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(54) **TRASH BAG MADE OF SYNTHETIC MATERIAL, METHOD AND APPARATUS FOR MANUFACTURING IT**

(57) A segment of a tubular element (10) made of a sheet of synthetic material is folded longitudinally twice respectively along a first centerline (L1) and a successive second centerline (L2) so as to have, in a flattened configuration, eight superimposed layers along its entire

width. The eight layers are mutually heat-sealed along a transverse heat-sealing line (16) that is proximate to an end of the segment of tubular element (10) and forms the bottom of the bag.

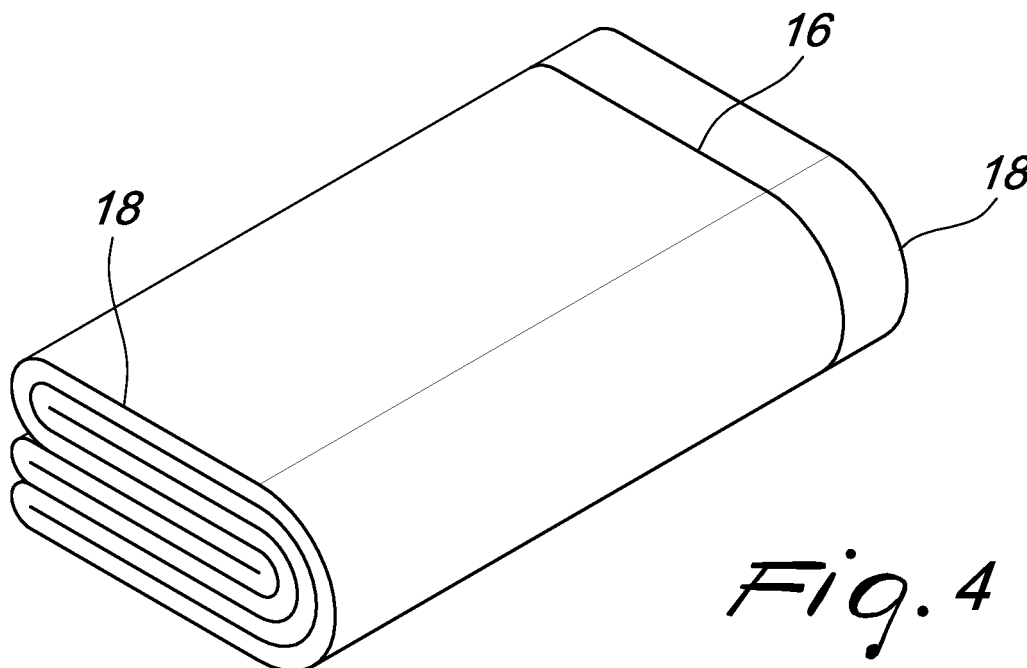


Fig. 4

Description

[0001] The present invention relates to a trash bag made of synthetic material and to a method and an apparatus for manufacturing it.

[0002] As is known, a generic trash bag can be mass-manufactured starting from a flattened tubular element made of synthetic material, typically low-density polyethylene (LDPE). The tubular element is subjected to successive operations for folding and heat-sealing which are aimed at obtaining a roll of bags that can be separated by tearing along pre-cutting lines provided at preset intervals.

[0003] As is known, a conventional trash bag in the flattened configuration can have two lateral edges which extend inward in an accordion-like fashion and are extended along the entire height of the bag, i.e., from the closed lower edge that delimits the bottom of the bag to the open upper edge that defines its mouth.

[0004] The bottom of the bag is closed by a transverse heat-sealing line. In the outermost regions engaged by the accordion-like portions, the heat-sealed seam engages four layers of material, whereas in the central region interposed between the accordion-like portions the heat-sealed seam engages only two layers of material.

[0005] One of the purposes of the accordion-like portions is to reduce the width of the row of bags during the heat-sealing of the bottom; in this manner, with a single heat-sealing bar it is possible to heat-seal effectively two or three parallel rows of bags, with a consequent increase in productivity.

[0006] As is known, however, the fact that the number of layers of material is not constant along the heat-sealing line causes considerable complications in the manufacture of the bag.

[0007] If heat-sealing parameters (pressure, temperature) suitable to heat-seal four layers are adopted, there is in fact the risk of "burning" the heat-sealed seam in the region in which there are just two layers of material. Vice versa, if parameters suitable for heat-sealing two layers are adopted, the heat-sealed seam in the region in which there are four layers is too weak, with the result that the bottom can easily open under the mechanical stresses to which the bag is subjected.

[0008] Furthermore, the border between the four-layer region and the two-layer region is particularly critical for heat-sealing. A step is in fact formed there which inevitably compromises the hermetic tightness of the heat-sealed seam.

[0009] The limitations described above of traditional trash bags often emerge during mechanical strength tests and hermetic tightness tests, to which the bags are conventionally subjected before being marketed.

[0010] The aim of the present invention is to provide a trash bag made of synthetic material that overcomes the drawbacks of traditional bags in relation to the tightness of the heat-sealed seam that closes the bottom of the bag, and a method and an apparatus for manufacturing

the bag.

[0011] This aim and other objects, which will become better apparent from the continuation of the description, are achieved by the trash bag having the characteristics described in claim 1, while the dependent claims define other advantageous, albeit secondary, characteristics of the invention.

[0012] The invention is now described in greater detail with reference to some preferred but not exclusive embodiments thereof, illustrated by way of nonlimiting example in the accompanying drawings, wherein:

Figure 1 is a schematic perspective view of a first step of the process for manufacturing the bag according to the invention;

Figure 2 is a schematic perspective view of a second step of the process for manufacturing the bag according to the invention;

Figure 3 is a schematic perspective view of a third step of the process for manufacturing the bag according to the invention;

Figure 4 is a perspective view of the bag according to the invention in a flattened configuration;

Figure 5 is a perspective view of the bag according to the invention after it has been filled;

Figure 6 is a perspective view of an apparatus for manufacturing the bag according to the invention;

Figure 7 is a perspective view of a first isolated component of the apparatus of Figure 6;

Figure 8 is a perspective view of a first isolated component of the apparatus of Figure 6;

Figure 9 is a plan view of the apparatus of Figure 6;

Figure 10 is a front view of the apparatus of Figure 6;

Figure 11 is a lateral elevation view of the apparatus of Figure 6.

[0013] With initial reference to Figure 1, a trash bag according to the invention can be mass-manufactured starting from a flattened tubular element 10 made of a sheet of synthetic material, for example Low-Density Polyethylene (LDPE) with a thickness preferably comprised between 15 and 45 μm depending on the size of the bag, in which both of its longitudinal edges 12, 14 are closed. In Figures 1-4, the thickness of the tubular element is conspicuously exaggerated for the sake of greater clarity in illustration.

