Sept. 28, 1954 H. L. MISCH 2,690,132

ROTATABLE VANED ELEMENT

Filed July 30, 1951

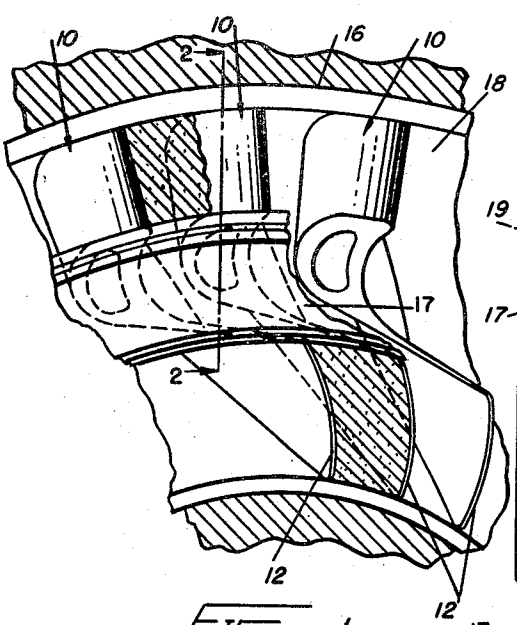

FIG. 1

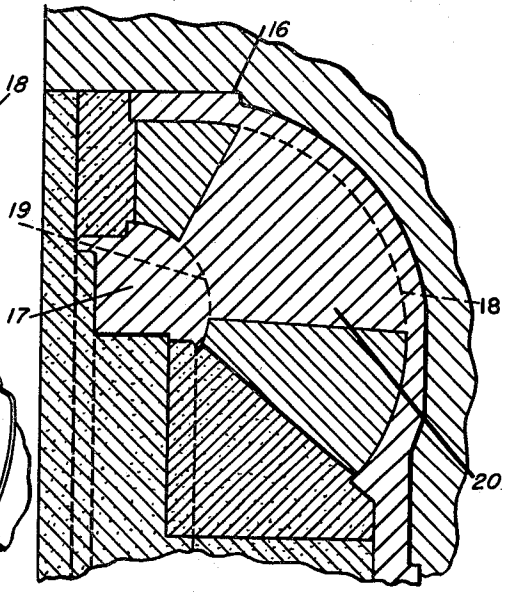

FIG. 2

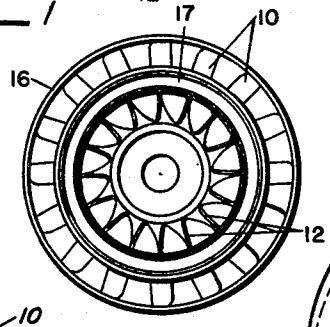

FIG. 5

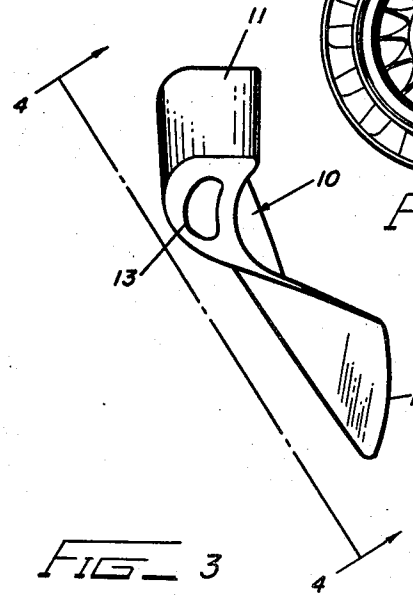

FIG. 3

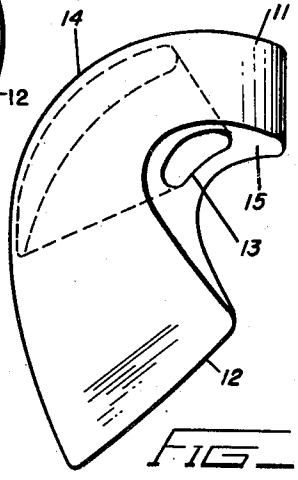

FIG. 4

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Patented Sept. 28, 1954

2,690,132

UNITED STATES PATENT OFFICE

2,690,132

ROTATABLE VANED ELEMENT

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Application July 30, 1951, Serial No. 239,323

2 Claims. (Cl. 103—115)

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This invention relates to fluid coupling means and more particularly to a vaned element of a torque converter or the like and to a method by which the element is formed.

