United States Patent [19]

Shaver

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[54] **BLOWER WHEEL CONSTRUCTION**

[75] Inventor: **J. Lyle Shaver,** Blue Springs, Mo.

[73] Assignee: **Allis-Chalmers Corporation,** Milwaukee, Wis.

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[52] **U.S. Cl.** **416/178,** 416/187

[51] **Int. Cl.** **F03b 3/12,** F01d 5/30, F01d 5/32

[58] **Field of Search** ..... 416/178, 184, 186, 187, 416/199; 29/156.8 CF

[56] **References Cited**

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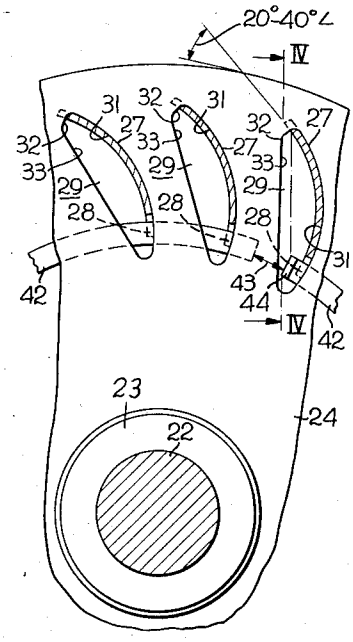
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Primary Examiner—Everette A. Powell, Jr.
Assistant Examiner—Louis L. Casaregola
Attorney, Agent, or Firm—Kenneth C. McKivett

[57] **ABSTRACT**

This invention relates to the attachment of blower wheel blades to support discs with interlocking notches secured by the wedging action of an internal spring retaining ring acting between the disc and the sloping surface of an inner notch in the blades.

