Feb. 14, 1961 J. SEJOURNET 2,971,644

EXTRUSION DIES

Filed May 9, 1955 3 Sheets-Sheet 1

Fig. 1

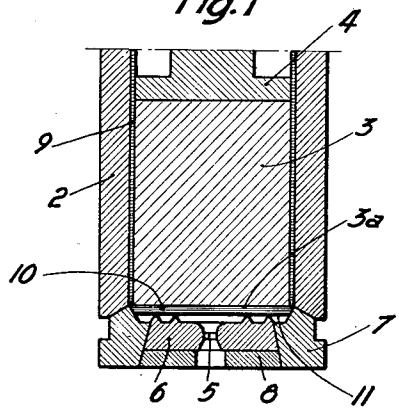


Fig. 3

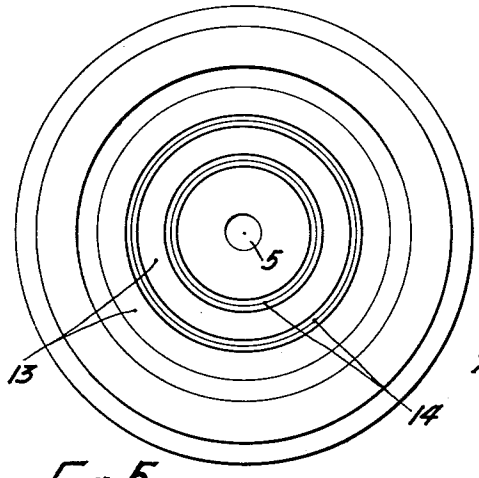


Fig. 2

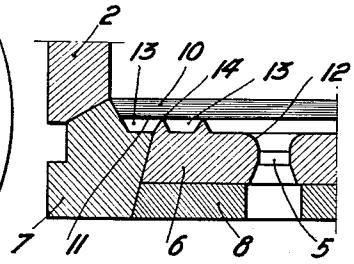


Fig. 5

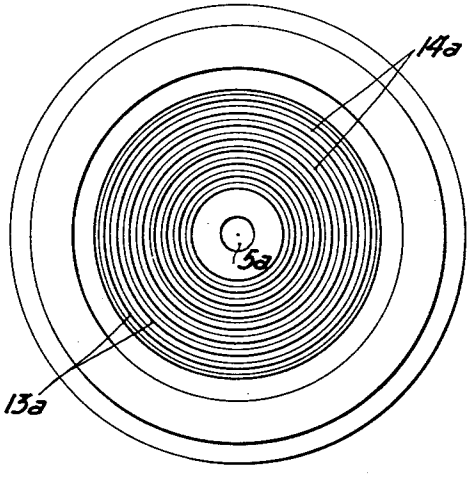
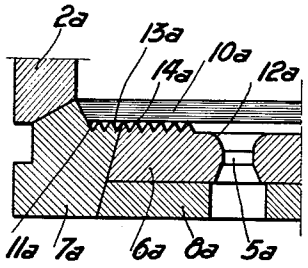