As a preferred example of this invention, reference is made herein to a hydraulic torque converter for the transmission of power from an engine to a load, and as normally constituted, such a converter includes at least three vaned elements which are so formed that the fluid operated upon by the elements travels in a closed path. This path is helical since the fluid is driven to rotate in the direction of the movement of the elements as well as across them. The vanes on the elements must therefore be formed to take advantage of the energy of the fluid movement, and this requirement necessitates the use of vanes having rather complex forms and cross-sections.

The conventional method of forming vaned torque converter elements is to cast them simultaneously with an outer shell and an inner core member, said shell and core member being continuous and serving to make a rigid unified structure with the vanes. Due to the complex structure of the vanes, this is a difficult casting operation, it being almost impossible to cast the vanes with the smooth surfaces required for efficient operation. And because of the complexity of the shape of the casting, the problem of cleaning out the imperfections formed during the casting operation, is rendered more difficult.

The principal object of this invention is, therefore, to produce an improved method and means for forming the vaned element of a torque converter or the like, the element having smooth surfaces on the vanes as well as on the shell and core.

Another object of this invention is to provide an improved method of casting a vaned element of a torque converter wherein the vanes are formed separately and then united to the shell and inner shroud of the element.

A more specific object of this invention is to provide a method of forming a vaned element of a torque converter which comprises forming the vanes separately as hollow units, investing the vanes in a molding core, and casting the outer shell and inner shroud around the molding core, the cast material thus forming with the vanes a complete unit. The core material into which the vanes are invested may then be removed by any suitable method.

It is to be understood that the invention here disclosed is not to be limited in its application

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to the details of construction and arrangement of parts shown in the drawings since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is used for the purpose of description only and not by way of limitation.

The preferred embodiment of the invention, however, is shown in the drawings, wherein:

Figure 1 is a fragmentary front elevation of a mold for a vaned element of a torque converter showing the completed casting including a portion of the core in which the vanes are initially invested;

Figure 2 is a section through the vaned element taken on line 2—2 of Figure 1;

Figure 3 shows one of the vanes prior to its assembly in the molding core;

Figure 4 is a view of the vane of Figure 3 taken in the direction of the arrows 4—4 in Figure 3; and

Figure 5 is a front elevation of a completed casting made in accordance with this invention.

Referring now to the drawings for a more detailed description of the invention, and particularly to Figures 3 and 4 there is disclosed a vane 10 having a blunt, rounded trailing edge 11 and a sharp, flat leading edge 12, the plane surface of the leading edge being turned or twisted relative to the surface of the trailing edge in the manner shown. The portion of the vane adjacent trailing edge 11 is hollow and this space or aperture 13 extends across the entire vane. The particular shape of the leading and trailing edges of the vane is determined by the characteristics desired in the converter, and hence the shape may be varied without departing from the scope of this invention.

As shown in Fig. 4, an outer surface 14 of the vane has a contour which coincides with the interior of the enclosing housing or shell that is adapted to enclose a plurality of these vanes 10. The inner surface 15, is also formed to the contour of the inner shroud portion 17 of the completed element.

Referring now to Figs. 1, 2, and 5, it will be seen that the converter element is made up of a plurality of the vanes 10 spaced around the inner periphery of the outer housing 16 of the element, with the inner shroud or ring 17, serving to bridge the inner surfaces 15 of the vanes and thereby confine the movement of the fluid operated upon by the converter here shown, to a circular path.

It has been found in commercial operations that, if the converter element shown in Figs. 1 and 2 is made as a single unit by a casting process, it is difficult to insure the production of smooth surfaces on the vanes 10 and also on the fluid-contacting surfaces 18 and 19 of the shell and inner shroud, respectively. The casting of such elements results in the formation of a flash at the leading edge of each vane, thereby producing an irregularity in the contour of the vane and any irregularities found on these surfaces must, because of the complexity of the structure, be removed by a manual grinding operation which is expensive and time-consuming. Even when expertly done, the manual grinding operation is not always entirely satisfactory because it is quite difficult to insert the cleaning tool into certain portions of the curved space between the vanes to reach any irregularities on such surfaces.

