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G. D. ROGERS

2,245,608

DIE

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Fig-1-

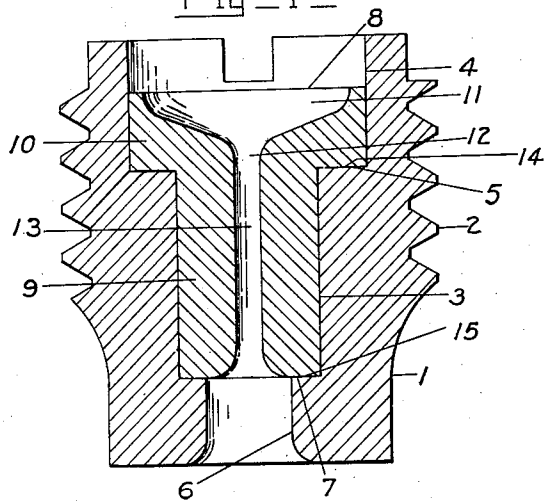


Fig-2-

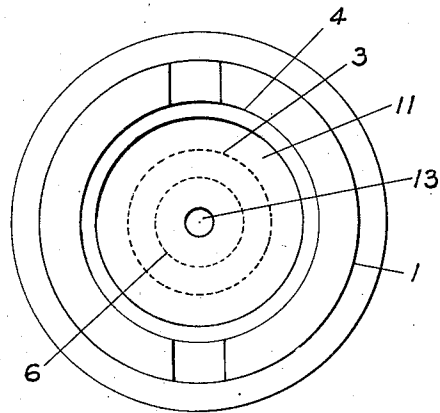
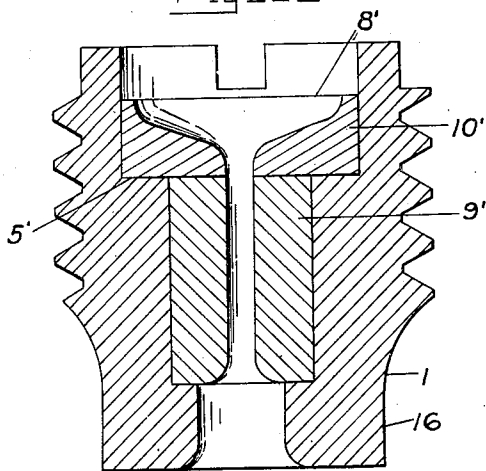


Fig-3-



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UNITED STATES PATENT OFFICE

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DIE

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1 Claim. (Cl. 18—12)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to an improved die for use in the granulation of smokeless powder or extrusion or squirting of similar plastic materials.

It has been a commonplace practice in the art, heretofore, to use steel dies for granulating or graining smokeless powder, however, dies made of steel are not entirely satisfactory owing to the abnormal variations in grain dimensions and other marked irregularities in the grains effected through wear of the die after a short period of service. As uniformity of grain dimensions is essential to uniformity of ballistic performance it is necessary to frequently exchange dies to avoid the variation in grain size effected by worn dies and depend on blending to give a lot of powder having grains conforming, within slight permissible tolerance, to the mean dimensions of a certain specified number of grains of the lot selected at random for purposes of this physical test. Inasmuch as experience has amply demonstrated that blending in itself, no matter how long continued, will not insure the high degree of ballistic performance required of a lot of powder, if grain dimensions are abnormally variable, it is imperative that the die dimensions remain constant or within small tolerable limits. Moreover the wear on dies in the extrusion of reworked unstable powder is considerably greater than the wear on dies in the extrusion of the regular colloid which is reflected in the unit cost of the reworked powder through increased die replacement cost.

It is an object of this invention to increase the uniformity of grain dimensions of powder granulated by extrusion through employment of dies having a maximum wear and corrosion resistance. For this purpose industrial jewels, natural or synthetic, are admirably adapted if mounted in a proper die body or holder.

While the use of industrial jewel dies, particularly diamond dies, is well known in the wire drawing art for reducing the stock being drawn, there is no appreciable transverse flow of the stock and no confinement of the original stock except at the die opening, which presents a very different problem in mounting the jewel compared to the one presented in mounting a jewel die for expressing a plastic material where the mass of material must be confined on all sides

and at all points under high pressure except at the die opening.

It is a further object of this invention to so form the die and die body or holder that shearing stress on the die body or holder will be distributed in a manner to eliminate the tendency of the foundation or support in the die body for the die to deform and thereby subject the die to bending strains of a magnitude sufficient to crack the jewel die.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawing in which:

Fig. 1 is a vertical sectional view through the die and die body or holder in assembled relation;

Fig. 2 is a top plan view of the die assembly;

Fig. 3 is a vertical sectional view similar to Fig. 1 showing a modification.

Referring now to the drawings by characters of reference wherein the same characters identify the same elements throughout the views there is shown in Fig. 1 a die body or holder 1.

