Sept. 8, 1959 H. S. GOBER 2,903,038

METHOD AND TOOL FOR SMOOTHING FORMED SHEET METAL

Filed Aug. 12, 1955 2 Sheets-Sheet 1

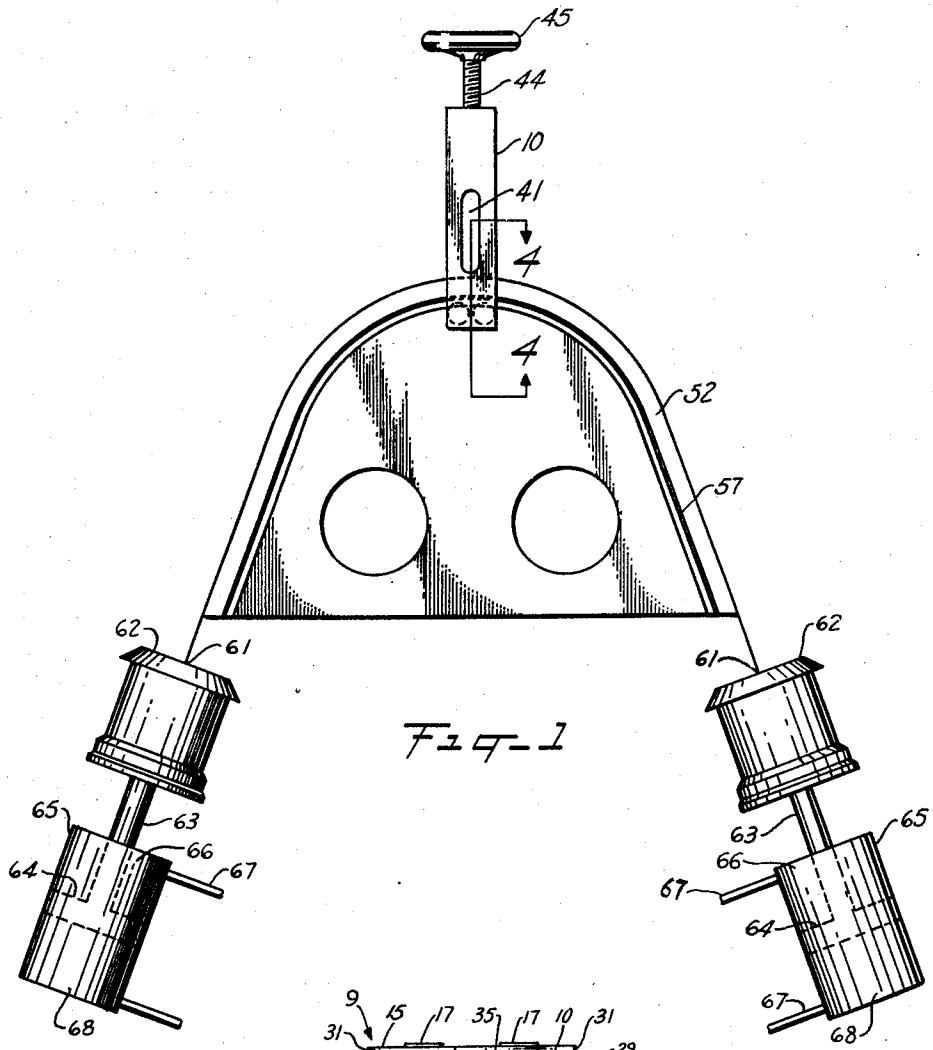
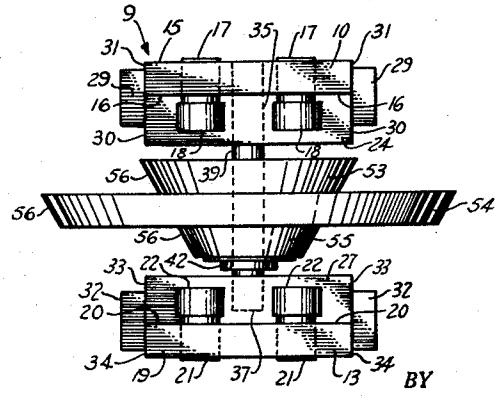


