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METHOD OF LOCATING THIN INSERTS IN ELONGATED CASTINGS

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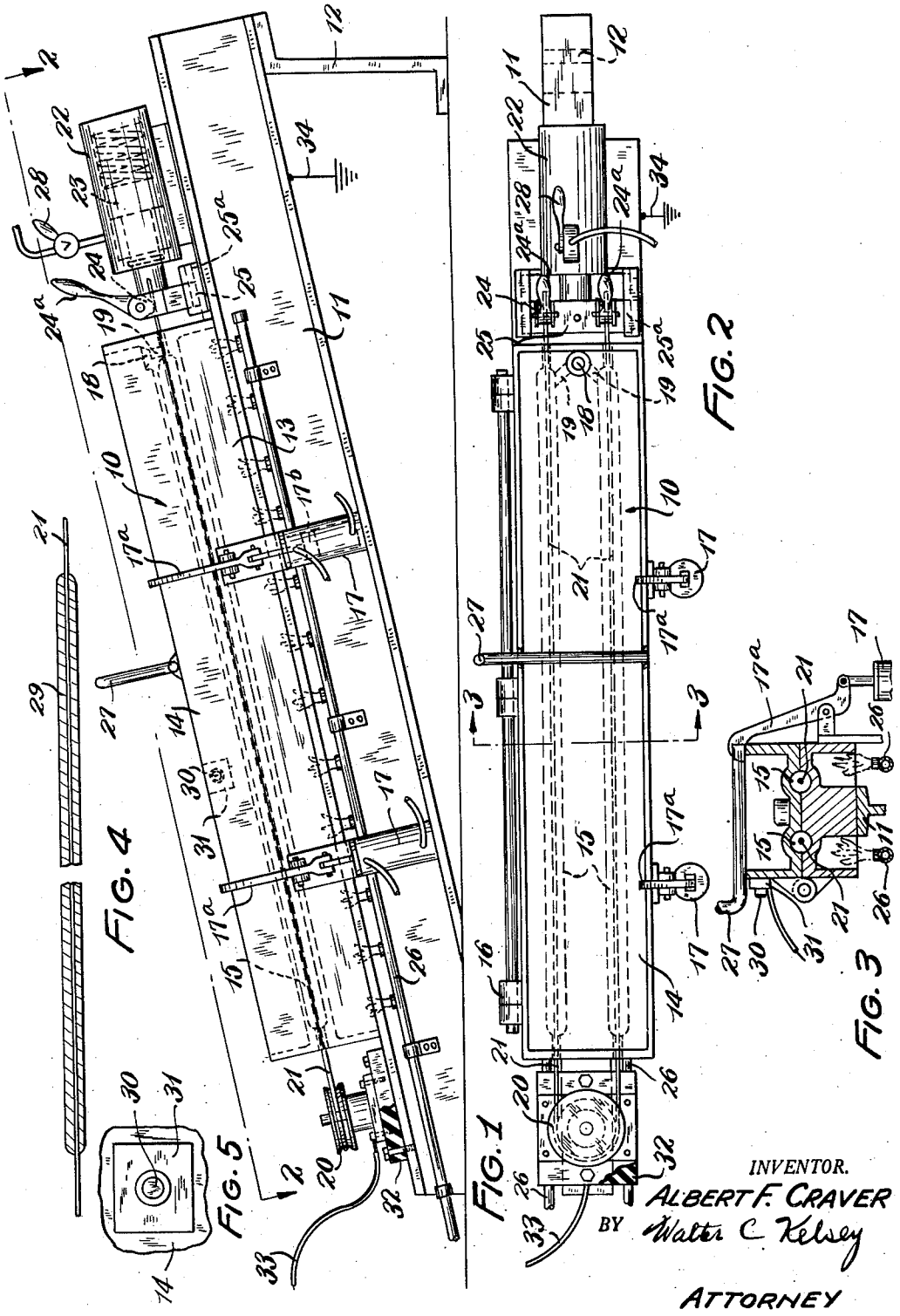


FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

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METHOD OF LOCATING THIN INSERTS IN ELONGATED CASTINGS

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This invention relates to thin metal inserts embedded in castings. Particularly, it relates to a method of maintaining such inserts at the required tension in the required position at the required temperature during the casting operation to obtain an improved bond between a casting and the insert.

This invention also relates to an improvemet in the method and apparatus disclosed in patent application of Albert F. Craver, Serial No. 423,900 filed April 19, 1954. The present embodiment of the invention relates to casting light metal rods, such as magnesium alloy rods having a thin ferrous metal insert or core wire embedded therein. The inserts may be made of various metals, having a higher melting point than the casting itself, and may be used in both ferrous and non-ferrous castings.

