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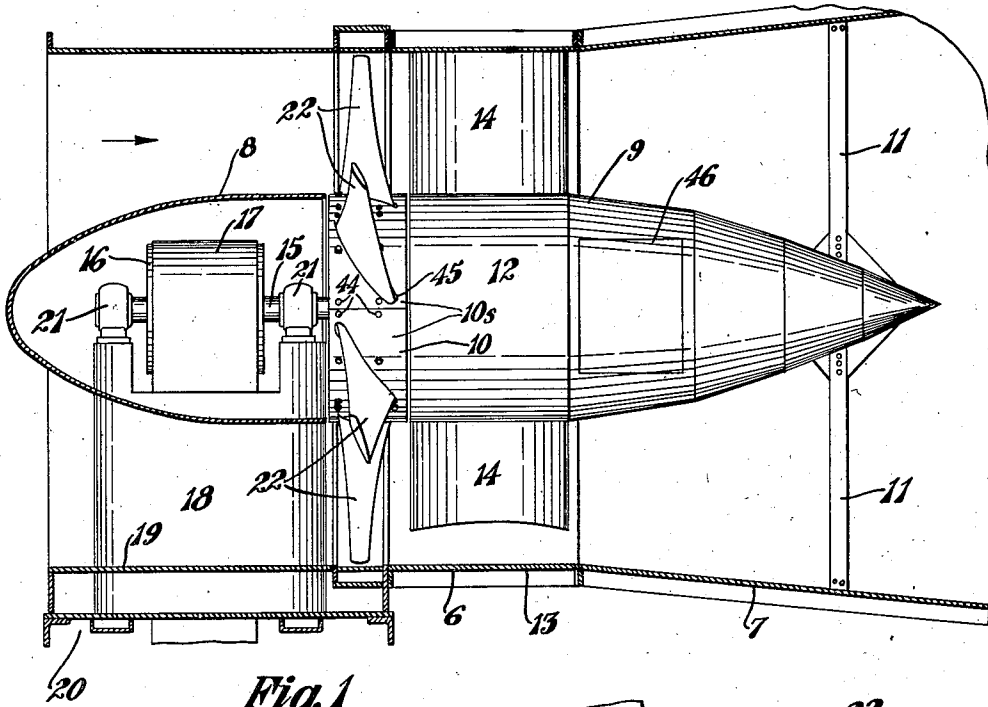
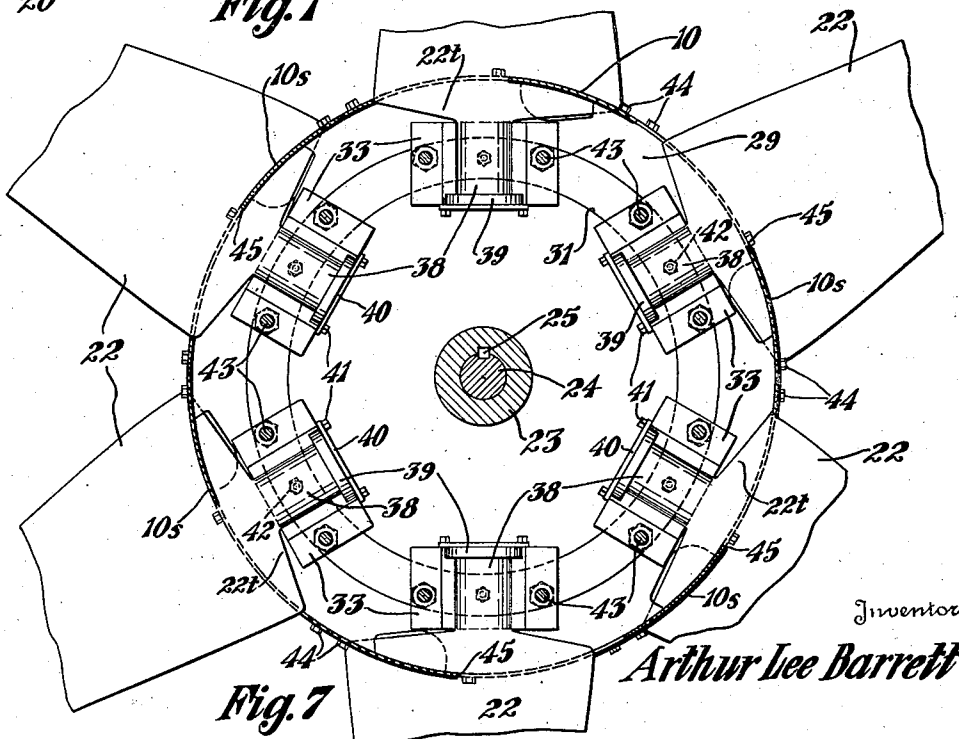
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2 Sheets-Sheet 1



