Aug. 4, 1942. M. H. FRISBIE 2,292,115

FAN IMPELLER

Filed April 8, 1937 2 Sheets-Sheet 1

Fig. 1

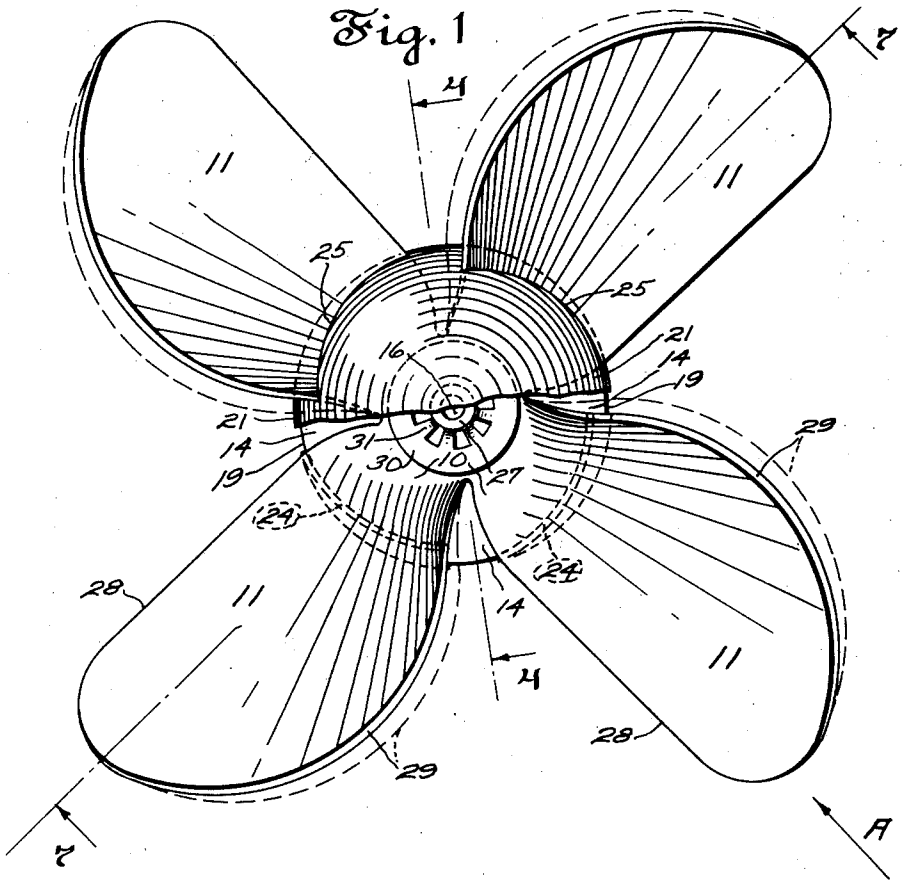
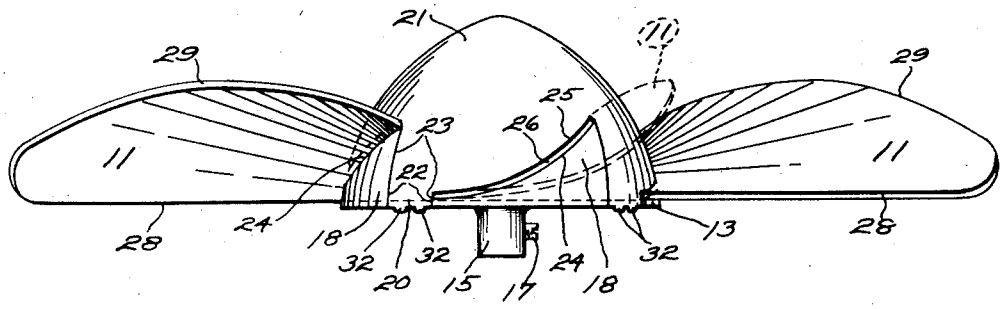


