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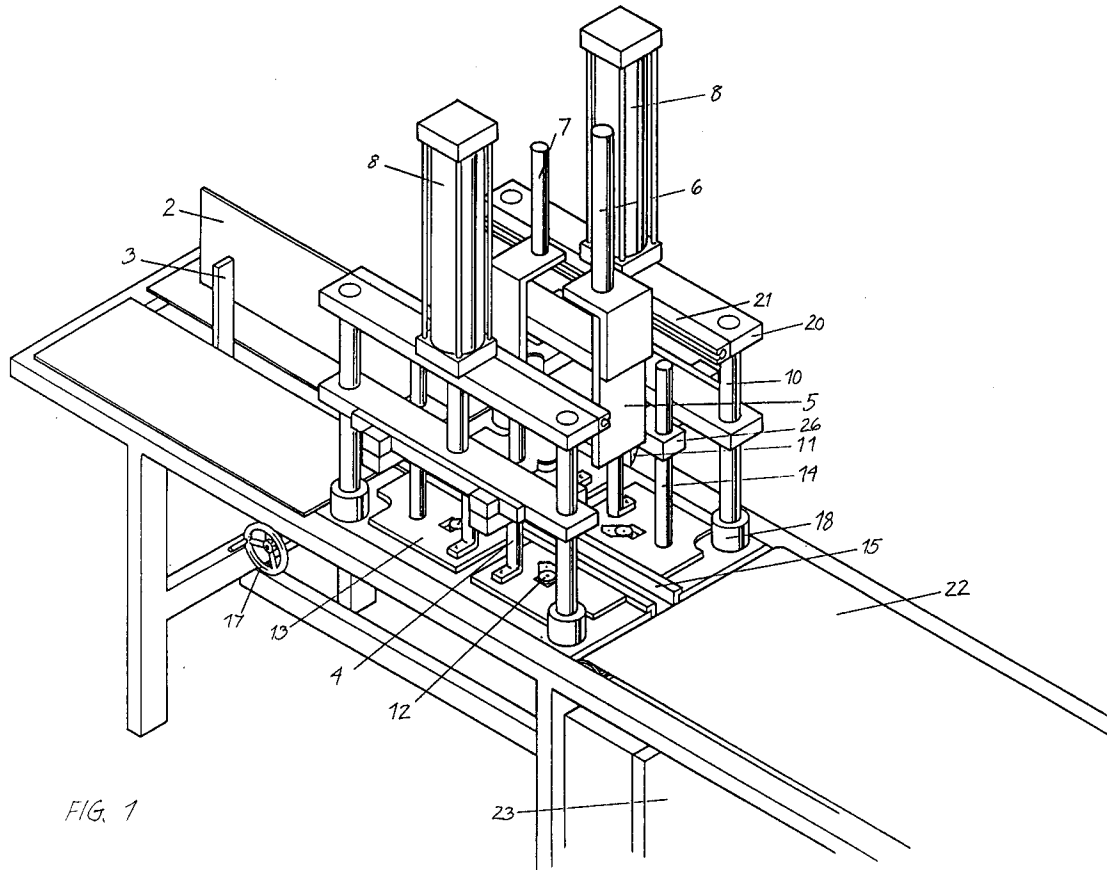
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(54) **Method and machine for cutting corners off sheet material.**

(57) In a method and a cutting machine according to the invention a pile (1) of sheets can be placed on a feeding plane and then carried into a given position in the cutting machine, wherein a pressing foot (7) secures the pile (1) while four cutting knives (11) are pressed down through the corners (24) of the pile against lower knives (12), which ensures a high cutting capacity and a perfect cutting result, the cutting being uniform in the entire height of the pile (1).

The machine may be built up with an adjustable part to the effect that the machine can cut in different widths of sheet, and the individual knives (11, 12) may be adjustable for different lengths of sheet. A universal machine is thus provided, which is easily and quickly adjusted for different formats, in addition to which it is easily operated since the pile (1) can be inserted, cut and removed through the machine in a continuous procedure.

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Prior art technique

The invention relates to a method of cutting off corners of material in the form of a sheet, especially material of cardboard, paper, fabric, plastic, metal foil and combinations of such materials, wherein the sheets are cut into preferably identical rectangular sizes and then arranged to form a pile, which is placed in a cutting machine with knives, which are pressed down, thereby cutting off the corners of the pile, and a cutting apparatus for the implementation of the method.

An application example of material in the form of a sheet, e.g. of metalfoil coated cardboard with cut off corners is a base for food articles, such as sliced fish or meat, which is subsequently wrapped into a transparent plastic film to form a sales package.

The rounded corners provide a pleasant impression of the appearance of the package, and at the same time the rounded corners protect against damage to the plastic film, in particular where the film is shrinked onto the package.

Furthermore, the rounded corners are used as a natural shape for e.g. playing cards and other cards, which should be easy to handle, and where sharp corners would be uncomfortable.

Finally, books might be mentioned, including telephone books and other directories, where sharp corners would be worn or bent while rounded corners provide an ideal shape for the pages.

Such rounded corners are normally produced in a cutting machine. An example of a machine of this type is known from DE Printed Specification no. 1.268.588, which relates to a machine capable of rounding off all four corners in one operation. This is accomplished by means of four knives, which are moved down simultaneously, thereby cutting off the corners of rectangular sheets.

This known machine is preadjusted for a specific format size, for instance playing cards. A pile of rectangular cards are positioned in a tray having a lateral guide, and four knives with press rams are then moved downwards, cutting off the four corners.

