



(19)

Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

**EP 0 699 487 A1**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**06.03.1996 Bulletin 1996/10**

(51) Int. Cl.<sup>6</sup>: **B21C 25/02**

(21) Application number: **95202102.0**

(22) Date of filing: **02.08.1995**

(84) Designated Contracting States:  
**AT BE CH DE ES FR GB IT LI NL SE**

(30) Priority: **02.08.1994 EP 94202225**

(71) Applicant: **NORSK HYDRO A/S**  
**N-0240 Oslo 2 (NO)**

(72) Inventors:  
• **Porksen, Ole**  
**DK-6270 Tonder (DK)**

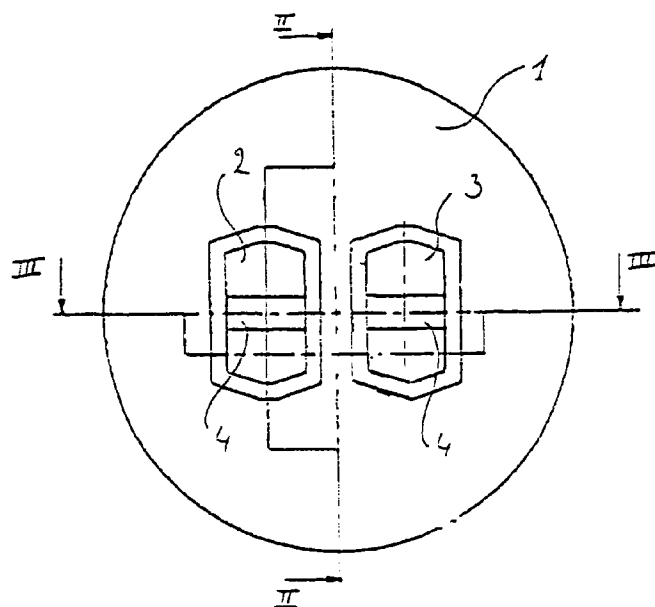
• **Brodersen, Gunnar**  
**DK- 6280 Hojer (DK)**  
• **Skov, Egon**  
**DK-6240 Logumkloster (DK)**

(74) Representative: **Bleukx, Luc**  
**P.O. Box 2**  
**NL-4540 AA Sluiskil (NL)**

**(54) Extrusion die**

(57) An extrusion die (1) for the extrusion of hollow extrusion products and having at least two extrusion cavities (15,16) each connected to at least two portholes (2,8;3,9), especially an extrusion die for aluminium or

aluminium alloys, at least one porthole (2,8;3,9) of each extrusion (15,16) cavity being connected to one porthole (2,8;3,9) of an adjacent extrusion cavity (15,16) by means of at least one channel (6,7).



**FIG. 1**

**EP 0 699 487 A1**

## Description

The invention relates to an extrusion die for the extrusion of hollow extrusion products, and having at least two extrusion cavities each connected to at least two portholes, especially an extrusion die for aluminium or aluminium alloys.

Such a die with more than one extrusion cavity is generally known in the art.

For the extrusion of aluminium profiles use can be made of different types of dies.

A first type is the so called flat die comprising generally a feeder contacting the aluminium billet to be extruded, a die plate and a backer

The die plate comprises a number of extrusion cavities, through which the extrusion takes place, the portion of which adjacent to the aluminium billet to be extruded having a cross section corresponding to the cross section of the extrusion product. The remainder of the extrusion cavity has a gradually increasing cross-section thus providing a free-running guidance for the extruded profile. In the backer corresponding free-running channels are provided. The flat die can be used for profiles with open configuration, i.e. profile with no tube-like portions in it.

Another type of dies is the so called hollow die. In this case the die is composed of a bridge, the die plate and a backer. The backer is basically identical to the backer of the flat die and provides free-running channels for the extruded profile.

The die plate comprises at least one extrusion cavity the portion adjacent to the billet to be extruded having a cross-section the outer circumference of which corresponds to the outer circumference of the cross-section of the profile to be obtained. The remainder of the extrusion cavity has also a gradually increasing cross-section providing a free-running guidance for the extruded profile.

At the side of the billet the extrusion cavity is connected to a recess, which is part of the porthole system to be described hereinafter. The bridge has basically at least two so called portholes facing the billet to be extruded. The portholes are separated from each other by bridge portions. The side of the bridge facing the die plates is provided with a mandrel. In assembled condition the mandrel is extending into the extrusion cavity of the die plate, thereby defining the inner and outer circumference of the profile to be extruded. The portholes in the bridge and the recess in the die plate together constitute the flow channels of the aluminium to be extruded through the extrusion cavities. These flow channels as a whole are commonly called the portholes.

