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(71) Applicant: Gebr. van Dijk B.V.
Industrieweg 66
NL-5422 VK Gemert(NL)

(72) Inventor: Van Dijk, Hendricus Johannes Maria
Gebr.Van Dijk B.V. Doonheide 18
NL-5421 ZP Gemert(NL)

(74) Representative: de Boer, Hindrik Geert Jan et al,
De Boer & Wigman De Lairessestraat 133
NL-1075 HJ Amsterdam(NL)

(54) Process and apparatus for contour-cutting.

(57) Process and apparatus for contour-cutting of a number of uniform plastic products from a block of starting material (30), using a plurality of longitudinally oscillating filaments disposed in parallel to one another in one plane on two parallel supports (10) and heated by an electric current, in which the supports (10) with the filaments are moved in a direction perpendicular to the plane thereof, whilst a relative movement of the block of starting material (30) and of the supports (10) with the electric filaments is effected in a direction parallel to the plane of and at right angles to the filaments, in which in contour-cutting only the supports (10) with the filaments are moved in the direction parallel to the plane thereof and perpendicular to the filaments, whereas the block of starting material (30) is maintained stationary.

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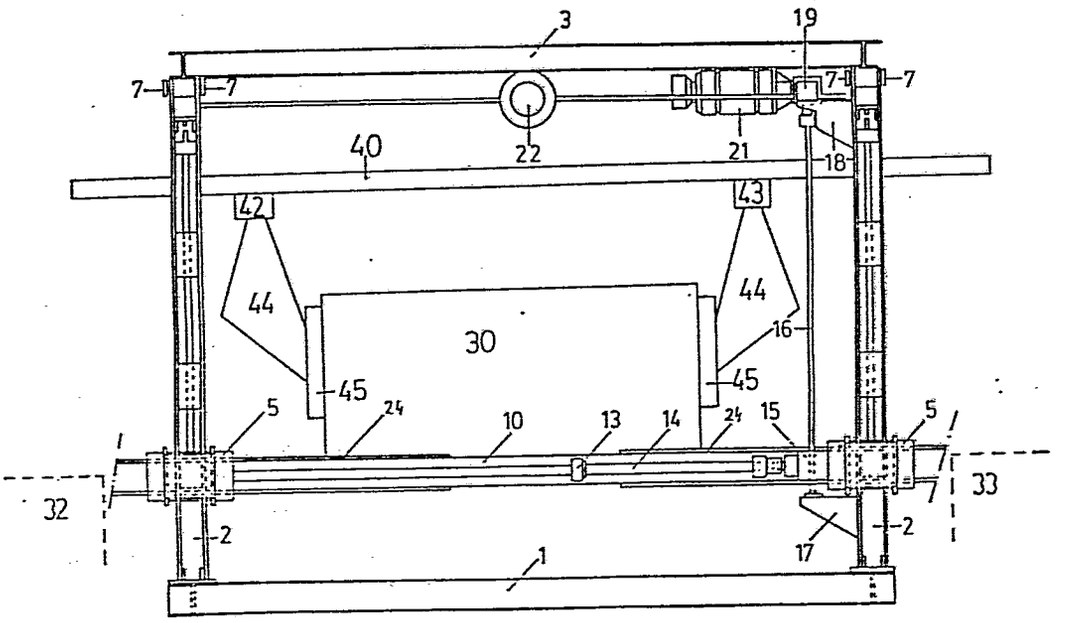
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Fig.1

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Gebrs. Van Dijk B.V., Gemert, The Netherlands

PROCESS AND APPARATUS FOR CONTOUR-CUTTING

The invention relates to a process for contour-cutting of a number of uniform plastic products from a block of starting material, using a plurality of longitudinally oscillating filaments disposed in parallel to one another in one plane on two parallel supports and heated by an electric current, in which the supports with the filaments are moved in a direction perpendicular to the plane thereof, whilst a relative movement of the block of starting material and of the supports with the electric filaments is effected in a direction parallel to the plane of and at right angles to the filaments, as well as to apparatus usable for such a process.

From the European patent application no. EP 0097.992 previously filed by the same applicant, a process and a contour-cutting device are known in which a U-shaped framework with a plurality of filaments disposed in parallel to one another performs a cutting movement going vertically up and down, whilst the block of starting material which is lying on the work table makes a horizontal reciprocating movement. In that set-up the vertical and the horizontal movements are mechanically independent inter se because of the use of separate drives. The number of possible contour configurations is thereby greatly enhanced.

A disadvantage of this apparatus is, however, that after the cutting the formed products in many cases have altogether lost mutual adhesion and cannot be withdrawn together. Removal and preparation for packing requires manual labour and a good deal of time, thereby causing a

rise in production costs and long periods of idling of the apparatus. In addition, there is the danger that a cut-out product becomes dislodged and wedged between the various parts of the apparatus. Yet another disadvantage is the fact that before the start of the cutting operation the position of the work table must first be calibrated.

