United States Patent [19]

Schmehl

[11] **3,901,065**

[45] **Aug. 26, 1975**

[54] **MULTIPLE APERTURE DIE**

[75] Inventor: **Glenn Lewis Schmehl**, Morrisville, Pa.

[73] Assignee: **Western Electric Company, Incorporated**, New York, N.Y.

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[52] **U.S. Cl.** **72/468**; 72/261; 425/464

[51] **Int. Cl.**[2] **B21C 3/06**

[58] **Field of Search** 72/261, 262, 268, 468; 425/461, 464

[56] **References Cited**

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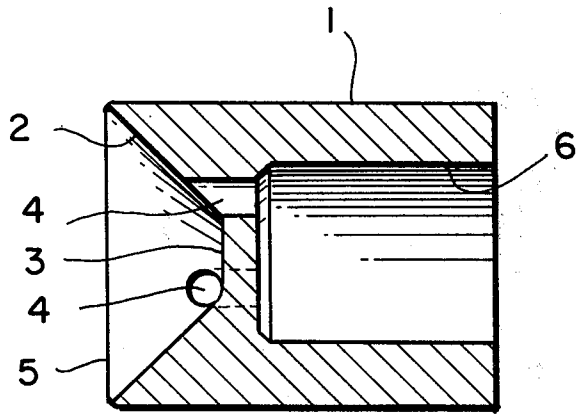
175,265	3/1876	Wicks	72/261
2,142,704	1/1939	Sparks	72/261
3,394,579	7/1968	Hall	72/261
3,740,985	6/1973	Fuchs	72/60

Primary Examiner—C. W. Lanham
Assistant Examiner—Robert M. Rogers
Attorney, Agent, or Firm—Jack Schuman

[57] **ABSTRACT**

Billet material is extruded through a die having a plurality of die apertures thereby to produce simultaneously a plurality of extruded products such as wire. The die has a conical mouth. The apertures are radially equispaced around a circle intermediate the entrance end of the die and the apex of the cone defining the mouth, the circle lying in a plane perpendicular to the longitudinal axis of the die so that all die apertures are spaced the same distance from the entrance end of the die and, consequently, all the said die apertures are spaced the same distance from the apex of the cone. The cone may be truncated.

4 Claims, 5 Drawing Figures



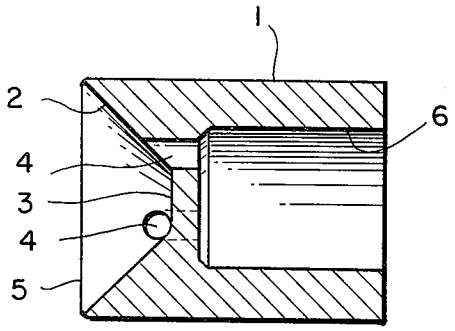


FIG. 1

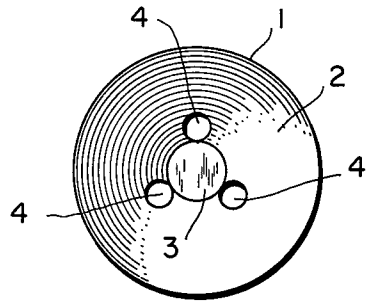


FIG. 2

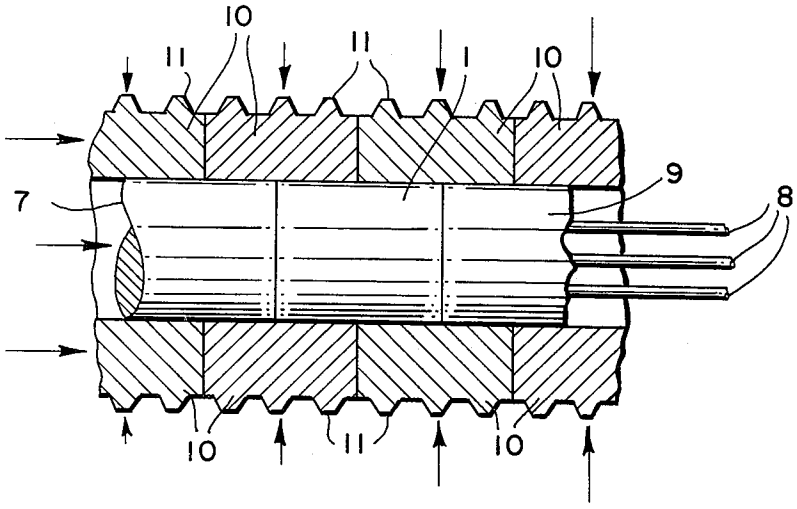


FIG. 3

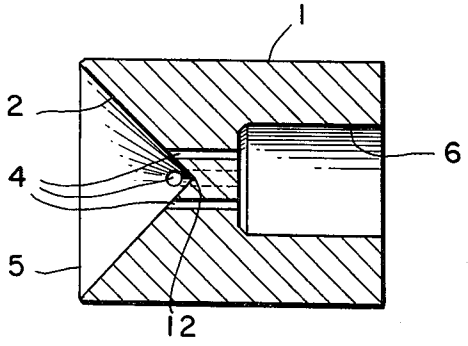


FIG. 4

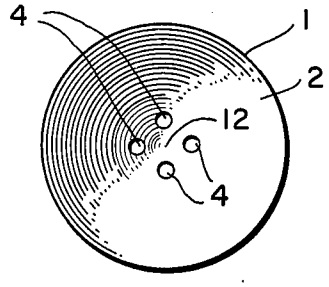


FIG. 5

MULTIPLE APERTURE DIE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates, broadly speaking, to apparatus for the multiple production of elongated product such as wire. More specifically, this invention relates to a die of particular design in which billet material, which may be of indefinite length, may be deformed to produce, simultaneously, a plurality of elongated products such as wire.

