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(71) Applicant: **BABBINI S.P.A.**
47012 Civitella di Romagna FC (IT)

(72) Inventor: **Prati, Ermanno**
47121 Forli (IT)

(74) Representative: **Modiano, Micaela Nadia et al**
Modiano & Partners
Via Meravigli, 16
20123 Milano (IT)

(54) **PRESSING UNIT FOR REMOVING LIQUIDS**

(57) A pressing unit for removing liquids contained in material of various types, comprising a chamber (2) for containing at least one screw feeder (3); the screw feeder (3) comprises a roller (4) that rotates about its own longitudinal axis (A) and a helical element (5) that is wound in a spiral around the roller (4); the chamber (2) is affected by an intake port for introducing the material to be pressed and by a discharge port for the pressed material, so as to define a forced pressing path (6) comprised between the chamber (2) and the screw feeder (3); the lateral surface of the roller (4), which is at least partially hollow, comprises a first portion (4a), which has a helical extension around the axis (A) and is provided with a plurality of holes (7), for the evacuation of the liquids removed progressively from the material during its advancement along the path (6), and a second portion (4b), which has a helical extension around the axis (A) and is complementary to the first portion (4a). The helical element (5) is wound around the roller (4) at the second portion (4b), which has a continuous, non-perforated shape.

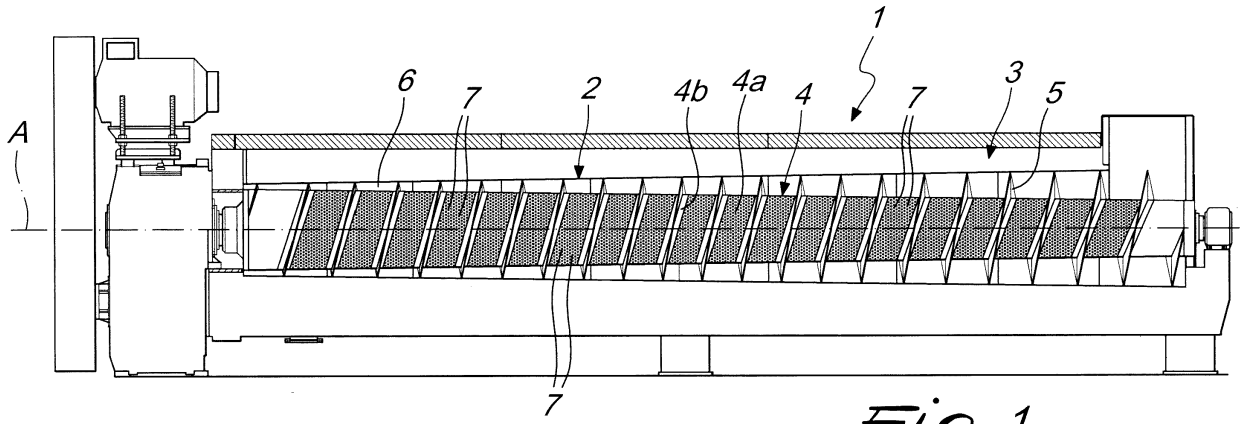

Fig. 1

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Description

[0001] The present invention relates to a pressing unit for removing liquids.

[0002] At the end of some industrial treatments or processes, various types of agroalimentary products or raw materials (or others) have a high content of water, which must then be extracted, since its presence is incompatible with subsequent processes or with the requirements of the end user.

[0003] In greater detail, water extraction must be performed for example in the sugar sector, with respect to beet pulp, but also with respect to the leaves of this plant and to other complementary products (and also in other industrial sectors).

[0004] However, sometimes the extracted water is rich in sugar (as indeed the water removed from beet pulp is) and can therefore be reused.

[0005] To extract the water, the material of interest is first of all subjected to the action of a press, which performs a sort of mechanical dehydration, removing a first part of the liquid substance; the material is then sent to a drying apparatus, which completes the extraction, obtaining dry mass contents that are per se unattainable by presses.

