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L. B. WALES

2,097,314

BLADED BODY

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Fig. 1.

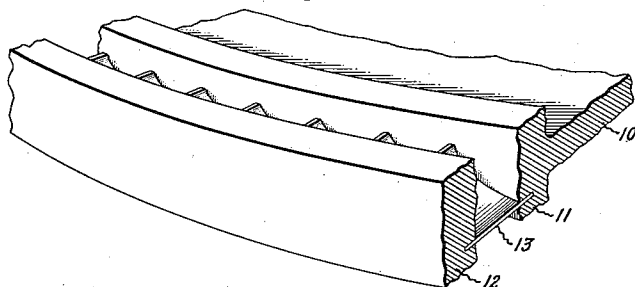


Fig. 2.

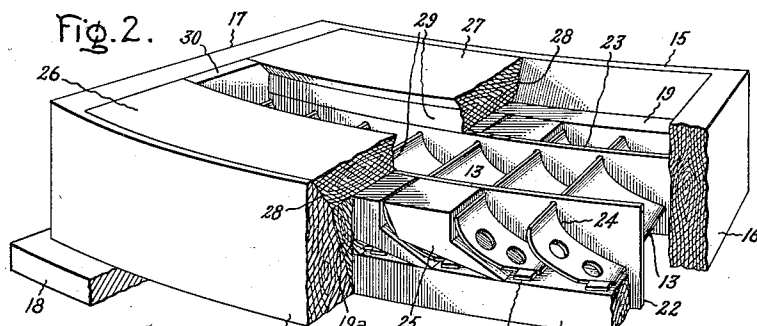


Fig. 3.

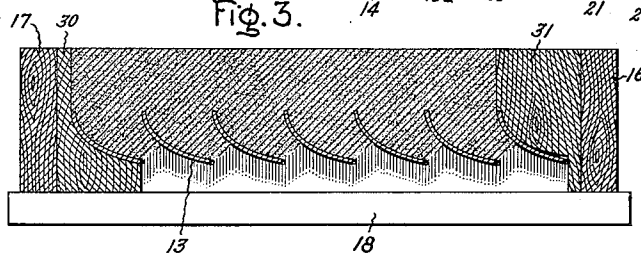


Fig. 4.

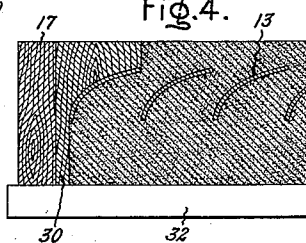


Fig. 5.

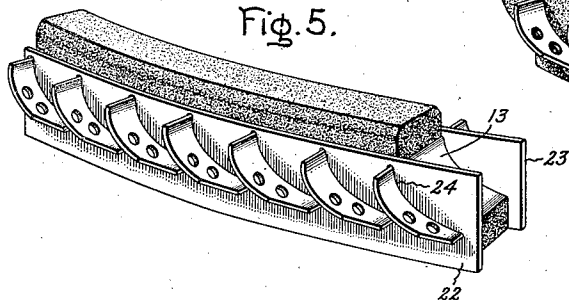
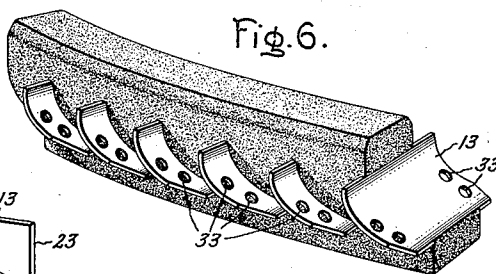


Fig. 6.



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UNITED STATES PATENT OFFICE

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BLADED BODY

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8 Claims. (Cl. 22—194)

The present invention relates to bladed bodies, that is, to methods of and arrangements for manufacturing such bodies or structures, for instance, diaphragms used in elastic fluid turbines for properly directing a stream or streams of elastic fluid towards rotary bucket wheels. These diaphragms usually include an inner ring or disk with a plurality of blades or partitions secured to the outer surface thereof and an outer ring or band secured to the outer ends of the partitions. The inner and outer ring together with the partitions define a plurality of nozzles or passages. In such arrangement the blade exit edges are radially or nearly radially directed from a common center. The securing of the partitions or blades to an inner and an outer ring or like members may be accomplished by casting the ends of a plurality of partitions into such rings. In preparation for the actual casting process the blades must be located accurately in the mold and the spaces between the blades, which are to become nozzle passages, protected against the entry of molten metal. This is commonly done by filling these spaces tightly with sand. To produce such a structure of sand and blades, commonly called a "core", of the required accuracy, a fixture is necessary, often known as a "core box", for locating and holding the blades in their correct relative positions while the spaces between blades are being filled with sand.

