



- (51) **International Patent Classification:**
E06B 3/673 (2006.01) *E06B 3/677* (2006.01)
- (21) **International Application Number:**
PCT/IB2013/050797
- (22) **International Filing Date:**
30 January 2013 (30.01.2013)
- (25) **Filing Language:** Italian
- (26) **Publication Language:** English
- (30) **Priority Data:**
TO2012A000076 30 January 2012 (30.01.2012) IT
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- (81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) **Title:** METHOD AND MACHINE FOR FORMING AN INSULATED GLASS SHEET

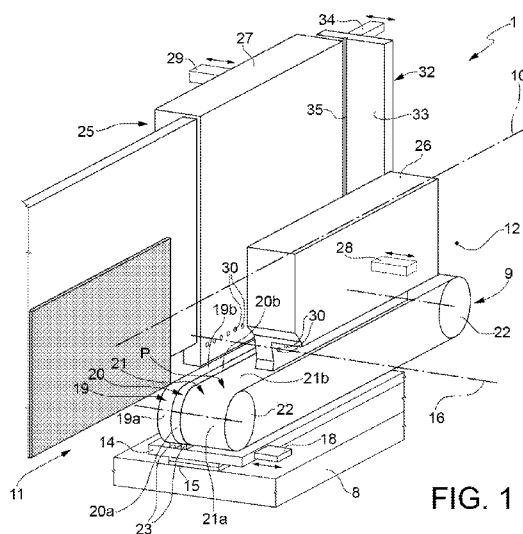


FIG. 1

(57) **Abstract:** A method and machine (1) for forming an insulated glass sheet (2), according to which the three glass sheets, two side sheets (3) (4) and a central sheet (5), are arranged on their edge in positions reciprocally distanced by internal frames over respective resting planes (19b) (20b) (21b), are displaced to a vertical translated position, in which the side glass sheets (3) (4) and the central glass sheet (5) are vertically displaced with respect to one another, an inert gas is simultaneously introduced between the glass sheets supporting the glass sheets in the vertical translated position and are translated, again vertically, taking them to a leveled position, in which the lower edges (3a) (4a) (5a) of the three glass sheets lay on a common horizontal plane before clamping in a pack the glass sheets and the internal frames (6) to one another.

METHOD AND MACHINE FOR FORMING AN INSULATED GLASS SHEET

TECHNICAL FIELD

The present invention relates to a method for forming an insulated glass sheet.

In particular, the present invention relates to a method for forming an insulated glass sheet comprising at least three sheets of glass facing one another, of which two are side sheets and one is intermediate, spaced apart from one another by internal peripheral frames delimiting, together with the respective sheets, two sealed chambers containing a heavy inert gas.

BACKGROUND ART

A three sheet insulated glass sheet of the type described above is made by initially forming a single chamber insulated glass sheet, i.e. by arranging a pair of glass sheets on opposite sides of an internal spacing frame so as to form a chamber for the inert gas and filling the chamber itself with inert gas before forcing the sheets against each other making them integral with the internal frame.

Once the single chamber insulated glass sheet is formed, a further glass sheet is taken to position facing one of the two glass sheets of the single chamber insulated glass sheet, after which a second internal peripheral frame is associated to the further sheet forming a second chamber, in which the inert gas is

introduced before making the glass sheets integral with the second internal frame. At this point, respective beads of sealant material are deposited on the internal edge of the internal frames and the respective sheets.

The manufacturing of double chamber glass sheets is long, complex and costly, and does not ensure constant product quality, above all when the insulated glass sheets are made "vertically", i.e. by arranging the glass sheets on their edge during the entire forming process. In such conditions, indeed, the single chamber insulated glass is kept suspended by suction caps which are coupled to one of the glass sheets. The single chamber glass is therefore overhangingly supported being one of the sheets coupled to the suction caps and the other withheld only by the coupling obtained by means of the internal frame. Consequently, during the advancement, the positioning and coupling of the further glass sheet often inevitably cause further displacements between the glass sheets of the single camber insulated glass sheet, with the consequence that geometric and dimensional consistency cannot be guaranteed, together with the sealing of both chambers, which, at the end of forming, are only partially filled with gas.

A different embodiment of an insulated glass sheets with three glass sheets is described in WO 2011/095732 A2.

DISCLOSURE OF INVENTION

It is an object of the present invention to provide a method for forming an insulated glass sheet, which allows to simply and cost-effectively solve the problems illustrated above and which, in particular, allows to simply and completely fill the spaces delimiting the glass sheets and continuously control the relative position between the glass sheets during forming and after forcing the glass sheets against the respective frames.

According to the present invention, a method for forming an insulated glass is provided as claimed in claim 1.

The present invention further relates to a machine for forming an insulated glass sheet.

According to the present invention, a machine for forming an insulated glass is provided as claimed in claim 9.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described with reference to the accompanying drawings which illustrate non-limitative embodiments thereof, in which:

figures from 1 to 14 diagrammatically show, substantially in blocks, a machine for forming an insulated glass sheet according to the present invention arranged in different functional conditions; and

figures 15 and 16 illustrate a variant of a detail of the figures from 1 to 14.

BEST MODE FOR CARRYING OUT THE INVENTION

In figures 1 to 14, numeral 1 indicates, as a whole, a machine for forming an insulated glass sheet (figure 14) comprising two side glass sheets 3 and 4, a central glass sheet 5 and an internal spacing frame 6 interposed between each side glass sheet 3,4 and the central glass sheet 5.

The machine 1 comprises a base 8 and a conveying assembly 9 for advancing the glass sheets 3-5 in a longitudinal direction 10 between an inlet station 11 of the sheets 3-5 and an outlet station 12 of the insulated glass sheet 2.

The conveying assembly 9 comprises a frame 14 of its own coupled to the base 8 of the machine 1 by means of a guide and slide assembly 15 for sliding in opposite senses in a horizontal transversal direction 16 orthogonal to the longitudinal direction 10 under the bias of its own linear actuator 18.

The conveying assembly 9 further comprises three motorized belt conveyors, indicated by numerals 19, 20 and 21, arranged side-by-side and corresponding belts 19a, 20a and 21a wound as a loop about respective diverter rollers 22 and having different widths. The diverter rollers 22 have the same external diameter, are rotational about respective axes horizontal and parallel to each other and to the transversal direction 16, and divide the respective belts 19a, 20a and 21a into an

horizontal upper delivery branch 19b, 20b and 21b, parallel to the longitudinal direction 10, and a lower return branch.

The conveyor 21 is coupled to the frame 14 in vertically fixed position, while a respective lifting actuator device 23, known in itself and not described in detail, is interposed between each of the conveyors 19 and 20 and the frame 14 itself. Each device 23 is adapted to vertically displace the respective conveyor 19, 20, orthogonally with respect to directions 10 and 16, and in particular to displace the delivery branch 19b, 20b between a raised position (figures 3 and 11) and a lowered position (figures 1 and 12), in which the delivery branches 19b, 20b and 21b are co-planar and lay on a horizontal plane P parallel to directions 10 and 16.

Again with reference to figures from 1 to 14, the machine 1 further comprises a side reference and supporting assembly 25 of the side glass sheets arranged essentially over the conveying assembly 9 and, in turn, comprising a front supporting and actuating device 26 and a rear supporting device 27 arranged reciprocally facing.

The supporting devices 26 and 27 comprise respective withholding devices of the glass sheets 3 and 4, conveniently of the suction cap type, known in themselves and not described in detail, each adapted to

withhold a respective glass sheet arranged on its edge in position orthogonal to the transversal direction 16 and parallel to the longitudinal direction 10.

At least the device 26 or, as in the present solution, both the devices 26 and 27 are coupled to the base 8 in sliding manner to slide in opposite directions parallel to itself and one respect to the other in the transversal direction 16 under the bias of respectively independent actuators indicated by numerals 28 and 29.

Each supporting device 26 and 27 then comprises a plurality of respective dispensing nozzles 30 adapted to generate respective inert gas flows over the conveyors 19, 20 and 21. The nozzles 30, which in the specific case are defined by conduits, are mutually aligned in the longitudinal direction 10, are arranged in adjacent position parallel to plane P and to the delivery branches 19b, 20b and 21b, when the delivery branches 19b, 20b and 21b themselves are arranged in their lowered position, as shown for example in figure 1.