After completion of the cutting operation the knives and the press rams are raised, whereupon the ready-cut cards can be removed from the tray, and a new pile placed into position.

The cutting procedure is accomplished alone by means of four movably mounted knives which sets a limit to the height of the pile and thus the cutting capacity of the machine, because the cutting procedure becomes unprecise and the cuts of inferior quality if the pile gets too high. This drawback is mainly a result of insufficient control of the knives near the processing area.

In view hereof, the machine has limited applicability because it is partly limited for use for particular formats, partly for manual feeding and removal of the pile of sheets, and finally the machine has a cutting capacity, which is limited to a comparatively low pile.

Object of the invention

It is an object of the present invention to remedy the above described drawbacks and limitations of the known methods for cutting corners off a pile of sheets, and this object is achieved by placing the pile on a feeding plane, which pile rests with one lateral face against a longitudinal guide, whereupon a transfer device carries the pile along the guide into the cutting machine between lateral guides until the pile abuts on an end stop, whereupon a pressing foot is pressed down and secures the pile while at the same time the cutting knives are moved down through the corners of the pile against lower knives, which are arranged below each corner, the cutting knives as well as the lower knives being shaped to form the finished outline of the corner, whereupon the cutting knives, the end stop and the pressing foot are raised, and the pile can be removed from the cutting machine.

A method of high capacity, which is up to now unknown, is thus provided to the effect that the height of the pile can be up to 500 mm with a perfect cutting result, which is in part due to the combined cutters comprising a cutting knife and a lower knife, ensuring a uniform, cut through the entire pile, and in part due to the pressing foot being pressed down to ensure that the pile is firmly secured during the cutting operation.

In addition to the increased cutting capacity and the perfect cutting result, the task is simplified by the continuity which the machine allows for in that a pile can be fed into the machine, proceed on the same level inside the machine and, after completion of the cutting operation, move out through the opposite end of the machine. The cutting operation can thus be automated, the machine becoming a continuous machine, thereby reducing running costs considerably.

Fast feeding and removal is ensured by letting a new pile push the ready-cut pile out of the machine, as described in claim 2, increasing the productivity of the machine and reducing manual labour in relation to the cutting operation.

By constructing the machine so that the knives are adjustable according to the width as well as the length of the pile, as described in claim 2, it becomes possible to cut different sizes of sheet in one machine, the machine being adjustable by means of a simple adjustment device.

An up to now unknown degree of adaptation in accordance with different sizes of sheets has thus become possible, without compromising the excellent cutting properties of the machine.

By mounting each cutting knife on a knife holder and mounting the holder on a beam or a head, which is slidable on a die set by means of a drive motor, as described in claim 4, perfect control and depression of the knives is guaranteed, in addition to which the distance between the knives is adjustable by regulating the knife holders.

By mounting each lower knife on a holder provided with a control, the cutting knife sliding on the said control, as described in claim 5, a perfect cutting result is guaranteed, including a clean cut and a cut which is gentle on the knives, due to the precise interaction between the cutting knife and the lower knife.

By cutting in a sector of a circle, whereby the lower knife may be formed like a circular disk-shaped knife, which can be rotated when it is worn, as described in claim 6, a considerable reduction of running costs as well as of the number of tool replacements are achieved.

Finally, it is advantageous that the cutting knives are wedge-shaped, as described in claim 7, the extreme pointed ends thus extending like spearheads through the pile. The intermediate and underlying material is hereby compressed during the cutting operation itself, resulting in a precise and clean cut.

The drawing

The invention will be described below with reference to the drawing, wherein

- Fig. 1 illustrates a cutting machine according to the invention without the pile of sheets,
- Fig. 2 illustrates, in a simplified form, a pile of sheets during its feeding into the machine,
- Fig. 3 illustrates the pile having been fed into the machine and with the pressing foot pressed down,
- Fig. 4 illustrates the pile during the cutting operation,
- Fig. 5 illustrates the pile moving out of the machine
- Fig. 6 illustrates details of the cutting knives and how they are controlled,
- Fig. 7 illustrates the cutting knives being pressed down and in the process of cutting,
- Fig. 8 illustrates the shapes of the set of knives, and
- Fig. 9 illustrates the interaction of the set of knives.

Description of an embodiment of the invention

An example of a cutting machine according to the invention is illustrated in Fig. 1.

The machine is built up on a frame with legs, and the transfer and cutting units are built on said frame.

The transfer unit comprises a feeding plane, which is illustrated on the left side of the frame, said plane being provided with a longitudinal guide 2 extending in the direction of transfer of the machine, and is so adjusted that a pile of sheets, which is not illustrated, can be placed on the feeding plane with one lateral face resting against the guide 2.

An arm 3, moved by a drive motor, which is not illustrated, then pushes against the rear edge of the pile, thereby pushing the pile into the cutting unit itself.

The cutting unit is made up of two sections, the distance between which is adjustable according to the width of the pile.

Each section comprises a cylinder 8 provided with a ram press, which is connected to a bridge or a beam 9 being slidable in upwards and downwards direction on a die set 10, which rests on the base of the frame.

At the lower end of the die set are provided distance bushes 18 to restrict the downwards movement.

The drive motor 8 is mounted on a fixed bridge or beam 20, resting against the die set 10.

The distance between the two sections is adjustable by means of a handwheel 17 to the effect that the machine can be adjusted to the desired cutting width of the pile.

Four guides 4 are provided for guiding the pile into the machine, and the pile is placed between these guides. In order to restrict feeding of the pile into the machine and to determine the position of the pile, and end stop 5 is provided, which can be raised or lowered by means of a work motor 6. The position of the end stop is adjustable, its motor 6 with carrier being movably mounted in a track 21 of the top bridge 20 and secured hereto.

