June 22, 1965 K. A. MERZ 3,189,982

METHOD OF MAKING INTEGRAL FAN AND SLINGER RING

Filed Oct. 3, 1961 2 Sheets-Sheet 1

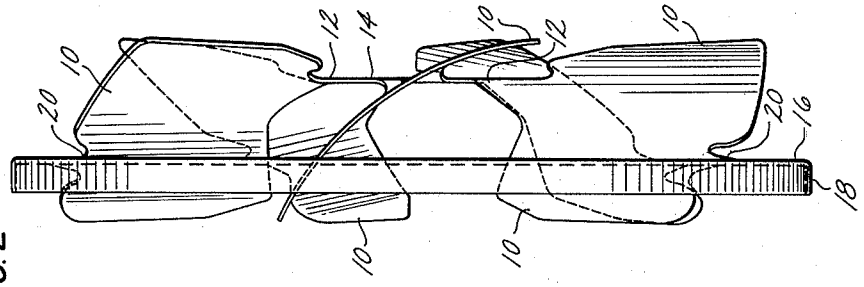


FIG. 2

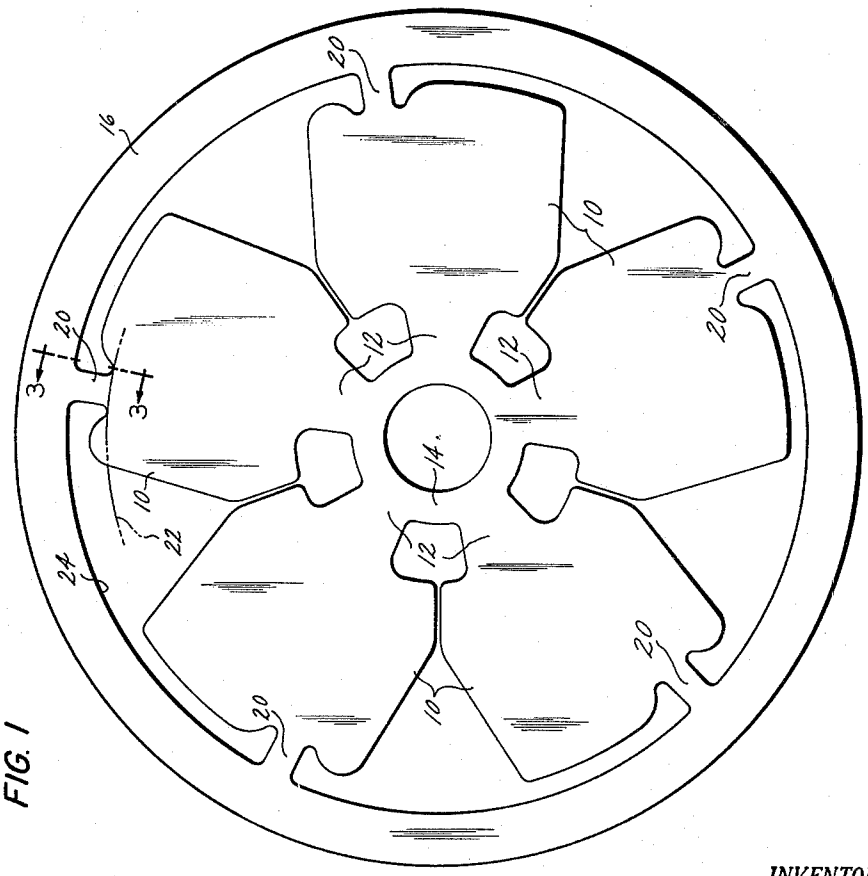


FIG. 1

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Filed Oct. 3, 1961 2 Sheets-Sheet 2

