May 31, 1949. T. J. NICHOLAS 2,471,445

SHEET METAL BENDING TOOL

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Fig 1

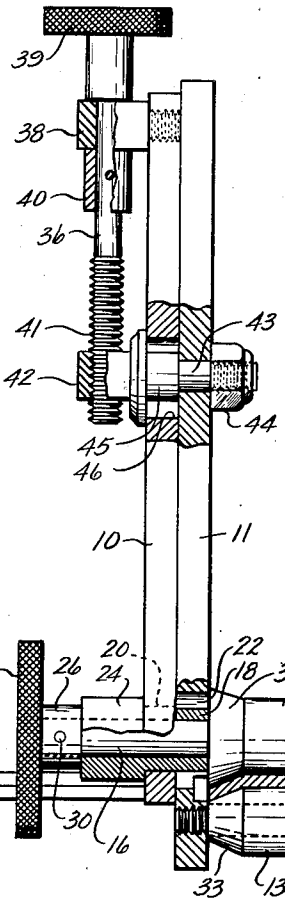


Fig 2

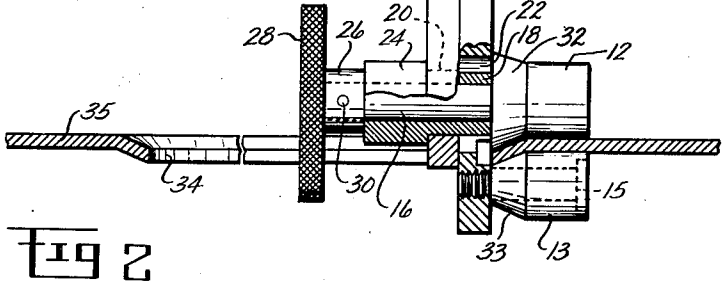
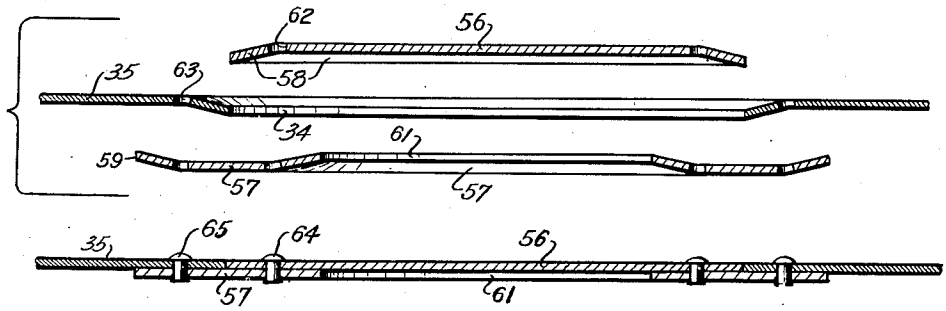


Fig 3



INVENTOR.
THOMAS J. NICHOLAS
BY Joseph W. Hazell and Wade Koontz
ATTORNEYS

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SHEET METAL BENDING TOOL

Thomas J. Nicholas, Boise, Idaho

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4 Claims. (Cl. 81—15)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to a hand-operated tool for bending the edge portion of sheet metal.

One of the objects of this invention is to provide an improved hand-operated tool for bending the edge portion of sheet metal at a slight angle from the main part of the sheet, which tool is compact and light so that it can be carried about by hand as well as being operated manually, and which is thus particularly useful for bending the edge portion of sheet metal located around an inspection aperture cut in an airplane wing or the like, and for bending the edge portion of the patch and of the backing plate used for patching such an aperture, so as to provide a close fit and a moisture-proof patch which is smooth on the outer surface of the wing.

A more particular object of this invention is to provide an edge bending tool wherein the companion bending members include a cam-equipped roller which is arranged to be rotated manually and thus caused to travel over the edge portion of the sheet metal for performing the bending operation.

Another object of this invention is to provide an improved method for patching inspection apertures that were cut in the sheet metal skin of airplane wings and the like where inside repair work is required, and by which method the various parts will have their edge portions bent, in consequence of which the patch can be readily seated in position and a moistureproof contact will be established between these parts, while the patch will also be made flush with the exterior surface of the wing.

These and various other objects and advantages are attained with this invention, as will become apparent from the following description, taken in connection with the accompanying drawing wherein the invention is shown in its preferred form, it being evident that other arrangements and forms of construction may be resorted to in carrying out the objects and purposes of this invention.

In the drawing:

Fig. 1 is an elevational view illustrating a bending tool embodying my invention, having parts broken away and being employed in bending the edge portion around an aperture in a sheet of metal.

Fig. 2 is a sectional view illustrating the involved sheet metal parts separated, including the

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patch, the main plate with its aperture, and the backing plate, having their edge portions bent and the rivet holes provided in the bend-lines, all ready for installation.

Fig. 3 is a sectional view illustrating the parts shown in Fig. 2, after the rivets have been positioned and the bent parts forced upon each other and secured air-tight together, providing a flush exterior.

