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(54) **WRAPPING UNIT AND METHOD FOR FOLDING A WRAP AROUND A GROUP OF SMOKING ARTICLES**

(57) A wrapping unit and method to fold a wrap (21) around a group (14) of smoking articles; there are: a spindle (32), which is provided with a tubular cavity (33), which is designed to accommodate the group (14) of smoking articles and has: an outer base wall (34), an inner base wall (35) opposite the outer base wall (34), and a pair of side walls (36), which are interposed between the two base walls (34, 35); a wrapping conveyor (30), which supports the spindle (32) and moves the spindle (32) along a wrapping path (P1); a first feeding device (44), which is designed to insert the group (14) of smoking articles into the tubular cavity (33) of the spindle (32); a second feeding device (48), which is designed to feed the wrap (21) to the spindle (32) laying the wrap (21) on the outer base wall (34) of the spindle (32); and a folding device (53), which is designed to fold the wrap (21) in a "U"-shape around the spindle (32) laying the wrap (21) on both base walls (34, 35). The outer base wall (34) of the spindle (32) is larger than the inner base wall (35) of the spindle (32) and the side walls (36) of the spindle (32) have respective inclined portions (37), which form a non-right angle with the base walls (34, 35) and give a trapezoidal shape to a cross section of the spindle (32).

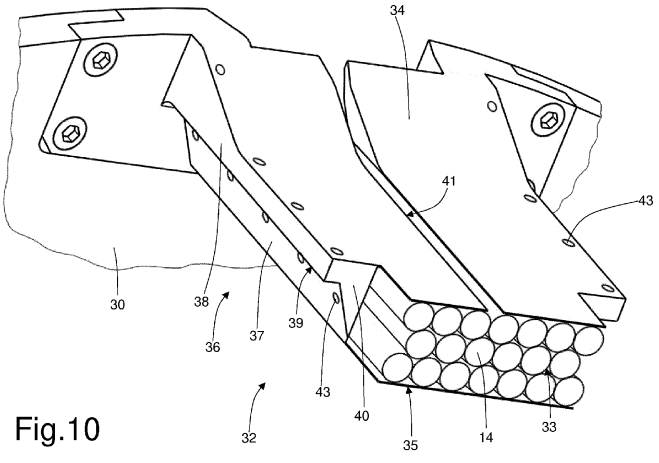

Fig.10

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from Italian Patent Application No. 102018000003936 filed on 26/03/2018.

TECHNICAL FIELD

[0002] The invention relates to a wrapping unit and to a wrapping method to fold a wrap around a group of smoking articles. The invention finds advantageous application in the manufacturing of a rigid cigarette pack with a hinged lid, to which explicit reference will be made in the description below without because of this loosing in generality.

PRIOR ART

[0003] Rigid cigarette packs with a hinged lid currently are the most commonly used cigarette packs in the market since they are easy to be manufactured, simple and practical to be used and offer a good protection to the cigarettes contained on the inside.

[0004] A rigid cigarette pack with a hinged lid comprises a wrapper consisting of a group of cigarettes wrapped in a sheet of metallized paper and a rigid outer casing housing, on the inside, the wrapper. The outer casing consists of a cup-shaped container, which houses the group of cigarettes and has an open upper end, and of a lid, which is also cup-shaped and is hinged to the container so as to rotate, relative to the container, between an open position and a closed position of the open end.

[0005] Patent application WO2010119473A1 describes a packer machine provided with spindles, into which a group of cigarettes is fed and around which a wrap is fed; the spindles have a rectangular cross section, namely the outer base wall of each spindle has the same width as the inner base wall of the spindle and, hence, the side walls of the spindle form a right angle with the base walls.

DESCRIPTION OF THE INVENTION

[0006] The object of the invention is to provide a wrapping unit and a wrapping method to fold a wrap around a group of smoking articles, said wrapping unit and wrapping method allowing manufacturers to obtain a high-quality wrapper (namely, a wrapper having extremely precise and square folds of the wrap), even operating at a high producing speed (measured as cigarette packs produced per unit of time). According to the invention, there are provided a wrapping unit and wrapping method to fold a wrap around a group of smoking articles according to the appended claims.

[0007] The appended claims describe embodiments of the invention and form an integral part of the description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The invention will now be described with reference to the accompanying drawings, showing a non-limiting embodiment thereof, wherein:

- figure 1 is a perspective front view, in a closed configuration, of a rigid cigarette pack;
- figure 2 is a perspective rear view of the cigarette pack of figure 1 in a closed configuration;
- figure 3 is a perspective front view of the cigarette pack of figure 1 in an open configuration;
- figure 4 is a perspective front view of a wrapper of the pack of figure 1;
- figure 5 is perspective view of a group of cigarettes contained in the wrapper of figure 4;
- figure 6 is a plan view of a wrap used to manufacture the wrapper of figure 4;
- figure 7 is a plan view of a collar of the cigarette package of figure 1;
- figure 8 is a plan view of a blank used to manufacture an outer container provided with a hinged lid of the cigarette pack of figure 1;
- figure 9 is a schematic front view of a packer machine, which produces the cigarette pack of figure 1 and is manufactured according to the invention;
- figure 10 is a perspective view of a spindle of a wrapping drum of the packer machine of figure 9;
- figure 11 is a front view of the spindle of figure 10;
- figures 12-15 show the folding sequence carried out to fold the wrap of figure 6 around the spindle of figure 10 so as to give a tubular shape to the wrap;
- figure 16 is a perspective view, with parts removed for greater clarity, of a feeding station, where the wrap of figure 6 is coupled to the spindle of figure 10;
- figure 17 is a schematic view of a folding device cooperating with the spindle of figure 10 in order to fold the wrap of figure 6 around the spindle;
- figure 18 is a schematic view of a further folding device cooperating with the spindle of figure 10 in order to fold the wrap of figure 6 around the spindle;
- figure 19 is a schematic view of two linear wrapping conveyors of the packer machine of figure 9;
- figures 20-22 show the folding sequence carried out to fold the wrap of figure 6 around the group of cigarettes of figure 5 so as to complete the manufacturing of the wrapper of figure 4;
- figure 23 is a perspective view, with parts removed for greater clarity, of the two linear wrapping conveyors of figure 19;
- figure 24 is a perspective view, with parts removed for greater clarity, of an initial part of a blank feeding conveyor of the packer machine of figure 9;
- figure 25 is a schematic view of two linear wrapping conveyors of the packer machine of figure 9;
- figure 26 is a perspective view, with parts removed

for greater clarity, of the two linear wrapping conveyors of figure 25;

- figure 27 is a schematic view from the top of an initial part of the packer machine of figure 9; and
- figures 28, 29 and 30 are schematic front views of respective variants of the packer machine of figure 9.

PREFERRED EMBODIMENTS OF THE INVENTION

[0009] In figures 1, 2 and 3, number 1 indicates, as a whole, a rigid cigarette pack. The rigid cigarette pack 1 comprises an outer container 2, which is made of cardboard or stiff card and is cup-shaped, and a wrapper 3 (which is better shown in figure 4) housed inside the container 2.

[0010] The outer container 2 has an open upper end and is provided with a lid 4, which is cup-shaped and is hinged to the outer container 2 along a hinge 5 (shown in figure 2), so as to rotate, relative to the outer container 2, between an open position (shown in figure 3) and a closed position (shown in figures 1 and 2) of the open upper end. The outer container 2 substantially has the shape of a rectangular parallelepiped oriented according to a main vertical development direction, is cup-shaped and has the open upper end, a lower wall 6 opposite the open upper end, a front wall 7 and a rear wall 8 (where the hinge 5 is obtained), which are parallel to and opposite one another, and two side walls 9, which are parallel to and opposite one another. Between the front 7 and rear 8 walls and the side walls 9 of the outer container 2 there are defined four longitudinal corners, whereas between the walls 7, 8 and 9 and the bottom wall 6 of the outer container 2 there are defined four transverse corners. The lid 4 substantially has the shape of a rectangular parallelepiped, is cup-shaped and has an open lower end (facing the open upper end of the outer container 2, when the lid 4 is in the closed position), an upper wall 10 (which is parallel to and opposite the lower wall 6 of the outer container 2, when the lid 4 is in the closed position), a front wall 11 (which is parallel to and aligned with the front wall 7 of the outer container 2, when the lid 4 is in the closed position), a rear wall 12 (which is parallel to and aligned with the rear wall 8 of the outer container 2, when the lid 4 is in the closed position, and is hinged to the rear wall 8 of the outer container 2 along the hinge 5), and two side walls 13 parallel to and opposite one another (which are parallel to and aligned with, in particular coplanar and adjacent to, the side walls 9 of the outer container 2, when the lid 4 is in the closed position). Between the front 11 and rear 12 walls and the side walls 13 of the lid 4 there are defined four longitudinal corners, whereas between the walls 11, 12 and 13 and the upper wall 10 of the lid 4 there are defined four transverse corners. The longitudinal corners and the transverse corners of the lid 4 are parallel to and aligned with the corresponding longitudinal and transverse corners of the outer container 2, when the lid 4 is in the closed position.

[0011] The wrapper 3 encloses a group 14 of cigarettes (partially shown in figure 3 and completely shown in figure 5) with the shape of a parallelepiped. Furthermore, the wrapper 3 has, at the top and at the front, a removable portion 15, which is separated from the rest of the wrapper 3 by a pre-weakened tearable line 16; when the cigarette 1 pack is opened for the first time, the user grabs and tears the removable portion 15 in order to access the underlying cigarettes of the group 14 of cigarettes.

[0012] According to figures 3 and 7, the cigarette pack 1 further comprises a rigid collar 17, which is connected (through gluing) folded in a "U"-shape inside the outer container 2 so as to partially projects outwards from the open upper end of the container 2 and engage a corresponding inner surface of the lid 4, when the lid 4 is in the closed position. The collar 17 comprises a front wall 18, which is connected to the front wall 7 of the container 2 and is arranged in contact with the front wall 11 of the lid 4, when the lid 4 is in the closed position, and two side walls 19, which are connected to the side walls 9 of the container 2 and are arranged in contact with the side walls 13 of the lid 4, when the lid is in the closed position 4. According to the embodiment shown in the accompanying figures, the front wall 18 of the collar 17 is provided with pair of claws 20, which project on the side so as to engage, through interference, the side walls 13 of the lid 4, when the lid 4 is in the closed position, so as to hold the lid 4 in the closed position. According to a different embodiment which is not shown herein, the front wall 18 of the collar 17 has no claws 20.

[0013] According to figure 6, the wrapper 3 is obtained by folding, around the group 14 of cigarettes, a wrap 21 provided, on a side, with the tearable line 16 delimiting the removable portion 15. According to figure 4, at first, the wrap 21 is folded in "U"-shape around the group 14 of cigarettes, thus defining, on the two minor side walls of the group 14 of cigarettes, two open ends, each delimited by a transverse wing 22 (or corner wing 22) and by two longitudinal wings 23 and 24. At first the transverse wing 22 is folded by 90° against the group 14 of cigarettes, then the longitudinal wing 23 is folded by 90° against the group 14 of cigarettes and on top of the previously folded transverse wing 22 and, finally, the longitudinal wing 24 is folded by 90° against the group 14 of cigarettes and on top of the previously folded transverse wing 22 and longitudinal wing 23 (according to the folding mode known as *"soap wrap"*); in this way, the wrap 21 gains a tubular shape having one single open end in the area of the upper wall (where the cigarette filters are arranged) of the group 14 of cigarettes; said open end is delimited by two transverse wings 25 (or corner wings 25) and by two longitudinal wings 26 and 27. At first the transverse wings 25 are folded by 90° against the group 14 of cigarettes, then the longitudinal wing 26 is folded by 90° against the group 14 of cigarettes and on top of the previously folded transverse wings 25 and, finally, the longitudinal wing 27 is folded by 90° against the group 14 of cigarettes and on top of the previously folded transverse wings 25 and longitudinal wing 26 (according to

the folding mode known as "soap wrap"); in this way, the folding of the wrap 21 around the group 14 of cigarettes is completed. According to a preferred embodiment, the final shape of the wrap 21 around the group 14 of cigarettes is not stabilized in any way (namely, no glue is applied to the wrap 21 and no seals are made on the wrap 21); as a consequence, the final shape of the wrap 21 around the group 14 of cigarettes is maintained only due to the containing action of the outer container 2.

[0014] According to figure 8, the outer container 2 and the lid 4 are obtained by folding a conventional blank 28, wherein each side wall 9 of the outer container 2 is obtained by overlapping and gluing two wings 9' and 9" and each side wall 13 of the lid 4 is obtained by overlapping and gluing to wings 13' and 13". Furthermore, the front wall 11 of the lid 4 is obtained by overlapping and gluing a panel 11' and a flap 11".

[0015] In particular, the blank 28 has two pre-weakened longitudinal folding lines (which define the longitudinal corners of the outer container 2 and of the lid 4) and a plurality of pre-weakened transverse folding lines (which define the transverse corners of the outer container 2 and of the lid 4), which delimit, between the two longitudinal folding lines, a panel 7', which makes up the front wall 7 of the outer container 2, a panel 6', which makes up the lower wall 6 of the outer container 2, a panel 8', which makes up the rear wall 8 of the outer container 2, a panel 12', which makes up the rear wall 12 of the lid 4, a panel 10', which makes up the upper wall 10 of the lid 4, a panel 11', which makes up the front wall 11 of the lid 4, and a panel 11", which makes up the reinforcement flap and is folded by 180° and glued against an inner surface of the panel 11' (namely, against an inner surface of the front wall 11 of the lid 4). The blank 28 comprises a pair of wings 9', which are arranged on opposite sides of the panel 7', are connected to the panel 7' along the two longitudinal folding lines, and make up part of the side walls 9 of the outer container 2. The blank 28 comprises a pair of wings 9", which are arranged on opposite sides of the panel 8', are connected to the panel 8' along the two longitudinal folding lines, make up part of the side walls 9 of the outer container 2, and are glued to and overlap the corresponding wings 9'. Each wing 9" comprises a tab, which is folded by 90° relative to the wing 9" so as to be subsequently laid on and glued to the panel 6' .

[0016] The blank 28 comprises a pair of wings 13', which are arranged on opposite sides of the panel 11', are connected to the panel 11' along the two longitudinal folding lines, and make up part of the side walls 13 of the lid 4. The blank 28 comprises a pair of wings 13", which are arranged on opposite sides of the panel 12', are connected to the panel 12' along the two longitudinal folding lines, make up part of the side walls 13 of the lid 4, and are glued to and overlap the corresponding wings 13'. Each wing 13" comprises a tab, which is folded by 90° relative to the wing 13" so as to be subsequently laid on and glued to the panel 10'.

[0017] In figure 9, number 29 indicates, as a whole, a packer machine, which is designed to manufacture the pack 1 of cigarettes described above and operates with an intermittent motion (namely, with a motion which involves a cyclic alteration of motion phases and standstill phases).

[0018] The packer machine 29 comprises a wrapping drum 30 (namely, a wrapping conveyor 30), which is mounted so as to rotate (with an intermittent motion, namely *"in a stepped manner")* around a horizontal rotation axis 31 (which is perpendicular to the plane of figure 9). The wrapping drum 30 supports twelve tubular spindles 32, each of them being internally hollow so as to accommodate, on the inside, a group 14 of cigarettes and being arranged in an axial manner (namely, parallel to the rotation axis 31); each spindle 32 is mounted on the wrapping drum 30 in a projecting manner, namely each spindle 32 is fixed to the wrapping drum 30 only on one side, whereas the opposite side is completely free (namely, does not touch in any way the wrapping drum 30), as shown, by way of example, in figure 10.

[0019] The rotation of the wrapping drum 30 around the rotation axis 31 cyclically moves each spindle 32 along a circular wrapping path P1 and through: a feeding station S1, where a group 14 of cigarettes is axially inserted into the spindle 32 (namely, with a movement which is parallel to the rotation axis 31), a control station S2, where the ends o the group 14 of cigarettes contained in the spindle 32 are optically controlled, a feeding station S3, where a wrap 21 is coupled to the spindle 32, a folding station S4, where the wrap 21 is folded in a "U"-shape around the spindle 32, a rejection station S5, where a possible faulty group 14 of cigarettes is expelled from the spindle 32, and, finally, a transfer station S6, where the group 14 of cigarettes, together with the wrap 21, is axially pulled out of the spindle 32 (namely, parallel to the rotation axis 31).

[0020] According to figures 10 and 11, each spindle 32 has a tubular shape (oriented axially, namely parallel to the rotation axis 31 and is provided, on the inside, with a tubular cavity 33, which is designed to accommodate the group 14 of cigarettes and has: an outer base wall 34, an inner base wall 35 opposite the outer base wall 34, and a pair of side walls 36, which are interposed between the two base walls 34, 35. In each spindle 32, the outer base wall 34 is larger than the inner base wall 35; furthermore, in each spindle 32, the side walls 36 have respective inclined portions 37, which form, with the base walls 34 and 35, a non-right angle and give a trapezoidal shape to a cross section of the spindle 32. In particular, each side wall 36 of the spindle 32 has the inclined portion 37, which forms a non-right angle with the base walls 34 and 35 of the spindle 32 and originates from the inner base wall 35, and a perpendicular portion 38, which forms a right angle with the base walls 34 and 35 of the spindle 32, originates from the outer base wall 34 and is joined to the inclined portion 37 by means of a parallel portion 39, which is parallel to the base walls 34 and 35 of the

spindle 32.

[0021] According to a preferred embodiment, each inclined portion 37 of each spindle 32 has a width which is equal to the width of the longitudinal wings 23 of the "U"-folded wrap 21; in this way, each longitudinal wing 23 of the "U"-folded wrap 21 can be folded against a corresponding inclined portion 37 of a spindle 32 (as shown in figure 15 and as better described below), becoming flush with the corresponding parallel portion 39.

[0022] According to a preferred embodiment shown in the accompanying figures, in each spindle 32, the side walls 36 have an (axial) longitudinal extension which is smaller than an (axial) longitudinal extension of the base walls 34 and 35 and, as a consequence, the side walls of a group 14 of cigarettes housed in the tubular cavity 33 of the spindle 32 are left partially uncovered (namely, are partially exposed).

[0023] Each spindle 32 has an input opening of the tubular cavity 33, through which a group 14 of cigarettes enters the tubular cavity 33, and an output opening of the tubular cavity 33 (opposite the input opening of the tubular cavity 33), through which a group 14 of cigarettes gets out of the tubular cavity 33; in each spindle 32, the input opening is arranged close to the wrapping drum 30 (namely, on the same side as the wrapping drum 30), whereas the output opening is the arranged on the opposite side relative to the wrapping drum 30. In other words, each spindle 32 is mounted on the wrapping drum 30 in a projecting manner, so that the input opening of the tubular cavity 33 is arranged in the area of the wrapping drum 30 and the output opening of the tubular cavity 33 is arranged far from the wrapping drum 30. According to a preferred embodiment shown in the accompanying figures, each spindle 32 has, in the area of the input opening of the tubular cavity 33, a first thickness, which is greater than a second thickness of the spindle 32 in the area of the output opening of the tubular cavity 33; in particular, the thickness of each spindle 32 remains constant along a given segment starting from the output opening of the tubular cavity 33 and progressively and linearly increases close to the input opening of the tubular cavity 33. In other words, the inner base wall 35 of each spindle 32 is perfectly flat in every part thereof, whereas the outer base wall 34 of the spindle 32 has a first part, which is arranged in the area of the output opening o the tubular cavity 33 and is parallel to the inner base wall 35 of the spindle 32, and a second part, which is arranged in the area of the input opening of the tubular cavity 33 and forms an acute angle with the first part.

[0024] According to a preferred embodiment shown in the accompanying figures, each spindle 32 has two front walls 40, which are arranged on opposite sides of the tubular cavity 33 and delimit the side walls 36.

[0025] According to a preferred embodiment shown in the accompanying figures, the outer base wall 34 of each spindle 32 has, at the centre, a through slit 41, which is arranged longitudinally (namely, axially and, hence, parallel to the rotation axis 31 of the wrapping drum 30) and perpendicularly to the wrapping path P1; the function of the through slit 41 is that of allowing a pusher 42 (shown in figures 19 and 23) to pass through the spindle 32 so as to axially pull a group 14 of cigarettes out of the tubular cavity 33 (in the ways described below).

[0026] Each spindle 32 is provided with a plurality of sucking holes 43, which are designed to hold, through suction, the wrap 21 in contact with the spindle 32; namely, the sucking holes 43 are connected to a suction source (for example a chamber having a smaller pressure than atmospheric pressure) by means of a valve system so as to hold, through suction, when needed, the wrap 21 in contact with the spindle 32. The sucking holes 43 are arranged through the outer base wall 34 of each spindle 32; in particular, the sucking holes 43 are distributed along two parallel rows arranged at the opposite margins of the outer base wall 34 of each spindle 32. Furthermore, the sucking holes 43 are arranged through the inclined portions 37 of the side walls 36 of each spindle 32; in particular, the sucking holes 43 in each side wall 36 of a spindle 32 are distributed along a row arranged close to the perpendicular portion 38 (namely, close to the parallel portion 39).

