Feb. 17, 1953

C. E. WILKEN

BLOWER

2,628,419

Filed Nov. 22, 1946

3 Sheets-Sheet 1

FIG. 1

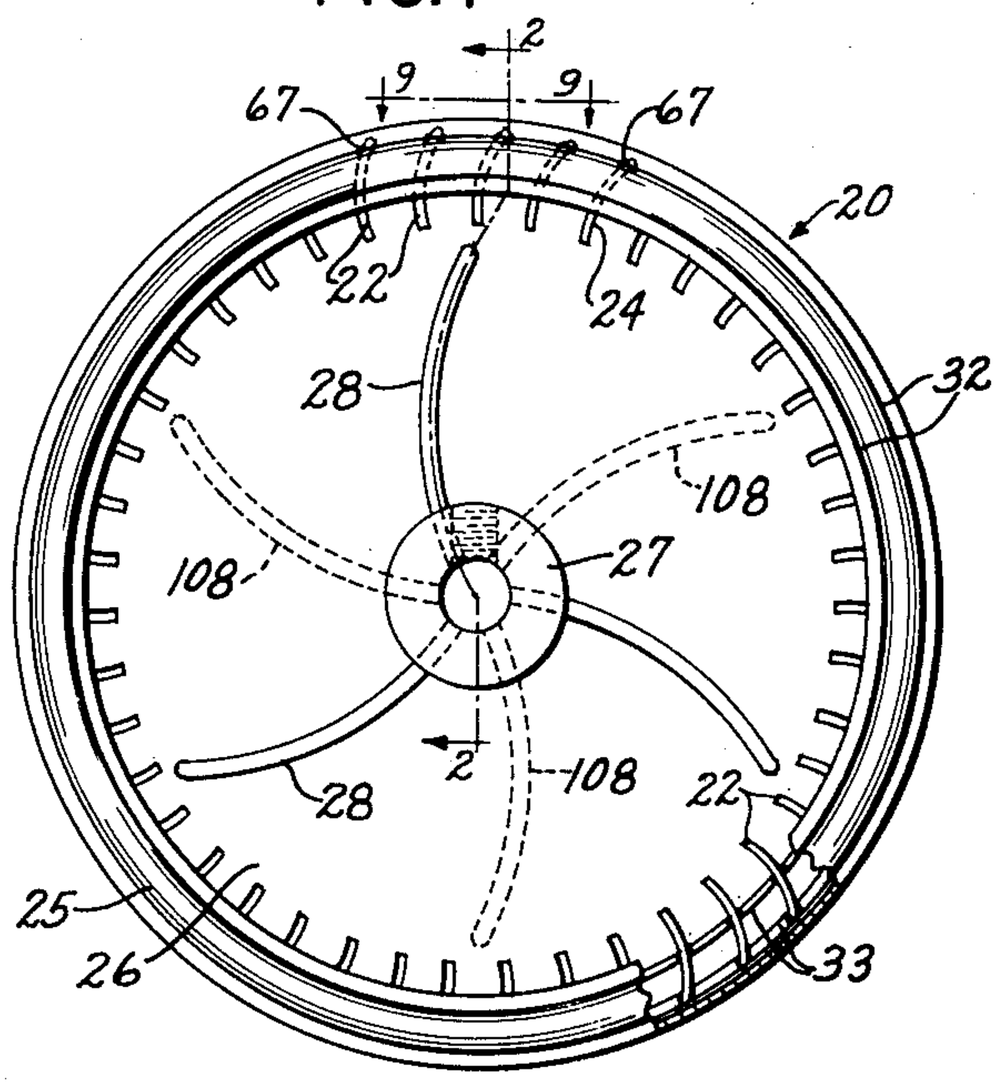

FIG. 2

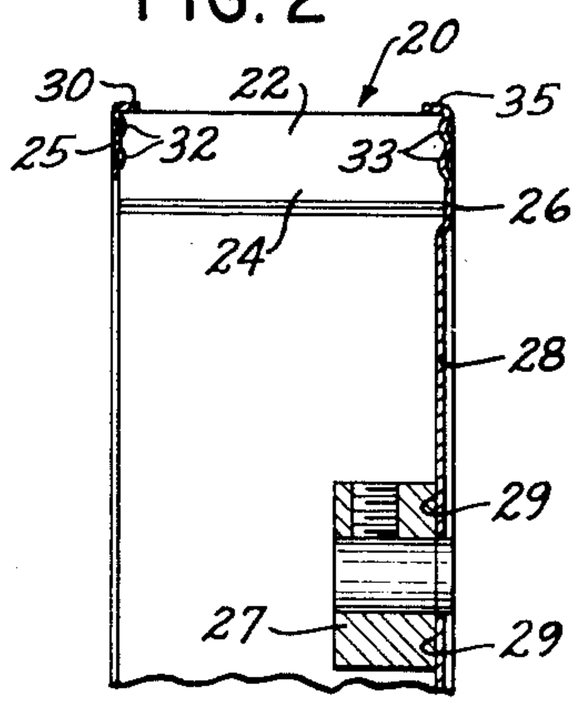

FIG. 3

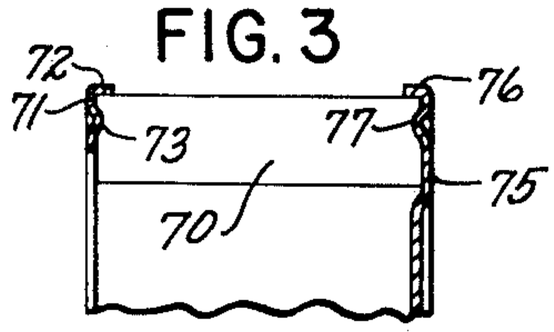

FIG. 4

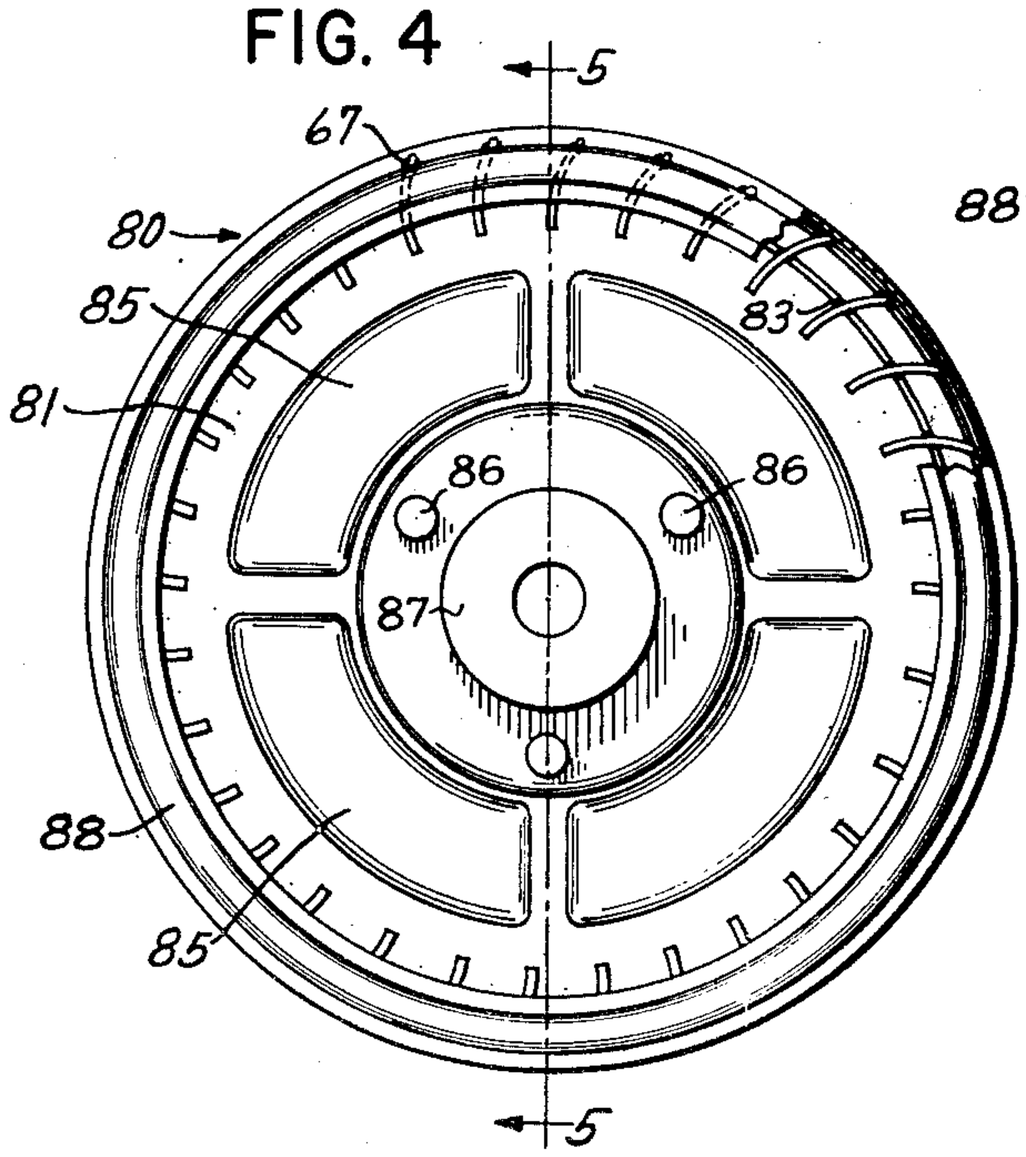

FIG. 5

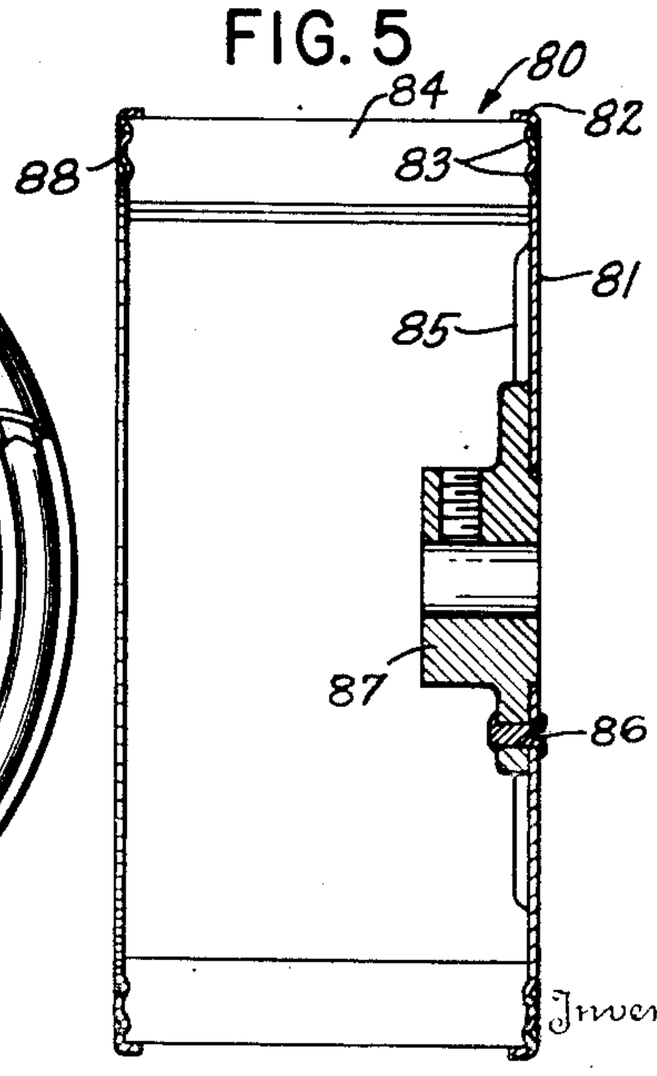

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FIG. 6

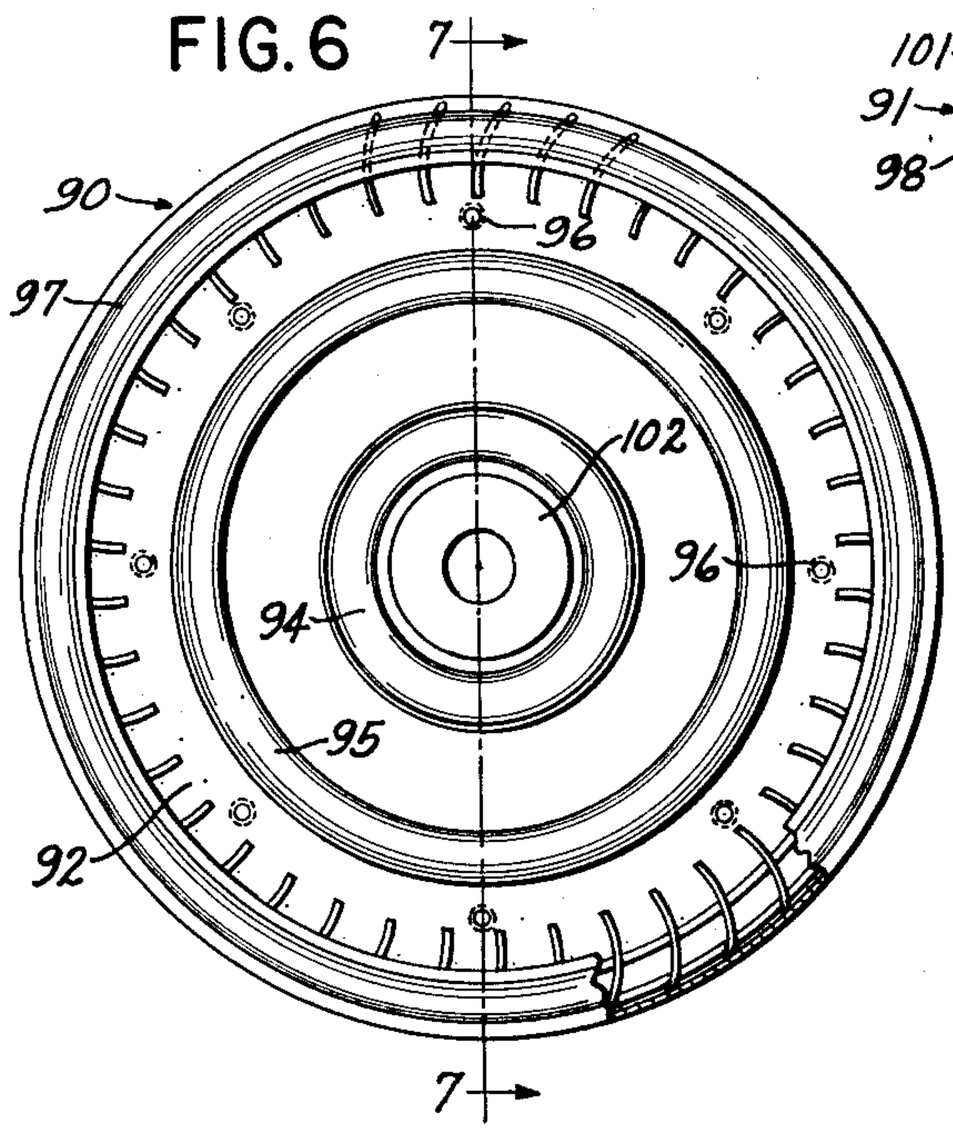

FIG. 7

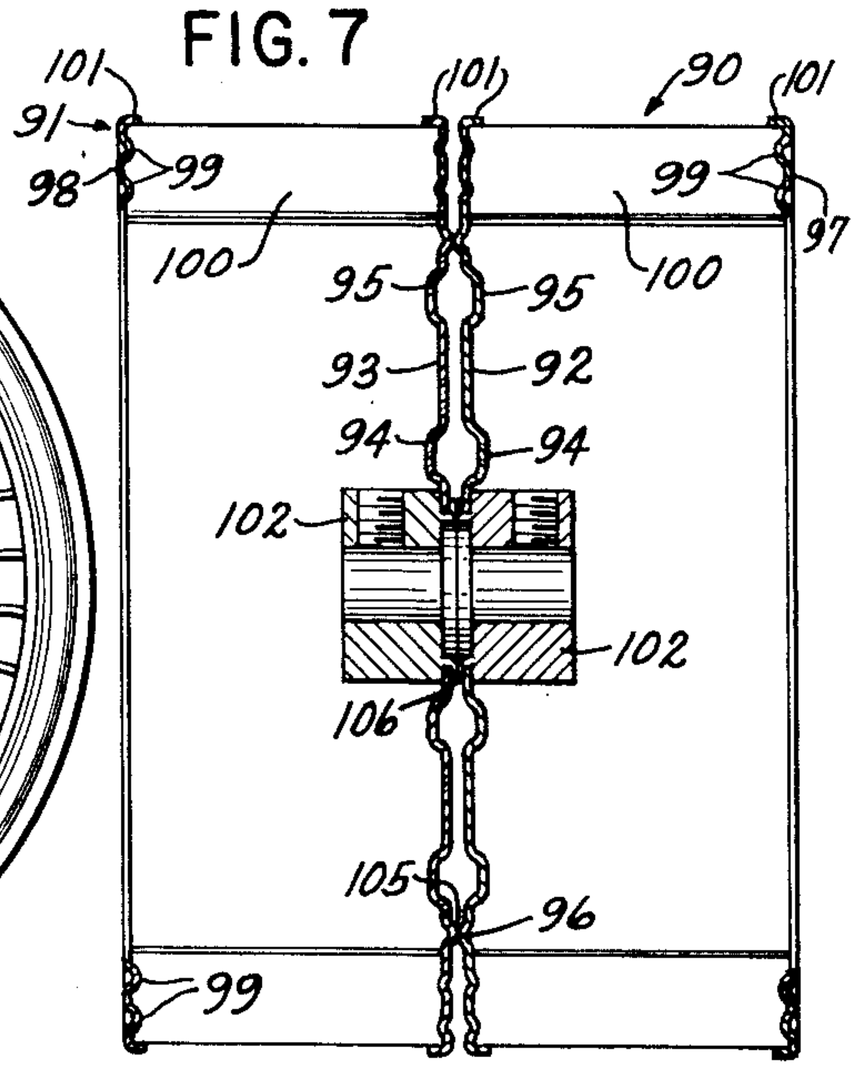

FIG. 9

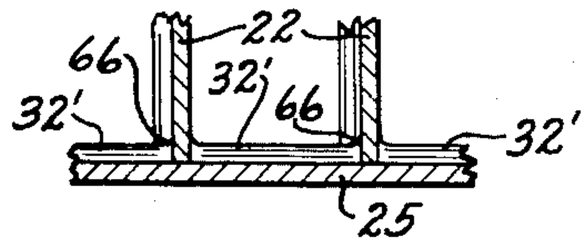

FIG. 8

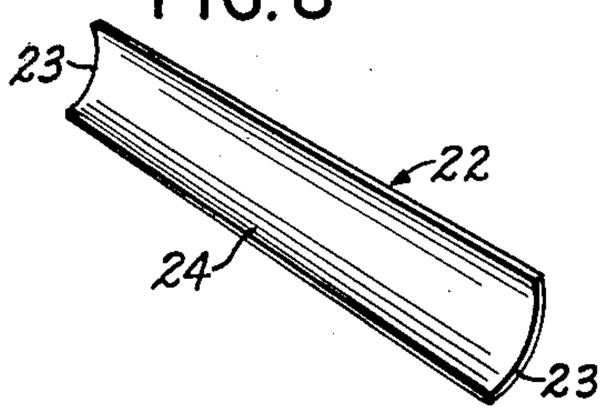

FIG. 10

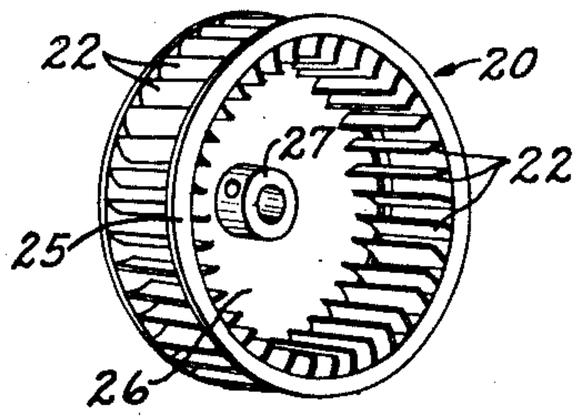

FIG. 15

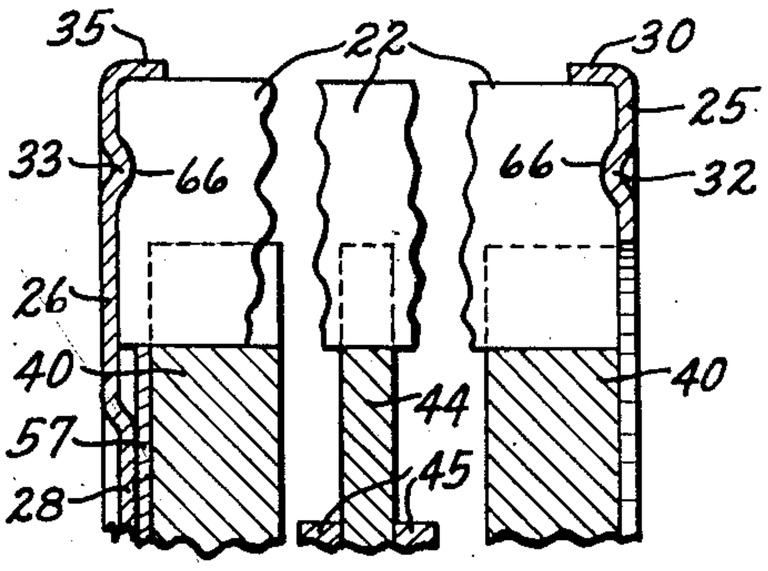

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FIG. 11

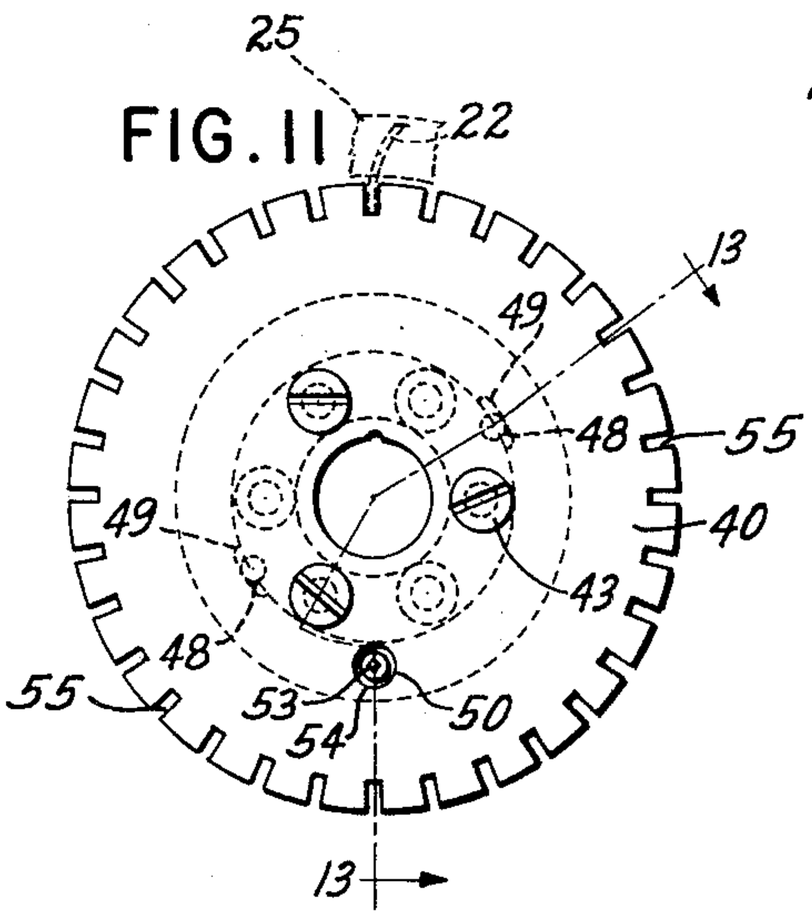


FIG. 12

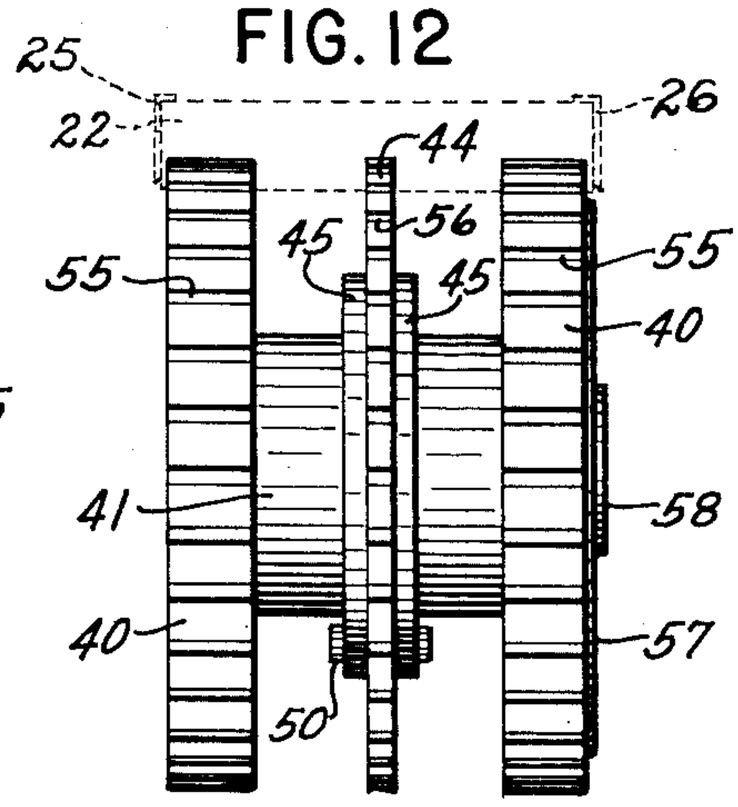


FIG. 13

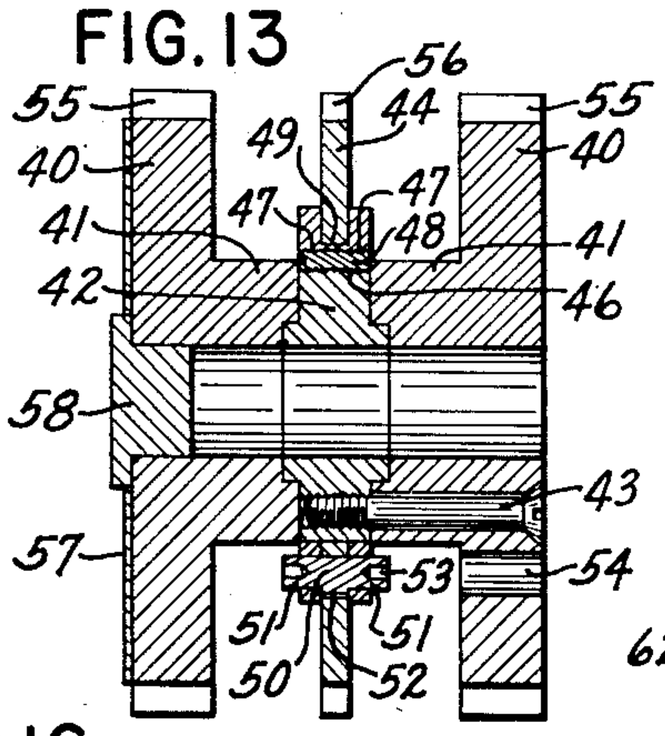


FIG. 14

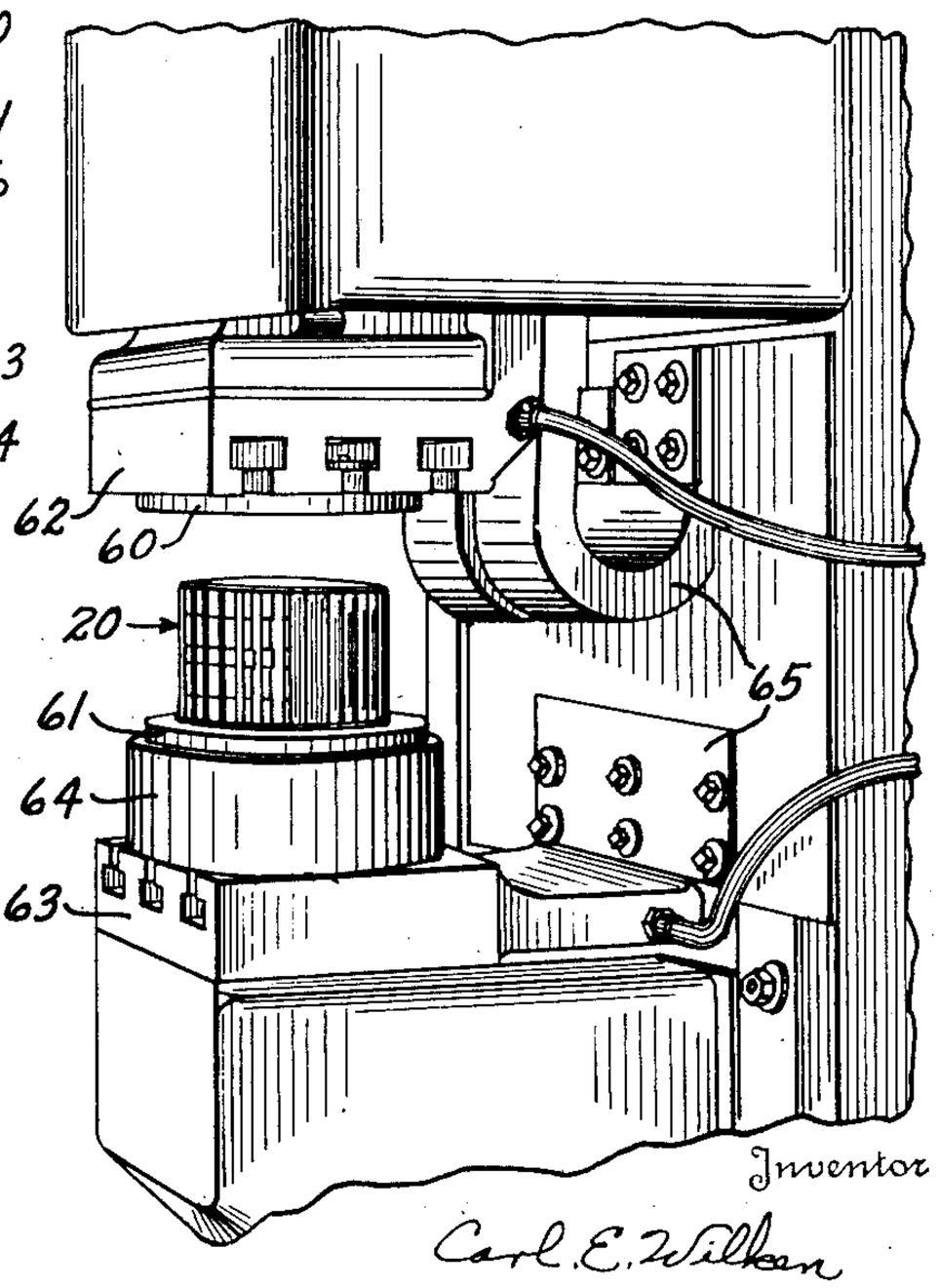


FIG. 16

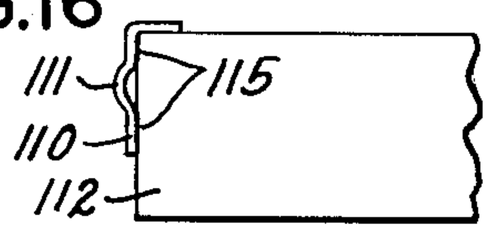


FIG. 17

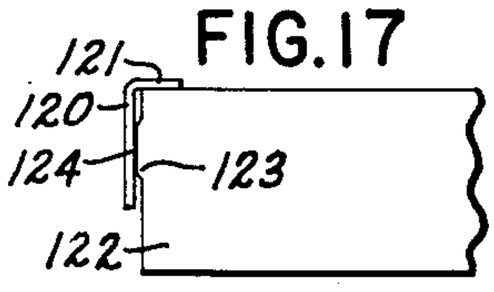
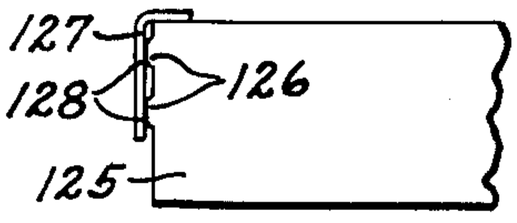


FIG. 18



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UNITED STATES PATENT OFFICE

2,628,419

BLOWER

Carl E. Wilken, New Lebanon, Ohio, assignor to The Lau Blower Company, Dayton, Ohio, a corporation of Ohio

Application November 22, 1946, Serial No. 711,785

8 Claims. (Cl. 29—156.8)

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This invention relates to multiple blade centrifugal fans of the type commonly known as a blower, and more particularly to rotors or blower wheels therefor.

