May 15, 1951 C. A. O'NEILL ET AL 2,552,810

METHOD OF LOCATING INSERTS IN CASTINGS

Filed May 26, 1948 2 Sheets-Sheet 1

Fig. 1

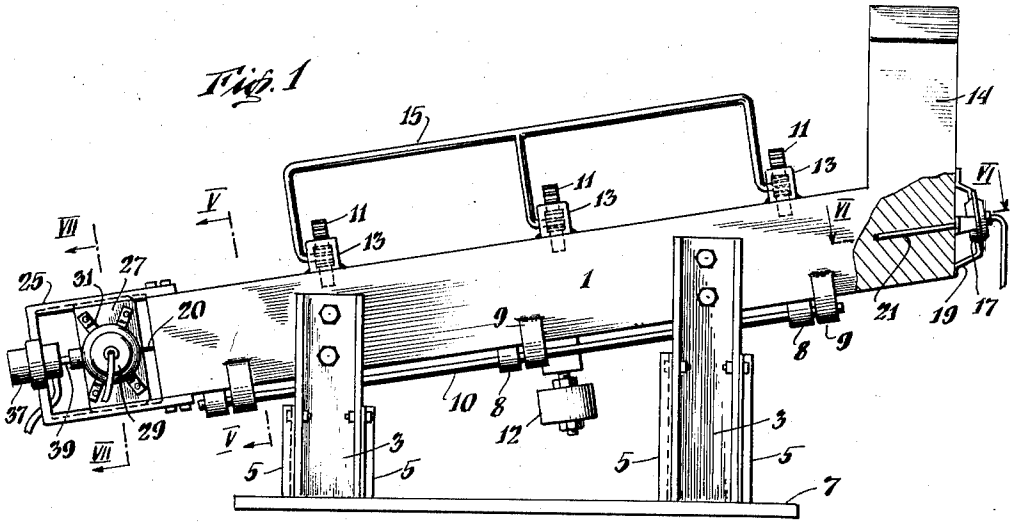

Fig. 2

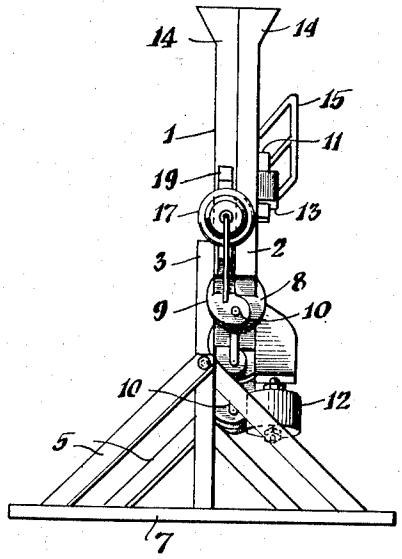

Fig. 3

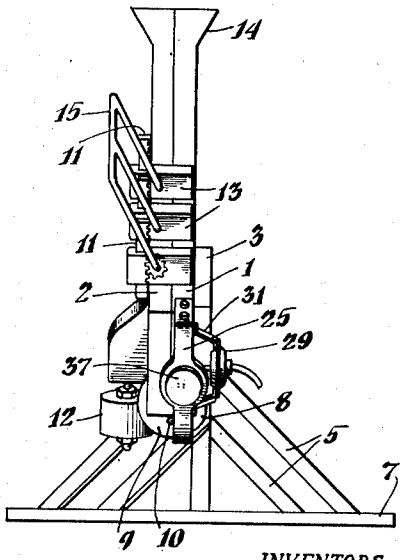

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Fig. 4

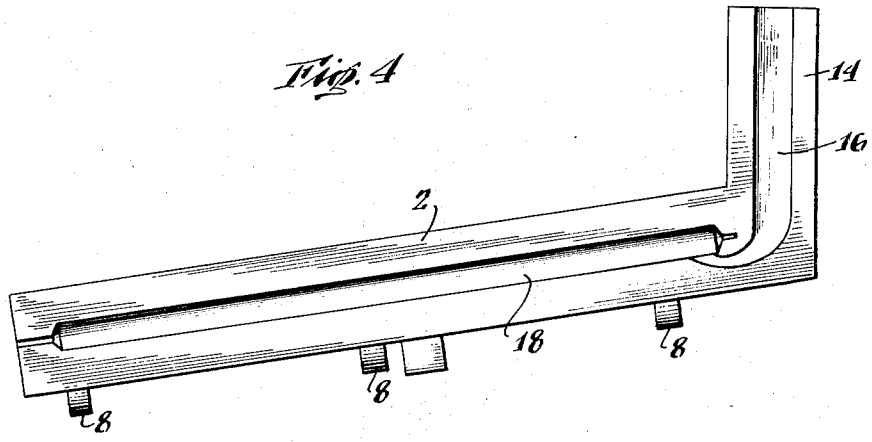


Fig. 8

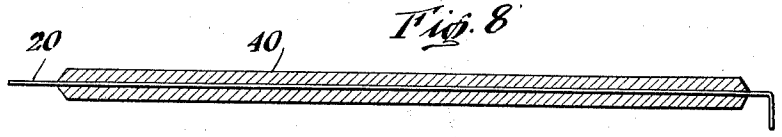


Fig. 5

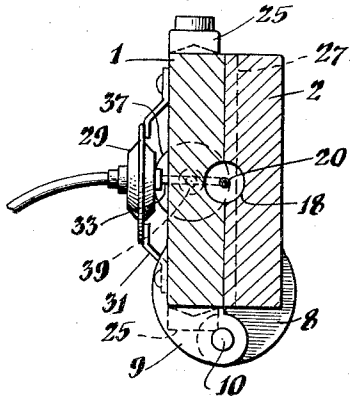
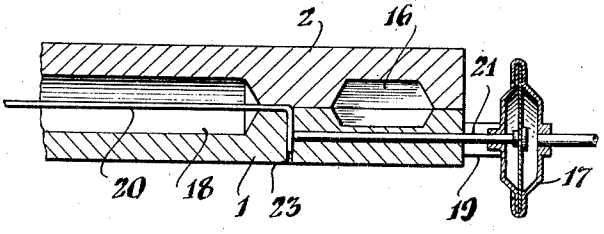


Fig. 6



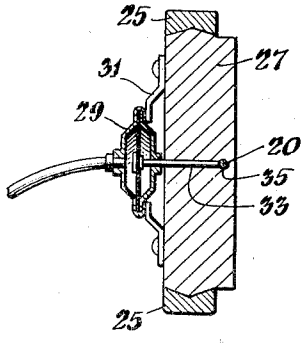


Fig. 7

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METHOD OF LOCATING INSERTS IN CASTINGS

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Application May 26, 1948, Serial No. 29,226

5 Claims. (Cl. 22—203)

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This invention relates to metal inserts embedded in castings and especially a method of maintaining the inserts in the desired position during the casting of metal around them.

Inserts of different metals are often used in parts of castings to impart strength or other properties not possessed by the casting itself. In producing castings having long thin inserts embedded therein trouble is often encountered in maintaining the inserts in position during the metal pouring operation. In some cases, the inserts can be supported in places by cores or portions of the mold if the shape of the casting permits it, but if the insert is to be completely surrounded by metal except for portion protruding from the casting, a difficult positioning problem arises. If the insert is not too long it can be mounted in a vertical position in the mold cavity and anchored at the top and bottom of the cavity, it can be satisfactorily located in the casting. However, if the insert is thin and of considerable length, the expansion and softening of the insert in contact with the molten metal will displace it from the desired location in the casting. The problem of maintaining the location of an insert in a mold cavity is especially acute where wires, thin rods or tubes of considerable length are embedded in castings poured in a horizontal or inclined position. In such cases the expansion of the insert as it comes in contact with the molten metal causes it to sag with resultant dislocation in the final cast product.

It is the object of our invention to provide a method for overcoming the aforementioned difficulty of locating inserts in castings. More particularly, it is an object to provide a simple and effective method, which can be used in any foundry, for establishing and maintaining the position of long thin inserts in molds as the inserts expand during the pouring operation. A special object is to provide a method by which wire inserts can be accurately located in a mold and maintained in the desired location as the molten metal freezes around them.

