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3,459,366

FAN CONSTRUCTION

Filed May 2, 1967

2 Sheets-Sheet 1

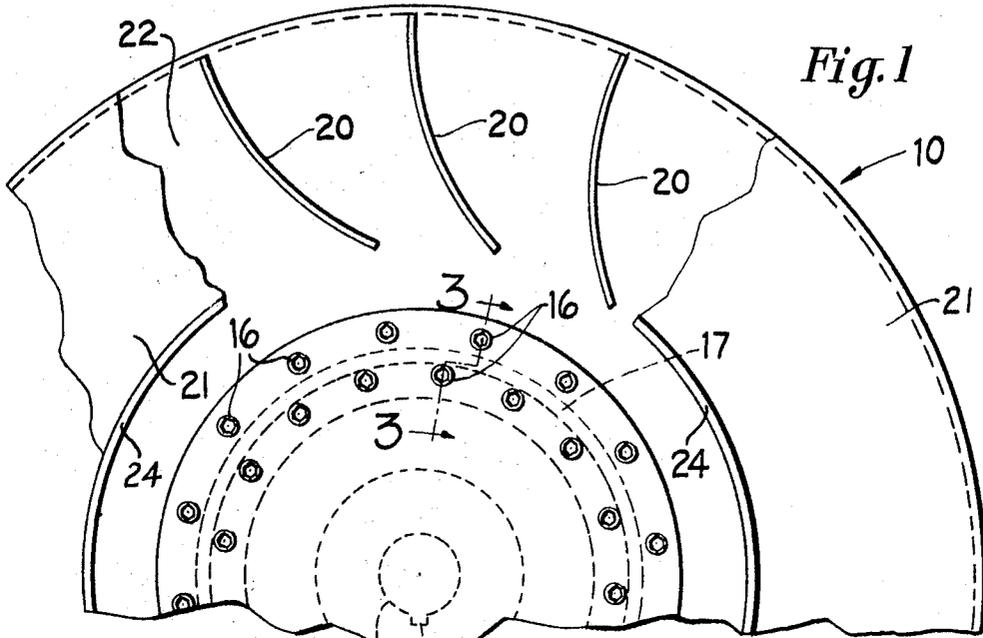


Fig. 1

