

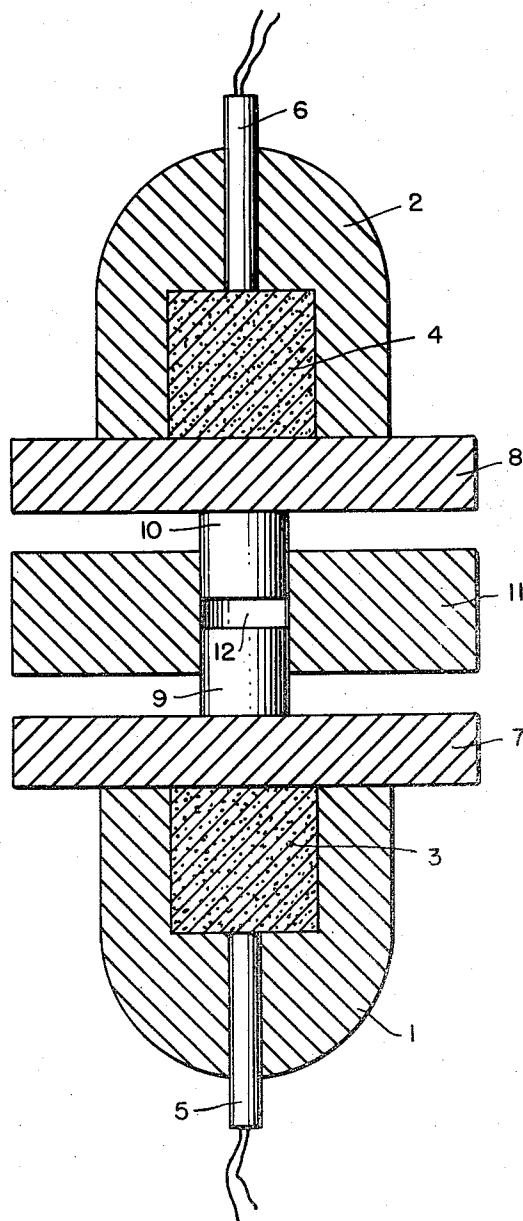
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HIGH PRESSURE, EXPLOSIVE-ACTIVATED PRESS

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1

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HIGH PRESSURE, EXPLOSIVE-ACTIVATED PRESS

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1 Claim. (Cl. 18—16.5)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to a novel type of press and to a method for press forming materials.

In the press forming contemplated by this invention, very high pressures are required. Hydraulic presses have been used in the past because they were the only presses available capable of producing such high pressures. However, such presses are not capable of producing high enough pressures and loading rates to produce a press-formed metallic product of satisfactory strength. Further, such presses are bulky and expensive.

It is therefore an object of this invention to provide a method and apparatus for producing higher pressures than has heretofore been possible for press-forming objects.

Another object is to provide a method and apparatus for producing a more rapid loading rate than has been possible in the past in the art of press-forming.

Further objects are to provide a relatively small and low cost press for press forming materials.

The above mentioned objects are accomplished by an explosive press in which a sample of material is compressed by a piston driven by an explosion.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing.

Referring to the drawing, the preferred embodiment, confining shells 1 and 2 of steel are flat at one end and are provided with cavities in the flat ends which hold the explosive 3 and 4. Said shells also contain channels which communicate between the explosive-containing cavities and the exteriors of the shells and into which detonators 5 and 6 are placed.

Adjacent the flat sides of the confining shells and loosely attached thereto are outer plates 7 and 8 of steel which function to seal the explosive-containing cavities and hold the explosive in place.

Pistons 9 and 10 of steel are adjoined to the plates 7 and 8 respectively at one end as shown with their free ends extending into a cylinder in a center plate 11 of steel to form a compartment or pressure chamber 12 wherein the material to be compressed is placed.

In operation, the material to be compressed is placed into the cylinder of the center plate and the pistons are placed into either end of the cylinder, firmly in contact with the sample. Then the outer plates 7 and 8 are placed next to the pistons and the cavities in the confining shells are filled with equal amounts of explosive and placed next to the outer plates. The assembled parts are weakly held in contact. Then detonators 5 and 6 are placed in the shells and the apparatus is ready for firing.

The two explosive charges are detonated simultane-

2

ously, driving both pistons against the sample at once, resulting in very high pressures in the pressure chamber 12. The confining shells 1 and 2 move in directions opposite to their pistons into back-stops not shown.

Conventional electric detonators are preferred though other types may be used. Sand-bags make good back-stops, though various structures may be used.

