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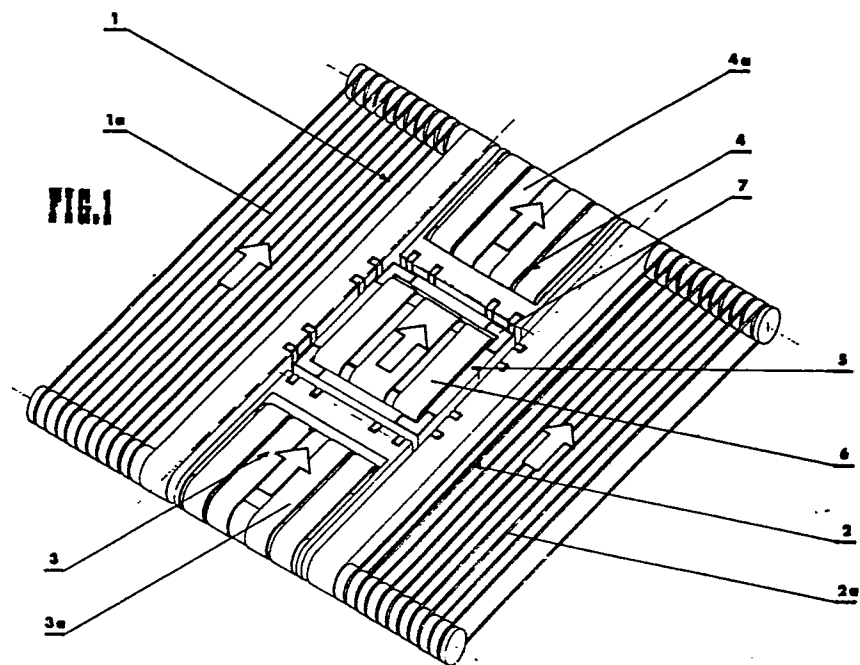
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(54) **Device for folding linen.**

(57) The folding device with vanes of an apparatus for folding cloth articles and especially linen, of the type comprising a folder table having a fixed section and a plurality of vanes hinged externally to said section and tilting towards the same to perform the folding, has both the fixed section and the tilting vanes conceived in the form of belt conveyors. These conveyors are moved at the same speed, the fixed section conveyor under direct control, and the vane conveyors by indirect control through contact with revolving rollers lying under the vanes.

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"DEVICE FOR FOLDING LINEN"

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The present invention relates to an improved folding device with vanes, for apparatuses designed to carry out the quality folding, at high speed, of linen articles.

Apparatuses apt to carry out the folding of cloth articles or the like, especially of linen such as napkins and towels, are already known in technique. In said apparatuses, such articles are fed to a folding device with vanes (which automatically carries out the folding, first on two parallel sides and then on the other two sides) and are discharged therefrom after the folding.

Though the folding devices with vanes provided in said apparatuses have already reached - by using different solutions - a good degree of functionality, always new problems have to be faced in their connection, due to the rising need - common to many fields in the present development of technique - of increasing more and more the production of the folding apparatuses in the unity of time. This requirement evidently imposes to use, in the devices in question, faster and faster movements of the vanes, in the presence of which - in order to obtain a high quality folding - the condition of the surface of the vanes contacting the article to be folded is of fundamental importance. In fact, in the presence of very fast movements, the forces of inertia to which the fabric is subjected are no longer negligible, whereby it is possible that the article may move out of place and that, therefore, the final dimensions obtained for the folded article may be va-

riable, with consequent poor quality folding.

5 In order to simultaneously obtain a high speed and high quality work, it is thus indispensable for the surface of the vanes to provide the utmost friction in respect of the fabric of the article to be folded.

On the other hand, there is also the other fundamental requirement of the presence, in the vanes, of a certain number of openings (said number increasing as the speed increases), in order to prevent the forming of differences in pressure between the upper surface and the
10 lower surface of the vanes, which may produce suction and sticking of the article onto the vanes during their return path.

However, a high friction of the vane surface and the presence thereon of wide openings, are two contrasting requirements hard to conciliate.

