

Jan. 17, 1956

K. J. LALL ET AL
AIR CIRCULATING FAN CONSTRUCTION
AND METHOD OF MAKING THE SAME

2,731,193

Filed May 19, 1951

4 Sheets-Sheet 1

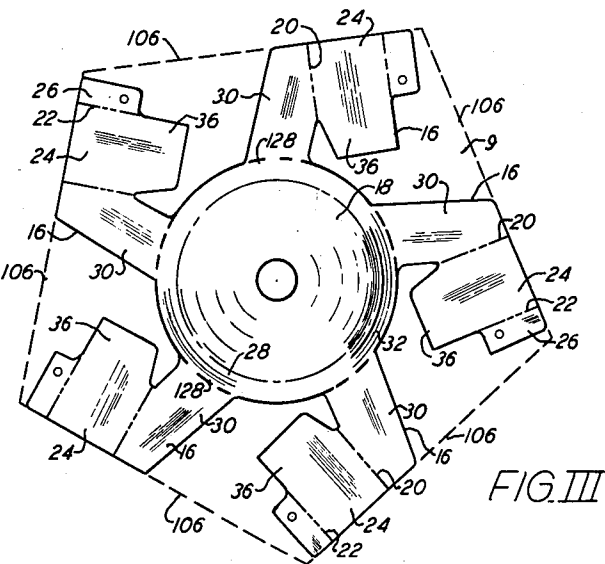


FIG. III

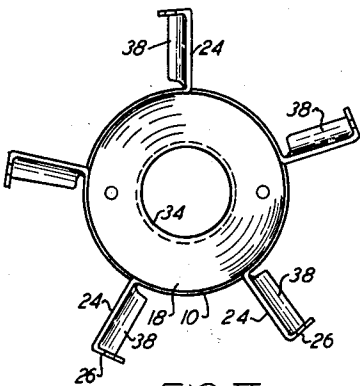


FIG. II

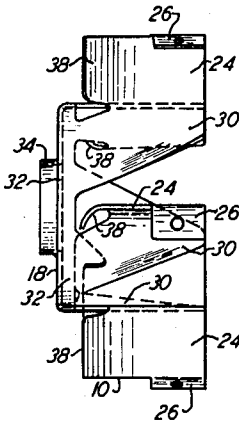


FIG. I

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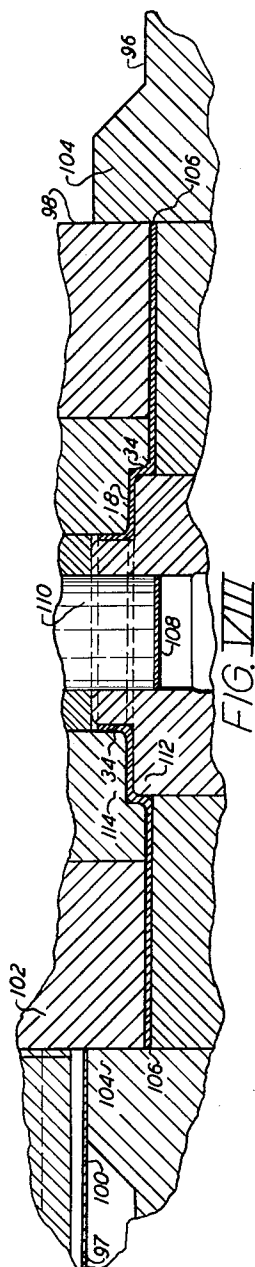


