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(54) **Apparatus and method for the folding of laundry**

(57) The invention relates to an apparatus (10) for the folding of laundry (20), comprising a frame (11), a first conveyor belt (1) for transporting an item of laundry (20), above which and at a short distance from which a folding ruler (2) is located which extends in the transport direction, a second conveyor belt (3) for a lateral portion of the item of laundry (20) which is next to the folding ruler (2) and at a higher level than the first conveyor belt (1), and air blower means (4) present underneath the second conveyor belt (3) and comprising an air outlet

(5) directed laterally across the folding ruler (2).

According to the invention, the apparatus comprises a movable plate (7) that is located underneath the second conveyor belt (3) at a higher level than the folding ruler (2) and that is provided with displacement means capable of moving the plate (7) laterally over the folding ruler (2). This advantageously provides a possibility of folding either with the air outlet (5) or with the movable plate (7), or - inter alia in asymmetrically constructed apparatus - with both these means (7, 71, 51), as desired.

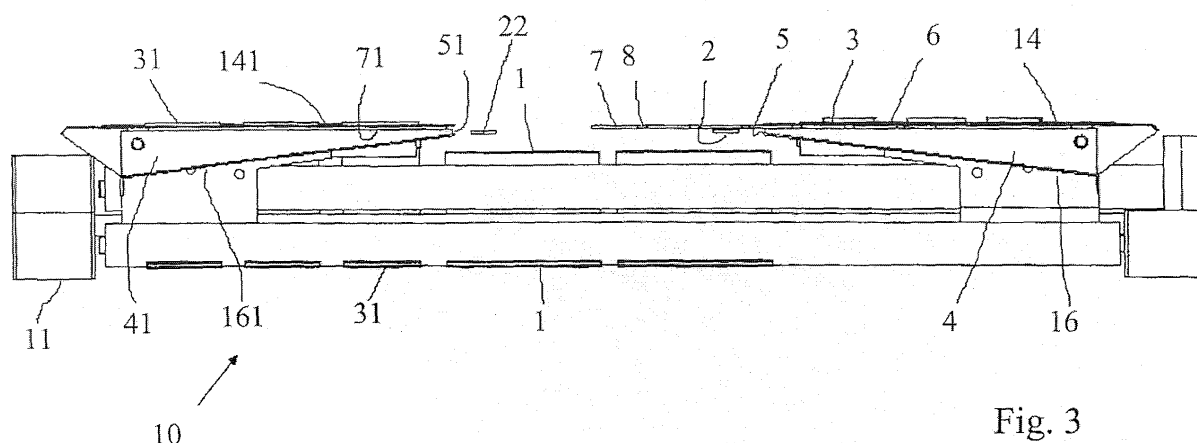


Fig. 3

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## Description

### BACKGROUND OF THE INVENTION

**[0001]** The invention relates to an apparatus for the folding of laundry, comprising a frame, a first conveyor belt for transporting an item of laundry, above which and at a short distance from which a folding ruler is located which extends in the transport direction, a second conveyor belt for a lateral portion of the item of laundry which is next to the folding ruler and at a higher level than the first conveyor belt, and air blower means present underneath the second conveyor belt and comprising an air outlet directed laterally across the folding ruler. Such an apparatus is used inter alia in laundries such as those working for hospitals, hotels, and the like, where large quantities of laundry (having been washed and dried) are to be folded quickly and inexpensively. The invention also relates to a method of folding an item of laundry by means of such an apparatus.

**[0002]** Such an apparatus and such a method are known from a European Patent published on December 2nd, 1998, under no. EP 0 881 320. In the known apparatus, an item of laundry is transported by a first conveyor belt through the apparatus and is folded (up) therein in one or more steps over a folding ruler present above the conveyor belt. This is effected by air blower means present underneath a second conveyor belt that is at a higher level and next to the folding ruler and that supports a lateral portion of the item of laundry that is to be folded. The air blower means comprise an air outlet adjacent the folding ruler whose blowing action blows the lateral portion of the item of laundry over the folding ruler so that it is folded. The air blower means comprise a further air outlet located underneath the second conveyor belt, by means of which the lateral portion of the item of laundry can be slightly lifted off the second conveyor belt by air. This facilitates the folding of the lateral portion by means of the air outlet. It renders it possible on the one hand to limit the air throughput, and thus the power consumption of the apparatus, and on the other hand to give it a high processing capacity.

**[0003]** It is a disadvantage of the known apparatus that the air throughput of the known apparatus is still comparatively high, in particular during folding of laundry that is of a heavy texture or heavy on account of its large surface area. Additional problems may arise in specific manners of folding of an item of laundry. Laundry provided with sleeves, such as shirts and coats, is also not always folded correctly.

### SHORT DESCRIPTION OF THE INVENTION

**[0004]** It is accordingly an object of the present invention to provide an apparatus of the kind mentioned in the opening paragraph that has a low air throughput under all circumstances and that is also suitable for a greater number of folding patterns.