When the pile has been positioned in the machine between the guide 4 and the end stop 5, a pressing foot 7 is pressed down by means of a work motor, said pressing foot being formed like a plate, which compresses the pile and secures it firmly during the subsequent procedure.

Finally, the cutting unit itself comprises four cutting knives, each secured to its knife holder 26, which is movably mounted on the bridge 9 of the knife holder. The distance between the cutting knives is thus adjustable according to the length of the pile.

Each set of knives comprises a lower knife 12, which is secured in a holder 13, said holder also carrying a die set 14 for the holder 26 of the cutting knives to the effect that a precise control and thus precise interaction is guaranteed between the individual upper and lower knives of each set of knives.

Each holder 13 is movable between a guide track 15 and a guide portion of the base to the effect that the distance between the sets of knives can be adjusted precisely in the longitudinal direction of the machine.

At the opposite side of the feeding place is mounted a conveyor 22, capable of carrying the ready-cut pile away from the cutting unit.

Finally, a box 23 is mounted on the frame, with the electric controls being built in, to control the individual functions of the machine by means of commonly known hydraulic and/or pneumatic controls for the drive motors.

The method will be described below with reference to Figs. 2-9.

The cutting machine is adjusted according to the current dimension of the pile so that the sets of knives 11, 12 are positioned exactly at the corners 24 of the pile 1, when the pile 1, as illustrated in Fig. 2, is placed in the machine between the guides 4 and the end stop 5, as illustrated in Fig. 3.

In this position the pressing foot 7 is pressed down to the effect that the pile 1 is firmly secured and compressed in the cutting position.

The cylinders 8 are then activated, and the upper knives of the bridges 9 are pressed down through the corners 24 of the pile.

The corners having been cut off, the bridges 9 with the cutting knives 11 are raised, and the pressing foot 7 and the end stop 5 are raised at the same time in order that the pile 1 with its cut off corners can be moved out onto the conveyor 22, as illustrated in Fig. 5.

This is achieved in that the pile 1 is pushed out by means of the transfer device 3 carrying a new pile 1 into the machine for cutting.

The cutting procedure may then be repeated, and corners can be cut off in a continuous, automated process.

In the above described manner it is possible to cut up to 30.000 sheets per hour, by far exceeding the capacity of the machines known up to now.

To achieve a production of such capacity is especially the result of the precise control of the movement of the knives and the design of the set of knives itself.

As illustrated in Fig. 6, the cutting knives 11 are mounted on the holder 26, which is controlled by the die set 14, which for its part is firm with the lower knife 12. The cutting knife 11 is hereby controlled in its entire length of stroke, and a com-

pletely uniform cut of the corners 24 is achieved, the control of which extends in the entire length of cutting.

Fig. 7 illustrates how the pointed edges 25 of the cutting knives 11 keep the sheets of the pile 1 in a fixed position to the effect that the subsequent cutting of the corners 24 is effected in a condition wherein corner material is compressed and under tension as compared to the cutting edge of the cutting knife 11.

As illustrated in Fig. 8, the cutting knives 11 are provided with a notch, which is shaped like a sector of a circle, and since the knives at the same time are wedge-shaped, the pointed end 25 illustrated in Fig. 7 is formed with an intermediate circular edge extending in an arc.

When this edge needs sharpening it can be done by simply grinding the diagonal underside.

The lower edge is illustrated in Figs. 8 and 9. It is configured as a circular disk 27 of essentially the same diameter as the cutting knife 11. A screw 28 secures the disk 27 to the holder 12 so that when the circular edge 27 is worn, the screw 28 can be released, whereupon the knife 27 can be turned by means of a handle with a pin in the holes 29, until a new edge 30 is carried forwards under the cutting knife 11.

By means of this extremely simple design of the set of knives, it is possible to cut precisely and uniformly through a pile of sheets up to a height of 500 mm and without much strain on the cutting edges, whereby the tool life becomes quite high. In addition hereto, the quality of the cutting is high to the effect that the rounding of corners becomes uniform in the entire height of the pile.

Claims

1. The invention relates to a method of cutting off corners of material in the form of a sheet, especially material of cardboard, paper, fabric, plastic, metal foil and combinations of such materials, wherein the sheets are cut into preferably identical rectangular sizes and then arranged to form a pile, which is placed in a cutting machine with knives, which are pressed down, thereby cutting off the corners of the pile, **characterized in** that the pile (1) is placed on a feeding plane resting with one lateral face against a longitudinal guide (2), whereupon a transfer device (3) carries the pile (1) along the guide (2) into the cutting machine between lateral guides (4) until the pile (1) abuts on an end stop (5), whereupon a pressing foot (7) is pressed down and secures the pile (1) while at the same time the cutting knives (11, 12) are moved down through the corners (24) of the pile (1) against lower knives

(12), which are provided under each corner, the cutting knives (11) as well as the lower knives (12) being shaped to form the finished contour/shape of the corner, whereupon the cutting knives (11), the end stop (5) and the pressing foot (7) are raised, and the pile can be removed from the cutting machine. 5

2. Method according to claim 1, **characterized in** that the ready-cut pile (1) is pushed out of the cutting machine by the subsequent pile being fed into the cutting machine. 10

