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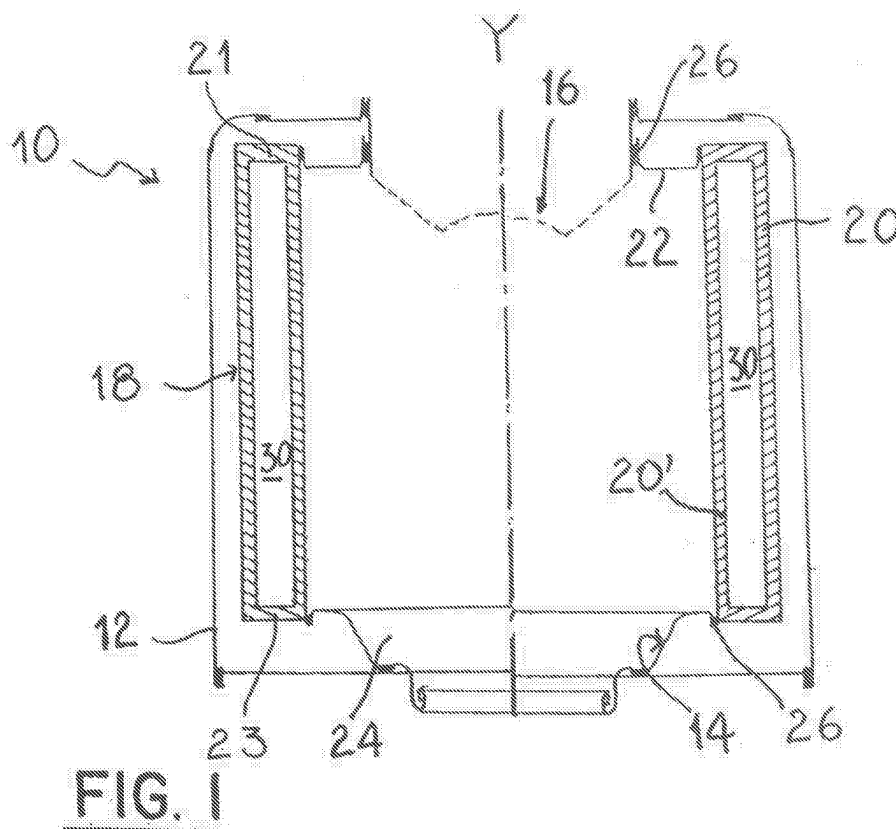
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(54) **Household laundry dryer with thermally insulated drum**

(57) An improved household laundry dryer comprises a rotatable drum (10) with an opening (14) associated to closing means for the laundry items to be dried, an inlet (16) for drying air directed to said items to be dried, support means and driving means for said drum, and is

characterized in that at least a portion of the drum (10) comprises an insulating double wall element (18) enclosing an evacuated and sealed space (30). The laundry dryer minimizes the waste of thermal energy through the walls of the drum containing the laundry items to be dried.



Description

[0001] The present invention relates to a household laundry dryer with a thermally insulated drum.

[0002] Household laundry dryers are not very energy efficient. A reason for energy waste is heat transfer through the walls of heated bodies due to poor thermal efficiency.

[0003] DE 41 04 678 A1 discloses a household laundry dryer with an improved energy efficiency achieved by shortening the path of warm air to be fed to the drum containing the laundry items to be dried. Shortening the path of warm air is in turn achieved by mounting a heating element close to a perforated portion of the drum through which heated air flows directly into the drum. This reduces the contact of warm air with parts other than the drum.

[0004] US 5,107,649 discloses embodiments of vacuum insulation panels to be used in a variety of applications, including generally clothes dryers, with no mention to insulating rotating members of household appliances. In all cases the evacuated space between the walls of an insulated panel is filled with spacers in the form of spheres, beads or elements with other discrete shapes to provide mechanical support. Although such filling elements can be made of glass or ceramic, namely of materials that minimise thermal conductance, undesired thermal bridges between the internal and external walls of the panel still exist due to numerous points of contact through the filling elements. Therefore, a waste of energy due to significant heat transfer through the walls of heated bodies still occurs. Also, when a stream of warm air transporting water evaporated from the laundry hits the cold walls of the drum, condensation of water occurs and liquid water flows back into the laundry.