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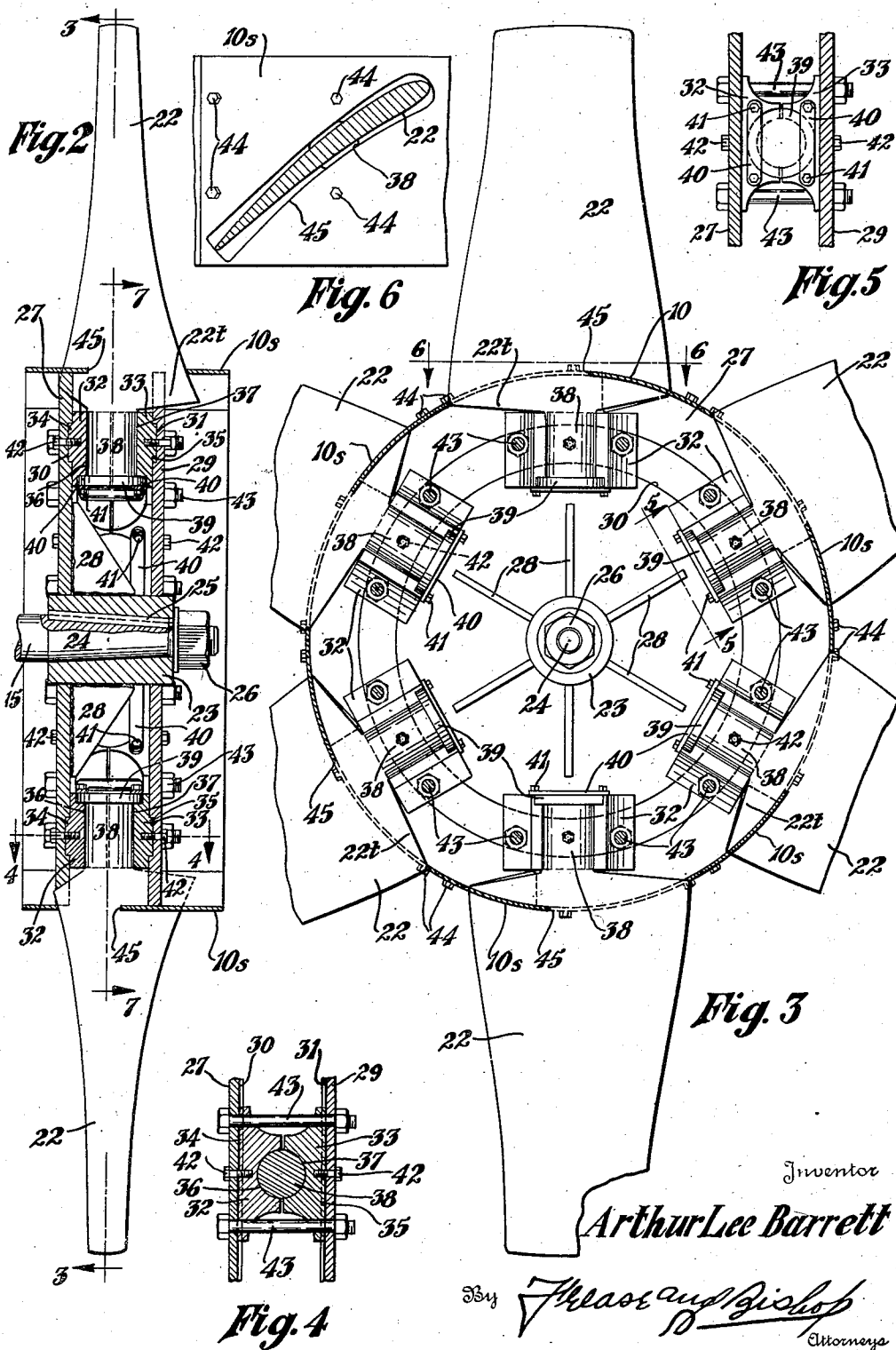
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FAN HUB CONSTRUCTION