9 Claims, 9 Drawing Figures



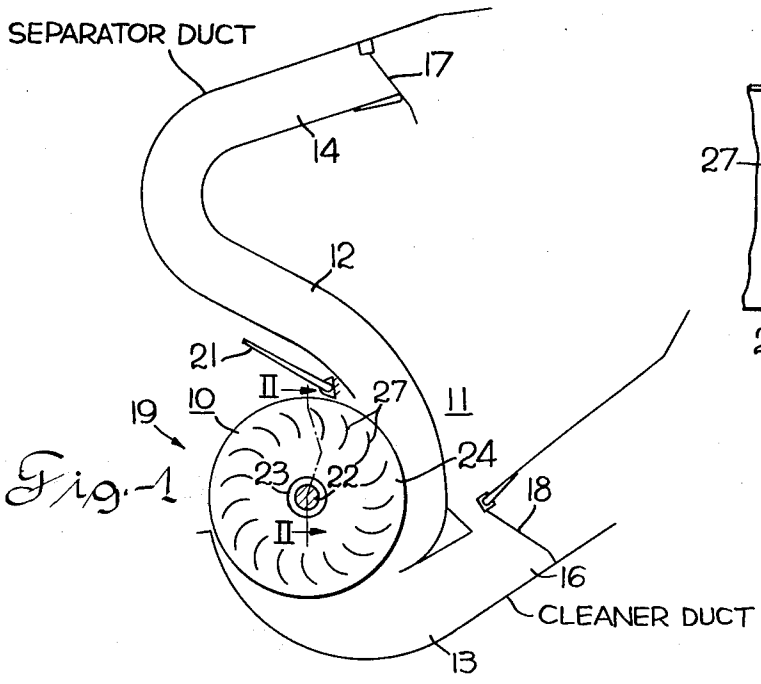


Fig. 1

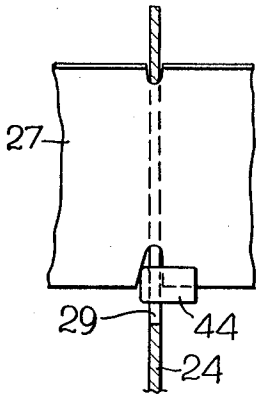


Fig. 4

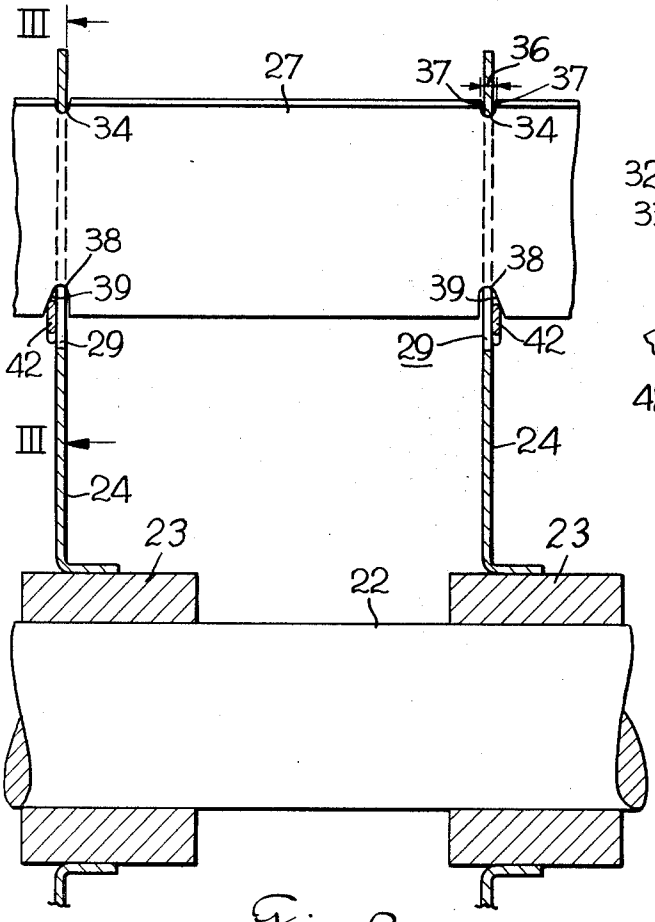


Fig. 2

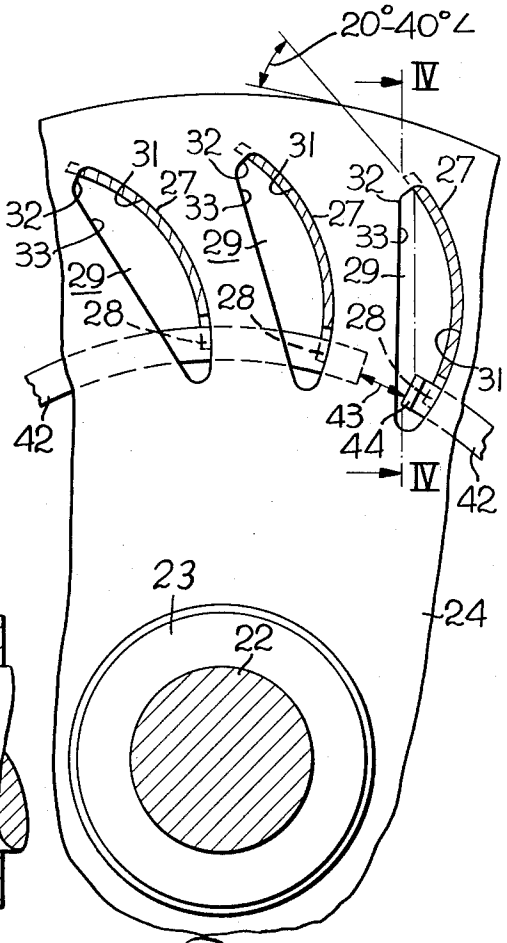


Fig. 3

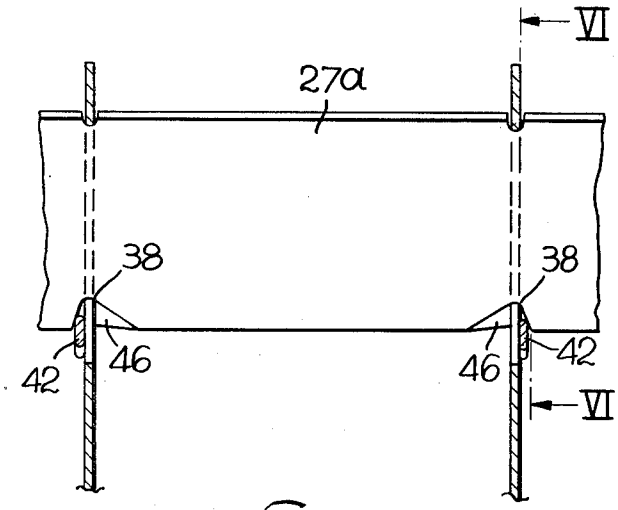


Fig. 5

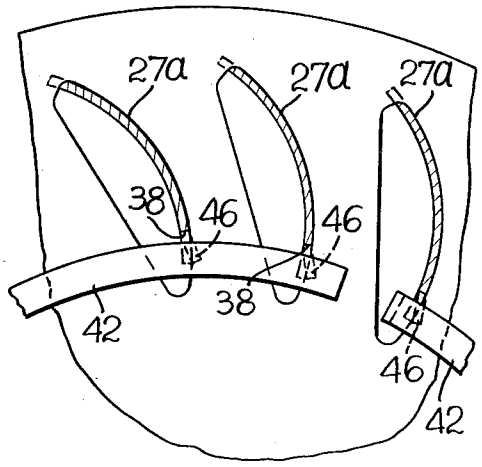


Fig. 6

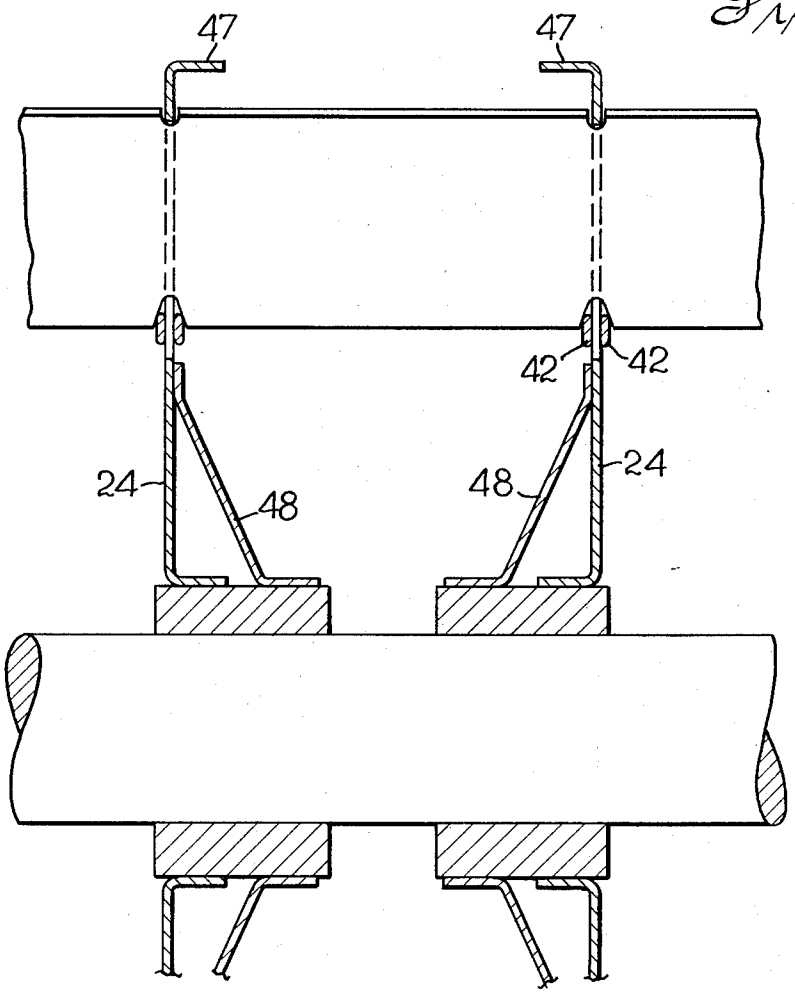


Fig. 7

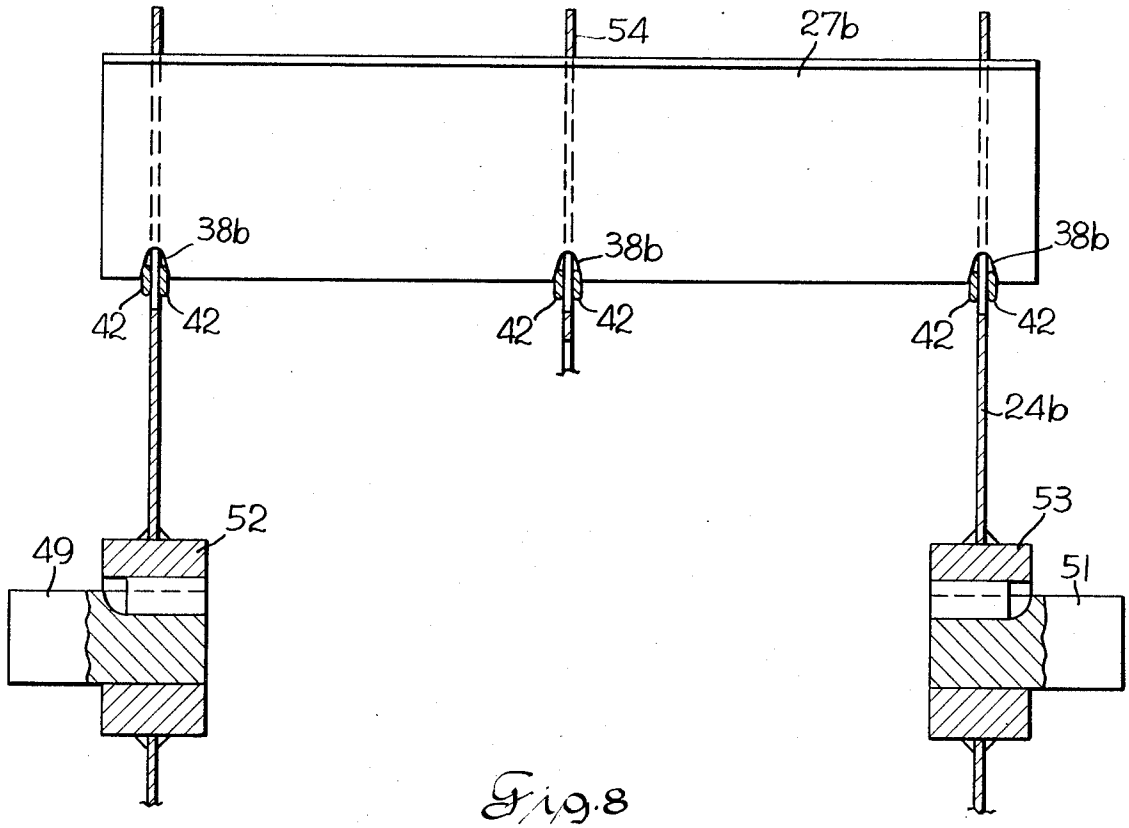

54
27b
38b
38b
38b
42
42
42
42
42
42
24b
52
53
49
51

Fig. 8

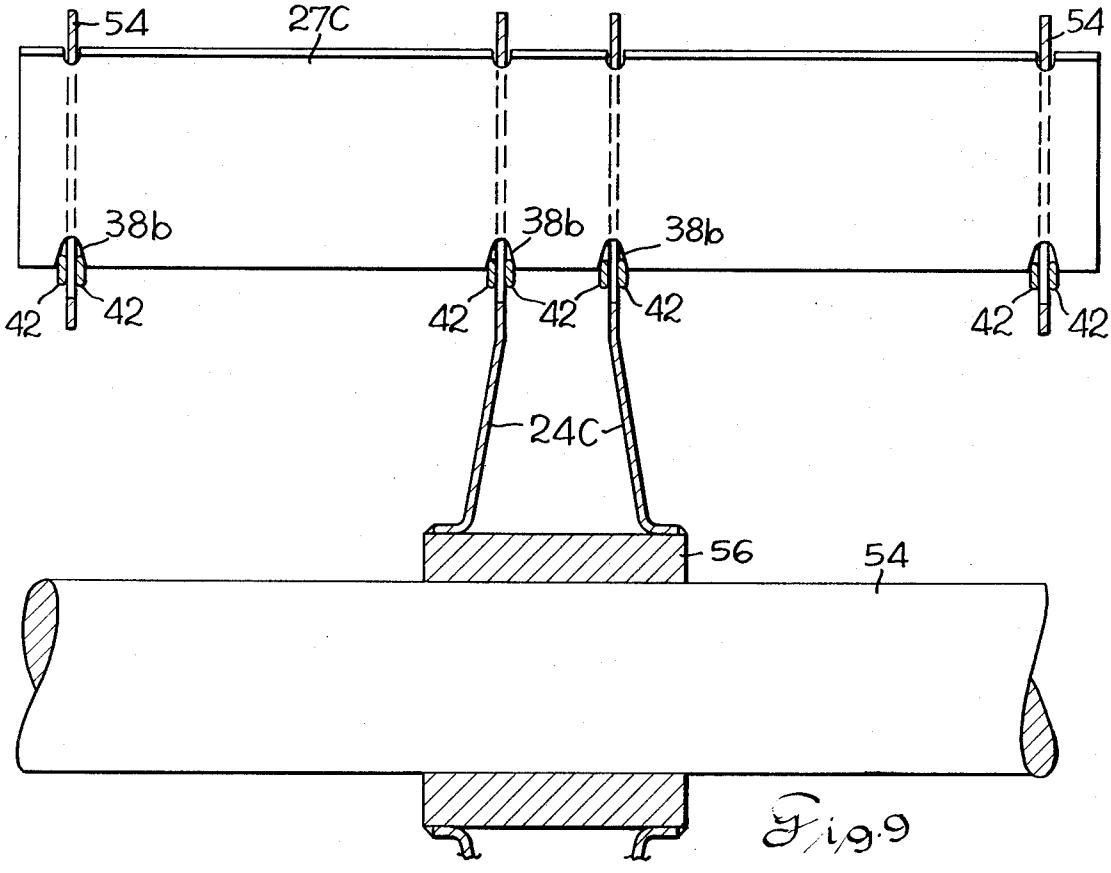

54
27C
54
38b
38b
38b
42
42
42
42
42
42
42
42
24C
56
54

Fig. 9

BLOWER WHEEL CONSTRUCTION

This invention is concerned with providing a blower wheel structure which is simple and rigid in construction, easy to assemble, requires a minimum amount of tooling and can be built in any desired length at a minimum cost.

