Sept. 22, 1959 R. A. LALLI 2,905,225

STRETCH FORMER WITH REPLACEABLE HEATED DIE AND PIVOTALLY MOUNTED DRAW BAR

Filed Sept. 13, 1956 3 Sheets-Sheet 1

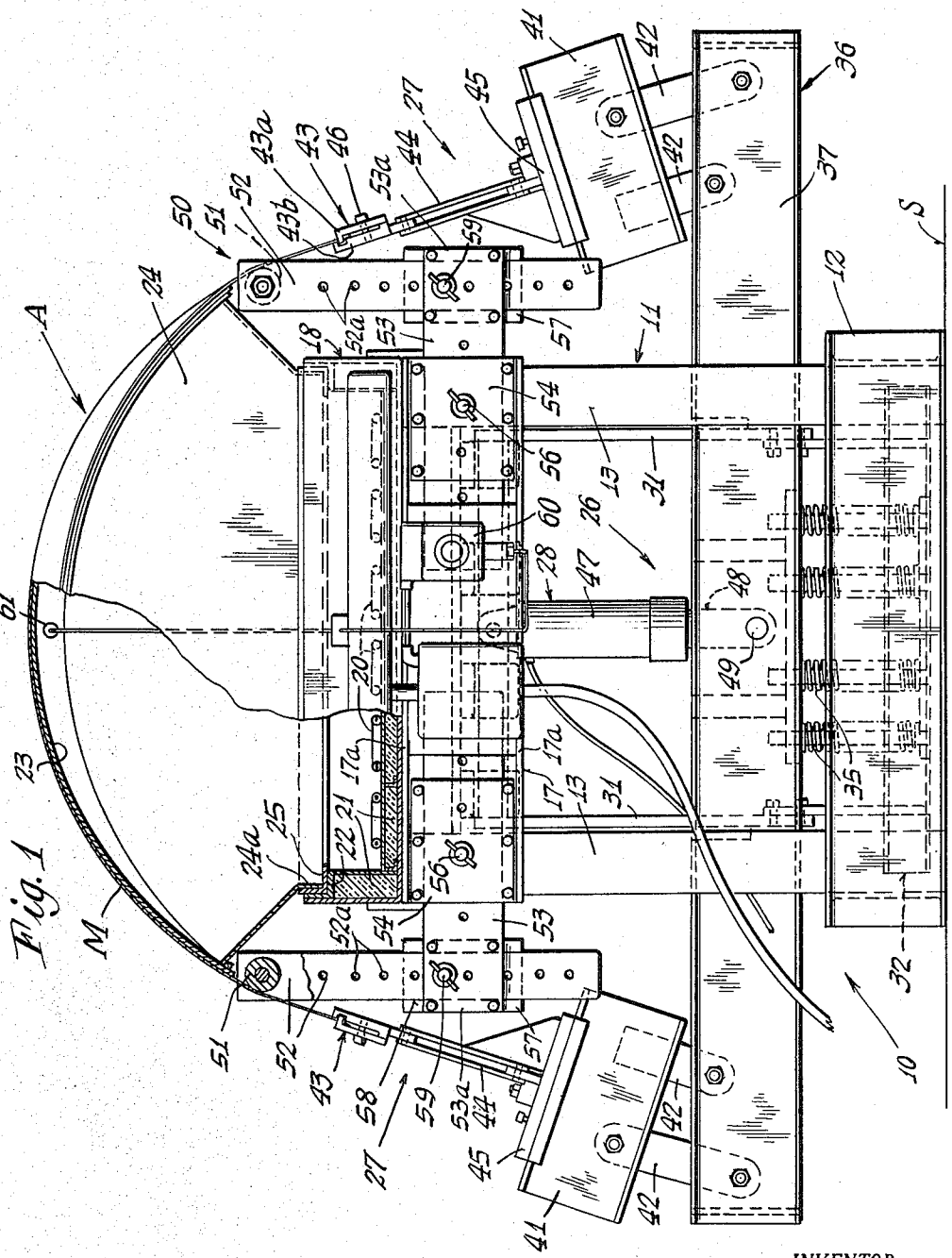


Fig. 1

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Filed Sept. 13, 1956 3 Sheets-Sheet 2

