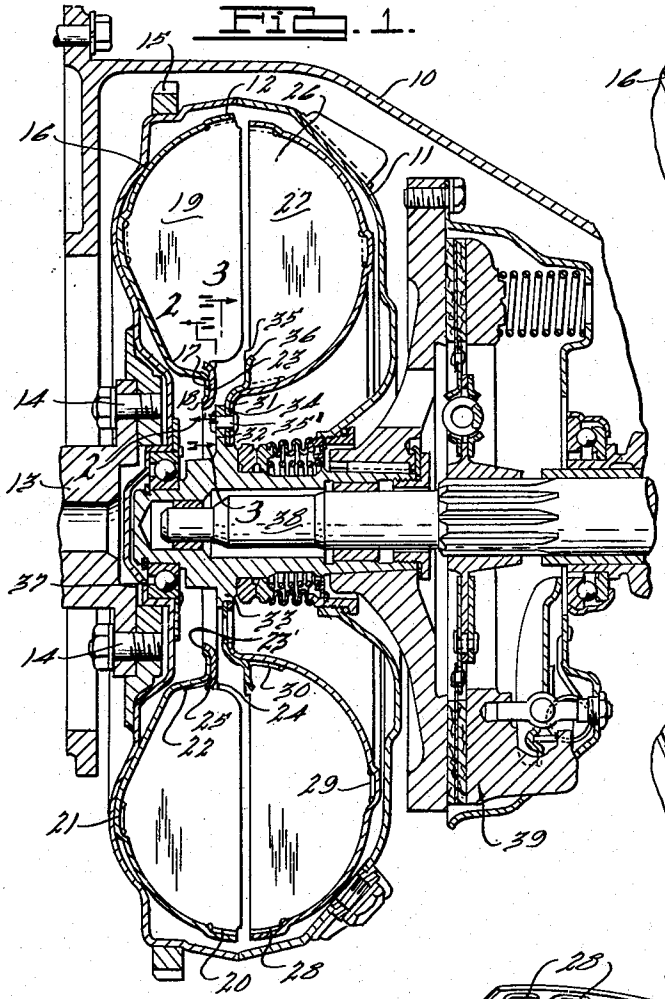
Dec. 1, 1953 O. M. KOSKINEN 2,660,970

METHOD OF MAKING FLUID COUPLING ROTOR ELEMENTS

Original Filed Jan. 23, 1948 2 Sheets-Sheet 1

Fig. 1.



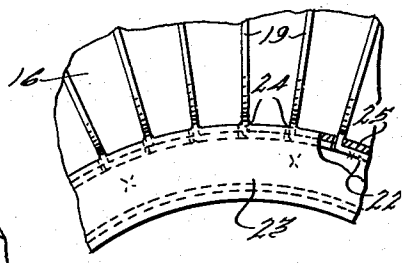


Fig. 2.

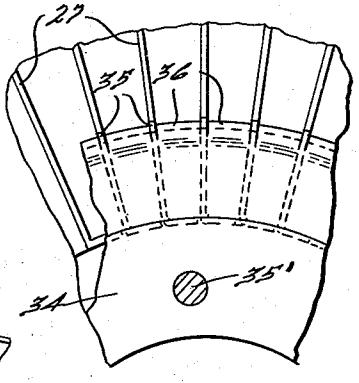


Fig. 3.

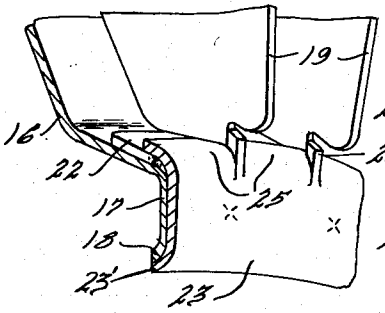


Fig. 4.

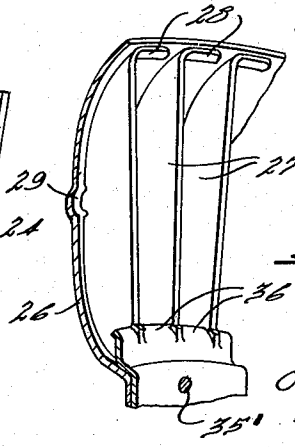


Fig. 5.

