

July 17, 1962

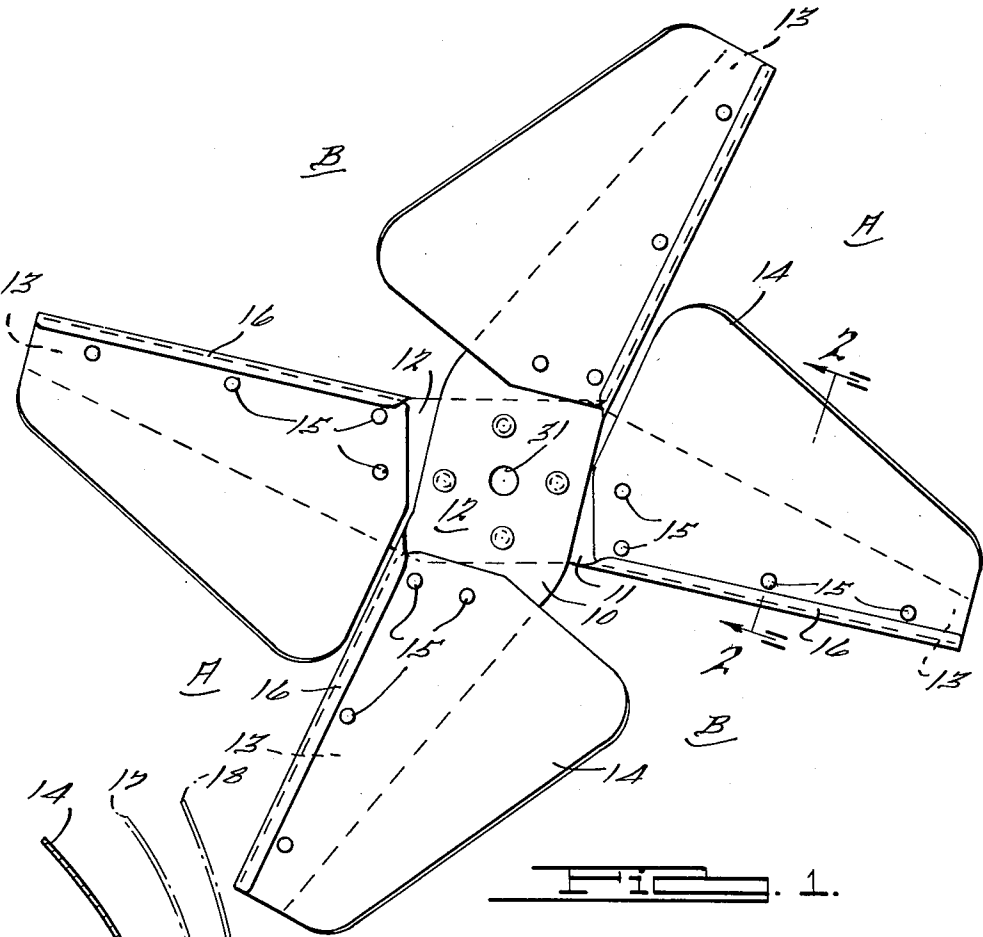
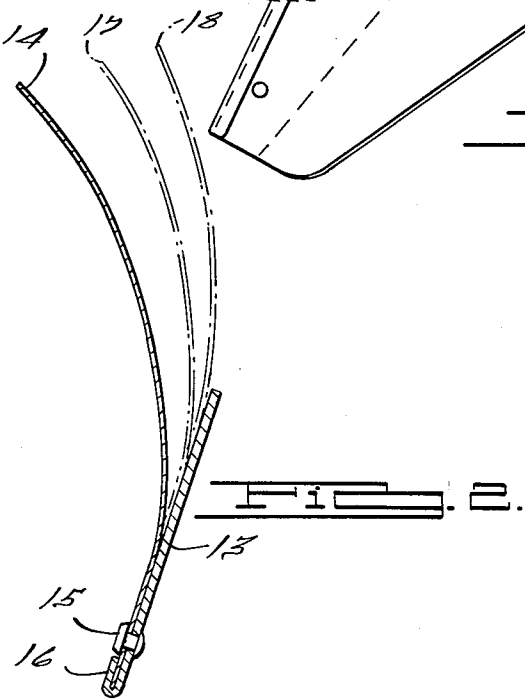
R. C. POSH

3,044,557

VARIABLE PITCH FAN BLADE

Filed Jan. 8, 1959

2 Sheets-Sheet 1



INVENTOR.
Raymond C. Posh.
BY
Harness, Dickey & Pease
ATTORNEYS.

