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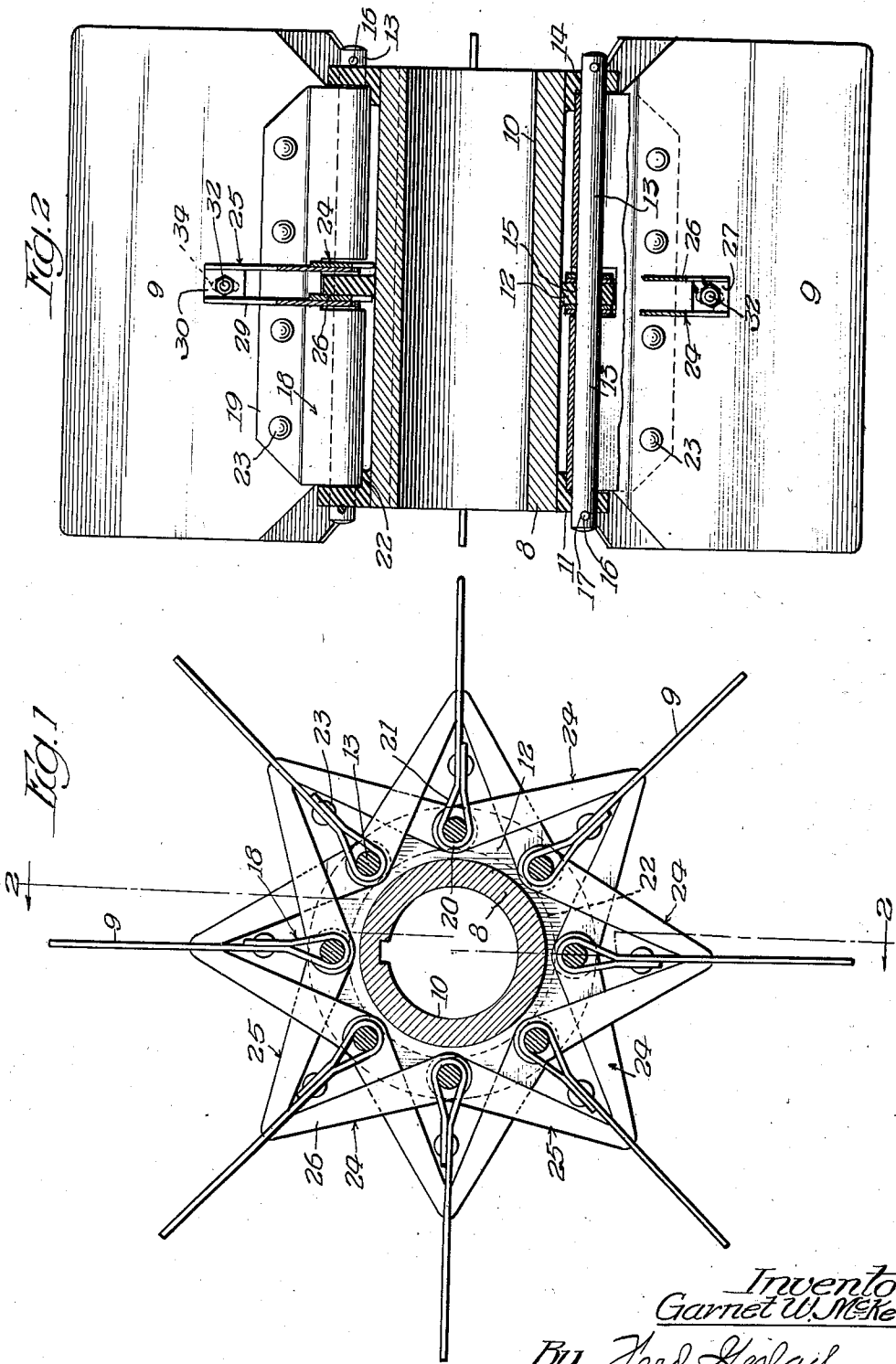
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CENTRIFUGAL BLOWER ROTOR

