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Hecht

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[54] **ENGINE COOLING FAN SPACER STRUCTURE**

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[52] **U.S. Cl.** **64/6,** 64/5, 64/4, 64/8, 123/41.46, 417/201, 308/29

[51] **Int. Cl.** **F16d 3/00**

[58] **Field of Search** ..... 64/6, 8, 5, 4, 3, 1 C, 64/1 R, 9; 123/41.46, 41.11, 41.12, 41.65; 417/201; 287/53 SS, 56; 308/29

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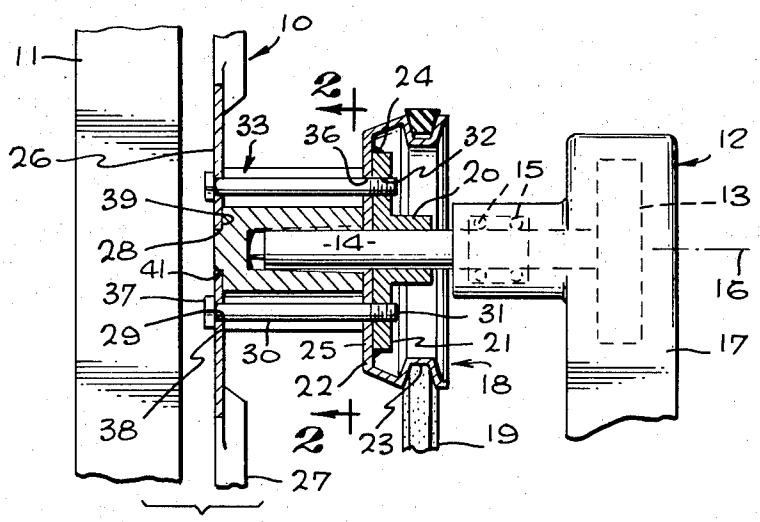
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[57] **ABSTRACT**

A spacer for mounting an engine cooling fan to a drive structure in spaced relation thereto, with the spacer having a forward centering portion engageable with the fan in centering relation, and having a rear pilot recess for receiving a pilot shaft of the drive structure, and with the pilot recess having a peripheral wall defining a series of circularly spaced elongated ribs of uniform internal diameter for engaging the pilot shaft. Circularly between these ribs, the wall of the pilot recess has surface areas which progressively taper as they advance more deeply into the recess.