15 At present, there are on the market essentially two types of folding devices with vanes.

The first one, already used by the Applicant since several years and forming the object of the Italian patents No. 764039 and No. 929318, uses vanes which have been constructed taking into account the requirements of equilibrium - already set forth hereabove - between friction
20 and openings.

In this device, the article is placed on the folder table by external mechanisms, when the folding is performed by machines with fully automatic cycle, or else by the operator himself, in semiauto-
25 matic machines.

The second type of folding device comprises instead vanes being more abundantly provided with holes and/or openings, in order to allow the arrangement of underlying conveyor belts used for positioning the article to be folded.

30 Both these devices have their drawbacks, especially when increasing the production speed of the folding apparatuses of which they form part. The devices of the first type are very evolved mechanically and could be adapted to provide excellent performances even at the highest

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speeds, but the problems of cost and bulk which they involve would become even more serious. As for the devices of the second type, the folding quality obtained, which is already poor enough at ordinary speeds, would no doubt become unacceptable at higher speeds. It
5 should in fact be noted that the use of conveyor belts for positioning articles in the folding devices with vanes - already known since a long time in apparatuses for folding linen products, especially in the old apparatuses with folding vane designed for the treatment of medium-
-large articles such as table-cloths, sheets and the like - is exclu-
10 sively due to economical reasons and to reasons of bulk, and by no means represents a functional progress; on the contrary, it has in itself great limits and a restricted field of use. To start with, the possibility of having good friction surfaces of the vanes is thereby strongly limited; the proper sliding of the article actually requires
15 smooth vanes, considering that the belts cannot protrude much in order not to create any crumples. Furthermore, the frequent alternation of belts and fixed surfaces tends to create problems during the positioning of the article, in that any discontinuity may block cloth edges and lead to crumpling. A further limit for such devices lies in the
20 dimensions of the article. As the dimensions increase, the problems get worse and may become critical with some types of fabrics, as for example sponge-cloths or other particularly heavy fabrics.

All these drawbacks are eliminated with the folding device with vanes, according to the present invention, which has been conceived
25 to obtain the folding of linen, as well as of articles of any type of woven fabric, either natural or synthetic, and of non-woven fabric, of small and average dimensions, at high speed and with high quality results.

This device which, beyond allowing a perfect folding at high speed,
30 brilliantly solves also the problems of bulk and of cost of the folding apparatuses, is of the type comprising a folder table having a fixed section and a plurality of vanes hinged externally to said section and tilting towards the same to perform the folding, and is substan-

tially characterized in that, both said fixed section and said tilting vanes are conceived in the form of belt conveyors.

Preferably, each vane consists of a frame comprising a main hinged bar and two or more rollers onto which wind belt elements having discontinuances in order to form said conveyor, the motion of said conveyor
5 being obtained through contact of said belt elements - themselves idle - with revolving rollers lying under the vane.

In the device according to the invention, the tilting movement of the vanes takes place in sequence, by separate control, vane after
10 vane, under the control of mechanical operating means. Said movement consists of a rotary motion of the vane about the tilting hinge and of a vertical shifting motion of said hinge. Preferably, the mechanical means operating the tilting movement of each vane comprise an oscillating toggle-lever which controls the rotation of the vane through a connecting
15 ting rod and is operated by a sector-gearwheel unit, and a leverage consisting of a lever and a connecting rod, which operates the vertical shifting of the hinge support, said sector-gearwheel unit and said leverage being operated by an arm oscillating about a fixed point and being driven by a cam.

20 The invention will now be described in further detail, by mere way of example, with reference to the accompanying drawings, which show a preferred embodiment thereof and in which:

Fig. 1 is a top, external, prospect view, of the folding device with vanes according to the invention;

25 Fig. 2 is a view similar to that of figure 1, but illustrating the means for operating the belt conveyors which form the vanes of the device;

Fig. 3 is a view similar to that of figure 1, but with one of the vanes in motion;

30 Fig. 4 is a vertical cross section view of the device illustrated in the previous figures, with the vanes operating means; and

Fig. 5 is a section view similar to that of figure 4, but in which the device is adjusted for folding articles of very thick fabric,

instead of thin cloth articles.

Referring first of all to figures 1 to 4, the device with vanes according to the invention is shown to comprise four vanes 1, 2, 3 and 4, having one of their sides hinged to the sides of a fixed central section 5. Of course the vanes can vary in number, in which case the fixed section could also not be central, without thereby influencing the characteristics of the invention.

