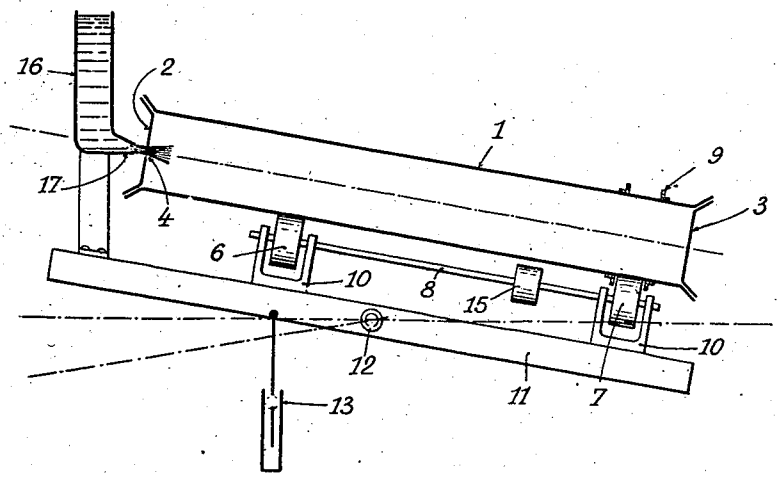
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METHOD OF CENTRIFUGALLY CASTING TUBULAR BODIES

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METHOD OF CENTRIFUGALLY CASTING TUBULAR BODIES

Jacques Boucher, Paris, France; vested in the Alien Property Custodian

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The present invention has for its object to produce by centrifugal moulding, tubular bodies of metallic or other nature. These bodies are obtained by introducing, in a suitable mould, the required quantity of material in the liquid or plastic state, and by then causing the mould to rotate on its longitudinal axis at a suitable speed, so that the whole of the liquid mass is subjected to the action of centrifugal force and assumes the position of equilibrium resulting together from the centrifugal force exerted, from gravity and from the reaction of the mould. The rotary movement, the speed of which can be selected according to an arbitrary law, is then maintained until, by the subsequent cooling to which it is subjected, the material has become completely solid and has assumed sufficient consistency for maintaining by itself the shape previously acquired by centrifugation.

The tubular body thus obtained can have any outer shape whatever, which will be determined solely by the shape which will have been initially chosen for the mould.

The inner shape of the tubular body will be determined by centrifugation. This shape will therefore be a body of revolution about the axis of rotation of the mould. Said shape will be cylindrical in the case in which the axis of rotation is maintained in a horizontal position, and the diameter of the cylindrical axial space can be freely determined by charging the volume of liquid material cast in consideration of the useful volume of the mould adopted. The inner shape of the tubular body will be that of a paraboloid in the case in which the axis of rotation of the mould is maintained in an inclined position and the parameters of the central space thus created will depend both on the volume of material cast in the useful capacity of the mould, on the angle of inclination of the axis of rotation of the mould relatively to the horizontal and on the speed of rotation adopted.

The mould utilised according to the invention is substantially constituted by a bare metallic body, as for instance copper, pig-iron, steel or any other suitable alloy, but it might also be constituted by a metallic casing or the like internally lined with an insulating or refractory material, and said material can be arbitrarily chosen from among all those suitable for the moulding art.

The mould is closed at its ends by metallic end walls or end walls made of metal coated or covered with insulating or refractory material, one of said end walls being provided with an orifice for the introduction of the material to be moulded, and the other can be entirely closed or can be provided with vents.

According to the invention, at any moment during the operation, the mould can be caused to pivot according to an arbitrary law, so as to cause the axis of rotation to assume a position more or less inclined on either side of the horizontal and, the final inclination which it is desired to give to the axis of rotation of the mould can be determined, at every instant.

According to another feature of the invention, the introduction of the metal into the mould is effected by projecting the liquid material in the form of a jet which freely penetrates through an orifice provided for that purpose in one of the end walls of the mould. The device producing the casting jet accompanies the mould in all its movements of inclination, and the casting can be effected as well with the mould in an inclined position as with the mould in a horizontal position.

The inlet orifice can be arranged according to the axis of rotation of the mould. As its position thus remains fixed during the rotation of the mould, it is very easy to effect the casting as well when the mould is rotating as when it is at rest.

According to another feature of the invention, the most varied modes of action can be carried out in accordance with the principles under which the cast material is cooled and on the steps of its solidification. Among all these modes of action, those can be chosen which contribute to the result sought for, in particular those which lead to the most favourable physico-chemical constitution of the masses of materials constituting the moulded member.

It is possible to act in the most efficient manner in the cooling to which the cast mass is subjected externally by conductability through the wall of the mould and by radiation at the free surface of the latter:

1. The mould can, in fact, be constituted by a body which is a more or less good conductor of heat and has a more or less active radiating surface. If desired, the mould can also be cooled artificially at the outside by convection in a suitable fluid. The mould can also act by its relative volume, more or less large, that is to say by the thermal inertia represented by the calorific capacity of said volume, and said thermal inertia can be modified at will by the initial temperature imparted to the mould before casting.

2. On the contrary, if desired, the mould can be internally lined with a more or less thick layer

of insulating or refractory material which allows of retarding as much as desired the cooling effect exerted by the mould and through the mould, it being noted that the thermal condition of the wall of the mould can also be caused to intervene at the time of casting.

3. It is also to be noted that, according to the result sought for, these thermal influences can be caused to vary arbitrarily, throughout the extent of the mould, so as to produce any differential law of cooling at the outer surface of the moulded member.