The object of my invention is to provide an improved method of and an arrangement for producing bladed bodies, such as turbine diaphragms, in which a plurality of spaced partitions, blades or like members have their ends cast into adjacent portions of rings or like holding members. This is accomplished in accordance with my invention by locating and holding the blades, during the formation of the core, with two bands or strips of material having punched openings for receiving end portions of such partitions, blades or like members. The strips or bands for holding the blades in properly spaced relation are made in accordance with my invention from an organic material, such as cardboard, which chars, burns, decomposes or becomes brittle under the influence of heat. The bands or strips with the blades assembled therewith are placed in a core box. As the strips are flexible, spacing blocks are inserted between the strips and the core box walls between the ends of adjacent blades projecting through the strips. Sand is then filled and pounded into the spaces defined between the strips and adjacent blades to form a core. The core together with the strips and blades thereafter is

removed from the core box and put into an oven for drying at a temperature of several hundred degrees F. Under the influence of the heat the strips become brittle or decompose and thus may be removed easily from the dried core. The core then is put into a mold for casting inner and outer holding members to the end portions of the blades. The important feature of this method and arrangement, as will be readily seen, is the use of strips of material for assembling the blades and making a core. As stated before, the strips must be made of a certain kind of material which is destroyed or rendered easily destructible after having been exposed to heat. The material best suited to this purpose must have a number of other properties. It must be of such a nature that the core sand does not adhere or bake onto it while in the core oven. In addition to certain cardboards, I have found suitable for the present purpose sheets made of a phenolic condensation product united by an artificial resin and provided with a paper surface molded on one side in such a way that the binder, that is, the artificial resin for the phenolic condensation product does not penetrate the paper completely. This paper side is placed next to the sand. In the core oven the paper chars just sufficient to make a clean, smooth parting between the sand and the remaining part of the strip so that no trimming of the core is required. Furthermore, the strips should be of a material little or not at all affected by humidity.

For a full understanding of my improved method and arrangement of producing bladed bodies, attention is directed to the following description and the claims appended thereto in connection with the accompanying drawing.

In the drawing, Fig. 1 illustrates an elastic fluid turbine diaphragm produced in accordance with my invention; Fig. 2 shows a core box embodying my invention; Fig. 3 is a sectional view through Fig. 2; Fig. 4 shows the arrangement of Fig. 3 upside down with certain parts removed; Fig. 5 shows a core produced in the core box; and Fig. 6 shows the core after completion of the baking process.

The diaphragm shown in Fig. 1 comprises a disk or inner holding member 10 with a rim 11. An outer ring or holding member 12 is concentrically spaced from the outer surface of the rim 11 and a plurality of radially directed blades or partitions 13 uniformly spaced have end portions cast into the rim 11 and the ring 12 respectively.

The casting of a diaphragm includes the step of producing a core box for making a core, which

latter is put into a mold in which the diaphragm is cast. A core box according to my invention is shown in Fig. 2. In the present instance, where the diaphragm is of considerable diameter, the core box serves to produce a part or segment of the complete core. The different core segments in known manner are placed together in a mold. The term "core" will be used hereinafter to designate a segment produced in the core box. The core box includes a box-like frame having concentrically spaced front and rear walls 14 and 15 respectively and radially directed side walls 16 and 17 respectively, resting on a base 18. The front and rear walls 14 and 15 each include a removable, tapered wall portion 19 and 19a respectively contacting the tapered surface of a stationary portion of the walls 14 and 15 respectively. These stationary portions are securely fastened to the end walls 16 and 17 to form a box-like structure. A supporting ring 20 with a plurality of spaced stops 21 rests on the base 18 and has an outer surface engaging the adjacent surface of the wedge-shaped removable wall member 19. The supporting ring serves to locate radially the outer end portions of a plurality of blades 13. A similar ring, not visible, is provided for locating the inner end portions of the blades 13. The dimensions of parts 19 and 20 depend upon the dimension of the diaphragm to be produced. The box may be used for the manufacture of different kinds of diaphragms. The blades 13 are supported by two spaced-apart strips 22 and 23 made of a material destroyed or rendered easily destructible under the influence of heat, as pointed out before. A plurality of openings 24 are punched into the strips for receiving and maintaining in properly spaced relation the end portions of the blades 13. The outer and inner edges of the blades engage the stops 21. In order to prevent deformation of the strips 22, 23 during the core forming, spacing blocks 25 are provided between the ends of adjacent blades. Accuracy of the spacing blocks 25 is necessary only with respect to their thickness in order to insure uniform and concentric relation between the adjacent surfaces of the strips 22, 23, and the removable wall sections 19. Otherwise, no accurate machining of the blocks is necessary, it being sufficient if they engage adjacent surfaces of blade end portions along a few points or lines. With this arrangement it is no longer necessary to accurately machine the sides of the spacing blocks to conform with the curvature of the adjacent sides of the blades. This fact reduces considerably the manufacturing cost of nozzle core boxes made in accordance with my invention.

