(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 260 352 A1

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**27.11.2002 Bulletin 2002/48**

(51) Int Cl.[7]: **B30B 11/28**

(21) Application number: **02425290.0**

(22) Date of filing: **10.05.2002**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR**
Designated Extension States:
**AL LT LV MK RO SI**

(30) Priority: **14.05.2001 IT FI20010089**

(71) Applicant: **Ecotre System S.r.l.**
**50019 Sesto Fiorentino (FI) (IT)**

(72) Inventor: **Soldaini, Fulvio**
**50030 Vaglia (FI) (IT)**

(74) Representative: **Martini, Lazzaro**
**Studio Brevetti Ing. Dr. Lazzaro Martini s.r.l.**
**Via dei Rustici 5**
**50122 Firenze (IT)**

## (54) Pelletizing machine and method of producing pellets

(57) Pelletizing machine comprising at least a drawplate (1) made up of a cylindrical hollow body on the outer surface of which is a toothing consisting of more teeth (10) on the grooves (12) of which through holes (120) are provided able to define corresponding radial passages or ports between the outer surface (E) and the cavity (C) of said body, the latter being received with the possibility of rotating about the relevant longitudinal axis within the stationary structure (2) and being associated with means (4) provided for the movement thereof, characterized in that the said teeth (10) are provided with through holes (100) able to define corresponding radial passages or ports between the outer surface (E) and the inner cavity (C) of said body.

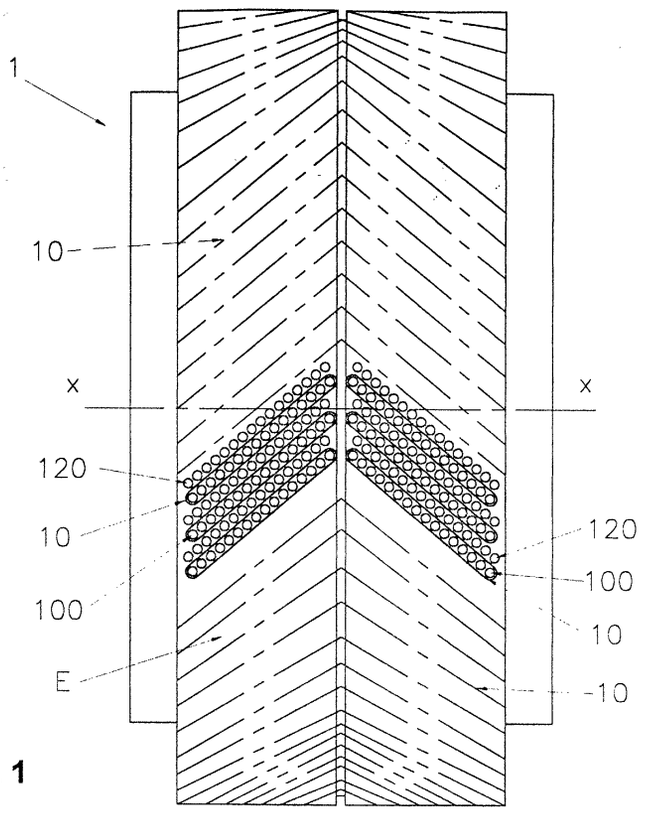



Fig. 1

EP 1 260 352 A1

## Description

**[0001]** The present invention refers to a pelletizing machine and method of producing pellets.

**[0002]** Pelletizing machines are known having rotary drawplates. Such drawplates consist of cylindrical hollow bodies meshing between them via respective external toothings. The said cylindrical bodies are provided, in correspondence of the grooves delimited by the respective toothings, with a plurality of through holes able to delimit corresponding radial channels. The material under treatment are forced to pass through said channels by virtue of the compression exerted in the meshing regions of the toothings. In this way, there is obtained the formation of pellets, that is, short cylindrical bars made from the material worked by the drawplates.

**[0003]** Machines of this type are described in documents FR 1371346, DE 2151865, WO 93/22132 and EP 846.554. However, the pelletizing machines thus constructed imply an excessive energy consumption with respect to the current requirements of production and, moreover, the pellets thus produced result somewhat brittle and release too much dust from their ends.

**[0004]** The main object of the present invention is to overcome the said drawbacks.

**[0005]** This result has been achieved, according to the invention, by adopting the idea of making a machine having the features disclosed in the characterizing part of the independent claims. Further characteristics being set forth in the dependent claims.

**[0006]** The present invention makes it possible to reduce the energy consumption inasmuch as the specific power for pelletization, that is, the power required for treating a predetermined amount of material, is less than that required by the conventional machines. It is also possible to arrange the drawplates according to a plurality of operating configurations. Moreover, a machine according to the invention is relatively simple to make and is reliable even after a prolonged service life, and the pellets produced by a machine according to the invention result relatively less brittle and release less dust from their ends.

**[0007]** These and other advantages and characteristics of the invention will be best understood by anyone skilled in the art from a reading of the following description in conjunction with the attached drawings given as a practical exemplification of the invention, but not to be considered in a limitative sense, wherein:

- Fig. 1 is a schematic side view, with parts taken away, of a drawplate for a pelletizing machine according to the invention;
- Fig. 2 is a sectional view of a detail of the drawplate in Fig. 1 in enlarged scale;
- Fig. 3 is a view similar to that of Fig. 1, but in a different scale, of a punch roller able to be associated with the drawplate of Fig. 1;
- Figs. 4A-4D show possible schematic representations of possible associations of drawplates with punch rollers;
- Fig. 5 shows schematically a possible configuration of a machine according to the invention, with two work fronts;
- Fig. 6 shows schematically a pelletization plant provided with a machine according to the invention;
- Fig. 7 is a view similar to that of Fig. 1, relating to a further embodiment of the drawplate;
- Fig. 8 shows schematically an alternative embodiment of the machine, with two drawplates having vertical axis;
- Fig. 9 shows schematically the formation of a pellet;
- Fig. 10 shows schematically the pneumatic driving of the pellets being formed;
- Figs. 11-13 are three examples of further embodiments of the drawplates;
- Fig. 14 shows a detail, in a scale enlarged with respect to the other drawings, of a drawplate according to a further embodiment;
- Figs. 15 and 16 are sectional view taken along A-A and B-B in Fig. 14;
- Fig. 17 shows a detail, in a scale enlarged with respect to the other drawings, of a punch roller;
- Figs. 18 and 19 are sectional view taken along B-B and D-D in Fig. 17;
- Fig. 20 is a side view partly in section of a punch roller according to a possible embodiment;
- Fig. 21 is a perspective view of a portion of a roller according to the invention; and
- Fig. 22 is a view similar to that of Fig. 21 but relating to a drawplate.

**[0008]** Reduced to its basic structure, and reference being made to the figures and the attached drawings, a pelletizing machine according to the invention comprises at least a drawplate (1) made up of a cylindrical hollow body. The said body (1) is mounted, with the possibility of rotating about its longitudinal axis (x-x), within a stationary structure (2) provided with a housing for each drawplate. The said axis (x-x) is horizontal in the figures 1 and 4A-4D of the attached drawings. The axis of the drawplates is instead vertical in the example of Fig. 8.

**[0009]** The outer surface of said body (1) is provided with a toothing to allow the meshing thereof with other bodies (equal to or different from each other, as best described later on) cooperating with the drawplate to achieve the desired effect. The said toothing may consist, as shown by way of example in Fig. 1, of two sets of teeth having helical arrangement, with their axes converging to a central portion (11) lacking of teeth. Alternatively, as shown in Fig. 7, the said teeth (10) lie also in the central portion of the drawplate (1). The grooves (12) between said teeth (10) exhibit a plurality of through holes (120) lined up along the development of the same grooves (12).

**[0010]** In the drawings, the teeth, holes and grooves of said drawplates (and of the rollers to be described

later on) are represented only partially for the sake of clarity.

The toothing of the drawplates may be shaped in any other suitable fashion. For example, as shown in Fig. 11, the teeth can develop either parallel to the axis of rotation (x-x) of the drawplate or, as shown in Fig. 12, orthogonally to such axis. The teeth of the drawplates may have any suitable profile. In the example of Fig. 13, the drawplate's teeth have a triangular or substantially so profile.

