being arranged to move relative to the semifinished block (2), both vertically, and horizontally in a direction substantially parallel to a diagonal of the horizontal faces (2''') of the parallelepiped; during the cutting of the semifinished block (2) the first wire (31) being parallel to a first vertical face (2') and the second wire (32) being parallel to a second vertical face (2''); said frame (30) being moved relative to the semifinished block (2) in accordance with a cyclic sequence of vertical steps in one and the same direction and diagonal horizontal steps alternating in one direction and in the opposite direction so as to form the required overlap elements (20), the vertical movements of the wires (31) and (32) determining the vertical faces of the overlap elements (20) and the horizontal movements of the wires (31) and (32) determining the horizontal faces of the same elements (20).

2. A machine as claimed in claim 1 in which the flat slabs to be obtained each comprise a central portion (10) of parallelepiped shape, on the four minor side faces (12) of which there are provided four overlap elements (20), of those elements (20) provided on two mutually parallel side faces (12) one being coplanar with one major face (11) of the central portion (10) and the other being coplanar with the other major face (11), characterised in that said frame (30) carries two first wires (31) and two second wires (32), said first wires (31) and said second wires (32) being parallel to each other and spaced apart by a distance equal to the corresponding horizontal dimension (L1), (L2) of the major face (11) of the central portion (10) plus the width (L3), (L4) of a corresponding overlap element (20).

3. A machine as claimed in claim 1, characterised in that said first wires (31) are positioned in one ideal horizontal plane and said wires (32) are positioned in another ideal horizontal plane, the distance between said two planes being equal to the thickness (S) of the slab (1) to be obtained, or to a multiple thereof.

4. A machine as claimed in claim 1, characterised in that said first wires (31) and said second wires (32) are positioned in the same ideal horizontal plane.

5. A machine as claimed in claim 2, characterised by comprising:
a second substantially flat, quadrangular horizontal frame (36) secured to a fixed support frame (40) in such a manner as to be able to move vertically; said first frame (30), of sub-

stantially flat quadrangular horizontal shape, being positioned on the second frame (36) with its sides parallel in pairs to the sides of the second frame (36); said first frame (30) being secured to the second frame (36) in such a manner as to be able to move horizontally relative thereto in a non-parallel direction, said first and second wires (31) and (32) being parallel to the sides of the first frame (30);
a station (50) for supporting the semifinished block (2) in a position which in plan view is within said first and second frames (30) and (36);
first means (45)-(49) for vertically moving said second frame (36) relative to the fixed frame (40) through same-direction steps equal to the thickness (L6) of the overlap elements (20), and second means (39) for horizontally moving said first frame (30) relative to the second frame (36) through diagonal steps alternately in one direction and in the opposite direction which equal the dimension (L5) in the diagonal direction of the horizontal faces (21), (22) of the overlap elements (20); said first means (45)-(49) and second means (39) being controlled in such a manner as to produce the following cyclic sequence: a vertical step (L6), a horizontal diagonal step (L5) in a first direction, a second vertical step (L6) and a second horizontal diagonal step (L5) in the opposite direction to the first.

6. A machine as claimed in claim 5, characterised in that the station (50) for supporting the semifinished block (2) comprises grooves corresponding to said first wires (31) and to said second wires (32) and having a width equal to the movements undergone by said wires in the horizontal plane.