14 Claims, 5 Drawing Figures



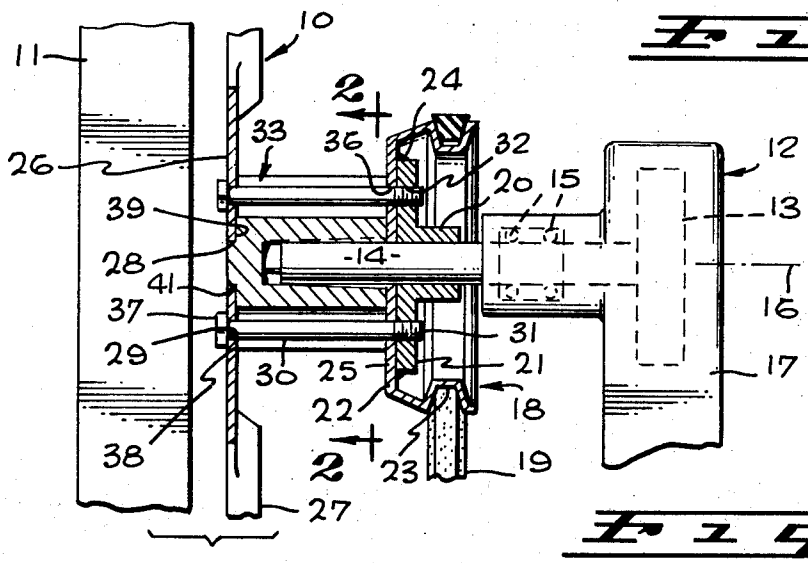


Fig. 1

Fig. 2

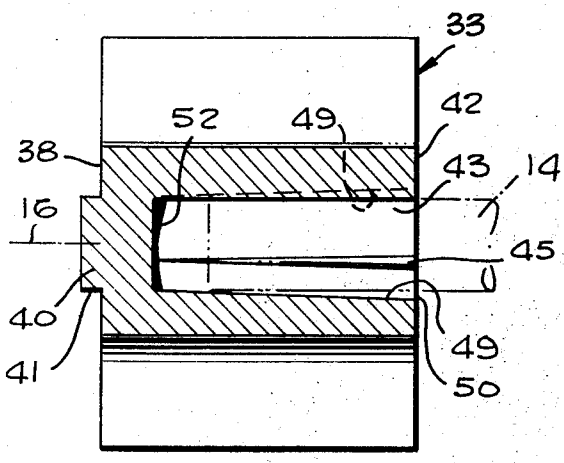


Fig. 3

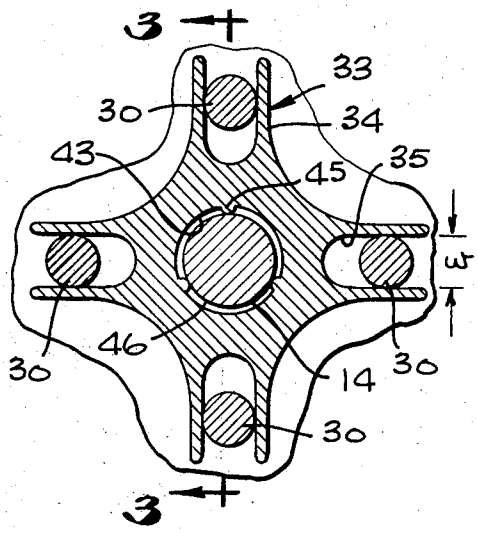


Fig. 5

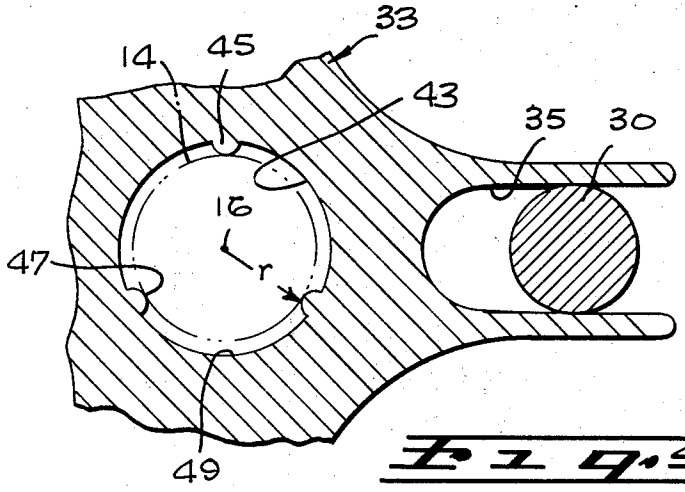
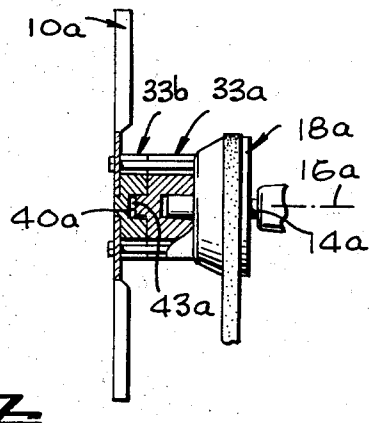


Fig. 4



ENGINE COOLING FAN SPACER STRUCTURE

BACKGROUND OF THE INVENTION

This invention relates to an improved spacer arrangement for mounting an engine cooling fan to a drive structure such as the water pump shaft of an engine.