The die body 1 may be made from an elongated steel die blank of conventional form and is externally threaded at 2 for the purpose of facilitating its attachment to a powder graining press head or similar plastic pressing mechanism. For the purpose of mounting a jewel die 8 within the die body 1 the latter is cylindrically bored longitudinally of its axis on two diameters, stepped relative to each other, to provide axial cylindrical bores 3 and 4 joined by an annular ledge or abutment 5. The ledge or abutment 5 is made as nearly a plane surface normal to the axis of the die body 1 as possible and likewise the surfaces defining the bores 3 and 4 are made as nearly cylindrical as possible for reasons hereinafter made apparent. A third cylindrical bore 6 of smaller diameter than bore 3 is made in axial prolongation of bore 3 to provide a second annular ledge or abutment 7 and to also complete the axial passage through the die body 1. The ledge or abutment 7 is made as nearly parallel to the ledge 5 as possible.

The die 8 consists of a suitable jewel, such as natural or synthetic sapphire, or agate, shaped to provide an elongated annular die bushing 9 and die cup 10. The bushing 9 is of an axial length conforming to the corresponding distance between ledges 5 and 7 and has an outside diameter slightly greater than the diameter of bore 3 at normal temperature. The die cup 10 in the form shown in Fig. 1 is made integral with

the bushing 9 and is suitably shaped interiorly of its periphery to provide a funnel shape cavity 11 terminating in an orifice 12 forming a prolongation of the axial passage 13 in die bushing 9. The diameter of the die cup 10 is also of slightly greater diameter than the diameter of bore 4 at normal temperature and its peripheral surface is joined to the peripheral surface of die bushing 9 by a plane surface 14 made as nearly normal to the axis of orifice 13 as possible. The end of die bushing 9 remote from die cup 10 is provided with a plane bearing surface 15 also made as nearly normal to the axis of orifice 13 as possible.

The precaution of making surfaces 5 and 7 of the die body 1 and surfaces 14 and 15 of the jewel die 8 plane and parallel to each other when the die 8 is positioned in the die body 1 is to insure as nearly perfect bearing relation between cooperating bearing surfaces 7-15 and 5-14 as is possible so that the jewel will not be subjected to bending strains upon application of pressure in extruding.

In assembling the jewel die 8 in the die body 1 the die body is first heated to a temperature to expand the bores 3 and 4 sufficient to permit the insertion of the die 8 within the bores 3 and 4 as shown in Fig. 1 after which the die body is shrunk upon the die by cooling, which places the die under compression and the die body in tension transversely of their respective axes. The magnitude of compression under which the jewel die is originally stressed will be governed by the working pressure to which the die is subjected, and will be greater than such working pressure so that the die will not be expanded beyond the accuracy desired in the diameter of the extruded material.

As shown in Fig. 1 the axial passage 13 of die bushing 9 and orifice 12 of die cup 10 are of cylindrical form and have their axes coinciding with the axis of die body 1 but it is understood that the extruding passage in the die 8 may be of any suitable shape and that likewise the cavity 11 in die cup 10 may be modified to suit it for use with any particular plastic material being extruded.

It will be observed that because of the frictional engagement between the outer surface of the die 8 with the cooperating surface of the die body 1 that the stress on the ledges 5 and 7 in the body are reduced and hence the shearing action in the metal of the die body 1 as seen below the steps 5 and 7 in Fig. 1 is mini-

mized with the result that this portion of the die body will not be deformed and the jewel will not be subjected to bending strains. It will also be observed that the die cup 10 is supported by a comparatively long extent of metal in the die body 1 below the ledge 5 as seen in Fig. 1 which gives a more substantial support for the die in that region where the total pressure acting thereon is greatest.

In the form shown in Fig. 3 the jewel die 8' consists of a die bushing 9' and die cup 10' made as separate parts. By this arrangement it is possible to use a die bushing made of one character jewel and a die cup made of another character jewel whereby jewels may be selected for use in the die which collectively give combined characteristics desired but not attainable in a single jewel. Moreover, another important advantage lies in the fact that the die cup may be replaced independently of the die bushing. It will be observed that the accurate dimensioning and fitting is of importance to adequately support the die cup 10' part of which engages the ledge 5' and the remainder the jewel bushing 9'.

In both forms of the invention the stock of metal surrounding the bore 6 is sufficient to provide a seat 16 of suitable shape for a tool to expedite threading the die into the press head.

Having now particularly described what is at present regarded a preferred embodiment of this invention I claim and desire to secure by Letters Patent of the United States:

A powder extrusion die comprising in combination an elongated die body having an axial passage therethrough formed by at least three cylindrical bores of successively stepped diameters, said bores being joined at their contiguous ends by annular ledges having plane surfaces substantially normal to the axis of the passage, a jewel die disposed within the two bores of largest diameter comprised of an annular die bushing having a plane end bearing surface engaging the annular ledge of smallest diameter and an annular die cup of greater diameter having a plane bearing surface extending outwardly from the periphery of the die bushing engaging the other annular ledge joining the two bores within which the die is disposed, said die being circumferentially engaged throughout its length by the die body under substantially uniform inherent pressure.

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