June 8, 1965 C. W. GUY 3,187,549

SEGMENTED DIE ASSEMBLY

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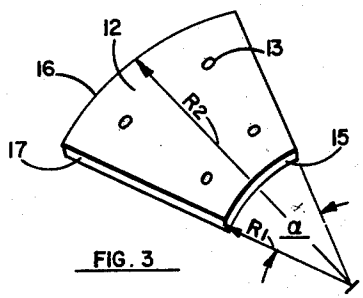


FIG. 3

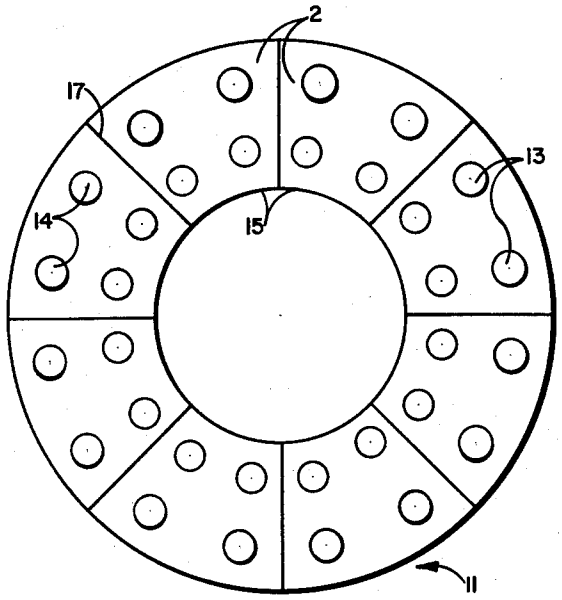


FIG. 2

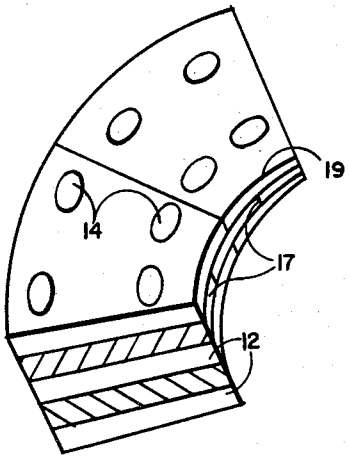


FIG. 4

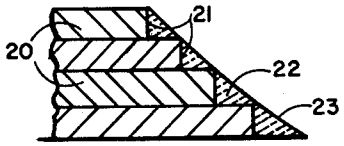


FIG. 5

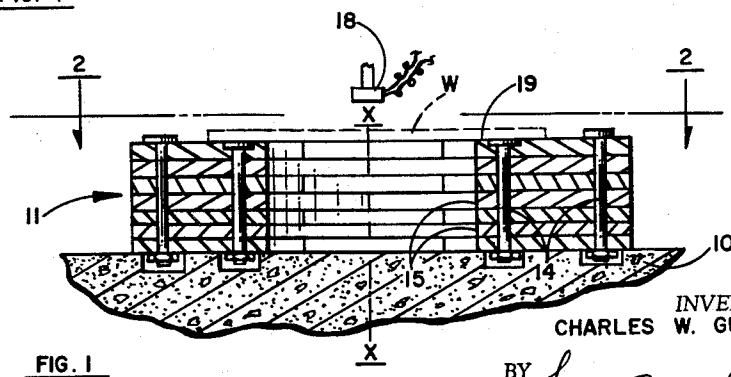


FIG. 1

INVENTOR.
CHARLES W. GUY

BY Thomas S. MacDonald

ATTORNEY

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SEGMENTED DIE ASSEMBLY

Charles W. Guy, Northridge, Calif., assignor to North American Aviation, Inc.

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This invention relates to a segmented die assembly and more particularly relates to a forming die which may be selectively constructed and arranged to comprise various die cavity configurations by utilizing a plurality of integrated die segments.

Present-day forming dies generally constitute unitary structures which only afford one or a very limited number of forming operations. Such prior art die structures generally involve relatively high production, maintenance and replacement costs. Furthermore, such die structures are particularly inadequate when used in conjunction with explosive forming methods. Such an undesirable condition primarily exists due to the fact that the die edges thereof provide a relatively short life expectancy due to the extremely high damaging explosive forces which are inherently imparted thereon during such an operation.

The present invention has overcome many of the above described prior art inadequacies by providing a segmented die assembly which may be expeditiously assembled to provide a die cavity of predetermined configuration. The die assembly of this invention essentially comprises a first layer of first die segments which are arranged to have their respective adjacent edges in substantial abutting relation to each other and a second layer of second die segments arranged on said first layer with said second segments overlying the adjacent abutting edges formed by said first segments. Said die segments are so constructed and arranged to provide an internal die cavity of predetermined configuration. Means are provided to removably secure the first and second layers in relatively fixed relation to each other. Therefore, it can be readily seen that the configuration of the internal die cavity of the single die assembly may be selectively and expeditiously changed to meet a wide range of specific design requirements.

An object of this invention is to provide a segmented die assembly which is low in cost and durable in construction.

A further object of this invention is to provide a segmented die assembly which may be expeditiously assembled and disassembled to provide internal die cavities comprising a wide range of desired configurations.

A still further object of this invention is to provide a segmented die assembly whereby manufacture, maintenance and replacement costs are substantially reduced.

These and other objects of this invention will become apparent from the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a cross-sectional view of a segmented die assembly, illustrating the novel concepts of this invention;

FIG. 2 is a plan view taken in the direction of lines 2—2 in FIG. 1;

FIG. 3 discloses a preferred die segment configuration;

FIG. 4 is a partial sectional view more particularly disclosing the novel die segment interlocking features of this invention; and

FIG. 5 is a partial cross-sectional view disclosing an alternative internal die cavity construction and arrangement.

