Feb. 2, 1943. W. E. DALBY 2,309,828

DIE SET

Filed April 14, 1941 2 Sheets-Sheet 1

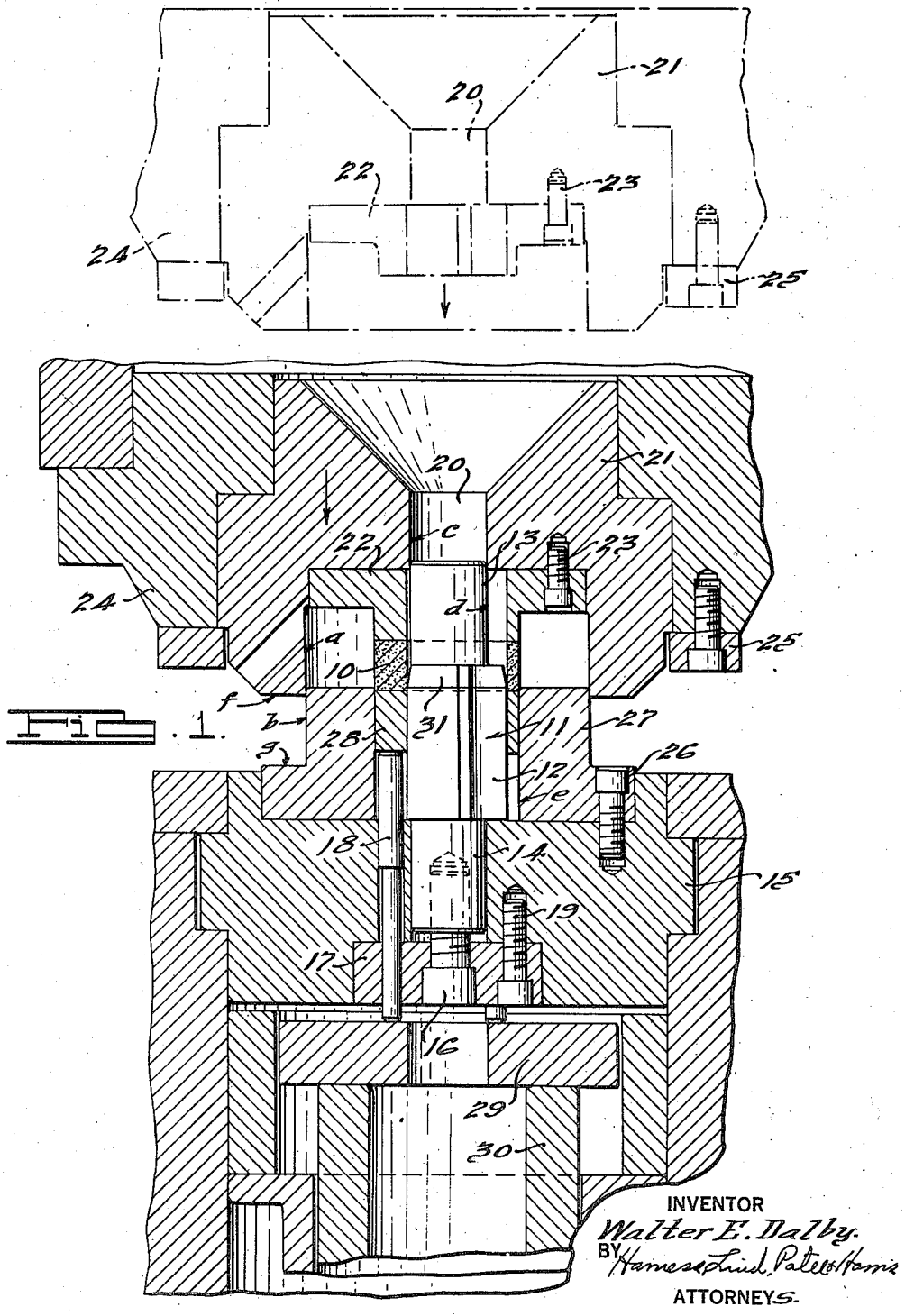


Fig. 1.

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Fig. 3.

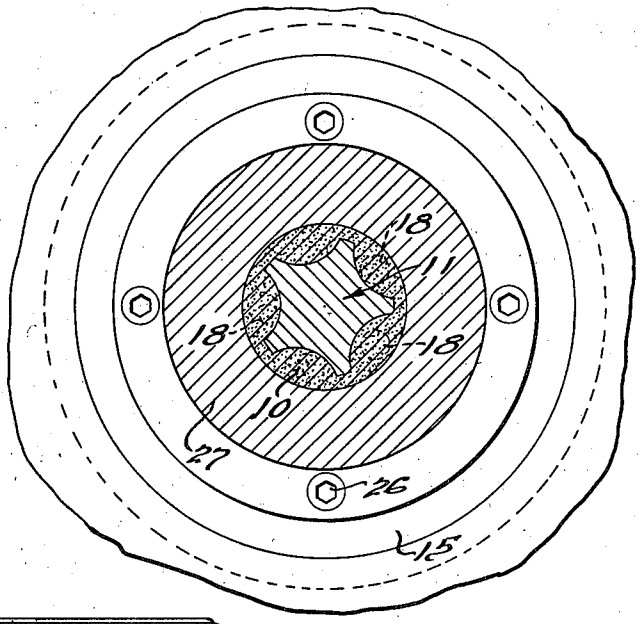


Fig. 2.

