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None

(58) Field of search
F1F
Selected US specifications from IPC sub-classes F01C F03C F04C

(54) Manufacture of rotors for rotary fluid pumps

(57) A hollow cylindrical body 12 and side plates 20,30 are assembled to form a hollow rotor body. The hollow rotor body is thereafter formed with a plurality of sockets 50. Alternatively, the body 11 and side plates 20,30 may be preformed with slits so that when the body and plates are assembled with the slits in register, the sockets are defined thereby. Moreover, each socket 50 receives a separately fabricated U-shaped vane-groove-forming member 60, e.g. fixed by brazing. The vane-grooved-forming member can thus be made from a suitable material sufficiently finished independently from the rotor body.

FIG. 4

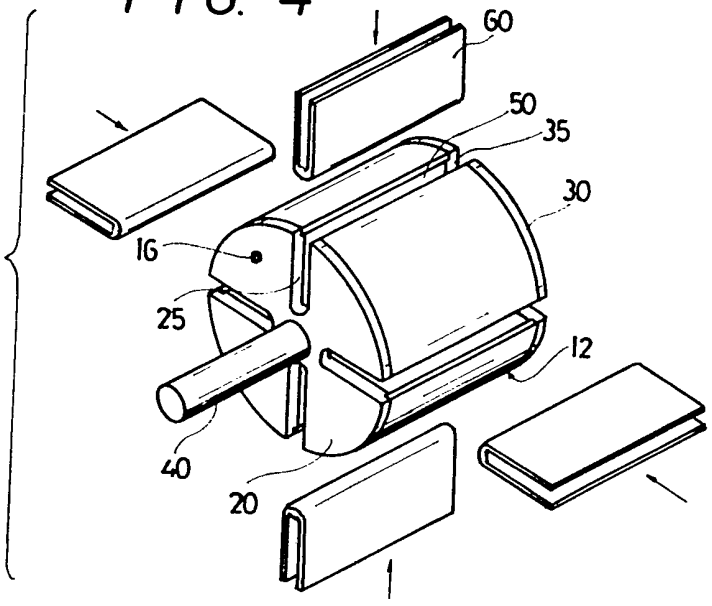

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FIG. 1

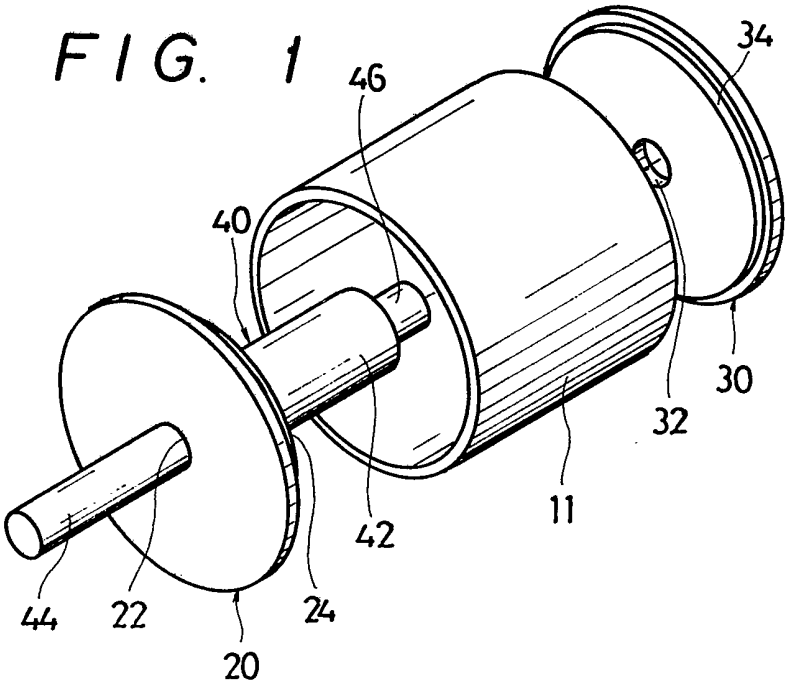

FIG. 2

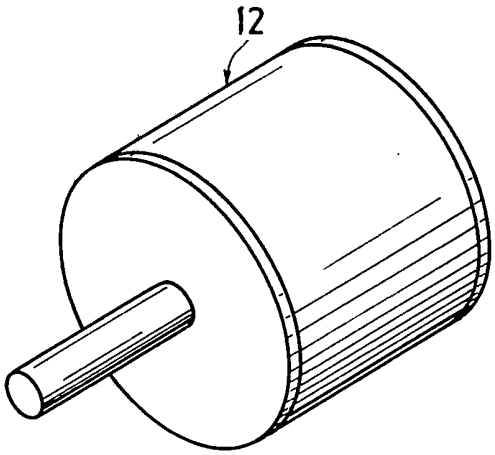

FIG. 3

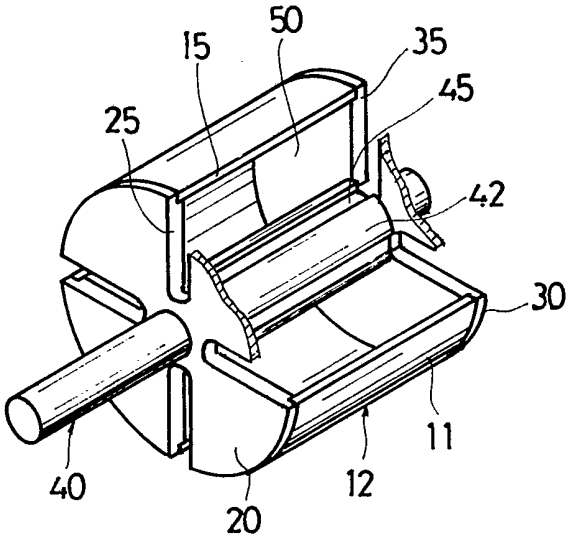

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FIG. 4

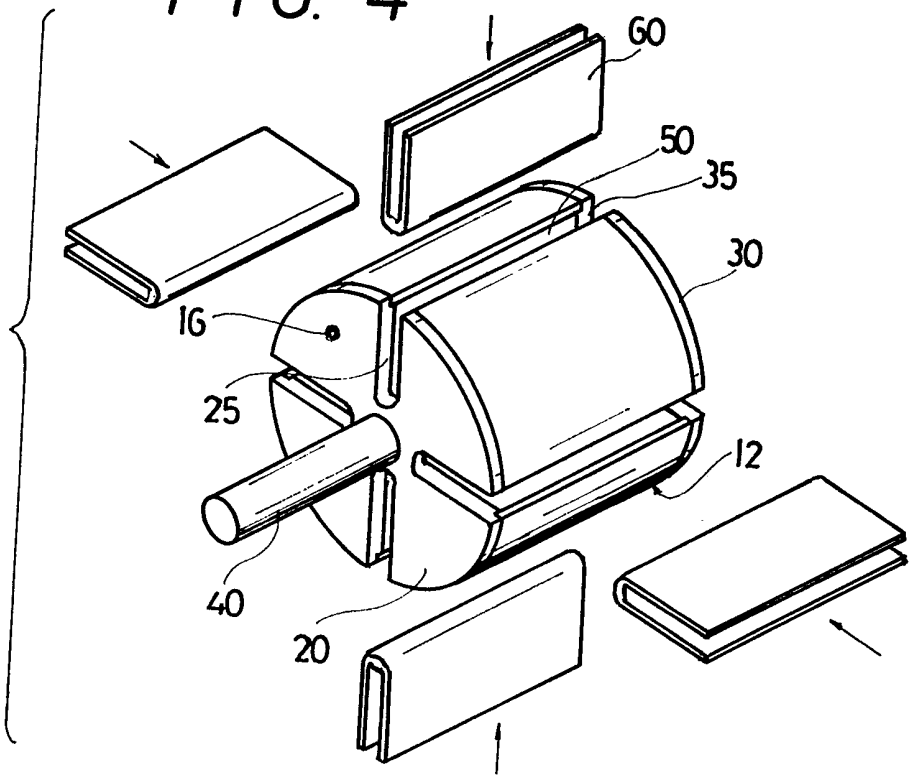

FIG. 5

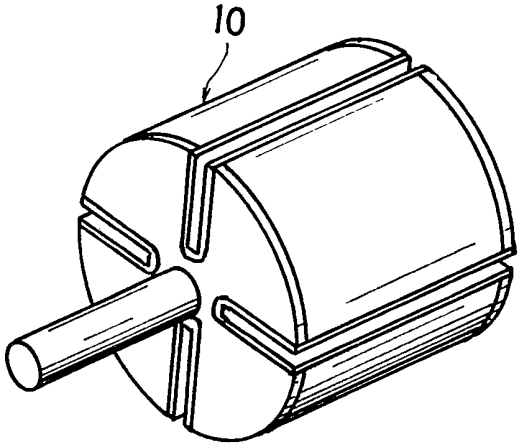

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FIG. 6

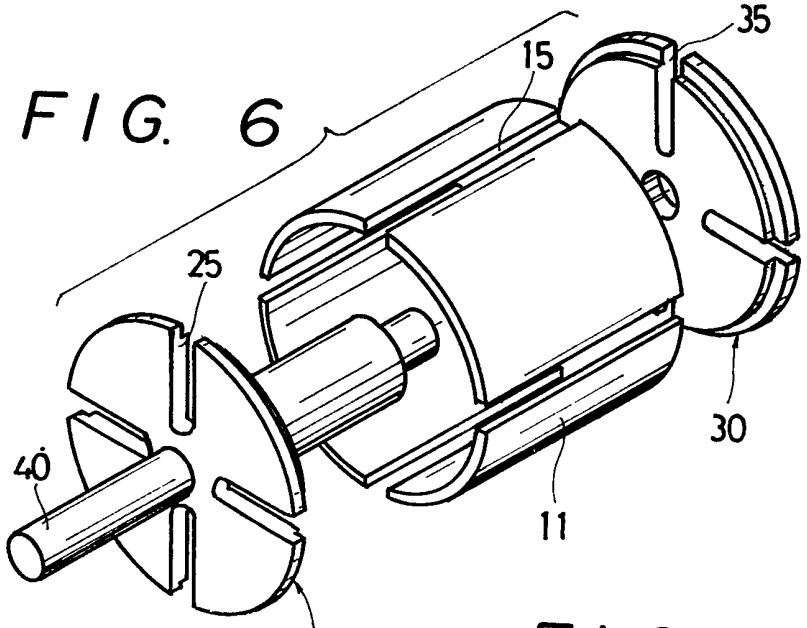

FIG. 7

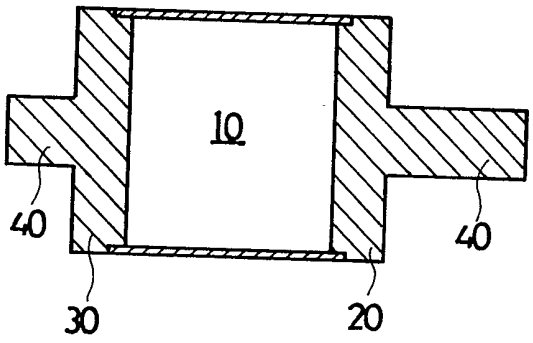

FIG. 8

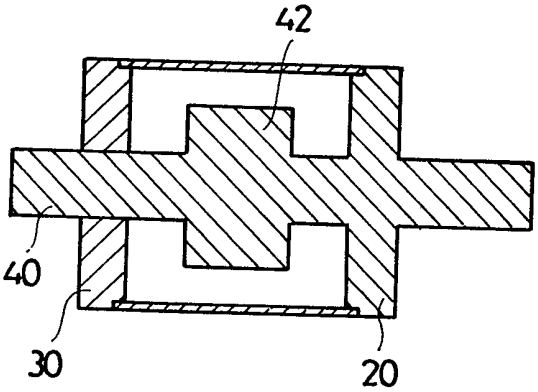

FIG. 9

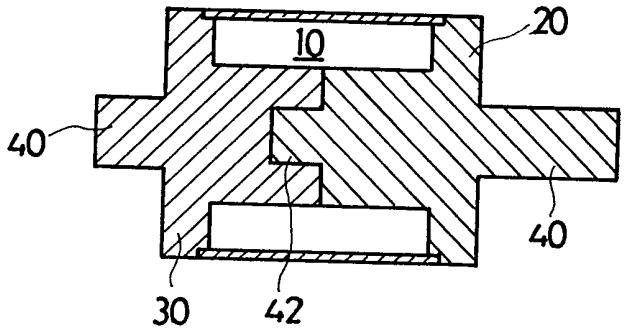

