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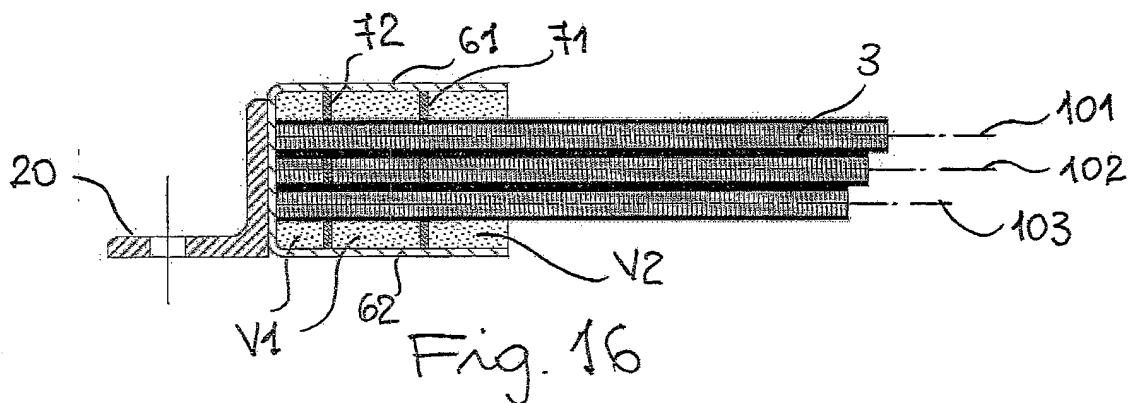
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(54) **GRIT CONTAINMENT DEVICE FOR A SURFACE PROCESSING MACHINE AND SURFACE PROCESSING MACHINE CONTAINING THIS DEVICE**

(57) Containment device (1) for containing grit in a surface processing machine (120), said machine (120) comprising a plurality of walls (51 a, 51 b) that define a working space (51 c) for an object (160) to be treated, characterized in that said device (1) comprises:

- at least one supporting body (4) that can be coupled to one of the walls (51 a, 51b);
- a plurality of flexible elements (3), at least one of which has at least one portion configured as a helical spring that extends about a central reference axis, each of the elements (3) comprising a first end portion (3a) coupled to the supporting body (4) and a second end portion (3b), opposite to the first, adapted to take on, after the coupling of the supporting body (4) to said wall (51 a, 51 b), a projecting position over the working space, wherein said elements (3) are coupled to the supporting body (4) according to an arrangement defining a plurality of overlapping planes (101, 102, 103) of said elements (3) according to an overlapping direction (300).



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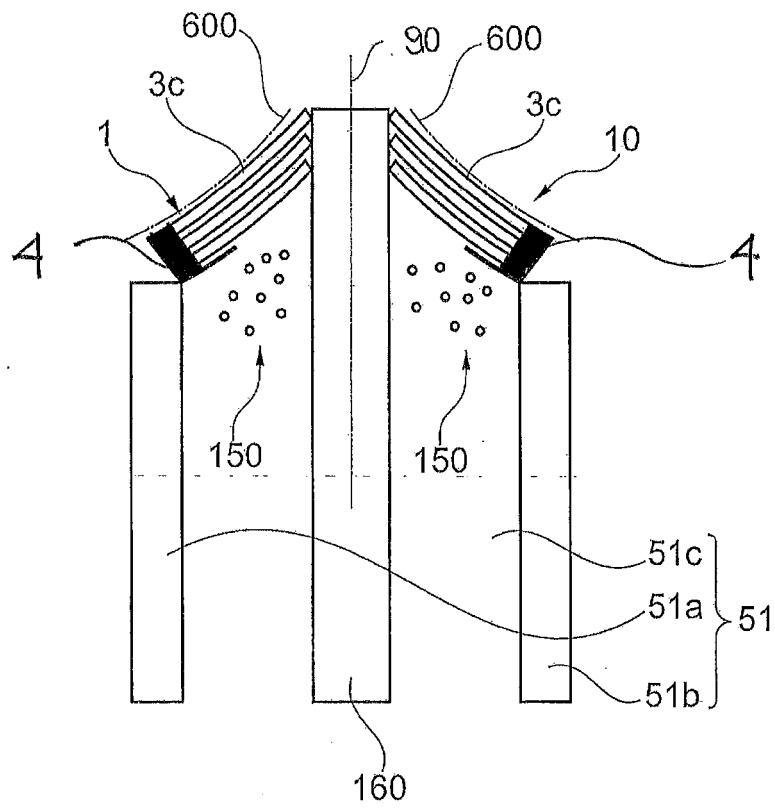


Fig. 20.

## Description

### FIELD OF THE INVENTION

**[0001]** The present invention relates to a containment device for the containment of grit in a surface processing machine that can, for example, be a grit blasting machine or a grit peening machine. The present invention also relates to a surface processing machine comprising this device.

### STATE OF THE ART

**[0002]** Grit blasting and grit peening are industrial processes widely used for treating the surfaces, preferably, but not exclusively, of metal pieces. In particular, there is recourse to these processes to clean, roughen or harden a surface to be treated and make it suitable for a particular purpose. To accomplish this process, suitable grit blasting/grit peening machines have been developed wherein the piece to be treated remains stationary, rotates or alternatively moves along a treatment path. In all cases, the machines project small-sized particles (known in the industry by the term "grit") onto the surface to be treated.

**[0003]** A grit blasting/grit peening machine of the "passage" type comprising two opposing walls between which a working space is determined within which the piece to be treated is struck by the grit. A movement unit is arranged to move the piece along the working space, while a suitable device projects the grit toward the surfaces of the object. A recovery system for the grit used during treatment of the piece is also provided in these machines.

**[0004]** In a processing machine of the static type, the piece to be treated instead remains stationary or at most rotates about a rotation axis within a chamber that defines the working space for the movement of the grit. The piece is inserted into the chamber through a door and brought to the correct treatment position through a movement unit, usually outside the chamber. More specifically, the piece to be treated is suspended to a supporting element that is anchored above the movement unit. The supporting element is therefore partially within the chamber, to support the piece, and partially outside. To allow the piece to reach the correct operating position, at least one opening is therefore provided to guide the supporting element of the piece to the treatment position. Other openings may be provided through the chamber for other purposes.

**[0005]** In both types of machine there is, in any case, a need to contain the grit within the working space in which the process occurs. In the case of passage machines, following impact with the surface of the piece to be treated, the grit tends to escape from the upper part of the passage to disperse in the surrounding environment. This is because the passage is traditionally open at its upper part to allow action of the movement unit of the piece to be treated. In machines of the static type,

the grit, on the other hand, tends to escape from the openings defined through the chamber for different purposes as indicated above.

**[0006]** To prevent the grit from escaping, these machines usually comprise a containment system, which, depending on the type of machine, is installed on the opening of the passage or at the openings defined through the chamber. In a final analysis, a grit containment system has the purpose of protecting the safety of the operators who are in proximity to the machine and of keeping the work environment in a good state of cleanliness. At the same time, containment of the grit in its working space also has the aim of preserving the grit in quantitative terms for using the same grit for subsequent treatments.

**[0007]** In a first known embodiment, these containment systems comprise brushes that are mounted along the opposing walls that define the passage or, in the case of machines of the static type, along the opposing portions that define the guide openings of the supporting element. In particular, in the case of passage machines, these brushes are located on the upper part of the walls so as to come into contact, from opposite sides, with the piece to be treated during movement along the passage. Similarly, in machines of the static type, the brushes are located on opposite sides of the opening or openings defined by means of the chamber.

**[0008]** According to other known solutions, the use of screens made of polymeric material is provided, which with the walls of the passage or the guide opening, depending on the type of machine, define a sort of "closed chamber", within which the grit treatment is implemented. These screens are therefore deformable to allow the insertion, transport and escape of the object treated by the machine.

**[0009]** The Applicant has realised that the grit containment systems traditionally used offer an inadequate and unreliable level of protection, especially for the processing of specific objects that demand an intense grit blasting phase. Indeed, spaces through which the waste grit can escape are generated in the contact region between the piece to be treated/supporting element of the piece (be it formed by screens made of polymer material or by the brushes). Even if installation is conducted according to the highest possible standards, it has been noted that these spaces are difficult to eliminate due to the structure of the containment system. These spaces are also susceptible to increase with use of the machine over time on account of the powerful wearing action of the grit and of the movement of the pieces/supports

### SUMMARY OF THE INVENTION:

**[0010]** The main object of the present invention is to provide a containment device for containing grit in a surface treatment machine that allows the drawbacks above-mentioned drawbacks to be overcome. In the context of this object, a first aim of the present invention is

to provide a containment device that allows the grit to be more efficiently contained with respect to conventional devices. Another aim of the present invention is to provide a containment device that is reliable and easy to produce at competitive costs.

**[0011]** This object and these aims are achieved by means of a containment device that can be installed on a surface processing machine comprising a plurality of walls that define a working space for an object to be treated, which device comprises:

- at least one supporting body that can be coupled to a wall of said machine;
- a plurality of flexible elements, at least one of which has at least one portion configured as a helical spring that extends about a central reference axis, each of said elements comprising a first end portion coupled to the supporting body and a second end portion, opposite to the first, and adapted to take on, after the coupling of said supporting body to said wall, a projecting position over said working space. According to the present invention, said elements can be coupled to the supporting body according to an arrangement that defines a plurality of planes of elements. The elements of each plane of elements preferably occupy an offset position with respect to the elements of another plane of elements adjacent to the first.

**[0012]** Further advantageous technical characteristics of the present invention are set out in the dependent claims, which are to be considered an integral part of this description.