[0014] The tubular element is folded longitudinally twice first along its centerline L1 (Figure 2) and then along its new centerline L2 (Figure 3).

[0015] In the final flattened configuration, the tubular element therefore has eight superimposed layers along its entire width, which is substantially equal to one quarter of the initial width.

[0016] Finally, transverse heat-sealed seams 16 are provided on the tubular element 10 at constant intervals and are followed directly by respective transverse pre-cuts 18 (Figure 3). The heat-sealed seams 16 and the pre-cuts 18 form respectively the bottom of a bag, con-

stituted by a segment of the tubular element 10, and the line for separation with respect to the next bag, which corresponds to the mouth of the latter.

[0017] The bags thus obtained can be advantageously packaged in rolls.

[0018] Figure 4 shows a bag 100 that is obtained by the method described above, in a flattened configuration as it appears just after separation from the tubular element.

[0019] As shown in Figure 5, after the bag 100 has been opened and filled, the bottom substantially assumes a dome-like profile which converges, in a curled configuration, in the heat-sealing line 16.

[0020] In Figure 5, the mouth of the bag is constricted into a knot 102.

[0021] In practice it has been found that the curl adjacent to the heat-sealed seam 16, due to the overlap of multiple layers of material and of the friction between them, has the effect of increasing the mechanical strength and hermetic tightness of the bag at the bottom.

[0022] Furthermore, simulation models and filling tests have pointed out an increase by approximately 9% in the capacity of the bag for an equal height.

[0023] The bag according to the invention can be advantageously provided by means of the folding apparatus 104 shown in Figures 6-10.

[0024] The folding apparatus 104 is adapted to receive three flattened tubular elements that lie side by side. Typically, the three tubular elements can originate from a single tubular element that is divided longitudinally into three parts by two longitudinal heat-sealing/cutting lines.

[0025] The folding apparatus 104 comprises a frame provided with horizontal guiding means. Such means are composed advantageously of four horizontal tubular guides 105, 106, 107, 108, which are aligned vertically and horizontally in pairs, so as to be arranged ideally at the corners of a rectangle. The horizontal tubular guides 105, 106, 107, 108 are interconnected at the ends by two vertical plates 110, 112.

[0026] A first pair of horizontal tubular guides 105, 106 which are aligned vertically supports first folding means, which comprise a set of three first folding units 114, 116, 118 arranged side by side.

[0027] The first folding units 114, 116, 118 are adapted to fold the tubular element 10 along the first centerline L1.

[0028] With particular reference to Figure 7, each folding unit 114 comprises a folding triangle 120 with an isosceles triangle profile, which is supported by a slider 122 by virtue of height adjustment means which are described in greater detail hereinafter. The slider 122 engages, with the possibility of lateral adjustment, the lower guide 105 by means of two bushings 124, 125 and the upper guide 106 by means of a third bushing 126.

[0029] Preferably, the height adjustment means comprise a vertical tubular guide 128, which is fixed to the slider 122 by means of a pair of supports 132, 134.

[0030] The folding triangle 120 comprises three rollers 136, 138, 140, which are arranged along the three sides

of the isosceles triangle and are supported rotatably by a T-shaped frame 142. The folding triangle 120 is arranged so that the base is parallel to the guides 105, 106, 107, 108 and the symmetrical sides protrude obliquely upward from the base and converge toward the end of the T-shape. A disk 144 is supported rotatably at the vertex between the two symmetrical sides of the isosceles triangle with an axis that is parallel to the base, i.e., is horizontal.

[0031] The T-shaped frame 142 is fixed to a supporting base 146, to which two vertical guiding rollers 148, 150 are pivoted which are parallel and mutually adjacent. A flap of the disk 144 is inserted between the two guiding rollers 148, 150.

[0032] In the example described herein, the central folding unit 116 of the first set of three is in a raised position with respect to the two lateral folding units 114, 118. In this configuration, the bases of the folding triangles of the two lateral folding units 114, 118 are mutually aligned under the base of the triangle of the central folding unit 116.

[0033] The second pair of horizontal tubular guides 107, 108 which are aligned vertically supports second folding means which comprise a set of three second folding units 154, 156, 158 downstream of the first folding units 114, 116, 118.

[0034] The second folding units 154, 156, 158 are suitable to fold the tubular element 10 along the second centerline L2. In particular, the second folding units 154, 156, 158 are similar to the first folding units but have the respective folding triangles tilted through 90° about a horizontal axis that is transverse to the longitudinal extension of the horizontal tubular guides 105, 106, 107, 108.

[0035] In detail, each one of the second folding units 154 comprises a folding triangle 160, which has the profile of an isosceles triangle and is supported by a slider 162 by virtue of additional height adjustment means. The slider 162 engages, with the possibility of lateral adjustment, the lower guide 105 by means of two bushings 164, 165 and the upper guide 106 by means of a third bushing 166.

[0036] Preferably, the height adjustment means comprise a vertical tubular guide 168, which is fixed to the slider 162 by means of a pair of supports 172, 174.

[0037] The folding triangle 160 comprises three rollers 176, 178, 180, which are arranged along the three sides of the isosceles triangle and are supported rotatably by a T-shaped frame 182. The triangle is arranged so that its base is vertical and the symmetrical sides protrude laterally and obliquely from the base and converge toward the end of the T-shape. A disk 184 is supported rotatably at the vertex between the two symmetrical sides of the isosceles triangle with an axis that is parallel to the base, i.e., vertical.

[0038] The T-shaped frame 182 is fixed to a supporting base 186, to which two horizontal, parallel and mutually adjacent guiding rollers 188, 190 are pivoted. A flap of the disc 184 is inserted between the two guiding rollers

188, 190.

[0039] In the example described herein, the central folding unit 156 of the second set of three is in a raised position with respect to the two lateral folding units 154, 158.

[0040] The folding apparatus 104 described above allows to fold longitudinally three tubular elements that run in a parallel arrangement along two successive centerlines L1, L2, as required for the manufacture of the bag according to the invention.

[0041] In particular, the three tubular elements are first folded longitudinally into two identical parts by the three folding units of the first set of three. For this purpose, each one of the tubular elements is made to pass under the roller 136 at the base of the isosceles triangle, over the rollers 138, 140, at the sides of the isosceles triangle, and finally between the two guiding rollers 148, 150, with the disk 144 marking precisely the folding line.