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FIG. 10

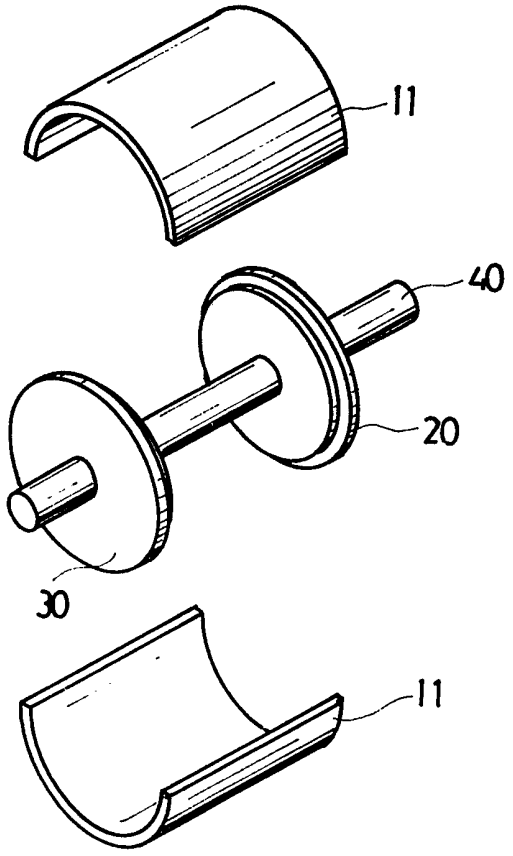

FIG. 11

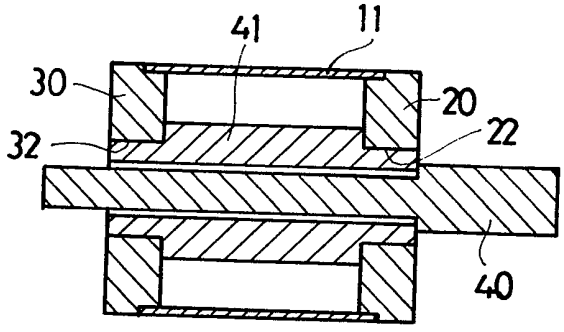

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FIG. 12

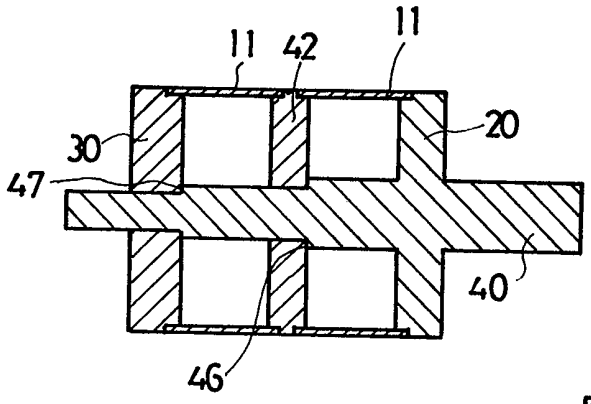


FIG. 13

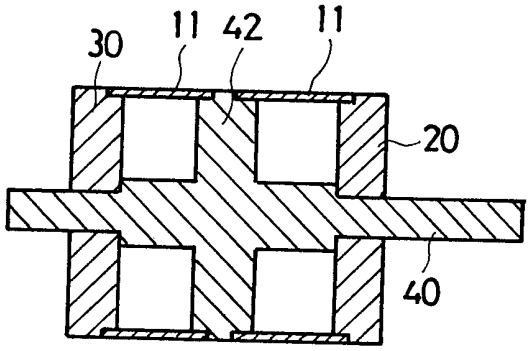


FIG. 14

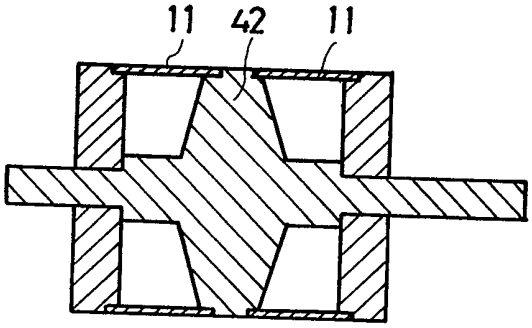
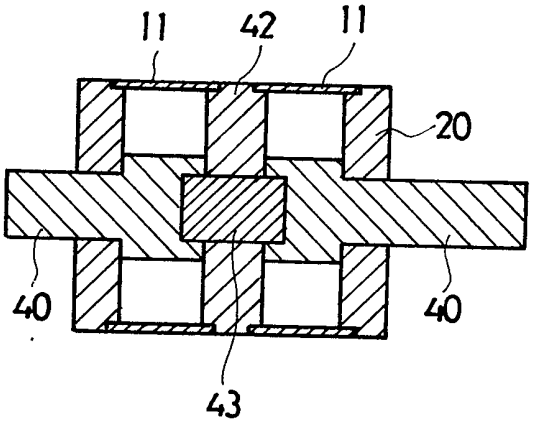


FIG. 15



SPECIFICATION

Manufacture of rotors for rotary fluid pumps

The present invention relates to rotors for rotary fluid pumps, and more particularly to a method of making a hollow rotor provided with vane grooves to allow the smooth slide of vanes.

Recently, the rotary fluid pump for use in vehicles has been desired to be less in weight for saving energy. The pump can not reduce its weight without replacing the known solid rotor by a hollow rotor. The inventors of this application have proposed an easily producible rotor which is composed of a hollow rotor body, both side plates welded to the both sides of the body and either or both rotary shafts fixed to the side plates. The rotor has been disclosed under JP A 59-155592. However, the rotor has a problem that it is not always easy to finish the vane groove to the extent that the vane smoothly slides in the vane groove. The reason for this is that the vane groove is neither always made from a material suitable as a vane groove nor easy to be sufficiently finished because of being integrally made with the rotor body.

It would be desirable to resolve the problem described above and provide a method to easily produce a rotor that is light in weight and provided with vane grooves which can be sufficiently finished to allow the smooth slide of vanes.

The present invention provides a method of manufacturing a rotor for rotary fluid pumps comprising the steps of

providing a plurality of slits in each of a hollow cylindrical body and side plates,

assembling said hollow cylindrical body and said both side plates to a rotor body, and

inserting separately fabricated U-shaped vane-groove-forming members in the respective sockets defined by said slits to fix the same to said rotor body.