Fig. 4



Feb. 14, 1961 J. SEJOURNET 2,971,644

EXTRUSION DIES

Filed May 9, 1955 3 Sheets-Sheet 2

Fig. 7

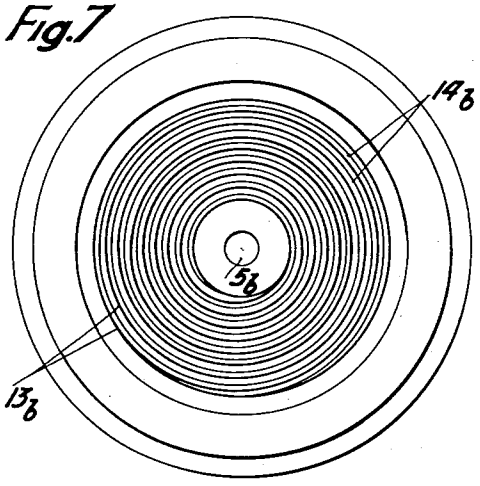


Fig. 6

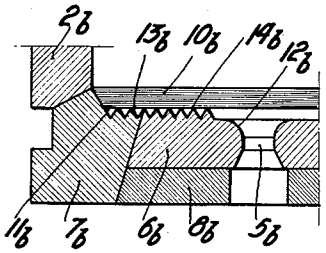


Fig. 9

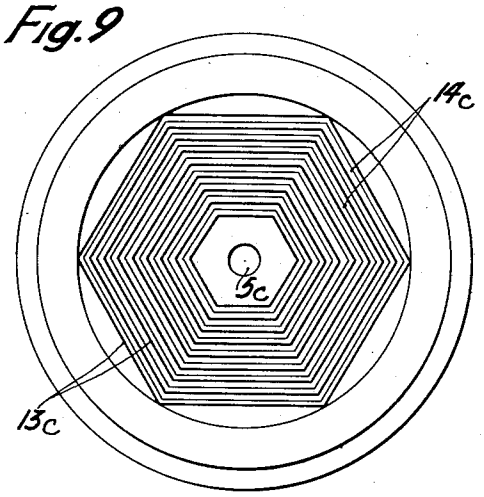
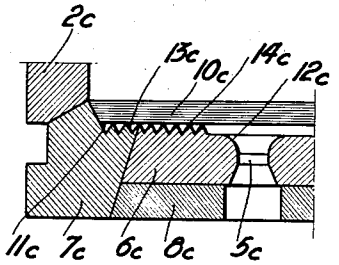


Fig. 8



Feb. 14, 1961 J. SEJOURNET 2,971,644

EXTRUSION DIES

Filed May 9, 1955 3 Sheets-Sheet 3

Fig. 11

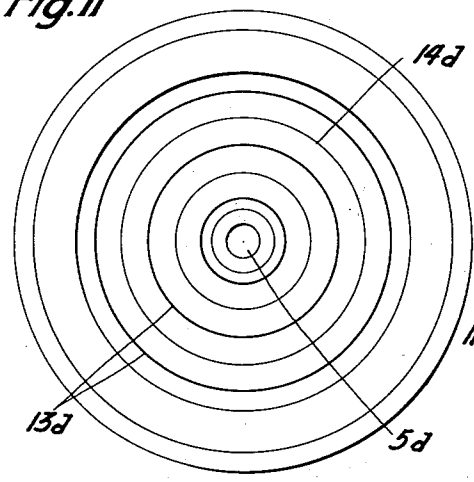


Fig. 10

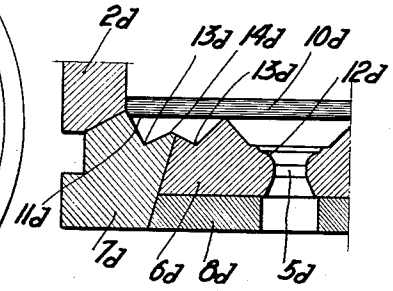


Fig. 13

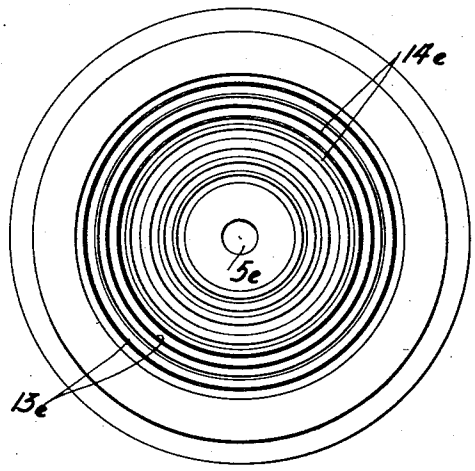
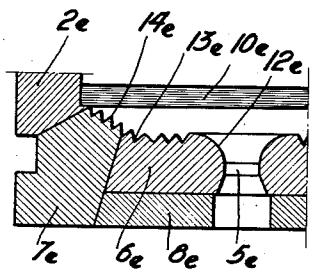


Fig. 12



United States Patent Office 2,971,644 Patented Feb. 14, 1961

2,971,644

EXTRUSION DIES

Jacques Sejournet, Paris, France, assignor to Compagnie du Filage des Metaux et des Joints Curty

Filed May 9, 1955, Ser. No. 507,000

Claims priority, application France Feb. 11, 1955

7 Claims. (Cl. 207—17)

This invention relates to extrusion dies. It is known to extrude a heated metal billet from a container by forcing the billet from the container through an orifice in the die. Various lubricants have been used between the billet and the container and between the billet and the die with the object of improving the surface characteristics, the microstructure and physical properties of the extruded product, decreasing wear on the die and increasing the extrusion speed. Lubricants such as graphite, soapstone and glass have been used for these purposes.

In the extrusion of some aluminum and copper alloys, the use of a lubricant is necessary if the extrusion is to be carried out at high speed without causing surface defects on or transverse cracking of the extruded product. Additionally, the high pressures involved in extrusion tend to eject the lubricant through the die orifice before the extrusion operation has been completed which, of course, results in poor lubrication or complete absence of lubrication during later stages of the extrusion process, causing excessive wear on the die and even more serious imperfections in the extruded bar. These conditions become more aggravated as the metal to be extruded has a greater tendency to seize the steel tools and as the metal being extruded possesses increased tendencies toward hot shortness.