Apparatus for carrying out our process is illustrated in the accompanying drawings, in which:

Fig. 1 is a side elevational view, partially in section, of a permanent mold designed for making long rod-like castings;

Fig. 2 is an end elevation of the pouring end of the mold;

Fig. 3 is an elevation of the opposite end of the mold;

Fig. 4 is a broken view of the movable half of the mold on the parting face;

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Fig. 5 is an enlarged section taken on line V—V of Fig. 1;

Fig. 6 is an enlarged section taken on line VI—VI of Fig. 1;

Fig. 7 is a section taken on line VII—VII of Fig. 1; and

Fig. 8 is a longitudinal cross sectional view of the cast rod with a wire insert embedded therein.

We have found that if long thin inserts to be embedded in castings are placed in a mold and sufficient tension is applied to them below their yield strength to produce a taut condition prior to contact with the molten metal and this condition is maintained as the mold is being filled and then the tension is released as freezing of the metal begins, the inserts will be properly located in the castings. It is important that the taut condition be maintained until solidification of the molten metal has started and then be quickly relieved so that normal contraction can occur as freezing is completed. To provide the tension, the insert is gripped in any suitable manner and tension applied through the grips. In referring to the inserts as being long and thin, it is to be understood that the length exceeds by many times the greatest transverse dimension and the thickness of the insert is such that it is quickly heated by the surrounding molten metal, usually to the temperature of the liquid metal. A taut condition is considered to exist in the insert when no sagging occurs which is not corrected by the applied tension and the tension is insufficient to cause any permanent reduction in cross section by stretching of the metal. The tension, therefore, should not exceed the yield strength of the metal at the temperature to which to which it is exposed.

The inserts may be made of any of the conventional metals, the choice depending upon the purpose of the insert and the character of the casting metal. The inserts, obviously, should have a higher melting point than the metal surrounding them and they should not be readily soluble in the molten metal or attacked to such an extent as to destroy or substantially impair their usefulness. Metals commonly used as inserts are copper, brass, bronze, iron, steel, stainless steel, Monel metal, chrome-nickel alloys and low expansion alloys. Although the inserts may have any desired cross sectional shape, those of uniform shape such as bars, wires, or tubes are most easily handled.

The long thing inserts may be employed in either ferrous or non-ferrous castings, but they find special application in light metal castings

because of the favorable combination of properties gained by their use. In referring to light metals, it is to be understood that this term includes aluminum, magnesium and the alloys in which these metals predominate. As a practical matter those compositions containing at least 70% aluminum or magnesium find the greatest utility.

The shape of the casting may introduce problems in applying tension to the long insert; however, apparatus can be designed to meet the requirements of any particular mold. The castings may be solid bars or tubes, or of more intricate shape. It is essential, in any case, that the insert be so placed in the mold cavity as to permit the application of tension without collapsing the mold or distorting the cast product. An example of a difficult casting in which to place a long thin insert is that of a magnesium base alloy anode rod having a ratio of length to cross section greater than 15 to 1. To embed a steel wire in the center of such a rod offered many practical difficulties. It was found, however, that by gripping opposite ends of the insert, tautening it, maintaining the wire taut during pouring of the molten metal and then releasing the tension as freezing started a concentrically located wire was obtained in the cast rod. The wire extended beyond the ends of the casting thus providing a convenient place for gripping the wire and applying tension thereto. An apparatus suitable for making such anode castings is described hereinbelow.

The inserts should be clean and dry, of course, to insure good contact with the surrounding metal. It may be desirable to clean or pickle the inserts as well as to dry them prior to placement in the mold or the drying may be done after the inserts have been placed in the mold. In making the foregoing anode rods having bare steel wire inserts, it was found that the wires should be pickled in conventional acid baths or otherwise cleaned and then preheated to establish the proper contact between the insert and the cast magnesium base alloy.

The tension applied to the insert should only be high enough to keep it taut, as mentioned hereinabove, during the pouring operation. The tension may be maintained at a constant value or it may be varied especially where there is danger of deforming the insert at an elevated temperature. Thus, as the insert becomes heated through contact with the molten metal, it will be kept taut without danger of acquiring a permanent set. A convenient means of applying the desired tension is to use a constant load which is of such a magnitude that it does not exceed the yield strength of the insert at the temperature of the molten metal poured around the insert. Any suitable means may be employed to anchor the ends of the insert and to provide the desired tension. Usually hydraulic or pneumatic means will be found to be best suited to operate clamps and the movable head member. Only that portion of the insert which is to be embedded in the casting need be placed under tension but generally it is most convenient to grip the ends of the insert.