FIG. VII

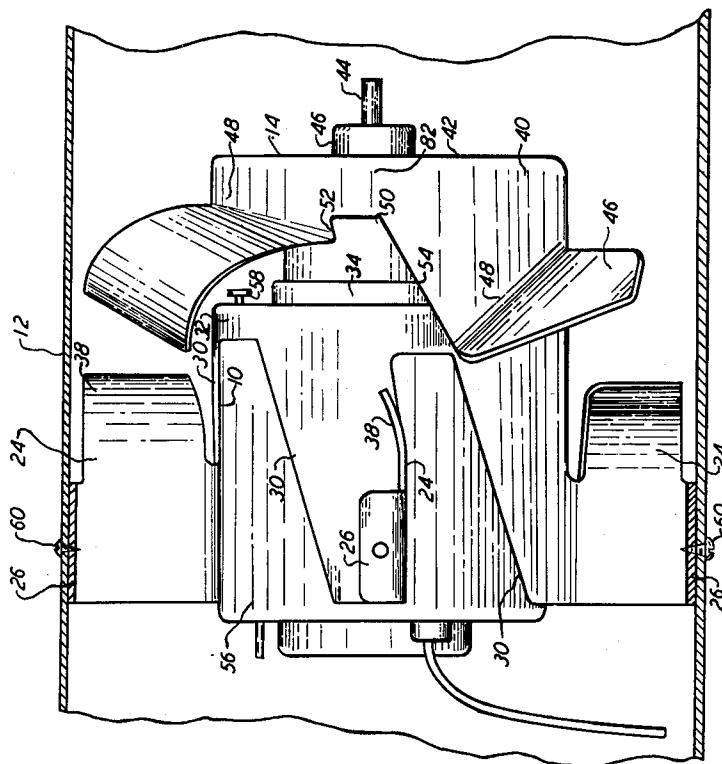


FIG. IV

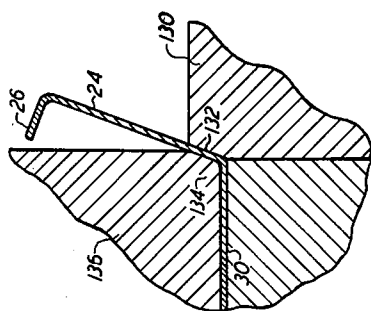


FIG. XII

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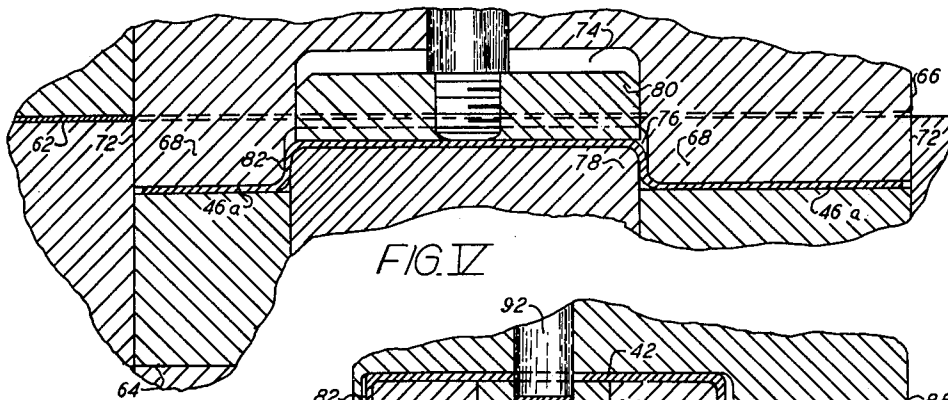


