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(54) APPARATUS FOR FORMING PACKAGES

(57) An apparatus comprises:
- an advancement device (4) for advancing in an advancement direction (F) a plurality of objects (2) to be packaged, wrapped in a tubular wrapper (27) of packaging material;
- an upper presser device (38; 138) and a lower presser device (47);
- a driving system for moving the upper presser device (38; 138) and the lower presser device (47) towards each other or away from each other, so that the upper presser device (38; 138) and the lower presser device (47) exert pressure on the packaging material to generate a transversal joint (39) or, alternatively, disengage from the packaging material;
- a longitudinal movement device (67) for moving the upper presser device (38; 138) and the lower presser device (47) along the advancement direction (F) so that the upper presser device (38; 138) and the lower presser device (47) remain engaged with the packaging material while the packaging material is advancing in the advancement direction (F).

The driving system comprises a first driving device (52) connected to the upper presser device (38; 138) and a second driving device (53) connected to the lower presser device (47), the first driving device (52) and the second driving device (53) being distinct from each other for moving the upper presser device (38; 138) and the lower presser device (47) transversally to the advancement direction (F) independently from each other.

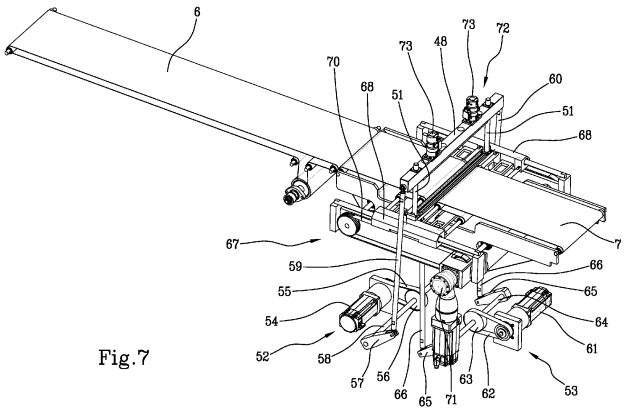

Fig.7

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Description

[0001] The invention relates to an apparatus for producing packages containing objects, by wrapping consecutive objects with a flexible material, for example paper.

[0002] The apparatus according to the invention is particularly suitable for packaging, one after the other, objects of different types, which consequently have dimensions generally variable between one object and the next.

[0003] The apparatus according to the invention may be used in the online sales sector, in order to package objects ordered using the Internet, which must be packaged before being delivered to the customers who have made a request.

[0004] Apparatuses are known for producing packages by wrapping consecutive objects with a flexible material, for example paper, in the form of a web unwound from a reel. The objects to be packaged are advanced in a row along an advancement direction and the paper is folded in such a way as to form a tubular wrapper around the row of objects. While the paper is still in an extended configuration, glue is applied to it according to a predetermined pattern. In particular, a longitudinal strip of glue is applied which will be used for longitudinally closing the tubular wrapper. A plurality of transversal strips of glue are further applied, extending perpendicularly to the advancement direction. The transversal strips of glue are used for closing respective open ends of the package, generated by cutting the transversal wrapper perpendicularly to the advancement direction. In this way, consecutive bags are obtained inside each of which an object is present.

[0005] The glue which is applied on the paper in the apparatuses described above is usually a hot melt glue or rubber-based glue.

[0006] After applying glue on the paper, the paper is folded to form the tubular wrapper by superposing two longitudinal edges of the web and pressing them against each other. This allows the two longitudinal edges to adhere to each other thanks to the glue previously applied.

[0007] There is also a transversal cutting and pressing station, in which pressure is applied to the tubular wrapper, already closed longitudinally, at the strips of transversal glue to close the ends of the bag. Simultaneously, the tubular wrapper is cut perpendicularly to the advancement direction, in a position interposed between two adjacent transversal strips of glue, for separating from the tubular wrapper closed consecutive packages, each of which contains an object.

[0008] The transversal cutting and pressing station of the prior art apparatuses comprises an upper presser device and a lower presser device which interact with each other to apply pressure at the transversal strips of glue. The lower presser device and the upper presser device are moved towards each other, or alternatively, away from each other, by means of a shared drive device. The latter acts simultaneously on the lower presser device and on the upper presser device, moving them along a predetermined stroke which brings the lower presser device and the upper presser device into contact with the paper at a constant and predetermined height.

[0009] US 5666788 discloses an apparatus for producing packages containing food products with a heat-sealable plastic film, which wraps the food product positioned in a tray. The apparatus disclosed in US 5666788 comprises a lower sealing bar and an upper sealing bar, movable transversely to an advancement direction of the heat-sealable plastic film and the food products, to make a transversal joint by sealing the heat-sealable plastic film. The lower sealing bar and the upper sealing bar always meet at the same height, so that the transversal joint is positioned at a constant distance from an advancement plane of the food products.

[0010] A drawback of the prior art apparatuses is that the lower presser device and the upper presser device close the packages forming on the latter transversal joining lines which are always positioned at the same height. This may be disadvantageous when it is necessary to package objects which have dimensions, and in particular a height, which vary between one object and the next. In effect, if the prior art apparatuses are used to produce in sequence packages having a variable height, the transversal joining lines are shifted towards a lower face or an upper face of the package, which worsens the appearance of the package and may cause defects.

[0011] An object of the invention is to improve the apparatuses for packaging objects inside respective packages, formed around the object from a flexible web material, for example paper.

[0012] Another object is to increase the quality of the packages made from a flexible web material, for example paper.

[0013] Another object is to provide a versatile apparatus which is able to make packages of good quality, having dimensions which vary between one package and the next.

[0014] According to the invention, there is provided an apparatus comprising:

- an advancement device for advancing in an advancement direction a plurality of objects to be packaged, wrapped in a tubular wrapper of packaging material;
- an upper presser device and a lower presser device;
- a driving system for moving the upper presser device and the lower presser device towards each other or away from each other, so as to exert pressure on the packaging material to generate a transversal joint or, alternatively, disengage from the packaging material;
- a longitudinal movement device for moving the upper presser device and the lower presser device along the advancement direction so that the upper presser device and the lower presser device remain engaged with the packaging material while the packaging ma-

terial is advancing in the advancement direction;

wherein the driving system comprises a first driving device connected to the upper presser device and a second driving device connected to the lower presser device, the first driving device and the second driving device being distinct from each other for moving the upper presser device and the lower presser device transversally to the advancement direction independently from each other.

[0015] The first driving device and the second driving device are configured to move the upper presser device and the lower presser device transversely to the advancement direction along respective strokes which can be selected independently from each other, so as to vary the height of the transversal joint relative to an advancement plane of the objects to be packaged.

[0016] The first driving device and the second driving device allow the stroke of the upper presser device to be made independent of the stroke of the lower presser device.

[0017] Consequently, the lower presser device and the upper presser device can move along strokes having different lengths from each other, in such a way as to meet at a height which can be freely selected. This allows the transversal joint to be positioned at different heights as a function of the thickness of each object to be packaged, even if the thickness is variable between one object and the next.

[0018] In particular, the transversal joint may be positioned at approximately half the height of each object to be packaged, which allows objects wrapped in good quality packages of to be obtained.

[0019] By operating the upper presser device and the lower presser device independently from each other, it is also possible to freely vary the pressure applied by the upper presser device and the pressure applied by the lower presser device and/or the methods by which the presser devices apply the respective pressures, which allows a very flexible and versatile apparatus to be obtained.

[0020] The longitudinal movement device allows the upper presser device and the lower presser device to follow the packaging material to maximise the time the upper presser device and the lower presser device apply pressure at the transversal joint. This makes it possible to obtain a well closed and resistant transversal joint.

[0021] The longitudinal movement device is configured to move the upper presser device and the lower presser device along a stroke which depends on the length of each object to be packaged, that is to say, which depends on the dimension which each object has along the advancement direction F. In other words, this stroke is variable depending on the length of the object. The above-mentioned stroke may also vary between one object and the next.

[0022] The invention can be better understood and implemented with reference to the accompanying drawings which illustrate non-limiting example embodiments of it and in which:

Figure 1 is a schematic perspective view showing an apparatus for forming packages containing objects starting from a web of flexible material;

Figure 2 is an enlarged perspective view showing a first part of the apparatus of Figure 1;

Figure 3 is a schematic perspective view showing a package which the apparatus of Figure 1 is able to produce;

Figure 4 is a front view of the package of Figure 3;

Figure 5 is an enlarged perspective view showing a second part of the apparatus of Figure 1, wherein some components of the apparatus of Figure 1 have been removed and wherein other components not visible in Figure 1 are shown;

Figure 6 is a side view of the apparatus of Figure 5;

Figure 7 is a perspective view of the apparatus of Figure 5, showing some driving devices which make possible the movement of the components of the apparatus;

Figure 8 shows a detail of a transversal cutting and pressing device of the apparatus of Figure 1;

Figure 9 shows a detail of a package obtained with the transversal cutting and pressing device of Figure 8;

Figure 10 shows a detail of a transversal cutting and pressing device similar to that of Figure 8, according to an alternative embodiment;

Figure 11 shows a detail of a package obtained with the transversal cutting and pressing device of Figure 10;

Figure 12 is a front view of a blade of the apparatus of Figure 1;

Figure 13 is a view like that of Figure 12, showing a blade according to an alternative embodiment;

Figure 14 is a view like that of Figure 4, showing a package according to an alternative embodiment;

Figure 15 is a front view of the package of Figure 14;

Figure 16 is an enlarged perspective view showing a first part of an apparatus similar to that of Figure 1, according to an alternative embodiment;

Figure 17 is a schematic perspective view showing a package according to an alternative embodiment, having a handling element which comprises a gripping handle;

Figure 18 is a schematic perspective view showing a part of an apparatus for producing the package of Figure 17;

Figure 19 is a side view of the part of the apparatus of Figure 18;

Figure 20 shows a detail of the package of Figure 17, in a configuration of use;

Figure 21 is a view like that of Figure 20, showing a detail of a package according to an alternative embodiment;

Figure 22 is a view like that of Figure 18, showing a part of an apparatus for producing a package having

a gripping handle according to another embodiment;
Figure 23 is a side view of the part of the apparatus of Figure 22;
Figure 24 is a perspective view showing a package produced by the apparatus of Figures 22 and 23.

[0023] Figure 1 shows an apparatus 1 for packaging objects 2, which are generally of different types from each other and have dimensions which can vary between one object and another. The apparatus 1 is designed to be used in the online sales sector in order to package objects which have been ordered using the Internet before dispatching these objects to the customers who requested them. By way of a non-limiting example, the objects which the apparatus 1 allows to be packed may be books, CDs, items of clothing, items for the home or for free time, and many others.

[0024] The apparatus 1 makes it possible to produce, for each object 2, a package 3 which contains the object 2 and is made of a packaging material, which in the example shown is paper. However, packaging materials other than paper can also be used.

[0025] The apparatus 1 comprises an advancement device 4 for advancing the objects 2 in an advancement direction F. In the example shown, the advancement device 4 may comprise a plurality of conveyors, for example of the belt type, with rollers or the like, positioned in sequence along the advancement direction F. More specifically, the advancement device 4 may comprise an infeed conveyor 5, positioned for receiving the objects 2, one after the other, from an introduction device not illustrated. The advancement device 4 may further comprise an outfeed conveyor 7 for moving the packages 3 already formed away and a packaging conveyor 6 interposed between the infeed conveyor 5 and the outfeed conveyor 7. The packaging conveyor 6 may be configured in such a way that the objects 2 are wrapped with the packaging material whilst they advance along the direction F, transported by the packaging conveyor 6.

[0026] In the example shown, the advancement device 4 defines an advancement plane Q along which the objects 2 are moved.

[0027] The apparatus 1 may further comprise a feed device 8 for feeding towards the packaging conveyor 6 a web 9 of packaging material, particularly paper. The web 9 is a continuous web, which is unwound from a reel 10. The feed device 8 may be configured to unwind the web 9 from the reel 10 in a direction of unwinding S which is transversal, more particularly perpendicular, to the advancement direction F.

[0028] Along the path from the reel 10 to the packaging conveyor 6, the web 9 interacts with a plurality of diverting elements, not illustrated, for example rollers, having the aim of modifying a direction of movement of the web 9, which initially coincided with the unwinding direction S perpendicular to the advancement direction F. After interacting with the diverting elements, the web 9 is positioned parallel to the advancement direction F, immediately above the packaging conveyor 6, in such a way that the objects 2 coming from the infeed conveyor 5 are positioned above the web 9.

[0029] The apparatus 1 may also have a layout of a different type from that described above. For example, in an embodiment not illustrated, the unwinding direction S may be parallel to the advancement direction F. The apparatus 1 comprises a gluing system 11 for applying on the web 9 a plurality of lines or spots of glue, in such a way that opposite edge zones of the web 9, after the latter has been folded around the objects 2, can be joined to form the packages 3.

[0030] More specifically, the gluing system 11 comprises a first applying device 12 for applying on the web 9 a first type of glue, in particular a hot-melt glue, that is to say, a glue without liquid solvents which is applied on the packaging material after being heated to a relatively high temperature. The gluing system 11 further comprises a second applying device 13 for applying on the web 9 a second type of glue, different from the first type of glue. The glue of the second type may be a liquid glue, that is to say, containing a solvent such as, for example, water. In an embodiment, the glue of the second type may be a vinyl glue.

[0031] The glue of the first type is a glue having a relatively short setting time, that is to say, which takes a relatively short time to obtain a satisfactory adhesion between the edge zones to be joined. The glue of the second type may have a longer setting time than the glue of the first type, but it is able to maintain a strong bond between the edge zones which it joins also in the presence of relatively high temperatures. In effect, whilst the hot-melt glue, if heated, tends to soften, allowing the reopening of the glued joint, the glue of the second type, that is, the solvent-based glue, is not particularly sensitive to high temperatures and ensures that the glued joint remains substantially intact even if it is heated, for example because the package 3 is transported or stored in a very hot environment. This prevents unwanted reopening of the package 3 following the application of heat.

[0032] Moreover, when the solvent-based glue is applied to the paper, the solvent, which is in the liquid state, penetrates between the fibres of the paper to a greater extent than the hot-melt glue. Due to the penetration of the solvent-based glue between the fibres of the paper, in order to break the joint glued with this type of glue it is necessary to tear the fibres of the paper, which causes a clearly visible deterioration of the glued joint. It is therefore impossible to fraudulently open and reclose the glued joint without leaving signs. The solvent-based glue thus makes the package 3 tamper-proof.

[0033] According to the example shown, the first applying device 12 is positioned along the path of the web 9 upstream of the second applying device 13. This means that the hot glue is applied to the paper before the solvent-based glue. However, this condition is not necessary and in an embodiment not illustrated the opposite could happen.

[0034] The first applying device 12 comprises a first longitudinal applicator 14 for applying the glue of the first type, that is to say, the hot-melt glue, along a longitudinal direction, that is, parallel to the advancement direction F, or in other words, parallel to the length of the web 9.

[0035] The first applying device 12 further comprises a first transversal applicator 15 for applying the glue of the first type, that is to say, the hot-melt glue, along a direction transversal, in particular perpendicular, to the advancement direction F, that is to say, to the length of the web 9.

[0036] In the example shown, the first longitudinal applicator 14 and the first transversal applicator 15 are located side by side, at the same level, along the path of the web 9. However, this condition is not necessary, and the first longitudinal applicator 14 could also be located upstream of the first transversal applicator 15, or downstream of the latter.

[0037] The second applying device 13 may comprise a second longitudinal applicator 16, positioned for applying the glue of the second type, that is to say, the liquid solvent-based glue, along a longitudinal direction, that is to say, parallel to the advancement direction F, or in other words parallel to the length of the web 9.

[0038] The second applying device 13 may further comprise a second transversal applicator 17, for applying the glue of the second type in a direction transversal, in particular perpendicular, to the advancement direction F, that is, to the length of the web 9.

