July 27, 1954 H. MORRISON, JR 2,684,521

METHOD OF MAKING BLOWER WHEELS

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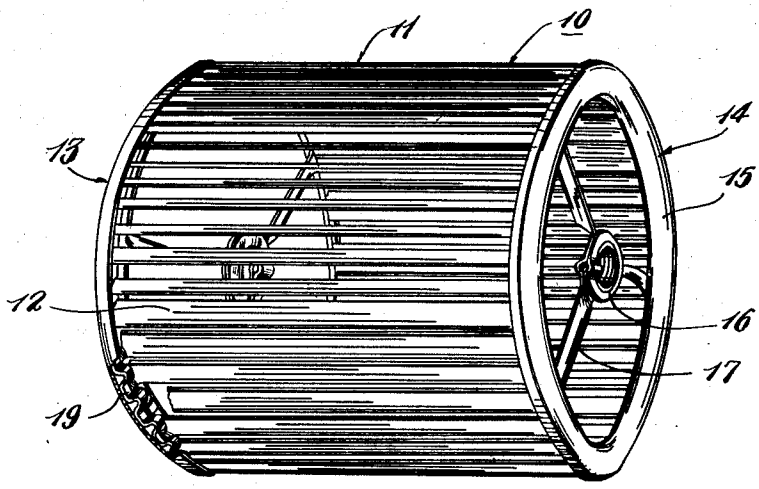


