



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.03.2001 Bulletin 2001/12

(51) Int Cl.7: **B02C 18/14**

(21) Application number: **00870198.9**

(22) Date of filing: **11.09.2000**

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

(72) Inventor: **Van den Eynde, Willy**
2860 Sint-Katelijne-Waver (BE)

(74) Representative: **Luys, Marie-José A.H. et al**
Gevers & Vander Haeghen,
Livornostraat 7
1060 Brussel (BE)

(30) Priority: **10.09.1999 BE 9900605**

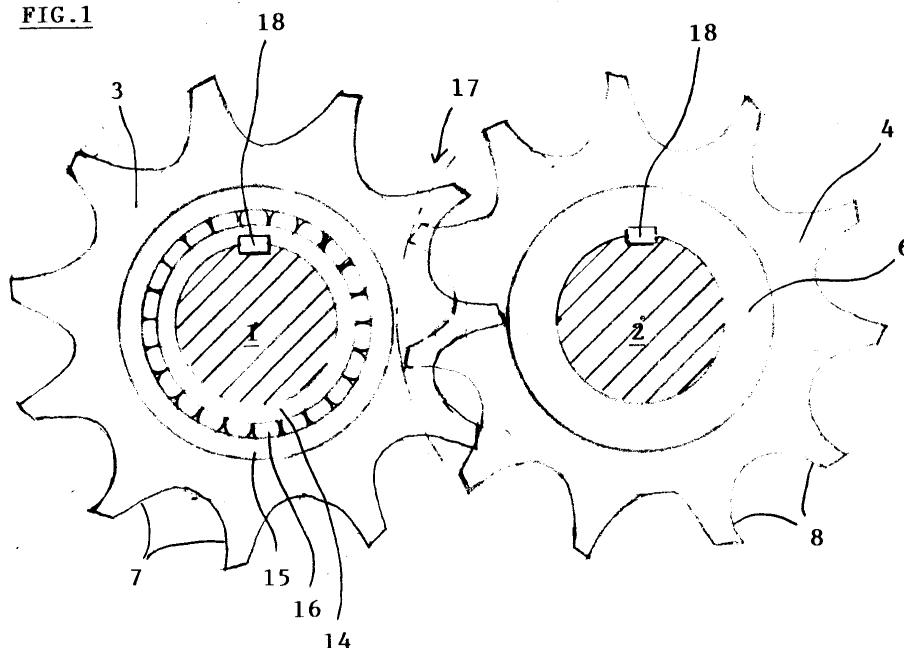
(71) Applicant: **Van den Eynde, Willy**
2860 Sint-Katelijne-Waver (BE)

(54) **Device for cutting up materials**

(57) This invention relates to a device for cutting up materials comprising a first and a second shaft (1, 2) which are mounted substantially parallel to each other, and which are provided to rotate in opposite directions. The first shaft (1) has a higher rotation speed than the second shaft (2). On each shaft (1, 2) cutting wheels (3, 4) are mounted alternating with intermediate rings (5, 6), the shafts (1, 2) being positioned in such a way that the first cutting wheels (5) on the first shaft (1) are situ-

ated between the second cutting wheels (6) on the second shaft (2). During rotation the first cutting wheels (3) on the first shaft (1) come into contact with the second intermediate rings (6) on the second shaft (2) and the second cutting wheels (4) on the second shaft (2) come into contact with the first intermediate rings (5) on the first shaft (1). The first and second cutting wheels (3, 4) have such a number of cutting teeth (7, 8) that the cutting teeth of the first and second cutting wheels move past each other.

FIG.1



Description

[0001] This invention relates to a device for cutting up materials according to preamble of the first claim.

[0002] A device for cutting up materials is for example known from EP-A-727.255. The device described herein comprises two shafts which are mounted parallel to each other. The first shaft comprises first cutting wheels alternating with first intermediate rings. The second shaft comprises second cutting wheels alternating with second intermediate rings. Each cutting wheel is provided with a set of cutting teeth and has a sharp cutting edge at both side surfaces. Each cutting tooth comprises a concave cutting face and a convex back face. The first and the second shaft are mounted in such a position towards each other that the first cutting wheels on the first shaft are situated between successive second cutting wheels on the second shaft. The cutting wheels and the intermediate rings on the first shaft have the same diameter as the cutting wheels and the intermediate rings on the second shaft. The shafts are driven by means of a driving gear and a gear wheel transmission in such a way that they have different rotation speeds and rotate in opposite directions. The gear wheel transmission from the first shaft to the second shaft is chosen in such a way that the peripheral velocity of the first cutting wheels is higher than the peripheral velocity of the second intermediate rings and the peripheral velocity of the second cutting wheels is higher than the peripheral velocity of the first intermediate rings.

[0003] During rotation of the shafts the first and second cutting wheels rotate towards each other. The first cutting teeth of the first cutting wheels have a higher speed than the second cutting teeth of the second cutting wheels. In the region between the shafts the cutting face of each first cutting tooth moves past the back face of the second cutting teeth of the adjacent second cutting wheels. Similarly, the cutting face of each second cutting tooth moves past the back face of the first cutting teeth of the adjacent first cutting wheels. The material that is situated between the first and the second cutting wheels is cut through by this movement of the cutting wheels in relation to each other.

[0004] A known problem with devices for cutting up materials is ribbon formation. This means that long, narrow pieces of material that has to be cut up passes between the cutting wheels without being cut up. These "ribbons" or long, narrow pieces of material can get wound around the intermediate rings and may obstruct the good working of the device.

[0005] The device described in EP-A-727.255 tries to solve this problem on the one hand by giving the shafts a different rotation speeds and on the other hand by making the peripheral velocity of the cutting wheels larger than the peripheral velocity of the associated intermediate ring. Ribbon formation would be prevented by the different rotation speeds of the shafts. Because of the higher peripheral velocity of each cutting wheel in

relation to the associated intermediate ring it would be obtained that no material to be cut up gets wound around the intermediate ring.

[0006] The device described in EP-A-727.255 however has the disadvantage that it solves the problem of ribbon formation insufficiently.

[0007] It is an aim of this invention to provide a device for cutting up materials, by means of which the problem of ribbon formation can be solved in a more sufficient way.

[0008] This aim is achieved according to the invention by means of a device having the technical features of the characterising part of the first claim.