In making light metal castings of the type above described, it was found that in some instances the insert or wire was not properly bonded to the casting and that separation of the two metals occurred. It is known that in order to establish the proper contact between light metals such as aluminum or magnesium and heavier metals such as iron wire and the like, the heavier metal should be cleaned and preheated prior to the casting operation. Various means have been used unsatisfactory from my viewpoint for preheating the insert. These were found to be both time-consuming and impractical. I have discovered that satisfactory preheating of the stressed insert or wire just prior to casting may be accomplished by applying electrical current directly to the wire to bring it quickly up to the desired temperature by electrical resistance of the wire itself. Thus the wire, stressed beyond its yield point at the temperature of the molten casting metal, will cool down simultaneously with the freezing of the molten metal about it, thereby forming a proper bond between the wire and the casting.

For example, in the casting of a magnesium alloy anode around a central core wire, I have found that for an anode of approximately one inch outside diameter and length of 36 inches, and core wire of about 0.105 inch diameter, and when 20 pounds per square inch air pressure (gage) is applied to an air cylider having a 4 inch diameter piston that is joined to the core wire in the manner described in this application, the core wire will elongate at least 5/8 inch when the hot casting metal enters the mold and commences to surround the wire. I have found that during this 5/8 inch elongation the wire is stressed beyond its yield point and that the wire does not return to its former length when the stress is removed and the wire is cooled. The failure of the core wire, to return to its former length, is not caused by the bond formed between the core wire and the anode, as proven by appropriate tests.

An object of my invention is to insure the creation of a proper bond between a relatively thin centrally located insert, such as a ferrous metal wire, and a casting of non-ferrous metal, such for example as a magnesium alloy or aluminum alloy casting.

Another object of this invention is to provide a method employing electrical resistance heating means for quickly preheating the insert or wire, to heat it to a temperature higher than that of the mold just prior to the casting operation, such means requiring only a few seconds, being quickly and easily controlled and producing a casting having the insert properly centered and firmly bonded to the casting.

Other objects are to provide a mold with a plurality of cavities, which is adapted to simultaneously cast two or more elongated castings having thin metal inserts centrally disposed therein, such mold being provided at a relatively low cost, permitting relatively low unit operating costs, and being sturdy and reliable in operation.

These and other objects of the invention will be apparent from the following specification.

In the drawings disclosing an illustrative embodiment of the invention:

Fig. 1 is a side view of my mold in closed position;

Fig. 2 is a plan view taken on the lines 2—2 of Fig. 1;

Fig. 3 is a vertical section taken on the line 3—3 of Fig. 2;

Fig. 4 is a broken central section through a casting formed in the illustrated mold, showing the central disposition of the metal insert or wire therein, while

Fig. 5 is a view of an electrical switch button which controls the flow of current to the device.

In general, the embodiment of the invention herein disclosed comprises a two sectional hinged-type permanent mold, disposed in an inclined position, including a lower mold portion and a similar upper mold portion, adapted to be disposed over the lower mold portion during the casting operation, each mold portion including two elongated mating mold cavities, the mold portions being hinged together permitting the upper portion to be moved from a position directly over the lower portion to a position at the side thereof. Sprue holes are located at the top of the mold, while a rotatable grooved sheave, mounted at the lower end of the lower mold portion below the cavities and having its axis disposed at right angles to the axis of the mold cavities, is positioned and arranged in such manner, that a single wire disposed centrally of one mold cavity may be mounted around the sheave and brought into the other cavity, centered and retained therein during the casting operation. Means are also provided for preheating the metal insert wire by electrical resistance, which is supplied after the insert has been disposed in the cavities and placed under tension, but before the mold is closed and the molten meal is poured.

It has been found necessary to maintain the wire relatively taut and properly preheated at the instant of beginning of pouring of the hot molten alloy, essentially to insure that the necessary core wire be centrally located within the casting and that optimum heating of the wire be had. When the molten alloy is about to be poured the temperature of the wire will be relatively high. I have found that a tension should be applied to the preheated insert or wire sufficient so that when its temperature is further raised by the pouring of the molten alloy, the wire will be stressed beyond its yield point and will so remain during the pouring of the molten metal alloy. It has been proposed heretofore to apply a tension that will not exceed the yield strength of the insert or wire, but I have found that a considerably better bond between the casting and the insert or wire is secured when the insert or wire is stressed beyond its yield point at the temperature to which it is subjected as a result or coming in contact with the molten metal for the casting. And, as a matter of fact, I have found it advisable at no time to reduce the applied tension on the insert or wire during the casting of the molten alloy. After the casting of the metal has been completed and the molten metal has at least begun to freeze around the insert, the tension may be released.