[0027] Figures 12-15 show the folding of a wrap 21 around a spindle 32 containing a group 14 of cigarettes (namely, the folding of a wrap 21 around a group 14 of cigarettes contained in a spindle 32). At first, according to figure 12, the flat wrap 21 (which is still free from folds) is laid on the spindle 32 by laying the wrap 21 on the outer base wall 34 of the spindle 32; during this step, the wrap 21 is held on the wrap 32 by the holding action generated by the sucking holes 43 of the outer base wall 34 of the spindle 32. Subsequently, according to figure 13, the wrap 21 is folded in an "L"-shape around the spindle 32, thus causing the wrap 21 to cover the output opening of the tubular cavity 33. Subsequently, according to figure 14, the wrap 21 is folded in a "U"-shape around the spindle 32 by laying the wrap 21 on both base walls 34 and 35; simultaneously, on each side of the wrap 21, the corresponding transverse wing 22 is folded against the group 14 of cigarettes (as already mentioned above, the side walls 36 have a longitudinal extension which is smaller than a longitudinal extension of the base walls 34 and 35, so that the transverse wings 22 of the "U"-folded wrap 21 are folded against a portion of the group 14 of cigarettes left uncovered by the side walls 36 of the spindle 32). Finally, according to figure 15, on each side of the wrap 21, the longitudinal wing 23 of the "U"-folded wrap 21 is folded against the inclined portion 37 of a corresponding side wall 36 of the spindle 32; during this step, the longitudinal wings 23 of the "U"-folded wrap 21 are held on the spindle 32 by the holding action generated by the sucking holes 43 of the inclined portions 37 of the side walls 36 of the spindle 32.

[0028] Thanks to the fact that, in each spindle 32, the side walls 36 are relatively thick, ducts to bring the suction to the sucking holes 43 can be obtained inside the side walls 36. The presence of the sucking holes 43 is very

useful in order to ensure an ideal adhesion of the wrap 21 to the spindle 32 during the movement along the wrapping path P1, thus avoiding undesired displacements of the wrap 21 relative to the spindle 32, which cause a misalignment of the wrap 21 relative to the spindle 32 (said misalignment significantly reducing the precision with which the wrap 21 is folded and, hence, the quality of the wrapper 3); as a consequence, the presence of the sucking holes 43 in each spindle 32 allows the quality of the wrapper 3 to be high, even when operating at a high operating speed.

[0029] As already mentioned above and shown in figure 9, the rotation of the wrapping drum 30 around the rotation axis 31 cyclically moves each spindle 32 along the circular wrapping path P1 and through the feeding station S1, where a group 14 of cigarettes is axially inserted into the spindle 32 (namely, with a movement which is parallel to the rotation axis 31). In the feeding station S1 there is a feeding device 44, which is designed to insert a group 14 of cigarettes into the tubular cavity 33 of each spindle 32; the feeding device 44 comprises three hoppers 45, which are arranged in succession along the wrapping path P1, operate in parallel and are provided with respective lower output mouths, from which respective pushers cyclically extract groups 14 of cigarettes, which are axially inserted into the spindles 32. In the control station S2 (which is arranged immediately downstream of the feeding station S1 along the wrapping path P1) there is an optical control device 46, which, by means of video cameras, controls both ends (namely both on the filter side and on the tobacco side) of the cigarettes of the group 14 of cigarettes contained in each spindle 32; if the control device 46 detects the presence of faulty cigarettes, the wrap 21 is not fed to the spindle 32 in the successive feeding station S3 and the group 14 of cigarettes is pulled out of the spindle 32 in the rejection station S5 by activating an expulsion device 47, which directs the group 14 of cigarettes towards a waste collecting container.

[0030] In the feeding station S3 there is a feeding device 48, which couples a wrap 21 to each spindle 32 (as shown in figure 12 and as described above). According to figure 16, the feeding device 48 comprises a feeding conveyor 49, which picks up the wraps 21 in succession from a cutting station (not shown), where the wraps 21 are separated, by means of a transverse cut, from a continuous band of wrapping material. The conveyor 49 moves the wraps 21 in succession from the cutting station (not shown) to the feeding station S3, where each wrap 21 is coupled to a corresponding spindle 32. According to a preferred embodiment shown in figure 16, the feeding conveyor 49 comprises two sucking belts 50, which are arranged parallel to one another and at a given distance from one another and engage (by holding through suction) two opposite ends of each wrap 21. The feeding device 48 comprises a pusher 51, which picks up each wrap 21 from the two sucking belts 50 of the feeding conveyor 49 and lays the wrap 21 on the outer base wall 34 of a spindle 32 (as shown in figure 12); in particular, the pusher 51 goes through the two sucking belts 50 of the feeding conveyor 49 with a movement which is radial (namely, perpendicular to the rotation axis 31) relative to the wrapping drum 30.

[0031] Furthermore, there is a folding device 52, which is arranged in the area of the feeding device 48 (beside the pusher 51), is movable parallel to the pusher 51 (hence, radially) and is designed to fold the wrap 21 in an "L"-shape against the spindle 32 (as shown in figure 13 and as described above). As a consequence, in the feeding station S3, each wrap 21 - at first - is laid on the outer base wall 34 of the spindle 32 (as shown in figure 12) and - then - is folded in an "L"-shape against the spindle 32 (as shown in figure 13).

[0032] According to figure 17, in the folding station S4 there is a folding device 53, which folds the wrap 21 in a "U"-shape around each spindle 32 by laying the wrap 21 on the two base walls 34 and 35 of the spindle 32 (as shown in figure 14). The folding device 53 comprises a "U"-shaped, rigid folding body 54, which, by axially moving relative to the wrapping drum 30 (namely, parallel to the rotation axis 31), *"embraces"* the spindle 32, thus determining the "U"-folding of the wrap 21 around the spindle 32. According to a preferred embodiment, the folding device 53 is also designed to fold, on each side, a transverse wing 22 of the "U"-folded wrap 21; to this aim, the "U"-shaped, rigid body 54 also supports a pair of folding elements 55, which, when the rigid body 54 *"embraces"* the spindle 32, determine a 90° folding of the transverse wings 22 of the "U"-folded wrap 21 against the side walls of the group 14 of cigarettes (as shown in figure 14). As already mentioned above, in each spindle 32, the side walls 36 have a longitudinal extension which is smaller than a longitudinal extension of the base walls 34 and 35, so that the transverse wings 22 of the "U"-folded wrap 21 are folded, by the action of the folding elements 55, against a portion of the group 14 of cigarettes left uncovered by the side walls 36 of the spindle 32.

[0033] Furthermore, according to figure 18, in the folding station S4 there is also a further folding device 55, which folds, on each side, the longitudinal wing 23 of the "U"-folded wrap 21 against the inclined portion 37 of a corresponding side wall 36 of the spindle 32 (as shown in figure 15 and as described above); in other words, after the folding device 53 has *"embraced"* a spindle 32 in order to fold the wrap 21 in a "U"-shape around the spindle 32, the folding device 55 engages the spindle 32 so as to fold the longitudinal wings 23 of the "U"-folded wrap 21 against the inclined portions 37 of the side walls 36 of the spindle 32. The folding device 55 comprises a "U"-shaped, rigid folding body 56, which, by radially moving relative to the wrapping drum 30 (namely, perpendicularly to the rotation axis 31), *"embraces"* the spindle 32, thus determining the folding of the longitudinal wings 23 of the "U"-folded wrap 21 against the inclined portions 37 of the side walls 36 of the spindle 32.

[0034] According to a preferred embodiment, the fold-

ing device 55 engages the spindle 32 after the folding device 53 has *"embraced"* the spindle 32 and while the folding device 53 keeps *"embracing"* the spindle 32; as a consequence, for a given amount of time the spindle 32 is simultaneously engaged by the folding device 53 and by the folding device 55.

[0035] According to figure 19, in the transfer station S6, a group 14 of cigarettes - together with a wrap 21 - is axially pulled out of a corresponding spindle 32 (namely, parallel to the rotation axis 31) by means of the pusher 42, which goes through the spindle 32 by passing through the through slit 41. When a group 14 of cigarettes together with the wrap 21 are axially pulled out of the corresponding spindle 32, the wrap 21 is folded in a "U"-shape in the configuration shown in figure 15, namely with the longitudinal wings 23 of the "U"-folded wrap 21 partially folded and with the longitudinal wings 24 of the wrap 21 still to be folded. The pusher 42 extracts a group 14 of cigarettes together with a wrap 21 from a corresponding spindle 32 and moves the group 14 of cigarettes together with the wrap 21 along a straight wrapping path P2, which is oriented axially (namely, parallel to the rotation axis 31) relative to the wrapping drum 30. In other words, the pusher 42 is part of a linear wrapping conveyor 57, which is designed to pull the group 14 of cigarettes, together with the "U"-folded wrap 21, out of each spindle 32 in the transfer station S6 and is designed to move the group 14 of cigarettes, wrapped in the "U"-folded wrap 21, along a straight wrapping path P2, which is parallel to the rotation axis 31 of the wrapping drum 30. The straight wrapping path P2 develops from the transfer station S6, where each group 14 of cigarettes wrapped in the wrap 21 gets out of the wrapping drum 30 and gets into the linear wrapping conveyor 57, to a transfer station S7, where each group 14 of cigarettes wrapped in the wrap 21 gets out of the linear wrapping conveyor 57.

[0036] Along the wrapping path P2 there is a folding device 58, which is designed, on each side of the "U"-folded wrap 21, to fold the two longitudinal wings 23 and 24 on top of one another, so as to give to the wrap 21 a tubular shape having one single open end (as shown in figure 20). In other words, as the group 14 of cigarettes together with the "U"-folded wrap 21 move along the wrapping path P2, the folding device 58, at first, completes the folding of the longitudinal wings 23 against the group 14 of cigarettes and on top of the previously folded transverse wings 22 and then, subsequently, the folding device 58 folds the longitudinal wings 24 by 90° against the group 14 of cigarettes and on top of the previously folded transverse wings 22 as well as on top of the previously folded longitudinal wings 23. As already mentioned above, the transverse wings 22 of the "U"-folded wrap 21 are folded by the folding device 53 in the folding station S4; according to an alternative embodiment which is not shown herein, the transverse wings 22 of the "U"-folded wrap 21 are folded by the folding device 58 instead of by the folding device 53.

[0037] According to a preferred embodiment shown in the accompanying figures, the folding device 58 comprises two fixed folding elements 59 (namely, folding propellers), which have no moving parts and are arranged along the wrapping path P2; in particular, the folding device 58 comprises only fixed folding elements, which have no moving parts and are arranged along the wrapping path P2.

[0038] In the transfer station S7, each wrap 21 is wrapped around a group 14 of cigarettes with a tubular shape having one single open end, as shown n figure 20. Figures 20, 21 and 22 show the folding of the wrap 21 around the group 14 of cigarettes in order to complete the formation the wrapper 3 by closing said one single open end of the wrap 21 having a tubular shape. At first, according to figure 21, a transverse wing 25 is folded by 90° against the group 14 of cigarettes and, subsequently, the other transverse wing 25 is also folded by 90° against the group 14 of cigarettes. Subsequently, according to figure 22, the longitudinal wing 26 is folded by 90° against the group 14 of cigarettes and on top of the previously folded transverse wings 25 and, finally, the longitudinal wing 27 is folded by 90° against the group 14 of cigarettes and on top of the previously folded transverse wings 25 and longitudinal wing 26 (according to the folding mode known as *"soap wrap*"). According to figure 19, in the transfer station S7, a pusher 60 transfers, by means of a movement which is perpendicular to the wrapping path P2, each group 14 of cigarettes wrapped in a wrap 21 having a tubular shape from the linear wrapping conveyor 57 to a following linear wrapping conveyor 61, which is designed to move the group 14 of cigarettes wrapped in the tubular wrap 21 along a straight wrapping path P3, which is perpendicular to the straight wrapping path P2. In other words, the linear wrapping conveyor 61 receives the group 14 of cigarettes, together with the tubular wrap 21, from the wrapping conveyor 57 and is designed to move the group 14 of cigarettes, wrapped in the tubular wrap 21, along the straight wrapping path P3. The pusher 60 transfers the group 14 of cigarettes wrapped in the tubular wrap 21 from the wrapping conveyor 57 to the wrapping conveyor 61 along a transfer direction D1 (shown in figure 27), which is horizontal and is perpendicular both to the wrapping path P2 and to the wrapping path P3.

[0039] As already mentioned above, the straight wrapping path P2 is parallel to the rotation axis 31 of the wrapping drum 30 and is horizontal; on the other hand, the straight wrapping path P3 is perpendicular to the rotation axis 31 of the wrapping drum 30 and is vertical.

[0040] According to a possible embodiment, the wrapping conveyor 61 comprises a drawer 62, which cyclically moves along the straight wrapping path P3 between the transfer station S7 (where the drawer 62 receives a group 14 of cigarettes wrapped in the wrap 21) and a transfer station S8 (where the drawer 62 releases a group 14 of cigarettes wrapped in the wrap 21); the use of a drawer 62 to move the group 14 of cigarettes wrapped in the wrap 21 from the transfer station S7 to the transfer station

S8 allows the wrap 21 to be adequately held in place so as to keep the folded configuration of the wrap 21 unchanged (namely, without undesired elastic returns).

[0041] Along he wrapping path P3 there is a folding device 63, which is designed to fold a transverse wing 25 of the open end of the tubular wrap 21 by 90° against the group 14 of cigarettes and, then, is designed to fold the two longitudinal wings 26 and 27 of the open end of the tubular wrap 21 by 90° against the group 14 of cigarettes and on top of one another. According to a preferred embodiment shown in the accompanying figures, the folding device 63 comprises fixed folding elements 64 (namely, folding propellers), which have no moving parts and are arranged along the wrapping path P3; in particular, the folding device 63 comprises only fixed folding elements, which have no moving parts and are arranged along the wrapping path P3.

[0042] Along the wrapping path P3 (in particular, at the beginning of the wrapping path P3) there is a folding device 65, which is designed to fold a transverse wing 25 of the tubular wrap 21 (namely, the transverse wing 25, which was not folded by the folding device 63). The folding device 65 comprises a movable folding element 66, which cyclically moves parallel to the wrapping path P3. To this regard, it should be pointed out that the folding of a transverse wing 25 of the tubular wrap 21 takes place in an opposite direction relative to the moving direction along the wrapping path P3 and, therefore, said folding can be carried out by means of the fixed folding elements 64 of the folding device 63; on the other hand, the folding of the other transverse wing 25 of the tubular wrap 21 takes place in a direction which is concordant with the moving direction long the wrapping path P3 and, therefore, said folding can be carried out only by means of the movable folding element 66, which cyclically moves parallel to the wrapping path P3.

[0043] In the transfer station S8, a pusher 67 transfers, by means of a movement which is perpendicular to the wrapping path P3, each wrapper 3 (consisting of a group 14 of cigarettes wrapped in a wrap 21) from the linear wrapping conveyor 61 to a wrapping drum 68. The pusher 67 transfers each wrapper 3 from the wrapping conveyor 61 to the wrapping drum 68 along a transfer direction D2 (shown in figure 27), which is horizontal, is parallel to the direction D1 and is perpendicular both to the wrapping path P2 and to the wrapping path P3.

[0044] According to figure 9, the packer machine 29 comprises the wrapping drum 68 (namely, a wrapping conveyor 68), which is mounted so as to rotate (with an intermittent motion, namely *"in a stepped manner")* around a horizontal rotation axis 69 (which is perpendicular to the rotation axis 31). The wrapping drum 68 supports eight pockets 70, each designed to accommodate, on the inside, a wrapper 3 and designed to receive and hold, on the outside (typically through suction), a flat collar 17 (namely, still without folds).

[0045] The rotation of the wrapping drum 68 around the rotation axis 69 cyclically moves each pocket 70 along a circular wrapping path P4 and through: the transfer station S8, where a wrapper 3 coming from the wrapping conveyor 61 is radially inserted (namely, perpendicularly to the rotation axis 69) into the pocket 70, a feeding station S9, where a flat collar 17 is fed on the outside of the pocket 70 (namely, on the periphery of the wrapping drum 68), and, finally, a transfer station S10, where the wrapper 3 together with the collar 17 are radially pulled out (namely, perpendicularly to the rotation axis 69) of the pocket 70.

[0046] In the transfer station S8, each wrapper 3 is *"clamped"* (namely, grabbed) between the pusher 67 and a counter-pusher 71 and, then, is moved from the wrapping conveyor 61 to a pocket 70 of the wrapping drum 68 by means of a synchronized and concordant movement of the pusher 67 and of the counter-pusher 71. In the transfer station S10, a pusher 72 pulls a wrapper 3 together with a collar 17 out of a pocket 70 of the wrapping drum 68 along a horizontal transfer direction D3 (shown in figure 27).

[0047] In the area of the feeding station S9 there is a feeding unit 73 (only partially shown in figure 9), which cyclically feeds the flat collars 17 (namely, still without folds) to the pockets 70 of the wrapping drum 68. The feeding unit 73 comprises a feeding drum 74 (namely, a feeding conveyor 74), which is mounted so as to rotate (with an intermittent motion, namely *"in a stepped manner")* around a horizontal rotation axis 75 (which is parallel to the rotation axis 69). The feeding drum 74 supports four holding heads 76, each designed to receive and hold, through suction, a flat collar 17 (namely, still without folds).

[0048] The rotation of the feeding drum 74 around the rotation axis 75 cyclically moves each holding head 76 along a circular feeding path and through: a holding station S11, where the holding head 76 receives a collar 17, which was cut from a continuous band of wrapping material (or, alternatively, was picked up from bottom of a stack housed in a hopper), and, then, a release station S12, where the holding head 76 releases the collar 17.

[0049] The feeding unit 73 comprises a transfer conveyor 77, which is cyclically movable between the release station S12, where it receives a collar 17 from a holding head 76 of the feeding drum 74, and the feeding station S9, where the collar 17 is fed to a pocket 70 of the wrapping drum 68. In the feeding station S9 there is a pusher 78, which, by means of a radial movement (namely perpendicular to the rotation axis 69 of the wrapping drum 68), cyclically feeds the collars 17 from the transfer conveyor 77 to the pockets 70 of the wrapping drum 68.

[0050] According to an alternative embodiment which is not shown herein, the feeding unit 73 could also feed, together with the collars 17, coupons, which are fed to the holding heads 76 of the feeding drum 74 upstream of the holding station S11, in the holding station S11 together with the collars 17, or downstream of the holding station S11.

[0051] According to figure 9, the packer machine 29

comprises a wrapping drum 79 (namely, a wrapping conveyor 79), which is mounted so as to rotate (with an intermittent motion, namely *"in a stepped manner")* around a horizontal rotation axis 80 (which is parallel to the rotation axis 69). The wrapping drum 79 supports twelve pockets 81, each designed to accommodate, on the inside, a wrapper 3 coupled to a collar 17 and designed to receive and hold, on the outside (typically through suction), a flat blank 28.

[0052] The rotation of the wrapping drum 79 around the rotation axis 80 cyclically moves each pocket 81 along a circular wrapping path P5 and through: the transfer station S10, where a wrapper 3 and a collar 17 coming from the wrapping drum 68 are radially inserted (namely, perpendicularly to the rotation axis 80) into the pocket 81 (by getting into the pocket 81, the collar 17 folds in a "U"-shape around the wrapper 3), a feeding station S13, where a blank 28 is fed on the outside of the pocket 81 (namely, on the periphery of the wrapping drum 79), and, finally, a transfer station S14, where the wrapper 3 together with the collar 17 ad the blank 28 are radially pulled out (namely, perpendicularly to the rotation axis 80) of the pocket 81.

[0053] In the transfer station S10, a wrapper 3 together with a corresponding collar 17 are *"clamped"* (namely, grabbed) between the pusher 72 and a counter-pusher 82 and, then, are moved from a pocket 70 of the wrapping drum 68 to a pocket 81 of the wrapping drum 79 by means of a synchronized and concordant movement of the pusher 72 and of the counter-pusher 82 along the transfer direction D3, which is horizontal and perpendicular to the rotation axes 69 and 80. In the transfer station S14, a pusher 83 pulls a wrapper 3 together with a collar 17 and a blank 28 out of a pocket 81 of the wrapping drum 79.

[0054] In the area of the feeding station S13 there is a feeding unit 84 (only partially shown in figure 9), which cyclically feeds the flat blanks 28 to the pockets 81 of the wrapping drum 79. The feeding unit 84 comprises a hopper 85, which houses a stack of blanks 28 and has, at the bottom, an output mouth, from which the single blanks 28 are cyclically extracted. There is provided a transfer drum 86 (which is cross-shaped, namely is provided with four arms), which is mounted so as to rotate (with an intermittent motion, namely *"in a stepped manner")* around a horizontal rotation axis 87 (which is parallel to the rotation axis 80). The wrapping drum 86 supports four holding heads 88, each designed to receive and hold, through suction, a flat blank 28 (namely, still without folds). The rotation of the feeding drum 86 around the rotation axis 87 cyclically moves each holding head 88 along a circular transfer path and through: a holding station S15, where the holding head 76 receives a blank 28 coming from the output mouth of the hopper 85, and, then, a release station S16, where the holding head 88 releases the blank 28.

[0055] According to a preferred embodiment, in the area of the holding station S15 there is a transferring device 89, which cyclically picks up the blanks 28 from the output mouth of the hopper 85 (holding them through suction) and lays the blanks 28 on the holding heads 88 of the transfer drum 86. According to figure 24, the transferring device 89 comprises a plurality of arms 90, which are provided with respective suction cups 91 and are movable with a rotation-translation movement (so that they can pull the blanks 28 out of the output mouth of the hopper 85 without pulling the blanks 28 too much, which could cause them to tear). According to figure 24, the transferring device 89 and the wrapping drum 86 are made with *"comb"* structures with a complementary shape, so that they can mutually penetrate one another without interferences.

[0056] Between the holding station S16 and the release station S17 there is a stretching station S17, where there is a folding device 92, which pre-folds each blank 28 along the pre-weakened longitudinal folding lines, so as to stretch the pre-weakened longitudinal folding lines and, hence, facilitate the subsequent final folding of the blank along the pre-weakened longitudinal folding lines. In other words, the folding device 92 folds each blank 28, "*to no purpose"* and for the first time, along the pre-weakened longitudinal folding lines; this folding has *"no purpose"* as, at the end of the folding, the blank 28 is left free to go back, through elastic return, to the initial flat configuration (namely, the folding does not produce any type of final result and only serves the purpose of stretching the pre-weakened longitudinal folding lines). The folding device 92 comprises two opposite folding elements 93, which are mounted so as to rotate around respective rotation axes 94, which are horizontal and parallel to the rotation axis 87, so as to move between a rest position, in which the folding elements 93 are far from one another, and a work position, in which the folding elements 93 are close to one another in order to *"squeeze"* a blank 28 between them so that they can cause the folding of the blank 28 along the pre-weakened longitudinal folding lines and against shaped countering elements carried by the holding heads 88 of the transfer drum 86 (not shown in figure 24). The two folding elements 93 are supported by a support body 95, which is arranged beside the transfer drum 86 and houses, on the inside, the motor.

