Oct. 12, 1965 W. H. WENTLING ETAL 3,211,364

BLOWER WHEEL

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FIG-1

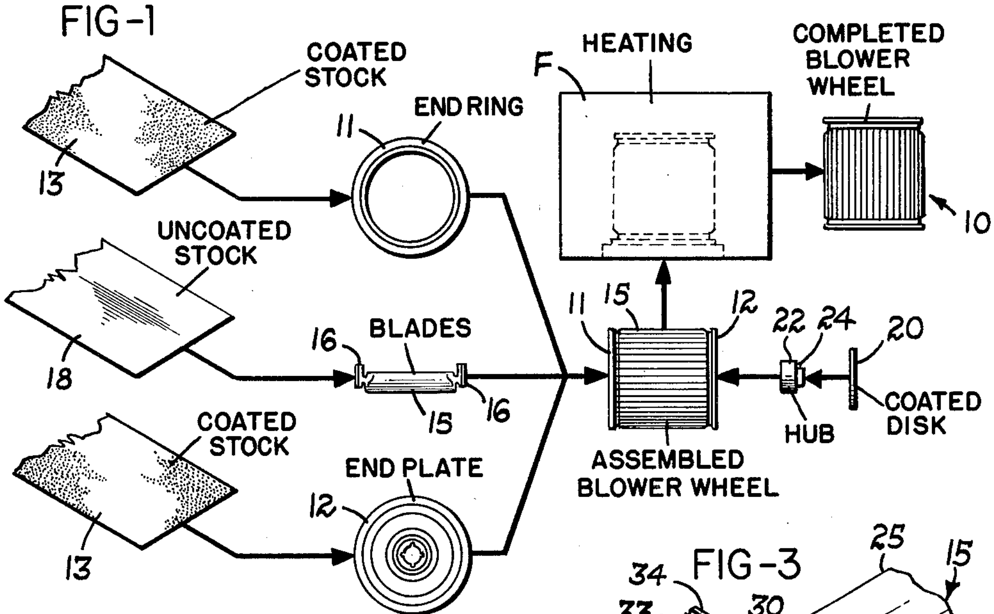


FIG-2

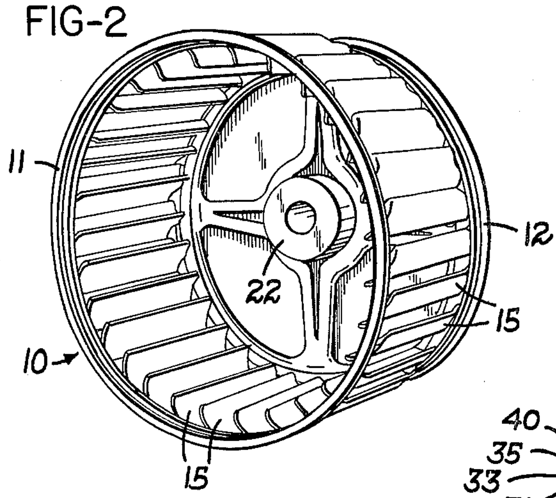


FIG-3

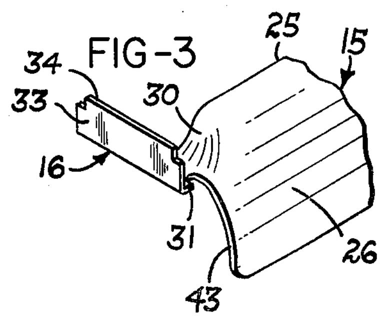


FIG-4

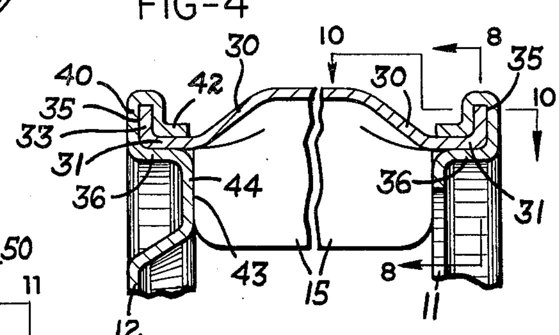
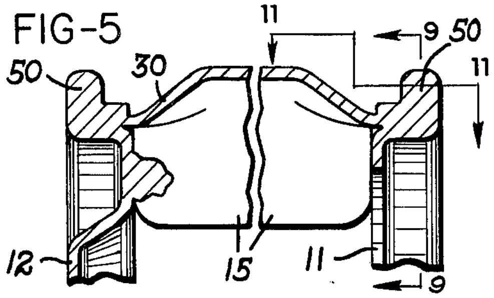