[0042] After this, the three tubular elements are again folded longitudinally into two identical parts by the three folding units of the second set of three. For this purpose, each one of the tubular elements is made to pass under the roller 176 at the base of the isosceles triangle, over the rollers 178, 180 at the sides of the isosceles triangle, and finally between the two guiding rollers 188, 190, with the disk 184 marking precisely the folding line.

[0043] The subsequent heat-sealing and pre-cutting operations can be performed by virtue of heat-sealing means and cutting means that are commonly used in the field and therefore are not described.

[0044] The apparatus as described above, despite having a compact structure that is relatively economical to provide, allows to adjust accurately the position of the various folding units, in particular along the vertical axis and the transverse axis with respect to the direction of origin of the tubular elements. This allows to fold the tubular elements exactly along the two successive longitudinal centerlines, so that the folded tubular element has eight layers over its entire width, so as to facilitate the adjustment of the heat-sealing parameters (temperature, pressure).

[0045] A preferred embodiment of the invention has been described, but of course the person skilled in the art will be able to provide numerous modifications and variations within the scope of the appended claims.

[0046] The disclosures in Italian Patent Application No. 102016000031372 (UA2016A002018) from which this application claims priority are incorporated herein by reference.

[0047] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A trash bag, **characterized in that** it consists of a segment of a tubular element (10) made of a sheet of synthetic material that is folded longitudinally twice respectively along a first centerline (L1) and a successive second centerline (L2) so as to have, in a flattened configuration, eight superimposed layers along its entire width, said eight layers being mutually heat-sealed along a transverse heat-sealing line (16) that is proximate to an end of the segment of tubular element (10) and forms the bottom of the bag.
2. The trash bag according to claim 1, **characterized in that** said synthetic material is Low Density Polyethylene (LDPE).
3. The trash bag according to claim 1 or 2, **characterized in that** said sheet of synthetic material has a thickness comprised between 15 and 45 μm .
4. A method for manufacturing a trash bag according to claim 1, **characterized in that** it comprises the steps of:
 - folding a tubular element (10) made of a sheet of synthetic material that unwinds from a spool in a flattened configuration along said first centerline (L1) by virtue of first folding means (114, 116, 118),
 - folding the tubular element (10) again along said second centerline (L2) by virtue of second folding means (154, 156, 158),
 - providing transverse heat-sealed seams (16) directly followed by respective transverse pre-cuts (18) on said tubular element (10) at constant intervals, respectively by virtue of heat-sealing means and cutting means.
5. An apparatus for manufacturing a trash bag according to claim 1, **characterized in that** it comprises a frame provided with horizontal guiding means (105, 106, 107, 108) which support at least two first folding units (114, 116, 118) arranged side by side and adapted to fold respective tubular elements (10) along said first centerline (L1), and at least two second folding units (154, 156, 158) arranged side by side downstream of said first two folding units and adapted to fold said tubular element (10) along said second centerline (L2).
6. The apparatus according to claim 5, **characterized in that** it comprises a set of three of said first folding units (114, 116, 118) and a set of three of said second folding units (154, 156, 158).
7. The apparatus according to claim 5 or 6, **characterized in that** each one of said folding units comprises

a folding triangle (120) with an isosceles triangle profile and, downstream thereof, two guiding rollers (148, 150), which are parallel and mutually side by side and are supported at right angles to the base of the isosceles triangle.

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8. The apparatus according to claim 7, **characterized in that** each one of said folding units is supported, by virtue of height adjustment means (128), by a slider (122) that engages said horizontal guiding means (105, 106) with the possibility of lateral position adjustment. 10
9. The apparatus according to claim 7 or 8, **characterized in that** said folding triangle (120) comprises three rollers (136, 138, 140) arranged along the three sides of said isosceles triangle. 15
10. The apparatus according to one or more of claims 7-9, **characterized in that** said folding triangle comprises a disk (144) that is rotatably supported at the vertex between the two symmetrical sides of said isosceles triangle with an axis that is parallel to the base of the isosceles triangle. 20
11. The apparatus according to one or more of claims 5-10, **characterized in that** said second folding units (154, 156, 158) are tilted through 90° with respect to said first folding units about a horizontal axis that is perpendicular to the longitudinal extension of said guiding means (105, 106, 107, 108). 30