2. Description of the Prior Art

Simultaneous production of multiple wires from the deformation of billet material is known to those familiar with this art.

U.S. Pat. No. **3,394,579 (1968)** to Hall et al. discloses method and apparatus for extruding a plurality of products simultaneously. In one embodiment, a single billet is extruded through a die having plural apertures. In another embodiment, a plurality of billets is simultaneously extruded through respective apertures in a die having plural apertures.

U.S. Pat. Nos. **2,050,298 (1936)** and **2,077,682 (1937)** both to Everett disclose assembling a plurality of discrete billets in a bundle, placing the bundle in a metallic sheath, packing the sheath around the bundle with a pulverulent or a plastic material which functions as a separating medium between the billets, drawing the sheath and the bundle enclosed thereby through a series of dies, seriatim, to reduce the sheath and the enclosed bundle, and thereafter removing the drawn sheath by chemical or electrolytic means or by stripping the drawn sheath from the wires formed by the drawn billets.

U.S. Pat. No. **3,540,114 (1970)** to Roberts et al. discloses assembling a plurality of wires in a bundle, placing the bundle in a sheath, applying a thin film of lubricant to the bundle, drawing the sheath and bundle through a die to reduce the individual wires to fine filaments, and then unwrapping or chemically etching the drawn sheath to remove it from the filaments.

SUMMARY OF THE INVENTION

An object of this invention is to provide an improved die for the simultaneous extrusion therethrough of a plurality of wires from billet material.

Other and further objects of this invention will become apparent during the course of the following description and by reference to the accompanying drawing and the appended claims.

Briefly, the improved die which is the subject of this invention has a flared mouth with a plurality of die apertures radially spaced around a circle intermediate the mouth of the die and the apex of the flare. Billet material, which may be coated with die lubricating material such as beeswax or polyethylene wax, is advanced into the mouth of the die, and the said billet material and the said die lubricating material are evenly distributed among all of the die apertures, whereby each die aperture is properly lubricated and a plurality of extruded products, such as wire, is produced by the die simultaneously.

BRIEF DESCRIPTION OF THE DRAWING

Referring now to the drawing in which like numerals represent like parts in the several views:

FIG. **1** represents a medial longitudinal section through the improved die of the present invention;

FIG. **2** represents a view in elevation of the entrance end of the improved die of FIG. **1**;

FIG. **3** represents a medial longitudinal section through one form of extrusion apparatus incorporating the improved die of the present invention, showing the plurality of elongated products produced simultaneously thereby;

FIG. **4** represents a medial longitudinal view through an alternate embodiment of the improved die of the present invention; and

FIG. **5** represents a view in elevation of the entrance end of the improved die of FIG. **4**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. **1** and **2**, die **1** is seen as comprising a conical mouth **2**, the cone of the mouth **2** being truncated at **3**. A plurality of die apertures **4** is formed in the conical mouth **2** between the entrance end **5** of die **1** and the apex of the cone of the mouth **2**. More specifically, the die apertures **4** are radially equispaced around a circle lying intermediate the entrance end **5** of die **1** and the truncation **3**, the said circle lying in a plane perpendicular to the longitudinal axis of die **1** so that all of the said die apertures **4** lie the same distance from the entrance end **5** of die **1**, and thus all of the said die apertures **4** lie the same distance from the truncation **3**. All of the die apertures **4** communicate with passageway **6** at the rear end of the die **1**.

It has been found that with the specific arrangement hereinabove described, a billet of material **7**, coated with die lubricating material such as Castor oil, beeswax or polyethylene wax, when advanced into the mouth **2** of die **1** as in a hydrostatic extrusion process, will be evenly distributed among all of the said die apertures **4**, together with the coating of die lubricating material, so that each of the said die apertures **4** will receive billet material and die lubricating material at an equal rate, will be lubricated to the same degree as the other die apertures **4**, and will produce extruded product such as wire **8** at the same rate as the other die apertures **4**.

Die **1** has been shown with three die apertures **4**, spaced **120°** apart. It will be understood that die **1** may have two of such die apertures **4** spaced **180°** apart or may have more than three such die apertures **4** equispaced around the conical mouth **2**, e.g., four die apertures **4** spaced **90°** apart.

Die **1** may be used to particular advantage in hydrostatic extrusion apparatus of the type disclosed in U.S. Pat. No. **3,740,985 (1973)**, although it is capable of use in other types of extrusion apparatus. The said hydrostatic extrusion apparatus will be briefly described hereinbelow to aid in understanding the present invention.