FIG. 3

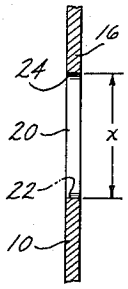


FIG. 4

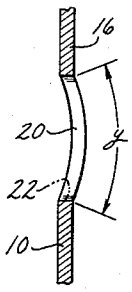


FIG. 5

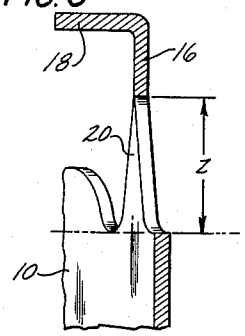


FIG. 6

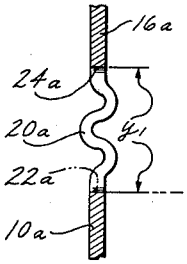


FIG. 7

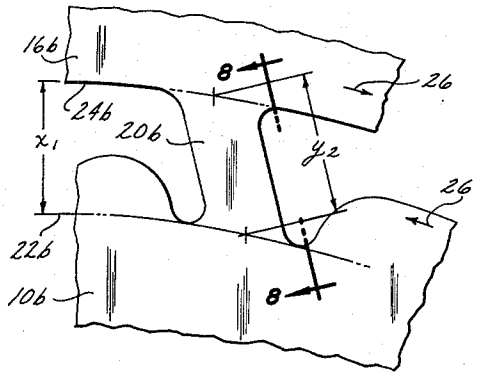
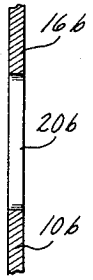


FIG. 8



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3,189,982

METHOD OF MAKING INTEGRAL FAN AND SLINGER RING

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8 Claims. (Cl. 29—156.8)

This invention relates to an integral fan and slinger ring of the type wherein a hub section of the fan is offset axially with respect to the slinger ring and, more particularly, the invention relates to a method of making such a fan and slinger ring.

It is the general object of the invention to provide a method of producing a fan and slinger ring of the type mentioned wherein the need for expensive blanking and drawing tools is eliminated and a substantial economic advantage in manufacture is achieved.

The drawings illustrate structure specific to three forms of the method of the invention, but it will be understood that various changes may be made from the structure shown and the method forms described, 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 the specification being relied upon for that purpose.

Of the drawings:

FIG. 1 is a plan view of an intermediate blank formed in accordance with the method of the present invention;

FIG. 2 is a side elevation of a completed integral fan and slinger ring produced in accordance with the method of the invention;

FIG. 3 is an enlarged fragmentary section taken generally as indicated at 3—3 in FIG. 1 and showing a portion of a fan blade, a connecting tab, and a slinger ring, background parts being omitted:

FIG. 4 is an enlarged fragmentary section similar to FIG. 3, but showing the tab in a preformed condition;

FIG. 5 is an enlarged fragmentary section similar to FIGS. 3 and 4, but showing the parts completed;

FIG. 6 is an enlarged fragmentary section similar to FIG. 4, but showing a tab performed in accordance with a second form of the method of the invention;

FIG. 7 is an enlarged fragmentary plan view showing a tab formed and arranged in accordance with still another form of the method of the invention; and

FIG. 8 is an enlarged fragmentary section taken generally as indicated at 8—8 in FIG. 7.

It has heretofore been a conventional practice to form an integral fan and slinger ring of the type referred to by providing a flat circular blank and forming the same into a conical configuration as in a drawing operation. Subsequently, as in a blanking operation, selected portions of the conical blank have been severed to define the various elements of the fan and slinger ring and, finally, the necessary forming has been accomplished to provide an annular flange on the slinger ring and to pitch the blades. This method is capable of producing a satisfactory integral fan and slinger ring, but the method has not been economically advantageous. Drawing tools required to form the cone and blanking tools suitable for operation on a conical blank are extremely expensive. In fact, the costs encountered have been so excessive as to

prevent the manufacture of this type of fan in low quantity production.

