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(54) **DUST SUCTION UNIT FOR A CONTINUOUS CUTTING UNIT OF A SHEET OR COIL MATERIAL, CONTINUOUS CUTTING UNIT, PRODUCTION LINE**

(57) A dust suction unit for a continuous cutting unit (50) for a production line (100) of sheet or coil material, comprising: a casing (10) defining an inner casing chamber (11) adapted to accommodate a circular rotary blade (51) and defining a blade rotation axis, said inner chamber allowing the rotation of said blade about the blade rotation axis (52), said casing (10) comprising a casing opening (56) adapted to allow a portion of said blade to protrude from said casing opening (56) with respect to said casing (10); a suction duct (30) connected to said

inner chamber (11), defining a suction duct axis (31') arranged along a predetermined suction direction (A), so as to convey a forced suction stream (31) in output from said inner chamber (11) along said predetermined suction direction (A); a blowing duct (40) connected to said inner chamber (11) defining a blowing duct axis (41') arranged along a predetermined blowing direction (S), so as to convey a forced blowing stream (41) in input to said inner chamber (11) and in accordance with said predetermined blowing direction (S).

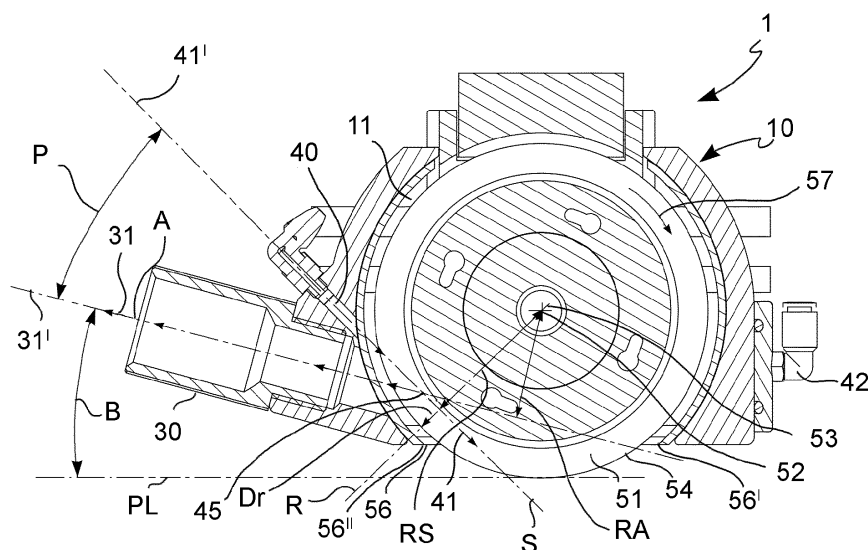


FIG. 6

Description

Field of the invention

[0001] The present invention relates to a dust suction unit for a continuous cutting unit for a production line of sheet or coil material, for example, for making a continuous longitudinal cut of a sheet of paper or other powdered material wound in a coil. A plurality of such cutting units flanking one another allows a plurality of strips of undefined length and width to be obtained from the aforesaid sheet or coil.

Background

[0002] In the field of processing materials in a coil, for example cutting of paper, cardboard, plastic film and non-woven material, a cutting unit is used having a disk blade arranged along a cutting plane parallel to an advancing direction of the material coming off the coil.

[0003] All cutting units generate a fine powder, in the form of dust and fibers, which tends to stick to the material itself in proximity of the cut, to the cutting blade, to the parts of the cutting unit facing the blade itself.

[0004] When such fine powder sticks to the material being processed, it remains trapped between the layers of material, already cut and wound in a coil, downstream of the cutting unit leading to increased coil diameters and a product, which is low quality since it is full of dust.

[0005] The dust and fibers trapped in the coils coming off the cutting unit will be released again by a successive process of unwinding of the coil obtained, on successive processing lines, inevitably affecting the end product.

[0006] Furthermore, the dust, sticking to the blades, can create thicknesses, which interfere with the quality of the cut and, in the worst cases, result in the breakage of the material during the cut, which requires a stop in production.

[0007] In an attempt to overcome this problem, the technique of using a suction hood is known, which partially envelops the blade, wherein such hood is provided with a suction collector arranged facing the blade to form a suction stream to remove the dust produced by the cut.

[0008] This prior art is not without drawbacks.

[0009] For example, while removing a small part of the dust produced from the cutting area, the suction stream is unable to remove all of the dust and, above all, it is unable to remove the dust, which remains stuck to the blade and accumulates continuously thereon during processing.

Summary of the invention

[0010] It is an object of the present invention to conceive and provide a dust suction unit for a continuous cutting unit for a production line of sheet and coil material, which allows the aforesaid needs to be satisfied, and to overcome, at least in part, the drawbacks denounced

above, with reference to the prior art.

[0011] In particular, it is an object of the present invention to provide a dust suction unit, which allows the dust produced by the cut to be prevented from sticking to the blade, and/or such dust to be removed effectively from the blade itself.

[0012] It is also an object of the invention to provide a dust suction unit, which allows the dust to be effectively removed from the cutting area, in particular from the material being processed and from the area surrounding the blade of the cutting unit.

[0013] It is a further object of the present invention to provide a production line comprising a plurality of dust suction units capable of preventing the dust produced by the cut from sticking to the blades, and/or effectively removing such dust from the blades themselves.

[0014] These and other objects and advantages are achieved with a dust suction unit for a production line for producing coil and sheet material, as well as a production line comprising a plurality of dust suction units for cutting units, according to the independent claims.

[0015] Further objects, solutions and advantages are present in the embodiments described below and claimed in the dependent claims.

[0016] The presence of a suction duct and a blowing duct, both connected to the inner chamber defined by the casing, wherein the suction duct is arranged so as to convey a forced suction stream outside the inner chamber away from the rotary blade along said predetermined suction direction, and wherein the blowing duct is arranged so as to convey a forced blowing stream inside the inner chamber towards the circular rotary blade and according to a predetermined blowing direction, produces considerably forceful turbulent movements about the blade and in proximity of the blade cutting edge.

[0017] In this situation, the turbulent stream, which is generated into the inner chamber is forceful enough to remove the particles of dust both from the blade and from the walls of the inner chamber and drag them, together with the aforesaid turbulent stream, until they have been completely removed by the suction stream.

[0018] In this way, the removal of the dust from the blade and from the inner chamber is extremely effective.

[0019] A further advantage of the present invention comes from the fact that the blowing stream allows the rotary blade to cool during use.

[0020] This allows two different advantageous effects to be achieved.

[0021] A first advantage comes from the fact that the cooling of the blade by the blowing stream offers greater efficiency and cutting precision on sensitive and thin materials, which might not be cut perfectly due to the heat of the blade, or ruined on the surface.

[0022] A second advantage deriving from the blowing stream on the blade is that of protecting the blade from overheating and reducing wear of the same as a result of the interaction between overheating and accumulations of dust on the blade.

