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APPARATUS FOR HYDROMECHANICAL DEEP-DRAWING

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Fig. 1 (PRIOR ART)

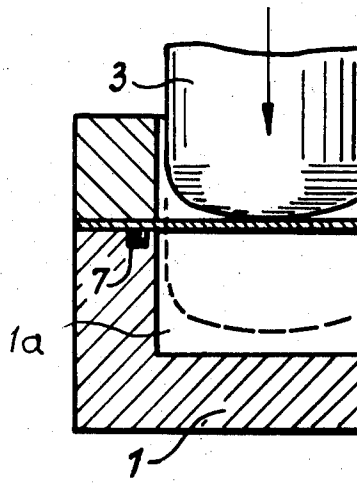
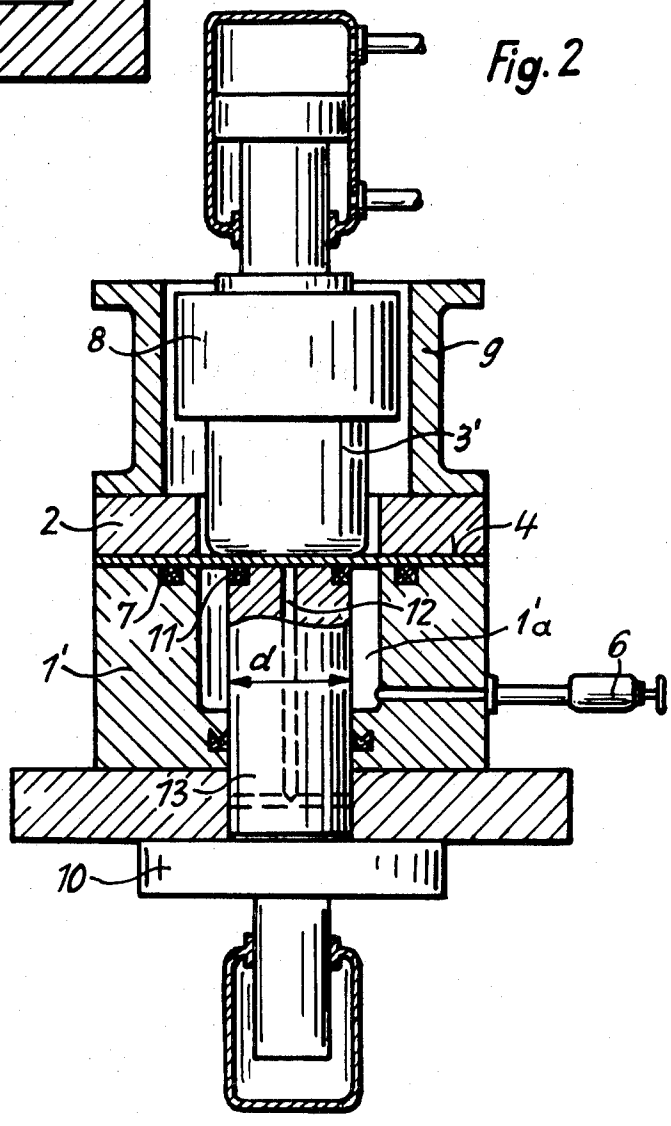


Fig. 2



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APPARATUS FOR HYDROMECHANICAL DEEP-DRAWING

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U.S. Cl. 72—60 3 Claims

ABSTRACT OF THE DISCLOSURE

In a deep-drawing apparatus wherein a metal sheet is forced into a die against water pressure, there is provided a supporting piston the terminal face of which is in contact with an area of said sheet on the underside thereof during the drawing process preventing said area from being exposed to said water pressure for the ultimate purpose of reducing the required ramming force.

BACKGROUND OF THE INVENTION

This invention relates to a hydromechanical deep-drawing process, particularly for shaping sheet metal and preferably using a hydraulic press. In such processes the marginal portion of a metal sheet is clamped to the upper edge of a die or pressure vessel filled with a liquid (usually water) and is deformed against the liquid pressure by a drawing ram.

Such hydromechanical deep-drawing processes are well-known in the art and have, among others, the following advantages over the classical drawing processes: an improvement of the drawing conditions; a possibility of conical shaping which in conventional drawing processes requires at least three drawing steps; the obtainment of a very clean outer surface of the shaped article since the sheet does not slide over the edge of the drawing die but is urged away therefrom by the water pressure.

It is a disadvantage of hydromechanical deep-drawing processes that a substantially higher ramming pressure is required because the ram has to deform the sheet metal against a substantial water pressure. The magnitude of the water pressure may vary according to the material of the sheet and the shape of the ram; it may be several hundred kilogram/cm.^{2} high. Since this high water pressure works against the entire face of the ram, additional deep-drawing ramming forces of substantial magnitudes may be necessary to overcome the water pressure. Thus, in case of a sheet with a base face of 1 m.^{2}, a 200 kg./cm.^{2} required water pressure needs an additional deep-drawing ramming force of

$$P=10{,}000\ (\text{cm.}^2)\times 200\ (\text{kg./cm.}^2)=2{,}000{,}000\ \text{kg.}=2000t$$

It follows that in hydromechanical deep-drawing processes, particularly in case of large sheets, substantially stronger presses have to be used. In view of the required higher energy input, the economic efficiency of hydromechanical deep-drawing process is often questioned.