[0039] The second longitudinal applicator 16 and the second transversal applicator 17 may also be positioned side by side, for example at the same level along the advancement direction F, but this condition is not necessary and other reciprocal positions are possible.

[0040] The first longitudinal applicator 14, the second longitudinal applicator 16, the first transversal applicator 15 and the second transversal applicator 17 may each comprise one or more nozzles for applying on the web 9 corresponding quantities of glue. Alternatively, the applicators 14, 15, 16, 17 may comprise elements other than nozzles, for example spreading elements, with rollers, or the like.

[0041] The first longitudinal applicator 14, the second longitudinal applicator 16, the first transversal applicator 15 and the second transversal applicator 17 may be configured to apply on the web 9 one or more spots of glue, or alternatively to apply on the web 9 one or more linear strips of glue.

[0042] In the example shown, the first longitudinal applicator 14 and the first transversal applicator 15 are configured for applying the glue in the form of continuous linear strips.

[0043] More generally speaking, the first longitudinal applicator 14 is configured for applying on the web 9 longitudinal arrangements 41 of glue of the first type, each of which is intended to close a package 3 parallel to the advancement direction F, as shown in Figure 3. Each longitudinal arrangement 41 of glue of the first type may comprise one or more continuous longitudinal strips 18 of hot-melt glue, that is to say, a strip parallel to the length of the web 9 or several strips which extend, one after the other, parallel to the length of the web 9, as shown in more detail in Figure 2.

[0044] The first transversal applicator 15 is configured to apply on the web 9 transversal arrangements 42 of glue of the first type, each of which extends transversely, in particular perpendicularly, to the advancement direction F to close a package 3 in that direction, as shown in Figure 3. Each transversal arrangement 42 of glue of the first type may comprise a plurality of continuous transversal strips 19 of hot-melt glue, aligned with each other transversely to a longitudinal dimension or length of the web 9. The second longitudinal applicator 16 and the second transversal applicator 17 are, on the other hand, configured to apply the liquid solvent-based glue in the form of spots, that is to say, substantially localised zones.

[0045] More generally speaking, as shown in Figures 2 and 3, the second longitudinal applicator 16 is configured to apply on the web 9 longitudinal arrangements 43 of glue of the second type, each of which may comprise a plurality of spots of glue 20 arranged in sequence in such a way as to form a row which extends parallel to the longitudinal dimension or length of the web 9. The longitudinal dimension or length of the web 9 coincides with the advancement direction F, when the web 9 is positioned on the packaging conveyor 6.

[0046] The second transversal applicator 17 is positioned to apply on the web 9 transversal arrangements 44 of glue of the second type, each of which may comprise further spots of glue 21 positioned along a transversal row, that is to say, a row which extends transversely, in particular perpendicularly, to a longitudinal dimension or length of the web 9.

[0047] The first longitudinal applicator 14 and the second longitudinal applicator 16 are positioned in such a way as to apply the corresponding glues close to a longitudinal edge 22 of the web 9. More specifically, the second longitudinal applicator 16 is configured for applying the glue of the second type closer to the longitudinal edge 22 than the glue of the first type applied by the first longitudinal applicator 14, for the reasons which will be explained below.

[0048] The first transversal applicator 15 and the second transversal applicator 17 are also positioned to apply the respective types of glue in such a way that, on the finished package 3, the glue of the second type applied by the second transversal applicator 17 is closer to a transversal edge 40 of the package 3 than the glue of the first type applied by the first transversal applicator 15.

[0049] The longitudinal arrangements 41 of glue of the first type and the longitudinal arrangements 43 of glue of the second type define a longitudinal pattern of glue.

[0050] The transversal arrangements 42 of glue of the first type and the transversal arrangements 44 of glue of the second type define a transversal pattern of glue.

[0051] As shown in more detail in Figure 2, the first

transversal applicator 15 and the second transversal applicator 17 are configured to apply, respectively, the continuous transversal strips 19 and the rows of spots of glue 21 (or, more generally, the respective transversal arrangements of glue) upstream and downstream of an object 2 along a longitudinal dimension or length of the web 9. In particular, on the web 9 it is possible to identify, between two consecutive objects 2, a distribution of adhesives 23 which, along the advancement direction F, that is to say, along a longitudinal dimension of the web 9, comprises in order:

- a transversal arrangement 42 of glue of the first type, that is to say, hot-melt glue, which in the example shown is formed by a plurality of continuous transversal strips 19 of glue of the first type;
- a transversal arrangement 44 of glue of the second type, that is to say, liquid solvent-based glue, which in the example shown comprises a plurality of further spots of glue 21 of the second type;

- a further transversal arrangement 44 of the second type of glue, further comprising a plurality of further spots of glue 21 of the second type;
- a further transversal arrangement 42 of glue of the first type, which in the example illustrated comprises a plurality of continuous transversal strips 19 of glue of the second type.

[0052] Between the two transversal arrangements 44 formed by glue of the second type, it is possible to define an ideal cutting line 24 along which two consecutive packages are separated. The transversal arrangements 44 of glue of the second type are closer to the corresponding ideal cutting line 24 of the transversal arrangements 42 of glue of the first type. In this way, the transversal arrangement 44 of liquid solvent-based glue is closer to the outside of the package 3 than the transversal arrangement 42 of hot-melt glue. This ensures that, even if the package 3 is subjected to high temperatures, the flaps of the package 3 do not separate from each other, even partially. Moreover, if a malicious person tries to tamper with the package 3, they first encounter the transversal arrangement 44 of liquid solvent-based glue. In order to separate the edge zones joined by this transversal arrangement, it is inevitable that the fibres will be broken of the paper inside of which the liquid solvent-based glue has penetrated. The tampering of the package 3 can thus be easily identified.

[0053] For similar reasons, as shown in Figure 3, on a finished package 3 the longitudinal arrangement 43 of glue of the second type, that is to say, solvent-based glue, is applied closer to a free longitudinal edge 45 of a superposing zone 46 of longitudinal edge zones of the web 9, with respect to the longitudinal arrangement 41 of glue of the first type, that is to say, hot-melt.

[0054] The distance between two consecutive cutting lines 24 may vary along the web 9 and depends on the dimensions of the object 2 to be packaged. For example, Figure 2 shows two objects 2a, 2b wherein the object 2b, positioned in front of the object 2a relative to the advancement direction F, has a length L2, measured in the advancement direction F, greater than the length L1 of the object 2a.

[0055] The distance d2 between two consecutive cutting lines 24 which separate the material intended to form the package 3 in which the object 2b is enclosed is consequently greater than the distance d1 between two consecutive cutting lines 24 which separate the material intended to form the package 3 in which the object 2a is enclosed.

[0056] The gluing system 11 is positioned to apply the transversal arrangements 42, 44 of glue of the first type and of the second type in a position which depends on the position of the ideal cutting lines 24, for example in such a way that the transversal arrangements 42, 44 of glue of the first type and of the second type are at respective predetermined distances from the closest ideal cutting line 24.

[0057] The apparatus 1 further comprises a longitudinal folding device 25, shown in an incomplete manner in the drawings, which may comprise two deflector elements 26, shown in Figure 1, and other folding elements not illustrated, positioned to fold opposite longitudinal flaps of the web 9 above the objects 2. The longitudinal folding device 25 may act on the web 9 after the latter has received the objects 2, for example along the packaging conveyor 6. The longitudinal folding device 25 is configured to move alongside the longitudinal edges 22 of the web 9, in such a way that the web 9 forms a tubular wrapper 27 around the objects 2.

[0058] The longitudinal edge 22 of the web 9 having the longitudinal arrangements 41, 43 of glue of the first type and, respectively, of the second type is thus brought into contact with the other longitudinal edge 22 of the web 9, to form a longitudinal joint 28, which extends continuously parallel to the advancement direction F, along which the longitudinal edges of the web 9 are superposed on one another.

[0059] A longitudinal pressing device 29 is positioned along the packaging conveyor 6 for applying pressure at the longitudinal joint 28, in such a way that the glue of the longitudinal arrangements 41, 43 (in particular the glue of the first type, which has a shorter setting time) keeps in contact the superposed longitudinal edges 22 of the web 9. In the example shown, the longitudinal pressing device 29 comprises a presser roller 34, better visible in Figure 5. The longitudinal pressing device 29 may also, optionally, comprise a pressing belt 35, which is wound around the presser roller 34, and, if necessary, a suction element 36 for generating a suction on the pressing belt 35. By using, in addition to the presser roller 34, the pressing belt 35, it is possible to increase the length of the zone in which pressure is applied on the longitudinal joint 28, compared with the case in which only the presser roller 34 is used. If air is also sucked

through the pressing belt 35 and a motor-driven pressing belt 35 is used, a pulling action is exerted by the pressing belt 35 on the packaging material which forms the tubular wrapper 27. This pulling action pulls the packaging material in the advancement direction F, keeping the longitudinal edges 22 of the packaging material superposed on each other, making it more difficult for the longitudinal edges 22 to fold or slide.

[0060] The longitudinal pressing device 29 may, however, be shaped differently from that shown in Figure 5.

[0061] The apparatus 1 may further comprise a printing device 30 for printing, on a portion of the web 9 intended to remain visible, an identification code 31 to which information is associated on the specific object 2 contained in the package 3 formed by that specific portion of the web 9. The identification code 31 may be a bar code. In the example shown, the printing device 30 is positioned upstream of the longitudinal presser roller 29.

[0062] There may further be a reader 32, located downstream of the printing device 30, for reading the identification code 31.

[0063] The printing device 30 may be used to personalise each package 3, that is to say, to print on each package 3 information characteristic of that package 3, different from the information printed on the other packages 3. For example, the identification code 31 printed by the printing device 30 may be used to uniquely identify each package 3 produced (that is to say, each order made by a consumer, if the apparatus 1 is used in the e-commerce sector). It is also possible to use the printing device 30 to print on the web 9 the name of the recipient to whom the corresponding package 3 must be sent, and/or its delivery address, and/or any other information useful for tracking the package 3 or for dispatching it.

[0064] The reader 32 is configured to read the identification code 31 immediately after the latter has been printed on the packaging material, so as to perform an immediate quality control. This control is used to check that the identification code 31 has been correctly generated and printed. In the absence of checks on the identification code 31, there would be the risk of losing the traceability of the package 3. In effect, after the package 3 has been closed, the identification code 31 is the only element which is able to establish a unique connection between the object 2, the package 3, the customer's order and the customer.

[0065] The apparatus 1 further comprises a transversal cutting and pressing device 33, which is better visible in Figure 5, for separating consecutive packages 3 from each other and for closing the packages 3 transversally to the advancement direction F.

[0066] The transversal cutting and pressing device 33 may be interposed between the packaging conveyor 6 and the outfeed conveyor 7.

[0067] The cutting and pressing device 33 comprises a cutting blade 37, which extends transversely, in particular perpendicularly, to the advancement direction F to cut the web 9, which has been folded to form the tubular enclosure 27, so as to separate two adjacent packages 3.

[0068] The cutting blade 37 is interposed between two upper presser elements 38 of an upper presser device. The upper presser elements 38, which are better visible in Figures 6 and 8, extend transversally, in particular perpendicularly, to the advancement direction F. The upper presser elements 38 are arranged to apply pressure to two portions of the tubular wrapper 27 located, respectively, upstream and downstream of the cutting blade 37, on which the transversal strips 42, 44 of glue have been previously applied.

[0069] The transversal cutting and pressing device 33 further comprises a lower presser device which includes two lower presser elements 47, positioned below the corresponding upper presser elements 38 in such a way that the packaging material forming the tubular wrapper 27 is pressed between the upper presser elements 38 and the lower presser elements 47.

[0070] In this way, two transversal joints 39 are obtained which close, respectively, a rear end of one package 3 and a front end of the next package 3.

[0071] The transversal cutting and pressing device 33 further comprises an upper supporting element 48 for supporting the upper presser elements 38. In the example shown, the upper supporting element 48 also supports the cutting blade 37.

[0072] The upper supporting element 48 may extend transversally, in particular perpendicularly, to the advancement direction F. More specifically, the upper supporting element 48 may be shaped like a rectilinear bar. The upper supporting element 48 is positioned at a level higher than the advancement plane Q along which the objects 2 move.

[0073] The transversal cutting and pressing device 33 further comprises a lower supporting element 49 for supporting the lower presser elements 47. The lower supporting element 49 also extends transversely, in particular perpendicularly, to the advancement direction F. The lower supporting element 49 may be shaped like a bar.

[0074] The lower supporting element 49 may further support a contact element, the presence of which is optional and which is not shown in the drawings, designed to operate in conjunction with the cutting blade 37 for cutting the tubular wrapper 27.

[0075] The lower supporting element 49 is positioned below the advancement plane Q along which the objects 2 move.

[0076] The upper supporting element 48 and the lower supporting element 49 are aligned with each other in a vertical direction.

[0077] The upper supporting element 48 and the lower supporting element 49 are movable towards each other, or alternatively, away from each other to move the upper presser elements 38 and the lower presser elements 47 to engage with the packaging material which forms the tubular wrapper 27 (so as to apply sufficient pressure to close the tubular wrapper 27 along the transversal joint 39), or alternatively to disengage from the tubular wrap-

per 27 (so as to allow the objects 2 wrapped in the packaging material to advance in the advancement direction F). More specifically, the upper supporting element 38 and the lower supporting element 49 are movable towards each other along a vertical pressing direction, as indicated by the arrows P in Figure 5, and may move away from each other in a direction opposite to the direction indicated by the arrows P. The transversal cutting and pressing device 33 further comprises a guide system 50 for guiding the upper supporting element 48 and the lower supporting element 49 whilst they are moved towards each other or away from each other. The guide system 50 ensures that the upper supporting element 48 and the lower supporting element 49 remain vertically aligned with each other not only when they interact with the tubular wrapper 27, but also when they move relative to each other.

[0078] The guide system 50 may comprise a pair of vertical guides 51, for example shaped like rods, located on opposite sides of the advancement device 4, in particular of the packaging conveyor 6.

[0079] The upper supporting element 48 and the lower supporting element 49 are slidable along the vertical guides 51.

[0080] The apparatus 1 comprises a driving system for moving the upper presser device, which comprises the upper presser elements 38, and the lower presser device, which comprises the lower presser elements 47, towards or away from each other. The driving system may comprise a first driving device 52 and a second driving device 53.

[0081] The upper supporting element 48 is movable along the respective pressing direction P owing to the first driving device 52 shown in Figure 7. The lower supporting element 49 is movable along the respective pressing direction P owing to the second driving device 53, which is also visible in Figure 7. The first driving device 52 and the second driving device 53 are independent of each other.

[0082] Consequently, the upper presser element 38 may be moved by the first driving device 52 along a stroke of different length to the stroke along which the second driving device 53 moves the lower presser element 47. This makes it possible to select the height Z (relative to the advancement plane Q of the objects 2) at which the upper presser element 38 and the lower presser element 47 interact with the packaging material forming the tubular wrapper 27, that is to say, the height Z of the transversal joint 39. In this way, the transversal joint 39 may be positioned at different heights Z on different packages 3, to take into account the thickness of the object 2 contained in each package 3. In other words, if the object 2 has a very thin thickness, such as in the case of a DVD, the transversal joint 39 may be positioned at a height Z less than the case in which the object 2 has a large thickness, such as in the case of a book with many pages or, in general, a large box.

[0083] This improves the appearance of the packages 3 and limits the defects formed by the packaging material, such as undesired creases, folds and corrugations.