#### LIST OF DRAWINGS

**[0013]** The technical characteristics of the present invention and the advantages thereof shall become apparent from the below description, provided purely by way of a non-limiting example, to be considered alongside the accompanying drawings, wherein:

- Figure 1 is a perspective view of a grit containment device according to the present invention;
- Figure 2 is a front view of a grit containment device according to the present invention, installed on a wall of a surface processing machine;
- Fig. 3 is a detailed view of a grit containment device according to the present invention;
- Figure 4 and 4A are perspective views of two possible installations of a grit containment device according to the present invention;
- Figure 5 is a perspective view of a grit containment device according to the invention a modular configuration;
- Figure 6 is a magnification of detail VI of Figure 5.
- Figures 7 and 8 are detailed views that respectively relate to a first coupling method and to a second

coupling method of two modules of the containment device of Figure 5;

- Figures 9 to 12 are views according to the X-X cross-sectional plane of Figure 2 of possible embodiments of a supporting body of a containment device according to the present invention;
- Figure 13 is a front view of a possible embodiment of a supporting body of a containment device according to the present invention;
- Figures 14 and 15 are cross-sectional views according to the XIV-XIV and XV-XV cross-sectional planes indicated in Figure 13;
- Figure 16 is a cross-sectional view of a containment device according to the invention comprising the supporting body of Figure 13.
- Figures 17 to 21 are views relating to possible installations of a containment device according to the present invention;
- Figure 22 is a view relating to a surface processing machine comprising a containment device according to the present invention;

#### DETAILED DESCRIPTION

**[0014]** Both this description and said drawings are to be considered for illustrative purposes only and are not therefore exhaustive; the present invention may only be implemented according to other and different embodiments; it must moreover be taken into account that these drawings are schematic and simplified.

**[0015]** The containment device thus devised is susceptible to a number of modifications and variants, all of which fall within the scope of the inventive concept; in addition, all the details can be replaced by other technically equivalent details. In practice, any materials and any contingent shapes and sizes can be used depending on requirements and the state of the art.

**[0016]** Figure 1 generically indicates, with reference 1, a grit containment device in a grit blasting/grit peening machine 120 according to the present invention. In particular, the device 1 can be installed both within the scope of a grit blasting machine of the "passage" type or alternatively within the scope of a machine of the static type. Solely for descriptive purposes, the following refers to a machine of the "passage" type. The considerations shall nevertheless also apply in the case of a machine of the static type.

**[0017]** The machine according to the invention comprising a plurality of walls 51 a, 51 b, that define a working space 51 c for an object 160 to be treated. For the purposes of the present invention, the term "*working space*" is used to indicate a space inside the processing machine, in which the grit is free to move to strike the piece to be treated 160 and in which the grit itself must remain without escaping to the outside environment. In the case of machines of the "passage" type, the working space 51 c is substantially defined between a first wall 51 a and a second, frontally arranged, wall 51 b. It is highlighted that

in "passage" machines, the grit tends to escape from the upper part of the working space. In the case of machines of the "static" type, the working space is delimited by a chamber comprising one or more openings, for example for the passage of a supporting element that supports the piece within the working space. In machines of the static type, the grit therefore tends to escape from these openings through the chamber. Each of these openings is in any case defined between two walls 51 a, 51 b that at least partially define the working space.

**[0018]** The device 1 according to the invention comprises at least one supporting body 4 that can be directly or indirectly coupled to one of the walls 51 a, 51 b of said grit blasting/grit peening machine 120. In particular, the term "indirectly" is used to indicate the possibility of using interface means to fix the position of the supporting body 3 with respect to the corresponding wall 51 a, 51 b. These interface means may for example comprise, a coupling bracket 2, fastened to the wall 51 a, 51 b and projecting over said working space as shown in the schematization of Figure 6. The interface means could alternatively be represented by a bracket 20, coupled to one side of the supporting body as can be seen in the cross-sectional views of Figures 9 and 11.

**[0019]** The device 1 according to the invention also comprises a plurality of flexible elements 3 that have at least one portion configured as a helical spring. In particular, this portion, configured as a spring, extends about respective central reference axes 201, 202, 203.

**[0020]** The elements 3 comprise a first end portion 3a coupled to the supporting body 4, and a second end portion 3b (also known as free end 3b), adapted to take on, after coupling of the supporting body 4 to the walls 51 a, 51 b, a projecting position over the working space. In particular, in machines of the "passage" type, this second end portion 3b is intended to come into contact with the object 160 to be treated or the support that supports it.

**[0021]** The elements 3 are coupled to the supporting body 4 according to an arrangement that defines a plurality of planes 101, 102, 103 of overlapping elements along an overlapping direction, indicated in Figure 2 with the reference number 300. The elements of a first plane (101 or 102 for example), can occupy an offset position with respect to the elements of a second plane (102 or 103) adjacent to the first plane. In particular, the position of the elements of the first plane can be offset along a transverse direction 400 orthogonal to the central reference axes 201, 202, 203 of the elements 3 and at the same time orthogonal to the overlapping direction 300. According to one possible embodiment, the planes of elements may also be offset along a longitudinal direction 200 (indicated in Figures 4 and 4A) parallel to the central reference axes 201, 202, 203 of the elements 3 as described in greater detail hereinafter. It is in general highlighted that for the evaluation of the offset arrangement along the longitudinal direction 200 and along the transverse direction 400, the central axes of reference of the elements 3 are considered in a non-deformed condition

of the elements themselves.

**[0022]** Figure 2 illustrates this "plane" arrangement. The elements 31 (which constitute a first subset of the plurality of elements 3) are coupled to the supporting body 4 defining a first plane 101 of elements. The elements 32 (which constitute a second subset of the plurality of elements 3) are coupled to the supporting body 4 by defining a second plane 102 of elements. As can be seen in Figure 2, the second plane 102 is adjacent and parallel to the first plane 101 and the elements 31 of the first plane 101 occupy a position that is preferably offset, according to the above-defined transverse direction 400, with respect to the elements 32 of the second plane.

**[0023]** In the embodiment shown, there are further elements 33 (which constitute a third subset of the plurality of elements 3) coupled to the supporting body 4 so as to define a third plane 103 of elements. The latter is adjacent and parallel to the second plane 102 (in turn, as described, adjacent to the first plane 101). The elements 33 of the third plane 103 occupy a position, evaluated according to the offset direction 400, preferably offset with respect to the elements 32 of the second plane 102, while they are aligned with those of the first plane 101 according to the overlapping direction 300 indicated above.

**[0024]** Figure 3 is substantially a magnification of a portion of the device of Figure 2, and allows the offset arrangement, according to the transverse direction 400, of the elements 3 arranged on adjacent and parallel planes 101, 102, 103, to be observed in greater detail. In detail, a first plane 101 of elements is identified at a first distance 501 from a coupling surface 41 of the supporting body 4. The spring portions of the elements 31 of the first plane 101 of elements extend about the axes of reference 201, 201', 201". The second plane 102 of elements extends at a second distance 502, inferior to the first distance 501, from the coupling surface 41 of the supporting body 4, while the third plane 103 of elements extends at a third distance 503, inferior to the first distance 501 and to the second distance 502, again evaluated with respect to the same coupling surface 41. The spring segments of the elements 32 of the second plane 102 extend about respective axes of reference 202, 202' that occupy an "offset" position (again evaluated according to the transverse direction 400) with respect to the position occupied by the central axes of reference 201, 201', 201" of the elements 31 of the first plane 101. The spring segments of the elements 33 of the third plane 103 extend about respective axes of reference 203, 203', 203" that occupy an "offset" position (again according to the transverse direction 400) with respect to the position occupied by the central axes of reference 202, 202' of the elements 32 of the second plane 102, but aligned with the position of the central axes of reference 201, 201', 201" of the elements 31 of the first plane 101 of elements.

**[0025]** Figures 4 and 4A illustrate the containment device 1 of Figures 1 and 2 installed on a wall 51 a of a surface processing machine. The rest of the machine is

not shown for clarity of representation. In particular, in Figure 4 the device is installed on a wall 51 a of a machine of the "passage" type. The overhanging position of the elements 3 over the working space 51 c, within which the piece 160 to be treated passes, essentially defines a barrier for containing the grit in the space itself. Elements 3 are in fact arranged according to a "frame" that advantageously contains, rejecting and/or trapping, the grit that would tend to exit from the working space 51 c of the grit blasting machine. In addition, the elements 3 installed according to the 101, 102, 103 planes offer a fairly effective redundant containment, especially in view of the size and speed of the grit particles.

**[0026]** More precisely, the first subset of elements 31 offers a first level of containment for the grit particles that first tend to escape from the grit blasting machine. The second subset of elements 32 offers a second level of containment for the grit particles not retained/trapped by the first subset of elements 31. The third subset of elements 33 offers a third and further level of protection against any grit particles escaping from the machine. It is observed that the flexibility of the elements 3 of the device 1 is obtained by virtue of the "spring" configuration of the elements themselves. During the treatment process (grit blasting/grit peening), elements 3, for example, maintain a straight position about their central reference axis. On the passage of the piece to be treated, the same elements 3 flex, while their free ends 3b remain in contact with the piece to be treated 160 or with the element that supports the piece itself by virtue of their, at least partially spring, configuration. The grit is thus, in any case, preserved within the working space. Figure 4A shows the installation of the containment device 1 in a machine of the static type. The installation and operation principle of the containment device is similar to the one described above for Figure 4. The body of the device 1 is coupled to a wall 51 a of the machine so that the elements overhang the working space i.e. over the opening defined by means the chamber that defines the same working space.

**[0027]** It is observed that the guide opening to the supporting element of the piece to be treated could be oriented in any direction, for example, it could be vertical or horizontal. Therefore, even the containment device 1 could be installed on a wall 51 a in a corresponding manner.

**[0028]** According to one embodiment, the portion configured as a helical spring coincides with the entire longitudinal extension of the elements 3, and therefore comprises both the end portion 3a and the second end portion 3b. In other words, according to this embodiment, the elements 3 are configured as a helical tension spring along their entire length. Maximum flexibility of the elements 3 and, at the same time, containment of the grit in the contact zone between the free ends 3b are thus obtained, and the piece to be treated (or the supporting element of the piece) is optimized. It has in general been seen that the use of spring steel to produce the elements

3 is a preferred technical solution. This material gives to elements 3 the necessary flexibility and at the same time the toughness needed to withstand impact with the grit.

**[0029]** Figures 9 to 12 illustrate possible embodiments of the supporting body 4 that comprises one or more coupling surfaces 41, 42 that can be coupled to a wall 51 a of a grit blasting machine as already indicated above. Figures 10 and 11 indicate a first coupling surface 41 which can be welded directly to the wall 51 a or alternatively onto a support bracket 2 in turn fastened/welded to the wall 51 a (see Figure 6). In this second case, the coupling between supporting body 4 and wall is defined "indirect".

**[0030]** The supporting body 4 preferably comprises a second coupling surface 42 to which a bracket 20 can be welded, which can in turn be coupled, preferably removably, to a wall 51 a, 51 b of a surface processing machine. In this case also the coupling of the supporting body to a corresponding wall of the machine can therefore be defined indirect. Moreover, in this case the coupling is advantageously removable to the benefit of easier maintenance.

