

April 6, 1937.

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2,076,200

APPARATUS FOR EXTRUDING METAL

Filed Nov. 8, 1934

2 Sheets-Sheet 1

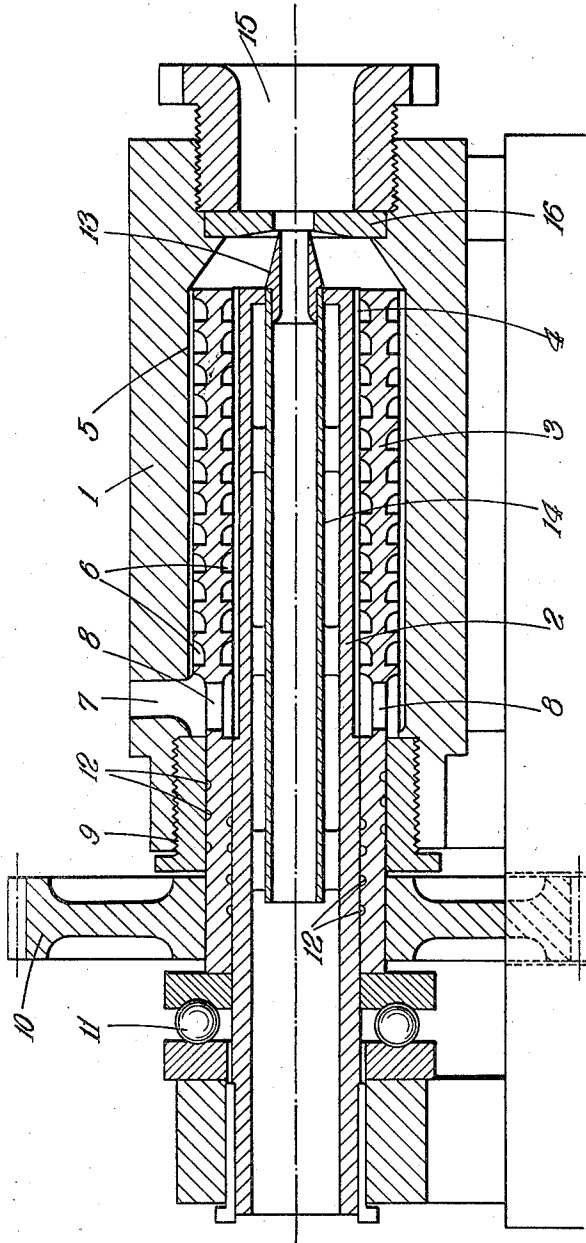


Fig. 1

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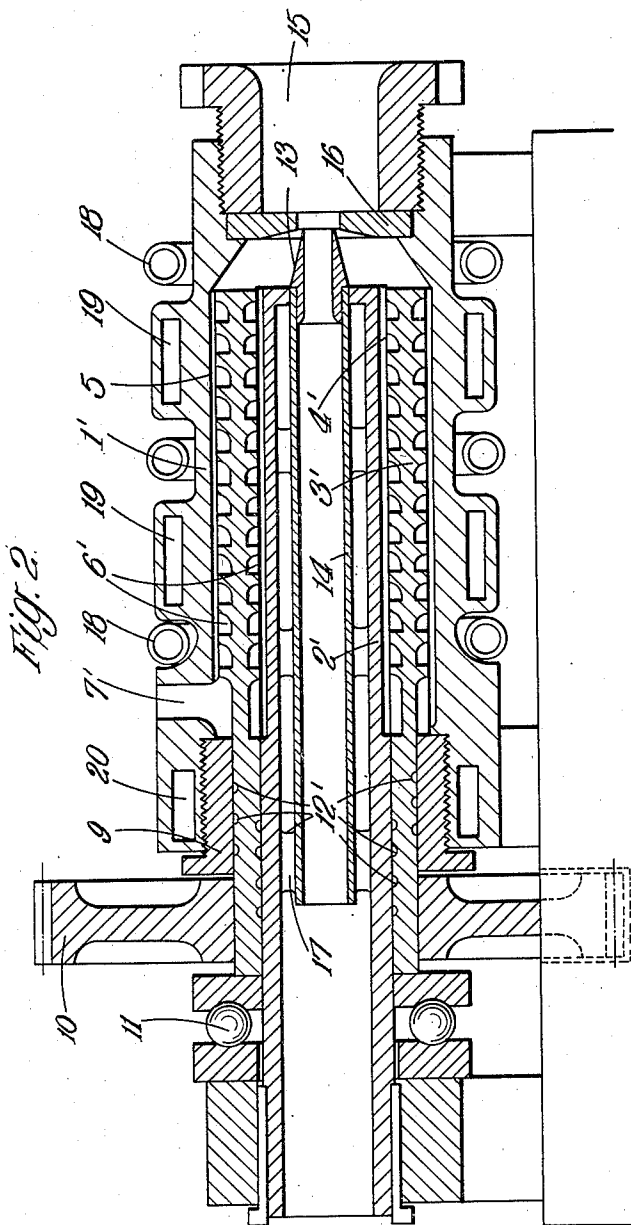
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2,076,200

