May 21, 1935. P. OTTO 2,002,415

METHOD OF PRODUCING SEAMLESS DRAWN TUBES AND OTHER TUBULAR ARTICLES

Filed March 5, 1932

Fig. 1

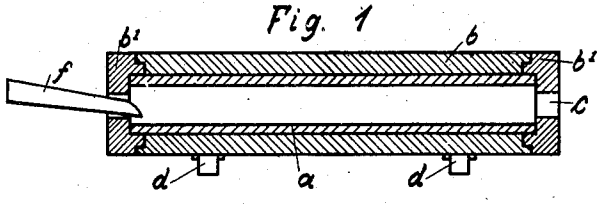


Fig. 2

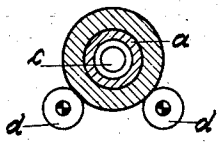


Fig. 3

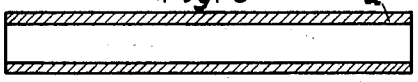


Fig. 4



Fig. 5

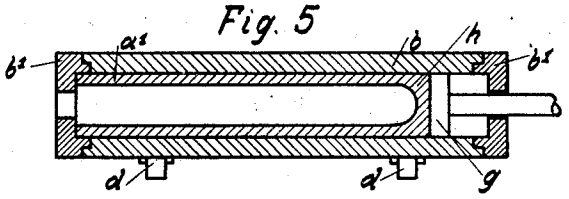


Fig. 6

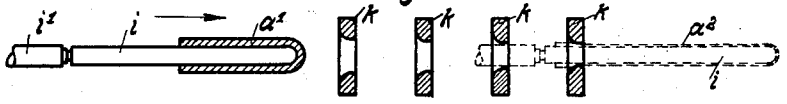


Fig. 7

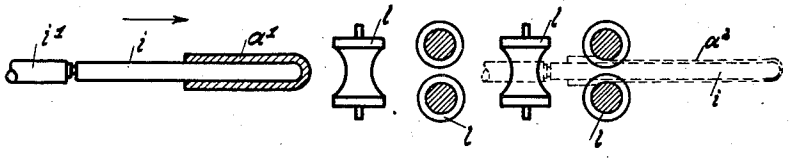


Fig. 8

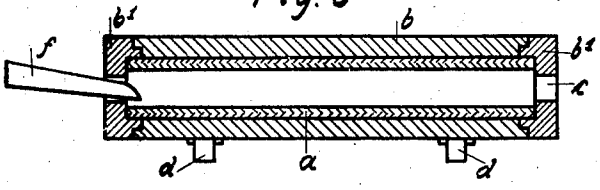
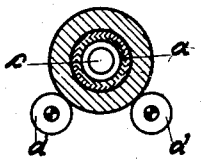


Fig. 9



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METHOD OF PRODUCING SEAMLESS DRAWN TUBES AND OTHER TUBULAR ARTICLES

Peter Otto, Dusseldorf-Oberkassel, Germany

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In Great Britain March 19, 1931

2 Claims. (Cl. 29—156)

My invention relates to an improved method of producing seamless tubes and other tubular articles; in extension of the method also sheet plates or plates can be produced out of the tubes.

The so-called push bench process for the production of seamless tubes particularly of iron and steel is coming more and more into favour. This method is executed as follows:—A rolled billet of square or other section is punched in longitudinal direction of the billet and in red hot condition by a mandrel until a short solid end remains. The sleeve thus obtained, the one end of which is closed, is put on a mandrel bar and then, by means of the push bench, pushed through a series of die rings which produce a longer, but thinner walled sleeve. This sleeve is still closed at one end by the solid remaining portion and together with the mandrel it is passed through a polishing mill which smoothes it down inside and outside to its required thickness and releases it from the mandrel bar. The latter is then withdrawn, whereupon the solid end is cut off leaving the required tube.

Medium-size tubes only are produced by this method which, besides, has many disadvantages. Producing billets is not a simple operation. They are cast as solid ingots and forged or rolled into the required section of the billet. Billets of desired length are then cut off and once more heated in a furnace.

The punching of the billets requires expensive presses and accumulators with large holding capacities, but the most difficult operation is to punch the billet exactly in the centre. If the punch is not set exactly in the centre or if the punching has commenced concentrically but the punch mandrel has not gone quite straight, for example due to an unequal heating of the billet, and a sloping bore has thus resulted, such billets are useless for further operations.

The latest art requires very long tubes. In order to produce them, the sleeves obtained from the billets are to have very thick walls to contain sufficient metal for the stretching out process. These thick walls must gradually be reduced in the push bench, for which purpose the sleeve must be passed through a large number of die rings in order to obtain the required long tube with thinned-out wall. The push benches, therefore, are very long and occupy a large amount of space. In addition it takes a comparatively long time to pass all the rings, so that the tube is cooled down to a great extent and thus very strong and powerful push benches are necessary. Further, the long mandrel bars required are easily bent, causing additional difficulties, so that the push bench process is very expensive for several reasons.

