Nov. 19, 1935. W. L. UPSON 2,021,707

FLUID REACTION DEVICE

Filed Nov. 1, 1934 2 Sheets-Sheet 1

Fig. 1.

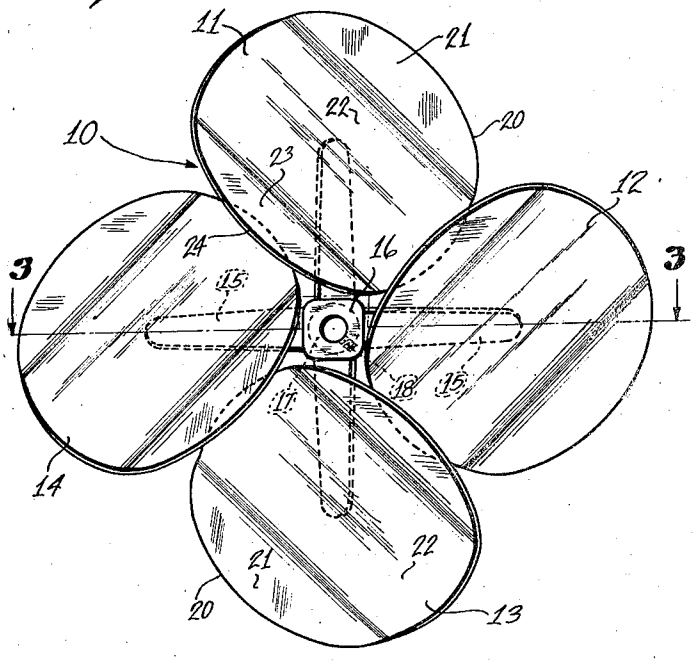


Fig. 2.

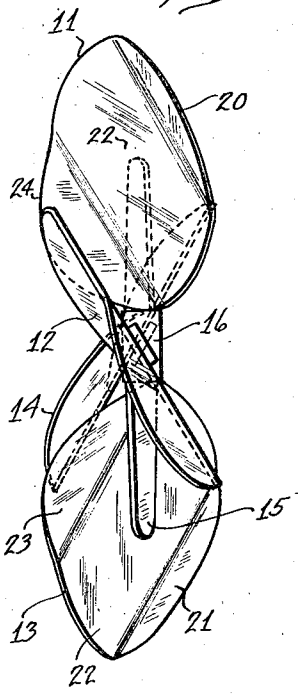


Fig. 3.

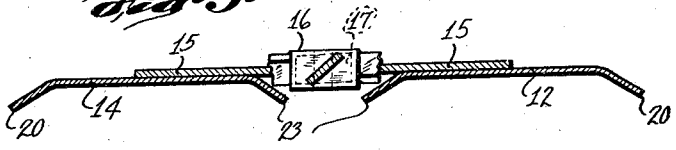


Fig. 4.

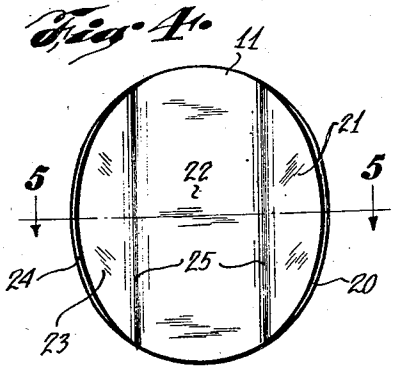
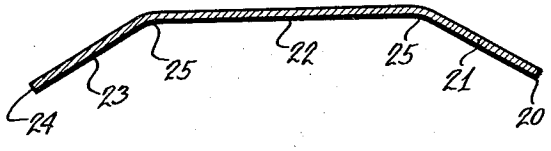


Fig. 5.



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Nov. 19, 1935. W. L. UPSON 2,021,707

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Filed Nov. 1, 1934 2 Sheets-Sheet 2

Fig. 6.