The invention also provides a rotor for a rotary fluid pump, comprising a hollow cylindrical body closed by side plates and having longitudinal slits extending into the side plates, and U-shaped vane-groove-forming members inserted in the slits.

In a preferred process, a U-shaped vane-groove forming member is fabricated separately from a rotor body. The vane-groove formimg member can be made from a suitable material and finished so as to allow the smooth slide of a vane. For example, a steel plate is easily U-shaped by press-working and finished by simple finishing steps to improve the sliding performance of a vane.

The hollow cylindrical body are formed with axially full-length slits by machining, while the both side plates are provided with radial slits. The axially full-length slits and the radial slits form a plurality of sockets each being adapted to receive a separately fabricated vane-groove forming member when the cylindrical body and the both side plates are assembled to a rotor body. The vane groove forming member is inserted into the socket and then joined with the rotor body by brazing. The slits may be provided after or before the cylindrical body and the both side plates are assembled. When the slit is formed after the assembling, the rotor body is made of a hollow cylindrical material such as a metal pipe and the like. When the slits are previously provided, the rotor body is made of a plurality of arcuate plates that is produced from the same hollow cylindrical material as when the slits are formed after the assembling.

The side plate and the rotary shaft can be fabricated separately from or integrally with each other. For example, the both are joined with each other by welding when separately fabricated. Otherwise, the both are molded as one body by casting or forging. The both side plates can be fabricated separately from or integrally with each other with the intervention of the rotary shaft.

The axially full-length slits in the cylindrical body as well as the radial slits in the both side plates are simple in shape and easy to be shaped by machining. The U-shaped vane-groove forming member is easily inserted into a socket defined by the slits both in the rotor body and the both side plates. The vane-groove forming member, after inserted in the slit, is fixed to the cylindrical body and the both side plates by brazing. It is easy to set a brazing material such as copper solder and the like in the slits in the side plate. For the purpose of easily setting the brazing material between the vane-groove forming member and the rotor body, the vane-groove forming member is arranged to have its upper edges slightly projected from the outer surface of the rotor body, the brazing material being disposed between the peripheral surface of the rotor body and the upper edges projected therefrom.

The advantages offered by the present invention are mainly that the vane-groove forming member is fabricated independently from the rotor body and made from a material suitable as a vane groove as well as by a method that is relatively simple and efficient as compared with the known method in which the vane groove is integrally formed in the rotor body, and that the vane groove is accurate and superior in sliding characteristics. The rotor body can be simple in shape and easy to be made because of being separated from the vane grooves. The rotor body is easy to join the side plates because of being simple in shape. The vane-groove forming member is easily manufactured by machining because of having a uniform U-shaped section. The separately fabricated vane-groove forming member

is accurately fixed to the rotor body by a simple brazing method in which the vane-groove forming member is inserted in the slit of the rotor body in which brazing solders are previously disposed and then put in a furnace together with the rotor body. All in all, the present invention provides a simple method of manufacturing a hollow rotor superior in a vane-sliding performance.

One way of carrying out the invention is described in detail below with reference to drawings which illustrate some preferred embodiments, in which:

FIG. 1 is a perspective view of members to be assembled to a rotor body in accordance with the inventive method;

FIG. 2 is a perspective view of a rotor bodv constructed from the members of FIG. 1;

FIG. 3 is a perspective, partly cutaway view of the rotor body provided with sockets defined by slits to receive vane-groove-forming members;

FIG. 4 is a perspective view of the rotor body and vane-groove-forming members to be inserted into the sockets in the rotor body;

FIG. 5 is a perspective view of a complete rotor;

FIG. 6 is a view, similar to FIG. i, of another embodiment;

FIGS. 7 to 9 are sectional views of different embodiments;

FIG. 10 is a view, similar to FIG. 1, of still another embodiment; and

FIGS. 11 to 15 are sectional views of further different embodiments.

