April 25, 1967 K. W. PARSONS ETAL 3,315,749

FAN CONSTRUCTION

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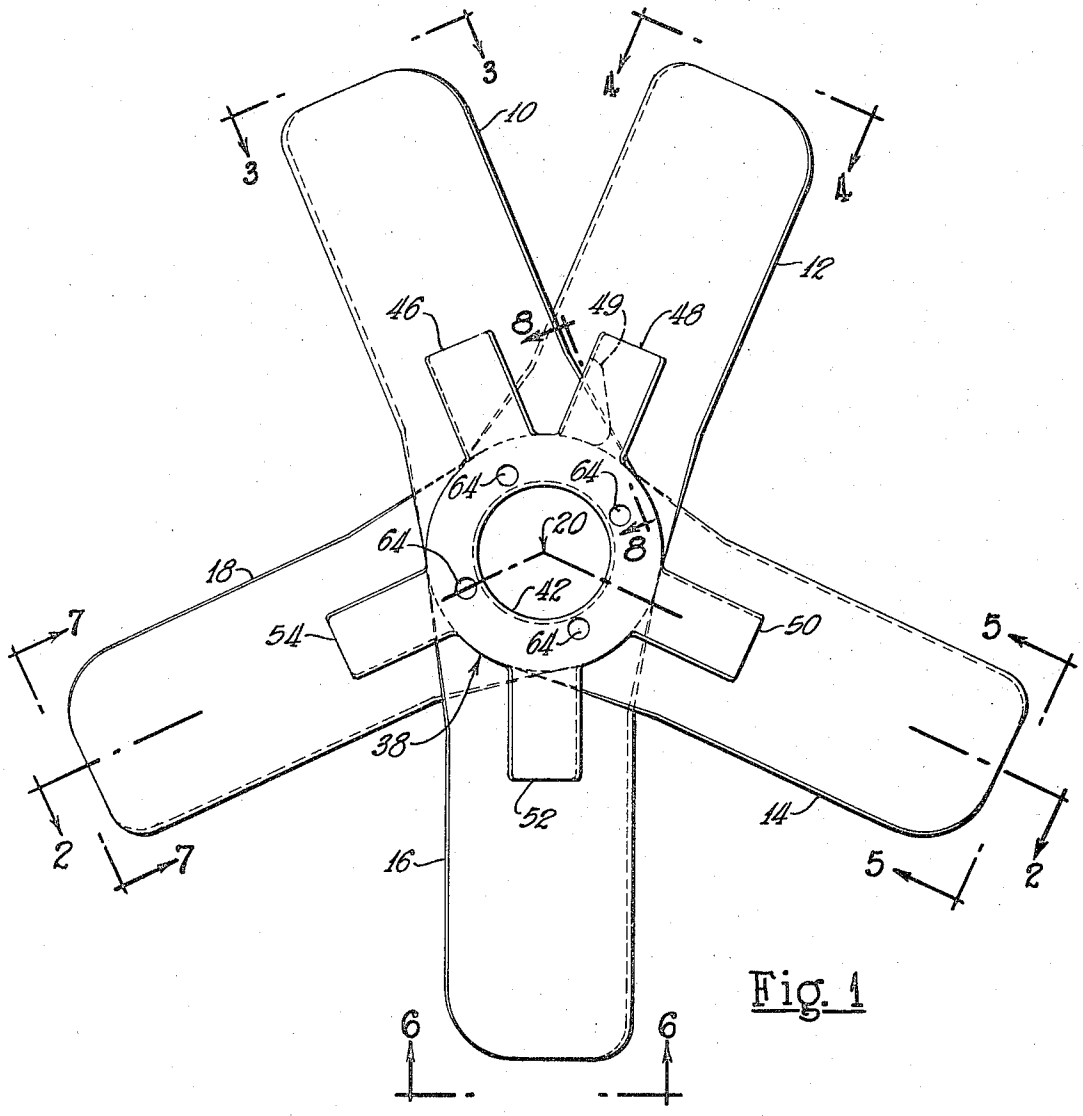


