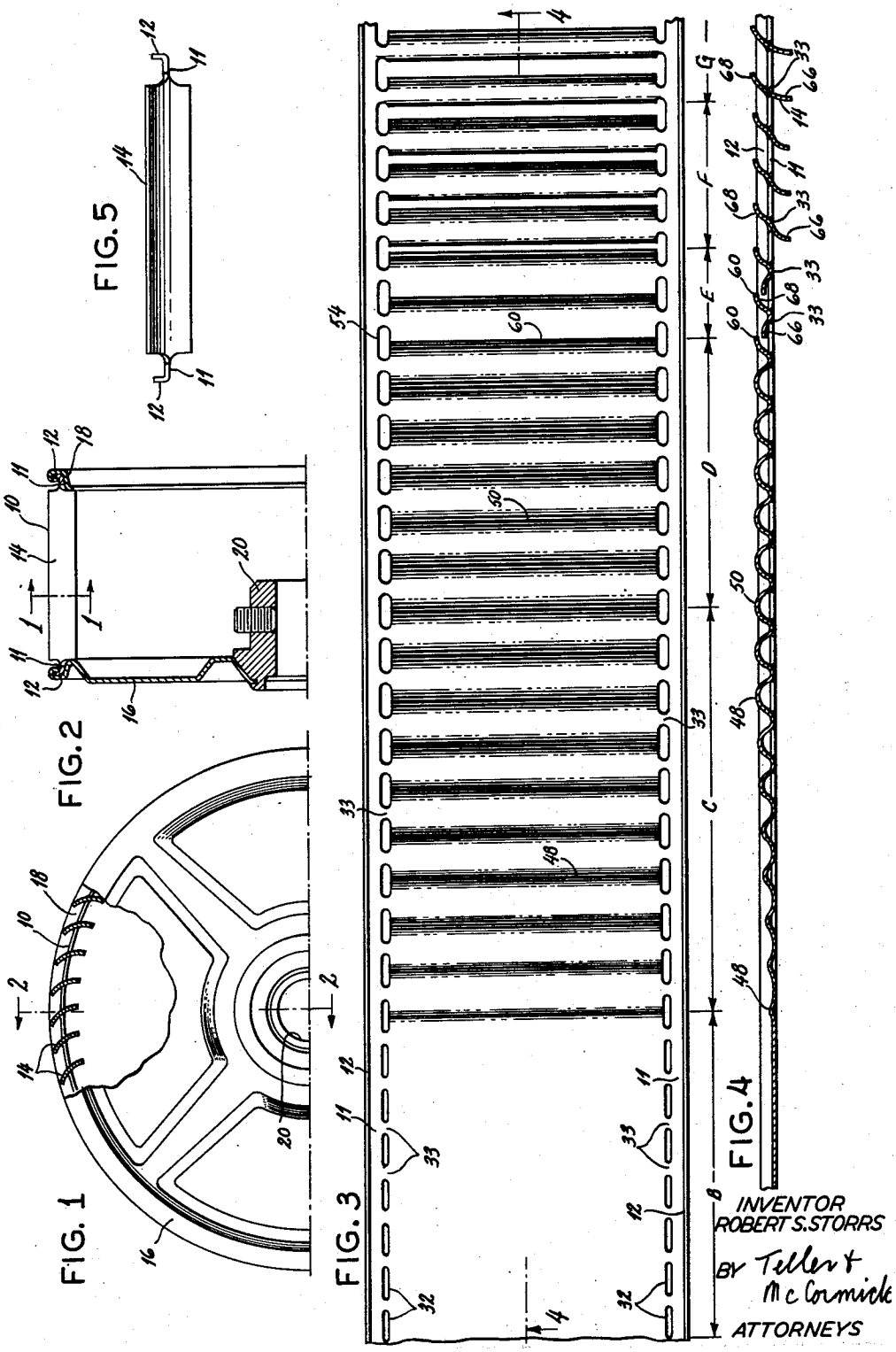
Nov. 14, 1961 R. S. STORRS 3,008,630

BLOWER WHEEL AND BLADE STRIP THEREFOR AND METHOD OF MAKING BLADE STRIP

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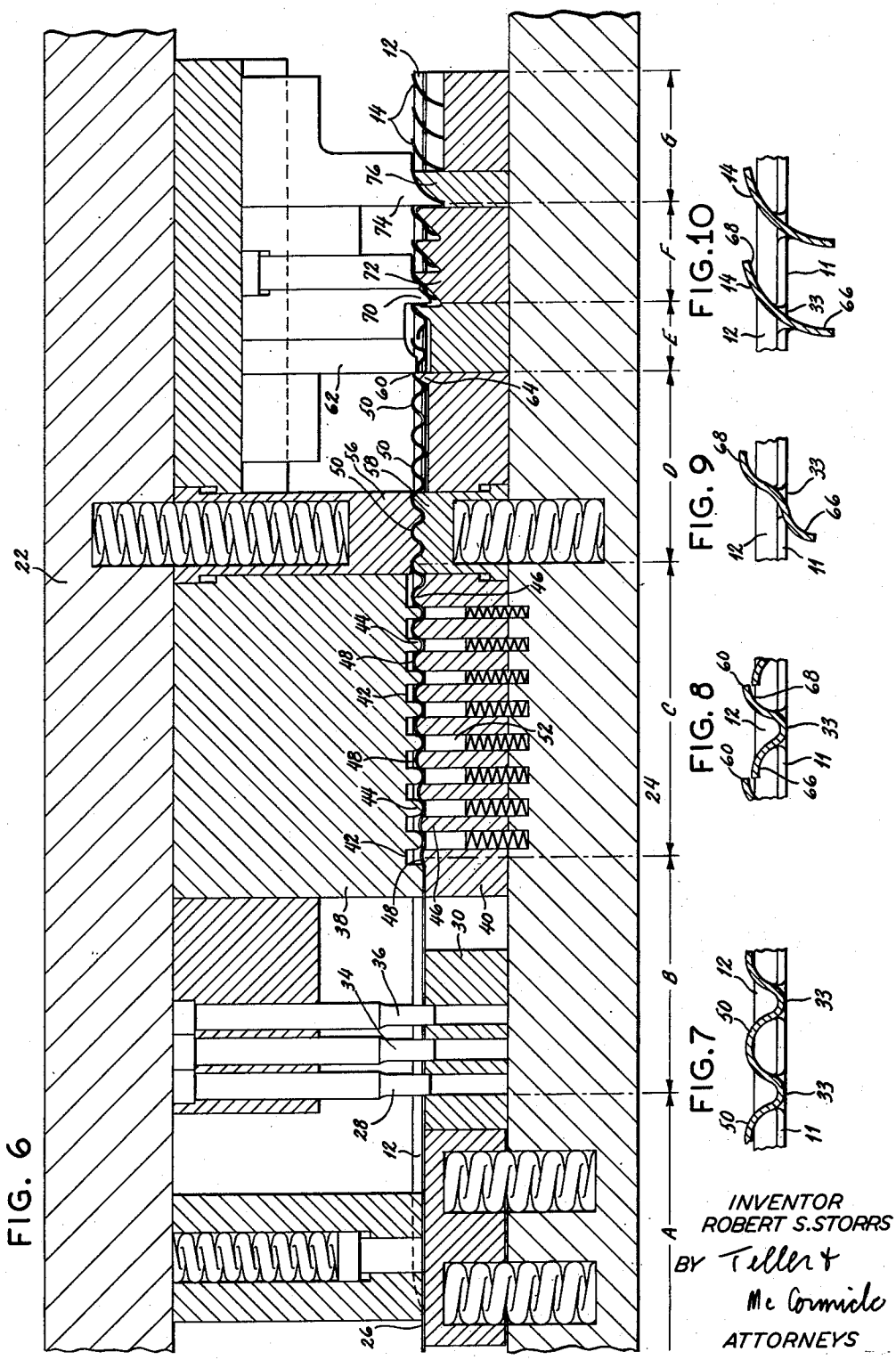


FIG. 6

FIG. 10

FIG. 9

FIG. 8

FIG. 7

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BLOWER WHEEL AND BLADE STRIP THEREFOR AND METHOD OF MAKING BLADE STRIP

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A centrifugal blower wheel commonly includes an end plate and an end ring having a common axis and spaced from each other axially and also includes a cylindrically bent sheet metal blade strip concentric with said axis and comprising two side elements connected respectively with said plate and ring and also comprising a plurality of inclined axially extending blades uniformly spaced from each other circumaxially and integrally connected at their ends with said side elements. In such a blower wheel, as heretofore made, the blade strip is transversely slitted to form the blades and the blades are relatively narrow as related to the blade spacing.