In conventional water cooled internal combustion engines, the fan for circulating air through the radiator is driven by a shaft which is located behind the radiator, and which usually serves also as the water pump shaft. This shaft itself may in turn be driven by a belt, engaging a sheave or pulley disposed about the shaft.

In order to locate the fan in close enough proximity to the radiator to produce an optimum flow of cooling air through the radiator, the fan may be mounted to its drive structure by means of a spacer which projects the fan forwardly a predetermined distance from its driving shaft. This spacer may be centered with respect to the driving shaft by reception of a forward portion of that shaft within a pilot recess formed in the rear of the spacer. Heretofore, it has been felt necessary, in forming this pilot recess, to first cast the spacer with a slightly tapered recess at the proper location, and then machine the wall of the recess to a slightly increased diameter cylindrical configuration adapted to fit closely on the mating pilot shaft or projection and assure rotation of the driven fan about exactly the right axis. This two step process has unduly increased the cost of the part and introduced a possibility of slight misalignment as between the machined wall of this recess and other portions of the spacer.

SUMMARY OF THE INVENTION

The present invention provides a unique spacer which is specially designed to eliminate the above discussed machining operation, and to enable the spacer to be completely formed in a single casting or molding operation. The production cost of the spacer is in this way substantially reduced, and the concentricity of the pilot recess with respect to the remainder of the spacer is more reliably assured than where the rear recess is completed by a separate machining operation after initial casting.

To attain these results, the wall of the pilot recess is shaped to form a series of circularly spaced elongated ribs, which project radially inwardly beyond a number of circularly intermediate portions of the recess wall between the ribs. Along their inner sides, these ribs have innermost surfaces which extend at a uniform or unchanging radial distance from the axis of the spacer as they advance progressively more deeply into the recess, and which therefore can locally engage and closely fit an externally cylindrical surface of the mating pilot shaft. Stated differently, these innermost surfaces of the ribs do not advance either radially inwardly or radially outwardly with respect to the axis as they advance along the length of the ribs. The intermediate surface areas circularly between the ribs, on the other hand, are shaped to gradually taper toward a reduced diameter as they advance more deeply into the recess. Desirably, these intermediate tapering surface areas have circular extents much greater than the ribs, and act by their presence to supply enough draft to the overall recess to allow the recess to be cast in a single operation in spite of the fact that the ribs themselves do not taper. Further, these ribs can in most instances have a tighter and closer fit on the coacting shaft than

is possible in the case of a circularly continuous precisely cylindrical recess or bore, since the ribs engage the coacting shaft at only relatively small localized areas, and can if necessary be deformed slightly by the shaft, upon assembly of the parts, to facilitate such assembly even with a very close fit of the parts.

BRIEF DESCRIPTION OF THE DRAWING

The above and other features and objects of the invention will be better understood from the following detailed description of the typical embodiments illustrated in the accompanying drawing, in which:

FIG. **1** is primarily an axial sectional view through an engine fan mounting assembly embodying the invention;

FIG. **2** is an enlarged transverse section taken on line **2—2** of FIG. **1**;

FIG. **3** is an axial section taken on line **3—3** of FIG. **2**;

FIG. **4** is a further enlarged view corresponding to a portion of FIG. **2**; and

FIG. **5** is a reduced scale representation of a variational arrangement utilizing two spacers together.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. **1**, I have represented at **10** a conventional internal combustion engine cooling fan, which is positioned behind a radiator **11** to draw a flow of air through the radiator in a rightward direction as viewed in FIG. **1**. The engine is cooled by water which circulates through radiator **11**, and which is pumped through the engine block, radiator, and the remainder of the cooling system by a conventional water pump represented at **12**. This pump includes the usual impeller **13** mounted on an externally cylindrical shaft **14** which is journaled by bearings **15** to turn about an axis **16** relative to the housing **17** of the pump. The bearings may be received within shallow grooves in the outer cylindrical surface of shaft **14**, to serve as both centering and thrust bearings. As will be understood, the housing or stator **17** of the water pump is mounted stationarily on the block of the engine.

