HYDROMECHANICAL METHOD AND DEVICE FOR THE REVERSE REDRAWING OF SHEET METAL

ABSTRACT: Blanks for sheet metal are drawn with the aid of a pressure container, a liquid displacing annular plunger pressure tightly glidable in the container and having a top adapted for accommodating the blank, a hold down for pressing the blank against the top, and a draw punch passing through the holddown. The container and plunger are first filled with liquid up to the top. Then the blank is placed onto the top, thereafter the holddown is forced downwardly against the blank, thereby pressing the plunger into the container. The increasing liquid pressure in the container draws the blank to a shape bulging upwardly into the holddown. Thereafter, the blank is reversely redrawn into the pressure container by pressing the punch from above against the blank and downwardly into the container.
HYDROMECHANICAL METHOD AND DEVICE FOR THE REVERSE REDRAWING OF SHEET METAL

My invention relates to a method and a device for the hydromechanical reverse redrawing of sheet metal with the aid of a pressure container which constitutes the bottom portion of the drawing tool assembly, an annular liquid displacement plunger glidably and pressure tightly seated in the container and having a top portion located outside and above the container and adapted for receiving the sheet-metal blank, a hold-down which presses the blank against the plunger top, and a drawing punch which passes through the hold-down.

It is known that a blank of sheet metal hydromechanically by first predrawing a blank with the aid of the conventional drawing method, using an ordinary die and punch press. Thereafter, the preshaped workpiece is reversely redrawn by the hydromechanical method. The two assemblies known for such purposes have the disadvantage that due to the necessity of first applying a conventional drawing operation, the equipment is rather complicated and expensive while still falling short of providing for optimal drawing conditions during the predrawing operation.

It is an object of my invention to provide a reverse redrawing method and device with whose aid a double-acting drawing press affords predrawing and reversely redrawning the workpiece on the hydromechanical drawing principle.

To this end, and according to my invention, the pressure container and the annular plunger glidable in the container are filled with liquid up to the top rim, whereafter the blank is placed upon the annular top of the displacement plunger and so loaded by the hold-down as to press the displacement plunger into the pressure container. The liquid pressure thus being increased in the interior of the container and plunger is deflected into the hollow space formed within the annular hold-down and, as the case may be, also by the withdrawn drawing punch. This results in preshaping the blank to a bulging or cup shape by the hydromechanical action. The blank, thus preshaped, is then subjected to the downward drawing pressure of the punch which turns the bulging shape inside out and forces it into the interior of the hold-down or container.

The predrawing operation does not require any particular control or regulation of the liquid quantity because the volume of liquid displaced can readily be so dimensioned as to render further control unnecessary. However, the reverse redrawing operation requires controlling the liquid to obtain a predetermined pressure because the volume of liquid in the pressure container must become reduced during redrawing.

The invention will be further explained with reference to an embodiment of a hydromechanical device according to the invention illustrated schematically on the accompanying drawings, in which:

FIG. 1, 2 and 3 illustrate the reverse redrawing device in cylindrical section through the essential components and in three different drawing stages respectively; and FIG. 4 shows a modified detail of the same device.

The bottom portion 1 of the tool assembly, to be used in, or as part of, a punch press, is designed as a pressure container in whose interior 2 an annular displacement plunger 4 is glidably displaceable. The plunger 4 is provided with sealing rings at its periphery for maintaining a liquidtight and pressure-tight seal. The top of the plunger 4 forms a flange above the container 1 and has a top face 5 for accommodating a blank 7. A sealing ring 6 surrounding the tubular hollow of the plunger 4 is inserted for securing a liquidtight and pressure-tight seal during operation of the device. The blank 7 is pressed against the seal 6 by means of an holddown member 8 whose hollow is traversed by a drawing plunger 9. The pressure space 2 within the tool bottom portion 1 is connected through pipes and a check valve 10 as well as an overpressure valve 11 to a tank 12 which receives compressed air through an air duct 13.