Arthur Lee Barrett, Mount Lebanon, Pa.

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7 Claims. (Cl. 230—120)

The invention relates generally to propeller type fans, and more particularly to an improved fan hub construction especially adapted for adjustable blade propellers used in ventilating fans.

5 Prior fan hub constructions have required welding or permanently securing substantially all of the hub parts together when the blades are assembled therein, so that it is very difficult to adjust the pitch of the blades, and the blades cannot be removed without dismantling the whole tail section of the fan.

10 Moreover, certain prior hub constructions utilize a polygonal or non-circular hub housing or fairing which does not conform to the outer contour of the nose and tail of the fan, and consequently creates turbulence in the air stream.

15 It is therefore an object of the present invention to provide an improved hub construction having a fairing which conforms to the outer contour of the nose and tail sections of the fan, making a smooth inner fairing which creates a minimum of turbulence and friction losses in the air stream.

20 Another object is to provide a hub construction for quickly and easily adjusting the pitch of the propeller blades secured therein.

25 Another object is to provide a hub construction enabling easy removal of one or more of the propeller blades without disturbing other parts of the fan.

30 A further object is to provide an improved hub construction for adjustably mounting the propeller blades in such a way that the portion between the shank and the inner end of each blade proper is within the hub fairing.

35 Another object is to provide an improved hub construction adapted for mounting a variable number of propeller blades.

40 A still further object is to provide a hub construction adapted for mounting propeller blades having a relatively gradual transition from the inner end of the blade proper to its reduced shank.

45 And finally, it is an object of the present invention to provide a novel and improved hub construction incorporating all of the foregoing objectives in a simple, compact and easily assembled structure.

50 These and other related objects are attained by the improvements, combinations of elements, and structures comprising the present invention, which is illustrated and described by way of ex-

ample herein, and which is defined in the appended claims.

The invention may be stated generally as including two circular plates mounted on the propeller shaft in axially spaced relation, and one plate being secured and the other plate movably mounted on the shaft, circular grooves or keyways in the opposing faces of said plates and separable shank socket members secured one part in one plate groove and the other part in the other plate groove for clamping around the blade shanks when the plates are drawn toward each other, and a cylindrical hub housing or fairing through which the propeller blades project, the movable plate being accessible from within the adjacent tail section of the inner fairing.

Referring to the drawings forming part hereof, in which a preferred embodiment of the invention is shown by way of example,

Figure 1 is a longitudinal view of a propeller type ventilating fan, showing the outer duct or fairing and the inner nose in section;

Fig. 2 is an enlarged sectional view of the improved hub construction, showing two of the propeller blades in elevation;

Fig. 3 is a transverse sectional view thereof, as on line 3—3, Fig. 2;

Fig. 4 is a fragmentary sectional view as on line 4—4, Fig. 2;

Fig. 5 is a fragmentary sectional view as on line 5—5, Fig. 3;

Fig. 6 is a fragmentary sectional view as on line 6—6, Fig. 3; and

Fig. 7 is a fragmentary transverse sectional view as on line 7—7, Fig. 2, looking in the opposite direction from Fig. 3.

Similar numerals refer to similar parts throughout the drawings.

The improved hub construction is shown in the drawings as applied to a ventilating fan of relatively large diameter, but it will be understood that the invention may be applied to propeller type fans adapted for other uses, without departing from the scope of the appended claims.

As shown in Fig. 1, the fan includes an outer conduit or fairing indicated generally at 6, preferably cylindrical throughout a portion of its length, and it may be outwardly flared at its discharge end as indicated at 7. The outer conduit 6 is prefer-

ably made up of several adjoining sheet metal sections secured together in a suitable manner.