July 17, 1962

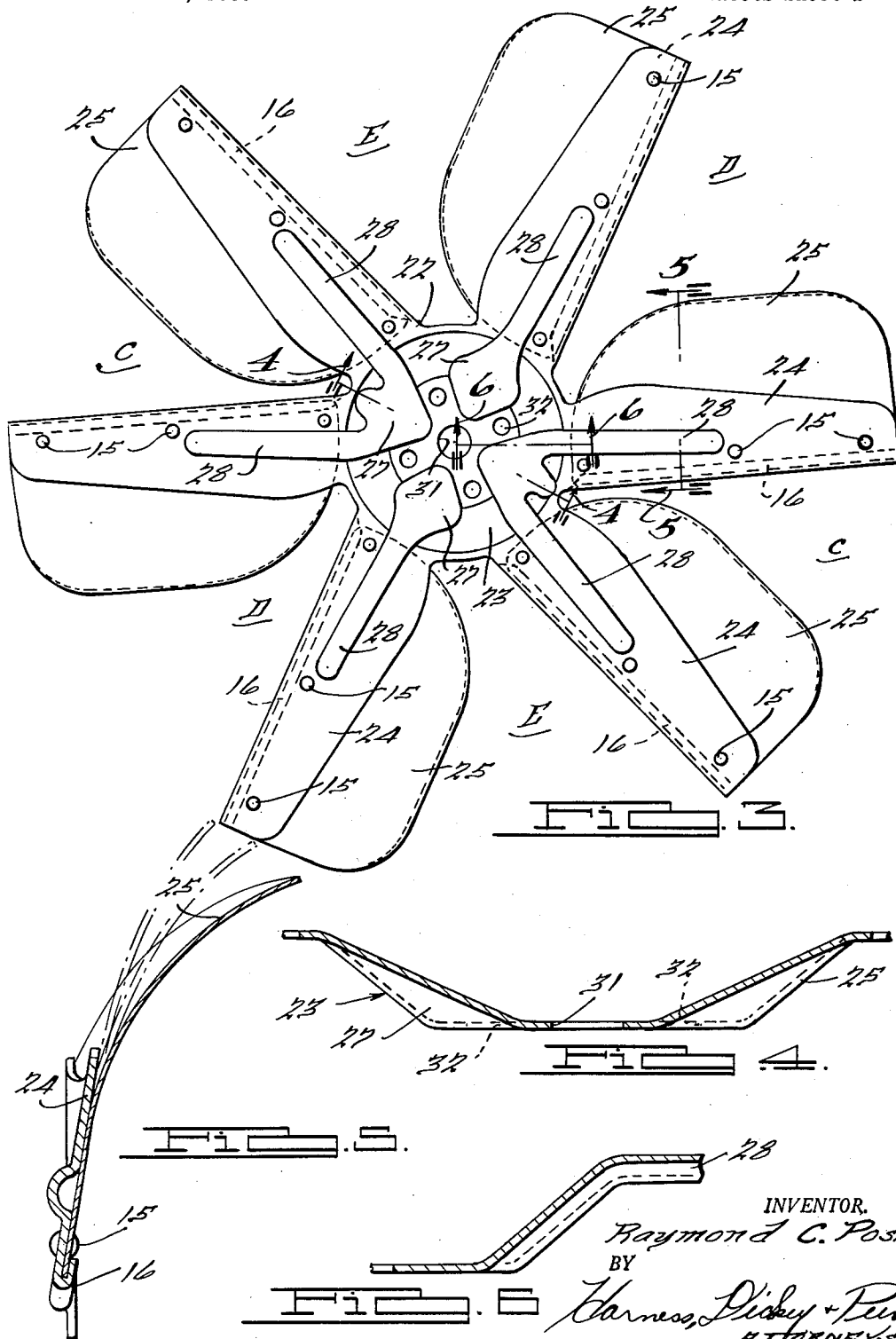
R. C. POSH

3,044,557

VARIABLE PITCH FAN BLADE

Filed Jan. 8, 1959

2 Sheets-Sheet 2



1

3,044,557

VARIABLE PITCH FAN BLADE

Raymond C. Posh, Garden City, Mich., assignor to American Metal Products Company, Detroit, Mich., a corporation of Michigan

Filed Jan. 8, 1959, Ser. No. 785,714

13 Claims. (Cl. 170-160.5)

This invention relates to multiblade fans, and particularly to a fan of the flexible multiblade type.

