

July 28, 1942.

F. G. MARBACH

2,291,480

BLOWER

Filed April 10, 1941

3 Sheets-Sheet 1

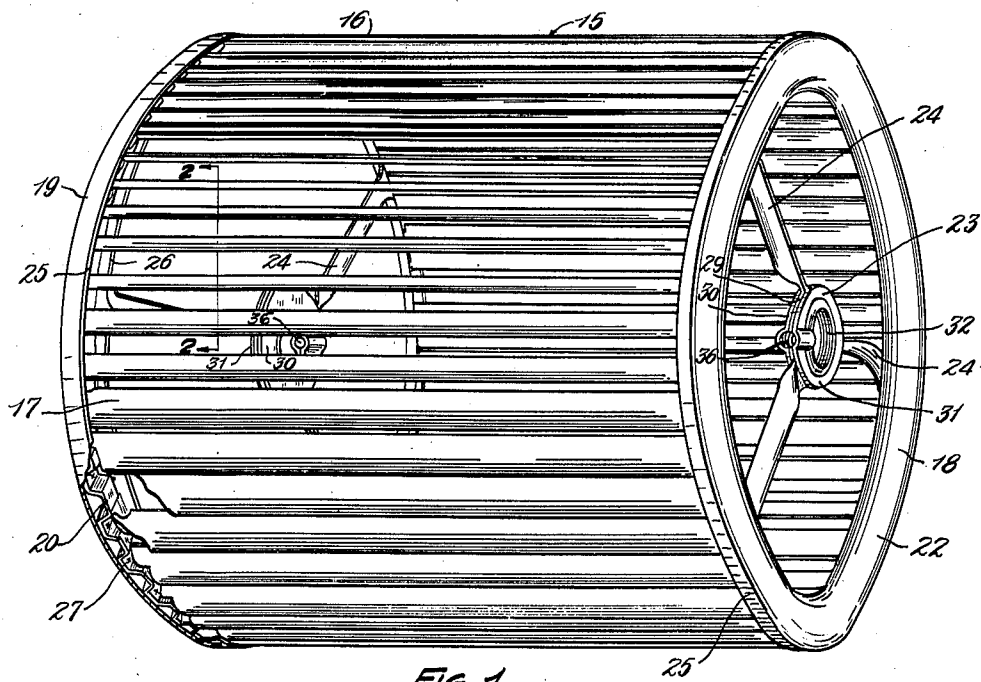


FIG. 1

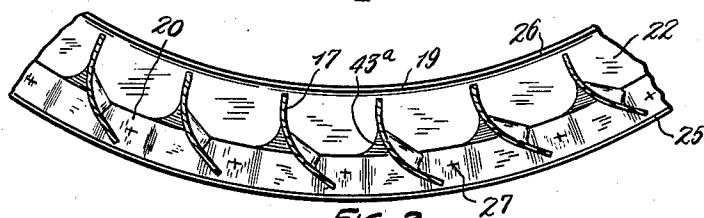


FIG. 2

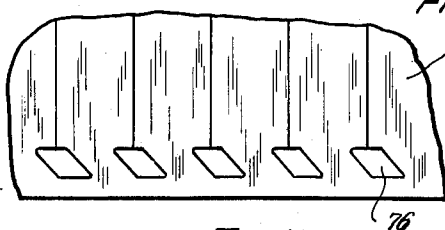


FIG. 16

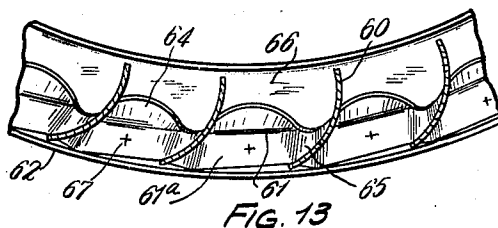


FIG. 13

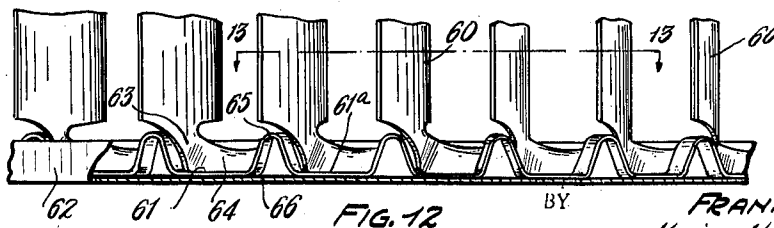


FIG. 12

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3 Sheets-Sheet 2

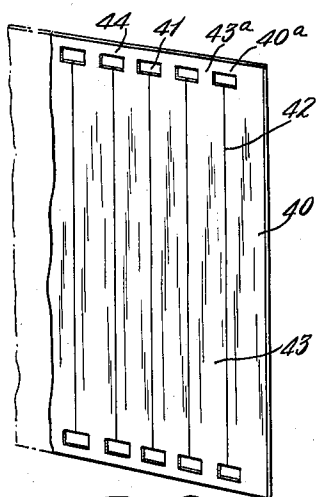


FIG. 3

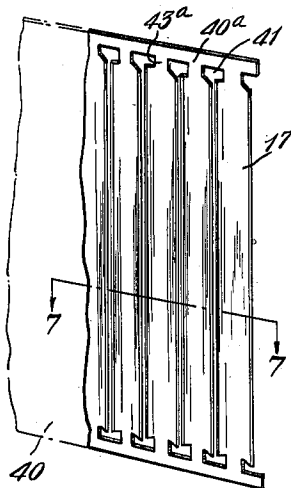


FIG. 4

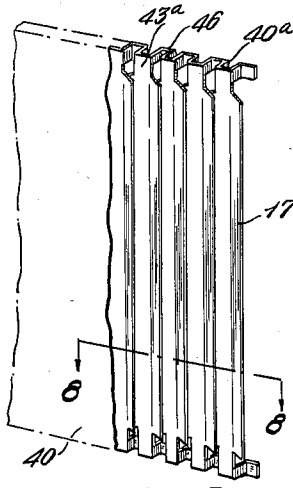


FIG. 5

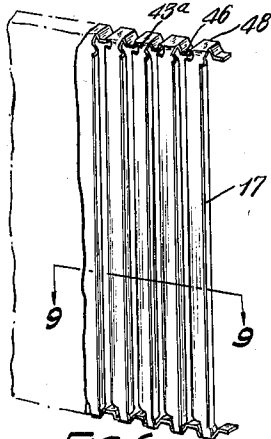


FIG. 6



FIG. 7

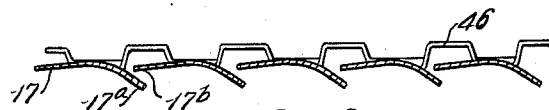


FIG. 8

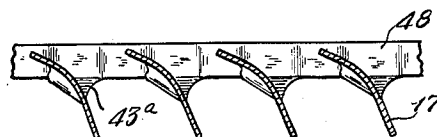


FIG. 9

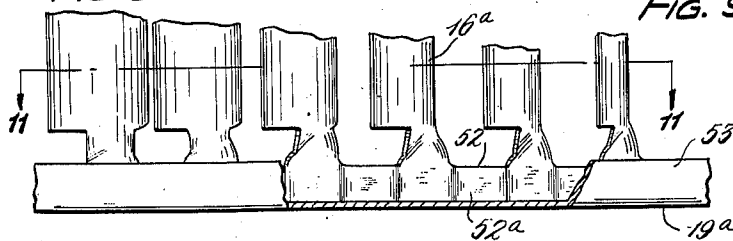


FIG. 10

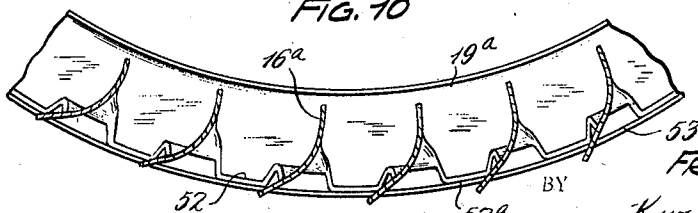


FIG. 11

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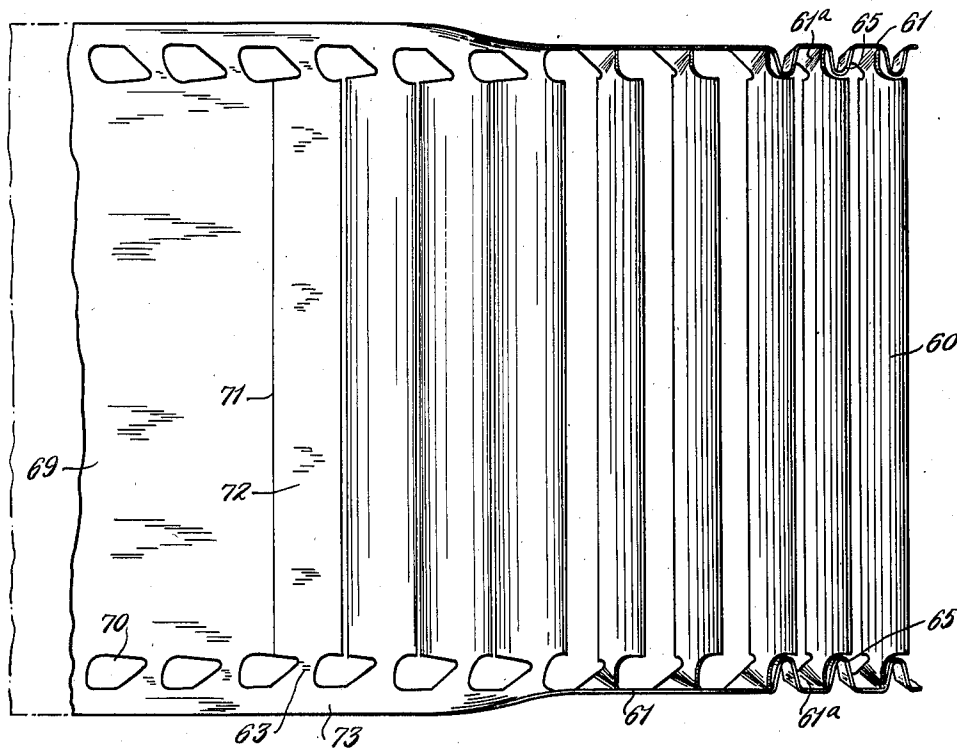
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2,291,480

BLOWER

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,291,480

BLOWER

Frank G. Marbach, Cleveland, Ohio, assignor to
Morrison Products, Inc., Cleveland, Ohio, a corporation of Ohio

Application April 10, 1941, Serial No. 387,931

12 Claims. (Cl. 230—119)

This invention has to do with the manufacture of blowers, and relates more particularly to an improved sheet metal construction for centrifugal blower wheels. This application is, in part, a continuation of my original application, Serial No. 258,009, filed February 23, 1939, now Patent No. 2,242,586, granted May 20, 1941. Certain method operations herein disclosed, but not claimed, are claimed in copending application Serial No. 419,605, filed November 18, 1941.