Brief description of the drawings

[0023] The invention will be illustrated below with the description of some embodiments thereof, illustrated by way of non-limiting examples, with reference to the appended drawings, wherein:

- figure 1 illustrates a front view of a cutting unit according to the invention, comprising a dust suction unit according to the invention;
- figure 2 shows a view from above of the dust suction unit in figure 1;
- figure 3 shows a section view according to the section plane III, of the cutting unit in figure 1;
- figure 4 shows a side view from the right of the dust suction unit and the cutting unit in figure 1;
- figure 5 shows a side view from the left of the dust suction unit and the cutting unit in figure 1;
- figure 6 shows a section view according to a section plane VI, of the dust suction unit and the cutting unit in figure 1;
- figures 7 and 8 show isometric views of the dust suction unit in figure 1 according to different directions;
- figure 9 shows an enlarged detail of the section in figure 3;
- figure 10 shows a schematic view of a cutting machine with multiple parallel rotary blades for the continuous cutting of material, comprising a plurality of dust suction units and cutting units in figure 1;
- figure 11 shows a front view of a suction unit according to the invention, having a distribution canalization of multiple jets of air transversal to the blade;
- figure 12 shows an isometric view of figure 11;
- figure 13 shows a front view of an embodiment of the suction unit in figure 1 further comprising a ionizer device associated with the blowing duct;
- figure 14 shows a front view of an embodiment of the suction unit in figure 1, further comprising an ionizer device associated with the further blowing duct arranged on the opposite side with respect to the suction duct;
- figure 15 shows a front view of an embodiment of the suction unit in figure 1, comprising a ionizer device associated with the blowing duct, and a further ionizer device associated with the further blowing duct.

Description of preferred embodiments

[0024] With reference to the figures, a dust suction unit according to the invention is globally indicated with reference 50.

[0025] A circular rotary blade 51 can be arranged inside the dust suction unit 50 for a production line 100 of material, defining a blade rotation axis 52, a cutting edge 54 of the blade lying on a blade plane L-L orthogonal to the blade rotation axis 52, a radial direction R orthogonal to the rotation axis 52 and parallel to the blade plane L-

L, a tangential direction T orthogonal to the radial direction R and parallel to the blade plane L-L.

[0026] Preferably, the blade 51 is of a type suitable for cutting paper, for example by rotation of the blade 51 about the blade axis, at the same time advancing the material to be cut along a direction T, with respect to the blade.

[0027] Besides paper, the present invention is effective with any powdered sheet material, for example non-woven material, tissue, cardboard, etc.

[0028] The cutting unit according to the invention also allows fine dust, fibers and scraps to be removed from the cutting area.

[0029] The dust suction unit 50 comprises a casing, 10 comprising an inner casing chamber 11 adapted to accommodate said circular rotary blade 51 allowing the rotation thereof about the blade rotation axis 52, said casing 10 comprising a casing opening 56 adapted to allow a portion of said blade cutting edge 54 to protrude from said casing opening 56 with respect to said casing 10, so as to be able to act on the material in order to cut it.

[0030] According to an embodiment, the inner casing chamber 11 has a substantially cylindrical shape and axis coinciding with the blade rotation axis 52.

[0031] More specifically, the inner casing chamber 11 is defined by two opposite base walls 12, 13 facing each other, and a side wall 14 joining the base walls 12, 13, having a substantially circular section transversely to the cylindrical chamber axis.

[0032] According to a preferred embodiment, the base walls 12, 13 are substantially flat and parallel to each other, preferably substantially circular.

[0033] The dust suction unit further comprises a suction duct 30 connected to the inner chamber 11, defining a suction duct axis 31' arranged along a predetermined suction direction A with respect to the blade 51, so as to convey a forced suction stream 31 outside the inner chamber 11 away from the circular rotary blade 51 along the aforesaid predetermined suction direction A.

[0034] The dust suction unit further comprises a blowing duct 40 connected to the inner chamber 11, defining a blowing duct axis 41' arranged along a predetermined blowing direction S, so as to convey a forced blowing stream 41 inside the inner chamber 11 towards the circular rotary blade 51 and in accordance with the predetermined blowing direction S.

[0035] In use, the blade 51 is rotated according to a predetermined blade rotation direction 57.

[0036] The casing opening 56 comprises a blade exit end 56' and an opposite blade entry end 56'', arranged downstream of the blade entry end 56' along the predetermined blade rotation direction 57.

[0037] According to an embodiment, both the suction duct 30 and the blowing duct 40 are connected to the inner chamber 11 in proximity of the aforesaid blade entry end 56''.

[0038] The closeness to each other of the suction duct 30 and the blowing duct 40, besides the positioning of

the same in proximity of the blade entry end 56", produces the combined effect of generating a forceful turbulent stream of air in proximity of the blade and the immediate suction and removal of the dust by means of the suction duct.

[0039] According to an embodiment, the predetermined suction direction A lies on a suction plane parallel to the blade rotation axis 52, and the predetermined blowing direction lies on a blowing plane parallel to the blade rotation axis 52, wherein the suction plane and the blowing plane intersect into each other along an intersection line 45 passing through the blade 51, in proximity of the cutting edge 54.

[0040] In other words, the intersection line 45 is radially internal with respect to the cutting edge 54.

[0041] By radially internal we mean a position interposed between the cutting edge 54 and the blade rotation axis 52, along a radial direction R of the blade.

[0042] According to an embodiment, the intersection line 45 is arranged at a predetermined radial distance Dr with respect to the cutting edge 54.

[0043] According to an embodiment, the aforesaid predetermined radial distance Dr is comprised between 0 and 1/5 of the radius of the cutting edge 54.

[0044] In this way, the area of maximum turbulent movement of the air stream is substantially concentrated on the blade in proximity of the cutting edge, to prevent the accumulation of dust on the blade itself.

[0045] According to an embodiment, the blowing plane S is inclined with respect to the suction plane A according to a predetermined acute inclination angle P.

[0046] Preferably, the inclination angle P is from 8° to 80°, more preferably from 10° to 45°, even more preferably of approximately 30°.

[0047] In this way, the suction stream and the blowing stream are substantially opposite each other, causing elevated turbulence.

[0048] According to an embodiment, the blowing plane A is inclined with respect to a work plane PL according to an angle B from 10° to 30°. By work plane we mean a plane along which the material to be cut is moved, for example a sheet of undefined length, possibly wound on a coil.

[0049] According to an embodiment, the suction plane is arranged at a predetermined suction radial distance RA from the blade rotation axis 52, and the blowing plane is arranged at a predetermined blowing radial distance RS from the blade rotation axis 52.

[0050] According to an embodiment, the predetermined blowing radial distance RS is different from the predetermined suction radial distance RA.

[0051] Preferably, the predetermined blowing radial distance RS is greater than the predetermined suction radial distance RA.

[0052] In this way, the forced blowing stream is arranged closer to the cutting edge than the forced suction stream. This arrangement is particularly advantageous because the removal action by means of blowing is con-

centrated in proximity of the cutting edge, while the suction action is more extended to the whole inner casing chamber.

[0053] According to an embodiment, the predetermined suction direction A is substantially parallel to the blade plane L-L.

[0054] According to an embodiment, the predetermined blowing direction S is substantially parallel to the blade plane L-L.

[0055] Preferably, the predetermined suction direction A and the predetermined blowing direction S are substantially parallel to each other and to the blade plane L-L.

[0056] According to an embodiment, the blade plane L-L is interposed, or substantially interposed, between the suction duct axis 31' and the blowing duct axis 41'.

[0057] According to an embodiment, the forced blowing stream 41 is directed in a direction opposite to the rotation direction 57 of the circular blade 51.

[0058] According to an embodiment, the suction stream is directed in a direction coinciding with the rotation direction 57 of the circular blade 51.

[0059] For example, the forced blowing stream 41 is directed in an direction which is opposite to the direction of the suction stream A.

[0060] In other words, according to an embodiment, substantially opposite suction and blowing stream directions correspond to the projections, on the blade plane L-L, of the predetermined suction direction A and the predetermined blowing direction S.

[0061] According to an embodiment, the suction unit comprises means for varying the aforesaid blowing stream periodically, for example means for producing the aforesaid stream alternately or intermittently.

[0062] According to an embodiment, the suction duct 30 is connected to the inner chamber 11 in proximity of the aforesaid blade entry end 56", while the blowing duct 40 is connected to the inner chamber 11 in proximity of the aforesaid blade exit end 56'.

