Nov. 28, 1939. F. J. SULLIVAN 2,181,592

BLADED STRUCTURE

Filed Oct. 10, 1938

Fig. 5.

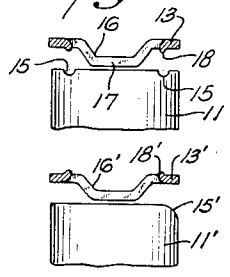


Fig. 6.

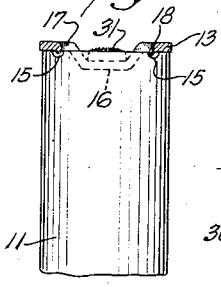


Fig. 7.

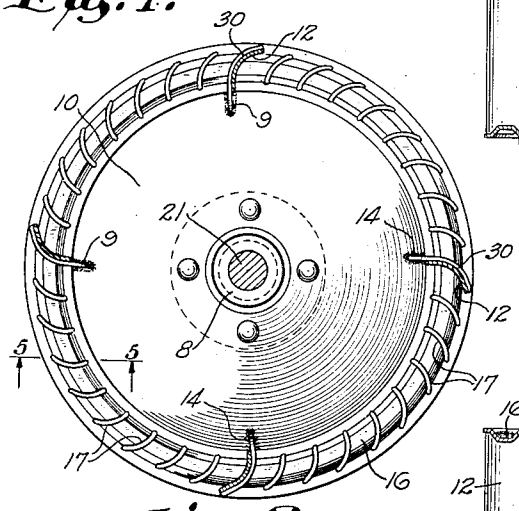


Fig. 2.

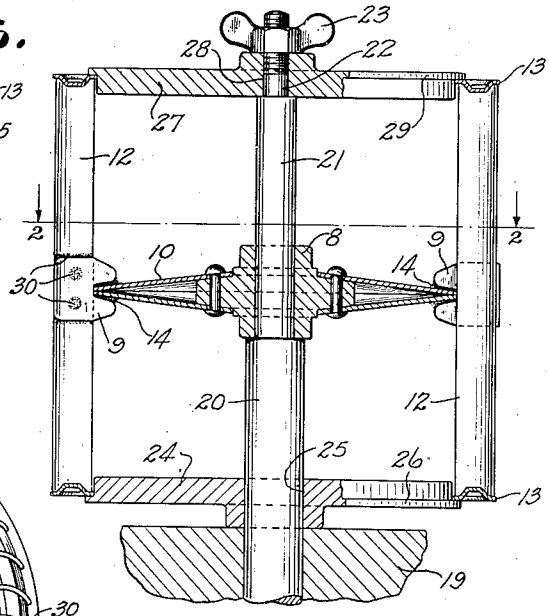


Fig. 1.

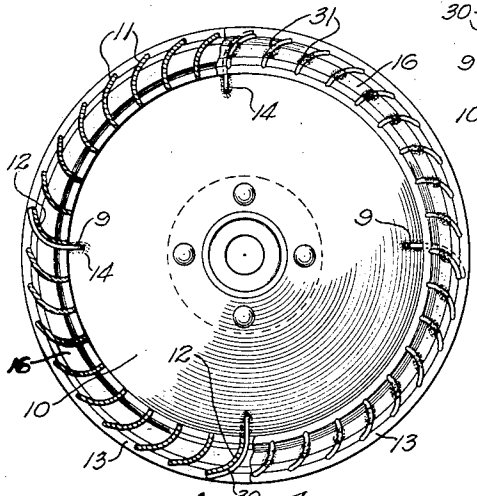


Fig. 4.

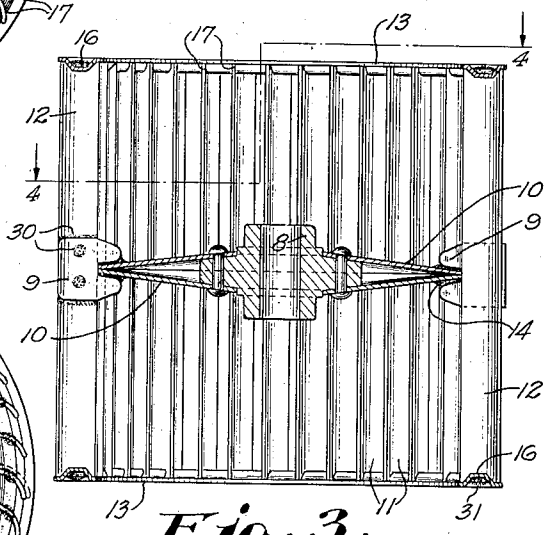


Fig. 3.