Once the mold cavity has been filled and freezing of the molten metal has started, the applied tension should be discontinued providing a solidification continues. Thus, freezing can be completed without further application of tension to the insert. The tension should not be terminated until the insert will remain in the desired location. On the other hand, the tension should not be retained until solidification is complete for undesirable strains can be created that may lead to loosening of the insert or warpage of the casting. We have found that by releasing the tension as freezing begins and progresses the insert can contract normally as the surrounding metal cools, a firm bond between insert and casting is established and no strains are left which would tend to loosen the insert.

The process of our invention may be carried out in any type of mold with suitable apparatus. It is most easily effected on a so-called permanent mold because means for clamping the insert in position and applying tension can be mounted directly upon the mold. Where a sand mold is employed a rigid frame outside the mold will generally be required for holding the insert and maintaining it under the desired tension. The same situation exists where plaster molds or molds made of similar material are employed. It will be understood, therefore, that the type of mold does not limit our invention.

The operation of our process is illustrated in connection with the apparatus shown in the accompanying drawings for casting magnesium base alloy anodes of rod-like proportions. In Figs. 1, 2 and 3 is a book type permanent (iron) mold composed of parts 1 and 2 pivotally joined together through hinges 8 and 9 and hinge pin 10. The mold half 1 is stationary being supported by vertical channel columns 3 and associated angle braces 5 attached to a base 7. The other mold half 2, which is movable, carries counterweight 12 to facilitate opening and closing the mold. The mold is held in closed position by the clamping pins 11 having rack teeth thereon and moved upwardly or downwardly by pinions within the housing and pin guides 13 on the top edge of the stationary mold half 2. The pinions are actuated simultaneously through movement of the bar 15 and associated legs leading to each pinion shaft. The mold is mounted at a slight inclination to the horizontal and the mold cavity 18, seen in Fig. 4, is fed through pouring sprue 16 in the upwardly extending portion 14 of the mold at the upper end of the mold. The mold cavity is gated on its underside close to the upper end thereof.

The means for applying tension to the wire insert 20 comprise two air operated clamping devices for gripping opposite ends of the insert, one of the clamping devices being movable. At the upper end of the mold is mounted an air diaphragm 17 attached to the mold by brackets 19. Clamping pin 21, actuated by the diaphragm, operates in a suitable bore provided in the mold body adapted to receive and support the pin. This pin in extended position contacts the bent portion of wire insert 20 in hole 23 which is at right angles to the clamping pin. At the other end of the mold is a guide and supporting U-shaped bracket 25 attached to the stationary mold part 1. A movable head 27 carrying wire clamping means is slidably mounted in the parallel arms of the bracket 25, the movement of the head being controlled through piston rod 39 operated by air cylinder 37 also attached to bracket 25. The wire clamping means mounted on the movable head 27 is similar to that at the other end of the mold and consists of an air diaphragm 29 attached by brackets 31 to the said movable head with clamping pin 33 passing into the head and contacting the wire in hole 35 at right angles to said pin. Compressed air for operation of the

diaphragms and air cylinder is obtained from a suitable source.

In operation the cleaned and preheated wire with a right angle bend close to one end is placed in the mold cavity, the bent end being inserted in the hole 23 and the other end in hole 35 in the movable head 27. Compressed air is admitted to the diaphragms thereby causing the clamping pins to lock the wire in position. The wire is then tautened by introduction of air at a predetermined pressure to the air cylinder 37. Generally it is most convenient to keep the pressure constant throughout the period that the wire is held under tension. For example, in a 2-inch diameter cylinder an air pressure of 80 p. s. i. will exert enough tension to hold taut a 0.100 inch diameter steel wire during the casting of a magnesium base alloy rod. After the wire has been tautened the mold is closed and molten metal introduced in conventional manner. The wire expands as it is surrounded by liquid metal but any tendency to sag is prevented by movement of head 27. As soon as the pouring has stopped freezing will have started and the air supply to diaphragms and air cylinder is cut off. Freezing of the molten metal continues and is completed as the wire contracts of its own accord. The insert will be found to be concentrically positioned in the casting. The mold may then be opened and the casting removed.

