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(54) Method of producing animal fodder flakes, and apparatus for executing said method.

(57) A method is provided for compressing a flour-like raw material into animal fodder flakes, by guiding it between counterrotating roller bodies (1, 2). The flakes thus obtained may be further compressed in a pelletizer, in order to obtain hard and durable animal fodder pellets. Also an apparatus is provided for executing the method described. The apparatus comprises two counterrotating roller bodies (1, 2), the diameters of which may differ. The roller bodies may comprise a plurality of disks (1a, 1b, 2a, 2b) having different diameters.

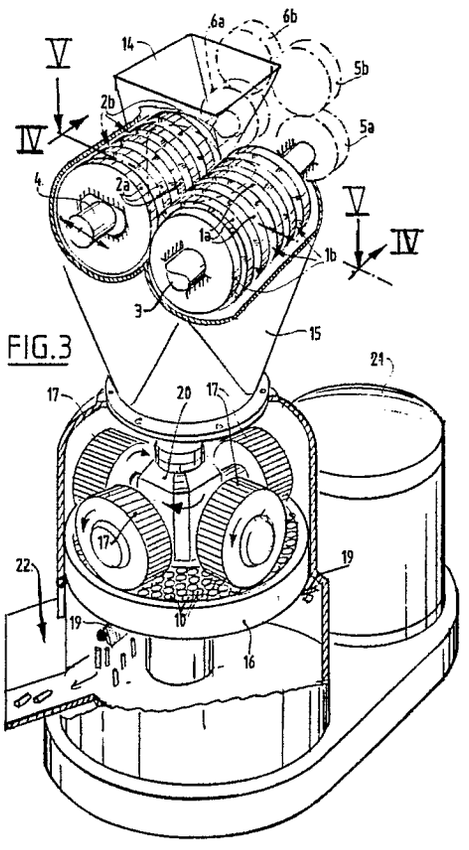

FIG.3

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Method of producing animal fodder flakes, and apparatus for executing said method.

The invention relates to a method of producing animal fodder flakes, and to an apparatus for executing this method.

It is generally known to produce animal fodder pellets from a number of raw materials, which may or may not be blended, in one or more pressing steps. Such pellets offer advantages with respect to unpressed animal fodder in that they may be more easily processed in automatic fodder systems, and in that they cause less dust and spillage related losses. It is very important that these pellets be sufficiently hard to prevent them from being crushed during processing in an automatic fodder system, or from lumping during storage in silos and thus eventually jamming the automatic fodder system.

The hardness of the animal fodder pellets is determined by various factors. These include for instance the composition of the raw material, the apparatus used in pelletizing, additions, if any, during the process, the number of operations performed on the raw material, etc. etc.. The manufacturers of animal fodders know from experience the minimum required hardness of their product, and apply the above mentioned measures in various combinations in order to attain that hardness. A problem in increasing the hardness by changing the composition of the product, is, however, that this is often detrimental to the nutritional value per product unit, or that this results in a higher unit price. Therefore, it is customary and well known to attain the required hardness by compressing the raw material in several steps.

The normal process of producing animal fodder pellets is therefore as follows: the flour to be pelletized, which may or may not be blended, is transported from its storage to a dispenser and is subsequently fed in doses to a blender. If so desired, molasses, vinasses (fermented molasses from which the alcohol has been removed) and/or other liquid may be added in the blender. Steam may also be introduced into the blender if required. The product thus obtained may optionally be kept for some time at a given temperature in a maturing tank, before being compressed a first time in a precompression apparatus. Thereafter the product is processed in the pelletizer to form animal fodder pellets. The pellets from the pelletizer are allowed to cool, and are subsequently sifted and stored.

Presently two types of pre-compression apparatuses are used. The first type is the extruder, comprising a housing in which a worm rotates for forcing the product through a narrow opening at one side of the housing, and the second type is the pelletizer, which is also used in the further process. Such a pelletizer comprises a flat, horizontally mounted die, provided with bores having the diameter required for the pellets, over which rotate one or more rollers which force the product, which is fed in at the top of the pelletizer,through the bores in the die. There are also embodiments in which the product is rolled through an annular, rotating die.