An object of my invention is to provide an improved construction for blower wheels in which sheet metal can be used for all of the parts thus enabling the blower wheel to be economically manufactured through the use of stamping operations.

Another object of my invention is to provide an improved blower wheel, of the centrifugal type, having an annular series of elongated blades and embodying ring structures or spiders stamped from sheet metal and connected to the ends of the annulus to impart strength and stiffness thereto and to also form axially spaced mounting means by which the blower wheel may be mounted on a shaft.

A further object of my invention is to provide an improved construction for centrifugal blower wheels in which a strip of sheet metal having a series of blades formed thereon is rolled into an annulus and a pair of spiders constructed from sheet metal and having rims of channel-shaped cross-section are connected with the annulus with the ends of the latter extending into the channel recess of the rims.

Still another object of my invention is to provide an improved construction for blower wheels in which an annular series of blades formed from a strip of sheet metal remain connected at their ends by portions of such strip which provide flanges on the annulus, and in which such flanges have gathers therein for decreasing the spacing of the blades and flat portions alternating with the gathers by which spiders can be connected with the ends of the annulus.

My invention may be further briefly summarized as consisting in certain novel combinations and arrangements of parts hereinafter described and particularly set out in the appended claims.

In the accompanying sheets of drawings,

Fig. 1 is a perspective view, with portions broken away, showing a centrifugal blower wheel embodying my improved construction;

Fig. 2 is a partial transverse sectional view of the blower wheel taken as indicated by line 2—2 of Fig. 1;

Figs. 3 to 6, inclusive, are partial perspective views showing progressive steps used in forming a series of blades from a strip of sheet metal;

Figs. 7 to 9, inclusive, are partial transverse sectional views taken through the blade strips of Figs. 4, 5 and 6, respectively, as indicated by the section lines 7—7, 8—8 and 9—9 thereof.

Fig. 10 is a partial side elevation showing a modified construction for my centrifugal blower wheel;

Fig. 11 is a partial transverse sectional view taken through such modified blower wheel as indicated by section line 11—11 of Fig. 10;

Fig. 12 is a partial side elevation of a blower wheel generally similar to that of Fig. 1 but illustrating a modified construction;

Fig. 13 is a partial transverse sectional view taken through this modified blower wheel as indicated by line 13—13 of Fig. 12.

Fig. 14 is a plan view showing a sheet metal strip used in producing the modified construction of Figs. 12 and 13;

Fig. 15 is an edge view of the strip; and

Fig. 16 is a partial plan view showing another sheet metal strip which may be used in producing a blower wheel of the modified construction of Figs. 12 and 13.