It has long been recognized that it would be advantageous to provide wider blades, and attempts have been made to provide blades wider than the blade spacing by expedients that involve the reduction of the spacing but such expedients have at the best been expensive. As an alternative, many blower wheels have been made with individually formed blades separately attached to the end plate and end ring. Such an individually bladed blower wheel is quite satisfactory as to performance, but the cost of such a wheel is considerably greater than that of a wheel wherein the blades are integral parts of a blade strip.

The general object of the present invention is to provide a blower wheel or a blade strip therefor wherein the blade width is considerably increased with little if any increase in cost. A further object of the invention is to provide a novel and advantageous method for making a blade strip having blades of increased width as above stated.

The drawings show a preferred embodiment of the mechanical features of the invention and they illustrate the preferred manner of practicing the method of the invention. The said embodiment and the said method will be described, but it will be understood that various changes may be made from the construction and method as shown and illustrated and that the drawings and description are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawings:

FIG. 1 is a fragmentary end view of a blower wheel which includes a blade strip embodying the structural features of the invention and made in accordance with the method of the invention, the end plate being broken away to show a portion of the blade strip in section along the line 1—1 of FIG. 2.

FIG. 2 is a fragmentary sectional view taken along the line 2—2 of FIG. 1.

FIG. 3 is an enlarged plan view of a straight blade strip as it would appear during manufacture.

FIG. 4 is a longitudinal sectional view of the blade strip as shown in FIG. 3, this view being taken along the line 4—4 of FIG. 3.

FIG. 5 is a right end view of the blade strip as shown in FIG. 3.

FIG. 6 is a longitudinal vertical sectional view showing a tool for the step-by-step formation of the blade strip as shown in FIG. 4, said strip being shown in conjunction with the tool but on a smaller scale than in said FIG. 4.

FIG. 7 is an enlarged longitudinal sectional view of a portion of the blade strip following maximum stretching to form corrugations.

FIG. 8 is an enlarged longitudinal sectional view of a portion of the blade strip after slitting.

FIG. 9 is an enlarged longitudinal sectional view of a portion of the blade strip after preliminary blade formation.

FIG. 10 is an enlarged longitudinal section of a portion of the blade strip after final blade formation.

Except as to the blades and the blade strip, the blower wheel as shown in FIGS. 1 and 2 is or may be of conventional construction. The wheel as shown comprises a blade strip **10** formed as hereinafter described in detail and bent to a cylindrical shape. The strip **10** includes two similar continuous side portions **11, 11** each of which has an outwardly turned flange **12**. Equally spaced blades **14, 14** extend between the side portions of the strip and are integral therewith. An end wall **16** and an end ring **18** are spaced from each other axially and they respectively engage the two side portions of the structurally separate strip, their peripheral portions being crimped around the flanges **12, 12**. The end plate **16** is connected with a central hub **20** which can be engaged with a shaft for supporting and rotating the blower wheel.

The construction and shape of the blade strip **10** will be best understood from an explanation of the manner of making it. As shown, said blade strip during making is intermittently moved longitudinally to successive positions spaced apart by distances equal to the required spacing between blades, and at the end of each movement the strip is acted upon by a plurality of instrumentalities for performing a series of operations which after a plurality of strip movements result cumulatively to the formation of one blade. This intermittent step-by-step method is presently preferred, but the invention in its broader aspects is not so limited.

