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APPARATUS FOR THE PRODUCTION OF TAPERED METAL SECTIONS BY EXTRUSION

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Fig. 1

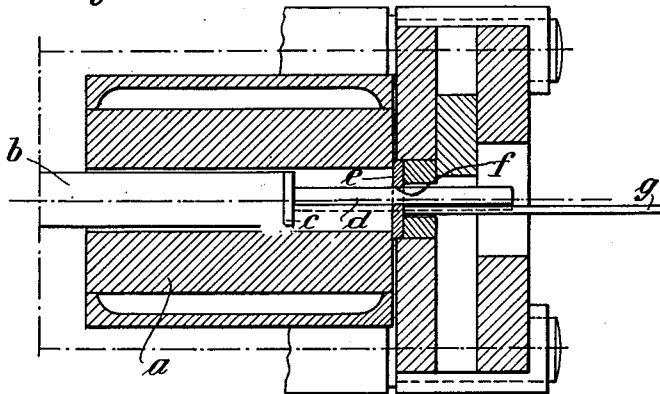


Fig. 2



Fig. 3



Fig. 4

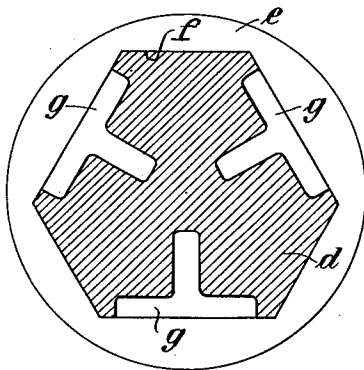
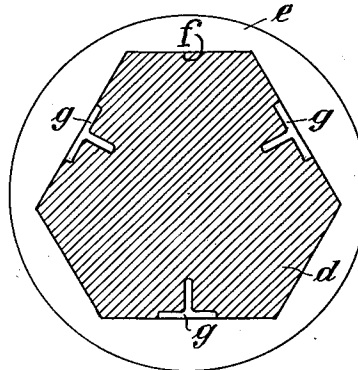


Fig. 5



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APPARATUS FOR THE PRODUCTION OF
TAPERED METAL SECTIONS BY EXTRU-
SIONHans Bothmann, Aken, Germany, assignor, by
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7 Claims. (Cl. 207—6)

This invention relates to apparatus for the production of tapered metal sections by extrusion.

According to a known process, tapered metal sections are produced in an extrusion press by forcing the metal through a die-opening together with a tapered mandrel attached to the ram of the press, and thus travelling through the die-opening along with, although at a much smaller speed than, the extruded metal, the taper of the mandrel being such that the cross-section of the mandrel, at individual points, together with the die-opening defines the desired cross-section of the metal section to be produced at corresponding points of its length (see e. g. British patent specification 386,518). In the actual embodiments there shown, provision is made for the aperture defining the section to be produced, to be more or less centrally disposed in relation to the periphery of the metal blank in the press chamber, and the mandrel attached to the press ram, while sliding on the surface of the die-opening, is not positively guided thereby. The mandrel thus is liable to be deflected from its desired position by the unilateral pressure forces exercised by the flowing metal; the latter thus tends to enter into the gap between the die surface and that surface of the mandrel supposed to slidably contact therewith, whereby undesirable variations in the dimensions of the section to be produced are set up; moreover, the considerable bending stresses to which the mandrel is subjected, in course of time, lead to a permanent change in its shape which, in turn, renders it entirely impossible, ab initio, to produce sections of predetermined dimensions. To some extent at least these phenomena are due to the fact that in the case of sections of radially asymmetrical cross-section the velocities of flow of the metal at the various points of the profile cross-section are not uniform and thus cause an intense unilateral stressing of the mandrel.

The main object of the present invention is to obviate the foregoing disadvantages by providing apparatus, with the aid of which sections of strictly predetermined dimensions may be produced. Further objects of the invention will become apparent as the specification proceeds.

In accordance with the invention the mandrel or mandrels, which are, in the manner above described, attached to the press ram, are positively guided in the die-opening of the press. This may be achieved in a manner known per se by a so-called "three point bearing guidance," that is to say, each mandrel must be guided in at least

three points of its periphery which, if the cross-section of the mandrel be of polygonal shape, must lie, respectively, on three sides of the polygon conforming to the condition that they define a triangle in which the mandrel is substantially enclosed. Provided however that, if any two sides of the said triangle are parallel to each other (the triangle thus being of such a kind, that one point thereof is located at an infinite distance from the others), then four bearing points lying on four sides of the polygon forming a quadrangle conforming to the aforesaid condition are required.