One of the principal objects of this invention is to provide a multi-blade blower wheel having blades of any desired shape and spacing secured by welding to form a wheel which is simple and economical in construction and which is of high strength and rigidity in operation.

Another object is to provide a blower wheel wherein the separately formed blades are individually and autogenously welded to the end members and wherein also the end members are constructed to reduce to a minimum the working stresses on the welded joints such as those resulting from centrifugal force in operation.

It is also an object of the invention to provide a method of forming a blower wheel of welded construction which is simple and inexpensive and which results in the production of a well-balanced finished wheel having great internal strength.

A further object is to provide such a method which will result in a blower wheel of substantially uniform welded construction throughout and also wherein any departure from the desired uniformity can be readily determined by simple inspection.

A further object is to provide such a method wherein the blades are forced radially outward against circular retaining members during the welding operation to assure maximum concentricity and balance in the finished blower wheel.

A further object is to provide a jig for holding the blades of a blower wheel during assembly and welding and which includes relatively movable parts adapted to lock the blades in properly spaced and properly angled positions and also to exert stress on the blades tending to force them radially outwardly.

An additional object is to provide a welded construction for a blower wheel which is readily applicable to a wide variety of sizes of wheels, sizes and shapes of blades, and also to both single and double inlet blowers.

A still further object is to provide a blower wheel wherein the blades are welded at their opposite ends to a continuous annular bead or beads extending inwardly of the wheel from each of the two end members and wherein each end member also has a flange extending inwardly of the wheel a sufficient distance to overlap the outer ends of the blades and thereby to add stiffness to the wheel and to assure concentricity in assembly.

Other objects and advantages of the invention

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will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings, in which like characters of reference designate like parts throughout—

Fig. 1 is a view in elevation showing the inlet side of a blower wheel constructed in accordance with the present invention, with portions broken away to illustrate details of internal construction;

Fig. 2 is a partial view taken substantially on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary view similar to Fig. 2 showing a blower wheel embodying a modification of the construction shown in Figs. 1 and 2;

Fig. 4 is a view similar to Fig. 1 showing another form of blower wheel constructed in accordance with the invention;