In the practice of the method in the present invention, the need for expensive drawing and blanking tools is eliminated and a substantial economic advantage is achieved in both low and high quantity production. In general, the method of the invention comprises the steps of providing a one-piece sheet metal blank which has selected portions severed therefrom so as to define all of the elements of the fan and slinger ring in connected relationship, but in substantially flat form. Thus, blanking can be accomplished at low cost on a flat rather than a cone-shaped blank. In order that subsequent forming of the blank to pitch the blades and to offset the hub section may be accomplished without excessive deformation and/or rupture of the said elements, the flat blank is provided with at least one annular area wherein the fan elements or portions thereof are arranged so as to have dimensions between inner and outer boundaries of the area which are greater than the radial distance between the boundaries. In forming of the blank which effects pitching of the blade and the axial offset relationship of the hub section, the differences between the interboundary dimensions of the said elements or portions thereof and the radial distance between boundaries are employed to accommodate axial movement of the hub section relative to the slinger ring. Thus, a particular arrangement of elements or portions thereof in a selected annular area on the blank accommodates the necessary movement for the final offset arrangement of the hub section and the necessity of providing an intermediate conical blank and the costs attendant upon the provision of such a blank are wholly eliminated.

Referring now particularly to FIG. 2, it will be observed that a completed fan and slinger ring shown therein comprises a plurality of similarly pitched and circumaxially spaced air moving blades 10, 10. Five blades 10, 10 are shown, but the method of the invention is equally adaptable to the production of fan and slinger ring assemblies with various numbers of blades. The blades 10, 10 are comparatively broad throughout major portions of their lengths, but relatively narrow inner parts 12, 12 thereof have their inner edge portions connected with and formed integrally with a hub section 14. The hub section 14 is offset axially with respect to an integral slinger ring 16 which includes an annular flange 18 extending in an axial direction from its outer edge. The slinger ring 16 is disposed about the blades 10, 10 as shown and is connected thereto by means of small connecting tabs 20, 20 extending between said ring and outer edge portions of the blades. Outer end portions of the tabs 20, 20 lie substantially in the plane of the slinger ring 16, but inner edge portions thereof are slightly twisted in keeping with the pitch of the blades 10, 10, FIG. 5.

Referring now to FIG. 1, it will be observed that a blank shown therein has selected portions severed therefrom so as to define all of the elements of the completed fan and slinger ring in connected relationship. The said elements are, however, defined in a flat form. A flat hub section 14 of the blank is connected with inner parts 12, 12 of flat blades 10, 10 which are in turn connected with a planar slinger ring section 16 by flat tabs 20, 20. The blank may be provided in a conventional flat blanking operation and may properly be characterized as an "intermediate blank," a flat circular "initial" or "first" blank being supplied for the blanking operation.

Now, the selection of a particular annular area on the intermediate blank as well as the manner in which elements or portions of elements falling within the boundaries of the area are arranged to provide for dimensions greater than the radial distance between said boundaries may vary within the scope of the invention. Preferably, however, an annular area on the blank is selected between the hub section 14 and the slinger ring section 16 and is at such location and of such width that it will bound a minimum aggregate mass of metal. Thus, in FIG. 1, an annular area including the tabs 20, 20 is selected and such area may be identified by its inner and outer boundaries which are represented respectively by the broken line 22 and the inner edge 24 of the slinger ring section 16. As will be noted, the inner boundary 22 of the area registers with the inner edges of the tabs 20, 20 while the outer boundary 24 thereof registers with the outer edges of said tabs.

In a first form of the method, the tabs 20, 20 are arranged so as to have dimensions between the boundaries 22 and 24 greater than the radial distance between said boundaries by displacing at least a portion of each tab from the plane of the flat intermediate blank. That is, the intermediate blank is provided as mentioned above by a flat blanking operation and the tabs 20, 20 are thereafter performed to the desired arangement of excess dimension.