**[0011]** Advantageously, according to the invention, the teeth (10) of body (1) are provided with through holes (100) likewise in correspondence of the grooves (12). Both the teeth (120) of grooves (12) and the holes (100) of teeth (10) are developed radially within the body (1).

**[0012]** Moreover, advantageously, as shown in Fig. 2, the said holes (100) exhibit an inlet section (101) flaring toward the outer side (E) of body (1) for the material under treatment.

The holes (120) of grooves (12) may exhibit a similar shape in correspondence of the respective inlet sections (121).

**[0013]** Advantageously, as illustrated in Figs. 2 and 9 of the attached drawings, the said holes (100; 120) may exhibit a first substantially cylindrical length having circular cross-section, which is followed by a second length of substantially frusto-conical shape (102; 122) diverging toward the cavity (C) of body (1). The tapering ratio of said second lengths may be, for example, 1:50, 1:70 or 1:100 where, preferably, the higher ratios are for drawplates working harder materials and the lower ratios for drawplates working softer materials.

**[0014]** It is believed that the very compression of the material takes place essentially through the first, cylindrical length of holes (100: 120). The second, frusto-conical length allows a slight expansion of the material (MA) leaving the first length and acts as a guide for the same material on its way toward the cavity (C) of body (1). Only in the first part of the travel within the frusto-conical length, owing to said slight expansion, the material tends to interfere with the inner wall of the hole (see Fig. 9). In the remaining part of its travel inside the said frusto-conical length, the material (MA) does not interfere with the wall of the hole, so that no relevant appreciable friction effect takes place.

**[0015]** A machine according to the invention may also be advantageously provided with one or more punch rollers (3) whose external surface has teeth (30) able to engage the grooves (12) of at least one drawplate (1). The axis (y-y) of each roller (3) is parallel to that of the drawplates which it is associated with.

**[0016]** In the example shown in Fig. 3, the teeth (30) of each roller (1) are solid, that is, not drilled, and exhibit a series of portions (31) filleted by concave surfaces which, at the root of each tooth (30), delimit a depression (32) having a predetermined depth. This particular shape of the teeth (30) of rollers (3) is obtainable by using a numerical control machine tool known per se, provided with a cutter allowing the removal of the material at selected points in the root of the teeth. The said portions (31) correspond to holes (120) provided within the grooves (12) of body (1).

The teeth (10) of drawplates (1) may also have the said shaping (see Figs. 14-16 in which the said depressions are designated by the reference number 110).

As illustrated in the examples of Figs. 14-16, the teeth (10) of drawplates (1) may be provided with depressions (111), having advantageously a conical shape with the base facing outwardly, in the space filled with respective head surfaces between each pair of adjacent holes (100).

**[0017]** Similarly, as illustrated in the examples of Figs. 17-20, the teeth (30) of rollers (3) may be provided with depressions (33), having advantageously a conical shape with the base facing outwardly, in correspondence of the respective head portions (31). It is believed that the presence of said depressions (111; 33) upon the head surface of teeth (10; 30) of drawplates (1) and, respectively, of rollers (3), will contribute to the formation o more compact pellets, less brittle and less subject to releasing dust from the ends.

**[0018]** As illustrated in Figs. 4A-4D of the attached drawings, a pelletizing machine according to the invention may include two drawplates meshing with each other (Fig. 4A), two drawplates meshing with each other and with two pairs of punch rollers (Fig. 4B) as well, a drawplate associated with more punch rollers (Fig. 4C) or two drawplates meshing with a punch roller interposed there between and, on the opposite side, meshing respectively with two pairs of punch rollers (Fig. 4D). The elements (1; 3) meshing direct with each other are counter-rotating.

It will be appreciated that further configurations or combinations of rollers and drawplates may also be adopted.

**[0019]** The operation of the machine, reference being made to the schematic diagram of Fig. 4A, is as follows. The material to be pelletized is fed from above by gravity (arrow "F"), in correspondence of the region (A) of engagement of the counter-rotating drawplates (1). Because of the compression thus exerted onto the material arriving from said region (A), the same material is forced to transit, by becoming compacted, through the holes (120) of grooves (12) of the two drawplates (1) and through the holes (100) of the respective teeth (10). The thrust on the material under treatment is exerted in the region of instantaneous meshing of the teeth of the two drawplates. In practice, each tooth pushes the material toward the groove of the drawplate which, in the same instant, comes opposite thereto and vice versa, so that the material is forced to pass both through the holes provided in the grooves and through the holes provided in the teeth. The compacted material out coming from the outlet sections of holes (120; 100) collects within the cavity (C) of drawplates (1). Within these cavities, means may be provided able to reduce the compact material into pieces or "pellets" of suitable length, such as

means able to intercept the material (MA) exiting from the holes (100; 120) and causing the breaking thereof at a preset height. Means suited to this purpose are described in EP 846554 previously mentioned.

**[0020]** Referring again to Figs. 4B-4D and 7, the material to be pelletized is introduced from above, in correspondence of preset points, as indicated by arrows (F).

**[0021]** The present machine may also have one or more work fronts. In other words, the said structure (2) may be provided with seats for drawplates and/or punch rollers either on one side only or on both sides. This is exemplified in Fig. 5 wherein a drawplate (2) is shown matched with two punch rollers (3) in correspondence of two fronts (G, H) of the structure (1). Shown in the same drawing, by way of nonlimiting example, are the means which drive the drawplates (1) and rollers (3) into motion with an electric motor (4) associated with a conical pinion (40) via a transmission consisting of a belt (41) and relevant pulley (42). The pinion (40) is engaged with two corresponding opposite crowns (43) with which the coaxial and opposite shafts (44) are associated for driving the drawplates (1) and rollers (3) into motion. The connection between each of said shafts (44), the respective drawplate (1) and respective rollers (3) is carried out by a toothed wheel (45) keyed onto the axis of the drawplate (1) and meshing, on opposite sides, with corresponding toothed wheels (46) each of which is keyed onto the axis of relevant roller (3).

**[0022]** The present machine is able to treat materials of different nature, such as biological dehydrated muds, biological and chemical manure, waste materials from industrial plants, pastes and pulps, fodders, combustible fractions of urban solid wastes, compost, paper, paperboard, textile waste, refuse and residuals, wooden shaving, saw dust, plastic materials and materials for pelletization in general.

**[0023]** With reference to the schematic diagram of Fig. 6, a plant provided with a machine (M) according to the invention is described here below by way of non limiting example. The said plant comprises:

- a hopper (50) into which the material to be treated is introduced, and downstream of which a grinding or refining mill (52) is provided: between said hopper (50) and said refiner (52) an aeration separator being interposed to separate heavy matter such as glass, ceramics, etc;
- an operating unit with a fan (53) and a filter interposed between said refiner (52) and a silo (54) from which the material to be treated is delivered to the machine (M) with the aid of a belt conveyor or feed screw (55) onto which the material falls by gravity when coming out from the silo (54);
- a pneumatic extractor (56) acting in correspondence of the cavity of each drawplate of the machine for removing the pellets by suction and allowing the pneumatic transfer thereof up to a trap (57) - see the detail in Fig. 10 in which the pellets (P) are represented in enlarged scale - intended for intercepting the pellets and guide them to an exit station thus preventing them from arriving in front of the air-conveying means; in Fig. 10, the arrows represent the direction of the stream of air produced by the aspirator (56) for moving the pellets away from the machine;
- a belt conveyor (58) developing from the outlet of said trap (57) and a vibration dust remover (59);
- a soundproof cabin (60) having the aspirator (56), refiner (52), trap (57), belt conveyor (58) and dust remover (59) installed therein;
- a feed screw (61) for conveying the pellets (P) out coming from the dust remover (59) to a bag-filling station (62).

A machine according to the invention can also be mounted on a structure either self-propelled or towed (by an engine or farm tractor, for example).

## Claims

1. Pelletizing machine comprising at least a drawplate (1) made up of a cylindrical hollow body on the outer surface of which is a toothing consisting of more teeth (10) between the grooves (12) of which through holes (120) are provided able to define corresponding radial passages or ports between the outer surface (E) and the cavity (C) of said body, the latter being received with the possibility of rotating about the relevant longitudinal axis within the stationary structure (2) and being associated with means (4) provided for the movement thereof, **characterized in that** the said teeth (10) are provided with through holes (100) able to define corresponding radial passages or ports between the outer surface (E) and the inner cavity (C) of said body.