The inner fairing preferably includes a hollow nose section 8 and a hollow tail section 9, which may be tapered to a point at the discharge end of the inner fairing in a usual fashion, as shown, and the nose and tail are circular in cross section. The housing or fairing 10 of the hub for the propeller blades is cylindrical according to the present invention, having the same diameter as the adjacent portions of the nose and tail section and conforms thereto in contour, so that the hub housing 10 forms a smooth inner fairing with the nose and tail sections.

The tail section 9 may be supported at its discharge end on the flared portion 7 of the outer fairing by radial members 11 in usual manner. At its other end, the tail section 9 preferably includes a cylindrical portion 12 which is connected to the cylindrical portion 13 of the outer fairing 6 by means of a series of radially extending straightener vanes 14.

The vanes 14 may be three or more in number, and are preferably streamlined, that is, rounded at the front and rear edges, so as to offer little resistance to the air flow between the outer and inner fairings. These vanes 14 are preferably designed to have a straightening effect on the whirling air stream which is set up by the propeller blades.

The nose section 8 preferably houses a propeller shaft 15 coaxial with the inner fairing which is formed by the nose section 8, housing 10 and tail section 9. The shaft 15 may have a pulley 16 thereon adapted to be driven by a belt 17, although other driving means may be provided without departing from the invention.

Preferably the belt 17 extends through a radially extending hollow belt housing 18 which passes through the wall 19 of the outer duct, being supported exteriorly of said duct wall 19 on a suitable base indicated at 20. The duct housing 18 provides means for shielding the belt 17 which preferably extends through the outer duct wall 19 for connection with suitable power drive means, and the ends of the duct 18 within the nose 8 at opposite sides of the pulley 16 are adapted to support shaft bearings 21. Preferably the belt housing 18 is streamlined or rounded at its front and rear edges so as to offer a minimum of resistance to the air flow through the outer duct.

Obviously, the propeller shaft may be directly connected to a driving motor located within the nose section 8, if desired.

A series of circumferentially arranged propeller blades 22 are mounted between the nose section 8 and the cylindrical portion 12 of the tail section 9 for being driven by the propeller shaft 15. The hub assembly of the propeller preferably includes a collar 23 secured on the tapered end 24 of the propeller shaft 15 by means of a key 25, a nut 26 being screwed on the end of the propeller shaft to wedge the collar 23 axially on the tapered portion 24 of the propeller shaft.

A circular hub plate 27 is axially mounted on the collar 23 at its front or entrance end, and a series of strengthening gussets 28 may be provided, being welded to the plate 27 and the collar 23 as indicated in Fig. 2, for rigidly securing the plate 27 on the propeller shaft.

A circular hub plate 29 is movably mounted axially on the shaft collar 23 at its rear or discharge end so as to be axially spaced from the

fixed hub plate 27, the plates 27 and 29 being of the same diameter.

The inner or opposing faces of the hub plates 27 and 29 are provided with registering circular grooves or keyways 30 and 31 respectively. Means for clamping the shanks of the propeller blades preferably includes a two part clamping collar or socket for each shank, one part 32 being secured to plate 27 and the other part 33 being secured to plate 29. The socket parts 32 and 33 are provided with curved ribs or projections 34 and 35 for fitting in the opposing grooves 30 and 31 respectively. Also, the parts 32 and 33 are provided with inner half cylindrical bores 36 and 37 respectively, arranged to extend radially of the hub plates when secured therein, for mating and fitting around the reduced shanks 38 of the propeller blades. As shown, the portion 22t of each blade which connects its innermost working section with its shank provides a relatively gradual transition therebetween.

Preferably the inner ends of said shanks 38 are provided with circular flanges 39 received in recesses formed by mating semi-circular recesses in the socket parts 32 and 33, for holding the propeller blades against radially outward movement. Straps 40 are provided abutting the radially inner surfaces of flanges 39, being secured to the socket parts 32 and 33 by screws 41, for holding the propeller blades from moving radially inward during adjustment thereof.