The above two pre-compression apparatuses have the disadvantage of being rather complex, and therefore expensive in procurement and maintenance. Furthermore, both apparatuses are characterized by a high energy consumption.

It is an object of the present invention to provide a pre-compression method in which the above mentioned disadvantages are overcome. According to the invention the raw material which may or may not be blended, heated or aged, is fed to a pre-compression apparatus comprising two counter rotating roller bodies and guided therethrough. In this manner a flake-like product is obtained. Such a pre-compression apparatus can be easily and inexpensively constructed and has a low energy consumption.

According to the invention the roller bodies may be disks, the rotational axes of which run parallel and which are coupled through a toothed gear, such that when one of the axes is driven, both axes counterrotate at equal speeds.

According to the invention roller bodies may be provided which counterrotate at different speeds, whereby the raw material is not only compressed, but also further blended. In a preferred embodiment of the invention an apparatus is used in which each of the axes is fitted with a plurality of adjacent disks, the diameters of adjacent disks varying, wherein the diameters of disks adjacent to a given disk both being larger or both smaller than the diameter of that disk, this such that the space between two facing disks is bounded at the sides by adjacent disks. Using such an apparatus is advantageous in that the raw material is compressed and blended as described above, without this requiring much additional energy. A further advantage is that in a pre-compression apparatus as described here, the cylindrical faces of two facing disks and the side faces of the two adjacent disks form an isolated compression rooms The application of such small, isolated compression rooms prevents the raw material from spreading out over the entire width of the pre-compression apparatus in the case only small amounts of the raw material are fed to the pre-compression apparatus, which would result in the raw material hardly being compressed at all. In the present

preferred embodiment of the pre-compression apparatus variations in the supply of raw material to be compressed will result in more or less compression rooms being filled.

According to the invention the pre-compression apparatus may be fitted with means for controlling the rotational speed of the roller bodies, through which the capacity of the pre-compression apparatus may be varied, and the apparatus in fact also acts as a metering apparatus for the pelletizer.

The pre-compression apparatus according to the invention may also be fitted with means for varying the distance between the roller bodies, thus controlling the degree of compression that is achieved in the pre-compression apparatus. Finally, the drive gear of the pre-compression apparatus may be provided with safety means which stop the pre-compression apparatus when the torque in the driven axis exceeds a given value, whereby hard objects are held in the pre-compression apparatus and prevented from damaging the expensive pelletizer.

Resuming, the method according to the invention has a great number of other advantages, in addition to the sought-after advantages of applying a simpler and thus less expensive pre-compression apparatus, having a lower energy consumption than prior art pre-compression apparatuses, which form the object of the invention. For instance the raw material is not just compressed but also additionally blended in the pre-compression apparatus according to the invention, the degree of compression is independant of the amount of raw material supplied, and the pre-compression apparatus acts not only as such, but also as metering device and even as a safeguard for the expensive pelletizer.

The accompanying figures illustrate several embodiments of an apparatus according to the invention.

Fig. 1 is a perspective view of the pre-compression apparatus in its most simple embodiment.

Fig. 2 is a partly sectional side elevational view of the preferred embodiment of the apparatus, shown in combination with a commercially available pelletizer.

Fig. 3 is a perspective view of the preferred embodiment of the apparatus, likewise shown in combination with a commercially available pelletizer.

Fig. 4 is a section along line IV-IV indicated in Fig. 3 of the preferred embodiment of the apparatus.

Fig. 5 is a section along the line V-V shown in Fig. 3 of the preferred embodiment.

As shown in Fig. 1 the pre-compression apparatus comprises two rollers or disks 1,2, each fixedly attached to a rotationally mounted shaft 3,4, to which shafts are also attached the interlocking gears 5,6. The shaft 3 is connec ted to a driven shaft 8 over a transmission gear 7. The rollers are housed in a housing 9 (only partly drawn here), which comprises a feed opening at the upper side and a discharge opening at the lower side. When the driven shaft 8 rotates, this movement is transmitted through gearing 7 to shaft 3, which transmits the movement in the opposite direction to the shaft 4 over the gearing 5 and 6. As a result the rollers 1 and 2 will rotate at the same speed but in different senses. The raw material, which falls through the feed opening of housing 9 onto the rollers 1 and 2 will be carried along by these rollers and compressed to flakes in the gap between the rollers 1 and 2, the flakes leaving the pre-compression apparatus through the discharge opening in the housing 9.