**[0005]** According to the invention, an apparatus of the kind mentioned in the opening paragraph is for this purpose characterized in that the apparatus comprises a movable plate that is located underneath the second conveyor belt at a higher level than the folding ruler and that is provided with displacement means capable of moving the plate laterally over the folding ruler. The presence of the movable plate renders it possible to fold an item of laundry over the folding ruler by means of the movable plate as well as by means of the air blower mechanism, or instead of the latter. The air flow from the air outlet can be reduced in any case here, and thus the total air and power consumption. In particular heavy and/or large items of laundry, such as beach towels, can be satisfactorily folded in this manner in that the movable plate, together with the lateral portion of the item of laundry, is passed over the folding ruler by the displacement means.

**[0006]** A major additional advantage of an apparatus according to the invention is that a greater number of folding patterns becomes possible. During folding of two lateral portions of less than one third of the width of the laundry in a symmetrically constructed apparatus, for example, the problem may arise in the known apparatus that after e.g. the right-hand portion has been folded by means of air, this portion will be blown back again during a similar folding of the left-hand portion. In an apparatus according to the invention, however, the right-hand lateral portion may be folded by means of air, whereas the left-hand portion is folded by the movable plate. Such a combination of folding techniques in one and the same apparatus may be used to equal advantage for other folding patterns. The above advantages also manifest themselves e.g. in the folding of laundry provided with sleeves, such as shirts or coats.

**[0007]** In a preferred embodiment, the air blower means comprise a further air outlet that is directed towards the item of laundry and that comprises openings in the movable plate for allowing the air to pass through. The provision of openings in the movable plate for forming a further air outlet renders it possible still to use this arrangement for slightly lifting the lateral portion of the item of laundry lying on the second conveyor belt. The movable plate may itself form the second air outlet, or alternatively the second air outlet may be formed by a different plate that is provided with holes, which plate will then preferably be located above the movable plate provided with openings.

**[0008]** In a modification of the apparatus according to the invention on the basis of the case described immediately above, the air passage openings in the movable plate are positioned such that a proportion of the openings is in alignment with the further air outlet in each and every position of the movable plate. The laundry lifting function of the air blower means is thus affected as little as possible by the use of the movable plate.

**[0009]** In a favorable embodiment, the air blower means comprise a chamber with an upper plate provid-

ed with holes and located underneath the second conveyor belt that is provided with holes and forms the further air outlet, and with a lower plate that forms the air outlet together with the upper plate at the side of the folding ruler, the movable plate being present in the chamber adjacent the upper plate. The apparatus according to the invention can be manufactured as easily as possible in this manner, while at the same time the functions of the movable plate and the air outlet can be relatively easily attuned to one another.

**[0010]** Preferably, the movable plate is fastened to the chamber by the displacement means. If so desired, the movable plate may also be fastened directly to the frame, but a desired distance between the upper plate and the movable plate that is as small as possible can be realized most readily in the above manner. The displacement of the movable plate may be achieved by means similar to those used for the displacement of the entire chamber. These means comprise, for example, hydraulically or pneumatically driven telescopic tubular elements that may be hinged to the frame. The displacement of the chamber is used, in particular in a symmetrical apparatus, for adjusting the width of the non-folded portion or at least the width of the item of laundry above the first conveyor belt. It is also possible that the upper plate and the movable plate are one and the same plate. In that case the displacement of the chamber involves two independent displacement means: one for the lower plate and one for the upper/movable plate.

**[0011]** In a favorable modification, the second conveyor belt is provided with round holes, and the upper plate of the air chamber and the movable plate are provided with slotted holes, while preferably the surface areas of the holes in the second conveyor belt are larger than the surface areas of the holes in the movable plate, and the surface areas of the latter holes are larger than those of the holes in the upper plate. The further air outlet is defined by the upper plate of the chamber in this manner, while a satisfactory operation thereof is guaranteed at all times by a suitable positioning of the holes in the movable plate.

**[0012]** In a further embodiment, the air outlet is fastened to the movable plate adjacent that end thereof that adjoins the folding ruler. The air outlet may then comprise, for example, a tube, preferably a flat tube, whose side adjoining the folding ruler is provided with regularly spaced openings and whose one or both ends is or are coupled to an air generator via a flexible hose. The tube may be fastened to the end face or to the lower side of the movable plate.

**[0013]** Preferably, as was noted above, the apparatus is symmetrically constructed with a third conveyor belt for another lateral portion of the item of laundry, which belt is located next to a further folding ruler and is at a higher level than the first conveyor belt, with further air blower means located underneath the third conveyor belt, and with a further movable plate and further displacement means. The two folding rulers will then be

present adjacent the lateral sides of the first conveyor belt.

**[0014]** In a further favorable embodiment, the movable plate and the further movable plate can be displaced independently of one another. This means that an item of laundry can be folded not only by means of two movable plates arranged to the left and to the right of the first conveyor belt, but also in a different manner, for example by means of a movable plate, for example present to the right of the first conveyor belt, and by means of an air outlet that forms part of the further air blower means to the left of the first conveyor belt.