Forwardly of the pump **12**, shaft **14** carries a structure **18** which is driven by the engine through an endless fan belt **19**. This structure may include a rigid tubular element **20** which is rigidly secured to and turns shaft **14**, and which has an annular radially outwardly projecting flange **21** disposed directly transversely of axis **16**. To the forward face of flange **21**, there is mounted a radially extending portion of a part **22**, whose periphery forms an annular groove **23** within which the belt **19** is received in driving relation. Element **22** may be secured to part **20** in any appropriate manner, as by welding at **24**, or otherwise. The forward face **25** of part **22** is planar and perpendicular to axis **16** of the shaft.

The fan **10** may have a flat mounting portion **26** perpendicular to axis **16** and peripherally carrying a series of circularly spaced vanes **27** adapted to produce an axial flow of air upon rotation of the fan. At its center, the portion **26** of the fan contains a circular opening **28**, which is utilized for centering the fan with respect to rotary axis **16**. At a series of evenly circularly spaced locations (typically four such locations), the fan contains apertures **29** through which axial bolts **30** extend. The bolts are utilized to secure the fan to drive struc-

ture 18, with a spacer 33 embodying the invention tightly clamped between the fan and the drive structure. As seen best in FIG. 2, the spacer has at the location of each of the bolts 30 a radially outwardly projecting portion 34, containing an axially elongated and also radially extending and radially outwardly opening slot 35 within which the associated bolt 30 is received. The width *w* of each of these slots or grooves 35 is desirably substantially the same as the diameter of the shank of the associated bolt 30, so that the bolt is a fairly close fit within the groove, and assists in maintaining the spacer and other parts against relative rotation.

At its rear end, each of the bolts 30 extends through an opening 36 in part 22 and has an externally threaded portion 31 which is connected to internal threads 32 formed in an associated one of several circularly spaced openings in flange 21. The forward ends of the bolts have enlarged heads 37 which bear against the portion 26 of the fan to clamp it tightly rearwardly against the spacer.

The spacer is desirably rigid, and may be cast of an appropriate metal having sufficient strength and stiffness to serve the intended function. At its forward end, the spacer has a front planar surface 38 disposed directly perpendicular to axis 16 and against which the rear correspondingly planar and transverse surface 39 of portion 26 of the fan abuts tightly. At its center, the forward face of the spacer forms a forwardly projecting pilot lug 40, having an axial extent corresponding approximately to the thickness of portion 26 of the fan, and projecting into the central opening 28 of the fan. The outer surface 41 of centering lug 40 is desirably cylindrical about axis 16, and of a diameter corresponding to the diameter of the internal surface formed by the fan within opening 28, to engage that surface essentially annularly about axis 16, and assure concentric mounting of the fan with respect to the spacer.

The back surface 42 of the spacer is also planar, and perpendicular to axis 16, and abuts against the forward planar transverse surface 25 of part 22. At the center of this rear surface 42, the spacer contains a pilot recess or hole 43, into which the forward end of shaft 14 projects. As seen best in FIGS. 2 and 4, this recess is defined peripherally by a generally annular wall 44, which is shaped to define a series of circularly spaced radially inwardly projecting ribs 45 for engaging the outer cylindrical surface 46 of shaft 14 in a precise centering or piloting relation. For best results, there should be at least three such ribs spaced equal circular distances apart (spaced 120 degrees apart in the illustrated three-rib arrangement). Preferably, the ribs extend directly axially with respect to main rotary axis 16. Also, the ribs may have the illustrated convexly rounded cross-sectional configuration, to each engage the outer surface of the shaft through only a very small portion of the circular extent of the recess wall, and more specifically in essentially line contact axially of the spacer. In order to effectively engage the external cylindrical surface of the shaft, the innermost surfaces of the ribs at 47 extend at a uniform or unchanging radial distance *r* from the axis 16 as they advance axially inwardly into the recess, and desirably through the entire axial extent of the ribs and the recess.