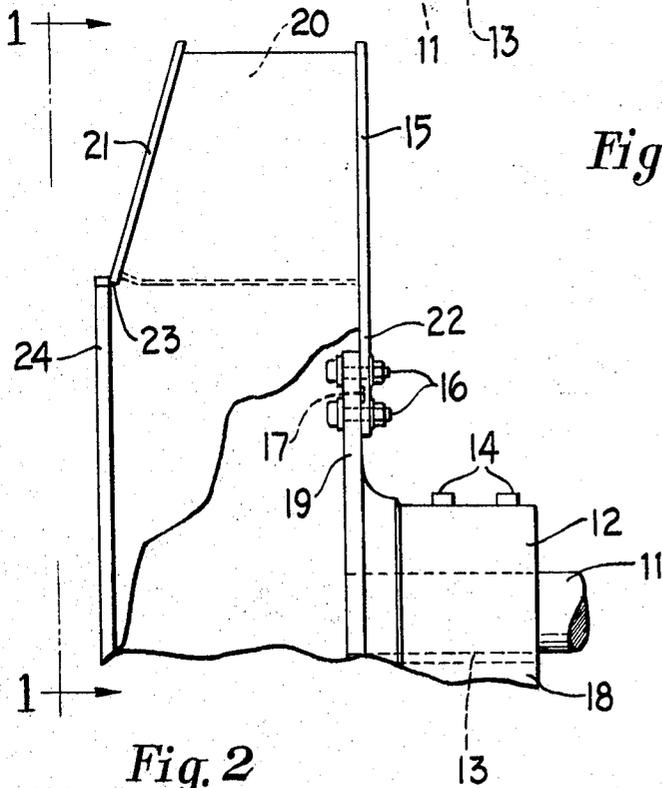


Fig. 2

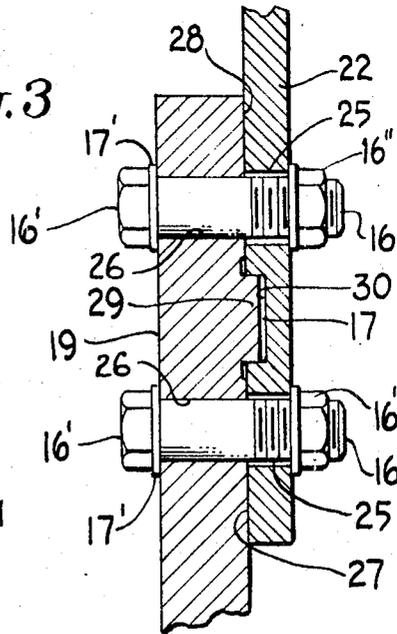


Fig. 3

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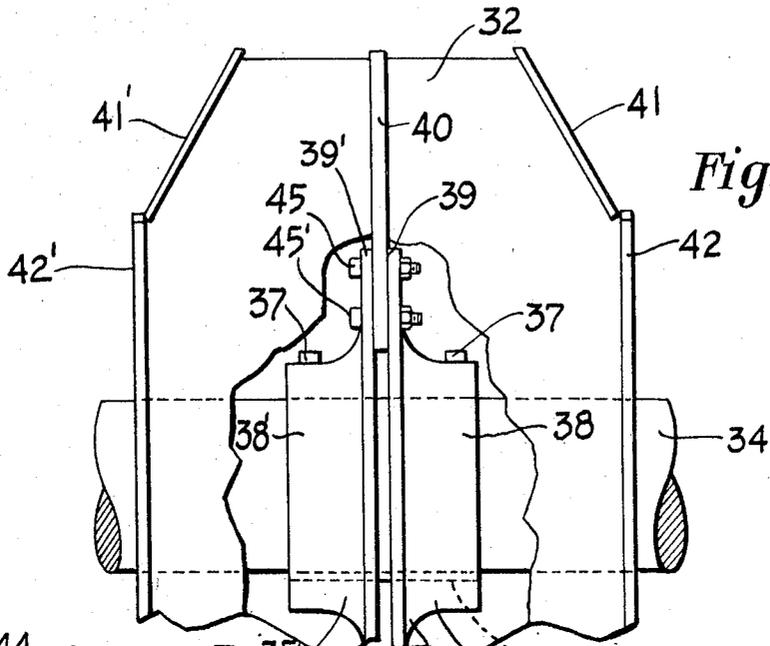


