Jan. 28, 1964 H. W. ROGERS 3,119,432

SHEET METAL FORMING TOOLS

Filed May 15, 1961

Fig.1

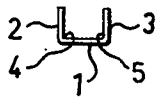


Fig.2

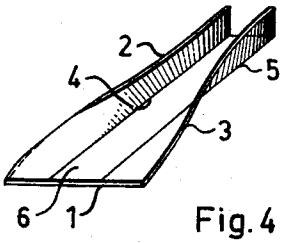


Fig.3

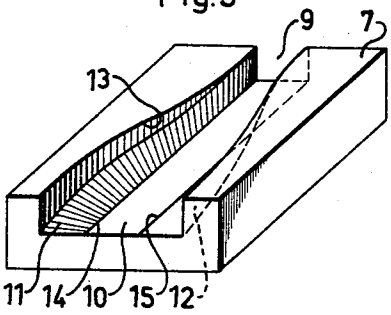


Fig.4

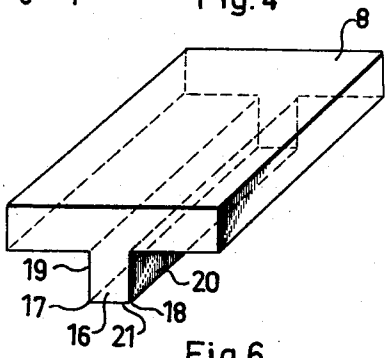


Fig.5

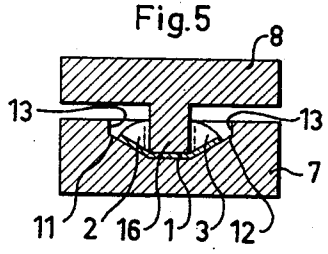


Fig.6

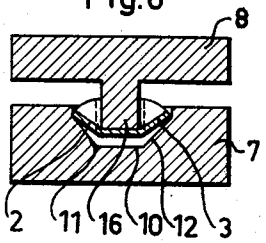
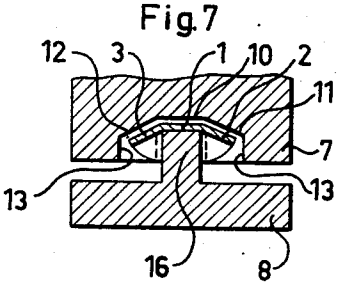


Fig.7



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SHEET METAL FORMING TOOLS

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The invention relates to a tool for forming sheet metal, preferably a sheet metal strip or the edge portion of a metal sheet, into a desired cross-sectional shape. Such sheet metal sections have previously been produced mostly by rolling the sheet metal between profiled rolls which usually requires that the forming is carried out in several steps between a plurality of pairs of rolls operating one pair after the other. It is also known previously to form sheet metal edges by compressing the sheet between an upper and a lower die in which the sheet is depressed into a channel of uniform width in the lower die accordingly as the sheet is fed along in the longitudinal direction of the channel. This method has the disadvantage that the forming takes place under the action of a strong pressure causing stresses in the sheet which in turn cause warpage of the formed sheet metal strip.

It has also been proposed to bring about the desired change of shape of the sheet by using a tool comprising two forming parts, for instance, an upper and a lower die, between which the sheet is fed in a direction parallel to the edge of the sheet and of which one is stationary while the other is adapted to perform a hammering motion with a short stroke and of high frequency. The lower die is provided with a channel wherein the edge of the sheet is formed while the sheet is progressively fed along during the intervals between the working strokes. The channel is confined by a bottom surface and two side surfaces which form helically extending working surfaces from the entrance to the exit end of the channel. In forming methods of this kind previously known the forming of the sheet is carried out by the aid of the pressing action of a male die member provided with working surfaces, likewise helical, corresponding to the helical channel surfaces, the sheet being pressed between these working surfaces. This pressing action is inadequate from several points of view. The present invention is related to an improvement of this method and has for its object to provide shaping of the sheet merely by bending without the sheet metal being pressed against the helical working surfaces of the lower or female die. The invention is chiefly characterized by the feature that the part of the male die coacting with the channel in the female die comprises a bar-shaped body having a plane working surface conformed to the bottom surface of the channel and confined between two straight side edges of said body, and having such a cross-sectional configuration that it leaves a free clearance between the side surfaces of the bar and the opposite surfaces of the channel during the complete working stroke of the tool. In this way the forming is performed merely by the sheet being bent about the straight side edges of the bar-shaped body while the sheet is bearing with its edges against the helical working surfaces. As a result the stresses in the material are reduced to such an extent that warpage of the finished product is avoided.

The invention is illustrated in the annexed drawings wherein:

FIG. 1 is a cross section view of a metal strip shaped according to the invention;

FIG. 2 is a perspective view illustrating the progressive shaping of the metal strip in FIG. 1;

FIG. 3 is a perspective view of a female tool die according to the invention;

FIG. 4 is a perspective view of a male tool die according to the invention;

FIGS. 5 and 6 are cross section views of the tool dies in FIGS. 3 and 4 in cooperative relationship and illustrates the tool in two operating positions;

FIG. 7 is a cross section view of a modification of the tool shown in FIGS. 5 and 6.

With reference to FIGS. 1–7 it will first be described how a flat sheet metal strip of uniform width may be formed into a bar having a U-shaped cross section. FIG. 2 shows the part of the strip which is being worked on within the tool, and the figure illustrates how the strip 1 continuously changes its shape while passing the tool, the two edge portions 2, 3 being bent along lines 4, 5 which define the uniform bottom portion 6 of the finished bar. The tool is a pressing tool comprising a lower part 7, FIG. 3 and an upper part 8, FIG. 4, in the following called the lower die and the upper die, respectively.