Filed Oct. 20, 1937

2 Sheets-Sheet 1



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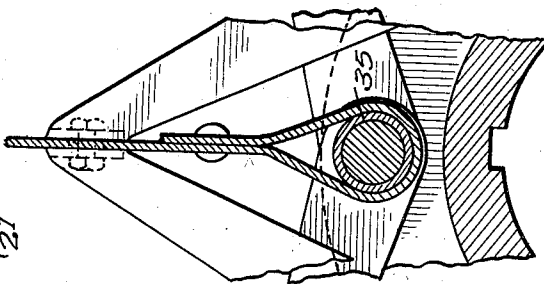
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2 Sheets-Sheet 2



## UNITED STATES PATENT OFFICE

2,130,145

## CENTRIFUGAL BLOWER ROTOR

Garnet W. McKee, Rockford, Ill.

Application October 20, 1937, Serial No. 169,970

15 Claims. (Cl. 230—134)

The present invention relates generally to blade-equipped rotors for centrifugal blowers. More particularly the invention relates to that type of centrifugal blower rotor which is adapted for high speed drive and to draw gas or air at either normal or high temperature through the inlet opening in the side of the casing of the blower and to discharge the gas or air under pressure from the casing via the peripheral outlet thereof and comprises a hub with a shaft opening therethrough and an annular series or set of separately formed stamped plate metal blades which are anchored to and project radially from the hub.

One object of the invention is to provide a centrifugal blower rotor of this type which not only is a material improvement upon previously designed rotors of the same general character but also is more lasting and durable by reason of the fact that the blades thereof are so designed and anchored that regardless of the speed of drive or the temperature of the gas or air to be impelled, they remain at all times in substantially perfect balanced and radial relation with the hub and hence do not set up strains or stresses tending to unbalance the rotor as a whole and cause vibration with resultant crystallization and damage of parts.

Another object of the invention is to provide a blower rotor of the aforementioned type in which the hub embodies outwardly extending annular members at its ends and has therearound an annular series of longitudinally extending pins with the ends thereof fitting in aligned holes in the annular members and the stamped plate metal blades have the inner ends thereof doubled back upon themselves to form eyes which fit around and are anchored to the pins and comprise semi-cylindrical inner end parts and flat or straight outwardly convergent side parts between the semi-cylindrical inner end parts and the contiguous or adjoining portions of the blades.

Another object of the invention is to provide a centrifugal blower rotor of the last mentioned character which includes simple and novel means for holding the semi-cylindrical inner end parts of the eyes at the inner ends of the blades in concentric relation with the inner portions of the pins and thus preventing transverse displacement of the eyes with respect to the pins.

A further object of the invention is to provide a blower rotor of the type and character under consideration in which the blades are held or braced against tilting by means of front and rear outwardly convergent arms which have the inner

ends thereof mounted on and connected to the pins and are bolted at their outer or distal ends to the central portions of the blades.

A still further object of the invention is to provide a centrifugal blower rotor which is generally of new and improved design and may be manufactured in a simple manner and at an extremely low cost.

Other objects of the invention and the various advantages and characteristics of the present blower rotor will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a transverse sectional view of a centrifugal blower rotor embodying one form of the invention;

Figure 2 is a longitudinal sectional view taken on the line 2—2 of Figure 1 and illustrating in detail the arrangement and design of the blades and the manner in which they are mounted on the cross-pins of the hub and are braced by the front and rear outwardly convergent arms against tilting;

Figure 3 is a detail sectional view showing the manner in which the outer or distal ends of the front and rear arms are bolted to the central portions of the blades;

Figure 4 is a perspective of one of the blades; and  
Figure 5 is a perspective of one of the arms;

Figures 6 and 7 are fragmentary transverse and longitudinal sectional views respectively, of a modified form of rotor wherein the eyes at the inner ends of the blades have sleeves welded therein for engaging the pins and holding the eyes against lateral displacement with respect to the pins.

The rotor which is shown in Figures 1 to 5, inclusive, constitutes the preferred embodiment of the invention. It is designed in conjunction with a conventional casing (not shown) having an inlet opening in the side thereof and a peripheral outlet to form a centrifugal blower and is adapted to be driven at a comparatively high speed and to draw gas or air at either normal or high temperature inwardly through the inlet opening in the side of the casing and to discharge the gas or air under pressure via the pe-

ripheral outlet. As the main parts thereof the rotor comprises a hub 8 and an annular series or set of separately formed blades 9.