[0057] The feeding unit 84 comprises a feeding conveyor 96, which moves the blanks 28 along a straight feeding path P6, which extends from the release station S16, where the feeding conveyor 96 receives the blanks 28 from the transfer drum 86, to the feeding station S13, where the feeding conveyor 96 releases the blanks 28 to the wrapping drum 79. In the preferred embodiment shown in figure 24, the feeding conveyor 96 comprises two sucking belts 97, which are arranged parallel to one another and at a given distance from one another and engage (by holding through suction) two opposite ends of each blank 28; in order to do so, each belt 97 is provided with a plurality of suction cups 98.

[0058] According to figure 9, in the area of the transfer drum 86 there is a spray gluing device 99, which applies glue (typically hot glue, namely fast-acting glue) on the

flap of the lid 4 (indicated with reference number 11" in figure 8) of each blank 28. Along the feeding path P6 and immediately downstream of the release station S16 (namely, immediately downstream of the transfer drum 86) there is a folding device 100, which folds the flap of the lid 4 (indicated with reference number 11" in figure 8) by 180° against the front wall 11 of the lid 4 (indicated with reference number 11' in figure 8). According to a preferred embodiment, the folding device 100 only comprises fixed folding elements (namely folding propellers), which have no moving parts and are arranged along the feeding path P6. Along the feeding path P6 and downstream of the folding device 100 there is a pressing device 101, which typically comprises a drum and applies a pressure to the flap of the lid 4 (indicated with reference number 11" in figure 8), which was just folded by the folding device 100, so as to help the flap of the lid 4 (indicated with reference number 11" in figure 8) be correctly glued to the front wall 11 of the lid 4 (indicated with reference number 11' in figure 8).

[0059] Along the feeding path P6 and downstream of the folding device 100 (namely, between the folding device 100 and the feeding station S13) there is a spray gluing device 102, which applies glue (typically cold glue, namely slow-acting glue) on the blanks 28. In particular, the gluing device 102 applies glue at least on the front wall 7 of the container 2 (indicated with reference number 7' in figure 8) so as to glue the front wall 7 of the container 2 to the front wall 18 of the collar 17; the gluing device 102 could apply glue also on the side walls 9 of the container 2 (indicated with reference number 9" in figure 8) so as to glue the side walls 9 of the container 2 to the side walls 19 of the collar 17. At the end of the feeding path P6 and in the area of the feeding station S13 there is a transfer device 103, which cyclically picks up the flat blanks 28 from the feeding conveyor 96 and lays the flat blanks 28 on the outer periphery of the wrapping drum 79 in the area of the respective pockets 81. The transfer device 103 comprises an arm 104, which is provided, at one end, of sucking cups and is hinged, at the opposite end, so as to rotate around a rotation axis 105, which is horizontal and parallel to the rotation axis 80; the arm 104 is preferably arranged between the belts 97 of the feeding conveyor 96 so that is can get into the feeding conveyor 96 in order to pick up the blanks 28.

[0060] According to figure 9, the packer machine 29 comprises a wrapping drum 106 (namely, a wrapping conveyor 106), which is mounted so as to rotate (with an intermittent motion, namely *"in a stepped manner")* around a horizontal rotation axis 107 (which is parallel to the rotation axis 80). The wrapping drum 106 supports twelve pockets 108, each designed to accommodate, on the inside, a wrapper 3 coupled to a collar 17 and to a blank 28.

[0061] The rotation of the wrapping drum 106 around the rotation axis 107 cyclically moves each pocket 108 along a circular wrapping path P7 and through: the transfer station S14, where a wrapper 3, a collar 17 and a blank 28 coming from the wrapping drum 79 are radially inserted (namely, perpendicularly to the rotation axis 107) into the pocket 108 (by getting into the pocket 108, the blank 28 folds in a "U"-shape around the wrapper 3 and the collar 17) and a transfer station S18, where the cigarette pack 1, which is almost complete, is radially pulled out (namely, perpendicularly to the rotation axis 107) of the pocket 108. Between the transfer station S14 and the transfer station S18 there is arranged a folding device 109, which folds the blank 28 around the wrapper 3 and the collar 17 until it reaches the configuration shown in figure 25, in which, in order to complete the cigarette pack 1, the wings 9' and 13' need to be folded by 90° against the wings 9" and 13" which were previously folded (in particular, when the blank 28 gets into a pocket 108 together with an inner wrapper 3 and a collar 17). According to a preferred embodiment, the folding device 109 only comprises fixed folding elements, which have no moving parts and are arranged along the wrapping path P7.

[0062] In the transfer station S14, a wrapper 3 together with a corresponding collar 17 and a corresponding blank 28 are *"clamped"* (namely, grabbed) between the pusher 83 and a counter-pusher 110 and, then, are moved from a pocket 81 of the wrapping drum 79 to a pocket 108 of the wrapping drum 106 by means of a synchronized and concordant movement of the pusher 83 and of the counter-pusher 110 along a transfer direction, which is inclined (namely, neither horizontal nor vertical) and perpendicular to the rotation axes 80 and 107. In the transfer station S18, a pusher 111 pulls an almost complete cigarette pack 1 out of a pocket 108 of the wrapping drum 106 by means of a movement along a transfer direction D4, which is horizontal and perpendicular to the wrapping path P7 and to the rotation axis 107 (namely, arranged radially relative to the rotation axis 107).

[0063] According to figure 25, in the transfer station S18, the pusher 111 transfers, by means of a movement which is perpendicular to the wrapping path P7 and to the rotation axis 107 (namely, by means of a radial movement), each almost complete cigarette pack 1 (namely, with the wings 9' and 13' still to be folded) from the wrapping drum 106 to a following linear gluing conveyor 112, which is designed to move the almost complete pack 1 along a straight gluing path P8, which is perpendicular to the circular wrapping path P7. The gluing device 112 comprises, among other things, a pusher 113, which is movable with a reciprocating motion (namely, with a cyclic alternation of forth and back travels) along the straight gluing path P8. Along the straight gluing path P8 there are two gluing devices 114, which apply glue 115 (typically hot glue, namely fast-acting glue) on the wings 9' and 13' still to be folded of each blank 28. The straight gluing path P8 develops from the transfer station S18, where each almost complete cigarette pack 1 gets out of the wrapping drum 106 and gets into the linear gluing conveyor 112, to a transfer station S19, where each almost complete and glued cigarette pack 1 (namely, pro-

vided with the glue 115) gets out of the linear gluing conveyor 112.

[0064] In the transfer station S19, a pusher 116 transfers, by means of a movement which is perpendicular to the gluing path P8, each almost complete cigarette pack 1 from the linear gluing conveyor 112 to a following linear wrapping conveyor 117, which is designed to move the almost complete cigarette pack 1 along a straight wrapping path P9, which is perpendicular to the straight gluing path P8. In other words, the linear wrapping conveyor 117 receives the almost complete cigarette pack 1 from the gluing conveyor 112 and is designed to move the almost complete cigarette pack 1 along the straight wrapping path P9. According to a preferred embodiment, the pusher 116 is part of the wrapping conveyor 117 and moves the almost complete cigarette packs 1 along the straight wrapping path P9. Along the straight wrapping path P9 there is a folding device 118, which folds the wings 9' and 13' by 90° against the wings 9" and 13" which were previously folded (in particular, when the blank 28 gets into a pocket 108 together with an inner wrapper 3 and a collar 17), thus completing the formation of the cigarette pack 1. According to a preferred embodiment shown in the accompanying figures, the folding device 118 only comprises fixed folding elements, which have no moving parts and are arranged along the wrapping path P9; in particular, the folding device 118 consist of a ring with a rectangular shape, through which the cigarette packs 1 are forced to pass. The straight wrapping path P9 develops from the transfer station S19, where each almost complete and glued cigarette pack 1 (namely, provided with the glue 115) gets out of the gluing conveyor 112 and gets into the linear wrapping conveyor 117, to a transfer station S20, where each complete cigarette pack 1 gets out of the linear wrapping conveyor 117.

[0065] In the transfer station S20, each complete cigarette pack 1 gets out of the linear wrapping conveyor 117 and gets into a following linear drying conveyor 119, which is designed to move the complete cigarette pack 1 along a straight drying path P10, which is perpendicular to the straight wrapping path P9. According to a possible embodiment, the drying conveyor 119 comprises a drawer 120, which cyclically moves along the straight drying path P10 between the transfer station S20 (where the drawer 120 receives a complete cigarette pack 1) and a transfer station S21 (where the drawer 120 releases a complete cigarette pack 1); the use of a drawer 120 to move the complete cigarette pack 1 from the transfer station S20 to the transfer station S21 allows the blank 28 that was just folded to be adequately held in place so as to keep the folded configuration of the blank 28 unchanged (namely, without undesired elastic returns), thus allowing the glue 115 to have a sufficient action.

[0066] In the transfer station S21, a pusher 121 transfers, by means of a movement which is perpendicular to the drying path P10, each almost complete cigarette pack 1 from the linear drying conveyor 119 to a following linear drying conveyor 122, which is designed to move the almost complete cigarette pack 1 along a straight drying path P11, which is perpendicular to the straight drying path P10. In other words, the linear drying conveyor 122 receives the complete cigarette pack 1 from the drying conveyor 119 and is designed to move the complete cigarette pack 1 along the straight drying path P11. According to a preferred embodiment, the pusher 121 is part of the drying conveyor 122 and moves the complete cigarette packs 1 along the straight drying path P11. According to a preferred embodiment, a horizontal stack of complete cigarette packs 1 is formed along the straight drying path P11.

[0067] In the transfer station S22, the complete cigarette packs 1 get into an output conveyor 123, which moves the complete cigarettes packs 1 along a straight output path P12, which is vertical and perpendicular to the straight drying path P11. The linear drying path 123 comprises a conveyor belt, which is wound around two end pulleys and has a plurality of pockets 124, each designed to hold a cigarette pack 1.

[0068] The straight gluing path P8 is horizontal and parallel to the rotation axis 107 of the wrapping drum 106. The straight wrapping path P9 is horizontal and perpendicular to the rotation axis 107 of the wrapping drum 106 (namely, is perpendicular to the gluing path P8). The straight drying path P10 is vertical and perpendicular both to the wrapping path P9 and to the rotation axis 107 of the wrapping drum 106 (namely, it is perpendicular to the gluing path P8); it should be pointed out that, in figure 25, the drying path P10 is show in a horizontal position for greater clarity (namely, to avoid overlaps which would have made the representation confused), whereas figure 26 correctly shows the vertical arrangement of the drying conveyor 119, which moves the cigarette packs 1 along the vertical drying path P10. The straight drying path P11 is horizontal, perpendicular to the drying path P10 and parallel to the wrapping path P9. The output path P12 is vertical, perpendicular to the drying path P11 and parallel to the drying path P10; it should be pointed out that, in figure 25, the output path P12 is show in a horizontal position for greater clarity (namely, to avoid overlaps which would have made the representation confused), whereas figure 9 correctly shows the vertical arrangement of the output conveyor 123, which moves the cigarette packs 1 along the output path P12.

[0069] According to figure 27, the wrapping drum 30 is parallel to and staggered, namely non-coplanar, relative to the wrapping drum 68; in other words, the wrapping drum 30 lies on a plane which is different and spaced apart from a plane on which the wrapping drum 68 lies. This geometric arrangement of the wrapping drums 30 and 68 is due to the presence of the wrapping conveyor 57, which develops along the wrapping path P3, which is arranged horizontally and parallel to the rotation axes 31 and 69 of the wrapping drums 30 and 68. On the other hand, the wrapping drums 68, 79 and 106 are coplanar to one another, namely they all lie on the same plane.

[0070] In the embodiment shown in figure 9, the feeding unit 73 comprises the transfer conveyor 77, which is interposed between the feeding drum 74 and the wrapping drum 68, namely the transfer conveyor 77 receives, in the release station S12, a collar 17 from a holding head 76 of the feeding drum 74 and releases, in the feeding station S9, the collar 17 to a pocket 70 of the wrapping drum 68. In the alternative embodiment shown in figure 28, the feeding unit 73 has not transfer conveyor 77, namely in the feeding station S9, each collar 17 is directly fed from a holding head 76 of the feeding drum 74 to a pocket 70 of the wrapping drum 68.

[0071] In the embodiment shown in figure 29, the feeding unit 73 used to feed the collars 17 is absent and is replaced by a feeding unit 125 for the collars 17, which is arranged in a different position: the feeding unit 73 cyclically feeds the flat collars 17 (namely, still without folds) on top of the pockets 70 of the wrapping drum 68 in the feeding station S9, whereas the feeding unit 125 cyclically feeds the flat collars 17 (namely, still without folds) into the pockets 81 of the wrapping drum 79 in a feeding station S23.

[0072] The feeding unit 125 comprises a feeding drum 126 (namely, a feeding conveyor 126), which is mounted so as to rotate (with an intermittent motion, namely *"in a stepped manner")* around a horizontal rotation axis 127 (which is parallel to the rotation axis 80). The feeding drum 126 supports three holding heads (not shown), each designed to receive and hold, through suction, a flat collar 17 (namely, still without folds) .

[0073] The rotation of the feeding drum 126 around the rotation axis 127 cyclically moves each holding head along a circular feeding path and through: a holding station S15, where the holding head receives a collar 17, and, then, the feeding station S23, where the holding head releases the collar 17. The feeding unit 125 comprises a transfer conveyor belt 128, which is arranged vertically, cyclically picks up the blanks 17 from a holding station S25 and cyclically releases the blanks 17 to the feeding drum 126 in the holding station S24. In the holding station S25, the collars 17 are cut from a continuous band of wrapping material or, alternatively, are picked up from the bottom of a stack housed in a hopper. In the holding station S24 there is a pusher 129, which, by means of a horizontal movement (namely perpendicular to the rotation axis 127 of the wrapping drum 126), cyclically feeds the collars 17 from the transfer conveyor 128 to the holding heads (not shown) of the feeding drum 126.

[0074] Generally speaking, the feeding unit 73 is used when the collars 17 are simpler and, for example, do not comprise a rear wall (namely, according to figure 7, when they only comprise a front wall 18 and two side walls 19), whereas the feeding unit 125 is used when the collars 17 are more complicated and also comprise, for example, a rear wall (examples of "complex" collars 17 are described, for example, in patent applications WO2015114587A1, WO2016088063A1). When the feeding unit 125 is used, the collars 17 are inserted into the still empty pockets 81 of the wrapping drum 80 and arrange themselves folded in a "U"-shape inside the pockets 81; subsequently, in the transfer station S10, the wrappers 3 coming from the wrapping drum 68 are radially inserted (namely, perpendicularly to the rotation axis 80) into the pockets 81 and, hence, inside the previously fed collars 17. In the alternative embodiment shown in figure 30, there is the feeding unit 73, which, in the feeding station S9, feeds the collars 17 on the outside of the pockets 70 (namely, on the periphery of the wrapping drum 68), and there is also a further feeding unit 130, which feeds fillers (or other type of inserts which have to be placed inside the cigarette pack 1) to the pockets 70 f the wrapping drum 68. By way of example, fillers to be inserted in cigarette packs are described in patent US4771882A1 or in patent application WO2016005949A1.

[0075] The feeding unit 130 comprises a feeding drum 131 (namely, a feeding conveyor 131), which is mounted so as to rotate (with an intermittent motion, namely *"in a stepped manner")* around a horizontal rotation axis 132 (which is parallel to the rotation axis 69). The feeding drum 131 supports four pockets (not shown), each designed to receive and hold a filler.

[0076] The rotation of the feeding drum 131 around the rotation axis 132 cyclically moves each pocket along a circular feeding path and through: a holding station S26, where the pocket receives a filler, and, then, the feeding station S27, where the pocket releases the filler to a pocket 70 of the wrapping drum 68.

[0077] The feeding unit 130 comprises a transfer conveyor belt 133, which is arranged vertically, cyclically picks up the fillers from a holding station S28 and cyclically releases the fillers to the feeding drum 131 in the holding station S26. In the holding station S28, the fillers are cut from a continuous band of wrapping material or, alternatively, are picked up from the bottom of a stack housed in a hopper.

[0078] In the transfer station S26 there is a pusher 134, which, by means of a vertical movement (namely perpendicular to the rotation axis 132 of the wrapping drum 131), cyclically feeds the fillers from the transfer conveyor 133 to the pockets (not shown) of the feeding drum 131. Similarly, in the feeding station S9, there is a pusher 135, which, by means of a vertical movement (namely perpendicular to the rotation axis 132 of the wrapping drum 131), cyclically feeds the fillers from the pockets (not shown) of the feeding drum 131 to the pockets 70 of the wrapping drum 68.

[0079] According to other embodiments which are not shown herein, the feeding unit 130 could be combined with the feeding unit 125 instead of being combined with the feeding unit 73. According to a preferred, though non-binding embodiment, the movements of the different components (wrapping drums, feeding conveyors, pushers, movable folding elements...) of the packer machine 29 are carried out by means of respective electric motors, which are independent of one another and are synchro-

nized (namely operated in phase) in a virtual manner (namely, not by means of a physical connection, but by means of a control connection). An electric motor (for example, the electric machine controlling the rotation of the wrapping drum 30) is usually used as a reference ("*master*") and all the other electric motors (*"slaves"*) pursue the position of the reference electric motor ("*master*"). In order to obtain the linear movements (namely, those movements that involve a displacement along a straight trajectory), a rotary electric motor is generally used, which causes the rotation of a pinion meshing with a rack; namely, a *"pinion-rack"* mechanism is used to turn the rotary movement generated by the electric motor into a linear movement.

[0080] The embodiments described herein can be combined with one another, without for this reason going beyond the scope of protection of the invention.

[0081] The packer machine 29 described above has numerous advantages.

[0082] First of all, the packer machine 29 described above allows manufacturers to produce wrappers 3 for cigarette packs 1 with a high production quality (namely, having extremely precise and square folds of the wrap 21), even operating at a high production speed (namely, with a large number of wrappers 3 produced per unit of time).

[0083] Furthermore, the packer machine 29 described above allows manufacturers to change the format of the cigarette packs 1 in a relatively simple and quick fashion.

[0084] Finally, the packer machine 29 described above is compact and allows ideal access to all the components thereof; indeed, an operator standing in front of the packer machine 29 is capable of reaching the active parts of the packer machine 29 with his/her own hands in a simple, quick and ergonomic fashion.

[0085] The embodiment shown in the accompanying figures relates to the production of a cigarette pack, but the invention can also be applied, without significant changes, to the production of any other type of pack for smoking articles (for example, a pack for cigars, a pack for electronic cigarettes with liquid vaporisation, a pack for new-generation cigarettes without tobacco combustion...).

Claims

1. A wrapping unit to fold a wrap (21) around a group (14) of smoking articles; the wrapping unit comprises:

a spindle (32), which is provided with a tubular cavity (33), which is designed to accommodate the group (14) of smoking articles and has: an outer base wall (34), an inner base wall (35) opposite the outer base wall (34), and a pair of side walls (36), which are interposed between the two base walls (34, 35);

a wrapping conveyor (30), which supports the spindle (32) and moves the spindle (32) along a wrapping path (P1);

a first feeding device (44), which is designed to insert the group (14) of smoking articles into the tubular cavity (33) of the spindle (32);

a second feeding device (48), which is designed to feed the wrap (21) to the spindle (32) laying the wrap (21) on the outer base wall (34) of the spindle (32);

a first folding device (53), which is designed to fold the wrap (21) in a "U"-shape around the spindle (32) laying the wrap (21) on both base walls (34, 35); and

a second folding device (55), which folds, on each side, a longitudinal wing (23) of the "U"-folded wrap (21) against a corresponding side wall (36) of the spindle (32);

the wrapping unit is **characterized in that:**

the outer base wall (34) of the spindle (32) is larger than the inner base wall (35) of the spindle (32);

the side walls (36) of the spindle (32) have respective inclined portions (37), which form a non-right angle with the base walls (34, 35) and give a trapezoidal shape to a cross section of the spindle (32);

the second folding device (55) folds, on each side, a longitudinal wing (23) of the "U"-folded wrap (21) against the inclined portion (37) of a corresponding side wall (36) of the spindle (32); and

the spindle (32) is provided with a plurality of sucking holes (43), which are arranged through the inclined portions (37) of the side walls (36) of the spindle (32) and are designed to hold, through suction, the longitudinal wings (23) of the "U"-folded wrap (21).

2. The wrapping unit according to claim 1, wherein the sucking holes (43) are arranged through the outer base wall (34) of the spindle (32).

3. The wrapping unit according to claim 1 or 2, wherein the inclined portion (37) of each side wall (36) of the spindle (32) has a width that is equal to the width of the first longitudinal wings (23) of the "U"-folded wrap (21).

4. The wrapping unit according to claim 1, 2 or 3, wherein the second folding device (55) is built-in in the first folding device (53).

5. The wrapping unit according to claim 4, wherein:

the first folding device (53) comprises a "U"-shaped, rigid folding body (54), which, by axially

moving relative to the wrapping conveyor (30), *"embraces"* the spindle (32), thus determining the "U"- folding of the wrap (21) around the spindle (32); and

the second folding device (55) comprises a pair f folding element (55), which are supported by the rigid body (54) of the first folding device (53) and, when the rigid body (54) *"embraces"* the spindle (32), determine the 90° folding of the transverse wings (22) of the "U"-folded wrap (21).

