Sept. 13, 1949. A. G. SCHNEIDER 2,481,541

BLADED WHEEL

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Fig. 1

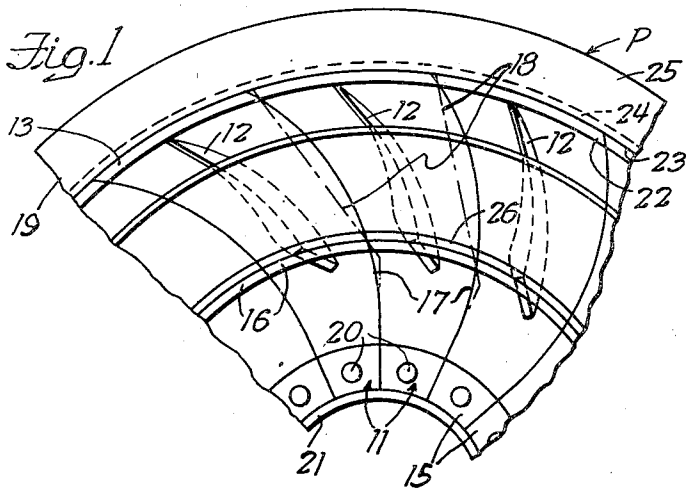


Fig. 2

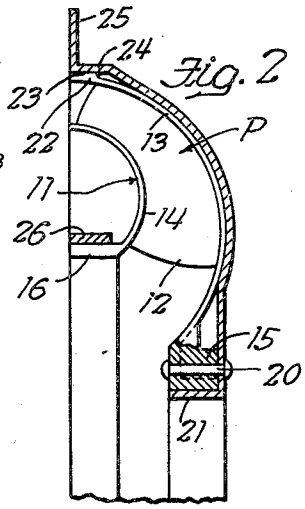


Fig. 3

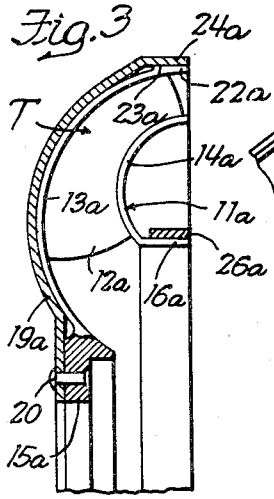


Fig. 4

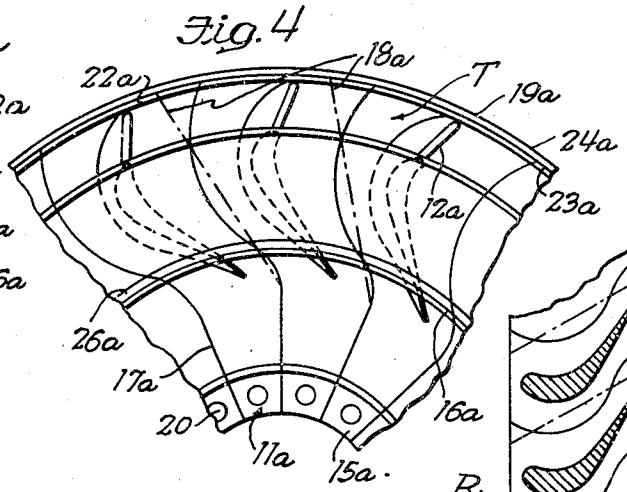


Fig. 7

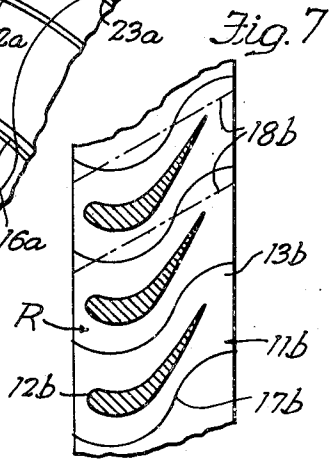


Fig. 5

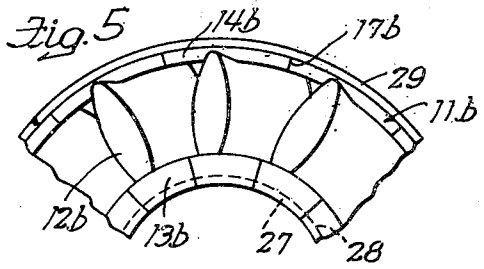
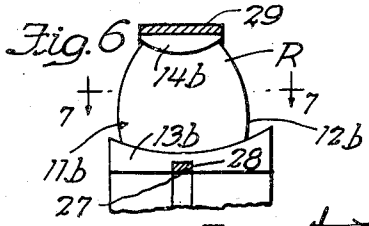