**[0031]** According to a first possible embodiment, illustrated in Figures 9 to 12 the supporting body 4 comprises a prismatic block 44 that defines a first seat for housing the first end portion 3a of the elements 3. This first seat can be continuous or defined so as to contain the ends of all the elements. According to a preferred embodiment, the prismatic block 44 defines a plurality of seats 45, 45', 45" each to house the first end portion 3a of each of the elements 3 of the device 1. These seats 45, 45', 45" are preferably defined by means a drilling operation and so as to subsequently obtain the arrangement in planes of the elements 3 according to the principles described above. In particular, the offsetting of the planes of elements 3 along the transverse direction 400 (described in the commentary to Figures 2 and 3), can also be obtained by creating the seats 45, 45', 45" in a corresponding manner.

**[0032]** Again with reference to Figures 9 and 10, the seats 45 can have the same depth H with respect to a reference surface 43 or different depths H1, H2, H3 depending on the arrangement to be assigned to the elements. Providing for example a final arrangement of the elements 3, such as that described in the commentary to Figure 1, a first series of seats 45, intended to house the first portions 3c of the elements of the first plane of 101 elements, has a first depth H1 that is inferior to a second depth H2 of a second series of seats 45' intended to house the first portions 3c of the elements 32 of the second plane 102 of elements. Likewise, the second depth H2 will be lesser than a third depth H3 of a third series of seats 45" intended to house the first portions 3c of the elements 33 of the third plane of 103 elements. The length assigned to the elements 31, 32, 33 being the same, the different depths of the seats 45, 45', 45" will allow a longitudinal offset of the elements 31, 32, 33 to be obtained such that the ends 3c of the elements 32 of

the second plane 102 of elements are in a less advanced longitudinal position with respect to the ends 3c of the elements 31 of the first plane 102 is more advanced with respect to the ends 3c of the elements of the third plane 103. This longitudinal position being evaluated with respect to a reference direction 200 parallel to the central axis of reference of the elements 3 of the device 1.

**[0033]** Again with reference to Figures 9 to 12, the supporting body 4 preferably also comprises four side walls 61, 62, 63, 64, each welded to a corresponding surface of the prismatic block 44 so as to define a containment seat 46 that partially houses an intermediate connecting portion 3c between the first end portion 3a and the second end portion 3b of the elements 3. This containment seat 46 is designed to contain fastening means 5 for fastening the elements 3 to the supporting body 4.

**[0034]** Preferably, the fastening means 5 comprise a fastening foam, for example, polyurethane-based. In particular, the fastening foam is expanded in the second seat so as to surround the intermediate portion 3c of the elements 3. Therefore, when the first ends 3a of the elements 3 are inserted into the seats 45, 45', 45" of the supporting body 4, one part of the intermediate portion 3c of the elements 3 is surrounded by the containment seat 46 defined by the side walls 61, 62, 63, 64. The fastening foam is subsequently injected into the same containment seat 46. On expanding, the latter envelops the part of intermediate portion 3c, firmly fastening the plurality of elements 3 to the supporting body 4. With reference to Figure 4, the remaining part of the intermediate portion 3c and the second portion 3b therefore take on a "projecting" position with respect to the supporting body 4. As indicated above, in the absence of interaction with the piece to be treated 160 or with the supporting element thereof, the elements 3 maintain a substantially "straight" orientation by the effect of their portion configured as a spring that keeps the element under tension preventing flexion thereof.

**[0035]** Figures 13 to 16 relate to a further embodiment of the device 1 according to the invention, wherein the supporting body 4 has a different configuration from the one described for Figures 9 to 12. With reference to Figures 14 and 15, the supporting body 4 is in this case defined by a box made of metallic material comprising a far wall 60, a first side wall 61' and a second side wall 62' parallel to each other and orthogonal to said far wall 60. Said box further comprises a third side wall 63' and a fourth side wall 64' orthogonal to said far wall 60. The third side wall 63 and the fourth side wall 64' can be orthogonal to the first side wall 61' and to the second wall 62' or alternatively, as shown in Figure 13, can be inclined to allow modular coupling of the supporting body 4 with another supporting body according to principles described hereinafter. The box can be coupled directly to a wall of the processing machine or indirectly using a bracket 20 according to the principles already mentioned above.

**[0036]** The supporting body 4 comprises a first anchor

wall 71 parallel to said far wall 60. This anchor wall 71 can be defined by a sheet metal welded at the inner sides of the side walls of the supporting body 4 to a first predetermined distance from the far wall. This first anchor wall (71) divides the inner volume of the box (i.e. the space between the walls 60, 61', 62', 63', 64') into a first volume V1 and a second volume V2.

**[0037]** More precisely, the first end portions 3a of the flexible elements 3 of the containment device are inserted within the first volume V1, between the far wall 60 and the first anchor wall 71. The volume V2 is open towards the outside and is instead intended to contain an intermediate portion 3c of the elements 3 and fastening means, preferably a fastening foam, for the purposes described above in relation to the containment seat 46 provided in the solution illustrated in Figures 9 to 12.

**[0038]** The supporting body 4 comprises a second anchor wall 72 arranged within the first volume V1 between the far wall 60 and the first anchor wall 71. The second anchor wall 72 can also be defined by a sheet metal welded to the inner sides of the walls of the supporting body 4 at a second predetermined distance from the far wall. The two anchor walls 71, 72 have a plurality of holes 77 arranged so as to correspond to the arrangement in planes 101, 102, 103 of the elements 3 of the containment device 1 according to the principles already described above. Figures 14 and 15 are cross-sectional views that allow the holes 77 obtained through the anchor walls 71, 72 to be observed. Figure 16, on the other hand, illustrates the containment system 1 assembled with the supporting body 4 shown in Figures 13 and 14. According to this embodiment, the flexible elements 3 are inserted through the holes obtained through the anchor walls 71, 72 so that the end portions 3a remain flush against the inner side of the far wall 60. Once in position, the fastening foam is expanded within the second volume V2 to fasten the position of the intermediate position 3c of the elements. Preferably, the fastening foam is also expanded within the first volume V1, using openings defined through the side walls 61', 62', 63', 64' of the box. The anchoring effect of the elements 3 to the supporting body 4 is thus advantageously increased.

**[0039]** In the embodiment of Figure 15, a "longitudinally offset" arrangement, already described above, of the elements 3 was provided. In particular the longitudinal offset was obtained by varying, the length of the elements depending on the plane 101, 102, 103. It should be noted that this solution can also be provided for the supporting body 4 in the commentary to Figures 9 to 12.

**[0040]** Figures 5, 6, 7 and 8 relate to a further possible embodiment of the device 1, which has a configuration that is substantially modular or is formed by containment modules 1', 1'', 1''', each of which comprises a supporting body 4 and flexible elements 3 according to the principles described above. In particular, Figure 5 illustrates a containment device 1 comprising three modules 1', 1'', 1''', which are installed in an adjacent position along an installation direction 600. Figure 6 is a detail that shows

the coupling principle between two consecutive modules (for example 1' and 1''). With reference to Figures 7 and 8, according to one preferred embodiment, the supporting body 4 of each module has a geometrically conjugated configuration to that of the supporting body 4 of the adjacent module so as to maintain, insofar as possible, continuity between the planes 101,102,103 of elements 3 that form each module 1', 1'', 1'''.

**[0041]** In the case of Figure 8, for example, the supporting body 4 of the first adjacent module 1' has a first inclined portion 81 with respect to the installation direction 600 parallel to the planes of elements 101,102,103. This first inclined portion 81 is geometrically conjugated to a second portion 82 of the supporting body 4 of the second module 1''. In the embodiment of Figure 8, the first portion 81 of the first module 1' has the shape of a "step" that is geometrically conjugated to a second portion 82 of the second module 1''.

**[0042]** In both solutions (Figures 7 and 8), the two modules 1', 1'' are installed so that the two portions 81, 82 are in contact so as to fit together by virtue of their geometrically conjugated shape. The overlap between elements of different planes is thus substantially maintained even in the contact region between the portions themselves. Discontinuity of the planes 101,102,103 of elements is thus reduced to a minimum and the grit containment effect is therefore guaranteed in a final analysis.

**[0043]** It is generally observed that the modular configuration of the containment device is especially advantageous in relation to maintenance interventions and possible replacement of the flexible elements. The modules are in fact removably installed so as to be easily removed and potentially replaced. The present invention also relates to a containment unit 10 for a surface processing machine of the "passage" type comprising a first wall 51 a and a second wall 51 b, facing each other and that define a working space 51 c along which an object 160 be treated in a movement direction 700 can be moved. In particular the unit 10 comprises:

- a first containment device 1 of the type previously described, wherein the respective supporting body 4 can be coupled to the first wall 51 a of the grit blasting machine;
- a second containment device 10 of the type previously described wherein the respective supporting body 4 can be coupled to the second wall 51 b of the grit blasting machine itself.

**[0044]** In addition to an embodiment of the containment unit, Figures 17 to 21 show the functional examples thereof. In Figure 17, the elements 3 of the two devices 1 and 10 have a "resting" condition corresponding to a working space 51 c that is free from objects 160 to be treated. It is noted that the plurality of elements 3 has a substantially straight main extension, concordant with that of the straight axis indicated by the reference number 500. Moreover, the elements 3 of the two devices 1, 10 are

installed so that the containment space 51 c is closed at the top thus preventing the grit 150 from escaping. In other for each of the two devices 1, 10 at least the free ends 3b of the elements of a plane of 101,102,103 of elements reach or exceed a reference plane 90, defined in an intermediate position between the two walls 51 a, 51 b, that define the working space 51 c.

**[0045]** The elements in Figure 19 are also illustrated in a resting condition, but have a configuration that is longitudinally offset according to the principles set out above. It is observed that through this configuration, the free ends 3b of all the elements 3 of the two devices 1, 10 reach or exceed the reference plane 90 indicated above. Again with reference to Figures 17 and 18, it is noted that the supporting body 4 is indirectly coupled to the wall 51 a, 51 b through interface means comprising a bracket 2 coupled to the corresponding wall 51 a, 51 b and on one side of which the supporting body 4 of a corresponding containment device 1, 10 is fastened.