In the past, blades in blowers, have been attached to support discs by numerous methods including riveting, welding, and deforming either the discs or the blades to lock them together. Riveting requires considerable assembly time and is difficult to automate. Welding often causes warping. Various methods of deforming the discs or the blades is often complicated and requires considerable investment in tooling and past methods required that intermediate discs and end discs be attached in a different manner.

In the present invention, all blades are attached to support discs in an identical manner. There is no welding or riveting. Only one fastening device is required at each support disc to attach all blades. Assembly of blades requires a minimum of time and only simple tools are required. Use of centrifugal force is made to retain the blades in position by pulling them tightly against the outer end of a closed slot in support discs and centrifugal force also aids the expansion and wedging action of an internal retaining ring against the inner end of the blade.

An object of this invention is to provide a transverse fan requiring a minimum number of different parts.

A further object of this invention is to provide a trasnsverse fan wherein individual blades thereof may be readily replaced in the field in case of damage.

A further object of this invention is to provide a transverse fan which is readily balanced.

Other features and advantages will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification, wherein:

FIG. **1** is a side elevation of a blower in a combine harvester with parts of the combine removed for clarity of illustration;

FIG. **2** is a longitudinal partial section taken through two adjacent support discs on line II—II of FIG. **1**;

FIG. **3** is a partial section view taken along line III—III of FIG. **2**;

FIG. **4** is a partial section view taken along line IV—IV of FIG. **3**;

FIG. **5** is a partial section view similar to FIG. **2** illustrating an alternate type of construction;

FIG. **6** is a partial section view taken along line VI—VI of FIG. **5**;

FIG. **7** is an illustration similar to FIG. **2** showing an alternative construction;

FIG. **8** is an illustration similar to FIG. **2** showing an alternative construction using a pair of stub shafts in place of a single shaft; and

FIG. **9** is an illustration similar to FIG. **2** showing an alternative construction adapted for use as a centrifugual fan.