[0009] In the device according to the invention the cutting wheels on the first, respectively second shaft come into contact with the intermediate rings on the second, respectively first shaft. Due to this there is not only cutting action between the cutting wheels in relation to each other, but also between the cutting wheels and the intermediate rings.

[0010] An analysis of the problem of EP-A-727.255 shows that the device is constructed in such a way that the cutting teeth of the cutting wheels do not come into contact with the associated intermediate rings and always remain at a distance of the intermediate ring. The distance is necessary to avoid material to be cut up that ends up between a cutting wheel and its associated intermediate ring, from getting compressed too much. This could cause a pressure increase and force the shafts apart. It is also possible that, because of a pressure increase, one or both shafts are bent and the device gets damaged permanently. Providing the distance between the cutting wheels and their associated intermediate rings however solves the problem of ribbon formation insufficiently, because it is still possible for ribbons to pass in between the cutting wheels and the intermediate rings without being cut up.

[0011] To minimise the risk of a pressure increase caused by a pile-up of the material to be cut up between the cutting wheel on the one shaft and the associated intermediate ring on the other shaft, each cutting wheel has such a number of cutting teeth that during rotation of the shafts the cutting teeth of the first and second cutting wheels move past each other. As the first cutting wheels have a higher peripheral velocity than the second cutting wheels, each first cutting tooth, when moving through the region where the cutting teeth of the first and second cutting wheels pass each other by, moves past at least one of the cutting teeth of the adjacent second cutting wheel. At this moment, the cutting faces of the first cutting teeth meet the cutting faces of the second cutting teeth. As the shafts rotate further, the second cutting teeth pass the first cutting teeth, and the cutting faces of the first cutting teeth meet the back faces of the second cutting teeth. In the device according to the invention each first cutting tooth cuts, every time it passes the region between the shafts, not only past the back face of a second cutting tooth, but also past the cutting

face of a second cutting tooth. This is not the case in the known device.

[0012] The above described movement of the first and second cutting teeth in relation to each other allows material to be cut up far more finely than by the known device. Because the pieces of material that end up between the cutting wheels and the intermediate rings are smaller, it is possible to decrease the risk of a too high pressure increase between the shafts. On the other hand it is also possible to let the cutting teeth on the one shaft come into contact with the intermediate rings on the other shaft, so that there is less risk of ribbon formation, during which long pieces of material pass between the intermediate rings and cutting wheels without being cut up.

[0013] A good cutting action between a cutting wheel and the associated intermediate ring is achieved because the peripheral velocity of the cutting wheel is higher than the peripheral velocity of the intermediate ring. In fact, this arrangement allows the cutting tooth to move faster than the material that be cut up that is situated on the intermediate ring, so that an improved cutting action can be obtained. This arrangement also makes it possible to prevent the cutting tooth from only pressing the material without completely cutting it through, which could cause a pressure increase that forces the shafts apart. In order to improve the cutting action, the difference in peripheral velocity between the cutting wheel and the associated intermediate ring is preferably as big as possible.

[0014] In a first preferred embodiment of the device according to the invention, the cutting wheels have substantially the same diameter on the first and the second shaft and each first intermediate ring comprises an inner ring and an outer ring, the outer ring being rotatably mounted with respect to the inner ring.

[0015] Because of the rotatable mounting of the outer ring in relation to the inner ring a good cutting action is achieved even though the two cutting wheels have a lower peripheral velocity than the first intermediate rings. Specifically in the case where material to be cut up is situated on the outer ring and ends up between the outer ring and a tooth of the associated cutting wheel, the outer ring is slowed down in relation to the inner ring, for example to the peripheral velocity of the associated second cutting wheel or slower. Because of this slowdown, it becomes possible that material between the cutting teeth of the second cutting wheels and the outer ring is still being cut through and an undesirable pressure increase, that forces the shafts apart, can be avoided.

[0016] The rotatable mounting can be obtained by means of a ball-bearing or by any other method known to the man skilled in the art.

[0017] To improve the cutting action the rotation speeds of the first and the second shaft are preferably chosen in such a way that the peripheral velocity of the first intermediate rings on the first shaft is higher than

the peripheral velocity of the second cutting wheels on the second shaft. Such a choice of rotation speeds involves the fact that the peripheral velocity of the first cutting wheels on the first shaft is a lot higher than the peripheral velocity of the second intermediate rings on the second shaft. In addition, such a choice makes the rotation speed of the first cutting wheels on the first shaft a lot higher than the peripheral velocity of the second cutting wheels on the second shaft.

[0018] The first embodiment of the device according to the invention offers the advantage that it allows improving the global cutting action of the device, by the difference in rotation speed between the first and the second shaft, with the provision that the outer rings are rotatably mounted on the inner rings on the first shaft in order to achieve a good cutting action between the second cutting wheels of the second shaft and the first intermediate rings of the first shaft.

[0019] In a second preferred embodiment of the device according to the invention the device comprises a first driving gear on a first shaft that meshes with a second driving gear on the second shaft. The first driving gear has a first core diameter, the second driving gear has a second core diameter. The first cutting wheels on the first shaft have a diameter larger than the first core diameter, the second cutting wheels on the second shaft have a diameter larger than the second core diameter. In this respect, the first and second core diameters are defined as the diameter of the first and second driving gear respectively, as measured in a first, and second core circle respectively, drawn halfway the teeth of the first and second driving gears respectively. The core circles of the driving gears contact each other where the driving gears mesh, and have exactly the same peripheral velocity during rotation of the shafts. Due to the fact that the cutting wheels of the first shaft are bigger than the first core circle, they have a higher peripheral velocity than the first core circle. Similarly, the cutting wheels on the second shaft have a higher peripheral velocity than the second core circle. As the intermediate rings on one shaft and the cutting wheels on the other shaft have been dimensioned in such a way that they exactly contact each other, it follows that the intermediate rings on the first and second shaft respectively are smaller than and have a lower peripheral velocity than the first and second core circles respectively. This results in the peripheral velocity of the cutting wheels on the first and second shaft respectively being higher than the peripheral velocity of the intermediate rings on the second and first shaft respectively, thus achieving proper cutting action.

[0020] The second embodiment offers the additional advantage that the use of ball-bearings, in order to obtain a good cutting action, can be avoided. In addition, because the first cutting wheels on the first shaft and the second cutting wheels on the second shaft differ in size, a big difference in peripheral velocity of the cutting wheels can be obtained, which allows for an additional

improvement of the cutting action.