**[0046]** In Figures 18, 20 and 21, the elements 3 are illustrated in a working condition i.e. such that a treatment object 160 (for example subject to a grit blasting/grit peening process) moves along the working space 51 c. In this working condition, the second end portion 3b is in contact with the object to be treated 160. The elements 3 consequently flex taking on a shape that is substantially curved towards the escape direction of the grit 150. In this regard, from the schematic plan view of Figure 21, it is observed that the elements 3, also flex in the entrainment direction of the element to be treated 160. The flexibility of the elements, by effect of the spring portion that identifies them, therefore allows an orientation thereof in substantially any direction. At the same time, the arrangement of the planes of said elements 3 increases the grit containment effect to keep it within the working space 51 c.

**[0047]** With reference to Figure 22, the present invention also relates to a surface processing machine of the "passage" type. The term "passage" is therefore used to indicate a working space 51 c along which an object or its support 160 to be treated (to undergo grit blasting/grit peening for example) is moved. This space is defined by a first wall 51 a and a second wall 52a facing each other and spaced so as to allow the passage of the piece 160. The grit blasting machine according to the invention is characterized in that it comprises at least a containment device 1 according to the invention, coupled to one of said walls 51 a, 51 b.

**[0048]** Again with reference to figure 22, the grit blasting machine 120 preferably comprises a containment unit as indicated above. In detail, the machine 120 comprises a first device 1 coupled to the first wall 51 a and a second device 10 coupled to the second wall 51 b. According to a first embodiment, the supporting body 4 of the first device 1 of the containment unit and the supporting body 4' of the second device 1 of the containment unit are directly coupled to the first wall 51 a and to the second wall 51 b respectively. Alternatively, the supporting bod-

ies 4 of the corresponding containment devices are indirectly coupled to the corresponding walls 51 a, 51 b by means of a support bracket 2.

## Claims

1. Containment device (1) for containing grit in a surface processing machine (120), said machine (120) comprising a plurality of walls (51 a, 51 b) defining a working space (51 c) for an object (160) to be processed, **characterized in that** said device (1) comprises:
  - at least a supporting body (4) which can be coupled with one of said walls (51 a, 51 b);
  - a plurality of flexible elements (3), at least one of them having at least a portion shaped as a helical spring developed around a central reference axis, each of said elements (3) comprising a first end portion (3a) coupled with said supporting body (4) and a second end portion (3b), opposed to the first one, which can take, after the coupling of said supporting body (4) with said wall (51 a, 51 b), a projecting position over said working space, wherein said elements (3) are coupled with said supporting body (4) according to an arrangement defining a plurality of overlapping planes (101, 102, 103) of said elements (3) following an overlapping direction (300).
2. Device according to Claim 1, wherein said elements (3) are coupled with said supporting body (4) according to an arrangement such that the elements in a plane (102) take an offset position with regard to the elements of at least another adjacent plane (101, 103), and wherein said position is offset with regard to a direction orthogonal to the overlapping direction (300) of said planes of elements, and orthogonal to a direction parallel to said central reference axis.
3. Device according to Claim 1, wherein said elements (3) of each plane of elements take a position offset with regard to the elements of another plane of elements, and wherein said position is offset with regard to a direction parallel to said central reference axis.
4. Device according to any one of Claims 1-3, wherein said supporting body (4) defines at least a coupling surface (41, 42) which can be coupled with said wall (51 a, 51 b) of said machine.
5. Device according to any one of Claims 1-4, wherein said supporting body (4) comprises a prismatic block (44) defining one or more seats (45, 45', 45'') wherein the first end portions (3a) of said elements are housed, and wherein said supporting body (4) comprises a plurality of side walls (61, 62, 63, 64), each of them being coupled with a corresponding face of said prismatic block (44) in order to define a containment seat (46) housing an intermediate portion (3c) of said elements (3), said containment seat (46) comprising fastening means of said elements (3) to said supporting body (4).
6. Device according to any one of Claims 1-4, wherein said supporting body (4) comprises a metal box comprising a bottom wall and a plurality of side walls (61', 62', 63', 64'), said supporting body (4) comprising a first anchoring surface (71) parallel to said bottom wall (60) which defines a first volume (V1) and a second volume (V2) of said box, said first volume (V1) being designed to house the first end portions (3a) of said elements (3), and said second volume (V2) being designed to house an intermediate portion (3c) of said elements (3), said first volume (V1) and/or said second volume (V2) comprising fastening means of said elements (3) to said supporting body (4).
7. Device according to Claim 5 or Claim 6, wherein said fastening means comprise a fastening foam expanded in said second seat in order to surround said intermediate portion (3c) of said elements (3).
8. Containment group for a processing machine (120) of the type comprising a passageway (51) along which an object (160) to be processed is movable, said machine (120) comprising a first wall (51 a) and a second wall (52a), facing each other, which define said passageway (51), said containment group being **characterized in that** it comprises:
  - a first containment device (1) according to any one of Claims 1-7, wherein said supporting body (4) can be coupled with said first wall (51 a);
  - a second containment device (10) according to any one of Claims 1-7, wherein said supporting body (4) can be coupled with said second wall (51 b).
9. Machine (120) for surface processing by means of grit, of the type comprising a passageway (51), along which an object (160) to be processed or its support is movable, said machine (120) comprising a first wall (51 a) and a second wall (52a), facing each other, which define a working space inside said passageway (51), **characterized in that** it comprises at least a containment device according to any one of Claims 1-7.
10. Machine according to Claim 9, wherein the supporting body (4) of said first device (1) and the supporting body of said second device (10) are directly coupled with said first wall (51 a) and with said second wall (51 b), or wherein the supporting body (4) of said

first device (1) and the supporting body of said second device (10) are respectively indirectly coupled with said first wall (51 a) and with said second wall (51 b) by means of a coupling element (2

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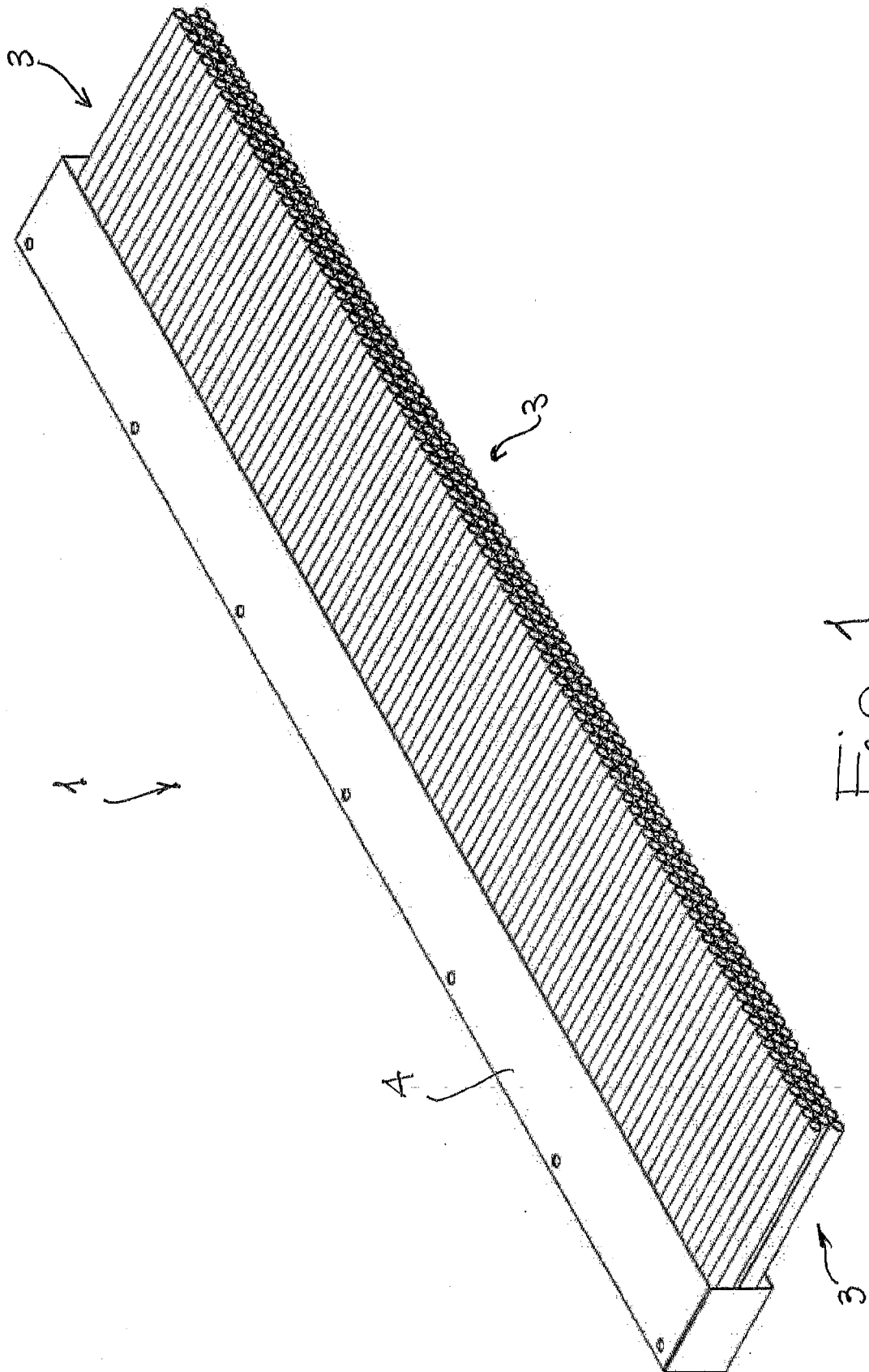