[0006] In other applications, after mechanical pressing the material is not subjected to drying or other processes to reduce the water content but is simply treated while partially humid.

[0007] In any case, according to known methods the presses comprise a sort of screw feeder, which comprises a rotating shaft around which an appropriately contoured helical element is wound.

[0008] The pulp (or other material from which water is to be removed) is thus conveyed toward a forced path, which is delimited by the screw feeder and by a respective containment chamber.

[0009] By way of an adequate sizing of the components involved, while the product advances, propelled by the screw feeder, it is forced to pass through progressively decreasing volumes, in practice being progressively pressed and deprived of water.

[0010] The water can thus be evacuated through the walls of the containment chamber, which is appropriately perforated.

[0011] In some high-efficiency constructive solutions, the shaft is covered by a bent metal plate that is completely perforated: the water can thus pass through said metal plate and flow away into an interspace comprised between the metal plate and the shaft.

[0012] In this embodiment, therefore, an increase in the useful filtering surface is obtained and consequently an increase in the efficiency of the press, in terms of greater final dry substance (or lower humidity) of the final pressed product, for equal size and capacity.

[0013] If the other parameters are kept unchanged, a press of the last type indicated above therefore has a higher pressing efficiency than the first type described, since it allows the outflow of water not only in a centrifugal direction from the external metal plates of the containment chamber, but also in a centripetal direction, through the interspace between the metal plate and the shaft.

[0014] This is of high interest in practice, since the industrial requirement is indeed to be able to remove as much water as possible by means of the presses, reducing more and more the work of drying apparatuses, which have distinctly higher costs (especially due to the high consumption of fuel).

[0015] Even where no drying is intended, the possibility to remove the maximum possible amount of water is highly appreciated, since by doing so the subsequent processes occur on a material that has a significantly smaller volume, obtaining in any case significant advantages in logistic and economic terms.

[0016] However, this constructive solution is not devoid of drawbacks.

[0017] While on the one hand, as shown, the perforated metal plate that covers the shaft ensures higher dehydration efficiency, on the other hand it poses problems that are difficult to solve for press manufacturing companies.

[0018] In greater detail, it is useful to note that the helical element is coupled directly to the perforated metal plate by means of a welding process, but welding performed on a perforated surface is highly subject to the formation of cracks and to the subsequent failure of the shaft or of the metal plate that covers it.

[0019] This occurs (with a frequency that is now unacceptable) for example when the penetration of debris or abnormal objects causes excessive mechanical stresses or friction on the helical element.

[0020] If one observes that vice versa the need is felt to subject presses and shafts in particular to ever increasing stresses, indeed in order to reduce as much as possible the humid mass content, it is evident that the limited strength that can be observed at the welding region is a highly unwelcome problem, for which no remedy has yet been found.

[0021] The aim of the present invention is to solve the problems described above, by providing a pressing unit that ensures high effectiveness in water removal without renouncing high mechanical strength.

[0022] Within this aim, an object of the invention is to provide a unit that ensures high pressing efficiencies, though containing (or eliminating) the risk of cracks and failures on the components involved.

[0023] Another object of the invention is to provide a pressing unit that ensures high reliability in operation and at the same time has low costs.

[0024] Another object of the invention is to provide a pressing unit that adopts a technical and structural architecture that is alternative to those of units of the known type.

[0025] Another object of the invention is to provide a pressing unit that can be obtained easily starting from commonly commercially available elements and materi-

als.

[0026] Another object of the invention is to provide a pressing unit that is safe in application.