The screw type multiblade fans which are employed on automotive vehicle engines are driven at a greater speed as the speed of the vehicle is increased. This increases the horsepower requirement and also fan noise due to the increase in air velocity. The present invention overcomes these difficulties by providing flexible blades on the arms of the fan body which tend to flatten thereagainst upon the increase in speed due to centrifugal force and the resistance of the air, to thereby substantially reduce the air flow and the horsepower requirement. As a result, the vehicle is run more efficiently and with a substantial reduction in fan noise.

One or more stampings are provided having extending arms to which flexible blades are secured as by riveting and additionally by having the leading edge bent back upon itself over the forward edge of the blade. The arms may be flat or helically shaped from the hub outwardly and are curved forwardly away from the arms from their leading edges so that at slow speed operation a maximum flow of air will be provided. As the speed of rotation of the fan increases, the action of the centrifugal force and the pressure of the air on the flexible blades will cause the blades to flatten against the arms to an increasing degree with an increase in speed. This flattening of the blades substantially reduces the air flow produced thereby and reduces the horsepower requirement. This reduction in air flow maintains the noise at a minimum and harmonics are prevented from being set up by having the angular spacing of the blades varied.

Accordingly, the main objects of the invention are: to provide a fan having a plurality of flexible blades which reduce the air flow and horsepower requirement upon the increase in the speed of rotation thereof; to provide a fan having extending arms to which flexible blades are secured and on which the blades roll as they become flattened due to air resistance and centrifugal force as the speed of rotation of the fan is increased; to provide a stamping with a plurality of extending arms which are spaced different angular distances apart and to which flexible blades are secured, so curved away from the arms and on a helix outwardly therealong as to increase the efficiency in its operation while reducing the noise produced thereby, and, in general, to provide a multi-arm fan having flexible blades which is simple in construction, positive in operation and economical of manufacture.

Other objects and features of novelty of the invention will be specifically pointed out or will become apparent when referring, for a better understanding of the invention, to the following description taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a plan view of a fan embodying features of the present invention;

FIG. 2 is an enlarged sectional view of the structure illustrated in FIG. 1, taken on the line 2-2 thereof;

FIG. 3 is a plan view of a fan, similar to that illustrated in FIG. 1, showing a further form thereof;

FIG. 4 is an enlarged sectional view of the structure illustrated in FIG. 3, taken on the line 4-4 thereof;

FIG. 5 is an enlarged sectional view of the structure illustrated in FIG. 3, taken on the line 5-5 thereof, and

FIG. 6 is an enlarged, broken sectional view of the

2

structure illustrated in FIG. 3, taken on the line 6-6 thereof.

Referring to FIGS. 1 and 2, a four-bladed fan of the present invention is illustrated made of two similar stampings 10 and 11 and having hub portions 12 from which oppositely disposed arms 13 extend. The hub portions are angularly disposed to each other so that the arms 13 of the different stampings are closer together in the area A than in the area B to prevent undesirable sounds which may be produced due to harmonics set up in the blades during operation. Each of the arms has a flexible blade 14 thereon of predetermined pitch or curvature, as clearly illustrated in FIG. 2. The flexible blade is secured to the arms by rivets 15 and also at the leading edge by the reversely bent flange 16 of the arm which is clamped thereover. The blade swings outwardly and upwardly from the arm and, as illustrated in the broken line positions 17 and 18 of FIG. 2, the blade will roll outwardly on the surface of the arm 13 as it is deflected by centrifugal force and that of the contacting air as the speed of rotation of the fan is increased. Thus, by selecting the proper shape and curvature of the blade 14 and its resistance to deflection, the air flow may be maintained substantially constant, thereby reducing the horsepower requirement as the speed of rotation of the fan is increased.

A fan of this type will have special applications on an automotive engine as a substantial flow of air is required when the engine is idling or driving the vehicle at low speed, which requirement progressively reduces as the speed of the vehicle increases. If the same amount of air is propelled by the blades of the fan at high speed, a substantial amount of horsepower is required, resulting in inefficient operation of the vehicle. With the flexible blade type of fan as herein illustrated and described, the increased speed will progressively flatten the blade 14 from its position as illustrated in solid line of FIG. 2 to the position 17 illustrated in broken line. The further increase in speed of rotation of the fan will cause the blades to further flatten to the position illustrated at 18, which flattening continues to increase as the speed of rotation increases. Thus, when a substantial amount of air is required at low speed, the blades will maintain their initial form and produce a maximum flow of air. As the speed increases, requiring a less amount of air, the blades will flatten and produce a decrease in air flow which thereby decreases the horsepower requirement and the noise which would be increased if the flow of air were increased.