6. The wrapping unit according to claim 4 or 5, wherein the side walls (36) of the spindle (32) have a longitudinal extension which is smaller than a longitudinal extension of the base walls (34, 35), so that the transverse wings (22) of the "U"-folded wrap (21) are folded against a portion of the group (14) of smoking articles left uncovered by the side walls (36) of the spindle (32).

7. The wrapping unit according to one of the claims from 1 to 6, wherein each side wall (36) of the spindle (32) has:

the inclined portion (37), which forms a non-right angle with the base walls (34, 35) of the spindle (32) and originates from the inner base wall (35); and

a perpendicular portion (38), which forms a right angle with the base walls (34, 35) of the spindle (32), originates from the outer base wall (34) and is joined to the inclined portion (37).

8. The wrapping unit according to one of the claims from 1 to 7, wherein the spindle (32) is mounted on the conveyor (30) in a projecting manner, so that an input opening of the tubular cavity (33) is arranged in the area of the wrapping conveyor (30) and an output opening of the tubular cavity (33) is arranged far from the wrapping conveyor (30).

9. The wrapping unit according to one of the claims from 1 to 8, wherein the spindle (32) has, in the area of an input opening of the tubular cavity (33), a first thickness which is greater than a second thickness of the spindle (32) in the area of an output opening of the tubular cavity (33).

10. The wrapping unit according to claim 9, wherein the thickness of the spindle (32) remains constant along a given portion starting from the output opening of the tubular cavity (33) and progressively and linearly increases close to the input opening of the tubular cavity (33).

11. The wrapping unit according to one of the claims from 1 to 10, wherein the inner base wall (35) of the spindle (32) is perfectly flat in each part thereof.

12. The wrapping unit according to one of the claims from 1 to 11, wherein the outer base wall (34) of the spindle (32) has:

a first part, which is arranged in the area of a first outlet opening of the tubular cavity (33) and is parallel to the inner base wall (35) of the spindle (32); and

a second part, which is arranged in the area of an input opening of the tubular cavity (33) and forms an acute angle with the first part.

13. The wrapping unit according to one of the claims from 1 to 12, wherein:

the second feeding device (48) lays the flat wrap (21) on the outer base wall (34) of the spindle (32); and

a third folding device (52) is provided, which is arranged in the area of the second feeding device (48) and is designed to fold the wrap (21) in an "L"-shape against the spindle (32) .

14. The wrapping unit according to one of the claims from 1 to 13, wherein the second folding device (55) is arranged in the area of the first folding device (53).

15. A wrapping method to fold a wrap (21) around a group (14) of smoking articles; the wrapping method comprises the steps of:

moving, along a wrapping path (P1) and by means of a wrapping conveyor (30), a spindle (32), which is provided with a tubular cavity (33), which is designed to accommodate the group (14) of smoking articles and has: an outer base wall (34), an inner base wall (35) opposite the outer base wall (34), and a pair of side walls (36), which are interposed between the two base walls (34, 35);

inserting, by means of a first feeding device (44), the group (14) of smoking articles into the tubular cavity (33) of the spindle (32);

feeding, by means of a second feeding device (48), the wrap (21) to the spindle (32) laying the wrap (21) on the outer base wall (34) of the spindle (32);

folding in a "U"-shape, by means of a first folding device (53), the wrap (21) around the spindle (32) laying the wrap (21) on both base walls (34, 35); and

folding, by means of a second folding device (55), on each side, a longitudinal wing (23) of the "U"-folded wrap (21) against a corresponding side wall (36) of the spindle (32);

the wrapping method is **characterized in that:**

the outer base wall (34) of the spindle (32) is larger than the inner base wall (35) of the spindle (32);

the side walls (36) of the spindle (32) have respective inclined portions (37), which form a non-right angle with the base walls (34, 35) and give a trapezoidal shape to a cross section of the spindle (32);

the second folding device (55) folds, on each side, a longitudinal wing (23) of the "U"-folded wrap (21) against the inclined portion (37) of a corresponding side wall (36) of the spindle (32); and

the spindle (32) is provided with a plurality of sucking holes (43), which are arranged through the inclined portions (37) of the side walls (36) of the spindle (32) and are designed to hold, through suction, the longitudinal wings (23) of the "U"-folded wrap (21).

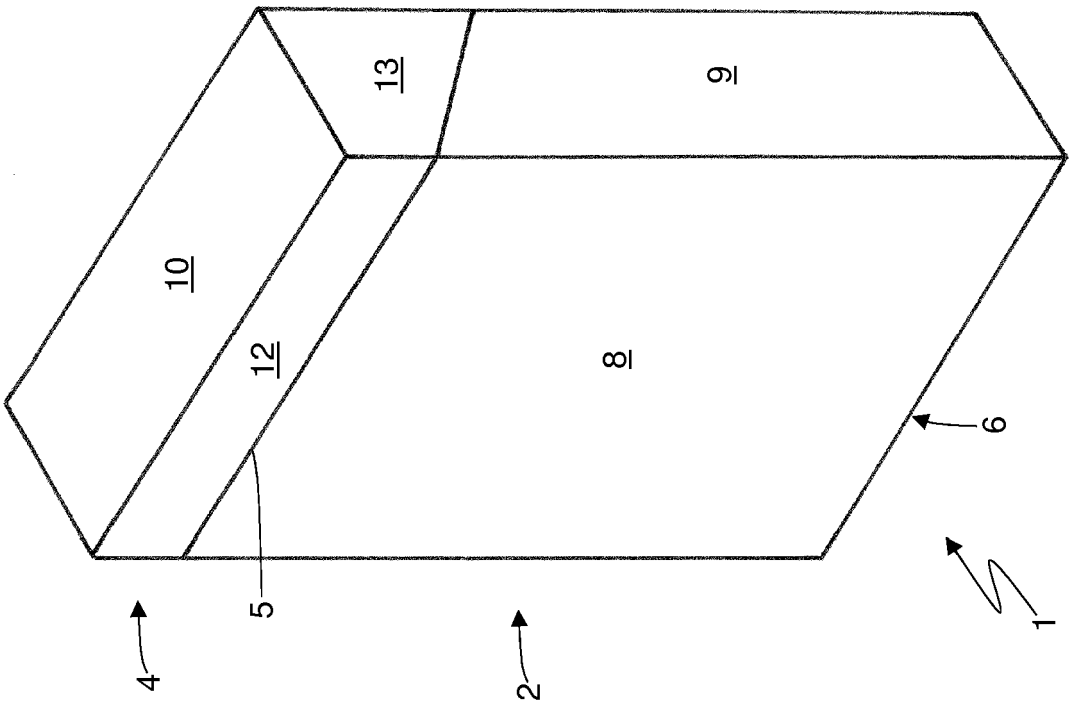


Fig.2

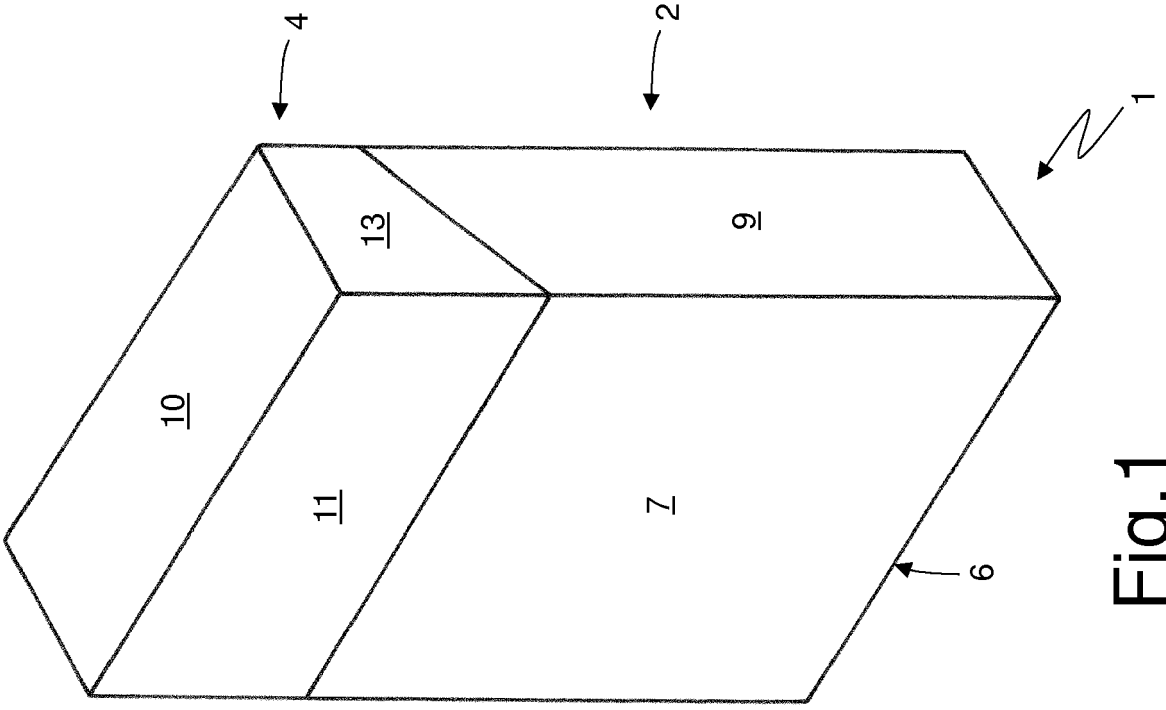


Fig.1

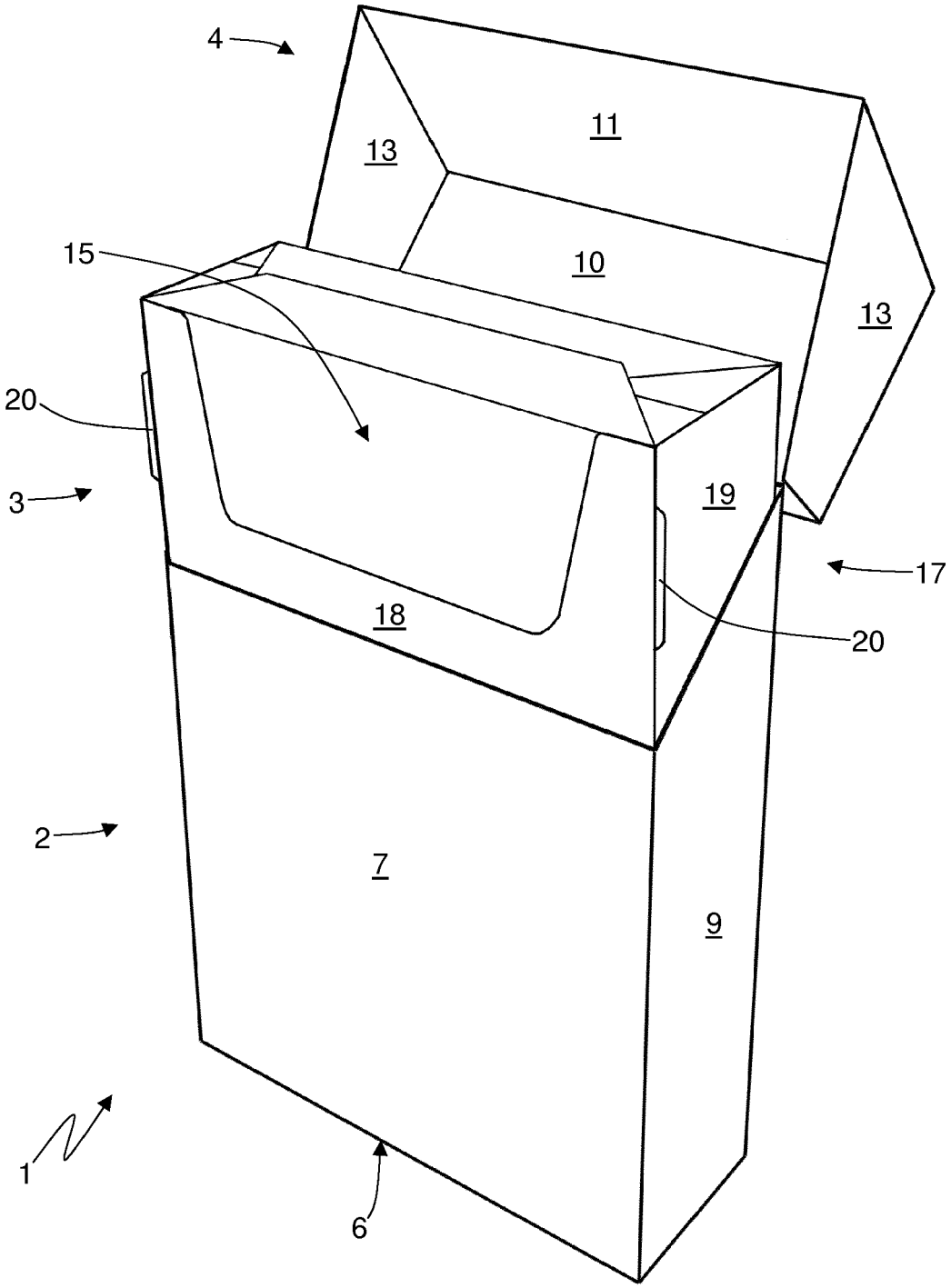


Fig.3

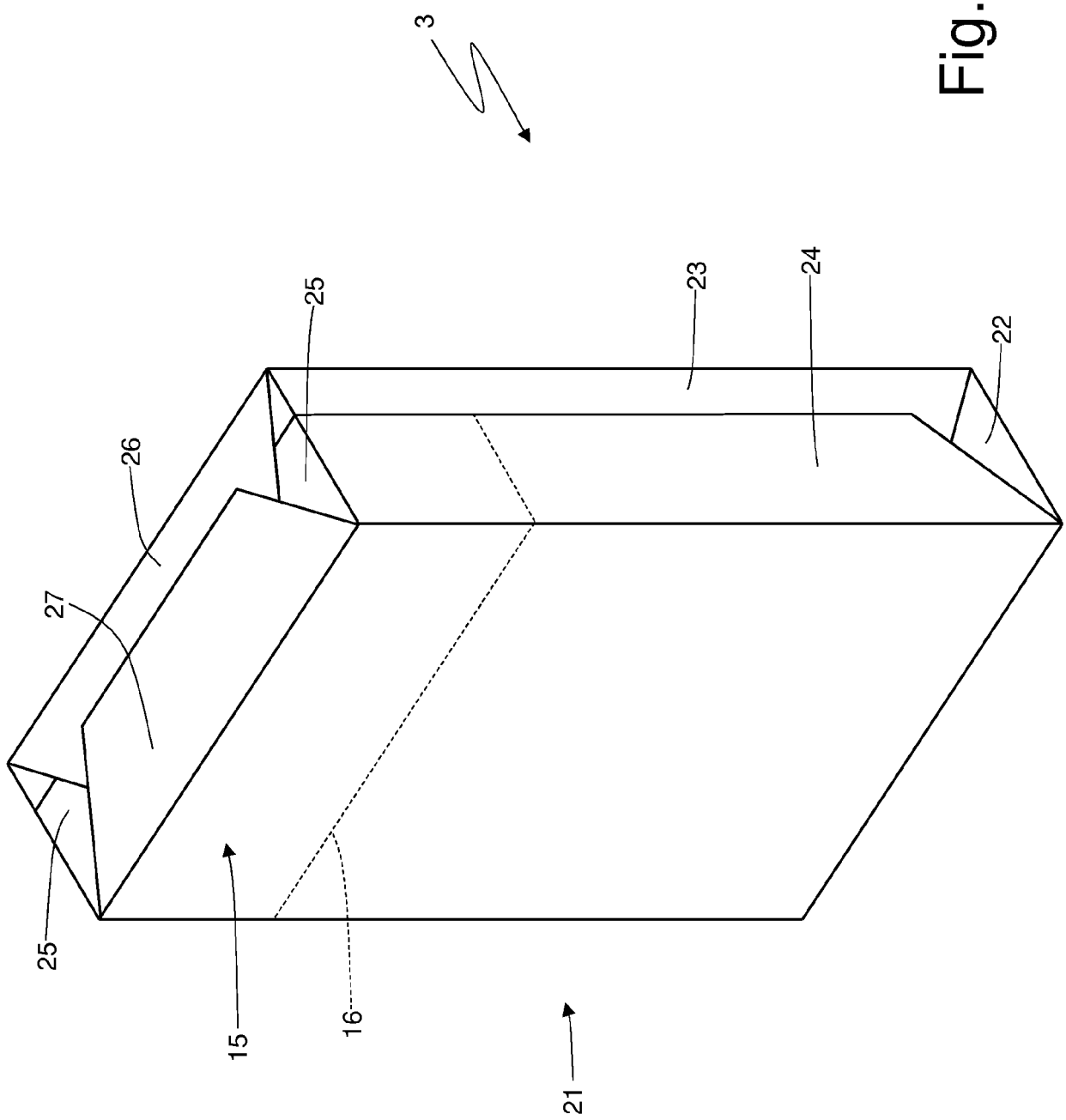
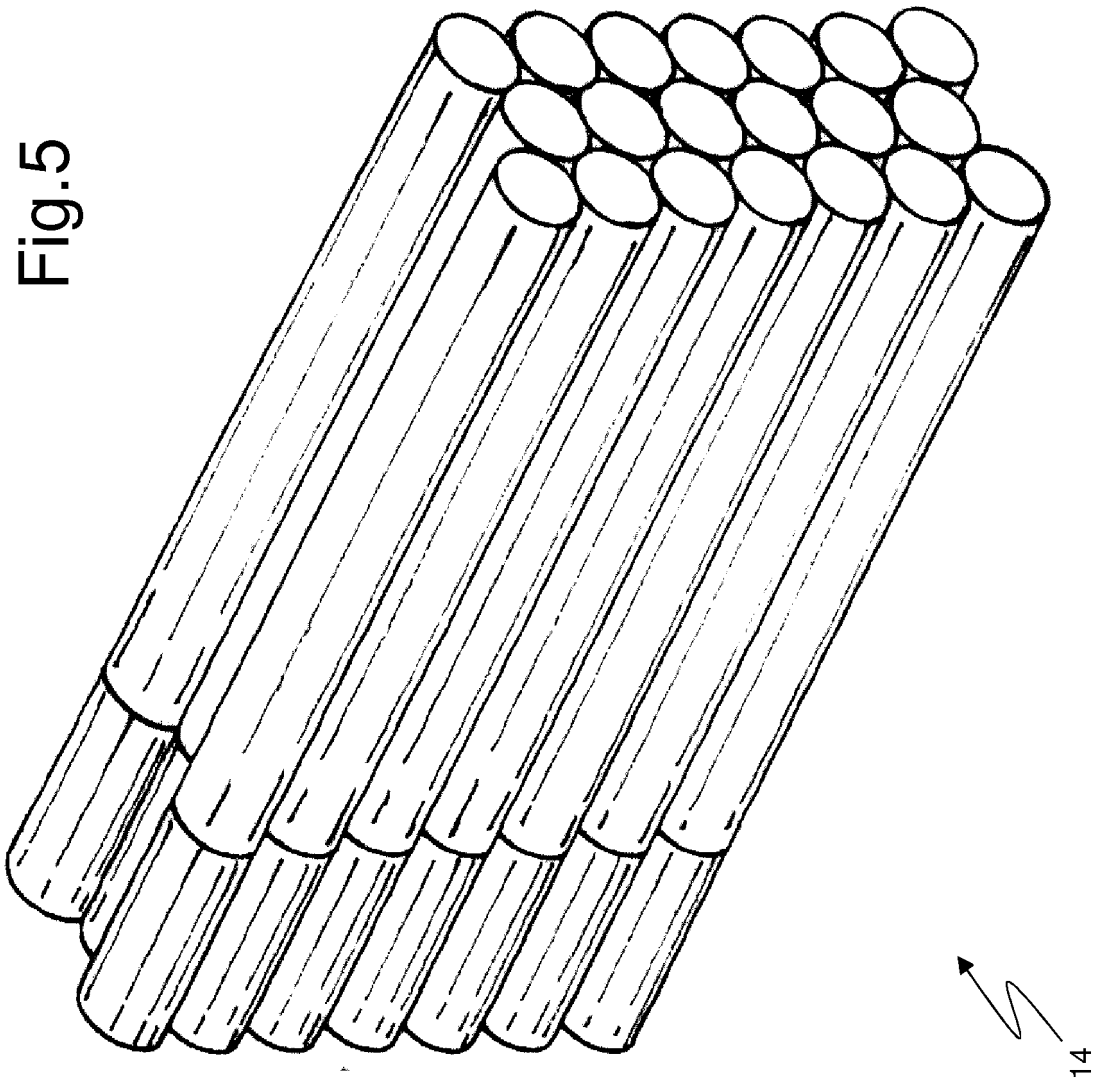