Dies of the hollow type can also be provided with multiple extrusion cavities.

A special form of dies, especially used for producing thinwalled multiport extrusion tubes having a number of parallel channels is a die comprising a die holder and a die plate to be positioned in the die holder. The die holder is provided with the portholes and the bridge portions

thus giving support to a mandrel extending into the extrusion cavities of the die plate to be provided in the holder. Such a type of die will be described in more detail hereinafter.

In case of such so called multiport dies it has been found that pressure differences are present between the individual extrusion cavities, due to irregularities in the extrusion channels and pressure acting upon the billet. As a result of said pressure differences there are differences in the extrusion speed between the different extrusion cavities, which differences may be up to 50%.

In order to reduce the pressure differences, it has been proposed to use weblike structures in the portholes. These structures equalize the pressure differences between the individual extrusion cavities and thus reduce the extrusion speed differences between the individual profiles. Although giving excellent results in a number of applications these weblike structures can not be used in the extrusion of multiple port extrusion products in which high accuracy and small wall thickness are required. Due to the elasticity of the die, there is not enough support to ensure the required accuracy.

It is therefore an object of the invention to provide an extrusion die of the above identified type wherein the above-mentioned problem can be avoided.

This object is achieved in that at least one porthole of each extrusion cavity is connected to one porthole of an adjacent extrusion cavity by means of at least one channel.

By providing channels between the individual portholes an equilibration of the pressures within the individual cavities can be obtained, thus reducing the differences in extrusion speed for the individual cavities to below 10%. Otherwise the channels do not weaken the supporting structure of the die, thus ensuring sufficient support for high accuracy profiles.

Other characteristics and advantages of the invention will be clear from the following description, references being made to the drawings.

Herein is:

- Fig. 1 a front view of an extrusion die holder according to the invention,
- Fig. 2 a cross-section according to line II-II in Fig. 1, and
- Fig. 3 a cross-section according to line III-III in Fig. 1.

In Fig. 1 there is shown an extrusion die 20 comprising a die holder 1 for a two-cavities-extrusion die. The die holder is provided with four portholes 2,8 and 3,9. The portholes 2,8 belonging to one extrusion cavity 15 and the portholes 3,9 belonging to a second extrusion cavity 16. Between the portholes 2,8 and 3,9 respectively there are provided bridge portions 4,5 respectively. The die holder 1 further has two recesses 15, 16 for receiving a die plate (not shown). Each die plate being provided with an extrusion cavity in accordance with the circumference of the cross-section of the extrusion profile to be

made. The bridge portion may be provided with a mandrel (not shown) extending into the extrusion cavity of the corresponding die plate and thus providing the inner circumference of the extrusion profile to be made.

Between the portholes 2, 3 a channel 6 has been provided, and between the portholes 8, 9 a second channel 7 has been provided. The channels are positioned as close as possible to the die plate, and are able to provide a pressure equalisation between the portholes. It is supposed that in this area the temperature and pressure in the metal to be extruded is such that a nearly fluid state is reached whereby such a pressure equalisation can be obtained. As a result of this pressure equalisation, the extrusion speed between both cavities becomes nearly the same, thereby providing a constant quality in extruded products independent of the extrusion cavity. This is especially important for thin walled product such as heat exchanger tubes, especially as used in air conditioning systems for cars.

It has been found that good result can be obtained when using channels with a cross section which is at least equal to the surface of one porthole.

It is clear that the invention is not restricted to the embodiment shown or to the use of special types of extrusion profiles, but is generally applicable to multiport extrusion dies.

#### Claims

1. Extrusion die for the extrusion of hollow extrusion products and having at least two extrusion cavities each connected to at least two portholes, especially an extrusion die for aluminium or aluminium alloys, **characterized in that** at least one porthole of each extrusion cavity is connected to one porthole of an adjacent extrusion cavity by means of at least one channel. 30
2. Extrusion die according to claim 1, **characterized in that** every channel has a rectangular cross-section. 40
3. Extrusion die according to any of the preceding claims, **characterized in that** the cross-section of a channel connecting two portholes is at least equal to the cross-section of one porthole. 45
4. Extrusion die according to any one of the preceding claims **characterized in that** each channel is connected to the porthole adjacent to the extrusion cavity. 50
5. Extrusion die according to any one of the preceding claims, and comprising two extrusion cavities each connected to at least two portholes, **characterized in that** 55

only the adjacent portholes of the different extrusion cavities are connected by means of at least one channel.

