

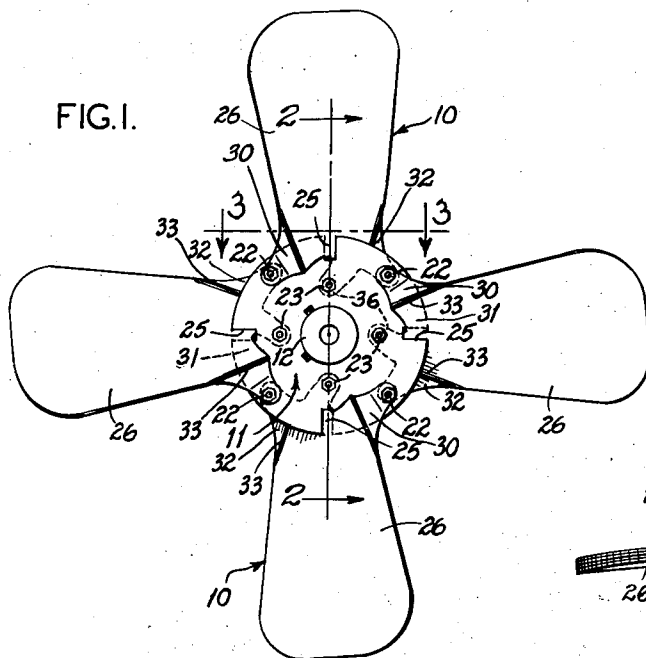
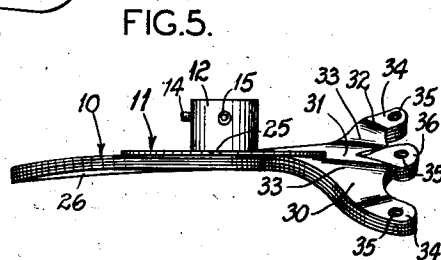
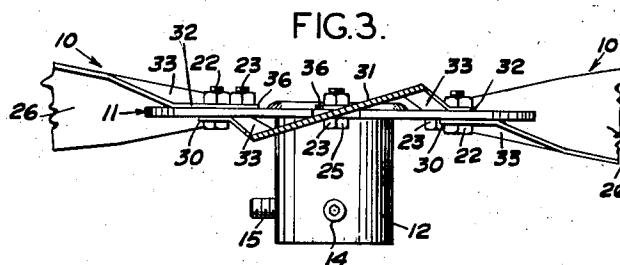
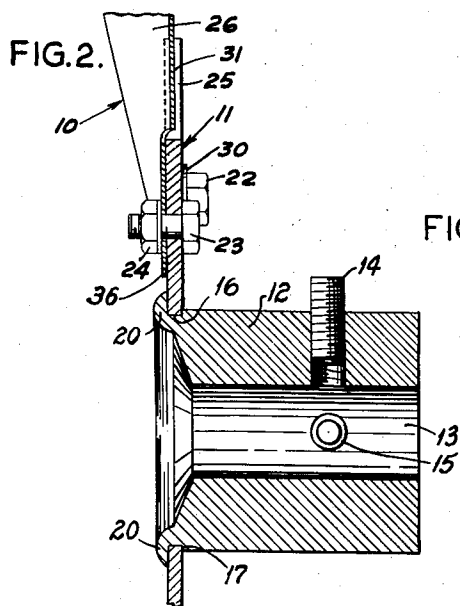
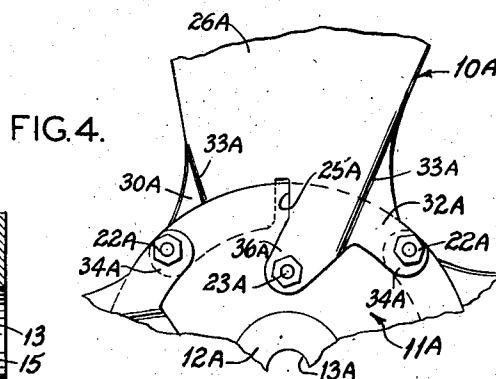
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PROPELLER FAN BLADE RETAINING CONSTRUCTION

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PROPELLER FAN BLADE RETAINING
CONSTRUCTION

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This invention relates to improvements in propeller fan blade retaining construction, and more particularly to a novel and improved construction of the elements of propellers of spiderless type, being those in which the blades are directly carried by a center disc or plate, connected as through a hub, to the shaft. The invention is particularly, but by no means exclusively, applicable to heavy duty fans of larger diameters.