According to the fundamental characteristic of the present invention, the four vanes 1, 2, 3 and 4, are conceived in the form of belt conveyors, comprising idle revolving end rollers onto which wind a plurality of parallel adjacent belts 1a, 2a, 3a and 4a. In the case of the vanes 1 and 2 - where the hinge is parallel to the conveying direction - said rollers are mounted overhanging at the ends of a stiff bar forming the hinged side of the vane; while, in the case of the short vanes 3 and 4 - where the hinge is orthogonal to the conveying direction - the same rollers are instead supported by a frame. Also the fixed central section 5 of the device with vanes is conceived in the form of a belt conveyor 6, said section 5 comprising a rim provided with suckers 7. The movement of the conveyor belts forming the vanes is obtained through contact of the lower sections of the belts 1a, 2a, 3a and 4a, with revolving rollers 8 of equal diameter, mounted on shafts 9 positioned below the rollers of the vanes and being parallel thereto. A shaft (not shown) synchronized with the shafts 9, causes the rotation of the belt conveyor 6 forming the fixed central section 5 of the device.

The means operating the vanes, which cause the rotation thereof around their side pivoted to the fixed central section 5 up to almost complete tilting of said vanes, and which provide at the same time for a lifting of their rotation axis - as already foreseen in the folding apparatus of Italian patent No. 929318 - substantially comprise: a toggle-lever 10 having one end connected, through a connecting rod 11, to the frame of the vane, and the opposite end pivoted onto an axis parallel to the pivoting axis of said vane, said toggle-lever comprising - at the end pivoted onto said axis - a gearwheel 12 meshing

with a sector gear 13; a vertically moving support 14 for the hinge of the vane; a control leverage comprising an arm 15 pivoted to a fixed point 15'; and a drum cam 16 causing the arm 15 to oscillate about the point 15'. The control leverage is connected to the support 14 of the
5 vane hinge through a lever 17 and a connecting rod 18, so as to cause vertical movements thereof, and it controls the rotation of the gearwheel 12 through the sector gear 13 being fixed at its end far from the cam 16.

The operation of the device takes place as follows:

10 At the start of the working cycle, the vanes are in a horizontal position and the belts of the vane conveyors and of the conveyor of the fixed central section of the device, lying substantially on the same plane, all move at the same speed. They form an excellent conveying surface, with minimum discontinuances, as can also be seen from
15 the drawings. The suckers 7, provided on the rim of the fixed section 5, are now at rest.

In these conditions, the article to be folded is fed to the device and conveyed by the belts of the vanes 1, 2, 3 and 4, and of the central part 5, up to taking up the folding position. At this point,
20 the motion of the conveyors is stopped in known manner and the article is positioned for its folding on the device.

After stopping of the belts and before the folding movement starts, the suckers 7 start to operate, fed by a depression circuit, thereby blocking the article. Their zone of influence is indicated by way of
25 example, in figure 3, by a section lining 7'.

At this point, the vanes start to move - figure 3 shows an intermediate phase of the movement of the vane 1 - and this movement takes place in sequence, independently for each vane, under the control of the operating means, up to complete folding of the article. With
30 reference to figure 4, for each vane the cam 16 causes the oscillation of the arm 15 about its fulcrum 15' and produces, on one hand, the oscillation of the sector gear 13 and thus the rotation of the gearwheel 12 of the toggle-lever 10 and, consequently, of the vane, and on the

other hand, the movement of the connecting rod 18 and thus the vertical displacement of the support 14 and of the vane hinge. The vane so performs the composite movement illustrated in figure 4; this is a very precise and carefully controlled movement which allows very high quality work even at high speeds. The law of this movement, and particularly the final result to which it leads for what concerns the position of the vane, can easily be changed. Figure 5 shows a change connected with the use of the folding apparatus, onto which the device according to the invention is mounted, for folding articles of far thicker fabric than that shown in figure 4. This change - consisting in a wider vertical displacement of the vane hinge - has been obtained by simply replacing the cam 16 with a different cam 19, and the lever 17 with its connecting rod 18 by a longer lever 20 and a longer connecting rod 21.

The drum cam 16 has to be changed because, wanting to keep unvaried the final rotation - A - with the new displacement - $\bar{D}$ - of the hinge support, the angle - C - (which becomes - $\bar{C}$ -) of the toggle-lever 10 must necessarily vary.

The normal working sequence is 1-2-3-4 (or else, by symmetry, 2-1-4-3).

The large vanes 1, 2, always move a single thickness of fabric, while the vanes 3, 4, move three thicknesses of fabric.

The first two vanes therefore require to have wide openings, to make sucking easier, whereas the last two vanes require to have highly frictioned vane-fabric contact surfaces, such as to withhold the higher forces of inertia and the inner folding resistances caused by three superposed thicknesses of fabric.

This is the reason why (as illustrated) it is preferable to provide the large vanes 1 and 2 with conveyors having round belts (allowing wide openings), while the small vanes 3 and 4 may be equipped with conveyors having flat belts (which guarantee high frictions with the article to be folded). It should be noted that the inner folding resistances in the case of the small vanes are most probably three times higher than the inner resistances present in the case of the large

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vanes. Furthermore, the stiff articles - as for example just ironed linen-cloth, or thick or very compact fabrics, or non-woven fabrics - provide different problems from this point of view.

It should also be underlined that the design scheme of the vanes
5 1 and 2 allows to obtain more easily, with large sizes, mobile structures of low inertia and acceptable thickness.

In any case, beyond these technical considerations (quite detailed) the system may also provide the use of belts being all alike and of different types, or of a suitably perforated single belt, as long as
10 these provide a good friction with the fabric to be treated.

The device according to the invention represents no doubt, for what concerns the article to be folded, the optimal solution, even though economically more burdensome compared to other solutions adopting pneumatic control means, which are however far more approximate.

15 In fact, in no folding stage the fabric gets crushed. The mechanism has the same delicacy of manual folding. This may also be scarcely important for certain types of fabric, but it represents a fundamental requirement for other types of fabric, which are delicate and soft and which have to stay like that also after folding.

20 There is, furthermore, a great improvement in the mechanical performances of the device.

The controlled movement of the vanes allows to use angles of rotation of said vanes being less than 180° and thus to fully eliminate any noise in the working (there can be no contact between the vane
25 and the fixed part), but also and above all, to guarantee the life of the vane.

No type of vane could in fact adequately resist if, at each movement, the vane were to come in contact with - or, rather, hit against - the fixed central part and the underlying vanes in a rest position,
30 even through the thickness of the article being folded.

The vertical displacement of the hinge then allows the vane to tilt without meeting any resistance and, thus, without any overstresses.

It should also be noted that, the fact of having realized an inde-

pendent mechanical control for each single vane, allows the movements in sequence of said vanes to be synchronized in an optimal way for what concerns the speed and reliability of the working.

5 It is understood that there may be many practical embodiments of the invention, other than the one described and illustrated by way of example, all obviously falling within the scope of the invention itself. For instance, there could be changes in the number of the vanes, in the position of the fixed section and in the position of the suckers (which, in some cases, could also not be arranged on the periphery
10 of the fixed part, as illustrated, but could be placed elsewhere on the same fixed part or even on the outside thereof). Moreover, means (of any type) could be provided for rapidly stopping the motion of the belt conveyors forming the vanes, when these move away from the driving rollers 8.



CLAIMS

1) Folding device with vanes for apparatuses carrying out the folding of cloth articles and especially of linen, of the type comprising a folder table having a fixed section and a plurality of vanes hinged externally to said section and tilting towards the same to perform the folding, characterized in that, both said fixed section and said tilting vanes are conceived in the form of belt conveyors.

2) Folding device as in claim 1), wherein each vane consists of a frame comprising a main hinged bar and two or more rollers onto which wind belt elements having discontinuances in order to form said conveyor, the motion of said conveyor being obtained through contact of said belt elements - themselves idle - with revolving rollers lying under the vane.

3) Folding device as in claims 1) and 2), wherein said belt elements consist of a plurality of parallel adjacent belts.

4) Folding device as in claims 1) and 2), wherein said belt elements consist of one or more perforated belts.

5) Folding device as in claims 1) to 4), in which the belt conveyor forming said fixed section is synchronized with those forming the vanes.

6) Folding device as in claims 1) to 5), further comprising depression suckers for holding the article in a folding position.

7) Folding device as in claims 1) to 6), wherein said fixed section is central and has a rim surrounding the conveyor, provided with

said suckers.

8) Folding device as in claims 1) to 7), wherein the tilting movement of the vanes takes place in sequence, by separate control, vane after vane, under the control of mechanical operating means, said movement consisting of a rotary motion about the tilting hinge of the vane and of a vertical shifting motion of said hinge.

9) Folding device as in claim 8), wherein the mechanical means operating the tilting movement of each vane comprise an oscillating toggle-lever which controls the rotation of the vane through a connecting rod and is operated by a sector-gearwheel unit, and a leverage consisting of a lever and a connecting rod, which operates the vertical shifting of the hinge support, said sector-gearwheel unit and said leverage being operated by an arm oscillating about a fixed point and being driven by a cam.

10) Folding device as in claim 9), wherein said cam and said leverage can be replaced by different ones in order to vary the vane movement law.

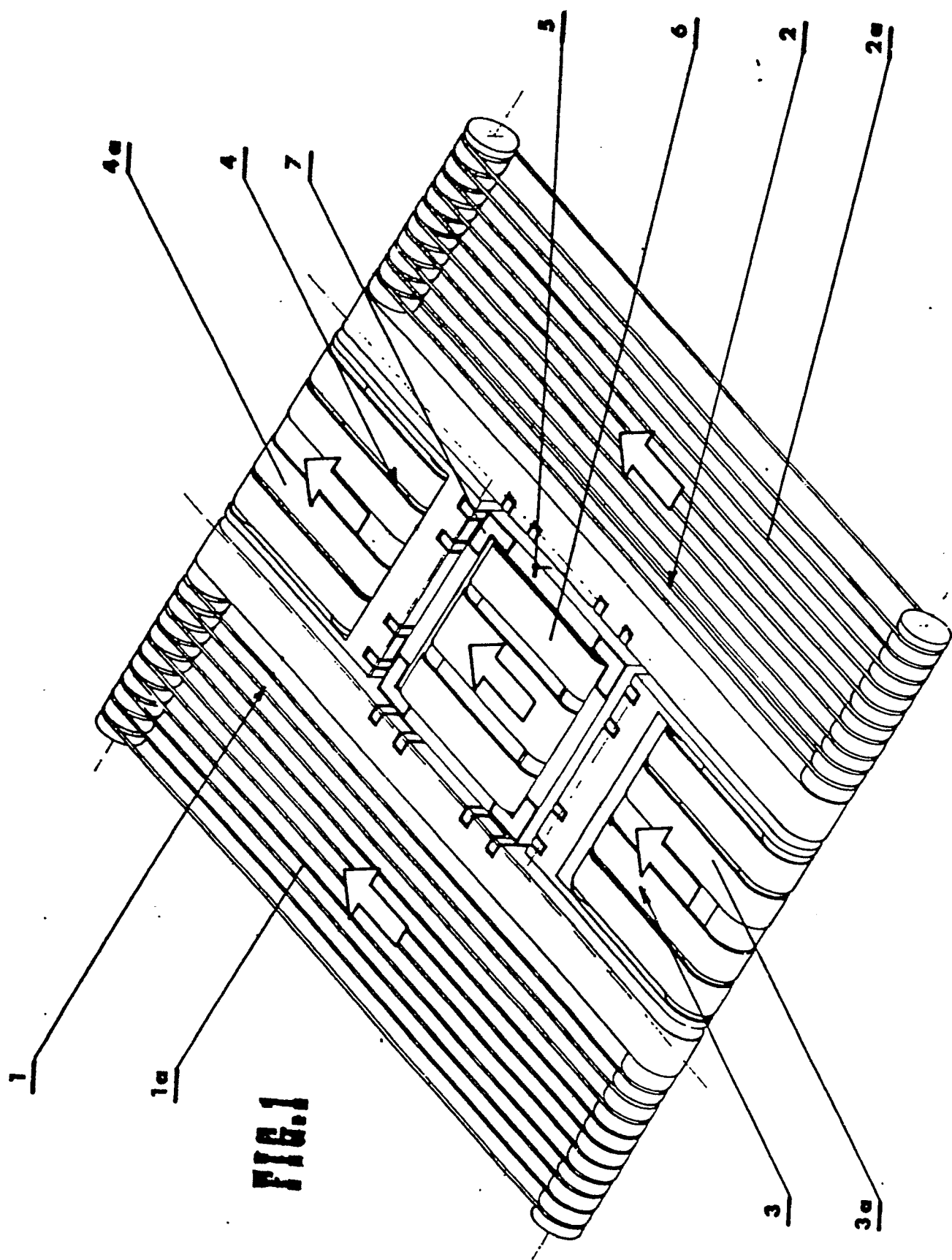
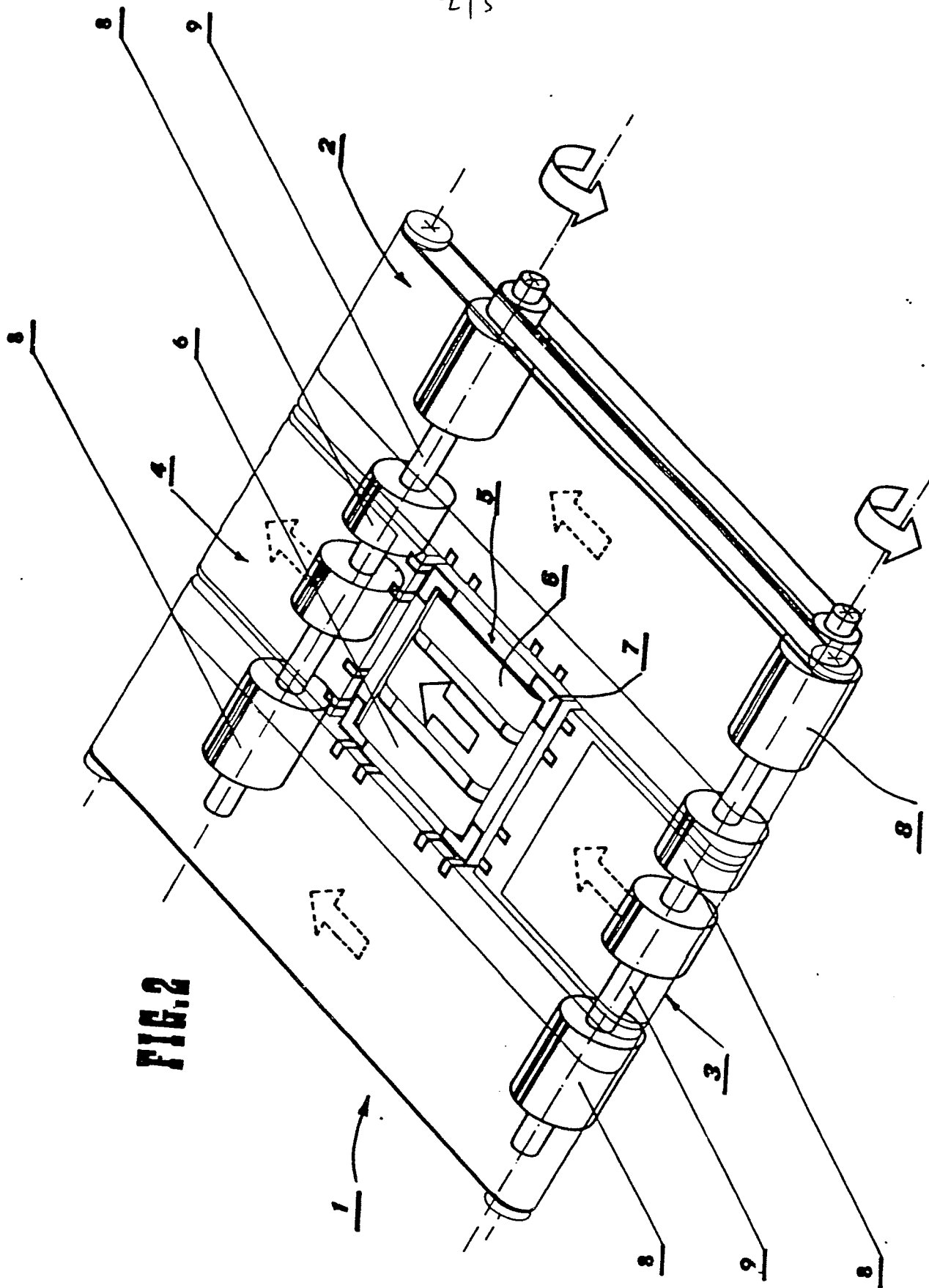


FIG. 1



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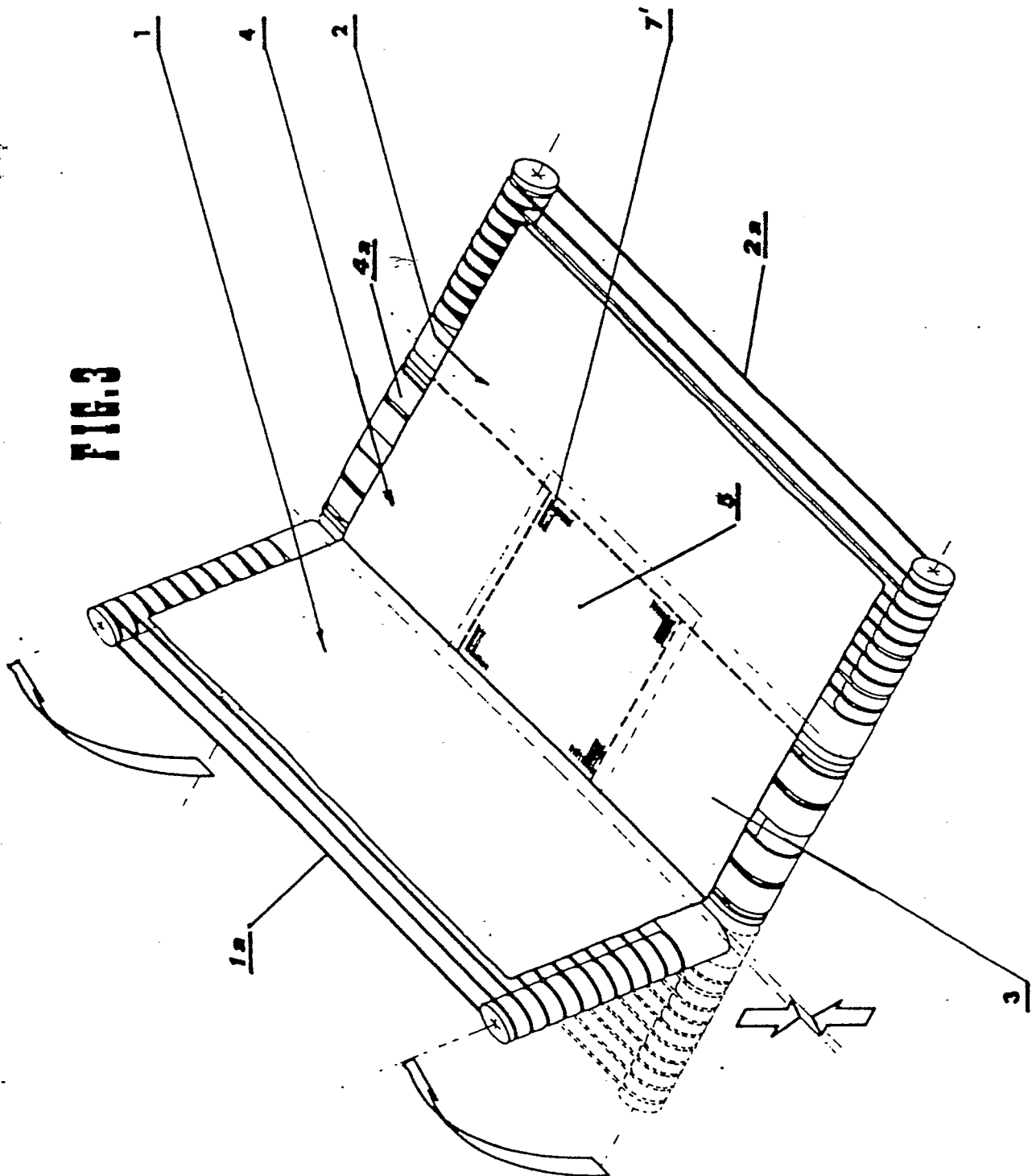
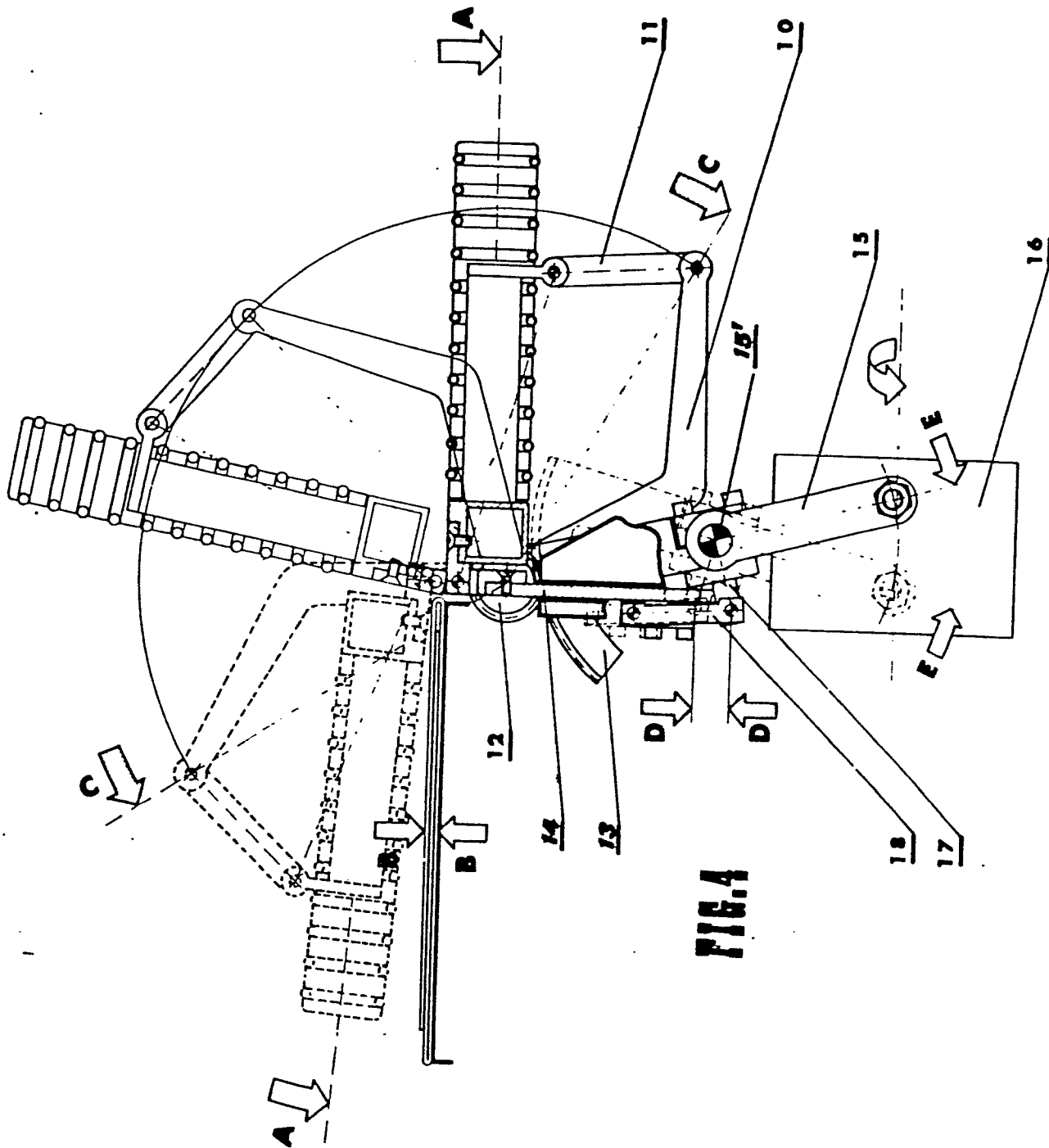


FIG. 3

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