Fig. 1

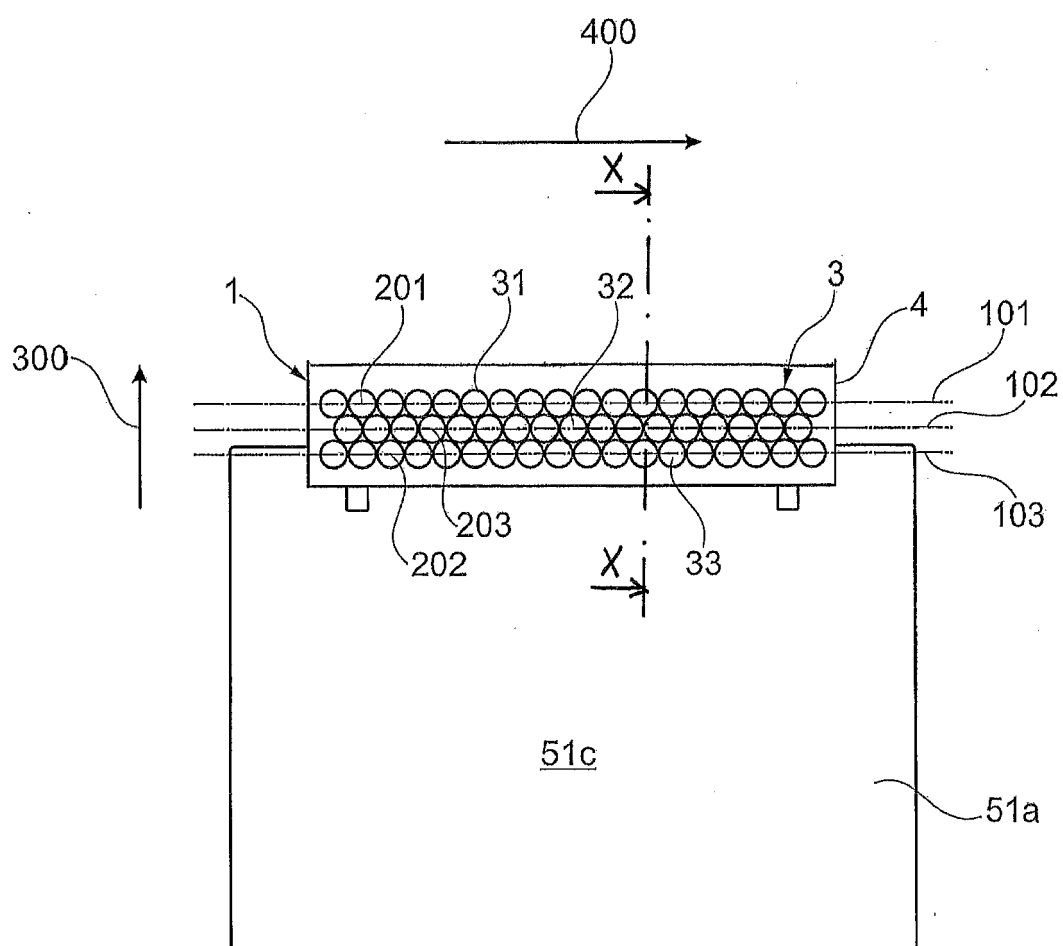


Fig. 2

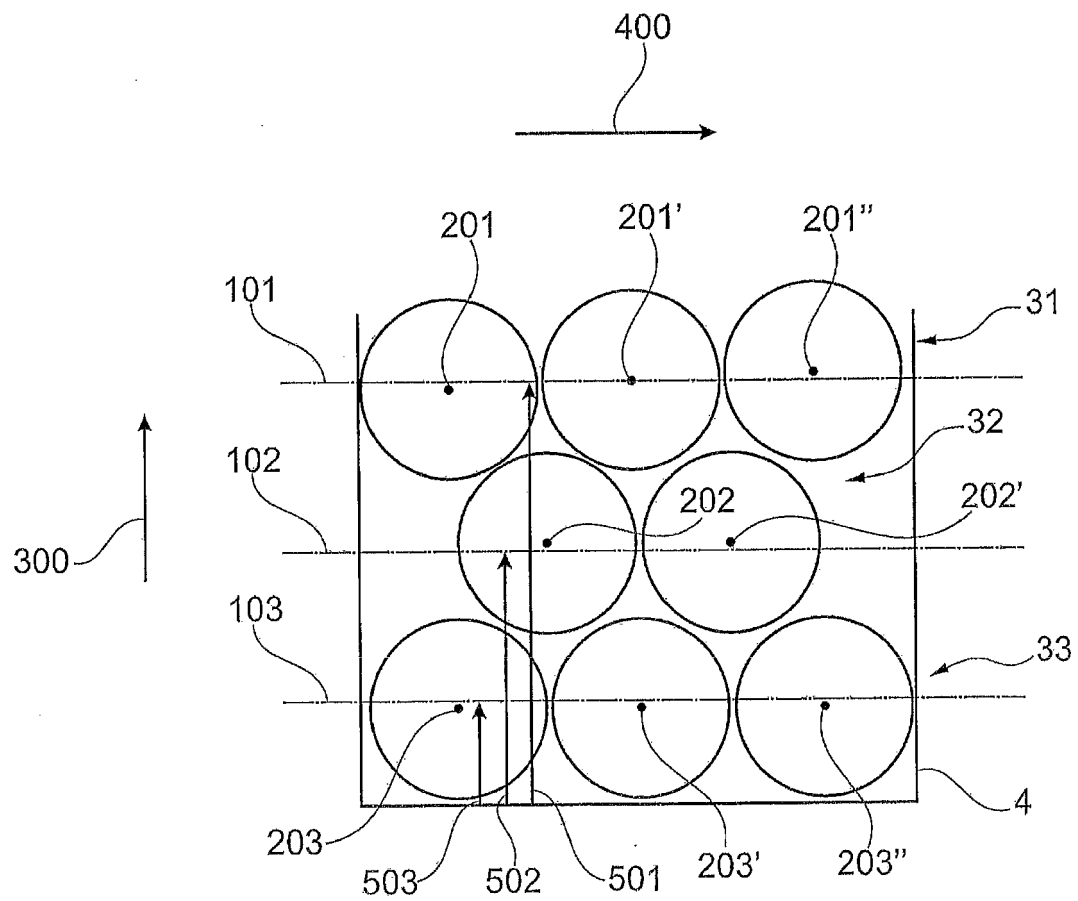


Fig. 3

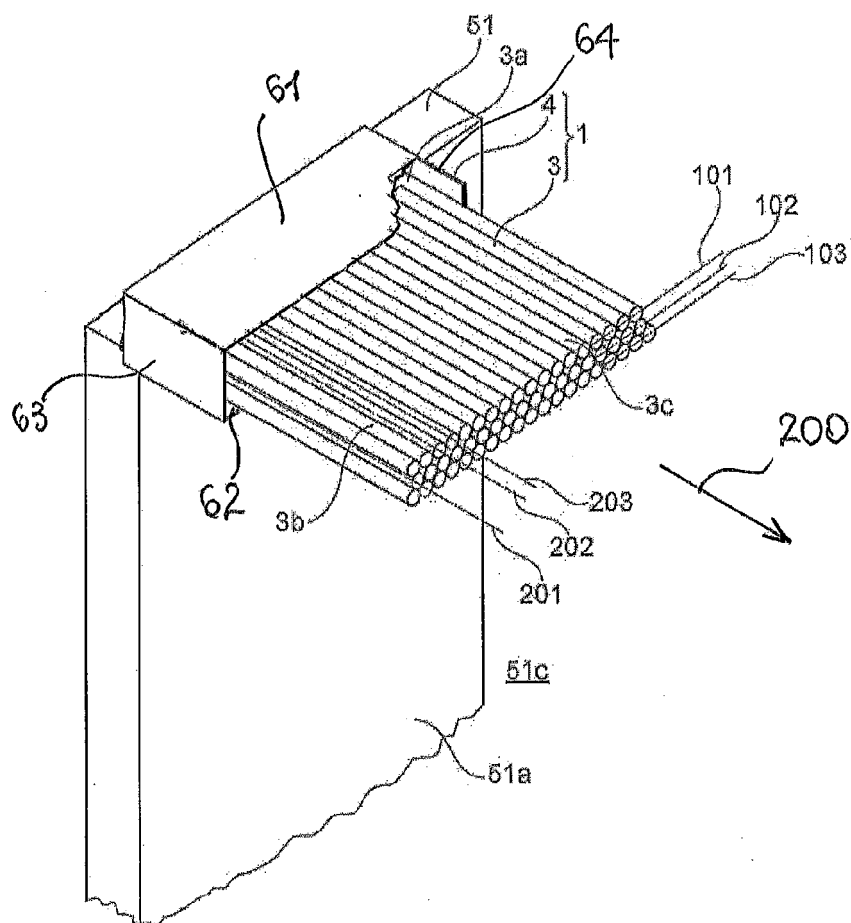


Fig. 4

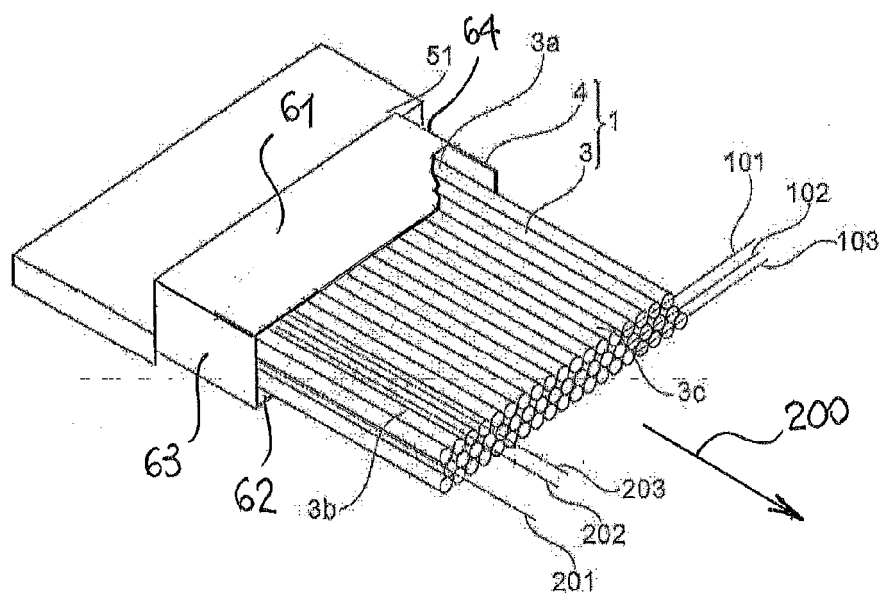
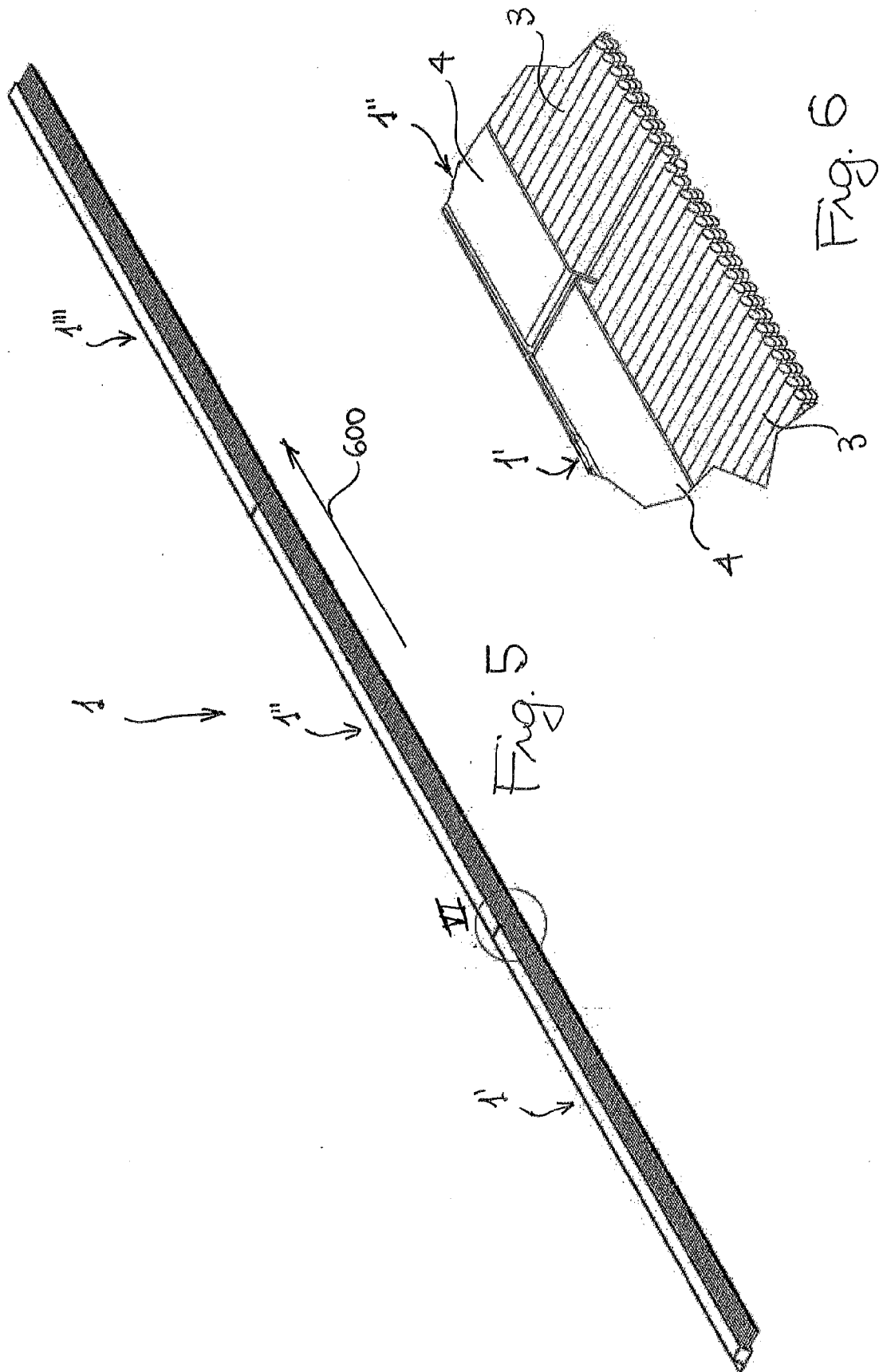


Fig. 4A