In Fig. 2 and 3 is shown how according to a preferred embodiment of the invention the rollers 1 and 2 each comprise a plurality of disks of various diameters, 1a and 1b or 2a and 2b respectively, which are again fixedly attached to the shafts 3 and 4, such that every disk with a larger diameter 1a faces a disk with a smaller diameter 2b and vice versa. Fig. 2 shows how the shaft 3, which is borne rollingly in bearings 10,10, is connected to a pulley 12 through safety means 11. When the pulley 12 is driven, the shaft 3 with the disks 1a and 1b and the tooth gear 5 mounted thereon will rotate. The tooth gear 5 will transmit the rotation to the tooth gear 6 mounted on shaft 4 (not shown in Fig. 2). Fig. 3 illustrates how, according to a preferred embodiment of the invention, the toothed gearing 5,6 is replaced by a toothed gearing 5a,5b,6b,6a, which enables the shafts 3,4 to be moved to and from each other, in order to control the degree of compression. Fig. 2 shows the raw material being fed by transport means 13 to the feeder opening 14 of the housing 9, and the raw material subsequently falling on the rollers 1,2 and being carried along by these rollers and being compressed in the gap between the rollers. The compressed flakes leave the pre-compression apparatus through the discharge opening 15, and then fall on the die 16. The flakes are then forced through holes 18 by compression rollers 17 which roll over the die, after which the thus compressed end product is cut by rotating knives 19. The compression rollers 17 and the knives 19 are attached to a vertical, rotating head 20 which is driven by the power plant 21 shown in Fig. 3. Finally, the compressed pellets are carried away by transport means 22.

Fig. 4 shows a section of two facing disks 1a and 2b, and a partial side elevational view of two disks Ib and 2a. The disks are fixedly attached to the shafts 3,4 by means of wedges 23,24. The disks are provided with grooves 25 for carrying

along the raw material. It is clearly shown that the cylindrical faces of the disks 2a and 2b together with the side faces of adjacent disks 2a define a compression room (as do the cylindrical faces of the disks 1b and 2a together with the side faces of the adjacent disks 1a).

Fig. 5 shows a top view of various pairs of disks 1a,2b and 1b,2a. The pairs of disks are all fixedly attached to shafts 3 and 4 by means of wedges 23 and 24. Each two facing disks define a compression space 26.

Claims

1. Method of producing animal fodder flakes by guiding a flour-like raw material between two counterrotating roller bodies.

2. Method according to claim 1, **characterized in that** the roller bodies move slidingly with respect to one another.

3. Method of producing hard, pelletized animal fodder by compressing an intermediate product in a so-called pelletizer, **characterized in that** the intermediate product has been obtained by the method according to claim 1 or 2.

4. Apparatus for executing the method according to claim 1, **characterized by** means for compressing a flour-like raw material into animal fodder flakes.

5. Apparatus according to claim 4, **characterized in that** said means comprise two counterrotating roller bodies separated by a gap for the product to be compressed.

6. Apparatus according to claim 5, **characterized in that** the two roller bodies move slidingly with respect to one another.

7. Apparatus according to claim 5, **characterized in that** the roller bodies are disks, the rotational axes of which run parallel, and which are mutually coupled through a toothed gear such that when one of the axes is driven, both axes counterrotate at equal speeds.

8. Apparatus according to claim 7, **characterized in that** the diameters of the disks differ.

9. Apparatus according to claim 8, **characterized in that** a plurality of disks is mounted adjacent one another on each of the axes, the diameters of adjacent disks varying, and wherein the diameters of disks adjacent to a given disk are both larger or both smaller than the diameter of that disk, this such that the space between two facing disks is bounded at the sides by adjacent disks.