The embodiment of the invention as disclosed herein,

comprises a two-sectional hinged-type mold **10** mounted on a support beam **11** carried by leg **12**. The mold **10** comprises a stationary lower portion **13** suitably mounted on the beam **11** and a movable upper mold portion **14**, each of the mold portions including two elongated one-half round mating mold cavities **15**, illustrated in dotted lines in Figs. 1 and 2 and in full lines in Fig. 3. Hinge means **16** permit the upper mold portion **14** to be swung away from its position over the lower mold portion **13**, as illustrated, to a position at the side thereof in a manner similar to moving a page of a book from a position over a page to a position at the side thereof. The opening and closing of the mold **10** is accomplished by means of operating handle **27**, while pneumatic clamping valve cylinders **17** operate the clamps **17***a* in an obvious manner, to clamp the two mold sections **13** and **14** together and release them.

Molten metal poured through sprue hole **18** at the top of the mold passes through connecting sprue hole leads **19** into the two elongated cavities **15**, thus permitting the making of multiple castings from one pouring. A rotatable grooved sheave **20**, as shown in Figs. 1 and 2, is mounted on the support beam **11** below the lower end of the mold **10** below the cavities, where it is positioned and arranged in such manner, that a wire insert **21** extending the length of said mold cavities **15** and mounted around the sheave **20** is retained in each mold cavity **15** by merely securing one end of the wire **21** at the top of said mold **10**, placing it along one mold cavity **15** and then around the sheave **20** back into the adjacent mold cavity **15** and securing it at the top. The wire is centered within the mold cavity when sufficient tension is applied to the wire to make it taut.

As shown in Fig. 5 an electrical switch button **30**, mounted on a panel **31** and disposed in close proximity to the mold **10**, provides means for regulating the flow of current to the metal insert **21** as hereinafter described. As shown in Figs. 1 and 2, the sheave **20** is insulated from the mold **10** by a block of insulating material **32**, while an electric conductor wire **33**, suitably electrically connected to the sheave **20** at one end, is connected at its other end to a terminal connected to the switch button **30**. The mold **10** is grounded by wire **34** as shown in Figs. 1 and 2. The switch button **30** is connected to a direct current line, preferably of 200 amp. 240 volts in such manner that whenever said button is pressed by the operator, current of the character above specified is caused to flow to the wire insert **21** and through the wire **21** to the mold **10**, causing it to be quickly preheated. The lower ends of the insert **21** extend through apertures at the lower end of each half mold cavity and at initial preheating preferably do not touch the mold itself at that point, in order that the electric current passing to the sheave **20** is transmitted along the insert **21** to its upper end without being shorted out between these two points. If necessary, a block of insulating material may be provided in the mold adjacent the projecting insert ends to support them in alignment with the apertures without touching the mold structure. Preferably there should be a clearance of about ⅛" around the insert where it projects through the mold. When the mold sections **13** and **14** are closed, however, the weight of the top mold section **14** will force the wire insert **21** into proper position. A series of fuel burners **26** are disposed below the lower mold portion **13**, which may be used to bring the mold **10** up to the proper temperature before starting a cast.

Means for gripping the upper ends of the insert wire **21** and stressing it comprise an air cylinder **22**, controlled by a valve handle **28**, having a piston **23** connected to a slidable base **25** operating in ways **25***a*, while clamping fixtures **24** mounted on base **25** and provided with operating handles **24***a* are adapted to clamp insert wire **21** disposed in horizontal bores therein. Compressed air at predetermined and controlled pressures, usually around 20 lb. per square inch is supplied to the piston **23** having a

diameter of 4", and upon admitting such compressed air to the cylinder **22**, clamping fixtures **24** will securely retain such wire ends at the required tension.

When using the mold **10**, pneumatic clamp cylinders **17** operate clamp arms **17***a*, which are connected to the pistons **17***b* in cylinders **17** to release the two mold portions **13** and **14**. When the two mold portions are released the operating handle **27** on upper mold portion **14** is grasped permitting the upper mold portion **14** to be swung on hinge means **16** to a position along the side of lower mold portion **13** with each mold cavity **15** facing upwardly. One end of wire **21** of predetermined length is inserted in the base of one clamping fixture **24** and handle **24***a* is operated to clamp it therein. The wire **21** is then strung through its adjacent mold cavity **15** and wound around the sheave **20** and strung back through the other mold cavity **15**, and the other wire end is similarly clamped to the other clamping fixture **24**. Operating handle **27** is then used to return upper mold portion **14** to its position over lower mold **13**. The pneumatic clamping valves **17** then operate the clamping arms **17***a* to lock the upper mold portion **14** over the lower mold portion **13**.

The rotatable sheave **20** serves to retain the wire insert **21** centrally in each of the two mold cavities **15** as shown in Figs. 2 and 3, and as such matching mold cavities are each of one-half round construction in cross-section, castings **29** which are round in cross-section are produced, each having the wire insert **21** disposed centrally thereof throughout the entire length, as shown in the completed casting in Fig. 4.