Should the guiding tracks of the work table become fouled with adventitious matter of exhibit wear or some other damage, the work table may make an undesirable vertical movement, for instance when a carrier wheel passes over the affected spot. Such undesirable vertical movements are very detrimental to the reproducibility of the cut contour shapes. Furthermore, a continuously reciprocating work table exposes the operating personnel to an additional risk of being caught.

It is an object of the present invention to provide an improved process of the type specified in the introduction and an apparatus to be used for the application of such a process. To this end, it is proposed according to the invention for a process of the type specified in the introduction that in contour-cutting only the supports with the filaments should be moved in the direction parallel to the plane thereof and perpendicular to the filaments, whereas the block of starting material should be maintained stationary.

Inasmuch as the block of starting material is held stationary during the cutting and only the filaments perform a programmed movement in two directions, a very precise shape of the workpiece is realized, whilst even very intricate patterns can be imparted.

An apparatus for the application of the process, which comprises a work table and means of conveyance for the supply and support of a block of starting material, a number of substantially vertical columns, beam sections which can be moved vertically up and down along the vertical columns, supports connected to the movable beam sections between which a plurality of filaments have been mounted in parallel to one another for the cutting of the material, a drive mechanism for the displacement of the beam sections and associated supports in a vertical direction along the columns, drives for a relative horizontal displacement of the block of starting material to be cut relative to the supports with filaments, whilst means have been provided for a co-ordinated performance of the two movements according to a predetermined programme, known as such from the aforementioned European patent application no. EP 0097.992 in the name of the same applicant, is designed according to the invention such that the supports with filaments are movable in the plane of the filaments and at right angles to the filaments relative to the beam sections, whilst the supports consist of two parallel support sections which are exclusively connected together by means of the filaments and each of the support sections is connected in such a fashion to a beam section which can be moved vertically along a column as to permit transfer of all forces in the horizonal plane to the column. As the support sections are only connected together by the filaments, blocks of starting material of indefinite length can be processed.

Preferably, use is made of four vertical columns disposed round the work table in a rectangle and supporting four beam sections, each of the columns being provided with a

mutually synchronous drive for the vertical displacement of the beam sections supported by the columns, whilst according to the invention the beam sections are equipped with guiding means for conducting horizontal movements of the support sections perpendicular to the filaments, which guiding means comprise bearing rollers along which the support sections can be moved by means of the guiding tracks attached thereto, whilst the drive for the horizontal displacement of the support sections consists of at least one drive mechanism which has been mounted at some distance from the beam sections such that the movement is transmitted to the beam sections and the support sections by means of one or more keyed shafts, a gear-wheel transmission and a worm-shaft and nut construction.

In an apparatus designed on such lines, the drives may be mounted in the most appropriate or least awkward position, for instance either underneath the work table or at the top of the columns, or even at the sides of the columns, at all events in such a way as to cause virtually no hindrance in the transport of the starting material and the resultant products.

In a preferred embodiment, a clamping member is used for gripping the ends of a block of starting material and the products cut therefrom on the work table during the cutting. The said clamping member may, in addition, be designed for the supply in the longitudinal direction of the block of starting material and the discharge in the forward direction of the products cut therefrom.

Other potential clamping means include a clamping bar which presses the block of starting material during the

cutting onto the work table such that the products cannot shift under the influence of the cutting movements, and a clamping member for gripping the long sides of the block of starting material, which member can perform a horizontal movement over the roller conveyor, the cutting device and the conveyor beyond the cutting device, as well as a slight vertical movement in order to lift either the block of starting material or the finished products.

Alternatively, it is possible simply to allow a free passage to the block of starting material or the finished products, that is to say, without any clamping whatever, with a roller conveyor being used for the supply of the block of starting material and a belt conveyor beyond the cutting device for the discharge of the finished products.

To elucidate the invention, some embodiments will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a side view of an embodiment of an apparatus according to the invention;

figure 2 is a plan view of the embodiment according to figure 1;

figure 3 is a front view of the embodiment according to figure 1;

figure 4 shows the detail IV of the embodiment according to figure 3 on an enlarged scale;

figure 5 is a side view of another embodiment according to the invention; and

figure 6 is a side view of a further embodiment according to the invention.

The contour-cutting machine represented in the invention comprises a base frame 1 provided at its four corners with four vertical columns 2. These columns are interconnected at their tops by longitudinal beams 3 and cross-beams 4. It is to be observed that either beams 3 or beams 4 or both types of beam may be omitted, if desired, provided that the drives to be mentioned hereinafter are mounted at some other point.

A beam section 5 has been mounted along each column. This section has the form of a channel bar, the open side of the bar being turned inwards. The beam section 5 can be moved along a column by means of a guide member 6 whose vertical movements are controlled with the aid of a counterweight 8 hanging in balanced suspension from a cable passed over rollers 7. The vertical displacement of each guide member 6 is effected by means of a screwed-spindle and nut construction - not further specified - which has been fitted within or alongside each column 2. The vertical drive may be provided either by separate, synchronously operating motors for each of the columns 1 or through a mechanical link-up of the drives for each of the four columns. Again, no further details are given, because the system has already been described in the aforementioned European patent application no. EP 0097.992.

