June 12, 1956 J. H. ENGEL 2,749,867

CONTROLLED PRESSURE METAL FORMING APPARATUS

Filed Dec. 3, 1952 2 Sheets-Sheet 1

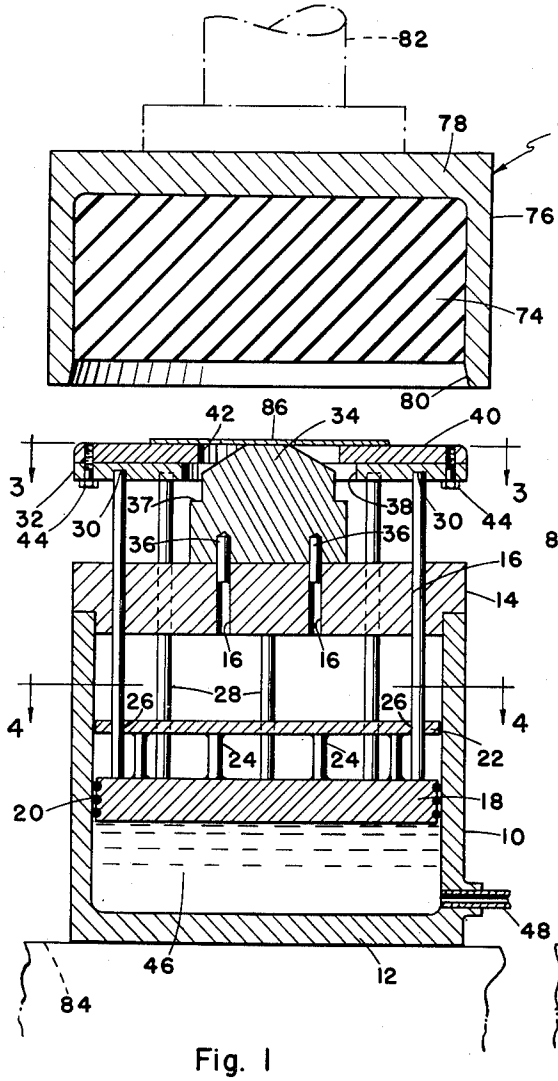


Fig. 1

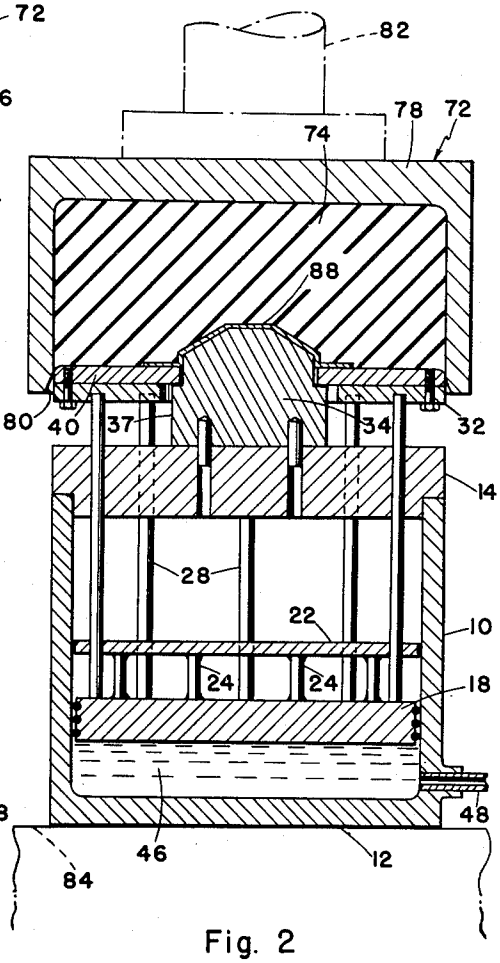


Fig. 2

INVENTOR.
JOHN H. ENGEL

BY

Knox & Knox

AGENTS

June 12, 1956 J. H. ENGEL 2,749,867

CONTROLLED PRESSURE METAL FORMING APPARATUS

Filed Dec. 3, 1952 2 Sheets-Sheet 2

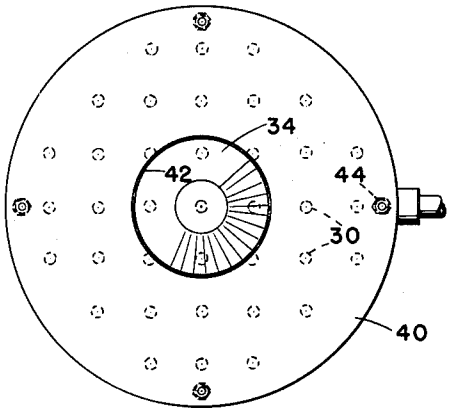


Fig. 3

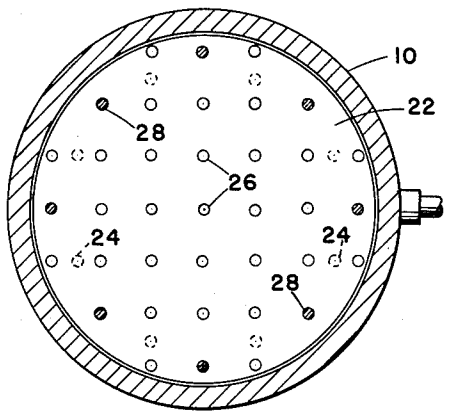


Fig. 4

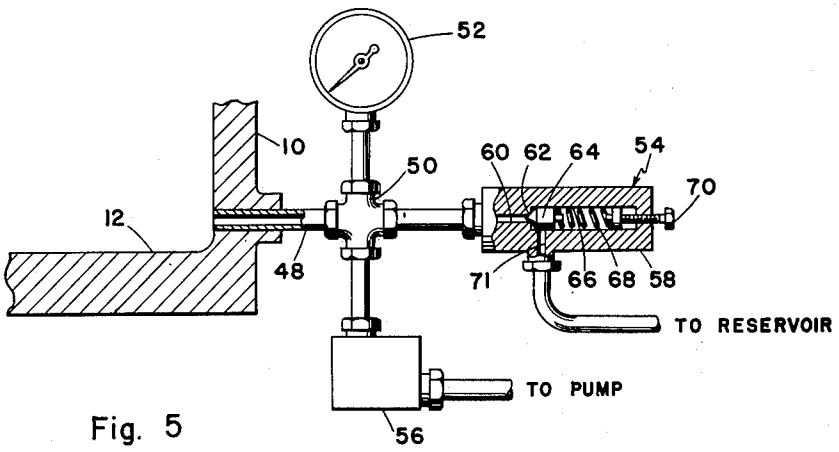


Fig. 5

INVENTOR.
JOHN H. ENGEL

BY
Knox & Knox
AGENTS

United States Patent Office 2,749,867 Patented June 12, 1956

2,749,867

CONTROLLED PRESSURE METAL FORMING APPARATUS

John H. Engel, Escondido, Calif.

Application December 3, 1952, Serial No. 323,778

4 Claims. (Cl. 113—44)

The present invention relates generally to metal forming apparatus and more particularly to controlled pressure metal forming apparatus.

The primary object of this invention is to provide metal forming apparatus using a male die over which parts may be formed by means of a resilient pad forced against said male die.

Another object of this invention is to provide for progressive forming by percussion means, with special means for the accurate control of the effective percussive force applied to the work during each of the forming strokes, while avoiding any necessity for accurately controlling the total impact force generated.

Another object of this invention is to provide for absorption or dissipation of the excess impact force in a simple manner and with a minimum of equipment.

Another object of this invention is to provide a forming machine wherein percussive force is repeatedly applied for progressive die forming.