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Dec. 1, 1953 O. M. KOSKINEN 2,660,970

METHOD OF MAKING FLUID COUPLING ROTOR ELEMENTS

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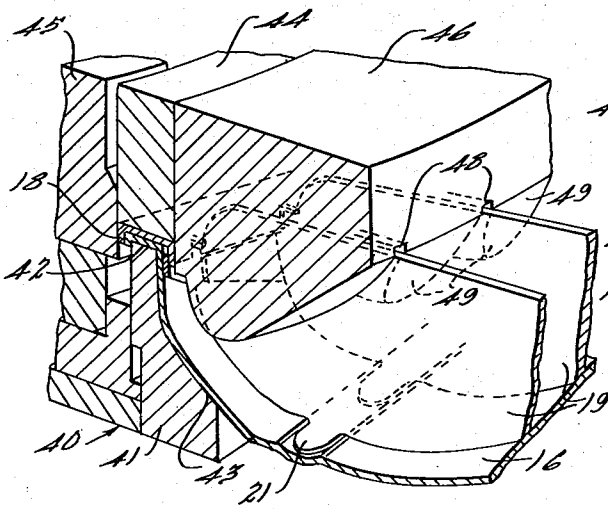


Fig. 6.

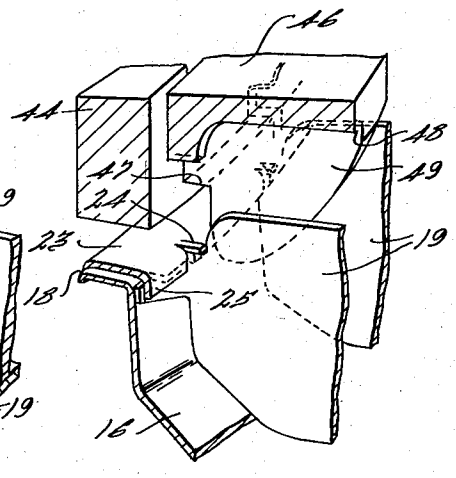


Fig. 7.

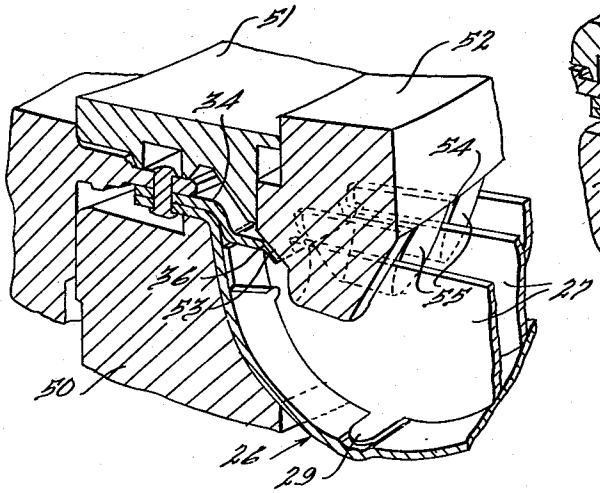


Fig. 8.

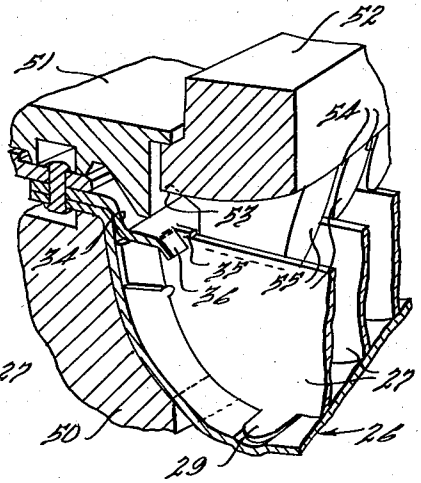


Fig. 9.

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METHOD OF MAKING FLUID COUPLING ROTOR ELEMENTS

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Original application January 23, 1948, Serial No. 3,996, now Patent No. 2,599,461, dated June 3, 1952. Divided and this application July 13, 1949, Serial No. 104,470

4 Claims. (Cl. 113—116)

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This invention relates to improvements in the manufacture of a vaned structure and is a division of my application Serial No. 3,996, filed January 23, 1948, now Patent 2,599,461, granted June 3, 1952. The invention is illustrated and described in connection with the manufacture of a vaned structure for a hydrodynamic torque transmitting fluid coupling wherein the invention has particular application, although in the broader aspects the invention is not limited to such particular application.