Again with reference to figures from 1 to 14, the machine 1 further comprises a front longitudinal reference and retaining device 32, which is arranged upstream of the outlet station 12 and comprises a stop body 33, which extends upwards from the conveying assembly 9 and is coupled to the base 8 in sliding manner in a direction parallel to the transversal direction 16 under the bias of an actuator 34 of its

own, independent from the actuators 28 and 29. The body 33 has, over the plane P, a vertical groove 35 adapted to accommodate and to withhold a frontal peripheral position of the central glass sheets 5.

In the described machine 1, the insulated glass sheet 2 is made in the following manner.

Starting from the condition shown in figure 1, in which the delivery branches 19b, 20b and 21b are arranged in the lowered coplanar position and the side devices 26 and 27 and the front device 32 are arranged in a retracted waiting position, the side glass sheet 3 is arranged essentially on edge over the delivery branch 19b of the conveyor 19 and from here advanced in the longitudinal direction 10 to make it abut against the body 33 of the device 32 and rest on the device 27, as shown in figure 2. At this point, the delivery branch 19b is raised and the glass sheet 3 carried with its lower edge 3a over the nozzles 30 (fig. 3), after which the device 26 is advanced towards the device 27 in direction 16 to positively couple with the sheet 3 (figure 4), thus the device 26 is retracted again to its waiting position or to a position near this position. After having completed the retraction of the glass sheet 3, the conveying assembly 9 advances towards the device 27 until the branch 20b of the conveyor 20 extends under the device 27 itself. At this point, the central glass sheet 5 supporting one of the internal frames 6 is

arranged over the branch 20b and is advanced by the branch 20b itself and in contact with the device 27 in direction 10 towards the front device 32, as shown in figure 6.

Either simultaneously or before loading the sheet on the branch 20b, the front device 32 is adjusted in direction 16 so as to allow to insert and withhold the portion or front end edge of the sheet 5 in the slot 35 and consequently maintaining the sheet 5 itself in vertical position (figure 7).

Thus, the conveying assembly 9 is retracted again to take the branch 19b under the device 27 by spacing the glass sheet 7 from the device 27, as shown in figure 7, after which, the side glass sheet 4 with coupled the respective internal frame 6 is arranged on the conveyor 19 and progressively displaced by the branch 19b and against the device 27 to make it abut against the body 33 (figure 8). Having reached the body 33, the conveyor 19 is lifted and the sheet 4 carried at the same height of the sheet 3, i.e. in position such as to display a lower edge 4a thereof arranged over the nozzles 30 (figure 9). The side sheets 3 and 4 withheld by the suction caps of the respective devices 26 and 27 are, at this point, shifted parallel to themselves displacing the devices 26,27 in direction 16, approached to the central sheet 5 and stopped in positions so as to leave a predetermined access passage comprised between the

glass sheets and delimited laterally by the frames 16 themselves (figure 10) between the respective frames 6 and the corresponding glass sheets 3 and 5.

By means of the nozzles 30 and through the mentioned passages, two inert gas flows directed towards the central glass sheet 5 are thus simultaneously conveyed from the bottom until the spaces between the central glass sheet 5 and the side sheets 3,4 are filled with inert gas. Having reached such a condition, the delivery branch 20b is displaced upwards and the central glass sheet 5 is raised to take it to a leveled position, in which the lower edges 3a,4a and 5a of the glass sheets 3,4 and 5 all lie on a plane parallel to the plane P, as shown in figure 11. Withholding the glass sheets 3,4 and 5 in such a position, the devices 26 and 27 are displaced towards one another in the transversal direction 16 clamping in a pack to one another the sheets 3,4 and 5 and the respective frames 6 forming the insulated glass sheet 2. After clamping, the devices 26 and 27 release the respective glass sheets and the branch 20b of the conveyor 20 is lowered again and, when it is coplanar with the other delivery branches (figure 12), the insulated glass sheet 2 again resting on the delivery branches 19b,20b and 21b and guided by the device 27 is advanced by the conveying assembly 9 towards the outlet station 12 and evacuated (figures 13 and 14).

The variant shown in figures 15 and 16, relates to a machine 40 similar to machine 1 and wherein the component parts are identified, where possible, with the same reference numbers as the corresponding parts of machine 1.

In machine 40, only the conveyor 20 is adjustable in height with respect to the conveyors 19 and 21, which are vertically fixed and support the respective side glass sheets 4 and 3 resting on the plane P. In such a position, the sheets 3 and 4 are blocked by the suction cups of the respective withholding devices 26 and 27.

In the machine 40, the devices 26 and 27 are free from the dispensing nozzles 30 and the machine 40 itself comprises respective nozzles 45 which are carried by the central conveyor 20 to convey two opposite inert gas flows towards the side glass sheet 3 and 4 when the conveyor 20 and the respective delivery branch 20b are arranged in their raised position, shown in figure 16.

The forming steps of the insulated glass sheet 2 by means of machine 40 differ from those of machine 1 in that the side glass sheets 3 and 4 are no longer raised with respect to the plane P but are maintained stationary over the branches 19b and 21b, i.e. over the vertically fixed resting surface. In machine 40, instead, only the central glass sheet 5 is displaced by vertically displacing the conveyor 20 so as to allow to convey the inert gas flows by means of the nozzles 45

through the passages present between the sheets 3 and 5 and the internal frames 6 (figure 16).

In the machine 40, after completing the introduction of the gas, the central sheet 5 is lowered and taken to the leveled position with external glass sheets 3, i.e. with the lower peripheral edges 3a, 4a and 5a arranged on the plane P (figure 15), after which the sheets 3, 4 and 5 and the frames 6 are clamped in a pack by displacing the devices 26 and 27 towards one another in direction 16 forming, in such a manner, the insulated glass sheet 2 which, at this point, is simply displaced and advanced towards the outlet station 12.

From the above, it is apparent that in both described machines 1 and 40, the glass sheets are always supported and therefore always maintained in predetermined positions without, therefore, any possible relative movement during the entire forming process. The above allows to make insulated glass sheets all having the same quality level and unchanged size, geometry and thermal-acoustic properties.

From the above it is then apparent that, with respect to the known solutions, the machines 1 and 40 and the described forming methods allow to drastically reduce the forming time. This is consequent to the fact that the three glass sheets are positioned in sequence and only after having been positioned are forced against one another avoiding the formation of intermediate semi-

finished products.

Furthermore, according to the forming methods described above, the spaces between the glass sheets are filled with gas simultaneously instead of during subsequent steps as in the known solutions, thus reducing times and simplifying the filling.

From the above, it is apparent that the conveying assembly 9 could comprise a different number of conveyors and one or more conveyors could be replaced by a common resting and/or sliding surface of the glass sheets.

Furthermore, the central glass sheet 5 could be maintained in vertical position by using a clamp or jaw device adapted to be coupled to a peripheral edge of the sheets 5, e.g. the upper one in combination with, or instead of, the longitudinal reference and retaining device 32. Finally, the device 23 could comprise a further stop body, e.g. facing the body 33 and provided with seats or other retaining elements of the central sheet 5.

Finally, the nozzles 30 and/or the nozzles 45 which, in use, send gas flows to the central glass sheet 5 and, respectively, towards the side glass sheets 3,4 in directions orthogonal to the glass sheets themselves may be oriented, conveniently upwards, so as to send gas flows in directions forming angles other than 90° with the respective glass sheets, so as to reduce turbulences

and, in general, losses of load and facilitate the introduction of gas into the spaces between the glass sheets and the complete filling of the spaces themselves. With this regard, the nozzles 30,45 could be adjustable as a function of the features of the insulated glass sheet and, for example, the size of the spaces between the glass sheets or the vertical position of between the glass sheets themselves.