Another object of this invention is to provide metal forming apparatus of the type described in which the pressure exerted on the metal being formed may be controlled within pre-set limits.

Another object of this invention is to provide metal forming apparatus of the type described which may be used in a drop hammer or the like.

Another object of this invention, ancillary to the preceding objects, is to teach the best known mode of implementing the principles of the invention in carrying the invention into actual practice.

Another object of this invention is to provide a metal forming apparatus which is inexpensive and practicable to manufacture.

Finally, it is an object to provide metal forming apparatus of the aforementioned character which is simple, safe and convenient to operate, and which will give generally efficient and durable service.

With these and other objects definitely in view, this invention consists in the novel construction, combination and arrangement of elements and portions, as will be hereinafter fully described in the specification, particularly pointed out in the claims, and illustrated in the drawings which form a material part of this disclosure and wherein similar characters of reference indicate similar or identical elements and portions throughout the specification and throughout the views of the drawings, and in which:

Fig. 1 is a vertical sectional view of the device in the open position.

Fig. 2 is a vertical sectional view of the device in the closed position after forming the metal part.

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1.

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 1.

Fig. 5 is a partially sectioned and enlarged side elevation view of the pressure controlling mechanism.

Referring now to the drawing, it should first be noted

that the complete machine is not illustrated, since it includes a drop hammer or like structure, the structural characteristics of which are well known. The present disclosure is directed particularly to the special means for use with a drop hammer or similar percussive tool for progressive forming by a series of successive strokes of such a machine, the total impact force being not necessarily accurately controlled or even known, although the effective force applied to the work is accurately controllable by the device herein described. The device includes a cylinder **10** having a closed lower end **12**, the other end being fitted with a guide block **14** in which are a plurality of holes **16** arranged in a certain manner as will later be described. Within the cylinder **10** is a piston **18** having piston rings **20** of the type commonly used in hydraulic equipment, said piston having a piston guide **22** secured in spaced relationship to the piston by means of spacers **24**, said piston guide being a sliding fit within said cylinder. The piston guide **22** has a plurality of holes **26**, said holes being aligned with the holes **16** in the guide block **14** to provide access for push rods **28** which are inserted through the holes **16**, then through the holes **26** so that the lower ends of said push rods rest on the upper surface of the piston **18**.

The upper ends of the push rods **28** extend upwardly from the guide block **14** and fit into sockets **30** formed in a platen **32**. The platen **32** is provided with a plurality of the sockets **30**, said sockets being aligned with the holes **16** and the holes **26** so that said push rods may slide freely in the holes **16**.

The male die **34** is attached to the guide block **14** by means of locating pins **36** fitted into the lower end of said male die, said locating pins extending downwardly into holes **16** to retain the male die in alignment, said male die also having a stop portion **37**, the purpose of which will be later explained. The platen **32** has a clearance hole **38** to fit over the male die **34** and is provided with a platen cover **40** having a clearance hole **42** which is a close fit around said male die. The close fit of the clearance hole **42** around the male die **34** is necessary to prevent jamming of metal parts formed over said male die by the metal being distorted and forced into the space between said male die and the platen cover **40** under the considerable pressure used in the forming operation. The platen cover **40** is secured to the platen by means of bolts **44**.

The lower portion of the cylinder **10** is filled with hydraulic fluid **46** which flows through an outlet pipe **48** secured in the wall of said cylinder. The outlet pipe **48** is connected to a coupling **50** to which are also connected a pressure gauge **52**, an excess impact pressure relief valve **54** and a check valve **56**. The excess impact pressure relief valve **54** actually comprises a means for absorption and dissipation of considerable force. The valve **54** includes a body **58** having an inlet **60** provided with a valve seat **62** in which rests a valve plunger **64** which is slidably mounted in the internal bore **66**. The valve plunger **64** is retained in the valve seat **62** by a spring **68**, the tension of which may be adjusted by means of an adjusting screw **70**. At each stroke, when the valve plunger **64** is forced into open position by the pressure of hydraulic fluid, the outlet **71** will be uncovered allowing a portion of said hydraulic fluid to escape to a reservoir (not shown).