An object of the invention is the provision of an improved method for securing vanes relative to a carrier or support therefor, and more particularly the invention has for its object the provision of a method for manufacturing a vaned structure by which a retainer is interlocked with the vanes to prevent relative displacement of the latter. The vane retainer in its final form includes a plurality of notches respectively receiving a vane and a plurality of tongues one extending into each space between adjacent vanes. The improved method includes the feature of utilizing the vanes, when the latter are positioned relative to the carrier, as an implement against which the retainer is pressed to deflect a portion of the retainer into each space between adjacent vanes and for cutting or lancing the retainer to provide the vane-receiving notches. The tongues formed by cutting the retainer are deflected one into each space between adjacent vanes by the application of the aforesaid pressure, and that portion of the retainer displaced by the cutting of the notches constitutes a tongue which is maintained in the plane of and engages an edge of that vane in such notch. Each vane utilized in the aforesaid cutting and lancing of the retainer is maintained against lateral deflection during the pressure operation, preferably by the pressure-applying means. The invention is illustrated and described in connection with a fluid coupling of the foregoing type having juxtaposed rotatable impeller and runner structures or rotors defining a fluid circulating circuit and in which the runner structure is driven by flow of pressure fluid impelled thereto by the impeller structure, each structure including a plurality of vanes forming fluid passages for the circuit and the pressure fluid impelled by the impeller impinging against the vanes of the runner to drive the latter. Each of these structures may be formed from sheet metal components, in the interest of economy, and includes a vane carrier or support having an annular dished section in which a plurality of radially extending, circumferentially spaced fluid passage-forming vanes are seated.

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In the illustrated embodiment, the tongues formed by cutting the retainer extend between respective adjacent vanes and constitute a baffle in the runner structure, each such tongue being disposed generally radially whereas in the impeller structure each such tongue is folded over the vaned tab in the space between adjacent vanes. This folding of the tongues is accomplished by the pressure operation by which the tongues are formed as aforesaid.

Other objects and advantages of the invention will be more apparent from the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a fragmentary sectional view in side elevation illustrating a fluid coupling embodying the invention.

Fig. 2 is a fragmentary elevational view, partly in section, taken on line 2—2 of Fig. 1.

Fig. 3 is a fragmentary elevational view taken as indicated by line 3—3 of Fig. 1 with a part thereof broken away to show the underlying structure.

Fig. 4 is an enlarged, fragmentary perspective view, partly in section, further illustrating the assembly of the vanes, vane support, and retainer at the inner diameter of the coupling rotor.

Fig. 5 is a view similar to Fig. 4 illustrating the assembly of the vanes, vane support, and retainer at the inner diameter of the coupling driven rotor.

Fig. 6 is a fragmentary perspective view, partly in section, illustrating the cutting and forming apparatus for the impeller vane retainer at the completion of an operation.

Fig. 7 is a view similar to Fig. 6, showing the cutting and forming elements in partially retracted position.

Fig. 8 is a view similar to Fig. 6 illustrating the apparatus for operating on the runner vane retainer at the completion of an operation.

Fig. 9 is a view similar to Fig. 8 showing the cutting and forming elements in partially retracted position.

Referring to the drawings, particularly Fig. 1, the invention is illustrated in a fluid coupling operable to transmit a drive between driving and driven shafts in the drive system of a motor vehicle, a releasable friction clutch being shown between the coupling and driving shaft. In the broader aspects, the coupling embodying the in-

vention can be employed in drive systems other than that illustrated herein.

The fluid coupling and friction clutch are shown in a housing 10, the coupling including an annular casing 11 which may be formed by two parts welded together as at 12, and secured to a driving shaft 13 by bolts 14 for rotation therewith. Inasmuch as the fluid coupling functions as a flywheel, the same is provided with a ring gear 15. The casing 11 has a dished section to which is secured, as by welding, a vane carrier or support 16 having an annular marginal portion or dished section, an annular flange 17 extending radially inwardly from the latter adjacent the inner diameter of the carrier, and an annular terminal flange 18 extending generally axially. Seated in the dished section of the carrier 16 are a plurality of radially extending, circumferentially spaced vanes 19, each of which has a tab 20 at the radially outer end abutting and secured, as by welding, to the carrier at the outer diameter thereof, and a tab 21 abutting and secured, as by welding, to the carrier intermediate the innner and outer diameters of the latter. The inner end of each vane 19 has a tab 22 abutting the carrier 16 adjacent the inner diameter, it being understood that the tabs 20, 21, 22 of each vane are disposed in the space between the latter and an adjacent vane. The foregoing construction constitutes the impeller structure or driving rotor of the coupling which is driven directly from the shaft 13.