The socket parts 32 and 33 are preferably secured in position in the grooves 30 and 31 respectively by means of screws 42 extending through the plates 27 and 29 and screwed into the collar parts.

Means for drawing up plate 29 for moving it toward plate 27 to clamp the socket parts 32 and 33 around the blade shanks 38 preferably includes a series of clamping bolts 43, which may consist of two bolts extending through the hub plates and each of the clamping collar parts, one bolt at each side of each blade shank 38.

It will be apparent that if greater strength is desired or required in the hub to resist the centrifugal force on the propeller blades, the depth of the circular keyways 30 and 31 and the interfitting ribs 34 and 35 on the sockets may be increased, or additional keyways and socket parts may be provided for securing extensions of the blade shanks.

The hub housing 10, which forms part of the inner fairing, is preferably constructed in cylindrical segments 10s, one for each propeller blade 22. These segments are preferably secured to the peripheral edges of the plates 27 and 29 by screws 44, and each segment has a slot 45 through which a blade 22 passes at its innermost portion. The slots 45 substantially conform to the cross sections of the blades at their radially inner ends, but are enough larger to permit adjusting the pitch of the blades between their maximum and minimum requirements.

In assembling the improved hub construction in the ventilating fan shown in the drawings, the blades are first assembled in the hub, and then the entire hub assembly is mounted on the propeller shaft 15. Preferably, this is accomplished by first securing the socket parts 32 in their respective positions in keyway 30 of hub plate 27 which is fixed on the shaft collar 23, by means of cap screws 42. Similarly the socket parts 33 are secured in position in the keyway 31 of movable hub plate 29 by cap screws 42. In both cases the cap screws are not fully tightened, so

that the sockets can be adjusted slightly when assembled.

Next the propeller blades 22 are positioned with their shanks 38 in the semi-cylindrical bores 5 36 of socket parts 32, with the plate 27 in a horizontal position. The movable hub plate 29 is then placed in position over the shaft collar 23 with the socket parts 33 fitting around the shanks 38 and mating with parts 32. The blades 22 are then adjusted to the desired pitch, after which 10 the clamping bolts 43 are inserted and tightened, and the cap screws 42 also fully tightened.

The hub fairing segments 10s are then placed over the blades and secured to the edges of the 15 hub plates 27 and 29 by tightening the screws 44, and the hub assembly is then mounted on the propeller shaft 15 by wedging the shaft collar 23 onto the tapered portion 24 of the drive shaft, and the nut 26 tightened.

If it is desired to adjust the pitch of the blades 20 after the fan is assembled, access to the movable plate 29 at the rear side of the hub may be had through a hatchway 46 provided in the tail section 9 of the inner fairing. Thus the nuts on clamping 25 bolts 43 may all be loosened sufficiently to allow the blades 22 to be turned in their sockets formed by the socket parts 32 and 33, permitting adjustment of the pitch of the blades, after which the clamping bolts are again tightened. During this 30 adjustment, the straps 40 prevent radially inward movement of the blades.

If it is desired to remove one or more of the blades, this can be accomplished by loosening the 35 clamping bolts 43 and moving plate 29 rearwardly a sufficient distance so that the blades can be withdrawn radially, and thus the blades can be removed without disturbing the other parts of the fan, as for instance dismantling the vanes 14 and tail section 9.

The improved hub construction is adapted for 40 mounting a variable number of propeller blades, as for instance in the example shown, alternate blades can be removed to provide a three-bladed propeller instead of a six-bladed propeller. Moreover, by relocating the bolt and screw holes in the 45 plates 27 and 29, a different number of propeller blades can be secured in socket parts in the keyways 30 and 31, so that for example a four-bladed or five-bladed propeller may be provided without 50 constructing a new hub.

Since the blade sections 22 extend through the slots 45 in the hub fairing segments 10s, the transition portion 22t from the last working section of the blade proper to the blade shank is out of the air 55 stream, thereby greatly reducing turbulence in the air stream. Furthermore, the transition from the blade to the shank may be made relatively gradual so as to reduce the stress concentration at any one point and increase the effective 60 strength of the blades. Due to this fact, the blades may be made of light weight metal such as aluminum alloy in order to meet certain requirements.