[0027] This aim and these and other objects that will become better apparent hereinafter are achieved by a pressing unit for removing liquids contained in material of various types, comprising a chamber for containing at least one screw feeder, said screw feeder comprising a roller that rotates about its own longitudinal axis and a helical element that is wound in a spiral around said roller, said chamber being affected by an intake port for introducing the material to be pressed and by a discharge port for the pressed material, in order to define a forced pressing path comprised between said chamber and said at least one screw feeder, characterized in that the lateral surface of said roller, which is at least partially hollow, comprises a first portion, which has a helical extension around said axis and is provided with a plurality of holes, for the evacuation of the liquids removed progressively from the material during its advancement along said path, and a second portion, which has a helical extension around said axis and is complementary to said first portion, said helical element being wound around said roller at said second portion, which has a continuous, non-perforated shape.

[0028] Further characteristics and advantages of the invention will become better apparent from the description of a preferred but not exclusive embodiment of the pressing unit according to the invention, illustrated by way of nonlimiting example in the accompanying drawings, wherein:

Figure 1 is a partially sectional side elevation view of the pressing unit according to the invention, taken along a longitudinal plane;
Figure 2 is a highly enlarged-scale view of a detail of Figure 1;
Figure 3 is a side elevation view of the screw feeder of the unit of Figure 1;
Figure 4 is a side elevation view of the roller of the unit of Figure 1.

[0029] With particular reference to the cited figures, the reference numeral 1 generally designates a pressing unit, which is preset to remove liquids contained in material of various types.

[0030] It is useful to specify from the outset that in the preferred application, to which reference will be made occasionally in the continuation of the present application, the material from which liquids are extracted by means of the unit 1 is constituted by agroalimentary products of various kinds, supplied to said unit 1 impregnated with water (the liquid to be removed) as a result of previous industrial processes.

[0031] In greater detail, the unit 1 finds an effective application in the sugar sector, in which the treated material is beet pulp (or also leaves or other complementary materials).

[0032] Likewise, the unit 1 is used to remove water or other liquids from other agroalimentary products or by-products, from fishmeal, alfalfa, waste, biomasses, raw materials and intermediate products of the alternative energy field, or others, without thereby abandoning the protective scope claimed herein.

[0033] At the same time, although the liquid to removed is preferably water, the protection claimed herein is to be understood as extended to the use of the unit 1 also to remove different liquids as a function of the specific practical requirements.

[0034] The unit 1 therefore comprises a chamber 2 for containing at least one screw feeder 3; in turn, the screw feeder 3 comprises a roller 4, which rotates about its own longitudinal axis A, and a helical element 5, which is wound in a spiral around the roller 4.

[0035] The chamber 2 is affected by an intake port for introducing the material to be pressed and by a discharge port for the pressed material, so as to define a forced pressing path 6 comprised between the chamber 2 and the screw feeder 3.

[0036] For the sake of simplicity, the ports are not shown in the accompanying figures but can be simple nozzles or openings, provided along the chamber 2 and preferably (but not exclusively) facing end regions of the roller 4, so as to define a path 6 that is extended substantially along the entirety of such roller 4, maximizing the material pressing and expressing capabilities.

[0037] According to substantially known methods, it is specified therefore that while the screw feeder 3 rotates about the axis A it propels the material along the forced path 6 around the roller 4, and this material is forced to assume a progressively decreasing useful volume on at least one segment of adequate length of the roller 4 (and in the manners that will be described for example in the paragraphs that follow). This allows indeed to obtain the desired pressing of the material and therefore the removal of at least part of the water (or other liquids) contained therein.

[0038] According to the invention, the lateral surface of the roller 4, which is at least partially hollow, comprises a first portion 4a that has a helical extension around the axis A and has a plurality of holes 7 in order to allow the evacuation of the liquids progressively removed from the material during its advancement along the path 6. Furthermore, the lateral surface of the roller 4 comprises a second portion 4b, which also has a helical extension around the axis A and is complementary to the first portion 4a. The second portion 4b instead has a continuous non-perforated shape and indeed the helical element 5 is wound around the roller 4 at this second portion.