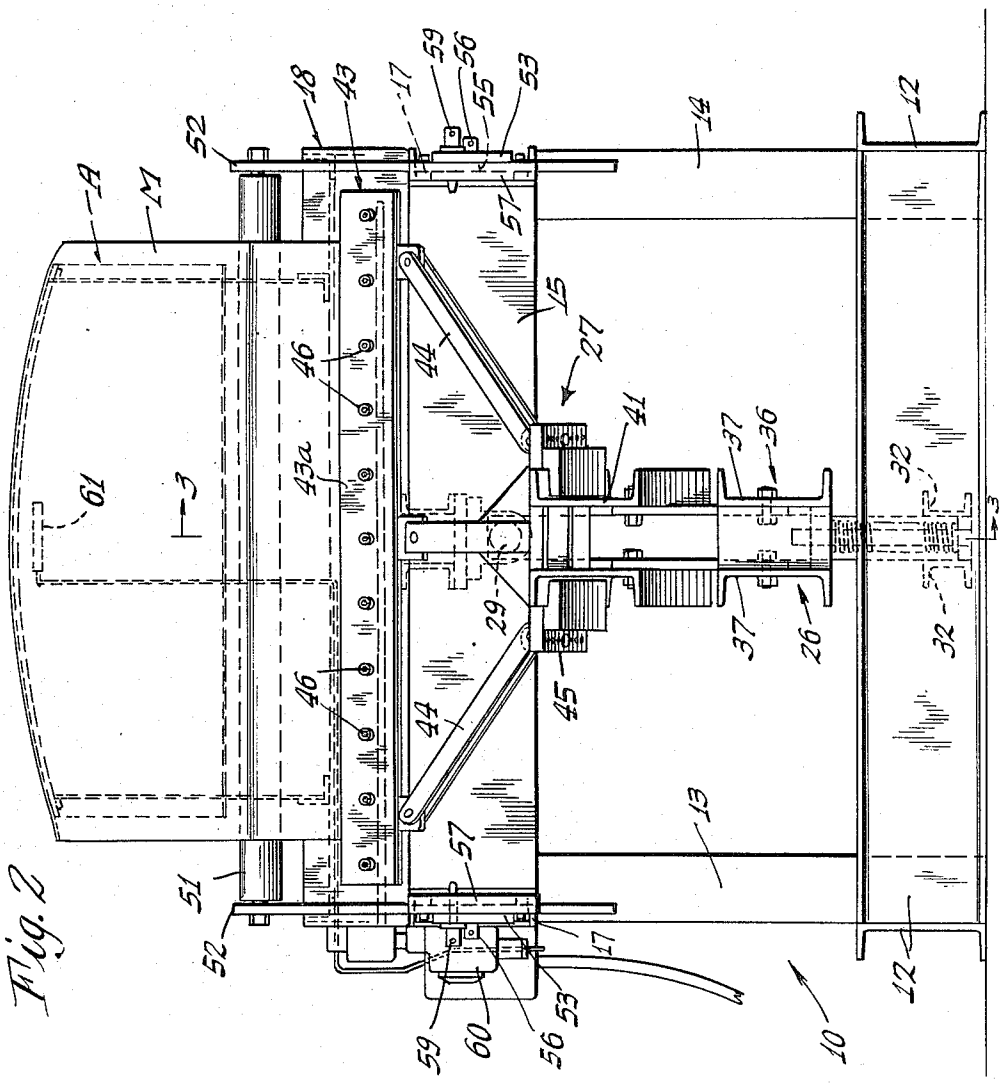


Fig. 2

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Fig. 3

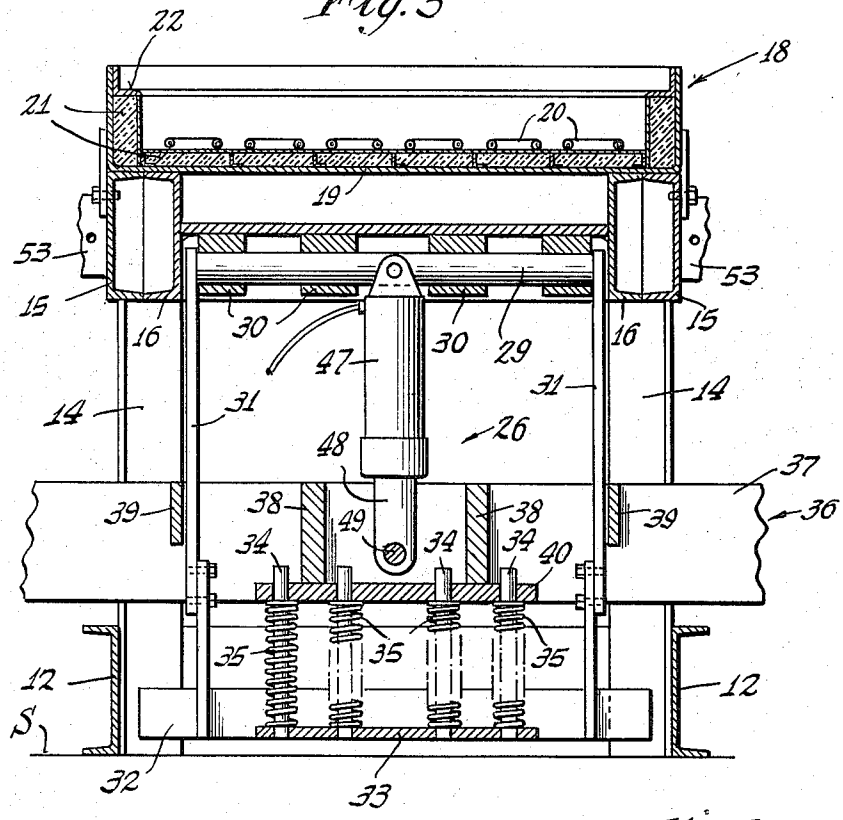


Fig. 4

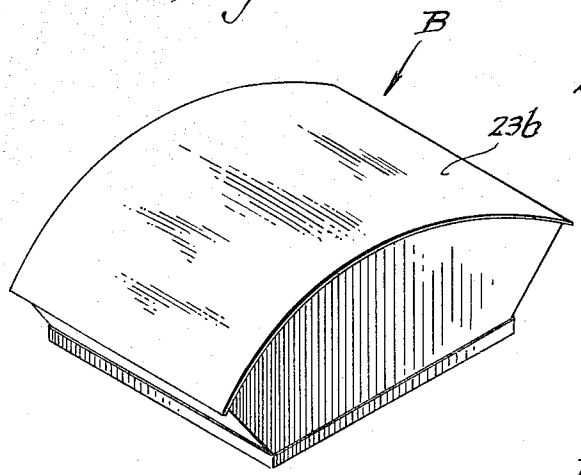
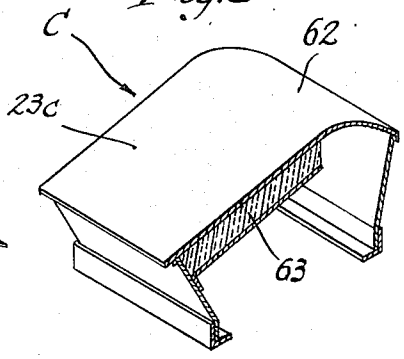


Fig. 5



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2,905,225

STRETCH FORMER WITH REPLACEABLE HEATED DIE AND PIVOTALLY MOUNTED DRAW BAR

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Application September 13, 1956, Serial No. 609,659

13 Claims. (Cl. 153—32)

This invention relates to a stretch press and more particularly to a stretch press comprising an improved universal frame structure having means universally adaptable for stretching a sheet material over a plurality of differently shaped die members which are interchangeably supported thereon.

In shaping magnesium and titanium sheet material or the like, such as are used in the formation of component sections of an airplane, helicopter and the like, it has been discovered that a practical way of shaping such sheet material into a desired form or shape is by securing the marginal portions of a sheet material in a clamping means and stretching the material over a heated die member by relative movement between the clamping means and die member. Heretofore, in performing such stretching operations, it has been the practice to support a die member conforming to the particular shape or section of a fuselage or the like on a frame having a stretching mechanism arranged thereon in a particular manner to specifically accommodate a particular die. A disadvantage inherent in stretch presses of this type now used is that each of the differently shaped dies necessary to form the various skin components of an airplane or the like required a special frame with the related stretching components arranged thereon in a particular manner. Consequently, since an airplane or helicopter required a relatively large number of variously shaped, component skin sections, the initial capital outlay for providing each of the required die members with a special frame structure was considerable. These initial capital outlays were further aggravated when a particular die was to be used for short runs only. In such instances the initial cost of the stretch press had to be amortized over a relatively small number of pieces, the result being a greater increase in the ultimate cost of the end product.

An object of this invention is to overcome the above disadvantages by providing a universal frame structure on which a plurality of die members having varying contoured forming surfaces can be interchangeably mounted thereon, thereby greatly reducing initial capital expenditures and effecting a material saving in the ultimate cost of the end product.

Another object of this invention is to provide the universal frame structure of this invention with a heating box having means for removably supporting any of a plurality of die members to be used in conjunction therewith in proper heat transfer relationship thereto.