[0063] According to an embodiment, the dust suction unit 50 comprises a ionizer device 44 associated with said blowing duct 40, arranged along said forced blowing stream 41 in input to said inner chamber 11.

[0064] According to an embodiment, the ionizer device 44 is directly mounted onto said casing 10.

[0065] According to an embodiment, the dust suction unit 50 comprises a further blowing duct 42 connected to said casing 10 and leading into said inner chamber 11, so as to convey a further forced blowing stream in input to said inner chamber 11, said further blowing duct 42 being connected to the casing 10 on the opposite side with respect to said suction duct 30.

[0066] According to an embodiment, the dust suction unit 50 comprises a further ionizer device 46 associated with said further blowing duct 42, arranged along said further forced blowing stream.

[0067] The ionizer device comprises a high-voltage electrode configured to ionize the blowing stream upstream of the inner chamber 11. In this way, the blowing

stream, in particular, the air going in, is ionized so as to attract and separate the particles of dust from the blade and drag them outside the inner chamber 11 by means of the suction duct. It has been found that in this way, the removal of dust from the inner chamber is further optimized.

[0068] According to an embodiment, the blowing duct 40 comprises a distribution canalization for the blowing stream having a plurality of exits, which lead into the inner chamber 11.

[0069] According to an embodiment, the further blowing duct 42 comprises a distribution canalization 47 having a plurality of exits 48 inside the inner casing chamber 11.

[0070] According to an embodiment, said plurality of exits 48 comprises at least one exit orthogonal to the blade rotation axis 52.

[0071] According to an embodiment, said casing 10 is formed by only one casing wall substantially orthogonal to the blade axis 52 and is configured to be associated with a blade-carrying device 100 to form said inner casing chamber 11.

[0072] In this way, the casing 10 can be adapted to a blade-carrying device 100 to form the inner chamber 11, together with the blade-carrying device.

[0073] According to a further aspect of the invention, the aforesaid advantages are achieved with a cutting unit comprising a dust suction unit, as described above, and the aforesaid circular rotary blade 51 defining a blade rotation axis 52, a blade cutting edge 54 lying on a blade plane L-L orthogonal to the blade rotation axis 52, a radial direction R orthogonal to the rotation axis 52 and parallel to the blade plane L-L, a tangential direction T orthogonal to the radial direction (R) and parallel to the blade plane L-L.

[0074] The inner casing chamber 11 is configured to allow the rotation of the circular rotary blade 51 about the blade rotation axis 52, and the casing opening 56 is adapted to allow a portion of said blade cutting edge 54 to protrude from said casing opening 56 with respect to the casing 10.

[0075] The suction duct axis 31' is arranged so as to convey a forced suction stream 31 in exit from said inner chamber 11 away from said blade 51 along said predetermined suction direction A, and wherein the blowing duct axis 41' is arranged so as to convey a forced blowing stream 41 in input to said inner chamber 11 towards said blade 51 along said predetermined blowing direction S.

[0076] In other words, the aforesaid objects and advantages are achieved through a continuous cutting unit 50 for a production line 100 for producing sheet or coil material comprising;

- a circular rotary blade 51 defining a blade rotation axis 52, a blade cutting edge 54 lying on a blade plane L-L orthogonal to the blade rotation axis 52, a radial direction R orthogonal to the rotation axis 52 and parallel to the blade plane L-L, a tangential di-

rection T orthogonal to the radial direction R and parallel to the blade plane L-L;

- a casing 10 comprising an inner casing chamber 11 adapted to accommodate said circular rotary blade 51 allowing the rotation thereof about the blade rotation axis 52, said casing 10 comprising a casing opening 56 adapted to allow a portion of said blade cutting edge 54 to protrude from said casing opening 56 with respect to said casing 10;
- a suction duct 30 connected to said inner chamber 11, defining a suction duct axis 31' arranged along a predetermined suction direction A with respect to the blade 51, so as to convey a forced suction stream 31 in output from said inner chamber 11 away from said circular rotary blade 51 along said predetermined suction direction A;
- a blowing duct 40 connected to said inner chamber 11 defining a blowing duct axis 41' arranged along a predetermined blowing direction S, so as to convey a forced blowing stream 41 in input to said inner chamber 11 towards said circular rotary blade 51 and in accordance with said predetermined blowing direction S.

[0077] According to another aspect of the present invention, the aforesaid objects and advantages are met with a production line 100 comprising a plurality of cutting units as described above, wherein the cutting units of said plurality flank one another so that the blade planes of each cutting unit of the plurality are parallel to one another.

[0078] In order to satisfy contingent needs, a person skilled in the art can make modifications, adaptations and replacements of components with other functionally equivalent ones to the embodiment of the device described above without departing from the scope of the following claims. Each of the features described as belonging to a possible embodiment can be produced independently of the other embodiments described.

[0079] The means and materials for producing the various functions described can be of a different type without departing from the scope of the invention. Furthermore, the figures are not necessarily to scale.

[0080] All of the features described herein can be combined in every combination, except combinations, wherein at least some of such features are mutually exclusive.

Claims

1. A dust suction unit for a continuous cutting unit (50) of sheet or coil material, comprising;

- a casing (10) defining a casing inner chamber (11) adapted to accommodate a circular rotary blade (51) and defining a blade rotation axis (52), said inner chamber being adapted to allow the rotation of said blade about said blade rota-

- tion axis (52), said casing (10) comprising a casing opening (56) adapted to allow a portion of said blade to protrude from said casing opening (56) with respect to said casing (10);
- a suction duct (30) connected to said casing (10) and leading into said inner chamber (11), defining a suction duct axis (31') arranged along a predetermined suction direction (A), so as to convey the forced suction stream (31) in output from said inner chamber (11) along said predetermined suction direction (A);
 - a blowing duct (40) connected to said casing (10) and leading into said inner chamber (11), defining a blowing duct axis (41') arranged along a predetermined blowing direction (S), so as to convey a forced blowing stream (41) in input to said inner chamber (11) and in accordance with said predetermined blowing direction (S).
2. A suction unit according to claim 1, wherein said casing opening (56) comprises a blade exit end (56') and an opposite blade entry end (56''), arranged downstream of the blade entry end (56'') along a predetermined blade rotation direction (57), wherein both the suction duct (30) and the blowing duct (40) are connected to the inner chamber (11) in proximity of the aforesaid blade entry end (56'').
 3. A suction unit according to claim 1 or 2, wherein the predetermined suction direction (A) lies on a suction plane parallel to the blade rotation axis (52), and the predetermined blowing direction lies on a blowing plane parallel to the blade rotation axis (52), wherein the suction plane and the blowing plane intersect into each other along an intersection line (45) passing through the blade (51), in proximity of the cutting edge (54).
 4. A suction unit according to claim 3, wherein the blowing plane is inclined with respect to the suction plane in accordance with a predetermined acute inclination angle (P).
 5. A suction unit according to claim 3 or 4, wherein the suction plane is arranged at a predetermined suction radial distance (RA) from the blade rotation axis (52), and the blowing plane is arranged at a predetermined blowing radial distance (RS) from the blade rotation axis (52), wherein the predetermined blowing radial distance (RS) is greater than the predetermined suction radial distance (RA).
 6. A suction unit according to at least one preceding claim, wherein the predetermined suction direction (A) lies on a plane orthogonal to the rotation axis (52).
 7. A suction unit according to at least one preceding claim, wherein the predetermined blowing direction (S) lies on a plane orthogonal to the rotation axis (52).
 8. A suction unit according to at least one preceding claim, wherein the forced blowing stream (41) has a direction opposite to the direction of the suction stream (A).
 9. A suction unit according to at least one preceding claim, comprising a ionizer device (44) associated with said blowing duct (40), arranged along said forced blowing stream (41) in input to said inner chamber (11).
 10. A suction unit according to at least one preceding claim, comprising a further blowing duct (42) connected to said casing (10) and leading into said inner chamber (11), so as to convey a further forced blowing stream in input to said inner chamber (11), said further blowing duct (42) being connected to the casing (10) on the opposite side with respect to said suction duct (30), wherein the further blowing duct (42) comprises a distribution canalization (47) having a plurality of exits (48) inside the inner casing chamber (11).
 11. A continuous cutting unit (50) for a production line (100) of sheet or coil material, comprising:
 - a dust suction unit for a continuous cutting unit (50) according to at least one preceding claim;
 - a circular rotary blade (51) defining a blade rotation axis (52), a blade cutting edge (54) lying on a blade plane (L-L) orthogonal to the blade rotation axis (52), a radial direction (R) orthogonal to the rotation axis (52) and parallel to the blade plane (L-L), a tangential direction (T) orthogonal to the radial direction (R) and parallel to the blade plane (L-L);
 - said casing inner chamber (11) being adapted to allow the rotation of said circular rotary blade (51) about the blade rotation axis (52), wherein the casing opening (56) is adapted to allow a portion of said blade cutting edge (54) to protrude from said casing opening (56) with respect to said casing (10),
 - wherein the suction duct axis (31') is arranged so as to convey a forced suction stream (31) in output from said inner chamber (11) away from said blade (51) along said predetermined suction direction (A), and wherein the blowing duct axis (41') is arranged so as to convey a forced blowing stream (41) in input to said inner chamber (11) towards said blade (51) along said predetermined blowing direction (S).
 12. A cutting unit according to claim 11, wherein the predetermined suction direction (A) lies on a suction plane parallel to the blade rotation axis (52), and the