Further reference will now be made to the accompanying drawings in which I have illustrated my improved construction for centrifugal blower wheels and although the different embodiments are described in considerable detail, it will be understood, of course, that the drawings are intended to be illustrative and that the invention is not to be regarded as limited to the particular blower wheels and details of construction herein disclosed.

In Fig. 1 I show a centrifugal blower wheel 15 which, according to my improved construction, is formed entirely of sheet metal. The blower wheel here shown comprises an annulus or cylinder 16 formed of a series of elongated substantially parallel transversely curved sheet metal blades 17, and a pair of ring structures or spiders 18 and 19 connected with the ends of the annulus and serving both as a stiffening means and a means for mounting the blower wheel on a shaft. As will be explained more in detail hereinafter, the blades 17 are all formed from a single strip of sheet metal by stamping operations performed thereon so as to leave the blades connected with each other along edges of the strip. These connecting edge portions of the strip are crimped or corrugated for the purpose of gathering the metal and thereby reducing the spacing of the

blades so that an increased number of blades can be accommodated in a given circumference. The strip containing the blades is rolled or formed into the annulus 16 with the corrugated portions of the strip forming end flanges or rings 20 at the ends of the annulus. These flanges or rings maintain the blades in the desired circumferentially spaced relation and provide a means by which the ends of the annulus can be readily connected with the spiders 18 and 19, as by spot welding or other suitable connecting means, with the blades accurately conforming to the desired cylindrical or annular shape so that very little labor need be performed on the blades after assembly for truing or straightening the same.

The spiders 18 and 19 are formed from sheet metal by appropriate stamping operations and, as shown in the drawings, each spider comprises a rim 22 of channel-like cross-section and a shaft-receiving hub 23 connected with the rim by a plurality of radial arms or spokes 24. By constructing the rim 22 of channel-like cross-section it will be seen that a spider of strong and rigid characteristics will be obtained and the connection of the spider with the annulus will be facilitated because an end of the annulus can be inserted into the channel recess and in so doing one or both of the axial flanges 25 and 26 of the spider may be used as a guide means for locating the blades of the annulus in the desired accurate cylindrical arrangement.

In Fig. 1 I show the annulus 16 formed with the integral flanges thereof extending outwardly or radially at substantially right-angles to the axis of the blower wheel. With these flanges arranged in this manner it will be seen that they will engage or seat against the end walls of the hollow spider rims and can be connected thereto at spaced points by the spot welding 27 or other suitable connecting means. It is not necessary, however, that these flanges of the annulus be radially extending flanges because they can extend axially of the blower wheel and can be connected with one of the flanges 25 or 26 of the spider rim, preferably the former flange, as described more in detail hereinafter and as shown in the modified construction of Figs. 10 and 11.

The arms 24 of the spiders are formed integral with the rims thereof and with the intermediate disk portions 29 of the hubs 23. These arms are bevelled or inclined, as shown in Fig. 1, so that they will act as a deflecting means during rotation of the blower wheel and will facilitate the flow of air into the interior of the blower wheel instead of retarding such flow as they would do if they were flat arms. It will be noted from Fig. 1 that the spiders 18 and 19 are of right and left-hand construction so that for a given direction of blower rotation the arms of both spiders will act to cause a flow of air into the blower wheel through the open ends thereof. It will also be noted that the spiders are connected with the ends of the annulus 16 so that the arms of one spider will be in staggered relation with the arms of the other spider. This arrangement is desirable for securing a more accurate balance and in securing maximum stiffness and rigidity of the blower wheel. When these spiders are connected with the ends of the annulus, as above explained and as shown in Fig. 1, it will be observed that the flanges 25 and 26 of the spider rims extend axially inwardly toward each other so that these rims form end rings which are smooth and regular in shape.

The hubs 23 are also of sheet metal construc-

tion, and in addition to the intermediate disk portion 29, include oppositely dished disk members 30 and 31 secured against opposite sides of such intermediate disk portion. Each hub is provided with a shaft-receiving opening 32 and with a threaded opening 36 adapted to receive a set screw or the like. These hubs are more fully disclosed and claimed in my copending application, Serial No. 382,222, filed March 7, 1941.