[0021] In the device of this invention preferably one or more supporting ball-bearings next to at least one of the shafts are provided to prevent the shafts from being moved apart from each other and to limit the risk of damage to the device. The supporting ball-bearings are mounted against one or more intermediate rings. These support ball-bearings can exercise an opposite force during pressure build-up resulting from the presence of material to be cut up between the shafts.

[0022] Preferably, one of the shafts can be moved to and from the other shaft, the shafts preferably remaining parallel to each other. By this arrangement the distance between the shafts can be minimised and the contact between the cutting wheels and their respective intermediate rings can be ensured, thus maintaining optimal cutting action in spite of wear of the cutting gears or intermediate rings.

[0023] The invention will be further elucidated with the following description and the appended figures.

[0024] Figure 1 shows a section in a plane at right angles to the shafts of a first preferred embodiment of the device according to the invention.

[0025] Figure 2 shows a top view of the embodiment of figure 1.

[0026] Figure 3 shows a series of alternating cutting wheels and intermediate rings to be mounted on a shaft of the device according to the invention.

[0027] Figure 4 shows two cutting wheels and intermediate rings of the device according to the invention.

[0028] Figures 5 and 6 show a schematic representation of a second preferred embodiment of the device according to the invention.

[0029] The device of this invention is suitable for cutting up various materials of various forms, for example plastic packaging, materials comprising plastic, but other materials and forms as well.

[0030] The device as shown in figures 1 and 2 comprises a first shaft 1 and a second shaft 2, which are mounted substantially parallel to each other. The shafts are provided to rotate in opposite directions, at different rotation speeds. The first shaft 1 has a higher rotation speed than the second shaft 2. On the first shaft 1 first cutting wheels 3 and first intermediate rings 5 are mounted alternately. The second shaft 2 with second cutting wheels 4 and second intermediate rings 6 are mounted alternately. The shafts 1, 2 are mounted in such a way, that the first cutting wheels 3 on the first shaft 1 are situated between the second cutting wheels 4 on the second shaft 2. Each cutting wheel 3, 4 comprises a plurality of cutting teeth 7, 8 for cutting up material. The number of cutting teeth 7 of the first cutting wheels 3 may be equal to or differ from the number of cutting teeth 8 of the second cutting wheels 4.

[0031] The cutting wheels 3, 4 and the intermediate rings 5, 6 are dimensioned in such a way, that, during rotation, the tips of the teeth of the cutting wheels 3, 4 come into contact with the outer wall of the intermediate

rings 5, 6. In addition, with regard to the cutting wheels 3, 4 and the intermediate rings 5, 6, the following applies: during rotation of the shafts 1, 2 the peripheral velocity of the first cutting wheels 3 is higher than the peripheral velocity of the second intermediate rings 6 and the peripheral velocity of the second cutting wheels 4 is higher than the peripheral velocity of the first intermediate rings 5. In addition, the cutting wheels 3, 4 comprise such a number of cutting teeth 7, 8 that the cutting teeth of the first cutting wheels 3 and the second cutting wheels 4 move past each other during rotation. This means that every first cutting tooth 7 of every first cutting wheel 3, when moving through the region 17 where the cutting teeth 7, 8 of the first cutting wheels 3 and the second cutting wheels 4 move past each other, passes at least one of the second cutting teeth 8 of the adjacent second cutting wheel 4.

[0032] In order to attach the cutting wheels 3, 4 and the intermediate rings 5, 6 to the shafts 1, 2, both shafts are provided with a bulge 18, which fits in a complementary cavity 19 in the inner wall 20 of the cutting wheels and the intermediate rings (cf. figures 3 and 4). The attachment of the cutting wheels and the intermediate rings to the shafts may also be carried out in any other way known to the man skilled in the art.

[0033] Preferably, the cutting wheels 3 on the first shaft 1 have an equal number of cutting teeth 7. If so desired the number of cutting teeth may also differ. Preferably, the cutting teeth 8 of the first cutting wheels 3 have substantially the same orientation, but they may also have a different orientation.

[0034] Preferably, the cutting wheels 4 on the second shaft 2 have an equal number of cutting teeth 8. If so desired the number of cutting teeth may also differ. Preferably, the cutting teeth 8 of the second cutting wheels 4 have substantially the same orientation, but they may also have a different orientation.

[0035] Preferably, the rotation of the shafts 1, 2 is brought about by means of a motor (not shown), preferably driving the first shaft 1, and a gear wheel transmission 13. This gear wheel transmission 13 comprises a first driving gear 9, mounted on an end 11 of the first shaft, which meshes with a second driving gear 10, mounted on an end 12 of the second shaft. As the rotation speed of the first shaft 1 is preferably higher than that of the second shaft 2, the first driving gear 9 is smaller than the second driving gear 10. The ratio between the first driving gear 9 and the second driving gear 10 is chosen in such a way that the peripheral velocity of the first cutting wheels 3 is higher than the peripheral velocity of the second intermediate rings 6, and that the peripheral velocity of the second cutting wheels 4 is higher than the peripheral velocity of the first intermediate rings 5.

[0036] The rotation of the shafts 1, 2 can also be brought about by means of 2 motors, one for each shaft, or by means of a motor driving the second shaft and a gear wheel transmission, or in another way known to the

man skilled in the art, in which case, however, the man skilled in the art should observe the above conditions of the speed ratio between the first and the second shaft. Driving the first and or the second shaft by means of a motor may be carried out either directly or indirectly with a gear wheel transmission.

[0037] The form of the cutting teeth 7, 8 of the cutting wheels 3, 4 of the device according to the invention is preferably as shown in figure 4. The cutting teeth 7, 8 as shown in figure 4 preferably comprise a cutting face 21, a back face 22 and a recess 23. The cutting face 21 and the recess 23 are preferably concave, and the back face 22 is preferably convex. Where the cutting face 21 and the back face 22 meet there is a cutting edge 24 that is the most protruding part of the cutting tooth and which is preferably as sharp as possible in order to obtain a good cutting action of the cutting teeth 7, 8 on the intermediate rings 5, 6 of the opposite shaft. The radius of curvature of the cutting face 21 is preferably smaller than the radius of curvature of the recess 23. As a result, when the cutting tooth 7, 8 scrapes off a piece of the material to be cut up, this piece gets a curve nearly identical to the curve of the cutting face 21. When this piece is cut from the material and ends up in the recess 23, it will fall out of the recess 23 and not become stuck as this recess has a greater radius of curvature. The first cutting teeth 7 of the first cutting wheels 3 preferably have the same form as the second cutting teeth 8 of the second cutting wheels 4. However, their form may also differ.