FIGS. 3, 4 and 5 show a blank for the blade strip **10** in process of manufacture. From left to right in FIGS. 3 and 4 the blank is shown in successive stages of formation. The blank as shown in the right portions of said FIGS. 3 and 4 constitutes a completely formed portion of a blade strip. FIG. 6 is similar to FIG. 4, but it shows the blank for the blade strip on a smaller scale and it shows a tool for progressing shaping and cutting said blank to form the strip. In the description which follows, reference will be made primarily to FIG. 6, with incidental references to other figures.

Said FIG. 6 shows upper and lower tool assemblies adapted for use in a press, the upper assembly including a plate **22** and being vertically reciprocable and the lower assembly including a plate **24** and being stationary. An initially blank sheet metal strip **26** is fed between the tool assemblies and toward the right by a step-by-step movement to different successive positions. The strip is advanced one step during each reciprocation of the upper assembly and the extent of movement is equal to the required spacing between two blades in the finished strip. The feeding mechanism for the strip is not shown and may be of any usual or preferred construction.

In the initial or first zone A, the strip **26** is engaged by suitable tools, not fully shown but included in the said tool assemblies, which act to bend the strip so as to form the lateral flanges **12, 12**. At the initial end of the second zone B, the strip is engaged by two transversely spaced piercing tools **28** carried by the upper plate **22** and cooperating with a die **30** carried by the lower plate **24**, only one of said piercing tools being shown. The tools **28** form relatively long and narrow slots **32, 32** which are closely adjacent the flanges **12, 12** as shown in FIG. 3. Narrow necks **33, 33** are provided between said slots **32, 32**. At successive feeding stages pilot pins **34**

and 36 enter the previously formed slots 32, 32 for a purpose that will be fully explained.

In zone C the blank is engaged by an upper block 38 and a lower block 40 which serve to longitudinally stretch the portions of the strip that are to constitute the blades so that the width of said blades measured longitudinally along one face thereof will be substantially greater than the longitudinal spacing of said slots 32. The strip is transversely slashed or slit between each slot 32 and the corresponding opposite slot so as to separate the metal for each blade from the metal for the immediately adjacent blades. Preferably and as shown, the slitting is effected after stretching and the procedure for slitting is hereinafter more fully set forth.

Preferably, said upper block 38 is provided with a series of transverse grooves 42, 42 with ribs 44, 44 between them. The spacing between the centers of said grooves and ribs is the same as the length of one feeding step for the blank. Although the center spacing is uniform, the grooves 42, 42 progressively increase in width from left to right and the ribs 44, 44 progressively decrease in width from left to right. The ribs 44, 44 are rounded at their bottoms and said bottoms are all at the same level. Said lower block 40 is provided with a series of upwardly projecting transverse ribs 46, 46 which are in register with the grooves 42, 42 in the upper block. Said ribs 46, 46 are rounded at their tops and they progressively increase in height and in width from left to right. As the strip 26 is fed from left to right, the ribs 44, 44 on the upper block force it successively into engagement with the ribs 46, 46 on the lower block, and the last said ribs by reason of their progressively increasing heights and widths form transversely extending corrugations which progressively increase in size from left to right, the formation of said corrugations serving to effect the before-mentioned longitudinal stretching of the metal. The partly formed or incomplete corrugations are designated 48, 48 and the complete corrugations are designated 50, 50. As shown, the corrugations are formed at nine stations within zone C, but the number of stations may be changed. It will be understood that the said corrugations 50, 50 result entirely from the stretching of the metal, the length of the strip not being changed as said strip passes through said zone C. It will be observed that the corrugations 50, 50 are tangent to the planes of said side elements 11, 11 and they are preferably so tangent at their bottoms, as shown in FIG. 7. Said points of tangency are preferably in register with the centers of the corresponding necks 33, 33 between the slots 32, 32. When the corrugations 50, 50 are tangent at their bottoms, they extend upwardly from said side elements 11, 11 of the strip. The corrugations 50, 50 remain attached to the side portions 11 of the strip at said necks 33, 33. It will be also observed that the corrugations are located as stated and the crest of each corrugation is at least approximately in register with the centers of the corresponding slots 32, 32.

Preferably spring-pressed pins 52, 52 are provided in vertical holes in the lower block 40, these pins being between the ribs 46, 46. Said pins 52, 52 serve to lift the strip after each action of the ribs 44, 44 thereon, the strip thus being free to be fed longitudinally prior to the next downward movement of said ribs 44, 44.