Circularly between the locations of the various ribs 45, the side wall 44 of the pilot recess 43 has intermediate surface areas 49 which extend arcuately about axis 16, but which taper progressively toward a reduced diameter as they advance axially inwardly into the recess. More specifically, as seen in FIG. 3, these intermediate surface areas 49 taper progressively but very gradually in radius from the location 50 at the entrance end of recess 43 to the axially inner end wall 52 of the recess, at which location the areas 49 desirably reach a minimum radius approximately equal to radius *r* of the innermost surfaces of the ribs. Thus, the three intermediate surface areas 49 may be considered as forming together a frustoconical composite surface interrupted only by the three ribs 45. It should also be noted that the circular extents of the individual intermediate surface areas 49 should desirably be considerably greater than (preferably several times as great as) the circular extents of the individual ribs. As will be apparent, the taper of the surfaces 49 gives the recess as a whole sufficient draft to enable a casting core to be withdrawn axially therefrom, while the nontapering configuration of the narrow ribs provides a sufficient centering effect to assure precise alignment of the spacer with shaft 14 and its axis.

In assembling the apparatus of FIG. 1, the spacer 33 may be easily slipped onto the projecting end of shaft 14 and to a position of engagement with surface 25 of the drive structure 18, following which fan 26 may be positioned in front of the spacer, with pilot lug 40 projecting into center opening 28 of the fan in aligning relation, so that bolts 30 may then be inserted into position and tightened into the threaded bores 32 in flange 21 to clamp the parts together in accurately aligned relation.

In various different engine and radiator installations, spacers of the described type but of different thicknesses may be utilized, in order to assure proper proximate positioning of the fan with respect to the radiator in each engine. Also, in some cases it may be desirable to employ two or more spacers in additive relation to attain a particular spacing distance for which a single spacer is not available. Such an arrangement is shown in FIG. 5, in which all of the parts may be considered as identical with those shown in FIG. 1 except that two separate spacers 33*a* and 33*b* have been inserted between the drive structure 18*a* and fan 10*a*, in lieu of the single spacer 33 of FIG. 1. Each of these spacers is identical with spacer 33, except as to thickness in the direction of axis 16*a*. The rear spacer 33*a* engages drive structure 18a and its shaft 14*a* in the same manner discussed in connection with spacer 33 of FIG. 1, and similarly the forward spacer 33*b* engages the fan in the same centering relation discussed with respect to FIG. 1. The two spacers are themselves maintained in accurate axial alignment with one another by reception of the forward pilot lug 40*a* of spacer 33*a* (corresponding to lug 40 of FIG. 1) within the rear pilot recess 43*a* of spacer 33*b* (corresponding to recess 43 of FIG. 1), with the outer cylindrical surface of lug 40*a* engaging the innermost surfaces of a series of spaced ribs in recess 43*a* corresponding to ribs 45 of FIGS. 1 to 4.

While certain specific embodiments of the present invention have been disclosed as typical, the invention is of course not limited to these particular forms, but rather is applicable broadly to all such variations as fall within the scope of the appended claims.

I claim:

1. A spacer for use in mounting an engine cooling fan to a drive structure turning about a predetermined axis, comprising a spacer body, centering means at a first

end of said body for locating said fan in a predetermined centered relation relative to said body for rotation therewith about said axis, said body having at its second end a recess for receiving a centering projection turning about said axis, said recess having a generally axially extending peripheral wall extending about said axis, said wall forming a plurality of circularly spaced elongated ribs having radially inner surfaces for engaging the outer surface of said projection in centering relation and extending at a predetermined uniform radial distance from said axis as the ribs advance more deeply into said recess, said wall of the recess having intermediate surface areas circularly between said ribs which commence at a radial distance from said axis which is greater than said radial distance of said inner surfaces of said ribs from the axis and which intermediate surface progressively taper to reduced radial distances from the axis in advancing more deeply into said recess.