Fig. 2



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Fig. 9

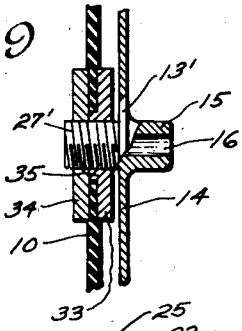


Fig. 10

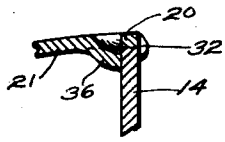


Fig. 7

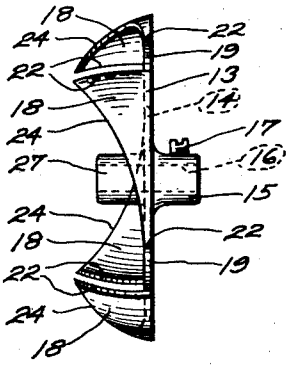


Fig. 6

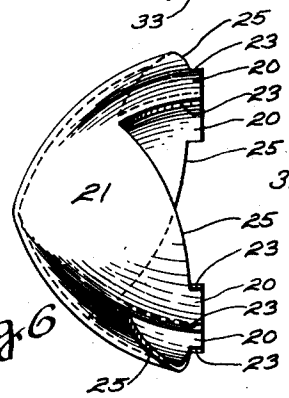


Fig. 8

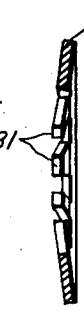


Fig. 5

Fig. 4

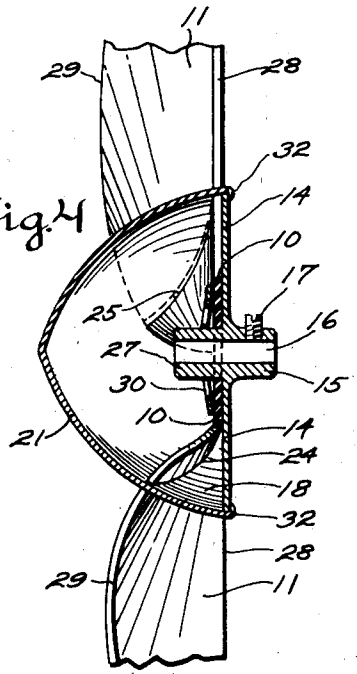
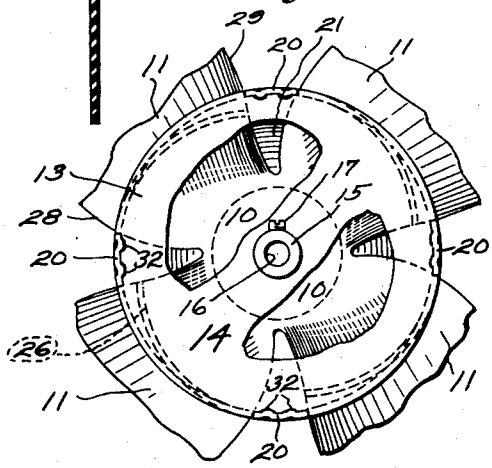


Fig. 3



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2,292,115

UNITED STATES PATENT OFFICE

2,292,115

FAN IMPELLER

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Application April 8, 1937, Serial No. 135,717

13 Claims. (Cl. 170—173)

This invention relates to safety impellers for blades are combined with and extend from the fans and to fan impellers in general in which inside to the outside of the peripheral wall of a hollow shell-like structure surrounding or comprising a central hub.

In safety impellers the blades may be made of relatively soft and flexible material preferably possessing enough resilient stability to maintain a designed curvature and disposition relative to the hub when stationary and to depart therefrom within only a limited range of deformity as a result of the forces occasioned by rapid rotation. Blades of this character when made of suitably soft material, of which rubber is an example, will yield and collapse upon striking an object even if rapidly rotating, and thus spare the object from damage, immediately reassuming their normal contours and disposition for fanning the air.

