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APPLICATION FOR A STANDARD PATENT

Alfons Haar Maschinenbau GMBH & Co. KG, of Fangdieckstrasse 67, 2000 Hamburg 53, FEDERAL REPUBLIC OF GERMANY, hereby apply for the grant of a standard patent for an invention entitled:

Tool for Deep-Drawing of Sheet-Metal Parts

which is described in the accompanying complete specification.

Details of basic application(s):

Basic Applic. No: Country: Application Date:
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1. Tool for deep-drawing sheet-metal parts, comprising a matrix, a draw core, a blank holder surrounding annularly the draw core and supported for axial movement and engaged by the matrix when the matrix and the draw core are relatively moved towards each other via the ram of a press, and a reaction means acting on the blank holder and producing a counterforce at the blank holder upon movement of the blank holder due to the pressure of the matrix, characterized in that the blank holder (22) and the draw core (25) are provided with effective surfaces which are operatively connected through a communicating system containing an incompressible fluid (28).
Complete Specification for the invention entitled:

Tool for Deep-Drawing of Sheet-Metal Parts

The following statement is a full description of this invention, including the best method of performing it known to me/us.
Tool for deep-drawing sheet-metal parts, comprising a matrix, a draw core, a blank holder surrounding annularly the draw core and supported for axial movement and engaged by the matrix when the matrix and the draw core are relatively moved towards each other via a ram of a press, and a reaction means acting on the blank holder and producing a counterforce at the blank holder upon movement of the blank holder due to the pressure of the matrix, the blank holder and the draw core being provided with effective surfaces which are operatively connected through a communicating system containing an incompressible fluid.
The invention is concerned with a tool for deep-drawing of sheet-metal parts according to the preamble of claim 1.

Notoriously deep-drawing is a forming technique for producing a hollow body from a flat sheet-metal piece. In the simplest case, this is done in that the punch or deep-drawing core draws a blank over the respective draw ring and matrix, thereby forming the hollow body. The force required for the deep-drawing operation is composed of the imaginary forming force, the frictional force between the draw ring and the blank holder, the frictional force due to the force deflection at the draw ring rounding as well as the redress force for straightening the chamfer emerging from the draw ring rounding in bent form. Moreover, a blank holding force is required through which the blank holder acts perpendicularly to the sheet-metal surface. This force is required to prevent wrinkles in the flange of the draw member as a result of the tangential compressive strain.

It is known to arrange the respective draw ring and matrix stationarily and to actuate the draw core and blank holder by a press. Since however separate actuating means are required for the draw core and the blank holder, such construction is relatively expensive.

It is therefore also known to arrange the deep-drawing core and the blank holder at the stationary part of the press, and to connect the matrix with the press ram. In this design, it is necessary for the blank holder to move with the matrix in the feed direction while the draw core enters into the matrix. In order to produce the required sheet-metal holding force, a spring assembly engages on the blank holder. Said spring assembly is
normally formed by a buffer actuator in which, upon movement of the blank holder, a force is built up which produces the necessary force at the blank holder and effects that the blank holder is returned to the starting position when the matrix executes its return stroke. The last-mentioned construction involves some drawbacks.

The energy stored in the spring assembly during the work stroke is admittedly returned to the system, but friction causes not insignificant losses during build-up of the actuator energy. So the expenditure of energy for the drive of the press ram increases correspondingly. Both this fact and the energy feedback from the actuator to the press ram results in a relatively non-uniform load for the drive of the press ram. A non-uniform drive results in relatively great wear and reduces the service life of a press.

A sheet-metal plate from which the individual blanks are stamped for deep-drawing purposes can, as is well known, be advanced only if the draw core has moved out of the matrix sufficiently far. The longer the travel of the matrix, the less the proportionally available time to effect an advance. In other words, the feed speed of a sheet-metal plate and thus the entire working speed is the smaller, the higher the share of a work cycle required for the deep-drawing operation. A relatively long working stroke involves the further drawback that the matrix and the blank holder collide at a relatively high speed. This entails corresponding strain on the press.

The invention therefore has for its object the provision of a tool for deep-drawing sheet-metal parts which reduces the expenditure of material and energy consumption and provides for a more uniform load on the press.

This object is solved by the present invention through the features of the characterizing part of claim 1.
In the invention the blank holder and the draw core are connected with effective surfaces which are operatively connected to a communicating system containing an incompressible fluid. In other words, the blank holder and the draw core are operatively coupled. Upon movement of the blank holder in the direction of the working stroke of the matrix the draw core executes automatically an opposite movement out of the matrix. Such design of a deep-drawing tool entails considerable advantages.

In the deep-drawing tool according to the invention, there is no necessity to build up during the working stroke the necessary energy for a spring actuator acting on the blank holder. Accordingly the frictional forces occurring otherwise are absent. The press or the drive thereof need only perform the work necessary to form the sheet-metal blank. In addition to the energy saving feature the required driving power for the press ram is considerably uniformed. The press ram is not so drastically braked during the forming stroke as in the known case, nor accelerated so drastically during the return stroke. Therefore the press is far less strained, entailing long service life and little wear.

The tool of the invention further has the advantage that the stroke length for the ram driving the matrix is smaller than in prior tools. The reduction in stroke length is due to the fact that the draw core more or less approaches the matrix. A small stroke length means, however, that a greater share of the cycle time available can be used for the feed of the sheet-metal plate, so that the production speed can be considerably increased. Moreover, the effect of a shorter forming stroke is that the matrix hits the blank holder at a lower speed, thereby further decreasing the load on the press.

Finally, it is of advantage that by omission of a buffer actuator the total expenditure and the overall size of the tool can be reduced.