The metal parts are formed by a pressure head **72** comprising a resilient pad **74** contained within a cylinder **76** having a closed upper end **78**, the lower edge of said cylinder being internally chamfered as indicated at **80** so that the cylinder will slide easily over the platen during the forming operation. The resilient pad **74** may be a rubber block or a liquid bag.

The pressure head **72** is secured to the head of a drop

hammer or the like indicated by the numeral 82 while the cylinder 10 is fastened to the base 84 in axial alignment with said pressure head. A metal blank 86 is placed on the platen cover 40 and positioned over the male die 34. The drop hammer is now operated causing the pressure head 72 to drop so that the resilient pad 74 will force the platen and platen cover downwardly, allowing the resilient pad 74 to press the metal blank 86 over the contours of the male die 34 to form the work 88 as illustrated in Fig. 2. The movement of the platen will be transmitted through the push rods 28 to the piston 18, forcing said piston downwardly against the hydraulic fluid 46. A quantity of the hydraulic fluid will be forced through the outlet pipe 48 at each stroke and will enter the pressure relief valve 54. In other words, the adjusting screw is set to allow the hydraulic fluid to escape through the outlet 71 when the pressure within the cylinder 10 is greater than that desired for the particular forming operation. The check valve 56 is arranged to permit flow of the fluid inwardly to the cylinder 10 for refilling the cylinder, but prevents fluid from flowing outwardly from said cylinder during the actual forming process. The pressure applied to the work 88 during the forming operation may be adjusted by means of the adjusting screw 70 so that all unwanted, excess impact pressure will be absorbed or dissipated by the spring 68 and the inertia of the piston, fluid and the platen. The desired impact force or pressure will be different for different materials and will also vary according to the size and shape of the work. At the end of the forming stroke, the downward movement of the piston will be arrested by the platen cover 40 striking the stop portion 37, thus assuring that the work 88 will be formed to the correct depth.

By way of further explanation, it can be stated that the drop hammer or similar machine used will generate greater impact force than is required for the individual forming strokes. The excess impact force is dissipated by the spring and inertia as stated above and the platen and piston assembly are allowed to move only after the excess force has been dissipated. For example, when using a relatively heavy metal blank to be formed, a correspondingly greater impact force will be required than when forming a lighter material. The excess impact pressure relief valve may be adjusted to release at a high pressure, so that the pressure head must impart that high pressure to the platen in order to force the platen and piston assembly downwardly over the male die. The high pressure will serve to hold the edges of the metal blank firmly against the platen cover to prevent buckling of the metal, and the resilient pad will have sufficient force to press the metal blank firmly around the male die. As the required high pressure is reached, the valve plunger 64 will open allowing fluid to escape and the platen and piston assembly will descend. The valve plunger 64, however, will only open at the pre-set high pressure so that the required pressure between the resilient pad and the platen cover will be maintained at all times during the forming stroke.

When a relatively light metal blank is to be formed, the excess impact pressure relief valve may be adjusted to open at a correspondingly lower pressure. The sequence of actions will remain the same as described above except that the pressure between the resilient pad and the platen cover will be held to the pre-set lower pressure.

It is a feature of the invention that the device may be used on almost any type of drop hammer, punch press, hydraulic press or the like, thus eliminating the necessity for complicated and costly mechanism for specific use with the device. The device may also be constructed in various sizes to accommodate all sizes of formed parts, and it is noteworthy that the male dies and the platen covers to fit those dies may be made interchangeable by arranging the holes 16, the holes 26 and the sockets 30 in a geometrical pattern common to all the particular sizes. The arrangement of the holes as illustrated in the drawings also permits the use of as many push rods 28 as may be required according to the requirements of the part to be formed, the particular size and shape of the metal part formed therein being illustrative only.