The drawing illustrates an embodiment of this invention, and in Fig. 1 my improved bending tool is shown in its preferred form of construction, which is conveniently operable for bending the edge portion of sheet metal; while the drawing further discloses a novel method whereby holes in sheet metal can be quickly and efficiently patched, especially by the use of this readily operable tool, and more particularly such holes as the inspection holes that are made in the sheet metal skin of an airplane wing and the like for doing repair work on the inside thereof.

This improved bending tool as shown herein comprises a pair of companion members 10 and 11 which carry, respectively, a pair of bending elements 12 and 13 at the lower ends thereof. Said companion members are preferably in the shape of a pair of bars having two faces contacting and being movable longitudinally relative to each other, so as to adjust the bending elements toward and away from one another, while said elements are preferably in the form of cam-equipped rollers.

This arrangement is conveniently provided by mounting the roller 13 rotary on a pin 15 which has its end threaded in an opening provided in bar 11; and providing the roller 12 with an integral shaft 16 which extends rotatably through a sleeve 18 seated in a hole 20 provided in bar 10, said sleeve being movable in a slot 22 provided in bar 11 so that it with bar 10 are adjustable longitudinally of said bar 11. The sleeve 18 contains a spacing collar 24 thereon disposed between the bar 10 and a neck 26 of the hand-operated member or knob 28, the knob 28 being fixed upon the shaft 16, as by a pin 30.

The rollers 12 and 13 include main portions which are substantially cylindrical and are provided with beveled cam portions 32 and 33 thereon, respectively. These cam portions 32 and 33 travel upon and bend the edge portion 34 of the sheet so as to extend at a slight angle or slant from the main body portion 35 of the sheet wherein the aperture exists, while the main cylindrical parts of these rollers travel along and are guided

by said main portion 35 of the sheet which extends beyond said edge portion, substantially as indicated in Fig. 1.

In operating this device the bars 10 and 11 are held and guided by one hand and the turning of member 28 by the other hand rotates the roller 12 secured thereto by shaft 16, and thereby causes the roller 12, and also the companion member 13 in this form of construction, to roll and travel progressively forward upon the sheet metal in performing the bending operation.

Means is further provided for moving the bars 10 and 11 longitudinally of each other and thereby adjusting the distance between the rollers 12 and 13, to suit the thickness of the sheet metal therebetween, and furthermore to force the rollers firmly upon the sheet metal and form the initial bend thereon, and then also to retain the rollers in the adjusted position. This adjusting means comprises an adjusting member in the form of a bolt 36 which is rotatably mounted in a bearing head 38 secured by its threaded end in said bar 10, while this bolt 36 is held against longitudinal movement by the knob 39 above said head 38 and by a collar 40 pinned on the bolt below said head. The threads 41 on the bolt function in the threaded head 42 provided on a shaft 43 secured in an aperture provided in bar 11 and held in place by a nut 44. A shoulder 45 on said shaft 43 is movable in a slot 46 extending longitudinally of bar 10.

By the operation of knob 39 and the adjusting bolt 36, the head 42 with its attached shaft 43 will be moved and will therewith shift the bar 11 longitudinally on the bar 10, whereby the roller 13 at the lower end of bar 11 will be adjusted relative to the roller 12 secured to the lower end of bar 10, so as to suit the thickness of the sheet metal operated upon. The pitch of the threads on bolt 36 will enable the operator to readily force the cam portion 32 of roller 12 against the edge portion 34 of sheet metal 35 and initially bend said edge portion onto cam portion 33 of roller 13, and will then retain the bars and the rollers securely in the adjusted position for continuing in the edge bending operation. The bolt 36 can also be manipulated and adjusted for gradually forcing the rollers together and gradually bending the edge portion, if the metal is of substantial thickness.

This bending tool is particularly arranged and adapted to be utilized in the patching of apertures in sheet metal especially such as inspection holes that were cut in the sheet metal skin of an airplane wing and the like, to get into for doing repair work on the inside, and the knob 28 is conveniently operable by the hand moving freely in such aperture.

In patching such holes in airplane wings and other sheet metal members as outlined above, by my improved method, it is preferred to proceed substantially as follows:

1. For such aperture or hole in the sheet metal skin of the airplane wing or the like, provide the proper sized patch 56 and provide a backing plate 57 which is substantially annular in shape and is provided with a central aperture, being of such shape and size that the plate will overlap the adjoining parts of the patch and of the wing metal around its aperture, which may all be accomplished in the usual manner.

2. Then bend the inner edge portion 34 of the sheet metal, entirely around the aperture in the wing metal 35, inwardly with regard to said wing; likewise bend the peripheral edge portion 58 of

patch 56 in an inward direction, and bend the outer edge portion 59 of the backing plate 57 as well as the inner edge portion 61 thereof upwardly, substantially as indicated in Fig. 2 of the drawing. This edge bending operation will slightly contract the diameter of the patch 56 and will thus enable the patch to be set freely in the wing aperture, and by then applying the backing plate 57 inward thereof said plate will have the upper edges of its bent portions 59 and 61 engaging under the body parts of the wing 35 and of the patch 56. The bendlines on these parts will make excellent rivet lines and will hereby be used for a guide in placing the rivet holes 62, 63, which are next provided herein.