APPARATUS FOR EXTRUDING METAL

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Application November 8, 1934, Serial No. 752,166
In Great Britain December 1, 1933

10 Claims. (Cl. 207-2)

This invention relates to apparatus for extruding metal, intended in especial for the manufacture of metal pipes, or electric cable sheaths such as are usually made of lead or lead alloy, or rods, bars or other continuous solid sections of metal, the said apparatus being of the kind in which the metal is fed in a molten state into one end of a working chamber through which, under the action of a rotary screw-threaded impelling device, it is driven forward and finally extruded, after it has solidified, through a suitably shaped die or dies at the other end of the chamber in the form of a bar, pipe or cable sheath.

Heretofore extrusion apparatus of the kind referred to that has been proposed generally comprised inner and outer longitudinally extending and relatively rotatable co-axial members of which the outer member formed the working chamber, one of the aforesaid relatively rotatable members being provided with a screw thread so as to constitute the impelling device whilst the surface of the other member was formed with longitudinal ribs or grooves parallel to the axis of rotation or with helical threads, ribs or flutes opposite in twist or inclination to those on the screw-threaded impeller. In some forms of apparatus of this type the dies between which the metal is extruded are carried by the relatively rotatable members, so that one or both of the dies revolve and impose a twist on the pipe, rod or other section being extruded; in particular in the sheathing of a cable a twisting action which is undesirable is imposed on the cable. Furthermore, if there is eccentricity in the rotation of the revolving member or members, the wall of a pipe or cable sheath produced is of an uneven thickness. It is therefore desirable to have both dies fixed in relation to one another and, in the case of cable sheathing, to the cable, and this is most readily accomplished when they are carried by stationary members. In that case, however, difficulties are experienced in providing satisfactory joints between the stationary die-holding member and the impeller, especially when the latter forms part of one wall of the working chamber, and preventing leakage through the said joints of the working metal, such as lead, which is in a plastic state. A further disadvantage lies in the comparatively low output that it has been possible to obtain under the most advantageous conditions.

The present invention has for its object to overcome various difficulties such as those above mentioned in connection with continuously work-

ing metal extrusion apparatus of the type in which a screw-threaded impelling device is employed for forcing the metal through the extrusion chamber and through the die or between an inner and outer die located at the discharge end of the extrusion chamber and to provide an apparatus having a large output for its size and in which, by a simple construction and positioning of the joints between the revolving and stationary parts of the apparatus, leakage of the working metal, such as lead, between the joints in question is obviated. For this purpose according to the present invention, for the continuous extrusion of metal pipes or cable sheaths or solid sections, there is employed an apparatus comprising stationary inner and outer cylindrical members between which there is located a rotary sleeve formed in such manner as to constitute the screw-threaded impeller, the outer surface of the inner cylindrical member and the inner surface of the outer cylindrical member being broken up, as by the provision of grooves, channels, recesses, projections, ribs, threads, etc., and the joints between the revolving sleeve and stationary cylindrical members being located at the rear end of the machine where the pressure is low (that is near the end where the molten metal is admitted to the apparatus and remote from the front end where the die chamber is located) and constructed in such manner as to prevent leakage of the working metal, such as lead, therefrom.

In order that the invention may be clearly understood and readily carried into effect it will now be described more fully with reference to the accompanying drawings wherein

Figure 1 represents in longitudinal section the essential features of one form of extrusion apparatus in accordance therewith suitable for sheathing cables or making pipes.

Figure 2 represents a longitudinal section, a modification of the structure illustrated in Figure 1.