[0084] In the example shown, the first driving device 52 comprises a first motor 54, shown in Figure 7, configured for moving in a vertical direction, upwards or, alternatively, downwards, the upper supporting element 48. Between the first motor 54 and the upper supporting element 48 there is interposed a transmission mechanism for transmitting the motion from the first motor 54 to the upper supporting element 48, transforming the rotary motion of a shaft of the first motor 54 into a forward and backwards rectilinear motion of the upper supporting element 48. The transmission mechanism may comprise a mechanism of the connecting rod and crank type. In more detail, the first motor 54 may have a drive shaft connected, for example by a belt 55, to a pulley 56 to which a crank 57 is connected, for example by a pin 58. The crank 57 is rotatably connected to a rod 59, which acts like a connecting rod. The rod 59 is in turn hinged to an end zone of the upper supporting element 48.

[0085] A further rod 60 is hinged to a further end zone of the upper supporting element 48, opposite the end zone to which the rod 59 is hinged. The further rod 60 can be moved by a further crank, not illustrated, in turn connected to the pin 58.

[0086] In that way, when the first motor 54 rotates, the pulley 56 is in turn rotated and rotationally drives the pin 58. The latter rotates the crank 57, which moves the rod 59 and the further crank, not illustrated, which moves the further rod 60. The upper supporting element 48 is thus moved in a vertical direction, alternatively downwards (in such a way as to move towards the lower supporting element 49 along the pressing direction P) or upwards (so as to move away from the lower supporting element 49).

[0087] As shown in Figure 7, the second driving device 53 comprises a second motor 61 positioned to actuate the lower supporting element 49 with a linear motion, alternatively upwards or downwards, by means of a respective transmission mechanism. The latter may comprise a mechanism of the connecting rod and crank type identical to that which drives the upper supporting element 48. In particular, the second motor 61 may be positioned to rotate, by means of a belt 62 and a pulley 63, a pin 64. Respective cranks 65, each of which is rotatably fixed to a movement rod 66, are connected to two opposite ends of the pin 64. Each movement rod 66 is hinged to an end zone of the lower supporting element 49. In this way, when the second motor 61 is active, the lower supporting element 49 is moved with alternating rectilinear motion upwards or, alternatively, downwards.

[0088] The first driving device 52 and the second driving device 53 are controlled in such a way that, when the first driving device 52 moves the upper supporting element 48 downwards, the second driving device 53 moves the lower supporting element 49 upwards, and vice versa. In this way, the upper supporting element 48 and the lower supporting element 49 simultaneously move to-

wards the tubular wrapper 27 for applying pressure to the transversal arrangements 42, 44 of glue in such a way as to form the transversal joints 39, or alternatively move away simultaneously from the tubular wrapper 27 to allow the latter, and the packages 3 already formed, to advance in the advancement direction F.

[0089] The first motor 54 and the second motor 61 are separate and independent of each other. This makes it possible not only to select the height Z of the transversal joints 39 but also to better adjust the pressure that the upper presser elements 38 and the lower presser elements 47 apply to the transversal arrangements of glue 42, 44. The pressure applied by the upper presser elements 38 and the pressure applied by the lower presser elements 47 may be varied according to the type of packaging material, its thickness, the type of glue, the shape of the upper presser elements 38 and the lower presser elements 47. The formation of the transversal joints 39 is thus optimised.

[0090] The transversal cutting and pressing device 33 further comprises a longitudinal movement system 67, shown in Figures 5 to 7, for moving the upper supporting element 48 and the lower supporting element 49 in a longitudinal direction, that is to say, parallel to the advancement direction F. This ensures that, as explained in more detail below, the upper presser elements 38 and the lower presser elements 47 can move together with the packaging material clamped between them, whilst the tubular wrapper 27 is advanced in the advancement direction F. It is thus possible to apply pressure on the transversal arrangements of glue 42, 44 for a sufficient period of time to effectively close the transversal joint 39. In effect, thanks to the longitudinal movement system 67, the upper presser elements 38 and the lower presser elements 47 can follow the packaging material which forms the tubular wrapper 27 whilst applying pressure on the transversal arrangements of glue 42, 44.

[0091] More in detail, as shown in Figure 7, the longitudinal movement system 67 comprises a pair of carriages 68 positioned on two opposite sides of the advancement device 4, to each of which is fixed a vertical guide 51. As indicated by the arrows H in Figure 5, each carriage 68 slides forwards and backwards along a respective horizontal guide 69, which extends parallel to the advancement direction F. For this purpose, each carriage 68 may be moved along the respective horizontal guide 69 by a movement element which may comprise a movement belt 70, shown in Figure 7, to which the carriage 68 is fixed. The movement belt 70 may be driven by a motor 71, for example coupled to a pulley on which the movement belt 70 is wound. The motor 71 is able to rotate in both directions of rotation, to move the carriage 68 associated with it forwards and backwards.

[0092] The movement of the carriages 68 is controlled in such a way that, when the packaging material is clamped between the upper presser elements 38 and the lower presser elements 47, the carriages 68 move in the advancement direction F at a speed equal to the speed of the packaging material.

[0093] The carriages 68 move parallel to the advancement direction F, in particular along the horizontal guides 69, performing a stroke which is not constant, but which depends on the dimensions of the objects 2 parallel to the advancement direction F. The greater is the size of the objects 2 parallel to the advancement direction F, the longer is the stroke of the carriages 68, that is to say, the greater is the stroke of the upper presser elements 38 and of the lower presser elements 47 in the advancement direction F. In other words, the greater is the size of the objects 2 parallel to the advancement direction F, the greater is the stretch along which the lower presser elements 47 and upper 38 follow the tubular wrapper 27. The upper supporting element 48 further supports an actuator device 72 for moving the cutting blade 37 forwards and backwards along a vertical direction, so as to periodically move the cutting blade 37 to interact with the packaging material forming the tubular wrapper 27 for cutting the latter, separating a package 3 from the tubular wrapper 27. The actuator device 72 may comprise two actuators 73, fixed to the upper supporting element 48. Each actuator 73 may have a rod designed to be fixed, directly or with the interposition of one or more additional components, to a protuberance 74, shown in Figure 12, which projects from the cutting blade 37.

[0094] As shown in Figure 12, the cutting blade 37 may have a serrated cutting edge 75. The serrated shape of the cutting edge 75 allows the packaging material to be cut more easily, particularly if the material is paper. In effect, the protruding ends of the serrations of the cutting edge 75 penetrate first into the packaging material, which is thus pierced. The cutting blade 37 is thus able to penetrate into the packaging material more easily than would occur if the cutting edge 75 were a straight edge without serrations.

[0095] In the example shown in Figure 12, the protruding ends of the serrations are all located at a common level, that is to say, they are arranged along a straight line.

[0096] Figure 13 shows a cutting blade 137 according to an alternative embodiment. The cutting blade 137 still has a serrated shape. However, the protruding ends of the serrations of the cutting blade 137 are not all at the same level. More specifically, the cutting blade 137 has a cutting edge 175 which has a central portion 76, having a length b, comprising a plurality of serrations having respective protruding ends which are arranged at a common level. The central portion 76 is interposed between two peripheral portions 77 which are inclined relative to the central portion 76, in such a way that the packaging material interacts firstly with the central portion 76 and subsequently with the two peripheral portions 77. The peripheral portions 77 may comprise a plurality of serrations whose protruding ends are positioned along a straight line inclined at an angle α relative to the horizontal direction. The two peripheral portions 77 may have the same length, denoted by the letter "a" in Figure 13.

[0097] The cutting blade 137 shown in Figure 13 has

a lower penetration resistance in the packaging material than the cutting blade 37 shown in Figure 12. In effect, when the cutting blade 137 encounters the packaging material, initially only the central portion 76 penetrates into the packaging material. The peripheral portions 77 penetrate the packaging material only subsequently, which reduces the strength which the packaging material offers to the penetration of the cutting blade during the initial phases.

[0098] Depending on the type of packaging material and its properties, it is also possible to select the number of serrations of the cutting edge and the dimensions of the serrations, in particular the height, the width and the spacing. In the example of Figure 12, the number of serrations is relatively small and the cutting blade 37 is provided with serrations having relatively large dimensions and a large spacing. In the example of Figure 13, the number of serrations is greater since the serrations are smaller and closer than the case of Figure 12.

[0099] As shown in Figure 8, the upper presser elements 38 are delimited by respective pressing surfaces 78 which may have a non-planar geometry. In particular, each pressing surface 78 may comprise a protruding zone 79, which projects towards the corresponding lower presser element 47, and a recess zone 80. In the example shown, the protruding zone 79 is positioned closer to the cutting blade 37 than the recess zone 80. However, this condition is not necessary and, in an alternative embodiment not illustrated, other provisions could be adopted.

[0100] The lower presser elements 47 are delimited by respective pressing faces 81 having a shape matching the shape of the pressing surfaces 78 with which they engage.

[0101] When the upper presser elements 38 and the lower presser elements 47 interact with the packaging material, applying pressure to that material, the upper presser elements 38 and the lower presser elements 47 deform the packaging material in a controlled manner.

[0102] This forms a transversal joint 39 having a geometry which is not flat, as shown in Figure 9. In particular, the transversal joint 39 comprises a first deformed zone 82, located at a position closest to the inside of the package 3, and a second deformed zone 83, located closer to the cutting line 24.

[0103] The first deformed zone 82 and the second deformed zone 83 may each have a concave geometry, with a concavity facing opposite directions relative to each other. For example, in the embodiment of Figure 9, the first deformed zone 82 has a concavity facing downwards, whilst the second deformed zone 83 has a concavity facing upwards. Thanks to the first deformed zone 82 and the second deformed zone 83, the packaging material has, in the transversal joint 39, a corrugated shape, for example in the shape of an "S".

[0104] By deforming the packaging material close to the transversal joint 39, it is possible firstly to increase the gluing surface, since the packaging material is smoothed locally and the surface available to the glue increases. Moreover, the first deformed zone 82 and the second deformed zone 83 define on the packaging material respective stiffening ribs, which render more rigid an edge zone of each package 3 and increase its resistance to impacts.

[0105] Lastly, thanks to the deformation of the transversal joint 39, and in particular thanks to the first deformed area 82, which is closest to the inside of the package 3, it is possible to prevent the object 2, if the object 2 slips towards the transversal joint 39 (for example because the package 3 has been positioned vertically), from coming into contact with the glue applied at the transversal joint 39 and soiling, or damaging the transversal joint 39. If the object 2 slides towards the transversal joint 39, the object 2 stops when it interacts with the first deformed area 82, which prevents the object 2 from coming into contact with the glue. In effect, the latter is normally applied in a position interposed between the first deformed area 82 and the second deformed area 83.

[0106] It is possible to adopt various types of geometry for the pressing surfaces 78 and for the pressing faces 81, for example depending on the characteristics of the packaging material and the glues used.

[0107] In the example shown in Figure 8, the protruding zone 79 and the recess zone 80 of each upper presser element 38 are delimited by a trapezoidal profile. Consequently, the first deformed area 82 and the second deformed area 83 present on the package 3 have a trapezoidal geometry.

[0108] It is, however, also possible to adopt other geometries for the protruding zones 79 and the recess zones 80. For example, in the embodiment of Figure 10, each upper presser element 38 is delimited by a pressing surface 78 which has a protruding zone 179 and a recess zone 180 with a curvilinear shape, in particular circular.

[0109] In this case, as shown in Figure 11, the transversal joint 39 has a first deformed area 182 and a second deformed area 183 with a curvilinear shape.

[0110] During operation, the web 9 of packaging material, particularly paper, is unwound from the reel 10 and brought to interact with the first applying device 12 and the second applying device 13, which apply on the web 9 the glue of the first type and of the second type according to respective longitudinal arrangements 41, 43 and according to respective transversal arrangements 42, 44.

[0111] After application of the glue, the web 2 is diverted towards the packaging conveyor 6 and positioned above the latter.

[0112] After receiving the objects 2 to be packaged on the packaging conveyor 6, the web 9 is folded to form the tubular wrapper 27 in which the objects 2 are enclosed. The longitudinal pressing device makes it possible to apply pressure to opposite longitudinal edge zones of the web 9, to bring the zones into contact and apply a sufficient pressure so at least one type of glue applied grips and keeps closed the longitudinal joint 28.

[0113] The tubular wrapper 27 is advanced in the advancement direction F at a speed which may be variable.

[0114] The upper supporting element 48 and the lower supporting element 49 are moved vertically towards each other in the pressing direction P by the respective independent driving devices 52, 53, so that the upper presser elements 38 and the lower presser elements 47 come into contact with the packaging material and clamp it between them, in the region of the packaging material in which the transversal arrangements 42, 44 of glue have been applied.

[0115] The upper presser elements 38 and the lower presser elements 47 move in contact with each other opposite zones of the tubular wrapper 27 intended to form the transversal joints 39. Moreover, the pressing surfaces 78 and the pressing faces 81 deform the packaging material, as described above with reference to Figures 8 to 11. Lastly, a pressure is applied to the glue of the first type and to the glue of the second type previously positioned on the web 9, so that the two glues penetrate between the fibres of the packaging material and create a resistant and long-lasting transversal joint 39.

[0116] The upper presser elements 38 and the lower presser elements 47, between which the packaging material is clamped, are advanced along the advancement direction F by the longitudinal movement system 67, so as to follow the packaging material and apply pressure to the transversal joint 39 for sufficient time to guarantee the closure.

[0117] That is to say, the pressing time is maximised during which the upper presser elements 38 and the lower presser elements 47 apply pressure to the packaging material. This makes it possible to obtain the maximum adhesive capacity of the glue with the packaging material, since the time available for the glue to penetrate into the fibres of the packaging material is increased.

[0118] Whilst the packaging material is clamped between the upper presser elements 38 and the lower presser elements 47, the actuator device 72 actuates the cutting blade 37 moving it downwards in a vertical direction, so that the cutting blade 37 pierces the layers of packaging material which it encounters and cuts the packaging material, separating the packages 3 from the tubular wrapper 27.

[0119] When the transversal joint 39 has been formed, the driving devices 52 and 53 move the upper presser elements 38 and the lower presser elements 47 away from each other, so as to free the packaging material.

[0120] The longitudinal movement system 67 returns the upper supporting element 48 and the lower supporting element 49 backwards, with the components supported by them, moving them in the opposite direction to the advancement direction F until reaching a position along the packaging conveyor 6 wherein the upper presser elements 38 and the lower presser elements 47 are ready to engage again with the packaging material.

[0121] As already explained above, the driving devices 52 and 53 which are independent of each other allow the transversal joint 39 to be positioned at a desired height Z. Moreover, by actuating the upper presser elements 38 and the lower presser elements 47 independently of each other, it is possible to vary the pressure force which the upper presser elements 38 and the lower presser elements 47 are able to apply, making it suitable for types of glue and packaging materials which are different to each other. Further, by actuating the cutting blade 37 with its own actuator device 72, independent of other actuators of the apparatus 1, makes the cutting operations extremely flexible. It is in effect possible to freely select the thrust force with which the cutting blade 37 acts, its cutting speed and the moment in which the cutting blade is moved to penetrate the packaging material.

[0122] According to the embodiments described above, a package 3 of the type shown in Figures 3 and 4 is obtained, wherein the packaging material protrudes outwards at two lateral faces 84 of the package 3, the lateral faces extending parallel to the advancement direction F. In this way, undesired swelling may be generated in the packaging material, which is particularly evident in the case of packages 3 of reduced height or of particularly thick or rigid packaging materials.

[0123] Moreover, the so-called "sweet wrapper" shape is generated, that is to say, the width of the transversal joints 39 is greater than the width of the package 3, measured in a central zone of the package. The transversal joints 39 protrude from a central zone of the package 3, which is not aesthetically attractive.

[0124] In order to overcome this drawback, the apparatus 1 may be provided with a pair of lateral folding elements 85, only one of which is shown in Figure 1, positioned to interact with portions of the tubular wrapper 27 designed to create two opposite lateral faces 84 of a package 3. The lateral folding elements 85 are configured to fold the packaging material towards the inside of the package, forming a package 103, shown in Figures 14 and 15, the lateral faces 84 of which are provided with respective longitudinal folds 86, delimited by two inclined surfaces 87 which penetrate towards the inside of the package 103.