Fig. 6



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Fig. 8

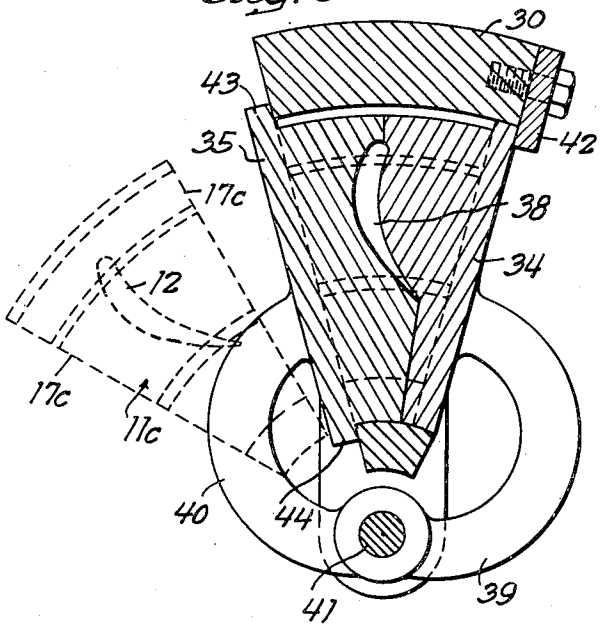


Fig. 9

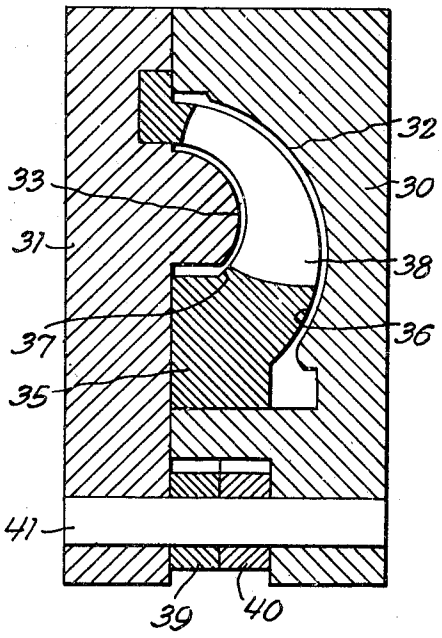
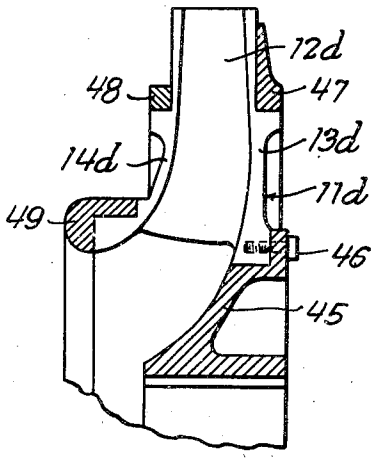


Fig. 10



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Patented Sept. 13, 1949 2,481,541

UNITED STATES PATENT OFFICE

2,481,541

BLADED WHEEL

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Application June 7, 1944, Serial No. 539,161

5 Claims. (Cl. 103—115)

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This invention relates to a new and improved construction of bladed wheels for torque converters and the like.