[0039] In other words, in practice, as also shown clearly by the accompanying figures, the lateral surface of the roller 4 (the one that in practice delimits the path 6, together with the chamber 2 and the helical element 5) comprises two portions 4a, 4b, which are extended with a helical shape in a mutually parallel manner and define together the entire lateral surface (or at least a main seg-

ment thereof).

[0040] By way of the different provision of the two portions 4a, 4b, it is possible to achieve both the desired evacuation of the water through the holes 7 (it should be noted that the first portion 4a indeed faces the path 6) and, at the same time, a high mechanical strength of the screw feeder 3, since the helical element 5 is fixed to the roller 4 at a continuous non-perforated area defined by the second portion 4b.

[0041] In particular, the helical element 5 is welded to the roller 4 at the second portion 4b, and indeed the choice to keep the second portion 4b of the lateral surface of the roller 4 continuous and without holes 7 ensures optimum welding, avoiding or at least reducing the risk of cracks and failures, during the normal operation of the unit 1 and/or in case of abnormal stresses, possibly of excessive intensity.

[0042] It is specified that preferably but not exclusively both the roller 4 and the chamber 2 are made of metal plate.

[0043] It should be noted that versions of the unit 1 that provide for evacuation of the water only through the first portion 4a are considered to be comprised within the protective scope provided herein.

[0044] However, in the preferred constructive solution, which ensures maximum effectiveness in water evacuation and removal, at least the side walls of the chamber 2, interposed between the ports, have a plurality of orifices, so as to ensure the evacuation of the liquids progressively removed from the material during its advancement along the path 6 through said orifices as well.

[0045] As a whole, therefore, the water can abandon the path 6 both through the holes 7 in the first portion 4a and through the orifices along the chamber 2.

[0046] In a possible constructive solution, the roller 4 has a substantially cylindrical shape, while the helical element 5 has a pitch that at least partially decreases (on at least one segment of the roller 5) if measured along the path 6 from the intake port to the discharge port. This choice allows to obtain the progressive reduction of the volume available to the material during its advancement along the forced path 6 in order to obtain, as already anticipated, the pressing of such material.

[0047] Likewise, the protective scope claimed herein includes a second constructive solution, in which the roller 4 has a substantially conical shape, with a progressively increasing transverse cross-section, if measured along the path 6 from the intake port to the discharge port. In this second solution, the helical element 5 therefore has an at least partially constant pitch (on at least one segment of the roller 5) or even a slightly decreasing pitch, if measured along the path 6 from the intake port to the discharge port, achieving again the progressive reduction of the volume available to the material during its advancement along the forced path 6.

[0048] Resorting to different geometrical choices for the shape of the roller 4 and the pitch of the helical element 5, which are constituted by a combination of the two cited above (partially conical and partially cylindrical roller 4, generically variable pitch) or by yet others, without thereby abandoning the protective scope claimed herein, is not excluded.

[0049] With further reference to the possible geometric choices for the unit 1 according to the invention, chambers 2 having a conical or cylindrical shape, in any case shaped substantially complementarily to the shape and transverse space occupation of the helical element 5, so as to delimit fully the path 6, are conveniently adopted.

[0050] In an embodiment of considerable practical interest, the chamber 2 accommodates two screw feeders 3, each of which comprises a respective roller 4 and a corresponding helical element 5.

[0051] In this solution, which usefully allows to process a larger quantity of material substantially with the same longitudinal space occupation of the unit 1, the rollers 4 are substantially side by side and delimit, with the helical elements 5 and the chamber 2, a single forced path 6. Optionally, the two screw feeders 3 can be arranged so that the turns of the helical element 5 of one screw feeder 3 enter, during rotation, the space comprised between two consecutive turns of the helical element 5 of the other screw feeder 3, and viceversa.

[0052] Furthermore, the provision of units 1 according to the invention in which the same chamber 2 accommodates three or more screw feeders 3 is not excluded.