It has been common practice in the past to use extrusion dies in which the face of the die and the die holder leading from the wall of the container to the die orifice is smooth so that the flow of metal of the billet along the die face toward the die orifice is unobstructed. It has been found, however, that irrespective of the particular lubricant employed, where the die face is smooth, the lubricant is not fed uniformly to the die orifice during the extrusion process. At times, there is a deficiency of lubricant which leads to scoring of the die and imperfections in the extruded product and at other times there is an excess of lubricant which leads to surface defects in the extruded product in the nature of pitting due to pockets of lubricant formed in the surface. This non-uniformity of lubricant feed increases with extrusion speed so that the pitting of the surface of the extruded article is particularly noticeable at high extrusion speed. Also, at high extrusion speed, the extruded article may exhibit transverse cracking as above indicated.

In accordance with the present invention, an extrusion die is provided which insures substantially uniform lubrication, thus enabling greatly increased extrusion speeds to be employed while still avoiding the above mentioned defects. Thus, in extruding high strength bronzes, speed increases of as much as tenfold have been made possible and in the case of aluminum-base alloys, speed increases of as much as fortyfold have been made possible by the use of dies made according to the present invention. In my die, the lubricant is retained on the face of the die and, if desired, on the face of the die holder by providing the face of the die or the face of the die and die holder with grooves completely surrounding and spaced radially from the die orifice and from each other. Preferably, the major portion of the area of said face is provided with grooves. A solid lubricant, i.e., glass, graphite, soapstone or the like, is placed on the face of the die in front of the leading end of the billet. As pressure is applied to the billet during extrusion, it forces the lubricant into the grooves in the die face, thus anchoring the lubricant to the die and preventing it from being expelled prematurely. In this manner, uniform feeding of the lubricant into the die orifice is assured throughout the extrusion process.

The metal of the billet in flowing along the die face toward the die orifice wipes over the lubricant which is anchored to the die face so that a thin uniform film of lubricant is delivered to the orifice. When the lubricant which overhangs or lies on top of the grooves is used up, that portion of the lubricant lying in the grooves is still available. In order to effectively retain the lubricant on the die face, there should be a plurality of ridges and grooves in the die face. These ridges and grooves preferably occupy the major portion of the area of the die face. The grooves completely surround the die orifice. They may be separate grooves spaced radially from each other or they may be constituted of a continuous spiral groove in which the turns of the spiral are spaced radially from each other. It is requisite that in every radial line or direction of movement of the metal of the billet along the die face there shall be an adequate number of grooves to control and render uniform the feed of the lubricant with the metal being extruded.

In the accompanying drawings which illustrate several embodiments of my invention:

Fig. 1 is a longitudinal section through an extrusion apparatus including a die made according to my invention;

Fig. 2 is a longitudinal section through one embodiment of a die according to my invention, back-up ring, die holder and a portion of the container which receives the billet, the figure also showing the solid plate of lubricant which is interposed between the face of the die and die holder and the end of the billet;

Fig. 3 is an elevational view of the face of the die and die holder of Fig. 2 which is turned towards the container;

Figs. 4, 6, 8, 10 and 12 are views similar to Fig. 2 but illustrating different forms of dies, and

Figs. 5, 7, 9, 11 and 13 are views, similar to that of Fig. 3, of the dies and die holders shown respectively in Figs. 6, 8, 10 and 12.

Referring more particularly to the accompanying drawings and for the present to Fig. 1, there is shown a container **2** for receiving a heated billet **3** which is extruded by a ram **4** through a die orifice **5** in a die **6** located at the lower end of the container and mounted in a die holder **7** and retained in the die holder by a backup ring **8**. A lubricant layer **9** is provided between the side of the billet and the interior wall of the container and a solid body **10** of lubricant is interposed between the end of the billet and the face **11** of the die and die holder which surrounds the orifice **5**. The die illustrated in Fig. 1 is shown in more detail in Figs. 2 and 3.

Referring to Figs. 2 and 3, the die orifice **5** has a throat **12** at its entrance side. Surrounding the throat is a face **11** provided with two continuous grooves **13** completely surrounding the die orifice for retaining the lubricant **10**. It will be understood that when pressure is exerted on the billet by the ram, the solid body **10** of lubricant is forced toward the die and a portion of it is forced into the grooves **13** which anchor the body on the die face. The grooves are separated by upwardly tapering ridges **14**.