An object of the present improvements is to provide blades of this nature by cutting a flat sheet of the blade material to form an annularly continuous central portion with a plurality of blade shapes continuous therewith and radiating outwardly therefrom. This saves the cost of molding special material into the form of individual blades as well as the cost of connecting or attaching separate blades to a common means of support. This cut sheet of material is hereinafter referred to as the blade sheet.

Another object is to provide a rigid and hollow central rotor structure for holding the blade portions of the blade sheet in suitably pitched condition and which shall be comprised of the fewest possible number of light weight parts suited for assemblage if desired, without the use of separate fastening means such as rivets, eyelets or screws.

A further object is to provide in the wall of a hollow rotor or hub shell, inclined elongated openings accommodating and imparting pitch to the blades with respect to the plane of rotation, the opposite sides of each such opening being formed by separable edges of the shell wall which edges may be forced toward each other to securely clamp the blades therebetween. Such edges may, if preferred, be rigidly held in definitely spaced relation to form a slot slightly wider than the thickness of the blades for enabling the blades to assume different angles of inclination toward the front or rear of the impeller with respect to the axis of rotation.

A further object is to form a hollow hub shell from axially separable cup-like parts whose rims are cooperatively shaped to register and engage while leaving between opposed edges thereof elongated narrow spaces through which impeller blades may extend.

A further object is to provide one of the said cup-like parts with a central lug by which it may be mounted upon the shaft of a fan motor.

A further object is to provide one of the cup-like parts with one or more stud-like projections adapted to engage with one or more perforations in the blade sheet inside the hub shell for centering the blades relative to said shell and to their axis of rotation.

A still further object is to provide removable holding means for determining the axial position of the blade sheet inside the hub shell and for varying such position when desired as an expedient for determining the inclination of the blade surfaces relative to the impeller axis in their portions outside the hub shell.

The foregoing and other objects will appear in further detail from the following description of structures by which these objects may be accomplished and in which reference is had to the accompanying drawings wherein:

Fig. 1 is a front view of a fan impeller embodying the present improvements, the lower half of the front impeller cup being broken away to expose the central portion of the blade sheet interior therof, and the developed shape of the blade sheet being indicated by broken lines.

Fig. 2 is a side elevation of the complete impeller of Fig. 1 looking in the direction of arrow A and showing the centrally positioned blade in broken lines to better expose the slotted surface of the blade shell.

Fig. 3 is a fragmentary rear view of the impeller of Figs. 1 and 2 showing the rear wall of the rear shell cup broken away in two locations to expose the interior portion of the blade sheet.

Fig. 4 is a sectional view taken on the plane 4—4 in Fig. 1 looking in the direction of the arrows.

Fig. 5 is a side elevation of the shell cup of Fig. 2 which comprises the rear part of the hub shell structure.

Fig. 6 is a corresponding side elevation of the front shell cup of Fig. 2.

Fig. 7 is a sectional view taken through the developed blade sheet of Fig. 1 on the plane 7—7.

Fig. 8 shows on an enlarged scale one form of retaining member for the blade sheet taken in section on the plane 4—4 in Fig. 1 looking in the direction of the arrows.

Fig. 9 shows a modified construction of retaining means for the blade sheet taken in section to correspond with Fig. 4.

Fig. 10 is a fragmentary view showing a stop construction for determining the width of the blade slots in the hub shell.

Fig. 7 represents in section a flat blade sheet of resilient flexible material which may be cut to the contours represented in part by the broken lines and in part by the full lines of the blades in Fig. 1. While the material may be metal, Celluloid, or any other flexible substance, in safety fans rubber has been found to be suitable. Many other substances of correspondingly resilient and non brittle qualities may be used. The blade sheet as a whole is designated **10**. The parts thereof which take the form of blades are designated **11**. Blade sheet **10** has the central aperture **12** or may be otherwise perforated to engage with locating projections inside the hub shell of the present improvements.