FIG-5



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BLOWER WHEEL

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FIG-6

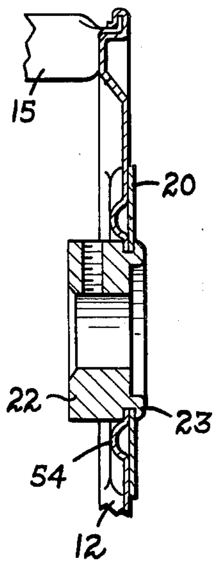


FIG-7

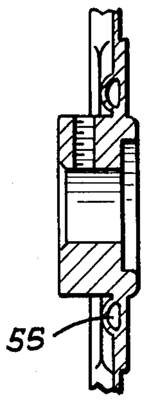


FIG-8

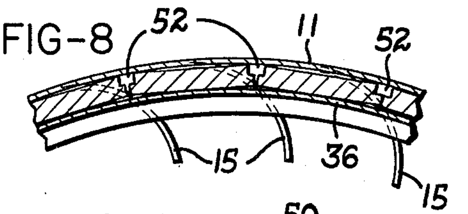


FIG-9

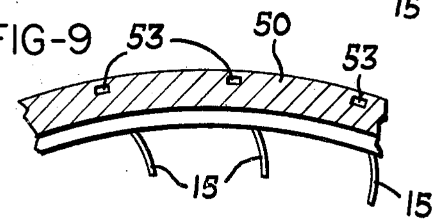


FIG-10

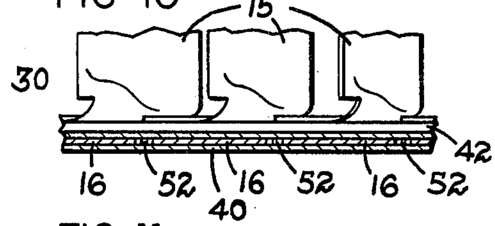


FIG-11

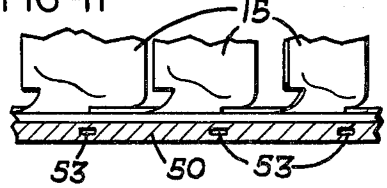


FIG-13

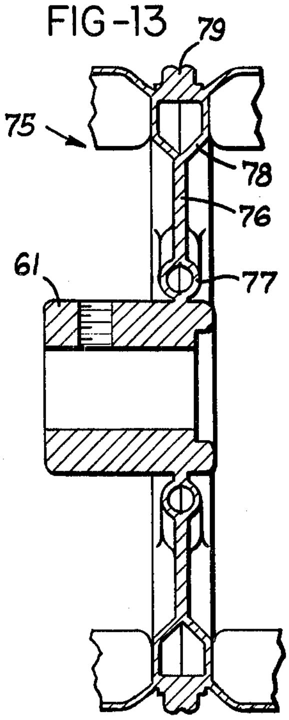
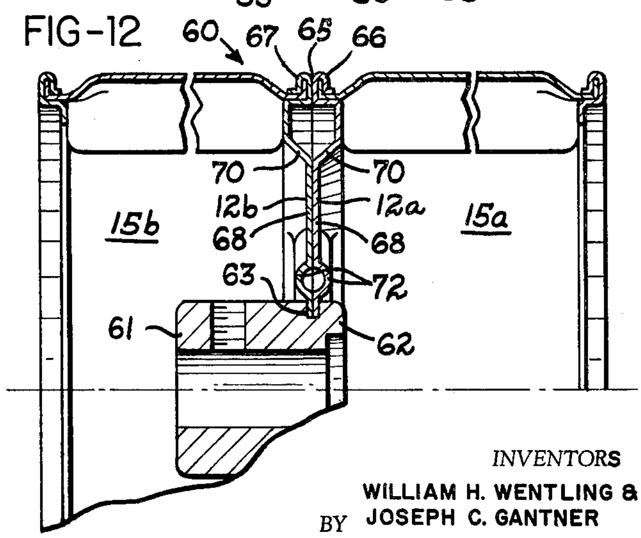