It is apparent that a large number of explosives can be used including liquids in containers and that the pressures obtained and their rates of application are functions of the particular explosive used, the quantities employed, the degree of confinement of the explosive and the particular detonator employed, all of which can be varied at will. High explosives are preferred because they produce great pressures. It is obvious that the hole in the center plate into which the pistons fit may have any cross-sectional shape, depending upon the shape desired in the formed article. It is also obvious that one piston can have a particular configuration sunk into its end and the other piston can have the same configuration raised on its end so that when the two come together, the configuration is pressed into the material.

Another obvious modification is to provide means for only one explosive charge to compress the sample in a well in the center plate.

The outer plates may be recessed to hold the pistons, and aligning pins or bolts may be used to assemble the system if desired.

The applications aforementioned have been directed to material forming but the method and apparatus is also useful in bonding applications, for instance, in the bonding of dissimilar metals in the manufacture of thermocouples. Another important bonding application is in the formation of metal parts by compressing a metal powder. The pressures developed are sufficiently high to form a coherent product from the powder, similar to that formed by sintering.

The method and apparatus have important applications in compressing samples so that the properties of the compressed material may be studied.

For many applications, only a small assembly a few inches long is required. Such an assembly is so cheaply made as to be expendable, as the steel is cheap and the machining is simple. However, the invention is not limited to small scale devices as the apparatus may be scaled up as required.

Small scale models of applicants' device have been made and tested. The shells were made in the shape of hemispherical capped cylinders, the hemisphere having a radius of about 1¼ inches, the cylinder being about 1½ inches high and 2½ inches in diameter. The cavity for containing the explosive was a cylinder about 1¼ inches in both height and diameter, centrally positioned in the flat end of the shell. The outer plates 7 and 8 had a four inch diameter and were about ⅝ inch thick. The center plate 11 had a four inch diameter and was one inch thick. The pistons were about ¾ inch in height and diameter and fitted fairly smoothly in the cylinder in the center plate. The explosives used were standard military explosives one containing 55.2 percent RDX, 40 percent TNT, 1.2 percent polyisobutylene, and 3.6 percent wax. RDX is trinitrotrimethylenetriamine; TNT is trinitrotoluene. Another explosive used was one containing 78 percent RDX and nitrocellulose in equal amounts, and 22 percent inert plasticizer for the nitrocellulose.

Tests of the above systems gave pressures ranging from about 1–5 million p.s.i. As little as ¾ of a cubic inch of the TNT-containing explosive aforementioned in each cavity gave pressures in excess of 2,000,000 p.s.i. on the sample.

The press can be scaled up or down by substantially

proportionately enlarging or reducing the parts over a pressure range of about 1-9 million p.s.i. An increase in the amount of explosive will not produce a simple proportional increase in the pressure produced, but will produce a greater pressure. The curve of the amount of explosive used versus the pressure exerted on the sample is believed to be exponential.

The present method and apparatus is capable of producing higher pressures and loading rates than has heretofore been possible.

With the higher pressures produced by the instant method and apparatus, it is possible to cold-form metallic products without the application of heat. With the much more rapid application of pressure attained by this invention, it is possible to form brittle materials of sufficient strength to prevent crumbling and breaking. The forming operation occurs so rapidly that the brittle materials do not have time to break up, nor is the material allowed to break up as it is so closely confined. Thus brittle materials in the press behave like ductile materials.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claim, the invention may be practiced otherwise than as specifically described.

What is claimed is:

A detonating explosive actuated high pressure press comprising two movable, hollow, elongated, steel, confining shells, each of said shells having a flat surface on one end thereof and a cavity in one end portion abutting said flat surface, a high explosive charge filling said cavity, and a channel interconnecting said cavity with

the exterior of the other end of the shell, a pair of electric detonators, each of said detonators being disposed within a respective channel for detonating the explosive charges, a pair of flat steel plates respectively abutting the flat surfaces of said shells and enclosing said cavities, a pair of pistons respectively adjoined to said plates at one end thereof; a central plate disposed between said pair of plates in close proximate spaced relation therewith and having a circular bore therethrough, each of said pistons extending into said bore for sliding movement therein as the pair of plates are suddenly moved toward each other and concurrently therewith the shells are moved in opposite directions away from the pair of plates, the ends of said pistons together with the bore forming a pressure chamber for receiving an object whereby the object is compressed under momentarily applied high pressure and shaped to a predetermined configuration in response to the simultaneous detonation of the explosive charges.

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