Inside each U-shaped beam section 5 a support 10 for the filaments has been inserted on both sides of the apparatus. A rocker arm 11 with tension bars 12 has been attached to each support 10. These tension bars are connected on both sides by filaments with springs, which are not represented in detail, having also been described in the aforementioned European patent application. A shaft for the supply of cooling air, not represented either, may also be present. Each support 10 extends on both sides beyond two columns, and is provided with a retaining nut 13 which engages with a threaded rod 14. As appears most clearly from figure 1, each threaded rod 14 is journalled on a beam section 5. One of these beam sections is invariably provided with a right-angled transmission 15 through which a splined shaft 16 extends. The bottom end of this shaft 16 is supported on a bracket 17 fixed to a column 2 and its top end on a second bracket 18 fixed to the same column, on which a right-angled transmission 19 has been mounted. The right-angled transmissions on both sides are connected to a motor 21 by means of sectional shafts 20. By the action of the motor 21 it will therefore be possible for the supports 10 to undergo a programmed reciprocating movement at all times through the said shafts and the retaining nut 13. It is to be observed that, if desired, each of these two shafts may itself be provided with a mutually synchronous motor, placed for instance on the associated beam section.

An electric motor 22 is connected through shafts to the columns in order to effect the vertical displacement of the sections 5 with guide members 6 along each column. Obviously, it is again possible to use separate, synchronously operating motors for each of the columns.

As appears most clearly from figure 4, the support 10 is invariably journalled in two beam sections 5 in such a way as to be horizontally movable. Within these beam sections, a number of bearing rollers 23 have been mounted against which the support rests by means of guiding tracks 24. Obviously, it is also possible to attach the rollers 23 as pivoting wheels to the support 10 and make them move along corresponding tracks provided in the beam sections 5.

It is to be observed that the two supports 10 are only connected together by means of the filaments. In consequence, there are no fixed cross connections between these two supports, so that besides the filaments themselves either clamping members or adjacent blocks of starting material may be present in the passage of the plastic material to be cut which have no adverse effect whatever on the proper operation of the contour-cutting apparatus. As is depicted in the figures 1 and 3, a block of starting material 30 rests on a work table 31, whilst dashed lines represent a supply conveyor 32 and a discharge conveyor 33. In addition, however, an effective operation is attained by the introduction of a couple of guiding tracks 40 and 41 in the upper part of the apparatus. Each of these guiding tracks may support a travelling crab 42 and 43, respectively, intended to exert pressure on a block of starting material by means of a suspended arm 44 and clamping plate 45. With such a configuration, it is not strictly necessary to employ a work table 31 and supply and discharge conveyors 32 and 33, so that the filaments of the cutting device themselves can be displaced to a position underneath the block of starting material. Thereupon a block of starting material can both be supplied and, after cutting of the

separate products, be discharged without experiencing any hindrance from the filaments.

Figures 5 and 6 show other possible ways of clamping designed to hold the block and the wholly or partially finished products in position during the cutting. The clamping means depicted in figure 5 consists of a bar 46 which presses the block onto the work table 31. In the embodiment of figure 6, the clamping means incorporated in the upper part of the apparatus comprise guiding tracks 47 and 48 which support one or more travelling crabs 49, whilst an arm block 50 suspended from a beam 51 is provided with two arms 52 which grip the long sides of the block of starting material or the wholly or partially finished products by means of clamping plates 53. This clamping system, which somewhat resembles the one shown in figures 1 and 3, is likewise capable of performing a horizontal movement over the roller conveyor, the cutting device and the conveyor beyond the cutting device, whilst this clamping member can also make a slight vertical movement in order to lift either the block of starting material or the finished products.

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Gebrs. Van Dijk B.V., Gemert, The Netherlands

CLAIMS

1. A process for contour-cutting of a number of uniform plastic products from a block of starting material, using a plurality of longitudinally oscillating filaments disposed in parallel to one another in one plane on two parallel supports and heated by an electric current, in which the supports with the filaments are moved in a direction perpendicular to the plane thereof, whilst a relative movement of the block of starting material and of the supports with the electric filaments is effected in a direction parallel to the plane of and at right angles to the filaments, characterized in that in contour-cutting only the supports with the filaments are moved in the direction parallel to the plane thereof and perpendicular to the filaments, whereas the block of starting material is maintained stationary.