With the hub and spider construction above described, it will be seen that the ends of the blower wheel can be mounted on or connected with a shaft at axially spaced points corresponding substantially with the transverse end planes of the blower wheel and, when thus mounted, the blower wheel will not be subject to warping or twisting nor does any part of the blower wheel project in a free over-hanging relation to become distorted or to produce vibrations. Moreover, it will be seen that the construction and arrangement which I have provided for the spiders will result in the blower wheel having sufficient stiffness and rigidity to prevent the same from being distorted or losing its accurate shape during shipping or handling.

My improved blower construction can be better explained by referring to Figs. 3 to 6, inclusive, which show progressive steps in the forming of the annulus 16 from a strip of sheet metal. Fig. 3 shows a strip 40 of sheet metal of appropriate length such that a full set of blades for a blower wheel can be formed thereon and the strip then rolled or shaped into an annulus to bring the blades into their desired cylindrical arrangement. Rows of openings 41 are punched in the strip adjacent the side edges thereof and the strip is slit transversely at longitudinally spaced points by cuts 42 extending from one row of openings to the other. The cuts 42 and portions of the openings 41 thus divide the strip longitudinally into a series of elongated substantially parallel sections 43 for the subsequent formation of the blades. As shown in Fig. 3 the ends of the sections 43 remain connected with the longitudinal edge portions 40a of the strip by means of stems 43a which are of reduced width, that is to say, are narrower than the sections themselves.

The strip resulting from the punching and slitting just explained above is subjected to a forming operation in which the sections 43 are bowed or curved transversely thereof and thus formed or partially formed into blades 17. In so shaping the blade sections 43, the edge 17a of each section is lifted up with respect to the plane of the strip, as shown in Fig. 7, so that during the subsequent metal gathering operation this uplifted edge can shift into overlying relation to the contiguous edge 17b of the adjacent section, as shown in Fig. 8. The blades 17 are later subjected to a rocking movement about their respective longitudinal center lines or axes by which the blades are set at a desired angle by a twisting of the stem portion 43a while the blades remain connected with the edge portions 40a of the strip.

The strip 40 is subjected to a forming operation in which the metal of the edge portions 40a is gathered at spaced points for the purpose of reducing the spacing of the blades so that an increased number of blades can be accommodated in a given circumference. The gathering of the metal may be accomplished by suitably crimping or corrugating the edge portions 40a of the strip, as shown in Fig. 7, the gathers preferably being

formed between the pairs of adjacent blades and at points opposite the punched openings 41. By comparing the strips shown in Figs. 4 and 5 of the drawings it will be seen that in gathering the metal of the edge portions 40a the bar-like sections 44 which are coextensive with the punched openings 41 are pressed or drawn in a direction at right angles to the plane of the strip to form a series of corrugations or gathers 46 which are connected with each other by the stems 43a.

For the purpose of stiffening the strip and providing a construction at the ends of the annulus which will facilitate the attachment of the spiders 18 and 19 I may subject the strip to a flanging operation. This flanging of the strip may be done either before or after the metal gathering operation. Fig. 5 shows the condition of the strip when the gathering is done before the flanging, while Figs. 14 and 15 show the strip flanged prior to the gathering as will be explained hereinafter. When the flanging is done after the gathering operation the corrugated edge portions 40a (Fig. 5) are bent over to a position extending substantially at right angles to the plane of the strip, as shown in Fig. 6, to thereby form the corrugated end flanges 48. This operation may be performed with suitable dies and can be readily carried out by the bending of the metal of the stems 43a on or adjacent the line at which these stems connect with the edge portions 40a.

The strip is rolled or shaped into an annulus or cylinder by curving the strip substantially uniformly therealong to bring the ends into adjacent or meeting relation, during which the integral flanges 48 are formed into the end rings or flanges 20 which extend outwardly generally radially with respect to the rotation axis of the blower wheel. The annulus thus formed is now ready for assembly with the spiders 18 and 19 and this is accomplished by inserting the ends of the annulus into the channel recesses of the rims and connecting the flanges or end rings 20 with the bottom walls of the latter. As mentioned above, this may be accomplished by spot welding 27 or any other suitable connecting means.

When the ends of the annulus are inserted into the rims of the spiders I find it desirable to use one of the flanges of the spider rim, for example the outer flange 25 thereof, as a guide means or abutment for locating the blades and truing the annulus to cylindrical shape. Since the spiders themselves are accurately formed in metal working dies the flanges of their rims will be truly circular in form and hence if the outer edge of the ring or radial flange 20 is held firmly against the flange 25 while the annulus is being welded or otherwise connected to the rim, it will be seen that the annulus will have the desired cylindrical shape after assembly and very little additional work will be required for straightening or truing the blades. In forming the corrugations 46 for gathering the metal of the edge portions 40a of the strip, it may be desirable to form the corrugations of square or nearly square shape so that the end flanges 48, and the end rings 20 resulting therefrom, will have a series of flat or nearly flat faces thereon. These flat faces provide contact areas which will have substantially flat engagement with the rims of the spiders and will facilitate the forming of the welds 27.