The before-mentioned stretching of the metal to form the corrugations 50, 50 is primarily longitudinal, but there would be a tendency for transverse stretching as the corrugations are formed. The tool assemblies are provided with means, not shown, that engage the strip flanges 12, 12 to prevent any narrowing of said strip as the result of the tendency toward transverse stretching. Said slots 32, 32 eliminate any substantial transverse stretching, and in lieu of such stretching the slots are progressively widened from left to right, as indicated at 54, 54 in FIG. 3. The widening of the slots is without any particular advantage.

In zone D the strip is not acted upon to change the shape or condition thereof, but at the initial end of said zone there are spring-pressed blocks 56 and 58 having transverse grooves at the bottom and top thereof, said grooves being shaped and positioned to fit the corrugations 50, 50 of the strip. These blocks when engaged with the strip constitute pilot means which prevent any longitudinal strip movement. The pilot blocks 56, 58 cooperate with the pilot pins 34, 36 to maintain a fixed length in the strip in the zone C wherein corrugation is effected. These pilot devices insure stretching of the metal to form said corrugations 50, 50, and they prevent any longitudinal drawing of the metal forwardly from zone B or rearwardly from zone D.

At the initial station in zone E, the beforementioned transverse slashing and slitting is effected. The strip is transversely slashed or slitted at a line 60 which is preferably at the crest of a corrugation 50 partly in said zone. The slitting extends between the corresponding slots 54, 54 and it is effected by a knife 62 carried by the upper plate 22 and by a cooperating ledger blade 64 on a block carried by the lower plate 24. As the result of the slitting, the leading portion 66 of one corrugation and the trailing portion 68 of the next preceding corrugation remain in attachment with the side portions 11, 11 of the strip, being attached by the necks 33, 33. As will be more readily apparent from FIG. 8, the knife 62 serves not only to effect the transverse slitting but also to slightly twist the metal portions 66 and 68 between the immediately formed slit 60 and the next preceding slit 60. This slight twisting is in the counterclockwise direction as shown, and each metal portion 66 is below the adjacent metal portion 68.

At the initial station in zone F, a tool 70 carried by the upper plate 22 engages each succeeding metal portion 66 to bend it downwardly to the position best shown in FIG. 9. An abutment member 72 on the lower plate 24 cooperates with said tool 70. The metal portions 66 and 68 are now similarly inclined and the necks 33, 33 have been twisted to some extent but not to the maximum extent.

At the initial station in zone G a tool 74 carried by the upper plate cooperates with an abutment member 76 carried by the lower plate 24 to additionally bend or shape said metal portions 66 and 68 so that they form a smoothly curved blade 14 such as is required. FIG. 10 shows the completely formed blades. The tools 74 and 76 effect the final twisting of the necks 33, 33.

At the leading end of zone G a cut-off tool, not shown, is provided for cutting the side elements 11, 11 and the flanges 12, 12 after the formation of the number of blades 14, 14 required for any selected blower wheel such as that shown in FIGS. 1 and 2. The cut-off tool and the timing thereof may be of any usual or preferred construction.

As the result of the described stretching of the metal in zone C, the metal in each corrugation is substantially reduced in thickness and there is a corresponding increase in the length of the metal as measured longitudinally along the surface from the crest of one corrugation to the crest of the next corrugation. The extent of increase in length, measured as last aforesaid, may be varied but it is shown as being on the order of 35%. When the corrugations are slitted and bent to form the blades 14, 14, the width of each blade, measured along the surface thereof, is obviously substantially greater than the spacing between each blade and the next, and the blade width may exceed the blade spacing by about 35% as illustrated. Notwithstanding the decrease in blade thickness as above mentioned, the blades have ample strength and rigidity, particularly in view of the fact that the connections with the necks 33, 33 are at or near the center lines of the blades, as clearly shown in FIGS. 5 and 10.

When a blade strip 10 has been made in the manner described, it can be bent to cylindrical shape and assembled

with the end plate 16 and the end ring 18 in accordance with conventional practice.