Fig-1



BY

Fig-3

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METHOD AND TOOL FOR SMOOTHING FORMED SHEET METAL

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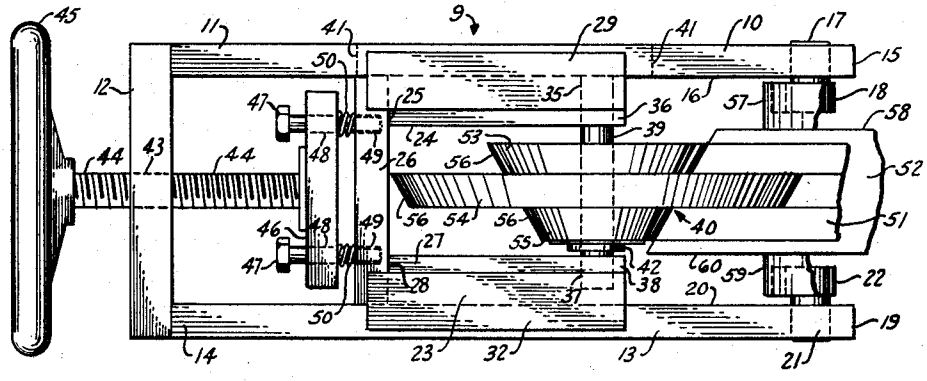

FIG. 2

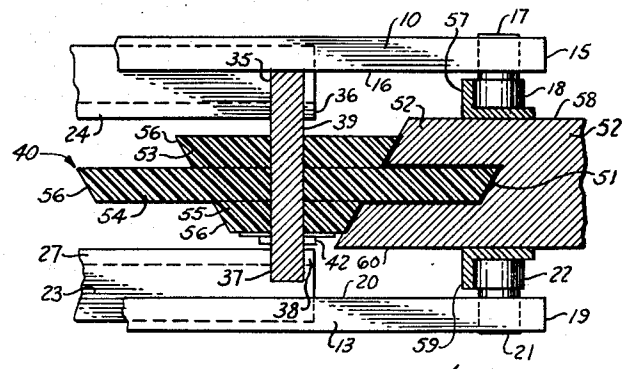

FIG. 4

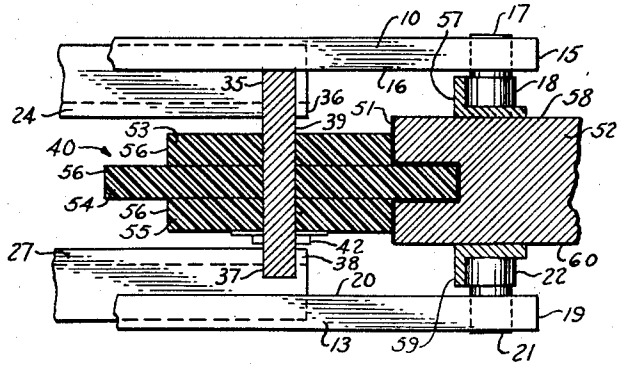

FIG. 5

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METHOD AND TOOL FOR SMOOTHING FORMED SHEET METAL

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Application August 12, 1955, Serial No. 527,997

5 Claims. (Cl. 153—32)

This invention relates to the art of metal forming and particularly to the art of forming sheet metal into parts having extreme curvatures and bends of complex shapes.

In forming sheet metals of various types into parts having intricate shapes it is customary to form the metal by applying sufficient tension to the workpiece to stretch the metal to or slightly beyond its elastic limit and, while thus stretched, to wrap the workpiece against the face of a forming die with sufficient force to cause it to conform to the shape of the die. This method of forming sheet metal usually produces accurately formed parts having smooth surfaces, however, in some instances the extremely complex shapes into which the parts must be formed results in the surfaces of the parts having irregularities, such as small compression waves and wrinkles, which must be removed to make the part usable. The removal of these irregularities has heretofore been accomplished by a difficult and time-consuming hand operation resulting in a substantial increase in the cost of producing the parts and also in a large number of parts being scrapped.