The cooling to which the cast mass can be subjected at its free internal surface can also be actively acted upon. As soon as centrifugation has produced the internal cylindrical or paraboloidal space, an adjustable cooling action can immediately be exerted in the internal space thus created, for instance by causing a fluid to circulate which penetrates through the casting orifice and escapes through the vents provided in the opposite end wall. If it is desired to exert a reheating action for slackening or preventing the cooling effect through the internal free surface, use can be made of a flame which is more or less hot, or more or less reducing or oxidizing. It is moreover possible, by utilising a flat and hermetically closed end wall at the end opposite the casting end, to prevent any natural renewal of the air contained in the central space and consequently, to practically annul the cooling of the material through its internal free surface. The interfering cooling effect imputable to the presence of the casting orifice can itself be eliminated, by suitably reheating.

On the other hand, the process allows of reducing said interfering effect to the minimum, owing to the very method of introducing the liquid material in the form of a jet of reduced cross section which allows of diminishing the cross section of the orifice to the strict minimum.

Furthermore, if the casting is effected in the mould arranged, for instance, in an inclined position, it is possible, during or after casting, to bring the mould to the horizontal or even beyond the horizontal position and into an opposite inclination by a suitable tilting movement, which has the effect of causing the liquid material to flow towards the casting orifice and to produce a disc-like portion of material which rapidly solidifies in front of the casting orifice which is thus automatically obturated, the solidification then continuing in a hermetically closed vessel and the cooling taking place only through the walls of the mould.

By effecting this tilting movement of the mould at the right moment with a suitable amplitude and at suitable intervals of time, and by suitably conforming the ends of the mould, a judicious cooling action can be easily exerted through the end walls, and tubular bodies can be obtained which are closed by end walls integral with the tubular portion and the shape and thickness of which can be easily controlled. Thus, according to the invention, it is possible to produce tubular bodies closed at the ends and the central space of which will be completely or partly of cylindrical or paraboloidal shape. The articles thus obtained will be perfectly suitable for use as vessels, bottles, containers, projectiles, etc.

For obtaining a tubular body open at its ends, it suffices to perforate the disc-like portion previously mentioned or to effect a slight sectioning of the member at its ends.

It will be noted that, for the manufacture of relatively short tubular members, it will be advantageous to obtain, according to the invention, long tubular bodies which will then be sectioned into elementary lengths.

Other features of the invention will be apparent from the following description.

The accompanying drawing diagrammatically shows, and by way of example, a plant for carrying the invention into practice.

In this example, given simply by way of illustration, the mould 1 which, in this case, is assumed to be cylindrical, is provided with an upper end wall 2 and a lower end wall 3, the upper end wall being provided with an orifice 4 for introducing the liquid material This orifice is of reduced cross section and can have for instance a diameter comprised between 30 and 70 m. m. The mould can, for instance, assume an inclined position at the moment of casting. It rests on sets of driving rollers 6 and 7 carried by shafts 8. The rollers 7 roll in contact with an abutment 9 provided on the mould for preventing the mould from sliding downwardly during the rotation. Each of the shafts 8 is carried by bearings 10 which rest on a frame 11. Said frame pivots at 12 on a supporting beam, not shown, and it can be tilted about said pivot, for instance by a hydraulic jack 13. The frame 11 carries an engine which drives the shaft 8 for instance by a pulley 15. Said frame moreover carries a casting pot 16 terminating at the bottom by a nose or nozzle 17 which can be brought opposite and near the casting orifice 4. The liquid material is brought to the casting pot 16 for instance by a ladle provided with a stopper-rod, not shown. The height of the casting pot is calculated so as to impart a suitable momentum to the casting jet. The quantity of liquid material to be introduced is determined according to the thickness and the calibre of the tubular member to be obtained. The liquid material is poured into the mould through the nozzle 17 in the form of a liquid jet which freely enters through the orifice 4. The mould being set in rotation (at an adjustable speed) the cast material is thus projected by centrifugation against the wall of the mould and, after complete solidification, a centrifugated tubular body is finally obtained. If it is desired to obtain a perfectly cylindrical internal space, the mould will be brought to a horizontal position as soon as the casting is finished. If the mould remains in any inclined position, the internal space will of course be in the shape of a paraboloid. If the cooling of the liquid mass has been suitably conducted, the wall of the tubular body obtained, will be perfectly compact and well constituted physically.

The invention is not limited to the embodiments illustrated and described which have been chosen simply by way of example.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. A method for the centrifugal casting of tubular bodies with two solid closed ends in a mould adapted to pivot round a horizontal axis, consisting in pouring molten metal into the mould, rotating latter at high speed for the production of the tubular body, tilting the mould into a position substantially at an angle with the horizontal with the inlet end of the mould at a higher level than the opposite end during a fraction of the time required for the production of said tubular body for forming a solid closure for the tubular body at said opposite end of the mould, simul-

taneously cooling said opposite end, tilting the mould back into approximately horizontal position and simultaneously cooling the inlet end of the mould for forming a second solid closure for the tubular body.

2. A method for the centrifugal casting of tubular bodies having closed ends, in a rotatable mold adapted to rock about a horizontal transverse axis, which consists in pouring molten metal into one end of the mold, rotating the latter rapidly, tilting the mold into an inclined position with the inlet end raised for a portion of the time required for cooling the body in order to form a solid end closure at the opposite end of the mold and tilting the mold into an oppositely inclined position and cooling the lowered inlet end in order to form a solid closure for the second end of the tubular body.

JACQUES BOUCHER.