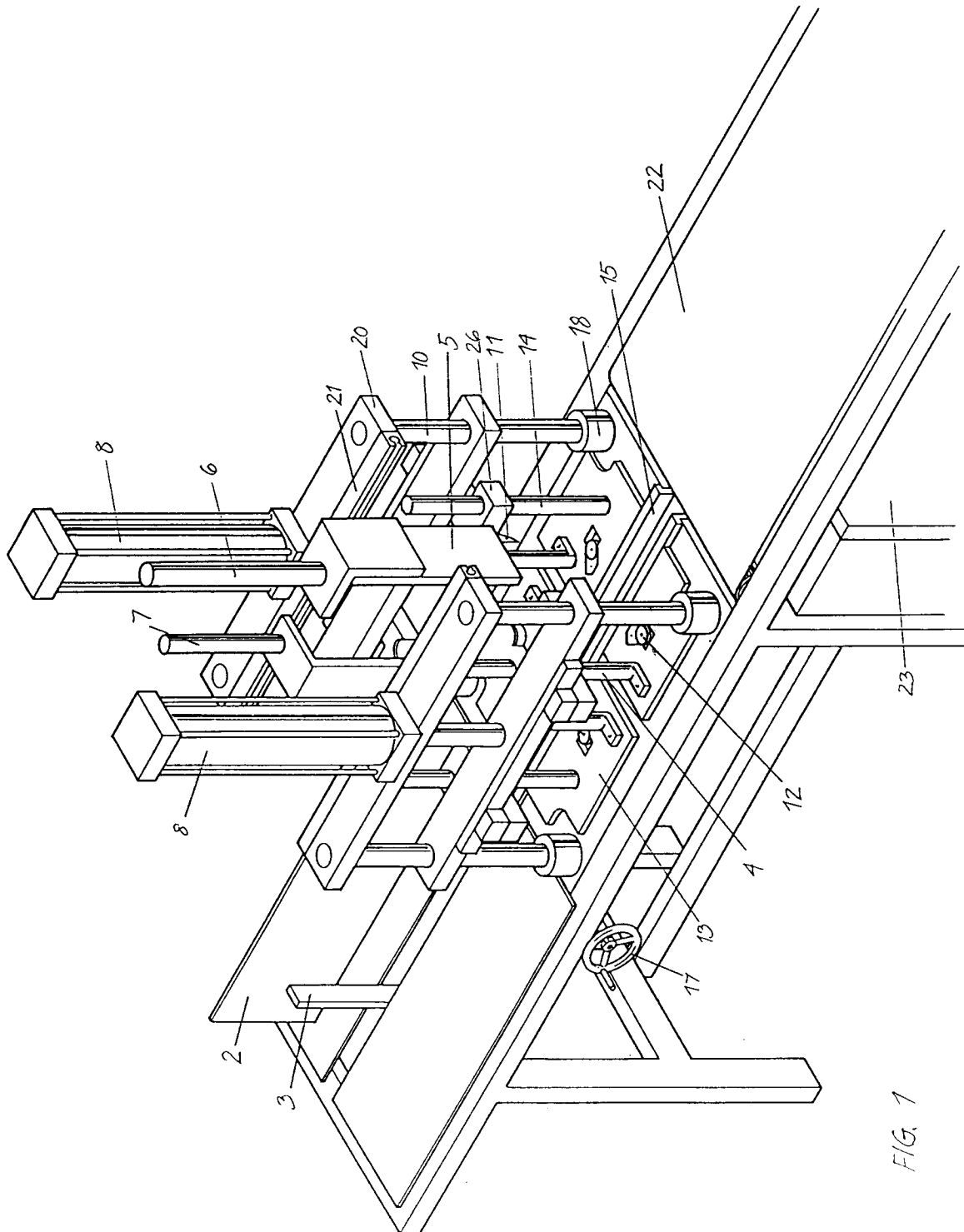
3. Cutting machine for use in the implementation of the method according to claim 1 and 2, **characterized in** that the machine comprises two cutting units (8, 9, 10) each provided with two sets of knives (13, 14, 26) having a cutting knife (11) and a lower knife (12), the distance between the said cutting units being adjustable according to the width of the pile (1), and the