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TORQUE CONVERTERS

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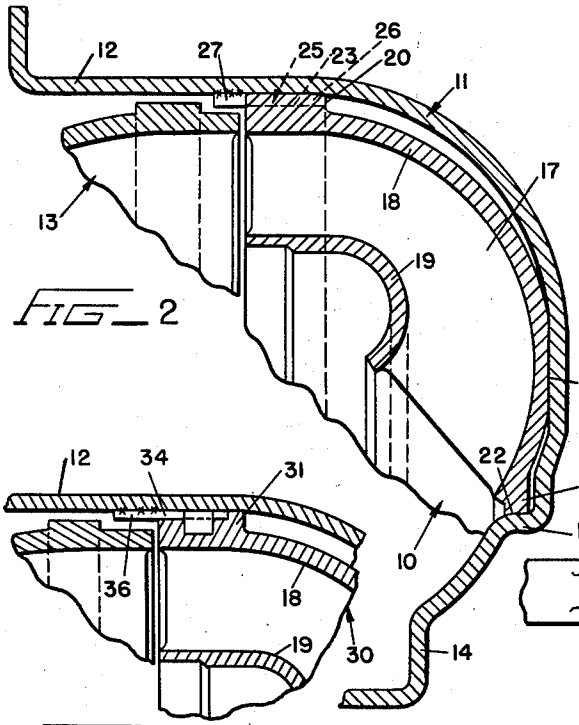


FIG_ 2

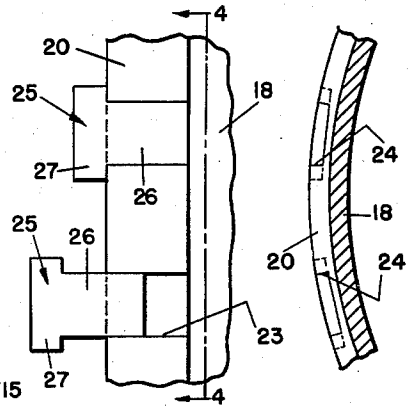


FIG_ 3

FIG_ 4

FIG_ 8

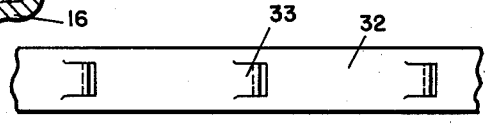


FIG_ 6

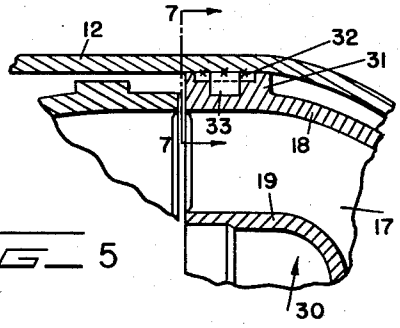


FIG_ 5

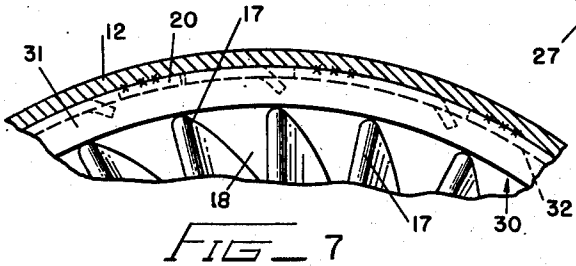


FIG_ 7

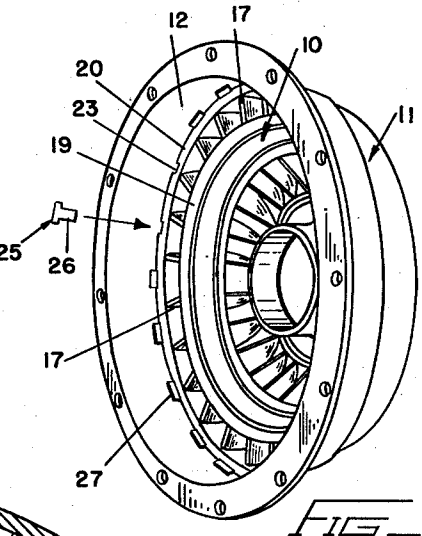


FIG_ 1

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TORQUE CONVERTERS

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3 Claims. (Cl. 103—115)

This invention relates to composite metal structures and more particularly to an article and method of forming such article from steel and aluminum parts.