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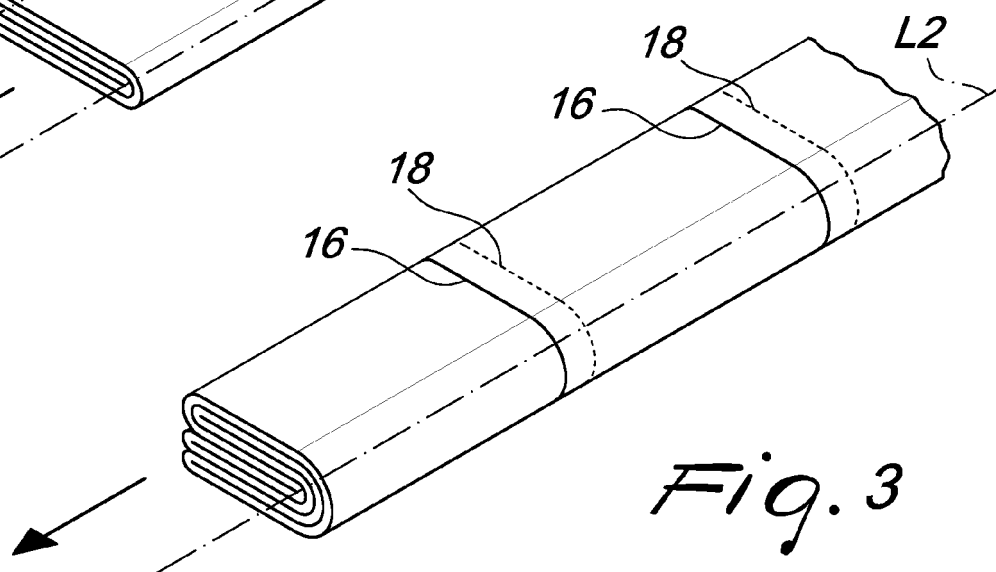
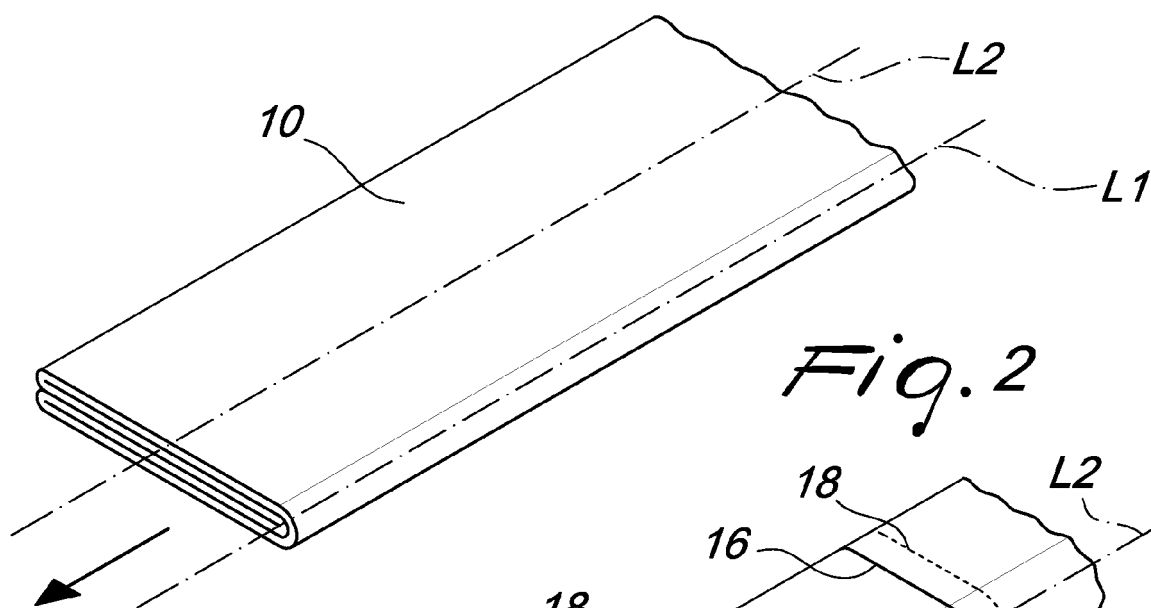
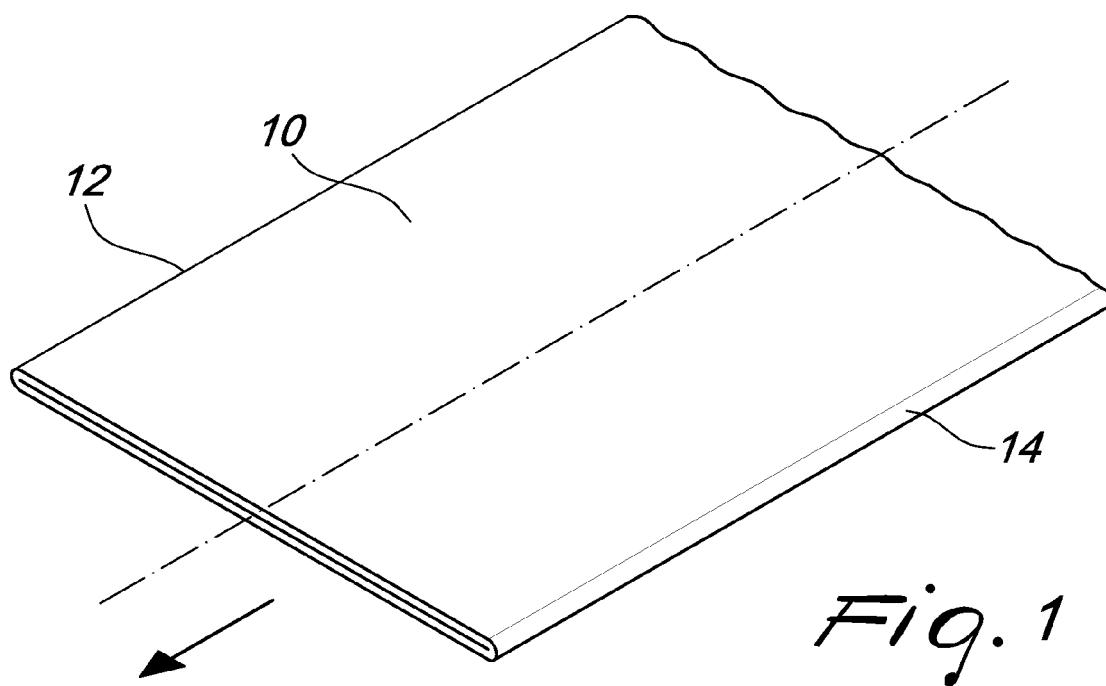