[0005] There thus exists a need for a household laundry dryer with improved energy efficiency, possibly for a household laundry dryer with Class A energy efficiency.

[0006] It is therefore the overall object of the present invention to disclose an improved household laundry dryer capable of minimising the waste of thermal energy through the walls of the drum containing the laundry items to be dried.

[0007] It is a further object of the present invention to disclose an improved household laundry dryer capable of minimising the waste of thermal energy with a relatively compact drum structure suitable to be adapted to the size of commercially available dryers.

[0008] It is an additional object of the present invention to disclose an improved household laundry dryer capable of minimising the waste of thermal energy with a relatively simple drum structure, namely a structure that does not require a major increase of the manufacturing cost.

[0009] The aforesaid and other objects of the invention, as it will appear from the following description, are achieved by an improved household laundry dryer comprising a drum with an opening associated to closing means for the laundry items to be dried, an inlet for drying air directed to said items to be dried, support means and

driving means for said drum, characterised in that at least a portion of said drum comprises an insulating element having a double wall enclosing a sealed space. Such sealed space is preferably an evacuated space, i.e. with a predetermined degree of vacuum therein.

[0010] According to another aspect of the invention, said insulating double wall extends along the entire cylindrical surface of said drum.

[0011] According to a further aspect of the invention, spacers are positioned at discrete points in the evacuated space of said insulating double wall.

[0012] According to a further aspect of the invention, said double wall is shaped with projections extending inwards.

[0013] Some embodiments of the invention will now be described by way of example with reference to the attached drawings, wherein:

Fig. 1 is a schematic sectional view taken along the longitudinal axis Y of a first embodiment of drum of a laundry dryer according to the invention;

Fig. 2 is a schematic sectional view taken along the longitudinal axis Y of a second embodiment of drum of a laundry dryer according to the invention;

Fig. 3 is a schematic cross-sectional view taken along a plane perpendicular to longitudinal axis Y of a third embodiment of a drum according to the invention;

Fig. 4 is a schematic cross-sectional view taken along a plane perpendicular to longitudinal axis Y of a fourth embodiment of a drum according to the invention;

Fig. 5 is a schematic cross-sectional taken along a plane perpendicular to longitudinal axis Y of a fifth embodiment of a drum according to the invention;

Fig. 6 is a schematic cross-sectional taken along a plane perpendicular to longitudinal axis Y of a sixth embodiment of a drum according to the invention; and

Fig. 7 is a schematic cross-sectional section taken along a plane perpendicular to longitudinal axis Y of a seventh embodiment of a drum according to the present invention.

[0014] With reference to Fig. 1, a drum of a laundry dryer is generally designated with 10. Drum 10 comprises an external jacket 12 with an opening 14 for introducing the washed clothes to be dried into the dryer. Closing means associated to opening 14 are not shown since they are known to the person skilled in the art.

[0015] Also not shown are support and driving means of drum 10 as well as the cabinet in which the drum 10 is rotatably mounted, since they are well known to the person skilled in the art. An inlet 16 for a flow of warm drying air heated upstream is also provided in drum 10. A double wall element for thermal insulation generally designated with 18 is mounted within jacket 12. Wall 20 and 20' of insulating element 18 extend along the entire

internal cylindrical surface of jacket 12 in the proximity thereof, and are fixed to jacket 12 by means of top and bottom plates 22, 24 by welding seams generally designated with 26, or other suitable means. A space 30 is defined between walls 20, 20' to provide an effective insulation against heat transfer through wall 20' and 20. The space 30 is preferably evacuated, even if the double-wall construction is already sufficient for providing a good reduction of thermal conductivity. The upper and lower portions 21, 23 of walls 20, 20' are bent and joined to each other, to provide a tight seal and ensure that vacuum is maintained in space 30. The degree of insulation depends on several factors, including the degree of vacuum used in space 30.