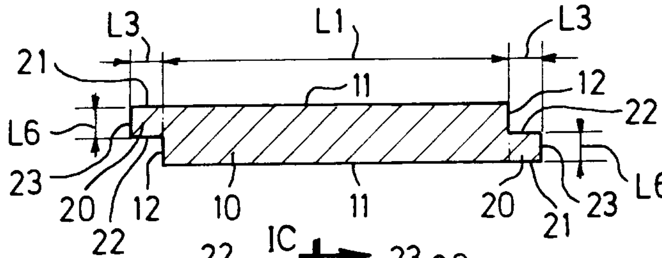


FIG.1B

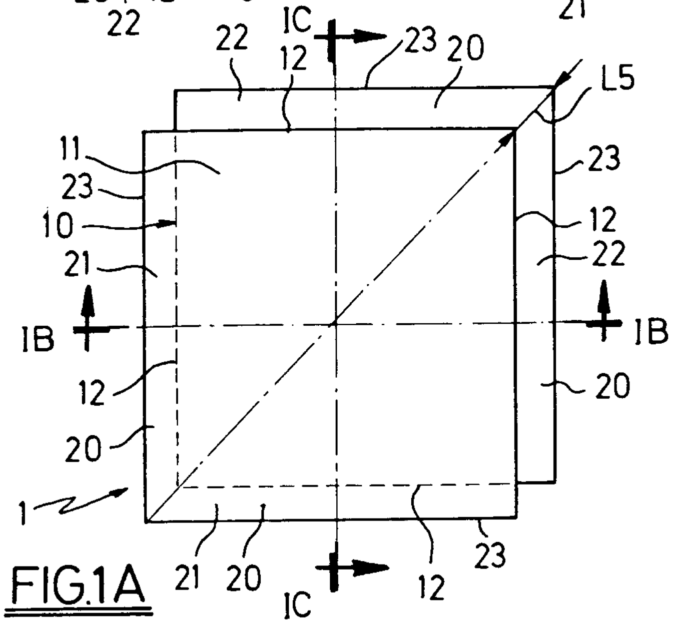


FIG.1A