It has heretofore been known to construct propellers, particularly propeller type fans, by avoidance of separate blade mounting arms, spiders or the like, as by attachment of the blades directly to a single rigid armless mounting element. Structures for this purpose, although utilized in limited number, offer certain objections, among which are a relatively high production cost, and the requirement in some cases at least, of an odd and expensive formation of hub or center disc. The present invention accordingly has as a principal objective, the attainment of a propeller of a type in which the blades are directly carried by a center disc of a sturdy planar form and of low cost construction.

Yet another object of the invention is attained in an improved construction of the root portions of the several propeller blades, such that each of the blades may be economically and rigidly attached to a planar center element such as a plate, and correctly, uniformly and permanently pitched with respect to such plate.

The foregoing and numerous other objects will more clearly appear from the following detailed description of a presently preferred form or embodiment of the invention, particularly when considered in connection with the accompanying drawing, in which:

Fig. 1 is a rear view of a fan constructed in accordance with the present improvement;

Fig. 2 is a somewhat enlarged partial section through the hub, center disc and one of the blades, particularly as taken along line 2—2 of Fig. 1;

Fig. 3 is a fragmentary sectional elevation, the sectional portions of which are taken along line 3—3 of Fig. 1;

Fig. 4 is a fragmentary rear view of a slightly modified form of fan, and

Fig. 5 is a side view of a shipping package comprised of the major parts of the fan as same might appear in the form of a unit sold as an article of manufacture, for assembling the fan.

Referring now by characters of reference to the drawing, there has been selected as a pre-

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ferred structure to illustrate the points of present novelty, a four blade propeller type fan in which the several blades are each indicated generally at 10, a center plate or disc by which the blades 10 are carried, being designated generally at 11. The disc 11 is secured to a hub 12 for shaft mounting the assembly on a suitable power shaft or the like (not shown).

The hub 12 is of a generally cylindrical form including a shaft bore 13, together with set screws 14 and 15 each occupying a suitable tapped aperture. An originally thin reduced end of hub 12 extends through a central opening 16 of the center plate 11, and beyond the opening 16, is flared outwardly as by spinning, swaging or by impact means such as a high speed hammer, so that in coaction with a shoulder 17, the resulting flared portion 20 serves, with the shoulder, firmly to grip the margins of the metal adjacent aperture 16 to hold the plate and hub in permanent assembly.

The center disc or plate 11 is preferably provided with a plurality of openings or bolt holes one of which appears in Fig. 2 and is indicated at 21. By reference to Fig. 1 it will be seen that four such holes are provided about an inner circle relatively close to the hub 12, while near the periphery of the center disc is provided a similar circle of bolt holes (not shown). These rows of holes serve to receive assembly bolts 22 in the outer circle, and 23 in the inner circle. Suitable nuts 24, with lock washers or their equivalents, coact with the bolts in assembly.

In the form shown by Fig. 1, the center disc 11 is provided with a series of notches 25. In this construction the notches open inwardly from the periphery of the disc 11 and each is shown as substantially coincident with the radius of the fan, and hence with the radius of the disc. These notched portions coact with the blade root portions and bolts in locating and angularly positioning the fan blades, as will hereinafter more fully appear.

Proceeding now to a description of the construction of blades and blade root portions, the displacement portion of each blade 10 is preferably a pitched sheet metal element, the particular configuration and conformity of which is chosen for best displacement characteristics, the displacement portion of each blade being indicated at 26. It may be assumed that the fan as shown in Fig. 1 is rotated in the counterclockwise direction, the displacement portions of the blades serving to move the air toward the left as viewed in Fig. 2. The direction in which the air

is moved will be regarded as the forward direction and the left face of the fan as viewed in Fig. 2 will be regarded as the front or forward face.