The primary object of this invention is, therefore, to provide a device with which small irregularities in the surface of a formed sheet metal part may be quickly and easily removed and the part made to accurately and smoothly conform to the shape of the forming die.

A further object is to provide a device for smoothing the surfaces of formed sheet metal parts which is easily adaptable for use on parts of various shapes and configurations.

Another object is to provide a device as above described which is of simple and inexpensive construction and requires no special skill or training to operate.

These and other objects and advantages will become apparent as the description of the invention proceeds.

For a better understanding of the invention reference is made to the accompanying drawing illustrating a preferred embodiment thereof and in which:

Fig. 1 is a top view of the device attached to a sheet metal forming die used in a stretch forming machine also showing parts of the machine.

Fig. 2 is an enlarged side view of the device and portions of the forming machine.

Fig. 3 is an end view of the device removed from the forming die.

Fig. 4 is a fragmentary view in cross section of Fig. 1 taken on line 4—4 and,

Fig. 5 is a fragmentary view in cross section similar to Fig. 4 illustrating a modification of the device.

With reference to Figs. 2 and 3 of the drawing the device comprises a generally U shaped frame 9 having a flat rigid upper arm 10 one end 11 of which is attached to a plate 12 as by welding and a flat rigid lower arm 13 positioned parallel to arm 10 and having one end 14 attached to plate 12 as by welding. Attached to arm 10 adjacent its extending end 15 and projecting downwardly from lower surface 16 thereof is a pair of pins 17 on

which a pair of small wheels 18 are rotatably mounted in spaced apart positions for a purpose to be explained. Attached to the extending end 19 of arm 13 and projecting upwardly from the upper surface 20 thereof is a second pair of pins 21 on which a second pair of small wheels 22 are rotatably mounted in spaced apart positions opposite wheels 18 for a purpose to be explained.

Positioned between arms 10 and 13 is a roller support 23 comprising an upper plate 24 having one end 25 secured to an end plate 26 and a lower plate 27 having one end 28 secured to end plate 26. Upper plate 24 is slidably engaged with lower surface 16 of arm 10 and is held in engagement therewith by two guide bars 29 attached to the sides 30 of plate 24 and extending upwardly to slidably engage sides 31 of arm 10 (see Fig. 3). Lower plate 27 is slidably engaged with upper surface 20 of arm 13 and is held in position on arm 13 by guide bars 32 attached to sides 33 of plate 27 and extending downwardly to slidably engage sides 34 of arm 13. Plate 24 is provided with an opening 35 passing vertically therethrough adjacent its end 36 and plate 27 is provided with an opening 37 adjacent its end 38 in vertical alignment with opening 35. A pin 39 extends between plates 24 and 27 with its ends seated in openings 35 and 37, a workpiece engaging roller 40 being rotatably mounted on pin 39. Pin 39 is easily installed in or removed from support 23 through a slot 41 (see Fig. 1) passing through arm 10. Roller 40 is supported on pin 39 by a collar 42 adjustably secured to the pin in any known manner.

Plate 12 is provided with a central threaded opening 43 extending therethrough for engagement with a similarly threaded rod 44 passing therethrough. The outer end of rod 44 has a handwheel 45 attached thereto which is used to rotate the rod and the inner end of rod 44 is rotatably attached to a connecting plate 46. Plate 46 is connected to end plate 26 of support 23 by means of bolts 47 which pass through openings 48 in plate 46 in sliding engagement with the walls thereof and extend into threaded openings 49 in end plate 26 in threaded engagement therewith. Plates 46 and 26 are held in spaced apart positions by helical compression springs 50 disposed between them and through which bolts 47 pass for a purpose to be explained.