The invention claimed is:

1. A blower wheel comprising in combination, an end plate and an end ring having a common axis and spaced from each other axially, and a structurally separate cylindrically bent one-piece sheet metal blade strip concentric with said axis and comprising two side elements connected respectively with said plate and ring and also comprising a plurality of inclined axially extending blades uniformly spaced from each other circumaxially and integrally and directly connected at their ends with said side elements, which side elements and blades are all portions of a single metallic strip and are approximately in their initial relationship with their initial interconnections maintained and each of said side elements having a cylindrical portion which extends directly and without interruption from blade to blade and the width of each of said blades measured from edge to edge along one face thereof being substantially greater than the spacing from blade to blade measured along the cylindrical portions of said side elements from a selected point on any blade to a corresponding point on an immediately adjacent blade.

2. A blower wheel comprising in combination, an end plate and an end ring having a common axis and spaced from each other axially, and a structurally separate cylindrically bent one-piece sheet metal blade strip concentric with said axis and comprising two side elements connected respectively with said plate and ring and also comprising a plurality of inclined axially extending blades uniformly spaced from each other circumaxially and integrally and directly connected at their ends with said side elements, which side elements and blades are all portions of a single metallic strip and are approximately in their initial relationship with their initial interconnections maintained and each of said side elements having a cylindrical portion which extends from blade to blade and the thickness of each of said blades being substantially less than the thickness of said side elements and the width of each of said blades measured from edge to edge along one face thereof being substantially greater than the blade spacing measured along the cylindrical portions of said side elements from a selected point on any blade to a corresponding point on an immediately adjacent blade.

3. A blower wheel comprising in combination, an end plate and an end ring having a common axis and spaced from each other axially, and a structurally separate cylindrically bent one-piece sheet metal blade strip concentric with said axis and comprising two side elements connected respectively with said plate and ring and also comprising a plurality of inclined axially extending blades uniformly spaced from each other circumaxially and integrally and directly connected at their ends with said side elements, which side elements and blades are all portions of a single metallic strip and are approximately in their initial relationship with their initial interconnections maintained and each of said side elements having a cylindrical portion which extends from blade to blade and the thickness of each of said blades being substantially less than the thickness of said side elements and the width of each of said blades measured from edge to edge along one face thereof being substantially greater than the spacing measured along the cylindrical portions of said side elements from a selected point on any blade to a corresponding point on an immediately adjacent blade, said greater width of the blades having resulted from drawing or stretching the metal thereof in the widthwise direction which drawing or stretching is evidenced by metallurgical changes in said metal.

4. A one-piece sheet metal blade strip for a blower wheel comprising two parallel side elements and a plurality of inclined blades integrally and directly connected at their ends with said side elements and uniformly spaced from each other, which side elements and blades are all portions of a single metallic strip and are approximately in their initial relationship with their initial interconnections maintained and each of said side elements extending directly and without interruption from blade to blade and the thickness of each of said blades being substantially less than the thickness of said side elements and the width of each of said blades measured from edge to edge along one face thereof being substantially greater than the blade spacing measured along said side elements from a selected point on any blade to a corresponding point on an immediately adjacent blade, said greater width of the blades having resulted from drawing or stretching the metal thereof in the widthwise direction which drawing or stretching is evidenced by metallurgical changes in said metal.

5. A one-piece sheet metal blade strip for a blower wheel comprising two parallel side elements and having two similar series of uniformly spaced slots adjacent said side elements with narrow necks between said slots which blade strip includes a plurality of inclined uniformly spaced blades integrally and directly connected at their ends with said necks, which side elements and blades are all portions of a single metallic strip and are approximately in their initial relationship with their initial interconnections maintained and each of said side elements extendng directly and without interruption from neck to neck and the width of each of said blades measured from edge to edge along one face thereof being substantially greater than the blade spacing measured along said side elements from a selected point on any blade to a corresponding point on an immediately adjacent blade.