OBJECT AND SUMMARY OF THE INVENTION

For the purpose of obviating the aforenoted disadvantages, it is an object of the invention to substantially reduce the high ramming pressure heretofore required in hydromechanical deep-drawing processes.

Briefly stated, according to the invention areas of the sheet are tightly covered mechanically during the deep-drawing process for the purpose of isolating those areas from the water pressure, thus permitting a decrease in the ramming force counteracting the water pressure applied to the sheet.

Accordingly, a substantial area of the underside of the sheet is engaged in a water-tight manner by the terminal face of a supporting piston urged against the sheet within the pressurized die.

The invention will be better understood as well as further objects and advantages will become more apparent from the ensuing specification of an exemplary embodiment taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial sectional elevational view of a hydromechanical deep-drawing apparatus according to the prior art; and

FIG. 2 is a sectional elevational view of a preferred embodiment of the deep-drawing apparatus according to the invention.

DESCRIPTION OF THE PRIOR ART

Turning now to FIG. 1, after the marginal portion of the metal sheet **4** of appropriate size is positioned over the upper edges of pressure vessel **1**, constituting the drawing die, the clamping frame **2** is lowered onto the sheet **4** to exert a certain pressure thereto so that the pressure chamber **1***a* is hermetically closed by the sheet **4**. A fluid-tight seal is enhanced by a gasket **7** disposed in a groove provided in the upper edge face of die **1**. For the deforming operation, the ram **3** is moved downwardly pushing the sheet **4** into the chamber **1***a* against a water pressure adjustable by a valve **6**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to FIG. 2, the structure of the novel apparatus will now be described simultaneously with its operation.

In the inoperative position the drawing plunger **8** with the drawing ram **3'** secured thereto and the clamping plunger **9** with the clamping frame **2** secured thereto are in an upwardly withdrawn position.

The sheet **4** to be shaped is placed on the upper edge of pressure vessel or die **1'** so that it closes the pressure chamber **1'***a*.

Thereafter the ram **3'** is moved downwardly together with the sheet clamping frame **2** until the latter, in alignment with the upper edge of vessel **1'**, engages the marginal portion of the sheet **4**. A supporting piston **13** extending through the pressure vessel **1'** in axial alignment with the ram **3'** is lifted into contact with the underside of sheet **4** by a device **10** exerting an adjustable small force to the piston **13**. This position is shown in FIG. 2.

Thereafter the pressure chamber **1'***a* is filled with water and pressurized to a predetermined value by means of valve **6**. Then, the ram **3'** is urged into the pressure chamber **1'***a* against the water pressure. As the ram **3'** moves into pressure chamber **1'***a* deforming the sheet **4**, the weak force urging the supporting piston **13** against the underside of sheet **4** yields and thus the supporting piston **13** is displaced with the drawing ram **3'** as a unit. The seal **11** disposed about the terminal face of supporting piston **13** prevents the water pressure prevailing in pressure chamber **1'***a* from affecting that area of the underside of the sheet **4** which is covered by the upper terminal face of the supporting piston **13**. It is seen that the drawing or ramming force necessary for the deformation of the sheet **4** is reduced by

$$d^2\frac{\pi}{4}P$$

wherein

d is the diameter of the supporting piston **13** in cm., and P is the water pressure in the pressure chamber **1'***a* in kg./cm.^{2}.

Upon termination of the deforming process, the supporting piston **13** is returned by the device **10** to its initial position.

Supporting piston **13** is provided with a bore **12** to drain the water which may leak through the seal **11**.

Since the supporting piston **13** is brought into its supporting position before the chamber **1'***a* is filled with water and pressurized, the quantity of water required to fill the chamber is, compared to water quantities in known deep-drawing apparatus, less by the volume of the supporting piston **13** occupying the pressure chamber **1'***a*.

A further advantage achieved by the invention resides in the fact that the supporting piston **13**, by being returned immediately after the drawing process by means of the device **10**, positively lifts the deformed workpiece partially out of pressure chamber **1'***a*. In known deep-drawing apparatus, after the drawing process the deformed article usually floats on the water and occasionally capsizes. Thus, according to the invention, the shaped article is positively brought into a raised position where it is adapted to be grasped by mechanical gripping means for further transportation.

In the embodiment described, that portion of ram **3'** which engages the sheet **4** in alignment with supporting piston **13** is planar. Accordingly, the terminal face of supporting piston **13** is also planar.

It is to be understood that the ram may have a configuration other than planar (e.g. conical, spherical, etc.), in which case the terminal face of the supporting piston has a complemental shape.

That which is claimed is:

1. In an apparatus for shaping sheet material of the type including a ram for forcing said sheet into a die

cavity or pressure chamber against a pressure of a liquid contained therein, the improvement comprising a supporting piston advanceable into and at least partially withdrawable from said pressure chamber, said supporting piston having a terminal face including means to engage said sheet in a fluid tight manner isolating a predetermined area of said sheet from the pressure of said liquid and means urging said supporting piston into fluid tight engagement with said sheet, said last named means yielding to said ram permitting said piston to move therewith as a unit.

2. The improvement as defined in claim **1**, wherein said supporting piston is in axial alignment with said ram and said terminal face of said supporting piston has a configuration complemental with the ram face in alignment with said terminal face.

3. The improvement as defined in claim **1**, wherein said means to engage said sheet in a fluid tight manner includes a circumferential gasket adapted to tightly engage the outline of said area for preventing said area from being exposed to said pressure.

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U.S. Cl. X.R.

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