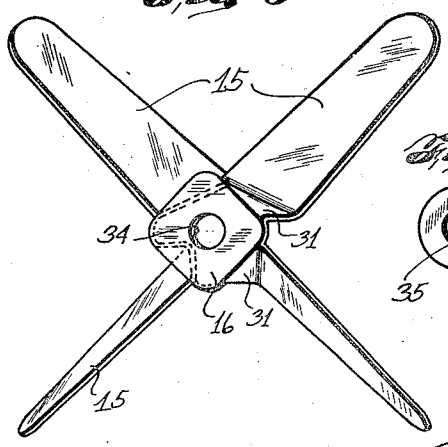


Fig. 7.

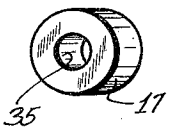


Fig. 8.

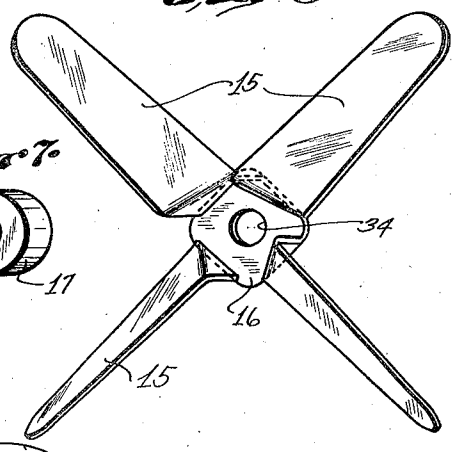


Fig. 12.

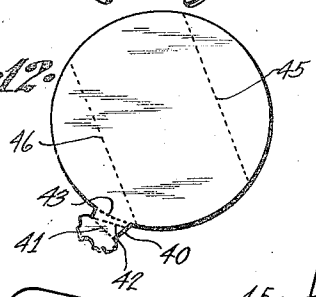


Fig. 10.

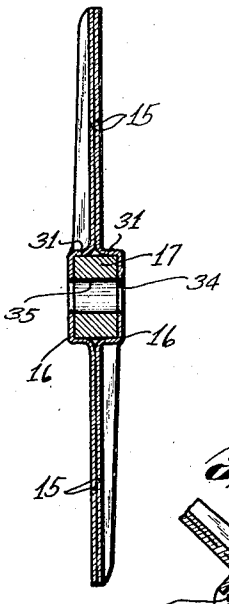
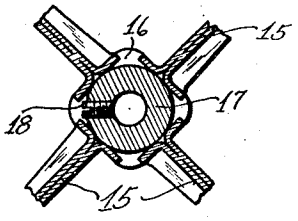


Fig. 9.

Fig. 11.



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UNITED STATES PATENT OFFICE

2,021,707

FLUID REACTION DEVICE

Walter L. Upson, University City, Mo.

Application November 1, 1934, Serial No. 750,927

27 Claims. (Cl. 170—159)

This invention relates to improvements in fluid reaction devices, and more particularly to improved blade or vane elements for such devices, together with means for mounting same for rotation about an axis.

The invention in its broader aspects is applicable to fluid-driven devices as well as fluid-impelling devices; since however, minor modifications may be necessary in embodying the invention, according to the nature of the fluid encountered by the blades or vanes, and according to the speed and other factors attending its operation, the invention will be described with reference primarily to its embodiment in the construction of fan blades and blade-mounting brackets or spiders of improved form, by which the blades are mounted for rotation about an axis. The present invention attains certain economies and production advantages over, and attains an efficiency of performance at least equal to the subject matter of my prior Patent No. 1,957,237, issued May 1, 1934.

With the increasing advent and use of air-conditioning apparatus both of commercial and domestic types, and with the increased use of fans and similar equipment in connection with heating devices for factory and domestic installation, the element of noise heretofore attending the operation of cooling and air-circulating fans, becomes increasingly objectionable. The prevailing tendency in design of mechanical and electrical appliances generally toward a reduction in noise, reflects itself in a similar requirement with respect to blowers, fans and air-circulating equipment employed either alone, or adjunctively to other apparatus.

It is accordingly an object of the present invention to improve the design of fluid-reaction blades generally, and particularly the design of fan blades, in a manner commensurate with the accepted speed ranges of fan operation, and the requirements of air velocity and air distribution, so as to produce a fan of given dimension and power requirement which operates with considerably less noise than those of heretofore prevailing types.