The lower die 7 is provided with a channel 9 which has a cross section changing continuously in the longitudinal direction of the channel and having a form substantially corresponding to that of the sheet metal strip shown in FIG. 2. The bottom of the channel forms a flat working surface 10 of uniform width while the side walls form adjacent the bottom face 10 helically curved working surfaces 11, 12, which extend from a plane coinciding with the bottom surface 10 and converge towards the exit end of the channel. These side surfaces thus correspond as to their shape to the edge portions 2, 3 of FIG. 2. The working surfaces 11, 12 are recessed in the lower die and connect to a side face 13 forming a cylinder surface having vertical generatrices. The helical surfaces may be considered as having a generatrix being at all points perpendicular to the border line 14 and 15, respectively, of the bottom surface 10.

The upper die 8 comprises a plate covering the lower die and being provided on its lower side with an integral male die member 16 having a parallelepipedal shape and the same length as the channel 9 of the lower die. By means of a suitable driving device an oscillating movement in the vertical is imparted to the upper die. The movement a short length of stroke but a high number of strokes per minute, for instance 1500, the upper die moving up and down in the channel 9. During the travel of the strip through the channel its edge portions 2, 3 are supported by the helical backing surfaces 11, 12 in the lower die. When the upper die 16 is moving downwards during its working stroke the strip 1 is pressed against the bottom plane 10, in doing which the edge portions 2, 3 of the strip are bent about the corners 17, 18 of the upper die without being actuated by the side surfaces 19, 20 of the male die member, as may be seen from FIG. 5. When the male die member is reversed and moves upwards, the strip is released so that it may be fed along one step, in doing which the strip slides forwards and upwards on the helical backing surfaces 11, 12 until it is stopped against the vertical side walls 13. In order to give the strip the necessary lateral space during the feed, the backing surfaces 11, 12 are suitably slightly wider than the edge portions 2, 3 of the strip. FIG. 6 shows the strip in its position when fed forward. The strip is slightly elevated above the bottom surface 10 of the channel. During the working stroke of the male die member the strip is pressed downwards against the bottom of the channel, the margins of the strip edge portions 2, 3 then slide against the helical surfaces 11, 12 at the same time as the edge portions are bent about the corners 17, 18 of the male die member. Not until the upper die reaches its bottom position are the edge portions 2, 3 pressed throughout the width of their side surfaces against the helical surfaces 11, 12, the bottom corners 4, 5 of the strip then being subjected to a compressing action which stabilizes the bottom

portion of the strip. Thus, during the bending substantially no sliding occurs between the opposed side surfaces of the strip and the lower die.

The male die member and its working surface 21 has the same width as the bottom surface 6 of the strip. When the latter reaches the exit end of the channel 9 its edge portions 2, 3 will therefore be bent up against the side surfaces 19, 21 of the male die member so that the strip leaving the channel obtains the desired U-section. In order to avoid friction between the strip and the side surfaces of the male die member at the exit end said member may be profiled in such a way that its side surfaces 19, 20 converge upwards. Possibly the side surfaces 19, 20 may be shaped in such a way so as to conform closely, all along the upper die, to the helical surfaces 11, 12 in the lower die, so that the edge portions 2, 3 of the strip are formed by means of pressure from both sides.

The lower or female die 7 need not necessarily be the stationary part of the tool but the arrangement may be reversed so that the die is movable and disposed above the stationarily mounted male die, as shown in FIG. 7. The strip will then rest firmly on the top surface 21 of the member 16 and be fed along without changing its level. As for the rest, the bending of the edge portions 2, 3 is performed in the same way as in FIG. 5. The recessed portion of the female die need not be confined by vertical surfaces 13 but the helical surfaces 11, 12 may extend all the way to the external surface of the female die.

What is claimed is:

1. A tool for forming sheet metal comprising two die members, one of said die members having a channel-like recess having an entrance end and an exit end and defined by a bottom surface and two helical side surfaces, said helical side surfaces starting at the entrance end of said channel from a plane coinciding with the bottom surface and converging towards the exit end of the channel, the other die member having a rib-shaped body portion effective to press the sheet metal into said channel when relative movement is imparted to one of said die members to impart relative movement to each other and the sheet metal to be formed is advanced stepwise longitudinally through said channel, said body portion having a plane working surface conforming to the bottom surface of said channel and having two side surfaces joining the working surface along straight line edges of the body portion, said body portion having at least at the exit end of the tool a cross-sectional configuration coinciding with the cross-section of the channel at the exit end thereof, and having along the remainder of its length a cross-sectional width less than that of the channel thereby to leave in operation a free clearance between the side surfaces of the rib-shaped body portion and opposing side surfaces of the channel in a terminal operative position of a working stroke of the die members, said clearance converging towards the exit end of the tool, whereby said sheet is shaped progressively solely by its being bent about said straight line of the rib-shaped body portion.

2. A tool according to claim 1, in which the rib-shaped body has throughout its length a cross-sectional configuration coinciding with the cross-section of the channel at the exit end of the tool.

3. A tool according to claim 1, in which the rib-shaped body side surfaces comprise plane side surfaces.

4. A tool according to claim 1, in which said side surfaces of the rib-shaped body are parallel with respect to one another.

5. A tool according to claim 1, in which the channel has a cylindrical wall surface adjoining the helical surface, said cylindrical wall surface having generatrices perpendicular to the bottom surface of the channel.

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