The bladed wheels of torque converters, fluid couplings, water turbines, compressors, and centrifugal pumps have heretofore usually been cast in one piece, using as many individual cores as there are blades. Obviously with so much core making and core setting work, and the fact that the castings produced had to be filed by hand and even polished to obtain smooth surfaces and accurate blades, wheels made in that way were quite expensive and, furthermore, not as accurate and well balanced as desired. That method of manufacture, furthermore, was not suitable for mass production. It would not be feasible to make these wheels of die castings, because the blades have such intricate shapes that the dies could not be withdrawn easily, and, hence, many loose die pieces would have to be provided and the die costs would be prohibitive. Other methods of manufacture have been proposed, as, for instance, the outer and inner shell of each wheel were made separately, and all of the blades likewise were made separately, the parts being suitably fastened together. However, such constructions were not satisfactory, because there was no assurance that all of the blades would be set accurately and remain so set, and there was always the danger of one or more blades coming loose and causing serious damage, if not complete destruction, of the whole converter or other bladed wheel unit.

It is, therefore, the principal object of my invention to provide a bladed wheel made up of as many die cast sections as there are blades, each section containing a blade and wall portions for either the outer or inner shell or both forming the fluid channels. All of the sections being die castings, they can be made to very close tolerances, and wheels built up from a number of these sections are far more accurate and well balanced than ones made in one piece or built up in accordance with old methods, as above outlined. The dies required in the die casting of the wheel segments are relatively small, simple, and economical, and easy to operate.

Another object of my invention is to provide a bladed wheel construction in which the die cast segments are either pressed into a shell or housing or held together by sleeves or rings, the segments being suitably secured to whatever annulus is used to form a unitary wheel assembly able to withstand the stress and strain of high speed rotation, fluid pressure, and torque reaction.

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The invention is illustrated in the accompanying drawings, in which—

Figs. 1 and 2 are a fragmentary face view and radial cross-section of a pump impeller for a torque converter, made in accordance with my invention;

Figs. 3 and 4 are a fragmentary radial cross-section and face view of a turbine wheel for a torque converter, made in accordance with my invention;

Figs. 5 and 6 are a fragmentary face view and radial cross-section of a reaction member for a torque converter, made in accordance with my invention;

Fig. 7 is a developed circumferential section on the line 7—7 of Fig. 6;

Figs. 8 and 9 are sections in planes at right angles to one another, illustrating the dies for making bladed wheel segments, and

Fig. 10 is a fragmentary radial cross-section of a centrifugal impeller, made in accordance with my invention.

Similar reference numerals are applied to corresponding parts throughout the views.

Referring first to Figs. 1 to 7, I have illustrated a pump impeller P, a turbine wheel T, and reaction member R for a hydraulic torque converter, similar to that disclosed in Schneider et al. Patent 2,306,758 and in the copending application of Schneider et al. Serial No. 467,864, filed December 4, 1942, now Patent No. 2,410,185. However, it should be understood that my invention is not limited to the wheels of torque converters, but is applicable to bladed wheels generally, as, for example, for water turbines, compressors, and centrifugal pumps, and wherever a similarly constructed bladed wheel would be advantageous.

The bladed wheel P, shown in Figs. 1 and 2, is made up of die cast segments 11, equal in number to the number of blades 12, each segment comprising an outer wall portion 13 and an inner wall portion 14 cast integral with the outer and inner edge portions of the blade 12, respectively. The outer wall portion 13 has a wheel hub portion 15 cast integral therewith, and the inner wall portion 14 has a hub portion 16 cast integral therewith. The segments 11, as shown in Fig. 1, have the ends of the inner and outer wall portions curved so that neighboring segments interfit snugly along generally radial lines, as indicated at 17. To simplify the dies, the parting lines may be straight, as indicated by the broken dot and dash lines 18. All of the segments 11 are pressed into an annular sheet metal wheel shell 19 and riveted, or otherwise

suitably secured, in place therein, as indicated at 20. The inner edge portion of the shell has an annular flange 21, which has a tight fit on the inner diameter of the hub portions 15 of the segments. The outer peripheral edge portions 22 of the segments have arcuate surfaces 23 thereon, on which the outer edge portion 24 of the shell, which is made of substantially uniform radius, has a tight fit, whereby to accurately locate all of the segments radially and made for good balance. An annular flange 25 is formed on the outer periphery of the shell 19 and is used in the fastening of the pump impeller P to the end plate of the torque converter which with the impeller P forms the housing for said converter, the turbine wheel T being enclosed within the housing in operative relation to the pump impeller P, in the usual way. A ring 26 is pressed over the outside of the other hub portion 16 of the segments 11, whereby further to insure accurate registration of all of the segments and close packing of the segments together to form a unitary bladed wheel.