[0016] Fig. 2 shows an embodiment of the invention in which an insulating element 18a extends along the internal cylindrical surface of jacket 12 for a significant portion of its height, not for the entire height as in the embodiment of Fig. 1. Internal wall 20' may be formed with recesses such as 32, providing a seat for spacer tubes or bolt, as it will be illustrated in the following. Although ideally it would be desirable to have an insulating element 18 that covers the entire surface of jacket 12, a compromise can be found among extent of the insulation element and structure of the external jacket, manufacturing needs, and so on.

[0017] Fig. 3 and Fig. 4 show a schematic cross-sectional view of two similar embodiments of the double wall insulating element according to the invention, designated with 18b and 18c, respectively. Internal wall 20' of element 18b is formed with four projections 34 directed inwardly, thereby increasing the size of the evacuated space 30. The function of projections 34 is twofold, since they constitute also baffles for the laundry items during rotation of the drum. Such baffles open and separate the laundry items, ultimately improving the drying efficiency. Spacer tubes 36 are forced between wall 20 and 20', to keep them spaced apart and avoid collapsing of the double wall insulating element. The number of such spacers is limited to avoid loss of insulation power due to thermal bridges. The number of spacers can be very small since the double wall insulating element of the invention exploits the "ring stability" effect of cylindrical hollow body, wherein the need for stabilisation is negligible or very limited. This makes unnecessary to fill-up the evacuated space with filling material such as glass or ceramic beads. Spacers 36 are small tubes that can engage projections formed by recesses 32 of Fig. 2.

[0018] Fig. 4 shows a structure of an insulating element 18c similar to the structure of insulating element 18b, but with more projections 38 from the internal wall 20', such projection being directed radially inwardly to a lesser extent than projections 34 of element 18b. However, they still perform both the function of increasing the volume of the evacuated space 30 and the function of baffle for the laundry items during rotation.

[0019] Fig. 5 shows an embodiment of insulating element 18d formed with projections 40 extending inwardly.

Portions 39 of element 18d not projecting inwardly run parallel to, and are in contact with, jacket 12 of the drum. Few spacers 36 are forced between wall 20, 20', to support the double wall structure of the insulating element.

[0020] Fig. 6 shows an embodiment of an insulating element 18e with two parallel walls 20, 20' and spacers 36 in the evacuated space in-between. Cup-shaped baffles 42, preferably made of plastic material, project inwardly from wall 20', and are fixed to it by means of bolts and nuts 44, or other suitable fastening means. Advantageously, bolts 44 are located in correspondence to spacers 36, which ensure stronger support than other portions of wall 20'.

[0021] Figure 7 shows an embodiment of an insulating element 18f with two parallel walls 20, 20' directly fixed together along longitudinal welded zone W. In this embodiment the distance between the walls 20 and 20' is kept by longitudinal grooves 48, so that no spacer is actually needed. Of course the welded zone W has a reduced area in order to avoid thermal bridges.

[0022] An improved energy efficiency of the household laundry dryer of the invention is achieved if a heating element of the air to be fed into the drum is positioned near the inlet 16 shown in Fig. 1 and 2. A combination of such feature with the use of a vacuum insulated drum maximises the efficiency of the dryer.

[0023] It is clear from the description above that other embodiments of the drum of a laundry dryer with insulating double wall element according to the invention are possible within the same inventive concept.