The operation of this invention will be clearly comprehended from a consideration of the foregoing description of the mechanical details thereof, taken in connection with the drawing and the above recited objects. It will be obvious that all said objects are amply achieved by this invention.

Further description would appear to be unnecessary.

It is understood that minor variations from the form of the invention disclosed herein may be made without departure from the spirit and scope of the invention, and that the specification and drawing are to be considered as merely illustrative rather than limiting.

I claim:

1. In a metal forming apparatus for use with a drop hammer or similar percussive machines, a cushion cylinder having one closed end, a guide block secured to the other end of said cylinder, a piston within said cylinder, means to admit fluid between said piston and said closed end, a variable restricted outlet for said fluid, a plurality of push rods slidably passing through holes in said guide block, the lower ends of said push rods resting on said piston, a platen secured to the upper ends of said push rods, a male die secured to said guide block, said platen having a clearance hole to fit around said male die, a platen cover having a clearance hole, an impact pressure head comprising a cylinder having one closed end, and a resilient pad within said cylinder; said male die having a stop portion incorporated therein to engage and arrest said platen cover before said pad reaches said cushion cylinder.

2. In a metal forming apparatus for use with a drop hammer or similar percussive machines, a cushion cylinder having one closed end, a guide block secured to the other end of said cylinder, a piston within said cylinder, means to admit fluid between said piston and said closed end, a variable restricted outlet for said fluid, a plurality of push rods slidably passing through holes in said guide block, the lower ends of said push rods resting on said piston, a platen secured to the upper ends of said push rods, a male die secured to said guide block, said platen having a clearance hole to fit around said male die, a platen cover having a clearance hole, said last mentioned clearance hole being a close fit around said male die, an impact pressure head comprising a cylinder having one closed end, and a resilient pad within said cylinder, said male die having a stop portion incorporated therein to engage and arrest said platen cover before said pad reaches said cushion cylinder.

3. In a metal forming apparatus for use with a drop hammer or similar percussive machines, a cushion cylinder having one closed end, a guide block secured to the other end of said cylinder, a piston within said cylinder, said piston having a plurality of piston rings, a piston guide in spaced relationship with said piston, means to admit fluid between said piston and said closed end, a variable, restricted outlet for said fluid, a plurality of push rods slidably passing through holes in said guide block, the lower ends of said push rods resting on said piston, said push rods passing through said piston guide and being supported thereby against bending, a platen secured to the upper ends of said push rods, a male die secured to said guide block, said platen having a clearance hole to fit around said male die, a platen cover having a clearance hole, said last mentioned clearance hole being a close fit around said male die, an impact pressure head comprising a cylinder having one closed end, and a resilient pad within said cylinder, said male die having a stop portion incorporated therein to engage and arrest said platen cover before said pad reaches said cushion cylinder.

4. A metal forming apparatus for use with a drop hammer comprising a cushion cylinder having one closed

end, a guide block secured to the other end of said cylinder, a piston within said cylinder, means to admit fluid between said piston and said closed end, an outlet pipe from said cylinder adjacent said closed end, a pressure relief valve connected to said outlet pipe, a check valve connected to said outlet pipe, a plurality of push rods slidably passing through holes in said guide block, the lower ends of said push rods resting on said piston, a platen secured to the upper ends of said push rods, a male die secured to said guide block, said platen having a clearance hole to fit around said male die, a platen cover having a clearance hole, an impact pressure head com-

prising a cylinder having one closed end, and a resilient pad within said cylinder, said male die having a stop portion incorporated therein to engage and arrest said platen cover before said pad reaches said cushion cylinder.

References Cited in the file of this patent

UNITED STATES PATENTS

2,605,731 Schulze et al. ---------- Aug. 5, 1952

FOREIGN PATENTS

488,409 Canada ---------- Nov. 25, 1952