Workpiece engaging roller 40 is preferably made in sections secured together in a known manner to form the complete roller, each section having a peripheral face adapted to press a portion of the workpiece against the die. In Fig. 4 of the drawing is shown a cross sectional view of a roller 40 pressing a workpiece 51 against the face of a die 52, in which the roller is composed of an upper section 53, an intermediate section 54 and a lower section 55. Each section has a workpiece engaging face 56 inclined at an acute angle to the axis of the roller and adapted to press the workpiece against the portion of the die disposed opposite that section. Each of sections 53, 54 and 55 is of such diameter that each of their faces 56 engage and press a portion of workpiece 51 against die 52 simultaneously as the roller advances along the workpiece.

In Fig. 5 of the drawing a modification of roller 40 is shown in which faces 56 are parallel to the axis of the roller and adapted to press workpiece 51 against a die 52 of corresponding shape. The roller is preferably made of a rigid material such as a hardened plastic resin or a plastic impregnated laminate which is softer than the metal being formed to avoid scratching or otherwise damaging the metal.

To attach the device to die 52 for movement thereof along the die face a rail 57 shaped to follow the general contour of die 52 is attached to the upper side 58 of the die and a similar rail 59 is attached to the lower side 60 of die 52 in vertical alignment with rail 57. Rails

57 and 59 are preferably L shaped in cross section as shown in Figs. 4 and 5 of the drawing and extend outwardly from sides 58 and 60 a sufficient distance to permit them to engage wheels 18 and 22 on arms 10 and 13 respectively as shown in the drawing, to movably support the device.

To use the device to remove waves or wrinkles from a sheet metal part, workpiece 51 is first formed on forming die 52 in a conventional sheet metal stretch bending operation as shown in Fig. 1 of the drawings. The ends 61 of workpiece 51 are secured in chucks 62 attached to the ends of piston rods 63 connected to pistons 64 contained in opposed cylinders 65. Fluid under pressure from a known source (not shown) is admitted into the rod ends 66 of cylinders 65 through conduits 67 moving pistons 64 toward the head ends 68 of cylinders 65 thus moving chucks 62 in opposite directions to apply tension to workpiece 51. The tension applied to workpiece 51 should be sufficient to stretch the metal to or slightly beyond its elastic limit and while stretched in this manner, workpiece 51 is wrapped against the face of die 52 by moving cylinders 65 about pivots (not shown) to the positions shown in the drawing thereby forcing the workpiece to conform to the shape of the die. Mechanism for supporting and moving the cylinders may be that disclosed in Figs. 1 and 2 of U.S. Patent No. 2,357,027 of R. Seifried. The device is then attached to die 52 at one end of rails 57—59 in the manner previously described while workpiece 51 is held wrapped against the die face under tension. Handwheel 45 is then rotated to rotate rod 44 in the direction necessary to advance connecting plate 46, support 23 and roller 40 toward die 52 until faces 56 of roller 40 contact the workpiece 51. Rod 44 is then further rotated to advance connecting plate 46 a sufficient amount to partially compress springs 50 between plates 46 and 26 so that support 23 is urged toward die 52 thereby pressing roller 40 in firm contact with workpiece 51 with a yielding pressure. The device is then moved along the face of die 52 guided by wheel 18 and 22 moving along rails 57 and 59 so that faces 56 of roller 40 press successive portions of the workpiece against die 52 with a rolling action which smooths the surface of workpiece 51 by removing all wrinkles and unwanted irregularities therefrom. The yielding pressure with which roller 40 is pressed against workpiece 51 as above described permits roller 40 to follow any small curves or other irregularities in the face of die 52 while maintaining a constant pressure against the workpiece. The yielding pressure supplied by springs 50 also permits roller 40 to maintain a constant pressure against workpiece 51 despite any small variances between the shape of rails 57 and 59 and the contour of the outside face of die 52. The device is moved back and forth along die 52 as often as necessary to smooth the surface of workpiece 51. After the smoothing operation is completed, roller 40 is withdrawn from workpiece 51 by rotating handwheel 45 to retract plate 26 and support 23, wheels 18 and 22 are then disengaged from one end of rails 57 and 59 and the device removed from the die. The pressurized fluid is then withdrawn from the head ends of cylinders 65 to relieve the tension on workpiece 51 and ends 61 of workpiece 51 are released from chucks 62 to permit removal of the formed workpiece from die 52.