Two core print forming blocks 26 and 27 are placed on top of the spacing blocks 25. The blocks 26, 27 have outer surfaces 28 which are inclined and in contact with correspondingly inclined surfaces of the walls 14 and 15 respectively. The inner sides 29 of the blocks 26, 27 are shaped in accordance with the desired core print shape. The arrangement also includes end blocks 30 and 31 (Fig. 3). All of the aforementioned elements 14 to 31, together with a plate 32 (Fig. 4) are necessary to form a core. It is to be noted that these elements also include the blades 13 forming part of the finished product, in the present instance a turbine nozzle diaphragm.

During assembly of the core box shown in Fig. 2 the strips 22, 23 with the blades 13 are assembled outside the core box. Thereafter one

of the removable wall sections 19, one of the supporting rings 20 and the end block 30 are placed into the outer frame or box proper. The assembly of blades 13 and strips 22, 23 are placed into the box with the outer ends of the blades bearing against the stops 21. Thereafter the inner blade-supporting member 20, not visible in the drawing, is placed into the box together with the inner removable wall portion 19a and the end block 31. Finally, spacer blocks 25 are inserted between adjacent blades, the end block 31 is inserted between the end blade 13 and the side wall 16, and core print forming blocks 26, 27 are placed on top of the blocks 25. The spaces defined between the strips 22, 23 and between adjacent blades and also between the core print forming blocks 26, 27 are then filled with sand. The sand in known manner is rammed down into these spaces, as shown in Fig. 3. The plate 32 then is placed on top of the box and the box turned over, as shown in Fig. 4, to receive sand from the opposite side of the nozzle passages. After the sand has been pounded into the box, the core together with the strips 22, 23 and the blades 13 are removed from the box, (Fig. 5). The core is placed in an oven and subjected to heat for a certain period of time, during which the core dries and the strips 22, 23 become brittle, that is, easily removable. A baked core is shown in Fig. 6. This core is assembled in known manner with other cores in a mold, that is, plurality of segments are placed end to end to form a complete ring or half of a ring. Metal is cast into the mold to unite with the blade end portions projecting from the core. The uniting of the metal with these end portions is facilitated by the provision of openings 33 in the blade end portions.

Having described the method according to my invention, together with the apparatus for carrying out the method, I wish to have it understood that changes may be made in both the apparatus and the method without departing from the spirit of my invention and the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In the method of forming a core for producing bladed bodies having a plurality of spaced blades cast to holding members, said method comprising assembling the blades and a thin, punched strip having a plurality of spaced openings conforming to the cross section of the blades to receive end portions thereof, filling the spaces intermediate the blades with sand, baking the core, and thereafter removing the strip.

2. In the method of forming a core for producing bladed bodies having a plurality of spaced blades cast to holding members, said method comprising assembling the blades and a strip having a plurality of spaced openings with the end portions of the blades projecting through the openings, said strip being made of a material rendered brittle by the application of heat, filling the spaces intermediate the blades with sand, baking the core, and thereafter removing the strip.

3. In the method of forming a core for producing bladed bodies having a plurality of spaced blades cast to holding members, said method comprising assembling the blades and a strip having a plurality of spaced openings, said strip being made from a phenolic condensation product united by an artificial resin filling the spaces

intermediate the blades with sand, baking the core and thereafter removing the strip.

4. In the method of forming a core for producing bladed bodies having a plurality of spaced blades cast to holding members, said method comprising assembling the blades with a strip having a plurality of spaced openings, said strip being made from a phenolic condensation product united by an artificial resin and a sheet of paper secured to one side of the strip in such a manner that the artificial resin does not penetrate the paper completely.

5. In the method of forming a core for producing bladed bodies having a plurality of spaced blades cast to holding members, the steps of producing a strip from a material which is rendered destructible by the application of heat, forming a plurality of spaced openings in the strip for receiving and holding in position the end portions of a number of blades, assembling the strip with the blades, placing the assembled strip and blades into a core box, forming a core and destroying the strip by the application of heat.

6. In the method of forming a core for producing bladed bodies having a plurality of spaced blades cast to holding members, the steps of forming two strips having a plurality of spaced openings and made from a material which decomposes by the action of heat, inserting the end portions of a plurality of blades into opposite

openings of the strips, reinforcing the strips by the insertion of spacing blocks between the projecting end portions of adjacent blades, filling the passages defined by the strips and the blades with core sand to form a core, subjecting the core with the strips to heat and removing the strips.

7. An article of manufacture for use in the production of bladed bodies having a plurality of spaced blades cast into holding members, such article including a punched strip having a plurality of openings conforming to the shape of the blades and spaced in accordance with the spacing of the blades of the bladed body, said strip being made from a material which changes its properties when subjected to a temperature of a few hundred degrees in such manner as to become easily destructible whereby the strip may be readily removed after the baking of a core including such article.

8. An article of manufacture for use in the production of bladed bodies having a plurality of spaced blades cast into holding members, said article comprising a punched strip with a plurality of spaced openings conforming to the shape of the blades and made from a phenolic condensation product united by an artificial resin and a sheet of paper secured to one side of the strip in such a way that the resin does not penetrate the paper completely.

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