FIG-12



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BLOWER WHEEL

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FIG-14

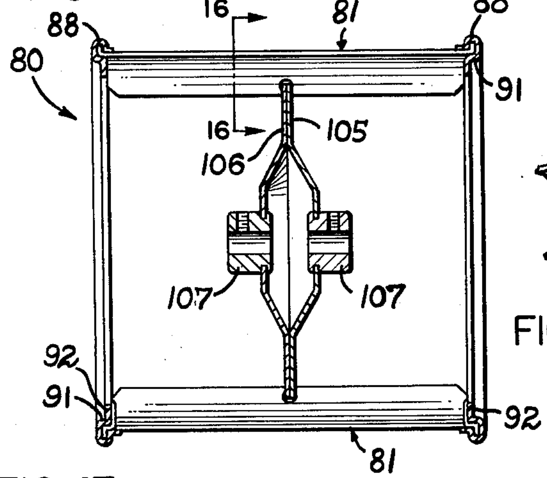


FIG-15

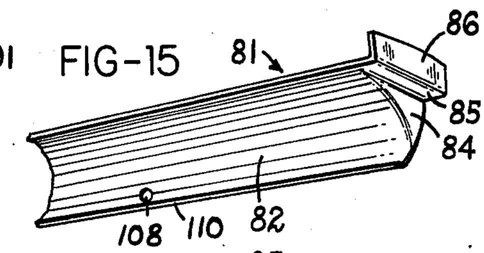


FIG-16

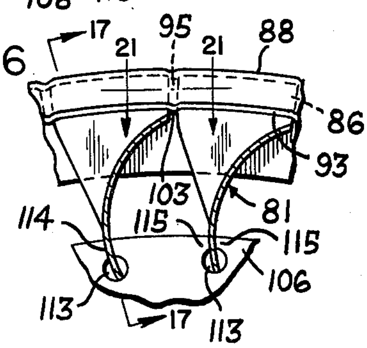


FIG-17

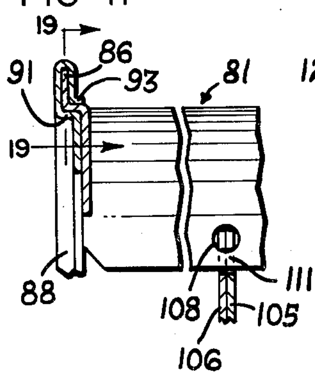


FIG-18

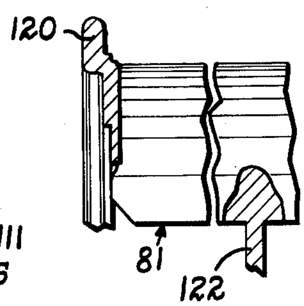


FIG-19

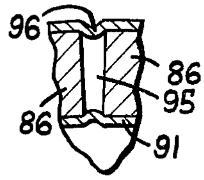


FIG-20

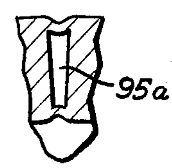


FIG-21

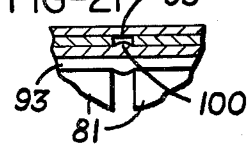


FIG-22

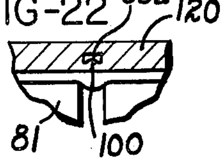


FIG-23

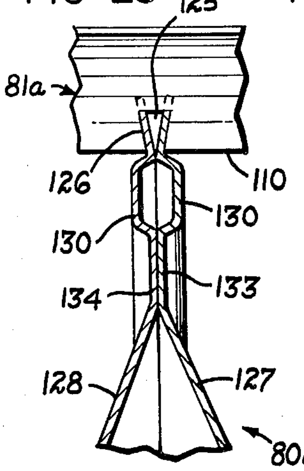
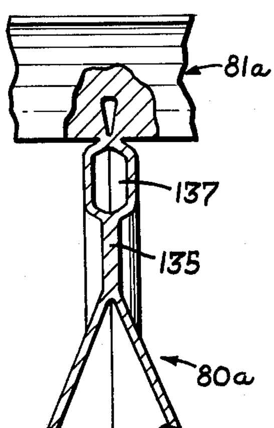


FIG-24



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United States Patent Office

3,211,364
Patented Oct. 12, 1965

3,211,364

BLOWER WHEEL

William H. Wentling, Dayton, and Joseph C. Gantner, Kettering, Ohio, assignors to The Lau Blower Company, Dayton, Ohio, a corporation of Ohio

Filed Oct. 30, 1963, Ser. No. 320,062
7 Claims. (Cl. 230—134)

The invention relates generally to air moving devices, and particularly to the improved construction of blower wheels.

A large percentage of the single inlet centrifugal blower wheels used today are fabricated from sheet metal by forming a plurality of individual blades having end flanges thereon, and then spinning an end ring and back plate over these flanges to lock the blades in the desired spaced relationship. Another popular construction utilizes a louvered blade sheet which is rolled into a tube and has an end ring and back plate suitably secured to the opposite ends thereof. The same methods are also used to construct double inlet blower wheels by securing an end ring to each end of the blades and securing a center disk intermediate the end rings.

The primary advantages of blower wheels of this type are their relatively low cost and light weight, and the ease with which the complex blade shapes required for efficient operation are formed. However, they suffer from a serious disadvantage in that they are susceptible to failure when subjected to the centrifugal forces present when they are rotated at high speed, or when subjected to vibration, e.g., as produced when the blower wheel is driven by an internal combustion engine. In order to construct a blower wheel which will withstand these forces and vibrations, it is necessary to weld the blades to the end ring and back plate or center disk, to form an integral blower wheel. Such a structure is difficult and expensive to manufacture, and it is necessarily relatively heavy since the components must be of heavier metal stock in order to permit brazing or welding.