As seen in FIG. 1, a rotor is constructed from a hollow cylindrical body 11 in the form of a cut steel pipe and both side plates 20, 30 in the form of a steel disc which are respectively formed with central bores 22, 32 and annular sheets 24, 34. The one side plate 20 has the central bore 22 fitted on and welded to a rotary shaft 40, which is solid and provided with a thicker middle portion 42 between the opposite end portions 44, 46 the diameter of which is similar to the inner diameter of the central bores 22, 32 in the both side plates 20, 30. The body 11 has its both sides fitted on the annular sheets 24, 34 in the both side plates 20, 30 and welded thereto. The rotary shaft 40 has one end portion 46 inserted in and welded to the central bore 32 in the other side plate 20. Thus, the above-mentioned members are assembled to the rotor body 12 of FIG. 2.

The rotor body 12 of FIG. 2 is shaped by machining to the rotor body 12 of FIG. 3 which is formed with four sockets 50 each being defined by radial slits 25, 35 in the both side plates 20, 30, axially full-length slits 15 in the cylindrical body 11, and a shallow groove 45 in the thicker portion 42 of the rotary shaft 40.

As shown by the arrows of FIG. 4, separately fabricated U-shaped vane-groove-forming members 60 are inserted into the respective sockets 50. Non-illustrated copper plates as a brazing solder are previously placed in the radial slits 25, 35 of the both side plates 20. 30 and in the shallow groove of the rotary shaft 40. The vane-groove-forming member 60 is made of a steel plate by press-working, having a uniform U-shaped cross-section. When the U-shaped member 60 is fitted in the rotor body, it is shaped to have its upper edges slightly projected from the outer surface of the rotor body 12. The brazing solder is set along the upper projected edges of the member 60. After the vane-groove-forming member is fitted in the socket, the rotor body is put in a brazing furnace to produce a complete rotor 10 of FIG. 5. Prior to being put in the furnace, the rotor body is provided with a vent 16 extending from the hollow inside to the atmosphere, as seen in FIG. 4. Otherwise, brazing would be prevented by the thermal expansion of inside air or gas produced by the solder flux burning. However, the vent is preferably plugged after brazing. Thus brazed rotor needs no more than simple finishing works to be provided with vane grooves in which the respective vanes smoothly slide.

As seen in FIG. 6, the slits 15, 25, 35 can previously be provided in the cylindrical body 11 and the both side plates 20, 30. The full-length slits 15 are produced by a process of cutting a steel pipe into four similar arcuate parts of a split cylinder. The radial slits 25, 35 are similar to those in FIG. 3 except being previously provided. Accordingly, The same rotor as in FIG. 3 is obtained when the arcuate parts and the both side plates are assembled. The shallow groove in the thicker portion of the rotary shaft can be provided before the assembling. The manufacturing step after the assembling is the same as in FIG. 4.

There are various embodiments with respect to the rotor body and the both side plates, inclusive of the rotary shaft. The light load type can have its right and left rotary shafts 40, 40 separated from each other and fixed to the respective side plates 20, 30, thereby no rotary shaft passing through the inside of the hollow rotor 10, as seen in FIG. 7.

As seen in FIG. 8, one side plate 20 is integrally formed with a rotary shaft 40 to which the other side plate 30 is fixed by welding. The rotary shaft 40 has a centrally thicker portion 42 to reinforce the vane-groove-forming member which is brazed in the thicker portion.

As seen in FIG. 9, the both side plates 20, 30 are integrally formed with the respective rotary shafts 40, 40 which are joined with each other inside the rotor 10. The rotary shafts 40, 40 have a common thicker portion 42 to reinforce the the vane-groove-forming member inside the rotor 10.

As seen in FIG. 10, the both side plates 20,

30 and the rotary shaft 40, previously fabricated as one piece, are covered by and welded to a pair of semi-cylindrical bodies 11, 11.