[0125] At the longitudinal folds 86, the packaging material is positioned to form a sort of "V", with the vertex of the "V" facing towards the inside of the package 103, in a transversal cross section in a vertical plane perpendicular to the advancement direction F.

[0126] This prevents undesired swelling of the packaging material towards the outside.

[0127] The lateral folding elements 85 may be shaped like bars which extend parallel to the advancement direction F on opposite sides of the tubular wrapper 27, for example above the packaging conveyor 6. The lateral folding elements 85 may be positioned at the sides of the longitudinal pressing device 29.

[0128] The lateral folding elements 85 may be activated selectively, when the packaging material is to be folded towards the inside of the package 3, moving them towards the tubular wrapper 27.

[0129] If there is no desire to fold the packaging material which forms the lateral faces 84 towards the inside

of the package, the lateral folding elements 85 may be positioned in a position spaced from the tubular wrapper 27, in such a way as not to interact with the packaging material. A package of the type shown in Figures 3 and 4 is thus obtained, wherein the packaging material protrudes outwards onto the lateral faces 84.

[0130] If, on the other hand, a more compact package is to be formed without swelling of the packaging material on the lateral faces 84 and/or without protruding lateral joints 39, it is possible to activate the lateral folding elements 85, moving them close to a centre line of the packaging conveyor 6, in such a way that they interact with the tubular wrapper 27. The lateral folding elements 85 will thus produce the longitudinal fold 86 on the lateral faces 84.

[0131] The transversal cutting and pressing device 33 is located downstream of the lateral folding elements 85 relative to the advancement direction F. For this reason, when the lateral joint 39 is formed, the packaging material is already folded according to a "V" shape along its entire length. The transversal joint 39 blocks the packaging material in the shape of a "V" at the two ends of each package 103. Thus, a more compact package 103 is obtained wherein the transversal joints 39 have the same width as the central zone of the pack.

[0132] Moreover, thanks to the packaging material folded towards the inside, the longitudinal folds 87 define an additional protection against impacts for the packaged object 2.

[0133] The lateral folding elements 85 may be activated or deactivated for each individual package. In other words, depending on the width of the object 2 to be packaged and the type of package to be obtained, it is possible to decide to make the lateral folding elements 85 work or leave them inactive. This allows the flexibility of the apparatus 1 to be increased.

[0134] Figure 16 shows a portion of the apparatus 1 according to an alternative embodiment, wherein it is possible to produce packages which can be easily opened by the consumer to extract the object 2 contained therein and check the correspondence to the consumer's wishes.

[0135] The packages produced by the embodiment of the apparatus 1 shown in Figure 16 may also be easily closed, without using adhesive tape, glue or similar anchoring systems applied by the consumer, if it is necessary to return to the sender the package 3 and the object 2 contained therein. The functions of simplified opening and reclosing capacity mentioned above may be obtained by applying a tear strip and a two-sided adhesive strip to the web 9 of packaging material.

[0136] In the embodiment shown in Figure 16, there is a first applying element 88 for applying on the web 9 a tear strip 89 designed to be gripped and pulled by the user to open the package 3 at a predetermined position. There is also a second applying element 90 for applying on the web 9 a two-sided adhesive strip 91 suitable for reclosing the package 3 after opening if necessary.

[0137] The first applying element 88 and the second applying element 90 may be configured to apply, respectively, the tear strip 89 and the two-sided adhesive strip 91 on a face of the web 9 of packaging material intended to face the object 2, that is to say, it is positioned inside the package 3.

[0138] The first applying element 88 is configured to apply the tear strip 89 in a position closer to the longitudinal edge 22 of the web 9 along which the glue will be applied, relative to the two-sided adhesive strip 91. The first applying element 88 makes it possible to unwind the tear strip 89 from a first reel 92 and to press the tear strip 89 against the web 9 still wound on the respective reel 10. Similarly, the second applying element 90 unwinds the two-sided adhesive strip 91 from a second reel 93 and applies it, by pressing, on the web 9 wound on the respective reel 10. More specifically, the tear strip 89 and the two-sided adhesive strip 91 are applied on a face of the web 9 facing towards the outside of the reel 10.

[0139] The tear strip 89 and the two-sided adhesive strip 91 adhere to the web 9 because on the side of the tear strip 89 and the two-sided adhesive strip 91 intended to come into contact with the web 9 there is an adhesive substance, for example a pressure-sensitive adhesive.

[0140] The feed device 8, already mentioned with reference to Figure 1, is configured to unwind from the reel 10 the web 9 to which the tear strip 89 and the two-sided adhesive strip 91 already adhere, advancing it in the unwinding direction S. The web 9 is thus brought to interact with a perforating device 94 configured to form on the web 9 a line of weakness 95 along which the packaging material is intended to be torn by the consumer.

[0141] The perforating device 94 may comprise a perforating wheel 96 having along its periphery a plurality of protrusions suitable for penetrating into the packaging material to form corresponding local weaknesses, for example holes. The perforating device 94 may further comprise an opposing roller 97, rotatable about an axis parallel to an axis of rotation of the perforating wheel 96. The web 9 is passed between the perforator wheel 96 and the opposing roller 97, which supports the packaging material whilst the latter is pierced.

[0142] As shown more clearly in the enlarged detail of Figure 16, the line of weakness 95 is formed parallel to an edge of the tear strip 89 and close to the latter. For example, the line of weakness 95 may be superposed on the tear strip 89, as shown in the enlarged detail of Figure 16, or outside the tear strip 89 and close to the latter.

[0143] After the line of weakness 95 has been made on the web 9, the glue is applied to the web 9, which may comprise, for example, a glue of the first type and a glue of the second type, as described with reference to Figures 1 and 2. In particular, the glue is applied on the same face of the web 9 on which the tear strip 89 and the two-sided adhesive strip 90 are present. As shown in the detail of Figure 16, the tear strip 89 and the two-sided adhesive strip 91 are positioned in a position further away

from the edge 22 than the longitudinal arrangement of glue which, in the example illustrated, comprises the longitudinal arrangement 41 of glue of the first type and the longitudinal arrangement 43 of glue of the second type.

[0144] The web 9 is then positioned on the packaging conveyor 6, where it receives the objects 2 and where it will be processed to form the tubular wrapper 27 and, therefore, the packages.

[0145] In the finished package, the tear strip 89 and the two-sided adhesive strip 91 extend in a longitudinal direction, parallel to the longitudinal joint 28, that is to say, they extend from one end of the package closed by a transversal joint 39 to a further end of the package closed by a further transversal joint 39.

[0146] When the user wishes to open a package, it is sufficient for the user to grip and pull the tear strip 89. Due to the force applied by the user, the packaging material tears at the line of weakness 95, allowing the user to open the package without external tools, such as scissors or paper cutters. Moreover, the package is opened without completely tearing the packaging material which constitutes it, but with a localised breakage in a predetermined zone. This makes it possible to re-use the package if desired or it is necessary to do so.

[0147] For example, if the package contains an object 2 sent to the user who ordered it and if, after opening the package, the user detects that the object 2 does not conform to their expectations, the object 2 may be reintroduced into the package and the latter may be reclosed thanks to the two-sided adhesive strip 91 and reused to return the object 2 to the sender. In order to do this, it is sufficient for the user to remove a protective band included in the double-sided adhesive strip 91 so as to make an adhesive accessible, for example of the pressure sensitive type applied on the double-sided adhesive strip 91. The user, does not, on the other hand, need to use glues, adhesive tapes, staples or other external fastening means to close the package.

[0148] Figure 17 shows a package 203 according to an alternative embodiment. The package 203 has a handling element 98 which can be used to handle the package. For example, the handling element 98 may be used by a consumer as a gripping element or handle to grip the package and transport it, or it may be used to hang the package, for example in a display unit, so as to show to the public the object 2 contained therein.

[0149] The handling element 98 is formed on a band protrusion 99 provided at one end of the package 203. The band protrusion 99 extends from a transversal joint 39 towards the outside of the package, so as to be interposed between a transversal joint 39 and a free edge 100, which delimits the band protrusion 99 on the opposite side with respect to the free edge 100.

[0150] In the example shown in Figure 17, the handling element 98 is defined by an incision 101 passing through the entire thickness of the band protrusion 99. The incision 101 at least partly surrounds a foldable portion 104 made from two superposed layers of packaging material. The foldable portion 104 may be folded manually by the user, as shown in Figure 20, so as to define an opening 102 in which the user can insert a hand for transporting the package 203.

[0151] The incision 101 may have different geometries. In the example shown, the incision 101 has a straight stretch interposed between two portions in the form of a "C", the concavities of which are facing each other. However, this condition is not necessary.

[0152] The incision 101 is an open line, that is to say, it is not a closed-loop line. Between two ends of the incision 101 an ideal hinge line may be defined about which the foldable portion 104 can be rotated to make the opening 102 accessible.

[0153] According to an alternative embodiment, shown in Figure 21, the handling element 98 may be defined by a closed incision 201. The incision 201 surrounds an opening 202 in which a hand of the user can be introduced, for transporting the package. Alternatively, a supporting element, for example a display unit, may be introduced in the opening 202 for hanging the package. In this case, the handling element 98 acts as a fastening element.

[0154] As shown in Figure 17, at least one spot of glue 109 may be applied to the band protrusion 99 to keep in contact opposite flaps of the packaging material, in particular close to the free edge 100. More than one spot of glue can be provided, for example a pair of spots of glue located, respectively, upstream and downstream of the handling element 98 relative to a longitudinal direction of the package.

[0155] The handling element 98 may be made from a transversal cutting and pressing device 133 of the type shown in Figures 18 and 19. The transversal cutting and pressing device 133 may be inserted in an apparatus similar to the apparatus 1 shown in Figure 1.

[0156] The transversal cutting and pressing device 133 comprises a plurality of components which are also present in the transversal cutting and pressing device 33 described with reference to Figure 5. These components are denoted by the same reference numerals used in Figure 5 and are not described again in detail.

[0157] In the transversal cutting and pressing device 133, the upper supporting element 48 supports a punch 105 which is provided, at a relative lower end, with a cutting edge having the same geometry as the incision 101, 201. The punch 105 is intended to interact with the packaging material constituting the band protrusion 99 for making on it the incision 101, 201. The upper supporting element 48 further supports an actuator element 106, for example comprising a pneumatic cylinder, configured for moving the punch 105 with an alternating rectilinear motion along a vertical direction, that is to say, downwards and upwards, for periodically moving the punch 105 to interact with the packaging material. The drive element 106 may be interposed between the two actuators 73 acting on the cutting blade 37.

[0158] On the lower supporting element 49 there is a

die 107, which may be positioned in a fixed position relative to the lower supporting element 49. The die 107 is positioned to interact with the punch 105 so as to make the incision 101, 201.

[0159] The transversal cutting and pressing device 133 comprises two upper presser elements 138 similar to the upper presser elements 38 described above and designed to apply pressure on the packaging material of the tubular wrapper 27 to form the transversal joint 39 of a package and the transversal joint 39 of the adjacent package. The upper presser elements 138 are spaced from each other in such a way that the band protrusion 99 is left between two consecutive transversal joints 39 (and belonging to two different packages). Interposed between the upper presser elements 138 there is the punch 105, which is movable independently of the upper presser elements 138 owing to the actuator element 106.

[0160] In the example shown in Figures 18 and 19, the cutting blade 37 is positioned between the punch 105 and the upper presser element 138 positioned in the most advanced position along the advancement direction F. In this way, it is possible to obtain a package 203 wherein the handling element 98 is located at a front end of the package 203, relative to the advancement direction F. However, this condition is not necessary.

[0161] The transversal cutting and pressing device 133 comprises two lower presser elements 147 designed to operate in conjunction with the upper presser elements 148 to form the transversal joints 39. One of the lower presser elements 147 may be provided with an extension 108 on which the die 107 is formed.

[0162] In the example shown, the extension 108 is provided on the lower presser element 147 positioned in a more withdrawn position along the advancement direction F.

[0163] The transversal cutting and pressing device 133 may optionally be configured to apply pressure on the spot of glue 109 in such a way as to facilitate the gripping of the corresponding glue.

[0164] Figures 22 and 23 show a transversal cutting and pressing device 233 according to an alternative embodiment, configured for producing a package 303 of the type shown in Figure 24, wherein the handling element 98 is positioned at the rear end of each package 203, with respect to the advancement direction F.

[0165] The die 107 and the punch 105 are in this case configured for making a cutting line which is symmetrical relative to that shown in Figures 18 and 19.

[0166] The presence of the punch 105 and of the die 107 is, however, optional.

[0167] It is also possible to selectively operate the actuator element 106 to produce packages provided with the handling element 98 only when this is requested.

[0168] The devices described so far in a single apparatus must not necessarily be present simultaneously in combination with each other.

[0169] For example, the transversal cutting and pressing device which comprises using independent driving devices for the lower presser elements and, respectively, for the upper presser elements could also be used in combination with gluing systems wherein only one type of glue is applied to the packaging material.

[0170] Vice versa, the gluing system which uses two different types of glue described with reference to Figures 1 to 4 could also be used in apparatuses wherein the lower presser elements and the upper presser elements are moved by a shared driving device.

[0171] Thanks to the apparatus 1, it is possible to obtain packages, in particular for products which can be purchased using e-commerce, made from a packaging material which is inexpensive and recyclable, such as paper.

[0172] It is also possible to minimise the consumption of packaging material, since the apparatus 1 allows selection of the distance between two consecutive cutting lines 24, that is to say, the length of the package, on the basis of the length measured for each object 2 to be packaged.

[0173] The dimensions of the packages can thus be optimised according to the dimensions of the corresponding objects 2, which allows the consumption of packaging material to be minimised.

[0174] Moreover, waste is not generated during operation of the apparatus 1. The apparatus 1 operates in a highly automated manner both with regard to the creation of the packages and with regard to their closing and is able to reach high production speeds.

Claims

1. An apparatus comprising:

- an advancement device (4) for advancing in an advancement direction (F) along an advancement plane (Q) a plurality of objects (2) to be packaged, the objects (2) being wrapped in a tubular wrapper (27) of packaging material;
- an upper presser device (38; 138) and a lower presser device (47);
- a driving system for moving the upper presser device (38; 138) and the lower presser device (47) towards each other or away from each other, so that the upper presser device (38; 138) and the lower presser device (47) exert pressure on the packaging material to generate a transversal joint (39) or, alternatively disengage from the packaging material;
- a longitudinal movement device (67) for moving the upper presser device (38; 138) and the lower presser device (47) along the advancement direction (F) so that the upper presser device (38; 138) and the lower presser device (47) remain engaged with the packaging material while the packaging material is advancing in the advancement direction (F);

wherein the driving system comprises a first driving device (52) connected to the upper presser device (38; 138) and a second driving device (53) connected to the lower presser device (47), the first driving device (52) and the second driving device (53) being distinct from each other for moving the upper presser device (38; 138) and the lower presser device (47) transversally to the advancement direction (F) independently from each other, **characterised in that** the first driving device (52) and the second driving device (53) are configured to vary the height (Z) of the transversal joint (39) with respect to the advancement plane (Q), by moving the upper presser device (38; 138) and the lower presser device (47) transversely to the advancement direction (F) along respective strokes which can be selected independently from each other.

2. The apparatus according to claim 1, wherein the upper presser device (38; 138) and the lower presser device (47) are configured to apply an adjustable pressure on the packaging material at the transversal joint (39).

3. The apparatus according to claim 1 or 2, wherein the first driving device (52) comprises a first motor (54) connected to the upper presser device (38; 138) by a motion transmission mechanism, the second driving device (53) comprising a second motor (61) connected to the lower presser device (47) by a further motion transmission mechanism.

4. The apparatus according to claim 3, wherein the motion transmission mechanism and the further motion transmission mechanism are connecting rod-crank mechanisms.