For purposes of illustration merely, this invention will be described with reference to its application in connection with one of the elements of a hydraulic vane tape torque converter, it being understood, however, that the invention can be adapted for use with other devices as well.

In such fluid coupling devices, for example, the pump element of the torque converter is usually constructed in in such form as to serve as a portion of the housing for the converter. The vanes themselves are disposed generally radially in the housing and they are centered approximately axially with respect to the outer and inner edges of the housing element. In the form of the invention here shown, the overhanging outer and inner portions of the housing serve to enclose the turbine and other parts of the torque converter structure which parts are disposed in the space which extends from the ends of the vanes and the flywheel of the engine to which the pump element of the converter is secured on the one hand, to the other ends of the vanes and the output shaft of the converter on the other hand.

This forms a complicated pump element structure which includes the vanes themselves that are of a rather complex form and contour to enable them to energize the fluid in the converter with maximum efficiency. A commonly used method of forming such a pump element of a converter is by casting the vaned element and the housing integral, the material used being generally aluminum, or some lightweight alloy of aluminum, to reduce the mass of the element and its rotational moment of inertia.

It is also apparent that when the unit is cast as one piece, a more complex molding operation is involved and that the rough casting presents a more difficult problem when it is necessary to remove rough spots from the surfaces of the vanes and burrs from the edges of the fluid flow passages. It should be noted too that a single casting of aluminum must be somewhat large or relatively bulky in order to provide the necessary strength and that sometimes castings are malformed to such an extent as to be porous. It is therefore desirable to minimize the casting operation and yet provide a way of constructing a complex shape having a relatively light weight yet strong and compact form.

The principal object of this invention is to provide an article of complex form, such as a vaned pump or turbine element for a torque converter or the like, which will have cast vanes of lightweight nonferous material, but which may be assembled by being welded to a steel housing. The composite structure may thus be completed in a manner to greatly reduce the cost of the final product so as to make it much less expensive than similar elements generally available at present.

Another object of this invention is to provide an article such as a vaned pump or turbine element of a torque converter wherein the vanes are cast of aluminum or its alloys and the outer shell is a steel stamping, with improved means for fixedly securing the cast vanes to the stamping.

A more specific object of this invention is to provide a method and means for securing an aluminum casting to a stamped steel housing wherein the casting is mechanically locked to the stamping, the locking means itself being a steel stamping that may be welded to the housing. In one embodiment thereof, the locking means may include one or more steel stampings inserted into grooves in the casting and having tabs which abut on the casting, the tabs being spot-welded to the housing to hold the casting in place. In another modification, the steel locking means is shaped like a hoop and has inwardly pressed projections around which the aluminum casting is poured to secure an integral mechanical lock between the hoop and casting. The hoop may then be welded to the stamped steel housing.

Another object of this invention is to provide a method of forming composite articles having cooperating locking means for joining together a cast portion which is made of a non-weldable material and a stamped portion of another material that may be welded.

In addition to the above, other objects will appear more fully in the specification below.

The preferred form of the invention is shown in the drawings forming a part of this specification, however, it is to be understood that the invention is not to be limited to the details of construction and arrangements of parts here shown, 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 for the purpose of description only and not by way of limitation.

In the drawings:

Figure 1 is a perspective view showing a composite torque converter pump structure embodying the principles of this invention;

Figure 2 is a quarter-sectional view of the element of a torque converter shown in Figure 1;

Figure 3 is a plan view partly broken away showing the periphery of the cast vaned element of Figure 1;

Figure 4 is a view taken along line 4—4 of Figure 2;

Figure 5 is a fragmentary section through a modified form of this invention;

Figure 6 is a plan view of the modified locking element shown in Figure 5;

Figure 7 is a section taken along line 7—7 of Figure 5; and

Figure 8 is a fragmentary section through still another modification of the invention.

Referring now to the drawings for a detailed description of the invention and particularly to Figures 1 and 2, the vaned pump element of the torque converter made in accordance with this invention is formed of a cast aluminum or aluminum alloy element **10** and a stamped steel shell **11**, the latter extending around the cast aluminum portion and axially beyond as at **12** to house other elements of the converter such as the turbine element **13**, and to provide a means for attaching the torque converter pump means to a flywheel or other driving means (not shown). The stamped shell **11** also extends radially inward as at **14** to cooperate with or have a bearing contact with an output shaft (not shown), to complete the space within which the operating fluid for the converter is confined.