CLAIMS

1.- A method for forming an insulated glass sheet comprising two side glass sheets, a central glass sheet and an internal spacing frame interposed between each side glass sheet and said central glass sheet, the method being characterized by comprising the steps of arranging the three glass sheets vertically in reciprocally spaced and parallel positions, of inserting in the space between each side glass sheet and central glass sheet the relative internal spacing frame, of displacing the three glass sheets in a vertically translated position, in which the side glass sheets and the central glass sheet are vertically offset one with respect to another, of simultaneously introducing an inert gas in said spaces, supporting the glass sheets in said vertically translated position, of translating the side glass sheets and the central glass sheet one with respect to another in a vertical direction bringing the sheets in a levelled position, in which the lower edges of the three glass sheets lie on a common horizontal plane and of clamping in a pack the glass sheets and said internal spacing frames the displacement and support of said glass sheets in said offset and levelled positions being carried out by resting the glass sheets on respective lower mobile supports, by vertically translating at least part of said mobile supports and maintaining the side glass sheets vertical by means of

first reference and retaining means and the central sheet by means of second reference and retaining means.

2.- The method according to claim 1, characterized in that said side glass sheets are maintained vertical by suction cup means and that said central glass sheet is maintained vertical by maintaining it partially in a fixed guiding and retaining seat.

3.- The method according to claim 1 or 2, characterized in that the displacement of the glass sheets in said offset position comprises the steps of maintaining the central glass sheet in a vertically fixed position and of lifting the side glass sheets with respect to the central glass sheet.

4.- The method according to claim 3, characterized in that said inert gas is introduced in said spaces inducing respective inert gas flows to flow simultaneously under the lower peripheral edges of said side glass sheets and directing them towards the central glass sheet in a direction forming an angle equal to or different from 90° with the central glass sheet.

5.- The method according to claim 1, characterized in that the displacement of the glass sheets in said offset position comprises the steps of maintaining the side glass sheets in vertically fixed positions and of lifting the central glass sheet with respect to the side glass sheets.

6.- The method according to claim 5, characterized

in that said inert gas is introduced by making it flow through nozzles carried by said resting means of said central glass sheet in opposite directions orthogonal to the side glass sheets or forming angles other than 90° with the side glass sheets.

7.- The method according to claim 5 or 6, characterized in that said inert gas is introduced in said spaces inducing respective inert gas flows to flow in opposite directions and under the lower peripheral edge of said central glass sheet.

8.- The method according to any of the preceding claims, characterized in that the vertical arrangement of said glass sheets comprises the steps of vertically feeding in a sequence in a longitudinal direction one of the side glass sheets until it is arranged in abutment against an axial catch member and resting against a side stop parallel to the longitudinal direction, of spacing the glass sheet from said side stop displacing it in a direction orthogonal to said longitudinal direction, of arranging the central glass sheet against said side stop, of introducing an end segment of said central sheet in a positioning and retaining seat borne by said axial catch member, of spacing the central glass sheet from said side stop and of bringing the other side glass sheet in contact with said side stop and said axial catch member.

9.- A machine for forming an insulated glass sheet

comprising two side glass sheets, a central glass sheet and an internal spacing frame interposed between each side glass sheet and said central glass sheet, the machine being characterized by comprising, for each of said glass sheets, a relative resting plane for supporting the relative glass sheet arranged vertically in a transversally spaced position and parallel to the other glass sheets, feeding means for feeding the glass sheets in a longitudinal direction, actuator means to vertically displace at least one of said resting planes with respect to the other resting planes between a levelled position, in which it is coplanar with the other resting planes, and a vertically offset position, first and second nozzles to simultaneously convey inert gas flows between each side glass sheet and central glass sheet, first and second releasable reference and retaining means adapted to couple to said side glass sheets and to said central glass sheet for maintaining the glass sheets in respective vertical positions and forcing means for displacing the reference and retaining means of said side glass sheets one with respect to another in a direction transversal to said longitudinal direction.

10.- The machine according to claim 9, characterized in that said nozzles are borne by said reference and retaining means of said side glass sheets.

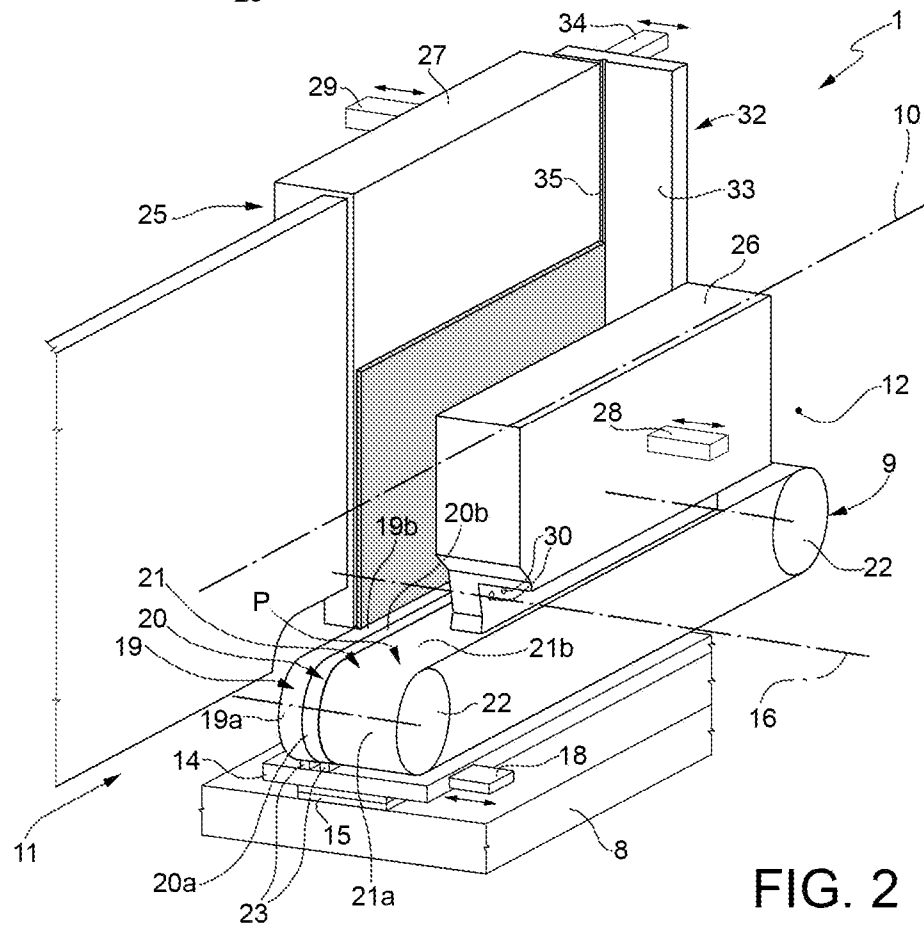
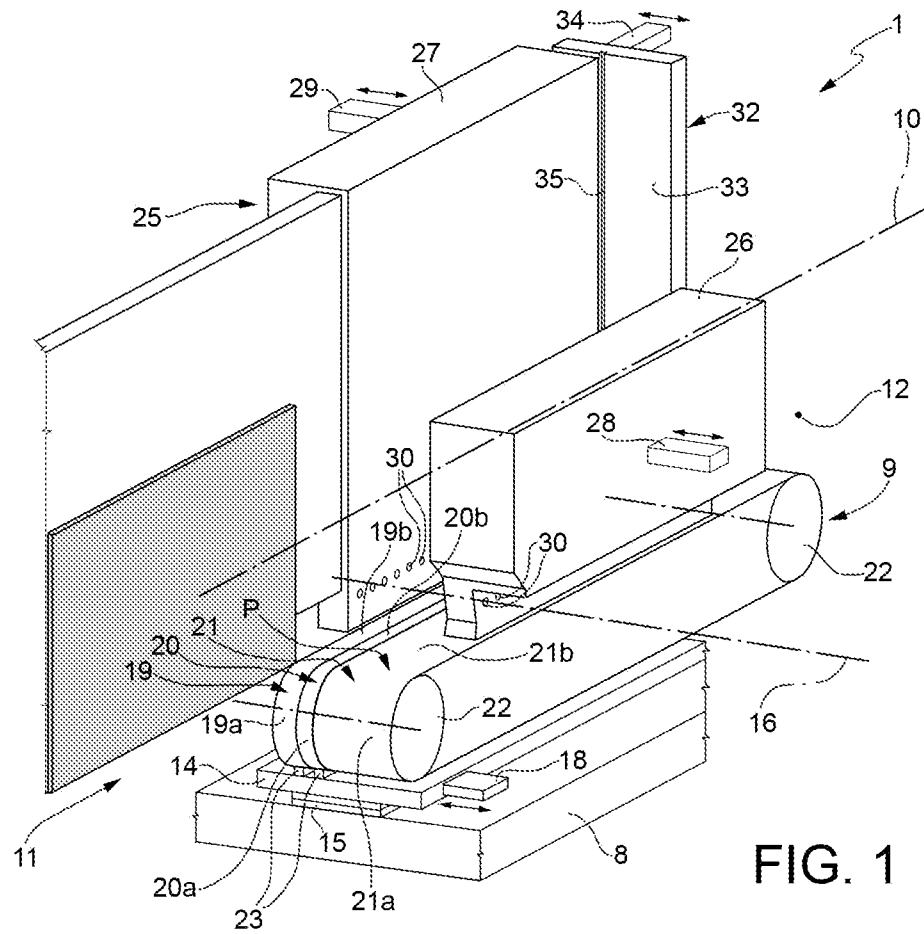
11.- The machine according to claim 9,

characterized in that said nozzles are borne by said vertically mobile resting plane.