Fig. 1

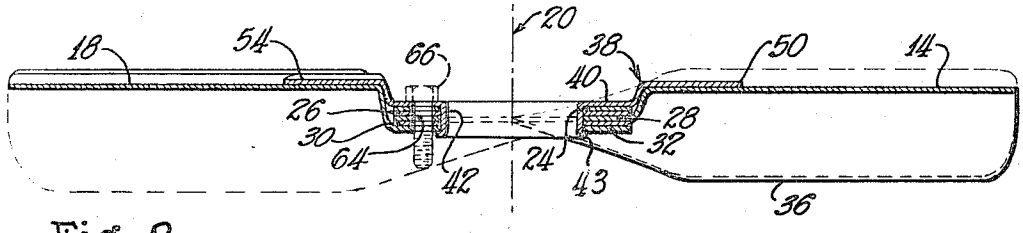


Fig. 2

INVENTORS
KENNETH W. PARSONS &
WILFRED E. WALTON
BY
Harry O. Ernsberger
ATTORNEY

April 25, 1967 K. W. PARSONS ETAL 3,315,749

FAN CONSTRUCTION

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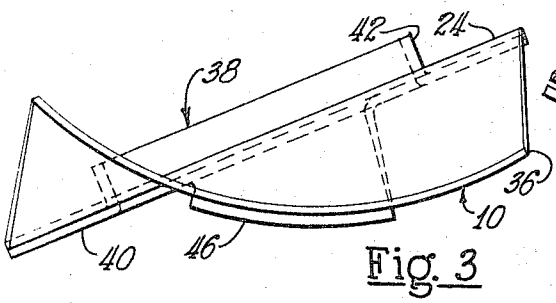