FIG. 1

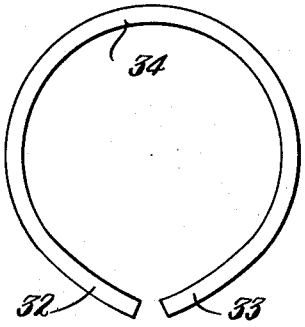


FIG. 5

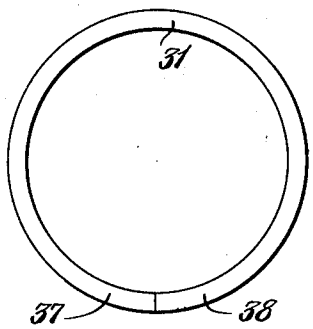


FIG. 6

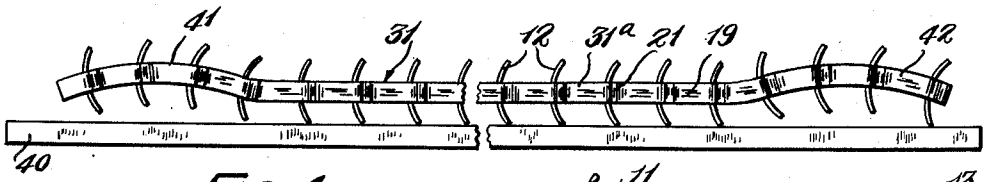


FIG. 4

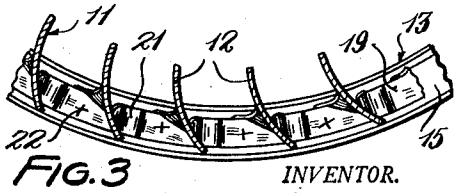


FIG. 3

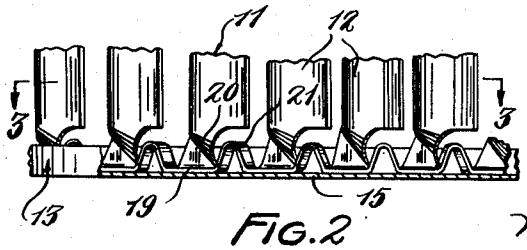


FIG. 2

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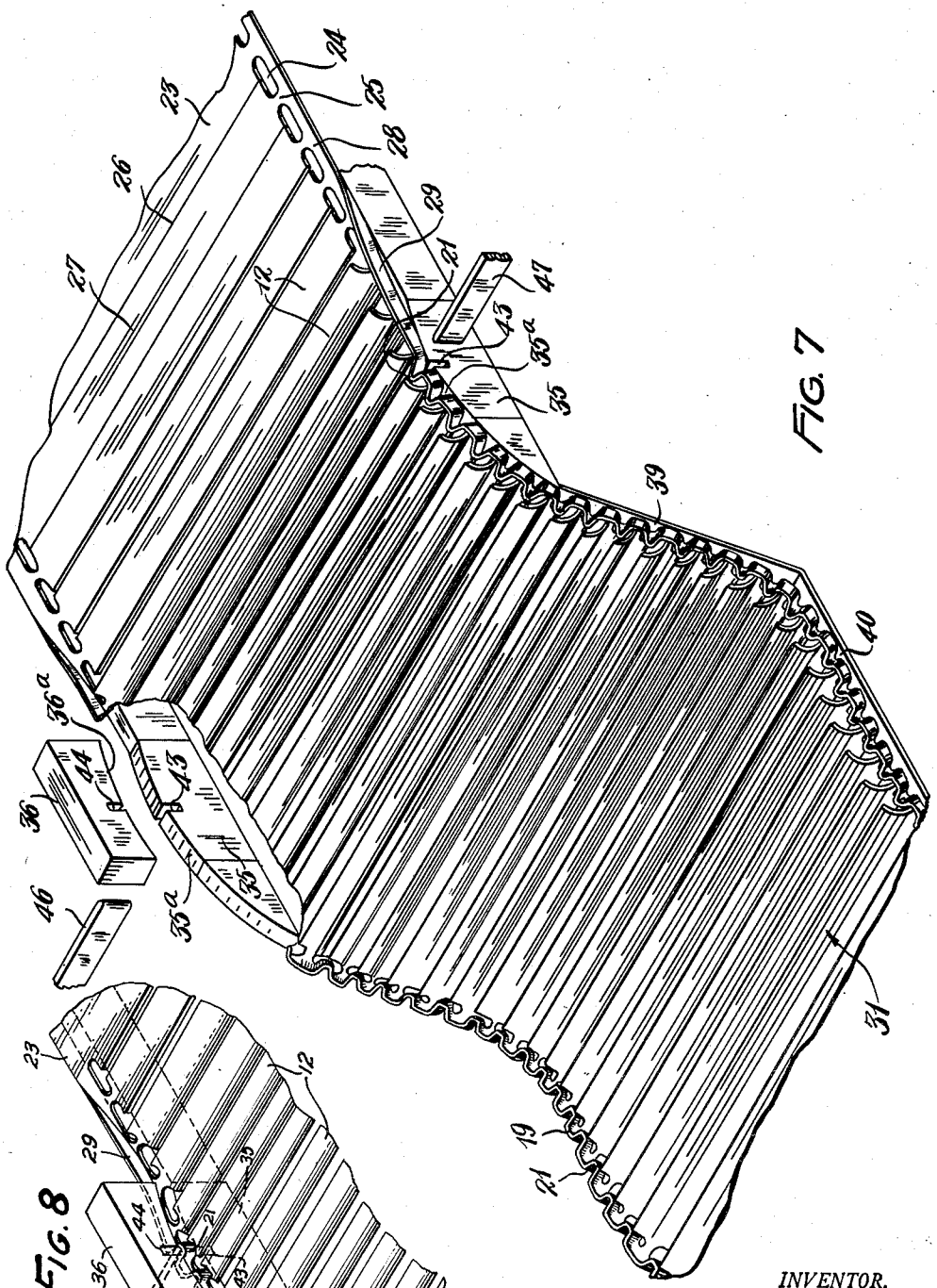


FIG. 7

FIG. 8

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METHOD OF MAKING BLOWER WHEELS

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2 Claims. (Cl. 29—156.8)

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This invention relates to the manufacture of blower wheels of the centrifugal type from sheet metal strip and, more particularly, relates to a novel method for producing such blower wheels. The method of the present invention represents an improvement over earlier U. S. Patents 2,242,586, granted May 20, 1941, and 2,291,480, granted July 28, 1942.

These earlier patents cover a blower wheel and method in which transversely extending, partially sheared, parallel portions of a sheet metal strip are formed into a row of blades whose ends remain integrally connected with edge portions of the strip, and in which the resulting bladed strip is subsequently formed into an annulus.

When it is desirable to form a cylinder from a strip of sheet material and the strip is curved into an annulus for this purpose, it is a well known phenomenon that the end portions of the strip resist such curving action and tend to assume a position in which they extend substantially tangent to the cylinder being formed. Unless this condition is overcome, such substantially straight end portions of the strip will result in a substantially flat spot and an out-of-round condition in the cylinder.