It is not necessary that the edges of the strip

be subjected to a flanging operation and if desirable the annulus may be formed with straight instead of flanged ends, as mentioned above and as shown in the modified construction in Figs. 10 and 11. In this modified construction the strip is rolled into an annulus, without the formation of the radial end flanges, and the spiders are then connected with the ends of the annulus. In Fig. 10 I show an annulus 16a which has been formed in this manner and show the corrugated axially extending end ring 52 of the annulus inserted into the channel recess of the rim of the spider 19a with its flat-topped corrugations or gathers 52a placed against the inner face of the outer flange 53 of the spider and connected therewith by spot welding or other suitable connecting means.

In Figs. 12 and 13 I have illustrated another modification of my improved blower wheel construction in which a relatively stronger connection is obtained between the ends of the blades and the end flanges of the annulus and in which the gathers or corrugations are located closer to the stems of the blades so as not to interfere with the spot welding operation. Although Figs. 12 and 13 show only portions of a blower wheel, it will be understood, of course, that these views illustrate a construction intended to be embodied in a blower wheel of the same general type as that illustrated in Fig. 1.

In this modified construction the blower wheel also comprises an annular series of transversely curved blades 60 which are connected at their ends by substantially radially outwardly extending corrugated flanges 61 formed from the same strip of sheet metal as that from which the blades are formed, and sheet metal spiders 62 connected to such end flanges. The blades 60 are connected with the end flanges 61 by means of stems 63 of reduced width which have been twisted so that the blades will have the desired position or set in the annulus. The connections between the stems 63 and the end flanges 61 include generally triangular webs 64 of metal which extend in angularly inclined or obtuse relation to these flanges. As will be seen from Figs. 12 and 13 these webs are integrally connected along one side with the flanges 61 and at their ends are integrally connected respectively with the stems 63 and the corrugations or gathers 65. These webs 64 serve to reinforce and strengthen the blades 60 at the point of connection of the same with the end flanges 61 and tend to hold the blades against deflection from their proper shape and position in the annulus.

In order to obtain an increased number of blades in an annulus of a given diameter, I form the gathers or corrugations 65 in the end flanges 61 between the pairs of adjacent blades. As shown in Figs. 12 and 13 the gathers 65 may be formed in the end flanges 61 so as to extend axially inwardly of the annulus at points closely adjacent to the stems 63 so as to leave flats 61a of relatively large area on the end flanges 61 between the adjacent gathers. In connecting the annulus to the spiders 62 the flats 61a are secured against the inner faces of the bottom walls 66 of the spiders by suitable connecting means, such as the spot welding indicated at 67. It will be observed that when the gathers 65 are formed in the end flanges 61 so as to lie closely adjacent to the stems 63, the flats 61a will lie opposite the spaces between adjacent blades thus affording clearance space which facilitates the spot welding indicated at 67.

In Figs. 14 and 15 I have illustrated the manner in which the bladed annulus is produced for the modified blower wheel construction of Figs. 12 and 13. In these views I show a strip of sheet metal 69 on which metal-working operations are performed to transform the same into a strip of transversely curved blades 60 which are integrally connected at their ends by the corrugated flanges 61. The strip may be advanced or fed by a step-by-step movement between suitable dies (not shown) which are made to close on the strip between the successive advance movements thereof to simultaneously perform a plurality of metal-working operations on the strip. During the advance movement of the strip between the successive die-closings, edge portions of the strip are deflected or bent upwardly by suitable die means to form the longitudinal flanges 61. The operations performed simultaneously on the strip by the closing of the dies consist in a punching step, a slitting step, a blade forming or shaping step and corrugating or gathering the metal of the flanges 61.

The punching step or operation consists in forming rows of openings 70 adjacent opposite edges of the strip. One pair of such openings is formed in the strip at each closing of the dies. These openings may be of a modified rectangular shape as shown in Fig. 14. The slitting of the strip consists in forming transverse cuts 71 therein which extend from the openings of one row to those of the other row. One such transverse cut or slit is formed in the strip at each closing of the dies. The slits 71 divide the strip into contiguous sections 72, from which the blades 60 are formed, and which sections remain connected at their ends with the edge portions 73 of the strip by the stems 63. The forming of the blades consists in curving the sections transversely to produce the partially formed blades 72a and then further forming the sections into the blades 60 by rotating the partially formed blades 72a to a more or less upright position relative to the plane of the strip. Such rotating of the blades may be done by twisting the stem portions 63. During each closing of the dies one of the sections 72 is curved into a partially formed blade 72a and one of the partially formed blades is further formed into one of the blades 60. The corrugating or gathering of the flanges 61 consists in deflecting portions of these flanges at points between adjacent blades to thereby form the gathers or corrugations 65 which extend toward each other, that is, in the direction of the length of the blades. The forming of the gathers 65 reduces the spacing of the adjacent blades 60. One pair of such gathers is formed in the flanges 61 during each closing of the dies.