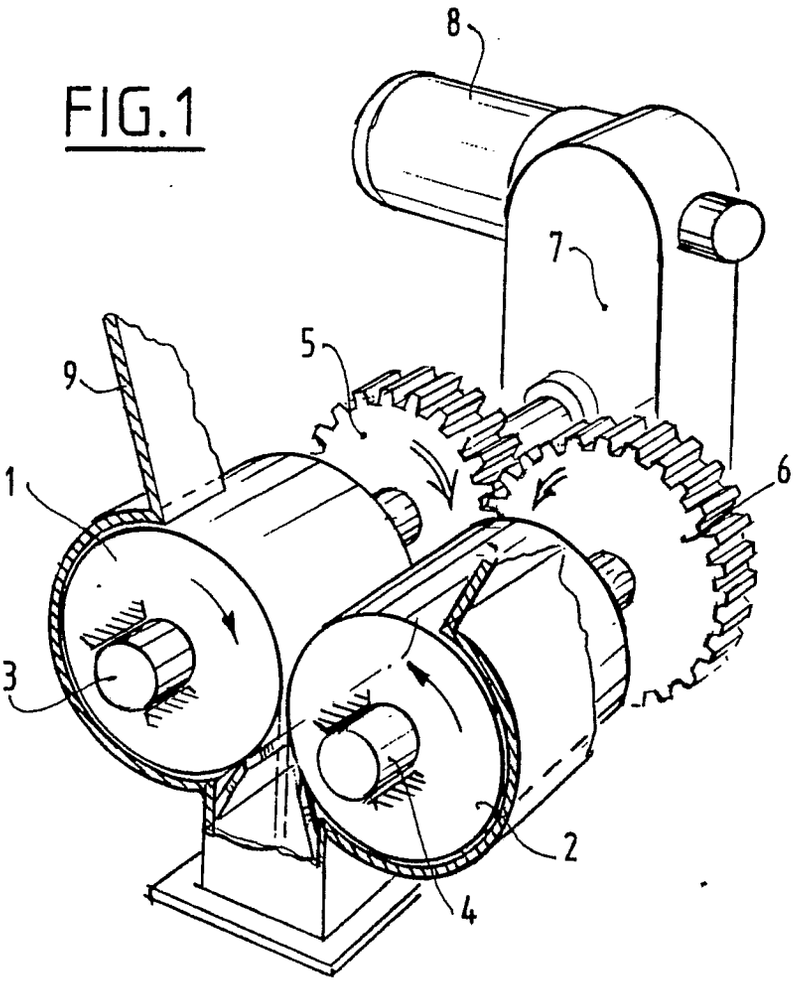
10. Apparatus according to any one of claims 7-9, **characterized by** means for controlling the rotational speed of the driven shaft.

11. Apparatus according to any one of claims 7-10, **characterized by** means for varying the distance between the two parallel shafts.

12. Apparatus according to any one of claims 7-11, **characterized in that** the drive means comprise safety means.

13. Apparatus according to any of the claims 7-10, **characterized in that** the safety means have the form of a pin which will break when subjected to an overload.