5. The apparatus according to any preceding claim, and further comprising an upper supporting element (48) and a lower supporting element (49) which extend transversely to the advancement direction (F) and support, respectively, the upper presser device (38; 138) and the lower presser device (47), the upper supporting element (48) and the lower supporting element (49) being movable by the first driving device (52) and by the second driving device (53) along at least a common guide element (51).

6. The apparatus according to any preceding claim, wherein the longitudinal movement device (67) comprises at least one carriage (68) and at least one guide (69) positioned parallel to the advancement direction (F), the longitudinal movement device (67) further comprising a motor (71) for driving the carriage forwards and backwards along the guide (69).

7. The apparatus according to claim 6, as appended to claim 5, wherein the common guide element (51) is fixed relative to the carriage (68).

8. The apparatus according to any preceding claim, wherein the upper presser device comprises a pair of upper presser elements (38; 138) arranged to interact with edge zones of two packages (3; 103; 203), the lower presser device comprising a pair of lower presser elements (47), each of which is vertically aligned with a corresponding upper presser element (38; 138) and wherein optionally each upper presser element (38; 138) is delimited by a pressing surface (78) suitable for coming into contact with the packaging material, the pressing surface (78) having a protruding zone (79; 179) which protrudes towards the corresponding lower presser element (47) and a recess zone (80; 180) positioned alongside the protruding zone (79; 179), each lower presser element (47) being delimited by a pressing face (81) having a shape complementing the pressing surface (78), so as to deform the packaging material in the transversal joint (39) according to an undulating shape.

9. The apparatus according to claim 8, and further comprising a cutting blade (37; 137) interposed between the upper presser elements (38; 138) or between the lower presser elements (47) for cutting the packaging material between two transversal consecutive joints (39).

10. The apparatus according to claim 9, wherein the cutting blade (37; 137) is delimited by a serrated cutting edge (75; 175).

11. The apparatus according to claim 9 or 10, wherein the cutting blade (137) has a substantially horizontal central portion (76) interposed between two inclined peripheral portions (77), the central portion (76) protruding from the peripheral portions (77) to interact with the packaging material before the peripheral portions (77).

12. The apparatus according to any one of claims 9 to 11, and further comprising at least one actuator (73) for actuating the cutting blade (37; 137) forwards and backwards in a direction transversal to the advancement direction (F), so as to periodically bring the cutting blade (37; 137) to interact with the packaging material.

13. The apparatus according to any preceding claim, and further comprising a punch (105) delimited by a cutting edge and a die (107) facing the punch (105), the punch (105) and the die (107) being positioned on opposite sides of the packaging material to obtain an incision (101; 201) between two adjacent transversal joints (39), so as to define on the package (203; 303) an opening by which a user can grip or hang the package (203; 303).

14. The apparatus according to claim 13, as appended to any one of claims 8 to 12, wherein the upper presser elements (38; 138) are spaced from each other along the advancement direction (F) and the lower presser elements (47) are spaced from each other along the advancement direction (F), so as to house the punch (105) between the upper presser elements (38; 138) and the die (107) between the lower presser elements (47) or vice versa.

15. The apparatus according to any preceding claim, and further comprising a pair of lateral folding elements (85) arranged upstream of the upper presser device (38; 138) and of the lower presser device (47) with respect to the advancement direction (F) and positioned on opposite sides of the tubular wrapper (27), so as to interact with respective lateral faces (84) of the tubular wrapper (27) for folding the packaging material towards the inside of the package (103), and wherein optionally the lateral folding elements (85) are selectively displaceable between an interaction configuration in which the lateral folding elements (85) interact with the tubular wrapper (27) for folding the packaging material and a spaced apart configuration in which the lateral folding elements (85) are far from the tubular wrapper (27).

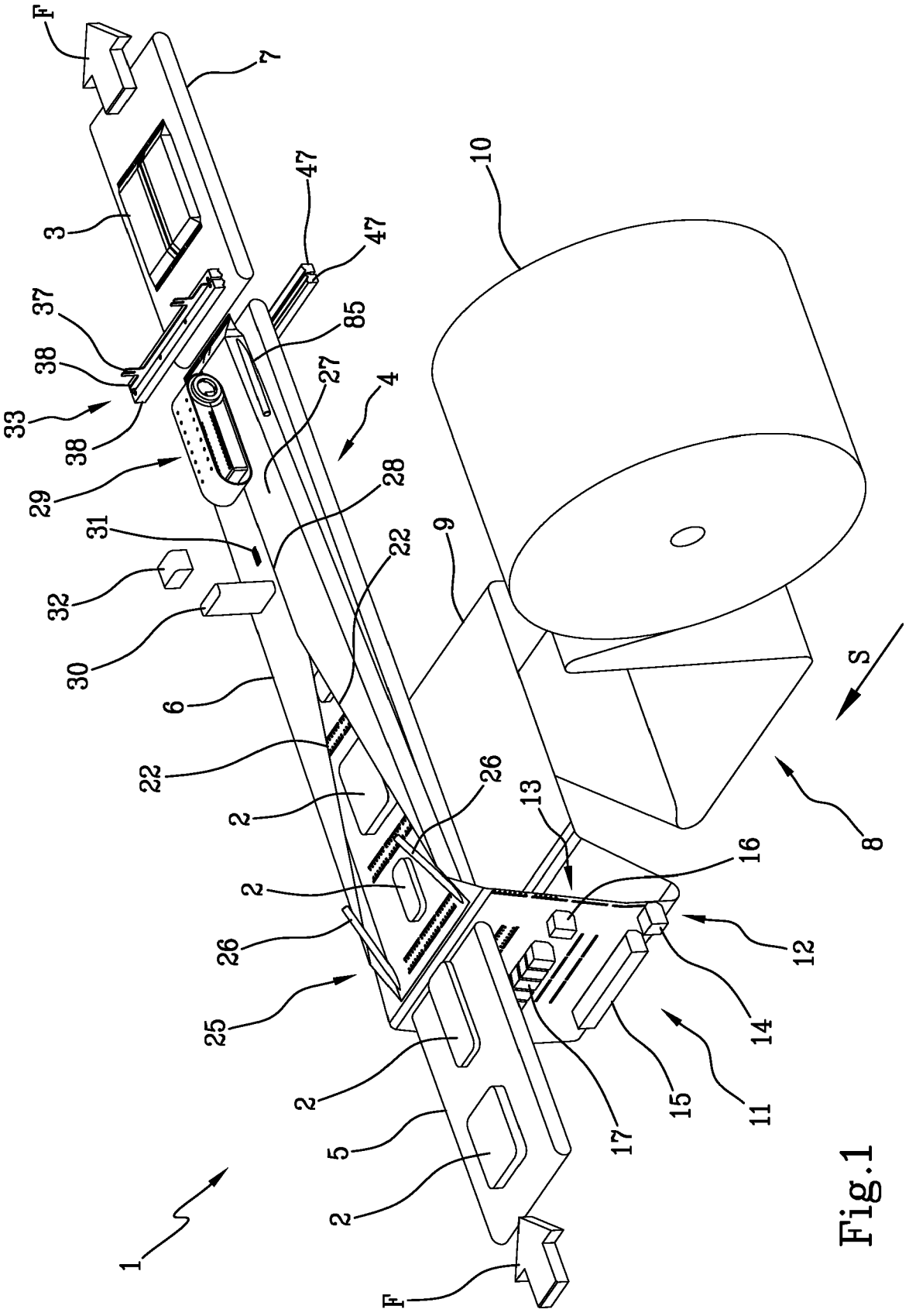
F
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Fig.1

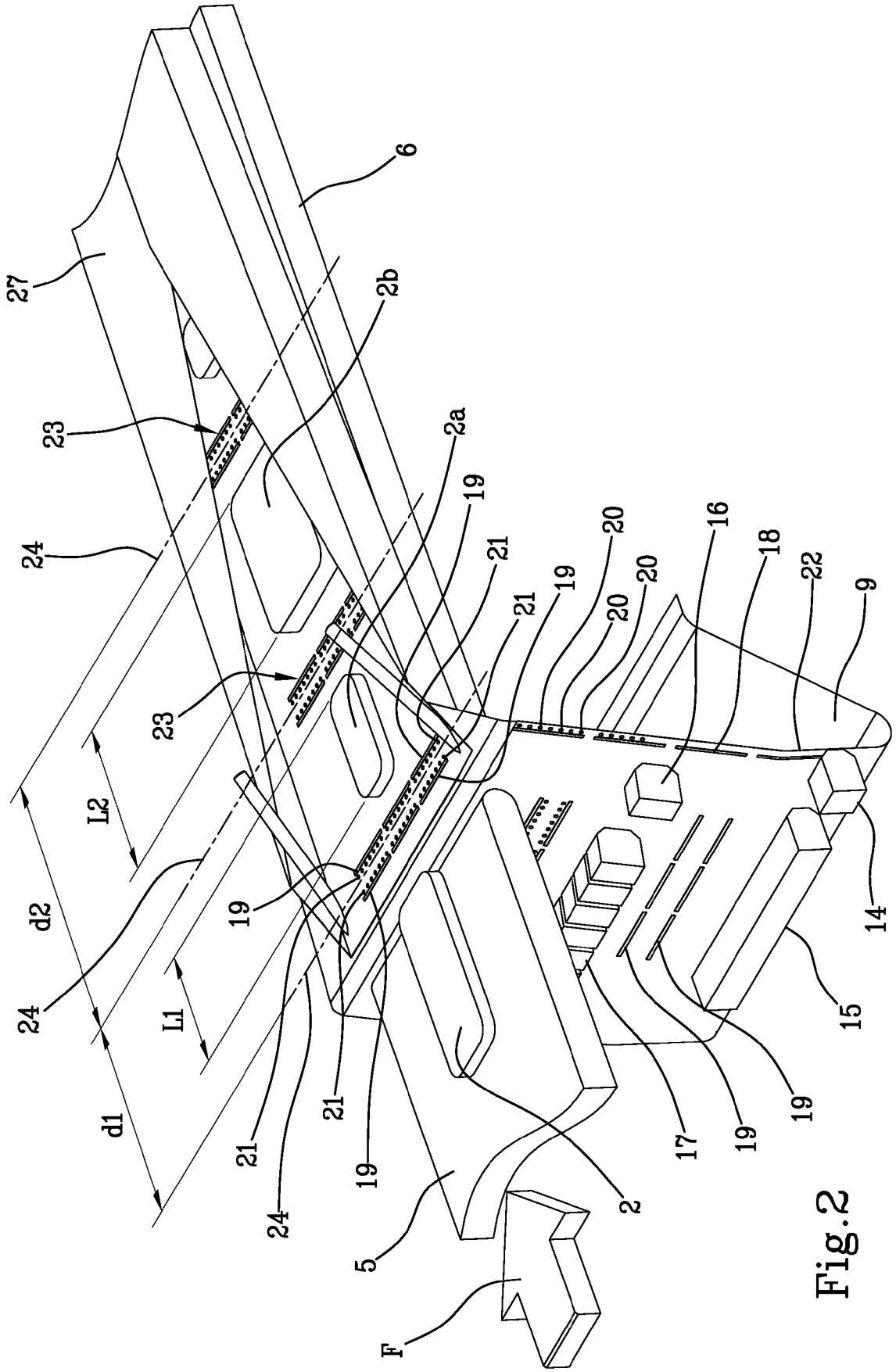
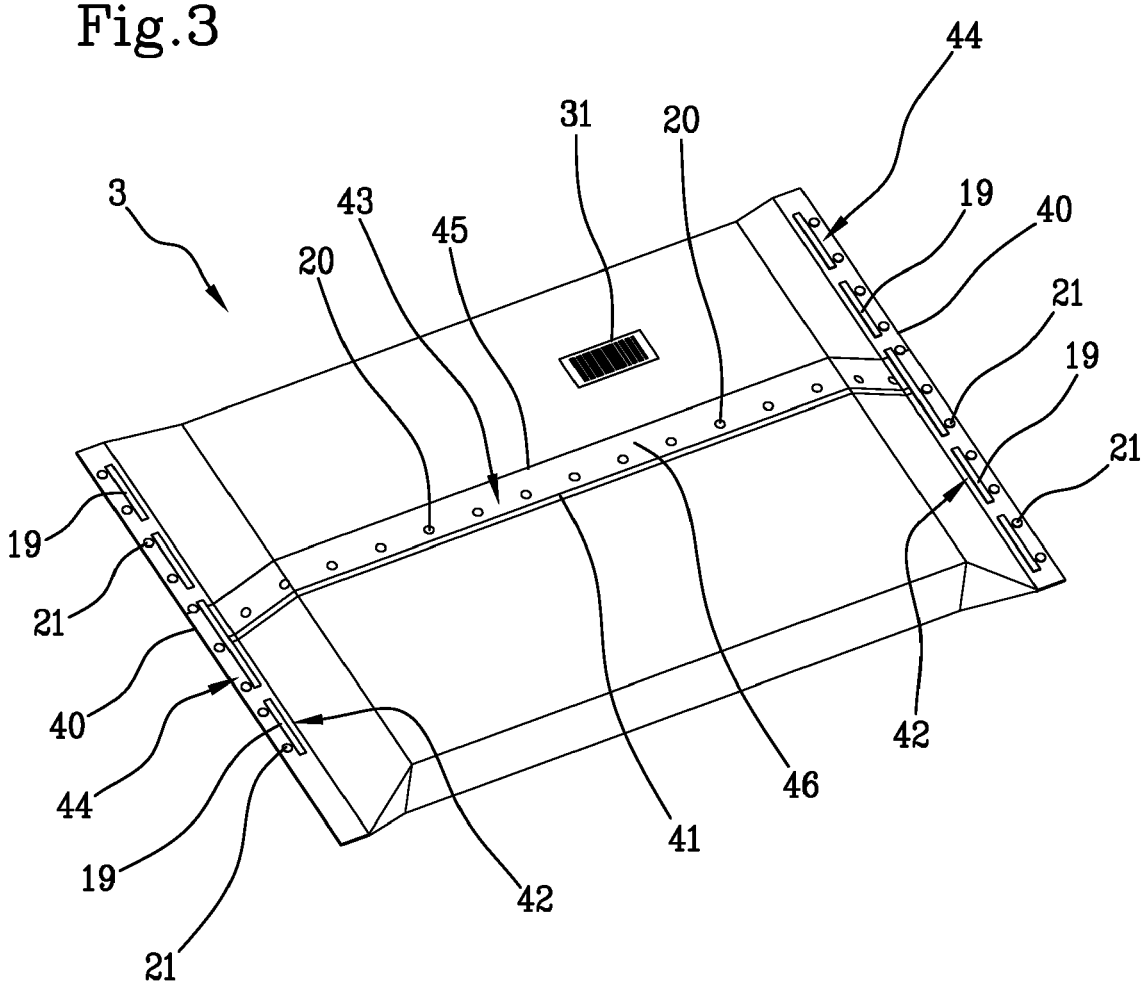