2. Apparatus for the application of the process according to claim 1, which comprises a work table and means of conveyance for the supply and support of a block of starting material, a number of substantially vertical columns, beam sections which can be moved vertically up and down along the vertical columns, supports connected to the movable beam sections between which a plurality of filaments have been mounted in parallel to one another for the cutting of the material, a drive mechanism for the displacement of the beam sections and associated

supports in a vertical direction along the columns, drives for a relative horizontal displacement of the block of starting material to be cut relative to the supports with filaments, whilst means have been provided for a co-ordinated performance of the two movements according to a predetermined programme, characterized in that the supports with filaments are movable in the plane of the filaments and at right angles to the filaments relative to the beam sections, whilst the supports consist of two parallel support sections which are exclusively connected together by means of the filaments and each of the support sections is connected in such a fashion to a beam section which can be moved vertically along a column as to permit transfer of all forces in the horizontal plane to the column.

3. Apparatus according to claim 2, in which the beam sections are supported by four vertical columns disposed round the work table in a rectangle, which columns are each provided with a mutually synchronous drive for the vertical displacement of the beam sections supported by the columns, characterized in that the beam sections are equipped with guiding means for conducting horizontal movements of the support sections perpendicular to the filaments, which guiding means comprise bearing rollers along which the support sections can be moved by means of the guiding tracks attached thereto, whilst the drive for the horizontal displacement of the support sections consists of at least one drive mechanism which has been mounted at some distance from the beam sections such that the movement is transmitted to the beam sections and the support sections by

means of one or more keyed shafts, a gear-wheel transmission and a worm-shaft and nut construction.

4. Apparatus according to either one of claims 2 and 3, characterized in that a clamping member is incorporated for gripping the ends of a block of starting material and the products cut therefrom on the work table during the cutting.

5. Apparatus according to either one of claims 2 and 3, characterized in that a clamping member is incorporated, consisting of a clamping bar which presses the block of starting material during the cutting onto the work table such that the products cannot shift under the influence of the cutting movements.

6. Apparatus according to either one of claims 2 and 3, characterized in that a clamping member is incorporated for gripping the long sides of the block of starting material and the wholly or partially finished products during the cutting.

7. Apparatus according to either one of claims 4 and 6, characterized in that the clamping member is also adapted to perform a horizontal movement over the gravity roller conveyor, the cutting device and the conveyor beyond the cutting device for the supply in the longitudinal direction of the block of starting material and the discharge in the forward direction of the products cut therefrom.

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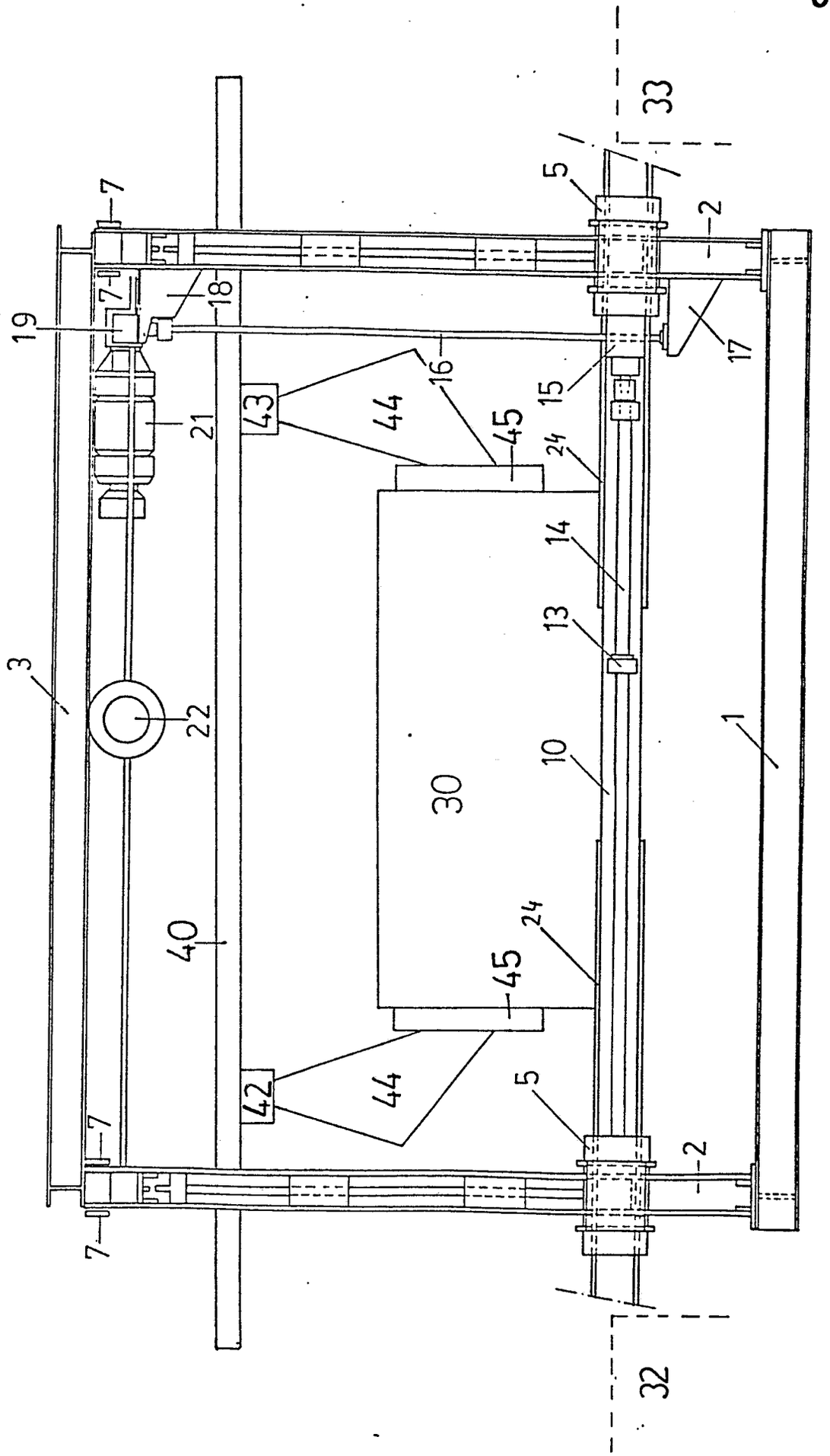