12.- The machine according to any of claims 9 to 11, characterized in that said resting planes are defined by the delivery branches of respective conveyor belts.

13.- The machine according to any of claims 9 to 12, characterized in that said reference and retaining means of said central glass sheet comprise a housing seat for an end segment of said central glass sheet.

14.- The machine according to any of claims 9 to 13, characterized in that said resting planes are mobile in said transversal direction.



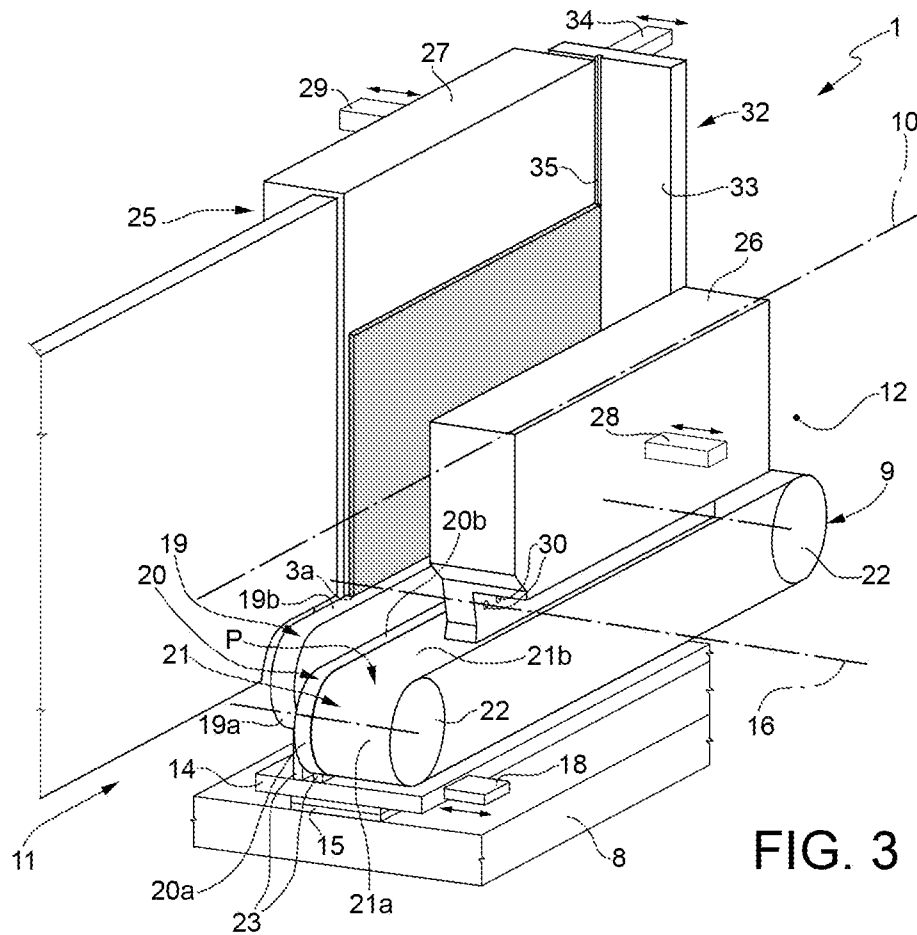


FIG. 3

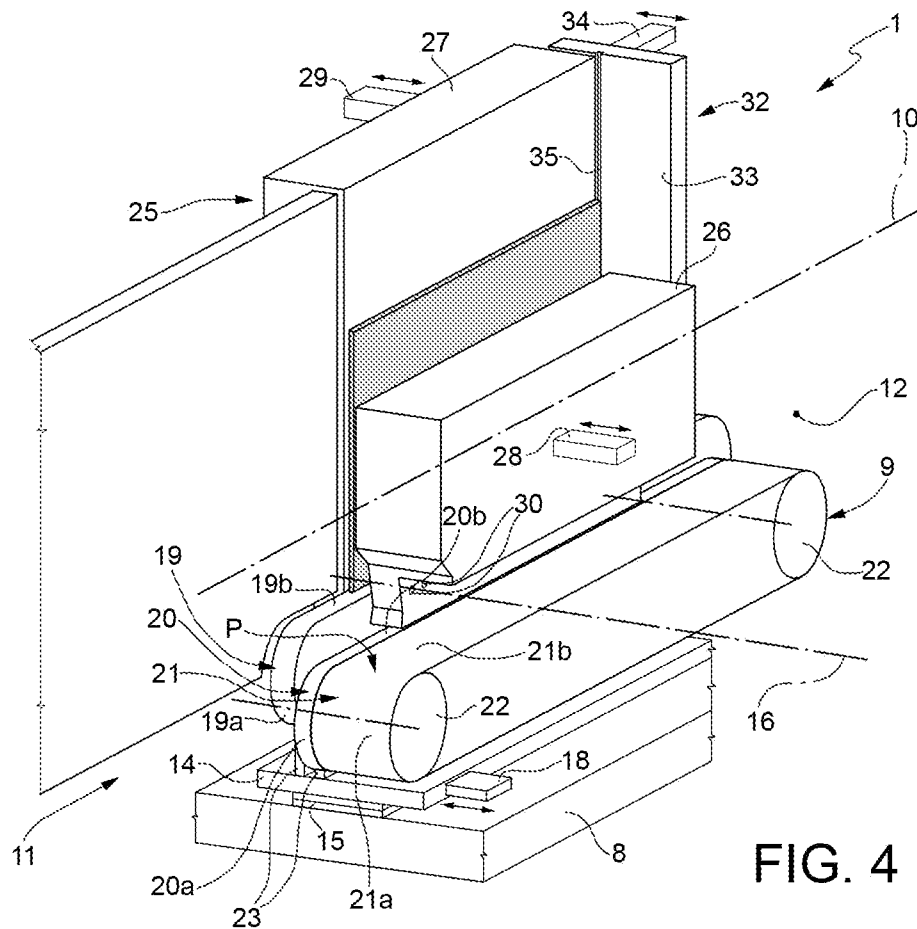


FIG. 4

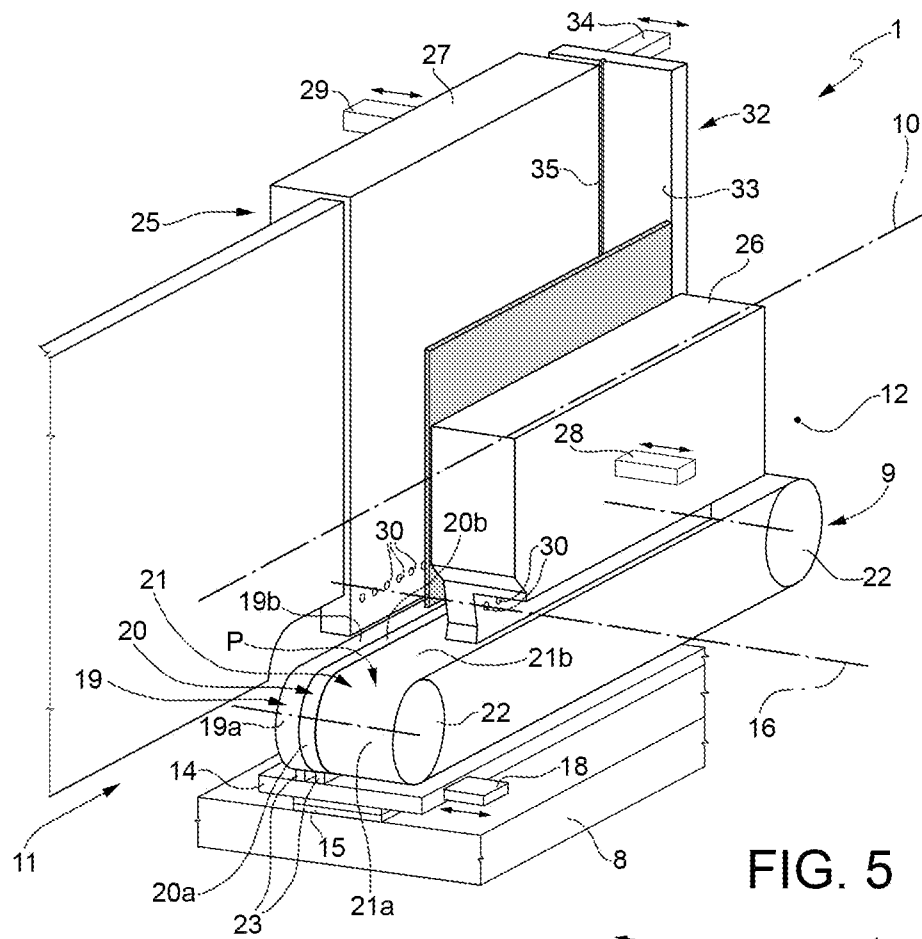


FIG. 5

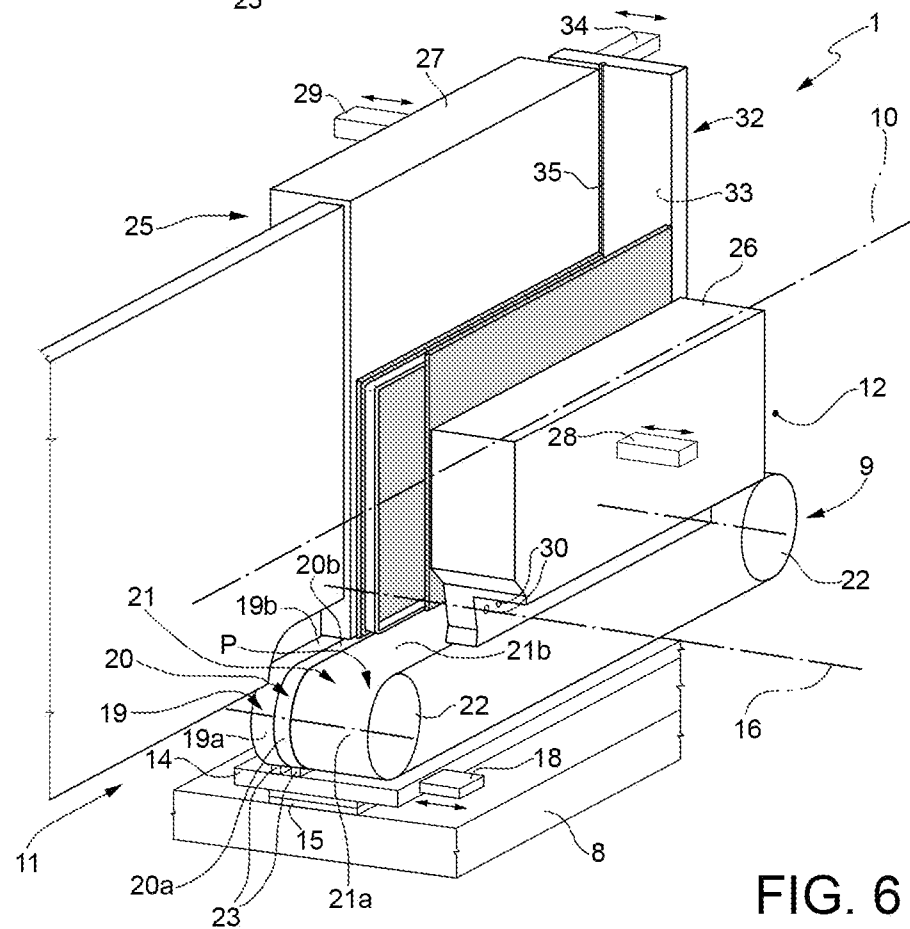


FIG. 6

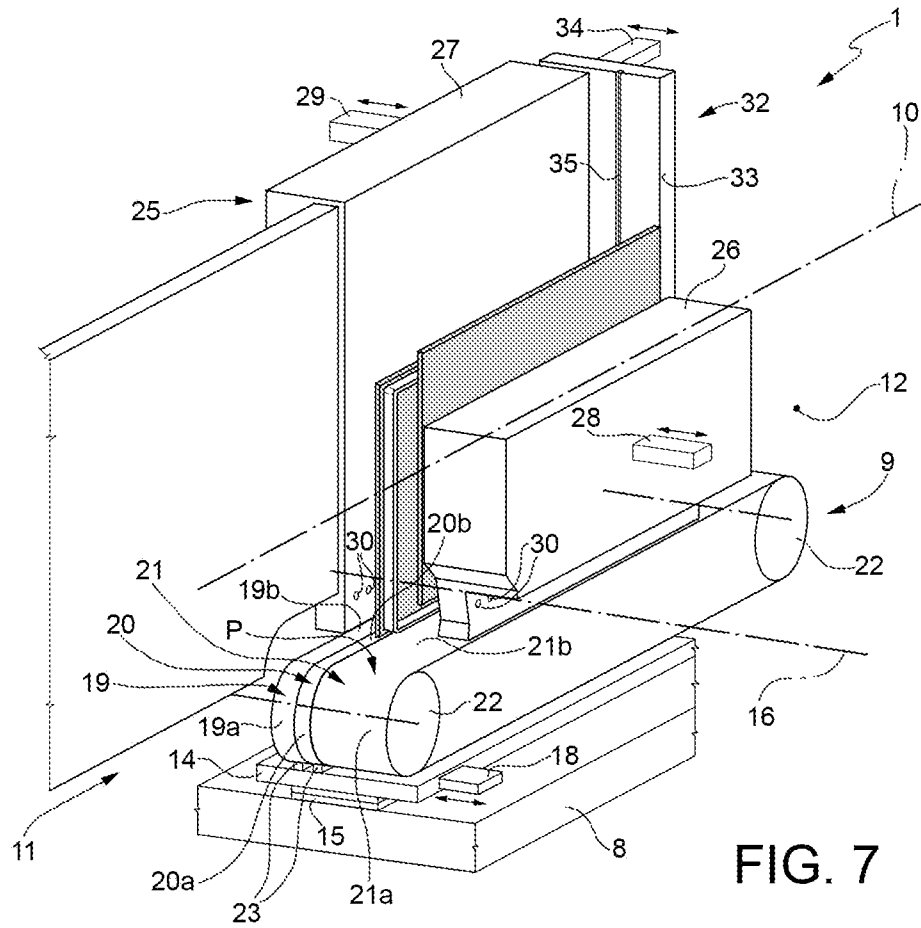


FIG. 7

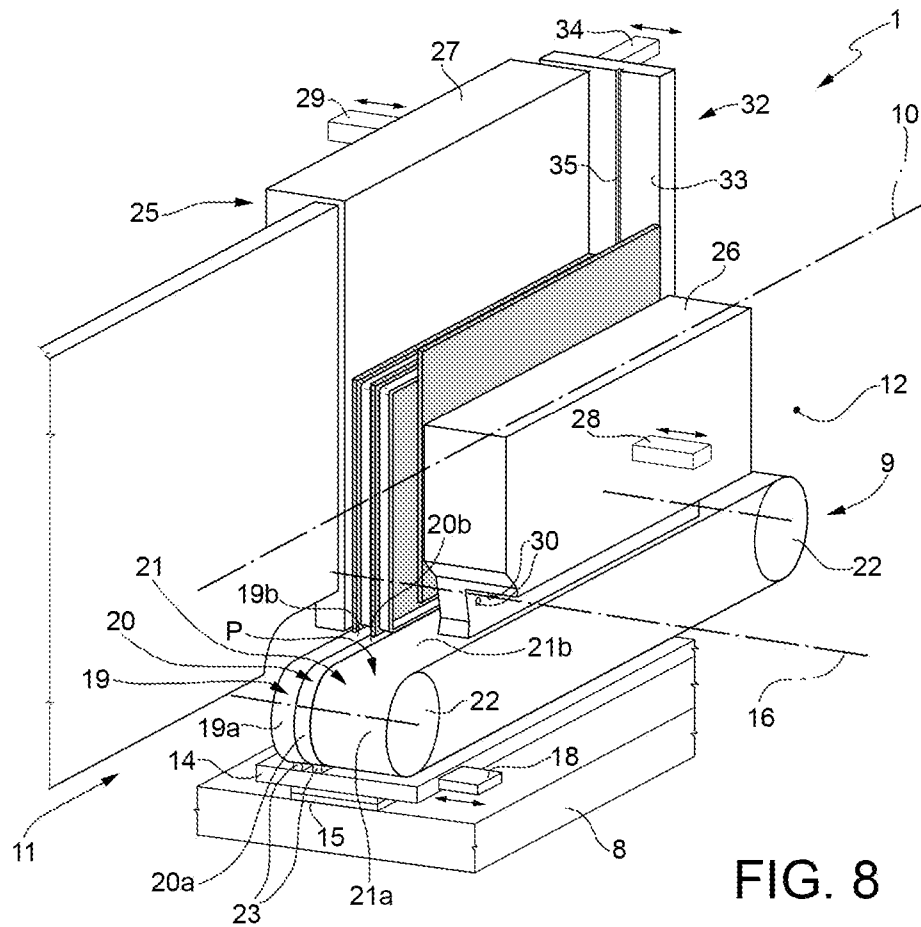


FIG. 8

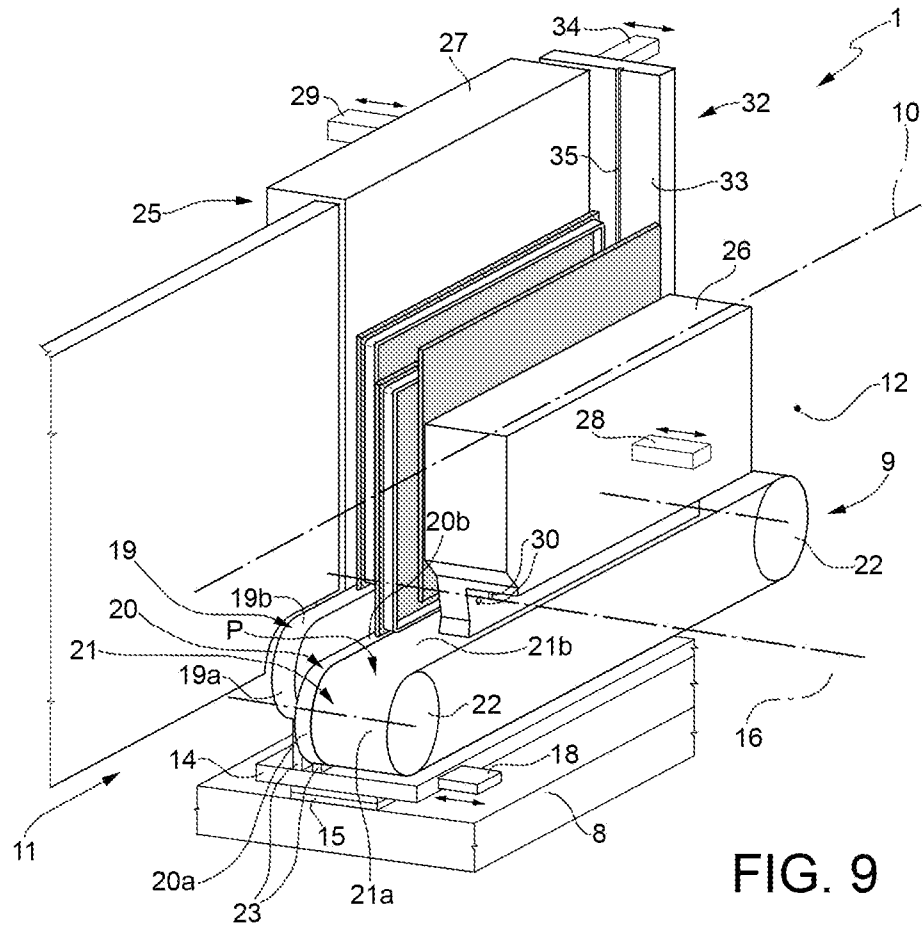


FIG. 9

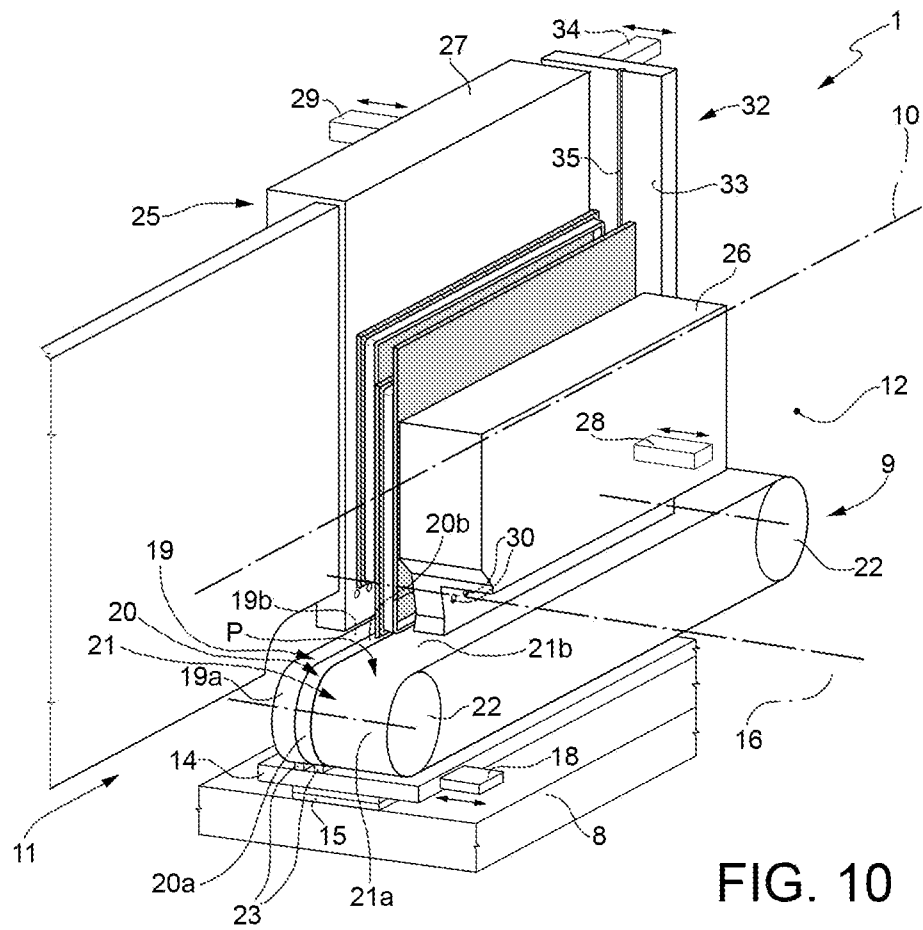


FIG. 10

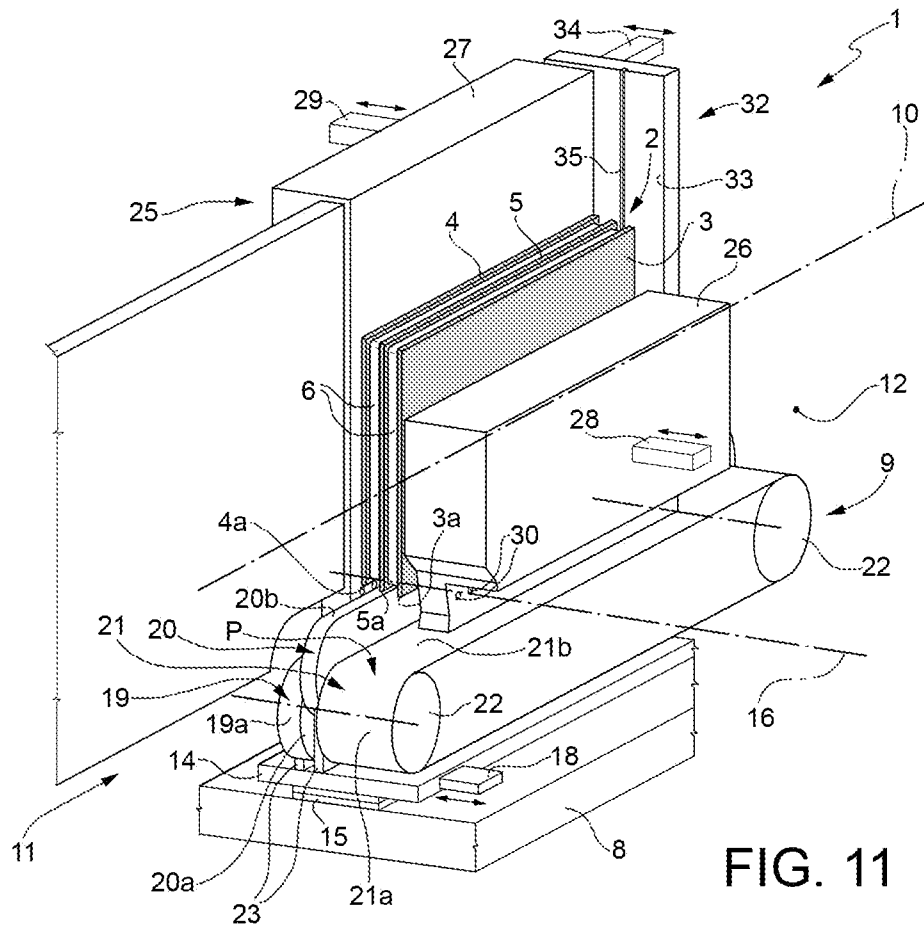


FIG. 11

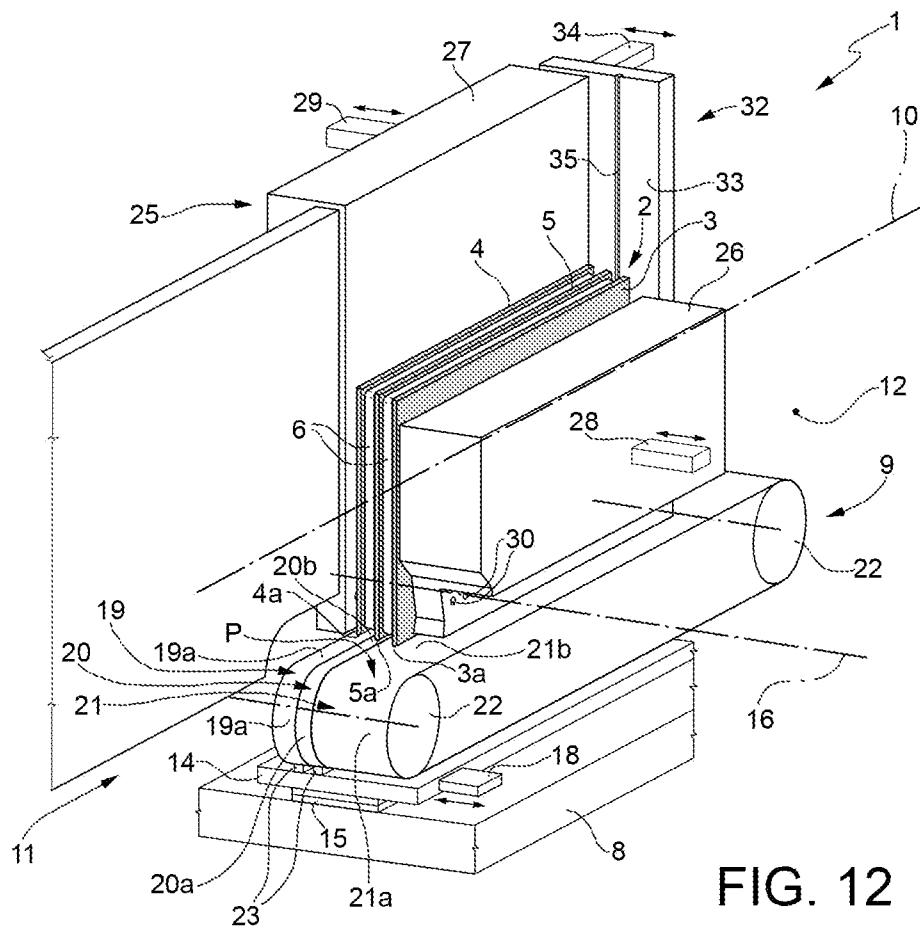


FIG. 12

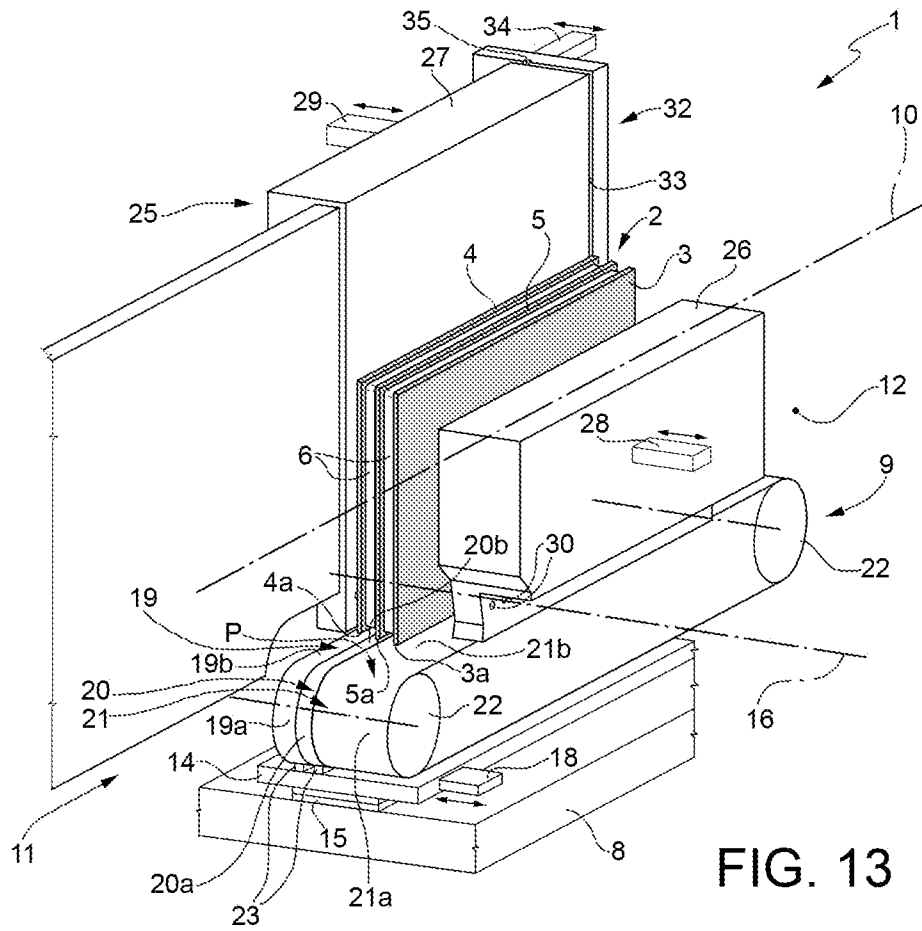