Fig. 4

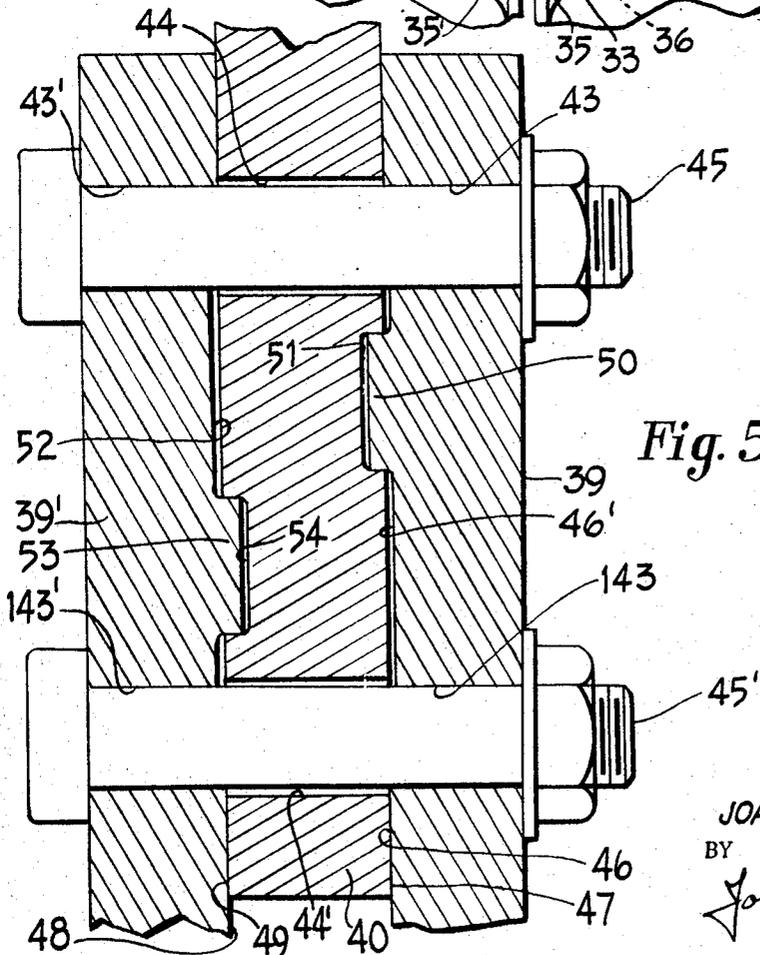


Fig. 5

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FAN CONSTRUCTION

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4 Claims

ABSTRACT OF THE DISCLOSURE

A fan construction including a blade mounting section attached to a hub by substantially circular interfitting ridge and groove means and fastener means extending through aligned apertures in the hub and blade mounting section.

Background of the invention

The present invention relates to an improved fan construction and more particularly to an improved fan to hub attachment arrangement.

By way of background, there are in common use extremely large fans which include an annular blade mounting section which is secured to a central hub. The blade mounting section may expand radially relative to the hub to which it is attached because of the centrifugal force of rotation and as a result of rapid temperature changes which cause an expansion of the blade mounting portion with respect to the hub. In the past, the blade mounting section was attached to the hub by means of fasteners, such as rivets or accurately machined bolts, which were inserted with a very close fit into carefully aligned, reamed apertures in the hub and blade mounting section so that the fasteners could carry the shear load. The reaming which was necessary to insure complete engagement between the fasteners and the sides of the apertures was a costly and time-consuming operation. In addition, sufficient fasteners had to be used to provide sufficient resistance to shear which was experienced during expansion of the blade mounting section relative to the hub. It is with an improved construction for attaching a blade-mounting section of a fan to a hub which overcomes the foregoing shortcomings that the present invention is concerned.

Summary of the invention

It is accordingly one object of the present invention to provide an improved construction for securing a blade mounting section of a fan to a hub in an extremely inexpensive and expedient manner by eliminating the costly reamed holes and prior type of shear-carrying fasteners, such as accurately machined bolts or rivets, and substituting therefor common bolts placed in unreamed holes which merely serve to fasten the sections together and which do not carry any appreciable shear loading.

It is another object of the present invention to provide an improved construction for attaching a blade mounting section of a fan to an associated hub in which the shear loading is carried by an interfitting ridge and groove construction associated with the adjacent faces of the sections.

A further object of the present invention is to provide an improved construction for attaching a blade mounting section of a fan to an associated hub in which the shear loading is absorbed by a substantially continuous interfitting ridge and groove construction extending between adjacent faces of the sections to distribute the load over a relatively large area which is much greater than the distribution on previous fastener constructions thereby providing an evenly distributed load and obviating the stress concentrations heretofore experienced. Other ob-

jects and attendant advantages of the present invention will readily be perceived hereafter.

The improved construction for attaching a blade mounting section of a fan to an associated hub includes a plurality of first aperture means in the hub, a plurality of second aperture means in the annular blade mounting section in alignment with the first aperture means, fastener means extending through said first and second aperture means for maintaining the hub section and blade mounting section in assembled relationship, and interfitting ridge and groove means extending between the hub and the blade mounting section for carrying the radial load. Preferably the interfitting ridge and groove means are of circular configuration concentric with the center of the hub. In addition, the second aperture means in the blade mounting section are preferably of slightly larger diameter than the diameter of the fastener means to permit the blade mounting section to expand outwardly slightly without imposing a shear loading on the fastener means. The present invention will be more fully understood when the following portions of the specification are read in conjunction with the accompanying drawings wherein:

Brief description of the drawing

FIG. 1 is a fragmentary and elevational view of a fan, taken substantially along line 1-1 of FIGURE 2, showing the improved attaching construction of the present invention;

FIG. 2 is a fragmentary side elevational view of the fan of FIGURE 1;

FIG. 3 is a fragmentary cross sectional view taken substantially along line 3-3 of FIGURE 1 for showing the bolts and the interfitting ridge and groove connection of the present invention;

FIG. 4 is a fragmentary side elevational view partially broken away, showing another embodiment of the present invention; and

FIG. 5 is a cross sectional view taken through a radial plane which includes the centerline of the shaft on which the fan construction is mounted, this view being analogous to FIGURE 3.