Another object is to provide the universal frame of this invention with a pivotally mounted stretching means having suitable clamping means connected thereto for securing the marginal edge portions of a sheet material disposable over the die member so that during the stretching operation the clamping means may be automatically positioned relative to the die so as to render the force acting on the sheet material to stretch the same substantially normal to the transverse axis of the die.

Another object of this invention is to provide means

for interchangeably supporting a plurailty of hollow die structures on a common frame.

Still another object of this invention is to provide a heat control means adjacent the forming surface of a die to control the output of the heating for maintaining the temperature of the die surface at a predetermined level to facilitate stretching of a sheet material thereover.

And still another object of this invention is to provide means to prevent deformation of the marginal portions of a sheet material engaging the edge portions of the die member during a stretching operation.

The above objects and advantages of this invention are accomplished by a universal frame including a heating box having means for interchangeably supporting thereon a plurality of differently shaped die members. According to this invention the die members, each of which is provided with a particular contoured forming surface over which a sheet material is disposed, are formed so as to be readily removably and replaceably mounted in heat transfer relationship on the heating box. A stretching means including a clamping means disposed adjacent the opposite sides of the heating box is provided, the clamping means being positioned to be secured to the marginal portion of the sheet material.

According to this invention the stretching means is pivotally suspended on the frame and has connected thereto a power means to provide the power for establishing the relative movement between the stretching means and die member to stretch the material, the stretching means automatically pivoting relative to the frame so that the forces acting on the sheet material during the stretching operation are rendered substantially normal to the transverse axis of the die.

Resilient means are provided to reposition the stretching means to normal inoperative position when the power means is rendered inoperative upon completion of the stretching operation. A heat control means is also provided to control and maintain the temperature of the die forming surface so that the material disposed thereover may be properly conditioned to facilitate the stretching operation in accordance to the shape of the die. To prevent malformation of the marginal portion of sheet material along the edges of the die during a stretching operation, adjustable guide means disposed adjacent the edges of the die are provided to protect the material from creasing thereon as the material is pulled into the shape conforming to that of the die.