Fig.4

Fig.5



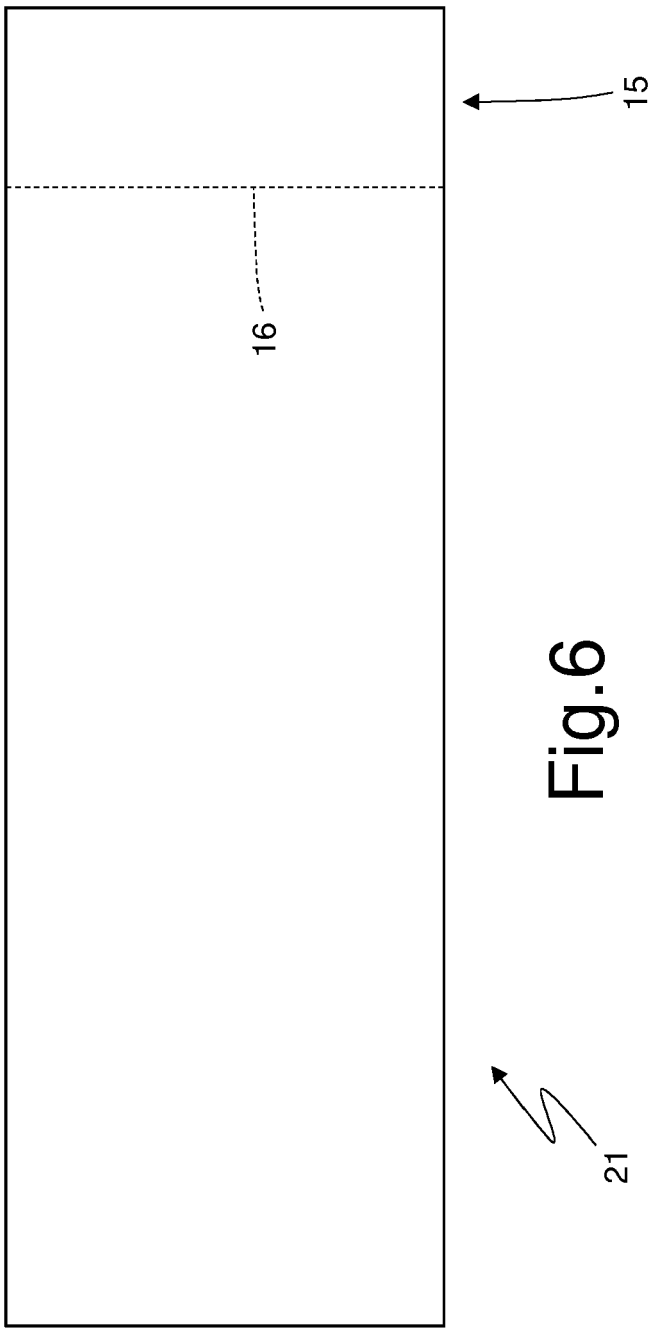


Fig.6

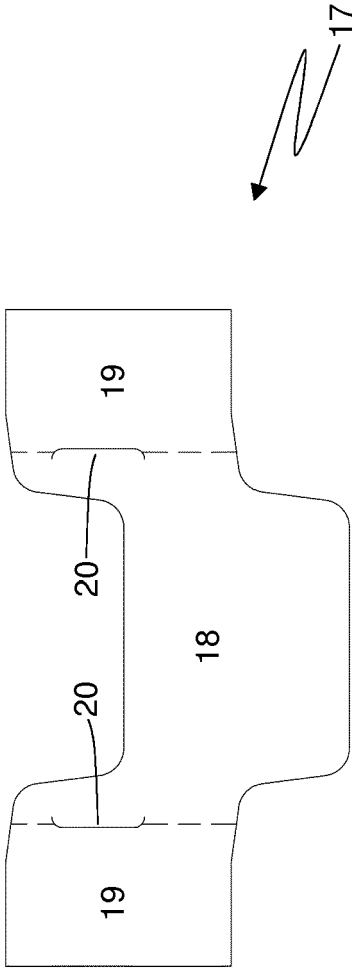


Fig.7

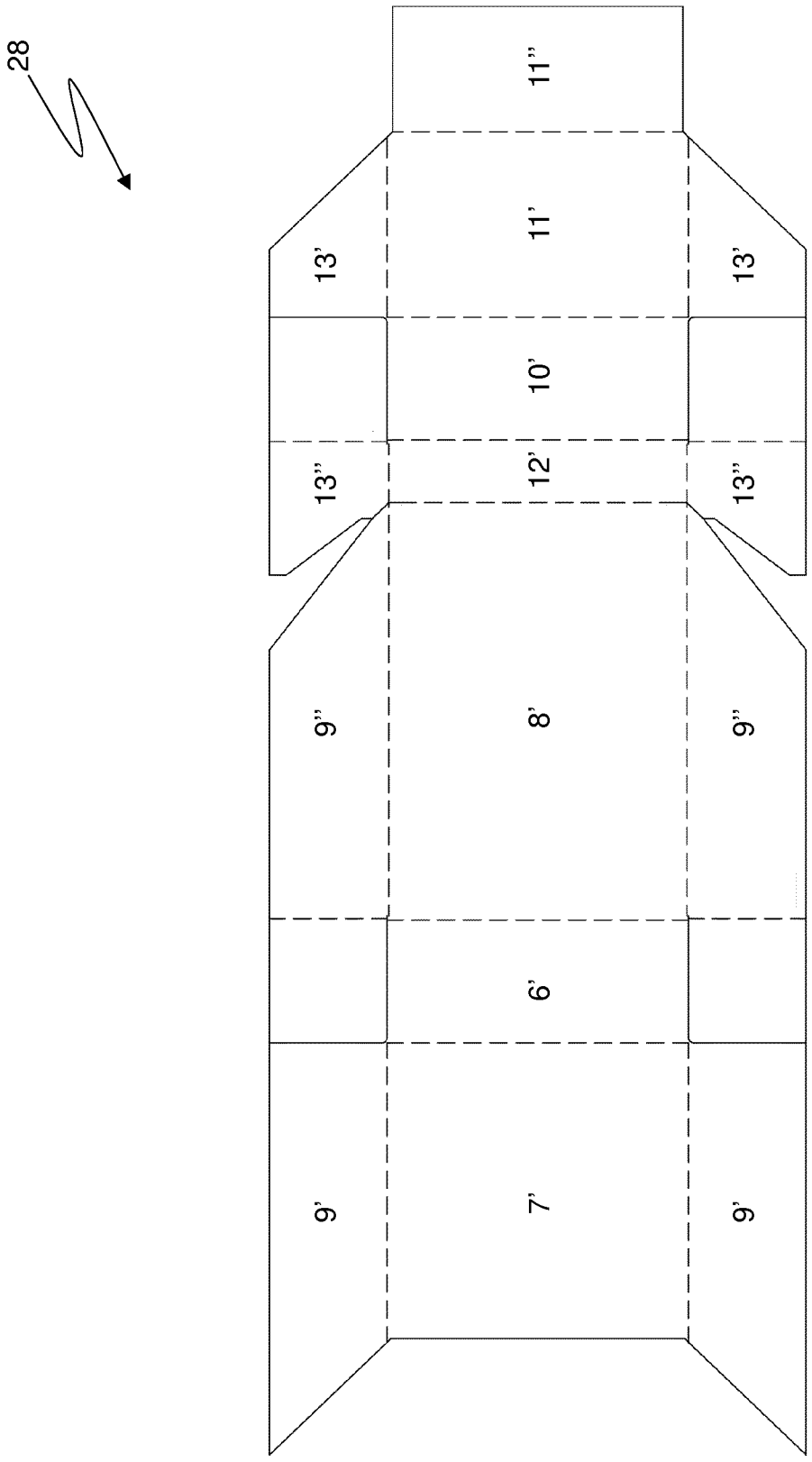
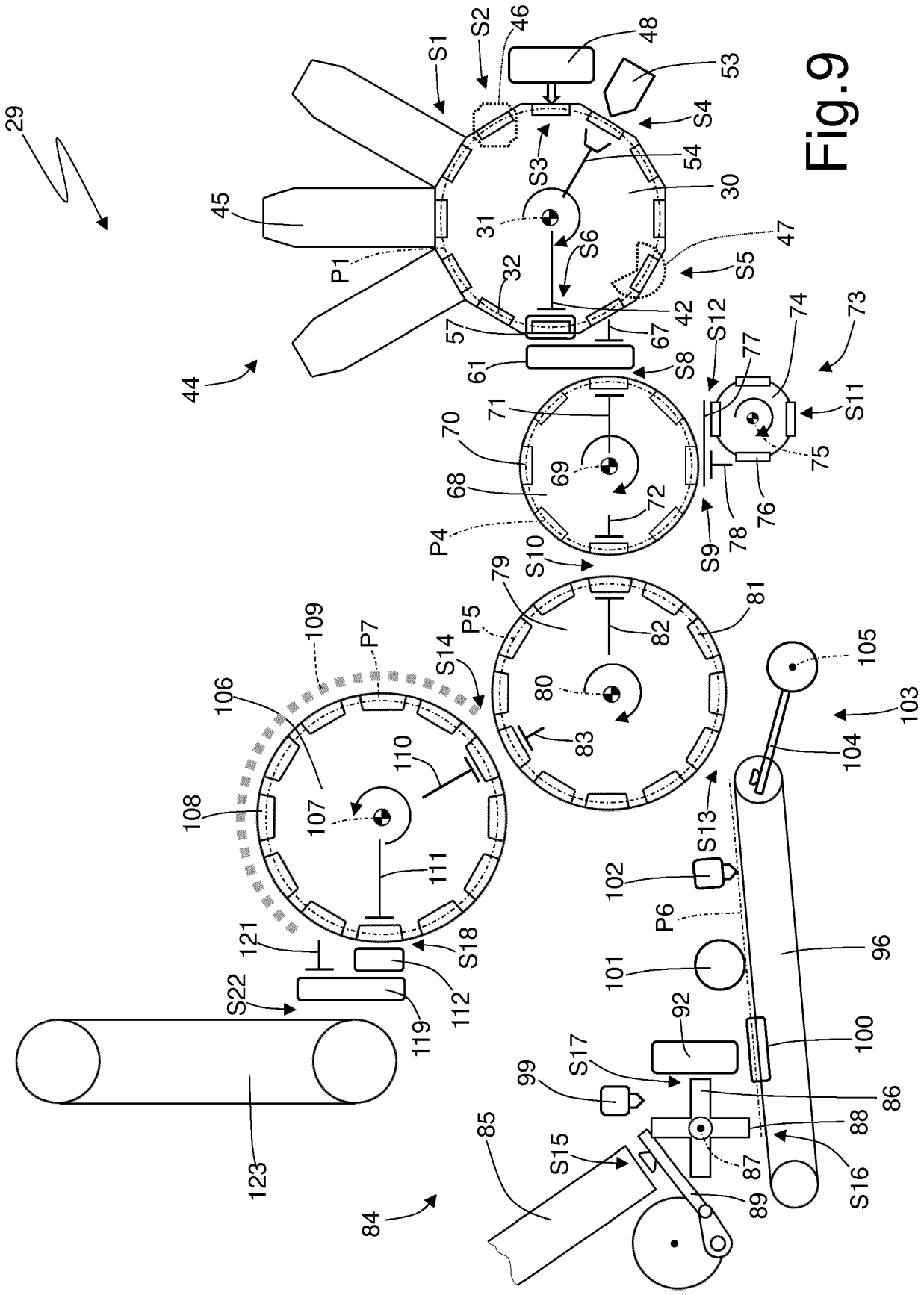


Fig.8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S6
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S8
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S11
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P4
S10
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Fig.9