**[0015]** Therefore, the apparatus is preferably provided with selection means for selecting the air blower means and the displacement means. This may be realized in a comparatively simple and inexpensive manner by means of suitable electronics and the use of a few additional valves and/or a switch. A fast and perfect folding of the laundry can thus be realized in this manner irrespective of whether or not the movable plate and/or the further movable plate is used. If so desired, the air outlet and the further air outlet may also be provided with air independently of one another.

**[0016]** The invention also relates to a method of folding an item of laundry by means of an apparatus according to the invention, wherein the air blower means or the movable plate is used for folding the item of laundry. This expressly covers the use of (both) air blower means as well as the (further) movable plate. A favorable embodiment of such a method indeed does use both of these options.

#### SHORT DESCRIPTION OF THE FIGURES

**[0017]** These and other elements, aspects, and advantages of the invention will be explained in more detail below with reference to preferred embodiments of the invention and in particular with reference to the appended drawings, in which:

Fig. 1 diagrammatically shows an embodiment of an apparatus according to the invention in perspective view,

Fig. 2 diagrammatically shows the apparatus of Fig. 1 in perspective view, with the movable plate partly moved out,

Fig. 3 diagrammatically shows the apparatus of Figs. 1 and 2 in the operational state corresponding to Fig. 2 in a cross-section taken on the line III-III, Figs. 4 and 5 diagrammatically show a portion of the apparatus of Fig. 1 in the presence of an item of laundry to be folded, in perspective views showing stages of the folding process corresponding to Figs. 1 and 2,

Figs. 6 to 8 diagrammatically show an item of laundry folded by means of the apparatus of Fig. 1 and a method according to the invention in the consecutive non-folded and folded states in cross-section-

al views taken on the line III-III.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0018]** Fig. 1 diagrammatically and in perspective view shows an embodiment of an apparatus according to the invention, and Fig. 2 diagrammatically and in perspective view shows the apparatus of Fig. 1 with its movable plate partly moved out. Fig. 3 is a diagrammatic cross-sectional view taken on the line III-III of the apparatus of Figs. 1 and 2 in the operational state corresponding to Fig. 2. The apparatus 10 for the folding of laundry (cf. e.g. Figs. 1 and 3) comprises a frame 11 that is only partly shown in the drawing and a first conveyor belt 1 for transporting an item of laundry 20, a folding ruler 2 that extends in the transport direction being present at the right-hand lateral side of said belt at a short distance therefrom. A second folding ruler 2 is present on the left-hand side in this example. To the right of the folding ruler 2 there is a second conveyor belt 3 for a lateral portion of the item of laundry 20, at a higher level than the first conveyor belt 1. A third conveyor belt 31 is present in this example, arranged and constructed symmetrically, to the left of the first conveyor belt 1 and serving for another, left-hand lateral portion of the item of laundry (20) to be folded.

**[0019]** In the operational state of the apparatus 10 as depicted in Figs. 1 and 2, the item of laundry 20 to be folded is present on further, sloping conveyor belts 50 by means of which the item 20 is fed into the folding apparatus 10. A central portion of the item of laundry then enters the first conveyor belt 1 under the folding rulers 2, 22, which each have a raised entry portion for this purpose. A left-hand and a right-hand portion of the laundry 20 enters the third conveyor belt 31 and the second conveyor belt 3, respectively, during this. All conveyor belts 1, 3, 31, 50 here comprise a number of sub-belts that rotate about shafts, that are provided with holes, and that are made of polyester. Figs. 1 and 2 only show a small portion of a single belt 3 from among the belts 3 for the sake of clarity so as to keep the subjacent parts visible. The holes 13, 313, round ones in this case, of the second and third conveyor belts 3, 31 are shown in some locations only.

**[0020]** Air blower means 4 are present below the second and third conveyor belts 3, 31 (see Fig. 3), which means here comprise a chamber 4 formed between an upper plate 14, 141 and a lower plate 16, 161 which form an air outlet 5, 51 directed laterally over the folding rulers 2, 22 at the edge of the first conveyor belt 1. A further air outlet 6, 66 is formed in the upper plates 14, 141 and here comprises slotted openings 15 in the upper plates 14, 141 (see Fig. 1). Said further air outlet 6 is capable of slightly lifting a lateral portion of the item of laundry 20 off the second and third conveyor belts 3, 31 by means of (compressed) air. It is subsequently possible by means of the air outlet 5 to fold the lateral portions

of the item of laundry 20 successively over the folding rulers such that, for example, the lateral portion that is folded last is laid over the lateral portion that was folded first. The laundry 20 then arrives at the rear of the apparatus 10, coming from the rulers 2, 22 in the folded state, and may subsequently be further folded, for example in a different folding direction, for example at right angles to the first folding direction.