Fig. 3

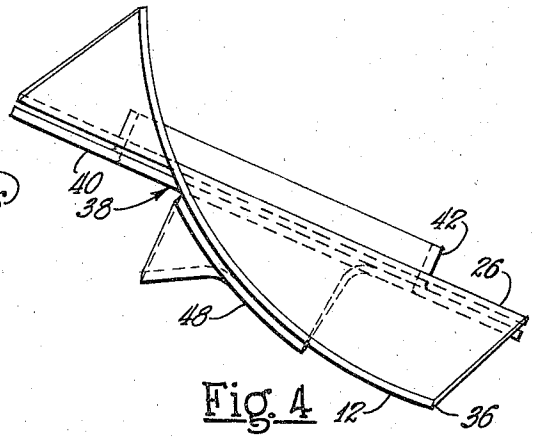


Fig. 4

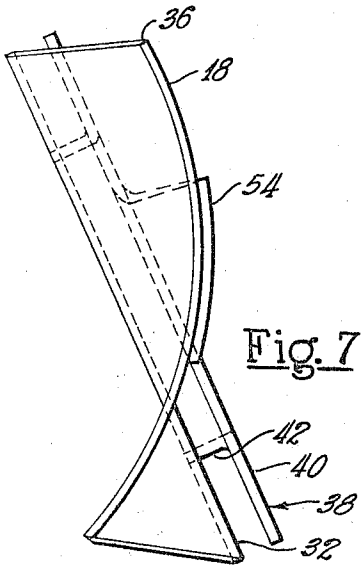


Fig. 7

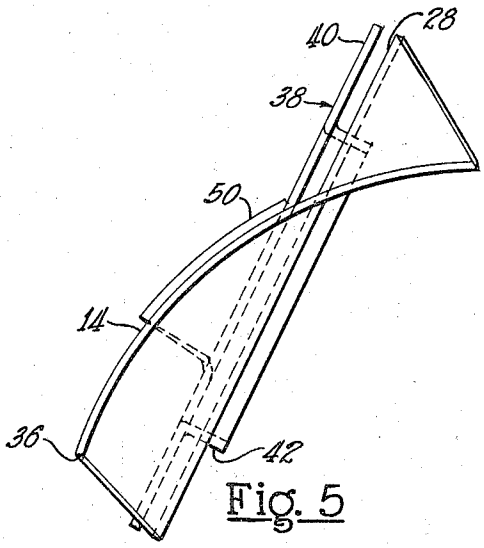


Fig. 5

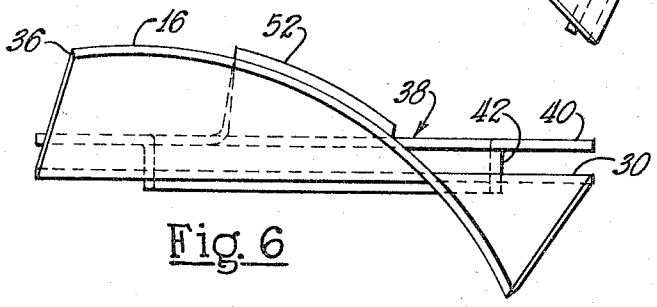


Fig. 6

INVENTORS
KENNETH W. PARSONS &
WILFRED E. WALTON
BY
Harry O. Ernsberger
ATTORNEY

April 25, 1967 K. W. PARSONS ETAL 3,315,749

FAN CONSTRUCTION

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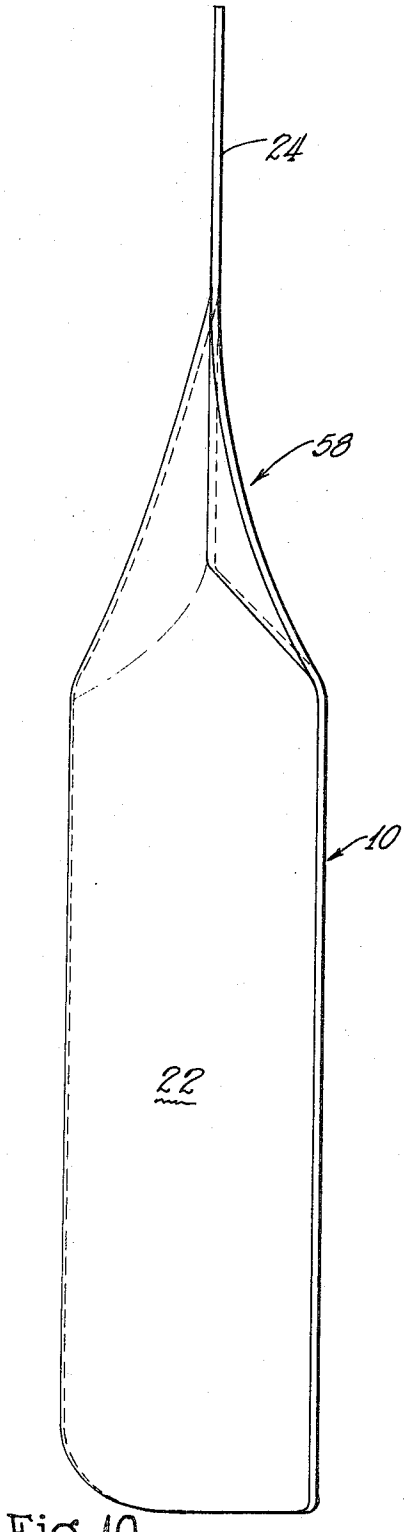