2. A spacer as recited in claim **1,** in which said ribs extend substantially directly axially as they advance into said recess.

3. A spacer as recited in claim **1,** in which said intermediate surface areas have circular extents substantially greater than the circular extents of said ribs.

4. A spacer as recited in claim **1,** in which said body has parallel planar spacing surfaces at its opposite ends disposed perpendicular to said axis for engaging and spacing apart two coacting surfaces.

5. A spacer as recited in claim **1,** in which said body has at said first end thereof a surface disposed transversely of said axis, said centering means including a pilot lug projecting beyond said transverse surface and having an external cylindrical surface centered about said axis.

6. The combination comprising an engine cooling fan turning about a predetermined axis, a drive structure for turning said fan about said axis, spacer means axially between said fan and drive structure for holding the fan in predetermined spaced relation to the drive structure, and means for securing said fan to said drive structure with said spacer means therebetween, said spacer means including a spacer body having centering means at a first end thereof for locating said fan in predetermined centered relation with respect to said body, said spacer body containing a pilot recess extending generally axially into its second end, there being a pilot projection associated with said drive structure and projecting into said recess, said recess having a peripheral wall extending about said projection and forming a plurality of circularly spaced elongated ribs having radially innermost surfaces engaging the outer surface of said projection in centering relation, said innermost surfaces of the ribs extending at a uniform radial distance from said axis as they advance more deeply into the recess toward said first end of the body, said wall forming intermediate surface areas circularly between said ribs which commence at a radial distance from said axis greater than that of said radially innermost surfaces of the ribs, and out of contact with said pilot projection, and which intermediate surface areas taper progressively to a reduced radial distance from said axis as they advance more deeply into the body toward said first end thereof.

7. The combination as recited in claim **6,** in which said fan has a radially inner portion extending transversely of said axis and abutting against said first end of said body and containing a circular central opening, said centering means on the body including a pilot lug projecting into said opening in the fan in centering relation.

8. The combination as recited in claim **6,** in which said drive structure includes a water pump having a driven shaft with a forward portion forming said pilot projection extending into said recess.

9. The combination as recited in claim **6,** in which said spacer body has front and rear parallel surfaces disposed directly transversely of said axis and engaging transverse surfaces on said fan and said drive structure respectively, said centering means being a short externally cylindrical pilot lug projecting into a central opening in said fan in centering relation.

10. A spacer for use in mounting an engine cooling fan to a drive structure turning about a predetermined axis, comprising a spacer body, centering means at a first end of said body for locating said fan in a predetermined centered relation relative to said body for rotation therewith about said axis, said body having at its second end a recess for receiving a centering projection turning about said axis, said recess having a generally axially extending peripheral wall extending about said axis, said wall forming a plurality of circularly spaced elongated ribs having radially inner surfaces for engaging the outer surface of said projection in centering relation and extending at a predetermined uniform radial distance from said axis as the ribs advance more deeply into said recess, said wall of the recess having intermediate surface areas circularly between said ribs which commence at a radial distance from said axis which is greater than said radial distance of said inner surfaces of said ribs from the axis and which intermediate surface areas progressively taper to reduced radial distances from the axis in advancing more deeply into said recess, said ribs being of convexly rounded transverse cross section and engaging the outer surface of said projection along only a relatively small portion of its circular extent.

11. A spacer for use in mounting an engine cooling fan to a drive structure turning about a predetermined axis, comprising a spacer body, centering means at a first end of said body for locating said fan in a predetermined centered relation relative to said body for rotation therewith about said axis, said body having at its second end a recess for receiving a centering projection turning about said axis, said recess having a generally axially extending peripheral wall extending about said axis, said wall forming a plurality of circularly spaced elongated ribs having radially inner surfaces for engaging the outer surface of said projection in centering relation and extending at a predetermined uniform radial distance from said axis as the ribs advance more deeply into said recess, said wall of the recess having intermediate surface areas circularly between said ribs which commence at a radial distance from said axis which is greater than said radial distance of said inner surfaces of said ribs from the axis and which intermediate surface areas progressively taper to reduced radial distances from the axis in advancing more deeply into said recess, said body containing axially extending passages through which a series of elongated bolts are to pass for securing said fan to said drive structure in spaced relation.