FIG. V

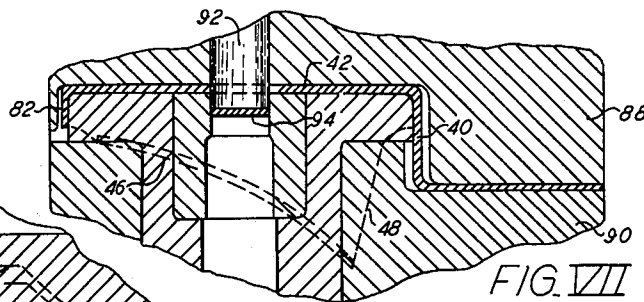


FIG. VII

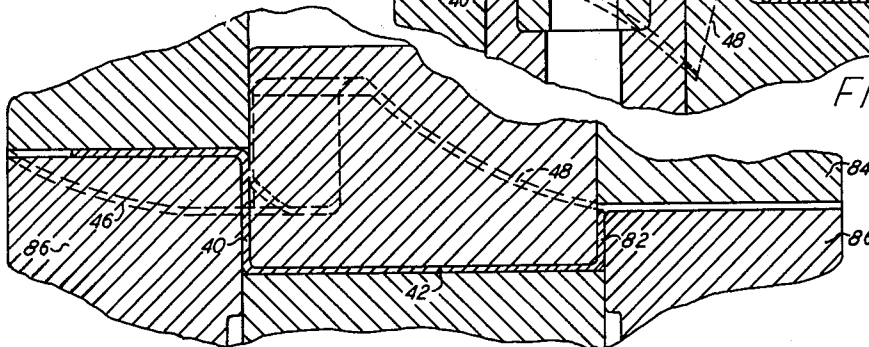


FIG. VI

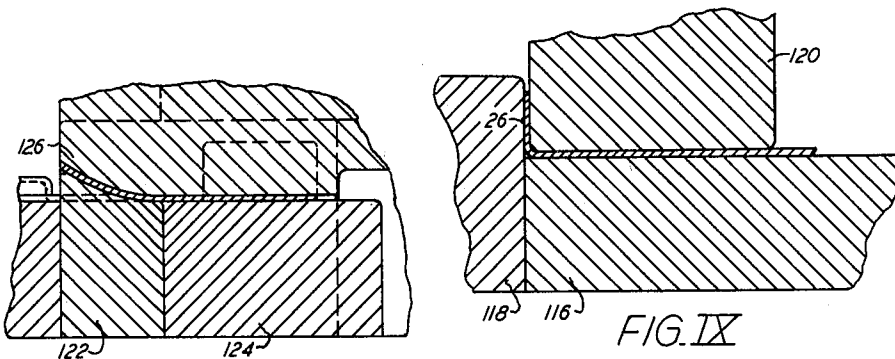


FIG. IX

FIG. X

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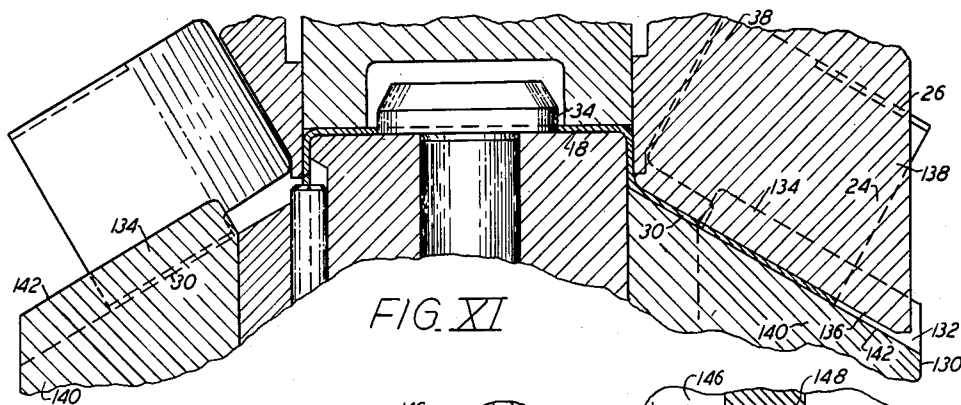