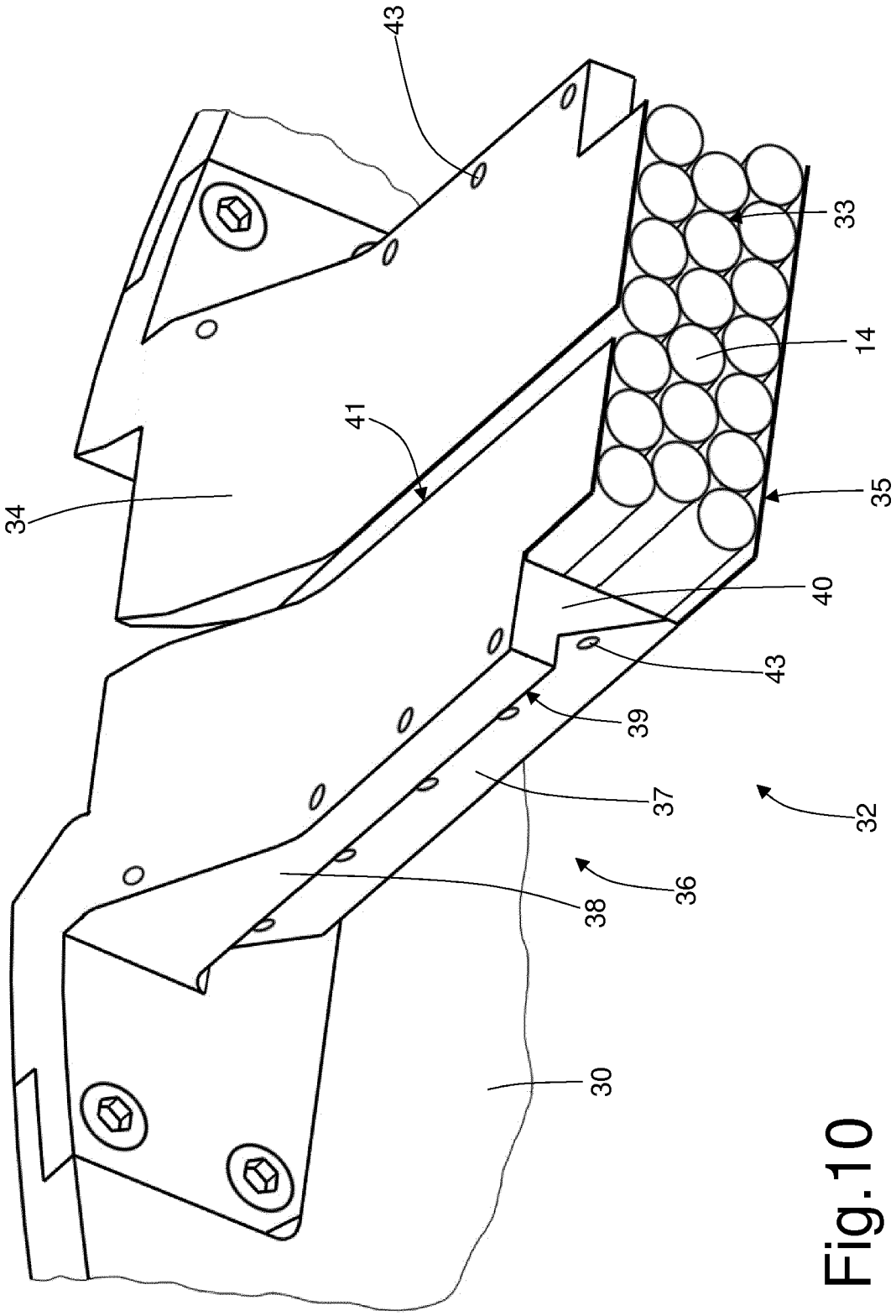


Fig.10

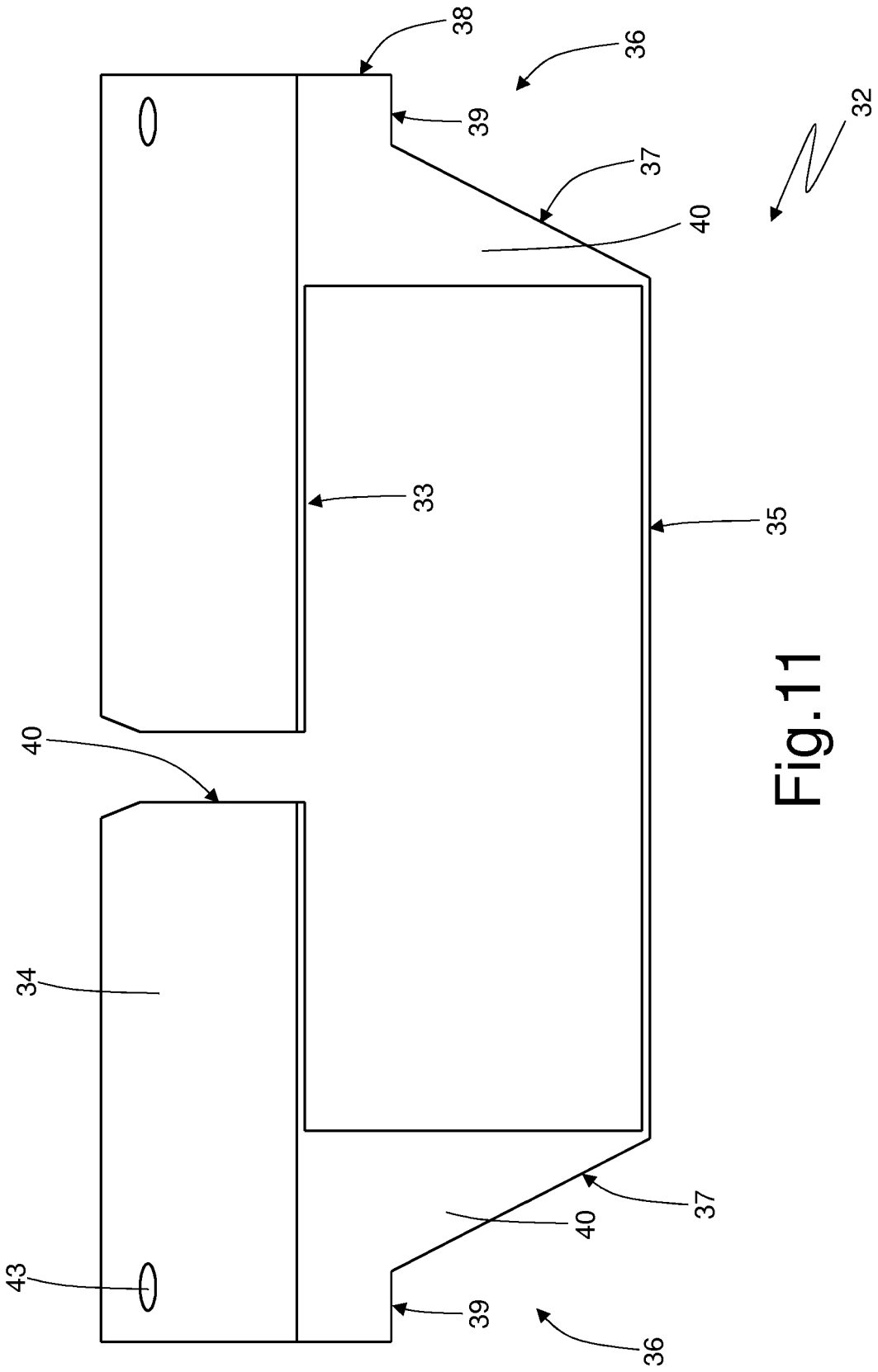


Fig.11

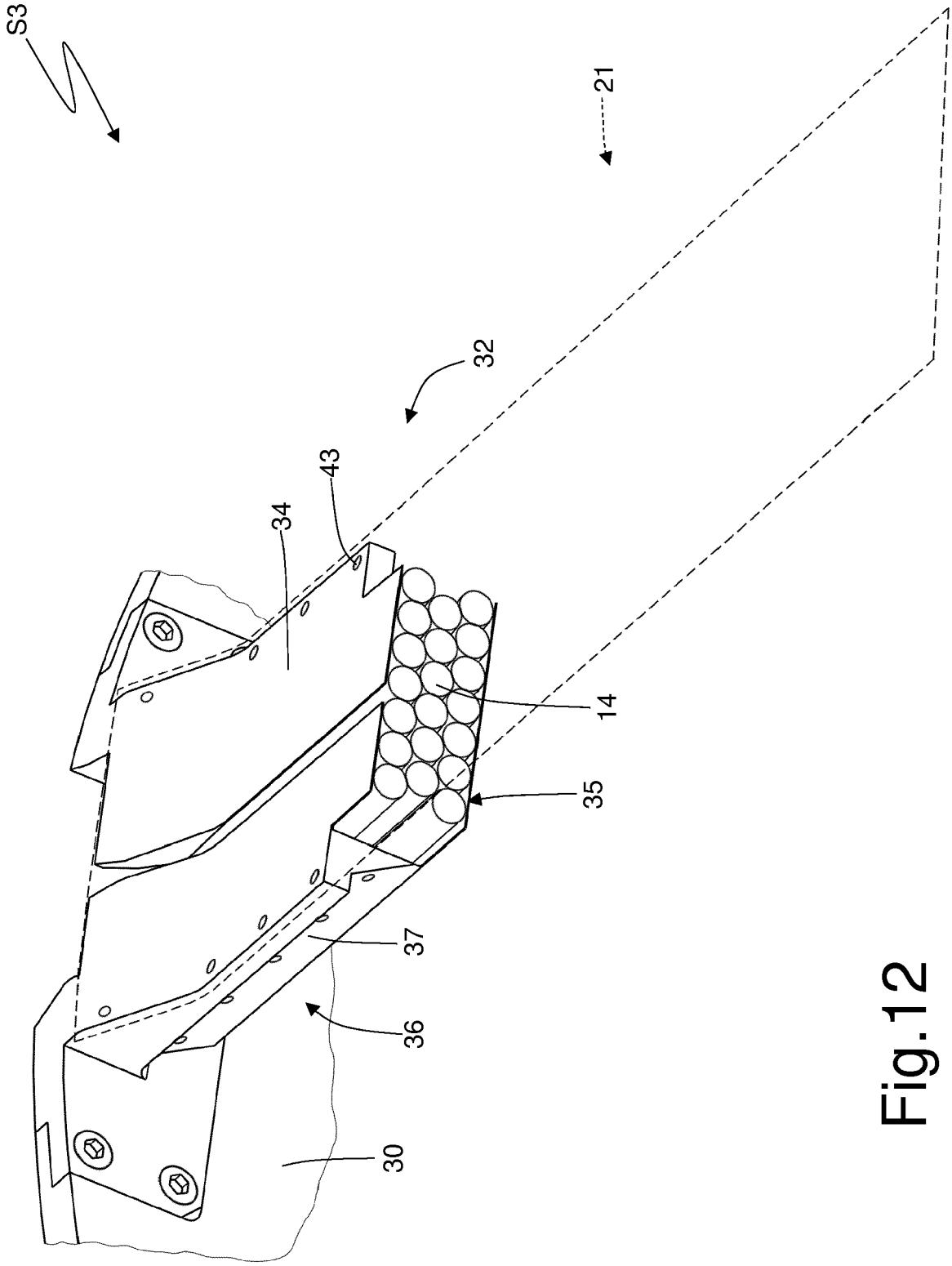


Fig.12

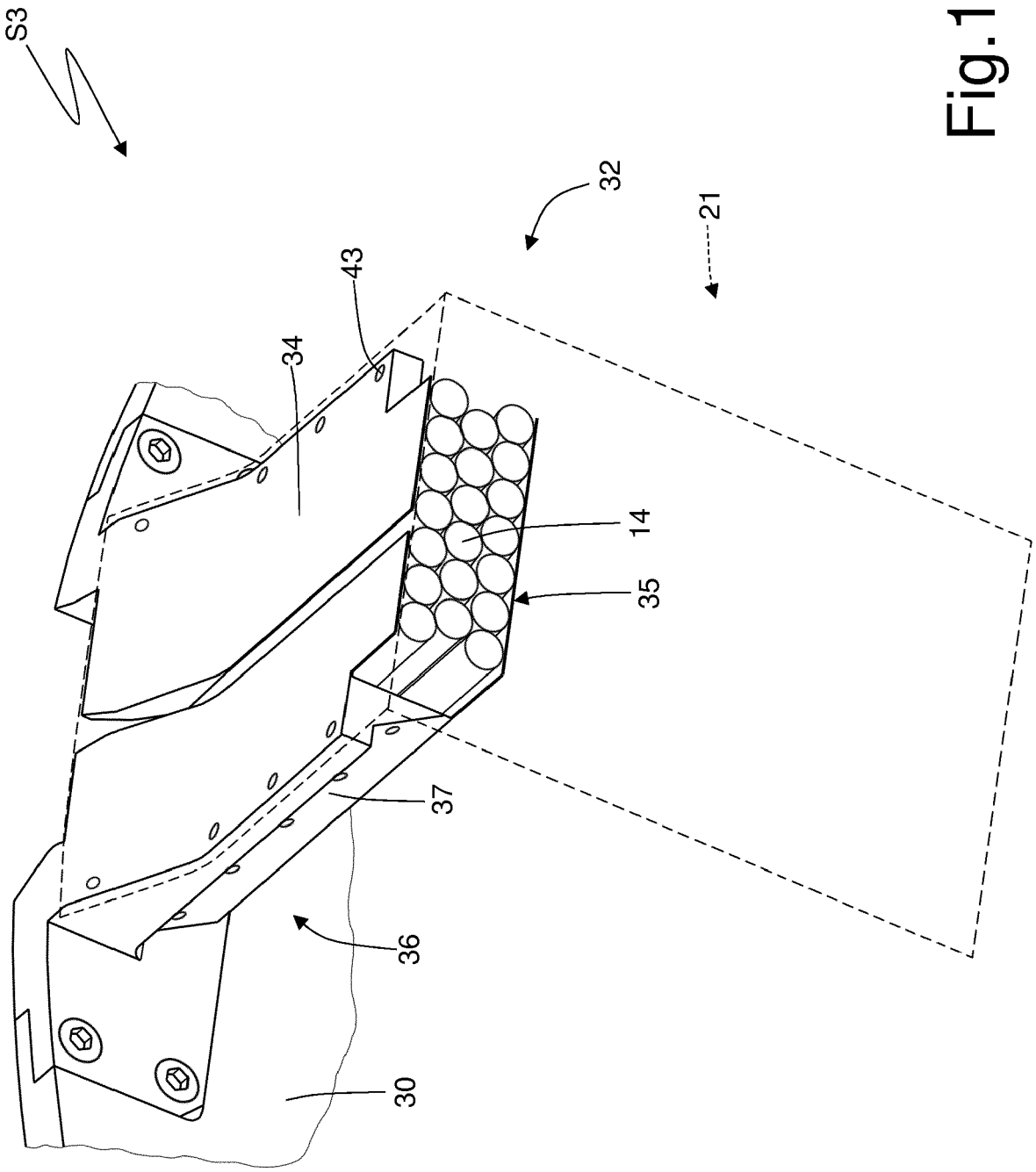


Fig.13

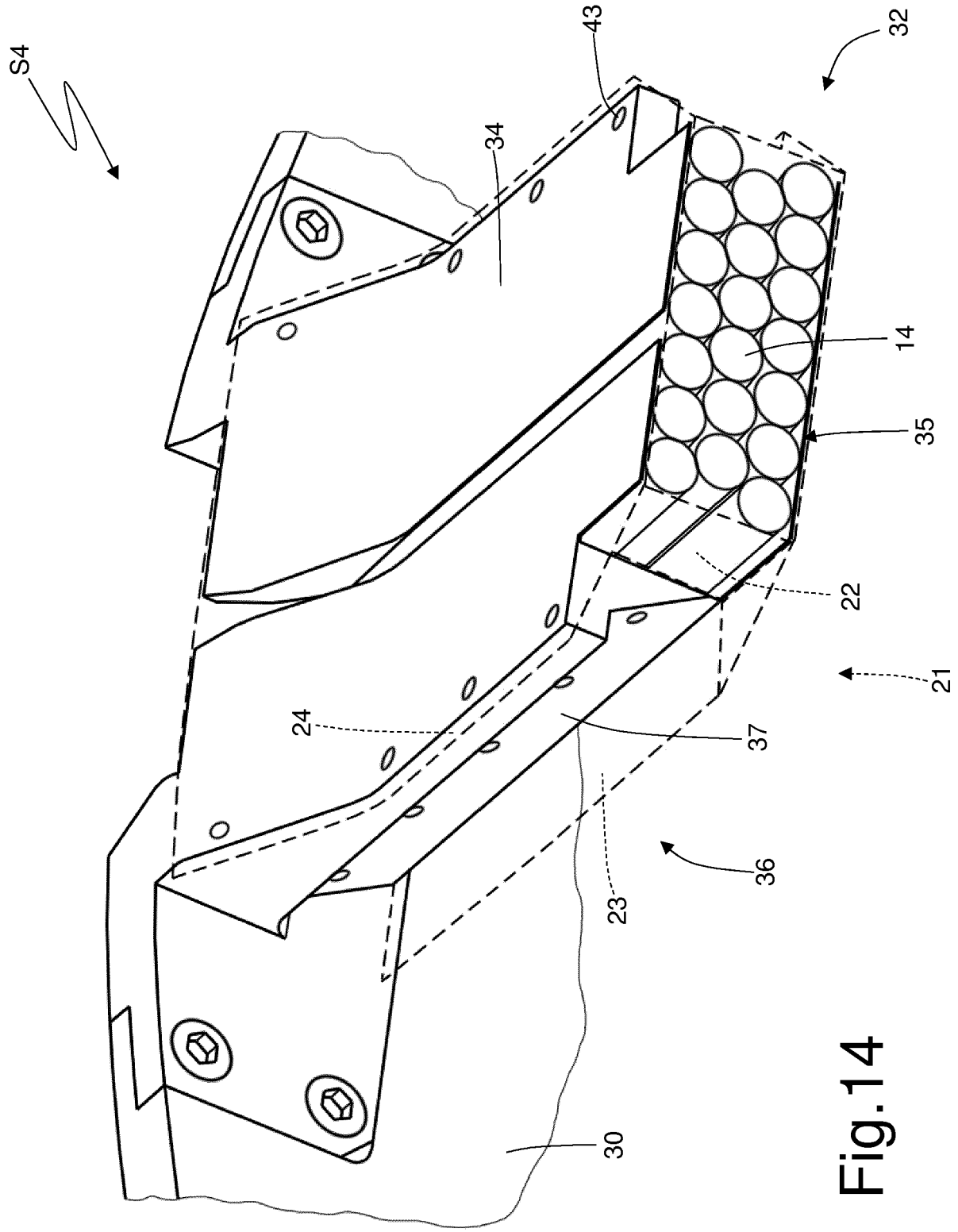


Fig.14

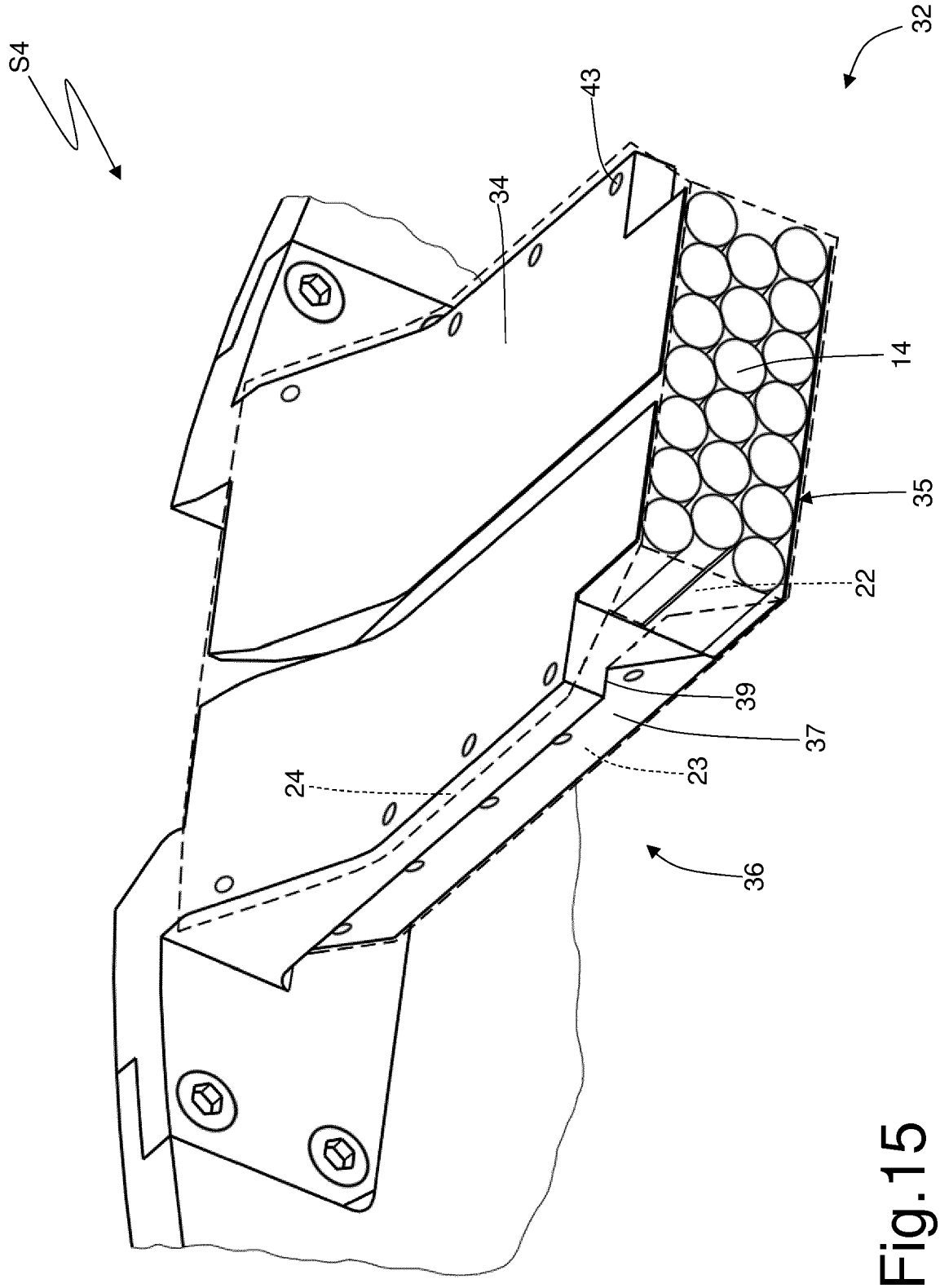


Fig.15

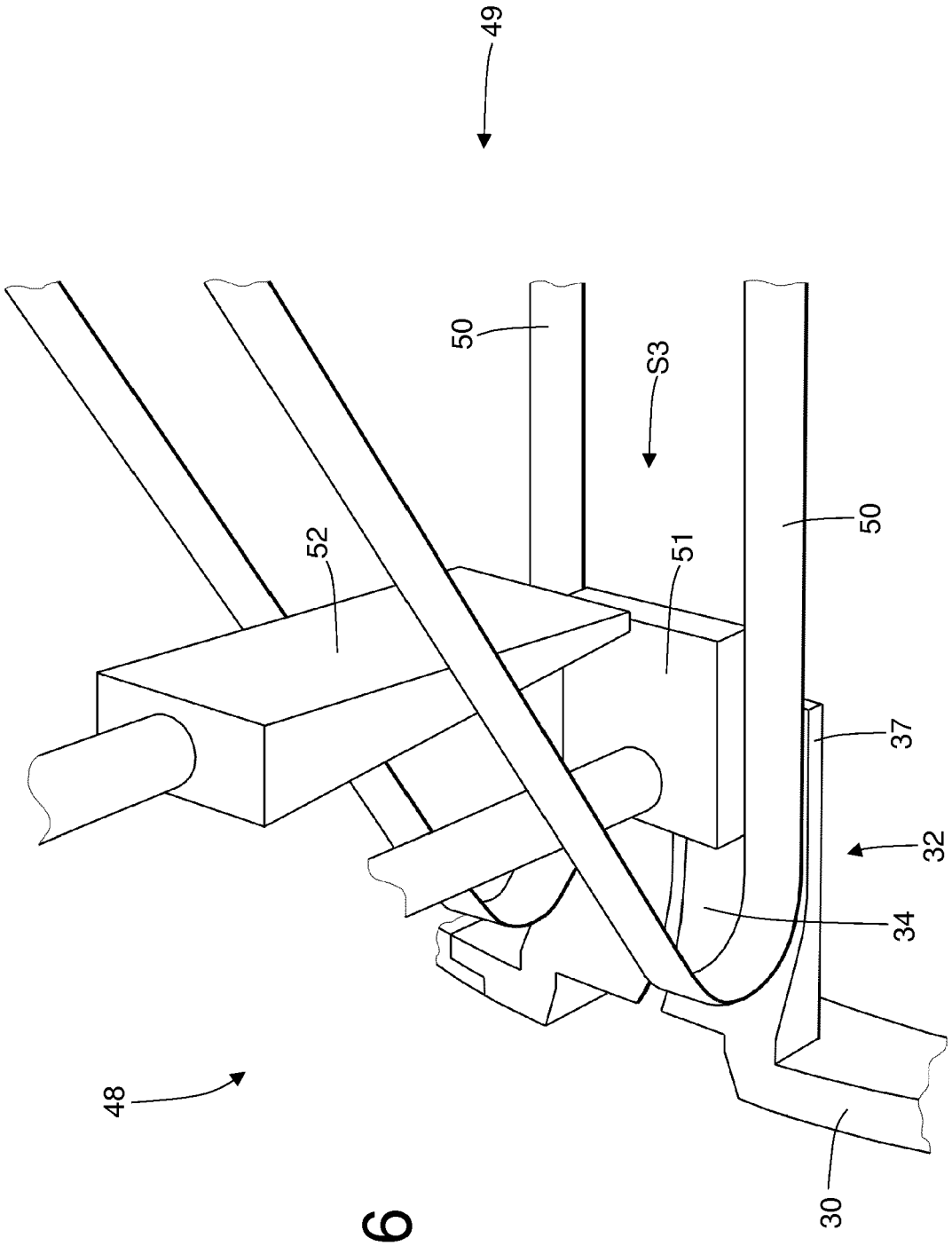


Fig.16

Fig.17

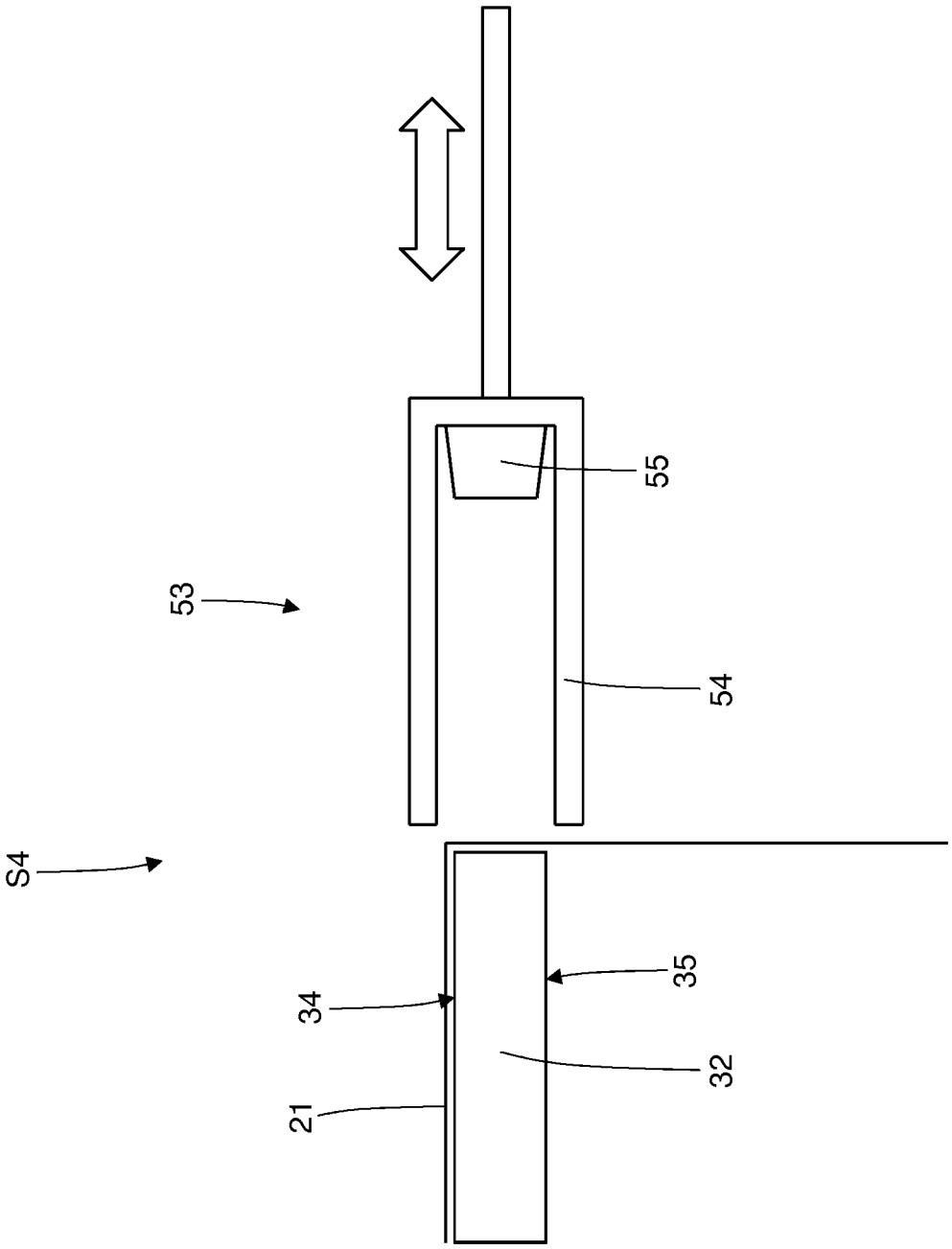
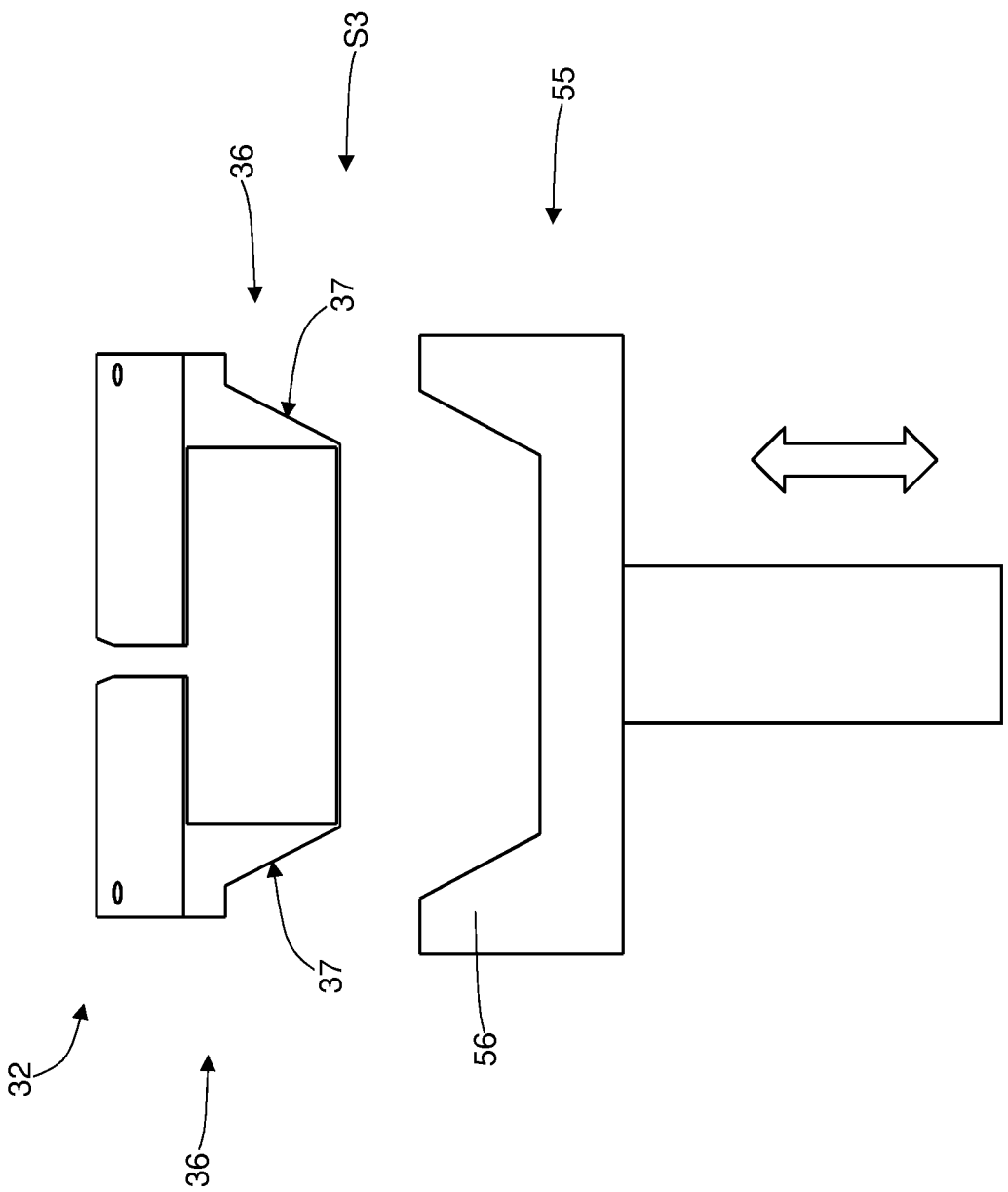