Yet another object of the invention is attained in accordance with the disclosed example, in an improved shaping of the leading edges and major fluid reaction portions of the blades so as to reduce the noise of pickup of the air.

An additional object of the invention is attained in so shaping and mounting the blades of a fan as to result in a considerable reduction in the noise of a fan of given diameter, while moving a greater volume of air, as compared with fans of heretofore prevailing types. It is important that the diameter of a fan of given pitch be maintained at a minimum, in order that the peripheral velocity of the blade ends be kept as low as possible, it having been determined that the great velocity at which the blade ends are usually impelled, is a substantial source of blade noise.

Still another object of the invention is attained in an improved blade mounting bracket or spider, by virtue of which the radially innermost portions of the blade, in reference to its axis of rotation, are brought as closely as possible to the fan shaft or axis of rotation, so as to obviate not only the substantial dead area heretofore existing about the fan shaft, but which minimizes the actual obstruction heretofore prevailing centrally of the fan disc and due solely to the hub and spider arms by which the fan is secured to the shaft.

More specifically stated, the foregoing object is advantageously realized in an improved spider for a fan which may be formed of one or more one-piece metal punchings, so bent or shaped that a minimum obstruction is presented to the flow of air along the shaft or axis of the fan.

The foregoing and still further objects will more clearly appear when the invention is considered in connection with the following detailed description, and by making reference to the accompanying drawings, in which:

Fig. 1 is a front or plan view of a fan of four-blade type, constructed in accordance with the present invention; Fig. 2 is a side elevation of the fan appearing in Fig. 1, as viewed transversely of the axis of rotation; Fig. 3 is a sectional elevation taken in a plane coincident with the axis of rotation and as indicated by line 3—3 of Fig. 1; Fig. 4 is a plan or front elevation of one of the blades utilized in the assembly of Fig. 1; Fig. 5 is a transverse section, somewhat enlarged, of the plan shown by Fig. 4, and as viewed along the line 5—5 thereof; Fig. 6 is an elevation in front perspective, of a blade-mounting bracket or spider formed in accordance with the present invention; Fig. 7 is an elevation in perspective of a hub or collar element adapted to be employed with a spider, such as shown by Fig. 6, for securing the spider to a power shaft; Fig. 8 is an elevation, in rear perspective, of the device shown by Fig. 6; Fig. 9 is a plan or front elevation of a punching, prior to bending or forming up to construct the device shown by Figs. 6 and 8; Fig. 10 is a sectional view in a plane parallel to the axis of rota-

tion, illustrating a modified form of blade bracket or spider, constructed by utilizing a pair of the elements, as shown by Figs. 6 and 8; Fig. 11 is a fragmentary central section through the device shown by Fig. 10, but taken in a plane transverse to the axis of rotation, and Fig. 12 is a plan view of one blade arm and integral blade-forming blank, this figure being a partial showing of a blank for an integral spider and blade structure which may be formed up similarly to that appearing in Fig. 9.

The fan assembly as a whole, is indicated by the numeral 10 (Fig. 1), and consists, in the illustrated form, of four blades 11, 12, 13, and 14, each blade being either formed integrally with, or secured as by riveting or welding to, a mounting arm 15 (Fig. 6), the arms being formed as a part of or secured at their inner ends to a disc 16, welded or otherwise secured to a hub element or collar 17, which, as through the agency of a set screw 18, is firmly secured to the power shaft, such as the shaft extension of a fan motor (not shown). The elements of novelty and method of constructing the mounting bracket or spider will be hereinafter described in greater detail.