distance between the sets of knives of each cutting unit being adjustable according to the length of the pile. 15
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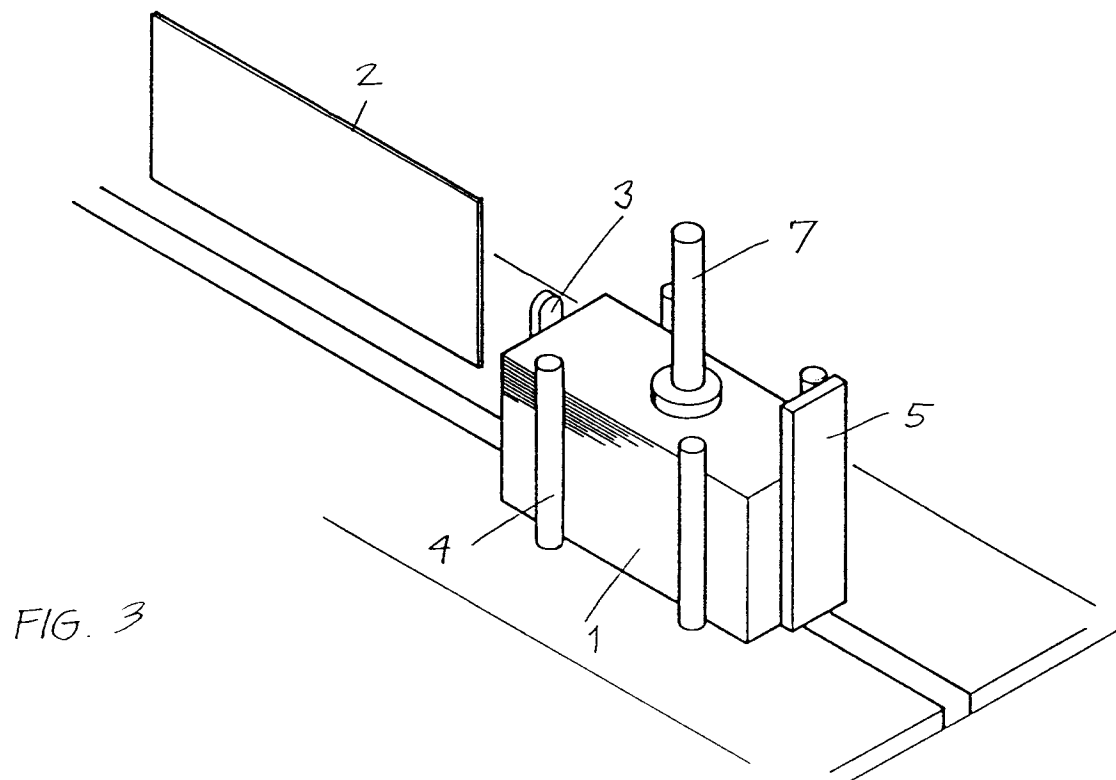
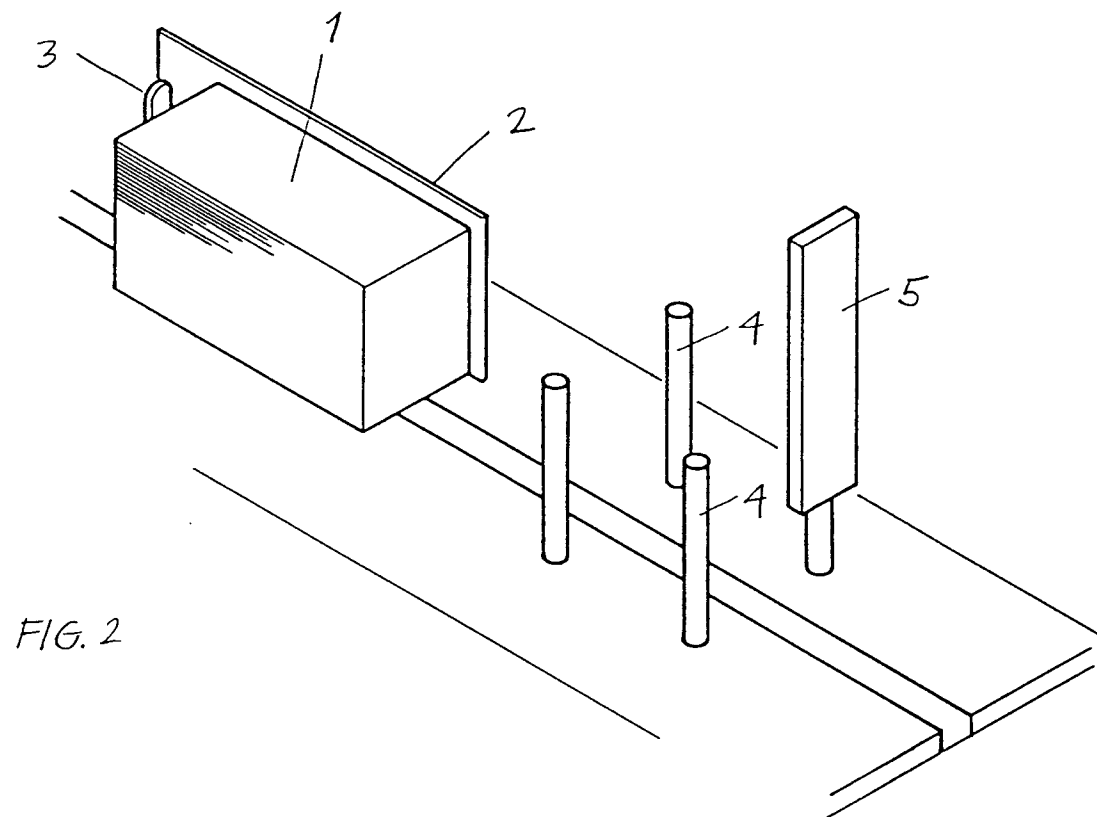
4. Cutting machine according to claim 3, **characterized in** that each cutting knife (11) is mounted on a knife holder (26), which is secured to a beam (9), which can be