It will thus be seen from the manner of carrying out these metal-working operations, as above explained, each closing and opening of the dies will account for the forming of one complete blade on the strip with its adjacent pair of gathers.

In Fig. 16 I show a sheet metal strip 75 on which blades may be formed in the manner above explained in connection with the strips 40 or 69 but in which the openings 76 punched adjacent opposite edges of the strip are substantially of the form of a rhombus. For the construction of certain blower wheels it may be desirable to punch openings of this shape rather than the rectangular openings 44 shown in Fig. 3 or the specially shaped openings 70 shown in Fig. 14.

From the foregoing description and the accompanying drawings it will now be readily seen that I have provided an improved construction for centrifugal blower wheels by which sturdy and accurate blower wheels of this type can be economically produced from sheet metal. With my improved construction and method I can produce a blower wheel having a rigidity comparable to that of a byower wheel of the present-day type of construction but which is 25% to 50% lighter in weight. This is important from the standpoint of economy of material and economy of power where the blower is operated with frequent starting and stopping. It will be seen furthermore that in accordance with my improved construction a blower can be formed with a set or series of blades stamped from a single strip of sheet metal and that sheet metal spiders attached to the ends of the annulus give the blower a desired rigidity and also provide for mounting the blower on a shaft without the use of a center plate and without having overhanging portions of the blower which are usually subject to distortion and frequently cause objectionable vibrations. The gathering of the metal at the ends of the blades, as provided in my invention, decreases the spacing of the blades and results in a construction in which a larger number of blades can be accommodated in an annulus of a given diameter. By reason of this feature a blower wheel of my improved construction may embody an aggregate blade area which is 25% to 50% greater than the area of a plain cylinder having the same length and outside diameter.

While I have illustrated and described my improved blower construction in a somewhat detailed manner, it will be understood, of course, that I do not wish to be limited to the details of construction herein disclosed, but regard my invention as including such changes and modifications as do not constitute a departure from the spirit of the invention and the scope of the appended claims.

Having thus described my invention, I claim:

1. In a centrifugal blower wheel, a cylindrical arrangement of elongated substantially parallel sheet metal blades connected at their ends by integral generally radial flanges constituting portions of the same sheet metal body as that from which said blades are formed, said flanges having gathers therein between adjacent blades and the aggregate area of the blades of the wheel being greater than the area of a cylinder having substantially the same length and outside diameter as said wheel.

2. A centrifugal blower wheel comprising a cylindrical arrangement of elongated substantially parallel sheet metal blades having integral stem portions connecting the ends thereof with outwardly extending generally radial flanges constituting portions of the same sheet metal body as that from which said blades are formed, said stem portions having twists therein holding said blades in a substantially radial position.

3. A centrifugal blower wheel comprising a cylindrical arrangement of elongated substantially parallel sheet metal blades connected at their ends by integral generally radial flanges constituting portions of the same sheet metal body as that from which said blades are formed, said flanges having gathers therein between adjacent blades and the aggregate area of the blades of the wheel being greater than the area of a cylinder having substantially the same

length and outside diameter as said wheel, the ends of the blades being connected with said flanges by integral stems having twists therein holding the blades in a substantially radially position.

4. In a centrifugal blower wheel, a cylindrical arrangement of elongated substantially parallel sheet metal blades connected at their ends by integral generally radial flanges constituting portions of the same sheet metal body as that from which said blades are formed, said flanges having gathers therein between adjacent blades and substantially flat portions between the gathers, the aggregate area of the blades of the wheel being greater than the area of a cylinder having substantially the same length and outside diameter as said wheel, and a pair of spiders having shaft-receiving hubs and also having rims against which said flat portions are secured.

5. A centrifugal blower wheel comprising a cylindrical arrangement of elongated substantially parallel sheet metal blades connected at their ends by integral generally radial flanges constituting portions of the same sheet metal body as that from which said blades are formed, said flanges having gathers therein between adjacent blades and having substantially flat portions between the gathers, the aggregate area of the blades of the wheel being greater than the area of a cylinder having substantially the same length and outside diameter as said wheel, the ends of the blades being connected with said flat portions by stems which include an integral generally triangular reinforcing web portion extending angularly to the corresponding flat flange portion.