Having thus described our invention, we claim:

1. The method of locating a long thin metallic insert within the body of a light metal casting, said insert having a higher melting point than the light metal, said method comprising providing a thin insert of sufficient length to extend through the casting and protrude from opposite sides thereof, placing said insert in the mold with a portion of said insert passing through the mold cavity in said mold, gripping opposite ends of said insert and solely supporting it outside of the mold cavity, applying a tension to said insert below its yield strength at the highest temperature to which it is exposed but sufficient to produce a taut condition, introducing molten metal into the mold cavity and around said insert, maintaining the taut condition of the insert as its temperature rises through contact with the molten metal, releasing said tension after the molten metal has begun to freeze around the insert and before all of the metal has solidified, and allowing the remaining molten metal to freeze and encase the insert.

2. The method of locating a long thin metallic insert within the body of a light metal casting, said insert having a higher melting point than the light metal, said method comprising providing a thin insert of sufficient length to extend through the casting and protrude from opposite sides thereof, placing said insert in the mold with a portion of said insert passing through the mold cavity in said mold, gripping opposite ends of said insert and solely supporting it outside of the mold cavity, applying a predetermined constant tension to said insert below its yield strength at the highest temperature to which it is exposed but sufficient to produce a taut condition, introducing molten metal into said mold cavity and around said insert, maintaining the same tension as the temperature of the insert rises through contact with the molten metal, releasing said tension after the molten metal has begun to freeze around the insert and before all the metal has solidified, and allowing the remaining molten metal to freeze and encase the insert.

3. The method of locating a longitudinally disposed wire insert in predetermined position with respect to the axis of an elongated light metal casting, said wire having a higher melting point than the light metal, said method comprising providing a wire of sufficient length to extend through said casting and protrude from opposite ends thereof, placing said wire in the mold with a portion of said wire passing through the mold cavity in said mold, securing one end of said wire insert in fixed position and the other end in axially movable position outside the mold cavity and thereby solely supporting said insert, axially moving the said second end a sufficient distance to establish a tension in said wire insert less than its yield strength at the maximum temperature to which it is heated by contact with the molten light metal but sufficient to create a taut condition, introducing molten metal into the mold cavity and around said wire insert maintaining said taut condition as the temperature of the wire rises through contact with the molten metal by further axial movement of said second end of the wire insert, releasing said second end of the wire insert after the molten metal has begun to freeze around the insert and before all of the metal has solidified, and thereafter allowing the remaining molten metal to freeze and encase the wire insert.

4. The method of concentrically locating a longitudinally disposed iron wire insert within the body of a rod shaped light metal casting, said method comprising providing a wire of sufficient length to extend through the casting and protrude from opposite ends thereof, placing said wire in the mold with a portion passing through and in concentric position with respect to the mold cavity in said mold, gripping opposite ends of said wire insert and solely supporting it outside of the mold cavity, applying a predetermined constant tension to said wire below its yield strength at the highest temperature to which it is exposed but sufficient to produce a taut condition whereby the wire is firmly held in said concentric position within the mold cavity, introducing molten metal into said mold cavity and around said wire, maintaining the same tension as the temperature of the wire rises through contact with the molten metal, releasing said tension after the molten metal has begun to freeze around it and before all the metal has solidified, and thereafter allowing the remaining molten metal to freeze and encase the wire insert.

5. The method of concentrically locating a longitudinally disposed iron wire insert within the body of a rod shaped magnesium base alloy casting, said method comprising providing a wire of sufficient length to extend through the casting and protrude from opposite ends thereof and through at least one end wall of the mold wherein the casting is formed, placing said insert in the mold with a portion of said insert passing through and in concentric position with respect to the mold cavity in said mold, securing one end of said insert in fixed position and the other end in axially movable position outside the mold cavity and thereby solely supporting said insert, axially moving the said second end a sufficient distance to establish a predetermined constant tension in said wire insert less than the yield strength of said wire at the maximum temperature to which it is heated by the molted metal but sufficient to create a taut condition whereby the wire insert is firmly held in concentric position within the mold cavity, introducing molten

magnesium base alloy into the mold cavity and around said wire insert, maintaining the same tension as the temperature of the wire rises by contact with the molten metal by further axial movement of said second end of the wire insert, abruptly releasing said second end of the wire insert after the molten metal has begun to freeze around the wire insert and before all the metal has solidified, and thereafter allowing the remaining molten metal to freeze and encase the wire insert.

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