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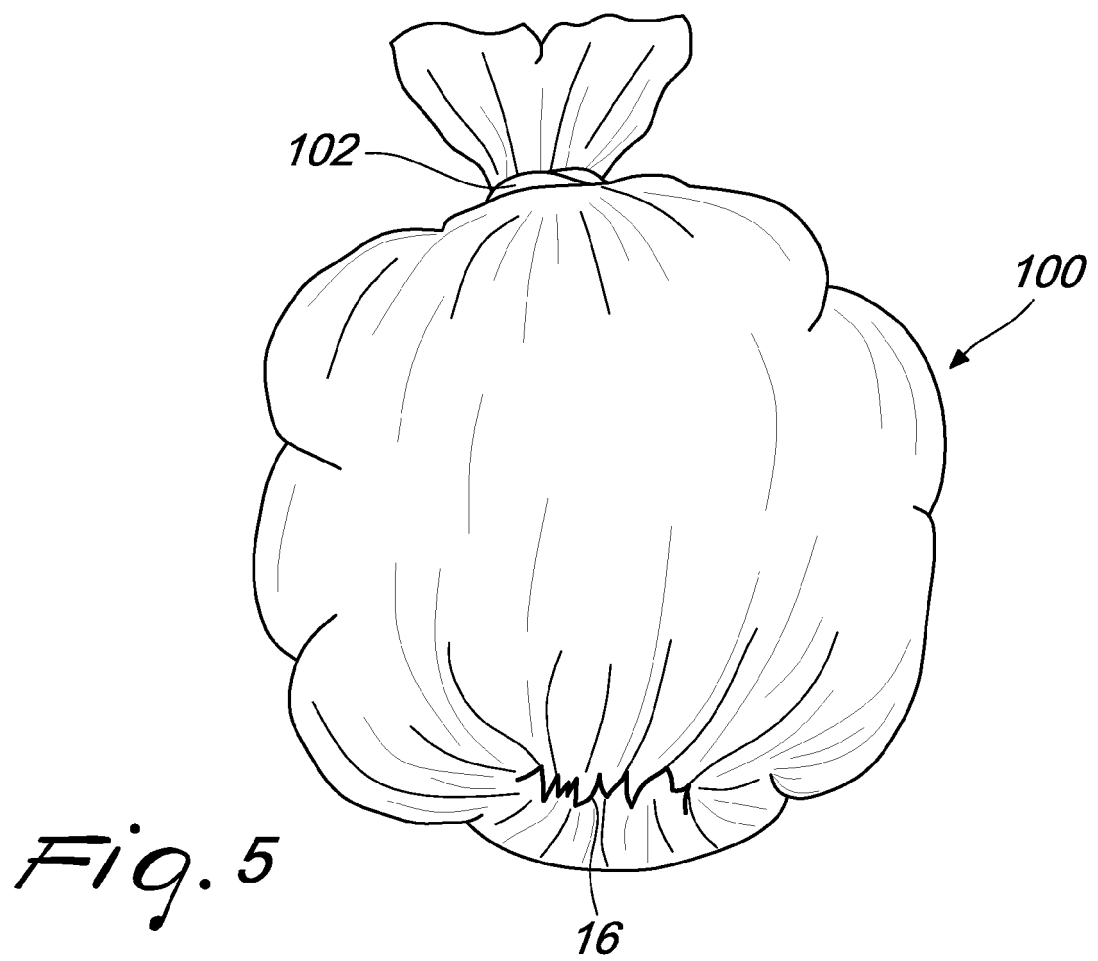
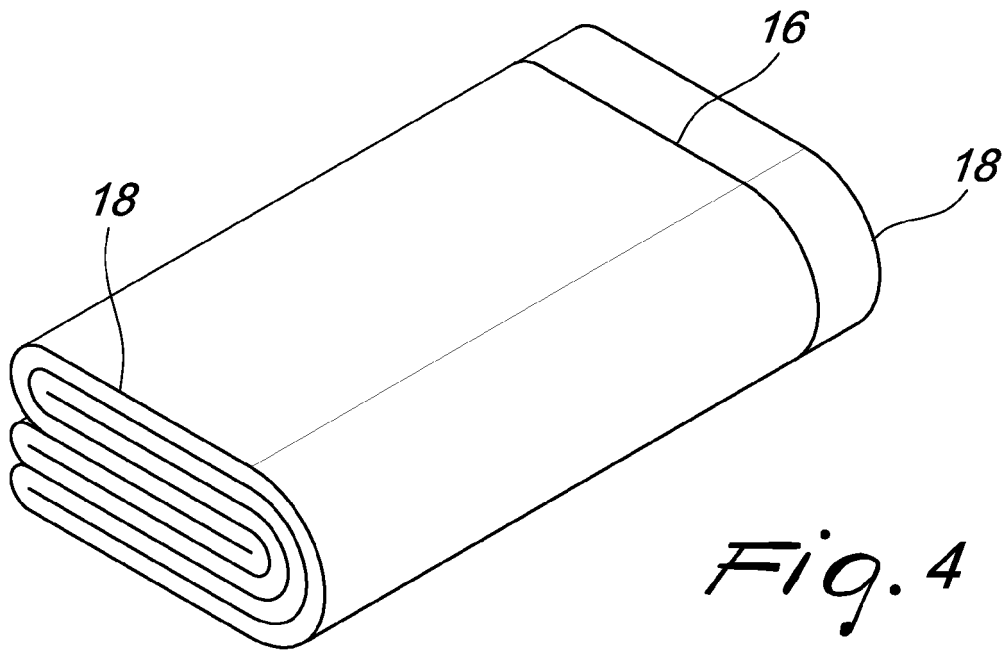