This behavior of the end portions of a strip also applies to the end portions of a bladed blower wheel strip, of the kind disclosed in the above-mentioned patents, when such a bladed strip is being formed into an annulus. To overcome this tendency for the end portions of such a bladed strip to remain straight has heretofore required the expenditure of considerable time and labor in forming the strip into a blower wheel of a desired truly cylindrical shape.

As one of its objects, this invention therefore provides a novel method of making blower wheels by first forming a bladed strip from a strip of sheet metal and then forming the bladed strip into an annulus, but in which a curvature set is imparted to the bladed strip and particularly to the end portions thereof prior to the forming of the strip into an annulus or cylinder.

Still another object is to provide a novel method of making blower wheels, as mentioned above, but in which the edge portions of the blade strip are flanged and have gathers formed therein for reducing the spacing between adjacent blades and in which a curvature set is imparted to such flanged edge portions after which the blade strip is formed into an annulus.

It is also an object of this invention to provide a novel method of making blower wheels as above

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referred to in which the curvature set is imparted to the edge portions of the blade strip by paired die members having cooperating convex and concave die surfaces.

Additionally, this invention provides a novel method of making blower wheels as referred to above, in which the sheet metal strip is advanced with a step-by-step intermittent movement during the forming of the blades and the flanged edge portions of the strip are subjected to a pressure forming operation between the cooperating convex and concave die surfaces for imparting a curvature set thereto and in which the gathers are formed in said flanged edge portions while the latter are held between such die surfaces.

Other objects and advantages of the invention will be apparent in the following detailed description and in the accompanying sheets of drawings in which:

Fig. 1 is a perspective view, with portions broken away, showing a sheet metal blower wheel produced by use of the method and bladed strip of the present invention;

Fig. 2 is a fragmentary elevational view partly in section further illustrating the construction of the blower wheel at the ends thereof;

Fig. 3 is a partial transverse section of the blower wheel taken approximately as indicated by section line 3—3 of Fig. 2;

Fig. 4 is an elevational edge view of the novel bladed blower wheel strip from which the blower wheel of Fig. 1 has been formed;

Figs. 5 and 6 are diagrams representing end views of strips being curved into annuli and illustrating certain phenomena relating thereto;

Fig. 7 is a top and side perspective view illustrating the novel blower wheel method of this invention; and

Fig. 8 is a fragmentary perspective view corresponding with a portion of Fig. 7 and showing the clamping die members in closed position and also showing the cooperating die plunger in gather-forming position.

In Fig. 1 of the drawings, a centrifugal blower wheel 10 is shown which is of the general kind forming the subject matter of the earlier patents mentioned above and which has been produced by the use of the novel method and bladed blower wheel strip described in detail hereinafter. The blower wheel 10 comprises an annulus 11 defined by a circumferential series of substantially parallel sheet metal blades 12 and a pair of ring structures or mounting spiders 13 and 14 connected to the ends of the annulus. The ring structures 13 and 14 each comprise a substan-

tially circular rim portion 15 of a substantially channel-shaped cross-section and a central hub 16 connected with the rim portion 15 by a plurality of substantially radial arms 17.

The annulus 11 is produced from a strip of sheet metal as will be presently explained and includes substantially radial flanges 19 at its ends with which the ends of the blades 12 are connected by stems 20. The stems 20 are somewhat twisted, as shown in Figs. 2 and 3, by which the blades 12 are positioned in the desired angular relation in the circumferential series. Between each pair of blades 12, the flanges 19 have gathers 21 formed therein which serve the purpose of shortening the segments of these flanges to thereby bring the blades into a more closely spaced relation such that a larger number of blades can be incorporated in the annulus 11 of a given diameter. In the assembled condition of the annulus 11 and the ring structures 13 and 14, the ends of the annulus extend into the channel recesses of the ring structures and are secured to the latter by having the flanges 19 of the annulus connected to the ring structures by welds 22 located between the gathers 21.

As has already been indicated above in a general way, the annulus 11 is produced from a strip of sheet metal 23 (see Fig. 7) and the operations by which the sheet metal strip is converted into a bladed strip and such bladed strip curved into an annulus, are described in greater detail in the earlier patents mentioned above. For the purposes of the present invention, it is sufficient to explain that the sheet metal strip 23 is provided with rows of punched openings 24 adjacent its longitudinal edges with intervening strip portions 25 remaining between the pairs of such openings. The strip 23 is partially sheared transversely thereof by forming slits 26 therein in substantially parallel relation and extending between pairs of oppositely located openings 24. The slits 26 divide the strip 23 into partially sheared parallel strip portions 27 from which the blades 12 are formed.