Fig. 10

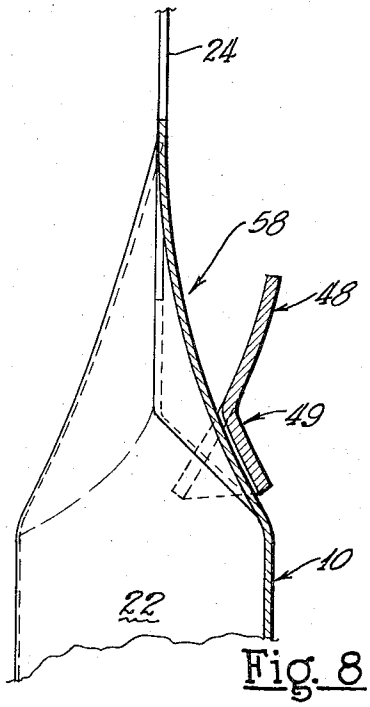


Fig. 8

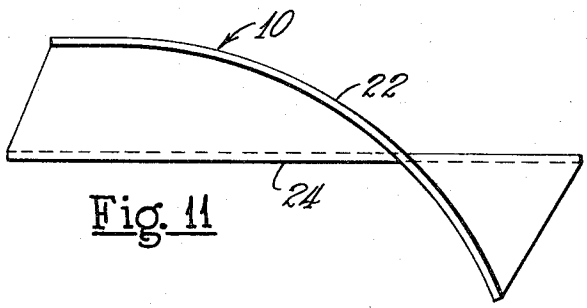


Fig. 11

INVENTORS
KENNETH W. PARSONS &
WILFRED E. WALTON
BY
Harry O. Ernsberger
ATTORNEY

April 25, 1967 K. W. PARSONS ETAL 3,315,749

FAN CONSTRUCTION

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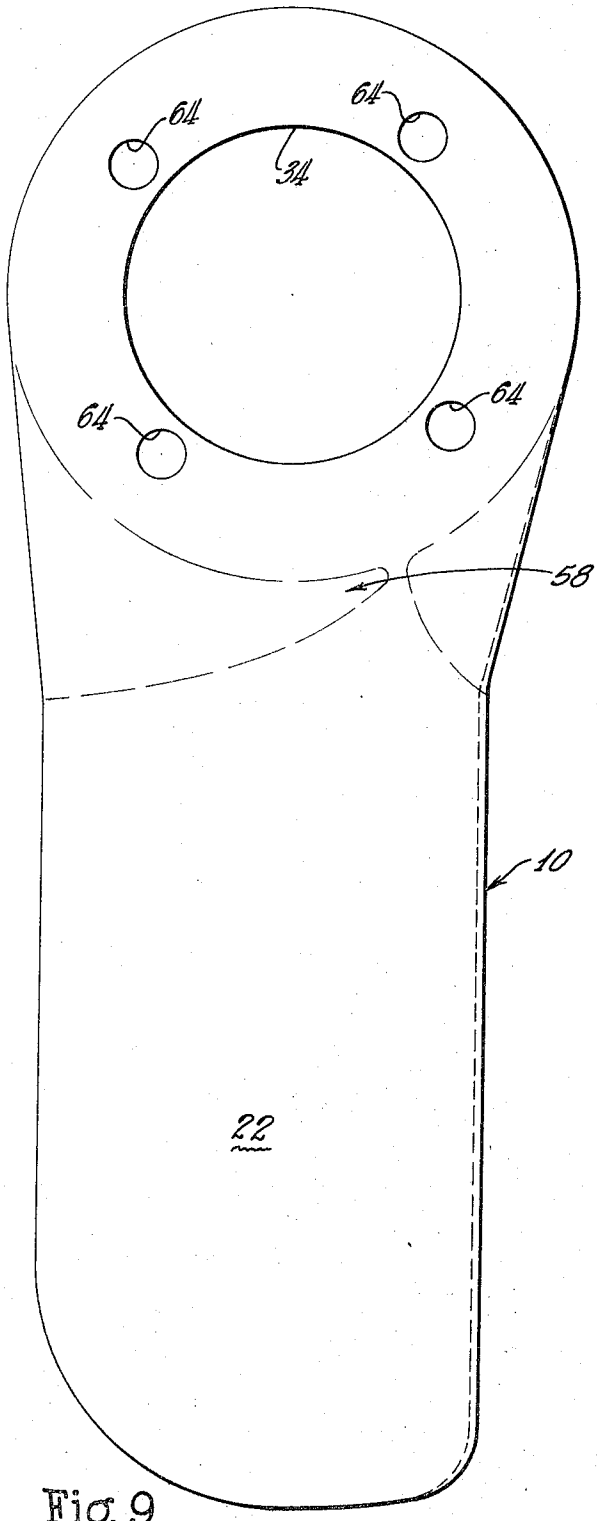