Fig.2

Fig.3



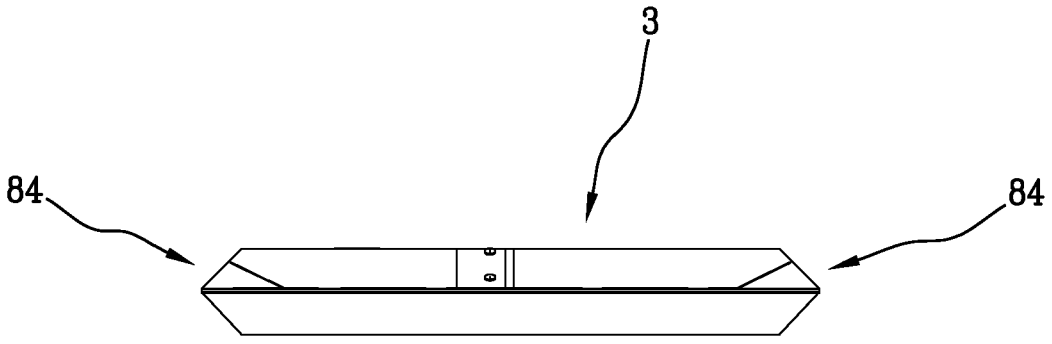


Fig.4

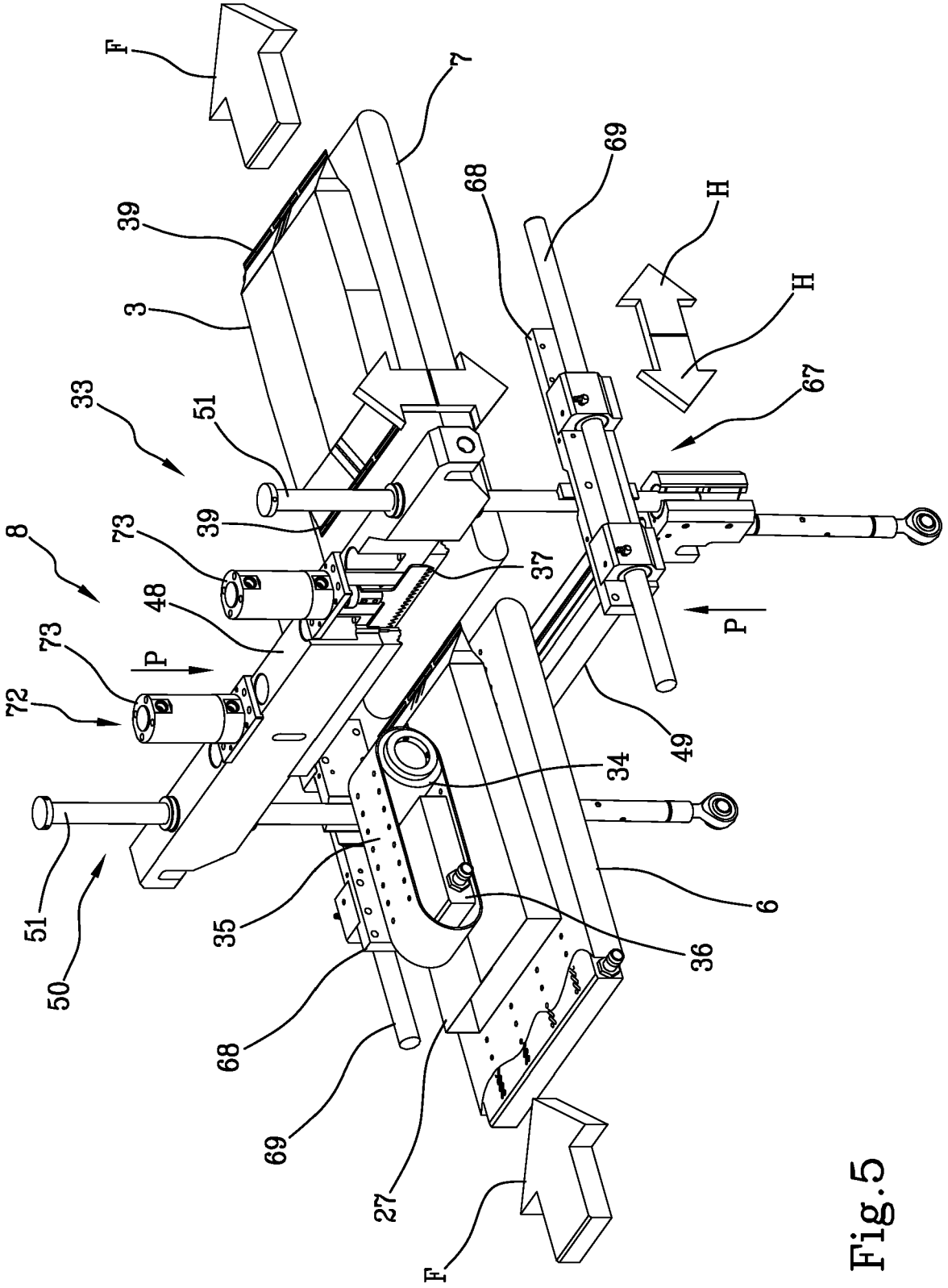

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Fig.5

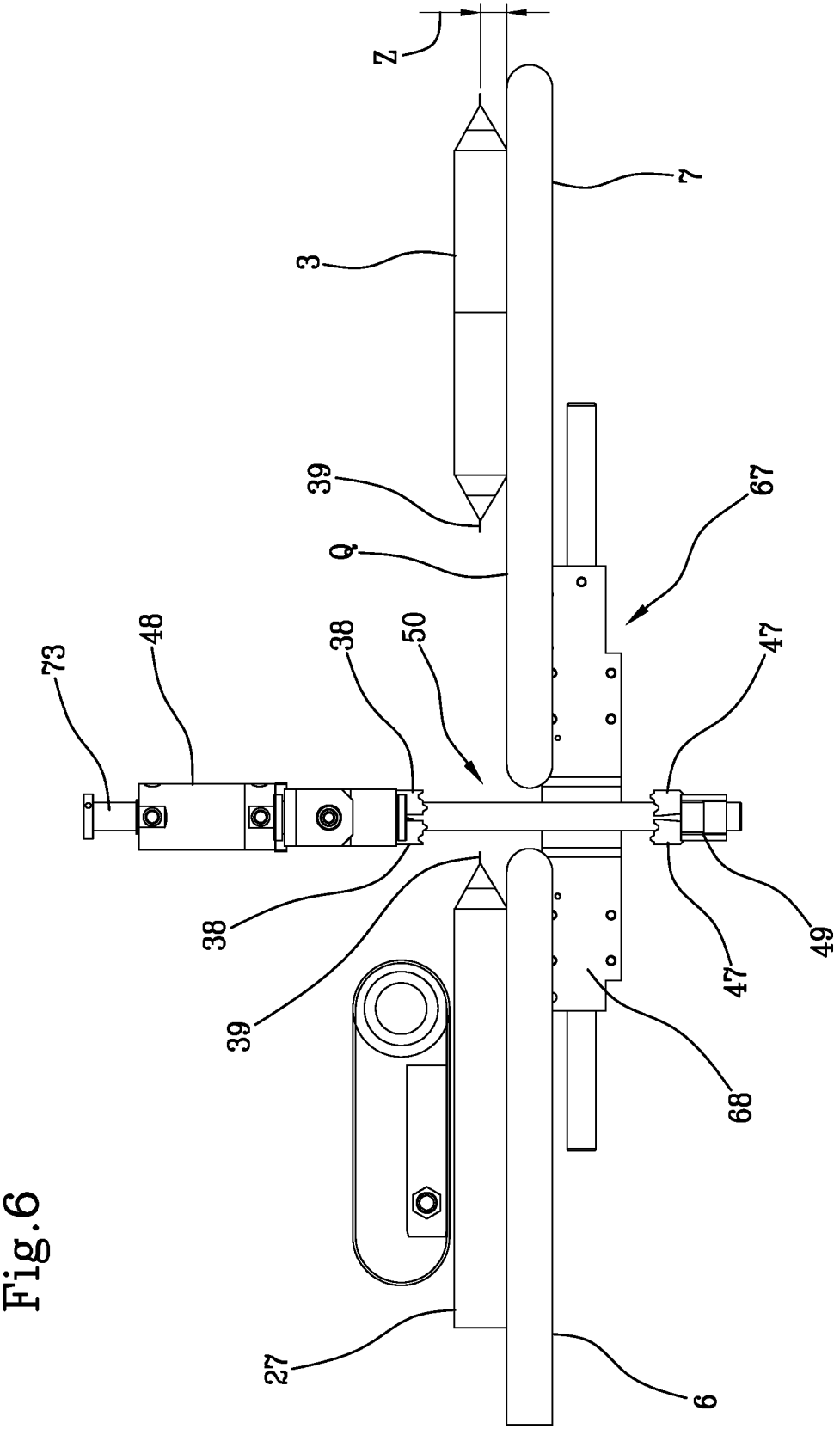

Fig.6

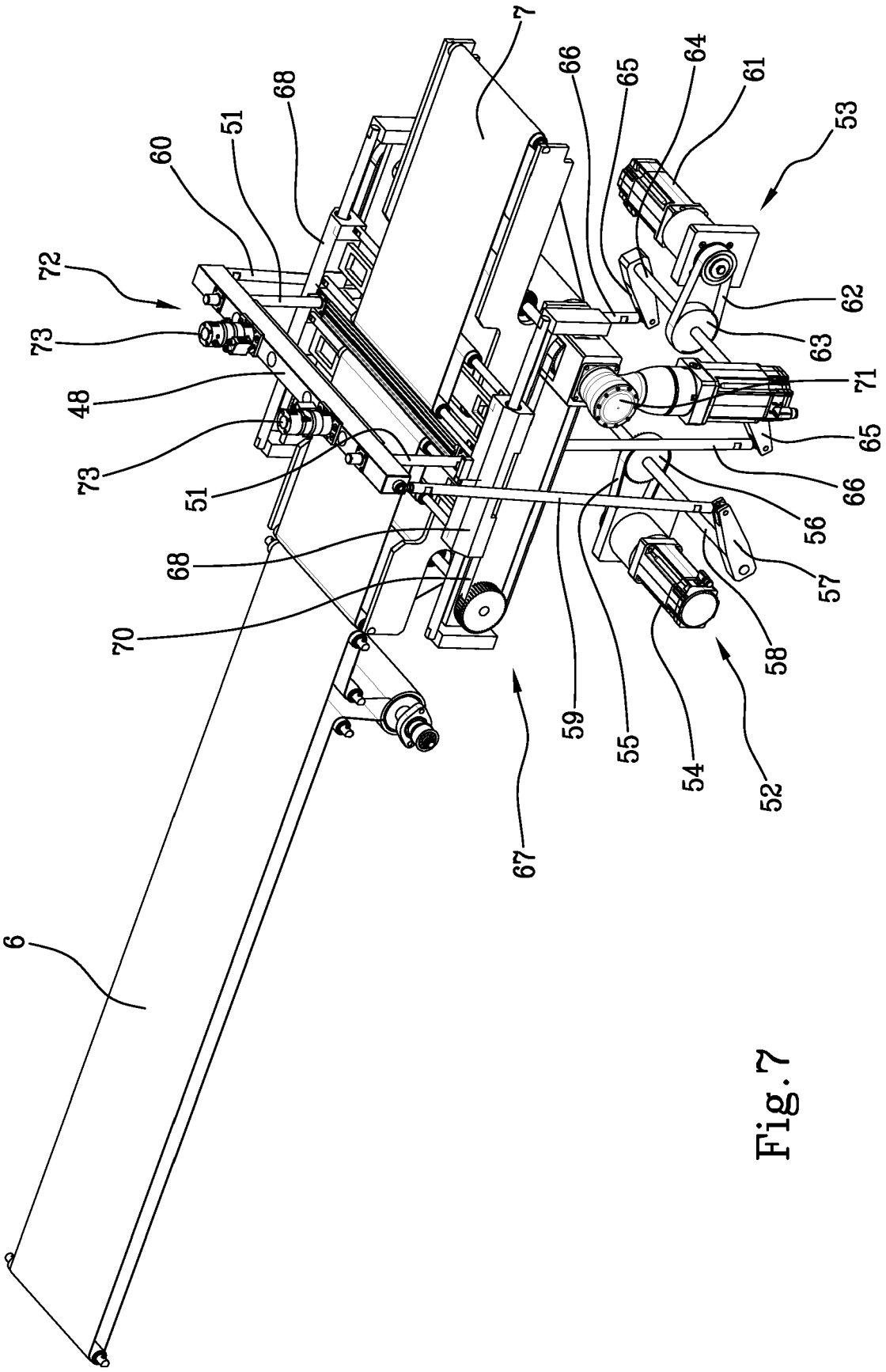
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Fig.7

Fig.10

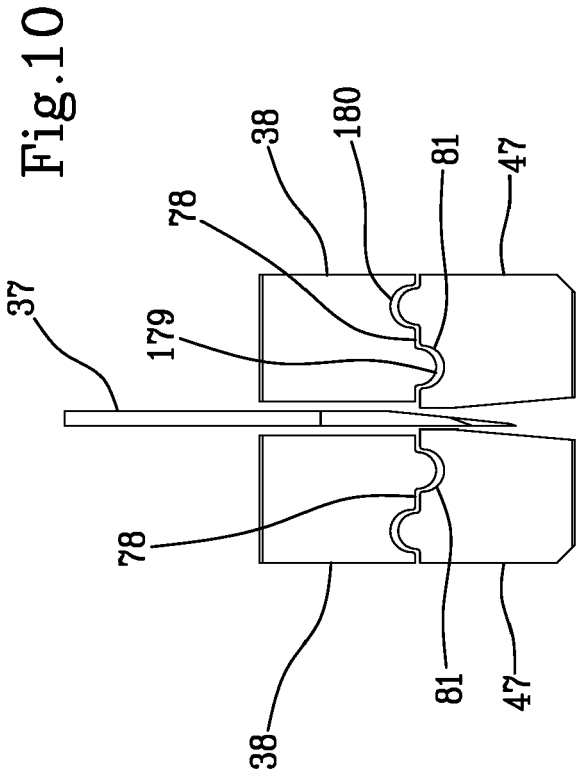


Fig.11

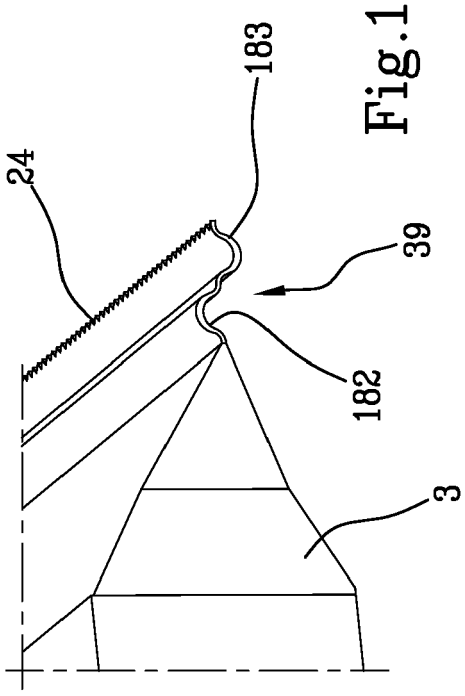


Fig.8

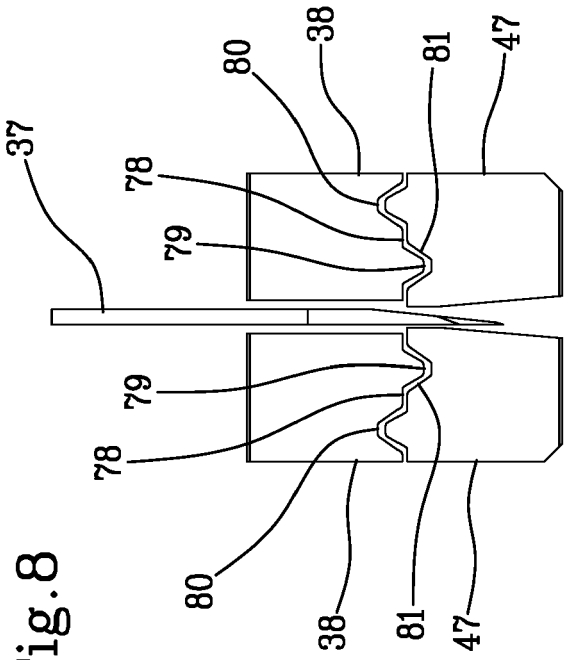
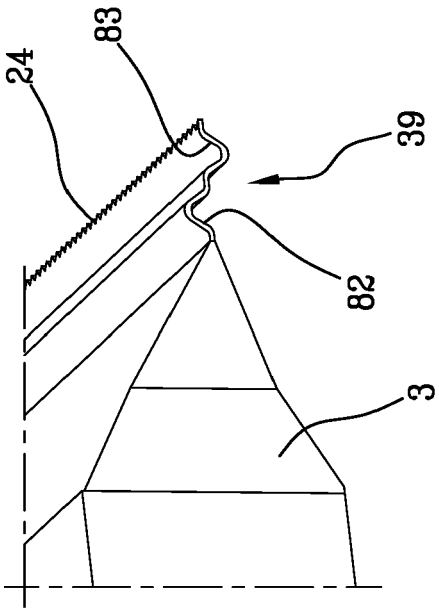