predetermined blowing direction lies on a blowing plane parallel to the blade rotation axis (52), wherein the suction plane and the blowing plane intersect into each other along an intersection line (45) passing through the blade (51), in proximity of the cutting edge (54), and wherein the intersection line (45) is arranged at a predetermined radial distance with respect to the cutting edge (54), preferably comprised from 0 to 1/5 of the radius of the circular rotary blade (51).

13. A cutting assembly according to claim 11 or 12, wherein the blade plane (L-L) is substantially interposed between the suction duct axis (31') and the blowing duct axis (41').
14. A cutting unit according to at least one claim from 11 to 13, wherein the forced blowing stream (41) is directed in a direction which is opposite to the direction of rotation (57) of the circular blade (51).
15. A production line (100), comprising a plurality of cutting units according to at least a claim from 11 to 14, wherein the cutting units of said plurality flank one another so that the blade planes of each cutting unit of the plurality are parallel to one another.

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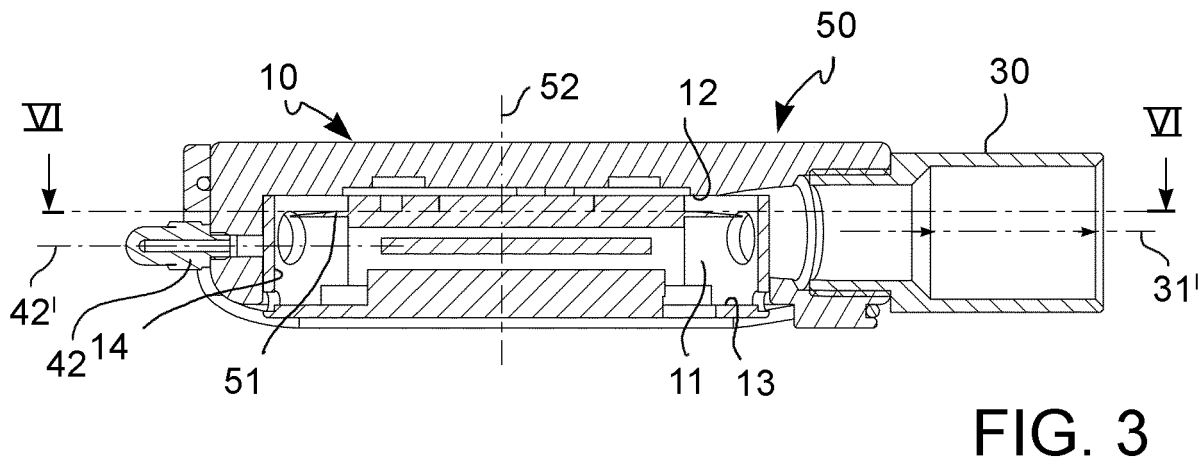
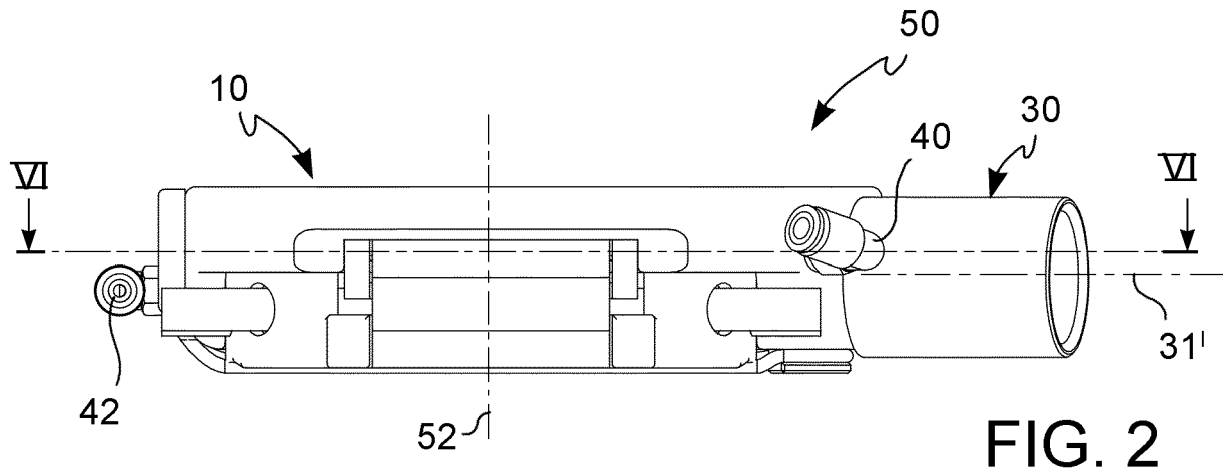
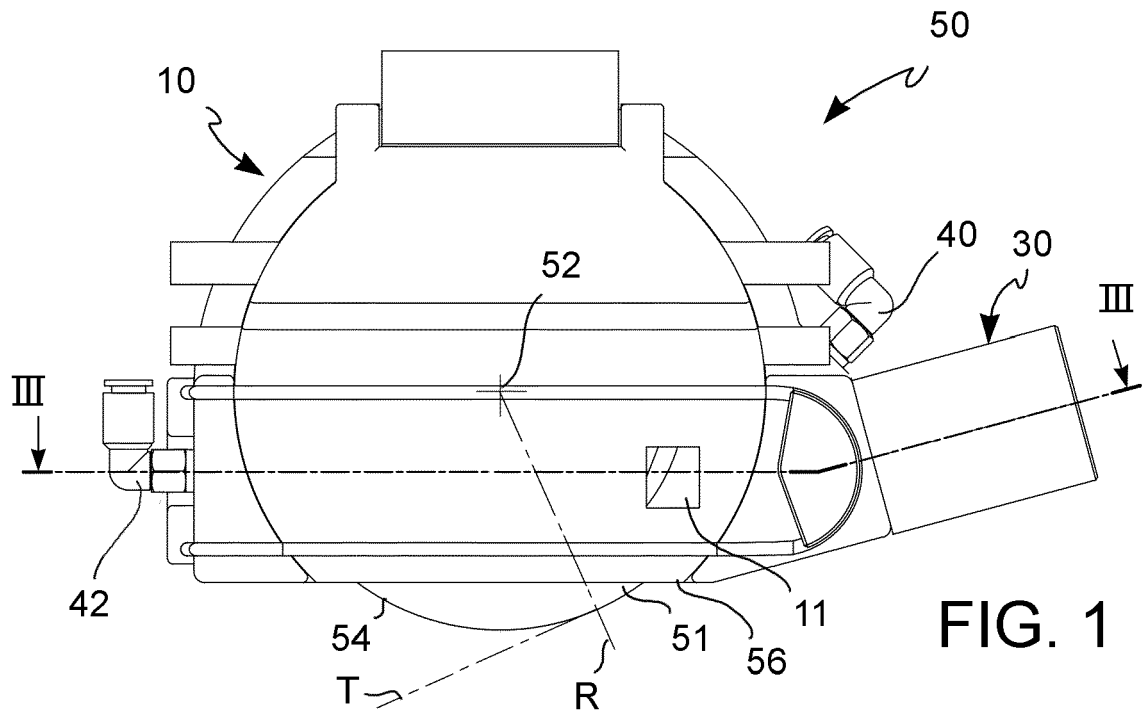
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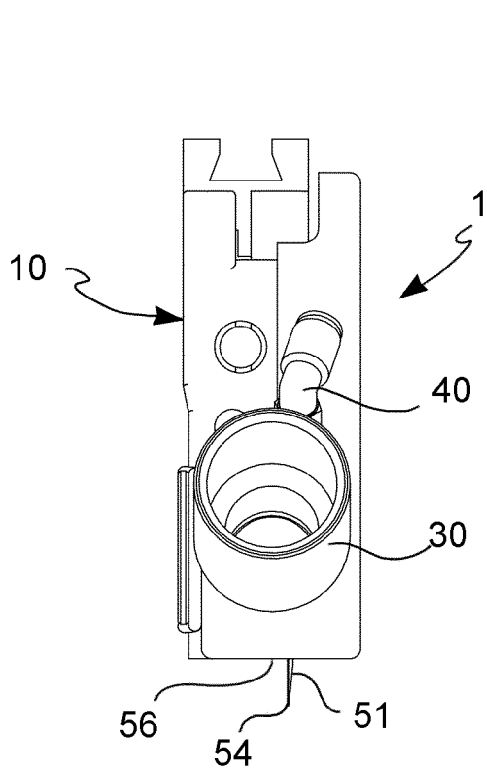


