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EXTRUSION OF METALS

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Fig. 1

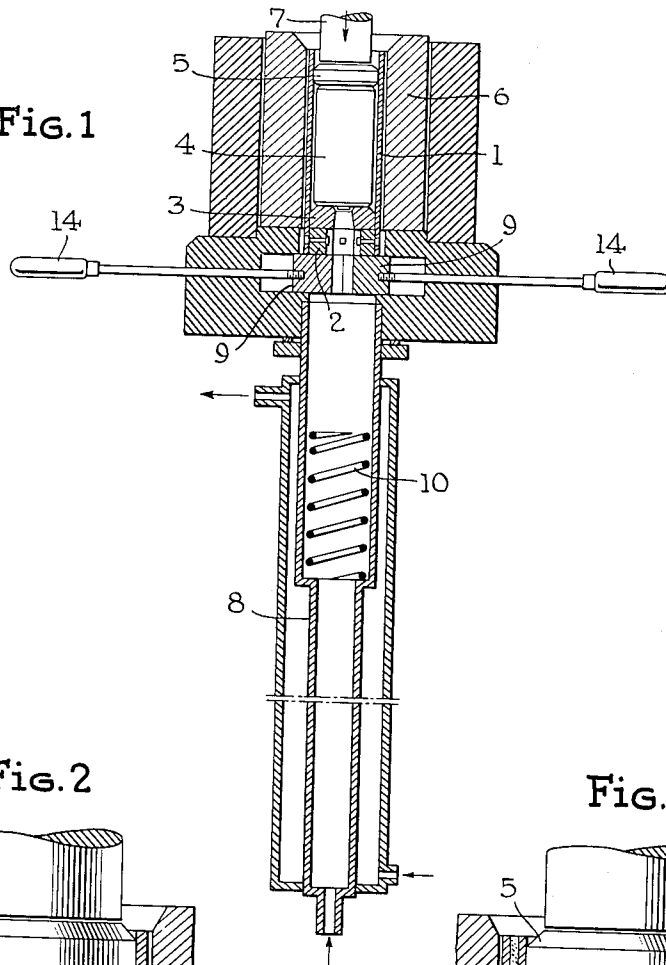


Fig. 2

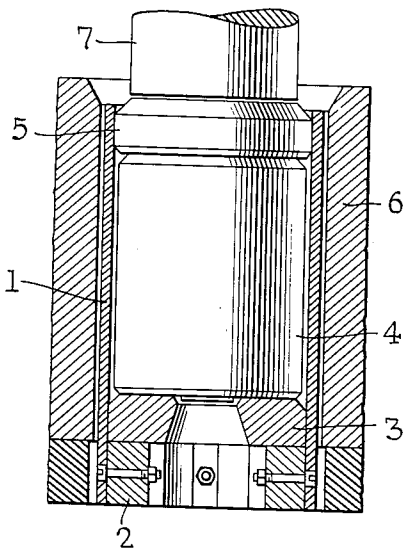
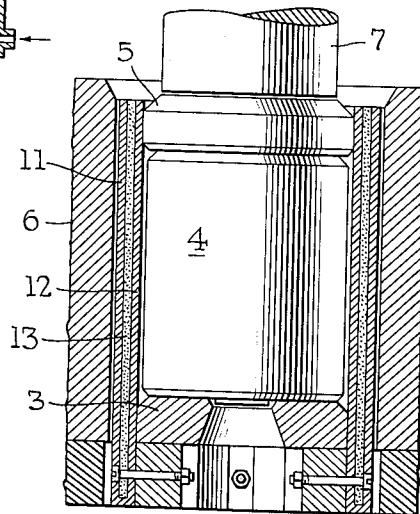


Fig. 3



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EXTRUSION OF METALS

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9 Claims. (Cl. 207—9)

The present invention relates to the extrusion of metallic materials. It is concerned more particularly with those metals which are highly susceptible to alteration at the temperature of extrusion, or which react with the materials commonly used in the construction of the extrusion apparatus.