Referring to FIG. **1** of the drawings, a blower rotor **10** for a transverse flow fan combination **11** positioned for operation in a combine harvester is shown. This fan is provided with dual outlets **12** and **13** providing a supply of air to the separator and cleaner ducts **14** and **16**, respectively, of the harvester. Ducts **14** and **16** are provided with dampers **17** and **18**, respectively, for regulating the flow of air through such ducts. This fan is also provided with an air receiving opening **19** extending the entire length of the fan. An adjustable vane **21** is mounted on the harvester and can be adjusted to control the volume of air entering opening **19**.

Fan **11** includes a central shaft **22** which is driven by power means (not shown) on the harvester. Hub members **23** may be attached to shaft **22** by various means such as set screws, keys, roll pins or bonding (locktite).

Discs **24** are attached to hub members **23** as be welding flanges of the discs **24** to hubs **23**.

Rotor **10** includes a plurality of circumferentially disposed blades **27**. Normally the blades **27** are curved with the projection of the leading or outer edge thereof making an angle of attack of 20° to 40° with a tangent to the wheel circumference as shown in FIG. **3**, and the inner blade surface **28** extends approximately radially from the longitudinal center line of shaft **22**.

Since the length of a transverse fan is functionally unlimited, several intermediate support discs **24** may be required to support and counteract centrifugal force acting on blades **27**.

Details of the rotor **10** are shown in FIGS. **2** and **3** and referring to such FIGS., the support discs **24** have a plurality of closed slots **29** equally spaced and positioned near the periphery of the disc. The shape of these slots **29** includes a curved surface **31** conforming to the blade shape to provide support and an outer surface **32** to intercept the outer ends of blades **27** to prevent outward radial movement thereof. The remaining slot surfaces **33** are shaped for convenience of manufacture and also to permit free passage when blades **27** are being inserted endwise into slots **29** for easy assembly.

After the blades **27** are slipped through slots **29**, it is seen that each blade is provided with a series of outer notches **34** (see FIG. **2**) corresponding with the number of support discs **24** being used and these outer notches **24** are transversely aligned with the support discs **24**. These relatively shallow notches **34** have an outer width **36** slightly greater than the disc thickness to allow interlocking. The sides **37** of these notches may also be tapered to provide a wedging action when forced over the disc. In radial alignment with notch **34** is an inner notch **38** provided with a sloping surface **39** to provide a radial outward force to insure interlocking of notches **34** with discs **14**.

To lock blades **27** to the discs **24**, a spring retaining ring **42** is compressed and installed in notches **38** adjacent to discs **24**. The retaining rings **42** are installed on opposite sides of adjacent discs **24** to counteract the axial force exerted on the blade by the wedging action of the rings acting on sloping surfaces **39**. During the operation of blower **10**, centrifugal force pulls the blades **27** into tight contact with discs **24** at the outer notches **34** and also causes the retaining rings **42** to expand tighter into the inner notches **38** thus affecting a relatively rigid connection between blades **27** and discs **24**.

To prevent rotation of retaining rings **42** relative to discs **24** and blades **27** and to compensate for the imbalance caused by gap **43** in the rngs **42**, a tab **44** (FIG. **3**) may be formed on one end of the rings **42**. The length of tab **44** is approximately equal to the width of gap **43**. When installed tabs **44** (FIG. **4**) protrude through slots **29** in discs **24** thus preventing rotation of

the ring and compensating for the aforementioned imbalance. Adjacent rings **42** may also be installed with their gaps on opposite sides of their discs to maintain balance. FIGS. **5** and **6** illustrate an alternate construction. The axial force exerted on blades **27***a* by the retaining rings **42** is counteracted by a tab **46** formed in the blade adjacent to notch **38.** When blade **27***a* is in proper position, this tab **46** locks against the opposite side of discs **24** forming a rigid attachment in cooperation with the retaining ring **42.**