The hub 8 is formed of any suitable metal or alloy material. It is cylindrical, as shown in Figure 2, of the drawings, and has a centrally disposed longitudinally extending opening 10 therethrough. This opening is adapted to receive a drive shaft (not shown) and is machined or formed so that it is truly concentric with respect to the outer periphery of the hub. The hub is adapted to be keyed or otherwise fixedly secured to the drive shaft and embodies a pair of outwardly extending annular members 11 at its ends. In addition to the members 11 the hub embodies a centrally disposed outwardly extending annular member 12 and an annular series of longitudinally extending pins 13. The members 11 are preferably in the form of separately formed metallic rings which are shrunk upon and hence fixedly connected to the ends of the hub. They are arranged so that the outer faces thereof are flush with the end faces of the hub 8 and are each provided with an annular series or set of circular holes 14. As shown in the drawings the holes 14 in one outwardly extending annular member 11 are the same in diameter as, and are longitudinally aligned with, the holes in the other member. The annular member 12 is disposed equidistantly between the members 11 and has an annular series of circular holes 15 in alignment with the holes 14 in the members at the ends of the hub. It is preferably in the form of a separately formed metallic ring, has the same internal and external diameters as the member 11, and is shrunk around the central portion of the hub 8 so that it is fixedly connected to the latter. The pins 13 are formed of steel or any other suitable metal and are slightly longer than the hub 8, as shown in Figure 2. They are externally positioned with respect to the hub and are spaced equidistantly apart. The central portions of the pins extend through and fit snugly in the circular holes 15 in the centrally disposed ring formed member 12 and the ends of the pins project through and fit snugly in the circular holes 14 in the members 11. Cotter pins 16 or like devices extend through transverse apertures 17 in the end extremities of the pins, that is, the portions of the pins which project beyond the members 11, and serve to hold the pins against axial displacement relatively to the hub 8. The pins 13 constitute anchoring or attaching means for the blades 9 and are held by the members 11 and 12 in a truly concentric position with respect to the outer periphery of the hub.

The blades 9 correspond in number to the pins 13 and are in the form of plate metal stampings. They are exactly the same in size and are made or fabricated so that they are of equal weight and have the same grain arrangement. The outer and central portions of the blades are flat and operate during drive of the rotor to impel and place under pressure the gas or air which is sucked or drawn inwardly through the inlet opening in the side of the casing with which the rotor is associated. The inner ends or portions of the blades correspond in length to the distance between the inner faces of the outwardly extending annular members 11 and embody integral eyes 18 and flaps 19. The eyes are formed by bending the inner ends of the blades outwards, then around and inwards, and then outwards, and comprise semi-cylindrical inner end parts 20 and flat or straight outwardly convergent side parts

21 between the semi-cylindrical inner end parts 20 and the contiguous or adjoining portions of the blades. The end portions of the eyes 18 fit around the portions of the pins between the centrally disposed member 12 and the outwardly extending members 11 at the ends of the hub and the central portions of the eyes are cut away, as shown in Figure 2, so as to accommodate the member 12. The semi-cylindrical inner end parts 20 of the eyes fit snugly around the inner peripheral portions of the pins 13 and are held in abutment and concentric relation with said portions of the pins by way of a pair of annular shoulders 22 which are formed on integral enlargements on the inner portions of the members 11. By employing the annular shoulders 22 at the ends of the eyes the semi-cylindrical inner end parts 20 are held in concentric and abutting relation with the pins 13 and the eyes and blades are thus held against sidewise displacement relatively to the pins. The flaps 19 are formed integrally with, and project outwardly from, the trailing side parts 21, that is, the parts which are not directly connected to the blades 9. They fit flatly against the contiguous inner portions of the blades and are secured to the latter by rivets 23 which, as shown in the drawings, extend through aligned holes in the flaps 19 and the contiguous inner end portions of the blades. By reason of the fact that the side parts 18 are flat and straight and outwardly convergent the bends at the inner ends are gradual as contradistinguished from sharp and hence they do not materially weaken the blades at the points where they are attached or connected to the eyes 18.