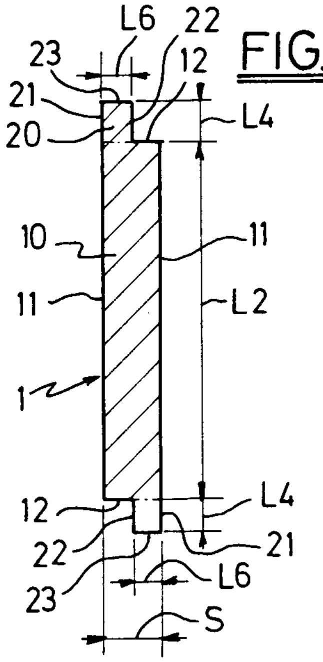


FIG.1C

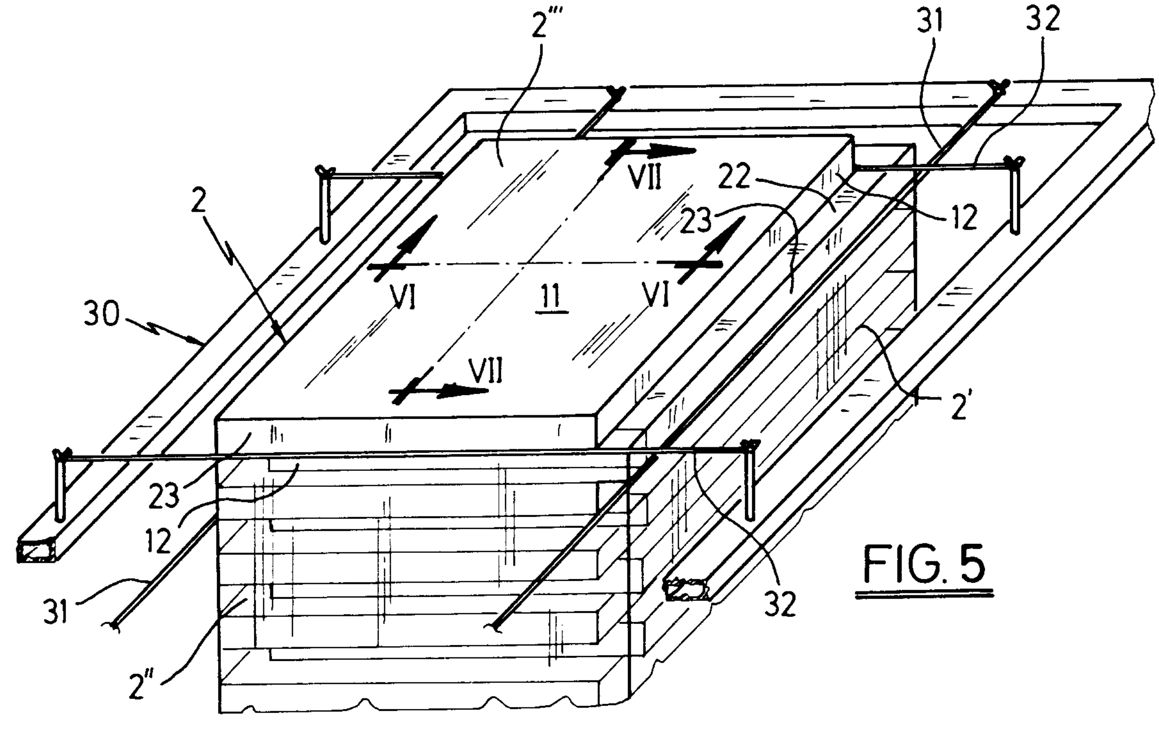
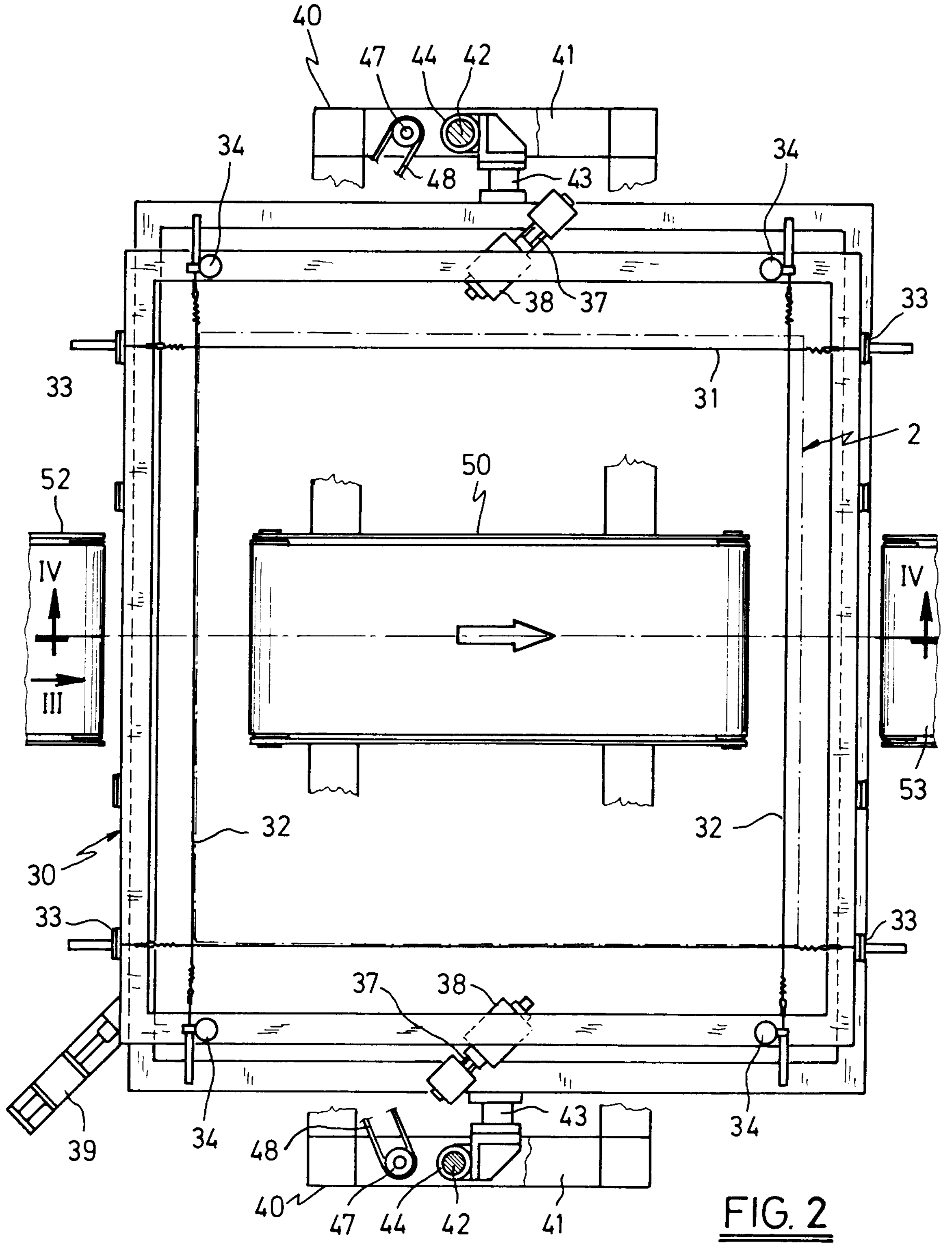