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BLADED STRUCTURE

Frank J. Sullivan, Oshkosh, Wis.

Application October 10, 1938, Serial No. 234,141

8 Claims. (Cl. 230—134)

My present invention relates generally to improvements in the manufacture of bladed assemblages, and relates more specifically to an improved bladed structure.

Generally defined, an object of my present invention is to provide a simplified and durable bladed structure which can be readily assembled.

In the manufacture of bladed structures such as fan or blower rotors, wherein a series of elongated substantially parallel blades are disposed in an annulus about the central axis of rotation, it is extremely desirable to be able to conveniently and accurately position the individual blades with respect to each other and to the rotor axis, so that a well balanced rotor assemblage operable at high speed results. In such rotor structures, inlets for air are ordinarily provided at opposite ends of the rotor, and the blades are suspended from a central drive shaft by means of a disk-like support located between the blade ends, these ends being provided with spacer and stiffening rings which also form guides for conducting the air outwardly through the spaces between the successive blades. Since all of the main elements of these rotor assemblages are adapted to be formed of material having substantially uniform thickness, it is desirable to construct these elements of sheet metal with the aid of punches and dies, and to interconnect the same to produce a strong and durable final assemblage, by fusion of metal as by welding.

My present invention therefore contemplates the provision of an improved bladed structure of a character wherein the bladed rotors are fabricated from sheet metal with the aid of punches and dies, the elements thus produced being rapidly and conveniently joined by welding to provide accurately formed and well balanced durable rotor assemblages of like and interchangeable construction.

A further specific object of the invention is the production of a new and useful rotor assemblage which is simple and compact in construction, and which is moreover highly efficient in operation.

An additional specific object of my invention is the provision of a neat appearing well built rotor structure wherein the blades are accurately spaced and firmly confined so as to provide for perfect dynamic balancing.

These and other specific objects and advantages of the present improvement will be apparent from the following detailed description.

The present application is a continuation in part of co-pending application Serial #157,820, filed Aug. 7, 1937.

A clear conception of an embodiment of my improved structure, and of the construction and operation of rotor assemblages embodying the invention, may be had by referring to the drawing accompanying and forming a part of this specification wherein like reference characters designate the same or similar parts in the various views.

Fig. 1 is a part sectional view of the structure and jigs for effecting initial assembly of my improved rotors, showing the central rotor support and several blades and the end rings in position;

Fig. 2 is a transverse section through the manufacturing and rotor assemblages of Fig. 1, taken along the line 2—2;

Fig. 3 is a central vertical section through one of the completed rotor structures built in accordance with my present invention;

Fig. 4 is a part sectional end elevation of the rotor structure of Fig. 3, the view being taken along the line 4—4 looking in the direction of the arrows;

Fig. 5 is an enlarged view of a fragment of one of the blades and a section through the adjacent end ring, showing these elements dismantled;

Fig. 6 is a similarly enlarged similar view of the blade and end ring, showing the same finally assembled and united; and

Fig. 7 is a view similar to Fig. 5 showing a slight modification.

While I have shown and described my invention herein, as being specifically and advantageously applicable to a sheet metal fan or blower rotor assemblage of a particular type, it is not my intention to thereby unnecessarily restrict the scope, since some of the novel steps or features may be more generally applicable to other types of assemblages.

Referring to the drawing, the improved fan rotor which is adapted to be quickly and accurately assembled with jigs such as shown in Figs. 1 and 2, is illustrated fully assembled in Figs. 3 and 4 and comprises in general a central circular support consisting of a hub 8 and a pair of oppositely dished sheet metal disks 10 secured to the hub; an annular series of elongated parallel blades 11 including four anchor blades 12 each having a curved plate 9 secured thereto, this blade series being disposed coaxial with and surrounding the central support; and a pair of slotted end rings 13 rigidly secured to the extreme ends of the blades 11, 12, and being disposed parallel to each other and concentric with the rotor axis.