Fig.1

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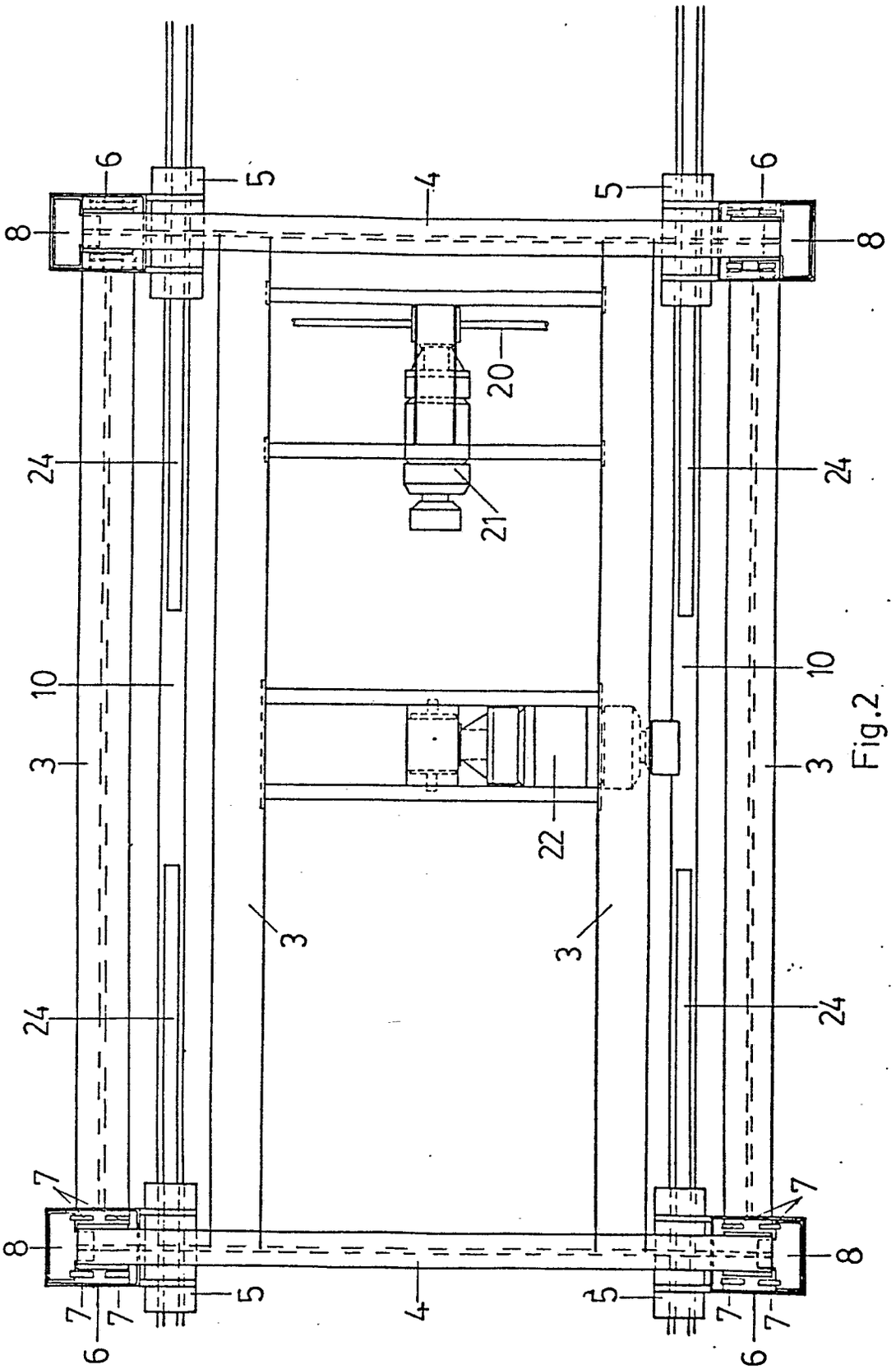