The displacement or main portion of each blade is at an acute angle to the faces of the disc 11, and each blade has an inner portion 31 which is also at an oblique angle to the faces of the disc. The said inner portion 31 is preferably partly within the corresponding notch 25 in the disc and it has opposite edges which project forwardly and rearwardly beyond the respective faces of the discs as clearly shown in the cross sectional portion of Fig. 3. The inner portion 31 of each blade has furcations or tabs, preferably three in number and respectively designated as 30, 32 and 36, the general arrangement of the said furcations or tabs being best illustrated in Fig. 5. The tabs 30 and 32 are widely spaced and they respectively extend directly from the said projecting opposite edges of the inner portion 31 of the blade. By means of angulate portions 33, 33 as shown in Fig. 3, the said tabs throughout their radial dimensions are offset from the said opposite edges and toward the said disc and they have portions 34, 34 with faces which are perpendicular to the axis of rotation and which respectively engage the front and rear faces of the disc 11. The portions 34, 34 of the tabs 30 and 32 are provided with bolt holes 35, 35 for the reception of the before-mentioned bolts 22, 22.

The intermediate furcation or tab 36 of each blade extends inwardly and is twisted to constitute a flat or planar securement portion, this being provided with a bolt hole 35 similar to those in the tab portions 34, 34.

It should be observed that although the center disc 11 is of appreciable thickness, it is most desirably of planar form, and the securement tabs are also all preferably of planar construction, and arranged in mutual parallelism or in substantially coplanar relation, so that in assembly, the tabs will lie flat against the lateral surfaces of the disc, assumed for present description to be planar.

From Fig. 1 it will appear that the blades and center disc are brought into interfitted relation in assembly, in this construction the disc extending between the furcations, but extended still higher upon each blade as is rendered possible by the provision of the several notches 25. Assembly of the blades to the center disc after complete formation thereof, may be readily and easily effected by insertion of each blade 10, with its median root portion traversing one of the notches 25. When thus positioned, the securement tabs 30 and 36 of each blade engage the rear side of the center disc and the other tab 32 of the same blade engages the opposite side of the disc, with each of the bolt holes 35 in register with corresponding holes in the center disc. The holes in the lateral tabs 30 and 32 are in register with a pair of widely angularly spaced bolt holes near the periphery of the disc, as will appear from Figs. 1 and 3, and the hole 35 in the center tab 36 is in register with one of the bolt holes of the inner row in the center plate or disc.

It is a preference in assembling the blades to the disc, to minimize the number of bolts and bolt openings, and better to tie together the blade roots to each other and to the disc, by overlapping the lateral tabs of adjacent discs, whereby as will appear from Fig. 1, a single one of the bolts 22 will engage a pair of the tabs of angularly adjacent blades, and a registering opening in

the disc. It is preferred also to locate and construct the lateral securement tabs in such manner that as the blade extends into the notch 25 thereof, the angulate tabs are at least slightly stressed in such manner that the central portion of the blade firmly abuts opposite lateral margins of the notch, in a way to prevent looseness or rattling in this zone, and to attain a distinct bracing effect of the inner blade region by the periphery of the center disc.

The fan is adapted for rotation in a predetermined direction which may be counterclockwise, as viewed in Fig. 1. It will be seen that the trailing lateral tab on each blade overlaps the leading lateral tab on the next following blade. The holes in said trailing and leading tabs are in register with each other and also in register with the corresponding hole in the disc for the reception of the corresponding bolt.

A somewhat modified form of fan embodying the present principles is shown by Fig. 4, this fan being adapted for rotation in the clockwise direction. The principal difference in construction lies in the fact that the blade 10A is provided with a notch 25A, the center disc 11A being either devoid of peripheral notches as shown, or optionally notched to a lesser extent than as shown by Fig. 1. In the modification the three securement tabs 30A, 32A and 36A are provided with holes quite similar to those shown at 35, bolts 22A engaging an outer circle in element 11A, and bolts 23A occupying an inner circle in locations corresponding to bolts 23.

