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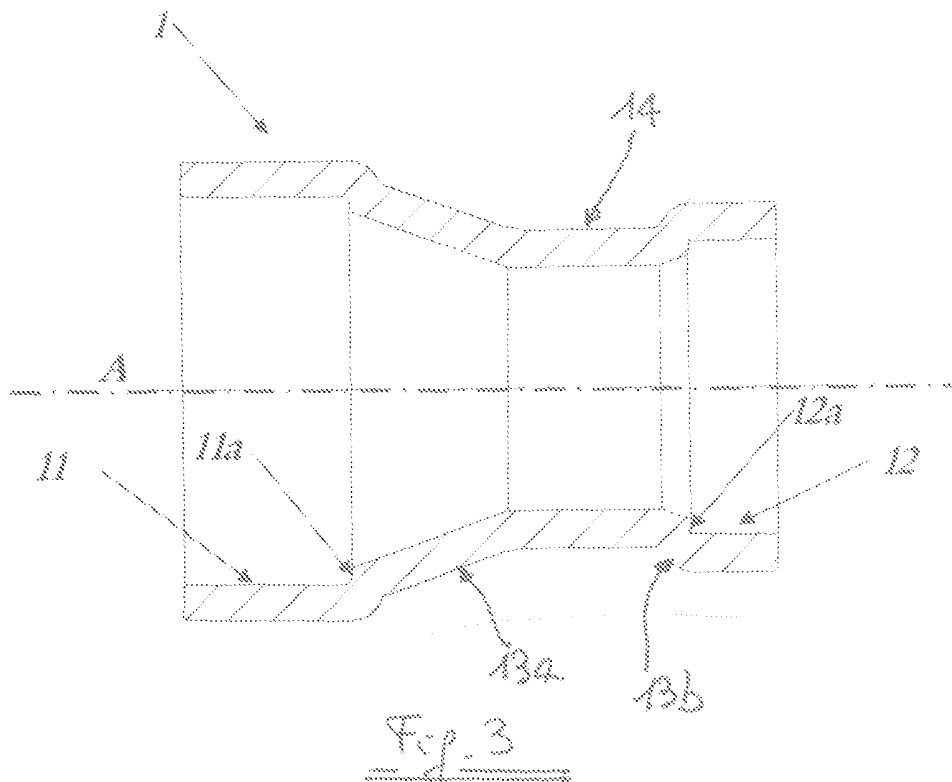
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(54) **Process for producing a metal hub of a washing machine and metal hub obtained through such process**

(57) A metal hub (1) for a laundry washing machine and process for producing said metal hub (1) comprising the steps of providing a steel tube portion, and expanding

by metal forming the two ends of the tube portion through so that such expanded ends (11,12) are adapted for mounting roller bearings for supporting a drum shaft in said hub (1).



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Description

[0001] The present invention relates to a process for producing a metal tubular member acting as the central hub of a laundry washing machine and provided with seats for roller bearings adapted to be inserted in the tubular member and in which a drum shaft is supported. In laundry washing machines provided with a drum with horizontal or inclined axis, the rotation of the drum which holds the laundry and is contained by the tub, that doesn't take part to the rotation and contains the wash liquid, is guaranteed by providing in the rear part of the tub a hub which generally is buried into the plastic polymer of the tub.

[0002] Examples of known metal tubular members constituting the hub of a laundry washing machine tub are shown in EP-A-43429 and in EP-A-198554. The hub of EP-A-43429 presents a complicate tubular shape, with a longitudinal axis, with the purpose of containing a couple of ball bearings, which have to sustain the weight of the drum and the dynamic stress, transferred through the shaft, and transmitting all these stresses to the tub. Transversal ribs on the external surface of the hub avoid the relative movement between hub and tub. The hub is inserted into the mould in which it is covered by the plastic polymer that, in the same mould, forms the tub. However, this complicate shape has some negative aspects. In order to produce such a kind of hub it is necessary to use a die-cast process with an aluminum alloy and to subsequently machine it at its end to form the seats and abutments for the bearings. It is immediately obvious that the construction and production of a hub of this kind is both complicated and expensive. Moreover since there are two different metals in contact, with two different coefficients of thermal expansion, in particular the aluminum alloy of the hub combined with the carbon steel of the bearings, a loss of adhesion between hub and bearings and, consequently, the drum lockout is possible.