The central blade supports for the improved bladed rotors may be constructed in any desired

manner, and in an assemblage having extremely long blades there may be several of these supports provided, while in a short bladed structure the lone support may be located at one extreme end of the blades. The hub 8 may be formed either of casting or by stamping, and the disks 10 which are preferably formed of sheet metal and are dished for increased strength, may be either riveted, welded, or otherwise attached to the hub 8. The blade engaging plates 9 are also preferably formed of sheet metal and are curved to fit the contour of the rear surfaces of the adjacent anchor blades 12, and these plates are preferably initially attached to the corresponding anchor blades by welding 30, and are subsequently attached to the periphery of the disks 10 by other welding 14, as shown in Figs. 1 to 4 inclusive. There may be any desired number of these blade engaging plates 9, preferably from three to six, depending upon the diameter of the rotor and the number of anchor blades 12, and the plates 9 are preferably equi-distant around the supporting disk periphery.

The individual blades 11, 12 are all of identical construction except for the attachment of the plates 9 to the blades 12, and these blades may be formed either of extruded metal bar stock, or from strips of sheet metal distorted into proper shape with the aid of punches and dies. The blades 11, 12 are of uniform cross section throughout their lengths, and the opposite ends of each blade extend either straight across in planes perpendicular to the rotor axis, or they may be disposed at flaring angles so as to produce outwardly enlarging passages for conducting the air between the adjacent blades. Each blade end is also provided with notches 15 such as clearly shown in Figs. 5 and 6, for facilitating assembly thereof between the spaced end rings 13.

The two end rings 13 are of identical construction except for the reversal of the blade spacing slots therein, and each of these rings is formed of a single continuous piece of sheet metal distorted to form a lateral annular projection 16, and punched to provide an annular series of blade receiving slots 17 which pierce the projection 16. During the operation of punching these slots 17 in the rings 13, small burrs 18 may be produced at the slot ends on the opposite sides of the projection 16, and the notches 15 in the ends of the blades 11, 12 are provided for the purpose of clearing these burrs 18, as clearly shown in Figs. 5 and 6.

When the various rotor elements have been properly constructed as above described, the successive rotors may be quickly, conveniently and accurately assembled with the aid of jig equipment such as shown in Figs. 1 and 2, and in the following manner. The special equipment comprises a suitable base plate 19 having an upright cylindrical post 20 secured thereto and provided with upper portions 21, 22 of lesser diameter, the latter of which portions is screw-threaded for the reception of a clamping wing nut 23; a lower jig disk 24 adapted to rest upon the base plate 19 and having a central bore rotatably engaging the larger portion of the post 20 and being provided with a peripheral flange 26; and an upper similar jig disk 27 adapted to rest upon the upper end of the medial post portion 21 and having a central bore 28 rotatably engaging the smallest upper post portion 22, the disk 27 being provided with a peripheral flange 29.

When utilizing this jig assemblage to initially assemble a bladed rotor, one of the end rings 13 may be positioned upon the peripheral flange 26 of the lower jig disk 24 which is rotatably mounted centrally upon the post 20 and rests upon the base plate 19. An assembled central support including a hub 8 and disks 10, may then be rotatably mounted centrally upon the post portion 21 above the lower disk 24. The upper jig disk 27 with another end ring 13 coacting therewith, may then be applied centrally to the upper smallest port portion 22 and held in place by the wing nut 23. After the central blade support and the end rings 13 have been thus positioned, the anchor blades 12 with the plates 9 attached thereto, may be slid into position within the alined slots 17 of the spaced rings 13, thereby causing the inner ends of the plates 9 to overlap the adjacent peripheral portions of the disks 10. The clamping nut 23 may then be tightened to clamp the rings 13 against the blade ends, whereupon welds 31 may be applied to the outermost ends of the blades 12 and to the adjacent portions of the rings to firmly unite these elements. The plates 9 may be thereafter firmly attached to the disks 10, by the application of the welds 14, thus firmly and permanently uniting the blades 12, end rings 13, and supporting disks 10.

After the supporting disks 10, blades 12, and rings 13 have been thus initially united, the rotor structure may be completed by sliding the remaining blades 12 inwardly into the alined slots 17 of the end rings 13 until their medial portions engage the periphery of the disks 10, and thereafter finally and permanently securing the ends of the blades 11 to the rings by other welds 31 applied to these elements. During such application of the blades 11, the rotor structure may be revolved about the post 20 and the successive welds 31 may thus be conveniently and quickly applied. This procedure should be continued until all of the blades 11, 12 have been rigidly attached to the end rings 13, whereupon the rotor will be completed, and it is to be noted that the notches 15 at the ends of the blades 11, 12 will greatly facilitate positioning of the blades within the end ring slots 17 without danger of interference by the burrs 18 which may have been formed on the rings 13 during the slot punching operation.