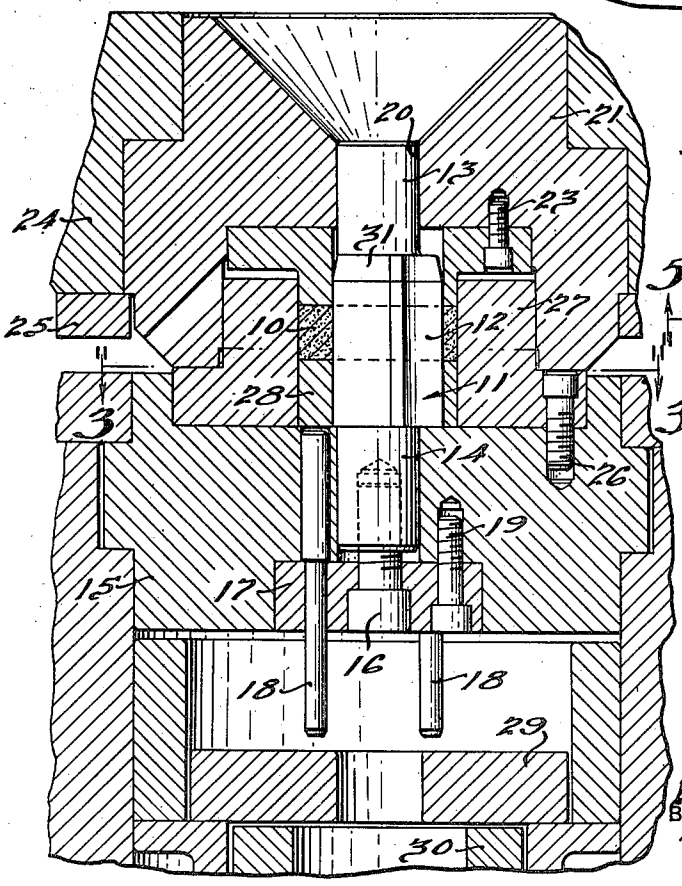
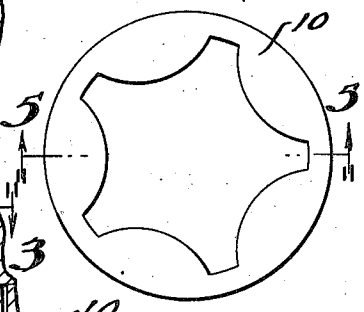


Fig. 4.



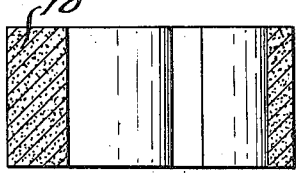


Fig. 5.

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2,309,828

UNITED STATES PATENT OFFICE

2,309,828

DIE SET

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Application April 14, 1941, Serial No. 388,363

3 Claims. (Cl. 78—60)

This invention relates to means for manufacturing articles of sintered metal.

It is the principal object of the invention to provide means for forming such articles with extreme accuracy and uniformity.

In the following description, apparatus for forming the outer rotor of a "Gerotor" pump is described, but it is desired to point out that the apparatus and method are applicable to the forming of articles of other shapes.

Gerotor pumps comprise inner and outer rotors which rotate relatively to one another and to the pump casing. The size and shape of both rotors must be held within extremely close tolerances during manufacture and considerable difficulty has been experienced in holding these tolerances in quantity production.

I have found that satisfactory rotors can be made in quantity at low cost by the following method; the finely divided material (which may be iron, brass or other suitable material) is first briquetted, then sintered, and then subjected to a rough sizing operation. Then, the article is subjected to a finishing or "coining" operation during which it is formed with extreme accuracy with respect to size and concentricity. This last operation is a particularly important one and requires a die set which is extremely rigid. The die set disclosed and claimed herein permits rapid operation and will hold the size and concentricity of the finished article to within .0005 inch. This is accomplished by my novel and improved arrangement wherein certain interengaging parts of the die are brought into engagement in definite sequence.

In the drawings accompanying the description:

Fig. 1 illustrates the die set just as the ram is starting to push the work in the die, the up position of the ram being shown in broken lines.

Fig. 2 illustrates the parts with the ram in down position.