Fig. 9

INVENTORS
KENNETH W. PARSONS
& WILFRED E. WALTON
BY
Harry O. Ernsberger
ATTORNEY

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3,315,749

FAN CONSTRUCTION

Kenneth W. Parsons and Wilfred E. Walton, Toledo, Ohio, assignors to Universal American Corporation, New York, N.Y., a corporation of Delaware

Filed July 1, 1965, Ser. No. 468,721
7 Claims. (Cl. 170—159)

This invention relates to fan construction and method of making same and more particularly to a fan construction built up of components of sheet metal, the fan construction of the invention being particularly usable for establishing air flow through a heat exchanger such as a radiator core of the liquid cooling system of an internal combustion engine.

Various types of cooling fans particularly for establishing air flow through a radiator core of a cooling system for an automobile engine have been used. Fans of this character have been made of cast metal. Fans have been utilized in which a cast metal hub supports sheet metal blades fashioned with reinforcing ridges to lend stability to the blades of the fan. Fan constructions have been devised wherein double bladed members of sheet metal are assembled in crossed relation at an axial region to form a multi-vane fan.

In constructions of the latter character the vanes or blades cannot be arranged in unequally spaced circumferentially arranged relation to reduce sound vibrations which otherwise tend to occur with blades in equally spaced relation.

The present invention embraces a method of producing a multi-bladed fan involving the steps of fashioning a plurality of blades of substantially identical shape and assembling the blades with hub portions in contiguous stacked relation wherein the blades may be unequally spaced circumferentially or equally spaced without modification of the shape or contour of the individual blades.

Another object of the invention resides in a rotatable fan construction comprising a plurality of individual fan blades fashioned of sheet metal, each having an annular hub portion, the hub portions of the blades being assembled with an annular hub member holding the blades in desired relation, the hub member providing reinforcement for each blade to impart stability to the blades.

Another object of the invention resides in a method of forming a rotatable fan construction of individual blades wherein the blades are of identical shape and contour enabling their formation by a single die, and wherein the hub portions are assembled in stacked relation and thereby disposing the blades in axially spaced relation providing for rotation of the blades with the leading edges in spaced parallel planes to obtain improved air moving efficiency.

Another object of the invention resides in a method of producing a multi-blade fan of sheet metal components wherein the sheet metal blades or vanes are of the same contour and are assembled with a sheet metal hub in desired circumferential spaced relation, the blades being formed with hub portions having openings receiving a central flange on the sheet metal hub and the flange expanded with the blades assembled thereon to securely retain the blades in proper relation.

Another object of the invention resides in a method of producing a multi-blade fan construction from sheet metal components wherein the blades or vanes are fashioned of the same contour with annular hub sections in stacked relation and fashioned with aligned openings to receive mounting bolts securing the blades against circumferential dislodgement.

Another object of the invention resides in a rotatable fan construction wherein the components are fashioned of sheet metal such as aluminum, steel or the like and

which are assembled in a manner to provide a low cost fan unit.