As illustrated in FIG. 3, each tab 20 has a lengthwise dimension x after formation of the intermediate blank of FIG. 1. As will be observed, the dimension x is also equal to the radial distance between the inner and outer boundaries 22 and 24 of the aforesaid annular area. Preforming of the tabs 20, 20 as by drawing with a suitable tool is then accomplished to displace at least a portion of each tab from the plane of the blank. As illustrated in FIG. 4, preforming is preferably accomplished to provide for a bowed configuration of each tab 20 viewed in an axial plane. A lengthwise dimension y of the tabs 20 measured arcuately then exceeds the former lengthwise dimension x of the tabs and accordingly exceeds the radial distance between the boundaries 22 and 24 of the selected angular area.

The amount by which the dimension y exceeds the dimension x may vary within the scope of the invention. However, preforming of the tabs 20, 20 is preferably accomplished so that their dimension y is substantially equal to a dimension z illustrated in FIG. 5. As will be observed, the dimension z represents the length of the tabs 20, 20 in the completed fan and slinger ring assembly. That is, the preformed tabs 20, 20 of FIG. 4 are stretched so as to be approximately straightened in the subsequent forming operation of pitching the blades 10, 10 and moving the hub section 14 to its axially offset position. Such stretching and approximate straightening of the tabs 20, 20 accommodates the necessary axial movement of the hub section 14 relative to the slinger ring 16 without excessive deformation and/or tearing of the tab as previously mentioned.

In FIG. 6 it will be observed that a tab 20*a* has a corrugated cross section in an axial plane. The said tab is preformed to such shape in the practice of a second form of the method of the invention. In the said second form of the method, a circular "initial" or "first" blank may be operated on in a blanking operation to form the flat intermediate blank of FIG. 1 as described above. Thereafter, each of the tabs 20*a*, 20*a* of the intermediate blank may be preformed to the corrugated cross section of FIG. 6 as in a suitable drawing operation.

Here again, the initial lengthwise dimension x of the tabs is effectively increased to exceed the radial distance between the boundaries 22*a* and 24*a* of an annular area selected as described above. An arcuate lengthwise dimension y_1 of the preformed tabs 20*a*, 20*a* approximately equals the aforesaid arcuate lengthwise dimension y of the preformed tabs 20, 20. Thus, subsequent forming of

the intermediate blank to pitch the blades and to axially offset the hub section of a fan and slinger ring including the tabs 20*a*, 20*a* will result in stretching and approximate straightening of the tabs to the configuration illustrated in FIG. 5. Obviously, excessive deformation and/or rupture of the tabs or other elements in the fan and slinger ring assembly will be positively avoided.

A third form of the method of the present invention involves the provision of tabs of the type shown at 20*b* in FIG. 7. The tab 20*b* is flat as illustrated in FIG. 8 and extends in an intermediate blank such as shown in FIG. 1 between a blade 10*b* and a slinger ring section 16*b*. The tab does not, however, extend along or have its center line disposed on a radius. Instead, the tab is inclined with respect to all radii and with respect to all axial planes. Thus, the tab 20*b* has a lengthwise dimension y_2 in excess of a dimension x_1, the dimensioin x_1 being measured along a radius and between inner and outer boundaries 22*b* and 24*b* of a selected annular area which includes the tab 20*b* and corresponding tabs not shown. Thus, a "dimensional excess" is provided to accommodate axial movement of a hub section relative to the slinger ring section 16*b* without excessive deformation or rupture of the tab 20*b* shown and corresponding tabs.

In practicing the third form of the method, the inclined arrangement of the tabs 20*b*, 20*b* for "excess dimension" is provided in a blanking operation which produces a flat intermediate blank similar to that shown in FIG. 1. Thereafter, and during the forming operation which effects pitching of the blades and axial movement of the hub section, relative rotation is effected between the slinger ring section 16*b* and the blades 10*b*, 10*b* to arrange the longitudinal center lines of the tabs 20*b*, 20*b* at least approximately in axial planes. Such relative rotation effectively elongates the tabs 20*b*, 20*b* so that the required axial hub section movement is accommodated without deformation or rupture of the tabs or other elements of the fan and slinger ring assembly. Arrows 26, 26 in FIG. 7 indicate the direction of relative rotation of the fan blades and slinger ring for the tab 20*b* shown.