Accordingly, it is an important object of this invention to provide improved blower wheels of the single or double inlet type which are not subject to failure as a result of the vibrations or centrifugal forces present during high performance operation thereof.

Another object of this invention is to provide a blower wheel of the aforesaid type which is light in weight and capable of being inexpensively manufactured at high speed, and further to provide a process for producing this improved blower wheel by using present machinery and equipment without major modifications, thus reducing the cost of producing the blower wheel.

A further object of the invention is to provide an improved process for producing an integral blower wheel of single or double inlet type which has the advantages of substantially all the fabricated blower wheels known today and which can be utilized at speeds and vibration rates substantially above those of present day blower wheels.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings—

FIG. 1 is a schematic illustration of the steps involved in the process of the invention;

FIG. 2 is a perspective view of a typical single inlet blower wheel in accordance with the invention;

FIG. 3 is a perspective view of one end of a blade used in the blower wheel shown in FIG. 2;

FIG. 4 is a cross-sectional view through a portion of the blower wheel shown in FIG. 2 subsequent to fabrication by conventional methods;

FIG. 5 is a sectional view similar to FIG. 4 and illustrating the blower wheel after the completion of the process;

FIG. 6 is a sectional view through the back plate after the fabrication step;

FIG. 7 is a sectional view similar to FIG. 6 after the process has been completed;

FIG. 8 is a sectional view taken along the line **8—8** of FIG. 4;

FIG. 9 is a sectional view similar to FIG. 8 taken along the line **9—9** of FIG. 5;

FIG. 10 is a sectional view taken essentially along the line **10—10** of FIG. 4;

FIG. 11 is a view similar to FIG. 10 taken along the line **11—11** of FIG. 5;

FIG. 12 is a sectional view through the center disk arrangement of another embodiment of the invention prior to the completion of the process;

FIG. 13 is a sectional view showing the blade arrangements of the double inlet wheel shown in FIG. 12 after the completion of the process;

FIG. 14 is a sectional view of another embodiment of a double inlet blower wheel;

FIG. 15 is a perspective view of a blade used in the blower wheel shown in FIG. 14;

FIG. 16 is a sectional view taken essentially along the line **16—16** of FIG. 14;

FIG. 17 is a sectional view taken along the line **17—17** of FIG. 16;

FIG. 18 is a sectional view similar to FIG. 17 but after the process has been completed;

FIGS. 19 and 20 are sectional views taken along the line **19—19** of FIG. 17 showing this structure before and after the brazing step, respectively;

FIGS. 21 and 22 are sectional views taken along the line **21—21** of FIG. 16 showing this structure before and after the brazing step, respectively;

FIG. 23 is a fragmentary sectional view showing another embodiment of the center disk structure; and

FIG. 24 is a sectional view similar to FIG. 23 but after the brazing step.

Referring to the drawings, which illustrate preferred embodiments of the invention, FIG. 1 shows schematically the process of the invention as it is employed to produce an integral blower wheel **10** of the single inlet type. The first step includes the production of the end ring **11** and back plate **12** from relatively thin sheet metal stock **13**, such as steel, which has been coated on both sides with a thin layer of copper or similar metal having a melting point substantially lower than that of the sheet metal.

The individual blades **15** having the flanges **16** on the opposite ends thereof are formed from an uncoated strip of sheet metal stock **18**, and then the blades **15**, end ring **11** and back plate **12** are formed into the blower wheel **10** by spinning, or otherwise deforming, the outer peripheries of the end ring and back plate over the flanges **16** of the blades **15**. Suitable apparatus for securing these components together is described and claimed in the copending U.S. application of Wentling et al., Serial No. 215,988, filed August 9, 1962 and assigned to the assignee of this invention.

Subsequently the reinforcing disk which is also copper coated is secured in contact with the back plate **12** by deforming the flange **23** on the hub **22**, as shown in FIG. 6, to lock the back plate **12** and disk **20** between the shoulder **24** of hub **22** shown in FIG. 1 and the deformed flange **23** on FIG. 6. The fabricated blower wheel **10** is then placed in a furnace F or otherwise subjected to a temperature slightly above the melting point of the copper for the brazing step which causes the copper to melt and flow into the space between the adjacent surfaces of the end ring **11**, the back plate **12** and the blades **15**.

Capillary action causes this molten metal to flow into small corners and voids, and between surfaces which are tightly in contact to fill substantially completely the spaces between adjacent surfaces. When the heat is removed and the blower wheel allowed to cool slowly, the copper solidifies causing the end ring **11** and back plate **12** to be integrally fused at opposite ends of the individual blades **15**, so that a rigid and very strong blower wheel **10** is formed. Similarly, the reinforcing disk **20** and hub **22** are integrally fused to the back plate.