[0053] Conveniently, and as a function of the specific requirements of application, the axis A of the roller 4 (of each roller 4) has an orientation selectively among a horizontal orientation, a vertical orientation and an inclined orientation (i.e., forming an angle comprised between 0° and 90° with the horizontal plane on which the entire unit 1 rests).

[0054] In a first practical option, the roller 4 is constituted substantially by a shaft, which rotates about the axis A and is internally hollow, so as to define an internal duct, which is indeed connected to the path 6 through the holes 7, for the evacuation of the liquids removed from the material. In other words, in this option the liquid expressed from the material that passes through the holes 7 flows outside the unit 1 through the duct (arranged along the axis A) that is defined inside the shaft.

[0055] In a second practical option, which ensures greater solidity to the structure, the roller 4 is instead constituted substantially by a sleeve for the coaxial covering of a shaft, which rotates about the axis A.

[0056] In this option, an interspace is defined between the sleeve and the shaft and is connected to the path 6 through the holes 7 in order to evacuate the liquids removed from the material (i.e., performing the role that in the other practical option is assigned to the internal duct of the shaft).

[0057] Advantageously, the dimensional and geometric parameters of the helical shape of the portions 4a, 4b of the lateral surface of the roller 4 correspond to the material that is intended to pass through the forced path 6 and/or to the desired residual liquid content present in

the material at the discharge port.

[0058] In other words, during design it is possible to choose the inclination of the helical shape, as well as the width of the two portions 4a, 4b or other parameters, and vary accordingly the shape and extension of the first portion 4b (and therefore of the area intended for water evacuation) as well as the shape and dimensions of the welding area and of the helical element 5 proper, which evidently depend on the geometric choices made for the second portion 4b.

[0059] Operation of the pressing unit according to the invention is as follows.

[0060] As already noted, the material to be pressed can be introduced in the chamber 2 through the intake port, which leads directly to the forced path 6, which is delimited by the screw feeder 3 and by the chamber 2 proper.

[0061] By way of adequate geometric choices, while the material is pushed by the screw feeder 3 toward the discharge port, the useful volume offered by the path 6 decreases and therefore the desired expressing of the material is obtained.

[0062] The water (or other liquid) that is removed progressively can then abandon the chamber 2 through the holes 7 provided along the first portion 4a of the lateral surface of the roller 4 and preferably also through the orifices defined along the side walls of the chamber 2.

[0063] The large filtering area available to the water ensures extremely high draining efficiencies and therefore better performance, which is assuredly of interest for users.

[0064] At the same time, the choice to weld or otherwise fix the helical element 5 to the roller 4 at the second portion 4b, which is not perforated, of its lateral surface ensures high mechanical strength, overcoming the problems of the background art, in which the helical elements welded to the perforated metal plates are subject to cracks (indeed at the weld) in case of abnormal mechanical stresses or frictions on the helical elements, with consequent failure of the shaft.

[0065] Partial perforation (only on the second portion 4b) therefore allows the unit 1 to achieve a high increase in reliability without reducing the draining effect, since the area offered for draining (composed by the first portion 4a and preferably also by the side walls of the chamber 2) is in any case maximum.

[0066] The higher mechanical reliability of the roller 4 further allows to utilize its potential more: for example, it is possible to reduce the rotation rate and increase the final content of dry substance in the pressed material, at the same time reducing machine downtimes, as well as maintenance interventions and inspections.

[0067] Finally, it should be noted that the advantages described above are achieved with a solution that can be obtained with low costs, further confirming the extreme practical interest of the invention.

[0068] In practice it has been found that the pressing unit according to the invention achieves fully the intended aim, since by adopting a roller that has a first portion with a helical shape provided with a plurality of holes and a second helical portion that is complementary to the first portion and is not perforated and around which the helical element is wound it is possible to achieve a high effectiveness in water removal without renouncing high mechanical strength.

[0069] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims; all the details may further be replaced with other technically equivalent elements.