Various possibilities offer themselves to constructionally embody the teaching of the invention. One thereof consists in
that the blank holder and the draw core are connected to pistons whose effective surfaces cooperate through the communicating system. In this embodiment, it is particularly easy to separate the tools from the incompressible fluid which in case of leaks could otherwise get into the effective surfaces of the tools and affect the deep-drawing operation.

Another embodiment provides that the blank holder and/or the draw core are formed as pistons. Such embodiment has the advantage that it can be very compact, in particular if the annular blank holder is slidingly and sealingly arranged in a cylinder and if the draw core is slidingly and sealingly supported in the bore of the blank holder, the cylinder being filled with the incompressible fluid. It will be understood that an adequate seal must be provided within the members to prevent leakage of the incompressible fluid into the forming area.

The communicating system must naturally be completely filled with the incompressible fluid at any time. An aspect of the invention therefore provides that the communicating system is permanently connected to a pressure source for the incompressible fluid.

The invention will be set forth below with reference to the accompanying drawing.

The single figure is a section through the deep-drawing tool according to the invention.

Before dealing with the drawing in detail, it is premised that each of the features described is of essential importance to the invention either per se or in conjunction with the features of the claims.

In the figure, a matrix 10 is actuated by a ram of a press (not shown). The matrix 10 is secured in a sleeve 12 which is at-
attached to a plate 13 connected to the press ram. The sleeve 12 is surrounded by a stripper ring 14 which concentrically surrounds also the matrix. The ring 14 is movable relative to the sleeve 12 and the matrix 10 respectively.

An ejector pusher 11 is connected to the plate 11a to eject the formed part in known manner.

A cup-shaped member 15 is secured via screws 17 to a plate 16 fixed to the frame. The upper edge of the cup-shaped member 15 has secured thereto a cutting ring 18 via screws 19. The cutting ring includes a cutting edge 20. The bores of the cutting ring 18 and the cup-shaped member 15 form a cylinder 21 in which a blank holder ring 22 is slingly displaceable. The blank holder ring 22 possesses a shoulder which cooperates with a shoulder of the cutting ring 18 as shown at 23, thereby limiting the upward movement of the blank holder ring 22. At the outer side of the blank holder ring is provided a peripheral seal 24 which cooperates with the cylinder wall.

In the bore of the blank holder ring 22 is seated a draw core 25 which is supported at its underside on an abutment 26 in the cylinder 21. An inner annular seal 27 in the blank holder ring 22 cooperates with the periphery of the draw core 25. Thus the blank holder ring 22 and the draw core 25 are formed as pistons the lower effective surface of each of which faces the cylinder space 21. In the cylinder space is an incompressible fluid 28 which is fed from a pressure source 29 through a conduit and a bore 31. A check valve 32 is arranged in the conduit 30. In the cylinder space are also helical springs 33 which permanently pull the draw core 25 towards the abutment 26.

The device shows works as follows. During the forming stroke the matrix 10 is moved downwardly in the direction of the arrow 34. Between the tools shown is a sheet-metal plate (not shown). The free end face of the matrix 10 first engages against the free end face of the blank holder ring 22 and the latter is pressurized by the sheet-metal plate respectively. Since said
free end face projects slightly beyond the free end face of the draw core 25, the blank holder ring 22 is lowered downwardly by a small amount, the cutting edge 20 becoming exposed to cooperate with the cutting edge 35 of the matrix 10 for cutting a blank from sheet-metal plate. The ring 14 rests on the cutting ring 18 and remains behind relative to the matrix 10.

The downward movement of the blank holder ring 22 has slightly raised the draw core 25. Now, upon further downward movement of the matrix 10 also the draw core 25 is moved correspondingly upwards. The downward movement of the blank holder ring 22 and the upward movement of the draw core 25 are coupled through the incompressible fluid 28. Thereby the draw core 25 is moved to meet the matrix 10 for performing the deep-drawing operation.

It is apparent that the matrix 10 needs to perform only a small stroke over a tool whose draw core is stationary.

The ratio of the forces at the draw core 25 and at the blank holder ring 22 is naturally variable by varying the effective surfaces. Since experience has shown that the forces at the blank holder ring 22 are usually greater than the forces at the draw core, with the holding force being predetermined though, it is easily attainable that a relatively short travel of the blank holder ring results in a relatively long travel of the draw core. As mentioned above, this ratio of the strokes is favourable as it results in a short forming stroke of the matrix 10.

Upon termination of the deep-drawing operation, the springs 33 pull the draw core back to the initial position shown in the figure, whereby also the blank holder ring 27 reaches its upper initial position.
Claims

The claims defining the invention are as follows:

1. Tool for deep-drawing sheet-metal parts, comprising a matrix, a draw core, a blank holder surrounding annularly the draw core and supported for axial movement and engaged by the matrix when the matrix and the draw core are relatively moved towards each other via the ram of a press, and a reaction means acting on the blank holder and producing a counterforce at the blank holder upon movement of the blank holder due to the pressure of the matrix, characterized in that the blank holder (22) and the draw core (25) are provided with effective surfaces which are operatively connected through a communicating system containing an incompressible fluid (28).

2. Tool as defined in claim 1, characterized in that the blank holder (22) and the draw core (25) are connected to pistons the effective surfaces of which cooperate through the communicating system.

3. Tool as defined in claim 1, characterized in that the blank holder (22) and/or the draw core (25) are formed as pistons.

4. Tool as defined in claim 3, characterized in that the annular blank holder (22) is slidingly and sealingly arranged in a cylinder (22), that the draw core (25) is slidingly and sealingly supported in the bore of the blank holder (22), and that the cylinder (21) is filled with the incompressible fluid (28).

5. Tool as defined in any of claims 1 to 4, characterized in that the communicating system is permanently connected to a pressure source (29) for the incompressible fluid.

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