A cup-like member **13** comprises the rear portion of the hub shell structure and in the form shown includes a solid disc which may be cast integrally with a central mounting lug **15** having an axial hole **16** to accommodate the shaft of a fan motor to which it may be secured by the set screw **17**. Extending toward the front from the peripheral edge of disc **14** are fin-like projections, flanges or rim portions **18** between which the disc **14** is peripherally notched at **19** to receive projections **20** comprising the rear terminals of the notched wall of the cup-like member **21** which comprises the front portion of the hub shell structure. Thus each of members **13** and **21** possesses walls which extend to the periphery of the hub structure. Projections **20** and equivalents therefor are referred to in certain of the appended claims as "shell sections."

Members **13** and **21** assemble to make up the hub shell of the present improvements and each may have many cup-like forms other than herein shown. Preferably, however, the hub shell which they combine to form will have an exterior surface of uninterrupted smoothness provided by the matching or registering of the circumferential walls of parts **13** and **21**. These walls may be termed the rim portions of flange-like cup members **13** and **21** and the edges of these rim portions may be cooperatively formed so that certain edges **22** of the fins **18** are parallel to the axis of rotation as are abutting edges **23** of the said rim portions formed by cut-outs in the shell wall of member **21**.

The inclined edge **24** of the fin-like projections or flanges **18** is shaped correspondingly to the inclined edge **25** of the corresponding notch produced flanges of the walls of member **21**, and the dimensions are further such that when members **13** and **21** are assembled as in Fig. 2, a narrow elongated space **26** is left between edges **24** and **25** through which spaces the blades **11** may respectively project.

One or more stud-like inward projections, such as **27** and apart from the hub or mounting lug **15**, may be of a size to fit one or more apertures such as **12** in the blade sheet **10** for centering the latter with respect to the hub shell and its axis of rotation. When the central portion of the blade sheet of Fig. 7 is placed over the lug **27**, the rear face of the former may be thrust into contact with the front face of disc **14**, except for such portions of the blades **11** as are held from so contacting with disc **14** by the inclined edges **24**. Thus, in Figs. 1 to 4 inclusive, the relatively straight edge **28** of the blade may closely flank the plane of disc **14** throughout its length, whereas the relatively curved edge **29** of blade **11** will be forced forwardly by the arcuate edge **24** of flange **18** thereby establishing the "pitch" of the blade and also determining its normal working surface curvature when the impeller is assembled.

To maintain the central portion of the blade sheet **10** flat against the disc **14**, a retaining washer **30** may be employed having centrally extending lock fingers **31** possessing enough spring to press and grab against the lug **27** when forced over the same. The front or nose cup **21** of Fig. 6 may then be forced to its position in Figs. 2 and 4 in which the rearmost edge portions **20** of its flange-like projections respectively engage with and fit the notches **19** in the periphery of disc **14**, after which these rear edge portions may be peaned over against the rear surface of disc **14** at points such as **32** to hold the members **13** and **21** securely together in concentric relationship.

These improvements contemplate the optional use of the structures herein disclosed for solidly clamping the blade sheet between wall edges **24** and **25** or for permitting the blades **11** to pass through the slots **26** more or less loosely as to the fit of the surfaces of the blades **11** in the width of the slots. It is preferable that there shall be no play of the blade longitudinally of the slot for which purpose the width of the blade along the edge of the slot equals the length of the slot causing the assembled peripheral hub walls to embrace both faces and both edges of the blade.

If the flange edges **24** and **25** are not arranged to clamp the blades **11** firmly therebetween, a certain control of the shape and position of the blade outside the hub shell may be effected by adjustively shifting the axial position of the center portion of blade sheet **10**. Means for doing this are illustrated in Fig. 9 wherein the lug **27'** is shown to be externally threaded and carrying two lock nuts **33** and **34** having threaded engagement therewith. A central shoulder **35** on one of these nuts may be of less height than is the thickness of the blade sheet **10** so that the nuts **33** and **34** may jam together in metal-to-metal locking contact while squeezing therebetween the blade sheet **10**.