The inner ends of the vanes 19 are secured to the carrier 16 by an annular retainer 23 which abuts the carrier flange 17 and is welded thereto. The retainer extends over the edge of the vanes 19 and is notched at the free edge thereof at those portions thereof respectively registering with the vanes 19 to receive the latter. That portion of the material displaced in forming each notch constitutes a tongue 24 which overlies an edge of the registering vane. This notching of the retainer provides a plurality of tongues 25 respectively registering with the space between adjacent vanes, each tongue 25 being deflected to overlie and engage that vane tab 22 which lies in the aforesaid registering space between adjacent vanes. The tongues 25 prevent circumferential displacement of the vanes and form a structural interlock between the vanes and the retainer which is in turn secured to the carrier. In order to insure against displacement of the retainer relative to the carrier under the influence of centrifugal force developed during operation of the coupling, the retainer 23 at the inner diameter thereof has a flange 23' which extends over and abuts the radially inner periphery of the carrier flange 18. In effect, the flanges 17, 18 and adjacent portion of the dished section of the carrier define in cross section an axially opening channel which is nested in a correspondingly open channel defined by the retainer and this provides a form of structural interlock operable to prevent relative separation of the carrier and retainer under the influence of centrifugal force.

The centrifugal force developed during operation of the impeller or driving rotor tends to deflect the carrier 16 radially outwardly at the outer diameter thereof and this produces a tendency of the vanes 19 to rock or fulcrum about an axis at the intermediate tabs 21, with a resulting tendency of the inner ends of the vanes 19 to move in a direction generally longitudinally of the axis of rotation of the impeller or driving rotor, that is, to the right as viewed in Fig. 1. This tendency is opposed by the retainer through the tongues 24 acting on the edges of the registering vanes and the tongues 25 acting on the vane tabs 22. Any tendency of the vanes 19 to move generally radially outwardly will be resisted by the tongues 25 acting on the tabs 22.

The runner structure or driven rotor of the coupling includes a vane carrier or support 26 having an annular dished section opening toward and disposed in juxtaposed relation to the impeller structure. Seated in the dished section are a plurality of radially extending circumferentially spaced vanes 27, each having a tab 28 at the outer end secured, as by welding, to the section at the outer diameter of the latter, and a tab 29 similarly secured to such section intermediate the inner and outer diameters of the latter. A third tab 30 of each vane abuts the carrier 26 adjacent the inner diameter thereof. The carrier has an annular flange 31 which overlaps a flange 32 of a hollow shaft 33. An annular member 34 has a part which extends between the flanges 31, 32 and together with flange 31 is secured by rivets 35' to flange 32. Thus the carrier, vanes and member 34 are rotatably connected to shaft 33.

The member 34 has a part which extends radially inwardly over the edge of the vanes 27 at the inner ends thereof and over the space between adjacent vanes and is notched at each vane to receive the latter and to provide relatively small tongues 35 respectively registering with and abutting such vane edge, and a plurality of relatively large tongues 36 which respectively extend into the space between adjacent vanes. The tongues 36 retain the inner ends of the vanes 27 against circumferential displacement and the engagement of each vane edge by its registering tongues 35 and by the member 34 at the base of the registering notch prevents movement of the adjacent vane ends in a direction to the left as viewed in Fig. 1, it being understood that the runner structure or driven rotor is subject to the action of centrifugal force as set forth in connection with the impeller structure. Rocking action of the vanes under the influence of such force is opposed at the inner vane ends by the member 34.

The impeller and runner structures at the dished, vaned sections provide a chamber for the circulation of a fluid medium, such circuit including a fluid passage between adjacent vanes of each structure. In this type of coupling the runner is driven by flow of pressure fluid impelled thereto by the impeller structure, such fluid moving from the impeller to the runner in the region of the outer diameter of the chamber and being returned to the impeller in the region of the chamber adjacent the inner diameter thereof. That portion of the member 34 which extends across the passages between adjacent vanes in the runner structure acts as a baffle to interrupt the flow of fluid from the runner to the impeller when the coupling is operating under relatively high slip between the impeller and runner, for example, when the impeller is rotating at a relatively low speed. When the coupling is operating under a relatively low slip condition the fluid circuit at the inner diameter moves outwardly beyond the region of the baffle and the latter does not exert any appreciable influence on the flow of fluid. This control of fluid flow by the baffle is particularly desirable when, for example, the coupling is employed in a motor vehicle drive including a change speed transmission which is

conditioned to transmit drive when the vehicle is at rest. Under such circumstance the interruption of fluid flow by the baffle prevents creeping of the vehicle.