As seen in FIG. 11, a hollow shaft 41 is fitted in the central bores 22, 32 of the both side plates 20, 30 which are previously fixed to the cylindrical body 11. Then, the cylindrical body 11 is easily provided with slits for insertion of the vane-groove-forming members by machining because of having no oppositely projecting shaft. The rotary shaft 40 is inserted in the rotor body after the slits have been provided.

The rotor body consists of two cylindrical bodies 11, 11 and a central reinforce disc 42 as seen in FIGS. 12 to 15. The rotor of FIG. 12 has a rotary shaft 40 integrally formed with one side plate 20 and shoulders 46, 47. The other side plate 30 and reinforce disc 42 are fitted on the respective shoulders 46, 47 of the rotary shaft. The two cylindrical bodies 11, 11 are fixed between either of the both side plates 20, 30 and the reinforce disc 42.

The rotor of FIG. 13 has a rotary shaft 40 integrally formed with the central reinforce disc 42. Two cylindrical bodies 11, 11 are oppositely fitted on the reinforce disc 42 prior to the both side plates 20, 30 are fitted on the rotary shaft 40. The two cylindrical bodies 11, 11 are welded both to the reinforce disc 42 and the side plates 20, 30. The reinforce disc 42 is desirably shaped to have a thicker central portion for the purpose of improving a reinforce effect, as seen in FIG. 14.

The rotor of FIG. 15 has a reinforce disc 42 separately fabricated from the both rotary shaft 40, 40 and a joint 43 to connect the both rotary shafts 40, 40 and the reinforce disc 42. The both side plates 20, 30 are fitted on the respective rotary shafts 40, 40 to fix the two cylindrical bodies 11, 11.

CLAIMS

1. A method of manufacturing a rotor for a rotary fluid pump. the rotor having a hollow cylindrical body closed by side plates, the method comprising

providing a hollow cylindrical body with slits and side plates with slits;

assembling the hollow cylindrical body and the side plates to form a rotor body in which the slits are in register; and

inserting separately fabricated U-shaped vane-groove-forming members in respective sockets defined by the slits.

2. A method as claimed in claim 1, in which the rotor body is provided with a rotary shaft passing through the side plates, the rotary shaft having a reinforcing portion in the middle.

3. A method as claimed in claim 2, in which side plates and the rotary shaft are formed as one body.

4. A method as claimed in claim 2, in which the rotary shaft is separately fabricated and then fixed to the side plates.

5. A method as claimed in any of claims 1 to 5, in which the slits are formed after the hollow cylindrical body and the side plates are assembled to form the rotor body.

6. A method as claimed in claim 5, in which the rotor body is fabricated from a hollow cylinder in which the slits are machined.

7. A method as claimed in any of claims 1 to 4, in which the slits are formed before the hollow cylindrical body and the side plates are assembled to form the rotor body.

8. A method as claimed in claim 7, in which the rotor body is fabricated from a plurality of arcuate plates forming a split cylinder.

9. A method as claimed in any preceding claim, in which the U-shaped vane-groove-forming members are fixed to the hollow cylindrical body and the plates by brazing.

10. A method as claimed in claim 9, in which a brazing material is disposed in each socket before the insertion of the vane-groove-forming member.

11. A method as claimed in claim 9 or 10, in which the U-shaped vane-groove-forming member has its upper edges slightly projected from the outer peripheral surface of the rotor body and joined therewith through the intermediary of a brazing material.

12. A method as claimed in any of claims 9 to 11, in which the rotor body is formed witha vent extending from the inside of said rotor body to the atmosphere before the vane-groove-forming members are brazed to the rotor body.

13. A method of manufacturing a rotor, substantially as described with reference to Figures 1 to 5 or any of Figures 6 to 15 of the accompanying drawings.

14. A rotor for a rotary fluid pump, comprising a hollow cylindrical body closed by side plates and having longitudinal slits extending into the side plates, and U-shaped vane-groove-forming members inserted in the slits.

15. A rotary fluid pump having a rotor according to claim 14.

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