[0038] If so desired next to one of both shafts means can be applied to prevent the shafts from being forced apart at the occurrence of a pressure between an intermediate ring and its associated cutting wheel. To this end, for example one or more supporting ball-bearings can be mounted (not shown) or any other means known to the man skilled in the art. The supporting ball bearings are preferably mounted against to one or more intermediate rings.

[0039] Preferably, one of the shafts can be moved to and from the other shaft, the shafts preferably remaining parallel to each other. In this way the distance between the shafts can be minimised and the contact between the cutting wheels and the intermediate rings can be ensured.

[0040] The intermediate rings 5, 6, the cutting wheels 3, 4, the shafts 1, 2 and the driving gears 9, 10 are preferably manufactured in steel, using a technique known to the man skilled in the art, for example milling, casting or another technique.

[0041] In the first embodiment as shown in figures 1 and 2 the first intermediate rings 5 on the first shaft 1 comprise an outer ring 15 which is rotatable around an inner ring 14. The ability to rotate is preferably obtained by means of a ball-bearing 16 between the inner and outer ring or in any other way known to the man skilled in the art. In this embodiment the first and second cutting wheels 3, 4 preferably have the same size, but they can

also differ in size. This first embodiment allows choosing the speed ratio between the first shaft 1 and the second shaft 2 in such a way, that the peripheral velocity of the first intermediate rings 5 of the first shaft 1 is higher than the peripheral velocity of the second cutting wheels 4 on the second shaft 2, which means that the first shaft 1 can rotate faster with respect to the second shaft 2 than in the device known in the present state of the art. By the ability to rotate of the outer ring 15, it is namely achieved that the material to be cut up that gets between the first intermediate ring 5 on the first shaft 1 and the second cutting wheel 4 on the second shaft 2, can still be cut up by the second cutting wheel.

[0042] The operation of the first embodiment of the device is as follows. The material to be cut up is supplied above the cutting wheels 3, 4 and the intermediate rings 5, 6 in a way known to the man skilled in the art. The shafts 1, 2 rotate in opposite directions, so that the cutting teeth 7 of the first cutting wheels 3 and the cutting teeth 8 of the second cutting wheels 4 move towards each other at the top. This leads to the material to be cut up being pulled by the cutting teeth 7, 8 into the region 17 where the cutting teeth 7, 8 move past each other. The cutting up of the material takes place in several ways. In the first place material is cut up when a cutting tooth 7 of a first cutting wheel 3 passes between two cutting teeth 8 of the adjacent cutting wheels 4, which happens for every cutting tooth 7 in region 17 because of its higher peripheral velocity than that of the cutting teeth 8. Apart from that, material is cut up when the cutting teeth 7 of the first cutting wheels 3 come into contact with the second intermediate rings 6, during which a good cutting action is obtained by the higher peripheral velocity of the cutting teeth 7 with respect to the second intermediate rings 6. In addition, material is also cut up between the second cutting wheels 4 and the first intermediate rings 5. In this case the peripheral velocity of the second cutting wheels 4 may be smaller than the peripheral velocity of the first intermediate rings 5, but a good cutting action is obtained nonetheless because the outer rings 15 of the first intermediate rings 5 slow down with regard to the inner rings 14 when material between the outer rings 15 and the second cutting wheels 6 causes pressure. This pressure exercises a force on the outer ring 15, that is directed against the direction of rotation, and slows down the outer ring 15 and the material on it to a speed nearly equal to the peripheral velocity of the second cutting wheels 4 or even slower.

[0043] Consequently, the first embodiment allows to increase the rotation speed of the first shaft 1 in respect to the second shaft 2 in such a way, that the peripheral velocity of the first intermediate rings 5 becomes higher than the peripheral velocity of the second cutting wheels 6. This results in a substantial increase in the difference in rotation speed of the first shaft 1 and the second shaft 2 compared to the device known in the state of the art. This way, the cutting action between the first cutting

wheels 3 and the second cutting wheels 4 and between the first cutting wheels 3 and the second intermediate rings 6 can be improved substantially, without any notable decrease of the cutting action between the second cutting wheels 4 and the first intermediate rings 5. This way, the global cutting action of the device can be increased, and ribbon formation can be avoided.

[0044] In the second embodiment of the device according to the invention, as shown in figure 5, the cutting wheels 3, 4 have such dimensions that they are larger than the core circles of the driving gears on the respective shafts, the core circles being defined as the circles drawn halfway the teeth of the respective driving gears. The first driving gear 9 has a first core circle 25 with core diameter D25. The second driving gear has a second core circle 26 with core diameter D26. From the definition follows that the core circles 25 and 26 contact each other where the teeth of the driving gears 9 and 10 mesh and that they have the same peripheral velocity. The first cutting wheels 3 on the first shaft are dimensioned in such a way, that they have a periphery circle 27 with a diameter D27 that is larger than the first core diameter D25 of the first driving gear 9. This results in the first cutting wheels 3 having a higher peripheral velocity during rotation than the first core circle 25. Similarly, the second cutting wheels 4 on the second shaft are given such dimensions that they have a periphery circle 28 with a diameter D28 which is larger than the second core diameter D26 of the second driving gear 10. This results in the second cutting wheels 4 having a higher peripheral velocity during rotation than the second core circle 26. As the first cutting wheels 3 on the first shaft and the second intermediate rings 6 on the second shaft come exactly into contact, the second intermediate rings 6 have a periphery circle 30, the diameter D30 of which is smaller than the second core diameter D26. Consequently, the peripheral velocity of the second intermediate rings 6 is lower than that of the second core circle 26. Similarly, the first intermediate rings 5 have a periphery circle 29 with a diameter D29 smaller than the first core diameter D25. Consequently, the peripheral velocity of the first intermediate rings 5 is lower than that of the first core circle 25. It follows that the peripheral velocity of the first cutting wheels 3 is higher than the peripheral velocity of the second intermediate rings 6 and that the peripheral velocity of the second cutting wheels 4 is higher than the peripheral velocity of the first intermediate rings 5. Thus, with the second embodiment a good cutting action is obtained between every cutting wheel 3, 4 and every associated intermediate ring 5, 6, without making use of ball-bearings. In addition, the second cutting wheels 4 are larger than the first cutting wheels 3, which may result in a bigger difference in peripheral velocity of the cutting wheels and which may improve the cutting action between the cutting wheels themselves.