Formation of the flange 18 on the fan and slinger ring is not critical in the practice of the method of the present invention. Irrespective of the form of the method practiced, the flange 18 may be formed at various stages in the manufacture of the fan and slinger ring. As one example, it will be noted that a drawing operation may be accomplished prior to formation of the intermediate blank.

Now from the foregoing it will be apparent that conventional and inexpensive cutting and forming tools can be employed in the practice of each form of the method of the present invention. Blanking can be accomplished on a flat initial or first blank or workpiece and the expense of providing blanking tools operable on a conical blank is wholly avoided. Expensive drawing tools for providing a conical blank are also obviously unnecessary. Moreover, light drawing tools operable on a flat intermediate blank to provide the bowed or corrugated tabs of FIGS. 4 and 6 may be of a comparatively simple and inexpensive design. Similarly, a tool rotating means for effecting relative rotation during forming with the tabs 20*b*, 20*b* is readily provided at low cost.

The invention claimed is:

1. A method of making an integral fan and slinger ring which includes a plurality of similarly pitched circumaxially spaced air moving blades, a slinger ring disposed about the blades, a plurality of connecting tabs extending respectively between outer edge portions of the blades and the slinger ring, and a hub section substantially offset axially with respect to the tabs and connected with inner edge portions of the blades; said method comprising the steps of providing a one-piece sheet metal blank which has selected portions severed therefrom so as to define all the aforesaid elements in

connected relationship but in substantially flat form and which has tabs with dimensions between their inner and outer end portions which are greater than the radial distance between said end portions, and forming said blank to pitch the blades and to offset the hub section thereof axially with respect to the tabs, said last mentioned step including the displacement of said tabs in such manner than the differences between their said end portion-to-end portion dimensions and the said radial distance between their end portions are employed to accommodate axial movement of the hub section without excessive deformation and rupture of the aforesaid elements.

2. A method of making an integral fan and slinger ring which includes a plurality of similarly pitched circumaxially spaced air moving blades, a slinger ring disposed about the blades, a plurality of connecting tabs extending respectively between outer edge portions of the blades and the slinger ring, and a hub section substantially offset axially with respect to the tabs and connected with inner edge portions of the blades; said method comprising the steps of providing a one-piece sheet metal blank which has selected portions severed therefrom so as to define all the aforesaid elements in connected relationship but in substantially flat form and which has tabs which extend at least partially out of the plane of the blank between their inner and outer end portions so as to have dimensions between said end portions which are greater than the radial distance between the end portions, and forming said blank to pitch the blades and to offset the hub section thereof axially with respect to the tabs, said last mentioned step including the displacement of said tabs in such manner that the differences between their said end portion-to-end portion dimensions and the said radial distance between their end portions are employed to accommodate axial movement of the hub section without excessive deformation and rupture of the aforesaid elements.

3. A method of making an integral fan and slinger ring which includes a plurality of similarly pitched circumaxially spaced air moving blades, a slinger ring disposed about the blades, a plurality of connecting tabs extending respectively between outer edge portions of the blades and the slinger ring, and a hub section substantially offset axially with respect to the tabs and connected with inner edge portions of the blades; said method comprising the steps of providing a one-piece sheet metal blank which has selected portions severed therefrom so as to define all the aforesaid elements in connected relationship but in flat form and which has tabs with center lines which extend angularly between their end portions with respect to radii so as to have end portion-to-end portion dimensions greater than the radial distance between their end portions, and forming said blank to pitch the blades and to offset the hub section thereof axially with respect to the tabs, said last mentioned step including the displacement of said tabs in such manner that the differences between their said end portion-to-end portion dimensions and the said radial distance between their end portions are employed to accommodate axial movement of the hub section without excessive deformation and rupture of the aforesaid elements.