2. Machine according to claim 1, **characterized in that** the said holes (100; 120) are countersunk in correspondence of the respective inlet sections (102; 121).

3. Machine according to claim 1, **characterized in that** is comprises at least one punch roller (3) whose outer surface has a toothing formed by a plurality of teeth (30) which can mesh with those of said at least one drawplate (1).

4. Machine according to claims 1 and 3, **characterized in that** the teeth (30) of said at least one roller (3) exhibit a plurality of portions (31) corresponding to holes (120) of said grooves (12) and delimited by surfaces joined with each other, a depression in the outer surface of the roller of predetermined depth being provided at the side of each said portions

(31).

**5.** Machine according to one or more preceding claims, **characterized in that** it comprises a pair of drawplates (1).

**6.** Machine according to one or more preceding claims, **characterized in that** it comprises at least a pair of drawplates (1) and more punch rollers (3).

**7.** Machine according to one or more preceding claims, **characterized in that** the said structure (2) has two fronts (A, B) each of which has at least one drawplate (1) in correspondence thereof.

**8.** Machine according to claim 1, **characterized in that** the said holes (100; 120) have a first substantially cylindrical length and a second substantially frusto-conical length (102; 122) diverging toward the cavity (C) of body (1).

**9.** Machine according to one or more preceding claims, **characterized in that** the teeth of said at least one drawplate (1) and/or of said at least one roller (1) are provided with depressions in correspondence of respective head surfaces.

**10.** Method of producing pellets, comprising the step of causing the drawing of pelletizable material through holes formed in one or more toothed drawplates, **characterized in that** the said holes are formed both on the teeth of said one or more drawplates and in the grooves between adjacent teeth thereof.