U.S. Pat. No. **3,740,985** discloses coating the elongated surface of billet material with a shear transmitting medium which may, for example, be beeswax or polyethylene wax, and exerting through the shear transmitting medium a frictional or viscous drag force along the elongated surface of the billet material thereby to advance the billet material through a die to produce extruded product.

The shear transmitting medium desirably has high viscosity and shear strength, is capable of lubricating the die, provides good wetting action on the billet material, and has minimal viscosity variation with respect to pressure, temperature and shearing rate.

The means which exerts, through the shear transmitting medium, viscous drag force along the elongated surface of the billet material comprises trains of gripping element segments, each train being continuously propelled by pinion gears around a separate endless path, all of the trains of gripping element segments meeting along one length of travel from a first station upstream of a die to a second station downstream of the die and cooperating along said common length of travel to form a continuously moving train of centrally apertured gripping elements moving toward the die. The inner peripheries of the said apertures engaging the outer surface of the coating of shear transmitting medium on the billet material generate shear forces in the said medium which shear forces produce a frictional or viscous drag force along the elongated surface of the billet material to build up axial stress in the billet material and advance the billet material through the die. A pressure cylinder surrounds the centrally apertured gripping elements upstream of the die and exerts a normal pressure gradient on said gripping elements increasing toward the die, whereby a normal stress gradient is built up in the billet material increasing toward the die. These axial and normal stresses stress the billet material far above its yield strength and increase its ductility, or capacity for deformation without fracture.

Specific details of the extrusion apparatus, insofar as they do not relate to multiple extrusion and die design, are not part of the present disclosure. Reference should be made to U.S. Pat. No. **3,740,985** if information on such details is desired.

The use of die **1** is illustrated in FIG. **3.**

Die **1** is supported on die stem **9** on the manner disclosed in U.S. Pat. No. **3,740,985,** the said die stem **9** having an aperture extending therethrough in registry with aperture **6** of die **1.**

Billet **7,** coated with shear transmitting medium such as beeswax or polyethylene wax, is advanced to and extruded through die **1** by means of gripping element segments **10** propelled toward and past the die **1** by pinion gears (not shown) engaging teeth **11** on the exterior surfaces of the said gripping element segments **10,** in the manner taught in U.S. Pat. No. **3,740,985.** The gripping element segments **10** cooperating as a train of gripping elements constitute a pressure chamber surrounding the billet **7** and exert, through the coating of shear transmitting medium, a frictional or viscous drag force along the surface of the billet **7** thereby advancing the said billet **7** against die **1** and through die apertures **4** therein.

It will be understood that, in the manner taught in U.S. Pat. No. **3,740,985,** the gripping elements are surrounded upstream of die **1** by a pressure cylinder (not shown) whereby a normal pressure gradient increasing toward die **1** and indicated diagrammatically by arrows of increasing length in FIG. **3,** is applied to the billet **7.**

In the foregoing manner, axial and normal stress gradients, increasing toward die **1** to a value above the yield strength of the material of billet **7,** are built up in the billet **7** as the said billet is advanced, by frictional or viscous drag force along its surface, toward and into die **1** and through die apertures **4** to produce simultaneously a plurality of extruded wires **8.**

An alternate embodiment of the improved die **1** is shown in FIGS. **4** and **5** as comprising a conical mouth **2** extending fully to an apex **12** (rather than being truncated at **3** as in FIGS. **1** and **2**). As before, a plurality of die apertures **4** is formed in the conical mouth **2** between the entrance end **5** of die **1** and the apex **12.** The die apertures **4** are radially equispaced around a circle lying intermediate the entrance end **5** of die **1** and the apex **12,** the said circle lying in a plane perpendicular to the longitudinal axis of die **1** so that all of the said die apertures **4** lie the same distance from the entrance end **5** of die **1,** and thus all of the die apertures **4** lie the same distance from apex **12.** All of the die apertures **4** communicate with passageway **6** at the rear end of die **1.** Die **1** shown in FIGS. **4** and **5** is used in the same manner and yields the same results as die **1** shown in FIGS. **1** and **2.**

I claim:

1. A die comprising:

a. a die body having an entrance end and an exit end;

b. a flared mouth formed in the die body, said flared mouth converging rearwardly from the entrance end of the die, the rearward end of the flared mouth being closed;

c. a plurality of die apertures extending through said die body, said die apertures being radially equispaced around a circle intermediate the entrance end of the die body and the apex of the flared mouth, the said circle lying in a plane perpendicular to the longitudinal axis of the die body so that the inlet ends of the die apertures are spaced the same distance rearwardly of the entrance end of the die body, the inlet ends of said die apertures communicating with the flared mouth of said die body.

2. A die as in claim **1,** wherein:

d. the flared mouth of the die body is defined by a cone.

3. A die as in claim **1,** wherein:

d. the flared mouth of the die body is truncated at its rear end.

4. A die as in claim **2,** wherein:

e. the flared mouth of the die body is truncated at its rear end along a plane perpendicular to the longitudinal axis of the die body.

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