3. Place the patch in the wing hole and place the backing plate inward of the patch and of the wing metal, by bringing together these three parts shown separated in Fig. 2, then secure the parts together by fastening the inserted rivets 64, 65 in place, and thereby force the bent edge portions firmly onto the adjoining sheet metal and also straighten the parts out upon each other, substantially as shown in Fig. 3 of the drawing. This will complete the patching job and create a tight moisture-proof fit which will be flush on the outer surface of the wing.

I claim:

1. A light portable hand-operated tool for bending the edge portion of sheet metal at a slant from the main part thereof, said tool consisting of a pair of supporting members connected to be adjustable longitudinally on each other, a pair of bending members each including cam means thereon, one bending member on each of said supporting members and at least one thereof being rotary, adjusting means including an element on one supporting member and a bolt with an operating knob on the other supporting member and having threaded engagement with said element, for adjusting said supporting members and thereby forcing the bending members upon the sheet metal and enable gradual bending of the edge portion, and hand-engaged and actuated means connected with said rotary bending member to cause it to roll over the sheet metal in performing the edge bending operation.

2. A compact light portable hand operated tool for bending the edge portion of sheet metal around an aperture formed in the metal, said tool comprising a pair of longitudinally adjustable contacting parallel bars arranged to be held by one hand during operation, a pair of first and second companion cam rollers positioned at one side of the bars adjacent the lower ends thereof including means mounting said first one of said rollers rotatably on one of the bars, an operating shaft journaled in the other bar and projecting laterally from the opposite sides there, said parallel bar with the first roller rotatably mounted thereon having an elongated guide opening formed therein receiving one end of the projecting portion of the said shaft therethrough, said second roller being fixed on the end of said shaft next to the outer face of the last mentioned parallel bar, and an operating knob fixed on the other end of said operating shaft, arranged to be grasped and turned by the other hand of the operator holding the tool, to rotate the connected second roller and advance the roller and the tool along the edge portion of the sheet metal surrounding the aperture during the bending operation, and manually operable adjusting means connected between the bars for adjusting one bar longitudinally of the other bar to adjust the

rollers into clamping and bending contact with the sheet metal therebetween.

3. A portable hand operated tool for bending the edge portion of a metal sheet around an aperture formed in the sheet, said tool comprising a pair of elongated parallel supporting bars disposed in juxtaposed parallel longitudinal sliding relation relative to each other, longitudinally spaced guide means projecting laterally from one face of each bar into a guide slot formed in the face of the other bar, an adjusting screw rotatably journaled at one end on one of the bars and fixed against axial displacement thereon with its axis extending parallel to the adjustment plane of the bars and threadably connected to the guide means on the other bar, said adjusting screw having an operating knob thereon at one end for manually rotating the same to adjust the bars longitudinally relative to each other, the other guide means incorporating a journal bearing having an axis perpendicular to the adjustment plane of the juxtaposed faces of the bars and a shaft rotatably journaled in the said bearing and extending therethrough, a sheet metal bending roll fixed on one end of said shaft, said roll having an annular concentric cam portion adjacent the outer face of the bar through which the guide means incorporating the journal bearing projects, said bending roll having a concentric cylindrical portion thereon adjoining the annular cam portion, a shaft operating knob fixed on the opposite end of said shaft to rotate the same and revolve the metal bending roll, a second complemental metal bending roll supporting shaft fixed on and extending from the end portion of the other bar in adjacent parallel relation to the rotatably journaled shaft just mentioned, a second complemental sheet metal bending roll rotatably journaled on the second mentioned shaft, having a concentric complemental annular cam portion opposite the annular cam portion of the first mentioned bending roll and a concentric cylindrical portion disposed opposite to the cylindrical portion of the first roll, whereby rotative adjustment of the adjusting screw in one direction moves the bars to adjust the complemental cam and cylindrical portions of the rolls toward each other to clamp and bend the edge of a metal sheet interposed between the bending rolls, and rotation of the shaft operating knob on the rotatable shaft rotates the first mentioned bending roll to advance the tool along the edge of the metal sheet clamped between the rolls and bend the edge portion of the sheet during said advancing movement.

4. A hand-operated portable tool for bending the edge portion of sheet metal at a slant from the main body part of the sheet metal, said tool comprising a pair of adjustable contacting parallel bars, each bar having a cam roller mounted at the lower end thereof, manually operable means at the upper parts of the bars connecting the bars together to readily adjust said bars longitudinally of each other and thereby adjust the rollers relative to each other to clamp and bend the initial part of the edge portion of a metal sheet that is positioned between the rollers and retain the rollers in adjusted position, a manually operable member connected to one of the rollers to rotate it and advance the rollers and tool along the edge portion of the sheet during the bending operation, and longitudinal guide means between the bars for guiding the bars longitudinally relative each other during adjustment thereof.

THOMAS J. NICHOLAS.

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