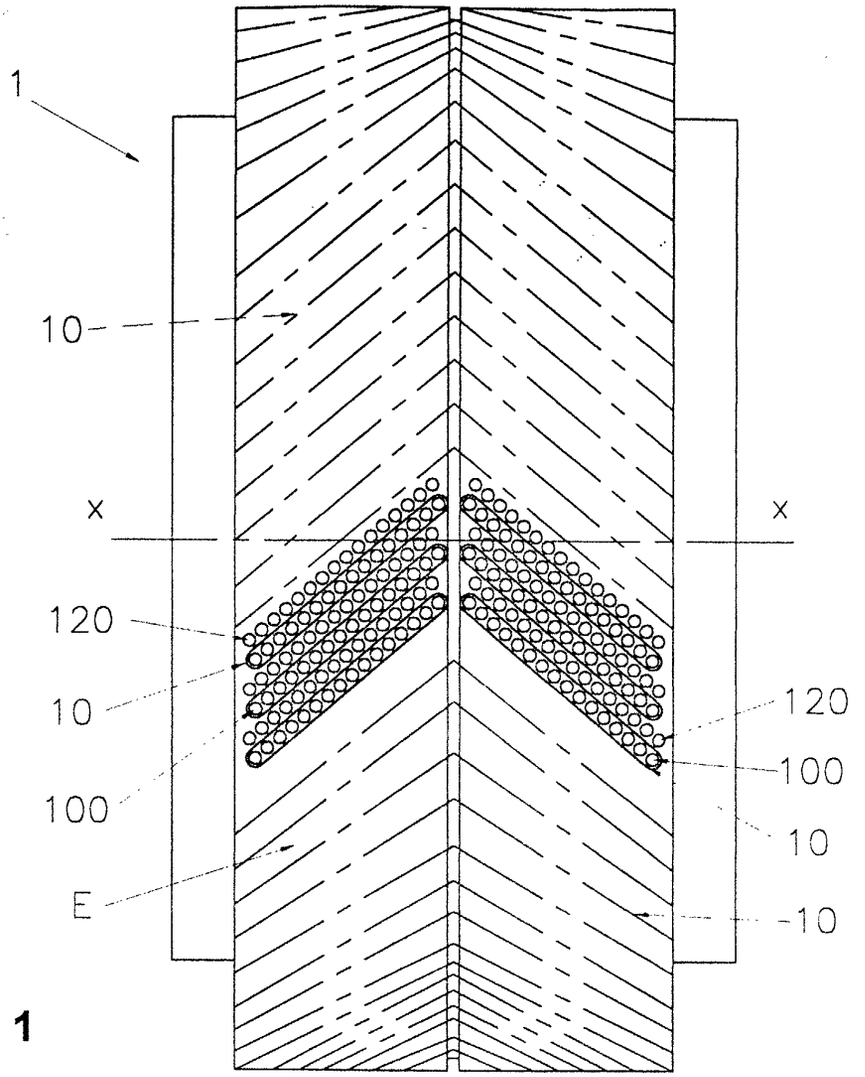



Fig. 1

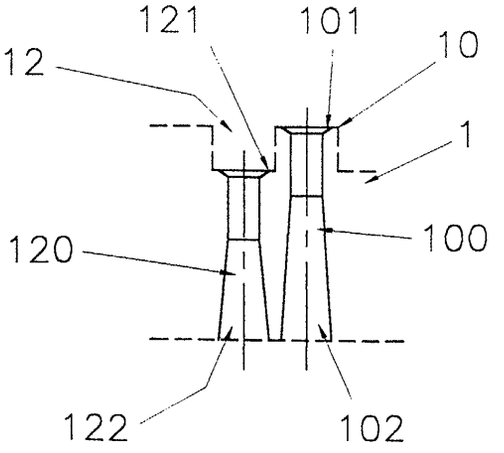



Fig. 2

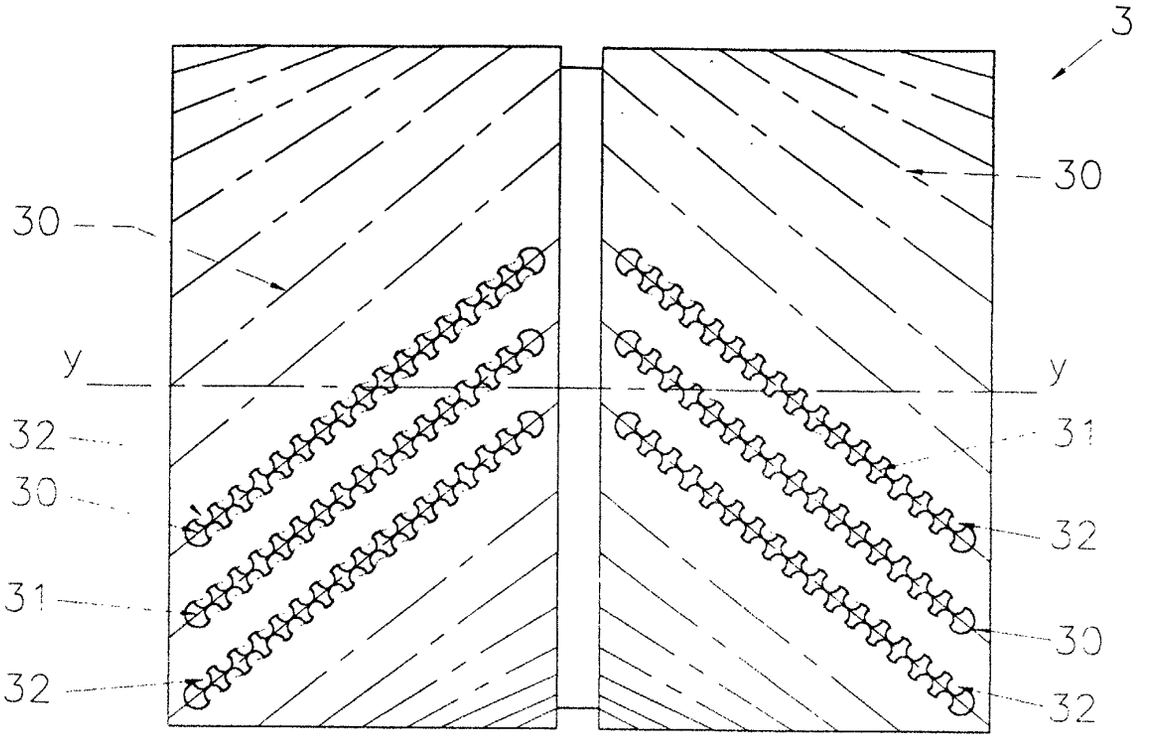



Fig. 3

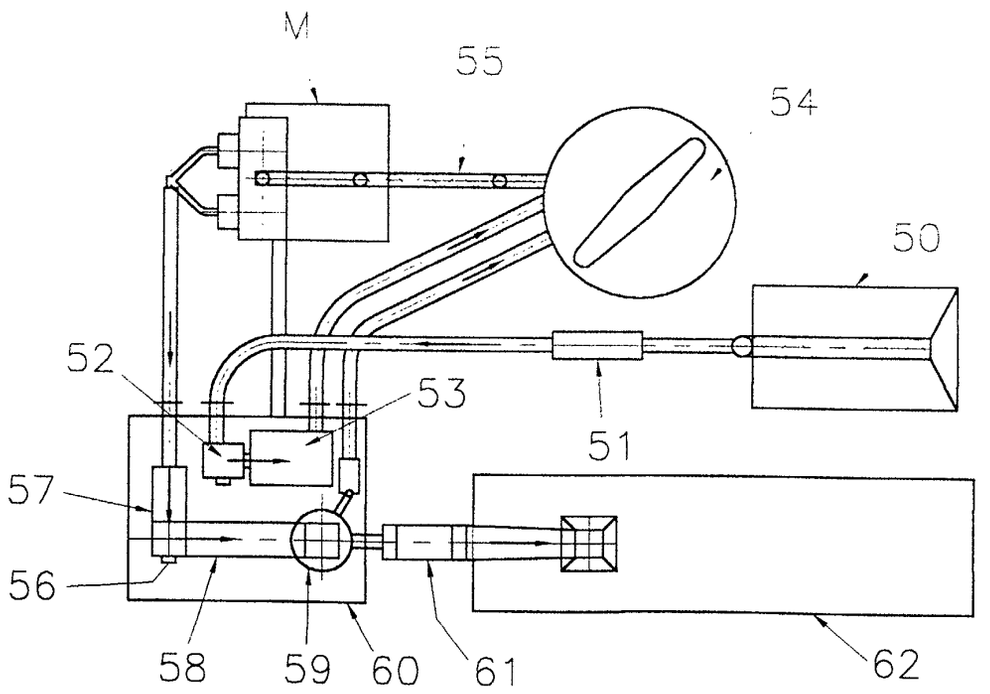



Fig. 6

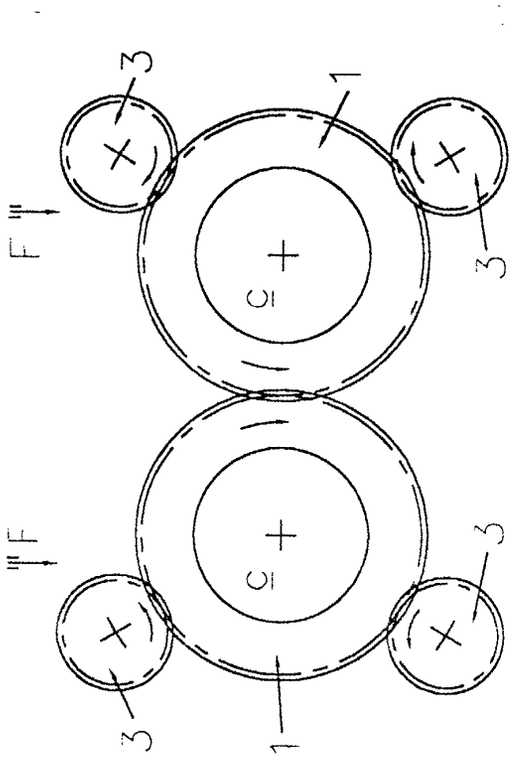