moved, sliding on a die set (14), by the ram press of a work cylinder (8). 25
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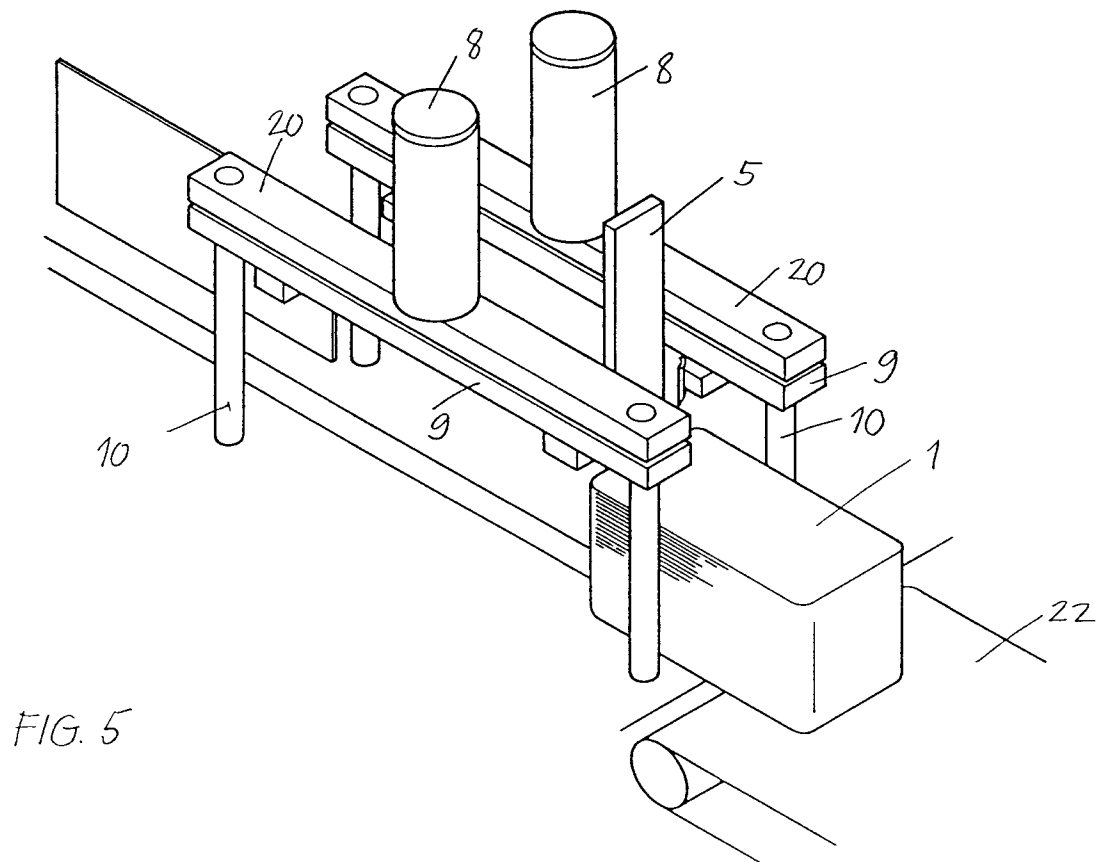
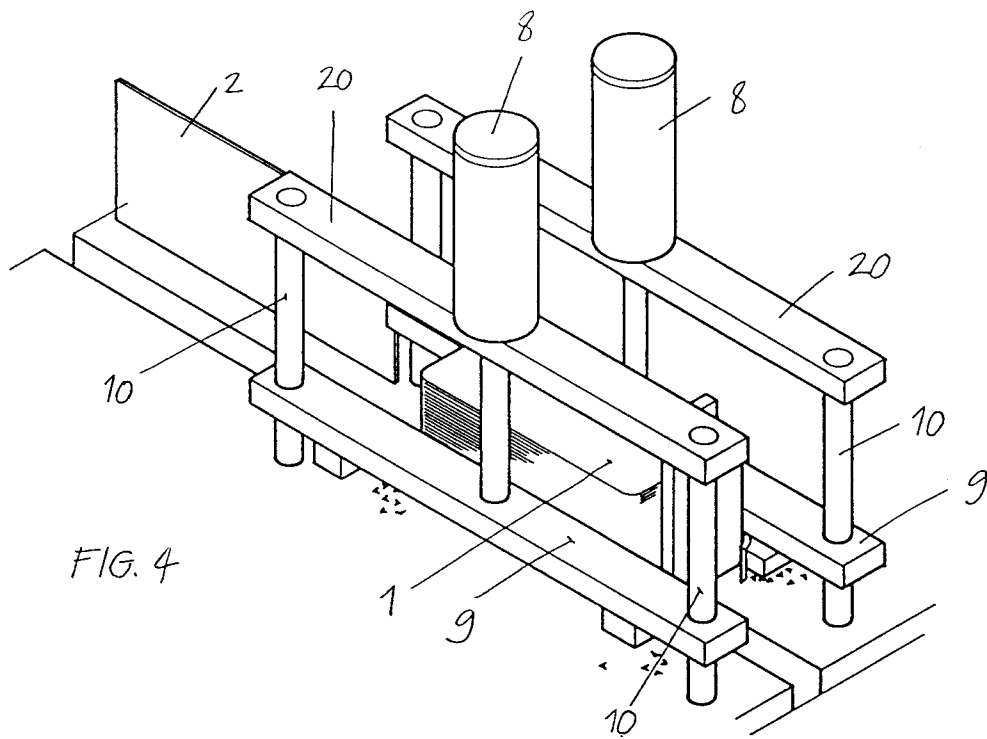
5. Cutting machine according to claim 4, **characterized in** that each lower knife (12) is mounted on a holder (13), which is provided with a vertical control (14) for the holder (26) of the cutting knives. 35