**[0021]** According to the invention, the apparatus comprises a movable plate 7, and also a second movable plate 71 in this case, present underneath the second conveyor belt 3 and underneath the third conveyor belt 31, respectively, at a higher level than the respective folding ruler 2(, 22), which plate is provided with openings 8 for allowing air from the further air outlet 6 to pass through and which is provided with displacement means by which the plate 7, and here also the second plate 71, can be moved laterally over the folding ruler 2(, 22). The plate 7 is not visible in Fig. 1 because it is not yet in its extended position. The plate 7 is partly visible in Fig. 2, as it is in Fig. 3. An item of laundry may be folded over the folding ruler 2 or the folding rulers 2, 22 by means of the air outlet 5, or alternatively wholly or partly by means of the movable plate 7 (or the further plate 71, or both plates 7, 71).

**[0022]** This folding process is visible in Figs. 4 and 5, which offer diagrammatic perspective views of a portion, here a right-hand portion, of the apparatus of Fig. 1 in the presence of an item of laundry to be folded in the operational stages corresponding to those of Figs. 1 and 2. The slotted openings 8 for allowing air to pass through the movable plate 7 are positioned such that a proportion of the openings 8 is in alignment with the further outlet 6, formed by the slotted openings 16 in the upper plate 14 of the air chamber 4, in each and every position of the movable plate 7. When laundry 20 is being folded in that the plate 7 is shifted, that laundry portion that is still above the upper plate 14 can be lifted slightly off the second conveyor belts 3 (not shown in Figs. 4 and 5).

**[0023]** In this example, the movable plate 7 is located in the chamber 4 adjacent the upper plate 14 thereof. Since the plate 7 has holes 8 that are suitably distributed over the surface of the plate 7, the further air outlet 6 formed by the holes 15 in the upper plate 14 is not obstructed. The plate 7 is fastened to the chamber 4 via the displacement means here. The holes in the plates 7, 14 are elongate, whereas the holes 13, 313 in the conveyor belts 3, 31 are round and have the larger surface areas. The slotted holes 8, 15 have smaller surface areas, the holes 8 having a larger surface area than the holes 15.

**[0024]** The movable plate 7 and the further movable plate 71 in this embodiment of the apparatus 10 can be moved independently of one another. The apparatus 10 is further provided with selection means for selecting the air blower means 4, 41 and the displacement means for the movable plates 7, 71.

**[0025]** Figs. 6 to 8 are diagrammatic cross-sectional

views taken on the line III-III of an item of laundry, which is folded by means of an apparatus of Fig. 1 and by a method according to the invention, in subsequent non-folded and folded states. In Fig. 6, the item 20 to be folded extends beyond the folding rulers 2, 22 in approximately equal measure on either side. The lateral portion on the right is folded first over the folding ruler 2, then the one on the left over the ruler 22. The two folding operations may be carried out by means of the air outlet 5 or by means of the movable plates 7, 71, for example in dependence on the nature and dimensions of the items 20 under treatment. A combination of folding operations is also possible, i.e. one folding operations being carried out by one of the movable plates 7, 71 and another one by one of the two air outlets 5, 51.

**[0026]** The laundry 20 shown in Fig. 7 has lateral portions to be folded that are (much) smaller than the portion present above the first conveyor belt 1. If such an item is folded twice by means of the air outlets 5, 51, there is a major risk that the lateral portion folded first will be blown back during folding of the second lateral portion. This is why the movable plates 7, 71 can be used to advantage in such a case for folding one or both lateral portions of the laundry item 20 over the folding rulers 2, 22.

**[0027]** An alternative folding pattern is shown in Fig. 8. The lateral portion on the right - much larger than the lateral portion on the left - is first folded by the movable plate 7 to beyond the two rulers 2, 22 up to the end of the left-hand portion. Then a return folding movement can be carried out by the air outlet 51 on the left, resulting in the lowermost situation depicted in Fig. 8.

**[0028]** The invention has been described above with reference to a preferred embodiment. Those skilled in the art will be aware that many modifications are possible without departing from the scope of protection of the appended claims. The embodiments should accordingly be regarded as merely illustrative, and no limitations are to be assumed in regard of the invention save those recited in the claims.

## Claims

1. An apparatus (10) for the folding of laundry (20), comprising a frame (11), a first conveyor belt (1) for transporting an item of laundry (20), above which and at a short distance from which a folding ruler (2) is located which extends in the transport direction, a second conveyor belt (3) for a lateral portion of the item of laundry (20) which is next to the folding ruler (2) and at a higher level than the first conveyor belt (1), and air blower means (4) present underneath the second conveyor belt (3) and comprising an air outlet (5) directed laterally across the folding ruler (2), **characterized in that** the apparatus comprises a movable plate (7) that is located underneath the second conveyor belt (3) at a higher level

than the folding ruler (2) and that is provided with displacement means capable of moving the plate (7) laterally over the folding ruler (2).

2. An apparatus (10) as claimed in claim 1, **characterized in that** the air blower means (4) comprise a further air outlet (6) that is directed towards the lateral portion of the item of laundry (20) and that comprises openings (8) in the movable plate (7) for allowing the air to pass through.