Fig. 4B

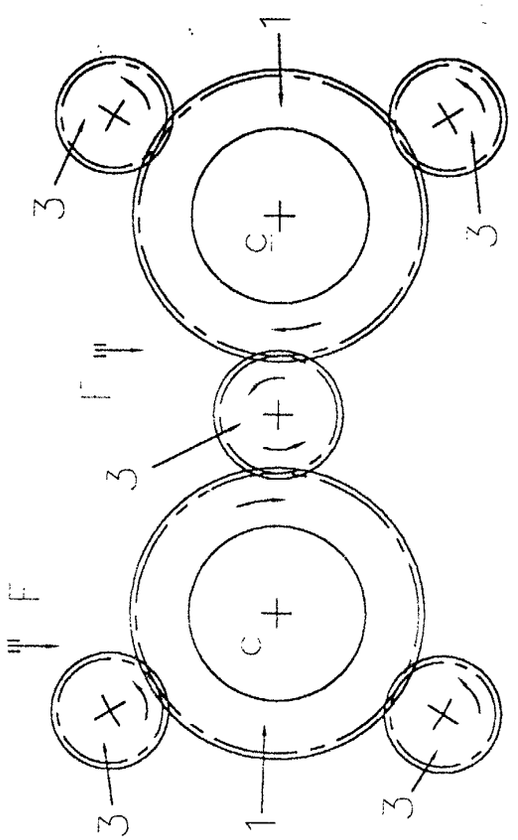



Fig. 4D

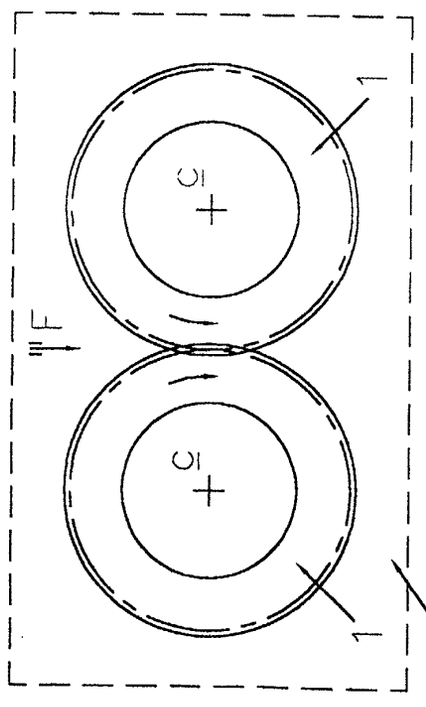



Fig. 4A

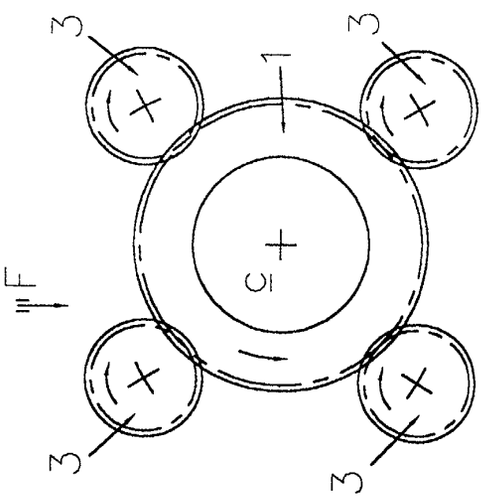



Fig. 4C

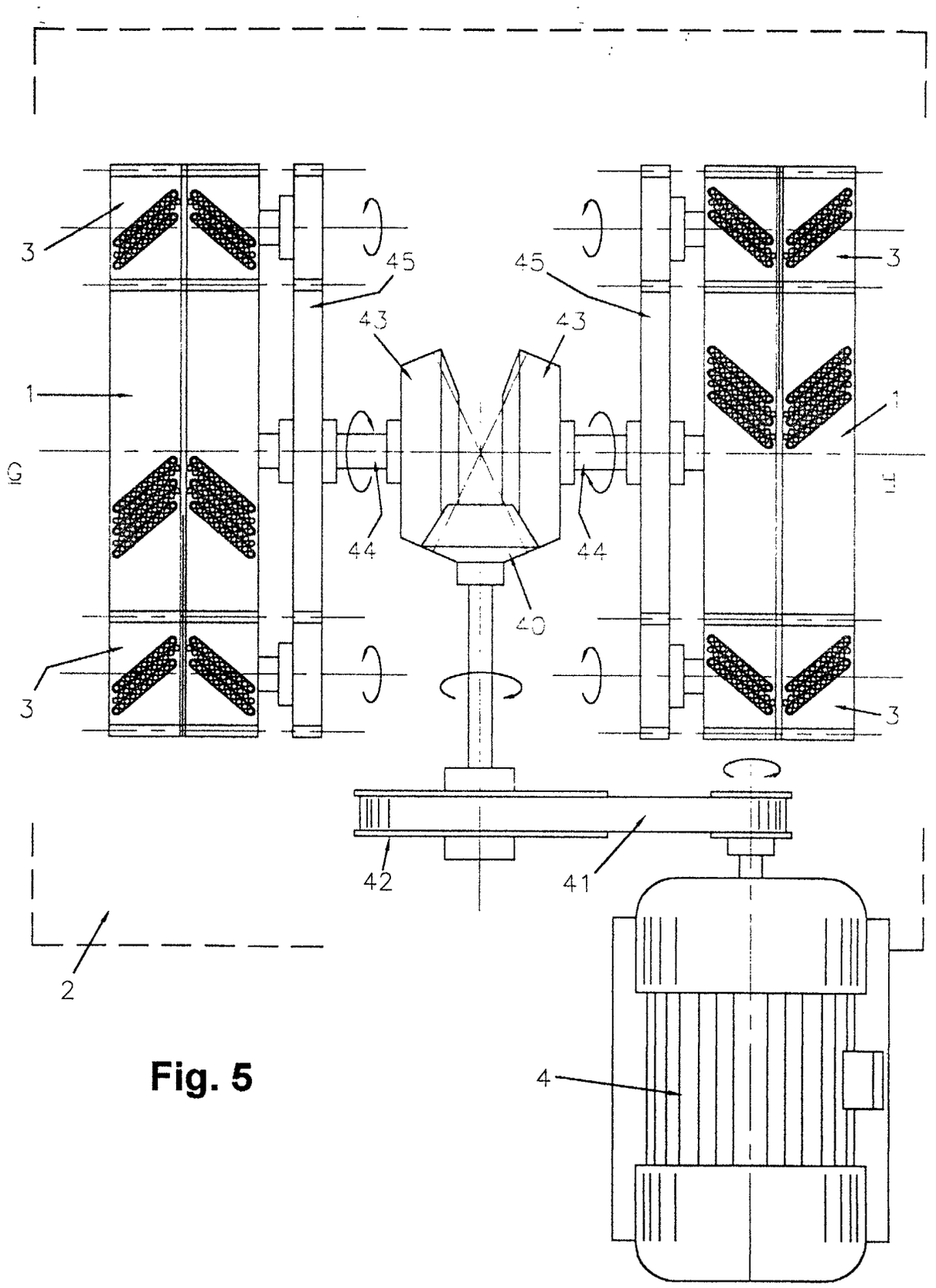



Fig. 5