A feature of this invention resides in the provision of a stretch press which is relatively simple, compact, inexpensive and positive in operation.

Another feature of this invention resides in the ease and simplicity with which the die members may be interchangeably mounted on a common frame.

Other features and advantages will be apparent from the specification and claims when considered in connection with the drawings in which:

Figure 1 is a front elevational view of a stretch press according to this invention having portions thereof shown in section.

Fig. 2 is a side view of the stretch press.

Fig. 3 is a fragmentary sectional front view taken along line 3—3 of Fig. 2 with the die member removed.

Fig. 4 is a detail perspective view of a modified die.

Fig. 5 is a sectional view of still another modified die having a portion thereof insulated.

Referring to the drawings, there is shown an improved stretch press 10 for shaping a sheet material of magnesium, titanium and the like into shapes such as might be used in forming the component skin sections of an airplane, helicopter or the like. According to this invention, the supporting structure 11 on which the various components of the press are supported consists of an open

frame having a rectangular base portion **12** for supporting the frame on a suitable supporting surface S. Vertical post members **13** and **14** formed of angle pieces are secured to the corners of the base **12** and are tied together adjacent the upper end thereof by suitable channel members. As shown in Fig. 3, the corresponding front and rear posts **13** and **14** respectively are tied together by a pair of channels **15**, **16** forming a hollow beam while the two front and two rear posts **13** and **14** respectively are tied together by single channel members **17**, the flanges **17***a* of the channel extending outwardly as shown in Fig. 2.

Supported on the top of the frame there is provided an open top heating box **18** in which there is mounted on the bottom **19** thereof a suitable heating means **20**, as for example electrically operated sheathed metallic heating elements or the like. While the heating box **18** may be suitably shaped, in the illustrated form of the invention, the box is substantially rectangular and consists of a double walled structure having a suitable insulating material **21** disposed between the walls thereof. Adjacent the open end of the box **18**, as seen in Fig. 3, it will be noted that the box is provided with a laterally disposed internal flange or shoulder **22** to form a seat for removably supporting thereon a die member which is adapted to be used in conjunction therewith.

An interchangeable die member A, Fig. 1, adapted to be used in conjunction with the stretch press **10** of this invention consists of a contoured die portion **23** of sheet steel formed to have a surface shaped similar to that of a particular component skin section usually required to make up a fuselage portion of an airplane or the like. As the interchangeable die may be variously shaped, as shown in Fig. 1, the portion **23** is provided with a compound curvature which is both longitudinally and transversely curved. Connected to the edge of the portion **23** to depend therefrom is an enclosing wall portion **24** opened at its bottom. Thus, the die member as described forms a substantially hollow die structure. If desired, the marginal portion **24***a* of the depending walls **24** of the die structure is provided with a flange collar **25** which tends to reinforce the same as well as form a means by which the die A may be supported on the shoulder **22**. (See Fig. 1.)

An important feature of this invention resides in the fact that the different die members illustrated as A, B and C in Figs. 1, 4 and 5 respectively for forming the variously shaped component skin sections as are generally required in the fabrication of an aircraft and the like are interchangeably supported on the press regardless of the shape of its respective shaping portion thereof. This is accomplished generally by extending the enclosing walls of each of the die members from the margins of the portions **23** to the supporting portion which forms an opening or mouth portion slightly smaller than that of the heating box on which it is supported. As the hollow die structure is opened at the bottom, it will be noted that the forming portion of the die when seated on the heating box is in heat transfer relationship therewith so that the sheet material stretched thereover is properly heated to facilitate the shaping of the same.

In order to conform the sheet material M to the form of the die over which it is disposed, there is provided according to this invention a stretching means **26** having connected thereto a pair of clamping means **27**, the clamping means being disposed at opposite sides of the die to grip the opposed marginal portions of the sheet disposed thereover. A power means **28** provides the relative movement between the die and the stretching means so that a pulling force is applied to the sheet to stretch the same over the die for conforming it to the shape thereof. While power may be applied to move the die relative to the stretching means or to move the die and stretching means relative to each other, in the illustrated form of the invention the stretching means is moved relative to the die.

According to this invention, the stretching means **26** is mounted on a frame so that it may be moved away from the die member. In the event that a die member C is utilized in which the forming surface **23***c* is sloped transversely to the direction in which the material is stretched, means are provided for enabling the draw bar and clamps to be simultaneously pivoted relative to the die so that the forces acting on the sheet material during such a stretching operation are maintained substantially normal to the transverse axis or slope of the die to exert thereon a uniform pull as will be hereinafter described.

According to this invention, the stretching means **26** is connected to the frame by means of a rod **29** which is pivotally mounted in suitable bearings **30** connected to the frame immediately below the heating box **18**, the rod **29** having connected at each end thereof a depending arm **31** extending downwardly therefrom to a point spaced above the bottom of the base. Tying the arms **31** together adjacent the lower end thereon is a pair of channel members **32**, the channels **32** being connected on either side of the arms **29**. Intermediate the ends of the channels **32** and connected therebetween is a bottom plate **33** on which there is mounted a plurality of vertically extending pins **34**, each pin having disposed thereon a helical spring member **35** for resiliently supporting the stretching means **26** for movement away from the die whereby the spring **35** normally biases the stretching means toward said die member in released or inoperative position.