The present invention obviates this difficulty by forming vanes 10 as individually die cast elements and the openings 13 can be formed in this casting operation. The individual vanes may then be readily cleaned by a tumbling operation or by a hand flash-trimming operation due to the accessibility of all surfaces of the vanes. After a number of the separate vanes have been cleaned, they may be assembled in a circular fixture (not shown) so as to be spaced apart in a predetermined pattern in the positions they will occupy in the finished torque converter element. In one form the fixture may be designed to have a surface corresponding to the inner surface 18 of shell 16 and another surface corresponding to surface 19 of inner shroud 17. The fixture is adapted to close off the ends of the opening 13 in each vane while leaving an opening to each of the spaces between the several assembled vanes. Plaster, or some other temporarily hardenable core material is then poured into this space between the vanes, thereby investing the vanes in a solid core which is used in the subsequent molding operation. The inner and outer surfaces 14 and 15 of the vanes as well as the openings or apertures 13 are set up in the fixture so as to be preserved free from contact with the core material and yet are fixedly but temporarily bonded together by the core in preparation for the final casting operation.

The fixture is removed after the plaster has hardened, and the core with the vanes invested therein is then placed in a previously prepared mold which corresponds in form, to the outer shell 16 and inner shroud 17. When the molten metal is poured into the mold, it forms the outer shell 16 and inner shroud 17, and it is also poured so that it flows around surfaces 14 and 15 into openings 13 to form posts 20 which pass through the openings 13 in the vanes and are integral with outer shell 16 and inner core 17. Inasmuch as the openings 13 are elongated and follow in general the cross section of each of the vanes 10, the posts 20 have a similar form and because of the elongated cross section thereof, prevent turning of the vanes 10 in the completed element.

It will be noted that openings 13 are of such form as to leave a substantially uniform wall thickness for each vane. This simplifies the casting operation in that difficulties usually encountered in casting articles of varying thickness are avoided. After the cast material of shell 16 and inner shroud 17 has been poured and cooled, the plaster core may be removed by any suitable method such as mechanically crushing it and blowing or washing it out. The torque converter element is then ready for its final machining operations to condition it for ready assembly with the remaining elements of the converter. Very little, if any, cleaning of the surfaces 18 and 19 is necessary, and none at all is required on the exposed surfaces of vane 10 at this time. Furthermore, the junction between the vanes and inner shroud and outer shell may be made as a sharp corner, but preferably it is curved to eliminate eddies in the flow of fluid through the converter.

Although the molding core material has been described above as a plaster, it may be any other suitable material which will hold its shape at the temperatures and pressures developed in the casting operation and yet will be readily removable after the casting operation is completed.

It is desirable to use a material for shell 16 and inner shroud 17 which will shrink slightly upon hardening in its position surrounding the surfaces 14 and 15 of the vanes, thereby producing a snug fit whereby to eliminate all possibility of the assembly rattling when the element is in use. This desired shrinkage is inherent in the conventional aluminum alloys.

Inasmuch as the element is to be mounted to rotate with a shaft, the areas of the shell 16, which are to be secured to the shaft by which the element is driven or which the element is to drive, and the clearance areas between adjacent elements, may be machined after the cast element is removed from the mold.

It is understood that various forms of the invention other than those described above may be used without departing from the spirit or scope of the invention.

I claim:

1. A rotatable vaned element for a hydraulic torque converter or the like, said element comprising a plurality of individual vanes disposed about the axis of rotation of the element in circumferentially spaced apart relation, each vane having an inner end and an outer end and having a somewhat thickened trailing edge therebetween and tapering to a thin leading edge, the inner ring having an outer surface relatively adjacent the axis of rotation of the element and engaging the inner end of each vane, an outer ring having an inner surface relatively remote to the axis of rotation of the element and engaging the outer end of each vane, said surfaces being of correspondingly convex curvature about the axis of rotation of the element, each of said vanes having a radially extending outwardly flared aperture therethrough extending from the inner to the outer end of the same, and a post formed integrally with the rings and completely filling the flared apertures of the respective vanes and cast from the common material of the rings that shrinks upon hardening whereby the vanes are securely locked in place between the rings in said element.

2. A rotatable vaned element for a hydraulic torque converter or the like, said element comprising a plurality of individual vanes disposed about the axis of rotation of the element in circumferentially spaced apart relation, each vane having an inner end and an outer end and having a somewhat thickened trailing edge therebetween and tapering to a thin leading edge, an inner ring having an outer surface relatively adjacent the axis of rotation of the element and engaging the inner end of each vane, an outer

ring having an inner surface relatively remote to the axis of rotation of the element and engaging the outer end of each vane, said surfaces being of correspondingly arcuate curvature viewed from the axis of rotation of the element, each of said vanes having a radially extending outwardly flared aperture therethrough extending from the inner to the outer end of the same, and a post formed integrally with the rings and completely filling the flared apertures of the respective vanes and cast from the common material of the rings that shrinks upon hardening whereby the vanes are securely locked in place between the rings in said element.

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