While the retainer 23 has the tongues 24 and the member 34 has the tongues 35, all arranged as aforesaid, nevertheless such tongues may be omitted from each and the disposition of the vanes in the respective notches in engagement with the base thereof can be relied upon to retain the inner ends of the vanes against displacement in response to tendency to rock under the influence of centrifugal force as aforesaid.

The carrier and vanes of the impeller and runner structures are preferably formed from sheet metal and the vane tabs at the outer diameter and at the intermediate location may be satisfactorily welded to the carrier. However, inasmuch as the spacing of the vanes decreases from a maximum at the outer diameter of the carrier to a minimum at the inner diameter, the space between adjacent vanes at the inner end so restricts the size of the tabs at this region that welding of the same to the carrier would not produce a strong tie therebetween due to the injurious effect of the welding operation on this small tab. The tab at the inner end of the vanes provides a seat which rests on the carrier and while these tabs may as in the impeller structure be engaged by the tongues 25 of the retainer, such engagement is not necessary, as shown in the runner structure, and the tongues 36 thus may be utilized as the baffle.

The sleeve shaft is journalled at 37, receives the driven shaft 38, and is releasably connected thereto by a friction clutch, generally designated by the numeral 39, of the conventional type. When employed in a motor vehicle drive, for example, the driven shaft 38 may constitute the input shaft of a change speed mechanism, not shown.

Referring to Fig. 6, there is shown apparatus by which the vane retainer 23 is operated on to provide the tongues 24, 25, to engage the tongues 25 with the respective vane tabs 22, and to flange the support 16 and retainer at the radial inner extremity thereof, to thereby produce the structural arrangement shown in Fig. 4. These operations are performed after the vanes 19 have been seated in the dished section of the support 16, the tabs 20, 21 have been welded to the support 16, and the retainer 23 welded to the support 16. The forming apparatus includes a support or anvil, generally designated by the numeral 40, having a section 41 on which the driving rotor assembly is placed with the radially inner end portion of the support 16 overlapping the top face 42 of section 41 sufficient to provide the flange 18. The side face 43 of section 41 has a curvature which conforms to the curvature of the support 16 and engages therewith. In this assembly that portion of the retainer which overlaps the adjacent vane ends and provides the tongues 25, and that portion which provides the radial inner flange which overlaps the flange 18 both project beyond the respective opposite edges of the face 42.

The movable part of the apparatus includes a pressure pad and stripper 44 registering with the top face 42, a flanging punch 45 and a lancing punch 46. With the part 44 positioned as shown, the punch 45 is moved in a direction normal to face 42 to thereby flange the adjacent ends of the retainer 23 and support 16. The punch 46 has a lancing face 47 which registers

with that extremity of the retainer which overlaps the adjacent ends of the vanes 19, and which projects beyond the face 42. A plurality of slots 48 respectively register with a vane 19 and a combined support and spacer 49 is provided intermediate each pair of adjacent slots. When the punch 46 is initially positioned each vane is received in its registering slot 48 and is thereby properly located, a spacer 49 extending between each pair of adjacent vanes. As the punch 46 is moved downwardly towards the carrier 16 the face 47 thereof presses the registering extremity of the retainer 23 against the inner vane ends to cause the latter to lance or cut such extremity into tongues 24, which respectively engage the edges of the inner vane ends, and to form tongues 25 which are respectively deflected into the space between adjacent vanes and into engagement with the vane tab 22 in such space. During this lancing and deflecting operation the vanes 19 and support 16 react against the section 41 and the vanes are retained against deflection under the force of the punch 46 by the support spacers 49. The pressure pad and stripper is held in position until the punch 46 is retracted.

As heretofore pointed out, the driving rotor is annular, as shown in Fig. 2, and the forming apparatus above is likewise annular.