Although the process has been initially described in connection with a single inlet blower wheel having a particular construction, it is not so restricted and may be utilized to produce other types of single inlet wheels, as well as double inlet blower wheels of many different types, as will be described hereinafter.

The proper thickness coating on the end rings, back plates and center disks is important since an inadequate thickness will result in inferior fusing action, whereas excessive copper will puddle into large masses thus complicating the balancing of the blower wheel. Preferred results have been obtained by using copper in a thickness of .0005″, and a coating within approximately the range of .0003″ to .001″ which will create a satisfactory integral connection between the components of the blower wheel.

Referring now to the specific construction of a single inlet blower wheel as shown in FIGS. 2–11, FIG. 3 illustrates the blade **15** having identical flanges **16** projecting longitudinally from each end thereof adjacent the leading edge **25** of the blade surface **26** for use in securing the blades **15** to the end ring **11** and back plate **12**. Each of the flanges **16** includes a tapered section **30** having an axially extending shoulder **31** at its outer end, and from the outer edge thereof the upturned flange **33** projects in a plane parallel to the leading edge **25** of the blade under consideration. Th edge **34** of each upturned flange **33** also lies radially inwardly of the blower wheel from the leading blade edges **25** so that the outer diameter of the end ring **11** and back plate **12** will be substantially equal to the outer diameter of the blower wheel at the blades.

The end ring **11** and back plate **12**, as seen in FIG. 4, have identical outer peripheral constructions which include a groove **35** for receiving the flanges **16** of each blade **15**. The grooves **35** are defined by an inner support wall **36** which supports the lower surface of the shoulder **31**, a radial side wall **40** which engages the outermost side wall of the flanges **33**, and the upper deformable wall **42** which has been spun over the inner side of the flanges **33** and into engagement with the top surface of the shoulder **31**. The side edge **43** of the blade surface **26** is compressed against the radially inwardly extending lip **44** during the spinning operation, and thus the end ring **11** and back plate **12** rigidly lock the blades **15** in position against movement in any direction. The blower wheel **10** is fabricated substantially in accordance with the teaching of the copending U.S. application of Wentling et al. Serial No. 270,582, filed April 4, 1963, now Patent No. 3,165,258, and assigned to the assignee of this invention.

During the heating or brazing step, the copper coating on the end ring **11** and back plate **12** is melted and flows into small spaces and between adjacent surfaces to fuse the blower wheel together, as shown in FIGS. 5, 7, 9 and 11. Upon cooling, solid beads **50** are formed in the area where the flanges **16** and the end ring **11** and back plate **12** were secured together. Similarly the side edges **43** of the blade surface **26** become fused to the adjacent portion **44** of the end ring **11** and back plate **12**, as shown in FIG. 5. The relieved corners **52** on the blade flanges **16** may create small voids **53** in the beads **50** (FIGS. 9 and 11) but otherwise these beads are a substantially solid integral mass of metal.

The hub **22** and the coated reinforcing disk **20** are also fused to the back plate **12** to form an integral hub structure, as shown in FIG. 7, and the circumferential groove **54** in the back plate **12** cooperates with the reinforcing disk **20** to create a tubular reinforcing rib **55** which resists angular and twisting forces on the back plate **12**. Moreover, the hub **22** also becomes integrally secured to the back plate **12** and the reinforcing disk **20** for providing additional resistance to vibration without a significant increase in weight.

Another embodiment of the invention is shown in FIGS. 12 and 13, and includes a double inlet blower wheel **60** formed by interconnecting, prior to the brazing step, two single inlet blower wheels **15*a*** and **15*b***, of the type described above, with their copper coated back plates **12*a*** and **12*b*** clamped together by the hub **61**. The blower wheel **15*a*** and **15*b*** are substantially identical except that one is designed for clockwise rotation and the other for counterclockwise rotation, so that when they are placed with their back plates in contact, they require rotation in the same angular direction.

To assemble the wheel **60**, the hub **61** is first inserted through a central aperture in each of the back plates **12*a*** and **12*b***, and then the flange **62** on one end thereof is deformed to clamp the back plates **12*a*** and **12*b*** between this flange and the shoulder **63** of the hub **61**. In this position, the side walls **65** of the outer peripheral flanges **66** and **67**, and the intermediate walls **68** between the slanted shoulders **70** and the reinforcing beads **72**, are in intimate contact.

The brazing and subsequent cooling operations form a double inlet blower wheel **75** having a single integral center disk **76** (FIG. 13) with the hub **61** integral therewith. The radially inner and outer reinforcing ribs **77** and **78** which are formed in the center disk **76** are tubular in cross-section and extend circumferentially of the hub **61** and thus add rigidity and strength to the blower wheel **75** for resisting the compound forces which would cause failure of conventionally fabricated blower wheels. The peripheral flanges **66** and **67** of the back plates **12*a*** and **12*b*** become fused into a solid bead **79** which adds further strength to the blower wheel **60**. Each of the single inlet blower wheels **15*a*** and **15*b*** which form the double inlet blower wheel **60** also has the structural features shown in FIG. 5, such as the solid bead **50** around each inlet.