The blades 11, 12, 13, and 14 are uniform in size and construction, the blade 11 being selected for description of each of these several similar elements. My preference in forming the fan blades to meet the usual service requirements, is to utilize a stamping or punching of sheet metal, which, according to present choice, is of elliptical or even circular plan or outline, being illustrated as elliptical in form by Fig. 4. It may be noted that certain production advantages exist in the use of an initially circular punching for forming up the blades, and that when the punching or stamping is shaped, as hereinafter described, it assumes, when viewed in plan, an elliptical outline. This general shape may, for example, in a two-blade fan, be relatively elongated to assume for example a blade of a more oblong configuration. The leading edge 20 of each blade is thus usually of a continuous and practically uniform curvature on a substantial radius; in fact, the margins of the blade as a whole are smoothly and regularly convex, and in the more elongate forms the lateral margins may be rectilinear over part of their length. The various marginal portions of each blade merge smoothly into each other, so as to avoid corners, marginal apices and all of the reentrants sometimes heretofore characterizing the blade edges, particularly on the leading margins of the blades.

The leading edge 20 bounds, exteriorly, a forwardly turned flange or lip 21, set at an angle to an intermediate area 22 of the blade which constitutes its major displacing portion. For fans operating in a speed range of 1000–1800 R. P. M., this angle is satisfactorily of the order of 30 degrees. This intermediate area is bounded on the left (Fig. 4) by a forwardly turned trailing lip or flange 23, which is shown as being of an area equal to the leading flange 21 and projecting forwardly of the intermediate portion 22 at about the same angle. The leading and trailing flange portions 21—23 are, however, relatively reversed, in that they bear, with respect to the major axis of the blade, a right and left handed relation. The trailing flange 23 is provided with a trailing edge 24 corresponding, in reverse relation, to the leading edge 20.

My preference is to form the leading and trailing flanges or lips and the central or intermediate body portion, so that each of these portions lies substantially in a plane. Obviously there may be some departure from a true planar aspect of these elements, in that each may be formed with a slight curvature, preferably concave on the forward side of the blade.

I prefer to form the flanges 21—23, each by bending the initially flat blade-forming element along parallel zones 25. By preference, this line of fold is gradual, rather than abruptly angulate and thus constitutes a true zone of appreciable width through which the angle of the blade changes, rather than a corner or distinct crease at these points. It is further to be noted as my preference, that the zones 25, besides being parallel to each other, are parallel to the major axis of the blade proper. It may for purposes of description, be considered that the elliptical blade of Fig. 4 is formed about a minor axis of symmetry corresponding to line 5—5 thereon, while a major axis of symmetry corresponds to a longitudinal median through the blade at a right angle to the line 5—5.

It will appear from Fig. 5 and the foregoing description, that the forward face of each blade as a whole, is of shallow channelled aspect, the channel or groove being of a trend parallel to the major axis of symmetry of the blade and hence along its length. It is however, to be noted as my preference, as will hereinafter appear, that this channel does not lie along a radius on the axis of rotation.

It is a further preference to proportion the blade, particularly when employed for air displacement purposes, so that its greatest transverse dimension approaches its length to an extent considerably exceeding the fan blades of usual, heretofore prevailing types. In the example disclosed, the ratio of the two dimensions is substantially three to four, and may even closely approximate equality in case the blade-blank before forming, is circular. Obviously, in case the fan is of two or three blade type, this ratio may be reduced somewhat from that illustrated. This increase in relative width over blades of heretofore prevalent designs, enables a more effective disposition of the blade area in respect to the full disc area of the fan. Although the arrangement of blades shown does not cover the full disc area of the fan, it enables a maximum displacement of air with a minimum blade-tip velocity, thus conducing to a minimization of the noises usually due to excessive and unnecessary blade-tip speeds.

My preference in mounting the blades, with respect to a fan of four-blade type, appears from Fig. 1 to consist in canting each blade, considered as lying in the plane of the fan disc, so that a radius on its axis of rotation substantially bisects the angle between the major and minor axes of blade symmetry. From this it results that the channel of each blade is disposed at an angle of substantially 45 degrees to a radius on the axis of rotation, without regard to the pitch angle, as determined by the mounting arms of the spider, later to be referred to. This manner of mounting the blade with its axes at an appreciable angle to a radius of rotation, tends materially to deaden the noise resulting from any blade vibration, since the blade as a whole is asymmetrically carried by the radial arm. It will further appear that the fan, as viewed along the axis of rotation, so presents its blades that the trailing lip of one blade at most only slightly overlies the inner end of the next adjacent blade, or may, according to the specific shape of blade,

and number thereof in the fan, be entirely out of overlapped relation. This arrangement avoids any adverse interference between adjacent blades, in a manner to create undesirable noise. It will appear from Fig. 1 that the described arrangement of blades in the fan goes far toward minimizing the heretofore large, non-active dead area along the axis or shaft.