Referring to Figure 1, the apparatus comprises an outer cylinder 1 constituting a working chamber and an inner cylinder 2, both these members being stationary and having between them a rotary sleeve 3 serving as the screw impeller. Longitudinal grooves or channels 4, 5 are respectively formed on the outer surface of the inner cylinder and on the inner surface of the outer cylinder, and the sleeve 3 is provided with helical grooves 6 in both its inner and outer surfaces, extending from about the inlet for the molten metal to about the die or discharge end

of the apparatus. The outer cylinder 1 is provided near one end with an inlet 7 for molten metal, which may thus be fed to the helical grooves or driving worm 6 of the sleeve 3, and means is provided for access of the molten metal, such as lead, to both sides of the sleeve by means of ports 8 in the sleeve. The sleeve 3 is prolonged at the feeding end, so that it projects from the cylinder 1 through a bearing bush 9, and at that end is provided with means, such as a gear-wheel 10, for rotating the sleeve and with a thrust bearing 11 to take the longitudinal reaction. The inner and outer surfaces of the sleeve are formed at the rear end with a number of annular grooves 12 for a purpose that will be subsequently referred to. Alternatively, the grooves may be cut on the inner surface of the bearing bush 9 and on the outer surface of the inner cylinder 2.

The front end of the inner cylinder 2 is formed to support the male die 13, and is provided with a tubular guide 14 for use when sheathing cables. The outer cylinder 1 is formed to constitute a die chamber and to support, by such means as a nut 15, a ring die 16. Any suitable means for adjusting the relative positions of these dies may be provided.

Any desired means of heating and cooling may be applied to the apparatus so as to control the temperature of the different parts as may be required in order to keep the metal (such as lead) in the screw impeller and the longitudinal grooves or channels 4 and 5 in the best condition for its extrusion through the dies. Further, the tubular guide 14 may be heat-insulated from the rest of the apparatus by such means as making webs 17, by which it is supported from the cylinder 2, of insulation material and, when a cable to be sheathed is to be passed through it, maintained at a temperature most suitable for the cable by circulation of a cooling medium around it such cooling medium being introduced through the rear end of the cylinder 2. As the cable enters the apparatus through the rear end of the die chamber, means may be provided to control the temperature also in the die chamber, so that the whole of the cable can be at a convenient temperature irrespective of the temperature of the rest of the apparatus. The above mentioned temperature regulation, whether in the portion of the machine over which the impeller extends or in the neighborhood of the die chamber, is conveniently effected by fuel burners or electrical heating coils 18 by the provision of jackets 19 for the circulation of a cooling fluid, as shown in Figure 2.

In operating the apparatus molten metal is fed through the inlet 7 and can travel in two directions, one towards the die chamber, taking two paths respectively along the inside and outside of the screw impeller 3 and thence out of the apparatus after extrusion through the dies 13 and 16, whilst the other direction for the molten metal is towards the driving end of the sleeve 3, where any leakage of the metal between the latter and the inner and outer cylinders may be easily prevented, since the static pressure on the metal is low, and by chilling a narrow portion of this end of the apparatus, the metal in the annular grooves 12 may be solidified and leakage prevented. As illustrated in Figure 2, this chilling effect may be secured by the provision of a jacket 20 for the circulation of a cooling fluid.

Figure 2 also depicts a further modification according to which the ports 8 of Figure 1 in the

sleeve 3' are omitted so that metal is supplied through the passage 7' into the outer cylinder 1' from which it passes to the interior of the sleeve 3' wholly from the die chamber, wherein considerable pressure is generated owing to supply of metal by the external threads 6'. As the metal entering from the die chamber fills the helical spaces 6' and complementary grooves or the like 4' within the sleeve 3' however, a reactive pressure is set up which ultimately balances the pressure in the die chamber, so that the rearward movement of the metal in these helical spaces and grooves ceases. When this state of balance has been arrived at no more metal is fed into the inner spaces and grooves from the die chamber, and it is arranged that this state of equilibrium shall be reached before the metal has travelled as far in the rearward direction as the bearing surface between the sleeve 3' and the inner cylinder 2', so that there is no tendency for leakage of metal along this surface, and accordingly the inner series of grooves 12' may be omitted.

In certain of the claims which follow the term "recesses" has been used to describe the provision in the surfaces of the cylindrical members, not only of recesses, but of grooves, channels, projections, ribs or threads, and is to be understood to cover any or all of these forms of construction.

It is to be understood that certain features and detailed structures illustrated in the present application but not claimed herein are illustrated, described and claimed in my previously filed application, Ser. No. 745,810, filed September 27, 1934, on Method of and apparatus for extruding metal.