According to the invention hollow bodies produced by the known centrifugal casting method are used instead of solid cast ingots which have been forged or rolled into billets and which then are punched. By this method tubes with both ends generally open are obtained and it will, therefore, be necessary to close one end by hammering or the like. The hollow bodies produced by the centrifugal casting process have the advantage that they can be made into long lengths with comparatively thin walls without difficulty and it is therefore not necessary to reduce the wall thickness to such an extent as with thick-walled sleeves. The operation of the push bench is, therefore, greatly simplified; the push benches are short and take up less space, are comparatively cheap and need not be so powerful. The tubes, therefore, are produced with greater exactitude, in less time and therefore at less expense. In addition, the hollow bodies obtained by the centrifugal casting method are cheap, due to the fact that no waste material is obtained and above all are absolutely symmetrical, so that they are much more suitable for the push bench process than billets punched under pressure. Further, by saving the expense of the cumbersome and dear punch presses, the cost of production of the tubes is greatly reduced.

The devices required for carrying the new method into effect are shown as examples in the annexed drawing. Schematically shown are in

Fig. 1 a vertical axial longitudinal section through a centrifugal casting mould or drum,

Fig. 2 a cross section through this mould or drum,

Fig. 3 a longitudinal section through the tubular body produced in the centrifugal casting mould or drum,

Fig. 4 a cross section of the same,

Fig. 5 a longitudinal section through another form of centrifugal casting drum,

Fig. 6 a diagrammatical sectional view of the principal parts of a push bench, namely the mandrel bar and the die rings,

Fig. 7 the same diagrammatical sectional view, but the die rings substituted by rollers,

Figs. 8 and 9, sectional view of the Figs. 1 and 2, metal being poured into the casting drum in various layers.

The method upon which the invention is based is as follows:—

At first a tubular body *a* is obtained by the

centrifugal casting process. The device required for this purpose substantially consists in a comparatively long cylindrical drum *b*, the bottoms b^1 of which have centrical openings *c* and are removable. The drum is revolvably carried on rollers *d*. The rotation is done by any suitable means not shown in drawing. If into said drum, whilst it revolves at a sufficiently high speed, molten metal is poured by means of a trough *f* reaching into one of the bottom openings, the metal is distributed not only over the whole length of the drum, but also over the entire inner wall of same in a uniform thickness, thus forming the cylindrical hollow body *a*, if the rotation of the drum is continued so long until the metal poured in is sufficiently solidified.

For the object in question it is necessary for the hollow body *a* obtained to be closed at one end. This can be done by any suitable means after the casting process, also in that way that the casting drum *b* is being closed up by a movable bottom or piston disc *g* and by pushing this disc inwards under corresponding power, at a time when the metal poured in is not liquid any more but still red hot, that means plastic and formative. The disc *g* moving inwards, in this instance pushes the metal in front of it thus that it is compressed inwards and by that forms a wall *h*. The tubular body a^1 thus is still open at one end only. With this opening it is pushed on a mandrel bar *i* of a push bench which is provided with a number of die rings *k*. The first of these die rings has an opening of circular cross section of a diameter slightly less than the outside diameter of the tubular body a^1. The subsequent die rings have circular openings decreasing from ring to ring. If therefore the body a^1, by means of the mandrel shaft i^1 and the mandrel bar *i* is being moved in the direction of the arrow, the body travels successively through the ring openings whereby its outside diameter is reduced and its length increased. Thereby the body a^2 is obtained. Owing to the pressure of the rings *k* this body a^2 sticks firmly upon the mandrel bar *i*. In order to release it from the mandrel bar, the body a^2 together with the mandrel bar *i* is passed through a so-called polishing mill, the rolls of which smooth the outside of the tubular body and at the same time slightly reduce its wall thickness, so that thus the body is released from the mandrel bar. The latter then can easily be drawn out of the tubular body a^2. By thereupon cutting off the solid end of the body a^2, by means of a hot saw or the like, a finished tube open at both ends is being obtained. This tube may be subjected still to further treatment in suitable rolling mills, such as reducing mill and expanding mill, in order to get it to the desired size and length; on the reducing mill it is being reduced and on the expanding mill expanded in diameter.

The new method embodies great advantages as compared to the methods employed hitherto. The centrifugal casting process is no dearer than the usual method of casting ingots. The forging or rolling of ingots into square billets is dispensed with. The closing of the one end of the centrifugally cast hollow body is very much cheaper than the punching of the solid billet described above. It is also of great advantage that the centrifugal casting process according to its nature supplies absolutely symmetrical hollowed bodies, whereby the waste which is prevalent in the case of asymmetric punched billets is avoided. The long lengths and thin walls of the hollow bodies make it possible to reduce considerably the number of die rings, and the push bench, therefore, can be much shorter and the pushing process is completed much sooner and with less power consumption.