Further objects and advantages are within the scope of this invention such as relate to the arrangement, operation and function of the related elements of the structure, to various details of construction and to combinations of parts, elements per se, and to economies of manufacture and numerous other features as will be apparent from a consideration of the specification and drawing of a form of the invention, which may be preferred, in which:

FIGURE 1 is an elevational view of a form of fan construction of the invention;

FIGURE 2 is a sectional view taken substantially on the line 2—2 of FIGURE 1;

FIGURE 3 is an end view of a first blade of the fan assembly, the view being taken on the line 3—3 of FIGURE 1;

FIGURE 4 is an end view of a second blade of the fan assembly, the view being taken on the line 4—4 of FIGURE 1;

FIGURE 5 is an end view of the third blade of the fan assembly, the view being taken on the line 5—5 of FIGURE 1;

FIGURE 6 is an end view of the fourth blade of the fan construction, the view being taken on the line 6—6 of FIGURE 1;

FIGURE 7 is an end view of the fifth blade of the fan assembly, the view being taken on the line 7—7 of FIGURE 1;

FIGURE 8 is a detail sectional view taken substantially on the line 8—8 of FIGURE 1;

FIGURE 9 is a plan view of one of the blades of the fan construction;

FIGURE 10 is a side view of the blade construction shown in FIGURE 9, and

FIGURE 11 is an end view of the blade shown in FIGURE 10.

While the illustrated embodiment of the fan construction made according to the method of the invention is particularly usable for moving air through a heat exchanger of a cooling system for an internal combustion engine, it is to be understood that fan construction made according to the method may be employed as a fluid moving means for other uses.

Referring to the drawings in detail, FIGURES 1 and 2 illustrate the assembly of fan blades and central hub means, the fan construction as shown being inclusive of five blades or air moving vanes identified by numerals **10**, **12**, **14**, **16** and **18**. Each of the blades is fabricated as an individual component as shown in FIGURES 9, 10, and 11, the several blades being assembled so as to extend radially about a common axis **20**, the blades being preferably spaced at unequal distances circumferentially to reduce noise of air movement set up by rotation of the fan.

The air engaging portions **22** of the fan blades are of conventional curvature and each blade fashioned with an annularly shaped hub configuration at an end region. The blades **10**, **12**, **14**, **16** and **18** are respectively fashioned with annular hub portions **24**, **26**, **28**, **30** and **32** as shown in FIGURES 2 through 7. Each annular portion of a blade defines a circular opening **34** and the annular portions are assembled in stacked or nested relation as shown in FIGURE 2.

As shown in FIGURES 2 through 7 the annular hub portions of succeeding blades are in stacked relation in assembly thereby positioning the several blades with the leading edges **36** of the blades in spaced parallel planes normal to the axis **20** of rotation of the fan, the distance between adjacent planes of the leading edges of the blades

being equal to the thickness of the metal of a blade. The annular portions of the fan blades, assembled as shown in FIGURE 2, provide a hub region of the fan assembly. A hub member **38** fashioned of sheet metal is provided for assembly with the annular hub portions of the fan blades in the manner shown in FIGURES 1 and 2.

The hub member **38** is provided with a recessed or dished surface **40** of planar shape which is integrally joined with a projecting circular flange **42** the center being the axis **20**, the exterior surface of the flange **42** being of a dimension to slidably, yet snugly receive the annular portions of the blades as shown in FIGURE 2. After assembly of the blades on the flange **42**, the assembly is disposed in a press and the flange **42** expanded outwardly of its axis to secure and maintain the blades in proper relation. The end of flange **42** is preferably swaged as at **43** during expansion of the flange to prevent axial dislodgment of the blades. The flange **42** of the hub member **38** serves as a support for each of the fan blades.

The hub member **38** is provided with integral projections providing reinforcement for the blades to resist lateral thrust set up by engagement of the rotating blades with the air. The hub member **38** is provided with a projection for each blade, each projection being shaped for contiguous engagement with an adjacent blade to attain the reinforcement desired for the blade. Referring to FIGURES 1 and 3 through 7, the hub member **38** is provided with projections **46**, **48**, **50**, **52** and **54** which respectively engage the blades **10**, **12**, **14**, **16** and **18**.