Referring now to FIGS. 14–22, which illustrate another embodiment of a double inlet blower wheel **80**, a typical blade construction is shown in FIG. 15 where the blade **81** has a curved working face **82** which is arcuately shaped in a uniform manner over the major portion of the length of the blade. Each end of the blade face **82** of the blade **81** is turned over at approximately right angles thus forming a laterally extending side wall **84** of the convex side of the blade. Beyond the walls **84**, the support walls **85** are formed and extend perpendicularly to the side walls **84**, and the flanges **86** are bent upwardly at right angles to the support wall **85** so that the flange **86** projects radially outwardly of and overhangs the working face **82** of the blade **81**.

The copper coated end rings **88** are suitably spun onto the opposite ends of the blades **81** in much the same manner as described above in connection with the embodiment shown in FIG. 2. As will be evident from FIG. 14, the end rings **88** are provided with offset shoulders **91** and inwardly projecting flange portions **92** which are adapted to interfit with the support wall **85** and the overhanging end flange **86**. The projections on the ends of the blades thus are received within the end rings and supported loosely on the shoulders **91** with the flanges **86** extending radially outwardly. The number of blades and the peripheral extent of their end flanges are preferably such that they are separated by a small clearance which is used to lock the blades securely in position, as will be explained.

As shown in FIG. 17, the length of the portion **91** of the end ring **88** is longer than the height of flange **86**, and thus in finished position, a lip **93** is formed on the inner portion of the ring. This lip bears against the outer surface of the blades **81** and extends axially of the blades toward the end ring on the opposite end of the blower wheel. As shown in FIGS. 16, 19 and 21, the width of the peripheral extent of flanges **86** is so limited that small clearance or gaps **95** are provided between adjacent blades. The actual dimensions of these gaps need not be large, but it is found that where even a limited space is provided, a desirable interlocking action is secured. The gaps should be present at least at the outer peripheries of the flanges **86** and may continue radially inwardly so that, as shown in FIG. 19, adjacent blades are actually separated from each other at all points.

This locking action is accomplished during the spinning operation when substantial forces are developed in the material of the copper coated end rings **88** tending to force the metal into the gaps **95** provided between the end flanges **86** of the blades **81**. This results in forming small projections **96** which extend into the gaps **95** and interlock each blade to hold it securely in position in the end rings.

The projections **96** on the outer periphery of the end rings **88** in conjunction with the gripping action afforded by the end rings engaging opposite sides of the flanges **86** serve to retain the blades **81** firmly in assembled relation. Further, during the spinning operation, the metal tends to flow into the gaps **95** between the sides of the flanges **86** to form projections **100** (FIG. 21) providing a further locking action of all of the blades in proper operative relation.

The spinning of the lip **93** may also develop projecting portions **103** which extend into the gaps (FIG. 16) between adjacent blades, thus further contributing to the desired locking action. It will be understood that it is not essential that all of these groups of locking projections be formed, but one or more of the interlocking actions may be utilized as desired.

The blower wheel of FIG. 14 incorporates a supporting center disk structure which includes a pair of disk members **105** and **106** of copper coated sheet metal, and both of these disks are shown as carrying hubs **107** for mounting the blower wheel on a drive shaft for rotation. The disks **105** and **106** are of lesser outer diameter than the inner diameter of end rings **88** to provide for assembly of the disks within the blower wheel after the end rings are in place.

The disks **105** and **106** are secured in mechanically coupled relation with intermediate portions of all of the blades **81** by interfitting parts which are located entirely within the projected inner diameters of the end rings **88**, and which therefore can be readily assembled and interconnected after the cage portion of the wheel is otherwise complete. As shown in FIG. 15, each blade **81** is provided with a small hole **108** located approximately midway between its ends and adjacent its innermost edge **110** which lies radially innermost in the finished wheel. The hole **108** is thus spaced radially outwardly of the blade **81** from the edges **110** by a small marginal portion **111** which may conveniently be of the same minimum radial diameter of the hole **108**.

Referring to FIG. 16, the disks **105** and **106** are provided initially with a plurality of openings **113** extending through the outer peripheral portion thereof and equal in number to the blades **81**. Satisfactory results have been obtained when each of these openings is of the same dimension as the holes **108** in the blades and located in similarly spaced relation with the outer periphery of the disk. Each opening **113** is also connected with the outer periphery of the disks **105** and **106** by a radially extending slot **114**.