FIG. 4

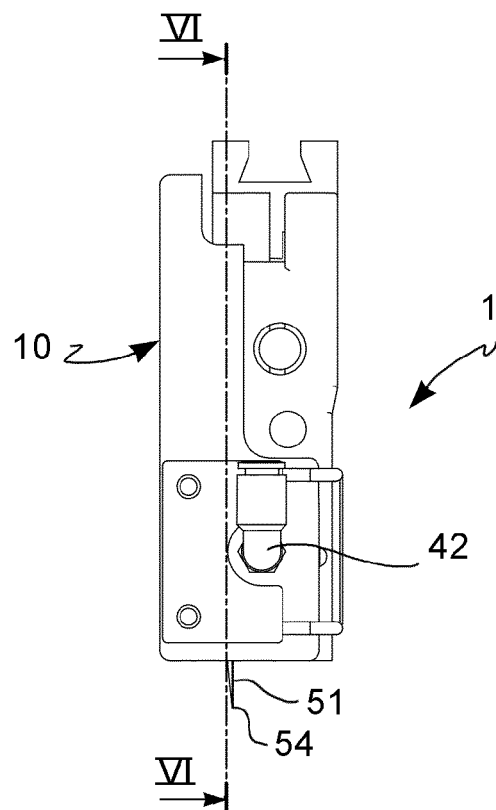


FIG. 5

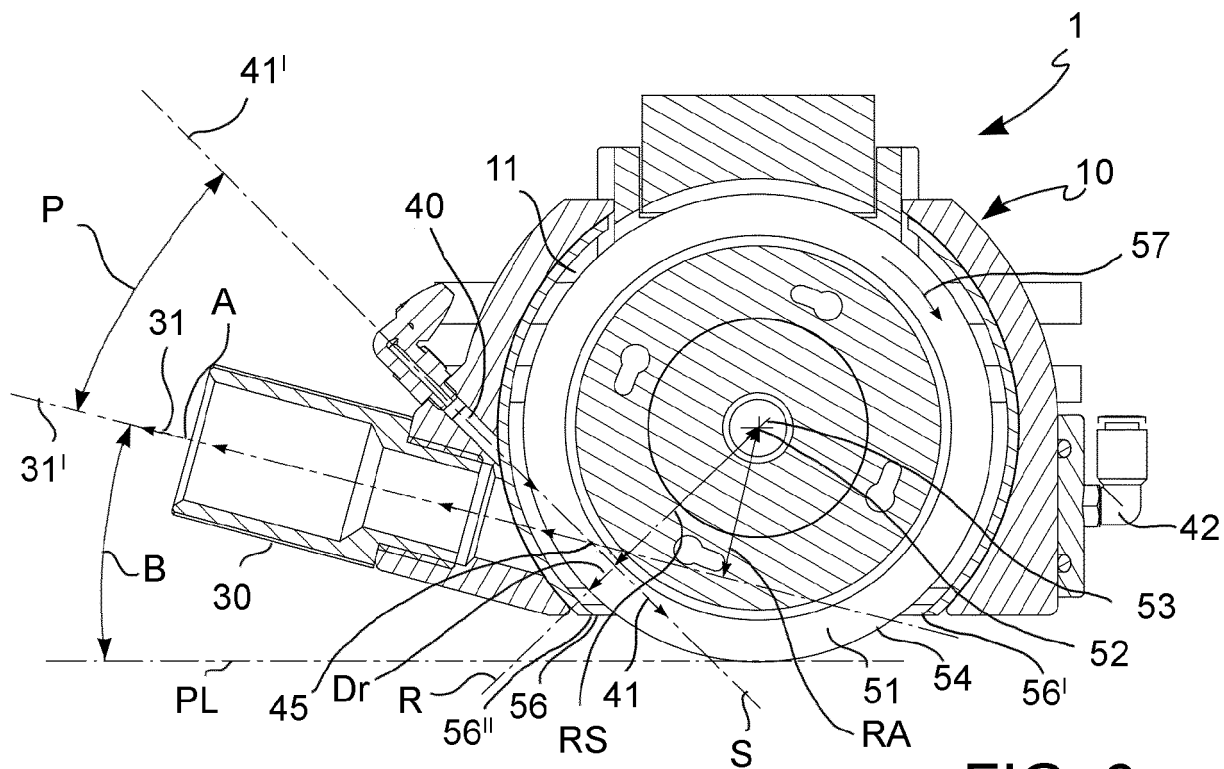


FIG. 6

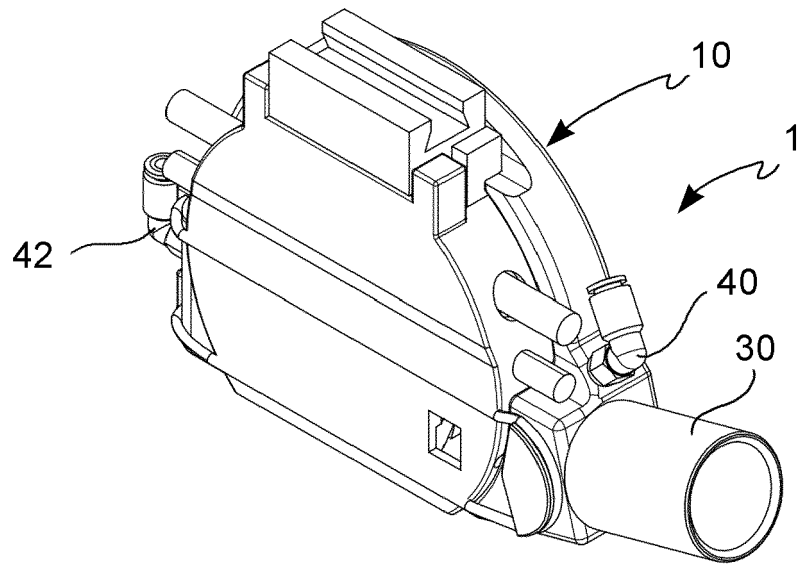


FIG. 7