In the extrusion of such metals, it is more often than not necessary to heat the billet (slug) to be extruded and, in many cases, it is necessary to avoid on the one hand the oxidation of the metal and, on the other hand, its contact with the apparatus, usually of ordinary or special steel, because of the alloying that may take place at the temperature of extrusion. Moreover, it is not always possible to reheat the die to the required temperature, and this may cause cracks or even interruption of the extrusion.

Up until now, it has been attempted to solve this problem either by means of a rotary (turret) furnace operating with a neutral atmosphere, which permits direct introduction of the billet into the container of the press, or by jacketing the billet with a sleeve which is extruded together with the metal. However, in the case of both these solutions, there is always contact between the metal to be extruded and materials which may react therewith.

The improvement, due to the present invention, enables the extrusion to be carried out while guarding the extruded material from contact with both the atmosphere and the walls of the apparatus used.

The invention primarily comprises a process which consists in enclosing the billet within a protective shell or sleeve before it is placed in the furnace where it is heated to the extrusion temperature, and in then introducing the billet—while still enclosed in said sleeve—into an extruding press and progressively pushing it out from the sleeve through the die, by means of the same pressure which is used to effect the extrusion, the billet being pushed out from the sleeve as the extrusion proceeds.

According to a preferred embodiment of this process, one or more parts of the extrusion apparatus, such as the dummy block, die, die block, etc., are enclosed together with the billet in said protective sleeve.

According to a particular feature of the invention, sufficient clearance (play) exists between the billet and its sleeve, so that it is possible to keep them apart by a layer of a solid, liquid, or gaseous substance.

According to another feature of the new process, the extruded hot material, as it leaves the die, continues to be protected—until it has been cooled—by a second shell which may contain (or be traversed by) a suitable gas, liquid or powder.

According to another feature of the invention, it can be so arranged that the withdrawal of the sleeve, following the extrusion, is effected by passing the same from the container into said second shell through a closable aperture.

The invention also relates to an apparatus for carrying out the described process.

This apparatus essentially comprises a sleeve or jacket which surrounds the billet laterally, and removable stops

(plugs) placed at the ends of the latter. These parts are made of materials which are appropriate for the mechanical stresses involved, the temperature, the nature of the material to be extruded, etc. They may be of a simple or composite nature, i. e. constituted, for example, of a single metal layer or of several layers comprising different materials alternately; for example, layers of insulating, refractory, fluid or other material can be superposed upon metallic walls.

In a particularly practical embodiment, the said plugs or stops are constituted of the die itself and its support, at one end of the billet while, at the other end, the dummy block (bearing plate) itself acts as a plug.

The assembly thus formed of the billet, its sleeve, the die, the die support and the dummy block, is adapted for use with extruding presses of known types, the assembly being placed in the container thereof.

However, an improved apparatus, according to the present invention, preferably comprises: a receptacle—tube and/or vessel—situated at the outlet of the die. It is generally advisable to cool the receptacle, as by means of a fluid circulating around its walls. Circulation of an inert gas, or the presence of suitable powder or liquid within said receptacle, protects the extruded articles against alteration.

An even more improved apparatus can be obtained, according to the invention, by disposing, below the die block, a device which makes it possible to open a sufficiently large passage so that the sleeve that contains the billet, can pass therethrough at the conclusion of the extrusion operation; a receptacle, so dimensioned that it can contain the sleeve, the dummy block, the die and its block, is then interposed between said device and the receptacle for the extruded articles. When a vertical extruding press is used, it is advisable to additionally provide at the bottom of the receptacle, a spring, acting as shock-absorber for the falling sleeve as it leaves the container of the press after the extrusion.

The invention is illustrated by the following description of two non-limitative embodiments of the new process and apparatus.

Figure 1 is a vertical section through an apparatus for the extrusion of a metal susceptible to alteration in air.

Figure 2 is likewise a vertical section of a billet with its protecting sleeve placed in the container of an extrusion press.

Figure 3, similar to Figure 2, illustrates the particular case of a protective shell having double walls.

Reference numeral 1 designates a cylindrical sleeve or shell of a material sufficiently resistant at the operating temperatures to support the weight of the billet. Its diameter and height are slightly greater than those of the billet.