Claims

1. Household laundry dryer comprising a drum (10) with an opening (14) associated to closing means for the laundry items to be dried, an inlet (16) for drying air directed to said items to be dried, support means and driving means for said drum, **characterised in that** at least a portion of said drum comprises an insulating double wall element (18;18a;18b;18c;18d; 18e;18f) enclosing a sealed space (30).
2. Household laundry dryer according to claim 1, **characterised in that** in the sealed space (30) there is a predetermined degree of vacuum.
3. Household laundry dryer according to claim 1, **characterised in that** spacers (36) are positioned between the internal wall (20') and the external wall (20) of said insulating element (18a;18b;18c;18d; 18e), and are not in contact with each other.
4. Household laundry dryer according to claim 3, **characterised in that** each of said spacer (36) is in contact with said internal wall (20') and said external wall (20) of said insulating element (18a;18b;18c;18d; 18e).

5. Household laundry dryer according to claim 3, **characterised in that** each of said spacer (36) has the shape of a tube.

6. Household laundry dryer according to any previous claim, **characterised in that** said insulating double wall element (18a;18b;18c;18d;18e) has projections directed inwardly, thereby forming baffles (34;38;40; 42) to operatively open or separate the laundry items. 5
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7. Household laundry dryer according to claim 6, **characterised in that** said baffles are formed by projections (34;38;40) directed inwardly from said internal wall (20') of said insulating double wall element (18b; 18c;18d). 15

8. Household laundry dryer according to claim 6, **characterised in that** said baffles are cup-shaped elements (42) directed inwardly from said internal wall (20') of said insulating double wall element (18e). 20

9. Household laundry dryer according to claim 8, **characterised in that** said baffles (42) are fixed to said insulating double wall element (18e) by fastening means located in correspondence to said spacers (36). 25

10. Household laundry dryer according to claim 1, **characterised in that** said double wall element (18d) comprises projections (40) extending inwardly and portions (39) that extend parallel to, and in contact with, an external jacket (12) of said drum (10). 30

11. Household laundry dryer according to claim 1, **characterised in that** said double wall element (18f) comprises an inner wall (20') having longitudinal grooves (48) fixed to an outer wall (20), the sealed space (30) being defined in zones between said longitudinal grooves (48). 35
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12. Household laundry dryer according to any previous claim, **characterised in that** air heating means is positioned just upstream said air inlet (16). 45

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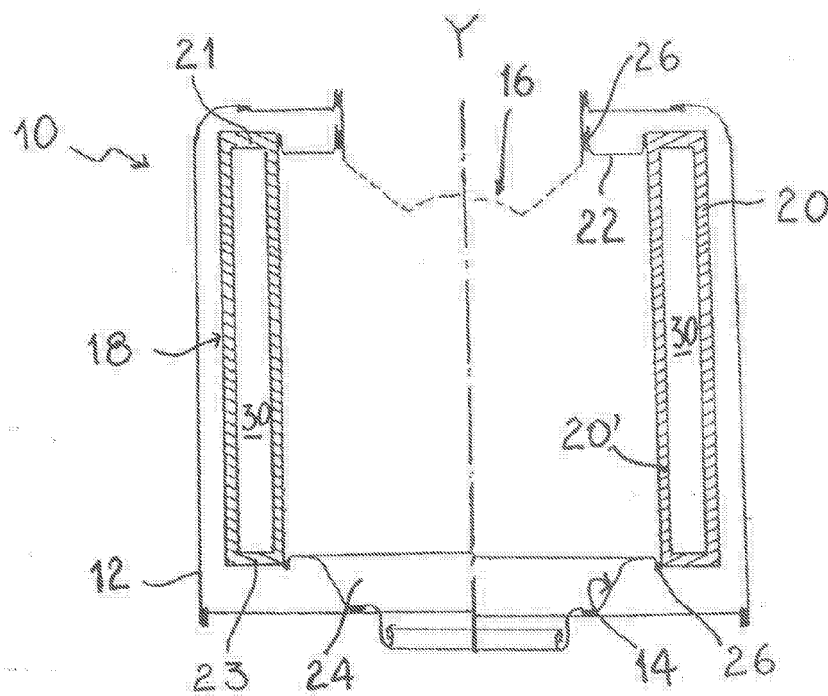