As illustrated in Figs. 1–3, the stretching means **26** comprises a draw bar **36** formed of a pair of elongate channel members **37** which are connected by brackets **38**, **39** in spaced relationship so that the depending arms **31** are adapted to extend downwardly therebetween, brackets **39** being disposed adjacent the arms **31** to prevent turning movement of the bar **36**. A mounting plate **40** connected between the channels **37** supports the draw bar on the spring, the plate **40** having apertures for receiving the pins so that the springs **35** are sandwiched between the plates **33** and **40**. Thus, it will be noted that the draw bar **36** is resiliently and floatingly mounted on the frame for movement away from the die. Also, it will be noted that the draw bar is free to pivot relative to the frame and the die member supported thereon.

As seen in Fig. 1, the draw bar **36** projects outwardly beyond the ends of the frame and has connected to each of its projected ends a clamping means **27** for securely gripping the marginal edge portion of the sheet material. The clamping means includes an angularly disposed support member **41** connected by suitable links **42** to the channel members **37** of the draw bar. A suitable clamp **43** connected by links **44** to a bracket **45** is attached to the support **41**.

In the illustrated form of the invention, the clamp **43** consists of a pair of movable jaw members **43***a*, *b* which are adapted to be moved into clamping position by a plurality of clamping bolts **46**. As shown, the clamping jaws **43***a*, *b* are sufficiently wide to accommodate the width of the material which is to be stretched so that upon actuation of the draw bar, the forces acting on the sheet may be uniformly distributed over the area of the material.

While any suitable means may be utilized to provide power for relatively moving the stretching means relative to the die member, in the illustrated form of the invention, a cylinder and piston assembly is utilized which may be actuated either pneumatically or hydraulically. According to this invention, the cylinder **47** is connected to the rod **29** so as to be pivoted relative to its axis of rotation, and the piston rod **48** which is movably mounted therein to project outwardly therefrom is connected to the draw bar by a pin **49** disposed intermediate the ends of the draw bar. Upon actuation of the cylinder assembly, the force applied to the piston causes the piston rod

to project outwardly therefrom and move the draw bar against the bias of the springs acting on the bar, thereby causing the bar to move away from the die. Thus, it will be noted that with the sheet material clamped between the clamping means, the material is drawn over the die so as to stretch the same to conform it to the shape of the die.

To prevent creasing or bending of the sheet material M on the edges of the die during a stretching operation, means **50** are provided for guiding the material over the edges thereof, it being preferred that the guide means be adjustably mounted on the frame so that they can be adjusted accordingly to accommodate any of the die members which are adapted to be interchangeably supported on the press of the instant invention. This is accomplished by adjustably supporting a guide roller **51** adjacent the transverse edge portions of the die, the guide roller **51** being substantially coextensive with the width of the material. As illustrated, the guide roller **51** is supported between a pair of spaced vertically disposed arm members **52** which are adapted to be adjustably mounted on a pair of spaced perpendicularly disposed supporting arms **53** slidably mounted to the front and rear tie channels **17** of the frame. According to this invention, a guide plate **54** is connected adjacent the ends of the front and rear tie channels **17** so as to form therewith a way **55** for slidably receiving the support arms **53**. Therefore, it will be noted that the guide rollers **51** may be adjusted relative to the frame by sliding the support arms **53** toward or away from the frame an amount sufficient to position the roller adjacent the edge portions of the die, a pin **56** extending through aligned openings in the supporting arms **53** and guide plate **54** secures the arm **53** in adjusted position relative to the frame.

In order that the roller may be vertically adjusted, there is connected to the projected end portion **53***a* of the supporting arm a channel member **57** in which the webs thereof are vertically disposed so as to form therewith a vertical channelway **58** in which the vertical arms **52** may be slidably mounted. Each vertical arm **52** is likewise provided with a series of spaced apertures **52***a* which are adapted to be aligned with an aperture in the supporting arm to render the vertical arm adjustable relative to its connecting support arm; a pin **59** inserted through the aligned openings secures the arms **52** and **53** in relative adjusted position. With the guide means properly adjusted as indicated in Figs. 1 and 2, the sheet material is smoothly guided over the edges of the die, thus preventing any creasing along the edges of the die during a stretching operation.

In operation, the sheet material M is readily formed to conform to the shape of the die by simply laying the sheet over the die A as illustrated in Fig. 1, and securing the marginal portions thereof in the clamps **43** as illustrated. Thence, upon actuation of the cylinder and piston assembly, the draw bar is moved away from the die, thereby causing the sheet material to be drawn and stretched over the die.