Fig.18



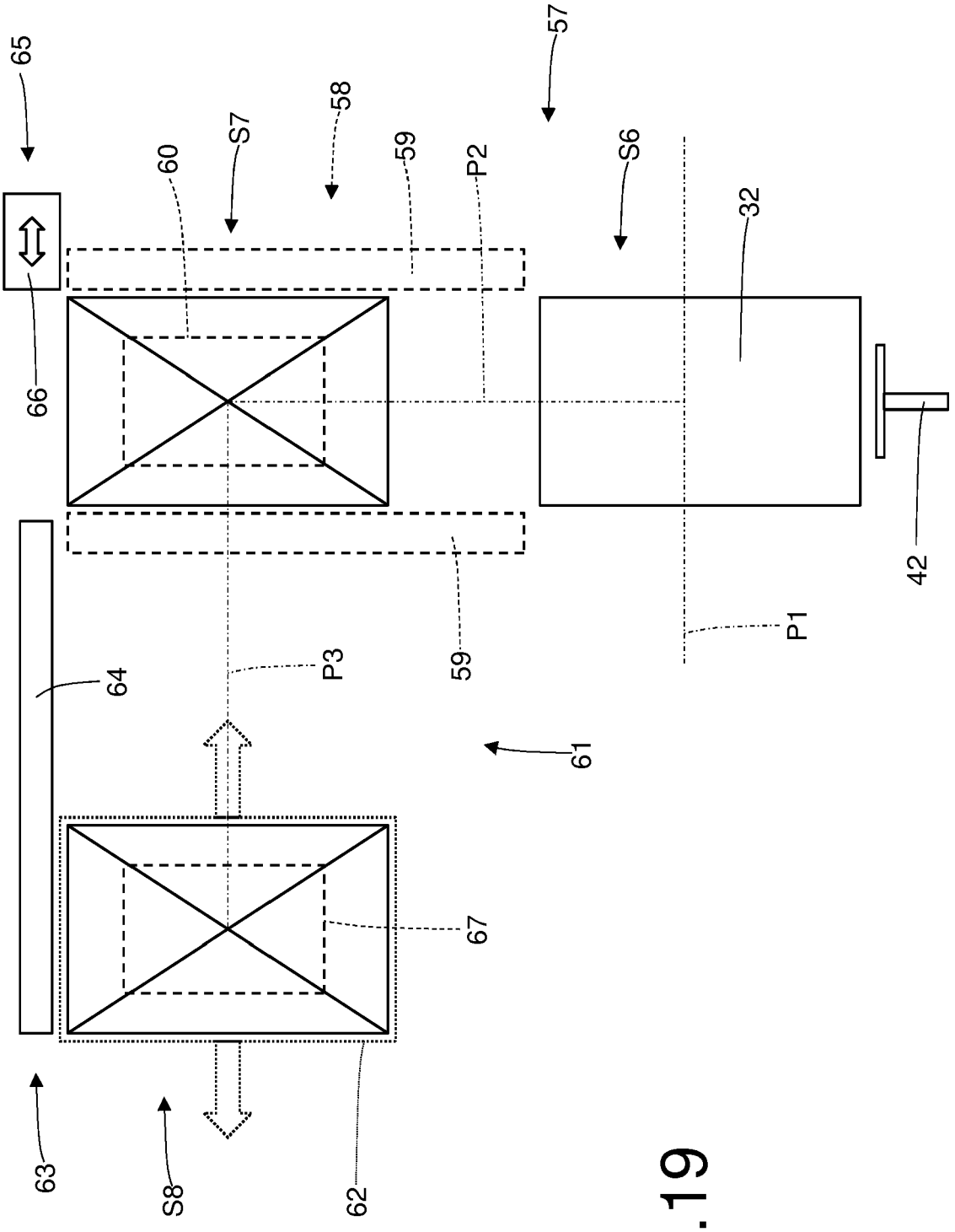


Fig.19

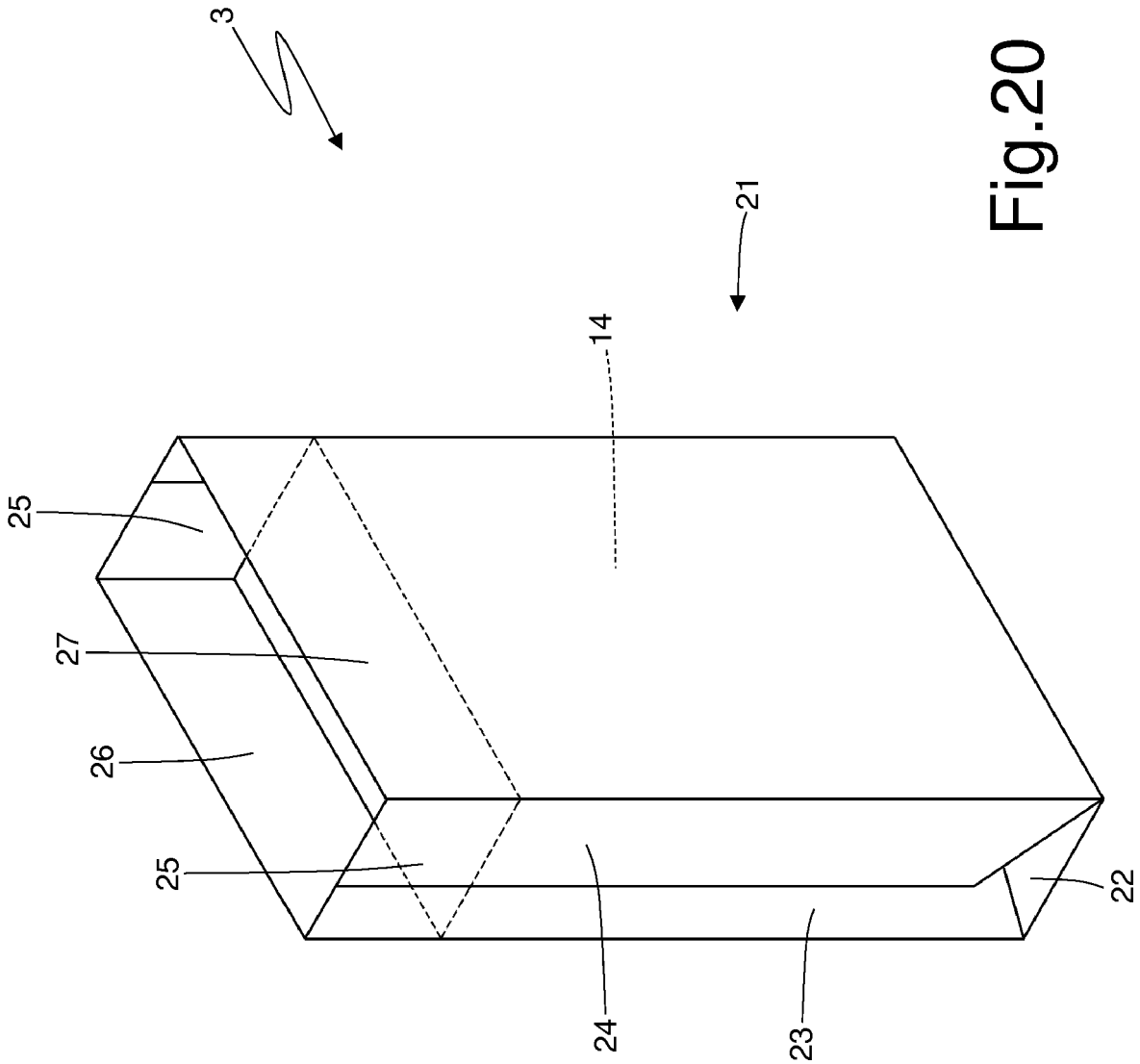


Fig.20

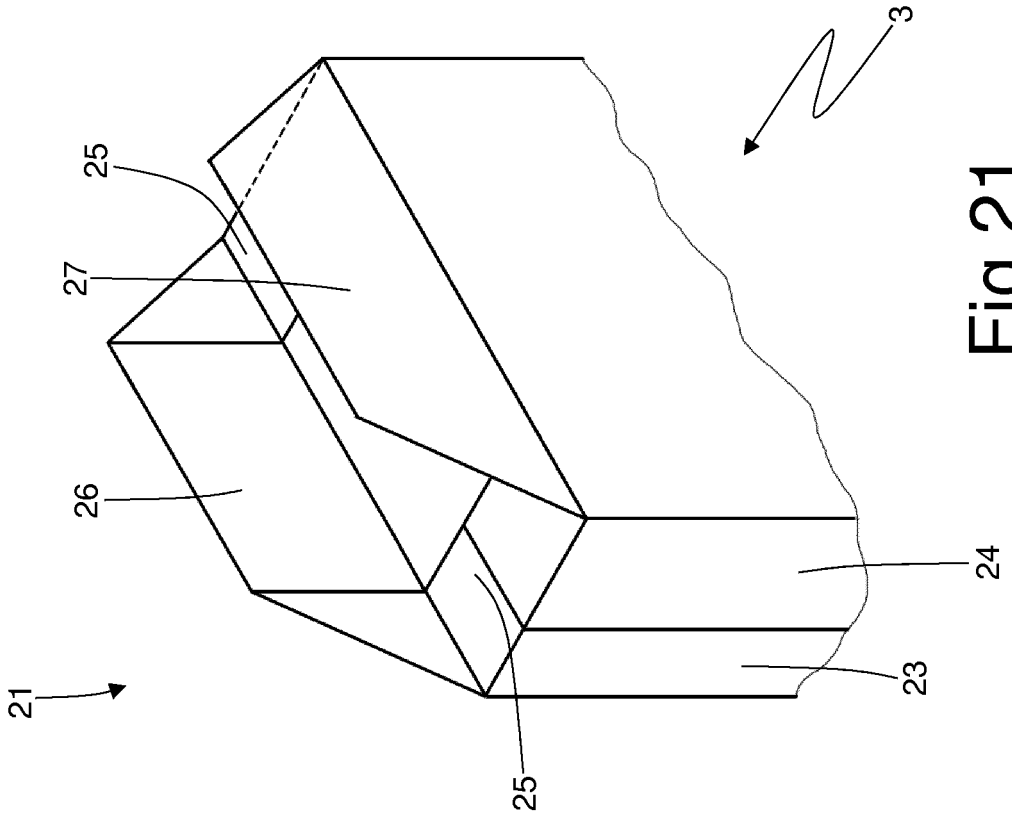


Fig.21

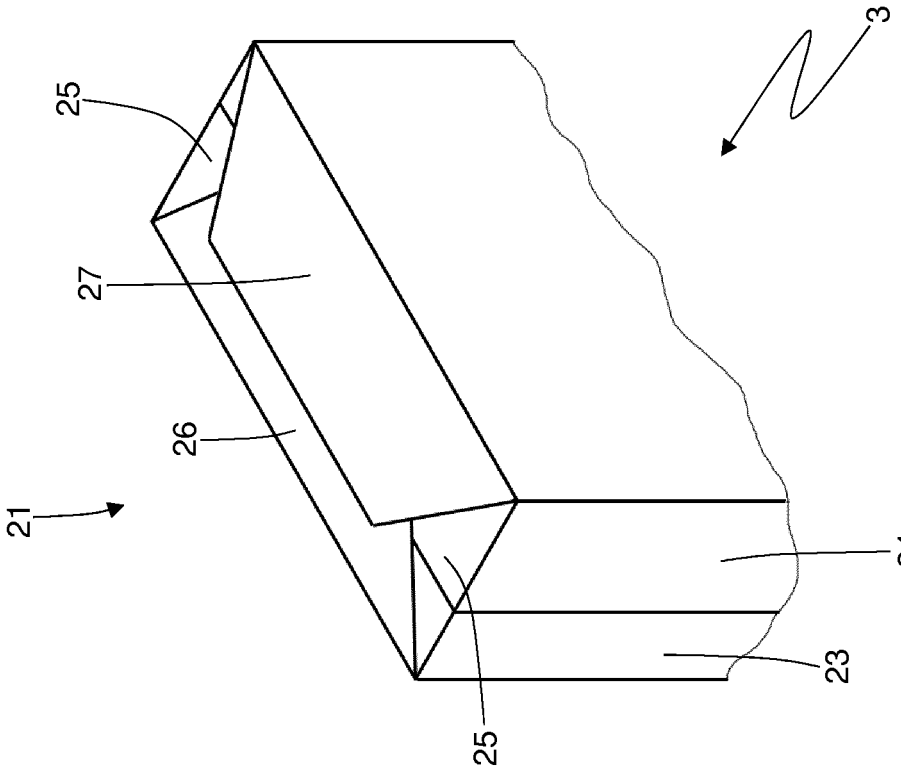


Fig.22

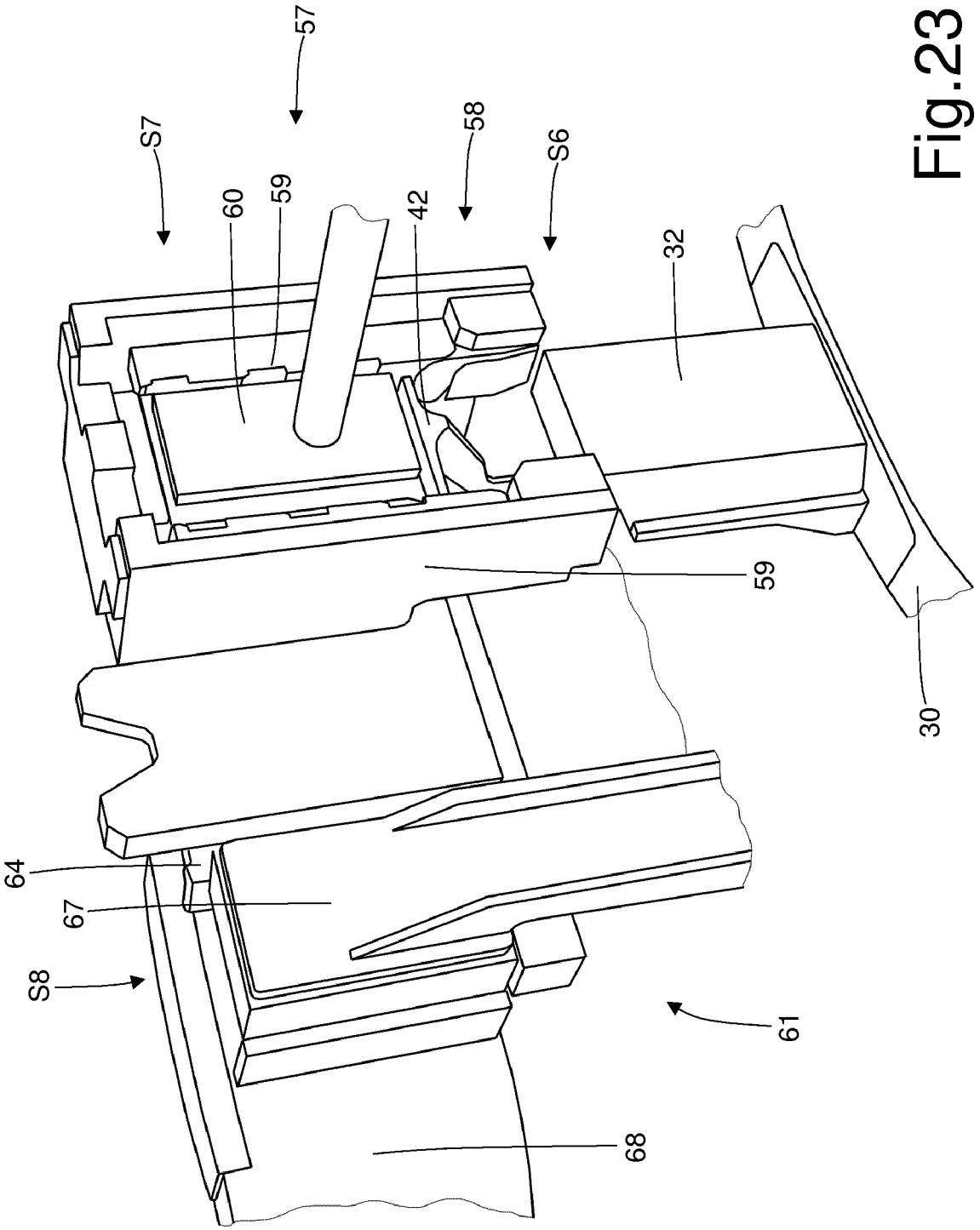


Fig.23

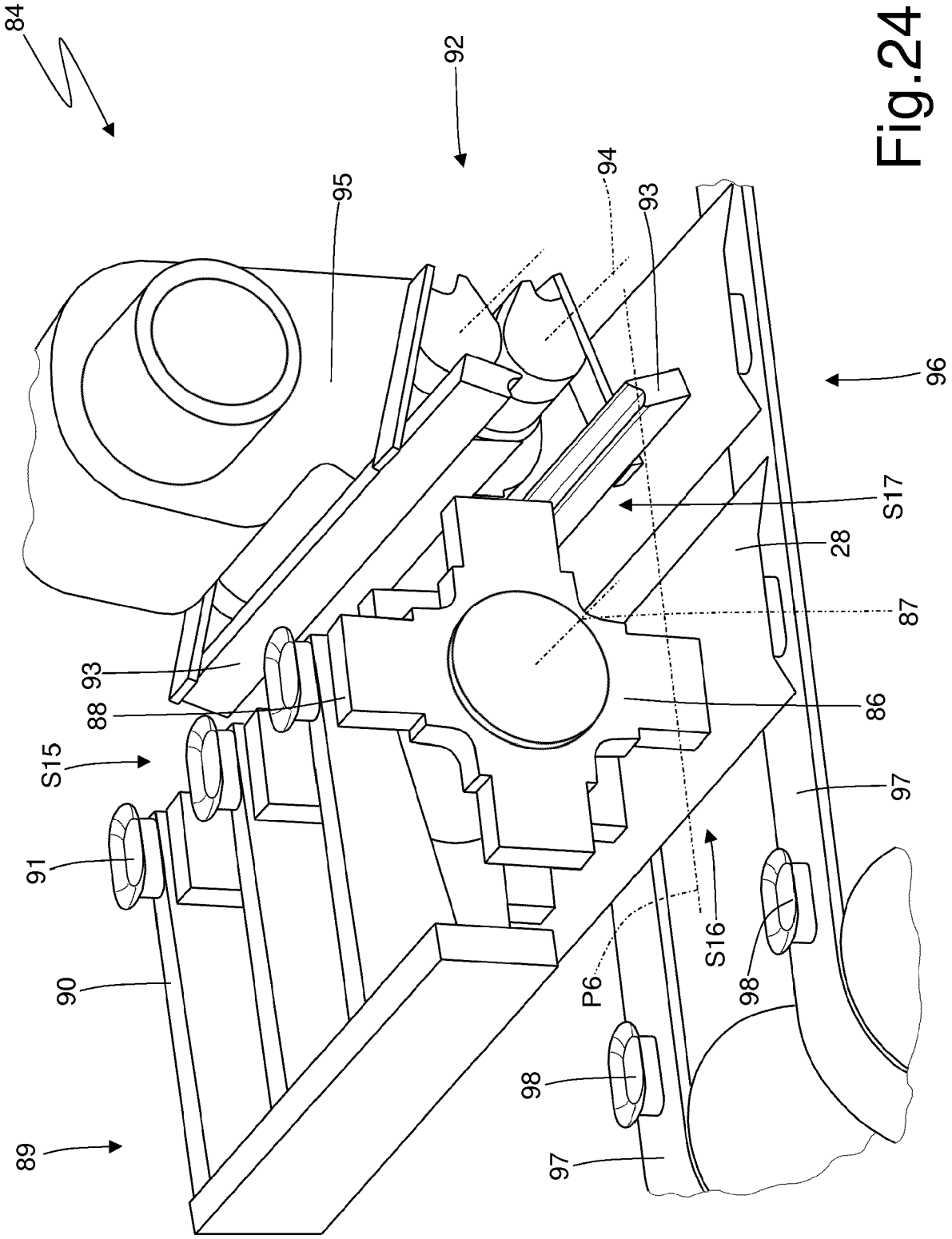


Fig.24

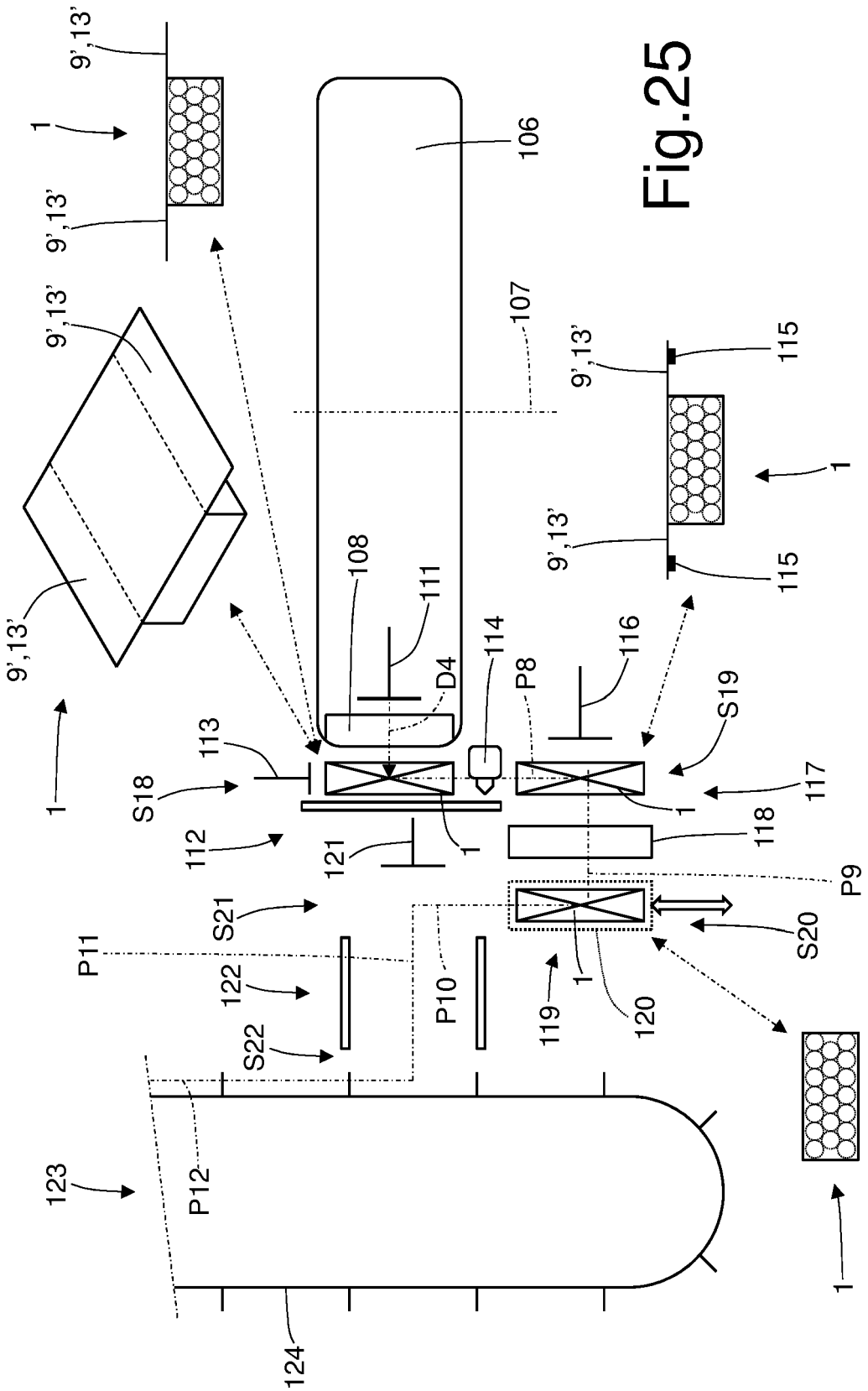

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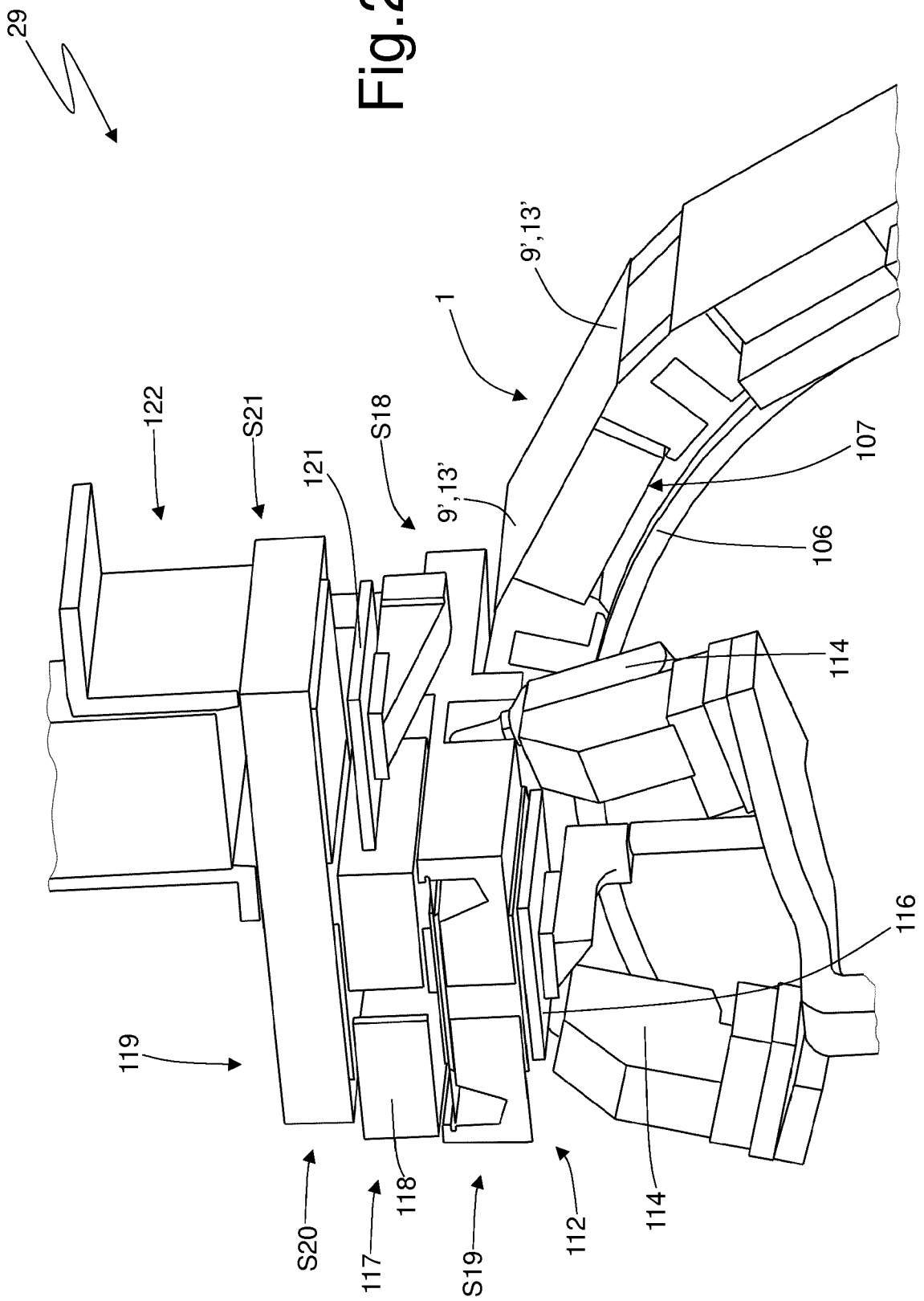
Fig.25

Fig.26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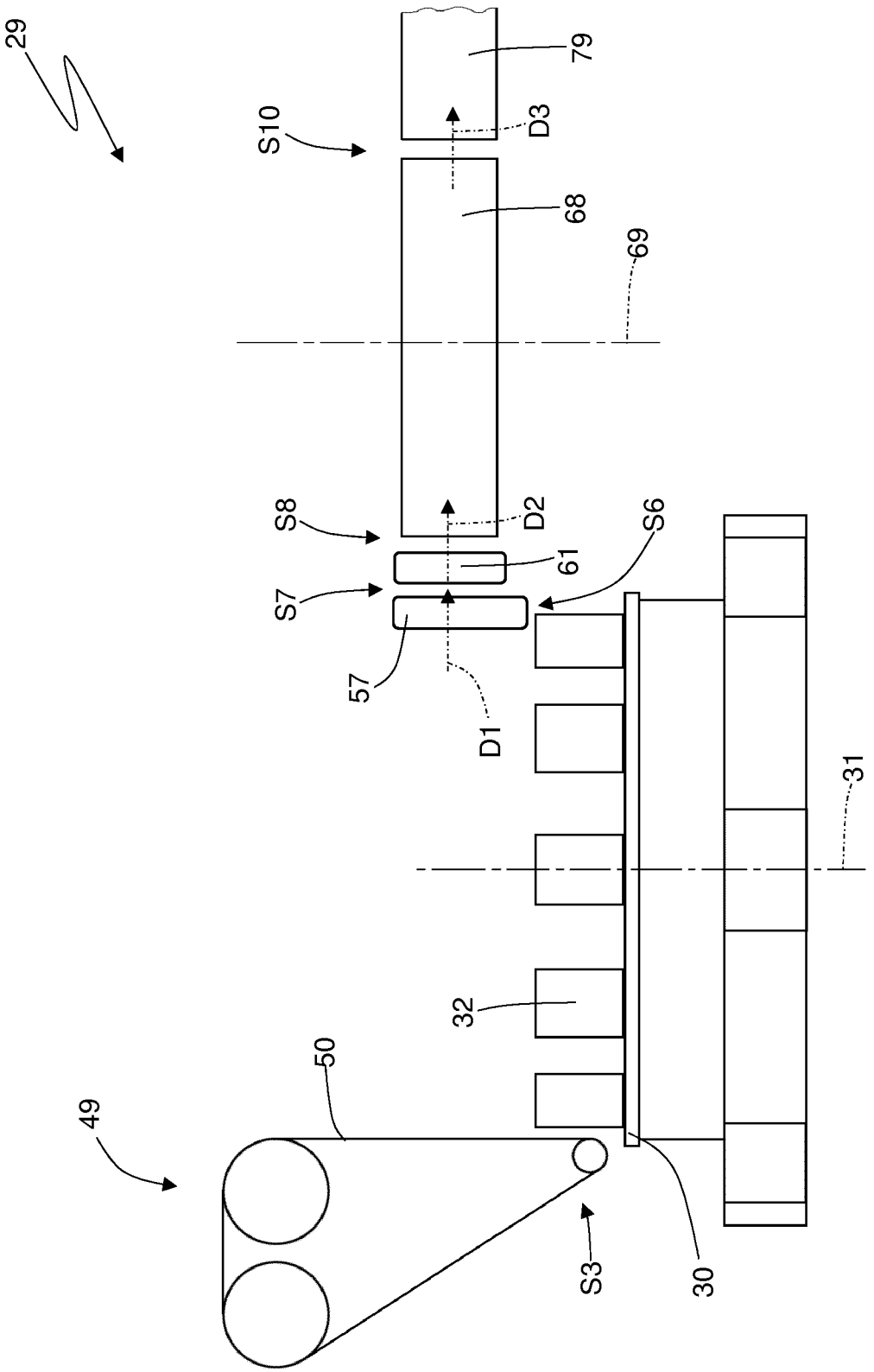

Fig.27