4. A method of making an integral fan and slinger ring which includes a plurality of similarly pitched circumaxially spaced air moving blades, a slinger ring disposed about the blades, a plurality of connecting tabs extending respectively between outer edge portions of the blades and the slinger ring, and a hub section substantially offset axially with respect to the tabs and connected with inner edge portions of the blades; said method comprising the steps of providing a flat sheet metal blank, severing selected portions from the blank to define the aforesaid elements in connected relationship but in flat form, effectively elongating each tab by displacing at least a portion thereof from the plane of the blank, and forming the blank to pitch the blades and to offset the

hub section thereof axially with respect to the tabs, said last mentioned step including the stretching and approximate straightening of the tabs whereby the axial offset movement of the hub section is accommodated without excessive deformation and rupture of the tabs.

5. A method of making an integral fan and slinger ring which includes a plurality of similarly pitched circumaxially spaced air moving blades, a slinger ring disposed about the blades, a plurality of connecting tabs extending respectively between outer edge portions of the blades and the slinger ring, and a hub section substantially offset axially with respect to the tabs and connected with inner edge portions of the blades; said method comprising the steps of providing a flat sheet metal blank, severing selected portions from the blank to define the aforesaid elements in connected relationship but in flat form, effectively elongating each tab by preforming the same in a bowed configuration which extends from the plane of the blank, and forming the blank to pitch the blades and to offset the hub section thereof axially with respect to the tabs, said last mentioned step including the stretching and approximate straightening of the tabs whereby axial offset movement of the hub section is accommodated without excessive deformation and rupture of the tabs.

6. A method of making an integral fan and slinger ring which includes a plurality of similarly pitched circumaxially spaced air moving blades, a slinger ring disposed about the blades, a plurality of connecting tabs extending respectively between outer edge portions of the blades and the slinger ring, and a hub section substantially offset axially with respect to the tabs and connected with inner edge portions of the blades; said method comprising the steps of providing a flat sheet metal blank, severing selected portions from the blank to define the aforesaid elements in connected relationship but in flat form, effectively elongating each tab by preforming the same to a corrugated cross section in an axial plane, and forming the blank to pitch the blades and to offset the hub section thereof axially with respect to the tabs, said last mentioned step including the stretching and approximate straightening of the tabs whereby axial offset movement of the hub section is accommodated without excessive deformation and rupture of the tabs.

7. A method of making an integral fan and slinger ring which includes a plurality of similarly pitched circumaxially spaced air moving blades, a slinger ring disposed about the blades, a plurality of connecting tabs extending respectively between outer edge portions of the blades and the slinger ring, and a hub section substantially offset axially with respect to the tabs and connected with inner edge portions of the blades; said method comprising the steps of providing a flat sheet metal blank, severing selected portions of the blank to define the aforesaid elements in connected relationship but in flat form with the tab center lines extending angularly with respect to radii, and forming the blank to pitch the blades and to offset the hub section thereof axially with respect to the tabs, said last mentioned step including relative rotation of the slinger ring and the blades to arrange the tab center lines approximately on radii and to thereby effectively elongate the tabs and accommodate axial offset movement of the hub section without excessive deformation and rupture of the tabs.

8. A method of making an integral fan and slinger ring which includes a plurality of similarly pitched circumaxially spaced air moving blades, a slinger ring disposed about the blades, a plurality of connecting tabs extending respectively between outer edge portions of the blades and the slinger ring, and a hub section substantially offset axially with respect to the tabs and connected with inner edge portions of the blades; said method comprising the steps of providing a one-piece sheet metal blank which has selected portions severed therefrom so as to define all the aforesaid elements in connected rela-

tionship but in substantially flat form, displacing the metal of the blank out of the plane of the blank in a narrow annular area bounding a minimum aggregate mass of metal located between the slinger ring and hub section portions of the blank, and forming the blank to pitch the blades and to offset the hub section thereof axially with respect to the tabs, said last mentioned step including the generally radial elongation of the displaced metal in said annular area to accommodate the axial movement of the hub section without excessive deformation and rupture of the aforesaid elements.

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