If it is in line with the working operation, the tubular body supplied by the centrifugal casting drum is immediately subjected to further treatment on the push bench, so as to utilize its casting heat. As a rule, however, the cast hollow bodies are put into a heating furnace where they are protected against cooling down and where also their heat is equalized against each other. The bodies are taken out of the furnace as they are required and then conveyed to the push bench.

The new method also makes it possible to produce in a simple manner tubes or tubular bodies, the metal of which on the outside is of different kind from that on the inside. These tubes, for instance, are corrosion-proof and heat-resisting tubes. Corrosion-proof tubes are tubes which on their outside and inside are immune to the touch of liquids or acids. Such tubes can readily be obtained by the centrifugal casting process, as the special metals or constituents which characterize the desired tube differ greatly in specific gravity from the ordinary iron or steel alloys or other tube material. If these special constituents have a higher specific gravity than the metal for the tubes, they are principally or exclusively deposited on the outside of the hollow body while being cast in the centrifugal drum. If they have a lower specific gravity, they are precipitated on the inside of the tubes. The centrifugal drum must, of course, rotate with sufficient speed to separate the materials in a satisfactory manner. Thus tubes may be produced which consist mainly of the required iron or steel alloy, but having outside and inside walls with quite different characteristics. In Figs. 8 and 9 the different layers of the tubular body are indicated by hatching differing from each other.

If heavy metals, such as nickel or the like, are added to the alloy, the outside wall of the hollow body and tube derived from this will consist mainly or exclusively of nickel or the like. If a light metal, such as for example aluminium, chromium, zinc, tin or the like, is used in large quantities the inside wall of the resulting tube will have a layer of the light metal used.

Such tubes have hithertofore been produced by coating the outside or inside of the tube of iron, steel or other metal afterwards with the required material, but this method is much more expensive and not so satisfactory.

Corrosion-proof tubes may also be produced in the same manner for other purposes than to protect them against liquids or acids. Due to their great strength they can advantageously be used as drill pipes and casings in oil drilling operations, and also as sludge pipes.

Instead of reducing the thickness of the walls of the sleeve by passing them through die rings, they may be pushed between rollers I of round or oval pass. The oval pass reduces the friction between work piece and mandrel bar, so that thereby the otherwise frequent snapping off of the closed bottom is avoided. The oval passes are replaced against each other for 90 degrees. The rollers should not be specially driven but set in rotation by the moving tubular body. The various sets of rollers may consist of 2, 3 or 4 rollers. The push bench also may alternately be provided with die rings and rollers as described above, so that the tubular body after having

passed a die ring travels through a set of rollers, whereupon it passes on to a die ring again, and so forth.

It is of advantage to use hollow mandrel bars and hollow mandrel shafts for producing large tubes in order to reduce the weight and also to prevent the mandrel bars from cracking as far as possible, owing to unequal cooling down and heating respectively. On account of the reduced weight of the hollow mandrel bars and mandrel shafts, besides, the accelerated masses in the push bench and in the polishing mill are reduced. The hollow mandrel bars as well as the hollow mandrel shafts, which move the mandrel bar forwards, are preferably made of thick-walled seamless tubes of carbon steel or alloyed steel.

The tubes of unequal constituents of material may be used for producing sheet plate, the one wall of which is of different property to that of the other wall. Such sheet plate is hitherto produced thus that for example a hot nickel plate is placed upon an iron plate and this iron plate is covered by a second nickel plate; all these plates are in hot condition. Thereupon this parcel of sheets or plates is rolled out between rolls. Through the pressure of the rolls the plates are more and more or more and less firmly combined with each other, at the same time rolled down to thinner thickness. The contact of the layers of plate, however, is often unsatisfactory. But if such plate is produced from a tubular body obtained by the centrifugal casting process and afterwards stretched out on the push bench, the contact of the various constituents of material is an absolutely firm one, as they are practically cast together to a whole. Such sheet plate, therefore, will never split or its outer layer peel off.

What I claim is:—

1. In the manufacture of seamless tubes, the steps of forming an open ended hollow ingot by centrifugal casting, closing one end of said ingot while the latter is still in the casting apparatus, and subjecting the thus formed ingot to a push bench drawing process to produce an elongated thin-walled tube.

2. In the manufacture of seamless tubes, the steps of forming an open ended multistrata hollow ingot by centrifugal casting, closing one end of said ingot while the latter is still in the casting apparatus, and subjecting the thus formed ingot to a push bench drawing process to produce an elongated thin-walled tube.

PETER OTTO.