12. A spacer for use in mounting an engine cooling fan to a drive structure turning about a predetermined

axis, comprising a spacer body, centering means at a first end of said body for locating said fan in a predetermined centered relation relative to said body for rotation therewith about said axis, said body having at its second end a recess for receiving a centering projection turning about said axis, said recess having a generally axially extending peripheral wall extending about said axis, said wall forming a plurality of circularly spaced elongated ribs having radially inner surfaces for engaging the outer surface of said projection in centering relation and extending at a predetermined uniform radial distance from said axis as the ribs advance more deeply into said recess, said wall of the recess having intermediate surface areas circularly between said ribs which commence at a radial distance from said axis which is greater than said radial distance of said inner surfaces of said ribs from the axis and which intermediate surface areas progressively taper to reduced radial distances from the axis in advancing more deeply into said recess, said body having a first transverse planar surface perpendicular to said axis at said first end of the body for engaging a coacting structure in spacing relation, said centering means including a short pilot lug at said first end of the body projecting beyond the plane of said last mentioned surface and having an outer centering cylindrical surface centered about said axis, said body having at its second end a surface disposed transversely of said axis and extending about said recess, said ribs being of convexly rounded cross-sectional configuration, said intermediate surface areas having circular extents several times as great as the circular extents of said ribs and tapering frustoconically relative to said axis from a diameter substantially greater than said inner surfaces of the ribs to a diameter approximately the same as said innermost surfaces of the ribs, said body having a plurality of passages at circularly spaced locations for passing bolts therethrough for securing said fan to said drive structure in spaced relation.

13. The combination comprising an engine cooling fan turning about a predetermined axis, a drive structure for turning said fan about said axis, spacer means axially between said fan and drive structure for holding the fan in predetermined spaced relation to the drive structure, and means for securing said fan to said drive structure with said spacer means therebetween, said spacer means including a spacer body having centering means at a first end thereof for locating said fan in predetermined centered relation with respect to said body, said spacer body containing a pilot recess extending generally axially into its second end, there being a pilot projection associated with said drive structure and projecting into said recess, said recess having a peripheral wall extending about said projection and forming a plurality of circularly spaced elongated ribs having radially innermost surfaces engaging the outer surface of said projection in centering relation, said innermost surfaces of the ribs extending at a uniform radial distance from said axis as they advance more deeply into the recess toward said first end of the body, said wall forming intermediate surface areas circularly between said ribs which commence at a radial distance from said axis greater than that of said radially innermost surfaces of the ribs, and out of contact with said pilot projection, and which intermediate surface areas taper progressively to a reduced radial distance from said axis as they advance more deeply into the body toward said first end thereof, said ribs extending substantially directly axially and being of convexly rounded cross sectional configuration, said intermediate surface areas having circular extents several times as great as the circular extents of said ribs.

14. The combination as recited in claim **13,** in which said drive structure includes a water pump rotor having a shaft with a forward externally cylindrical portion forming said pilot projection and engaging the inner surfaces of said ribs, and including means disposed about said shaft and forming a transverse shoulder perpendicular to said axis, said spacer body having front and rear planar surfaces perpendicular to said axis and engaging said fan and said shoulder respectively in spacing relation, said centering means including a short pilot projection extending into an opening in said fan in centering relation and having an external cylindrical surface engaging and locating the fan, said means securing the fan to said drive structure including a series of circularly spaced bolts extending axially at circularly spaced locations and clamping said fan and shoulder against opposite ends of said spacer body, said body containing a series of circularly spaced passages through which said bolts extend.

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