A six-bladed fan is illustrated in FIGS. 3 to 6 produced from a stamping 22 having an offset central hub portion 23 and six extending arms 24. Each of the arms has a flexible blade 25 secured thereto in any suitable manner, herein illustrated as by the rivets 15 and by the reversely bent flange 16 at the leading edge of the arms. It will be noted that the angular spacing C of the arms is less than the angular spacing D of the arms which is less than the angular spacing E of the arms, which produces non-uniformity to the location of the blades and prevents harmonics being set up thereby. The arms and blades are helically shaped from the hub outwardly, as illustrated in FIG. 5, to more uniformly pick up the air along the entire length of the blade from the hub to the outer end thereof. The central hub portion 23, as illustrated in FIG. 4, is of dish shape having embossed areas 27 which extend outwardly at 28 from the hub into the arms 24. A central aperture 31 locates the fan accurately on a central stud when provided on the driving device; otherwise the bolts extending through the apertures 32 secure the hub to a driving pulley or other device. It is to be understood that the contour of the blades 14 and 25 may be changed from those illustrated, the inner or outer ends of the blade being widened or narrowed, as the case may be, depending upon the location of the fan relative

to the engine block to produce the proper flow of air when discharged thereabout. The rolling of the blades on the arms prevents unnecessary deflection of the blade or localized bending and prevents the fatiguing of the thin spring blade material. In actual test it was found, when employing a fan as herein described, that the flow of air was proportional to the speed up to approximately 1500 r.p.m. and thereafter the flow of air proportionately decreased as the speed increased from 1500 to 2500 r.p.m., after which the flow approaches a constant up to approximately 4000 r.p.m.

The fan of the present invention has many advantages, primarily the increase in efficiency of the vehicle operation due to the decrease in the flow of air resulting from the flattening of the blades. This reduces the noise otherwise present which is further controlled by the different angular spacing of the blades. The provision of arms beneath the curved portion of the flexible blades on which the blades roll into a flat relationship reduces the possibility of fatiguing of the metal of the blade since the degree of deflection of any point of the blade when moving against the arm 13 is completely controlled. The supporting stamping for the blade may be in one or a plurality of pieces and may have the central hub portion offset to position the blades outwardly of a pulley or other driving means. By controlling the resiliency of the spring material of the blade, the degree of flattening thereof at a predetermined speed of rotation may be controlled and a maximum flow of air may be maintained up to a predetermined speed, as is normally desired, while the flow of air may be substantially reduced thereafter by the flattening of the blades, the air flow required being maintained by the movement of the vehicle at an increased speed.

What is claimed is:

1. A screw type multiblade fan having a body portion comprising a central hub from which rigid arms of substantial width extend in a plane disposed substantially normal to the axis of rotation of the fan, and flexible blades secured at the leading edges of the arms, each blade being curved forwardly away from the surface of the portion of the respective arm extending from the leading edge thereof and each blade engaging said surface when flattened thereagainst.

2. A screw type multiblade fan having a body portion comprising a central hub from which rigid arms of substantial width extend in a plane disposed substantially normal to the axis of rotation of the fan, and flexible blades secured at the leading edges of the arms, each blade being curved forwardly away from the surface of the portion of the respective arm extending from the leading edge thereof and each blade engaging said surface when flattened thereagainst, the leading edges of the arms being reversely bent over the forward edges of the blades forwardly of the wider portion thereof.

3. A fan having a body portion comprising a central hub from which rigid arms of substantial width extend, flexible blades secured at the leading edges of the arms, each blade being curved forwardly away from the surface of the portion of the respective arm extending from the leading edge thereof and each blade engaging said surface when flattened thereagainst, the leading edges of the arms being reversely bent over the forward edges of the blades, and rivets securing the forward portions of the blades and arms in fixed relation to each other rearwardly of said reversely bent leading edge.

4. A fan having a body portion comprising a central hub from which arms of substantial width extend, flexible blades secured at the leading edges of the arms, each blade being curved forwardly away from the surface of the portion of the respective arm extending from the leading edge thereof and each blade engaging said surface when flattened thereagainst, the leading edges of the arms being reversely bent over the forward edges of the blades, and rivets securing the forward portions of the

blades and arms in fixed relation to each other, the angular distance between the arms being different for adjacent arms to prevent harmonics from being built up during operation.