FIG. 5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38
37
33
33
31
2
50
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IV
III
IV
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FIG. 2

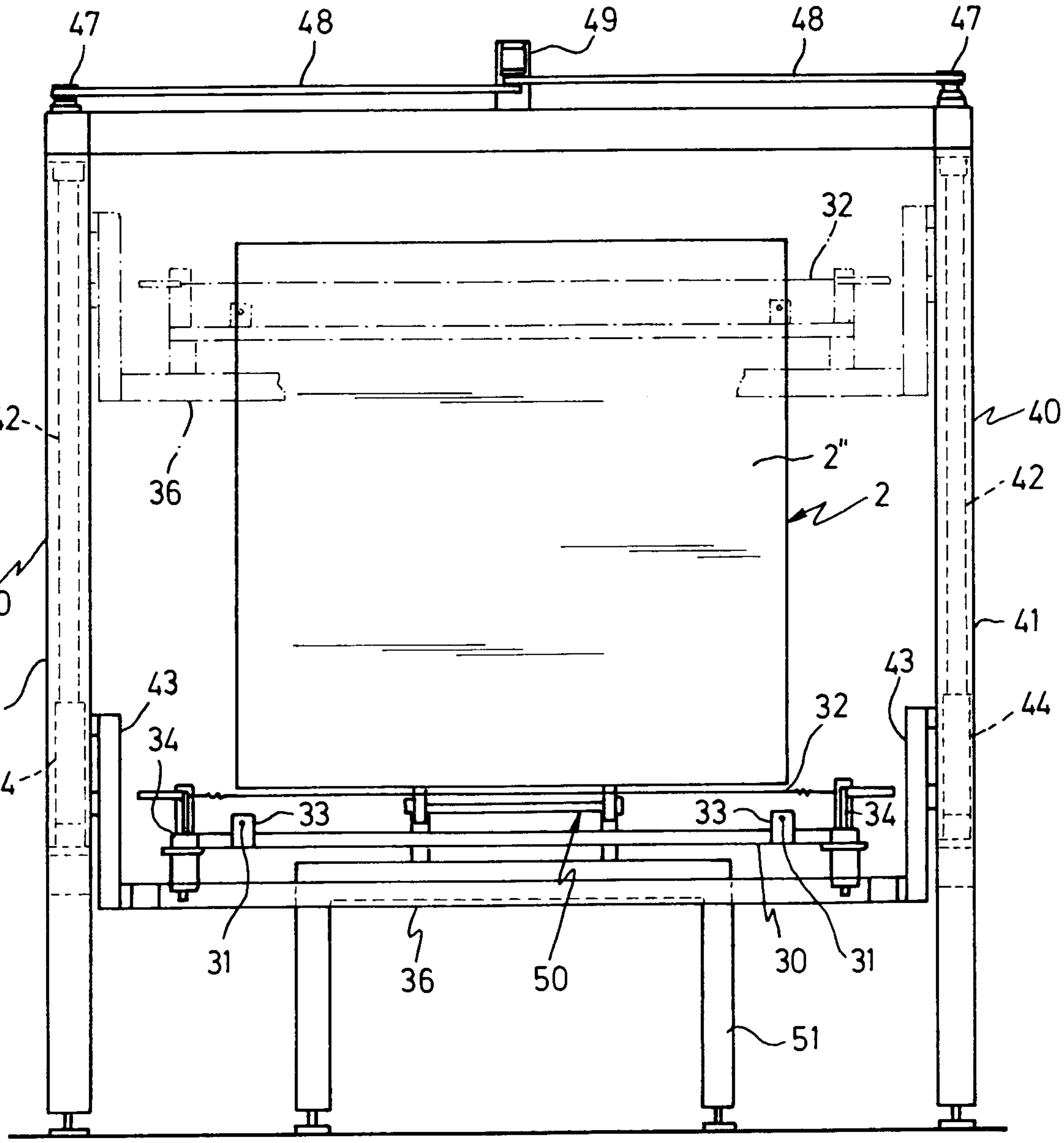
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FIG. 3