FIG. **7** shows another alternative design of more rigid construction. In this design, a second retaining ring **42** is used on the opposite side of the support discs **24.** This combination increases the rigidity of the blade-disc joint. Also a flange **47** is added to the outer periphery of disc **24** and a conical stiffener **48** is spot welded between the disc and hub for additional strength. Although a transverse flow rotor is illustrated in the drawings, the shown construction is also applicable to centrifugal blowers. By removing a central portion of one or more of the end discs, air inlets would be provided.

Although the embodiments of this invention so far have been shown as having an inner and outer blade notch which provides maximum rigidity of blade to disc connection, either notch alone is sufficient to interlock the blade with the disc. By using an appropriate fixture during assembly to axially locate the blades, the retaining rings **42** can be installed in the inner notches to locate and secure the blades to the discs. Thus, the necessity for the outer notch is eliminated as is shown in FIG. **8.**

In FIG. **8** a modified embodiment of this invention is shown. In place of having discs **24***b* attached to a central shaft, two stub shafts **49** and **51** are provided which are keyed to hubs **52** and **53,** respectively, for rotation therewith. Discs **24***b* are attached to hubs **52** and **53** as by welding. A central disc **54** is provided which is entirely supported from blades **27**b for stiffening same. This type of construction, using stub shafts, is entirely satisfactory for short rotor assemblies. In fact, if a single central shaft is not required structurely, its elimination from the center of the rotor improves fan efficiency. Where structural considerations permit, the rotor can be driven and supported by attaching means (e.g. gudgeons) to the outer discs only. Retaining rings **42** positioning in notches **38***b* retain the blades **27***b* positioned on discs **24***b.*

FIG. **9** shows a modified construction which adapts this invention for use in a centrifugal fan. In this embodiment the blades **27***c* are mounted on a pair of closely spaced discs **24***c* which are attached to a central shaft through the medium of an intervening hub **56.**

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A fan rotor comprising a pair of discs longitudinally spaced apart and attached to rotatable means;

a plurality of arcuate blades supported on said discs longitudinally parallel to the axis of rotation of said rotor;

said discs being provided with a plurality of closed slots therein with each slot having an arcuate surface complementary to said blades;

said slots being of a size permitting said blades to be inserted endwise therethrough;

said blades being provided with notches spaced apart longitudinally the same as the spacing between the discs so that when said blades are slid longitudinally through said slots registry is obtained between said notches and said discs;

and radially outward acting spring means positioned adjacent said discs and contacting radially inner portions of said blades for biasing same radially outward interlocking said blades with said discs.

2. A fan rotor as recited in claim **1** and wherein said notches are provided in the outer portion of said blades.

3. A fan rotor as recited in claim **1** wherein said notches are provided in the inner portion of said blades.

4. A fan rotor as recited in claim **2** and wherein said blades are provided with inner notches in radial alignment with said outer notches, and said spring means being received in said inner notches for biasing said blades radially outward against a surface of said disc extending generally parallel the periphery of said disc.

5. A fan rotor as recited in claim **4** and wherein said spring means comprises ring shaped springs positioned on each side of each disc and in contact therewith and positioned in said inner notches.

6. A fan rotor as recited in claim **5** and wherein said spring means includes a ring shaped spring having an opening therein, an offset portion extending at right angles thereto and into one of said slots so that said offset portion prevents rotation of said spring means relative to said disc, said offset portion being of size to counterbalance said spring means relative to said opening therein.

7. A fan rotor as recited in claim **6** and wherein said notches are tapered to provide a locking engagement between said blades and said discs.

8. A fan rotor as recited in claim **7** and wherein the distal ends of said discs are turned over at right angles thereto for stiffening said rotor.

9. A fan motor as recited in claim **3** wherein said spring means is received in said notches in the inner portion of said blades whereby said spring means biases said blades radially outward against the outer ends of said slots and locks said blades against movement in at least one axial direction relative to said discs.

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