Prior to assembly of the disks **105** and **106** within the blower wheel, the tongue portions **115** are deformed axially outwardly of the disks by an amount sufficient to widen the slots **114** until their width is sufficiently greater than the thickness of each blade **81** to permit ready movement of a blade therethrough. The tongue portions **115** of the two disks **105** and **106** are formed away from the hub portions of the disks so that when the disks are thus assembled with the tongue portions thereon aligned and facing each other, these tongue portions will abut each other and thus hold the adjacent disk portions in axially spaced relation. The two disks **105** and **106** are inserted in this relation in the wheel by sliding the blades through the aligned pairs of widened slots **114** until each of the double pairs of tongue portions **115** are in line with one of the holes **108** through the adjacent blade **81**.

The two disks **105** and **106** are then pressed together until the tongue portions **115** are returned to their original positions in coplanar relation with the adjacent portions of the disks, and until the peripheral portions of the two disks are substantially in face to face contact. As shown in FIG. 16, this action forces the tongue members **115** to enter into the holes **108** in the blades **81** from opposite sides thereof in overlapping relation with the marginal portions **111** of the blades. The result of these manufacturing operations is to establish firm locking of each blade **81** to the supporting center structure so that the intermediate portions of all of the blades **81** are thus secured in fixed radial relation with the axis of the wheel. This particular center disk structure is similar to that disclosed in U.S. Patent No. 2,852,182, issued September 16, 1958.

Subsequent to the fabrication of the blower wheel **80**, it is subjected to the heat during the brazing step thus causing the copper coating on the two end rings **88** and the center disks **105** and **106** to melt and flow into the space between adjacent surfaces of the blower wheel components. When the blower wheel is allowed to cool, this copper solidifies forming a rigid blower capable of high speed operation. Specifically, as shown in FIG. 18, the end rings **88** and the blades **81** become fused into substantially solid beads **120** and thus the blade flanges **86**, the walls **84** and **85**, and end rings **88** are integrally connected. The gaps or spaces **95** may result in small voids **95***a* (FIGS. 20 and 22) which lessen the weight of the blower wheel and do not detract from the rigidity thereof.

The center disks **105** and **106** become integrally fused together to form a solid outer portion **122** (FIG. 18), and the tongues **115** become similarly rigidly connected to the blades **81** so that the resulting product is a rigid integral blower having substantially all of the advantages of both fabricated and welded blower wheels. In a manner similar to that described above, the hubs **118** become fused to the disks **105** and **106**.

FIGS. 23 and 24 illustrate another embodiment of the center disk structure which can be used in the double inlet blower wheel, shown in FIG. 14. To accommodate this center disk structure, each of the blades **81***a* is provided with a dovetail slot **125** in the trailing edge **110** thereof for receiving the outer peripheral portions **126** of each of the copper coated disks **127** and **128**. The portions **126** are forced into the slots **125** by loosely placing the disks **127** and **128** in the blower wheel with the peripheries of the disks in the slots **125** and then flattening the beads **130** thus radially expanding the disks causing the peripheral portions **126** thereof to be forced tightly into the slots **125** in engagement with the blades **81***a*. In practice, this causes the blades **81***a* to be bowed slightly thus insuring that the disks are positioned securely in the blower wheel. Fabrication of the center disk structure mentioned above is substantially in accordance with that disclosed in the U.S. Patent to Mertz, No. 3,080,105, issued March 5, 1963.

After the blower wheel **80***a* has been fabricated and the center disks **127** and **128** are securely in position, the blower wheel **80***a* is placed in an oven or otherwise subjected to temperature sufficient to melt the copper coatings. This causes the end ring structure to be fused into rigid beads **120**, substantially as described above, and the center disks **127** and **128** to be fused to each other to the center portion of the blades as shown in FIG. 24.

The intermediate portions **133** and **134** of the center disks **127** and **128** are fused into a solid wall **135**, and the beads **130** form an enclosed tubular channel **137** which contributes substantially to the rigidity and strength of the finished blower wheel. Moreover, the outer peripheral portions **126** of the disks **133** and **134** are fused adjacent the edge portions of the dovetail slots **125** in the blade **81***a* thus integrally securing the disks and the blades. This rigid connection factor provides additional strength when the blades are subjected to centrifugal forces since it clearly offers additional resistance to outward radial movement of the blades as caused by centrifugal force.

While the invention has ben described as using a copper coated steel end ring, back plate, or center disk, it should be understood that the material utilized can vary widely within the scope of the invention. The important feature is that the coating must flow at temperatures below those that will cause the base metal to melt or become unduly distorted by warpage. Thus silver solder is one example of a metal which could be used in lieu of copper, and aluminum could be used rather than steel for the metal blades, end rings, back plates and center disks. Moreover, it is possible to coat the blades with the brazing metal, in lieu of or in addition to, the end ring, back plate or center disks. The invention also contemplates the use of resins in place of the coating, e.g., resins which will flow in response to being heated.