3. An apparatus (10) as claimed in claim 1 or 2, **characterized in that** the air blower means (4) comprise a chamber (4) with an upper plate (14) provided with holes (15) and located underneath the second conveyor belt (3) that is provided with holes (13) and forms the further air outlet (6), and with a lower plate (16) that forms the air outlet (5) together with the upper plate (14) at the side of the folding ruler (2), the movable plate (7) being present in the chamber (4) adjacent the upper plate (14).

4. An apparatus (10) as claimed in claim 3, **characterized in that** the movable plate (7) is fastened to the chamber (4) by the displacement means.

5. An apparatus (10) as claimed in claim 3 or 4, **characterized in that** the second conveyor belt (3) is provided with round holes (13), and the upper plate (14) and the movable plate (7) are provided with slotted holes (8, 15), while preferably the surface areas of the holes (13) in the second conveyor belt (3) are larger than the surface areas of the holes (8) in the movable plate (7), and the surface areas of the latter holes (8) are larger than those of the holes (15) in the upper plate (14).

6. An apparatus (10) as claimed in claim 1 or 2, **characterized in that** the air outlet (5) is fastened to the movable plate (7) adjacent that end thereof that adjoins the folding ruler (2).

7. An apparatus (10) as claimed in any one of the preceding claims, **characterized in that** the apparatus (10) is symmetrically constructed with a third conveyor belt (31) for another lateral portion of the item of laundry (20), which belt is located next to a further folding ruler (22) and is at a higher level than the first conveyor belt (1), with further air blower means (41) located underneath the third conveyor belt (31), and with a further movable plate (71) and further displacement means.

8. An apparatus (10) as claimed in claim 7, **characterized in that** the movable plate (7) and the further movable plate (71) can be displaced independently of one another.

9. An apparatus (10) as claimed in any one of the preceding claims, **characterized in that** it is provided with selection means for selecting the air blower means (4, 41) and the displacement means for the movable plates (7, 71). 5
10. A method of folding an item of laundry (20) by means of an apparatus as claimed in any one of the preceding claims, wherein use is made of the air blower means (4, 41) or of the movable plates (7, 71) for folding the item of laundry (20). 10
11. A method as claimed in claim 10, wherein use is made of the air blower means (4, 41) and of the movable plates (7, 71) for folding the item of laundry (20). 15

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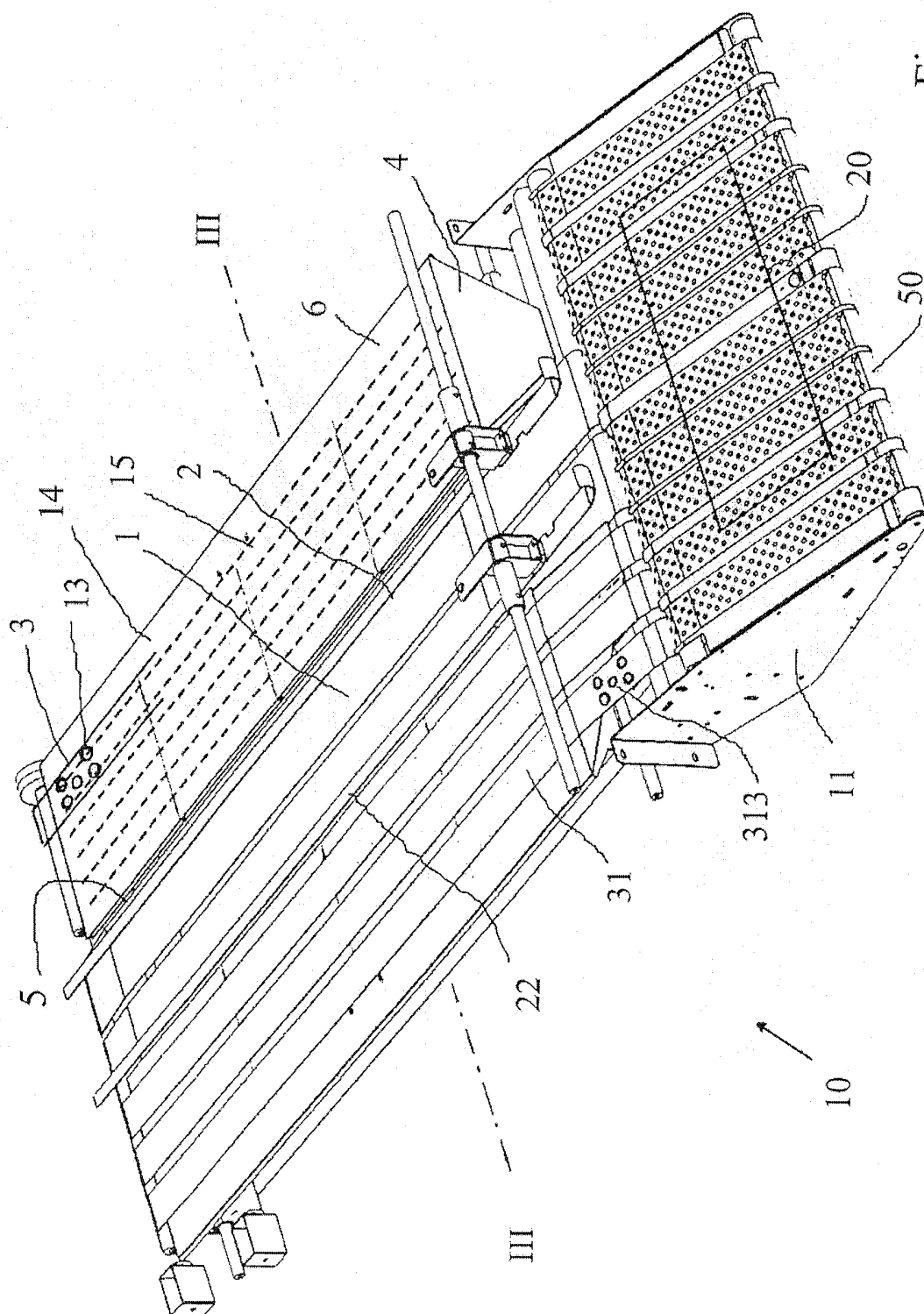


Fig. 1

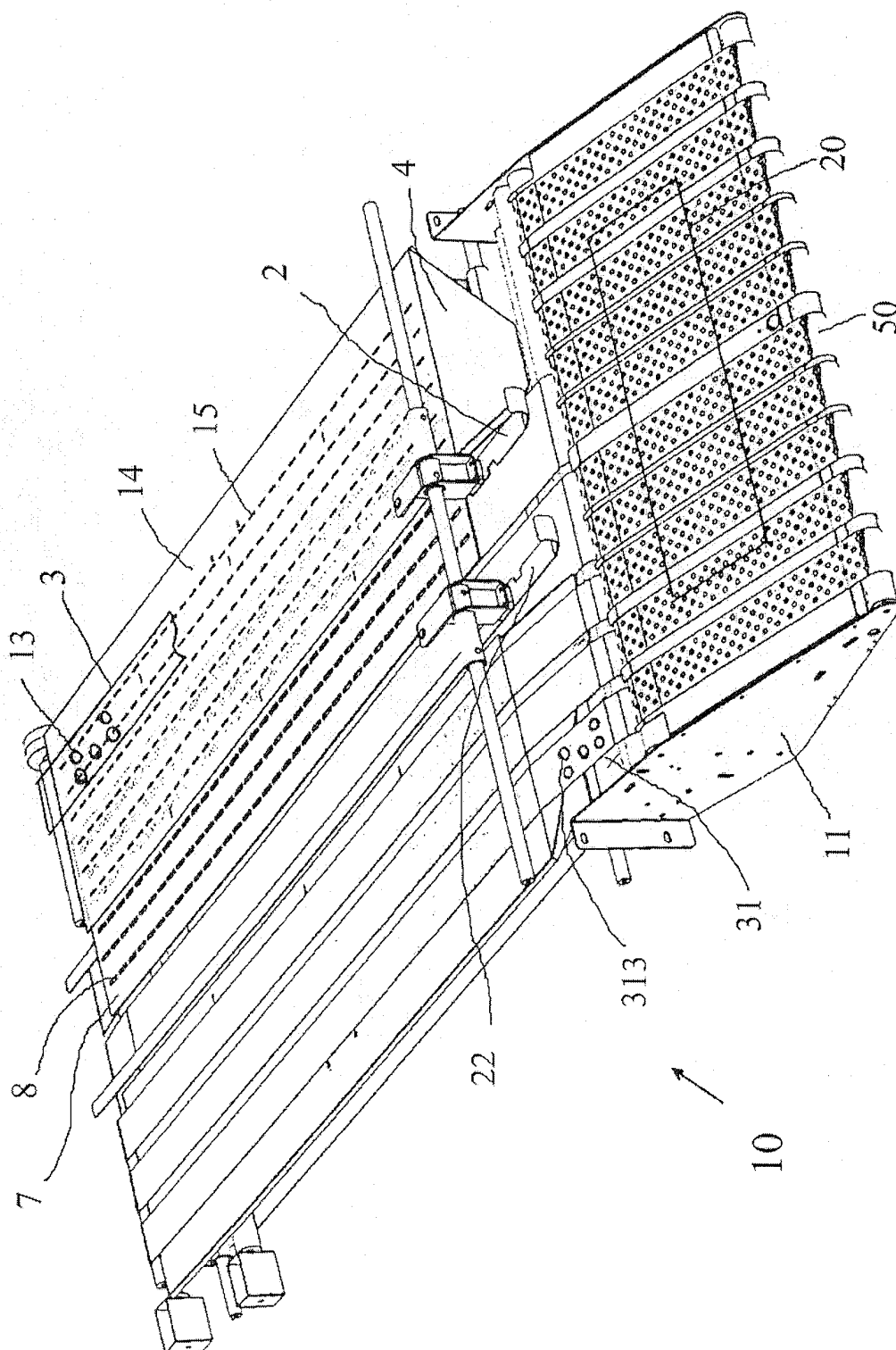