Fig. 5 is a sectional view taken substantially on the line 5—5 of Fig. 4;

Fig. 6 is a view similar to Fig. 1 illustrating a double inlet blower wheel constructed in accordance with the invention;

Fig. 7 is a sectional view taken substantially on the line 7—7 of Fig. 6;

Fig. 8 is a view in perspective of an individual blade used in constructing a blower wheel in accordance with the invention;

Fig. 9 is an enlarged detail view taken in section substantially on the line 9—9 in Fig. 1;

Fig. 10 is a perspective view on a smaller scale than Fig. 1 showing a blower wheel constructed in accordance with the invention, the view being taken from the inlet side;

Fig. 11 is a view in end elevation showing a jig used in constructing a blower wheel in accordance with the present invention;

Fig. 12 is a view in side elevation of the jig shown in Fig. 11;

Fig. 13 is a sectional view taken on the line 13—13 of Fig. 11;

Fig. 14 is a perspective view illustrating the method of welding together the individual parts of a blower wheel in accordance with the present invention;

Fig. 15 is an enlarged view of a fragment of Fig. 13, showing the wheel after the welding operation has been completed but before the holding jig for the blades has been removed; and

Figs. 16, 17 and 18 are detail views illustrating different constructions of the abutting portions of the blades and end rings of blower wheels.

In accordance with the present invention, there is provided a blower wheel or rotor for a centrifugal blower having outstanding features

of ease and economy of manufacture and strength and rigidity in operation. In this wheel, the blades are secured at each end to an end member by an autogenous weld to provide a strong and rigid joint. In addition, the end members are formed with outer portions overlapping the outer ends of the blades and thereby serving both to reinforce the weld by holding the blades against centrifugal force and also to add stiffness to the wheel, the end members thus cooperating with the welded joints to provide an exceedingly strong and rigid structure. The blower wheels of the invention are so designed that they are readily assembled in manufacture without requiring special skill on the part of the operator, and the individual parts are simple and easy to produce and also may be formed in a wide variety of desired configurations, sizes, and spacings.

Referring to the drawings, which illustrate preferred embodiments of the present invention, and more particularly to Figs. 1 and 2, the blower wheel indicated generally at 20 is provided with a multiplicity of separately formed blades 22, which have a suitable configuration such as illustrated in detail in Fig. 8. These blades may be readily formed by stamping from a suitable sheet metal and are provided, as shown, with simple square ends 23. Their working surfaces may, therefore, be provided with any of a wide variety of desired shapes, sizes and curvatures, the illustrated blades having a simple arcute form to provide a working surface 24. These blades may be arranged in any suitable uniform or non-uniform spacing about the axis of the wheel.