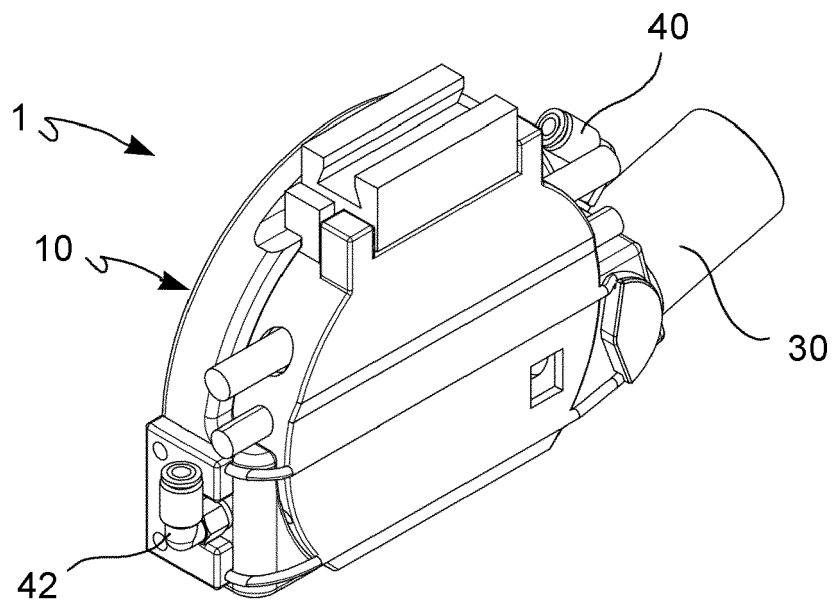


FIG. 8

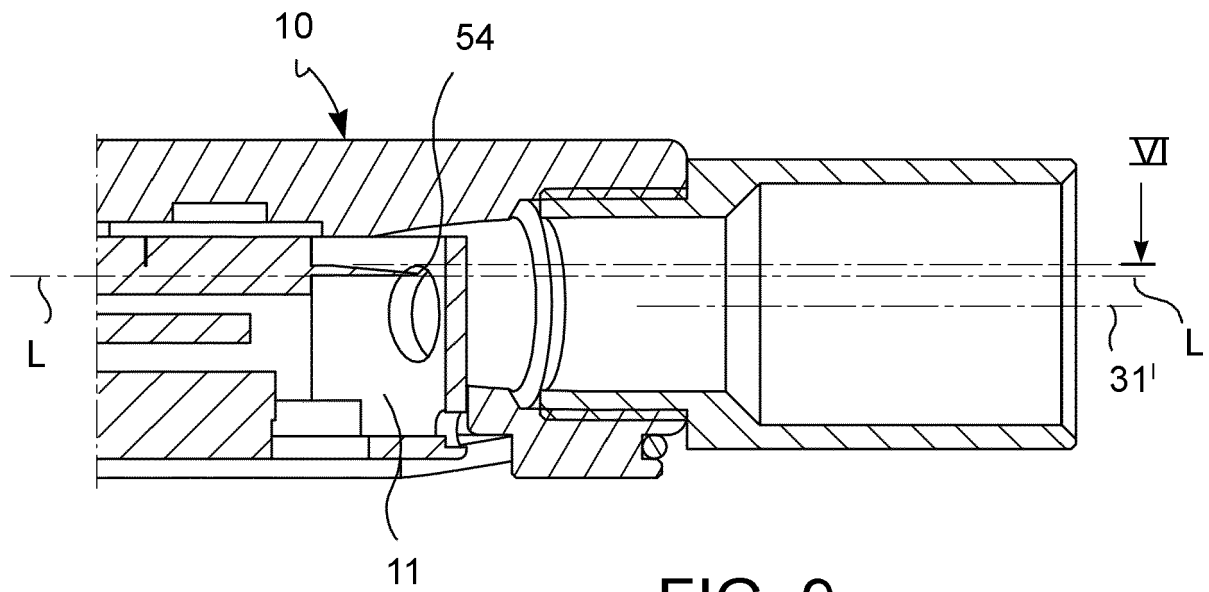


FIG. 9

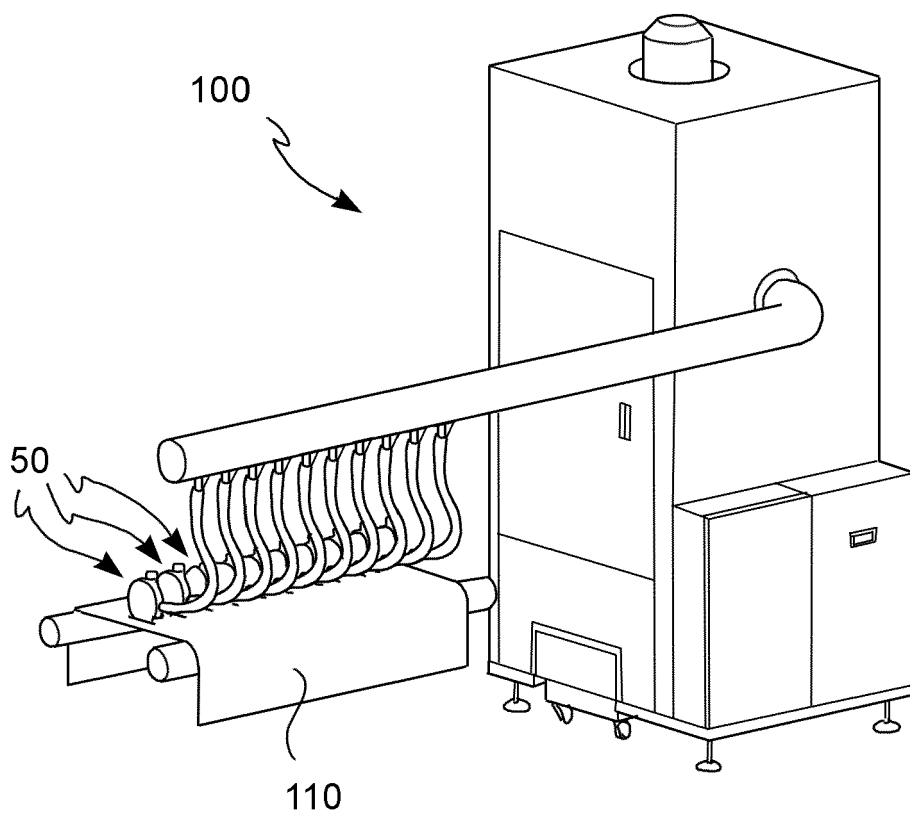


FIG. 10

