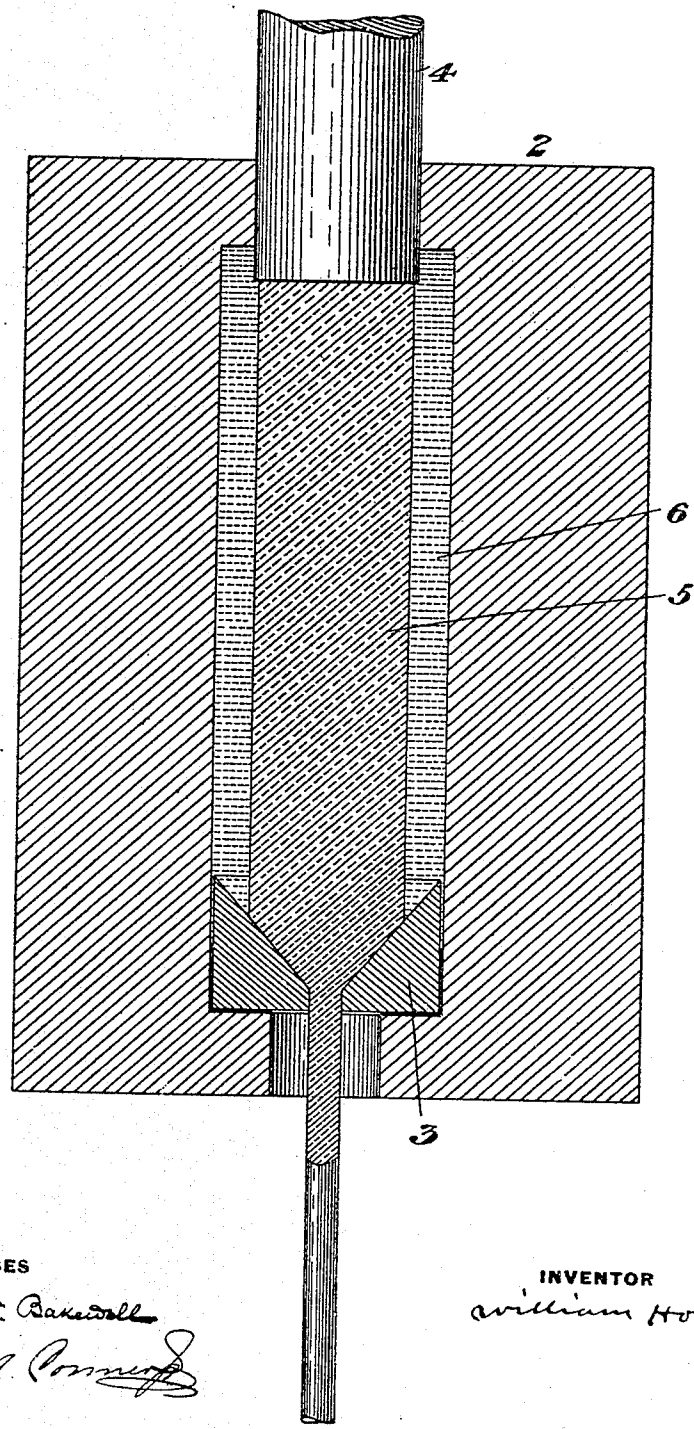
No. 796,970. PATENTED AUG. 8, 1905.

W. HOOPES.

METHOD OF EXTRUDING METAL

APPLICATION FILED JAN. 26, 1904.



WITNESSES

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METHOD OF EXTRUDING METAL.

No. 796,970 Specification of Letters Patent. Patented Aug. 8, 1905.

Application filed January 26, 1904. Serial No. 190,709.

To all whom it may concern:

Be it known that I, WILLIAM HOOPES, of Pittsburg, Allegheny county, Pennsylvania, have invented a new and useful Method of Extruding Metals, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, forming part of this specification, which shows in vertical longitudinal section one form of apparatus in which my invention may be practiced.

The method heretofore employed for shaping metals by extrusion is to either pour the metal in a molten condition into an extrusion-cylinder or to place an ingot of it therein in a condition of such high temperature that it is in a plastic state requiring comparatively little pressure to cause it to flow through the shaping-die. A hollow plunger is then run into the cylinder, and the metal in its soft condition is forced through a die carried at the end of the plunger and passes out through the hollow center of the plunger. If the die were mounted in the end of the cylinder and the plunger were forced against the back of the ingot so placed, the ingot would swell and lock itself against the sides of the cylinder so tightly that if long it could not move forward and it would be necessary to use short ingots of such length that the total force with which it adhered to the sides of the cylinder was less than the forward pressure exerted by the plunger. This would make an ingot so small as to be impracticable, and therefore in practice the method before referred to is adopted, which avoids the necessity of the ingots moving in the cylinder at all. This method, however, requires that the plunger should fit the cylinder throughout its entire length, and it must fit it so closely that no metal from the ingot can force its way between the plunger and the cylinder, and at the same time the fit must not be so tight as to cause the plunger to score the sides of the cylinder. These requirements put a limit upon the pressure which can be employed in the extrusion of metals by the ordinary processes, this limit being that at which the die carried by the end of the plunger will expand itself sufficiently to lock with the sides of the cylinder, and such limit is not very high, due to the fact that the die does expand in proportion to the strain put upon it, beginning with the smallest strain so applied. The real limit therefore is the amount of pressure which the die will stand without any appreciable change of shape. In addition to this it is impossible with this method to extrude metal in such a manner that the product is in a very hard state, owing to the fact that it must be very hot when it comes through the die and when the actual work is put upon it.