Fig. 3 is a sectional view along the line 3—3 of Fig. 2.

Fig. 4 is a plan view of the formed article.

Fig. 5 is a sectional view along the line 5—5 of Fig. 4.

In the present instance, the workpiece consists of an outer Gerotor element which is illustrated in Figs. 4 and 5. The element 10 is designed to run in mesh with an inner rotor having one less tooth and both rotors are adapted to be enclosed in a pump housing. In order to give the required pump efficiency, the upper and lower surfaces of the element 10 must be flat and parallel, the outer periphery must be round and concentric about the axis of the piece and the inner tooth surface must be concentric with the outer peripheral surface.

The element 10 is first briquetted, then sintered, then subjected to a rough sizing operation before being placed on the formed plug 11 which forms part of one of the die sections. The plug 11 is shown in section in Fig. 3 and comprises a central portion 12 having a shape identical with that of the inner rotor with which the finished workpiece is designed to run, and upper and lower reduced portions 13 and 14. The lower portion 14 is rigidly supported in a die adaptor 15 and is secured thereto by a bolt 16. The head of the latter is seated in a removable plug 17 which carries the knockout pins 18, the plug being secured to the adaptor by set screws 19. The upper reduced portion 13 is adapted to be received by a cylindrical hole 20 formed in the punch adaptor 21 which carries the die punch 22. The punch 22 is removably fastened to the adaptor 21 by screws 23.

The punch adaptor 21 is carried by a ram 24, to which it is removably secured by a ring 25, and the ram is adapted to be mounted in a suitable press or other machine (not shown).

Fastened by screws 26 to the die adaptor 15 is a formed die member 27 and slidably disposed in the space between the member 27 and the formed portion of the plug 11 is an insert 28 which is shaped identically with the finished workpiece.

A knockout plate 29 rests on a knockout sleeve 30, the latter being adapted for reciprocation in timed relation with the ram 24 as will be explained further on.

All of the parts of the die set are made of relatively heavy section and the diameters *a*, *b*, *c*, *d* and *e*, as well as the faces *f* and *g*, are formed with extreme accuracy.

The "coining" operation takes place as follows: The workpiece 10 is first placed over the plug 13 where it rests on the insert 28, the ram 24 being in the "up" position as shown in broken lines in Fig. 1. The plug 13 has a tapered portion 31 which permits the work to be located angularly. The insert 28 is held up by knockout pins 18 of which there are three, the pins in turn resting on the knockout plate 29. The knockout sleeve 30 is preferably actuated to its up position by a machine element (not shown) and held up by a spring when the element is retracted.

When the press is tripped, the ram 24 descends

from its broken line position to the full line position of Fig. 1 where the punch 22 engages the work 10 and presses it into the die 27. The positions of the parts at the bottom of the stroke of the ram are illustrated in Fig. 2.

It will be seen that as the ram descends, die 27 and formed plug 11 are held concentric in die adaptor 15 and at the instant the punch 22 engages the work 10, the diameter *a* of punch adaptor 21 engages diameter *b* of die 27 and diameter *c* of punch adaptor 21 engages diameter *d* of the plug 11. Plug 11 is thus held concentric with diameter *e* of the die during the pressing operation and concentricity of the finished part is assured.

At the bottom of the stroke of the ram face *f* of the punch adaptor 21 engages face *g* of the die 27 and this assures squareness of the upper and lower faces of the work with relation to the hole and the outer diameter thereof and also parallelism of the faces.

The work is removed from the die by the knockout pins 18 which engage the insert 28 and force the workpiece upwardly off the plug simultaneously with the upward movement of the ram.

It will thus be seen that I have provided apparatus for "coining" small parts which are required to be formed with extreme accuracy in large quantities. While the invention has been described in connection with the forming of parts from finely divided metal, it is obvious that it is also applicable to the forming of parts from solid material.

I claim:

1. In a die set for sizing preformed articles, a reciprocable ram; a punch carried by said ram; a stationary die member; a formed plug; means for rigidly holding said plug and die member in spaced relationship, the space therebetween being adapted to receive a workpiece; and means carried by said ram for engaging said plug upon descent of the ram thereby to hold said plug and punch in rigid relationship during closing of the die set.

2. In a die set for sizing preformed articles, a reciprocable ram; a punch carried by said ram; a formed plug; a stationary die member; means for rigidly mounting said plug and die member in spaced relationship whereby the space between them is adapted to receive a workpiece; means carried by said ram for engaging said plug upon descent of the ram whereby concentricity between the plug and punch is maintained during the working stroke.

3. In a die set for sizing preformed articles, a reciprocable punch; a punch adaptor for carrying said punch; a die member having an internal hole adapted to receive said punch and an external cylindrical portion adapted to be received by said punch adaptor, said die member and said punch adaptor being provided with flat surface portions adapted for engagement at the end of the working stroke.

WALTER E. DALBY.