By controlling the movement of the mandrel or mandrels in the die-opening in the aforesaid manner, the plastic metal entering the die-opening is efficiently prevented from penetrating into the gaps between the mandrel and the die-opening and thus is forced to flow exclusively through the predetermined opening of the die and mandrel aggregate defining the section to be produced.

Preferably, in order to equalize the flow of metal through the die-opening and thus to eliminate as far as possible unilateral stresses exercised on the mandrel or mandrels, a plurality of passages for the flowing metal are provided which are preferably of identical shape and size, such openings being distributed as uniformly as possible around the periphery of the die-opening. In such an arrangement it has been also found convenient to make the die aperture, and hence also the cross-section of the mandrel or mandrel aggregate (neglecting for the moment the recesses which are provided therein for the section to be produced) as nearly as possible circular in shape, in order to reduce the area of contacting surfaces sliding on one another.

In order to enable the invention to be more readily understood, reference is made to the accompanying drawing which illustrates diagrammatically and by way of example, one embodiment thereof, and in which:

Fig. 1 is a longitudinal cross-section of an extrusion press in accordance with the invention, whilst Figs. 2 and 3 show cross-sections of the section to be produced thereby at different points of its longitudinal extent; and

Figs. 4 and 5 show cross-sections of the die aperture and the mandrel as positioned therein at different stages of operation corresponding to those of Figs. 2 and 3, respectively.

In Fig. 1 *a* denotes the press cylinder in which a press ram *b* is movable in a longitudinal direction. The ram is provided with a press head *c*

which, in turn, carries the mandrel *d*. The latter is positively guided, in the manner described above, in the opening *f* provided in the die plate *e*.

Referring to Figs. 2, 3, 4 and 5, the same designations apply and additionally, the tapered profile to be produced is denoted by *g*.

While in the embodiment shown it is seen that the mandrel *d* which there is of hexagonal shape (neglecting for the moment the recesses provided therein for defining the sections to be produced), is positively guided in six points (lying, respectively, on each of the six sides of the polygon), it is noted, that, strictly speaking, only a three point bearing guidance is required, the polygonal sides bearing the recesses not being necessary for a positive guidance of the mandrel at all.

In the embodiment illustrated the mandrel lies centrally in the ingot to be worked, so that in the receiver of the extrusion press it is enclosed on all sides by the flowing metal. The compressive forces acting on the mandrel are thus distributed uniformly in the radial direction, so that lateral compressive forces practically no longer occur at all. The effect of this is that the resulting section actually corresponds in dimensions at all times to the apertures left free between the die and the mandrel, and that the latent tensile stresses in the resulting sections are also minimised. At the same time, the uniformity of the flow processes in the interior of the receiver are improved, which in the aggregate also provides more rapid deformation, which thus closely approximates to that in the pressing of ordinary tubes.

I claim:

1. Apparatus for the production of articles by extrusion, which comprises a press cylinder adapted to receive a block of metal, a press ram registering with said cylinder and movable therein in an axial direction, a mandrel attached to the head of said press ram, a die at one end of said press cylinder and located opposite said press ram, said die being provided with an opening coaxial with said mandrel and adapted to receive and to guide said mandrel upon the movement of the press ram toward said die, a longitudinal recess provided in the peripheral wall of said mandrel and adapted to cooperate with the adjacent surface in the die-opening to define the cross-section of the articles produced by extrusion, the periphery of said mandrel having a series of bearing points adapted to register with the die-opening and so located as to oppose substantial displacement of the mandrel and die-opening from coaxial relationship during movement of said mandrel within said die-opening.

2. Apparatus for the production of articles by extrusion, which comprises a press cylinder adapted to receive a block of metal, a press ram registering with said cylinder and movable therein in an axial direction, a mandrel attached to the head of said press ram, a die at one end of said press cylinder and located opposite said press ram, said die being provided with an opening coaxial with said mandrel and adapted to receive and to guide said mandrel upon the movement of the press ram toward said die, a plurality of longitudinal uniformly spaced recesses provided in the peripheral wall of said mandrel and adapted to cooperate with the adjacent surface in the die-opening to define the cross-section of the articles produced by extrusion, the periphery of said mandrel having a series of bearing points intermediate said longitudinal recesses adapted to register with the die-opening and to support said man-

drel during movement thereof within the die-opening.