Fig. 10 illustrates a simple expedient for determining a positive width of slot **26** consisting of an eyelid projection **36** punched inwardly from the metal wall of each projection **20** to engage with the front surface of cup disc **14**.

Among the advantages of my improved impeller construction herein proposed are the support of a hollow dome shaped hub housing solely at its rear end of greatest circumference enabling the walls of the cap member forming such housing to be extremely thin and light since for the most part they are required to transmit no rotary power from a motor shaft to the fan blades; the provision of a fully enclosed chamber containing and protecting the central portion of the blade sheet and the inner end of the blades; the edgewise holding of each blade within a wall slot closed at both ends whereby each blade is held as securely for movement in one rotational direction as in the other; the curvature of the blade surface conforming in general to that of the curved surface of a true cone because of the disposition of the blade constraining edges **24** and **25** which imparts a maximum degree of stiffness to any flexible sheet-like body; and the ease and low cost with which any parts of the improved

impeller may be salvaged and used over again in case of defective workmanship or repair.

All of these advantages arise from underlying principles of construction of which the present examples are but illustrative and the appended claims will be understood as intended to cover all equivalents thereof and substitutes therefor which might be suggested to those skilled in the art by the disclosure hereof.

I claim:

1. A fan rotor embodying in combination, a split hollow shell-like hub structure including front and rear coaxial members having walls extending to the periphery of said hub structure, blades pitched for fanning air anchored within and projecting radially outward from said hollow hub structure, and shell sections extending between neighboring edges of adjacent blades and fixedly joining said walls of the coaxial members at the periphery of said hub structure in a manner to hold said members axially together.

2. A fan rotor embodying in combination, a split hollow hub-like structure including front and rear coaxial members having walls extending in part to form the periphery of said hub structure, blades pitched for fanning air anchored within and projecting radially outward from said hub structure, and shell sections of generally cylindrical disposition extending between neighboring edges of adjacent blades and fixedly joining said hub walls of the coaxial members at the periphery of said hub structure in a manner to hold said members axially together.

3. A fan rotor embodying in combination, a multiple blade sheet composed of a central disc-like web and at least two pitched and circumferentially spaced air fanning blades outstanding radially from the perimeter of said web, a split hollow hub-like structure including coaxial members respectively at the front and rear of said web having walls extending to the periphery of said hub structure, and shell sections extending between adjacent edges of said blades radially outside of said perimeter of said web and fixedly joining said walls of the coaxial members at the periphery of said hub structure in a manner to hold said members axially together.

4. In a fan impeller having a dome-shaped hollow hub structure, the combination of a disc-like mounting member, flexible blades carried by and radiating outward from said member, and a cap comprising the dome-shaped portion of said hub having shell-like walls and peripheral edges in part inclined at the larger open end of said cap, said cap and member being fastened together at spaced points along said edges with the walls of said cap partially embracing the radially inward portions of said blades in such manner that the inclined parts of said edges impart pitch to said blades.

5. A fan rotor including a circumferentially split hollow structure concentric with the rotor axis and comprised of at least two separate coaxial cup-like members, at least one of said members having peripheral flanges notched in a manner to present edge portions in part inclined and flanking and spaced from cooperative portions of the neighboring member, and pitched air impelling blades projecting outward from the interior of said hollow structure extending radially between and beyond one of said members and the inclined edge portions of the other member in a manner to derive support and pitch from said inclined edge portions, said flanges extending axially between said blades and being fastened to said neighboring member by means of said edge portions.