The manner in which the coatings can be raised to a temperature sufficient to cause flow thereof can also vary widely within the scope of the invention. This can be accomplished by use of an oven, by induction brazing, or by direct application of a torch to raise the temperature. Preferred results have been obtained from using an oven since this allows each of the separate components of the blower wheel to be heated to the same temperature at the same rates thereby reducing warpage. When copper is coated on cold rolled steel, the wheel is preferably heated to approximately 2060° F. for one-half hour in an atmosphere of ExO gas, which contains approximately 40% hydrogen to hold corrosion to a minimum. The wheel is subsequently reduced to a temperature of 120° F. gradually over a period of one hour. After it is straightened and balanced as required, it is painted and packed for shipment or storage.

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. An integral blower wheel of the character described made substantially entirely of sheet metal parts comprising, a plurality of separately formed parallel sheet metal blades circumferentially arranged to form a wheel having a predetermined diameter, each said blade having a smooth pumping blade surface with radially outwardly extending flange portions at each end thereof, sheet metal ring means at each end of each said blade encompassing and supporting said flange portions to lock said flange portions and said ring means against relative movement in any direction, said ring means having weld material means disposed between the entire area of encompassing contact

between said flange portions and said ring means and providing a continuous annular ring of weld material securely locking said separating flange portions together and to said ring means, said ring means having an outer diameter substantially equal to or greater than said predetermined diameter to provide rigid supports at the opposite ends of said sheet metal blades, a relatively thin radial inner flange on each of said ring means which is integrally connected to at least part of the end portion of said sheet metal blades, and hub means integrally secured to at least one of said ring means to support the blower wheel for rotation.

2. An integral blower wheel as defined in claim **1** wherein one of said end ring means defines an inlet to said blower wheel and the other of said ring means is a back plate which has said hub means secured thereto thus forming a single inlet blower wheel.

3. An integral blower wheel as defined in claim **1** wherein one of said annular means is a sheet metal back plate, said hub means being connected integrally to said back plate, an annular groove in said back plate surrounding said hub, a reinforcing disk integrally secured to said back plate over said groove to create a hollow reinforcing rib in said back plate to add rigidity to said back plate.

4. An integral double inlet blower wheel of the character described made substantially entirely of sheet metal parts comprising, a plurality of separately formed parallel sheet metal blades circumferentially arranged to form a wheel having a predetermined diameter, each said blade having a smooth pumping blade surface with radially outwardly extending flange portions at each end thereof, sheet metal ring means at each end of each said blade encompassing and supporting said flange portions to lock said flange portions and said ring means against relative movement in any direction, said ring means having weld material means disposed between the entire area of encompassing contact between said flange portions and said ring means and providing a continuous annular ring of weld material securely locking said separate flange portions together and to said ring means, said ring means having an outer diameter substantially equal to or greater than said predetermined diameter to provide rigid supports at the opposite ends of said sheet metal blades, a relatively thin radial inner flange on each of said ring means which is integrally connected to at least part of the end portion of said sheet metal blades, a center disk assembly secured centrally with the cage formed by said blades and having an outer portion thereof which extends into cutout portions of said blades, said outer portion being integrally connected to the adjacent portions of said blades, and hub means secured to said center disk assembly to support the blower wheel for rotation.

5. A blower wheel as defined in claim **4** wherein at least one circumferentially hollow reinforcing rib is provided in said center disk assembly adjacent said outer portion to add rigidity to the blower wheel.

6. A double inlet blower wheel of the character described made substantially entirely of sheet metal parts comprising, a pair of single inlet blower wheels each including a plurality of separately formed parallel sheet metal blades circumferentially arranged to form a wheel having a predetermined diameter, each said blade having a smooth pumping blade surface with radially outwardly extending flange portions at each end thereof, a sheet metal end ring at one end of said blades and a back plate at the opposite end of said blades, each said end ring and back plate encompassing and supporting said flange portions of the adjacent said blades to lock said flange portions against relative movement in any direction, said end rings and back plates having weld material means disposed between the entire area of encompassing contact between said flange portions and providing a continuous annular ring of weld material securely locking said separate flange portions together and to said end rings and back plates, said back plates being substantially smooth so that they can be placed adjacent and in contact with each other means integrally securing the contacting areas of said back plates together to form the double inlet blower wheel, and hub means secured to at least one of said back plates to support the blower wheel for rotation.

7. A double inlet blower wheel as defined in claim 6 wherein complementary grooves are provided in said back plates to create hollow reinforcing ribs when said back plates are secured together.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,211,364

October 12, 1965

William H. Wentling et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, line 3, for "separating" read -- separate --; line 75, after "other" insert a comma; column 10, line 12, for "9/61" read -- 9/64 --.

Signed and sealed this 14th day of June 1966.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents