This invention relates to a shape-forming device and has for one of its objects the production of a simple and efficient means for shaping metal and the like, by a controlled and balanced pressure upon the work which is being shaped.

Another object of this invention is the production of a simple and efficient means for shaping metal and the like, by controlling and balancing pressure in opposite directions upon the work so that pressure may be proportionately relieved in one direction as pressure is increased in an opposite direction to insure an even and uniform shape, thickness and rigidity throughout the body of the completed work or product which is being formed.

Other objects and advantages of the present invention will appear throughout the following specification and claims.

In the drawing—

Figure 1 is a vertical sectional view through the shape-forming device or die illustrating the relative positions of the parts prior to the application of pressure;

Figure 2 is a vertical sectional view illustrating the positions of the parts while pressure is being applied;

Figure 3 is a vertical sectional view of a modified form of the invention;

Figure 4 is a vertical sectional view illustrating a modified form of seal or gasket.

By referring to the drawing, it will be seen that 10 designates the lower housing of the die or shape-forming device which is provided with a pressure compartment or cavity 11. The lower housing may be secured to or carried by a support in any conventional manner common to the trade.

A suitable control conduit 26, having a suitable control valve 27, communicates with the cavity 11 to control or regulate pressure entering into or reeding from the cavity 11. This valve 27 may be of the conventional type common to the trade for regulating intake and the relief of pressure.

A piston or die 14 is mounted within the cavity 11 and carries a seal 15 having a conventional tapering piston seal flange. A retaining plate 16 abuts the seal 15 and a suitable screw 17 retains the plate 16 in clamped relation with the seal 15 to anchor the seal 15 in place.

If desired, a seal such as is illustrated as at 18 in Figure 4, which is of a conventional type may be carried by the piston or die 14 in place of the seal 15 shown in Figure 1. It is not desired, however, to restrict this invention to any particular type of seal for the reason that any type of liquid or air seal may be used which will prevent an escape of pressure beyond the piston.

As shown in Figures 1 and 2, a co-acting housing or upper section 19 fits upon the lower housing 10, and the lower housing preferably extends slightly into the cavity 20 of the upper section 19. The lower housing is provided with a flat surface 21 upon which a flat sheet of work 22 is placed as shown in Figure 1, and the piston or die 14 is moved to a contacting position with the sheet of work 22, this position also being shown in Figure 1. The upper section or housing 19 is provided with the cavity 20 above referred to, in which cavity 20 is mounted a filler in the nature of a rubber or other flexible or yieldable shape-forming substance 23.

A suitable control conduit 26 communicates with the upper end of the cavity 20, and a suitable control valve 27 is carried by the conduit 26 to regulate pressure entering into or reeding from the cavity 11. The valve 27 is of the conventional type common to the trade for regulating intake and the relief of pressure.

It should be understood that by controlling the valves 13 and 27 and properly manipulating the valves, pressure in the cavities 11 and 20 may be controlled and varied to gradually and evenly form an article of a desired shape from the sheet 22. In other words, as pressure is admitted into the upper end 26 of the cavity 20 above the piston 24, the rubber or shape-forming substance 23 will be compressed against the sheet 22. As the pressure is proportionately relieved by the operator by manipulating the valve 13 to allow the piston 16 to recede into the cavity 11, the sheet 22 will be forced into the upper end of the cavity 11 against the piston or die 14 to press the sheet 22 into the desired shape under uniform pressure. The rubber substance 23 under pressure, exerts a uniform shape-forming pressure throughout the entire area of the sheet 23 against the die or piston 14 and the sides of the cavity 11 at the point where the piston 16 recedes so as to produce a uniform thickness with uniform strength throughout the entire area of the work, in view of the fact that pressure will be exerted upon the rubber substance 23 in all directions to an equal degree.

By means of the structure above described, it should be understood that because of the fact that the piston 16 recedes in proportion to the pressure applied to the yieldable substance 23, weak sections of the material cannot yield to a greater extent than other sections of the material being shaped, since the section 14 moves.
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only in proportion to the pressure applied above upon the substance 23. This operation will cause the sheet 22 to be uniformly shaped true to the form of the cavity 11, when a body of proper size is placed in the position as shown in Figure 1, and proper controlled pressure is applied, the sheet 22 may be completely and properly shaped to produce a finished product without the necessity of subsequent trimming. This operation will result in a great saving of material.

It should be obvious that the particular shape of the article formed is determined by the type of die used since various forms may be produced because of the fact that the rubber filler or substance 23, when under pressure, will exert pressure in all directions. This pressure will cause the metal plate 22 to conform to the exact shape of the die which may be placed in the cavity 11 in a manner common to the trade. The sheet 22 is initially held in the position shown in Figure 1, and when controlled pressure is applied the sheet 22 will be pressed or formed to the desired shape such as is shown, for example, in Figure 2.