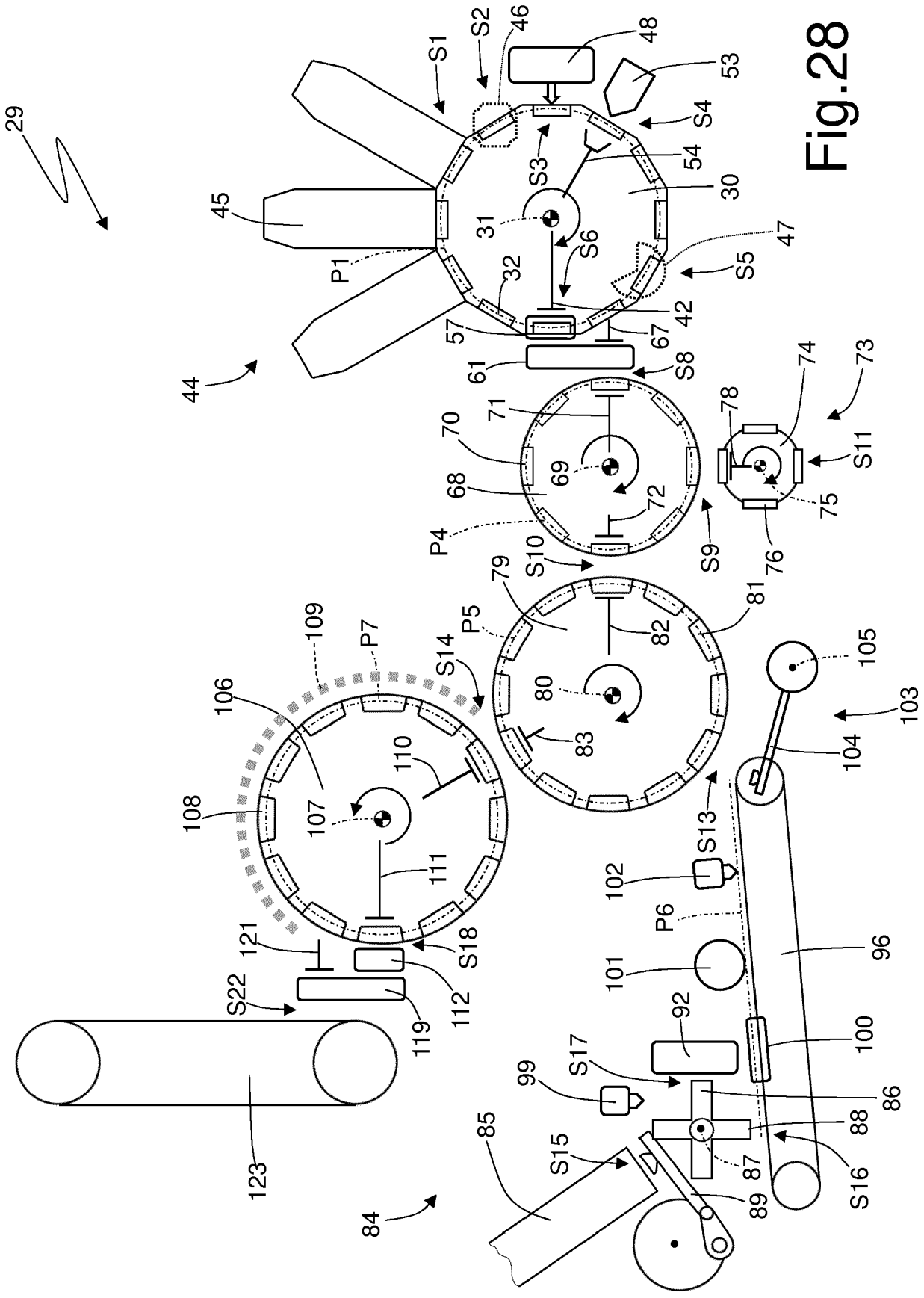
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Fig.28

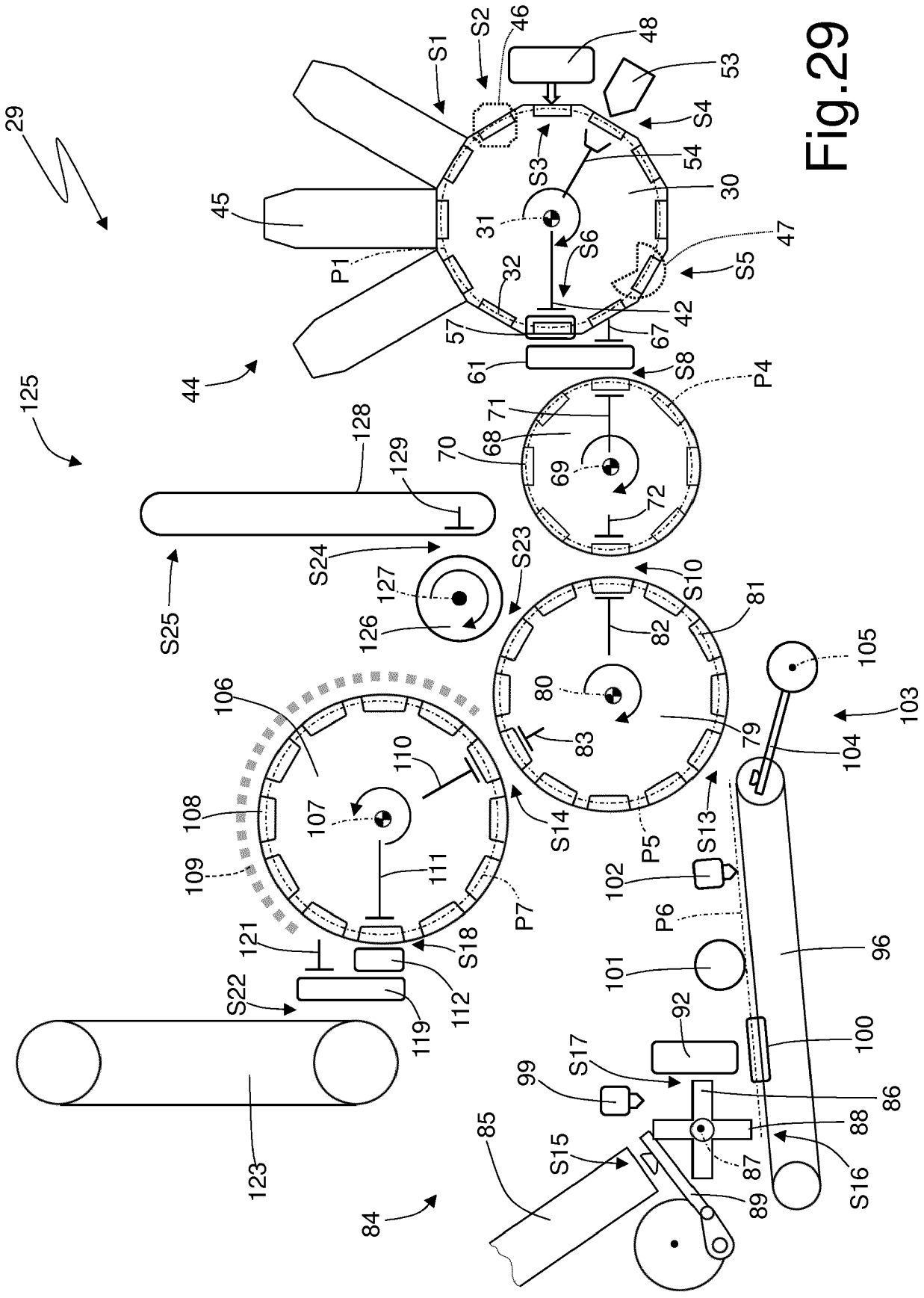
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Fig.29

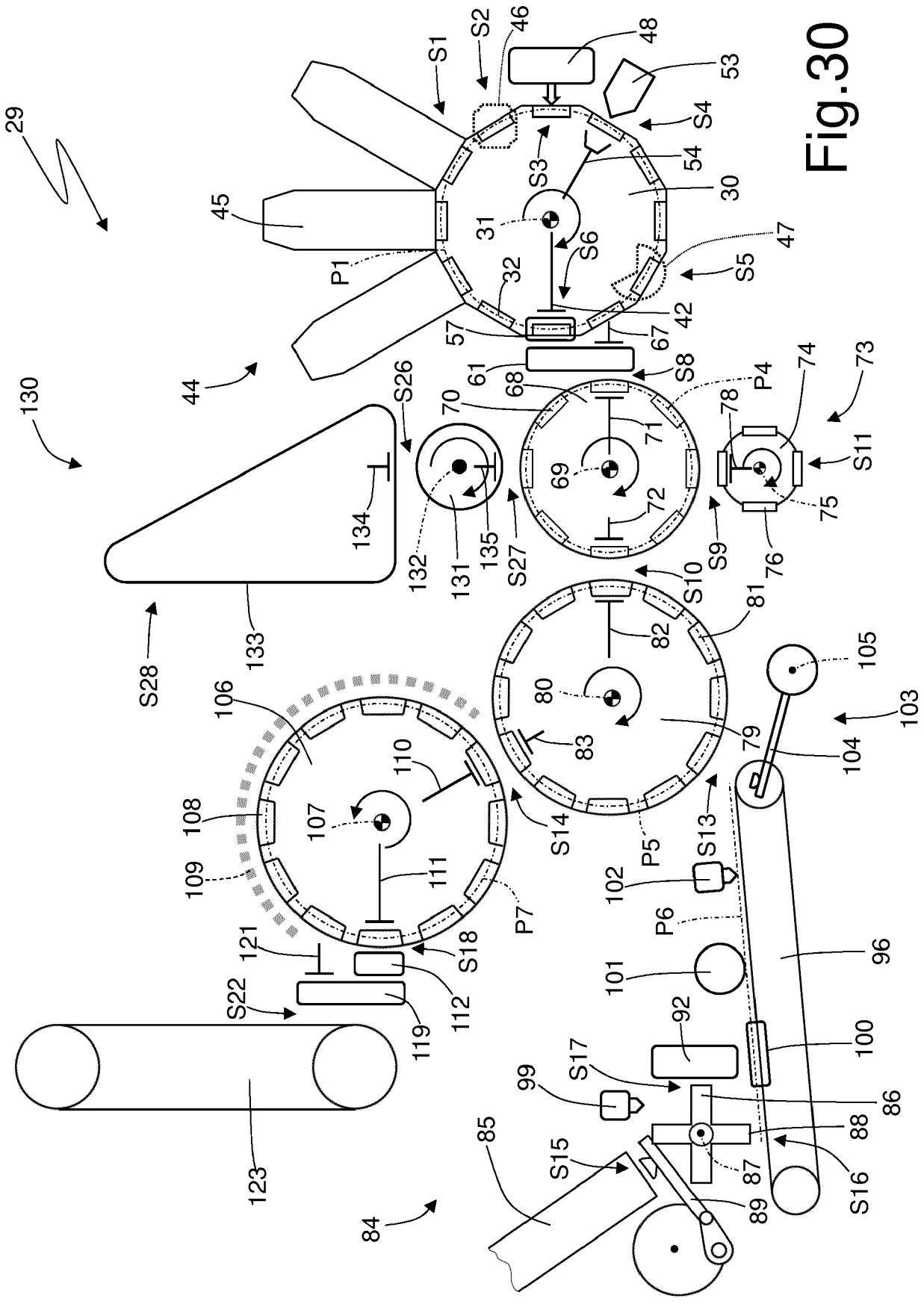
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Fig.30

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European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 19 16 5335

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Place of search	Date of completion of the search	Examiner
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