The apparatus shown in Fig. 8 for operation on the driven rotor of the coupling is generally similar to that shown in Fig. 6. The rotor assembly is supported by an anvil 50 and is held thereagainst by a pressure pad and stripper 51. A lancing punch 52 has a lancing face 53 adapted to engage with the extremity of the member 34 and by pressing the same against the edges of the vanes 27, lances or cuts the portion so engaged to form tabs 35 which overlie the vane edges and also forms tabs 36 which are deflected between adjacent vanes. The lancing punch has slots 54 respectively receiving a vane 27 and a combined support and spacer 55 between each pair of adjacent vanes. The vanes are thus properly located and supported as in the Fig. 6 showing.

The gauge of metal and the physical characteristics thereof for the vanes and the retainer, in both coupling structures, are so predetermined as to permit lancing or cutting the retainer by pressing the same against the vane faces when the vanes are positioned and supported as shown herein.

Although but one specific embodiment of the invention has herein been shown and described, it will be understood that various changes in the size, shape, and arrangement of parts may be made without departing from the spirit of the invention.

I claim:

1. The method of making a fluid coupling rotor element comprising providing an annular vane carrier having a dished, cross sectional configuration within which a plurality of radially extending, circumferentially spaced vanes are mounted with each vane normal to said carrier inner surface and having an exposed edge portion adjacent a peripheral marginal portion of said carrier, arranging a ring-like vane retainer about said carrier peripheral edges with the free inner marginal portions of the retainer extending over said exposed edge portions of said vanes, and applying pressure between said carrier and vane retainer at the free inner marginal areas of the retainer intermediate adjacent vanes to cause cutting of the free marginal portions of the retainer

by contact with said exposed vane edges, said pressure application cutting of said retainer by said vanes forming vane anchoring tabs overlying said exposed vane edges and causing deflection of those portions of the retainer inner margin intermediate said tabs into the spaces between respectively adjacent vanes.

2. The method of making a fluid coupling rotor element comprising providing an annular vane carrier having a dished, cross sectional configuration within which a plurality of radially extending, circumferentially spaced vanes are mounted with each vane normal to said carrier inner surface and having an exposed edge portion adjacent a peripheral edge portion of said carrier, arranging a ring-like vane retainer about said carrier peripheral edge with the free inner marginal portions of the retainer extending over said exposed edge portions of said vanes, and applying pressure between said carrier and vane retainer at the free inner marginal areas of the retainer intermediate adjacent vanes to cause cutting of the free marginal portions of the retainer by contact with said exposed vane edges, said pressure application cutting of said retainer by said vanes forming vane anchoring tabs overlying said exposed vane edges and causing deflection of those portions of the retainer inner margin intermediate said tabs into interlocking engagement with circumferentially projecting portions of the vanes located in the spaces between respectively adjacent vanes.

3. The method of making a vaned structure that includes an annular vane carrier of dished cross sectional configuration and a plurality of spaced vanes arranged interiorly of the carrier, comprising assemblying the vanes normal to the inner surface of the carrier in radially extending and circumferentially spaced relationship with an edge of each vane abutting said carrier inner surface and another edge of each vane exposed adjacent a peripheral portion of the carrier, securing said vanes to the carrier at points where the vane edges abut the carrier inner surface, arranging a ring-like retainer around the carrier peripheral portion with inner marginal portions thereof overlapping the exposed edges of said vanes adjacent the said peripheral portion of the carrier, securing said retainer to said carrier, applying pressure between the carrier and the marginal areas of the retainer respectively intermediate the vanes sufficient to cut said retainer inner marginal portions by contact with said exposed vane edges during the said application of pressure to form vane-receiving notches at each vane edge, said pressure application to said retainer being sufficient to deflect the vane retainer marginal portions intermediate said notches into the space between adjacent vanes, said pressure applying means acting between adjacent vanes to support the latter against lateral deflection during said pressure application.

4. The method of making a fluid coupling rotor element comprising providing an annular vane carrier having a dished cross sectional configuration and arranging a plurality of radially extending circumferentially spaced vanes within and normal to the inner surface of said carrier with each vane having a lengthwise exposed edge portion adjacent the carrier periphery, arranging a ring-like vane retainer on the carrier periphery with a first inner peripheral part thereof extending over said exposed vane edge portions and a second outer peripheral part extending over the carrier periphery, applying pressure between the carrier and the first part of the retainer at area of the latter respectively registering with the space between adjacent vanes, said pressure application being sufficient to cut said retainer first part on contact with said exposed vane edge portions and to thereby form tongues one registering with each space between adjacent vanes and to deflect at least a portion of each tongue into its said registering space, said pressure application also being applied to and deforming said retainer second part into structural interlocking relationship with the carrier periphery.

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