FIG. 1 is a cross-sectional view of a segmented die assembly illustrating the novel concepts of this invention. A base or foundation **10** comprising a cement constituent or the like is adapted to support the segmented die assembly **11** which is arranged on longitudinal axis X—X. The die assembly **11** comprises a plurality of die segments **12** which are arranged with their respective juxtaposed edges

in substantial abutting relationship (FIG. 2), to thus form one or more layers. It should be understood that although FIG. 1 discloses seven such layers, that any desired number thereof may be utilized depending on the particular design requirements. The die segments may comprise, for example, a high strength steel constituent which is capable of withstanding the extreme explosive forming forces which may be subsequently imparted thereon.

FIG. 3 discloses a preferred die segment **12** configuration. As shown, the segment **12** comprises a substantial truncated cone configuration having curved base and apex portions and side portions defined by the included angle α. As illustrated, the angle α constitutes 45°. However, it should be understood that such an angle may be more or less than said 45°, depending on the particular number of segments it is desired to employ for each layer. It should be also understood that other die segment designs may be employed, as will be hereinafter more fully discussed.

As shown in FIG. 1, a plurality of holes **13** are preferably formed through the die segments **12** to facilitate the reception and retention of fastening means preferably in the form of bolts **14** therein. Such fastening means function to maintain the respective overlying die segment layers in fixed relationship relative to each other.

It should be further noted, with respect to the illustrated die segment of FIG. 3, that a curved surface **15** may be constructed and arranged to face the longitudinal axis X—X (FIG. 1) to thus comprise any desired internal die cavity configuration when assembled together with the other die segments of the die assembly. For example, as shown in FIG. 2, the internally arranged curved surfaces **15** forming the die cavity and the externally arranged curved surfaces **16** are constructed and arranged to form radii R_1 and R_2, respectively. However, it should be understood that the particular shape of the internal die cavity formed by means of surfaces **15** may comprise any desired configuration depending on the particular formed workpiece design desired. For example, elliptical, rectangular, spherical, etc. shapes may be readily obtained pursuant to the novel segmented die concepts of this invention.

FIG. 4 more particularly discloses the novel die segment interlocking features of this invention. As shown, the juxtaposed edges **17** of the individual die segments in any one layer are covered by the die segments comprising the adjacent layers. Thus, when the securing bolts **14** are secured to the stacked die segment layers, an extremely sturdy and integrated die assembly is afforded primarily due to the above described interlocking features of this invention. It is further obvious from the above description that by utilizing die segments having a predetermined thickness and surface **15** configuration, the desired total height and internal die configuration of the integrated assembly may be expeditiously achieved.

Attention is now directed to FIG. 5 wherein a plurality of die segments **20** are constructed and arranged to comprise internal surface portions **21** having varied radii. The offset portions thus formed by the stacked die segment layers may be filled or coated with a suitable sizing material **22** such as a metallic weldment or standard plaster in order to provide the desired internal die surface configuration **23**.

Referring once again to FIG. 1, the die assembly **11** of this invention may be utilized in a conventional manner by initially placing a workpiece, shown by phantom lines W, in proper position onto the top surface portions of the die assembly **11**. A standard explosive charge **18** of appropriate size is then constructed and arranged thereabove as shown. The internal die cavity formed by the internal

surface portions 15 of the individual die segments 2 is shown in FIG. 1 as comprising a cylindrical shape. Thus, when the explosive charge 18 is subsequently ignited, the workpiece W will be forced and formed against said forming die cavity.

From the above description it can be seen that maintenance procedures are materially enhanced and the costs thereof substantially reduced. For example, it can be readily seen that damage might occur to the edge portions 19 of the uppermost die segments 12 pursuant to repeated use of the die assembly. Such damage oft-times functions to destroy the close workpiece tolerance desired. However, the novel aspects of this invention provide that the die segments comprising the top layer may be either turned over, replaced with new die segments or substituted for other die segments of the assembly. It should be further noted that such damaged segments may be readily disassembled and machined to comprise a larger radii at the internal surface portions 15 thereof.

Although this invention has been described and illustrated in detail, it is to be understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of this invention being limited only by the terms of the appended claims.

I claim:

1. A segmented female die assembly comprising a first layer of first die segments arranged to have their respective adjacent edges in substantial abutting relation to each other, a second layer of second die segments arranged on said first layer with said second segment overlapping the adjacent abutting edges formed by said first segments and means securing said first and second layers in relatively fixed relation to each other.

2. A sebmented female die assembly formed on a longitudinal axis and comprising at least two layers of die segments, said assembly comprising a first layer of first die segments arranged to have their respective adjacent edges in substantial abutting relation to each other, a second layer of second die segments arranged on said first layer with said second segments overlapping the adjacent abutting edges formed by said first segments, said first and second segments having die cavity forming surfaces arranged to face said axis to form a die cavity of predetermined configuration, and means securing said first and second layers in relatively fixed relation to each other.

3. The invention of claim 2 wherein said die cavity forming surfaces of said first and second layers are substantially flush relative to each other.

4. The invention of claim 2 wherein said die cavity forming surfaces of said first segments are offset from said second segments, relative to said axis, and a filling selectively formed thereon to provide a desired die cavity surface configuration.

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CHARLES W. LANHAM, *Primary Examiner.*

WILLIAM J. STEPHENSON, NEDWIN BERGER, *Examiners.*