FIG. XI

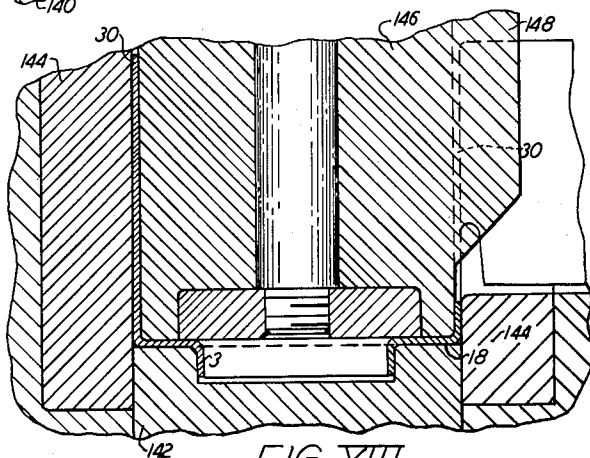


FIG. XIII

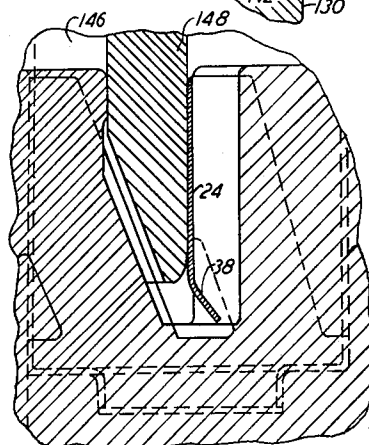


FIG. XIV

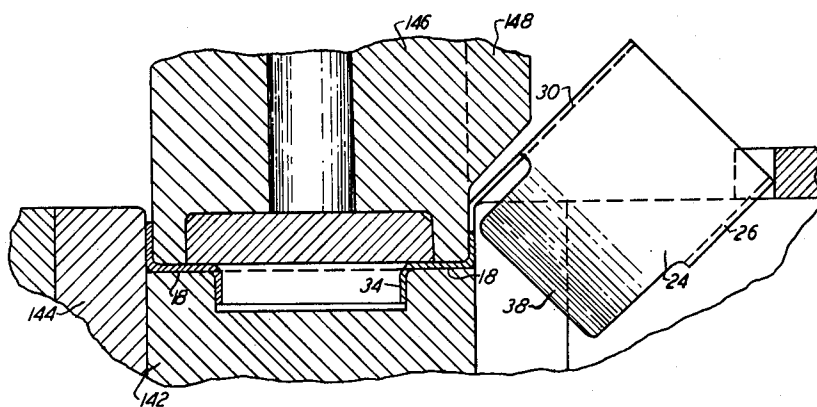


FIG. XV

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AIR CIRCULATING FAN CONSTRUCTION AND METHOD OF MAKING THE SAME

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Application May 19, 1951, Serial No. 227,134

2 Claims. (Cl. 230—117)

This invention relates to axial flow fan or blower constructions generally and more particularly to constructions of this character which are intended for use on automobiles for heating and ventilating purposes and which involve a motor and vane assembly mounted within an axial air flow casing.

In connection with these fan or blower constructions it has become the practice to form and shape the motor support and fan assemblies from sheet metal but on account of the shape involved in the construction of the motor support and fan assemblies and as disclosed in Patent No. 2,690,294 in the name of Beecher B. Cary, it has hitherto been the practice to make up these assemblies from separately formed parts.

This introduces time in assembling the parts as well as manufacturing costs, such as the present invention has overcome by providing for the manufacture of these motor mounting and fan assemblies from single-piece sheet metal blanks.

It is, therefore, an object of the present invention to provide a combination sheet metal motor support and guide vane assembly which is formed in one piece.

It is also an object of the invention to provide a method of manufacturing a sheet metal motor support and guide vane assembly from a single blank.

Further objects and advantages of the invention will appear clear from a consideration of the following description with reference to the accompanying drawings, in which

Fig. I is a side elevation of a one piece sheet metal motor support assembly in accordance with the invention.

Fig. II is a right hand end view of Fig. I,

Fig. III is a plan view of the single piece of sheet metal from which this assembly is made, showing the original blank in dotted outline and the first step in the forming operation by cutting the blank to shape, as indicated by the solid lines, prior to the bending and shaping operations,

Fig. IV is a perspective view showing this motor assembly mounted in an air flow duct and supporting a motor unit and impeller fan assembly, with the latter also formed from a single piece of sheet metal according to the invention,

Fig. V is a somewhat schematic view, in vertical section, illustrating the first stage in the formation of the single piece impeller fan,

Figs. VI and VII are similar views to Fig. V but illustrating the further steps in the formation of this impeller fan, and

Figs. VIII to XV are somewhat schematic views, in section, illustrating the various operations in the formation of the combination single piece sheet metal motor support and guide vane assembly.