The parallel strip portions 27 are subjected to one or more shaping operations by which these portions are given a curved or bowed shape transversely thereof corresponding substantially with the curved shape desired for the blades 12. The ends of the blades remain integrally connected with the imperforate longitudinal edge portions 28 of the strip by stems defined by the intervening strip portions 25. The strip portions 27, or the blades 12 resulting therefrom, are deflected or tilted to a desired angular position by a twisting of these intervening strip portions or stems 25.

The imperforate edge portions 28 of the strip are deflected angularly to form longitudinal edge flanges 29 on the blade strip being produced. The gathers 21 are formed in these edge flanges 29 of the strip by deflecting portions of these flanges into the spaces between the blades and in the general direction of the longitudinal axes of the blades.

The bladed strip 31 resulting from the sheet metal strip 23 and the operations just described above, is curved into the annulus 11 to which the ring structures 13 and 14 are then applied. As has already been mentioned above, the curving of a strip of sheet metal or a bladed strip of this character into an annulus, produces a condition which has been illustrated in the diagrammatic view of Fig. 5. As is represented in this view, the end portions 32 and 33 of a strip

34 will tend to remain in a substantially straight condition in which they extend in a direction substantially tangent to the circumference formed by the intermediate portion of the strip. This tendency for the end portions of the strip to remain straight is a well known phenomenon and probably results from the inherent resiliency of the strip. To overcome this tendency usually requires the application of additional force and shaping operations to these end portions to bring the same to the desired truly circular shape and if this is not done, the resulting annulus or cylinder will have a corresponding irregular shape caused by a flat spot thereon.

This problem has been solved by the present invention in the manner which will now be explained. During the forming of the bladed strip 31 from the sheet metal strip 23, the material is advanced with a step-by-step movement during which the edge portions of the strip defined by the flanges 29 are led over a pair of laterally spaced lower die members 35 so as to move along the convexly curved upper die surfaces 35a of these die members. During such movement of the strip over the die surfaces 35a, the flanged edge portions 29 are clampingly engaged by a pair of upper die members 36 which are reciprocably movable relative to the lower die members and have concave die surfaces 36a which cooperate with the curved die surfaces 35a of the lower die members.

The closing of the paired die members 35 and 36 on the edge flanges 29 of the strip 31, produces a forming operation on such edge flanges by which a curvature set is imparted thereto. The curved die faces 35a and 36a preferably have a radius of curvature substantially equal to the radius of curvature of the annulus 11 in the completed blower wheel 10, although if desired, the curvature of these die faces and the curvature set which is imparted thereby to the bladed strip 31, can be either greater or smaller than the radius of curvature of the annulus in the completed blower wheel. Each closing of the paired die members 35 and 36 causes a curvature set to be imparted to the edge flanges 29 for a modular portion of the length of the strip such as to a portion of the strip corresponding to the location or spacing of one or two of the blades 12. Between each such pair of closing operations of the paired die members 35 and 36, the strip is advanced while the die members are open.

In the completed blade strip 31, the modular segments of the edge flanges 29 which have been subjected to the successive curving forces of the cooperating die surfaces 35a and 36a will aggregate the full length of these edge flanges. The effect of these curving forces will be to stress and bend these segments of the edge flanges 29 in an edgewise direction thereby imparting more or less of a set to the metal of these flanges such that the curving of the bladed strip 31 into the annulus 11 can thereafter be quickly and easily accomplished.

The curvature set thus imparted to the edge flanges 29 of the bladed strip 31 greatly facilitates the curving of the strip into the annulus 11 by reason of the fact that the metal has been prestressed or influenced toward assuming the desired annular shape. The phenomenon of the tendency of such a prestressed strip to readily assume a truly cylindrical shape, is illustrated in the diagram of Fig. 6 in which the bladed strip 31 is shown with the end portions 37 and 38 thereof in a properly registering circumferentially

aligned relation. Facilitating the forming of the bladed strip 31 into an annulus by imparting such a curvature set to the strip greatly decreases the work and care heretofore required in obtaining an annulus of a truly circular form.