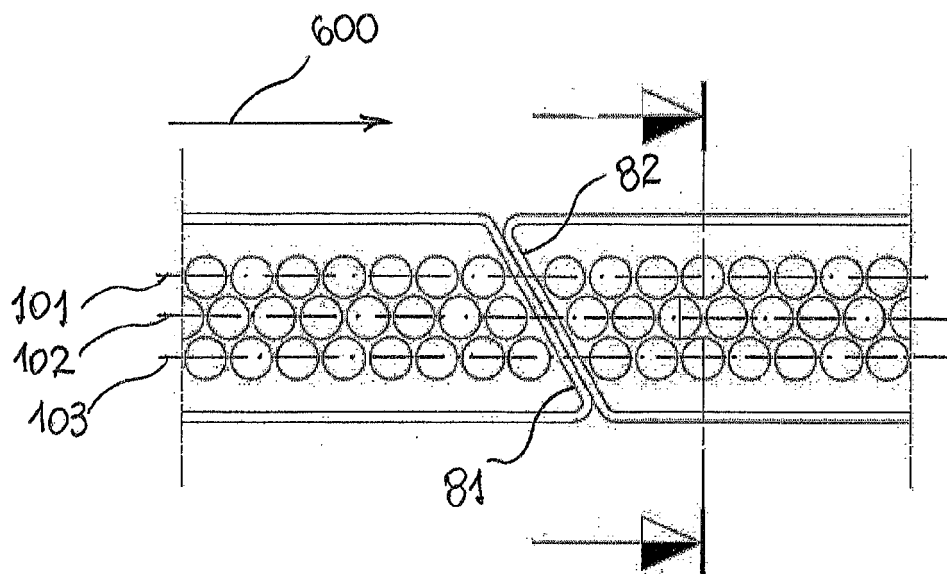


Fig. 7

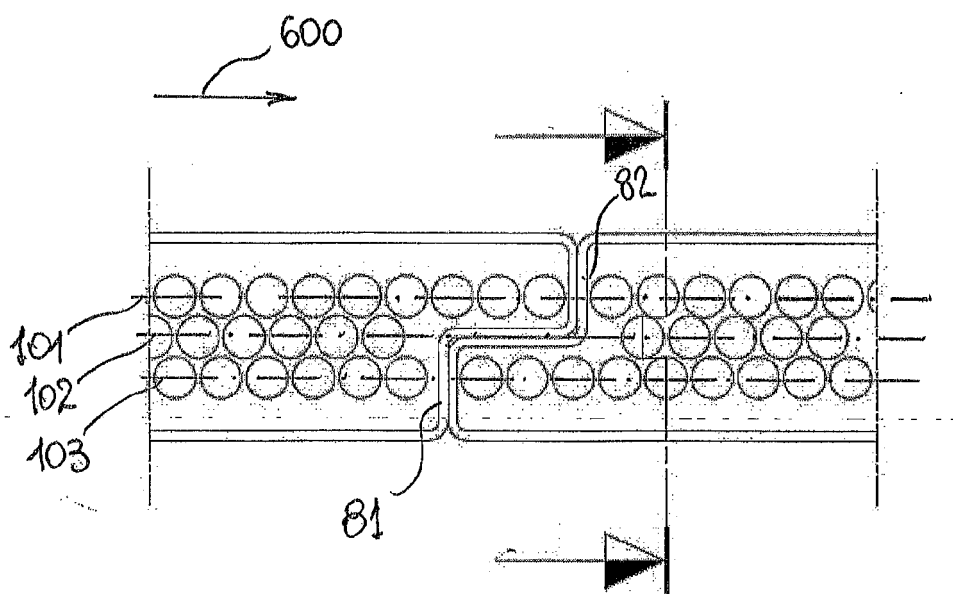
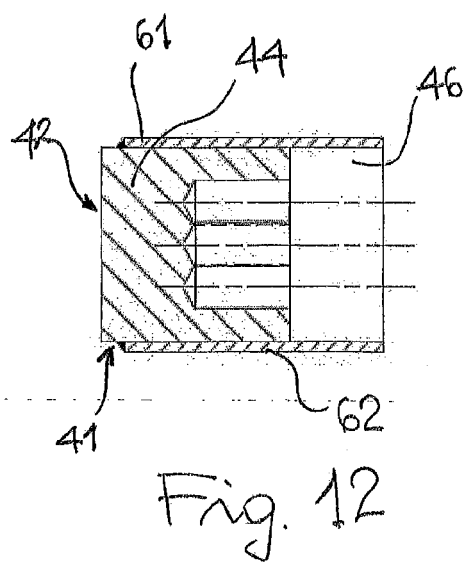
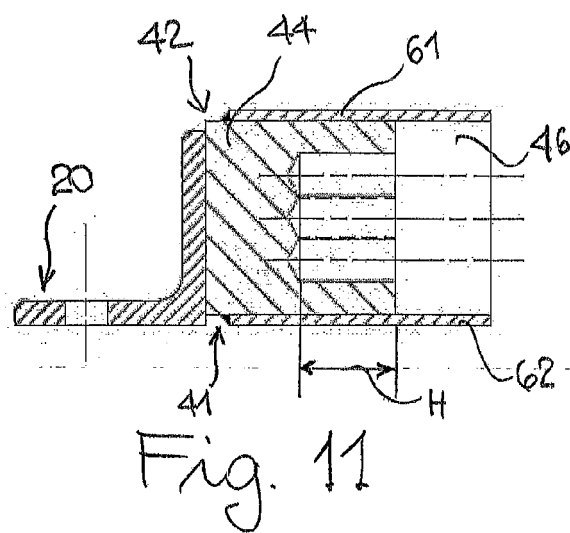
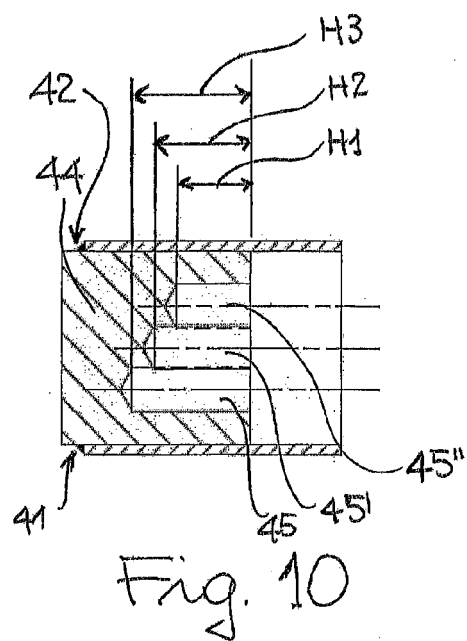
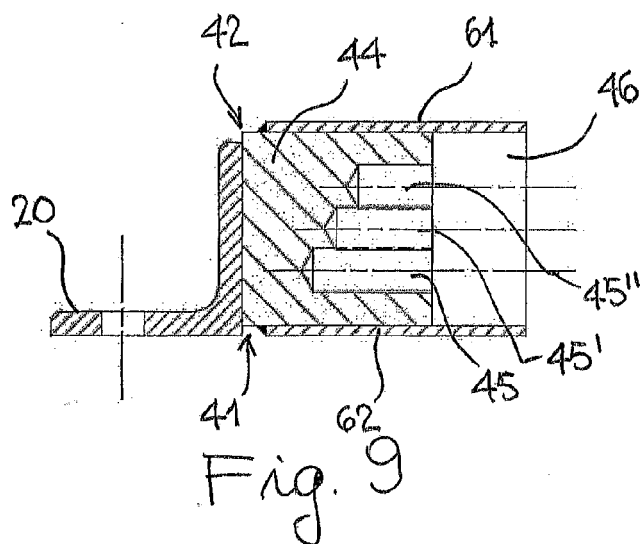