6. Extrusion die according to any one of the claims 1 - 4, and comprising at least three cavities arranged according to a regular poly... in the die and each cavity being connected to at least two portholes, **characterized in that** at least one channel is connecting each pair of adjacent portholes pertaining to adjacent cavities.

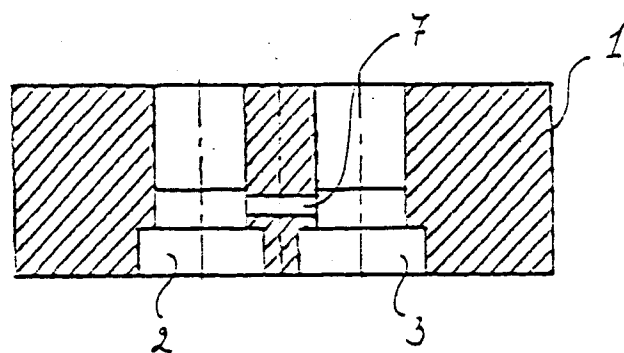
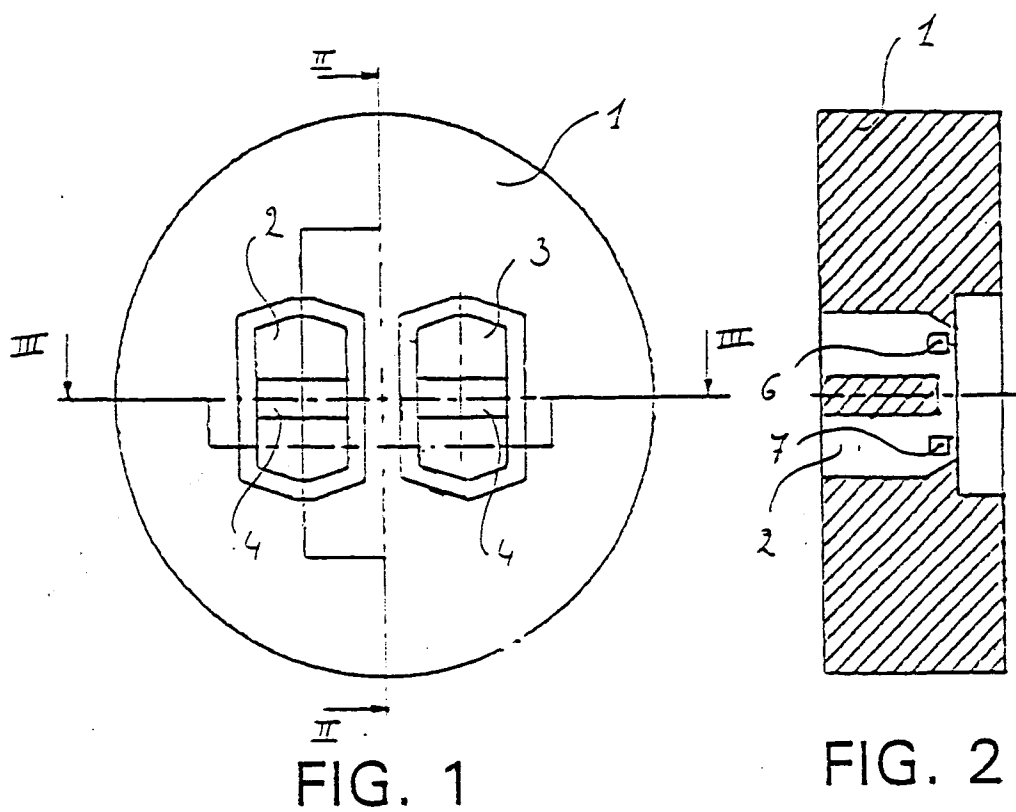


FIG. 3



European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 95 20 2102

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE-A-11 11 586 (HYDRAULIK GMBH) * column 1, line 28 - line 34 * * column 1, line 41 - column 2, line 33 * * claims; figures * ---	1-6	B21C25/02
A	WO-A-94 04291 (COOK) * the whole document * ---	1-6	
A	US-A-3 063 560 (EDGEcombe) * figures * ---	1,6	
A	DE-A-19 09 574 (WALSDORF) -----		
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B21C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 30 November 1995	Examiner Jensen, K
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)