The method which I have invented, which is shown in its simplest form in the accompanying drawing, is as follows:

In the drawing, 2 represents a cylinder in which the pressure is to be applied.

3 represents a die secured to the end of the cylinder.

4 is a plunger driven forward by any suitable means, preferably by hydraulic pressure, and 5 is an ingot of the metal to be extruded.

The ingot does not fill the cylinder 2, but there is space 6 between them, which is filled with oil or any suitable fluid. When the plunger 4 is moved forward in order to apply pressure to the ingot to force it through the die, the ingot is prevented from expanding and filling the cylinder, as it would do otherwise, by the oil contained in the surrounding space, and there is no friction between the ingot and any part of the apparatus in its forward motion excepting within the die itself.

My invention consists in employing a body of fluid within the chamber or cylinder from which the metal is extruded and in applying the pressure of the plunger or like device directly to the metal, so that pressure not only transmitted to the metal by the liquid, but is transmitted directly by the plunger at the end of the metal itself. This is important, because if the pressure were exerted upon the metal solely through the intervention of the liquid it would be exerted upon the chamber or cylinder to the same extent as upon the metal, and as the operation is carried on nearly at the limit of the strength of the apparatus this would seriously interfere with its efficiency. By exerting the pressure of the plunger directly upon the metal a greater pressure is transmitted to the metal than to the cylinder and an equal amount of work is accomplished with much less strain upon the apparatus.

By this method it is possible to extrude alu-

minium or any other ductile metal at atmospheric temperatures. The pressures required to perform the extrusion are, however, dependent upon and almost directly proportional to the ratio of the original area of the ingot to the area of the extruded product and also decrease as the temperature rises. Therefore if it is desired to produce a greater reduction of section than a given cylinder will permit at atmospheric temperature the fluid used in the cylinder may be heated by heating the cylinder itself. The metal will then flow at less pressure than is required at atmospheric temperatures. For instance, aluminium requires for its extrusion only about one-fifth the pressure at 600° Fahrenheit that it requires at 70° Fahrenheit. The use of the fluid-envelop around the ingot to prevent it from expanding and filling the cylinder when pressure is applied to the ingot also permits the use of very much higher pressures than in the case of extrusion by the ordinary means, because it is not necessary that the cylinder or the plunger shall withstand the pressure applied without any appreciable change of shape. No particular harm is done if the cylinder expands or if the plunger contracts under the pressure, for the only result would be to permit the escape of some of the fluid, which could be replaced by piping an additional supply of fluid into the cylinder from a suitable source of pressure, such as an ordinary intensifier used commonly in hydraulic work. In the method of extrusion heretofore used if there were any such relative change between the initial sizes of the plunger and cylinder some of the metal would be forced into the small space so created, thus binding the plunger fast to the cylinder and rendering impossible its removal or further progress.

I have described the use of oil as the medium for the fluid-pressure, but other fluids may be substituted. Water may be used in extruding metal at low temperature, or when the method is applied to the extrusion of metals at high temperature any fluid material which will withstand the necessary temperature without decomposition or volatilization may be used. For instance, when steel ingots are extruded by this method fused caustic potash may be used as the fluid medium.

The advantages of my invention are that the pressures that may be used are much higher than the pressures which may be used in the ordinary extrusion-cylinder. It is permissible to use very high pressures—much greater than heretofore. It is not necessary to have metals raised to the same temperature as is required in extruding them by ordinary processes. The oil or other suitable fluid used has the effect of lubricating the ingot and the die and reducing the pressure which would otherwise be required to extrude the metal. Since the metal can be extruded at a lower temperature and a higher pressure, it is possible to obtain a product of finer grain and greater hardness than can be produced by the ordinary processes.

I claim—

1. The method herein described of extruding metal, which consists in applying the pressure of a solid body directly to the body of metal within a chamber containing fluid, and forcing the metal therefrom through an orifice; substantially as described.

2. The method herein described of extruding metal, which consists in applying the pressure of a solid body directly to the metal within a chamber larger than the body of metal, the interstices between the metal and chamber being filled with fluid, and forcing the metal from the chamber through an orifice; substantially as described.

3. The method herein described of extruding metal, which consists in applying the pressure of a solid body directly to the metal while hot and within a chamber containing fluid, and forcing it therefrom through an orifice; substantially as described.

4. The method herein described of extruding metal, which consists in placing it within a chamber larger than the body of metal, filling with fluid the space between the metal and the chamber-wall and then forcing the metal through an orifice in the chamber by a plunger which impinges directly upon the metal extruded; substantially as described.

In testimony whereof I have hereunto set my hand.

WILLIAM HOOPES.

Witnesses:
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