5. A fan having a body portion comprising a central hub from which arms of substantial width extend, and flexible blades secured at the leading edges of the arms, each blade being curved forwardly away from the surface of the portion of the respective arm extending from the leading edge thereof and each blade engaging said surface when flattened thereagainst, said blades and arms being helically formed outwardly from the central hub.

6. A fan having a body portion comprising a central hub from which arms of substantial width extend, and flexible blades secured at the leading edges of the arms, each blade being curved forwardly away from the surface of the portion of the respective arm extending from the leading edge thereof and each blade engaging said surface when flattened thereagainst, said blades and arms being helically formed outwardly from the central hub, said hub portion being dish shaped to be offset from the plane of the blades.

7. In a fan, a body portion having a plurality of arms extending outwardly from a central hub portion, with the leading edges of the adjacent arms spaced different angular distances from each other, flexible blades secured to said arms and curved forwardly from the leading edges to be spaced from the surface of the rear portion of said arms against which the blades will progressively engage as they move rearwardly due to an increase of speed of the fan.

8. In a fan, a body portion having a plurality of arms extending outwardly from a central hub portion, with the leading edges of the adjacent arms spaced different angular distances from each other, and flexible blades secured to said arms and curved forwardly from the leading edges to be spaced from the surface of the rear portion of said arms against which the blades will progressively engage as they move rearwardly due to an increase of speed of the fan, said arms and blades being additionally curved from the hub portion outwardly to the end portion thereof.

9. In a fan, a body portion having a plurality of arms extending outwardly from a central hub portion, with the leading edges of the adjacent arms spaced different angular distances from each other, and flexible blades secured to said arms and curved forwardly from the leading edges to be spaced from the surface of the rear portion of said arms against which the blades will progressively engage as they move rearwardly due to an increase of speed of the fan, said arms and blades being additionally curved from the hub portion outwardly to the end portion thereof, the leading edges of the arms being reversely bent over the leading edges of the blades.

10. In a fan, a body portion having a plurality of arms extending outwardly from a central hub portion, with the leading edges of the adjacent arms spaced different angular distances from each other, flexible blades secured to said arms and curved forwardly from the leading edges to be spaced from the surface of the rear portion of said arms against which the blades will progressively engage as they move rearwardly due to an increase of speed of the fan, said arms and blades being additionally curved from the hub portion outwardly to the end portion thereof, the leading edges of the arms being reversely bent over the leading edges of the blades, and ribs disposed in the arms extending into the hub portion.

11. In a fan, a body portion having a plurality of arms extending outwardly from a central hub portion, with the leading edges of the adjacent arms spaced different angular distances from each other, flexible blades secured to said arms and curved forwardly from the leading edges to be spaced from the surface of the rear portion of said arms against which the blades will progressively engage as they move rearwardly due to an increase of speed of

5

the fan, said arms and blades being additionally curved from the hub portion outwardly to the end portion thereof, the leading edges of the arms being reversely bent over the leading edges of the blades, and ribs disposed in the arms extending into the hub portion, the hub portion being dished to have the central supporting portion thereof offset from the plane of the blades.

12. In a fan having a plurality of arms extending radially from a central supporting portion and spaced different angular distances apart, and flexible blades secured to said arms near the forward edges thereof and curved forwardly away from the engaged faces of the arms, said blades progressively flattening against the faces of the arms as the speed of rotation of the fan increases to reduce the developed noise and the flow of air and to permit the controlled flexing of the blades without any substantial fatiguing thereof.

13. In a fan having a plurality of arms extending radially from a central supporting portion and spaced different angular distances apart, and flexible blades

6

secured to said arms near the forward edges thereof and curved forwardly away from the engaged faces of the arms, said blades progressively flattening against the faces of the arms as the speed of rotation of the fan increases to reduce the developed noise and the flow of air and to permit the controlled flexing of the blades without any substantial fatiguing thereof, said arms being twisted adjacent to the central supporting portion to provide a substantially helical form thereto.

References Cited in the file of this patent

UNITED STATES PATENTS

1,427,307	MaKenney	Aug. 29, 1922
1,855,660	Allen	Apr. 26, 1932
1,868,008	Gardner	July 19, 1932
1,983,606	Geise	Dec. 11, 1934
2,032,224	Paton	Feb. 25, 1936
2,149,267	Bouvy	Mar. 7, 1939
2,251,888	Leflar	Aug. 5, 1941
2,442,783	Senn	June 8, 1948