6. A one-piece sheet metal blade strip for a blower wheel comprising two parallel side elements and having two similar series of uniformly spaced slots adjacent said side elements with narrow necks between said slots which blade strip includes a plurality of inclined uniformly spaced blades integrally and directly connected at their ends with said necks, which side elements and blades are all portions of a single metallic strip and are approximately in their initial relationship with their initial interconnections maintained and each of said side elements extending directly and without interruption from neck to neck and the thickness of each of said blades being substantially less than the thickness of said side elements and the width of each of said blades measured from edge to edge along one face thereof being substantially greater than the blade spacing measured along said side elements from a selected point on any blade to a corresponding point on an immediately adjacent blade.

7. The hereindescribed method for making a blade strip for a blower wheel which method comprises the following steps in sequence: (*a*) providing a longitudinal sheet metal strip having parallel sides, (*b*) cutting two similar longitudinal series of uniformly spaced slots in the strip adjacent the sides thereof to leave straight side elements between the slots and the edges of the strip and to leave narrow necks between the slots, (*c*) forming transverse corrugations in the portion of said strip located between said slots which corrugations have uniform spacing corresponding to that of the slots and which corrugations are produced by longitudinally stretching the metal located between said slots without any change in the length or shape of said side elements of the strip, (*d*) transversely slitting the strip at each of said corrugations and from one corresponding slot to the other with the metal between each two immediately adjacent slits remaining attached to said side elements by the corresponding necks, and (*e*) bending the last said metal between each two immediately adjacent slits to form blades each having a width measured longitudinally along one face thereof that is substantially greater than the longitudinal spacing from neck to neck measured along said side elements.

8. The method as set forth in claim 7, wherein the corrugations that are formed in accordance with step *c* are tangent to said side elements at points in register

with the corresponding necks, and wherein the slitting that is effected in accordance with step *d* is approximately midway between the points of tangency so that the subsequent bending in accordance with step *e* serves to twist said necks and to provide blades wherein the corresponding necks are approximately midway between the blade edges.

9. The method as set forth in claim 7, wherein the strip set forth in step *a* is intermittently moved longitudinally to successive positions spaced apart by distances equal to the spacing between slots, and wherein all of the steps *b*, *c*, *d* and *e* are simultaneously completed to the extent required for one blade while the strip is in each of said successive positions.

10. The method as set forth in claim 9, wherein the forming of the corrugations in accordance with step *c* is effected in successive stages throughout a zone which includes a plurality of said strip positions.

11. The method as set forth in claim 10, wherein the strip is held at both ends of said zone to prevent longitudinal movement of the strip portions at the ends of said zone and to resultantly insure stretching of the metal to form said corrugations.

12. The method as set forth in claim 11, wherein the strip is engaged within said slots adjacent the trailing end of said zone and is engaged at said corrugations adjacent the leading end of said zone.

13. The hereindescribed method for making a blade strip for a blower wheel which method comprises the following steps: providing a longitudinal sheet metal strip having parallel sides, cutting two similar longitudinal series of uniformly spaced slots in the strip adjacent the sides thereof to leave side elements between the slots

and the edges of the strip and to leave narrow necks between the slots, stretching the metal of the several portions of the strip that are between said side elements and are to constitute blades which said portions of the strip remain attached to said side elements by the corresponding necks, said metal of the last said portions being stretched independently of the side elements and in the direction to substantially increase the dimensions of said portions as measured along one face and in a generally longitudinal direction, transversely slitting the strip between each slot and the corresponding opposite slot so as to separate said blade portions from each other, said stretching and slitting steps being effected in a selected sequence, and bending the metal of said separated blade portions to form blades each having a width as measured along one face thereof and in a generally longitudinal direction that is substantially greater than the longitudinal spacing from neck to neck measured along said side elements.

References Cited in the file of this patent

UNITED STATES PATENTS

801,404	Schwarz	Oct. 10, 1905
1,028,066	Smith	May 28, 1912
1,648,060	Rowe	Nov. 8, 1927
2,242,586	Marbach	May 20, 1941
2,258,050	Evans	Oct. 7, 1941
2,315,407	Evans	Mar. 30, 1943
2,409,966	Voity et al.	Oct. 22, 1946
2,470,966	Abbott et al.	May 24, 1949
2,602,988	Klym	July 15, 1952
2,684,521	Morrison	July 27, 1954