[0045] The first cutting wheels 3 and the second cutting wheels 4 of the device according to the invention

may be of equal size, as shown in figure 1, or their size may differ, as shown in figure 5. The first cutting wheels 3 on the first shaft 1 may also differ in size between themselves. This applies to the second cutting wheels 4 on the second shaft 2, as well. When dimensioning each cutting wheel 3, 4 and the associated intermediate ring 5, 6, the man skilled in the art should take into account that the peripheral velocity of the cutting wheel 3, 4 should be higher than the peripheral velocity of the intermediate ring 5, 6, or, if this is not the case, he should construct the intermediate ring 5, 6 as an outer ring 15 which can rotate around an inner ring 14 according to the embodiment of figures 1 and 2.

[0046] Finally, the following is a practical construction example of the second embodiment of the device according to the invention. The shafts 1, 2 have a width of 12 cm and a length that can vary from half a meter to several meters. On the first shaft a first driving wheel 9 is mounted with a core diameter D25 of 21 cm. On the second shaft a second driving gear 10 is mounted with a second core diameter D26 of 33 cm. As a result, the centres of the shafts are situated at a mutual distance of $(21+33)/2=27$ cm. The first driving gear has 35 teeth, the second 55 teeth. On the first shaft first intermediate rings 5 and first cutting wheels 3 are mounted alternately. The first intermediate rings 5 have a diameter of 20 cm, i.e. smaller than the first core diameter D25 of 21 cm. The first cutting wheels 3 have a diameter of 27 cm, i.e. larger than the first core diameter D25 of 21 cm. On the second shaft second intermediate rings 6 and second cutting wheels 4 are mounted alternately, in such a way that the second cutting wheels 4 are associated with the first intermediate rings 5 and the second intermediate rings 6 are associated with the first cutting wheels 3. The second intermediate rings 6 have a diameter of 27 cm, i.e. smaller than the second core diameter D26 of 33 cm. The second cutting wheels have a diameter of 34 cm, i.e. larger than the second core diameter D26 of 33 cm. A good cutting action is obtained with first cutting wheels 3 with 32 first cutting teeth 7, and second cutting wheels 4 with 40 cutting teeth 8, the cutting teeth having a form according to figure 4.

List of used reference numbers

[0047]

- 1 first shaft
- 2 second shaft
- 3 first cutting wheel
- 4 second cutting wheel
- 5 first intermediate ring
- 6 second intermediate ring
- 7 first cutting tooth
- 8 second cutting tooth
- 9 first driving gear
- 10 second driving gear
- 11 end

12 end
 13 gear wheel transmission
 14 inner ring
 15 outer ring
 16 ball-bearing
 17 region
 18 bulge
 19 cavity
 20 inner wall
 21 cutting face
 22 back face
 23 recess
 24 cutting edge
 25 first core circle
 26 second core circle
 27 periphery circle (3)
 28 periphery circle (4)
 29 periphery circle (5)
 30 periphery circle (6)

D25 first core diameter

D26 second core diameter

D27-D33 diameter

Claims

1. Device for cutting up materials comprising a first shaft (1) and a second shaft (2) which are mounted substantially parallel to each other, and which are provided to rotate in opposite directions, the first shaft (1) having a higher rotation speed than the second shaft (2), on each shaft (1, 2), cutting wheels (3, 4) being mounted alternating with intermediate rings (5, 6), the shafts (1, 2) being positioned in such a way that the first cutting wheels (5) on the first shaft (1) are situated between the second cutting wheels (6) on the second shaft (2), the peripheral velocity of the first cutting wheels (3) on the first shaft (1) during rotation being higher than the peripheral velocity of the second intermediate rings (6) on the second shaft (2) and the peripheral velocity of the second cutting wheels (4) on the second shaft (2) being higher than the peripheral velocity of the first intermediate rings (5) on the first shaft (1), characterised in that, during rotation the first cutting wheels (3) of the first shaft (1), come into contact with the second intermediate rings (6) of the second shaft (2) and the second cutting wheels (4) of the second shaft (2) come into contact with the first intermediate rings (5) of the first shaft (1), and in that the first and second cutting wheels (3, 4) have such a number of cutting teeth (7, 8) that the cutting teeth of the first and second cutting wheels move past each other.

2. Device according to claim 1, characterised in that each first intermediate ring (5) on the first shaft (1)

comprises an inner ring (14) and an outer ring (15), the outer ring (15) being rotatably mounted with respect to the inner ring (14).

5 3. Device according to claim 2, characterised in that between the outer ring (15) and the inner ring (14) a ball-bearing is situated.

4. Device according to any one of claims 1-3, characterised in that the second cutting wheels (4) on the second shaft (2) have a diameter larger than that of the first cutting wheels (3) on the first shaft.

5. Device according to any one of the claims 1-4, characterised in that the device comprises a first driving gear (9) with a first core diameter (D25) on the first shaft (1) of which the teeth mesh with the teeth of second driving gear (10) with a second core diameter (D26) on the second shaft (2), the first cutting wheels (3) on the first shaft having a diameter (D27) larger than the first core diameter (D25) and the second cutting wheels (10) on the second shaft have a diameter (D28) larger than the second core diameter (D26).

6. Device according to any one of the claims 1-5, characterised in that next to at least one of the shafts (1, 2) one or more means, preferably ball-bearings, are mounted to prevent the shafts from separating.

7. Device according to one of the claim 1-6, characterised in that the means are mounted against one or more of the intermediate rings (5, 6).

8. Device according to one of the claims 1-7, characterised in that one of both shafts (1, 2) is moveable from and to the other shaft (2, 1), with the shafts remaining substantially parallel.