The pitch angle of each of the blades will be determined obviously by the factors attending the service to which it is subject. When employed for air displacing purposes, the speed, number of blades and volume of air to be handled will dictate the necessary pitch angle. In fans of usual type for air circulation purposes, designed to operate say within a rang of 1000–1800 R. P. M., this angle is conveniently of the order of 45 degrees between the planar intermediate portion 22 of each blade and a plane transverse to the axis of rotation.

In the operation of a fan constructed in accordance with the drawing and foregoing description, the particles of air first encountered by the leading edge 20, say of the blade 11, are engaged by the lip 21, which, because of being turned forwardly of the blade, first attacks the air at a minimum angle, it being also noted the air is first attacked by that part of the leading edge or lip of the blade which is moving at a reduced linear velocity. The direction of movement of the air with respect to the blade is thence into and along its channelled portion, whence the particles of air are encountered by the midsection 22, disposed at a greater effective pitch than the leading portion 21. During this time the air is impelled to a certain extent, centrifugally of the blade, due to its channelled formation, a portion of the air leaving the blade at or near its tip, and a still greater portion being further impelled by the trailing lip or flange 23. The latter element, being turned forwardly of the plane of the midsection 22, is presented to the air at a still greater pitch than this central blade area, and thus serves to impart a final kick or thrust to the air as it leaves the blade.

It will appear from the construction of each blade that its channelled aspect tends, centrifugally, to advance the air from its inner to its outer end, and in a direction along its major axis. This conduces to an initial displacement of the air by those blade portions which are moving at a relatively reduced linear velocity and a gradual advancement of the air stream under displacement, toward those blade portions which are moving at a higher velocity. It is, of course, understood that the primary movement of air is forwardly, rather than peripherally of the fan as a whole.

As a mounting expedient serving the purpose of the usual blade mounting bracket or spider, I prefer, particularly for certain types of service, the arrangement best illustrated by Figs. 6 through 11. This structure is conveniently formed, at a low cost, from a punching or stamping such as illustrated by Fig. 9 and indicated generally at 30. A central disc portion which ultimately results in the part 16 (Fig. 6) is provided with integral peripheral extensions at even intervals, and resulting in the plurality of radial blade-mounting arms 15 (Fig. 6). The innermost ends of these arms are angulately related to the bodies of each of the arms so as to provide angulate offsets 31.

In forming up the spider from a punching such as shown by Fig. 9, each of the offsets 31 is bent along a line of fold 32 so as to bring it rearwardly of and at a right angle to the central hub or disc portion 16. The resulting arrangement of offsets 31 will appear from Figs. 6, 8, and 10. In this condition the mounting arms 15 will extend rearwardly of the disc or hub element 16, although not parallel thereto. By further bending of each arm along a line 33, the arms are brought into radial relation, as illustrated by Figs. 6 and 8, and, depending upon the angle between the lines 32 and 33, are given the required pitch angle. The central or disc portion 16 is preferably apertured as at 34, to receive the power shaft, and may be conveniently secured as by welding, or otherwise, to a mounting collar 17, provided with a shaft aperture 35, forming a continuation of the aperture 34. As before noted, a set screw 18 may serve for detachable securement of the collar, and hence of the spider, to the shaft.

The punched or stamped element from which the spider is formed up, may be used either singly, of may desirably be made up in double thickness, as illustrated by Figs. 10 and 11. For given requirments of rigidity and strength, this enables each punching to be of somewhat lighter gauge, and presents an advantage in deadening objectionable noises and minimizing transference of vibration into and from the fan structure, due to the resulting laminated arrangement of blade-supporting arms 36. When the two punchings are disposed back to back, as shown by Figs. 10 and 11, they may be welded together, or secured together in assembly as by rivets, at the time of securing the fan blades to the arms 36. It will be noted that the disposition of the two punchings in opposed relation, results in a space between the paired hub elements, for the reception of the mounting collar such as 17.