The end members of the blower wheel shown in Figs. 1 and 2 comprise an annular end ring 25 at the inlet side of the wheel, and an end plate 26 shown as having a hub 27 secured thereto to serve as attaching means to a suitable drive shaft. In order to add stiffness, the end plate 26 may be provided with depressed portions such as the curved rib portions 28 formed therein as by a pressing operation, these ribs serving both to stiffen the plate and also to provide for convenient attachment of hub 27, which is indicated at 29 as being welded to the ribs 28.

The end ring 25 is formed with its inner diameter somewhat greater than the inner diameter of the blade portion of the wheel; for example, in a wheel having an outer diameter of 6¼ inches, the inner diameter of the end ring 25 may be 5½ inches and the inner diameter of the blade portion may be 5 inches. The outer periphery of end ring 25 is turned over or otherwise formed, as shown, to provide a flange 30 extending inwardly of the wheel and parallel to the wheel axis, with the inner diameter of this flange being substantially equal to the outer diameter of the blade portion of the wheel. The end ring 25 is also provided with one or more annular beads projecting inwardly of the wheel and having a diameter intermediate the inner diameter of the flange 30, two such beads 32 being shown in Figs. 1 and 2. These beads may readily be formed by a simple stamping operation, and satisfactory results have been obtained by causing them to extend beyond the plane of the inner surface of the ring 25 a distance substantially equal to the thickness of the stock from which the ring is formed. The outer portion of the end plate 26 is formed similarly to ring 25, with a pair of beads 33 projecting toward beads 32 and of substantially the same diameters, and with an outer flange 35 similarly extending towards the flange

30 and of substantially the same inner diameter.

In accordance with the present invention, the blades and end members constructed as described are united into the finished blower wheel by assembling them in abutting relation substantially as illustrated in Fig. 2 and then autogenously welding together the abutting portions of the blades and the beads 32 and 33 on the end members. Figs. 11–15 illustrate this assembling and welding operation.

Figs. 11–13 illustrate in detail a jig used for holding the blades during the assembling and welding operation. This jig includes two blade rings 40 having their hub portions 41 removably secured to a blade ring retainer 42, as by means of the bolts 43. An annular lock ring 44 is rotatably mounted on the blade ring retainer 42 between a pair of bearing rings 45 which are removably secured against rotation relative to the retainer 42. As shown in Figs. 11 and 13, the outer surface of the retainer 42 is provided with a pair of tapped semi-circular grooves 46, and the inner rims of the rings 45 are provided with similarly tapped semi-circular grooves 47. These grooves 46 and 47 are adapted to be brought into register to receive lock bolts 48. The inner rim of the lock ring 44 is provided with elongated grooves 49 permitting limited relative movement of the lock ring relative to the bearing rings 45 and retainer 42. In order to control this relative movement, a cam 50 is provided having co-axial end portions 51 journaled in the bearing rings 45 and an eccentric central portion 52 journaled in the lock ring 44. The degree of eccentricity between these portions 51 and 52 is such that as the cam 50 is rotated through 180°, the lock ring 44 is moved relative to the bearing rings 45 by an amount equal to the angular length of the slots 49, the ends of cam portion 51 being provided with sockets 53 to receive a manipulating wrench or other tool and at least one ring 40 having a hole 54 therethrough to provide ready access to the cam 50.

The outer rims of the blade rings 40 are provided with a series of angularly spaced radial slots 55 adapted to receive the inner edges of the blades 22 in the properly spaced relation, and the outer rim of the lock ring 44 is provided with similarly spaced slots 56. The size and proportions of the jig parts depend upon the size of wheel to be made with a particular jig. During assembly of the wheel, the jig is positioned within the wheel, and the diameter of rings 40 and 44 is accordingly less than the inner diameter of the end ring to permit withdrawal of the jig after completion of the welding operation. The axial lengths of blade rings 40 and their hub parts 41 are determined by the length of the individual blades and are preferably such that the axial length of the jig will be sufficiently near that of the blades to provide support for the blade ends in slots 55 while still permitting the necessary axial movement of the end members during welding, as will be described.

In fabricating a wheel with the aid of the jig shown in Figs. 11–13, the blades are inserted in the slots 55 and 56, as indicated in Figs. 11 and 12, and the blades and jig positioned between the end members as shown in Fig. 12. The jig holds the blades in the proper angularly spaced relation and in the proper angular position relative to the central axis of the wheel, and it also prevents their inward displacement. The two end members 25 and 26 overlie the ends of the blades so that the flanges 30 and 35 thereon pre-

vent outward displacement of the blades. In order to prevent short-circuiting from the jig to the back plate during welding, the blade retaining ring **40** which is positioned adjacent the end plate **26** is provided on its outer surface with an insulating disk **57** of fiber or the like. An insulating plug **58** may be inserted in the central bore of this ring **40**, as shown in Fig. 13, and this plug is adapted to engage in the central aperture for the drive shaft in the end plate, thus further aiding both in insulating and in accurately centering the parts in their proper relative positions.

Before the welding operation, the blades are locked in position by means of lock ring **44** and cam **50**. Thus with the blades **22** arranged as indicated in Fig. 11, the cam **50** will be rotated in counterclockwise direction as viewed in Fig. 11. This will cause corresponding rotation of lock ring **44** relative to blade rings **40** and will thus lock the blades in slots **55** and **56**. Also, this relative rotation of lock ring **44** will tend to force the blades radially outwardly and into firm contact with the overlapping flanges **30** and **35** on the end members, thus insuring maximum concentricity of the blades about the wheel axis in initial assembly, which greatly aids in obtaining proper balance in the completed wheel.

When these parts have been assembled as described, the whole assembly is placed between a pair of suitable electrodes **60** and **61** which are preferably so mounted, for example as the dies of a press, as to provide for exerting substantially uniform pressure axially of the assembled wheel. Fig. 14 illustrates such an arrangement wherein the electrode **60** is carried by the slide **62** of a press welder, and the other electrode **61** is mounted on the bolster plate **63** of the press welder, a spacing member **64** being positioned between electrode **61** and the bolster plate **63** to provide for shortening the stroke of the slide. These parts are all formed of electrical conducting metal, and electric current is supplied to the slide and bolster plate as indicated by the conductors **65**.

In operation, the slide of the press welder is actuated to apply pressure to the assembled wheel, and electric current is then supplied through the conductors **65** in sufficient intensity to produce local heating at the contacting points of blades **22** and the annular beads **32** and **33** capable of melting the metal and thus forming an autogenous weld of each blade end simultaneously to both end members, as indicated at **66**. As specific examples, in actual practice and with a wheel of the dimensions given above having 32 blades each 3'' in length and formed of 24-gauge sheet steel, this operation has been successfully carried out with the use of electric power of about 150 kva. applied for 8 cycles and with a pressure of the order of 2400 pounds, and with a wheel of the same size utilizing blades of 20-gauge sheet steel, satisfactory operating conditions include a pressure of 3000 pounds and current of 187 kva. applied for 24 cycles.

While the pressure and current are applied to the wheel parts, the beads **32** and **33** act initially to prevent contact between the blades and the end members except at the limited portion of contact between each blade end and bead, thus producing the resistance required to cause the heat necessary for a proper weld, and the current pulsates one or more times through these contacting portions of the blades and end members during welding. In order to avoid undue reduction of power as a result of the resistance of the length of the steel blades, the jig parts are preferably made of a good conducting material such as copper, thus providing for shunting the current from one end of each blade to the other through the blade rings **40** and retainer **42**. At the same time, it will be noted that these jig parts are not in direct electric contact with either end member, the upper blade ring **40** being spaced from the end ring **25** and the lower blade ring **40** being insulated from the end plate by the insulating disk **57** and plug **58**.