Fig.2

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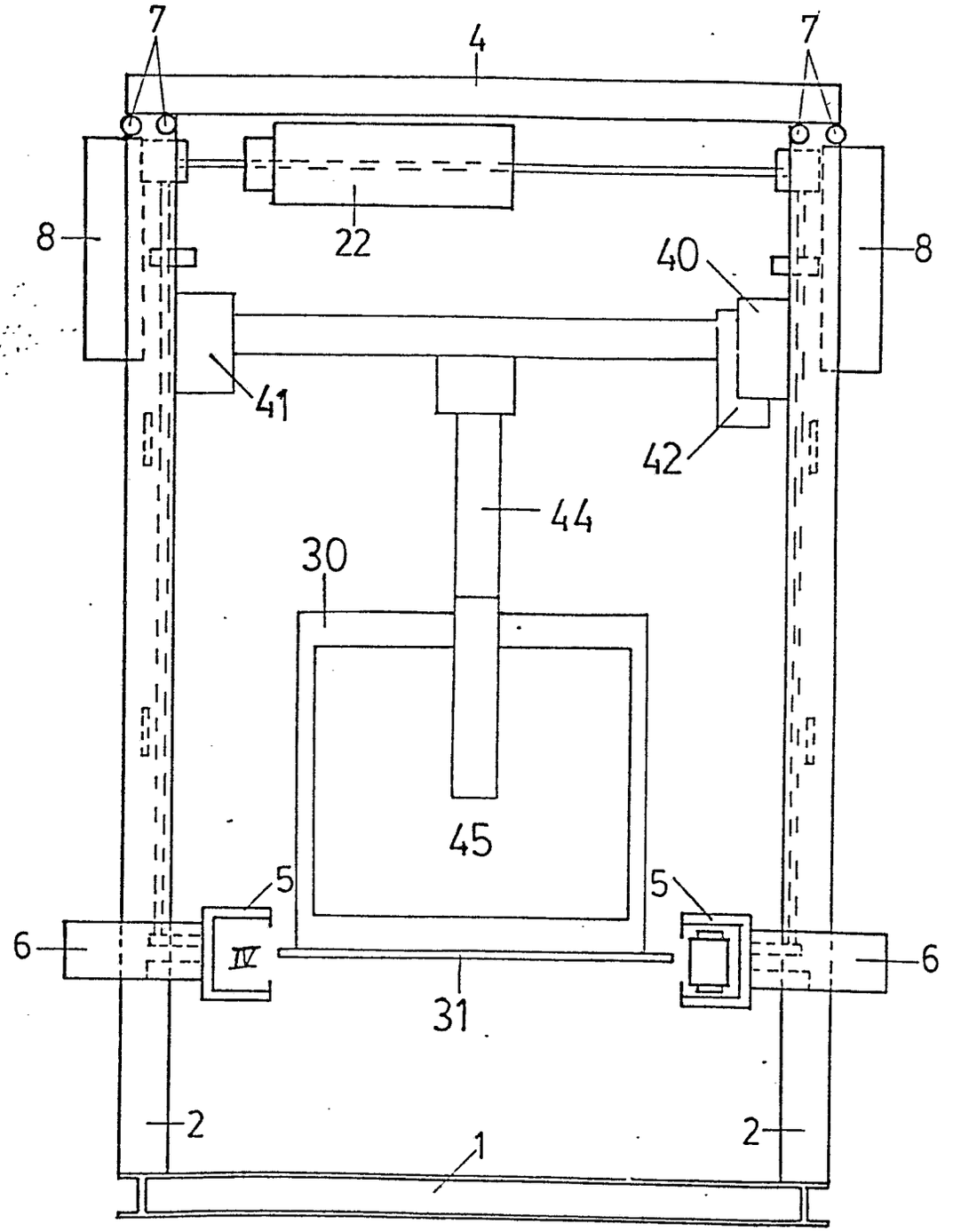