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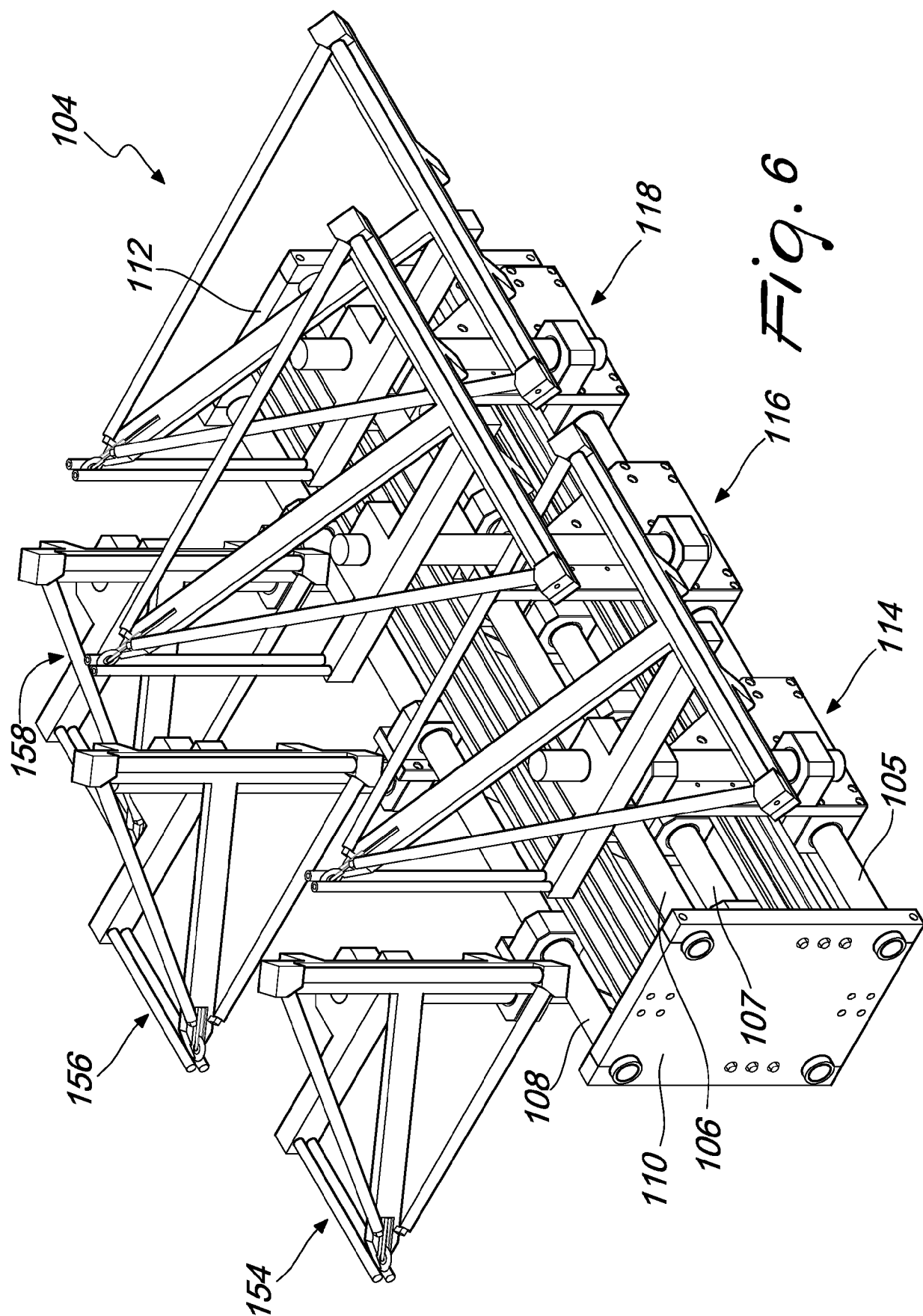
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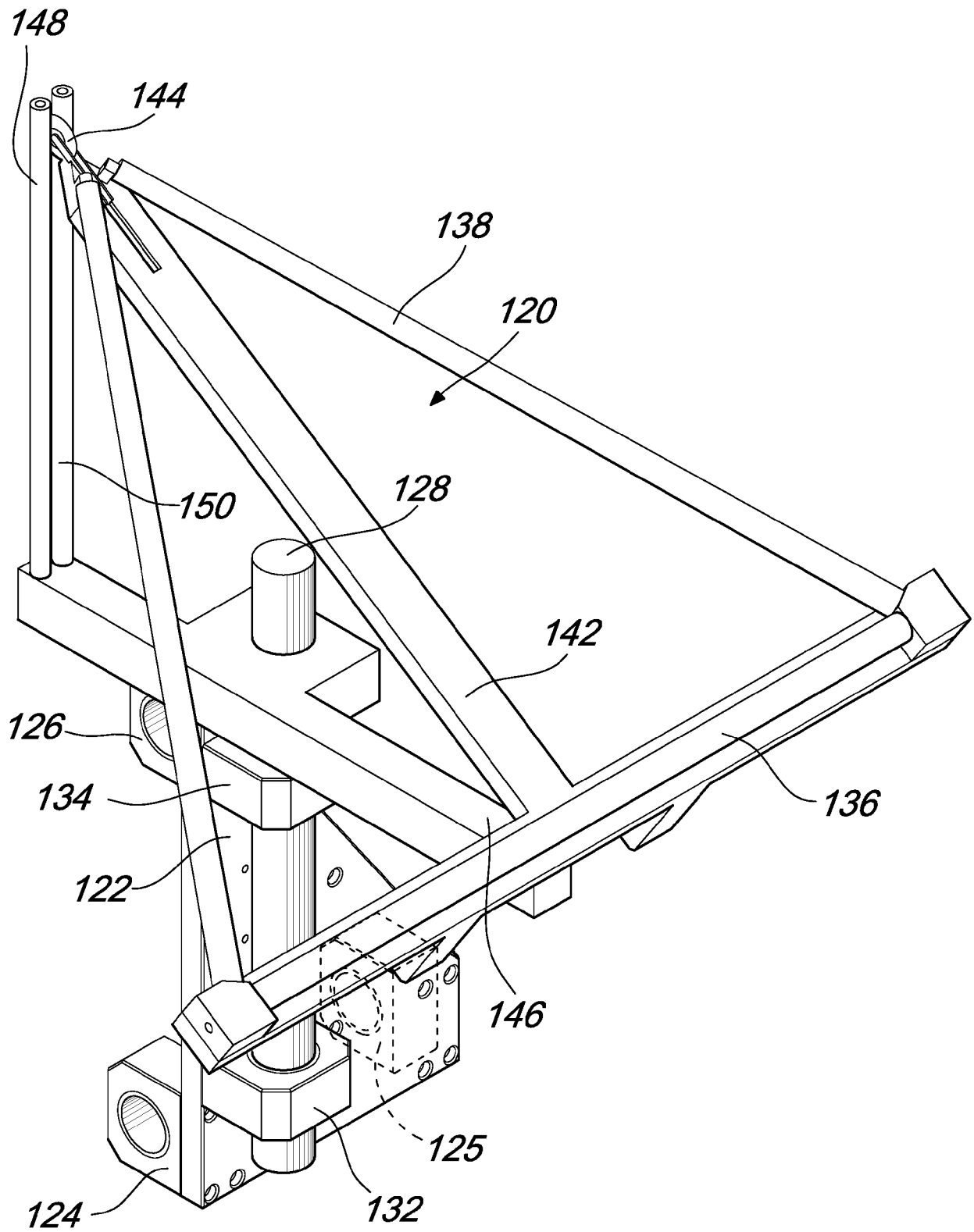