Each of the fan or air moving portions **22** of the blades is joined with its annular hub portion by a transition region **58**, the transition region of each blade joining the annular portion at the end of the blade with the curved blade portions **22** as shown in the blade **10** in FIGURES 8, 9 and 10.

As shown in FIGURES 3 through 7, each of the reinforcing projections on the hub member **38** is curved and contoured to fit the transition region **58** of the adjacent blade, each of the transition regions being of slightly different shape by reason of the stacking or nesting of the annular hub portions.

FIGURES 3 through 7 also particularly illustrate the relation of each reinforcing projection to its individual blade and the extent of offset of each projection with respect to the planar portion **40** of the hub member **38**. Each of the annular hub portions of the fan blades is provided with a plurality of small openings **64** which are formed in each blade, the particular positioning of the openings **64** in an annular region of a blade being dependent upon the desired circumferential spacing of the blades so that in assembly the openings **64** are aligned as shown in FIGURES 1 and 2.

The openings **64** are adapted to receive mounting bolts **66**, one of which is shown in broken lines in FIGURE 2, for mounting the fan upon a mounting member (not shown) of conventional construction carried by a drive shaft upon which the fan is to be supported for rotation, the securing means serving to positively secure the blades in assembled relation and prevent circumferential shifting of the blades. The blades **10**, **12**, **14**, **16** and **18** and the hub member **38** are fashioned of sheet metal such as aluminum or steel.

The method of forming the several fan blades making up the fan assembly enables all of the fan blades to be stamped, blanked or severed from sheet metal and the openings **34** formed therein at a single stamping operation. As will be seen from FIGURE 1, the blades **10**, **12**, **14**, **16** and **18** are identical in exterior contour including the annular portions of each blade.

The openings **64** are pre-punched in the annular portion of each blade in a particular position relative to the blade whereby the annular portions in contiguous assembly provide for alignment of the openings **64** in the several hub laminations provided by the annular portions of the several blades. The hub member **38** is stamped or severed from a sheet of metal and processed through an offsetting die to contour the reinforcing projections **46**, **48**, **50**, **52** and **54** to the respective positions shown in FIGURES 3 through 7 to provide for contiguous engagement of each projection with a transition region **58** of the adjacent fan blade.

FIGURE 8 illustrates a portion of the blade **10** and the reinforcing projection **48** for the adjacent blade **12**. As shown in FIGURE 1 the blades **10** and **12** are closely spaced. In order to provide adequate reinforcing support for the blade **12**, the projection **48** is contoured as shown at **49** in FIGURES 1 and 8 to provide clearance for the transition region of the blade **10**.

The fan construction of the invention is preferably fashioned of aluminum because of the advantage in weight reduction and the method of assembly of the blades and hub member eliminates welding operations. While in the embodiment illustrated, the hub portions of the blades are nested or stacked so that the leading edges of the blades rotate in spaced parallel planes, the annular hub portions of the blades may be individually offset to an extent to dispose the leading edges of the blades in a common plane.

In the former arrangement, the blades are offset one from another to an extent of the thickness of the metal, the leading edges of the blades being rotatable in adjacent parallel planes. If desired, the several fan blades may be equally spaced circumferentially. While the illustrated embodiment includes five blades, it is to be understood that a greater or lesser number of blades may be utilized in conjunction with a like number of reinforcing projections on the hub member.

It is apparent that, within the scope of the invention, modifications and different arrangements may be made other than as herein disclosed, and the present disclosure is illustrative merely, the invention comprehending all variations thereof.

We claim:

1. A fan construction including, in combination, a plurality of individual blades formed of sheet metal, each of said blades having an opening in an end region thereof defining a generally annular configuration, a hub member having a laterally extending circular flange of a shape to snugly fit into the openings in the blades, the annular regions of the blades defining the openings being in stacked relatio with the blades in radially-extending circumferentially-spaced relation and the circular flange of the hub member extending through the openings in all of the blades, said hub member having integral radially-extending projections equal in number to the number of blades, said projections being aligned respectively with and engaging the blades for reinforcing said blades.