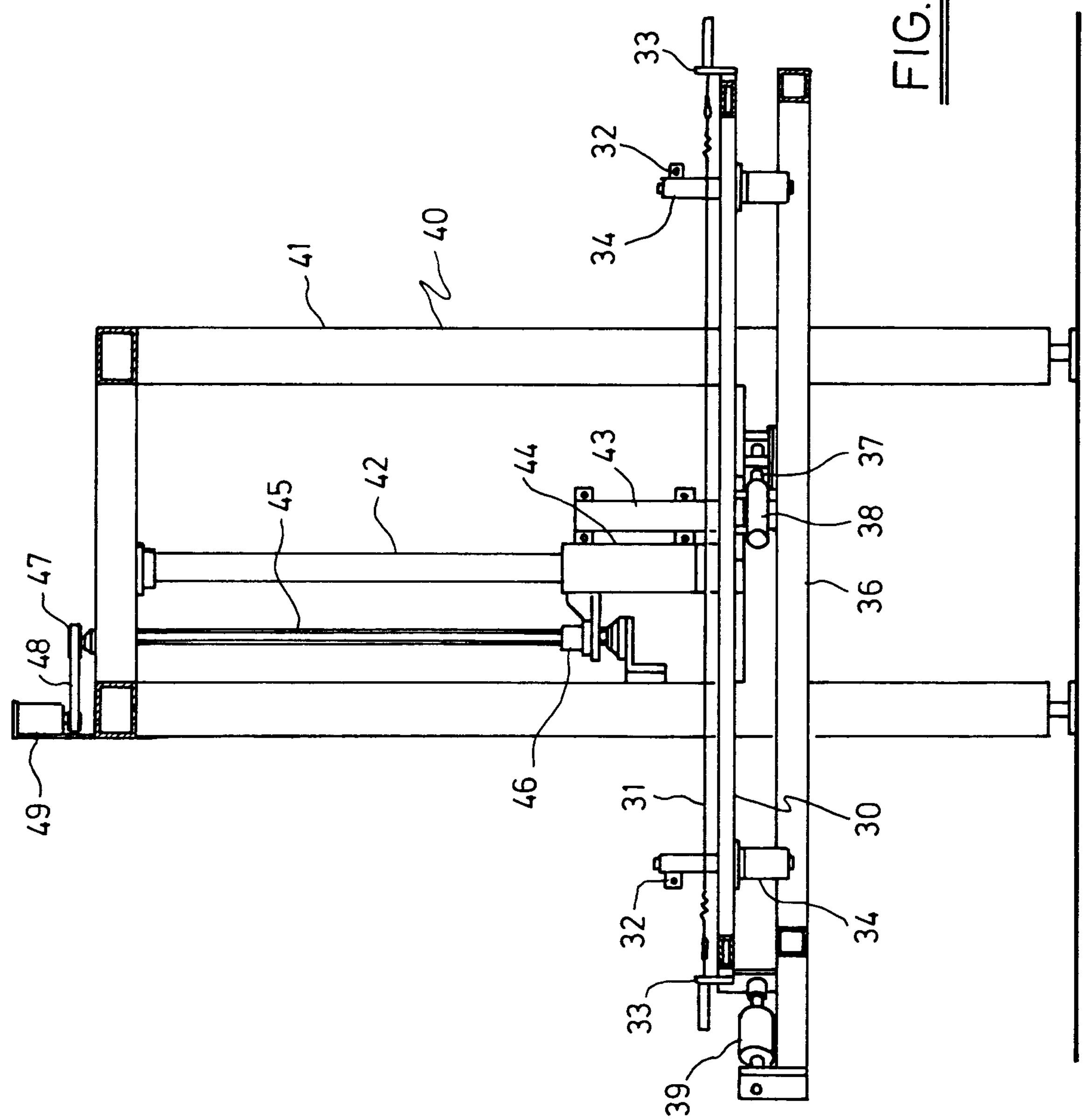

FIG. 4

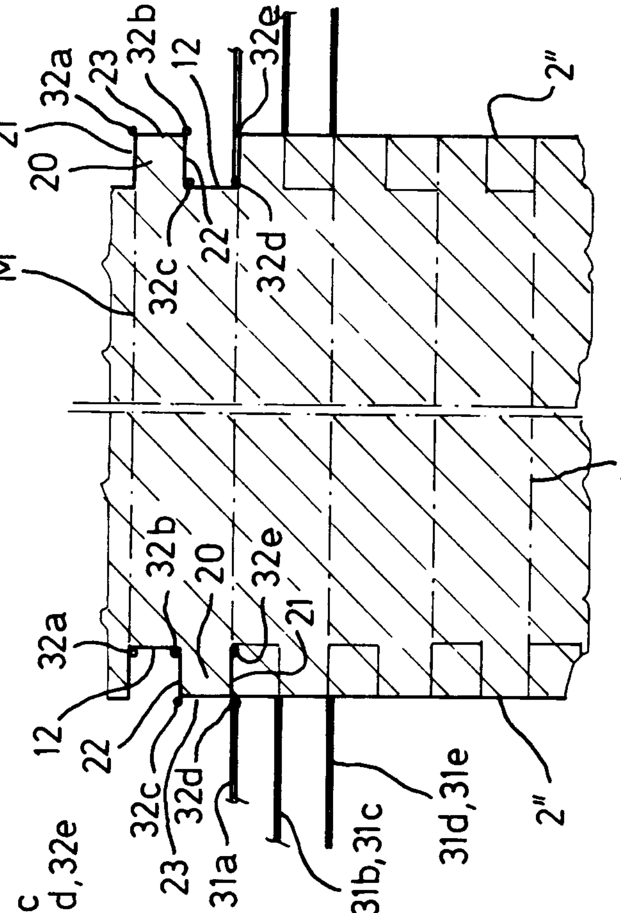
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