Fig.9



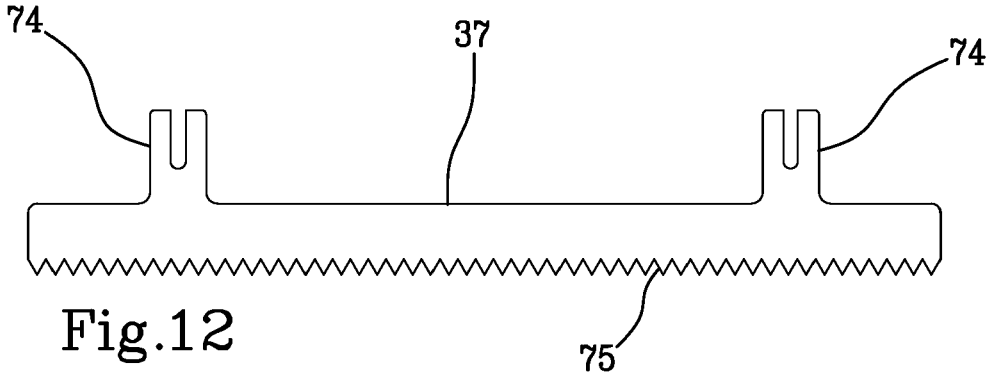


Fig.12

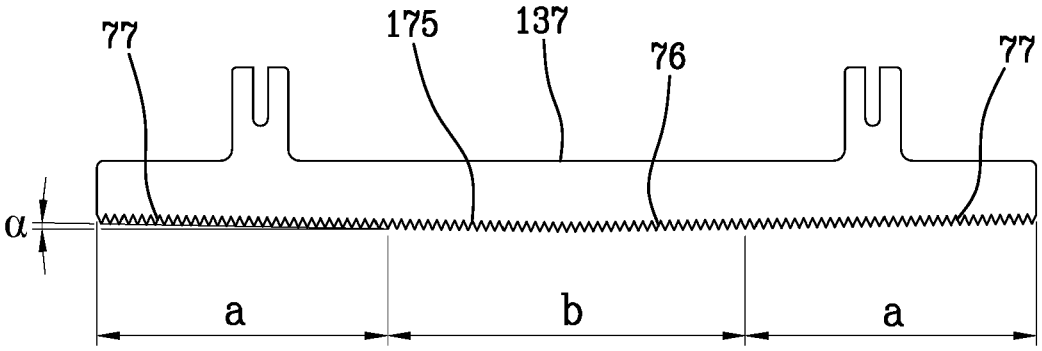


Fig.13

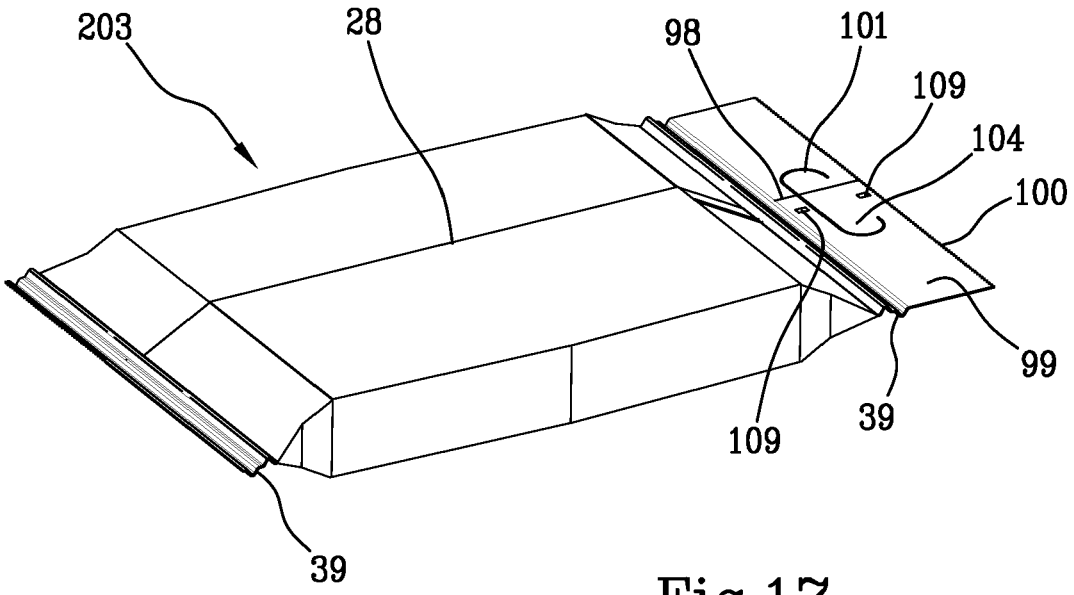
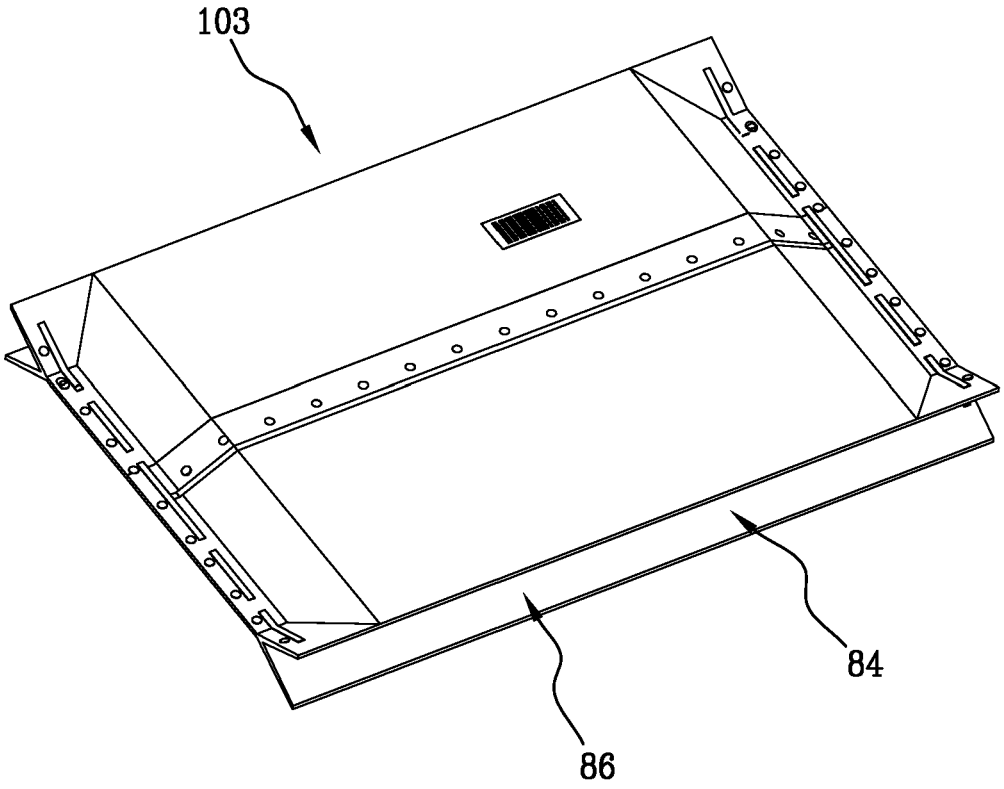