At the extreme right of the housing as viewed in Figure 2, a flat surface **15** is formed on the casting **10**, which as hereinafter described functions to assist in locating the casting in the housing **11**. Between flat surface **15** and the inward portion **14** of the housing, a shoulder **16** is provided in the housing, which acts as a centering means

taking the form of an annular seat for locating the aluminum casting in the housing.

The vanes **17** of the pump element may have any desired shape and for maximum efficiency in a torque converter, vanes **17** are not only curved, but also vary in thickness, which shape makes it quite difficult to form them by any operation other than by casting. Vanes **17** are held in spaced relation radially about casting **10** by an outer shell **18** and an inner shroud **19**, both of which are cast integrally with vanes **17**. The shell **18** is finished so as to have a generally flat outer periphery or flange **20**, and the shell also has an inner bead **21** having an inwardly facing cylindrical surface **22** formed thereon which fits snugly on shoulder **16** to center casting **10** in stamping **11**.

It is apparent from an inspection of Figures 1 and 2, that it would be difficult to make the entire pump element as a single casting. This is particularly true when aluminum is used, as is customary, to reduce the mass and rotational inertia of the element. In this case, the increased quantity of aluminum needed adds to the cost of the element, and also the cost is increased because of the required cleaning up and machining of the casting. The very size and complexity of such a casting would make the mold relatively expensive, and would greatly add to the difficulty of cleaning up the rough portions of the casting and particularly the working surfaces of the vanes, the shell **18**, and inner shroud **19**. The advantages inherent in limiting the casting operation to merely the vaned portion of the pump element are thus obvious.

In following the teaching of this invention, the aluminum vanes, and only as much of the pump shell and shroud as are necessary to support the vanes, are cast together as a unit. The remainder of the pump housing is formed of any other material which may be relatively inexpensive and which lends itself to a stamping operation, such as steel. It is essential, however, that the vaned casting be fixedly joined to the stamping without piercing it whereby to minimize the possibility of leaks forming through which the hydraulic fluid might pass in escaping from the converter.

One form of a means which may be used for so attaching the casting to the housing **11** is shown in Figures 1 to 4 to which reference is now made. In this form of the invention, the flange **20** at the periphery of the casting has the spaced axially disposed grooves **23** machined therein, the sides **24** of which are disposed at right angles with respect to the floor of each of their respective grooves, as shown in Figure 4. Said grooves **23** are designed to cooperate with the T-shaped steel inserts **25**, by receiving the tail portions **26** thereof while the cross bars **27** are adapted to be fitted snugly against flange **20** as shown in Figures 1 and 2. The edges of each of the tail portions **26** are rectangularly shaped so as to closely fit into grooves **23**. The T inserts **25** may be and preferably are made as stampings, which may be further machined, if necessary, to provide a snug fit in grooves **23**.

In making use of this form of the invention, the cast aluminum pump element **10** is temporarily pressed into the annular seat formed in the stamped steel shell **11**, and the inserts **25** are then placed in grooves **23** to form an assembly. After the inserts are all in place, the protruding cross bars **27** of each of the T-shaped locking members are spot-welded or otherwise integrally secured to shell **11**. The cast element **10** is held in the stamping so that the flat surface **15** abuts the rear wall thereof and the inner cylindrical surface **22** is centered on shoulder **16** whereby the cast part is properly located in shell **11** to hold it fixed during the welding operation. During performance of the spot welding operation, care must be exercised to press cross bars **27** against the front side of flange **20** and it is desirable that axial pressure be exerted on the cross bars during the welding operation so that the cast portion **10** will be tightly engaged against the stamped shell **11** when the juxtaposed cross bars and the housing are subjected to the welding operation. It is most important in the case of a torque converter that the pump element be fixed tightly in place to avoid all rattles and other possible sources of noise in the finished product.

The number of T locking inserts needed depends upon the forces involved and the strength of the materials used. To preserve dynamic balance, and to minimize weight, the use of a minimum number of two diametrically opposed inserts is preferred, but any number of inserts may be provided to complete the assembly, as long as it is dynamically balanced upon the completion thereof.

In one welding method it is possible to weld two juxtaposed pieces of metal together without having both pieces contacted by the welding electrodes. This welding method can best be performed in connection with the alternative designs of welding strips adapted for use in a torque converter element, which strips are shown in Figures 5 to 8 inclusive, to which reference is now made.