Fig. 8



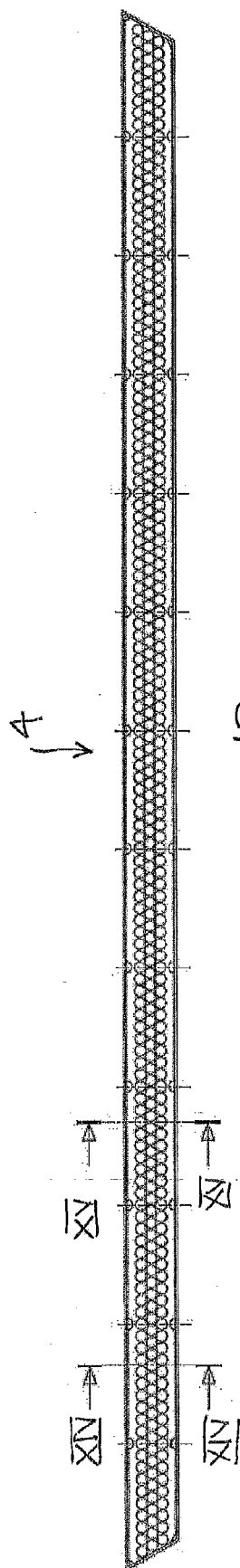


Fig. 13

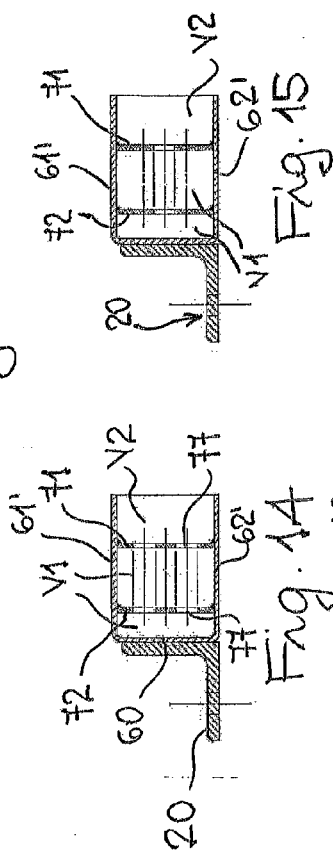


Fig. 15

Fig. 14

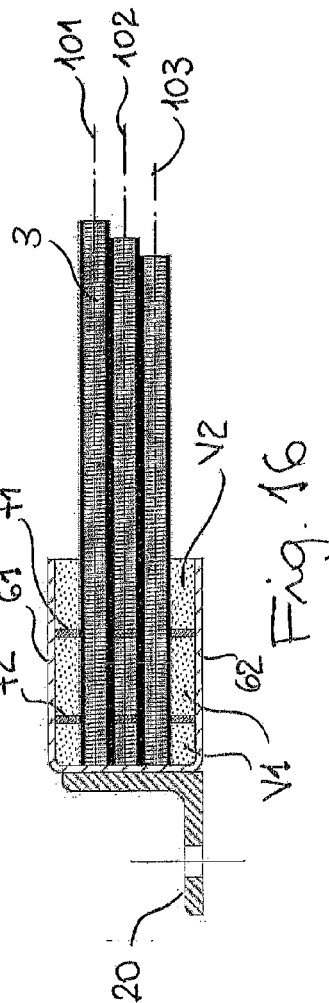


Fig. 16

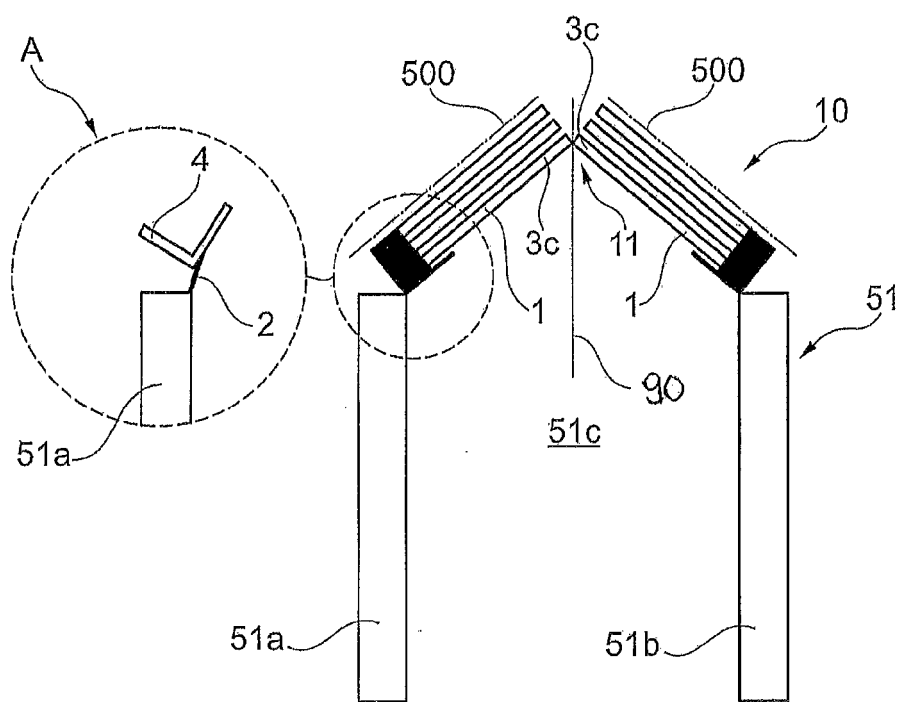


Fig. 17

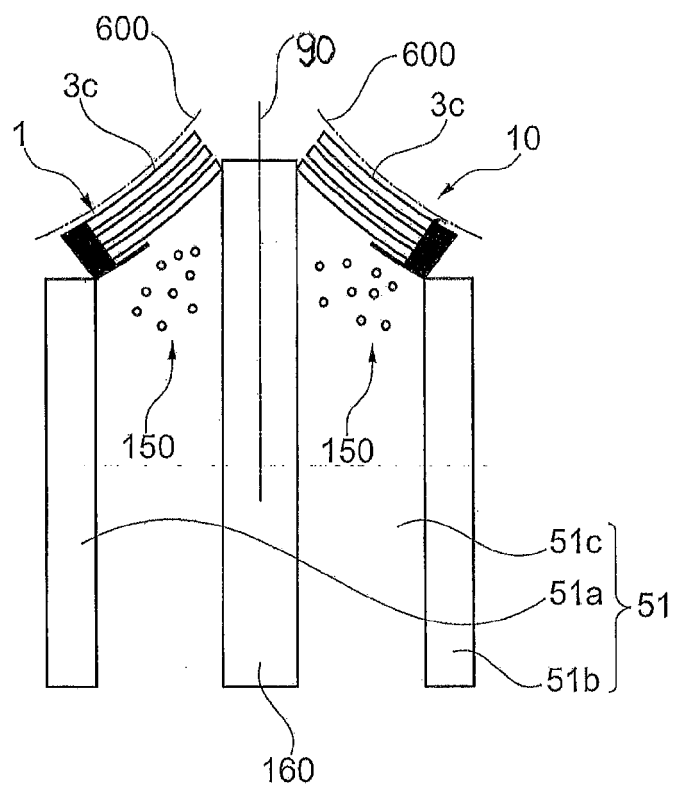


Fig. 18

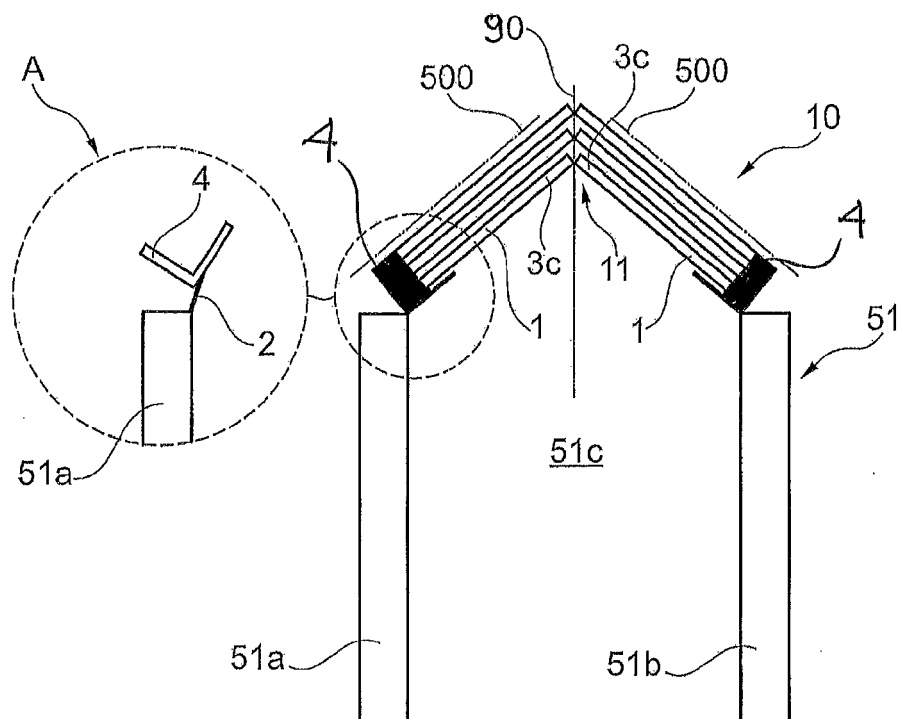


Fig. 19

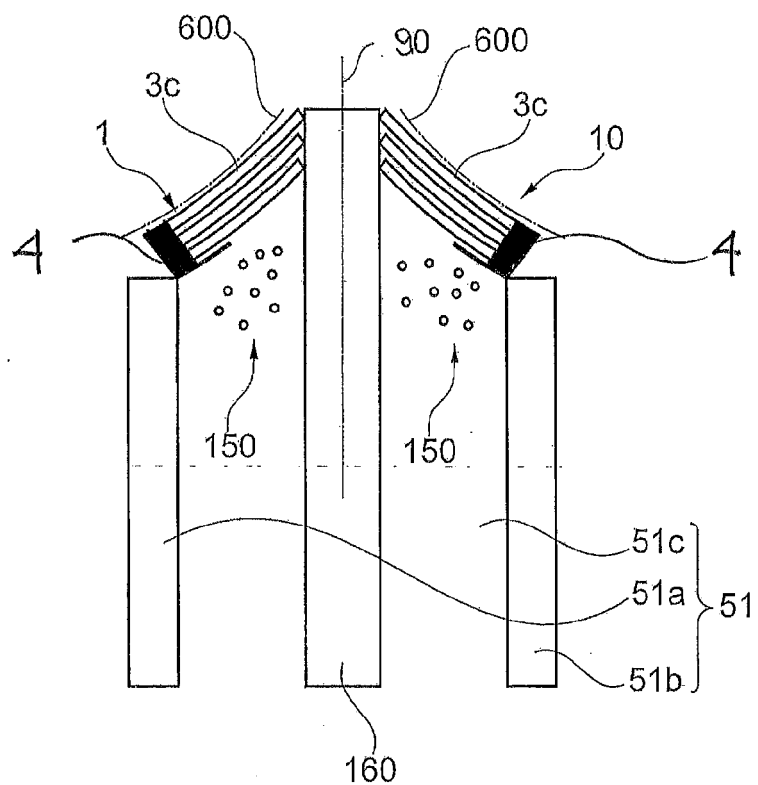


Fig. 20

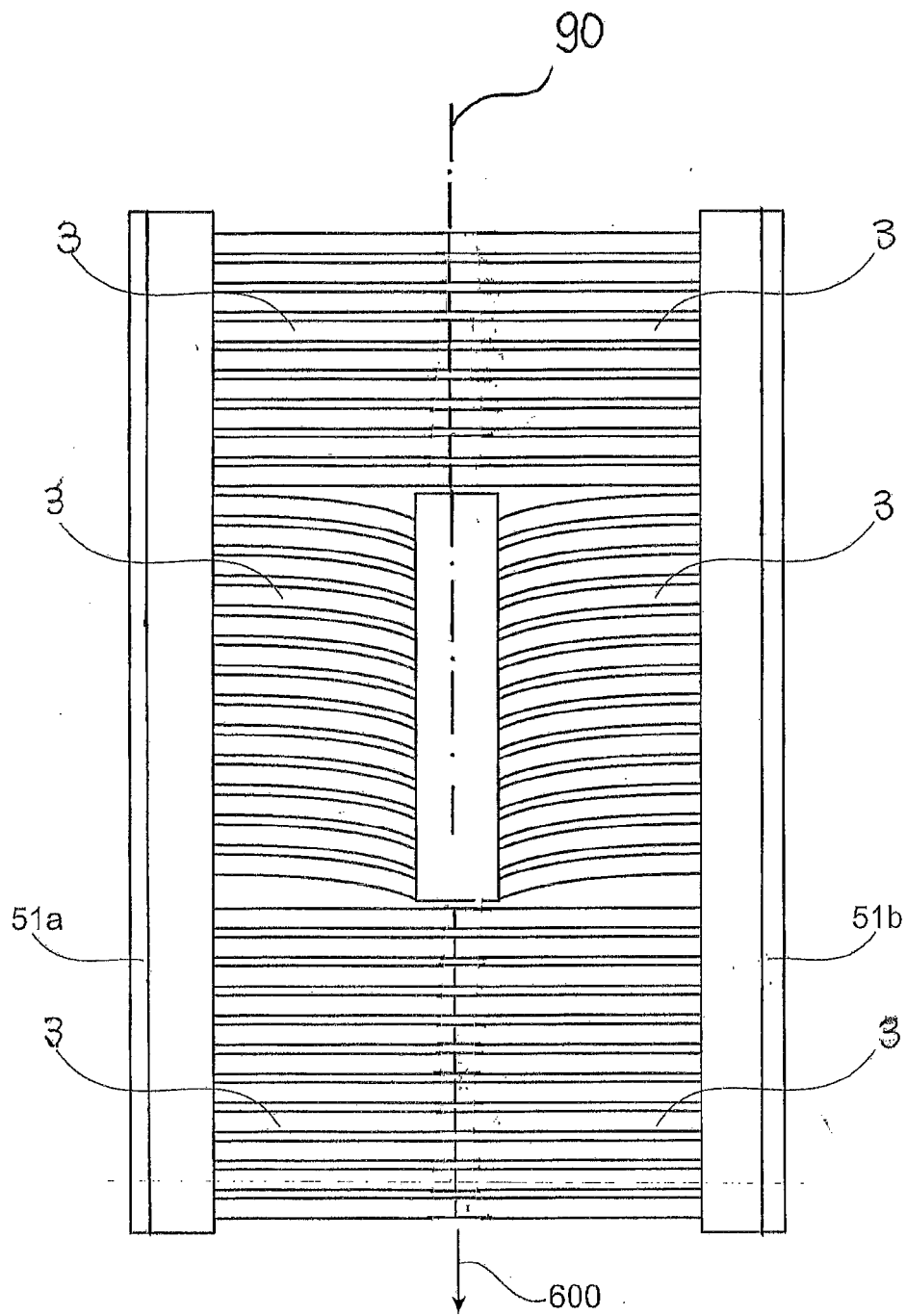


Fig. 21

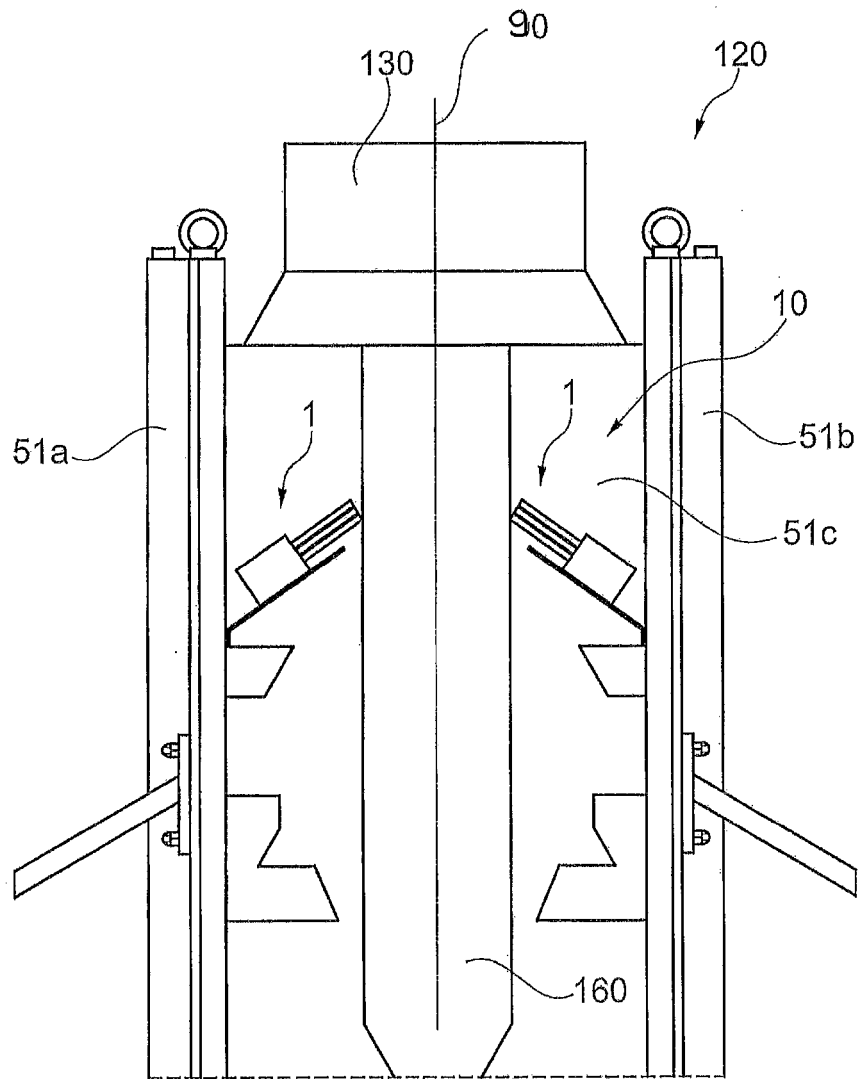


Fig. 22



## EUROPEAN SEARCH REPORT

Application Number  
EP 15 17 1607

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                            |                                                     |                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-----------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                                                              | Relevant to claim                                   | CLASSIFICATION OF THE APPLICATION (IPC) |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 4 872 294 A (WATTS W DAVID [US])<br>10 October 1989 (1989-10-10)<br>* column 4, lines 39-44 *<br>* column 7, lines 24-34,52-57 *<br>* figure 5 *                        | 1-10                                                | INV.<br>B24C9/00                        |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | DE 87 02 709 U1 (GLÄSNER SANDSTRAHLTECHNIK GMBH) 30 April 1987 (1987-04-30)<br>* page 3, lines 28-31 *<br>* figures 1,2 *<br>* claims 1-3 *                                | 1-10                                                |                                         |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 2012/315828 A1 (KUHLMAN FRANK W [US])<br>13 December 2012 (2012-12-13)<br>* paragraphs [0005], [0009], [0010], [0028], [0036] *<br>* figures 1-3 *<br>* claims 8,9,12 * | 1-10                                                |                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                            |                                                     | TECHNICAL FIELDS SEARCHED (IPC)         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                            |                                                     | B24C                                    |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                            |                                                     |                                         |
| Place of search<br>Munich                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                            | Date of completion of the search<br>23 October 2015 | Examiner<br>Watson, Stephanie           |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                                                            |                                                     |                                         |

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ANNEX TO THE EUROPEAN SEARCH REPORT  
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The members are as contained in the European Patent Office EDP file on  
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23-10-2015

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