A modification of the arrangement shown by Fig. 9 is indicated by Fig. 12, illustrating a structure which may be considered as identical with Fig. 9, except for changes in the blade-carrying arms 15. According to Fig. 12, each blade arm 40 is provided with a line of fold 41 corresponding to the line 32 of Fig. 9, and further with a line of fold 42 corresponding to the line 33 of Fig. 9. This modification differs from the spider-forming blank of Fig. 9 in that it constitutes a blank or punching from which may be formed a complete fan, including a complete spider adapted for securement to a collar such as 17, or which may be directly secured to a power shaft. In Fig. 12, a still further line of fold, indicated at 43, occurs at the innermost margin of the blade-forming portion of the blank, this fold preferably lying along a curved line corresponding to the innermost edge or margin of the blade proper. In forming up this blade and spider structure, the projection from the blade-forming blank constituted by arm 40 is, like the portion 31, first bent rearwardly of the central disc, thence outwardly in a direction to bring the blade into the proper position in the fan disc, and at the predetermined pitch angle. The lines or zones along which the blade will be bent to provide the angulate leading and trailing lips or flanges, corresponding to 21—23 of Fig. 4, are indicated respectively at 45 and 46. The latter fold lines correspond obviously to the breaks in the blade surface corresponding to the zones 25 of Fig. 4. It is, of course, understood that the fragmentary showing of Fig. 12 illustrates only one blade and blade-arm of a complete fan-forming blank, including a cen-

tral disc or hub portion corresponding to that of Fig. 9, together with other blade and arm elements according to the number of blades required. This arrangement possesses the advantage of a low cost device which may be produced from a single punching, and may also be used in superposed plurality to form laminated fan and spider structures. The laminated structure of this sort results materially in deadening vibration noises, in comparison to a structure of single thickness and of comparable mass.

Exhaustive tests conducted with fan and mounting structures in accordance with the present invention have shown an efficiency of performance and quietness comparing more than favorably with any prior development which has come to my knowledge. In service, a construction of fan and fan blade in accordance with the present disclosure, fully attains each of the several objects heretofore implied and expressed.

While I have described the invention by making detailed reference to a preferred embodiment, this description is to be understood solely in a descriptive, and not in a limiting sense, since many of the parts may be changed in certain respects, such as the specific shape or configuration of the blades disclosed, and the parts may be utilized in combinations other than as disclosed, and still further be utilized for different fluid-reaction purposes, all without departure from the spirit and full intended scope of the invention as defined by the appended claims.

What I claim is:

1. In a fluid displacement device, a plurality of spaced blades or vanes each including three connected, substantially planar portions, each disposed at a substantial angle to the other portions, and at least one of said portions being mounted at a substantial angle to a plane normal to the axis of revolution, each blade being formed to define a major blade axis, and means for revolvably mounting the blades with the major axis of each thereof at an acute angle to a radius on the axis of revolution.

2. A fluid reaction blade adapted to be mounted for rotation about an external axis, the blade being characterized by a major blade axis, and including three connected substantially planar portions, said portions being connected along rectilinear zones, substantially parallel to the major axis of the blade and the free margins of the blade being arcuately formed entirely on centers within the blade.

3. In a rotary fluid reaction device, a plurality of spaced blades mounted for revolution about an axis, each of said blades being formed substantially symmetrically with respect to a major axis therethrough, and including three substantially planar portions connected together along rectilinear zones extending along the major axis of the blade, each of said blades being mounted with its major axis at an angle to a radius on the axis of revolution.

4. A fluid-reaction blade adapted to be mounted for revolution about an axis external thereto, the reaction surfaces of the blade including a leading portion, a central portion and a trailing portion, the central portion constituting the major reaction area, and each of said portions lying substantially in a different plane with the leading and trailing portions projected from the central portion in the direction of the air stream the blade being substantially symmetrically formed with respect to a blade axis through the said central portion.