Fig. 7

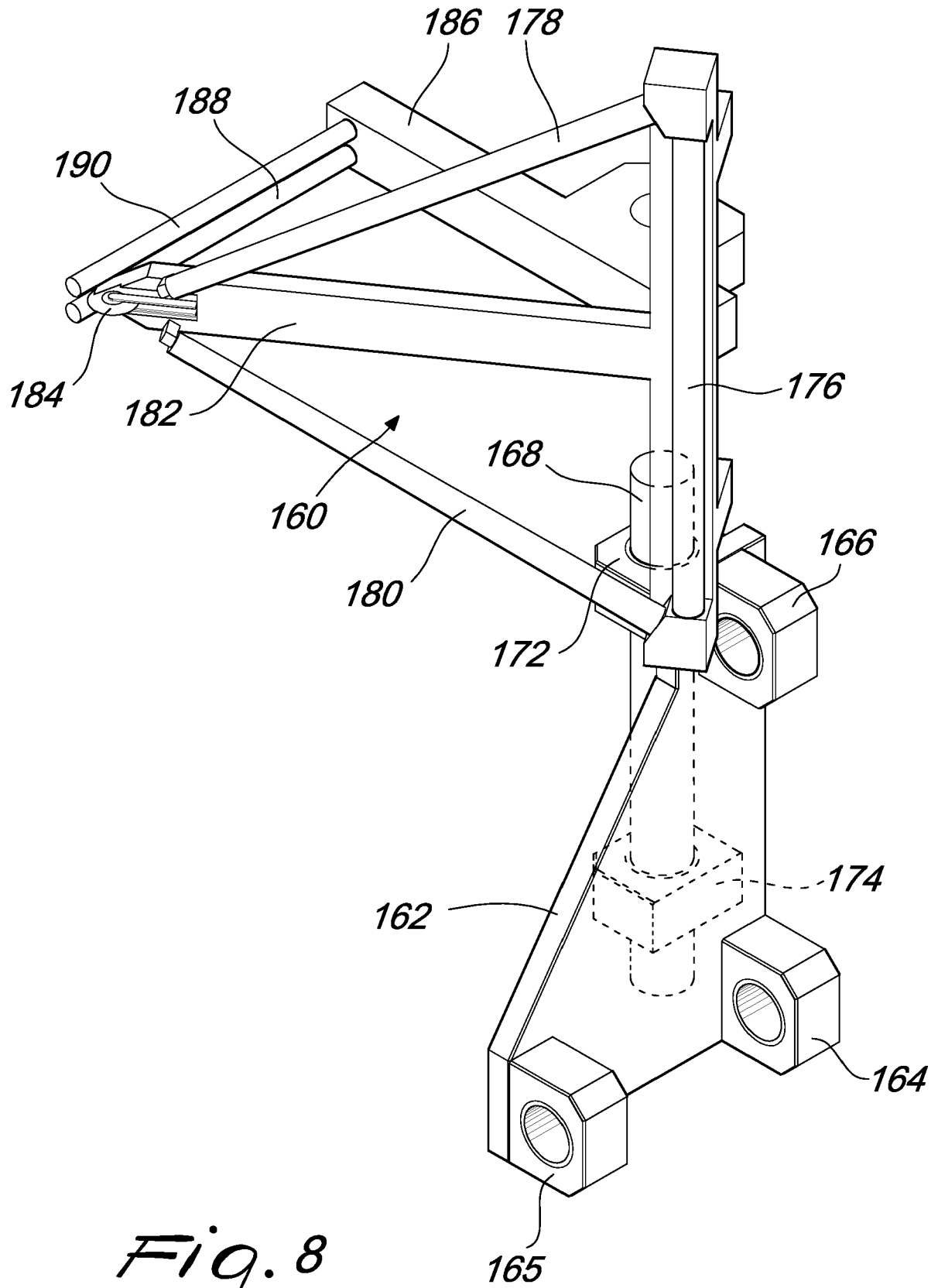
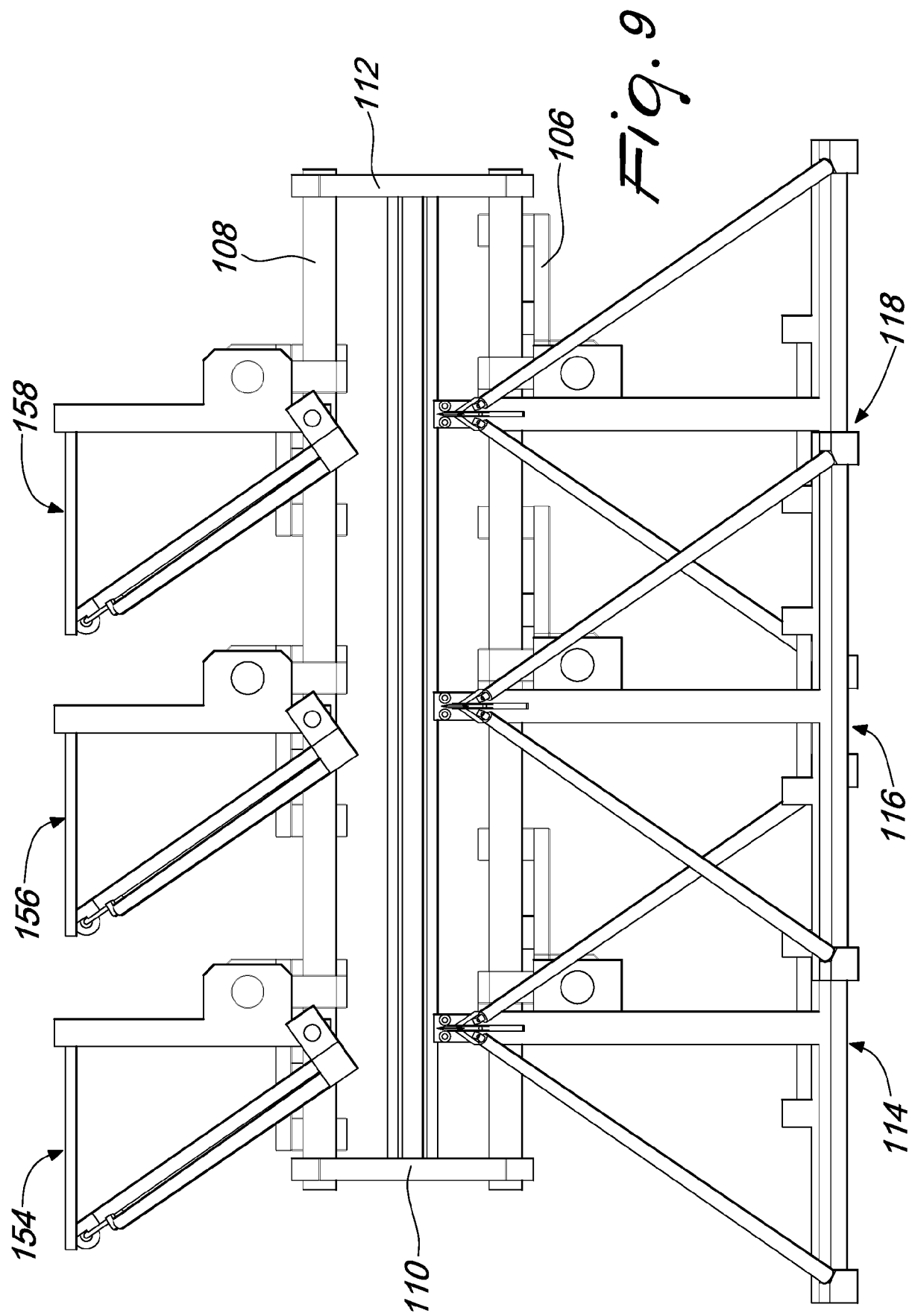
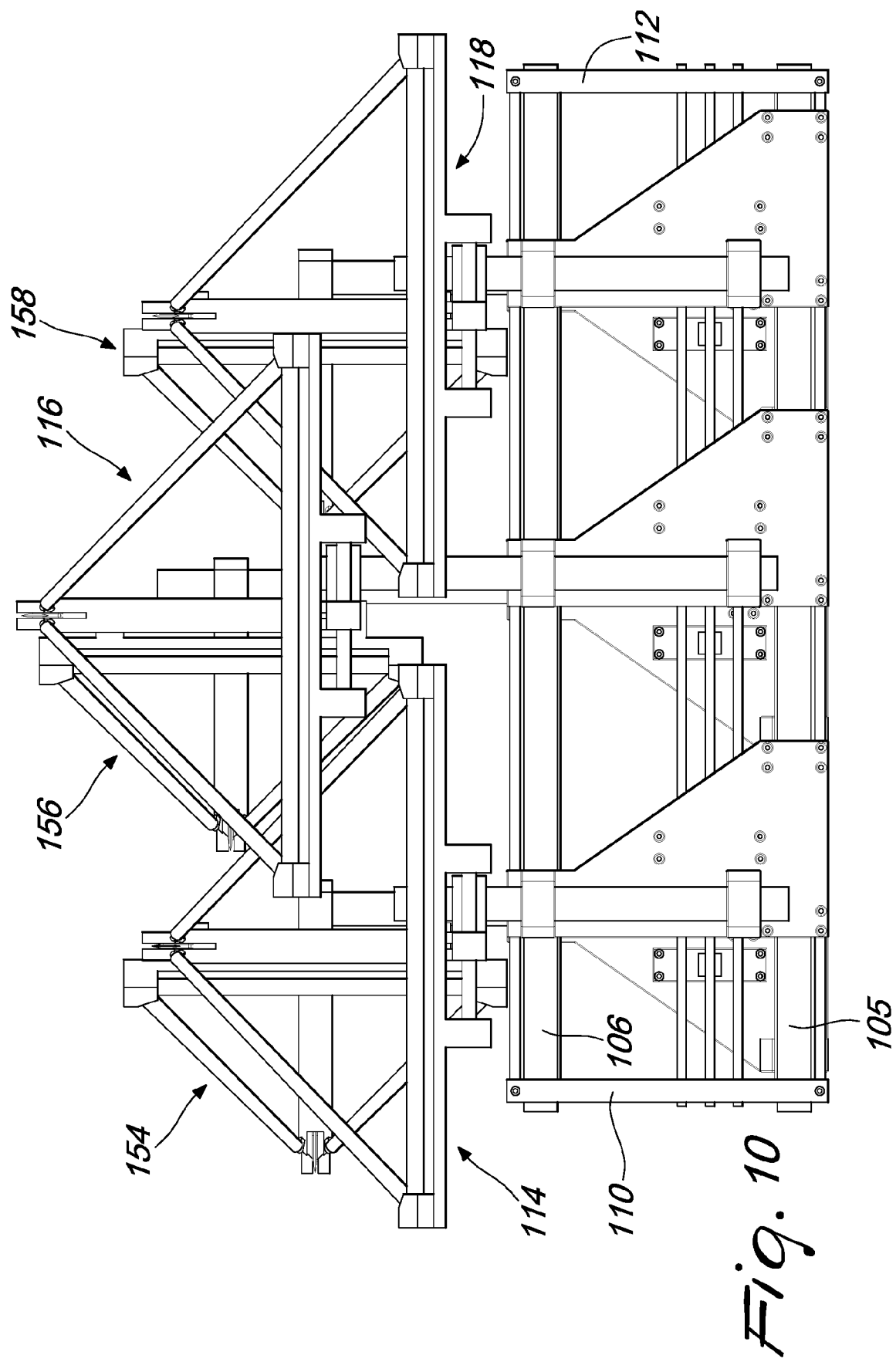