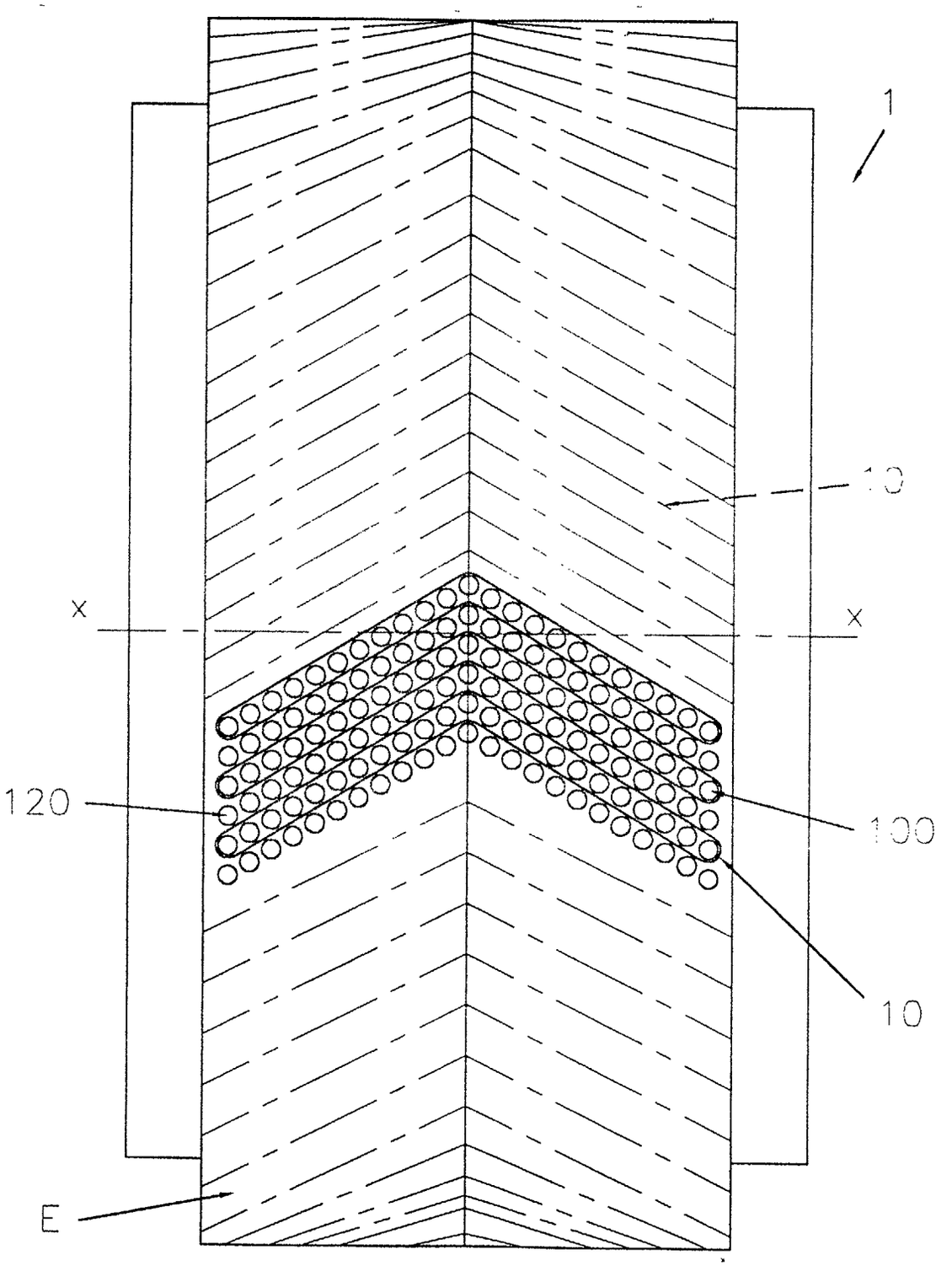



Fig. 7

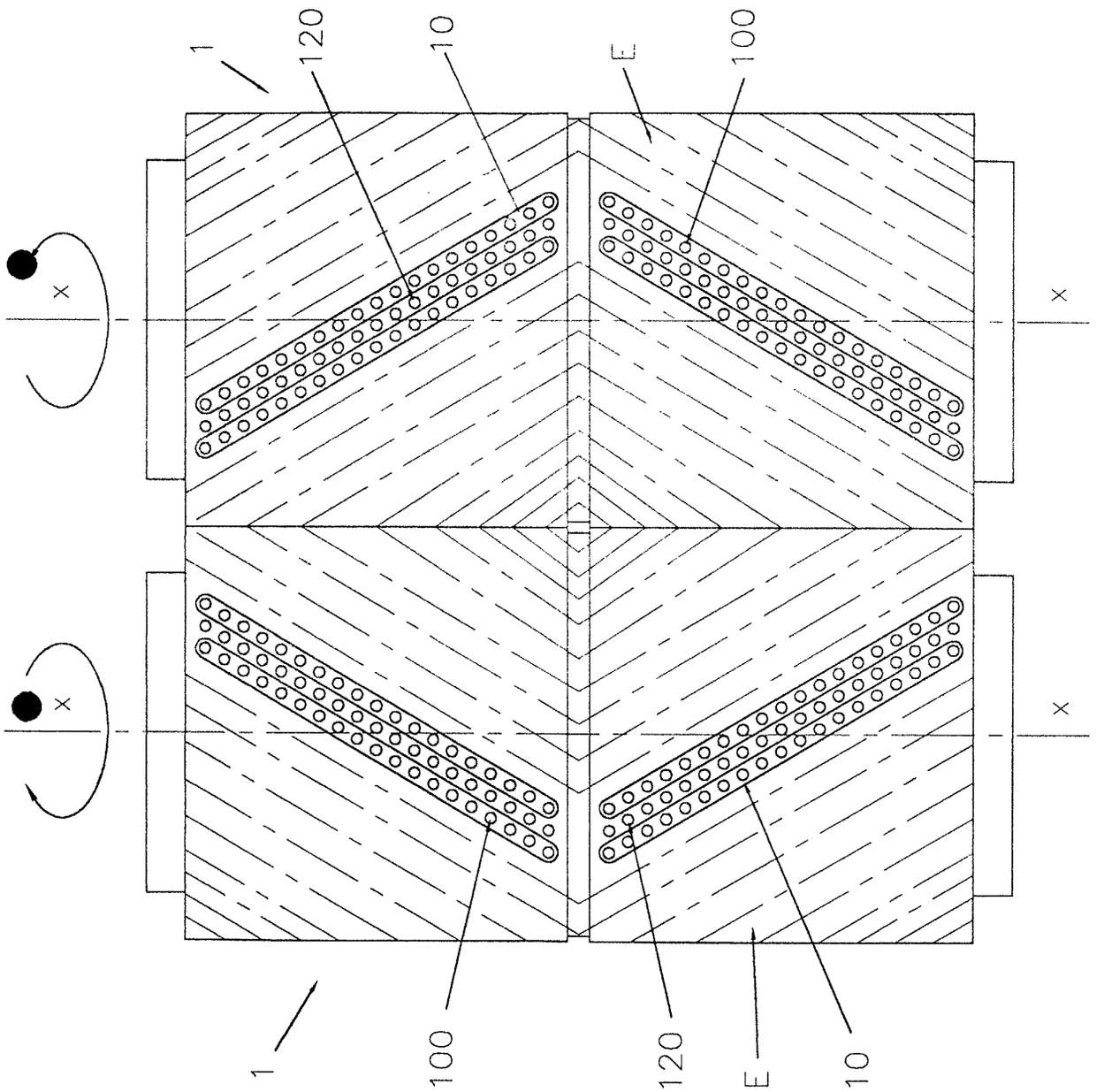



Fig. 8

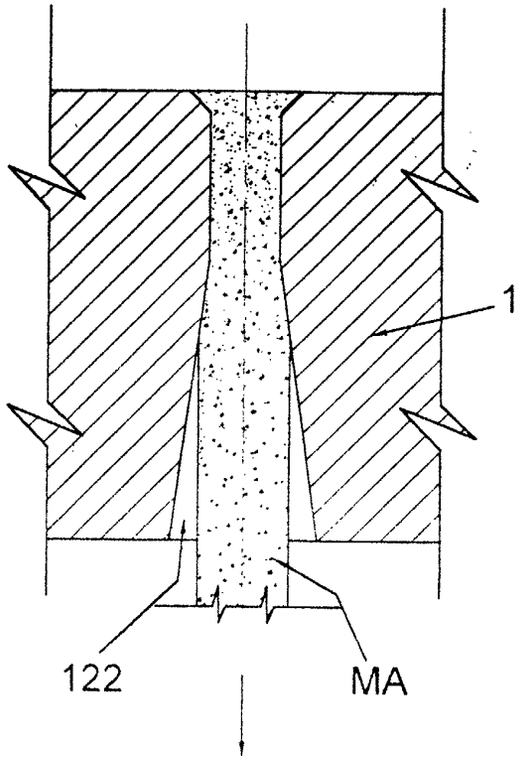



Fig. 9

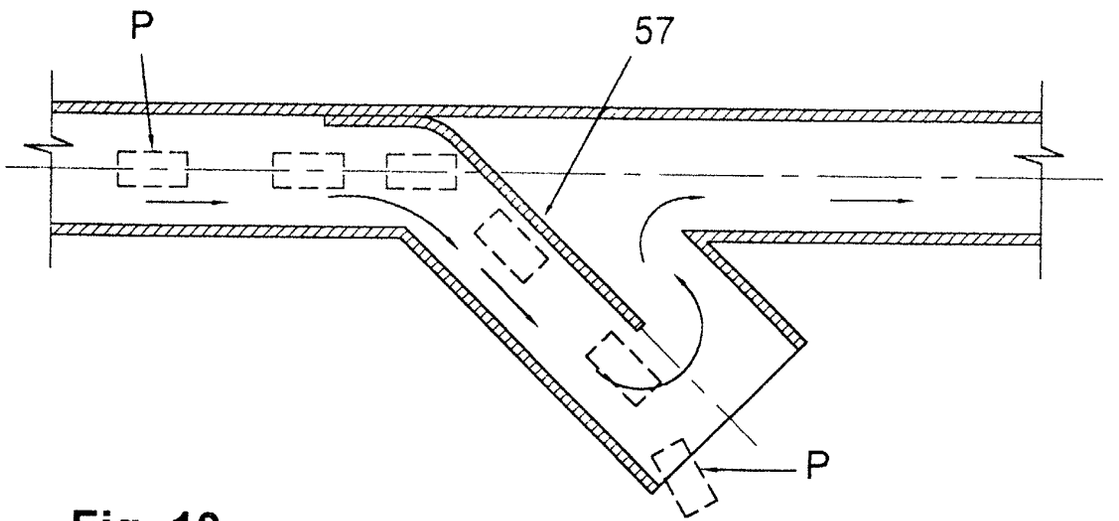
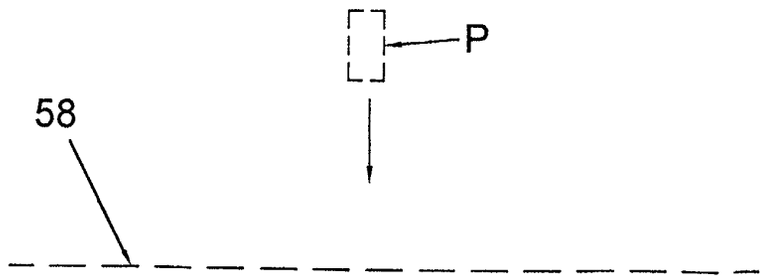