[0003] Generally, this problem can be overcome by using cast iron instead of aluminum, however with a high increase of cost.

[0004] The same problems do exist in a metal hub of the type shown in EP-A-198554 in which the hub is a metal member formed from an extruded aluminum tube. Even if the cost of an extruded aluminum tube which is cut to the required length is lower than a die cast component, nevertheless the cost of providing the tube with a plurality of holes for assuring a torsional coupling between the hub and the tub reduces the costs advantage. Moreover the use of the polymer extending in said holes for providing abutment surfaces of the ball bearings does not assure that such bearings are maintained in the correct position for the entire life of the laundry washing machine.

[0005] The main object of the present invention is to provide a process for producing a hub, and a hub obtained through such process, that will overcome all the above mentioned problems and will be simple and cost

effective.

[0006] The above object is reached by a process and by a hub according to the attached claims.

[0007] One of the main advantages of the invention is that the tubular hub is made of a metal that is the same of the ball bearings (steel). According to the invention, the hub is produced starting from a carbon steel tube with a process able to form, on the internal surface thereof, the two inner annular housings for the bearings, and on the external surface, a particular shape able to constrain the hub to the polymer of the tub in a reliable and secure manner so as to exclude any relative movement.

[0008] The invention will be clearer from the detailed description given hereinafter by way of example, with reference to the accompanying drawing in which:

- Figure 1 is a prospective view of a typical aluminum hub according to prior art and obtained by a die cast process;
- Figure 2 is a lateral view of the hub of a washing machine according to the invention;
- Figure 3 is a section view along the longitudinal axis of the hub of figure 2; and
- Figure 4 illustrates schematically a process sequence to realize the hub according to the invention.

[0009] With reference to the drawings, a metal hub 1 is formed from an extruded low carbon steel tube by cutting it to the required length and subsequently, thanks to a bulge forming process shown in figure 4, by forming at the two ends 11 and 12 the bearing housings.

[0010] In the metal forming process of the hub according to the invention, the cut down steel tube is inserted into a bulge forming machine with six stations, in which a couple of punches P perform an expansion of the two ends of the tube step by step, from the original diameter to the bearing housings diameter. In the last step the punches carry out a fine calibration of the dimensions and the abutments of the two bearing housings 11 a and 12a.

[0011] At the end of the forming process, the hub 1 is provided with an externally convergent-divergent shape which defines two truncated cone portions 13a and 13b with the purpose of excluding any relative movement in the direction of the longitudinal axis between the hub 1 and the plastic polymer of the tub (not shown). The roughness of the external surface of the hub 1, in contact with the plastic tub, is sufficient to prevent any movement thanks to the torsional friction. However, it is preferred to add a knurl process to the overall metal forming process in order to obtain a knurled portion 14 on the external surface in order to increase the torsional coupling. The knurled portion 14 (figure 2) is preferably situated in the central portion of the hub 1, between the two truncated cone portions 13a and 13b. Of course the knurled surface can be moved to other zones of the hub, or it can be extended on the entire outside surface of the hub.

[0012] The ends 11, 12 of the hub provide, on its in-

ternal surface, the two inner annular housings for the bearings (not shown) with, respectively, the two abutments 11a and 12a for the same bearings obtained without the need for any machining process subsequent to the bulge forming of the hub. However, it is possible to add a machining process in order to obtain better tolerances and roughness for the two bearing housings 11, 12 and abutments.

[0013] The hub according to the present invention can be used either in front loading washing machine or in top loading washing machine, and it can be also used not only for horizontal axis washers, but also for vertical axis washers.