In order to hold the blades 9 in a radial position with respect to the hub and also against tilting especially during starting of the rotor an annular series of front arms 24 and an annular series of rear arms 25 are provided. These arms constitute braces or struts for the blades, extend outwardly from the outwardly extending member 12 on the central portion of the hub 8, and are arranged so that each blade has one front arm 24 and one rear arm 25 and the latter are outwardly convergent, as shown in Figure 1 of the drawings. The front arms 24 are in the form of metallic stampings and each consists of a pair of laterally spaced side pieces 26 and an outer cross piece 27. They extend outwardly and rearwardly from the member 12 and are under tension during starting of the rotor. The inner ends of the side pieces 26 of the arms 24 are positioned in straddled relation with the centrally disposed annular member 12 and have circular holes 28 therein through which the central portions of the pins 13 extend and by which they are connected to the pins. The cross pieces 27 extend between and are formed integrally with the distal ends of the side pieces 26 of the front arms 24 and fit flatly against the central portions of the front or leading faces of the blades 9. Each of the arms 24 extends outwardly and rearwards from one of the pins 13 and is applied at the distal end thereof to the blade on the next following pin. The rear arms 25 correspond in number to the blades 9 and are the same in design and construction as the front arms 24. They extend or project upwardly and forwardly from the outwardly extending annular member 12 on the central portion of the hub 8 and are arranged in crossed relation with the arms 24. Each rear arm 25 consists of a pair of laterally spaced side pieces 29 and an outer cross-piece 30. The inner ends of the side pieces 29 of the

arms 25 are disposed in lapped relation with the inner or proximal ends of the side pieces 26 of the front arms 24 and have circular holes 31 through which the central portions of the pins extend and by which the rear arms 25 are attached to the pins. The outer cross pieces 30 of the rear arms 25 abut and fit flatly against the central portions of the rear or trailing faces of the blades and are positioned directly opposite to the outer cross pieces 27 of the front arms 24. The rear arms 25 are placed under compression by the blades 9 during starting of the rotor and each is arranged so that it backs or braces the blade on the pin in front of the one to which it is attached. As a result of the arrangement and design of the arms 24 and 25 there are two arms on each pin, one of which extends outwardly and forwardly and backs the blade on the preceding pin and the other of which extends outwardly and rearwards and struts or braces the blade on the following pin 13. By having a front arm 24 and a rear arm 25 for each blade the blades are effectively held in radial relation with the hub and are not subject to tilting or displacement during starting of the rotor. The outer ends of the arms 24 and 25 are fixedly connected to the central portions of the blades by way of bolts 32. These bolts extend through circular holes 33 in the outer cross pieces 27 and 30 of the arms and pass through elongated slots 34 in the central portions of the blades 9. The slots 34, as shown in Figure 4, extend in the direction of the outer end edges of the blades. They correspond in width to the diameter of the holes 33 in the cross pieces 27 and 30 and serve to take care of or compensate for the slight stretch of the blades when the rotor is brought to full speed for the first time. When the rotor is first run the bolts 32 are left in a partially tightened condition and hence the blades are free to stretch in response to the action of centrifugal force. At the conclusion of the first run of the rotor, the bolts are tightened to their fullest extent in order rigidly to lock the front and rear arms 24 and 25 in their operative brace or strut forming position. The arms are formed of the same type of metal as the blades 9 and are the same in thickness as the blades with the result that they have the same coefficient of expansion and hence do not distort or warp the blades when the rotor is subjected to high temperatures.