The same form of steel shell may be used and a cast aluminum vaned portion **30** is formed which is generally similar to the vaned element **10**, except that its outer periphery or flange **31** is not axially grooved. Instead, a steel ring, or hoop, **32** is cast integral with the flange **31**, said ring having angularly disposed tabs **33** punched inwardly at regular intervals. Ring **32** may be initially placed in the mold during the casting of the vaned pump element **30**, and the material from which the casting is being made will flow around tabs **33** thus locking the ring mechanically to the casting as shown in Figures 5, 7 and 8.

After the completed casting **30** is removed from the mold and suitably cleaned, it may be pressed into the annular seat provided in housing **11** as explained above, and the housing **11** may then be welded to ring **32** by the aforesaid welding technique. Since tabs **33** are embedded in the cast portion **30** it is not necessary, in this instance, to take any special precautions such as to press the pump member axially inwardly relative to the casting during the welding operation. The composite vaned structure should however be firmly and concentrically seated within the shell during performance of this welding operation.

A further modification of the invention is shown in Figure 8, wherein a ring **34** is disclosed as being cast integral with the pump element **30**. Ring **34** may be formed generally like ring **32** except that it is wider and overhangs the periphery of flange **31** of the vaned casting as shown at **36**. The overhanging portion may then be welded directly to housing **11** in the same manner as described in connection with inserts **25**, or ring **32**.

The composite article, formed in the manner outlined above, makes use of a steel housing **11** which is leakproof together with a rigidly mounted, lightweight, and relatively inexpensive vaned pump element. The preferred form of the invention has been disclosed in connection with the construction of a torque converter pump but it is obvious that it can be used in fabricating many similar composite structures where the factors of relatively light weight, strength, and compactness are important. In making use of this teaching the most desirable material for each of the several parts of the composite structure may be selected in accordance with the optimum specifications therefor, and all of the parts may then be subsequently assembled as here taught.

It is thus to be understood that the foregoing description is merely illustrative of a preferred embodiment of this invention and that various other forms thereof may be conceived, without departing from the spirit and scope of the invention, as set forth in the following claims.

What is claimed is:

1. A composite structure such as the pump element of a torque converter or the like formed of a ring-like steel housing having an interfitting ring-like vaned aluminum casting, the two metals being incompatible from a welding standpoint, said housing having an annular space formed therein to receive said casting, said casting having axially disposed slots cut therein at spaced points around its outer

periphery, said casting being adapted to be pressed into said annular space with its periphery in contact with said housing, a plurality of T-shaped steel locking means one of which is adapted to be engaged in each of said slots with the tail of the T in the slot and the cross of the T abutting the periphery of said casting, said locking means being compatible from a welding standpoint with said housing, the cross of said T-shaped piece being positioned with respect to said casting and said housing to overlay a portion of said housing, and welded joint means between each of the said cross parts of the T-shaped pieces and said housing to hold said composite structure assembled.

2. A composite structure such as the pump element of a torque converter or the like formed of a ring-like steel housing having an interfitting ring-like vaned aluminum casting, the two metals being incompatible from a welding standpoint, said housing having an annular space formed therein to receive said casting, said casting being adapted to be pressed into said annular space with its periphery in contact with said housing, steel locking means in the form of a ring cast integral with the outer periphery of said vaned casting, said steel ring overhanging one edge of said casting and being positioned juxtaposed said housing when said housing and casting are interfitted, said locking means being compatible from a welding standpoint with said housing, and welded joint means between the overhanging portion of said compatible locking means and said housing to hold said composite structure assembled.

3. A torque converter or the like, comprising a generally annularly shaped steel housing and an interfitted annular member, the inner portion of said housing being provided with a seating shoulder, said interfitted member being cast of a light weight metal incompatible with said steel housing from a welding standpoint, said annular interfitted member including a plurality of blades cast integral with inner and outer shroud members, one end of said outer shroud being adapted to engage on said seating shoulder when said housing and annular members are interfitted, locking means cooperating with the other end of said outer shroud, said locking means engaging the shroud in a manner to prevent the annular member from having any axial or rotative movement relative to the housing, and said locking means being formed of a material that is compatible from a welding standpoint with the housing and being welded to the housing to hold said annular member immobile and seated within the housing.

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