Referring to the drawings and first to Figs. I to IV, the single piece sheet metal combined motor support and guide vane assembly is indicated generally at 10, the air flow duct at 12 and the fan impeller at 14 (Fig. IV).

The assembly 10 is formed from a single blank 9 of

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sheet metal of the original configuration indicated by the dotted outline seen in Fig. III by cutting this blank by a single cutting operation to define five radial arms, indicated generally at 16, and an integral circular center piece 18.

The arms 16 are cut to the outline shown in Fig. III and are subsequently bent about the lines 20 and 22 to define vanes 24 and securing flanges 26, respectively, whereas the circular center piece 18 (which forms an end wall in completed assembly) is bent about the circular line 28 to cause the webs 30 and the outer annular peripheral portion 32 of the center piece to lie on the surface of a cylinder, as seen in Fig. I.

The various method steps employed in accordance with the present invention to cut the blank 9 and bend and shape the parts first described will be described later with reference to Figs. VIII to XV. It may be stated here, however, that the steps involved include removing a central disc from the center piece 18 to define the central opening 32 and a peripheral cylindrical flange 34. Further, the shaping operation involves bending end portions 36 of the vanes 24 into a partially curved formation, as indicated at 38 (Fig. I) whereby these end portions may function to assist in directing the air flow through the duct 12 by the fan assembly 14.

The impeller fan assembly is also formed from a single blank of sheet metal to define a cylindrical hub portion 40 having an end wall 42 with a central opening through which the motor spindle portion 44 extends and receives a collar 46 secured upon the outer surface of the end wall 42 by any convenient means and itself secured to the spindle portion 44, as by a grub screw (not shown). This one piece impeller fan assembly is shown formed with three radial blades 46 bent out from the cylindrical hub portion 40 along oblique lines 48 and separated by circumferentially spaced gaps 50 defined by relatively short edges 52 and relatively long oblique edges 54. The method of cutting this fan assembly from a single blank and bending and shaping the portions thereof to final form will be described with reference to Figs. V to VII. The resulting product is a one piece sheet metal impeller fan having the fan blades 46 bent along the oblique lines 48 to extend radially outward from the hub portion 40, whereby the open end of the hub, as seen in Fig. IV is given an axial tooth formation with one inclined edge of each tooth being defined at 48 by the base of each fan blade.

Referring to Fig. IV it will be seen that the one piece sheet metal motor support 10 and guide vane assembly and the one piece sheet metal impeller fan assembly 14 are mounted as a unit in the air flow duct 12, with the motor 56 being held gripped by the webs 30 within the cylindrical hub space defined by these arms and secured in position by through bolts, one of which is indicated at 58. The fan assembly 14 is mounted at one end of the motor and its vane support assembly by being secured upon the motor spindle portion 44 as above stated. The entire unit assembly is held mounted in position within the air flow duct 12 by the flanges 26 gripping the interior of the duct and by the securing screws 60.

Turning now to the method of forming and shaping the impeller fan assembly from a single piece sheet metal blank, this is exemplified by Figs. V to VII.

In Figs. V and VI sheet metal stock is shown at 62 being fed into position upon a die structure, indicated generally at 64, and under a punch structure, indicated generally at 66.

The punch 66 is formed with depending portions 68 defining a shape conforming to that of a flat blank having a central circular portion and radiating web portions. These punch portions cooperate, upon descent of the punch, with correspondingly shaped shearing edges 72

of the die to sever, from the sheet metal stock 62, a blank of said shape. The punch has a central circular recess 74 defining a lower portion 76 of somewhat larger diameter, into which recess an upstanding cylindrical part 78 of the die enters, upon descent of the punch, with all round clearance corresponding to the thickness of the sheet metal. The punch also incorporates a central circular plunger portion 80 which is mounted for movement within the said recess 74.