Claims

1. Process for producing a metal tubular member (1) to be used as a hub of a laundry washing machine, **characterized in that** it comprises the following steps:
 - providing a steel tube portion, and
 - expanding the two ends of the tube portion through a metal forming process with punches (P) so that such expanded ends (11, 12) are adapted for mounting roller bearings for supporting a drum shaft in the tubular member (1).
2. Process according to claim 1, wherein the expansion of the two ends (11, 12) is such that the tubular member (1) presents two truncated cone-shaped portions (13a, 13b) diverging from a central zone of the member (1).
3. Process according to claim 1 or 2, wherein the steel tube portion is obtained from an extruded low carbon steel tube.
4. Process according to any of the preceding claims, wherein it comprises a knurling process of at least a portion (14) of the outside surface of the metal tubular member (1).
5. Laundry washing machine provided with a metal tubular member (1) for rotatably supporting the drum shaft obtained through a process according to any of the preceding claims.
6. Metal tubular member (1) to be used as hub of a laundry washing machine and provided with seats (11, 12, 11a, 12a) for roller bearings adapted to be mounted in the tubular member (1) and in which a drum shaft has to be rotatably supported, **characterized in that** the metal tubular member (1) is made of carbon steel and presents two truncated cone-shaped portions (13a, 13b) diverging from a central zone of such member (1).

7. Metal tubular member according to claim 6, wherein a central zone of the metal tubular member (1) presents an outside knurled surface.
8. Metal tubular member according to claim 7, wherein the central knurled portion (14) is cylindrical.

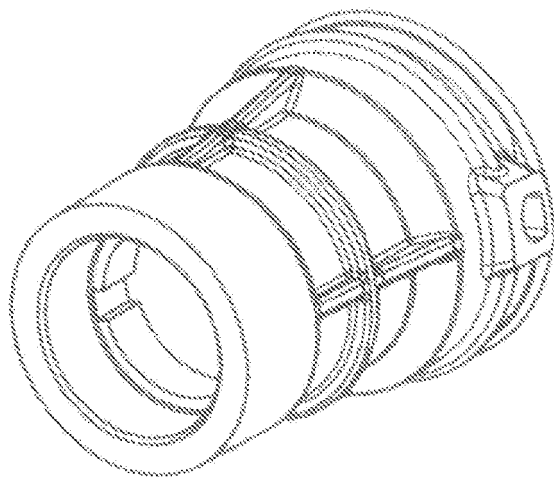


Fig. 1
(PRIOR ART)