FIG.1

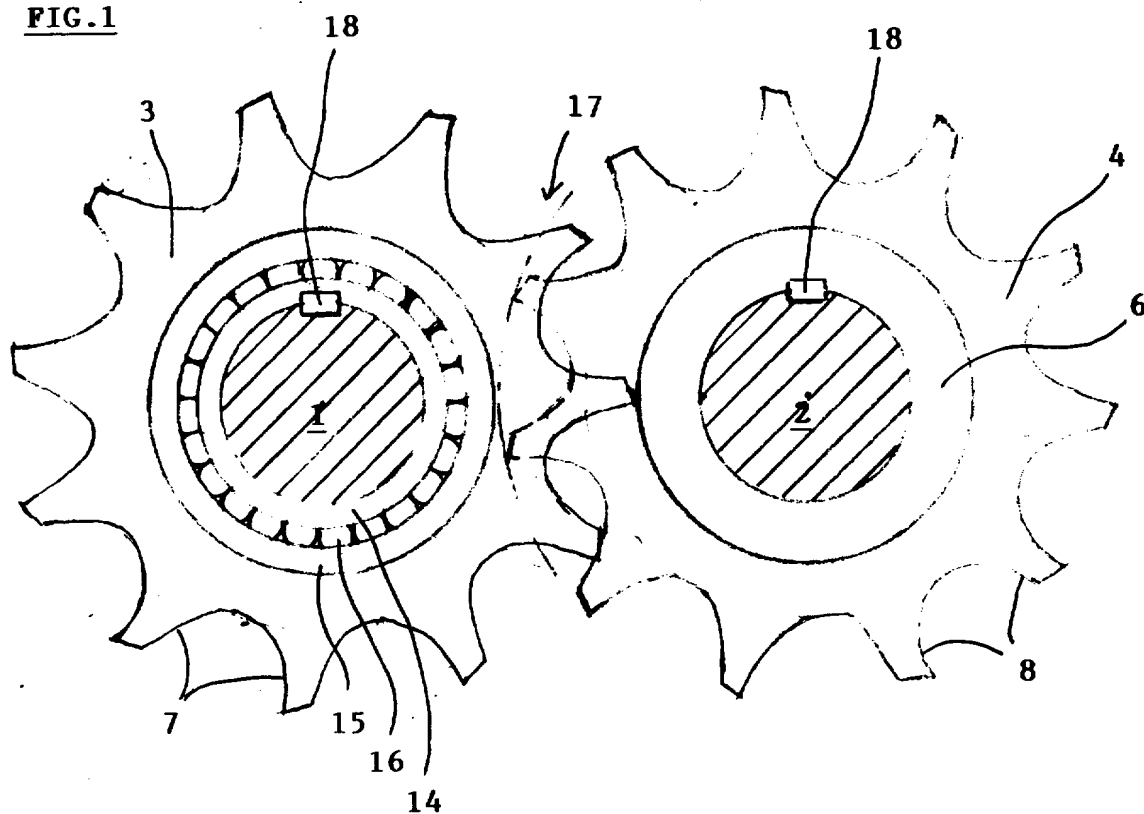


FIG.2

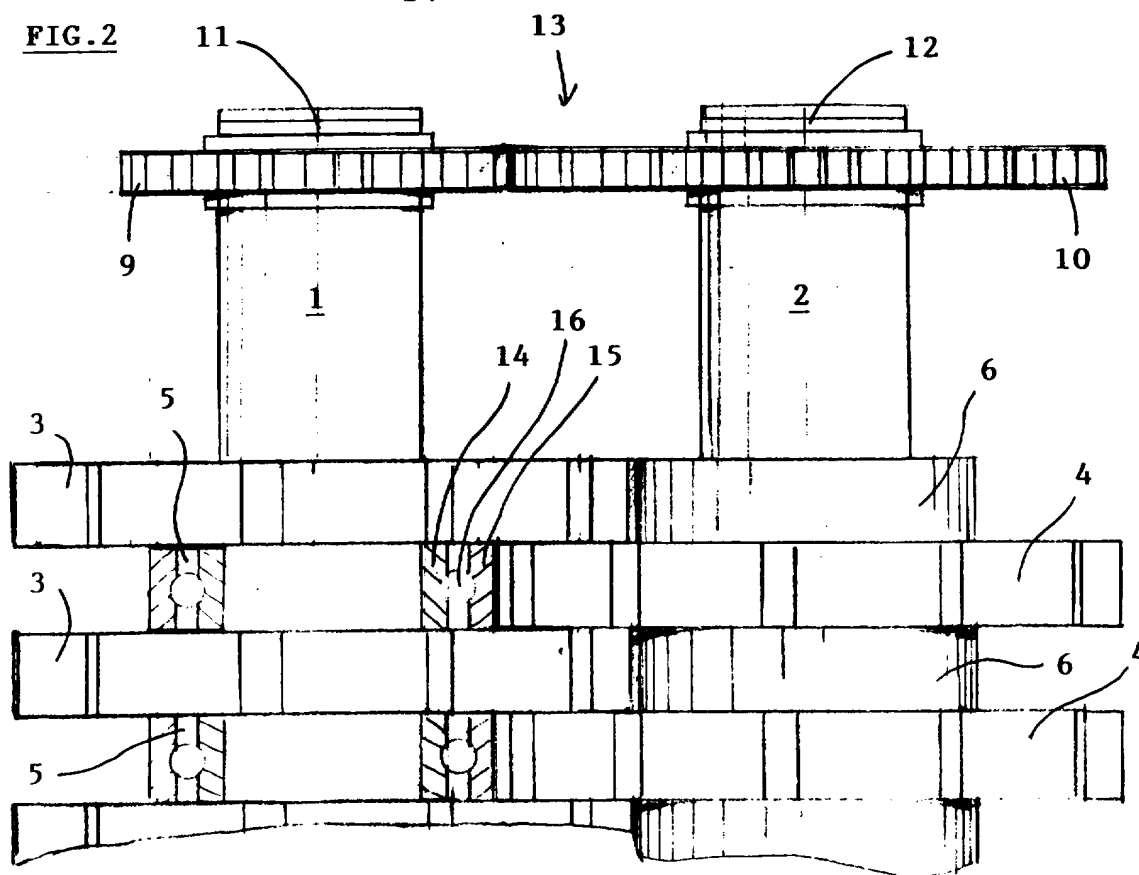