3. Apparatus for the production of metal articles by extrusion, which comprises a press cylinder adapted to receive a block of metal, a press ram registering with said cylinder and movable therein in an axial direction, a mandrel attached to the head of said press ram, a die at one end of said press cylinder and located opposite said press ram, said die being provided with an opening coaxial with said mandrel and adapted to receive and to guide said mandrel upon the movement of the press ram toward said die, longitudinal recesses provided in the peripheral wall of said mandrel and adapted to cooperate with the adjacent surface in the die-opening to define the cross-section of the metal sections produced by extrusion, said longitudinal recesses being of varying cross-sectional area whereby the advancement of said mandrel within said die-opening changes the cross-section of the metal articles produced by extrusion, the periphery of said mandrel having a series of bearing points intermediate said longitudinal recesses adapted to register with the die-opening and to support said mandrel during movement thereof within the die-opening.

4. Apparatus for the production of tapered metal articles by extrusion, which comprises a press cylinder adapted to receive a block of metal, a press ram registering with said cylinder and movable therein in an axial direction, a mandrel attached to the head of said press ram, a die at one end of said press cylinder and located opposite said press ram, said die being provided with an opening coaxial with said mandrel and adapted to receive and to guide said mandrel upon the movement of the press ram toward said die, a plurality of longitudinal uniformly spaced recesses provided in the peripheral wall of said mandrel and adapted to cooperate with the adjacent surface in the die-opening to define the cross-section of the metal sections produced by extrusion, said longitudinal recesses being of varying cross-sectional area whereby the advancement of said mandrel within said die-opening changes the cross-section of the metal articles produced by extrusion, the periphery of said mandrel, except for said longitudinal recesses, being adapted to register with the die-opening and to serve as bearing surfaces during movement of the mandrel within said die-opening.

5. An apparatus for the production of articles by extrusion, which comprises a press cylinder adapted to receive a block of metal, a press ram registering with said cylinder and movable therein in an axial direction, a mandrel attached to the head of said press ram, a die at one end of said press cylinder and located opposite said press ram, said die being provided with an opening coaxial with said mandrel and adapted to receive and to guide said mandrel upon the movement of the press ram toward said die, a longitudinal recess provided in the peripheral wall of said mandrel and adapted to cooperate with the adjacent surface in the die-opening to define the cross section of the articles produced by extrusion, said longitudinal recess being of varying cross sectional area whereby the advancement of said mandrel within said die-opening changes the cross section of the articles produced by extrusion, the periphery of said mandrel having a series of bearing points adapted to register with the die-opening and so located as to oppose substantial displacement of the mandrel and die-

opening from coaxial relationship during movement of said mandrel within said die-opening.

6. An apparatus for the production of articles by extrusion, which comprises a press cylinder adapted to receive a block of metal, a press ram registering with said cylinder and movable therein in an axial direction, a mandrel attached to the head of said press ram, a die at one end of said press cylinder and located opposite said press ram, said die being provided with an opening coaxial with said mandrel and adapted to receive said mandrel and to engage about its perimeter in bearing relationship whereby the mandrel is positively guided within the die-opening upon the movement of the press ram toward said die and substantial displacement of the mandrel and die-opening from their coaxial position is opposed, and a longitudinal recess provided in the wall of said mandrel and adapted to cooperate with the adjacent surface in the die-opening to define the cross section of the articles produced by extrusion.

7. An apparatus for the production of articles by extrusion, which comprises a press cylinder

adapted to receive a block of metal, a press ram registering with said cylinder and movable therein in an axial direction, a mandrel attached to the head of said press ram, a die at one end of said press cylinder and located opposite said press ram, said die being provided with an opening coaxial with said mandrel and adapted to receive said mandrel and to engage about its perimeter in bearing relationship whereby the mandrel is positively guided within the die-opening upon the movement of the press ram toward said die and substantial displacement of the mandrel and die-opening from their coaxial position is opposed, and at least one longitudinal recess provided in the wall of said mandrel and adapted to cooperate with the adjacent surface in the die-opening to define the cross section of the articles produced by extrusion, said longitudinal recess being of varying cross sectional area whereby the advancement of said mandrel within said die-opening changes the cross section of the articles produced by extrusion.

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