6. A centrifugal blower wheel comprising a cylindrical arrangement of elongated substantially parallel sheet metal blades connected at their ends by integral generally radial flanges constituting portions of the same sheet metal body as that from which said blades are formed, said flanges having corrugations therein between adjacent blades and having substantially flat portions between the corrugations, the aggregate area of the blades of the wheel being greater than the area of a cylinder having substantially the same length and outside diameter as said wheel, and a pair of sheet metal spiders having shaft-receiving hubs and channel-shaped rims, said flanges being secured in said channel-shaped rims with the flat portions of the flanges seating against the bottoms of the rim recesses.

7. A centrifugal blower wheel comprising a cylindrical arrangement of elongated substantially parallel sheet metal blades connected at their ends by integral flanges constituting portions of the same sheet metal body as that from which said blades are formed, said integral flanges extending outwardly with respect to the rotation axis and having alternate gathers and flats thereon, and a pair of sheet metal spiders at the ends of the blade arrangement, said spiders having shaft-receiving hubs and also having rims provided at their outer periphery with axial flanges extending toward each other, the flats of said integral flanges being secured against said rims with the outer edges of said integral flanges substantially in abutting relation to said axial flanges.

8. A centrifugal blower wheel comprising a cylindrical arrangement of elongated substantially parallel sheet metal blades connected at their ends by integral flanges constituting por-

tions of the same sheet metal body as that from which said blades are formed, said integral flanges having substantially flat-topped corrugations therein between adjacent blades, and a pair of sheet metal spiders at the ends of the blade arrangement and having rims provided with axial flanges extending toward each other, said flat-topped corrugations being secured against the inner faces of said axial flanges.

9. In a centrifugal blower wheel, a cylindrical arrangement of elongated substantially parallel sheet metal blades connected at their ends by integral generally radial flanges constituting portions of the same sheet metal body as that from which said blades are formed, said flanges having offset portions between the pairs of adjacent blades and which extend inwardly toward each other in the general direction of the blades, the aggregate area of the blades of the wheel being greater than the area of a cylinder having substantially the same length and outside diameter as said wheel.

10. A centrifugal blower wheel comprising a cylindrical arrangement of elongated substantially parallel sheet metal blades connected at their ends by integral generally radial flanges constituting portions of the same sheet metal body as that from which said blades are formed, said flanges having substantially axially extending inwardly tapered offset portions between the pairs of adjacent blades and substantially flat portions between the pairs of adjacent offset portions, the aggregate area of the blades of the wheel being greater than the area of a cylinder having substantially the same length and outside diameter as said wheel, and a pair of spiders having shaft-receiving hubs and also having rims against which said substantially flat portions of the flanges are secured.

11. A centrifugal blower wheel comprising a cylindrical arrangement of elongated substantially parallel sheet metal blades connected at their ends by integral generally radial flanges constituting portions of the same sheet metal body as that from which said blades are formed, said flanges having substantially axially extending inwardly tapered offset portions between the pairs of adjacent blades and substantially flat portions between the pairs of adjacent offset portions, the aggregate area of the blades of the wheel being greater than the area of a cylinder having substantially the same length and outside diameter as said wheel, and a pair of spiders having shaft-receiving hubs and also having rims against which said substantially flat portions of the flanges are secured, said blades having stem portions of reduced width at their ends by which they are connected with said substantially flat parts of said flanges and said stem portions being of a shape to hold said blades in a substantially radial position.

12. A centrifugal blower wheel comprising a cylindrical arrangement of elongated substantially parallel sheet metal blades connected at their ends by integral generally radial flanges constituting portions of the same sheet metal body as that from which said blades are formed, said flanges having substantially axially extending inwardly tapered offset portions between the pairs of adjacent blades and substantially flat portions between the pairs of adjacent offset portions, the aggregate area of the blades of the wheel being greater than the area of a cylinder having substantially the same length and outside diameter as said wheel, said blades hav-

ing stem portions of reduced width at their ends by which they are connected with said flanges and which stem portions are of a shape to hold said blades in a substantially radial position, and a pair of spiders having shaft-receiving hubs and also having rims against which said substantially flat portions of the flanges are secured by

welds, said offset portions being located relatively close to said stem portions and said flat portions being located to span the spaces between the pairs of adjacent blades so as to facilitate the forming of said welds.

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