2 indicates a die block, for example, of stainless steel, removably fastened to the bottom of the sleeve. 3 is a die of desired shape, formed of a material which does not react with the metal to be extruded, or which is protected from contact with the metal to be extruded by a suitable material interposed between them. The billet 4 itself rests on the die 3; it is completely surrounded by the sleeve 1. The dummy block 5 rests on the billet 4.

In Figure 3, which shows a variant, the walls 11 and 12 containing between them an appropriate material 13, are substituted for the single wall 1 of Figure 2. The material 13 can be a known substance, for example, alumina, of a suitable grain size and simultaneously serves both as a thermal and mechanical insulator by absorbing the stresses exerted on the sleeve.

The apparatus is used in the following manner:

Sufficient play is provided between billet 4 and sleeve 1 to avoid contact between these two parts during heating.

This assembly, disposed vertically, is heated up to the desired temperature of extrusion in a furnace contain-

ing a neutral atmosphere, and is then transferred into the container 6 of the press (Figure 1). During this transfer, which is made in open air, the dummy block 5 protects the metal from oxidation.

Thereupon, the ram or punch 7 of the press is actuated and the metal alone is extruded through the die. It is received in the tube 8 placed at the base of the press and which is filled with a gas which is neutral with respect to the metal.

By means of hand levers 14, the plugs 9 are operated to completely open the passage from 4 towards 8; the sleeve 1, the die 3, its block 2, the dummy block 5 and the remainder of the non-extruded metal (the extruded part thereof extends downward as the extruded rod) then fall into the upper enlarged part of tube 8, on the spring 10.

Tube 8 is now hermetically closed and is removed from the press so that it can be replaced with another similar tube and another billet extruded immediately. In the meantime, the extruded metal cools in the narrower portion of the tube; its cooling can be hastened by circulating water in the double-walled tube; the extruded metal is withdrawn when it has attained a temperature at which oxidation is no longer to be feared. The die block 2 is then removed from the sleeve, and what remains in the sleeve is pushed out. Thus the die, the sleeve and the dummy block are recovered and can be reused for another operation; eventually, after correcting the dimension of the outer diameter of the sleeve.

By operating in this manner, the die is heated to the same temperature as the metal, which facilitates the extrusion and avoids excessive heating of the container of the press when the extrusion is carried out at very high temperatures.

In the event it is not possible to find a metal for the protective sleeve which does not react with the material to be extruded, an improvement, according to the invention, consists in coating the internal wall of the sleeve with a thin sheet of a metal which does not react with the material to be extruded, or in spraying a protective metal or other material on said internal wall or else, in filling the space comprised between the billet and the sleeve with a powdered product (for example, alumina, graphite, etc.) which does not react with the material of the billet; contact between the billet and the sleeve is thus avoided during the extrusion operation.

Similarly, if a material which does not react with the metal to be extruded is not available for the construction of the die and the dummy block, the working surfaces of these parts may likewise be protected by spraying thereon a suitable substance which precludes any contact during the extrusion operation.

It is well understood that the process and apparatus described are also applicable when the billet is heated within the press itself and not in a separate furnace. Moreover, in that event, one or more of the aforementioned protective layers of the sleeve can serve for the reception of the heating means.

It is also understood that the present invention can, a fortiori, be applied to the extrusion of materials susceptible to alteration which do not require heating.

By way of example, mention is made of the extrusion carried out in accordance with the present invention. The difficulties encountered with this metal are: extreme susceptibility to oxidation and rapid reaction with any ferrous alloys at temperatures from 800° upwards (while the metal must be extruded at about 950° C. to 1000° C.) with formation of an undesirable liquid eutectic. A billet having a diameter of 92 mm. and a height of 200 mm. is introduced into a cylindrical sleeve of stainless steel, having an inner diameter of 98 mm. and a height of 330 mm. The outer diameter of the sleeve (107 mm.) is such that this part has sufficient mechanical strength at 1000° C. and can slide with but a slight clearance within the container of the press. The billet rests on a die of

tungsten carbide, itself supported on a die block. The sleeve is capped with a dummy block of tungsten carbide. The inner walls of the sleeve are coated with sprayed graphite in order to avoid any reaction between the uranium and the sleeve. An even better protection is obtained by filling the space between the sleeve and the billet with graphite powder.