6. In a fan impeller having a dome-shaped hollow hub structure, in combination, a supporting disc-like member disposed crosswise the larger rear end of said structure, means to mount said member upon a shaft, fan blades flanking the front face of said member and radiating outward therefrom and pitched for fanning air, and a hollow shell-like cap forming the front dome-shaped portion of said structure and covering and concealing the front end of said mounting means, said cap having peripheral walls terminating at rear edges in part inclined and disposed to impart pitch to said blades and fastened to said member at points circumferentially intermediate said blades.

7. In a fan impeller, the combination with a blade extending radially outward and pitched with respect to the axis of the impeller, of two separable cup-like members each comprising a hollow central shell-like structure and each having peripheral rim walls including marginal edge portions encompassing the hollow interior of said structure and in part inclined, said members being cooperatively shaped and fastened together at said marginal edge portions in a manner jointly to embrace both faces and both edges of the blade in a manner to impart pitch to the latter and to require no additional means for holding said members together.

8. In a fan impeller having a dome shaped hollow hub, the combination of, a mounting disc having a notched periphery, flexible blades carried by and radiating outwardly from said disc, and a shell-like cap comprising the nose portion of said hub and having peripheral walls terminating at circumferential edges shaped to engage and retentively interlock with the notched periphery of said disc thereby to hold said shell-like cap in a position surrounding the radially inward portions of said blades in a manner to flex and impart a pitch to the blades.

9. A fan rotor including a circumferentially split hollow structure concentric with the rotor axis and comprised of at least two separate hub-like bodies, peripheral flanges rigidly connecting said bodies and notched in a manner to present edge portions conformed to and spaced from parts of one of said bodies and air impelling blades projecting outwardly from the interior of said hollow structure and extending radially between and beyond one of said bodies and said flange edge portions in a manner to derive pitch imparting support therefrom, the body connecting portions of said flanges extending axially between said blades.

10. In a fan impeller having a dome-shaped hollow hub, in combination, a support disc disposed crosswise the larger end of said hub at the rear end of the latter, means to mount said disc upon a shaft, fan blades flanking the front face of said disc and radiating outwardly therefrom, and a hollow shell-like cap shaped and arranged to form a front nose portion for said hub in a manner to cover and conceal the front end of said mounting means, said cap having peripheral walls terminating at edges in part imparting pitch to said blades and in part supportingly connected to said disc at circumferential points between said blades.

11. A fan impeller embodying in combination, a sheet of flexible material of uniform thickness comprising an annularly continuous central portion and blade shaped portions continu-

ous therewith radiating outwardly therefrom, a rear cup-like member having a web wall thinner than the thickness of said sheet and a forwardly extending rim wall radially as thin as said web wall, means to hold the said central portion of said sheet flat against said web wall, and a front cup-like member containing said means within the hollow interior thereof and having a rearwardly extending rim wall adapted to meet edge to edge with the rim wall of the rear cup-like member, one of said rim walls being notched in a manner to form an inclined edge portion bordering on a space occupied by a pitched blade shaped portion of said sheet thereby to impart the pitch to said blade shaped portion.

12. In combination with a fan impeller as described in claim 11, means carried by the said web wall of the rear cup-like member and engaging with the said sheet of flexible material for holding the blade shaped portions of the latter in designed relation to said rear cup-like member.

13. In combination with a fan impeller as described in claim 11, means carried by one of said cup-like members and engaging with the said sheet of flexible material for adjustably shifting the said central portion thereof toward the front or rear of the impeller to produce respectively a rearward or forward inclination of the said blade shaped portions outside the cup-like members.

MARSHALL H. FRISBIE.

CERTIFICATE OF CORRECTION.

Patent No. 2,292,115. August 4, 1942.

MARSHALL H. FRISBIE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 4, strike out the word "normal"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 15th day of September, A. D. 1942.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)

CERTIFICATE OF CORRECTION.

Patent No. 2,292,115. August 4, 1942.

MARSHALL H. FRISBIE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 2, strike out the words "blades are combined with and extend from the" and insert the same before "inside" in line 4; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 13th day of October, A. D. 1942.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)