FIG. 1 shows the tool assembly open. The interior of the pressure space 2 within the tool bottom portion 1 and within the plunger 4 has been completely filled with liquid and a blank 7 has been placed upon the top of the plunger 4. When the tool assembly closes, the hold-down 8 moves against the blank 14 and presses it onto the seal 6, the downward travel of the hold-down relative to the plunger 4 being limited by spacers 14. Thereafter, the downwardly travelling plunger 4 is forced into the tool bottom portion 1. The spacers 14 are so dimensioned that, while permitting a slight deformation of the blank 7, they receive the pressing force from the hold-down 8 and transmit it to the displacing plunger 4. The displacing plunger 4 thus is pressed into contact of its top flange with the tool bottom portion 1 (FIG. 2), while the correspondingly increasing liquid pressure draws the blank 7 to the cup shape apparent from FIG. 2. The bottom of the draw punch 9 may then form a limiting stop. However, additional stops or abutments may also be inserted so as to form part of the holddown member.

A control or regulation of the liquid pressure can be dispensed with by dimensioning the stroke of the displacing plunger 4 in accordance with the volume of the predrawn workpiece. This can be done, for example, by providing correspondingly adjustable or changeable stops between the bottom portion 1 and the displacing plunger 4, such as the inserted stop 15 shown in FIG. 4.

FIG. 3 shows how thereafter the punch 9 reversely draws the predrawn workpiece 7 into the pressure container. During this operation, liquid is issued from the pressure container into the tank 12 in accordance with the predetermined pressure set by the control valve 11.

The liquid used for the method and device according to the invention may be water.

It will be obvious that the device for performing the method according to the invention is not limited to the embodiment illustrated but that a variety of shapes can be drawn during the predrawing stroke as well as during the reverse redrawing stroke. For predrawing it is merely to be taken into account that the volume of the hollow workpiece produced by the predrawing stroke is limited by corresponding wall portions of the hold-down and/or the drawing punch. It is preferable, however, to give the predrawn workpiece a diameter at least 30 percent larger that the diameter of the punch used for the redrawing operation.

To those skilled in the art, it will be apparent upon a study of this disclosure that a great variety of modifications are applicable with respect to the design or shape of the device components without departing from the essential features of my invention.

I claim:
1. A hydromechanical reverse redrawing method for shaping blanks of sheet metal with the aid of a pressure container, a liquid displacing annular plunger pressure tightly glidable in said container and having outside said container a top adapted for accommodating a blank, a hold-down for pressing the blank against the top and a draw punch passing through the hold-down, which method comprises the steps of filling the container and plunger with liquid up to the top, placing the blank onto the tool, forcing the hold-down against the blank and thereby pressing the plunger into the container whereby the increasing liquid pressure draws the blank to a preshaped bulging upwardly into the hold-down, and thereafter reversely redrawing the blank into the pressure container by pressing the punch from above against the preshaped blank and downwardly into the container.
2. The method according to claim 1, which comprises maintaining the pressure in the pressure container during reverse redrawing substantially constant and simultaneously discharging from the container a quantity of liquid corresponding to the reduction in liquid volume displaced by the workpiece being reversely redrawn.
3. A hydromechanical reverse redrawing device for shaping blanks of sheet metal, comprising an upwardly open container for pressure liquid having liquid supply ducts, a plunger having a hollow and being glidably and pressure tightly displaceable in said container, said plunger having a flange with a top out-
3. Side and above said container and having sealable means on said top for receiving the workpiece blank across the hollow so that the blank when pressed against the plunger forms a closure of said container, an holddown movable under pressure toward the container to force the plunger into the container whereby the increasing liquid pressure draws the workpiece blank to a shape bulging upwardly into the holddown, and a draw punch vertically movable in the hollow of said holddown for reversely redrawing the preshaped workpiece by pressing it from above into the container.

4. In a device according to claim 3, said punch, when in its top position, forming within the hollow of said holddown an abutment for limiting the upward draw of the blank.

5. In a device according to claim 3, said holddown having an inner width at least 30 percent larger than that of said punch.

6. A device according to claim 3, comprising stroke limiting stop means between said pressure container and said displacing plunger.

7. A device according to claim 3, comprising a liquid-collector tank and a pressure control valve through which said pressure container communicates with said tank for maintaining in said container a valve-controlled pressure during reverse redrawing.