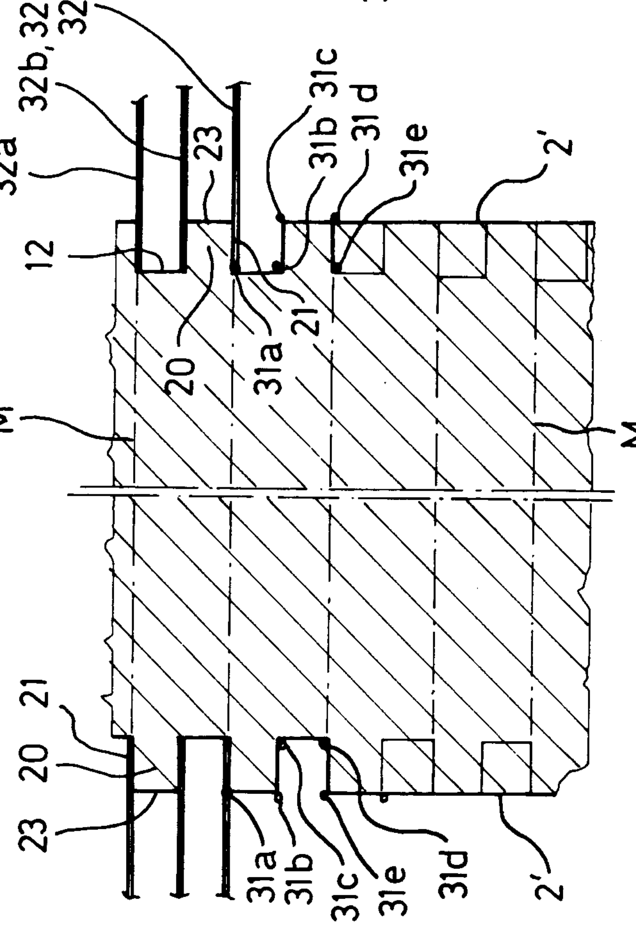
FIG.7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31d
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FIG.6