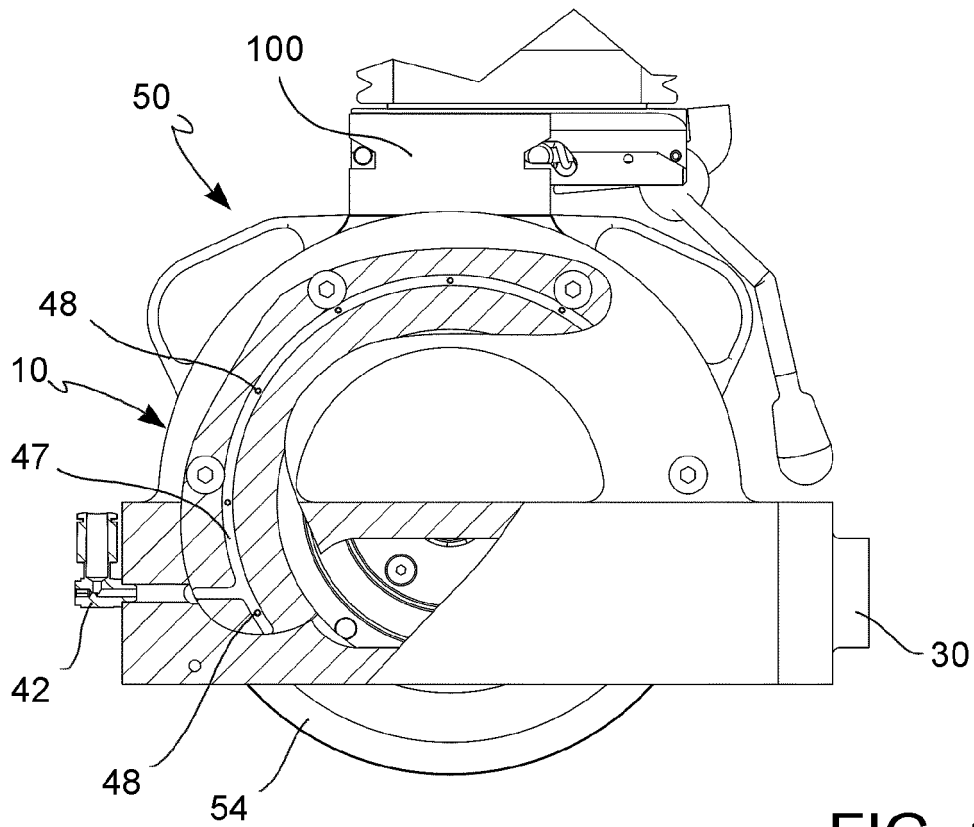


FIG. 11

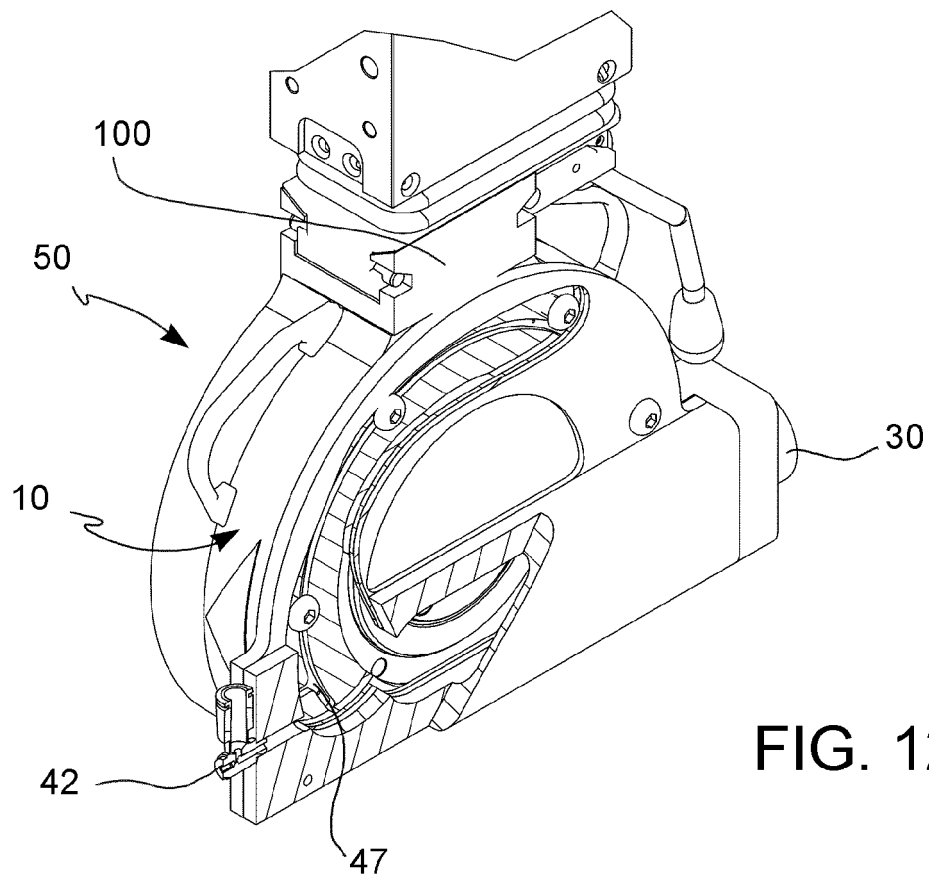
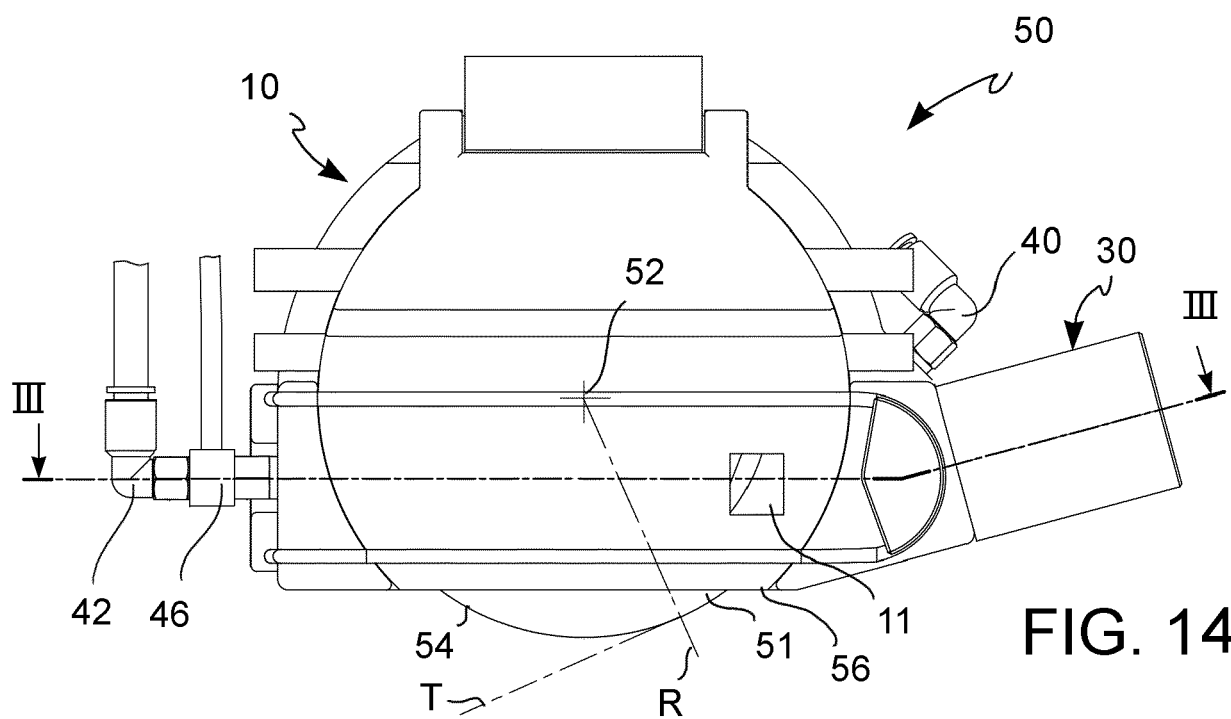
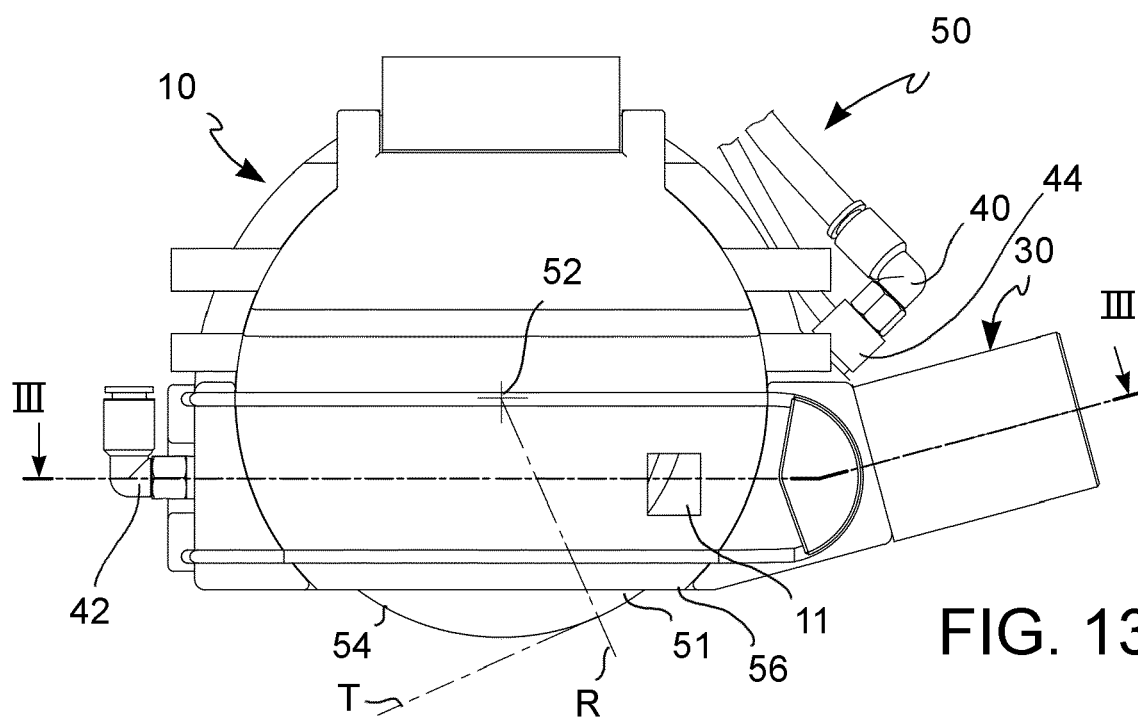