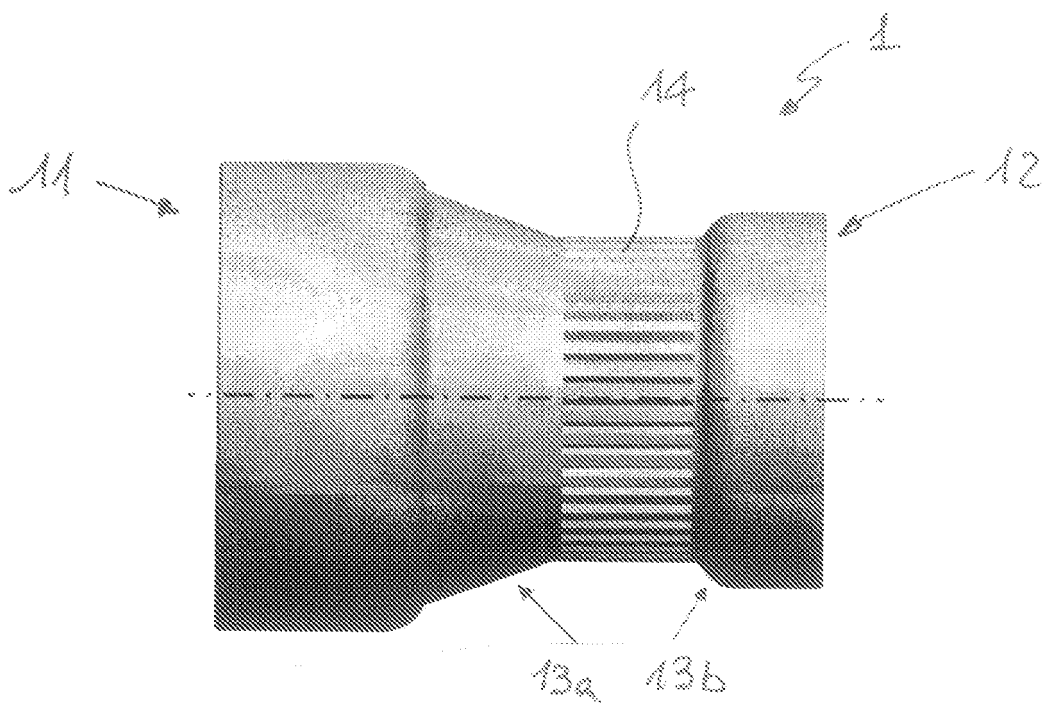
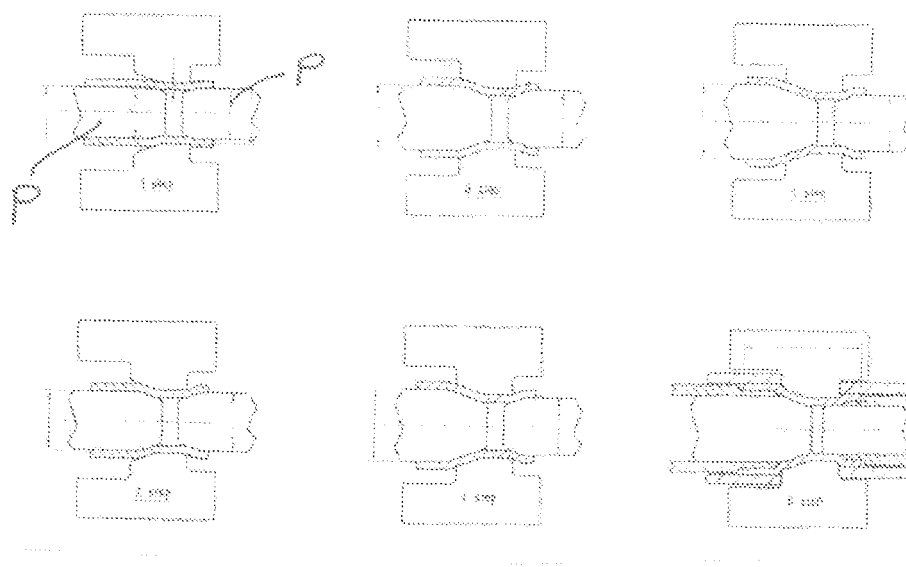
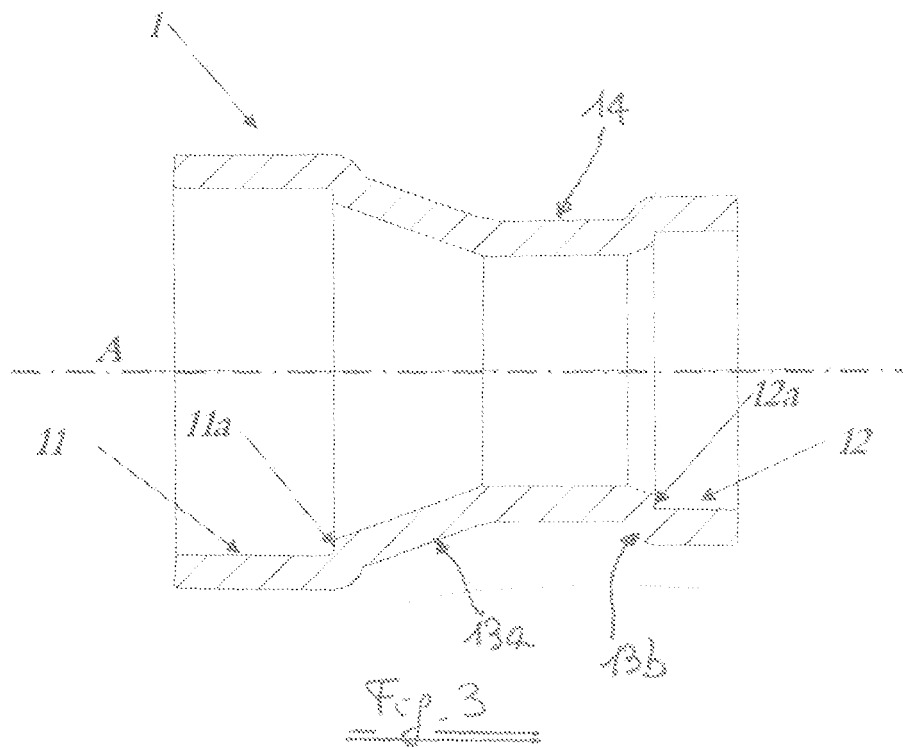


Fig. 2





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 08 10 1020

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 August 2008	Examiner Clivio, Eugenio
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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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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