As the bladed strip 31 leaves the pairs of curved die members 35 and 36, it moves forwardly and downwardly over a guide plate 39 onto a supporting table 40. Successive segments are cut from the leading end of the strip 31 corresponding with the strip length required for the annulus of the blower wheel being produced. Fig. 4 shows such a segment 31a which has been cut from the leading end of the bladed blower wheel strip 31 and still supported on the table 40. The bladed strip 31 and the segment 31a cut therefrom are supported on the table 40 by the lower edges of the blades 12 resting on the upper surface of the table.

Because of the curvature set which has been imparted to the strip 31 by the cooperating die members 35 and 36 as explained above, the free end portions 41 and 42 of the segment 31a will assume a curved condition approximately as shown in Fig. 4 and which extends along the segment for a distance of three or four blades. Although the intermediate portion of the segment 31a has been given a curvature set, the curvature set is not apparent therein from an edge view of the strip as seen from Fig. 4, because the weight of the strip causes the lower edges of the blades 12 to be held against the surface of the table 40. The end portions 41 and 42 of the segment, however, are subject to the weight of only relatively short portions of the length of the strip and, since these end portions are relatively free, they assume the curved condition of Fig. 4 under the influence of the curvature set which was imparted to the metal of the edge flanges 29 by the cooperating die members 35 and 36.

The segment 31a is now curved or rolled into the annulus 11 and the end portions 41 and 42 having the above-explained curvature set therein readily assume a circumferentially aligned truly cylindrical shape, as is illustrated for the end portions 38 and 39 of Fig. 6.

During the forming of the curvature set in the edge flanges 29 of the blade strip 31, these edge flanges are clamped or held between the paired cooperating die members 35 and 36 as explained above. The present invention utilizes this clamped condition of the edge flanges 29 to facilitate the forming of the gathers 21 in these edge flanges. As illustrated in Fig. 7, the cooperating die members 35 and 36 have lateral slots 43 and 44 formed therein and which register with each other when the die members are in their closed position. A pair of inwardly movable die plungers or blades 46 and 47 are associated with the paired die members 35 and 36 and act to form the gathers 21 in the edge flanges 29. While these edge flanges are clamped between the die members, the plungers 46 and 47 move into the passages defined by the slots 43 and 44 and deflect the edge flanges 29 inwardly at a point between a pair of the blades 12 to form the gathers 21. It will be understood, of course, that at the time the plungers 46 and 47 engage the edge flanges the clamping force of the closed die members 35 and 36 thereon will not be such as to prevent the deflection of portions of these flanges to form the gathers therein.

From the foregoing detailed description and the accompanying drawings, it will now be readily understood that this invention provides a novel method of making blower wheels from a sheet metal strip, in which a curvature set is imparted to the bladed strip and greatly facilitates the forming of the bladed strip into an annulus of a truly cylindrical shape. It will, likewise, be seen that the present invention also provides a novel method in which the gathers formed in edge flanges of the blade strip for the purpose of reducing the spacing of the blades, are formed in such edge flanges while the latter are held between the cooperating die members which impart the curvature set to the strip.

Although the method and bladed blower wheel strip of the present invention have been illustrated and described herein to a somewhat detailed extent, it will be understood, of course, that the invention is not to be regarded as being limited correspondingly in scope, but includes all changes and modifications coming within the terms of the claims hereof.

Having thus described my invention, I claim:

1. The method of making blower wheels which comprises, forming transversely extending contiguous portions of a sheet metal strip into blades whose ends remain integrally connected with longitudinally continuous edge portions of the strip, advancing the bladed strip thus produced so as to cause said edge portions to pass between pairs of relatively reciprocable paired die members having cooperating concavely and convexly curved die surfaces, applying bending forces to said edge portions by clamping the same between said die members for imparting a curvature set to the bladed strip, gathering the metal of said edge portions for reducing the spacing of said blades while said edge portions are clamped between said die members, and forming the bladed strip into an annulus.

2. The method of making blower wheels which comprises, forming transversely extending contiguous portions of a sheet metal strip into blades whose ends remain integrally connected with longitudinally continuous edge portions of the strip, flanging said edge portions of the bladed strip thus produced, advancing the bladed strip with a step-by-step movement so as to cause the flanged edge portions to pass between pairs of relatively reciprocable paired die members having cooperating concavely and convexly curved die surfaces, closing said die members in timed relation to said step-by-step movement and applying bending forces to said edge portions by clamping the same between said die members, forming gathers in said edge portions between pairs of said blades while said edge portions are clamped between said die members, and forming said strip into an annulus.

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