The present device provides for the rubber substance 23 which acts as a punch or pressure element, thereby eliminating the expensive metal punch which is used in the conventional apparatus usually employed.

In Figure 3 there is shown a modified form of the invention, wherein an upper section 30 is provided having a cavity 31 containing a rubber or flexible yieldable substance or filler 32, and a piston 33 similar to the structure shown in Figure 1. A suitable pressure conduit 34 supplies pressure above the piston 33. A lower section 35 supports the upper section 30, and a work sheet 36 rests upon the top of the section 35, the rubber filler 32 resting upon the lower section 35. A punch 37 extends through the lower section 35 and contacts the lower face of the work sheet 36. Any suitable means may contact the punch 37 for forcing the same against the sheet 36 and pressing the pressure of the filler or substance 32 while pressure is relieved as may be required by releasing the pressure proportionately through conduit 34 in a similar manner described with respect to Figure 1. This particular device has been found advantageous when great pressure is necessary, such for instance as when forming or shaping hardened stainless steel.

By means of the structure illustrated and described, wherein the hydraulic pressure is controlled or regulated to compensate one against the other in opposed relation, the rubber shape-conforming substance will flow and control the draw in a uniform manner. The rubber or shape-conforming substance drops or is forced to a lower level as the die recedes in the form shown in Figures 1 and 2, and this in turn forces the work sheet 22 down into the cavity 11 against the on or die 14. The work sheet 22 under pressure is constantly and equally drawn into the cavity 11 and conforms to the die or top of the piston 14. The desired shaped part is in this way shaped without strain being concentrated at any particular point, but pressure is equalized over the entire area of the work which is being formed or shaped.

It should be noted that the opposing pressures are at all times under control of the operator who may vary the pressure upon either side of the work, above or below, by actuating the valves 13 and 27, as occasion may require. It will be further noted that the cavity 11 is smaller than the cavity 20, and the rubber or other shape-conforming substance overhangs the cavity 11 to hold the work sheet 22 flat upon the upper face of the lower section 10 before shape-forming pressure is applied. By means of the device illustrated trimming of the product is not necessary forming, since all material or metal is used and no waste of material results to be made to a developed size and drawn to a pre-calculated finished product. The rubber filler is generally compressible ten to twenty-five per cent, but it is not desired to limit the invention to the use of rubber as a filler.

Having described the invention, what is claimed as new is:

1. A shape-forming device of the class described comprising a pair of co-acting housing sections, one section having a pressure-containing compartment, the other section having a companion pressure-containing compartment registering with the first mentioned compartment, a flexible compressible substance mounted in the first mentioned compartment and adapted to clamp a work sheet in contact with the co-acting section, means for selectively varying and controlling pressure within the compartments to force the flexible compressible substance from one compartment against the work sheet and to force the work sheet into the companion compartment as pressure is proportionately relieved from said companion compartment, a piston slidably mounted within the first mentioned compartment for contacting the flexible compressible substance, and a piston die slidably mounted in said companion pressure-containing compartment and contacting the work sheet, said piston die being adapted to recede into the companion compartment as pressure is applied to the first mentioned piston and is proportionately relieved from said piston die.

2. A shape-forming device of the class described comprising a pair of co-acting housing sections, one section having a pressure-containing compartment, the other section having a companion pressure-containing compartment registering with the first mentioned compartment, a flexible compressible substance mounted in the first mentioned compartment and adapted to clamp a work sheet in contact with the co-acting section, means for selectively varying and controlling pressure within the compartments to force the flexible compressible substance from one compartment against the work sheet and to force the work sheet into the companion compartment as pressure is proportionately relieved from said companion compartment, a piston slidably mounted in the first mentioned compartment for contacting the flexible compressible substance, a piston die slidably mounted in said companion pressure-containing compartment and contacting the work sheet, said piston die being adapted to recede into the companion compartment as pressure is applied to the first mentioned piston and is proportionately relieved from said piston die, and a pressure seal carried by each piston to prevent the escape of pressure beyond the pistons in said compartments.

3. A shape-forming device of the class described comprising a pair of co-acting housing sections, each section having a pressure compartment, a piston slidably mounted in each compartment, a pressure seal for each piston,
means for selectively supplying and relieving pressure within each compartment behind said pistons, one compartment overlying and being of larger size than the compartment in the co-acting section, a flexible and yieldable substance carried within the larger compartment and adapted to initially hold a work sheet in firm contact with the other piston and the co-acting section, the piston in the larger compartment being adapted to compress the flexible and yieldable substance when pressure is applied to said last mentioned piston, and the compressed flexible and yieldable substance being adapted to force a work sheet into the compartment into the co-acting section against the piston in the co-acting section for shaping the work sheet, as pressure in the larger compartment is increased and pressure is proportionately decreased in the co-acting compartment.

The following references are of record in the file of this patent:

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<tr>
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