FIG.1



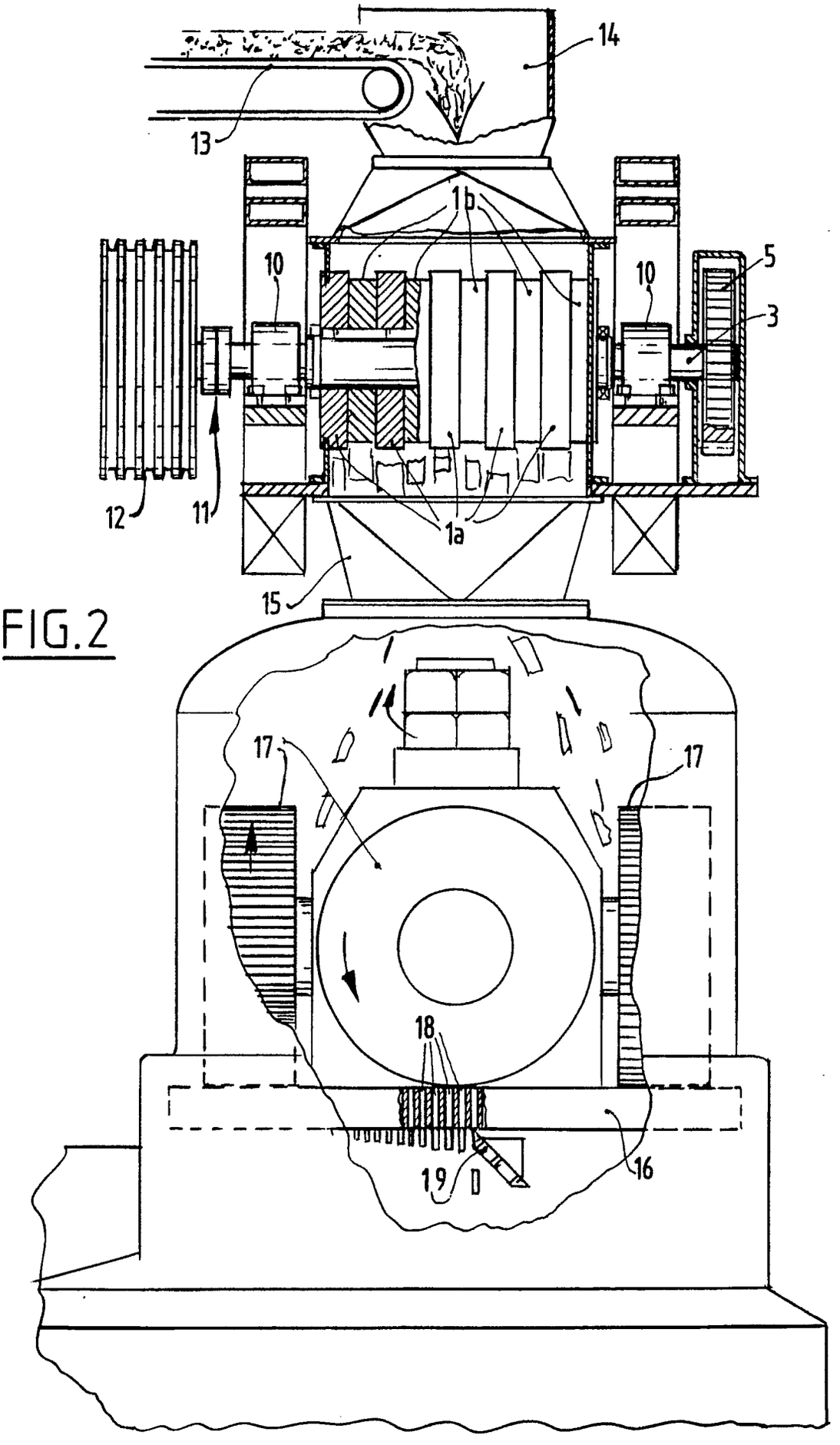


FIG.2

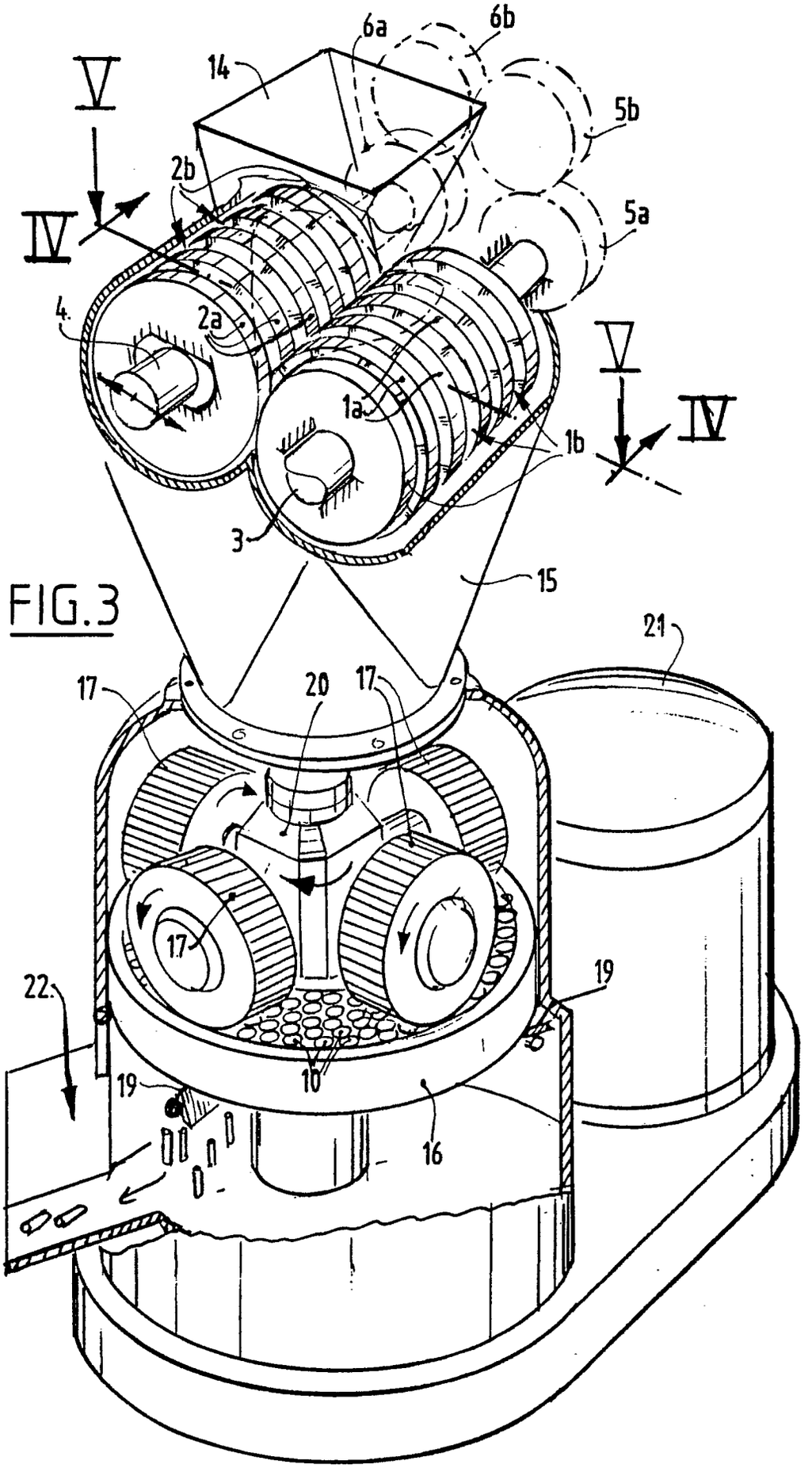


FIG.3

FIG.4

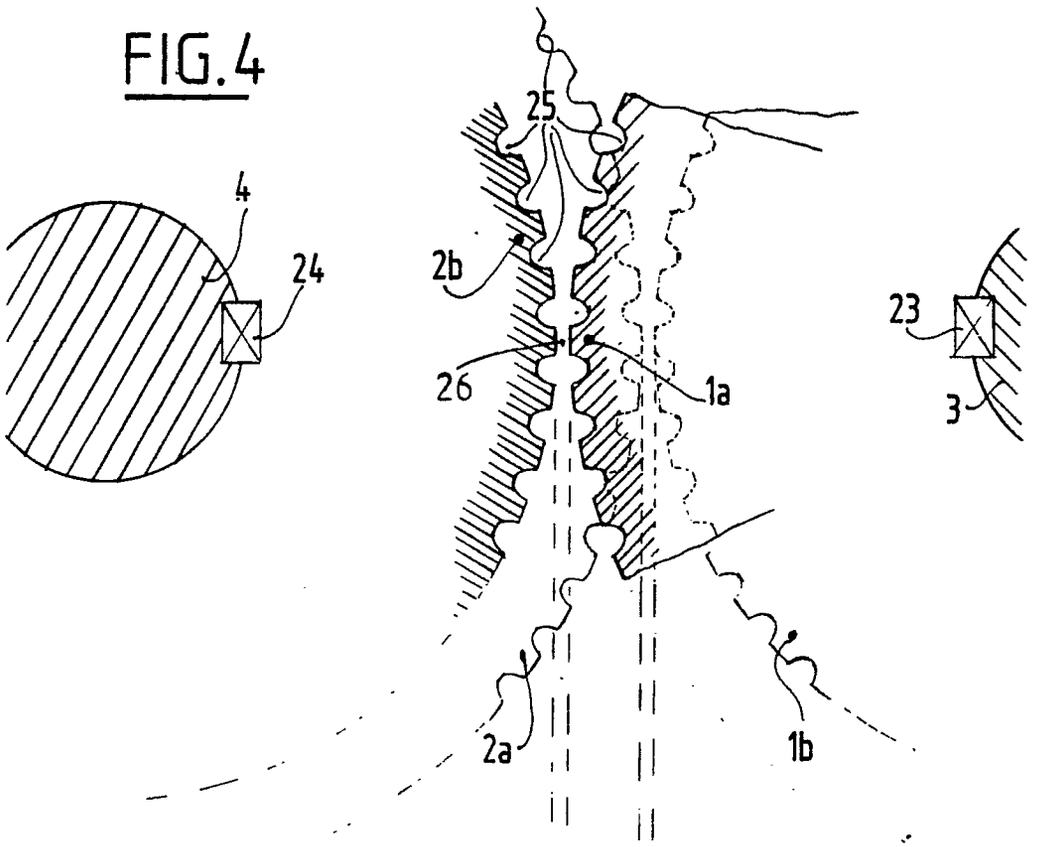
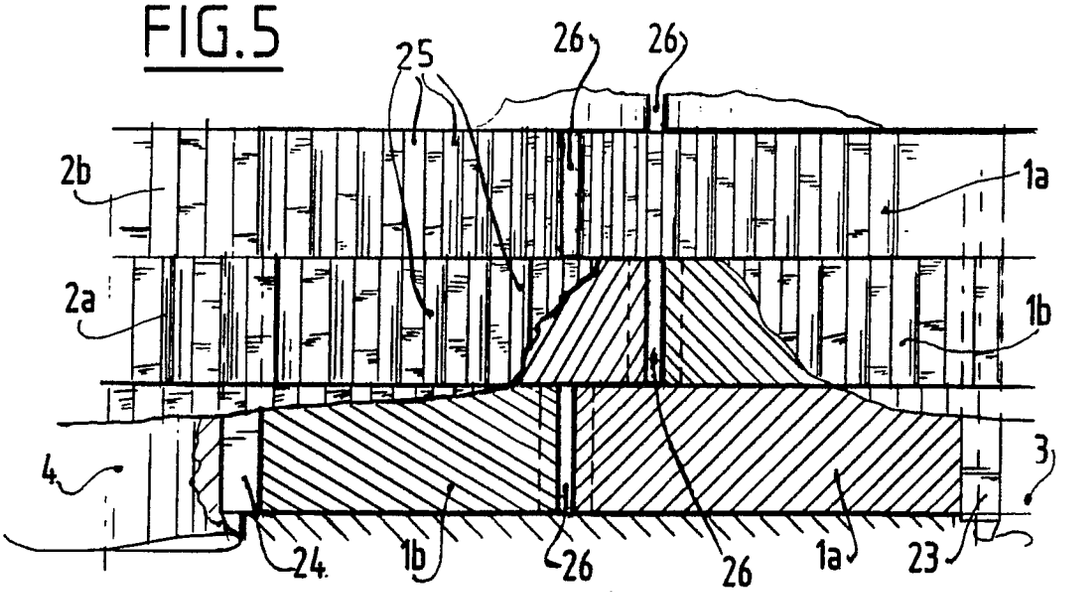


FIG.5



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EUROPEAN SEARCH REPORT

Application Number

EP 90 20 0826

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.5)
Y	DE-A-3 344 044 (KAHL) * The whole document *	1,3,4, 12,13	B 30 B 11/18 B 30 B 11/22
Y	DE-A-1 957 265 (BERGWERKSVERBAND) * The whole document *	1,4,5,7 ,11	
Y	GB-A-1 069 425 (ROSE, DOWNS, THOMPSON) * The whole document *	1,2,4-6	
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Y	US-A-3 879 157 (HEESEN) * The whole document *	1,3-5,7 -9,11	
Y	DE-A-2 420 515 (VEREINIGTE ÖSTERREICHISCHE EISEN- UND STAHLWERKE ALPINE MONTAN) * The whole document *	12,13	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 30 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	09-07-1990	BOLLEN J.A.G.

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