Fig. 8





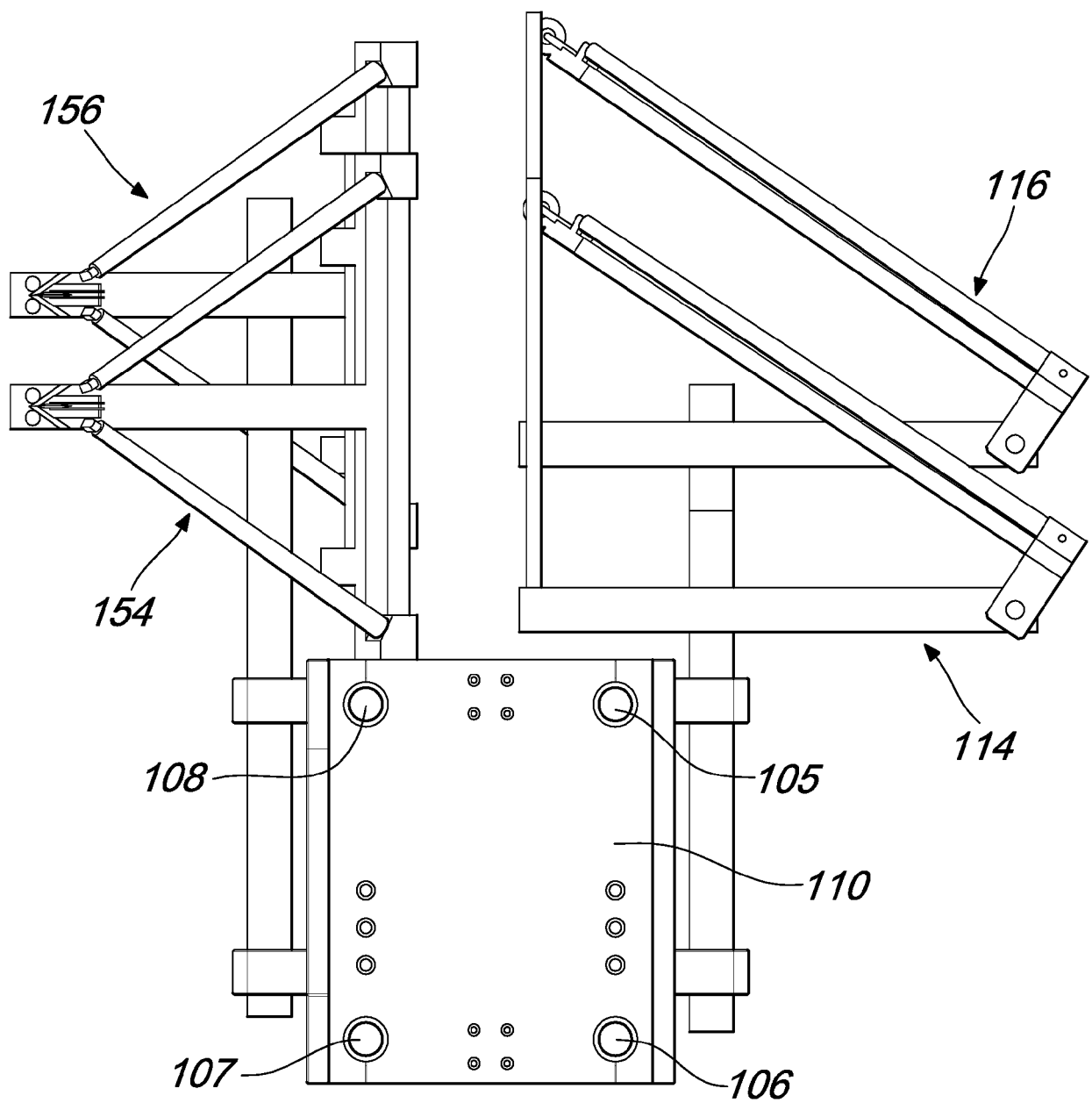


Fig. 11



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CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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