Fig. 10



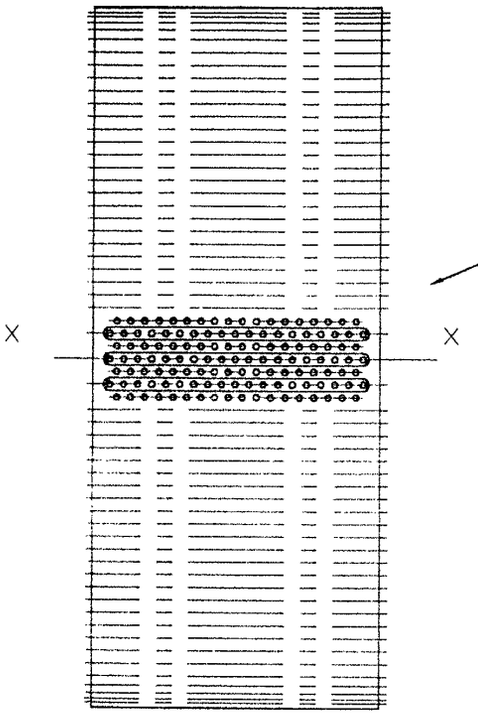



Fig.11

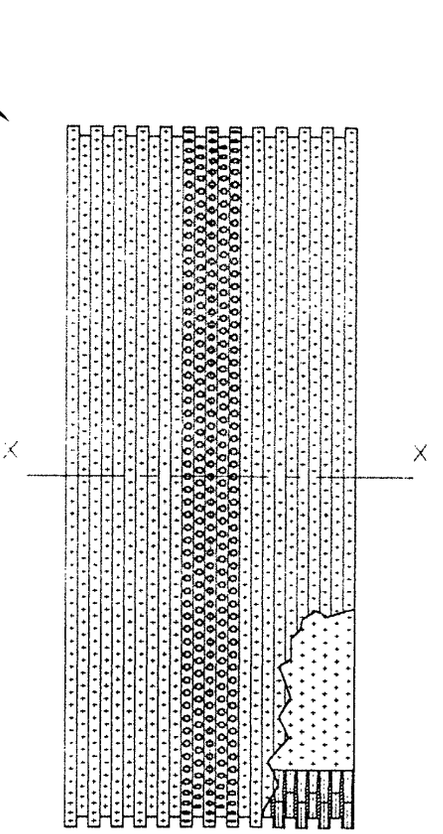



Fig.12

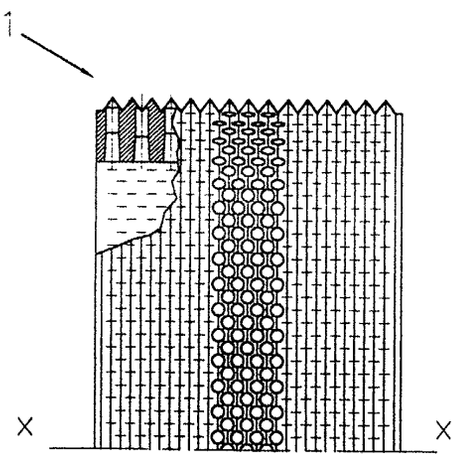



Fig.13

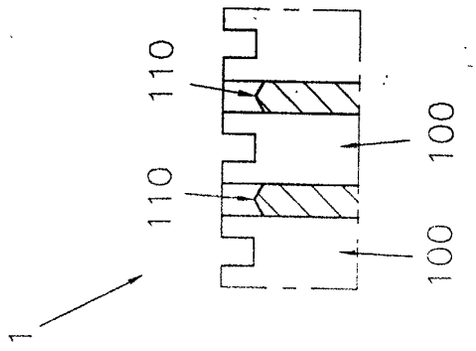



Fig. 16

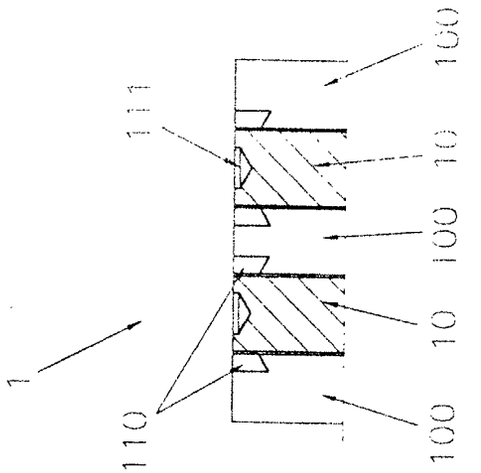



Fig. 15

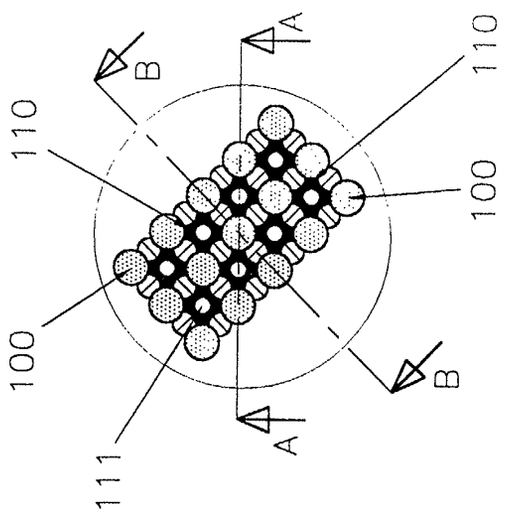



Fig. 14

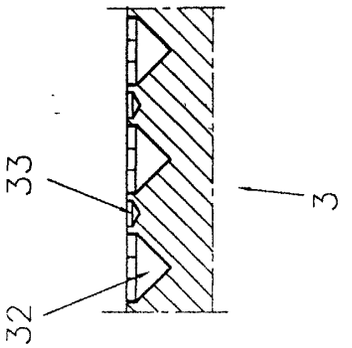



Fig. 18

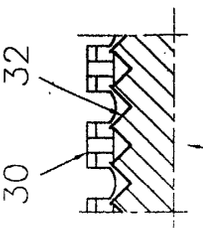



Fig. 19

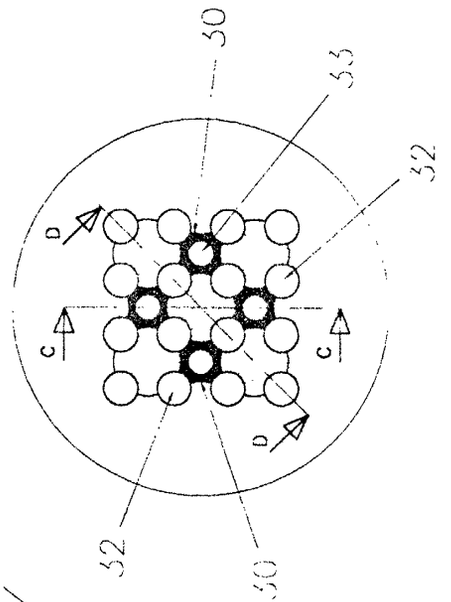



Fig. 17

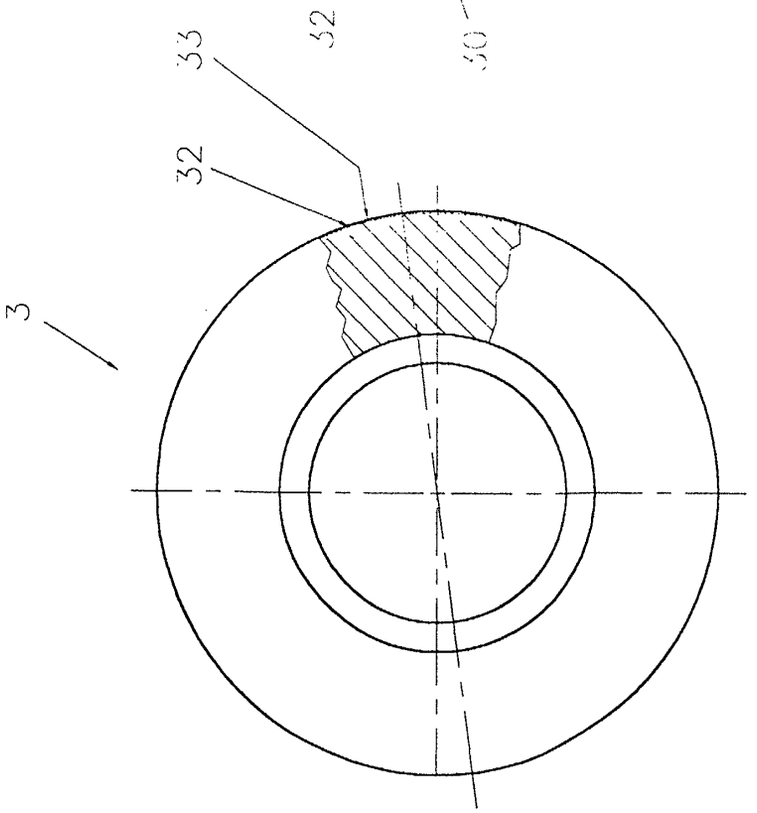



Fig. 20

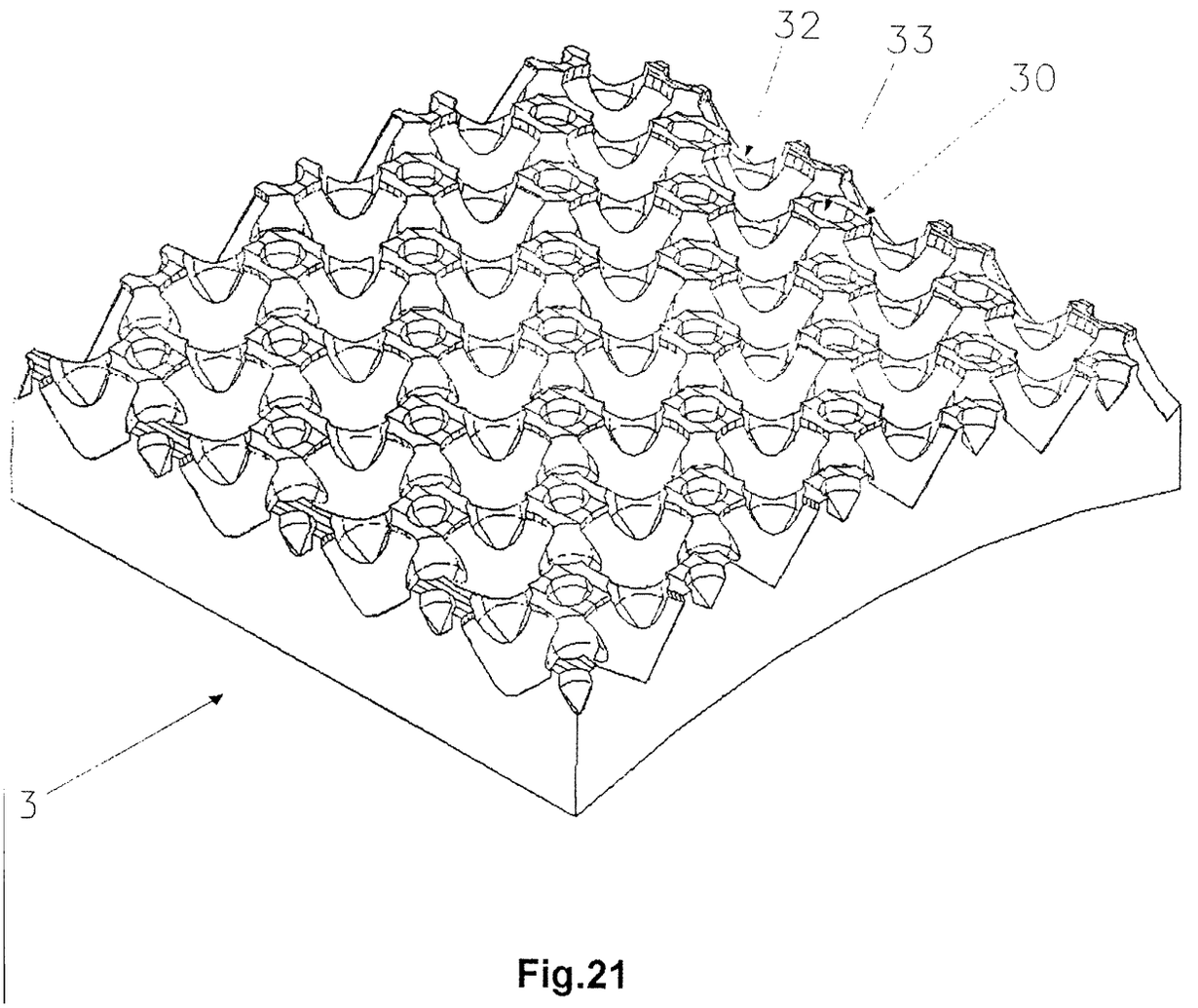



Fig.21

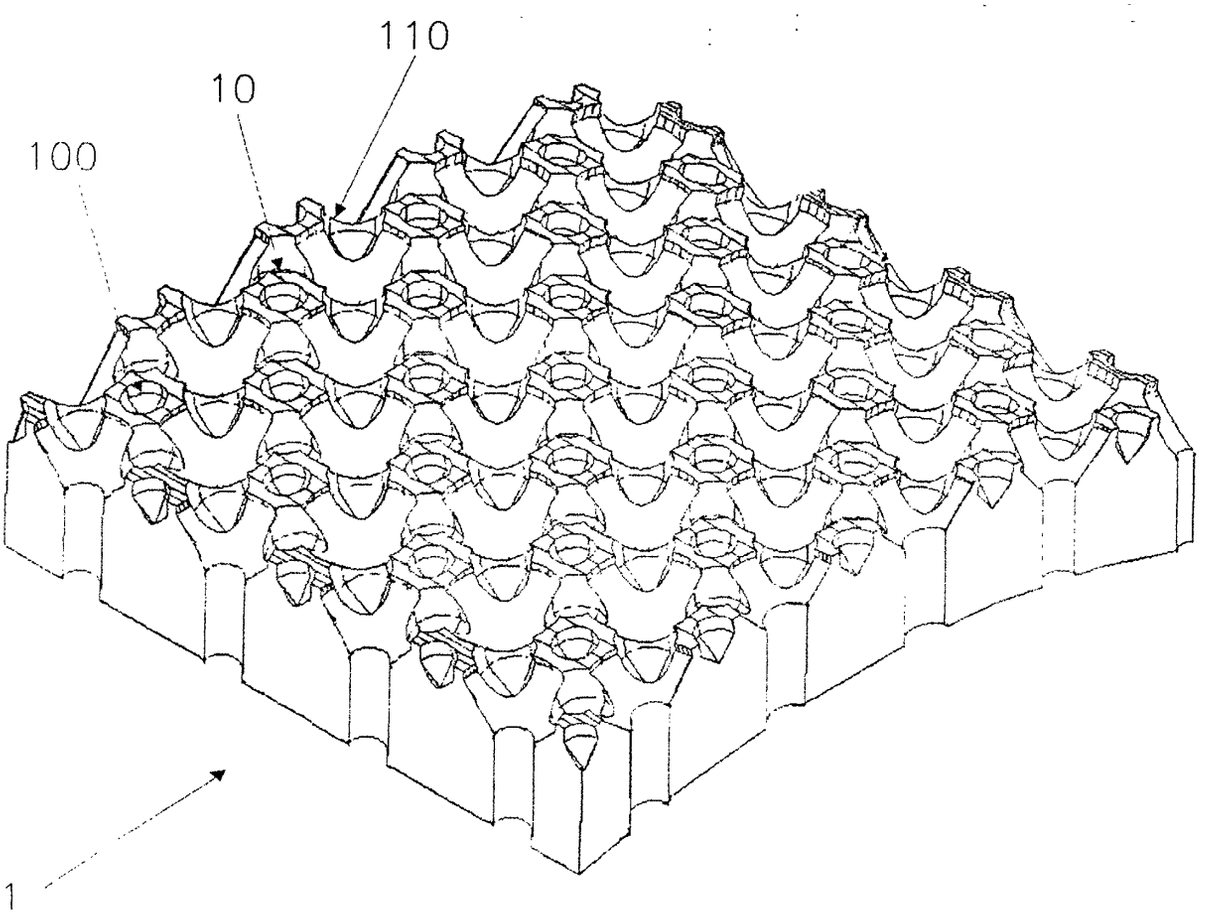



Fig.22

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 02 42 5290

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.7) |
|---|---|---|---|
| X | US 2 186 415 A (HAWORTH JAMES P)<br>9 January 1940 (1940-01-09)<br>* column 2, line 33 - column 3, line 33; figures 1,4 * | 1,3-5, 7-10 | B30B11/28 |
| D,A | EP 0 846 554 A (ECOGEST S R L)<br>10 June 1998 (1998-06-10)<br>* figure 4 * | 2 | |
| A | DE 42 14 111 A (HAIMER FRANZ)<br>4 November 1993 (1993-11-04)<br>* claims 23,24; figure 2 * | 3,6 | |
| A | GB 382 819 A (ALBERT WILLIAM SIZER)<br>3 November 1932 (1932-11-03)<br>* column 1, line 9 - line 18 * | 1 | |