The rotor is assembled by first arranging the blades 9 in radial relation with the hub and so that the semi-cylindrical inner end parts 20 of the eyes 18 are in concentric position with the circular holes 14 in the outwardly extending annular members 11 at the ends of the hub and at the same time. Thereafter the front and rear arms 24 and 25 are properly arranged with respect to the blades and so that the circular holes in the inner ends of the side pieces thereof are coaxially arranged with the holes 15 in the outwardly extending annular member 12 on the central portion of the hub. After so arranging the blades 9 and the strut or brace forming arms 24 and 25 the pins 13 are driven into place in order to lock the eyes and arms in their operative position. After the pins are driven in place the cotter pins 16 are inserted through the apertures 17 in order to hold the pins against axial displacement. When the pins are in place the annular shoulders 22 on the enlargements on the inner ends of the members 11 center the semi-cylindrical inner end parts 20 with respect to the inner peripheral portions of the pins and thus hold the eyes in

centered relation with the pins. After mounting and securing the pins 13 in place the distal ends of the arms 24 and 25 are secured to the blades 9 by inserting the bolts 32 through the holes 33 in the cross pieces of the arms and the slots 34 in the central portions of the blades. When the rotor is run for the first time the bolts are maintained in a partially tightened position only, as previously pointed out, in order to permit of stretching of the blades in response to the action of centrifugal force. After proper stretching of the blades the bolts are tightened in order to lock the arms in place.

The herein described centrifugal blower rotor due to the design, arrangement and strutting of the blades is perfectly balanced at all times regardless of temperature and hence does not become unbalanced and result in vibration with resultant crystallization and damage of parts. It has special utility in connection with a high speed blower for hot gas or air and is characterized by the fact that the blades thereof may be readily removed if necessary. It is further characterized by the fact that it may be manufactured at a much lower cost than previously designed rotors and does not include or embody any integral blade anchoring lugs on the hub. By reason of the fact that the rotor includes the front and rear arms 24 and 25 the blades at all times are maintained in their proper radial position with respect to the hub and are free to expand and contract in response to temperature changes without affecting in any way the balance of the rotor.

The rotor which is shown in Figures 6 and 7 constitutes a modified form of the invention. It is exactly the same in construction and design as the rotor of Figures 1 to 5 inclusive with the exception that the outwardly extending annular members at the ends of the hub are formed as integral parts of the hub and with the further exception that the eyes at the inner ends of the blades instead of abutting directly against the pins and being held in concentric relation with the pins by way of annular shoulders, embody sleeves 35 therein. These sleeves are welded or otherwise fixedly secured within and to the semi-cylindrical inner end parts of the eyes of the blades and fit around the pins and serve to center the eyes and hold the latter against lateral displacement with respect to the pins.

The invention is not to be restricted to the details set forth, since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent is:

1. A centrifugal blower rotor comprising a cylindrical hub adapted to be connected to and driven by a shaft and having outwardly extending members at its ends, pins arranged in an annular series around, and spaced from, the hub and having the ends thereof connected to and carried by the members, an annular series of separately formed blades corresponding in number to the pins and extending radially from the hub and having eyes at their inner ends extending around and anchored to the pins respectively, and angularly disposed arms extending between the hub and the inner central portions of the blades and serving to hold said blades in place and brace them against tilting.

2. A centrifugal blower rotor comprising a cy-

lindrical hub adapted to be connected to and driven by a shaft and having outwardly extending members at its ends, pins arranged in an annular series around, and spaced from, the hub and having the ends thereof connected to and carried by the members, an annular series of separately formed stamped plate metal blades corresponding in number to the pins, extending radially from the hub, and having eyes at their inner ends extending around and anchored to the pins respectively, and angularly disposed arms stamped from the same type of metal as the blades, extending between the hub and the blades, and serving to hold said blades in place and brace them against tilting.

3. A centrifugal blower rotor comprising a cylindrical hub adapted to be connected to and driven by a shaft and having at its ends annular outwardly extending members with equidistantly spaced aligned holes therein, pins arranged in an annular series around, and spaced from, the hub and having the ends thereof extending through and fixed within the holes in the members, a series of separately formed stamped plate metal blades corresponding in number to the pins and extending radially from the hub and having integral eyes at their inner ends extending around and anchored to the pins respectively and arranged with the ends thereof in abutment with the inner faces of said members, and pairs of angularly disposed arms for the blades respectively extending between the blades and the hub and serving to hold said blades in place and brace them against tilting.