Description of the preferred embodiments

The improved fan construction 10 of FIGURES 1-3 is adapted to be mounted on shaft 11 by securing hub 12 against rotation by key 13 and preventing other movement by set screws 14 which extend through the hub. A blade mounting section 15 is attached to hub 12 by means of an interfitting ridge and groove connection 17 and nut and bolt fastener assemblies 16, which include bolts 16', nuts 16'' and washers 17', as will be explained in greater detail hereafter.

The hub 12 includes a cylindrical portion 18 which is mounted on shaft 11 and an outer annular portion 19 which is formed integrally with portion 18. The fan mounting section 15 includes a plurality of blades 20 having their opposite side edges fastened, as by welding, between annular flange 21 and annular back plate 22. The inner edge 23 of flange 21 is attached, as by welding, to circular inlet ring 24 which defines the space through which air is drawn.

As noted briefly above, the improved construction for attaching plate 22 to hub 19 includes a plurality of nut and bolt assemblies 16 which are placed circumferentially in two rows about the center of shaft 11, as shown in FIGURE 1. Each bolt 16' extends through an aperture 26 in portion 19 and an aperture 25 in plate 22. Apertures 25 in plate 22 are of slightly larger diameter than bolts 16' and are also of slightly larger diameter than apertures 26 in hub portion 19. Therefore aperture 26 will center bolt 16' relative to aperture 25. This will permit plate 22 to move radially with respect to portion 19

without imposing a shear loading on bolt 16'. Thus nut and bolt fastener assemblies 16 serve the purpose of attaching the blade mounting section 15 to annular portion 19 but do not absorb the radial loading.

An interfitting ridge and groove connection is provided for absorbing the radial loading between plate 22 and portion 19. In this respect it is to be noted that plate 22 includes a machined face 27 which abuts machined face 28 of portion 19. An annular ridge 29 is machined integrally with portion 19 and extends outwardly of face 28 of portion 19. Ridge 29 fits into annular groove 30 which is machined into face 27 of plate 22. As can be seen from FIGURE 3, faces 27 and 28 are in contiguous abutting relationship. Suitable fillets, not numbered, are provided as shown to eliminate stress concentrations. In addition, a suitable clearance is provided between ridge 29 and groove 30 to permit convenient assembly but which is not so large as to permit excessive movements between plate 22 and portion 19. This clearance may be on the order of thousandths of an inch.

It can readily be seen that since ridge 29 and groove 30 are of annular configuration there will be a stress distribution throughout their entire circumferential length when there is contact between their sides due to radial movement of plate 22 relative to portion 19. It is to be noted at this point that the clearance between apertures 25 and bolts 16' is greater than the clearance between ridge 29 and groove 30 in a radial direction and therefore the ridge 29 will be loaded in shear before a shear loading can be applied to bolts 16'. In addition, since there is no effective shear loading on bolts 16', there will be no stress concentrations between these bolts and the plate in which they are mounted. Furthermore, the shear loading per unit area between ridge 29 and groove 30 will be relatively small considering the relatively large expanse in engagement because of their continuous circular configurations. The radial length of the ridges and grooves can be varied to carry different radial shears to meet different design requirements. In this respect it is to be noted that the radial dimension of ridge 29 will determine the amount of shear which it can carry. If greater shear loading is required, the radial dimension of ridge 29 will be greater, and vice versa. The depth, or axial dimension, of ridge 29 will determine the crushing force which it can resist, and this dimension is determined by the design requirements. It is to be especially noted that bolts 16' can be conventional stock bolts and need not be accurately machined bolts or rivets, which required reamed holes, as used in the prior constructions.

In FIGURES 4 and 5 an alternate construction of the present invention is shown for attaching a blade mounting section 32 to a hub 33. In this embodiment a shaft 34 is shown having spaced hubs 35 and 35' forming hub 33. Hubs 35 and 35' may be secured against rotation on shaft 34 by key 36 and also locked in position by set screws 37. Hubs 35 and 35' include a substantially cylindrical portion 38 and 38', respectively, and an outwardly extending annular portion 39 and 39', respectively, formed integrally therewith. The fan section 32 includes an annular center plate 40 and opposed frustoconical annular flanges 41 and 41' which are analogous to flange 21 of FIGURE 2. It is between plate 40 and flanges 41 and 41' that a plurality of circumferentially spaced blade members, such as 20 of FIGURE 1, are positioned, these blades having been omitted from FIGURE 4 in the interest of clarity. Circular inlet rings 42 and 42' are attached to flanges 41 and 41', respectively, and it is through these rings that air enters the fan.