In assembling the wheel P, the segments 11 are assembled in a form similar to the outer wheel shell 19 but providing more outside clearance. Then the ring 26 is pressed over the hub portion 16. In this way the group of segments are held together well enough to permit taking the assembly out of the form and machining it on the outside, if necessary, after which the assembly is then pressed into the outer wheel shell 19 and the rivets 20 are put in. The wheel thus assembled is quite compact, and all of the blades 12 are accurately located and will remain so throughout the life of the torque converter, or other bladed wheel unit, in which the wheel in question is used. The shell 19 and ring 26, plus the rivets 20, give the desired strength and rigidity, and the wheel, therefore, is able to withstand the stresses and strains incident to high speed rotation, fluid pressure, and torque reaction that are common in torque converters. While I have referred to the use of rivets for fastening the segments of the wheel to the housing, it should be understood that I may employ screws, or I may braze, solder, vulcanize, fuse, glue, or cement them together and to the housing, to obtain in effect a one-piece wheel. Furthermore, while I prefer to make the segments of die cast metal, it should be understood that I do not limit the invention to that, but may, for example, use whatever thermo-plastic materials may be suitable for the purpose. The parting lines 17 or 18 between the segments 11 preferably follow substantially the streamline of the fluid in the channels between neighboring blades, and there is sufficient interlocking or dovetailing of the segments, as a result of this formation of the interfitting neighboring segments, to reduce likelihood of any segments tending to work loose under centrifugal force.

The turbine wheel T is similarly made up of a plurality of die cast segments 11*a*, pressed into an annular outer wheel shell 19*a* and riveted thereto, as indicated at 20, a ring 26*a* being pressed over the hub 16*a*, similarly as in the pump impeller wheel. In this case, however, the parting lines 17*a* preferably have a double curvature, so as to conform to the streamline of the fluid in the channels between the blades 12*a* of the turbine wheel, and, as indicated by the broken dot and dash lines 18*a*, the parting lines may be straight to simplify the dies needed in the die casting of the segments 11*a*. The method of assembling this wheel T is substantially the same as that used in the assembling of the wheel P, and the same advantages are obtained.

The reaction member R, shown in Figs. 5, 6, and 7, is made up of a number of die cast segments 11*b*, each of which comprises a blade 12*b* and outer and inner wall portions 13*b* and 14*b*. A snap ring 27 fits in a groove 28 in the outer wall portion 13*b*, and a sleeve 29 is pressed or shrunk around the assembly to form a unitary bladed wheel structure possessing the advantages previously mentioned in connection with the discussions of the wheels P and T. The ogee-shaped parting lines 17*b* follow the streamlines between the blades of the reaction member, but to simplify the dies the parting lines may be straight, as indicated by the dot and dash lines 18*b*.

A torque converter made up of the wheels P, T, and R can easily be visualized by reference to Figs. 2, 3, and 6, the wheel R being disposed inside the hubs 16 and 16*a* of the wheels P and T, respectively, similarly as in Schneider et al. Patent 2,224,884, the wheels P and T being disposed in closely spaced relation to keep the vortex ring fluid circuit from the pump impeller P through the turbine wheel T and through the reaction member R back to the pump impeller P. There is no need for any change in overall dimensions for the torque converter when the wheels thereof are made in accordance with the present invention, the construction of each of the wheels being so compact.

