MULTIPLE HOLE EXTRUSION DIE

Fig. 1

Fig. 2

Fig. 3

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This invention comprises novel and useful improvements in a multiple die for extruding tubing and has for its primary object improvements in extrusion dies and methods for extruding tubing wherein the tube extrusion is of a greater diameter than the elongated billet from which the same is formed.

A very important object of the invention is to provide an apparatus whereby tubing may be extruded from elongated billets, the extruded tubing being of greater diameter than the billets from which the same is fabricated, and wherein the expansion of the diameter of the billet to form the finished tubing is effective with a minimum strain upon the internal construction of the die assembly.

Yet another object of the invention is to provide an apparatus as set forth in the foregoing object in which the billet is divided into a plurality of parallel streams of material which are disposed laterally from the central line of the axially moving billet, which streams are thereafter collected and welded together into an annular mass of greater diameter than the billet, and which annular mass is in turn forced through an extrusion die to provide the tubing of the requisite diameter.

A still further important object of the invention is to provide an adapter or feeder plate which may be interposed between the billet receiving guide portion of a die assembly and the die body to facilitate the separating of the billet into parallel streams and laterally displacing these streams from the axis of the billet.

These, together with various ancillary features and objects of the invention, which will later become apparent as the following description proceeds, are attained by the present invention, a preferred embodiment of which has been illustrated, by way of example only, in the accompanying drawings, wherein:

Figure 1 is a vertical central sectional view through a die assembly in accordance with this invention;

Figure 2 is a horizontal sectional view taken substantially upon the plane indicated by the section line 2—2 of Figure 1; and

Figure 3 is a fragmentary perspective view of the novel feeder plate or adapter plate for separating the billet into streams and dispersing these streams.

Referring more specifically to the accompanying drawings, and first more generally to Figure 1, it will be seen that the novel die construction incorporating the principles of this invention and serving to carry out the novel method of the same consists of a guide body 10, the adapter or feeder plate 12, a die body 14 having a detachable matrix 16, in conjunction with a mandrel 18 and a die supporting bed 20.

The guide body 10 may conveniently comprise a block of any suitable material and of the necessary dimensions, and which is provided with a preferably circular guide bore 22 disposed axially thereof for guidingly receiving an elongated billet from which the tubing indicated at 24 is to be extruded, this billet being designated by the numeral 25 as the same enters the guide bore.

The guide body 10 may be mounted in any suitable supporting construction such as that suggested by the numeral 28. Disposed immediately below the guide body 10 and overlaid and retained in assembled position in the die assembly by the member 29, is the feeder or adapter plate. The latter is constructed of any suitable material, and as shown in Figure 3 is preferably of a cylindrical or circular form, having a flat top surface 30 and a flat bottom surface 32 disposed in parallel relation thereto, this bottom surface having a shouldered recess 34 adjacent its periphery. Extending between the two surfaces 30 and 32 of the feeder plate 12 are a plurality of inclined passages or bores 36. As will be apparent from the figures of the drawings, each of these passages is inclined downwardly and outwardly from the longitudinal axis of the guide bore 22, and is disposed concentrically with respect thereto. The upper ends of the inclined feeder passages 36 enter the bore 22 substantially at the periphery of the same as shown in Figure 1, and may be of any desired cross-sectional area found to be expedient and convenient depending upon the nature of the material being passed through the extrusion die assembly. It is obvious that the number of such passages 36, and the cross-sectional area of the same will vary under different conditions under which the die is employed.

However, it is preferred to form the feeder or adapter plate 12 with a solid central core 38, lying within the passageways 36, this core being of a substantially conical shape as will be apparent from Figure 1.

This core serves to strengthen the feeder plate internally to enable the same to withstand the lateral pressures to which the same is subjected in use.

The die body 14 is preferably a cylindrical block of any desired material, and preferably of the same cross-sectional area and shape as
the feeder plate 12, the body 14 having flat parallel upper and lower surfaces 40 and 42 respectively, the former being provided with an internally shouldered annular depression 44 together with an upstanding peripheral flute or rim 46, the portions 44 and 46 being complementary to the surfaces 32 and 34 and receiving the same as shown in Figure 1.

Extending through the die body 14 are a plurality of parallel passages 48 whose upper ends register exactly with the ends of the inclined feed passages 36 in the feeder plate.

The lower surface 42 of the die body is provided with a recess shouldered portion 50 at its periphery. Between the passages 48, the die body is provided with a cylindrical solid, central core 52 which serves to strengthen the internal construction of the die body and reinforce the same against failure under the pressures to which the same is subjected.