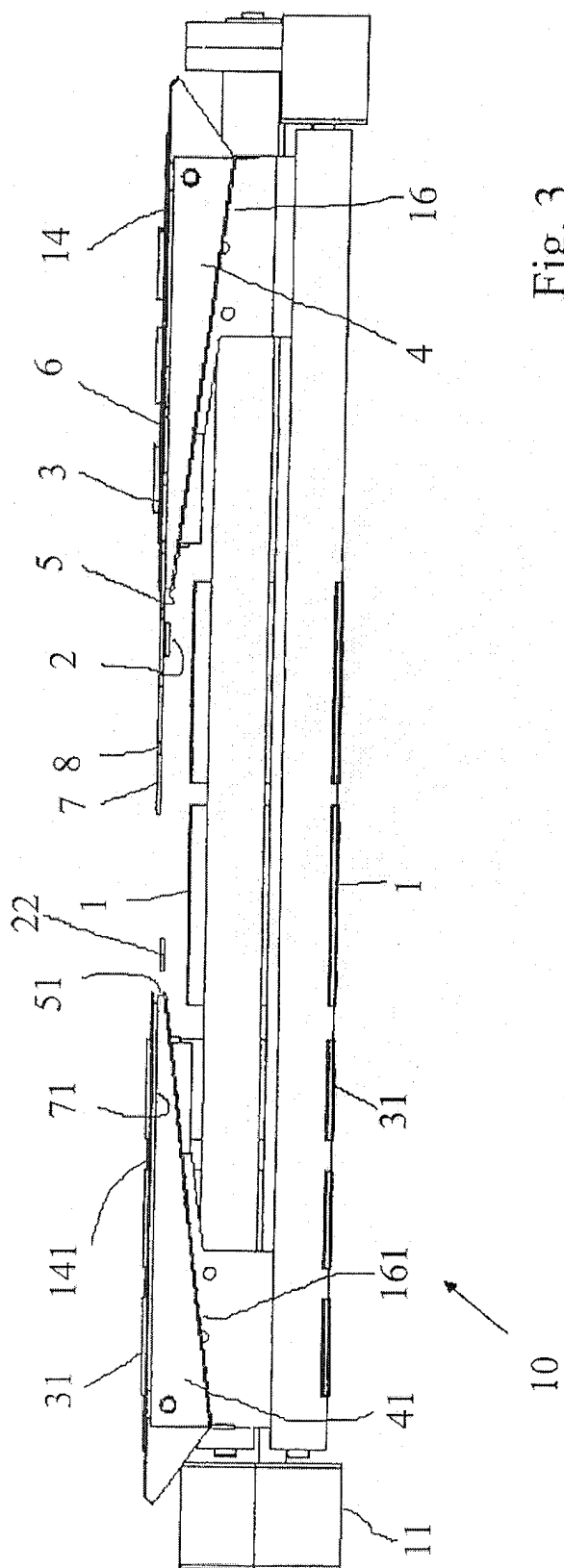