FIG. 1

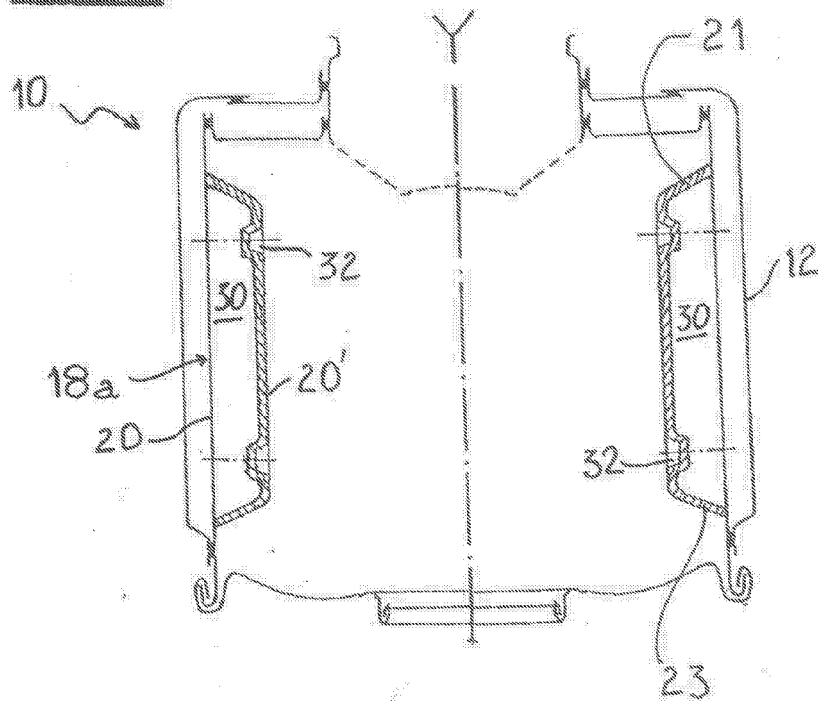


FIG. 2

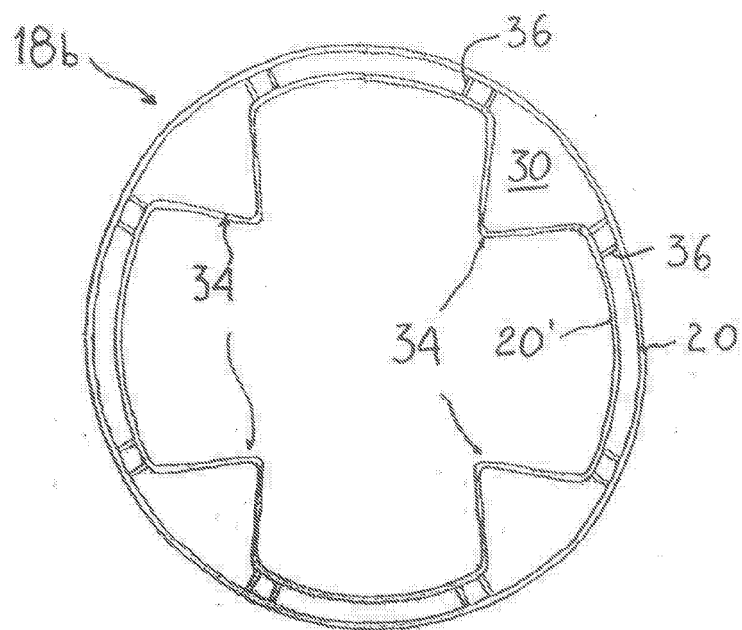


FIG. 3

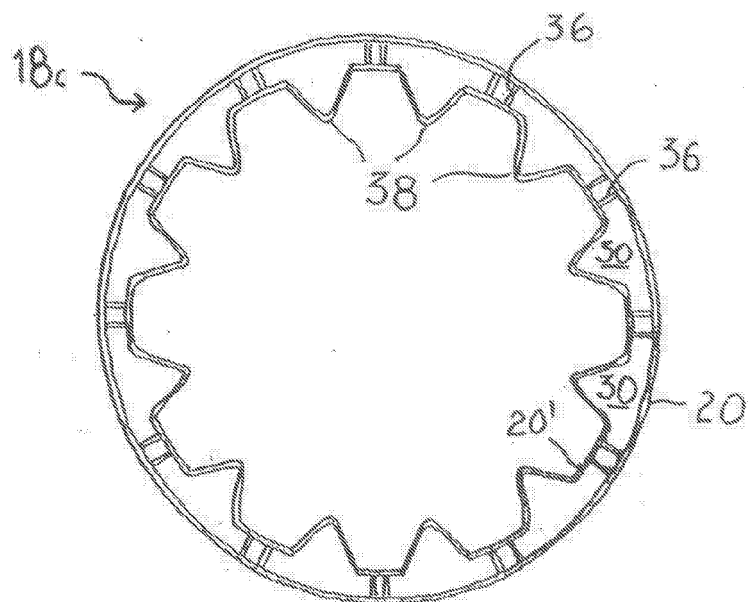


FIG. 4

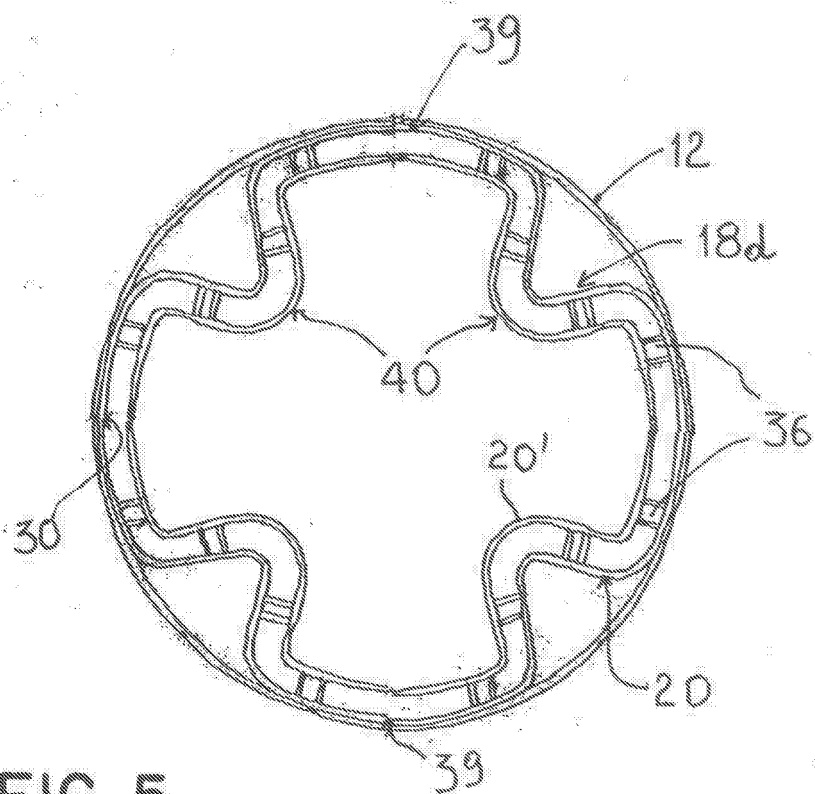


FIG. 5