FIG. 3

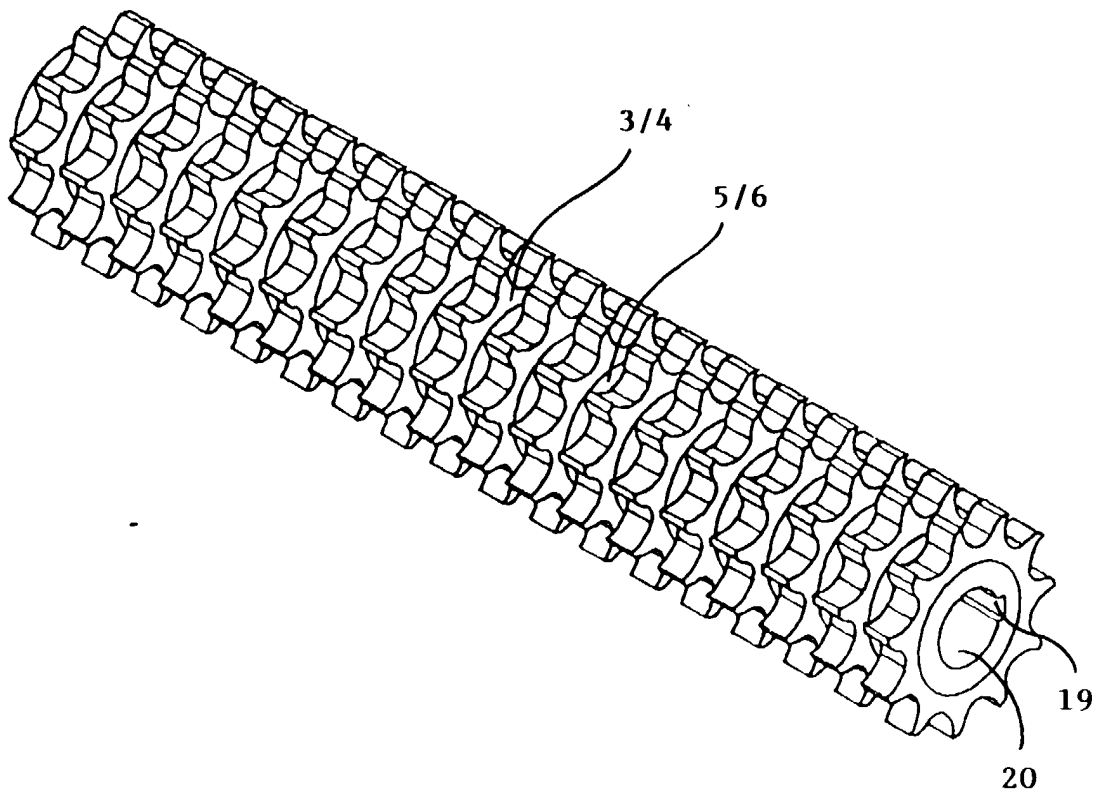
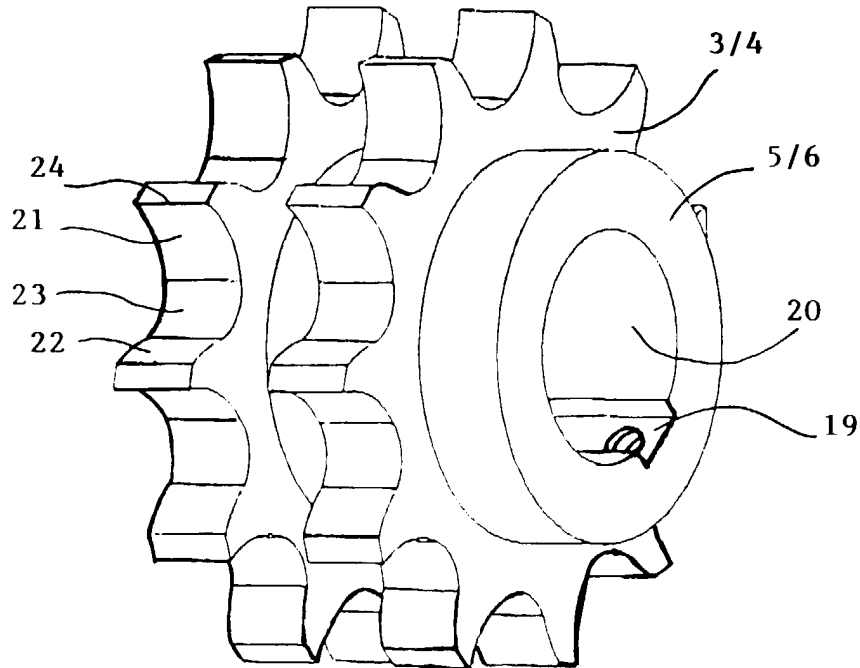