Fig.3

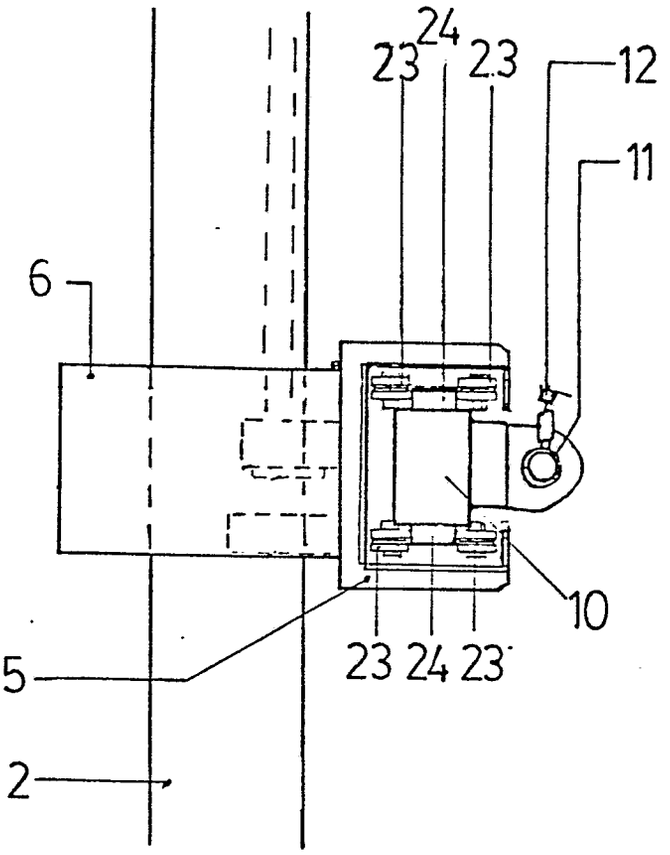

Fig. 4

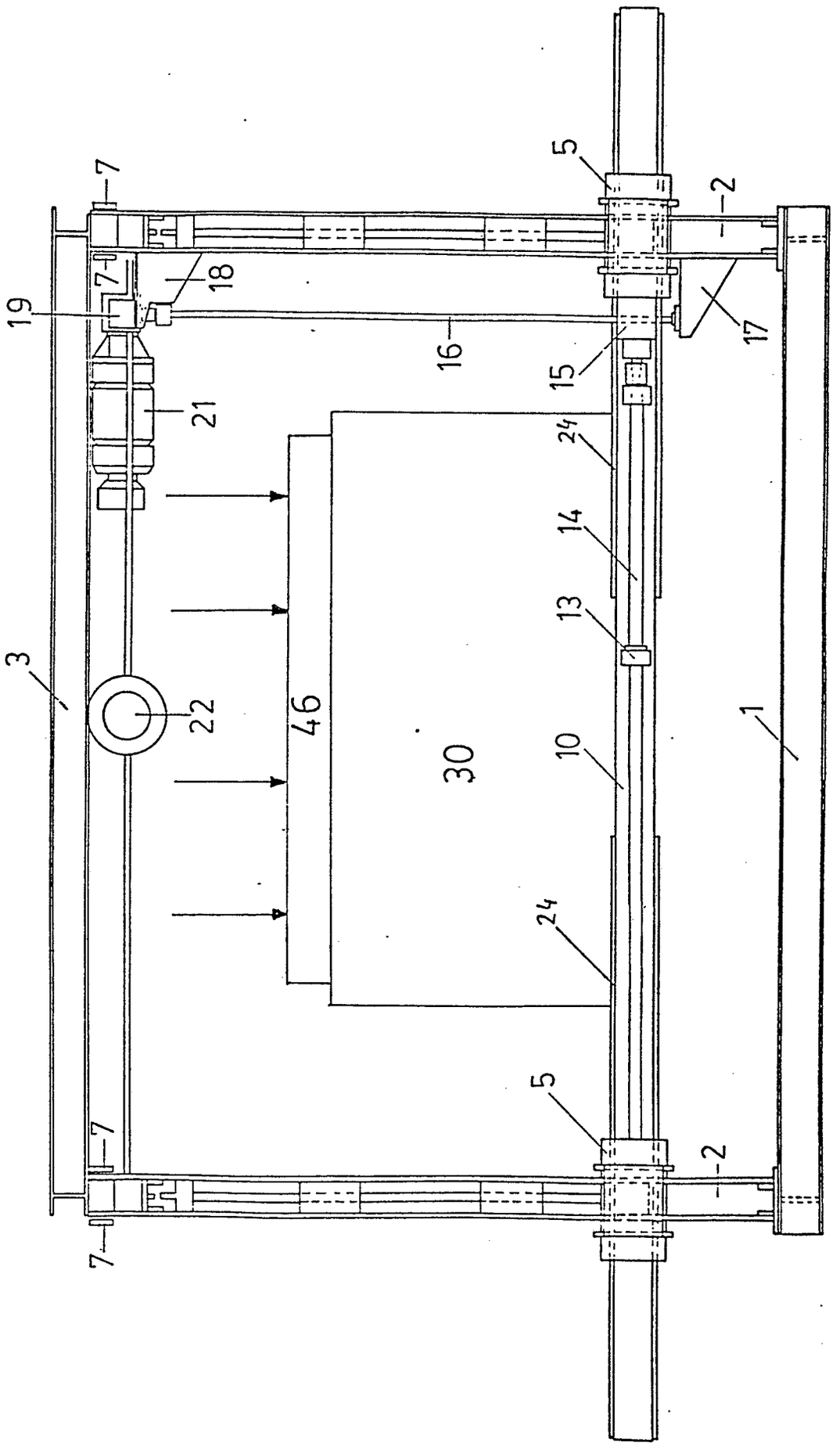

Fig. 5

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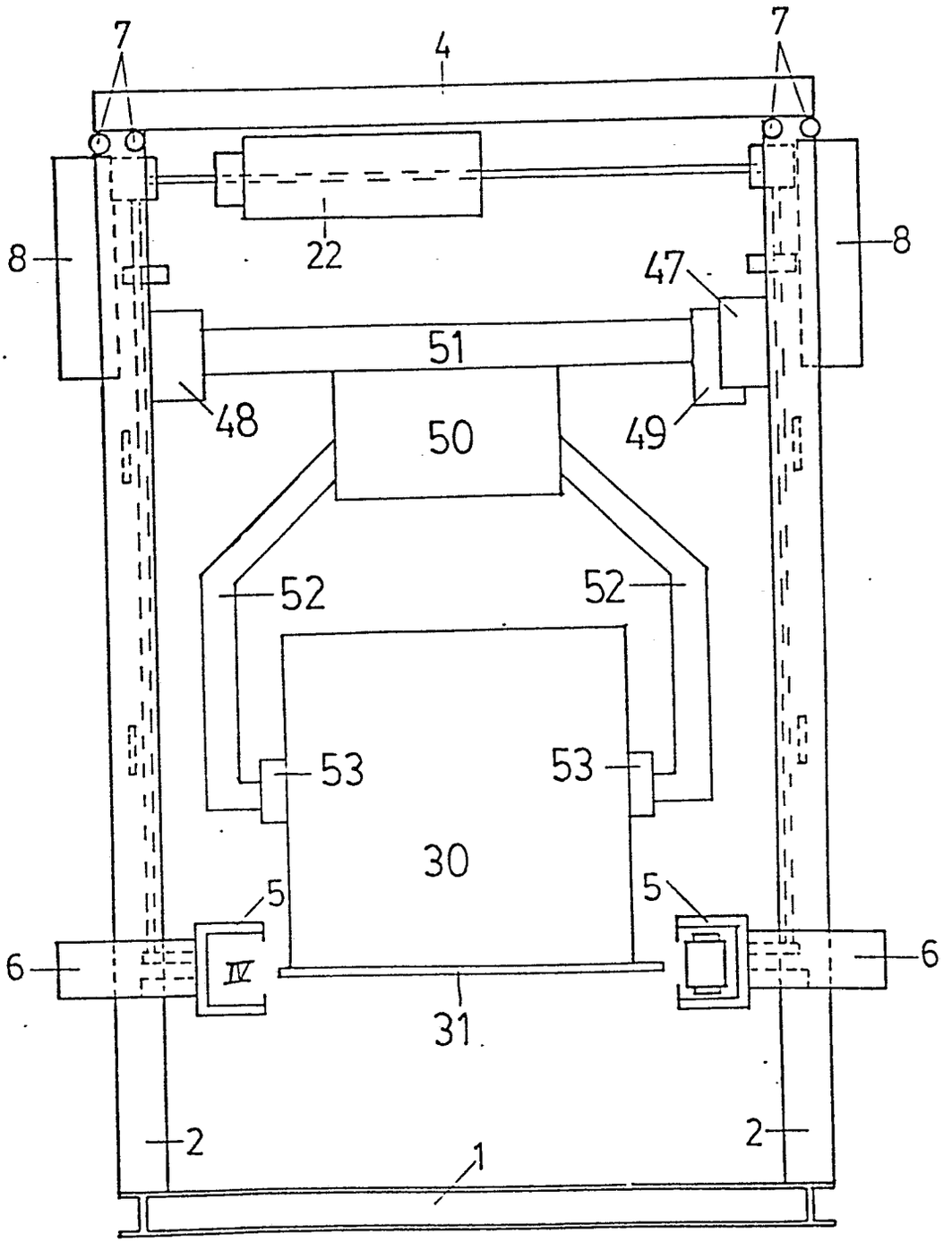

Fig. 6

European Patent Office

EUROPEAN SEARCH REPORT

0195470
Application number

EP 86 20 0281

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 4)
X	NL-A-7 208 952 (VISSER) * Whole document *	1,2,4, 5	B 26 F 3/12 // B 26 D 1/553
X	US-A-4 175 455 (J. GENIS) * Whole document *	1,3	
D,A	EP-A-0 097 992 (VAN DIJK)		
A	US-A-3 350 968 (MELANDER)		
A	DE-A-2 156 687 (POTTMANN)		TECHNICAL FIELDS SEARCHED (Int Cl 4)
A	EP-A-0 035 852 (KING)		B 29 H B 26 F B 26 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19-06-1986	BERGHMANS H.F.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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O : non-written disclosure
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
L : document cited for other reasons

& : member of the same patent family, corresponding document