After the above operation is completed, the jig is released from its locked relation with the blades by rotating cam **50**, in clockwise direction as viewed in Fig. 11, to cause corresponding rotation of lock ring **44** into a position of substantial parallelism between its blade slots **56** and slots **55** in blade rings **40**. The jig may then be withdrawn through end ring **25**, and the whole assembly of blades and end members will be found to have formed a unitary structure as shown in Fig. 10. The ends of the blades will have merged with and autogenously welded to the end members, but with this weld covering only a portion of the overlying parts of the blade ends and end members as a result of the action of the beads in initially limiting the areas of abutting contact. Also the axial length of the assembled structure will be reduced by an amount equal to from once to twice the distance to which each bead extends beyond the plane of the adjacent surface of the end member. Thus the ends of the blades will be in substantially abutting contact with the end members, and since at the same time the portions of the beads between adjacent blades will retain their shape and extend beyond the plane of the adjacent outer ends of the blades, they will serve to reinforce the wheel by bracing the blades against stresses such as generally tangential stresses incident to use and generally imparting stiffness to the end members. This is illustrated in enlarged detail in Fig. 9, which shows the portions **32'** remaining from one of beads **32** and extending between the welded joints **66** connecting blades **22** to the end ring **25**. The outer flanges **30** and **35** impart smooth and well finished edges to the wheel as well as providing stiffness in the end members.

The above method is applicable to a wide variety of sizes of blower wheels and to blades of many different shapes in addition to the curved rectangular outline illustrated in Fig. 8, the only change necessary for blades of materially increased length being to increase the electric current and the length of the jig parts as described. If for any reason a blade should not properly weld to the end member, such defect will be readily detectable upon simple inspection. This is because the welding operation produces a characteristic mark or spot on the outer surface of the end members opposite the weld, as indicated at **67** in Figs. 1 and 4, and any variations from the desired uniformity of the welded joint will be reflected in similar variation in these marks or spots. Thus such a defective joint may be readily detected upon simple inspection.

Blower wheels may be produced by the above described method from metal of substantially lighter gauge than has heretofore been conventionally used in blower wheels and yet will be substantially stronger and more rigid in use than a wheel produced by conventional methods from a heavier metal. Furthermore, the individual parts are easier and more economical to produce

since they may be readily formed by a single stamping operation from suitable sheet stock, it being noted in this connection that the blades do not require any subsequent forming treatment to adapt their simple square ends for interlocking cooperation or other engagement with end members of more complex construction. This same feature is of assistance in the initial assembly of the parts, since the blades are automatically set in properly spaced position by the jig and do not require fitting into any notches or other holding means on the end members, and the simultaneous welding of all the blades, as described, is a further factor making the present invention particularly adaptable to accurate and economical mass production. In addition, the method of the invention results in a wheel which as initially formed is more nearly balanced than is usually the case with wheels produced by other methods and requires comparatively little further balancing, thus affording a substantial saving of time and expense.

Fig. 3 illustrates a fragment of a blower wheel of generally similar construction to the blower wheel **20** as described, and which is produced in substantially the same manner as described in connection with blower wheel **20** and with similarly formed blades **70**. In Fig. 3, however, the end ring **71** has an outer flange **72** similar to the flange **30** on end ring **25**, but it has only one annular bead **73** instead of the two annular beads **32**. Similarly the end plate **75** has an outer flange **76** similar to the flange **35** on end plate **26**, but it also has only one annular bead **77**. This construction provides adequate strength in smaller size wheels, but the increased strength afforded by the double-weld construction of Figs. 1 and 2 is preferred for larger sizes of wheels and even more beads may be found desirable in wheels of substantial size.

Figs. **4** and 5 illustrate a blower wheel **80** which is generally of similar construction to the blower wheel **20** but wherein the end plate **81** is of somewhat different configuration from the end plate **26**. This end plate **81** has an outer flange **82** and annular beads **83** to which the blades **84** are welded as shown, these parts being similar to the corresponding parts in Figs. 1 and 2, but the inner portion of this end plate is somewhat different. In order to impart to the end plate **81** the desired stiffness in use, it is provided with a plurality of depressed portions **85** of generally segmental shape, these depressed portions being equally spaced about the center of the plate. The center of the end plate **81** is also formed somewhat differently from end plate **26**, being provided with a plurality of holes for the reception of rivets **86** or like devices utilized for securing a suitable hub **87** to the end plate to serve for mounting on an operating shaft in use. The end ring **88** and the remainder of the blower wheel **80** is similar in construction to the blower wheel **20**, and this wheel may be produced in substantially the same manner as described in connection with Figs. 11–15.

Figs. 6 and 7 illustrate a double inlet blower wheel constructed in accordance with the present invention and shown as formed from two single inlet wheels **90** and **91** formed generally similarly to the wheel **20** in Figs. 1 and 2 with the exception of the two end plates **92** and **93**. Each of these end plates is shown as provided with two concentric annular ribs **94** and **95** pressed inwardly of the wheel to impart the desired stiffness. These end plates are also shown as provided with a plurality of outwardly pressed dimples or lugs **96** which are utilized for welding the two wheels together. The remainder of this double inlet wheel, with the exception of its hubs, is similar in construction to wheels already described, each end plate and each of the end rings **97** and **98** being provided with annular beads **99** to which the blades **100** are welded. Each of the end rings and end plates also has a flange **101** corresponding to the flanges **30** and **35** in Figs. 1 and 2. The hubs **102** of the wheels **90** and **91** are each shown as provided with a flange **106** which is adapted to be inserted in the center hole in each end plate and then turned over to secure the hub and end plate firmly together, this operation being readily carried out before the wheels **90** and **91** are welded together.

In constructing the double inlet wheel shown in Figs. 6 and 7, the two component wheels **90** and **91** are first made separately, as by means of the same method described in connection with Figs. 11–15. Thereafter, these two wheels may be assembled back to back, with the dimples or lugs **96** in contacting relation, and electric current applied to the two end plates, which may be done in a manner similar to that used in carrying out the welding of the blades. This will cause the two end plates to weld together at the contacting points **96** to give a unitary construction as is indicated at **105** in Fig. 7. A similar double-inlet wheel may be produced from two wheels **20** constructed as shown in Fig. 1 with ribs **108** pressed out in the opposite direction from ribs **28**. Two such wheels may be readily assembled back to back and welded together at the contacting points of such ribs **108**. Such double-inlet wheels may accordingly be constructed with the same ease and economy as the single-inlet wheels, and will exhibit similar advantages of strength and rigidity in use.

Figs. 16, 17 and 18 show blades and end rings of modified configurations. In Fig. 16, the end ring **110** is provided with an annular bead **111** pressed axially outwardly instead of inwardly as in the case of the bead **32** on end ring **25**. Blade **112** is shown as substantially identical with the blades **22** as described, and when the blades and end ring are assembled in a manner similar to that shown in Fig. 15, there will be abutting contact between the end of each blade and the annular inner surfaces of the end ring on each side of the bead **111**. Thus when welding heat and pressure are applied as described, the blade will autogenously weld to each of these annular surfaces as indicated at **115**. It will be understood that the end plate may be formed with a similarly outwardly projecting annular bead but may otherwise be substantially the same as the end plates described in connection with Figs. 1–7.

Fig. 17 shows a fragment of a blower wheel wherein the end ring **120** (or a similarly formed portion of an end plate) is substantially planar except for its outer flange **121** which corresponds to the flange **30** on end ring **25**. In this construction, however, the blade **122** is provided in its outer end with a projecting tab **123** which is adapted to abut the inner surface of end ring **120**. This tab will accordingly serve in the same manner as bead **32** to limit the extent of the abutting contact between the blade and end ring, and when welding heat and pressure are applied, this tab will autogenously weld to the end ring as indicated at **124**. Fig. 18 shows a structure similar to that illustrated in Fig. 17 except that the blade **125** is provided with a plurality of tabs

126 which abut the inner surface of end member 127, to be autogenously welded thereto as indicated at 128. If desired the end members 120 and 127 in Figs. 17 and 18 may be formed with ribs or beads in the zones other than the portions to be welded to afford additional stiffness.