The improved attaching construction for mounting plate 40 on hubs 35 and 35' is shown in FIGURE 5, and includes a circumferential row of apertures 43 and 43' which are in alignment with each other and with apertures 44 in plate 40. A plurality of nut and bolt assemblies 45 fit through aligned apertures 43-44-43'. A second circumferential row of apertures 143 and 143' are

provided in alignment with each other and with apertures 44' in plate 40. A plurality of nut and bolt assemblies 45' fit through aligned apertures 143-44'-143'. Nut and bolt assemblies 45 and 45' are oriented in concentric circles in the same manner as noted above for the nut and bolt assemblies of FIGURE 1. The face 46 of hub portion 39 abuts face 47 of plate portion 40, and the face 48 of hub portion 39' abuts the face 49 of plate portion 40. A face portion 46' on hub portion 39 is relieved a bit from face portion 46, and an integral ridge 50 extends outwardly from face 46' and is received in groove 51 of portion 40. Extending outwardly from face portion 52 of annular portion 39 is an integral ridge 53 which is received in groove 54 of portion 40. Face 52 is relieved relative to face 48. It can readily be seen from FIGURE 5 that ridge-groove combinations 50-51 and 53-54 are staggered relative to each other. Thus, in an assembly which includes two hubs for mounting a center-supported fan the annular ridge and grooves can be divided into a plurality of units for distributing the load at spaced locations. However, it will be noted that the embodiment of FIGURES 4 and 5 has the same advantages as enumerated above relative to the embodiment of FIGURES 1 to 3.

It can thus be seen that the present invention has disclosed an improved mounting for attaching a blade mounting section of a fan to a hub in an extremely simple and expedient manner with the strength, simplicity of assembly, and economy heretofore unobtainable by conventional mounting constructions.

While preferred embodiments of the present invention have been disclosed it will readily be appreciated that it is not limited thereto but may be otherwise embodied.

I claim:

1. A centrifugal fan construction comprising a hub for mounting on a shaft, a fan including a plate, axially extending blades secured to the outer portion of said plate, interfitting ridge and groove means between said hub and said plate, said ridge and groove means being in full engagement with each other along a common area extending axially of said hub and plate, said engagement carrying substantially the entire radial load due to relative radial movement between said hub and said plate during all conditions of operation, retaining means between said hub and said plate comprising a first set of apertures in said hub, a second set of apertures in said plate, said second set of apertures having a larger diameter than said first set of apertures, and bolt means extending through said first and second sets of apertures for holding said hub and plate in assembled relationship, said bolt means having a diameter throughout its length which is no larger than the diameter of the first set of apertures whereby on rotation of the fan the radial relative movement of the fan under centrifugal action permits radial relative movement between said hub and said plate without subjecting said bolt means to shear action produced by said radial relative movement between said hub and plate.

2. A fan construction comprising a hub for mounting on a shaft, a fan including a plate, axially extending blades secured relative to said plate, interfitting ridge and groove means between said hub and said plate, said ridge and groove means being in full engagement with each other along a common area extending axially of said hub and said plate for carrying substantially the entire radial load between said hub and said plate during all conditions of fan operation, said ridge and groove means including a first clearance therebetween to permit convenient assembly between said hub and plate but which will prevent excessive movement therebetween because of said ridge and groove means being in engagement with each other along said common area, retaining means between said hub and said plate comprising a first set of apertures in said hub, a second set of apertures in said plate in alignment with said first set of aper-

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tures, bolt means extending through said first and second sets of apertures for holding said hub and plate in assembled relationship, and a second clearance between said bolt means and at least one of said sets of apertures which is greater than said first clearance between said interfitting ridge and groove means so that shear loading due to radial movement between said hub and plate will be carried by said ridge and groove means without subjecting said bolt means to shear loading.

3. A fan construction as set forth in claim 2 wherein one of said first or second sets of apertures is larger than the other of said sets of apertures whereby said one set of apertures centers said bolt means relative to said other set of apertures.

4. A fan construction as set forth in claim 3 wherein both said first and second sets of apertures are positioned in first and second rows in staggered relationship.

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U.S. Cl. X.R.

253—39; 287—52