In Figs. 8 and 9, I have shown diagrammatically the dies for use in the die casting of bladed wheel segements 11*c*, which are similar to the segements 11 and 11*a* of Figs. 1 to 4 but have straight radial edges 17*c*. These dies comprise blocks 30 and 31 in which the outer contours of the cross-section of the bladed wheel are turned, as indicated at 32 and 33, and other blocks 34 and 35 that are profiled, as indicated at 36 and 37, to form the inside contours of the fluid channels on opposite sides of the blade formed in the cavity 38 left between the faces of the two blocks 34 and 35. The blocks 34 and 35 are mounted to oscillate with respect to the blocks 30 and 31 on arms 39 and 40, pivoted on a pin 41 located on the axis of the bladed wheel. The pin 41 is carried on the blocks 30 and 31. A plate 42 locates the block 34 with respect to the block 30, and lugs 43 and 44 on the block 35 engage the other side of the block 30 when the blocks 34 and 35 are in contact in casting position. After the bladed wheel segment has been cast, it can be expelled by swinging the die blocks 34 and 35 to the left, as viewed in Fig. 8, the cast segment being then removable by separating the blocks 34 and 35 which extend into the cast segment from opposite sides thereof. It is obvious that dies can be constructed along these lines at relatively low cost, and are operable easily, and there is nothing apt to get out of order.

In Fig. 10 I have shown a centrifugal impeller in cross-section, built up of die cast segments 11*d*, each having a blade portion 12*d* between walls 13*d* and 14*d*. 45 is the hub upon which the segments 11*d* are mounted and fastened by bolts 46. Steel rings 47, 48 and 49 surround the segments 11*d* and are preferably pressed in place so as to hold them together in tightly assembled relation, similarly as in the other bladed wheels above described. An impeller constructed along these lines can be safely rotated at high speed and is well balanced.

It is believed the foregoing description conveys

a good understanding of the objects and advantages of my invention. The appended claims have been drawn to cover all legitimate modifications and adaptations.

I claim:

1. As an article of manufacture, a wheel for a bladed wheel unit, such as a torque converter, fluid coupling, or the like, said wheel comprising a body built up of separately cast segments, each segment consisting of a streamline shaped blade having cast integral therewith an annular portion of a substantially circularly shaped fluid channel defining wall, and an annular shell within which the cast segments are assembled in mating relation and secured in place, the parting lines between neighboring segments all departing from radial lines with respect to the center or axis of rotation of the wheel to an extent that the neighboring segments interlock so as to reduce likelihood of displacement of segments under centrifugal force.

2. As an article of manufacture, a wheel for a bladed wheel unit, such as a torque converter, fluid coupling, or the like, said wheel comprising a body built up of die cast segments, each including a streamline shaped blade and inner and outer profile wall portions substantially circularly shaped cast integral with the blade and defining fluid channels therebetween with respect to the blade, and an outer circular shell enclosing the grouped segments and secured thereto.

3. As an article of manufacture, a wheel for a bladed wheel unit, such as a torque converter, fluid coupling, or the like, said wheel comprising a body built up of die cast segments, each including a hydro-foil shaped blade and inner and outer profile wall portions substantially circularly shaped cast integral with the blade and defining fluid channels therebetween with respect to the blade, a ring having a press fit on contiguous arcuate portions of said segments which together define a circle to hold the same together in tightly assembled relation, and an outer circular shell enclosing the grouped segments and secured thereto.

4. As an article of manufacture, a wheel for a bladed wheel unit, such as a torque converter, fluid coupling and the like, said wheel comprising a body built up of separately and accurately cast segments, each segment consisting of a streamline shaped blade having cast integral therewith, on opposed edge portions, annular portions of substantially circularly shaped fluid channel defining walls, and an annular shell within which the cast segments are assembled in mating relation and secured in place, the parting lines between neighboring segments all extending in directions substantially following the streamlines of the fluid in the fluid channels defined between neighboring blades.

5. As an article of manufacture, a wheel for a bladed wheel unit, such as a torque converter, fluid coupling and the like, said wheel comprising a body built up of separately and accurately cast segments, each segment consisting of a streamline shaped blade having cast integral therewith, on opposed edge portions, annular portions of substantially circularly shaped fluid channel defining walls, and an annular shell within which the cast segments are assembled in mating relation and secured in place, the parting lines between neighboring segments all departing from radial lines with respect to the center or axis of rotation of the wheel to an extent that the neighboring segments interlock so as to reduce likelihood of displacement of segments under centrifugal force.

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