The present fan is particularly adapted for larger types and sizes of heavy duty propellers, although by no means exclusively intended for such restricted fields of usage. In these fields it is of course of considerable advantage to provide a fan of knock-down type. This objective is promoted by formation of blade roots and the blades themselves in such manner that they may be readily stacked or nested in a compact package as shown by Fig. 5, a part of which package consists of a companion center disc and hub assembly 11-12. It is now evident that substantial economies in shipping and storage space will result from this feature.

It will be seen that the present structure also lends itself admirably to the provision of relatively few standardized center disc or plate members each of which may be adapted to fan blades of a variety of lengths and shapes, but with similarly formed root portions, thus enabling assembly on the job of fans of different sizes with certain parts standardized through a moderate range of fan diameters.

In distinction from certain older less satisfactory types of spiderless propellers, the present arrangement presents a rugged, permanent assembly in which the center assembly occupies but a minimum of space axially of the propeller, and may utilize standard lengths of hub. It avoids the difficulty of imparting and maintaining exact twist to spider arms of the more conventional structures, and tests have indicated even under operation at speeds far in excess of rated rates of rotation, there results virtually no distortion or change in pitch of any of the blades, and no deviation from original balance, in spite of the simplification of structure. When sold as a knock-down package unit, as per Fig. 5 for example, the fan may be initially assembled for finishing and balancing, then disassembled for packaging.

Obviously, in case of no necessity for or ad-

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vantages in a knock-down package, the major elements may be assembled by rivets, or by welding as desired, in lieu of the bolted construction described.

Thus the present fan serves fully to attain each and all of the several objectives above set forth and others implied from the description. Although the examples herein are disclosed by detailed reference to their various elements and features, this detail of description is to be understood solely in an informative rather than in any limiting sense, many structural variants being possible within the scope of the claims hereunto appended.

I claim as my invention:

1. The combination in a fan, of a circular central disc provided with flat front and rear faces and adapted to be mounted for rotation in a predetermined direction about a central axis perpendicular to the said faces, the said disc having a plurality of circularly spaced holes extending therethrough near its periphery and also having a plurality of additional holes extending therethrough, a plurality of radially extending air moving blades each having a main portion at an oblique angle to the faces of the disc, each blade having two inwardly extending tabs widely spaced circularly and having inner faces perpendicular to the axis of rotation and respectively engaging the front and rear faces of the disc which tabs are positioned with the trailing tab on each blade overlapping the leading tab on the next following blade and which tabs have holes therein so located that the hole in the trailing tab on each blade is in register with a corresponding hole in the disc and is also in register with the hole in the leading tab on the next following blade and each blade also having an additional inwardly extending intermediate tab engaging one face of the disc and having a hole in register with one of the said additional holes in the disc, a plurality of fastening devices each extending through the hole in the trailing tab on a corresponding blade and through the corresponding hole in the disc and through the hole in the leading tab on the next following blade, and a plurality of additional fastening devices each extending through the hole in the central tab on the corresponding blade and through the corresponding additional hole in the disc.

2. The combination in a fan, of a circular central disc provided with flat front and rear faces and adapted to be mounted for rotation in a predetermined direction about a central axis perpendicular to the said faces, the said disc having a plurality of circularly spaced notches therein extending inwardly from its periphery and the said disc also having holes extending therethrough near its periphery and circularly spaced from the said notches, a plurality of radially extending air moving blades each having a main portion at an oblique angle to the faces of the disc and each having an inner portion at an oblique angle to the faces of the disc and extending through a corresponding notch each of which inner portions has opposite edges which project forwardly and rearwardly beyond the said disc faces and each of the said blades also having two widely spaced tabs extending directly from the said inner blade portion at the said opposite outer edges thereof which tabs throughout their radial dimensions are offset toward the disc from the respective edges of the said inner portion and have inner faces perpendicular to the axis of rotation and respectively engaging the

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front and rear faces of the disc, the trailing tab on each blade overlapping the leading tab on the next following blade and the said tabs having holes therein so located that the hole in the trailing tab on each blade is in register with a corresponding hole in the disc and is also in register with the hole in the leading tab on the next following blade, and a plurality of fastening devices each extending through the hole in the trailing tab on a corresponding blade and through the corresponding hole in the disc and through the hole in the leading tab on the next following blade.