| A | DE 40 38 582 A (HAIMER FRANZ)<br>11 June 1992 (1992-06-11)<br>* claims; figure 1 * | 4 | |
| | | | TECHNICAL FIELDS SEARCHED (Int.Cl.7)<br>B30B |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| MUNICH | 29 August 2002 | Lopez Vega, J |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 42 5290

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

29-08-2002

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| US 2186415 A | 09-01-1940 | NONE | |
| EP 0846554 A | 10-06-1998 | IT FI960284 A1 | 04-06-1998 |
| | | EP 0846554 A2 | 10-06-1998 |
| DE 4214111 A | 04-11-1993 | DE 4214111 A1 | 04-11-1993 |
| | | AT 130247 T | 15-12-1995 |
| | | CA 2128523 A1 | 11-11-1993 |
| | | DE 4227928 A1 | 24-02-1994 |
| | | DE 59300968 D1 | 21-12-1995 |
| | | DK 638018 T3 | 18-12-1995 |
| | | WO 9322132 A1 | 11-11-1993 |
| | | EP 0638018 A1 | 15-02-1995 |
| | | ES 2079977 T3 | 16-01-1996 |
| | | RU 2118079 C1 | 27-08-1998 |
| | | US 5622037 A | 22-04-1997 |
| GB 382819 A | 03-11-1932 | DE 570100 C | 11-02-1933 |
| DE 4038582 A | 11-06-1992 | DE 4038582 A1 | 11-06-1992 |

EPO FORM P0459

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