The removable matrix 16 likewise consists of a circular or cylindrical plate of the same cross sectional shape and area as the body 14, and having a flat lower surface 54 and a parallel upper surface 56. This upper surface is however centrally recessed and shouldered as at 58 to be complementary to and receive the lower surfaces 50 and 42 of the body 14.

The base or supporting plate 29 is likewise provided with a shouldered recess 60 in its upper surface adapted to receive and snugly seat the bottom and side portions of the matrix 16. Both the matrix and the supporting member 29 are provided with aligned, axially disposed bores or passages 62 and 64 respectively, and the mandrel 18 is suitably secured within these bores or orifices to provide a restricted annular space therebetween which constitutes a passageway for discharging the extruded tubing 24.

Depending from the die body 14 and disposed centrally thereof is the base portion 68 adapted to register with and form a continuation of the mandrel 18. The portion 68 is spaced from an annular inletted rib or lip 70 constituting the nib of the extrusion die. The restricted annular space between the nib 70 and the mandrel extension 68 constitutes the throat of the extrusion die which forces the material of the billet passing therethrough into the final shape of the tubing.

The adjacent surfaces of the matrix 16 and the die body 14 are provided with complementary, semi-toroidal recesses or channels 12 and 74 respectively which mate with each other to perform an annular or toroidal collection chamber extending circumferentially about the die body and communicating with each of the passages 48. This chamber also communicates with the throat of the extrusion die which latter constitutes an outlet for the collection chamber. This collection chamber receives the material passing through the various passages 48 and collects and welds the same into a ring like mass of material which in turn is forced through the throat of the die to provide the extruded tubing 24.

The operation of the die and the method of extruding tubing in accordance with this invention are as follows.

An elongated billet 25 is forced by the extrusion press, not shown, through the guide bore 22 of the guide body 10 until the same engages the upper surface of the feeder or adapter plate 12. Under the pressure of the extrusion press, the material of the billet is forced to divide and flow through the plurality of feeder passages 36, thus spreading or separating the material of the billet through the divided outwardly diverging streams to cause this material to occupy a greater cross-sectional area. These streams pass from the inclined passages 36 into the parallel passages 48 which are laterally displaced from the axis of the billet. The billet being broken into streams and these streams separated from each other to the requisite distance, are then recombined and welded together in the annular or toroidal collection chamber 72, 14, and from thence under the pressure applied are extruded through the throat formed between the annular nib 70 and the mandrel section 68.

It will be noted that by dividing the billet into a plurality of separate streams, the lateral forces applied to the die bodies are greatly reduced as the billet material is expanded to the requisite diameter to form the tubing therefrom. This expansion of the billet by forming separate diverging streams of material also enables the use of solid cores 35 and 52 for the sections 12 and 14 which thereby greatly strengthen the internal structure of the same.

The use of the adapter plate 12 with its diverging feeder passages 36 enables various die bodies 14 and guide bodies 10 to be combined, all from standard parts, to provide a die having the requisite characteristics for handling the particular size of billet, the particular material of the billet and for forming the tubing of the desired requisite size.

From the foregoing, the construction and operation of the device will be readily understood and further explanation is believed to be unnecessary. However, since numerous modifications and changes will readily occur to those skilled in the art after a consideration of the foregoing specification and accompanying drawings, it is not desired to limit the invention to the exact construction shown and described, but all equivalent modifications and equivalents may be resorted to, falling within the scope of the appended claims.

Having described the invention, what is claimed as new is:

1. An extrusion die for producing tubing of a larger diameter than a billet comprising a guide body having a guide bore receiving an elongated billet, a die body having parallel passages therethrough for dividing the material of the billet into parallel streams, the axes of said passages being at a greater distance from said axis of the guide bore than the wall of the guide bore, a mandrel, means for extruding said streams over the mandrel to produce a tube, a feeder plate interposed between said guide body and said die body, said feeder plate having feed passages inclined to the axis of said guide body and connecting each passage with the guide bore, said mandrel being mounted at the base of said die body.

2. The combination of claim 1 wherein said die body has a central, solid core.

3. The combination of claim 1 wherein said feeder plate has a central, solid core.

4. The combination of claim 1 wherein said feeder plate and said die body have central, solid cores.

5. The combination of claim 1 wherein said die body includes an annular collection chamber communicating with said passages, said extrud-
ing means communicating with said collection chamber.

6. The combination of claim 1 wherein said die body includes an annular collection chamber communicating with said passages, said extruding means communicating with said collection chamber, a removable matrix on said die body, said collection chamber consisting of complementary recesses in said die body and said matrix.

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