It has been observed, that due to a slow action of the uranium on the tungsten carbide, the dies and dummy block deteriorate. Wear of these parts is completely avoided by spraying a layer of graphite on their working surfaces. The assembly is heated in an argon atmosphere at 950°-1000° C. and then introduced into the container of the press, heated at 500° C., below which is placed the receiving tube through which argon is passed. As shown in Figure 1, the argon is introduced at the bottom of the tube (in the direction of the arrow) and escapes through the upper part of the apparatus, while enveloping the assembly of devices supporting the billet and filling the spaces existing, before and after extrusion, between the sleeve and the container. In this way, the argon supplied under pressure precludes entry of air from any direction. After the extrusion, the plugs are drawn out and the assembly drops into the receiver tube, the walls of which are cooled with water and which is closed with a tight cover. Following cooling, the assembly is withdrawn from the receptacle and the dummy block, die and die block are recovered.

We claim:

1. Process for extruding metallic substances susceptible to detrimental alteration at the temperature of extrusion by contact with the atmosphere and the metallic working parts of an extrusion press, comprising the steps of: fastening a die block inside the lower end of a protective sleeve; placing an extrusion die, a billet to be extruded, and a dummy block, in the order named, on top of said die block inside said sleeve, at least the inner surface of said sleeve and the working surface of die being non-reactive to the material of the billet at the temperature of extrusion; inserting the aforementioned sleeve assembly inside the container of an extrusion press, and on top of a support provided with a controllable aperture; applying pressure to the billet to force the same from its sleeve and simultaneously extrude it through the die to obtain an extruded article of the desired shape; and upon completion of the extrusion operation, increasing the opening of said aperture, to permit passage of the sleeve assembly therethrough.

2. An extrusion press comprising in combination: a container; a protective sleeve for the billet to be extruded placed inside said container; a die block removably fastened to the lower end of said sleeve; an extrusion die disposed inside said sleeve and supported on said die block; a dummy block forming a closure for said sleeve at the upper end thereof; a support for said die block comprising a controllable aperture; and means for increasing said aperture to permit passage therethrough of all the parts supported thereon.

3. An apparatus according to claim 2, characterized in that the sleeve is formed of concentric walls of different materials.

4. A removable assembly for use in the container of an extrusion press, comprising in combination: a sleeve; a die block removably secured to the lower portion of said sleeve; and an extrusion die; a billet to be extruded, and a dummy block placed inside said sleeve, in the order named, on top of said die block.

5. An extrusion press comprising in combination a container; a protective sleeve for the billet to be extruded placed inside said container; a die block removably fastened to the lower end of said sleeve; an extrusion die disposed inside said sleeve and supported on said die block; a dummy block forming a closure for said sleeve at the upper end thereof; a support for said die block comprising a controllable aperture; means for increasing

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said aperture to permit passage therethrough of all the parts supported thereon; a receiver for the reception of the extruded article, the upper portion of said receiver being provided with an enlarged section for the reception of said sleeve.

6. An apparatus according to claim 5, wherein shock absorbing means are placed inside the portion of the receiver beneath the enlarged section.

7. Process for extruding metallic substances susceptible to detrimental alteration at the temperature of extrusion by contact with the atmosphere and the metallic working parts of an extrusion press, comprising the steps of: fastening a die block inside the lower end of a protective sleeve; placing an extrusion die, a billet to be extruded, and a dummy block, in the order named, on top of said die block inside said sleeve, at least the inner surface of said sleeve and the working surface of the die being non-reactive to the material of the billet at the temperature of extrusion; inserting the aforementioned sleeve assembly inside the container of an extrusion press, applying pressure to the billet to force the same from its sleeve and simultaneously extrude it through the die to obtain an extruded article of the desired shape.

8. Process according to claim 5, characterized in that the billet is placed in the sleeve so as to leave a space therebetween, and in that the non-reactive inner surface of the sleeve is obtained by placing a layer of inert material on said inner surface.

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9. An extrusion press comprising in combination: a container; a protective sleeve for the billet to be extruded placed inside said container; a die block removably fastened to the lower end of said sleeve; an extrusion die disposed inside said sleeve and supported on said die block; a dummy block forming a closure for said sleeve at the upper end thereof, and a support for said block.

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