The improved hub construction is simple, compact and easily assembled, and provides a smooth 65 inner fairing which enables producing a fan of high efficiency.

I claim:

1. Fan hub construction including a propeller 70 shaft, a hub plate fixed on said shaft coaxial therewith, a hub plate axially movably mounted on said shaft coaxial therewith and in axially spaced relation to said fixed hub plate, said hub plates embodying the mounting means for mounting the 75 propeller blades on the shaft, the opposing faces

of said hub plates having registering grooves, socket parts removably secured in said grooves and mating to form radially extending sockets, propeller blades having shanks fitting in said 5 sockets, and means clamping the hub plates together and the blade shanks in the sockets.

2. Fan hub construction including a propeller shaft, a hub plate fixed on said shaft coaxial therewith, a hub plate axially movably mounted on said shaft coaxial therewith and in axially 10 spaced relation to said fixed hub plate, said hub plates embodying the mounting means for mounting the propeller blades on the shaft, the opposing faces of said hub plates having registering grooves, socket parts secured in said grooves and mating 15 to form radially extending sockets, a cylindrical hub housing secured to the peripheral edges of said hub plates, propeller blades extending through said hub housing and having shanks fitting in said sockets, and means clamping the 20 hub plates together and the blade shanks in the sockets.

3. Fan hub construction including a propeller shaft, axially spaced hub plates non-rotatably 25 mounted on said shaft for relative axial movement with respect to each other, separable sockets secured in the opposing surfaces of said hub plates, radially extending propeller blades mounted in said sockets for being rotated by said shaft, a hub housing secured to the peripheries 30 of said hub plates and comprising cylindrical segments fitting loosely one over each propeller blade, and means clamping the hub plates together and the blades in the sockets.

4. Fan hub construction including a propeller 35 shaft, axially spaced hub plates non-rotatably mounted on said shaft for relative axial movement with respect to each other, separable sockets secured in the opposing surfaces of said hub plates, a cylindrical hub fairing secured to the 40 peripheries of said hub plates and comprising cylindrical segments, propeller blades extending radially one through each hub segment and having reduced shanks fitting in said sockets for being rotated by said shaft, the transition portion of 45 each blade connecting its innermost working section and shank being within the hub fairing, and means clamping the hub plates and sockets together.

5. In a fan having an inner fairing including 50 a hollow nose section and a hollow tail section, a propeller shaft in said nose section and coaxial therewith, a fan hub between said nose and tail sections and having a housing conforming thereto, axially spaced hub plates in said hub housing 55 mounted on said propeller shaft for relative axial movement, separable sockets secured in the opposing surfaces of said hub plates, propeller blades extending radially through said hub housing and having shanks secured between said hub plates 60 and in said sockets, and means clamping said hub plates together and accessible from within said tail section whereby one of said hub plates may be moved away from the other to permit adjusting the pitch of the propeller blades. 65

6. In a fan having an outer fairing and a hollow inner fairing, a propeller shaft mounted in the inner fairing coaxial therewith, a hub plate fixed on said propeller shaft, a second hub plate movable axially on said propeller shaft and axially 70 spaced from said fixed hub plate, separable sockets secured in the opposing surfaces of said hub plates, a hub fairing secured to the peripheries of said hub plates coaxial with and conforming in contour to said inner fairing, propeller blades ex- 75

tending radially through said hub fairing and having shanks secured between said hub plates and in said sockets, and means adjustably connecting said movable plate to said fixed plate and
5 accessible from within the inner fairing adjacent to said movable hub plate for permitting adjustment of the pitch of the propeller blades.

7. Fan hub construction including a propeller shaft, a collar keyed on the shaft, axially spaced
10 hub plates one mounted immovably on said collar

and the other arranged for relative axial movement on said collar with respect to the first hub plate, separable sockets removably secured in the opposing surfaces of said hub plates, propeller
blades removably mounted in said sockets and
terminating short of said collar, and means clamping the hub plates together to clamp the blades
in said sockets.

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