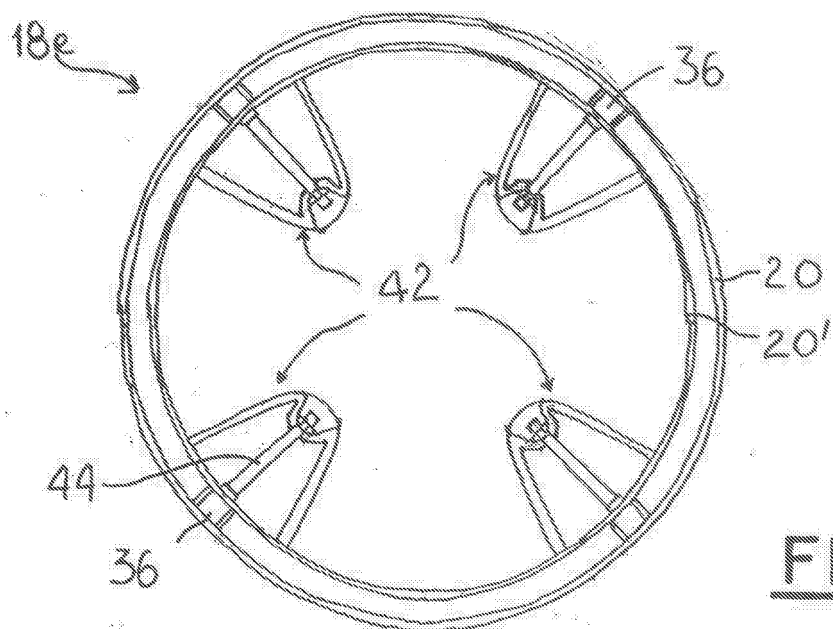


FIG. 6

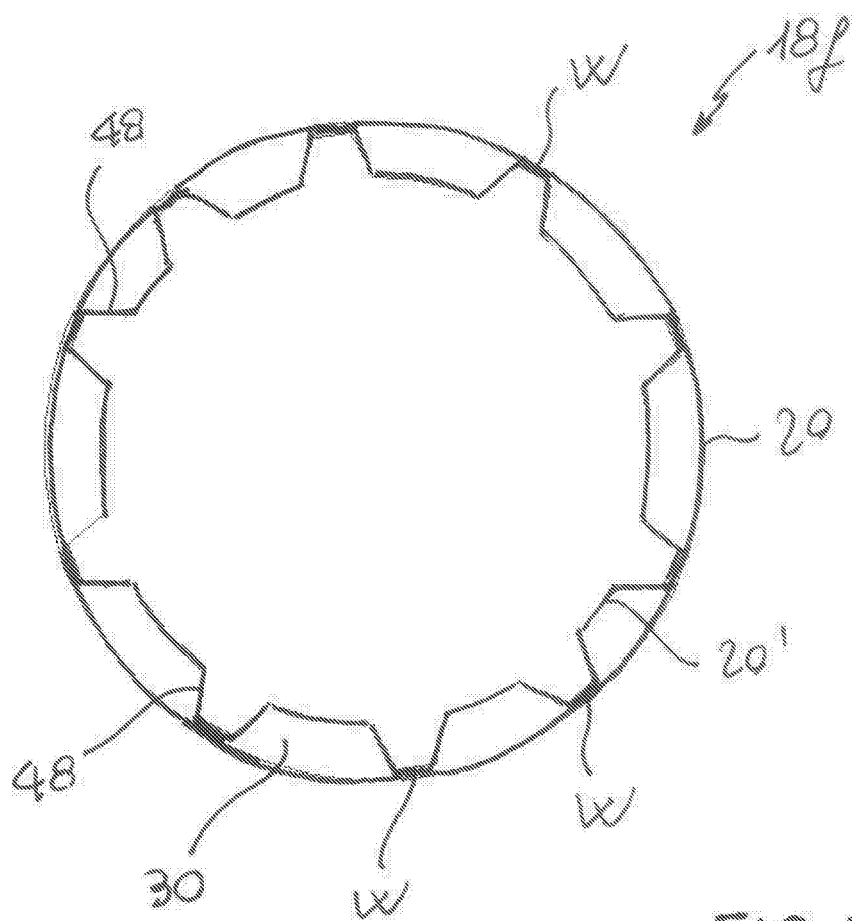


FIG. 7



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 06 11 6602

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Place of search The Hague		Date of completion of the search 28 December 2006	Examiner Ureta, Rolando
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			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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