In order to facilitate the drawing of the material to expedite the forming operation, a heating control **60** is included in the circuit of the heating means **20** so that the die portion **23** can be maintained at a proper temperature required for permanently shaping the material thereover. The means for controlling the output of the heating means **20** includes a thermocouple **61** which is physically located adjacent that portion of the curvature of the die where the material is subject to maximum stretch. As illustrated in Fig. 1, since the forming surface of the die consists of a compound curvature which has a substantial radius of curvature, the thermocouple **61** is positioned adjacent the high point of the curve. Also, it will be noted that the die A has its entire forming surface in heat transfer relationship to the heating means since the material is subjected to a stretching force throughout its entire area. In the modified die B illustrated in Fig. 4, the contoured surface **23***b* has a curvature which is substantially uniform along a longitudinal axis thereof, and it too is seated upon the heating box as having its entire surface in heat transfer relationship to the heating means for a similar reason.

However, in an irregularly formed die C as illustrated in Fig. 5, it will be noted that only the portion **62** of the die is curved so that only that portion of a sheet disposed thereover is subjected to substantial flow of metal while at the flat portions, relatively little or no stretching occurs. By suitably baffling or insulating the die member under the flat portion of the die as indicated at **63** so that the flat portion is not in direct heat transfer relationship with the heating means, the die can be used on the universal base and will be properly heated thereby to produce a smooth accurately formed piece.

Also, it will be significantly noted that according to this invention when a die member C, as illustrated in Fig. 5, is utilized in conjunction with the press of this invention, the draw bar **36** is pivoted during a stretching operation about the axis of the rod **29** so that the clamping jaws **43** may be angularly disposed so as to be substantially parallel to the slope or flat surface of die C. In this manner, it will be noted that the lines of force acting on the sheet material during a stretching operation are maintained substantially normal to the transverse axis of the die C, thereby tending to equalize the forces acting on the material. Consequently, the press of this invention is readily suitable for shaping and forming sheet material over either regularly or irregularly shaped die members of the type illustrated.

Accordingly, the instant press and associated die members are relatively simple in construction and positive in operation. Furthermore, it will be noted that the die members may be readily and simply interchangeably mounted on the stretch press of the instant invention so that the requirement heretofore necessary of supplying each of the differently formed die members with a special frame structure is eliminated. By supporting the draw bar **36** so that it is free to pivot in accordance to the shape of the particular die with which it is adapted to be utilized on the press, the stretch press of this invention is rendered readily universal for use with most of the die shapes required for facilitating the various skin components generally required to make up a fuselage section and the like of an airplane, helicopter, etc.

Variations and modifications may be made within the scope of the claims and portions of the improvements may be used without others.

I claim:

1. An improved stretch press for shaping an article of manufacture comprising a frame, a heating box having a heating means disposed therein supported on said frame, a readily removable and replaceable hollow die mounted on said heating box, said die having a contoured surface over which a sheet material is adapted to be stretched, said surface being in heat transfer relationship with said heating means so that the entire surface may be directly heated thereby, clamping means disposed on opposite sides of said die for gripping the marginal portion of the sheet material to be stretched, guide means mounted on the frame adjacent the sides of the die and disposed between said die and clamping means, said guide means having a curved surface and forming substantially an extension of the die surface throughout the operative width thereof, means for providing relative movement between said die and clamping means for stretching and permanently shaping a sheet of material disposed over said die so that the sheet is adapted to substantially conform to the contours of said die forming surface, said guide means guiding the marginal portions of the sheet over the edge portions of the die to prevent malformation of the sheet adjacent the edge portions of the die during the stretching operation.

2. The combination of a stretch press for shaping an

article of manufacture comprising a frame, a heating box having a heating means disposed therein supported on said frame, a readily removable and replaceable die mounted on said heating box in heat transfer relationship thereto, said die having a contoured surface over which a sheet material is adapted to be stretched, clamping means disposed on opposite sides of said die for gripping the marginal portion of the sheet material to be stretched, guide means mounted on the frame adjacent the sides of the die and disposed between said die and clamping means, said guide means having a curved surface and forming substantially an extension of the die surface throughout the operable width thereof, means for providing relative movement between said die and clamping means for stretching and permanently shaping a sheet of material disposed over said die so that the sheet is adapted to substantially conform to the contours of said die forming surface, said guide means guiding the adjacent marginal portions of the sheet secured by said clamping means over the edge portions of the die to prevent malformation of the sheet adjacent the edge portions of the die during the stretching operation.

3. An improved stretch press for shaping an article of manufacture comprising a frame, a heating box having a heating means disposed therein supported on said frame, a readily removable and replaceable die mounted on said heating box in heat transfer relationship thereto, said die having a contoured surface over which a sheet material is adapted to be stretched, clamping means disposed on opposite sides of said die for gripping the marginal portion of the sheet material to be stretched, a guide roller adjustably supported by the frame and disposed on opposite sides of said die between said die and clamping means, said guide rollers having a curved surface and extending across the full operable width of said die and forming substantially an extension of the die surface, means for providing relative movement between said die and clamping means for exerting a pulling force to stretch and permanently shape a sheet of material disposed over said die whereby the sheet is adapted to substantially conform to the contours of said die surface, said guide rollers being adjustably mounted on said frame for guiding the adjacent marginal portions of the sheet secured by said clamping means over the edge portions of the die to prevent malformation of the sheet on the edges of the die during the stretching operation.