[0070] In the examples of embodiment shown, individual characteristics, given in relation to specific examples, may actually be interchanged with other different characteristics that exist in other exemplary embodiments.

[0071] In practice, the materials used, as well as the dimensions, may be any according to requirements and to the state of the art.

[0072] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A pressing unit for removing liquids contained in material of various types, comprising a chamber (2) for containing at least one screw feeder (3), said screw feeder (3) comprising a roller (4) that rotates about its own longitudinal axis (A) and a helical element (5) that is wound in a spiral around said roller (4), said chamber (2) being affected by an intake port for introducing the material to be pressed and by a discharge port for the pressed material, in order to define a forced pressing path (6) comprised between said chamber (2) and said at least one screw feeder (3), **characterized in that** the lateral surface of said roller (4), which is at least partially hollow, comprises a first portion (4a), which has a helical extension around said axis (A) and is provided with a plurality of holes (7), for the evacuation of the liquids removed progressively from the material during its advancement along said path (6), and a second portion (4b), which has a helical extension around said axis (A) and is complementary to said first portion (4a), said helical element (5) being wound around said roller (4) at said second portion (4b), which has a continuous, non-perforated shape.

2. The pressing unit according to claim 1, **characterized in that** said helical element (5) is welded onto said roller (4) at said second portion (4b).

3. The pressing unit according to claim 1 or 2, **characterized in that** at least the side walls of said chamber (2), which are interposed between said ports, have a plurality of orifices, for the evacuation of the liquids removed progressively from the material during its advancement along said path (6).

4. The pressing unit according to one or more of the preceding claims, **characterized in that** said roller (4) has a substantially cylindrical shape, said helical element (5) having a pitch that decreases at least partially, measured along said path (6) from said intake port to said discharge port, for the progressive reduction of the volume available to the material during its advancement along said forced path (6).

5. The pressing unit according to one or more of claims 1 to 3, **characterized in that** said roller (4) has a substantially conical shape, with a progressively increasing transverse cross-section, measured along said path (6) from said intake port to said discharge port, said helical element (5) having a pitch that is at least partially constant, measured along said path (6) from said intake port to said discharge port, for the progressive reduction of the volume available to the material during its advancement along said forced path (6).

6. The pressing unit according to one or more of the preceding claims, **characterized in that** said chamber (2) has a conical or cylindrical shape that is substantially complementary to the shape and transverse space occupation of said at least one helical element (5).

7. The pressing unit according to one or more of the preceding claims, **characterized in that** said chamber (2) accommodates two of said screw feeders (3), each one of said screw feeders (3) comprising a respective said roller (4) and a corresponding said helical element (5), said shafts being substantially side by side and delimiting, with said helical elements (5) and said chamber (2), said forced path (6).

8. The pressing unit according to one or more of the preceding claims, **characterized in that** said axis (A) of said at least one roller (4) has an orientation chosen among a horizontal orientation, a vertical orientation and an inclined orientation.

9. The pressing unit according to one or more of the preceding claims, **characterized in that** said roller (4) is constituted substantially by a shaft that rotates about said axis (A) and is internally hollow, in order to define an internal duct that is connected to said path (6) through said holes (7) for evacuating the liquids removed from the material.

10. The pressing unit according to one or more of claims 1 to 8, **characterized in that** said roller (4) is constituted substantially by a sleeve for the coaxial covering of a shaft, which rotates about said axis (A), an interspace being defined between said sleeve and said shaft and being connected to said path (6) through said holes (7), for the evacuation of the liquids removed from the material.

11. The pressing unit according to one or more of the preceding claims, **characterized in that** the dimensional and geometric parameters of the helical shape of said portions (4a, 4b) of said lateral surface correspond to the material that is intended to move along said forced path (6) and/or to the desired residual liquid content that is present in the material at said discharge port.