Fig.17

Fig.14



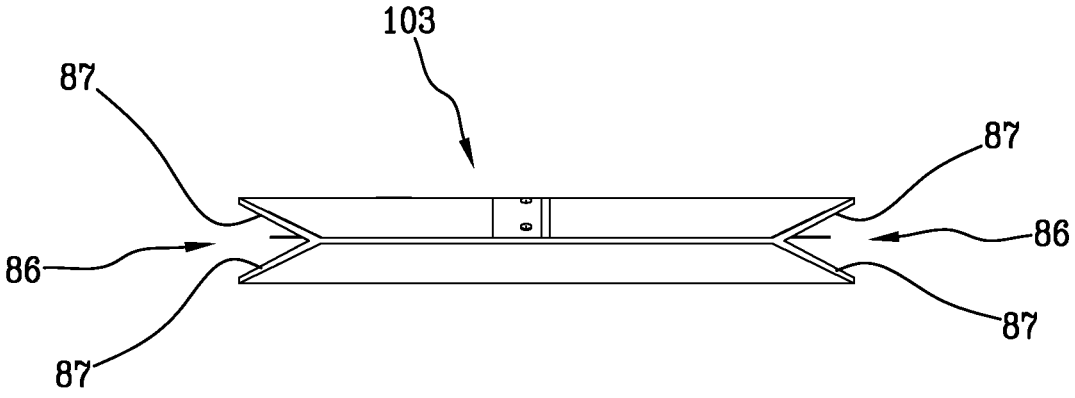


Fig.15

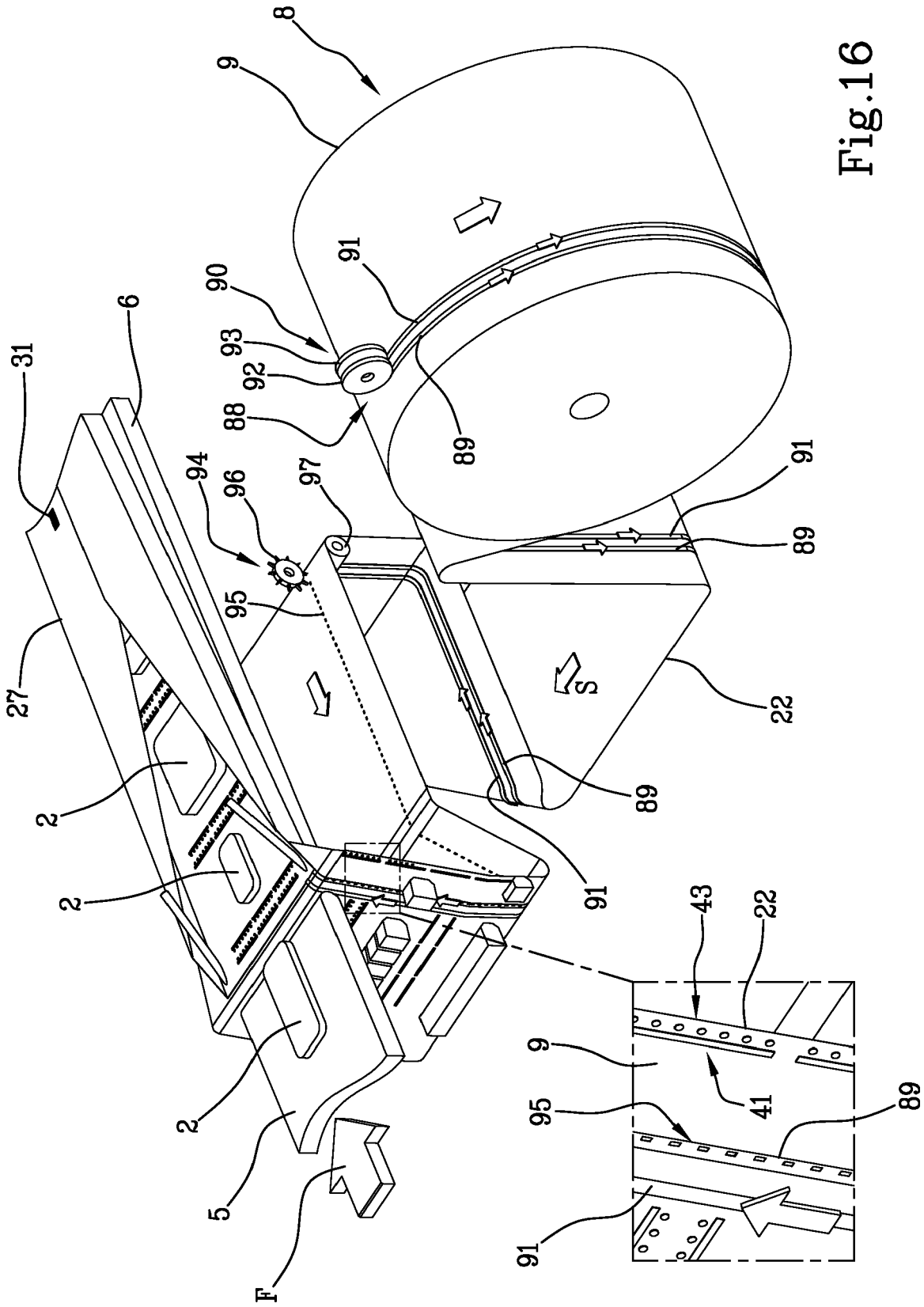


Fig.16

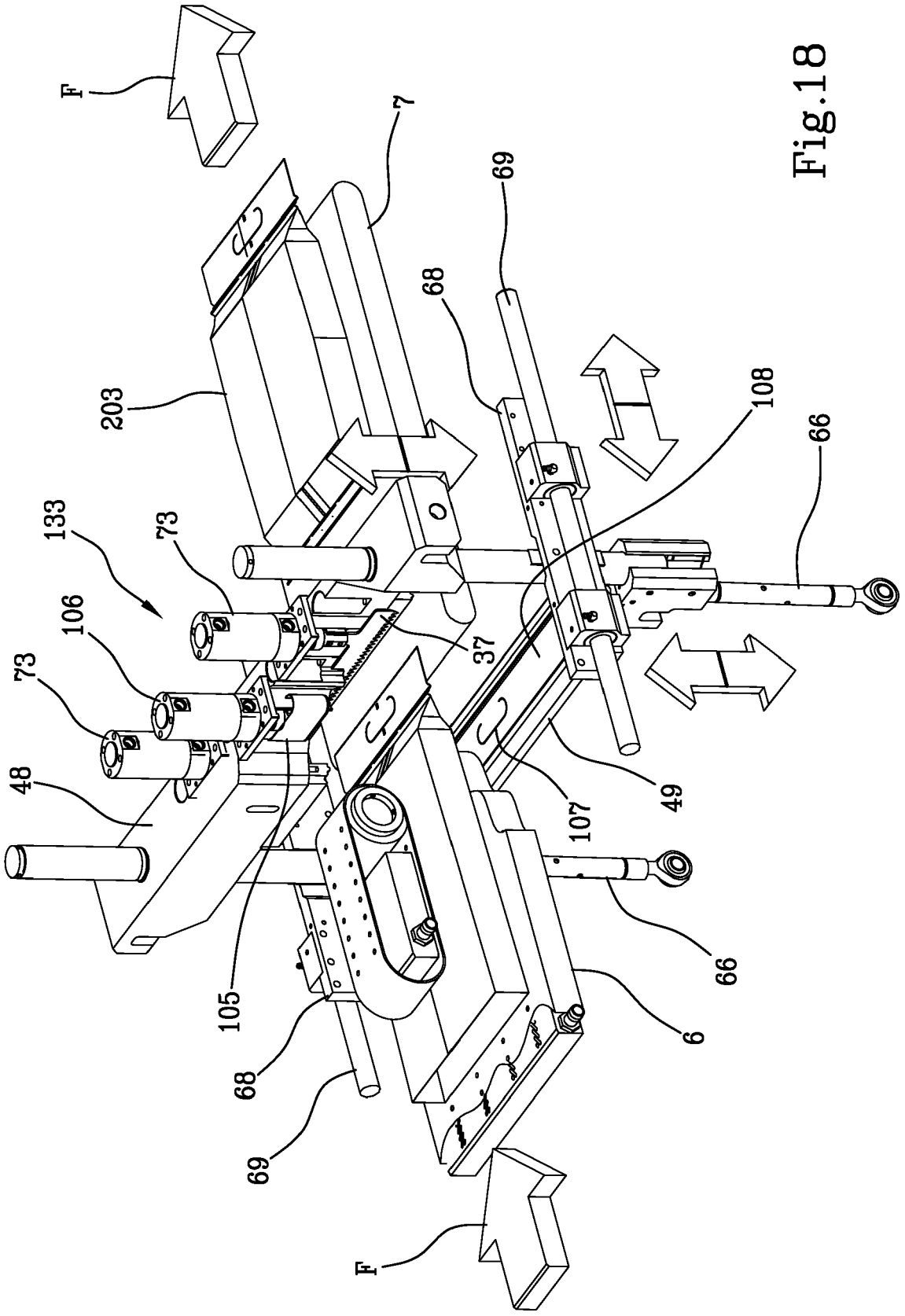


Fig.18

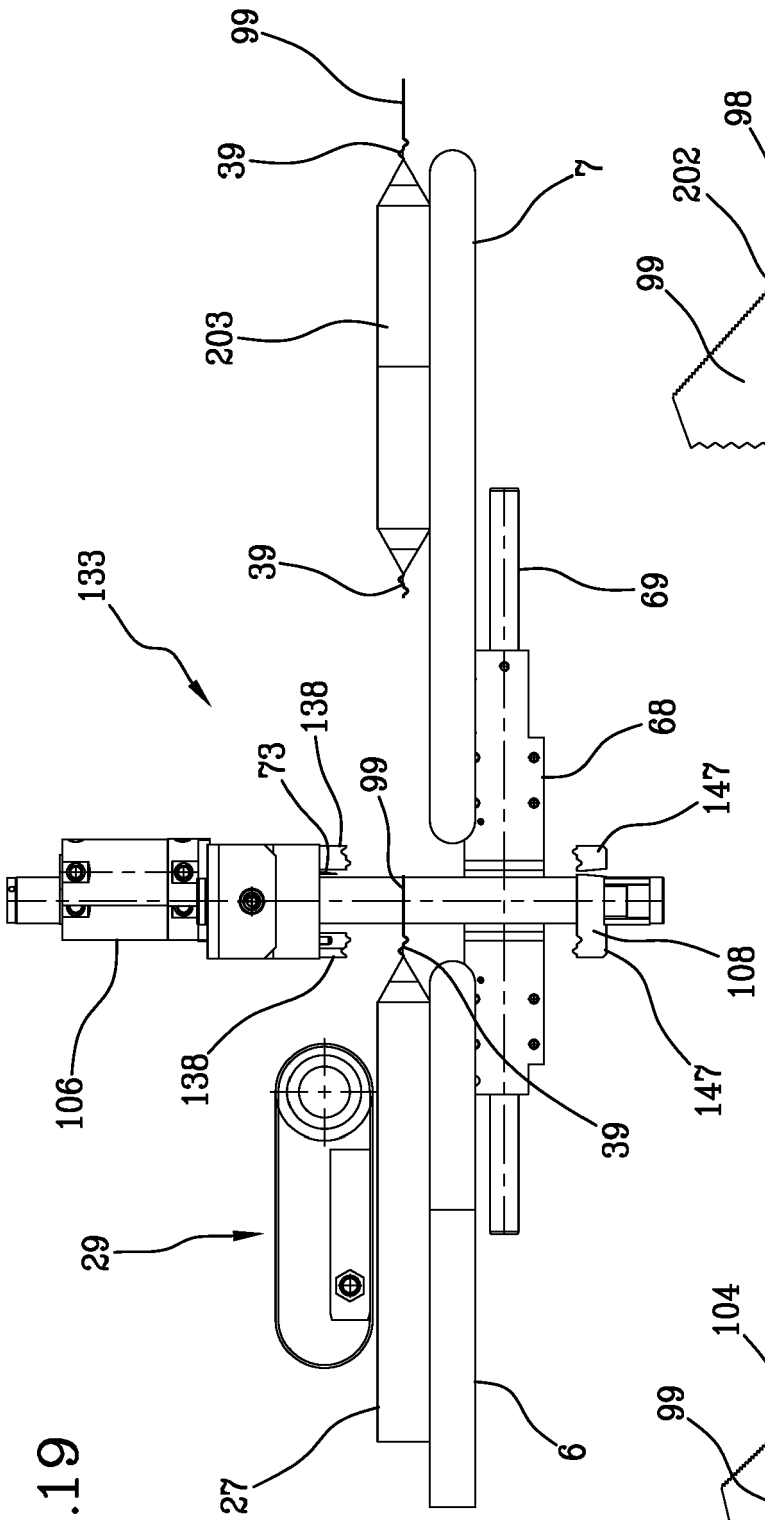


Fig.19

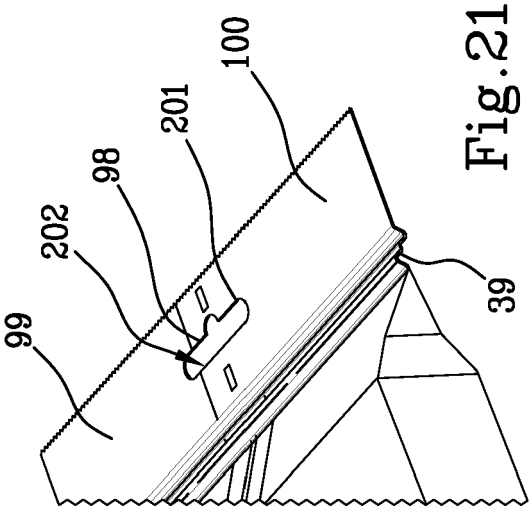


Fig.21

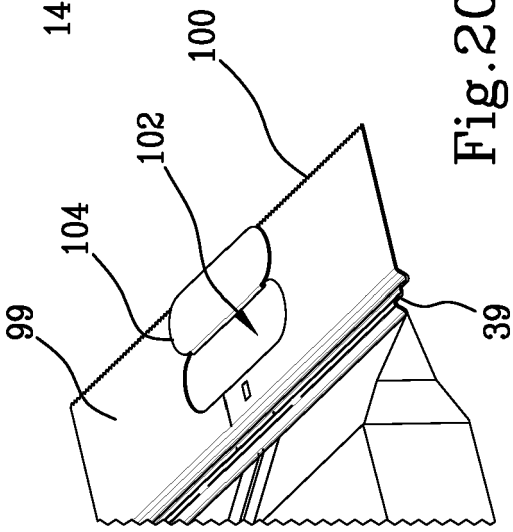


Fig.20

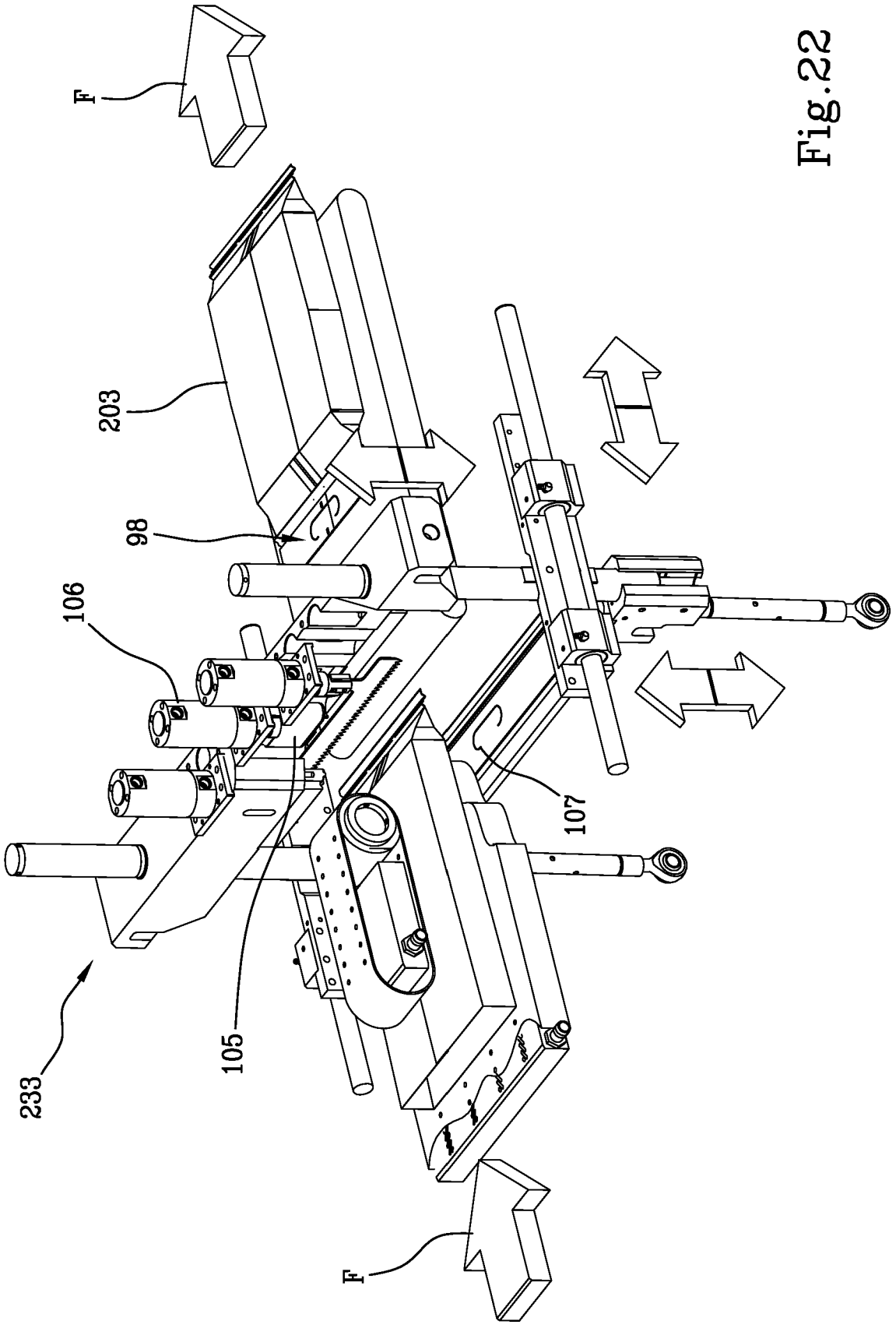


Fig.22

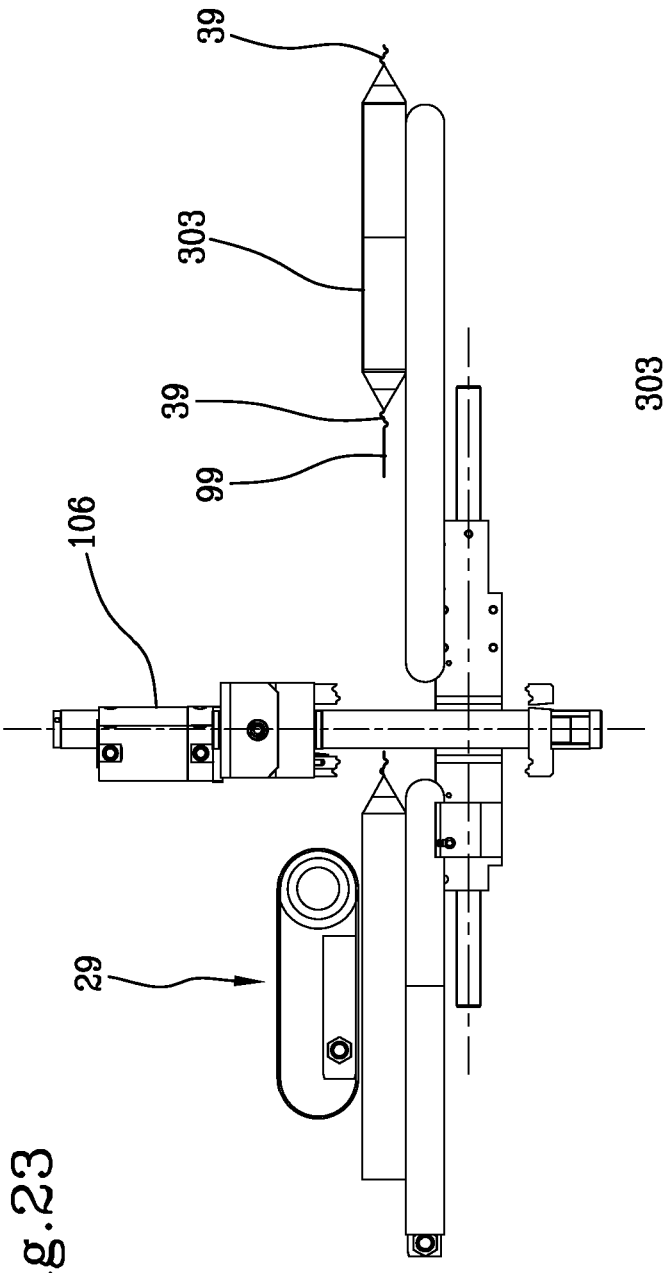


Fig.23

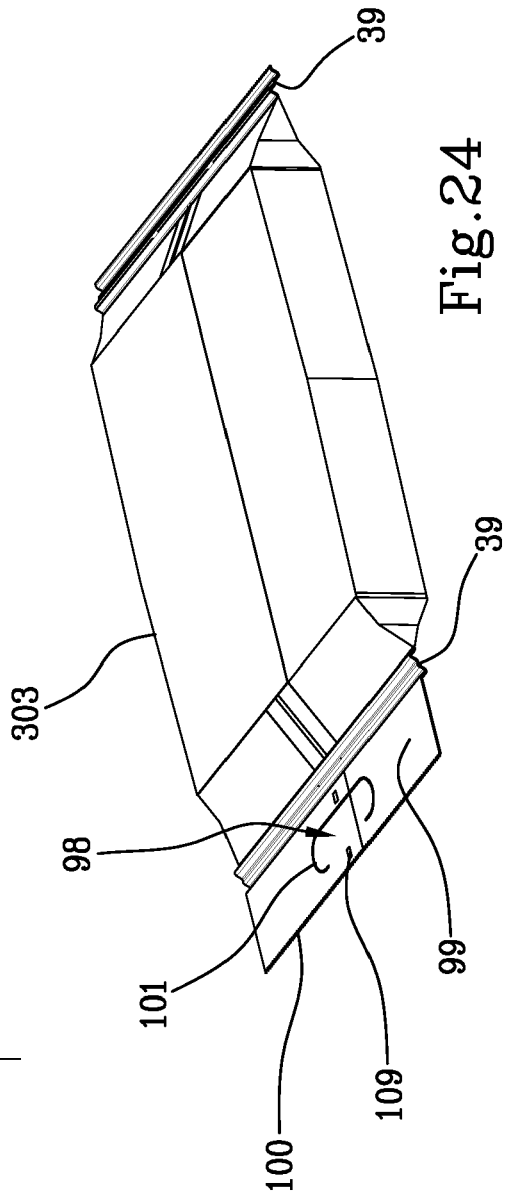


Fig.24

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EUROPEAN SEARCH REPORT

Application Number
EP 22 19 8634

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 5 666 788 A (TOLSON SIDNEY S [US]) 16 September 1997 (1997-09-16) * column 4, line 17 - column 5, line 66; figures *	1-15	INV. B65B9/067 B65B51/30 B65B59/00 B65B61/06
A	US 2007/227102 A1 (PRATAIOLA ALESSANDRO [IT]) 4 October 2007 (2007-10-04) * the whole document *	1-15	B65B65/02

TECHNICAL FIELDS SEARCHED (IPC)

B65B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 January 2023	Lawder, M

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23-01-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5666788 A	16-09-1997	NONE	
US 2007227102 A1	04-10-2007	EP 1776273 A1	25-04-2007
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