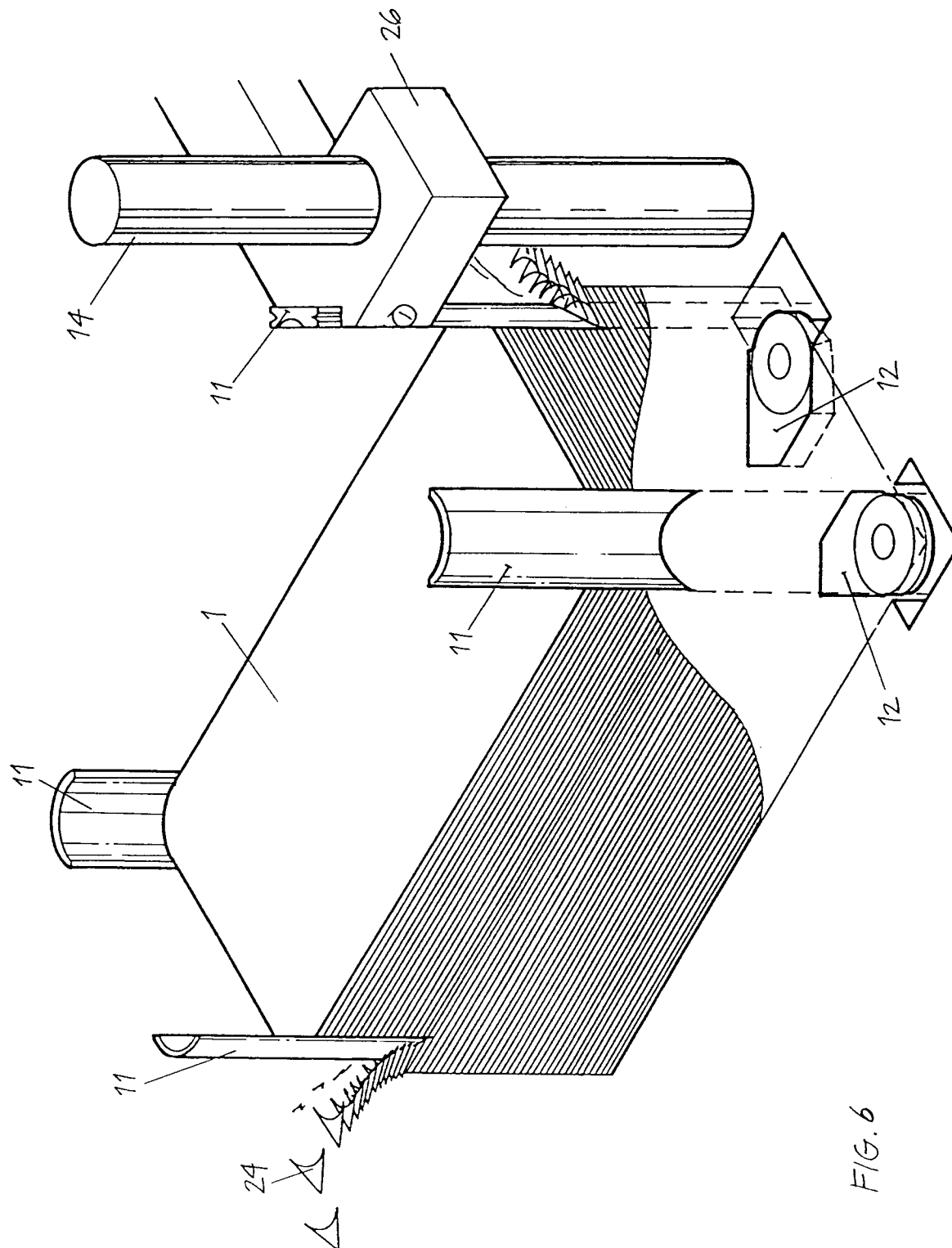
6. Cutting machine according to claim 4 and 5, **characterized in** that the cutting form of the knives (11, 12) is a segment of a circle, and that the lower knife (12) is formed like a disk (27) having a circular edge (30), which can be rotated about its center axis (28) and is secured to its holder (12). 40
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7. Cutting machine according to claims 4-6, **characterized in** that the cutting edges of the knives (11) extend along an upwardly directed arc between the outermost points (24) of the cutting edge of the knives, said cutting knives (11) being tapered to form a wedge, the tips of which are constituted by the lowermost points (25) of the edge. 50
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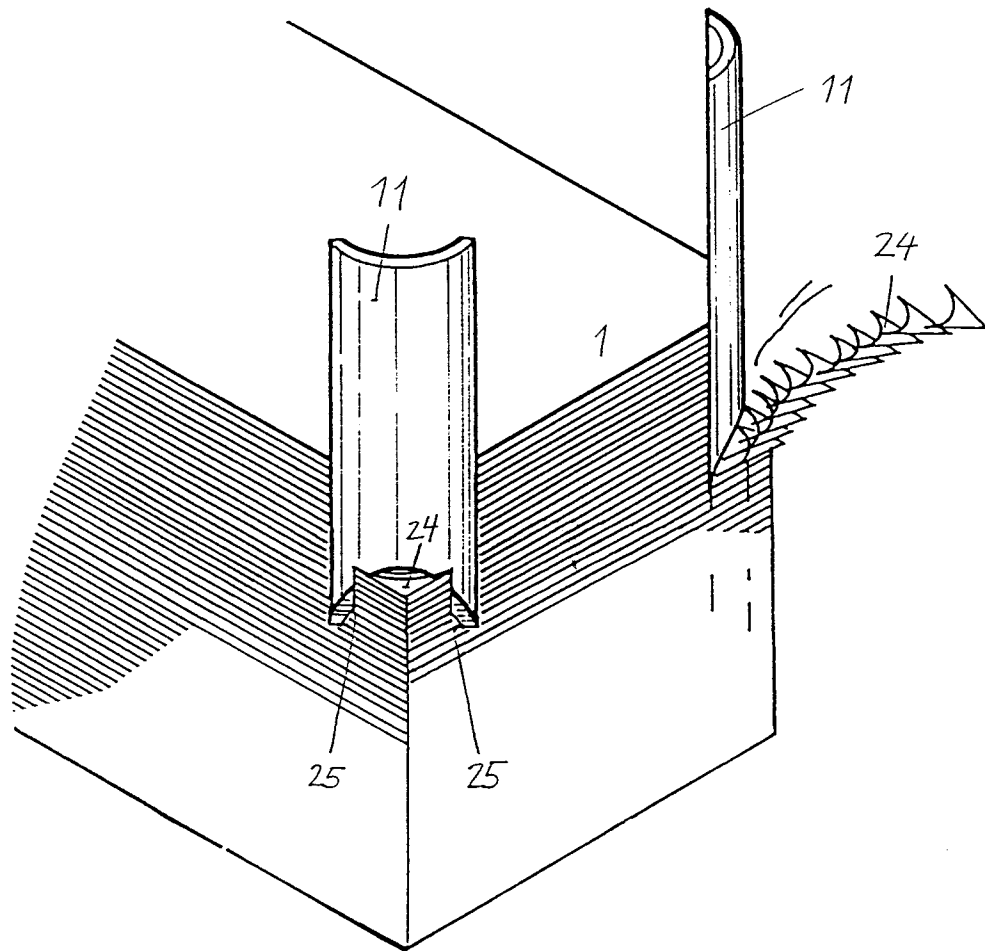