In the operation of this punch and die assembly, with a section of the sheet metal stock positioned between the die 64 and the punch 66, a single operative descent of the punch will sever the stock section to the outline shape of the blank and at the same time bend the central portion of the blank to define the circular end wall 42 of the fan assembly at the base of a cylindrical web 82 formed by pressure applied to the cut sheet between the plunger 80 and die part 78 and in the clearance space between this die part and the punch portions 68. All this is performed in a single operation.

The next step in the operation of forming the impeller fan assembly to shape involves the use of the punch and die assembly seen in Fig. VI between which the sheet metal product from the first punch and die assembly is treated to bend the blade portions 46a along the oblique lines 48 (Fig. IV) and define the relatively short radial edges 52 and the relatively long radial edges 54. This operation is performed with the use of co-operating punch parts 84 and die parts 86 which have "high" and "low" surface portions set at a surface angle and slightly curved to form the blade portions 46a to the required shape of the finished blades 46.

The next operation is seen in Fig. VII. Here, the product of the previous punch and die operation is treated between the punch and die parts 88 and 90, respectively, which include a central punch 92 which severs a disc portion 94 from the center of the end wall 42 to form the opening therein for the attachment of the collar 46 and the projection of the motor spindle portion 44 (Fig. IV).

It will be appreciated, therefore, that we have provided a method by which sheet metal fan assemblies can be cut and formed into shape from single pieces of sheet metal, which enables these assemblies to be produced quickly and in a most economical manner.

Referring now to Figs. VIII to XV, these illustrate the various steps employed in accordance with our invention to shape and form the single piece sheet metal motor support and vane assembly. Fig. VIII illustrates the first method step, which employs a die assembly, indicated generally at 96, and a punch assembly, indicated generally at 98 and results in the blank 9 (Fig. III) being cut to shape from sheet metal stock 97 and the center portion of this blank being pressed into disk form to define the end wall 18 and the annular web flange 34.

The sheet metal stock 97 is fed between the punch and die parts and one operation of these results in the blank being cut and the said end wall and flange pressed into shape. The punch and die parts 102 and 104, respectively, define an outline shape corresponding to that of the blank 9 and sever the blank from the stock along lines 106 (Figs. III and VIII). At the same time a disc 108 is cut out of the circular center piece 18 by the center punch 110 as the circular center piece and the flange 34 are bent into shape by pressure applied between the center die part 112 and the center punch part 114.

The next operation involves the use of cooperating punch and die assemblies defining, in outline, cutting edges corresponding in shape to that of the arms 16 seen in Fig. III, with the removal of the "waste" between the adjacent arms. As the shape involved is seen clearly in Fig. III it is thought unnecessary to illustrate the actual punch and die assembly employed for this operation.

The next operation is illustrated in Figs. IX and X. This involves two simultaneous operations in a punch

and die assembly which, as shown in Fig. IX, involves die parts 116 and 118 which combine to form a recess into which a punch part 120 enters to bend the arm portions 24 about the lines 22 (Fig. III) to form the flanges 26 at right angles to these arm portions, there being one such die part and punch assembly provided for simultaneous operation upon each arm 16 of the cut-out blank as seen in Fig. III. This punch and die assembly also includes die parts 122 and 124 which define a curved surface, as seen in Fig. XI, which cooperates with a correspondingly curved surface of a punch part 126 to press the end portions 38 of the vanes 24 into the curved shape shown. This curving operation is performed simultaneously with the bending operation of Fig. IX upon each of the arms 16 of the cutout blank.

Next, the product of Figs. IX and X is subjected to an operation which causes the vane portions 24 of the arms 16 to be bent back from the web portions 30 along the lines 20 as these webs are subjected to a first bending operation about the lines 128 (Fig. III).