FIG. 12



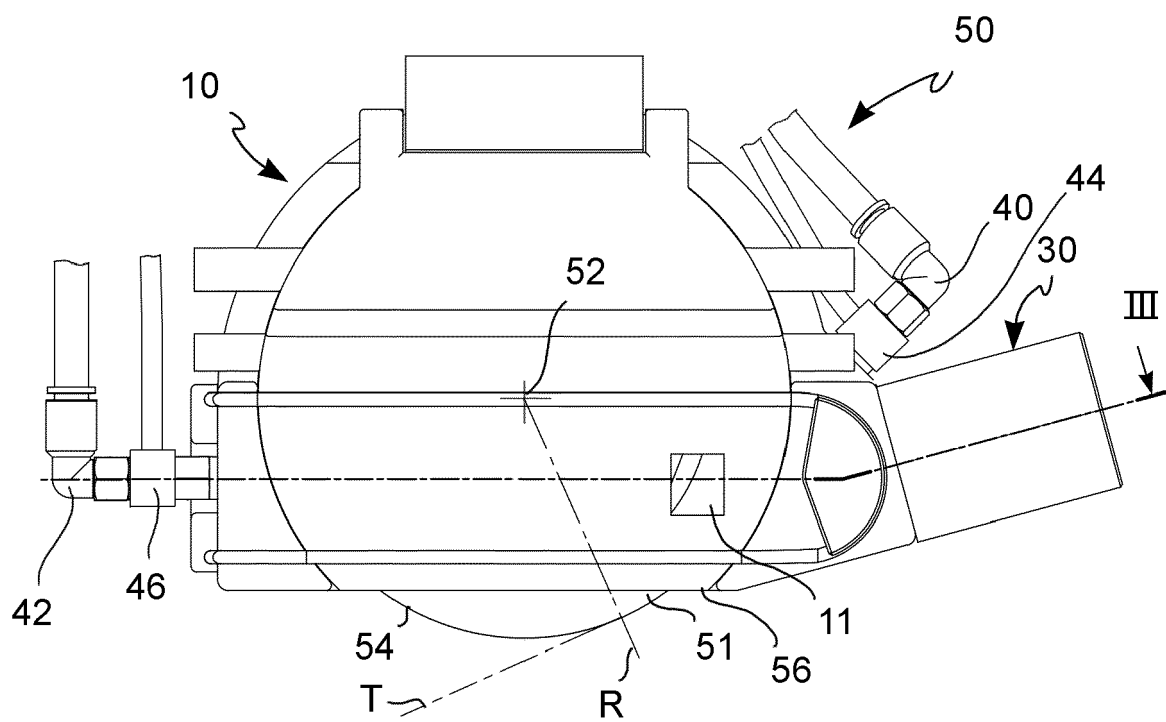


FIG. 15



EUROPEAN SEARCH REPORT

Application Number
EP 18 17 6571

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 02/066212 A1 (KOENIG & BAUER AG [DE]; KLUEPFEL ELMAR NORBERT [DE]; HERBERT BURKARD O) 29 August 2002 (2002-08-29) * the whole document *	1-23	INV. B26D7/18
A	DE 44 25 666 A1 (ROLAND MAN DRUCKMASCH [DE]) 25 January 1996 (1996-01-25) * the whole document *	1-23	ADD. B26D7/00 B26D1/15
A	GB 391 708 A (DAVID CARLAW & SONS LTD; ANDREW RITCHIE & SON LTD; DAVID CARLAW) 4 May 1933 (1933-05-04) * the whole document *	1-23	
A	DE 39 06 376 A1 (WILL E C H GMBH & CO [DE]) 6 September 1990 (1990-09-06) * figures *	1-23	
A	US 3 135 151 A (LINK PETER J ET AL) 2 June 1964 (1964-06-02) * figures *	1-23	
A	US 1 547 050 A (LAVINIOUS LALONE) 21 July 1925 (1925-07-21) * figures *	1	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 31 October 2018	Examiner Canelas, Rui
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	

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 17 6571

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

31-10-2018

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 02066212 A1	29-08-2002	AT 281908 T DE 10108234 A1 EP 1361937 A1 US 2004064911 A1 WO 02066212 A1	15-11-2004 26-09-2002 19-11-2003 08-04-2004 29-08-2002
DE 4425666 A1	25-01-1996	NONE	
GB 391708 A	04-05-1933	NONE	
DE 3906376 A1	06-09-1990	CA 2011173 A1 DE 3906376 A1 ES 2020771 A6 JP H0335997 A US 5072638 A	01-09-1990 06-09-1990 16-09-1991 15-02-1991 17-12-1991
US 3135151 A	02-06-1964	NONE	
US 1547050 A	21-07-1925	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82