4. An improved stretch press for shaping an article of manufacture comprising a frame, a heating box having a heating means disposed therein supported on said frame, a readily removable and replaceable die mounted on said heating box in heat transfer relationship thereto, said die having a contoured surface over which a sheet material is adapted to be stretched, a draw bar, means for mounting said draw bar on the frame for pivotal movement with respect to the die and also for linear movement toward and away from said die, clamping means connected adjacent the opposite ends of said draw bar for disposing said clamping means on opposite sides of said die to grip the marginal portion of the sheet material to be stretched, and means connected to the frame and draw bar for moving said draw bar and connected clamping means relative to said die to exert a pulling force to permanently shape a sheet of material disposed over said die so that the sheet is adapted to substantially conform to the contours of said die surface, said draw bar and connected clamping means being pivoted to said mounting means to pivot about an axis lying in a plane transverse to the line connecting the clamping means and in accordance to the transverse contour of said die so that the pulling force exerted on the sheet during the stretching operation is substantially normal to the transverse axis of said die.

5. The invention as defined in claim 4 wherein said means for moving said draw bar includes a cylinder pivotally mounted on said mounting means and having a movably mounted piston therein, said piston being pivotally connected to said draw bar so that upon actuation thereof said piston, the draw bar and connected clamping means are moved away from said die to exert a pulling force on said sheet.

6. An improved stretch press for shaping an article of manufacture comprising a frame, a heating box having a heating means disposed therein supported on said frame, a readily removable and replaceable die mounted on said heating box in heat transfer relationship thereto, said die having a contoured surface over which a sheet material is adapted to be stretched, a draw bar, means pivotally connecting the draw bar to said frame, clamping means connected adjacent the opposite ends of said draw bar disposing said clamping means on opposite sides of said die for gripping the marginal portion of the sheet material to be stretched, resilient means connected to said draw bar for normally biasing said draw bar in inoperative position, and actuating means included in the means connecting the draw bar to the frame for moving said draw bar and connected clamping means away from said die against the force of said resilient means acting on said draw bar to exert a pulling force for stretching and permanently shaping a sheet of material disposed over said die for substantially conforming the same to the contours of said die surface, said bar and clamping means being pivoted to said means pivotally connecting the draw bar to said frame to pivot about an axis lying in a plane transverse to the line connecting the clamping means and in accordance to the transverse contour of said die so that the pulling force exerted on the sheet during the stretching operation is substantially normal to the transverse axis of said die.

7. An improved stretch press for shaping an article of manufacture comprising a frame, a heating box having heating means disposed therein supported on said frame, a readily removable and replaceable die mounted on said heating box in heat transfer relationship thereto, said die having a contoured surface over which a sheet material is adapted to be stretched, a draw bar, means pivotally connecting the draw bar to said frame, clamping means connected adjacent the opposite ends of said draw bar for disposing said clamping means on opposite sides of said die to grip the marginal portion of the said material to be stretched, resilient means normally biasing said draw bar in inoperative position, guide rollers connected to the frame and disposed on opposite sides of the die between the latter and the clamping means, said rollers forming substantially an extension of the die surface at the ends thereof and actuating means connected to the draw bar for moving said draw bar and connected clamping means away from said die and against the force of said resilient means acting on said draw bar to exert a pulling force for stretching and permanently forming a sheet of material disposed over said die substantially shaping the same to conform to the contours of said die surface, said bar and clamping means being pivoted to said means connecting the draw bar to said frame to pivot about an axis lying in a plane transverse to the line connecting the clamping means and in accordance to the transverse contour of said die so that the pulling force exerted on the sheet during the stretching operation is substantially normal to the transverse axis of said die, said guide roller guiding the adjacent marginal portions of the sheet gripped by said clamping means over the edges of the die so as to prevent malformation of the sheet on said edges during the stretching operation.

8. An improved stretch press for shaping an article of manufacture comprising a frame, a heating box having heating means disposed therein supported on said frame, a readily removable and replaceable hollow die mounted on said heating box in heat transfer relationship thereto, said die having a contoured surface over which a sheet material is adapted to be stretched, control means

for regulating the output of said heating means, heat sensing means forming part of said control means and being positioned adjacent the contoured surface of said die so that the output of said heating means is controllable by the temperature of said die surface, a draw bar, means pivotally connecting the draw bar to said frame, clamping means connected adjacent the opposite ends of said draw bar for disposing said clamping means on opposite sides of said die for clamping the marginal portion of the said material to be stretched, resilient means biasing said draw bar in inoperative position, guide rollers connected to the frame and disposed on opposite sides of the die between the latter and the clamping means, said rollers forming substantially an extension of the die surface across the full operable width thereof, and actuating means included in the means connecting the draw bar to the frame and comprising a cylinder having a movable piston for moving said draw bar and connected clamping means away from said die and against the force of said resilient means acting on said draw bar to exert a pulling force for stretching and permanently forming a sheet of material disposed over said die and substantially shaping the same to conform to the contours of said die surface, said bar and clamping means being pivoted to said means connecting said draw bar to said frame to pivot about an axis lying in a plane transverse to the line connecting the clamping means and in accordance to the transverse contour of said die so that the pulling force exerted on the sheet during the stretching operation is substantially normal to the transverse axis of said die, said guide roller guiding the adjacent marginal portions of the sheet gripped by said clamping means over the edges of the die so as to prevent malformation of the sheet on said edges during the stretching operation.