FIG. 4



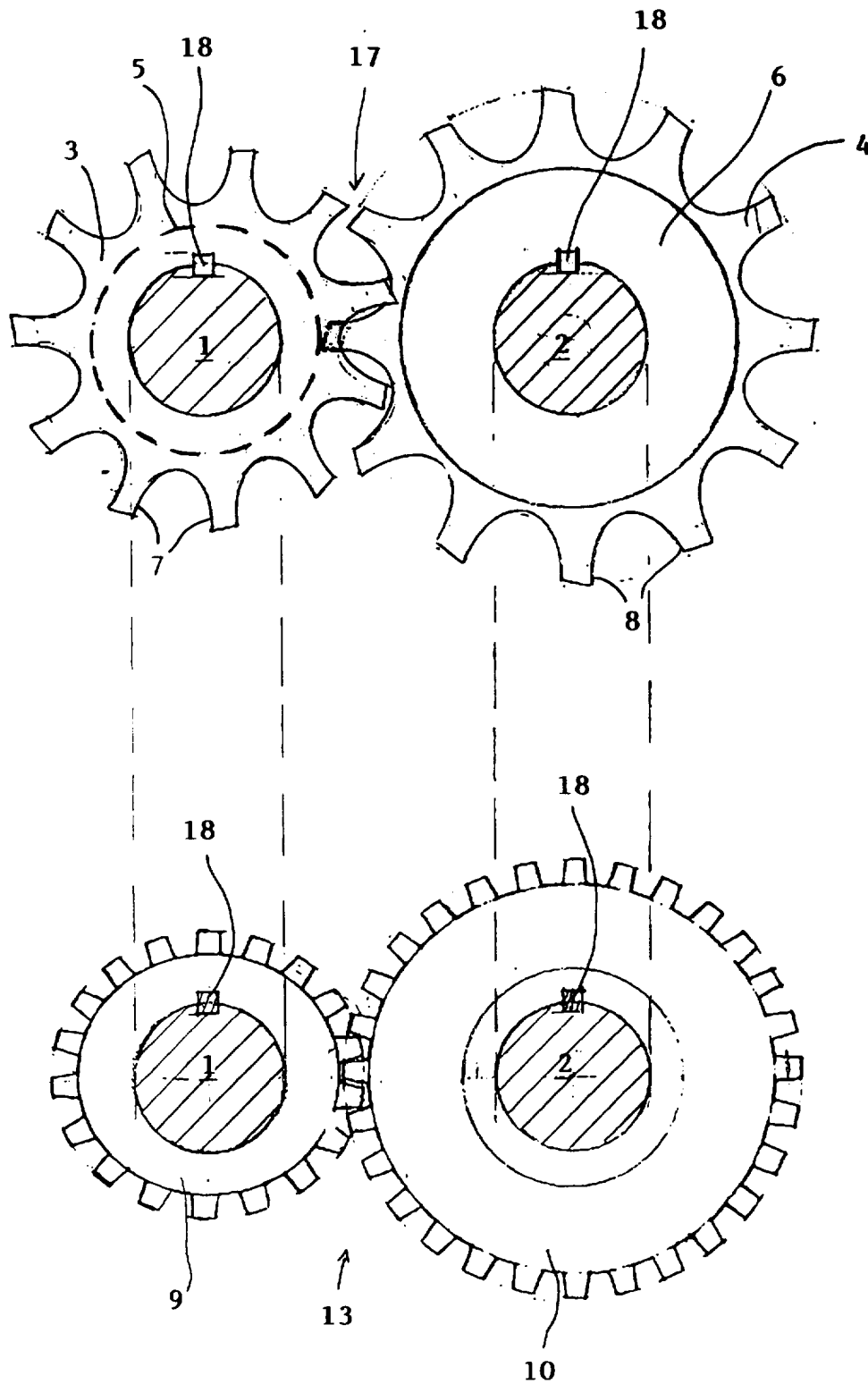


FIG. 5

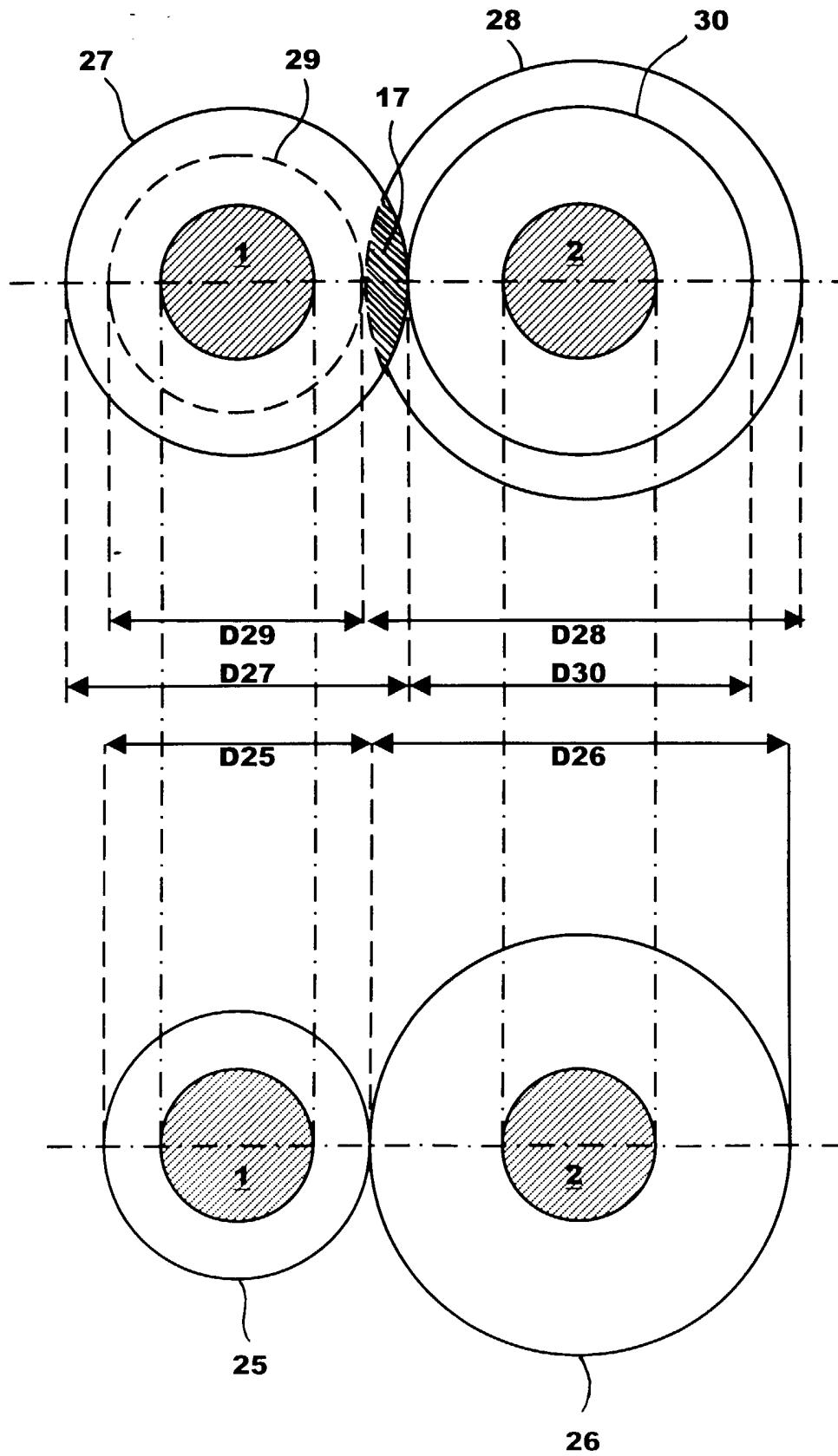


FIG.6



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 87 0198

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)
A,D	EP 0 727 255 A (MONO PUMPS LTD) 21 August 1996 (1996-08-21) * column 3, line 1 - column 4, line 4 * * figures 1-3 * ---	1	B02C18/14
A	DE 27 31 588 A (LINDEMANN MASCHFAB GMBH) 25 January 1979 (1979-01-25) * claim 1 * * page 7, paragraph 2 - page 8, paragraph 1 * * figures 2-6 * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B02C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 21 December 2000	Examiner Wennborg, 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 00 87 0198

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.

21-12-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0727255 A	21-08-1996	GB 2297927 A AU 4334896 A	21-08-1996 29-08-1996
DE 2731588 A	25-01-1979	NONE	

EPO FORM P0459

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