FIG. 13

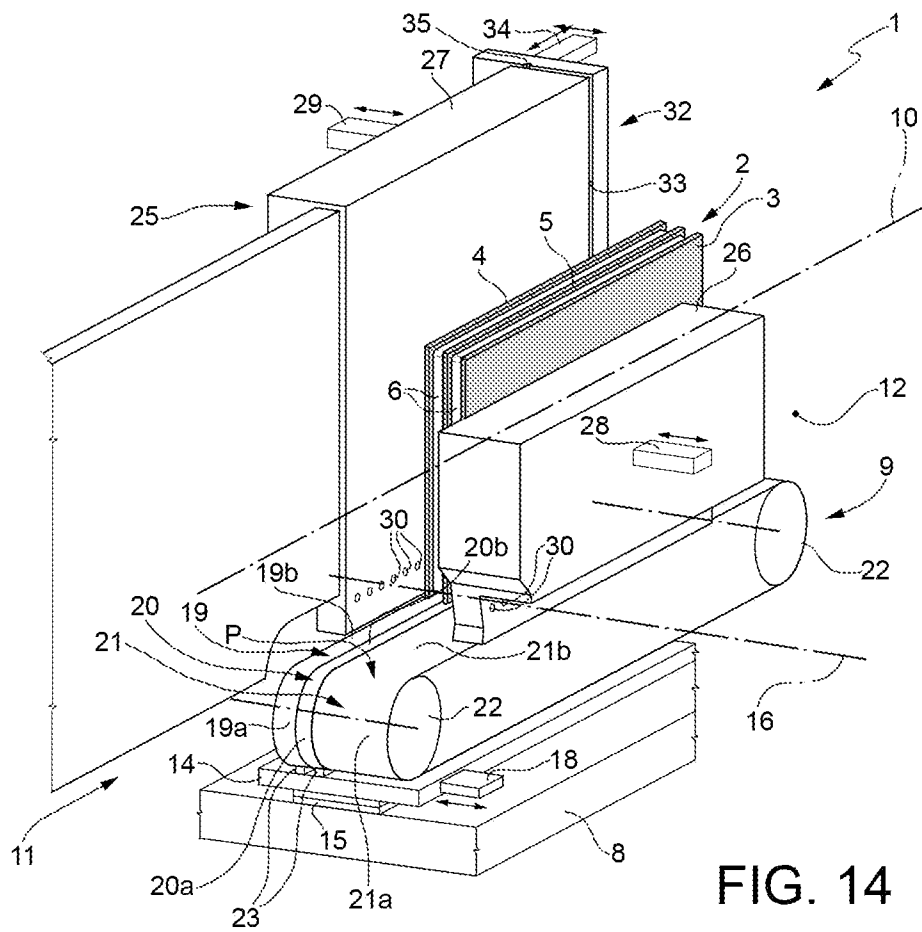


FIG. 14

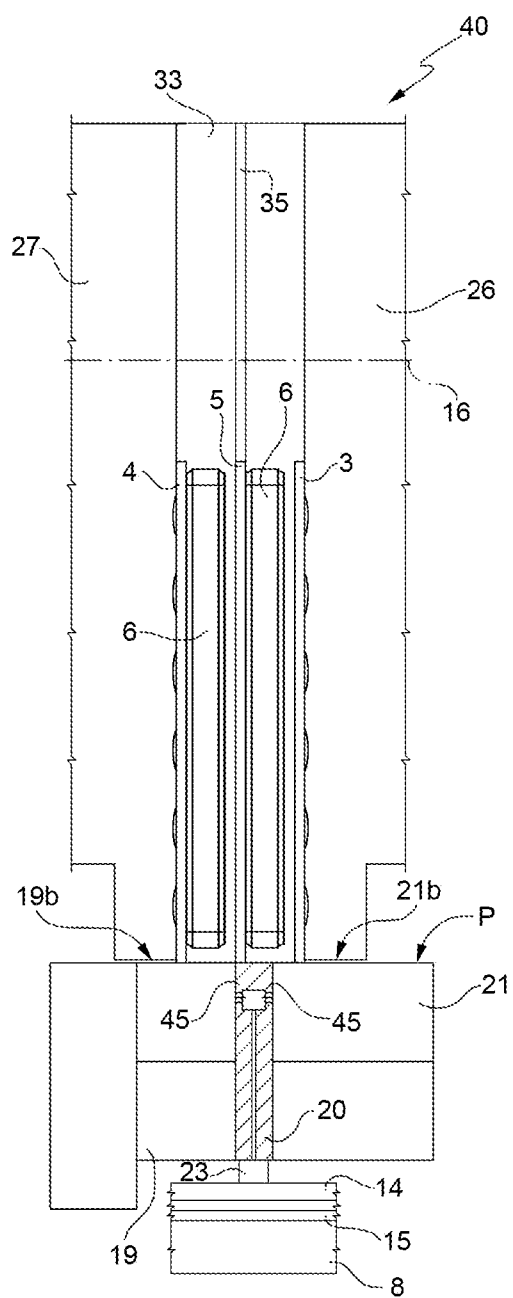


FIG. 15

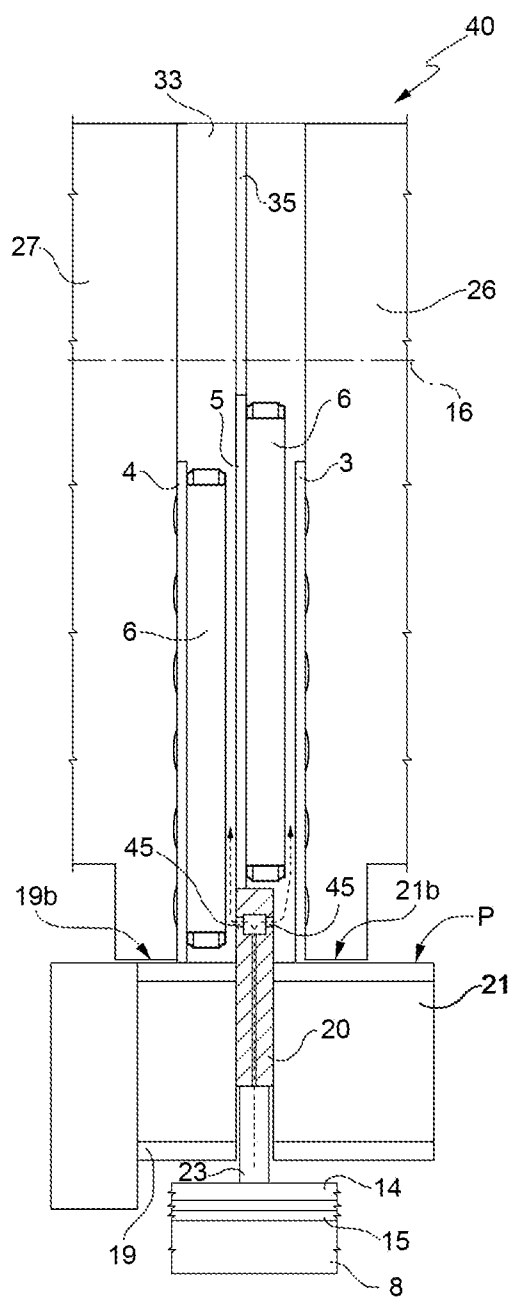


FIG. 16

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2013/050797

A. CLASSIFICATION OF SUBJECT MATTER

INV. E06B3/673 E06B3/677
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E06B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2011/095732 A2 (SAINT GOBAIN [FR]; RIPOCHE XAVIER [FR]; HERVIEUX SEBASTIEN [FR]) 11 August 2011 (2011-08-11)	9,10, 12-14
A	page 1, lines 14-25 page 2, lines 3-6 page 9, lines 1-26 page 10, lines 3-4,9-20,26-27 page 10, line 31 - page 11, line 11 page 11, lines 21-23 page 12, lines 16-23 page 13, lines 8-14 figures	1,11
Y	DE 199 62 034 C1 (LENHARDT MASCHINENBAU [DE]) 22 March 2001 (2001-03-22)	9,10, 12-14
A	column 10, lines 35-49; figures 1,9,10	1,11
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

6 May 2013

Date of mailing of the international search report

14/05/2013

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INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2013/050797

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 199 09 638 A1 (LENHARDT MASCHINENBAU [DE]) 14 September 2000 (2000-09-14) column 5, lines 27-30 column 7, lines 16-25; figure 4 -----	1,9-14
A	EP 2 093 370 A2 (FOR EL BASE DI DAVANZO NADIA & [IT]) 26 August 2009 (2009-08-26) paragraphs [0022], [0034], [0041]; figures 1a-1i, 7,9 -----	1,9-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2013/050797

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