What I claim and desire to secure by Letters Patent of the United States is:—

1. Apparatus for extruding pipes, sheaths or the like of hollow section or rods or the like of solid section from metal, comprising in combination stationary inner and outer cylindrical members having longitudinally extending smooth surfaces, a rotatable sleeve between said members, helical threads on the outer and inner surfaces of said sleeve both threads having the same hand and the threads of said sleeve being in direct contact with the longitudinally extending surfaces of the inner and outer members, and a die in operative relationship with said cylindrical members and said sleeve and means whereby the metal to be extruded has simultaneous access to both the internal and external threads of said sleeve.

2. Apparatus as in claim 1, wherein the outer cylindrical member has its inner surface broken up by recesses.

3. Apparatus as in claim 1, wherein the inner cylindrical member has its outer surface broken up by recesses.

4. Apparatus as in claim 1, including a tubular guide within said inner cylindrical member.

5. Apparatus as in claim 1, including a tubular guide within said inner cylindrical member and heat-insulating means for said guide.

6. Apparatus for extruding metallic bodies of constant external cross sectional contour, comprising stationary inner and outer cylindrical members, said inner cylindrical member extending into one end of the outer member and terminating at its inner end short of the other end of the outer member, a die secured in said other end of the outer member forming an outlet and forming means for metal forced therethrough, the area between the said other end of the outer member and the inner end of the inner member constituting a die chamber, a rotatable sleeve between

said members, helical threads on the inner and outer surfaces of said sleeve, said outer member having a molten metal inlet passage at a point remote from the said inner end of the inner member, said helical threads extending from said passage to and opening into the die chamber, and said rotatable sleeve being imperforate throughout whereby access is had by the molten metal to the threads on the inner surface of the sleeve only through the die chamber.

7. Apparatus for extruding metallic bodies of constant external cross sectional contour, including a fixed cylindrical inner member, a cylindrical fixed outer member concentric thereto but spaced therefrom, a die chamber formed at the outer ends of the fixed members, a rotatable impeller disposed between said members and having exterior and interior helical threads both of the same hand, the rear portion of the sleeve being unthreaded and fitting snugly against the confronting faces of the inner and outer members, the outer member having a port for the discharge of molten metal to the outer threads of the impeller and disposed adjacent the rear ends of said threads and forward of the unthreaded portion of the impeller, the inner threads of the impeller acting to counteract the back pressure generated in the die chamber and prevent molten metal from being forced in between the contacting surfaces of the inner member and the impeller.

8. Apparatus for extruding pipes, sheaths or the like of hollow section or rods or the like of solid section from metal, including stationary concentric inner and outer cylindrical members, the members being radially spaced from each other, an intermediate rotatable impeller sleeve having its forward portion provided on its inner and outer surfaces with helical threads both having the same hand, the rear portion of the sleeve being unthreaded and fitting closely against the rear confronting faces of the inner and outer members, both of said members on their faces confronting the screw threaded portion of the impeller having longitudinally extending smooth surfaces, the threads of the impeller being in con-

tact with the said surfaces, and a die disposed upon the forward end of the outer cylindrical member and in operative relationship with said sleeve, the outer cylindrical member having an inlet port for molten metal rearward of the threaded portion of the sleeve but adjacent thereto.

9. Apparatus for extruding pipes, sheaths or the like of hollow section or rods or the like of solid section from metal, comprising in combination stationary inner and outer cylindrical members having longitudinally extending smooth surfaces, a rotatable sleeve between said members, helical threads on the outer and inner surfaces of said sleeve, both threads having the same hand and the threads of said sleeve being in direct contact with the longitudinally extending surfaces of the inner and outer members, and a die fitted at one end of said outer cylindrical member and in operative relationship with said sleeve, said outer cylindrical member having a radial passage for the admission of molten metal at a point remote from said die and said sleeve having at least one radial port located at the adjacent end of said threads remote from said die.

10. Apparatus for extruding pipes, sheaths or the like of hollow section or rods or the like of solid section from metal, including stationary inner and outer cylindrical members having longitudinally extending smooth surfaces, the confronting faces of said members being radially spaced from each other, a rotatable impeller sleeve between said members, helical threads on the outer and inner surfaces of the sleeves, both threads having the same hand and the threads of the sleeve being in direct contact with the longitudinally extending surfaces of the inner and outer members, and a die carried at one end of the outer cylindrical member and in operative relationship with said sleeve, the outer member having a radial passage for the admission of molten metal at a point remote from said die and discharging molten metal to the exterior threads of the impeller sleeve.

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