9. In a stretch press for use in shaping an article of manufacture, the improvement of a frame having a heating box including a heating means disposed therein, said heating box having means adaptable for receiving in heat transfer relationship thereto any of a plurality of readily interchangeable, differently shaped die members over which a sheet material is adapted to be stretched, clamping means adapted to be disposed on opposite sides of said box for gripping the marginal edge portion of the said material disposed over the die, guide means mounted on the frame and located adjacent the sides of the die members and between the heating box and clamping means, said guide means having a curved surface and being substantially an extension of the die surface across the operable width thereof for facilitating the forming of the sheet material during a stretching operation, means for pivotally mounting the clamping means on the frame so that the said clamping means are automatically pivoted in accordance to the shape of any of the interchangeable die members adaptable to be supported on said heating box so that the forces acting on the material during a stretching operation tend to be equalized to insure a more uniform stretch, and actuating means for providing relative movement between the clamping means and the frame so as to stretch and permanently shape a sheet material disposed over a die member.

10. In a stretch press for use in shaping an article of manufacture, the improvement of a frame having a heating box including a heating means disposed therein, said heating box having means adaptable for receiving in heat transfer relationship thereto any of a plurality of readily interchangeable, differently shaped die members over which a sheet material is adapted to be stretched, a draw bar, means for mounting said draw bar on the frame for pivotal movement with respect to the die and also for linear movement toward and away from said die, said draw bar having its end portions extending beyond the heating box, clamping means connected adjacent the ends of said draw bar so as to be disposed on opposite sides of said box for gripping the marginal edge portion of the said material adapted to be disposed over a particular die, said draw bar and connected clamps being mounted on said mounting means to pivot about an axis lying in a plane transverse to a line connecting the clamping means so that the clamping means are rendered cooperative with any of the said interchangeable die members whereby resulting forces acting on the material during a stretching operation are substantially normal to the transverse axis of the die, and actuating means for providing relative movement between the clamping means and the frame so as to stretch and permanently shape a sheet material disposed over a die member.

11. The combination of a stretch press for use in shaping an article of manufacture comprising a frame, a heating box having a heating means disposed therein supported on said frame, a die-supporting shoulder on the frame extending around the heating box and adapted to receive and support one of a plurality of interchangeable, readily removable and replaceable hollow die members over said heating box in heat transfer relationship thereto, each of said die members having a contoured die surface over which a sheet material is adapted to be stretched and a support-engaging portion disposed below said die surface and having a shape complementary to said shoulder to be engaged thereby, clamping means disposed on opposite sides of said die for gripping the marginal portion of the sheet material to be stretched, and means for providing relative movement between said die and clamping means for stretching and permanently shaping a sheet of material disposed over said die so that the sheet is adapted to substantially conform to the contours of said die surface.

12. An improved stretch press for shaping an article of manufacture comprising a frame, a heating box having a heating means disposed therein supported on said frame, die-supporting shoulder means extending around the heating box and adapted to receive and support one of a plurality of interchangeable, readily removable and replaceable hollow die members, each having a contoured upper shaping surface secured to depending side walls provided with means at the lower edge thereof complementary with said shoulder means for engaging and removably supporting said die member on said shoulder with the die located over said heating box in heat transfer relationship thereto, control means for regulating the output of said heating means, heat sensing means forming part of said control means carried by the frame and adapted to extend into said removable hollow die and be located adjacent the undersurface of the contoured die surface of each interchangeable die member so that the temperature at the surface of the die may be accurately regulated to facilitate the shaping of the sheet material, clamping means disposed on opposite sides of said die member for gripping the marginal portion of the sheet material to be stretched, and actuating means for providing relative movement between said die and clamping means for stretching and permanently shaping a sheet of material disposable over said die so that the sheet is adapted to substantially conform to the contours of said die forming surface.

13. The combination of a stretch press for use in shaping an article of manufacture comprising a frame, a heating box having a heating means disposed therein supported on said frame, a die-supporting shoulder on the frame extending around the heating box and adapted to receive and support one of a plurality of interchangeable, readily removable and replaceable hollow die members over said heating box in heat transfer relationship thereto, each of said die members having a contoured die surface over which a sheet material is adapted to be stretched and a support-engaging portion disposed below said die surface and having a shape complementary to said shoul-

der to be engaged thereby, clamping means disposed on opposite sides of said box for gripping the marginal edge portion of said material adapted to be disposed over a die supported on said box, means for pivotally mounting the clamping means on the frame so that the said clamping means are pivoted in accordance to the shape of any of the interchangeable die members adapted to be supported on said heating box so that the forces acting on the material during a stretching operation tend to be equalized in a direction normal to the transverse axis of the die to insure a more uniform stretch, and actuating means for providing relative movement between said clamping means and frame so as to stretch and permanently shape a sheet material disposed over the die member.

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