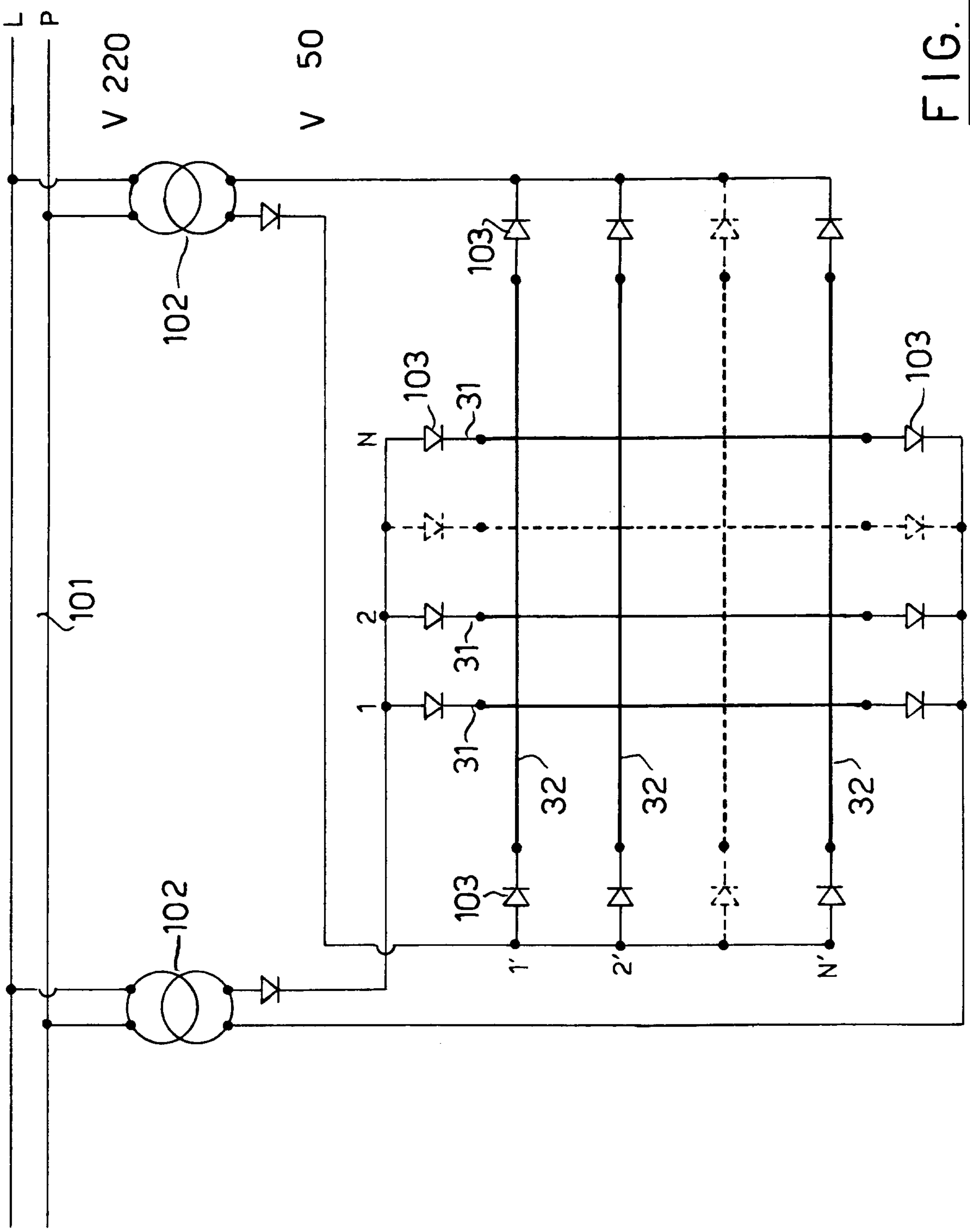

FIG. 8

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 20 2400

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	GB-A-1 145 177 (SWEDISH CRUCIBLE STEEL) * page 3, line 67 - line 114; figures 1,2 *	1	B26D1/00
A	US-A-4 164 160 (J-O. JOHANSSON) * column 3, line 37 - line 42; claim 1; figures 1-3 *	1,5	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B26D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30 MARCH 1993	VIBERG S.O.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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P : intermediate document

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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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& : member of the same patent family, corresponding document