FIG. 7

FIG. 8

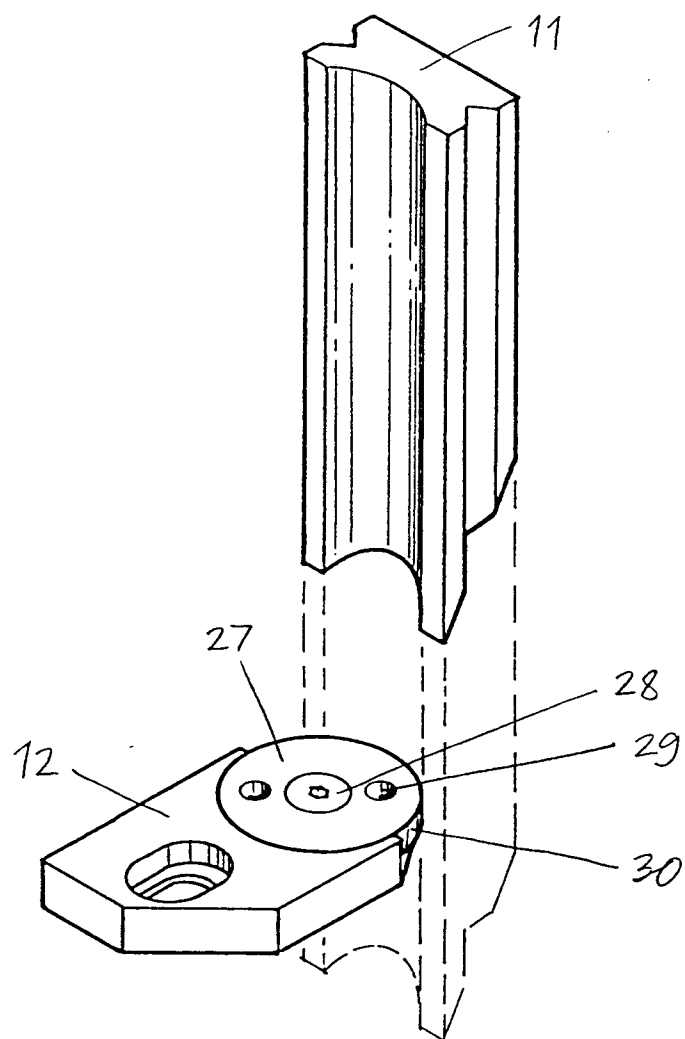
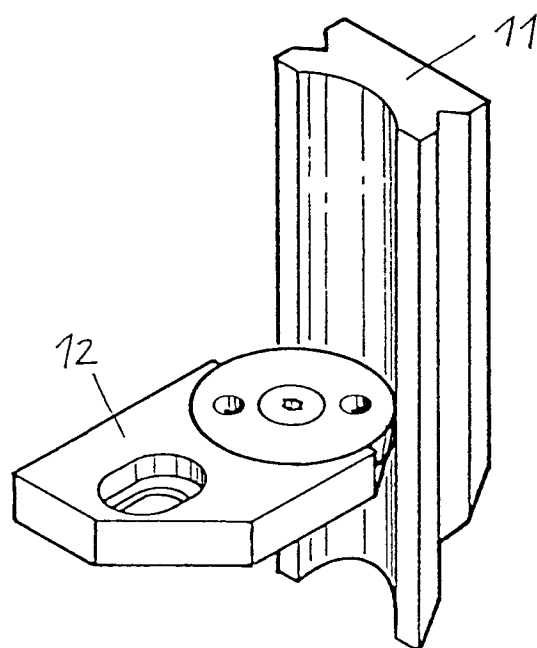


FIG. 9





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 94 61 0001

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)
Y	DE-A-41 04 428 (RATHERT) * column 1, line 47 - column 3, line 40; figures 1-5 * ---	1-3	B26D3/10 B26D7/01 B26D7/02
Y	US-A-3 125 920 (SMITH) * column 6, line 13 - column 9, line 49; figures 1-13 * * column 11, line 15 - line 38; figure 18 *	1-4	
Y	US-A-3 656 387 (WARK) THE WOHLER DOCUMENT ---	4,5	
Y	DE-C-40 784 (LEO) THE WOHLER DOCUMENT ---	5-7	
Y	DE-A-19 44 464 (SCHUMANN) * page 4-6; figures 1-4 * ---	6,7	
A	FR-A-2 271 894 (ASSOCIATED ENGINEERING LTD) -----	6	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			B26D B23B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 11 May 1994	Examiner Berghmans, H
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application I : document cited for other reasons ----- & : member of the same patent family, corresponding document	