2. A fan construction including, in combination, a plurality of individual blades formed of sheet metal, each of said blades having an annular portion at one end defining an opening, a hub member having a laterally extending circular flange of a dimension to snugly fit into the openings in the blades, the annular portions of said blades being in nested relation with the blades in radially-extending circumferentially-spaced relation whereby the leading edges of the blades are rotatable in spaced parallel planes, the laterally extending flange on the hub member extending through the openings in the annular portions of all of the blades, said hub member having integral projections equal in number to the number of blades and respectively engaging the blades for reinforcing said blades.

3. A fan construction including, in combination, a plurality of individual blades formed of sheet metal, each of said blades having an annular planar hub portion at one end, a hub member of sheet metal having a laterally extending circular flange, the annular hub portions of said blades being in nested relation with the blades in nested relation with the blades in radially-extending circumferentially-spaced relation and the circular flange ex-

tending through the openings in the blades defined by the annular hub portions, said hub member having radially extending integral projections equal in number to the number of blades, said projections being respectively aligned with and engaging the blades for reinforcing said blades.

4. A fan construction including, in combination, a plurality of individual blades, each of said blades being of sheet metal, an end region of each blade being of planar shape and having a first opening therein, a hub member of sheet metal having a laterally projecting circular flange, said blades being arranged with the planar portions in nested relation with the circular flange extending through the first openings in all of the blades, said blades extending radially from the hub member in circumferentially-spaced relation, radially extending projections integral with the hub member, said projections of the hub member being successively displaced axially whereby the projections engage respectively the radially extending portions of the blades for reinforcing said blades, said hub member and each of the planar portions of the blades having a plurality of small openings in aligned relation and adapted to receive means for securing the hub member and blades in asssembled relation.

5. A fan construction including, in combination, a plurality of individual blades formed of sheet metal, each of said blades having an end region of planar shape, a first opening in said end region and a plurality of small openings therein spaced from the first opening, a hub member of sheet metal having a laterally projecting flange of a shape to snugly fit into the first openings in the blades, the planar regions of the blades provided with the openings being in nested relation with the circular flange extending through all of the first openings in the blades, said blades extending radially from the hub member in laterally-offset circumferentially spaced relation, projections integral with the hub member equal in number to the number of blades and engaging the blades for reinforcing said blades, said hub member having a plurality of small openings aligned with the plurality of small openings in the planar end regions of the blades adapted to receive means for securing said blades and hub member in assembled relation.

6. A fan construction including, in combination, a plurality of individual blades of substantially identical shape formed of sheet metal, each of said blades having a curved air moving configuration and an annular hub portion, a hub member of sheet metal having a circular flange, the annular hub portions of the blades being disposed in successive contiguous nested relation with the circular flange of the hub member extending through the openings defining the annular hub portions of the blades, said hub member having integral projections contiguous with portions of the blades and engaging the blades for reinforcing said blades, each of said blades being offset axially from the adjacent blade an amount equal to the thickness of the metal of the annular hub portion.

7. A fan construction comprising five individual blades, each of said blades being of sheet metal having a curved air moving portion and an end region of planar shape provided with a circular opening therein, a hub member of sheet metal having a laterally projecting circular flange, said blades being arranged with the planar portions in nested relation with the circular flange extending through all of the openings in the blades, said blades extending radially from the hub member in nonuniform circumferentially spaced relation, the planar portions of the blades being offset equal distances with respect to the curved air moving portions whereby the leading edges of the air moving portions are rotatable in successive offset parallel planes.

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MARTIN P. SCHWADRON, *Primary Examiner.*

EVERETTE A. POWELL, JR., *Examiner.*