3. In a propeller type fan, a relatively heavy planar center plate, a hub for shaft-mounting the fan, assembled to the center region of the plate, a plurality of blades directly assembled to the plate, each blade having its root portion formed to result in three blade securement tabs, namely, a center tab and a pair of lateral or outside tabs, certain of said tabs of each blade engaging opposite faces of the center disc, means for securing the tabs to the faces of the disc, the center tabs of each blade being secured inwardly of the disc periphery and relatively close to the hub, and the lateral or outside tabs of each blade being secured near the periphery of the disc.

4. The combination and arrangement of elements as recited by claim 3, but further characterized in that certain of the tabs of each blade are mounted in straddling relation to the periphery of the center disc, the tabs being provided with apertures and the center disc provided with registering apertures, and assembly bolts extending through the registering apertures of the center disc and the said tabs.

5. A heavy duty propeller type fan of spiderless construction consisting of a hub provided with a shaft-receiving bore, a center disc of relatively heavy planar plate construction and substantially circular outline, a plurality of blades each directly carried by and pitched relatively to the center disc, each blade having a root portion of trifurcate construction, the three furcations of which are angularly spaced in location, about the center disc, the furcations formed and serving as tabs for securement of the blade to the disc, the several furcations being of angulate section and each being apertured at its extremity, the furcations of each blade including a center securement tab, and a pair of widely angularly spaced, lateral securement tabs, the center disc being provided with an inner row of bolt openings, bolts extended through each of the center tabs of the several blades and through one of the openings of said inner row, the center disc further provided with an outer row of bolt apertures, bolts extended therethrough, the outer tabs being formed and perforated to register with said openings, and to receive bolts in the last said openings, the center disc being notched inwardly from its periphery, and along radii coincident with the longitudinal median lines of the several blades, with a portion of the root of each blade extended into one of the said notches, the notches and engaging blade root portions, serving angularly to locate and to key the several blades in fixed angular relation to the center disc.

6. In a propeller fan construction of spiderless type, a center disc, a plurality of blades, each blade including a root portion formed to provide three blade securement tabs directly engaging surface portions of said disc, and assembled thereto; one tab of each blade secured to the disc substantially in the region of a longitudinal

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blade median produced inwardly along the disc, and other tabs of the same blade engaging the disc in regions widely angularly spaced from said first tab with the trailing tab of each blade overlapping the leading tab of the next following blade, and fastening means for securement of the tabs to the center disc, certain of said fastening means being common to the said overlapping tabs of adjacent blades.

7. The combination in a fan, of a circular central disc provided with flat front and rear faces and adapted to be mounted for rotation in a predetermined direction about a central axis perpendicular to the said faces, the said disc having circularly spaced holes extending therethrough near its periphery, a plurality of radially extending air moving blades each having a main portion at an oblique angle to the faces of the disc and each having an inner portion at an oblique angle to the faces of the disc each of which inner portions has opposite edges which project forwardly and rearwardly beyond the said disc faces and each of the said blades also having two widely spaced tabs extending directly from the said inner blade portion at the said opposite outer edges thereof which tabs throughout their radial dimensions are offset toward the disc from the respective edges of the said inner portion and have inner faces perpendicular to the axis of rotation and respectively engaging the front and rear faces of the disc, the trailing tab on each blade overlapping the leading tab on the next fol-

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lowing blade and the said tabs having holes therein so located that the hole in the trailing tab on each blade is in register with a corresponding hole in the disc and is also in register with the hole in the leading tab on the next following blade, and a plurality of fastening devices each extending through the hole in the trailing tab on a corresponding blade and through the corresponding hole in the disc and through the hole in the leading tab on the next following blade.

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