4. A centrifugal blower rotor comprising a cylindrical hub adapted to be connected to and driven by a shaft and having outwardly extending members at its ends, cylindrical pins arranged in an annular series around, and spaced from, the hub and having the ends thereof connected to and carried by the members, an annular series of separately formed blades corresponding in number to, and extending radially from, the pins and having eyes at their inner ends extending around and anchored to the pins respectively and embodying semi-cylindrical inner end parts and flat outwardly convergent side parts between the inner end parts and the adjoining inner end portions of the blades, means applied to the eyes for holding said semi-cylindrical inner end parts in fixed and concentric relation with the pins, and means extending between the blades and the hub for holding said blades in place and bracing them against tilting.

5. A centrifugal blower rotor comprising a cylindrical hub adapted to be connected to and driven by a shaft and having outwardly extending members at its ends, cylindrical pins arranged in an annular series around, and spaced from, the hub and having the ends thereof connected to and carried by the members, an annular series of separately formed blades corresponding in number to, and extending radially from, the pins and having eyes at their inner ends extending around and anchored to the pins respectively and embodying semi-cylindrical inner end parts and flat outwardly convergent side parts between the inner end parts and the adjoining inner end portions of the blades, means around the hub forming an annular shoulder in engagement with said semi-cylindrical inner end parts of the eyes for holding such parts in engagement with, and against lateral displacement with respect to, the adjacent peripheral portions of the pins, and means extending between the blades and the

hub for holding said blades in place and bracing them against tilting.

6. A centrifugal blower rotor comprising a cylindrical hub adapted to be connected to and driven by a shaft and having outwardly extending annular members at its ends, cylindrical pins arranged in an annular series around, and spaced from, the hub and having the ends thereof connected to and carried by the members, an annular series of stamped plate metal blades corresponding in number to, and extending radially from, the pins and having eyes at their inner ends fitting around the pins respectively and against the inner faces of the members and embodying semi-cylindrical inner end parts in engagement with the inner peripheral parts of the pins and flat outwardly convergent side parts between the inner end parts and the adjoining inner end portions of the blades, means around the ends of the hub and adjacent to and inwards of the members forming a pair of annular shoulders in engagement with the ends of the eyes for holding said semi-cylindrical inner end parts of the eyes in place against said inner peripheral portions of the pins, and means extending between the blades and the hub for holding said blades in place and bracing them against tilting.

7. A centrifugal blower rotor comprising a cylindrical hub adapted to be connected to and driven by a shaft and having metallic rings shrunk around the ends thereof and forming outwardly extending members, cylindrical pins arranged in an annular series around, and spaced from, the hub and having the end thereof connected to and carried by the members, an annular series of stamped plate metal blades corresponding in number to, and extending radially from, the pins and having integral eyes at their inner ends fitting around the pins respectively and against the inner faces of said members and embodying semi-cylindrical inner end parts in engagement with the inner peripheral portions of the pins and flat outwardly convergent side parts between said inner end parts and the adjoining inner end portions of the blades, means integral with and disposed inwardly of said outwardly extending members forming annular shoulders in engagement with the ends of the eyes for holding said semi-cylindrical inner end parts of the eyes in engagement with said inner peripheral portions of the pins, and angularly disposed arms extending between the hub and the inner central portions of the blades and serving to hold said blades in place and brace them against tilting.

8. A centrifugal blower rotor comprising a cylindrical hub adapted to be connected to and driven by a shaft and having outwardly extending members at its ends, cylindrical pins arranged in an annular series around, and spaced from, the hub and having the ends thereof connected to and carried by the members, an annular series of separately formed blades corresponding in number to, and extending radially from, the pins and having eyes at their inner ends extending around and spaced from the pins respectively and embodying semi-cylindrical inner end parts and flat outwardly convergent side parts between the inner end parts and the adjoining inner end portions of the blades, cylindrical sleeves fitting within and secured to said semi-cylindrical inner end parts of the eyes and constructed and arranged so that they fit snugly around the pins and hold the eyes against lateral

displacement with respect to the pins, and means extending between the blades and the hub for holding said blades in place and bracing them against tilting.

5 9. A centrifugal blower rotor comprising a cylindrical hub adapted to be connected to and driven by a shaft and having outwardly extending members at its ends, pins arranged in an annular series around, and spaced from, the hub  
10 and having the ends thereof connected to and carried by the members, an annular series of separately formed blades corresponding in number to, and extending radially from, the pins and having eyes at their inner ends extending  
15 around and anchored to the pins respectively, and a corresponding annular series of arms mounted on the pins and extending outwardly and substantially tangentially with respect to the hub and arranged so that the outer end of each  
20 one abuts against and serves to brace the blade on one of the next pins.