From the foregoing specific description, it will be apparent that my invention provides an extremely simple and highly effective bladed rotor structure. The formation of the rotor parts including the disks 10, plates 9, blades 11, 12, and end rings 13 of sheet metal with the aid of punches and dies, obviously enables the production of these parts at minimum cost, and also provides for interchangeability of like parts. While the initial attachment of the plates 9 to the anchor blades 12 greatly facilitates preliminary assemblage of the structures, these plates 9 may also be initially attached to the disks 10 and subsequently secured to the anchor blades 12. The rotatable mounting for effecting assemblage of these rotors is quite important and desirable when the ends of the blades 11, 12 are secured to the rings 13 by welding, since this rotation of the assemblage permits the welder to readily proceed from one blade to the next during the application of the welds 31, without changing his position around the rotor axis. The final assemblage is obviously extremely durable in construction and is also well balanced by virtue of the symmetrical disposition of the plates 9, blades 11, 12, and rings 13 about the central axis of the driving hub 8. By notching the ends

of the blades 11, 12, the end rings 13 may be brought snugly against the blade ends prior to application of the welds 31, and during application of these welds, it has been found that the rings 13 are drawn into snug engagement with the blade ends as the welds cool. The provision of the notches 15 also avoids necessity of grinding the burrs 18 from the rings 13 prior to final assemblage of the rotor structures, and my present invention has proven highly successful in actual commercial production of rotors of this general type.

In the modification of Fig. 7 the slots in the end rings 13' are punched from the blade side outwardly instead of toward the blade side as in Fig. 5. As a result the burrs 18' are formed on the outer side of end rings. In this modification in order to facilitate assembly the inner corners of the blade at both ends are rounded as at 15'. Thus when the blades are inserted into the slots 17' the corners will not catch on the ends of the slots.

It should be understood that it is not desired to limit this invention to the precise details of construction herein shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

I claim:

1. A centrifugal blower wheel comprising a pair of end rings having annular ribs formed on one face of each ring, each of said rings being provided with slots extending only through said ribs, blades seated in said slots with their ends against the inner sides of said rings and suitably secured thereto.

2. A centrifugal blower wheel comprising a pair of end rings having annular ribs formed on one face of each ring, each of said rings being provided with slots extending only through said ribs and spaced apart angularly thereon, blades seated in said slots with their ends against the inner sides of said rings, means intermediate the length of some of said blades forming radially extending notches, and a pair of center disks in contact with each other and having their outer edges seated in said notches.

3. A centrifugal blower wheel including a pair of end rings each having a member projecting from one face thereof, each of said members being provided with a slot extending only to the face of the ring upon which it is formed, a blade having its opposite ends seated in said slots and against the opposing faces of said rings and suitably secured thereto.

4. A bladed structure comprising, a pair of spaced end rings having slotted annular projections facing each other, a support disposed between said rings, and a series of blades having their opposite ends secured within alined slots of said rings, some of said blades having backing plates permanently attached to said support.

5. A bladed structure comprising, a pair of laterally spaced end rings each having an annular rib with a series of slots therein, a support disposed between said rings, several anchor blades having their ends secured within alined slots of said rings and having their medial portions secured to said support, and other blades disposed around the periphery of said support and having their ends secured within other alined slots of said rings.

6. A bladed structure comprising, a pair of laterally spaced, ribbed end rings, the ribs of said end rings being serially slotted, a support disposed between said rings, several anchor blades secured within alined slots of said rings and having backing plates secured thereto and to said support, and other blades secured only within other alined slots of said rings, said end rings being parallel to each other and all of said blades being parallel to each other and perpendicular to said end rings.

7. A bladed rotor comprising, an annular series of parallel blades having notched ends, end rings having laterial projections slotted to fit said blade ends, there being protuberances at the ends of the slots which engage in the notches in said blade ends, and means for rotatably supporting said blades and rings.

8. A bladed rotor comprising an annular series of parallel blades having rounded inner edge corners, spaced end rings having lateral projections formed with slots into which the blades may be inserted by movement longitudinally of said slots, the rounded corners of said blades permitting said insertion without interference from the ends of the slots in the end rings, and means for rotatably supporting said blades and rings.

FRANK J. SULLIVAN.