5. A fluid displacement device including a plurality of spaced blades arranged for rotation about an axis, each blade including, in the form of substantially planar elements, a leading portion, a central portion and a trailing portion, each blade further being formed substantially symmetrically about an axis through its central portion, and mounted with said blade axis disposed at an angle to a radius on the axis of revolution.

6. A blade for a fluid displacement device, adapted to be mounted for revolution about an axis beyond the blade, the blade being symmetrically formed, in plan, about a major axis and a minor axis, and comprising a relatively large central area containing the major axis, and lesser leading and trailing marginal areas constituted by forwardly turned portions bounded adjacent the central area by zones substantially parallel to the major axis, the said central area and marginal areas each being of substantially planar form.

7. A blade for a fluid displacement device, adapted to be mounted for revolution about an axis beyond the blade, the blade being symmetrically formed, in plan, about a major axis and a minor axis, and comprising a relatively large central area containing the major axis, and lesser marginal leading and trailing areas constituted by forwardly turned portions bounded adjacent the central area by zones substantially parallel to the major axis, the said central area and marginal areas each being of substantially planar form, and the blade as a whole having its free margins bounded by convexly curvilinear edge portions.

8. A blade for a fluid displacement device, arranged for revolution about an axis external thereto, and constructed to present in plan, major and minor axes of symmetry, the blade including a central, substantially planar portion containing one of said axes and constituting the major displacement area of the blade, and substantially planar marginal leading and trailing portions, each projecting from the central portion in the direction of the fluid-stream.

9. A fan characterized by a plurality of spaced blades, each constructed in substantial accordance with claim 8, in which the axis of each blade contained by the said central portion, is disposed at an angle to the radius of revolution.

10. A fan blade adapted for revolution about an axis external thereto and characterized by spaced, substantially planar leading and trailing portions and an intermediate portion, the leading and trailing portions being disposed at substantially equal but opposite angles to a plane normal to the axis of revolution, the said leading and trailing portions corresponding to each other in length and area, and each being of lesser length and area than said intermediate portion.

11. A fan blade of channelled transverse section and symmetrically formed with respect to a major axis and a minor axis of symmetry, the trend of the channel being lengthwise of the blade and at a substantial angle to said minor axis, and the greatest width of said blade being only slightly less than the greatest length thereof.

12. A fan blade adapted to be mounted for revolution about an axis external thereto, and including a substantially planar central area, the blade being bent lengthwise so as to form a pair of lips projecting laterally and forwardly of the central area and at substantially the same angle to the plane thereof, the blade being adapted for

mounting with its longitudinal axis at a substantial angle to a radius on its axis of revolution.

13. A fan blade adapted for mounting about an axis external to the blade, the blade having its free edges smoothly convexly curved, and the blade being substantially symmetrically formed about a longitudinal axis, and hollowed on its forward side so that its transverse chord dimension is at least equal to three-fourths of its longitudinal dimension along the said axis of symmetry.

14. A fan blade of channelled or trough-like aspect so as to present a hollowed forward face, the free blade margins being convexly curved, and the blade being characterized by longitudinal and transverse axes of symmetry and so formed that its dimension along the said transverse axis is at least equal to three-fourths of the dimension along said longitudinal axis.

15. A fan blade of sheet material elliptical in outline and of convex curvature along its free edges, the blade being longitudinally channelled in a direction along its major axis, and of angulate transverse section.

16. A fan blade of sheet material and elliptical in outline, the blade being longitudinally channelled in a direction along its major axis, and means for rotatably mounting said blade with the major axis thereof at a substantial angle to a radius on the axis of revolution.

17. A fan comprising a plurality of spaced blades, each including outturned leading and trailing margins resulting in a blade of channelled sectional aspect, each blade being mounted with its channelled side projecting toward the delivery side of the fan, and with its channel of a trend at a substantial angle to a radius on the axis of revolution and each blade being mounted with substantially its greatest chord width across said margins, lying along a radius on the axis of revolution, and with its major axis at an angle to such radius.