Fig. 2





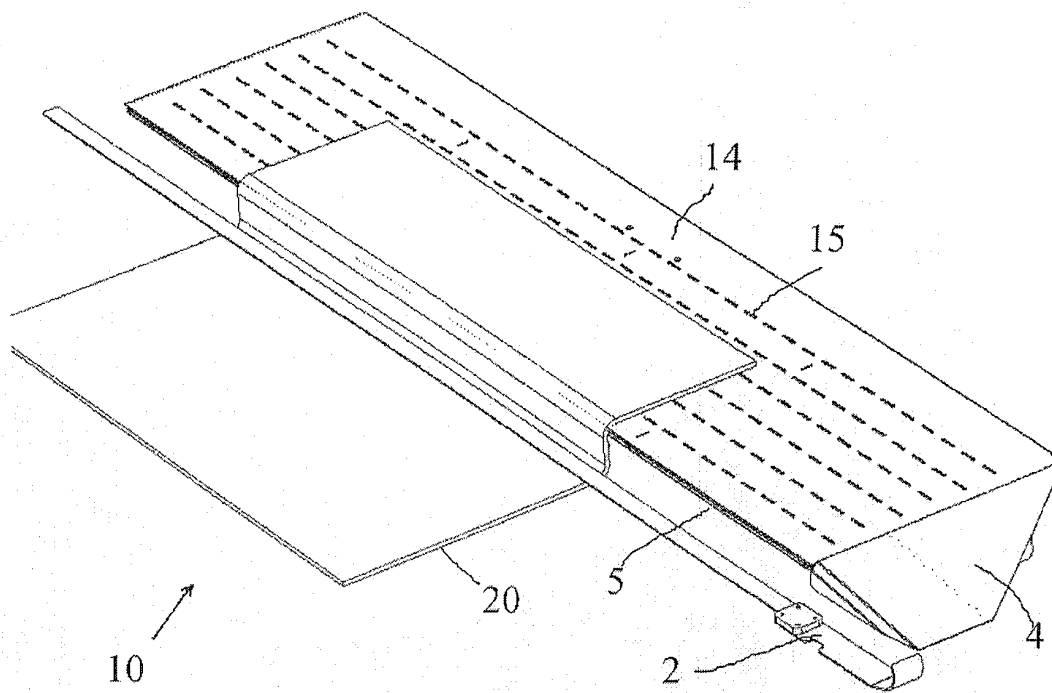


Fig. 4

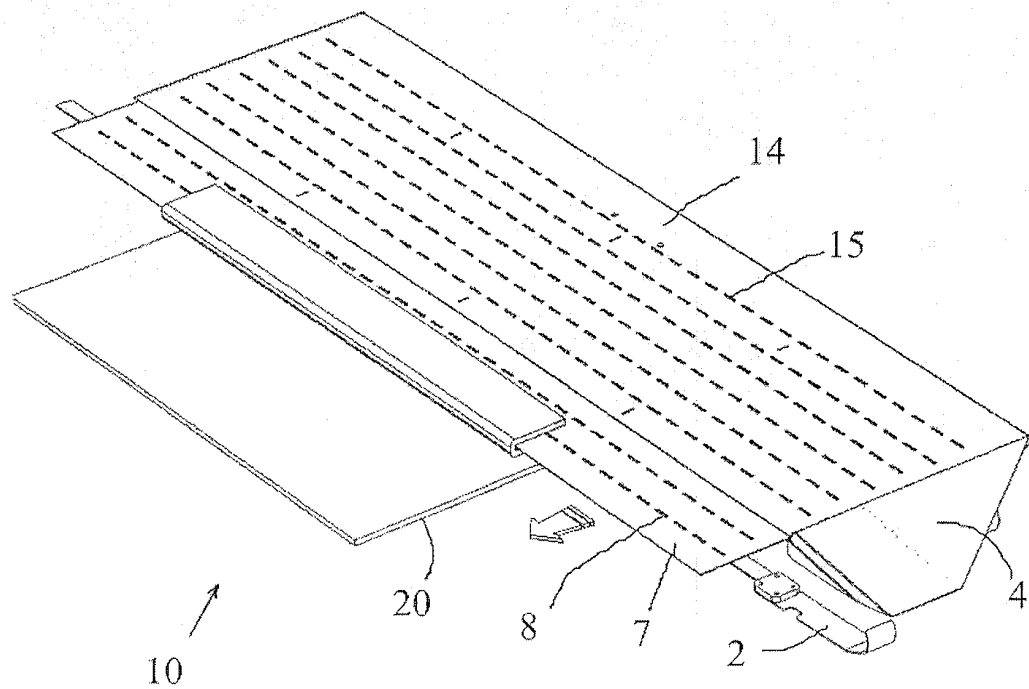


Fig. 5

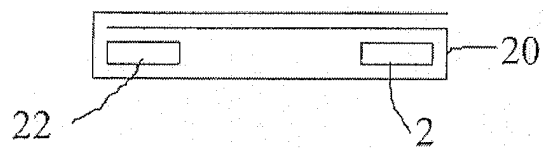
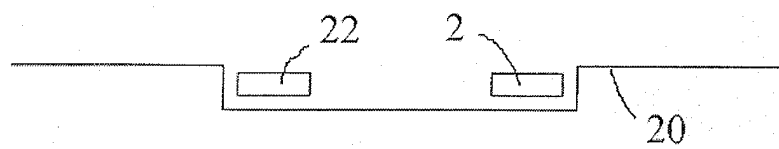


Fig. 6

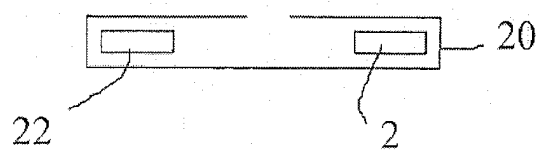
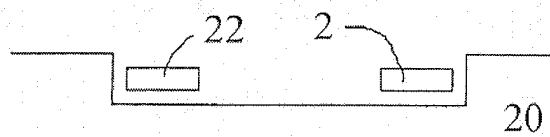


Fig. 7

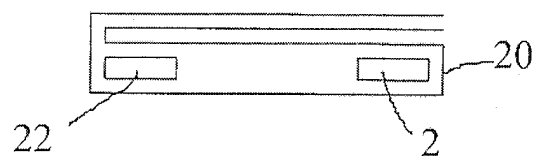
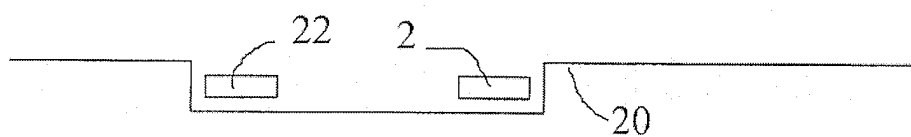


Fig. 8