This operation involves the use of punch and die parts which include die parts 130 located to enter the gaps between the adjacent webs 30 and each having an upper bevelled surface 132 which cooperates with a correspondingly bevelled surface 134 of a punch part 136 to bend the vane portions at an angle to the webs 30, as seen in Fig. XII. The punch part engages the outside surfaces of the webs 30 as the die parts 130 function to bend the vane portions back as seen in Fig. XIII. These punch and die surfaces operate between die parts 138 and punch parts 140 having mutually inclined surfaces 142 located to engage with the webs 30 to bend the webs to a corresponding angle as seen clearly in Fig. XI. The upward bending of the vane portions 24 as seen in Fig. XII is limited by the engagement of the previously bent flanges 26 with the punch parts 136.

With the sheet metal assembly 10 thus far shaped the next operation involves bending the webs 30 at right angles to the end wall 18 in order to complete the hollow hub defined by these webs in the finished article as seen in Fig. IV, and in hub which the motor 56 is capable of being firmly gripped and held by the thus bent webs 30.

In Fig. XIV the product from the punch and die assembly of Figs. XI and XII is shown mounted in inverted position with the flanged end wall 18 held seated upon the central die part 142, this die part being in the form of a plunger which is slidable with respect to outside die parts 144 located to engage the outer surfaces of the upwardly bent portions of the webs 30 as these are pressed upwardly from the bottom, as seen in Fig. XIV, by the descent of the central punch part 146. This punch part provides an all round clearance with respect to the die parts 144 corresponding to the thickness of the sheet metal and defines a space into which the corresponding web portion is pressed to finish the hub formation of the webs 30. The punch part 146 has projecting heels 148 located at circumferentially spaced intervals to enter the spaces between the adjacent vanes 24 and engage the outer surfaces of the vanes 24, as seen in Fig. XV, whereby to finish bending these vanes to shape as the said webs 30 are pressed to their final shape.

The various die and punch operations also take care of the necessary radiussing of the flange parts and involve gauge means and strippers, which it is thought unnecessary to describe in detail. The single piece sheet metal assembly from the operation of Figs. XIII-XV next undergoes treatment to form holes in the end wall 18 and the flanges 26 for the reception of the necessary securing studs or screws, but this requires no detailed description.

It will be realized, from the foregoing, that we have provided a combined motor support and vane assembly which is formed from a single sheet metal blank and can be manufactured upon a mass production basis in a highly efficient and economical manner ready for the introduction of the motor unit and impeller fan assembly and for

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installation in an air flow duct to the exclusion of any other assembling and manufacturing operations.

While the invention has been described in some detail with respect to specific forms of the invention, it is to be understood that the invention is not limited to such but that variations and modifications are possible within a fair and proper interpretation of the subject claims.

What we claim as novel and wish to protect by Letters Patent is:

1. Structure for supporting a motor in a cylindrical air flow duct of a heating or ventilating system, such as is employed on automobiles, said structure providing in an integral sheet metal structure, a hollow hub portion formed by circumferentially spaced part cylindrical web portions extending axially from the outer periphery of a radial circular end wall having a central opening therein, said web portions having longitudinal edge portions, said hub portion being formed to support said motor therein and said opening permitting the motor shaft to project therethrough to the outside of said radial wall, a vane portion extending radially from the longitudinal edge portion of each said part cylindrical hub forming portion, and a transversely extending flange extending from the outer extremities of each of said vane portions, said flanges being engageable with the interior surface of said air flow duct and being formed to permit connection of said structure within the duct.

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2. A sheet metal blank for use to form an integral hub and vane structure for connection in a cylindrical air flow duct, said blank comprising in an integral sheet metal structure a central circular portion with a central opening and five similar arms extending radially outwards from the outer periphery of said central portion in equally spaced circumferential relation thereto, each said arm having a straight outer edge surface located along a corner portion of the straight line of a five equal sided figure defined by joining said edge surfaces and each said arm defining hub, vane and flange portions of said structure, each said vane portion being partially separated from one edge of its arm and each said flange portion being defined by portions of the blank which extend partly from an edge of each said arm which extends adjacent to said straight edge.

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