This invention may be embodied in other forms or carried out in other ways without departing from the spirit or essential characteristics thereof. The present embodiment of the invention is therefore to be considered as in all respects illustrative and not restrictive, the scope of the invention being indicated by the appended claims, and all changes which come within the meaning and range of equivalency of the claims are intended to be embraced therein.

Having thus described my invention, what I claim as new and useful and desire to secure by Letters Patent is:

1. Means for pressing and smoothing successive portions of a workpiece against the curved face of a forming die, comprising: a rigid frame having a pair of spaced apart substantially parallel upper and lower members connected together at one end; said members extending from said one end thereof toward and beyond said face of the die in spaced parallel adjacency to opposite sides of the die respectively; guide means disposed along said opposite sides of said die adjacent the face thereof; spaced means attached to the opposing faces of said parallel members adjacent the extending ends thereof adapted to engage said guide means to support said frame for guided movement thereof along said die; a roller support disposed between said parallel members, said support being slidable along the opposing faces of said parallel members for movement toward and away from said die; a roller rotatably mounted on said support with its axis substantially normal to the faces of said parallel members and disposed in a plane passing between said spaced means, said roller having a face shaped complementary to said die face and adapted to engage and press successive portions of the workpiece against the die face as the frame is moved along the die; and means for selectively moving said roller support and roller toward and away from said die.

2. Means for pressing and smoothing successive portions of a sheet metal workpiece against the curved face of a forming die, comprising: a rigid frame having a pair of spaced apart substantially parallel upper and lower members provided with connecting means adjacent one end; said members extending from said one end thereof toward and beyond said face of the die in spaced parallel adjacency to opposite sides of the die respectively; guide means secured to said opposite sides of said die adjacent the face thereof; spaced means attached to said parallel members adjacent their extending ends adapted to movably engage said guide means to support said frame for guided movement thereof along said die; a roller support disposed between said parallel members and in sliding engagement therewith for movement of said support along said parallel members toward and away from said die; a roller rotatably mounted on said support with its axis substantially normal to the faces of said parallel members and disposed in a plane passing between said spaced means, said roller being provided with a workpiece engaging face shaped complementary to said die face and adapted to engage and press successive portions of the workpiece against the die face as said frame is moved along the die; and screw threaded means extending through said connecting means and in threaded engagement therewith to engage said roller support for selectively moving said support and roller toward and away from said die.

3. A device as claimed in claim 2; in which said screw threaded means is connected to said roller support by resilient connecting means arranged and constructed to provide a yielding pressure for urging said roller against the workpiece.

4. A device as claimed in claim 2; in which said guide means are rigid rails secured to each side of the die and shaped to follow the contour of the die.

5. Means for pressing and smoothing successive portions of a formed sheet metal workpiece against the curved face of a forming die, comprising: a rigid frame comprising spaced apart parallel upper and lower rigid members having a length substantially greater than their width and provided with rigid connecting means extending therebetween at one end thereof; said members extending from said one end thereof toward and beyond said face of the die in spaced parallel adjacency to opposite sides of the die respectively; guide means secured to said opposite sides of said die adjacent the face thereof, said guide means being shaped in conformance with the curvature of said die face and extending along the entire length thereof; a pair of spaced rollers attached to each of the

opposing faces of said rigid parallel members adjacent the extending ends thereof, said rollers being arranged and constructed to engage said guide means to movably support said frame for guided movement along said die face; a workpiece engaging roller member disposed between said rigid parallel members and adapted to engage and press successive portions of said workpiece against said die face as said frame is moved along the die; a support disposed between said rigid parallel members in sliding engagement with the opposing faces thereof and having means for supporting said workpiece engaging roller for rotation about an axis which is parallel to the axes of said spaced rollers and lies in a plane which passes therebetween, said support being arranged to support said workpiece engaging roller for movement toward and away from said die face; and means for selectively moving said support toward and away from said die face.

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