In Figs. 4 and 5 which illustrate another form of my

die, corresponding parts are designated by the same reference numerals with the letter *a* suffixed. In Fig. 4, the grooves **13***a* are formed in the face of the die **6***a* and die holder **7***a* whereas in Fig. 2 they are formed only in the face of the die **6**.

In Figs. 6 and 7 which illustrate another form of my die, corresponding parts are designated by the same reference numerals with the letter *b* suffixed. In this die, a continuous spiral groove **13***b* constituted of a plurality of radially spaced turns is employed instead of a plurality of separate grooves.

In Figs. 8 and 9 which illustrate another form of my die, corresponding parts are designated by the same reference numerals with the letter *c* suffixed. In this die, the grooves **13***c* are in the form of hexagons rather than circles.

In Figs. 10 and 11 which illustrate another form of my die, corresponding parts are designated by the same reference numerals with the letter *d* suffixed. In this die, the ridges **14***d* extend upwardly to different heights.

In Figs. 12 and 13 which illustrate another form of my die, corresponding parts are designated by the same reference numerals with the letter *e* suffixed. In this die, the peaks of the ridges **14***e* lie in a generally curved surface rather than in the same plane.

The solid body **10** of lubricant which is interposed between the billet and the die and die holder can be a vitreous material such as a suitable glass or slag or it can be compacted borax, graphite or soapstone, with or without a suitable binder, or other suitable lubricant depending upon the particular metal or alloy which is to be extruded. A wide variety of lubricants can be employed to form the layer **9** between the billet and the container but the lubricant preferably is a vitreous material such as a suitable glass or slag when the extrusion is carried out at a high temperature. The layer **9** can be applied either to the billet or to the interior wall of the container. My improved die can be used in extruding metals in general, for instance, steel, aluminum-base alloys, magnesium-base alloys and copper-base alloys but is especially effective when used in the extrusion of aluminum alloys and copper alloys. My improved die retains the lubricant layer **10** on the face of the die and die holder, thereby preventing it from being ejected through the die orifice prematurely, thus insuring adequate lubrication throughout the entire extrusion operation.

The invention is not limited to the preferred embodiments but may be otherwise embodied or practiced within the scope of the following claims.

What I claim is:

1. In an extrusion die having an orifice, a throat at the entrance side of the orifice and a face surrounding the throat, the die being adapted for use in extruding a heated metal billet from a container by interposing a solid body of lubricant between the end of the billet and said face of the die and forcing the billet through the die orifice, the improvement characterised in that said face of the die is provided with grooves completely surrounding and spaced radially from the die orifice and from each other for retaining the lubricant on the die face and feeding it uniformly to the die orifice.

2. A die according to claim 1, wherein the major portion of the area of said face is provided with grooves.

3. A die as claimed in claim 1, characterized by said grooves being a plurality of annular channels concentric with the axis of the die.

4. A die as claimed in claim 1, characterized by said grooves being a continuous spiral channel formed radially on the face of said die.

5. A die as claimed in claim 1, characterized by said grooves being a plurality of hexagonal channels formed symmetrically about the axis of the said die.

6. A die as claimed in claim 1, in which the walls separating the said grooves are of triangular cross-section.

7. In an extrusion die having an orifice, a throat at the entrance side of the said orifice, a face surrounding said throat, and a die-holder surrounding said face, the die being adapted for use in extruding a heated metal billet from a container by interposing a solid body of lubricant between the end of the said billet and said face of the die, and forcing the billet through the die orifice, the improvement characterised in that said die face and the face of said die-holder are provided with grooves completely surrounding and spaced radially from the said die orifice and from each other for retaining the lubricant on the die face and feeding it uniformly to said die orifice.

References Cited in the file of this patent

UNITED STATES PATENTS

285,896	Holland	Oct. 2, 1883
880,563	McTear	Mar. 3, 1908
1,582,434	Simons	Apr. 27, 1926
1,957,234	Schroter et al.	May 1, 1934
2,164,750	Nadler	July 4, 1939
2,538,917	Sejournet	Jan. 23, 1951
2,538,918	Sejournet	Jan. 23, 1951
2,630,220	Sejournet	Mar. 3, 1953

FOREIGN PATENTS

453,878	Canada	Jan. 4, 1949
161,466	France	Apr. 10, 1884
261,457	Germany	1913
19,891	Great Britain	Aug. 26, 1910
607,285	Great Britain	Aug. 27, 1948
340,192	Italy	May 4, 1936