18. In a fan, a plurality of blades, each substantially symmetrically formed about a blade axis, a mounting arm for each blade, lying substantially along a radius on an axis of revolution, the blades each being arranged in the fan with the blade axis at a substantial angle to the mounting arm therefor, and with the adjacent blade axis at an angle approximating the angle between adjacent mounting arms.

19. A four-blade fan, the blades of which are each longitudinally channelled on its forward face, and symmetrically formed about an axis parallel to its channel, the blades being arranged in the fan with their axes at an acute angle to a radius on the axis of actuation, and with the corresponding axes of adjacent blades substantially at a right angle to each other.

20. A fan blade having a major displacing portion, and a lip on the leading edge of the blade, projecting forwardly thereof at an angle to the major displacing portion and at a substantial angle to a radius on an axis of rotation of the blade, the lip being characterized by a continuous and regular convex margin.

21. A spider or blade-mounting bracket for a fan, including a central body transverse to the axis of revolution, a plurality of arms formed as a part of the central body, and an offset connecting piece between each of said arms and said body, the connecting pieces being bent sharply away from the central body, toward parallelism with the axis of revolution, and outwardly turned rearwardly of the central body to form the arms and so as to bring said arms to the desired pitch relation to said body.

22. A spider or blade-mounting bracket for a fan, formed of a stamping or punching including a central disc tranverse to the axis of revolution, a plurality of blade-engaging arms, and an offset connection between each of said arms and disc, the connecting pieces being substantially parallel to the axis and bent near the disc to provide an angular connection to the disc and angularly connected to the associated arm such as to bring the arms to the desired angular pitch relation to said disc.

23. A blade-mounting bracket or spider for a fan, comprising a pair of the elements according to claim 22, and in which said elements are mounted back to back with the arms in overlying relation to each other, and with the discs spaced axially of each other.

24. A mounting spider for fan blades, consisting of the stamping or punching of sheet metal providing a central hub or disc apertured to receive the fan shaft, a plurality of arms each provided with an offset substantially parallel to the axis of revolution, and connecting the blade supporting portion of the arm with said disc, the offset portions being bent away from the central disc toward the axis of revolution, and the blade-supporting portion of each arm being bent to lie along a radius on the axis of revolution, and at the desired pitch angle to a plane transverse to the axis.

25. A combined fluid-reaction blade and blade-mounting structure, including a plurality of laminations each including, as a one-piece element of sheet metal, a central axially apertured disc constituting a hub portion, a plurality of arms carried by the disc, and an enlarged portion on each arm, forming a blade.

26. A combined fluid-reaction blade and blade-mounting structure formed of a plurality of elements of sheet material, each of said elements being integrally formed, a hub portion on each element, a plurality of arms connected thereto and enlarged to constitute a blade, the said elements being disposed with their arms in adjacence, to constitute a bladed structure, each blade of which is of plural thicknesses of material.

27. A fan spider which consists in a single piece of sheet material including a central disc area and mounting arms projecting therefrom, the innermost portions of the mounting arms lying so as to approach parallelism with the axis of revolution, and beyond said innermost portions of the arms, including blade-supporting portions thereof the major axes of which lie substantially along a radius on the axis of revolution, the said blade-receiving portions of said arms, each being formed to lie in a plane corresponding substantially to the pitch angle of the blade to be mounted thereon.

WALTER L. UPSON.

Disclaimer

2,021,707.—*Walter L. Upson*, University City, Mo. FLUID-REACTION DEVICE. Patent dated Nov. 19, 1935. Disclaimer filed Feb. 5, 1948, by the assignee, *The Tarrington Manufacturing Company;* the inventor consenting.

Hereby disclaims from the scope of each of claims 1 to 20 inclusive, any fluid displacement device other than a fan comprising a plurality of distinct, wide blades mounted for rotation about a common axis, each blade being bounded over a predominant portion of its margin by convexly curvilinear edge portions and formed to provide a wide, open end, substantially pitched channel extending outwardly of the axis of fan rotation and rearwardly with respect to the direction of rotation.

[*Official Gazette Mar. 2, 1948.*]