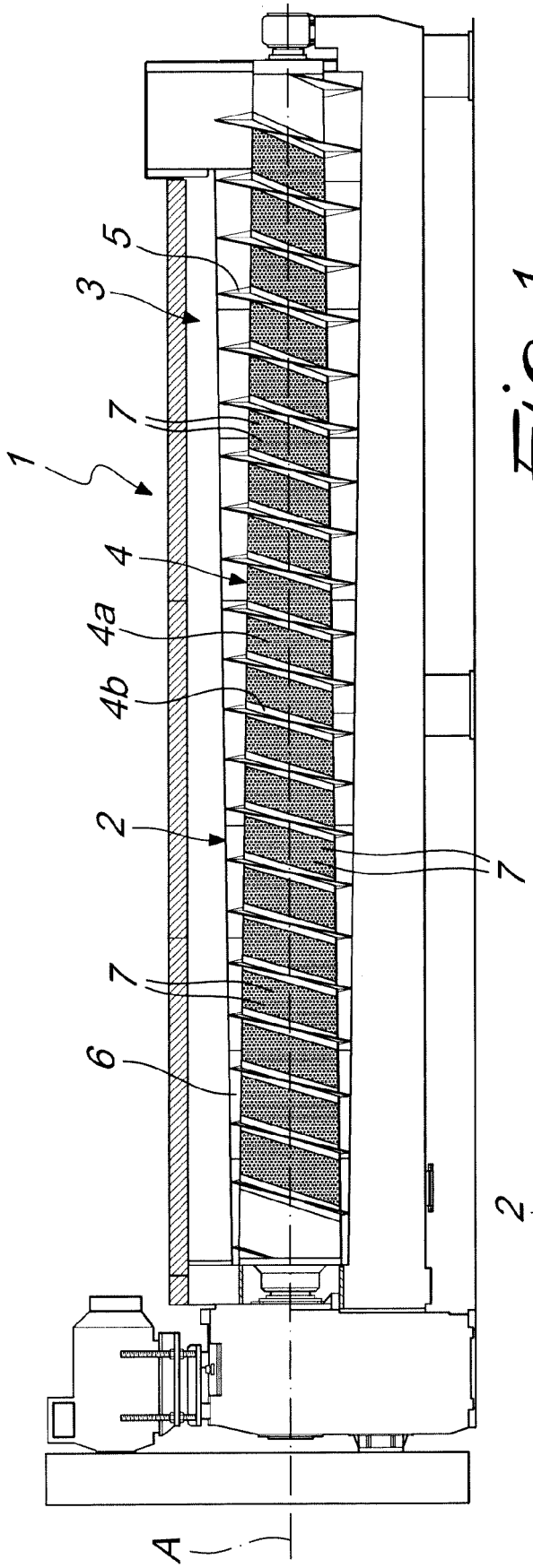

Fig. 1

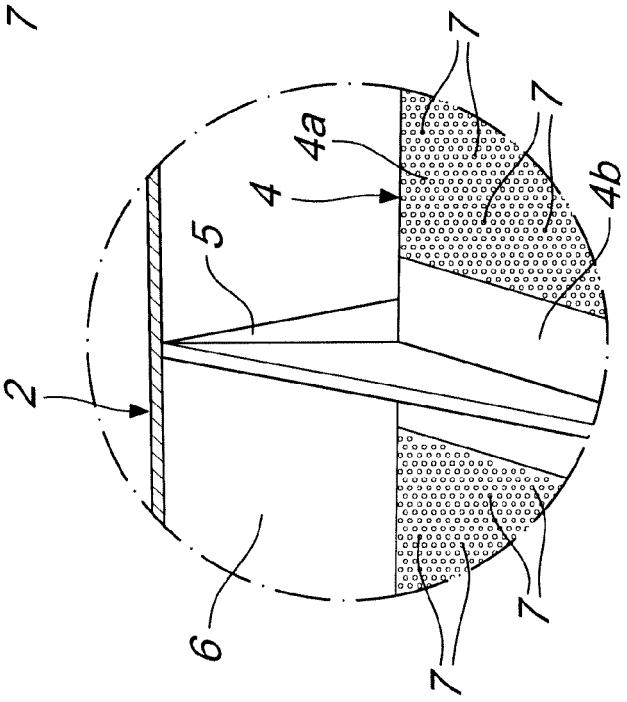

Fig. 2

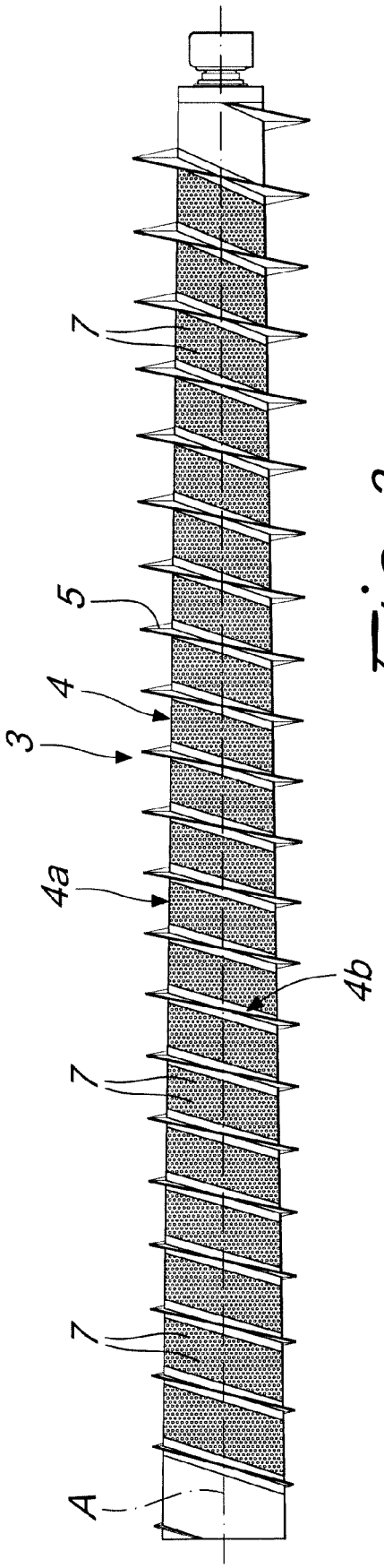

Fig. 3

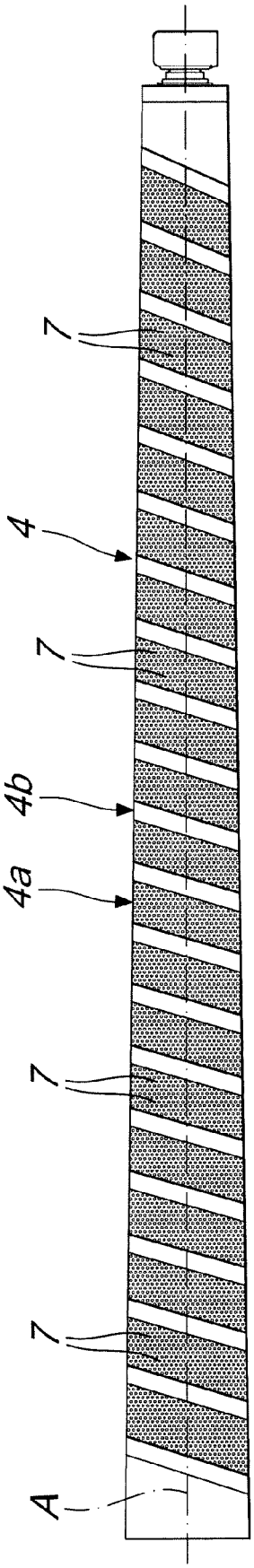

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 16 42 5028

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 October 2016	Labre, Arnaud

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 16 42 5028

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
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