10. A centrifugal blower rotor comprising a cylindrical hub adapted to be connected to and driven by a shaft and having outwardly extending  
25 ing members at its ends, pins arranged in an annular series around, and spaced from, the hub and having the ends thereof connected to and carried by the members, an annular series of separately formed blades corresponding in number to, and extending radially from, the pins  
30 and having eyes at their inner ends extending around and anchored to the pins respectively, and a corresponding annular series of arms mounted on the central portions of the pins extending outwardly from and substantially tangentially  
35 with respect to the hub and arranged so that the outer end of each abuts against the inner central portion of and serves to brace the blade on the preceding pin.

40 11. A centrifugal blower rotor comprising a cylindrical hub adapted to be connected to and driven by a shaft and having outwardly extending members at its ends, pins arranged in an annular series around, and spaced from, the hub  
45 and having the ends thereof connected to and carried by the members, and annular series of separately formed blades corresponding in number to, and extending radially from, the pins and having eyes at their inner ends extending around and  
50 anchored to the pins respectively, and a corresponding annular series of blade holding embracing arms mounted on the pins respectively extending outwardly and substantially tangentially with respect to the hub and having the outer end of  
55 each one thereof abutting against and connected by a bolt and slot connection to the central portion of the blade on one of the next pins.

12. A centrifugal blower rotor comprising a cylindrical hub adapted to be connected to and driven by a shaft and having outwardly extending  
60 ing members at its ends, pins arranged in an annular series around, and spaced from, the hub and having the ends thereof connected to and carried by the members, an annular series of sep-

arately formed blades corresponding in number to, and extending radially from, the pins and having eyes at their inner ends extending around and anchored to the pins respectively, and pairs of  
5 outwardly convergent brace forming arms for the blades respectively anchored adjacent to the hub and arranged so that the arms of each pair are positioned on opposite sides of and have their outer ends abutting against their respective blade.

13. A centrifugal blower rotor comprising a cylindrical hub adapted to be connected to and driven by a shaft and having outwardly extending  
10 ing members at its ends, pins arranged in an annular series around, and spaced from, the hub and having the ends thereof connected to and carried by the members, an annular series of separately formed blades corresponding in number to, and  
15 extending radially from, the pins and having eyes at their inner ends extending around and anchored to the pins respectively, pairs of outwardly convergent brace forming arms for the blades respectively anchored adjacent to the hub and  
20 arranged so that the arms of each pair are positioned on opposite sides of and have their outer ends abutting against their respective blade, and bolt and slot connections between the outer ends  
25 of the arms and the blades.

14. A centrifugal blower rotor comprising a cylindrical hub adapted to be connected to and driven by a shaft and having outwardly extending  
30 ing members at its ends, pins arranged in an annular series around, and spaced from, the hub and having the ends thereof connected to and carried by the members, an annular series of separately formed blades corresponding in number to, and  
35 extending radially from, the pins and having eyes at their inner ends extending around and anchored to the pins respectively, and pairs of blade bracing arms on the pins respectively arranged so that one arm of each pair extends outwardly  
40 and forwardly and abuts against the blade on the next preceding pin and the other arm extends outwardly and rearwardly and abuts against the blade on the next following pin.

15. A centrifugal blower rotor comprising a cylindrical hub adapted to be connected to and driven by a shaft and having outwardly extending  
45 ing members at its ends, pins arranged in an annular series around, and spaced from, the hub having the ends thereof connected to and carried by the members, an annular series of separately formed blades corresponding in number to, and extending  
50 radially from, the pins and having eyes at their inner ends extending around and anchored to the pins respectively, and provided with cut-outs, and a corresponding annular series of angularly positioned blade bracing and holding arms having  
55 the inner ends thereof mounted on the pins respectively and fitting within the cut-outs in the eyes, and arranged so that the outer end of each one thereof abuts against the central portion of  
60 the blade on one of the next pins.

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