It will accordingly be seen that the present invention provides blower wheels and a method of forming blower wheels which have numerous advantageous structural and operational features. The method of the invention is simple and economical, requiring a minimum of special or complex equipment or special skill on the part of the operator, and the individual component parts of the wheel are similarly simple and readily produced by inexpensive manufacturing operations. The blower wheels produced by these methods are of completely unitary construction, with all of the component parts welded together and also cooperating to reinforce the welded joints against the stresses and forces encountered in operation. In addition, these wheels may be successfully produced from lighter materials and in a wide variety of sizes and with blades of many different types and shapes.

While the methods and forms of apparatus herein described constitute preferred embodiments of the invention it is to be understood that the invention is not limited to these precise methods and forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. The method of manufacturing a blower wheel of the character described utilizing a plurality of separately formed axially extending blades and a pair of end members each having thereon an annular surface in face to face relation with the adjacent ends of said blades, said end members also having projections thereon located upon said annular surfaces and presenting substantially uninterrupted edge portions of materially smaller area than said surfaces, including the steps of arranging said separately formed blades in circumferential relation about a central axis, locating said end members at the opposite ends of said circumferentially arranged blades with said edge portions of said projections on said end members overlying and in contact with the ends of said blades to limit the area of contact of each said blade end with each said projection to an area correspondingly less than the entire area of said blade end, and autogenously welding said contacting portions of said blades and said projections together while confining said autogenous welding substantially to the overlying areas of said projections and said blade ends.

2. In a method of manufacturing a blower wheel of the character described including a plurality of axially extending blades circumferentially arranged about a central axis between a pair of end members, the steps of forming a plurality of separate blades, forming a pair of end members each having an annular surface adapted to overlie the ends of said blades in the finished wheel, forming projections on said annular surfaces adapted to abut the ends of said blades and presenting substantially uninterrupted edge portions of materially smaller area than said surfaces, arranging said blades in circumferential relation about a central axis, assembling said circumferentially arranged blades between said

end members with said edge portions of said projections in abutting contact with the ends of said blades to limit the total area of contact of each said blade with said end members to an area materially less than the total area of the ends of said blade, and autogenously welding said abutting portions of said blades and said projections together while confining said autogenous welding substantially to the abutting areas of said projections and said blade ends.

3. The method of manufacturing a blower wheel of the character described utilizing a plurality of axially extending blades and a pair of end members each having thereon an annular surface in face to face relation with the adjacent ends of said blades, said end members also having projections thereon located upon said annular surfaces and presenting substantially uninterrupted edge portions of substantially smaller area than said surfaces, including the steps of arranging said blades in circumferential relation about a central axis, locating said end members at the opposite ends of said circumferentially arranged blades with said edge portions of projections in contact with the ends of said blades to confine the total area of contact between said blades and said end members to an area materially less than the total facing portions thereof, and applying axial pressure and electric current to said end members to develop welding heat at said contacting portions of said blades and said projections causing autogenous welding of said blades to said end members at said confined areas of contact between said blades and said projections.

4. In a method of manufacturing a blower wheel of the character described including a plurality of axially extending blades circumferentially arranged about a central axis between a pair of end members, the steps of forming a plurality of separate blades, forming a pair of end members each having an annular surface adapted to overlie the ends of said blades in the finished wheel, forming projections on said annular surfaces adapted to abut the ends of said blades and presenting substantially uninterrupted edge portions of materially smaller area than said surfaces, arranging said blades in circumferential relation about a central axis, assembling said circumferentially arranged blades between said end members with said edge portions of said projections in abutting contact with the ends of said blades to confine the total area of contact between said blades and said end members to an area materially less than the total facing portions thereof, and applying axial pressure and electric current to said end members to develop welding heat at said abutting portions of said blades and said projections causing autogenous welding of said blades to said end members at said confined areas of contact between said blades and said projections.

5. The method of manufacturing a blower wheel of the character described utilizing a plurality of separately formed axially extending blades and a pair of end members each having thereon an annular surface in face to face relation with the adjacent ends of said blades and a peripheral flange adapted to extend axially inwardly of said wheel substantially parallel to the axis thereof and in overlapping relation with the radially outer edges of said blades, said end members also having projections thereon located upon said annular surfaces and presenting substantially uninterrupted edge portions of materially smaller area than said surfaces, including the

steps of arranging said separately formed blades in circumferential relation about a central axis, locating said end members at the opposite ends of said circumferentially arranged blades with said edge portions of said projections on said end members in contact with the ends of said blades and with said flanges on said end members overlapping the radially outer edges of said blades, and autogenously welding said contacting portions of said blades and said projections together while confining said autogenous welding substantially to the overlying areas of said projections and said blade ends.

6. In a method of manufacturing a blower wheel of the character described including a plurality of axially extending blades arranged in circumferentially spaced relation about a central axis between a pair of end members, the steps of forming a plurality of separate blades, forming a pair of end members each having a peripheral flange thereon and an annular surface adjacent said flange and adapted to overlie the ends of said blades in the finished wheel, forming projections on said annular surfaces adapted to abut the ends of said blades and presenting substantially uninterrupted edge portions of materially smaller area than said surfaces, arranging said blades in circumferential relation about a central axis, assembling said circumferentially arranged blades between said end members with the ends of said blades located within said flanges on said end members and in abutting contact with said edge portions of said projections to confine the total area of contact between said blade ends and said end members to an area materially less than the total facing portions thereof, and applying axial pressure and electric current to said end members to develop welding heat at said abutting portions of said blades and said projections causing autogenous welding of all of said blades to said end members at said confined areas of contact between said blades and said projections.

7. In a method of manufacturing a blower wheel of the character described including a plurality of axially extending blades arranged in circumferentially spaced relation about a central axis between a pair of end members, the steps of forming a plurality of separate blades, forming a pair of end members each having a peripheral flange thereon and an annular surface adjacent said flange and adapted to overlie the ends of said blades in the finished wheel, forming projections on said annular surfaces adapted to abut the ends of said blades and presenting substantially uninterrupted edge portions of materially smaller area than said surfaces, arranging said blades in circumferential relation about a central axis, assembling said circumferentially arranged blades between said end members with the ends of said blades located within said flanges on said end members and in abutting contact with said edge portions of said projections to confine the total area of contact between said blade ends and said end members to an area materially less than the total facing portions thereof, applying stress to said blades in a direction to force the ends of said blades radially outwardly into contact with said flanges, and applying axial pressure and electric current to said end members while maintaining said stress on said blades to develop welding heat at said abutting portions of said blades and said projections causing autogenous welding of all of said blades to said end members at said confined areas of contact between said blades and said projections.

8. A method of manufacturing a blower wheel of the character described utilizing a plurality of axially extending blades and a pair of end members each having thereon an annular surface in face to face relation with the adjacent ends of said blades, said end members also having projections thereon located on said annular surfaces and presenting substantially uninterrupted edge portions of substantially smaller area than said surfaces, comprising the steps of arranging said blades in circumferential relation about a central axis, locating said end members at the opposite ends of said circumferentially arranged blades with said edge portions of said projections in contact with the adjacent ends of blades to confine the total area of contact between said blades and said end members to an area materially less than the total facing portions thereof, applying axial pressure and electric current to said end members to develop welding heat at said contacting portions of said blades and said projections causing said blades and said projections to intersect and interlock in integral welds at said confined areas of contact therebetween with said blade ends substantially abutting the adjacent said annular surface.

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