By operating valve handle **28**, the air cylinder **22** is caused to carry the slidable base **25** and clamping fixtures **24** away from the end of the mold at a predetermined pressure, drawing the wire against the rotatable sheave **20**, causing the wire **21** to become taut and centered in each mold cavity **15** at the desired tension. When the mold portions **13** and **14** are in their open positions, while the wire **21** is under tension, as above described, and preceding the pouring of the metal, the operator presses the electric switch button **30** causing current of the character described to flow along the wire **21**.

It has been found that by using electrical resistance pre-heating, the temperature of the wire insert is quickly brought up to a temperature substantially higher than the mean temperature of the mold. We have found that if the wire is heated to 600–750° F. sufficient heat will remain in the wire insert during the interval between the closing of the mold and pouring of the metal to provide a satisfactory bond between the wire and the casting. The bond formed is thus stronger than that produced by not heating the wire to the above referred temperatures.

The time required for such heating of the wire **21** varies according to the type, length and diameter of wire used and to the magnitude of the applied voltage. If current is allowed to pass through the wire too long a time and it becomes overheated, the tension will cause the wire to break. In most instances, it has been found that passing current through the insert **21** for a period of time varying between 10 and 12 seconds is sufficient to bring a ferrous wire having a diameter within the range of .084 inch to .1055 inch, up to the proper temperature and permits excellent control of the process.

Quickly following the preheating of the insert, preferably within a period of a few seconds, the mold is closed, as described above, and while the insert is still at an elevated temperature, molten metal is poured into sprue hole **18** and flows through connecting sprue holes **19** into each of the two elongated mold cavities **15**, filling them and forming a casting around the portions of the core wires within the cavities. Usually it is only necessary to leave the two mold portions closed for a minute or so, but if desired, the casting may remain in the molds for a longer period. Obviously the mold should not be opened until the molten metal has hardened somewhat at its surfaces

and has at least begun to freeze around the insert. The core wire clamping fixtures **24** are then released and the clamping arms **17***a* are operated to release the two mold portions. The upper mold portion **14** is swung away from the lower mold portion **13**. The ends of the wire **21** projecting beyond the lower mold end are cut and the two finished castings **29** are removed from the mold cavities.

If desired more than a pair of castings may be formed at the same time and such construction is within the contemplated scope of this invention. It will be appreciated, however, that the method and apparatus herein disclosed may be used in casting other metals than those disclosed herein. By pouring sufficient molten metal to completely fill the cavities and the sprue hole **18** and the connecting sprue holes **19**, a cast formation in the form of an inverted "V" is formed at the tops of the finished castings, which may be grasped for removing both castings **29** from the mold in a single operation.

It has been found that by using a rotatable sheave at one end of the mold, for retaining the wire centrally in the cavities, the pulling force or tension exerted by the slidable base **25** on the wire in each cavity is equalized. By preheating the wire by electrical resistance heating, a satisfactory mechanical bond between the wire and the magnesium is produced. The operation of the electric switch button **30** may be accomplished by the same operator who pours the molten metal.

It will be apparent to those skilled in the art that the present embodiment of the invention is illustrative only and that the invention may be variously changed, used or modified without departing from the spirit of the invention or sacrificing the advantages thereof.

I 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 long thin metallic 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, electrically preheating said insert within the mold cavity, introducing molten light metal into the mold cavity and casting said metal around said insert while providing a taut condition of the insert of such magnitude that the pre-heated insert is stressed beyond its yield point as its temperature rises through contact with the molten metal, releasing said tension after the molten metal has at least begun to freeze around the insert, and allowing the insert to cool down simultaneously with the freezing of the metal around the insert for firmly bonding the insert to the casting.

2. The method of locating a long thin metallic iron wire insert within and bonding such insert to the body of a magnesium base allow metal casting, said method comprising providing a long thin iron wire insert of sufficient length to extend through the casting and protrude from opposite sides thereof, placing said insert in a mold with a portion of said insert passing through the mold cavity in said mold, gripping opposite ends of said insert, pre-heating said insert, introducing molten metal of said magnesium base alloy into the mold cavity and casting said metal around said pre-heated insert, and while providing a taut condition of the insert of such magnitude that the insert is stressed beyond its yield point as its temperature rises through contact with the molten metal, releasing said tension after the molten metal has at least begun to freeze around the insert, and allowing the insert to cool down simultaneously with the freezing of the metal around the insert for firmly bonding the insert to the casting.

3. The method of locating and firmly bonding a long thin metallic iron wire insert within the body of a magnesium base alloy casting, said method comprising providing a long thin iron wire 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, preheating said insert within the mold cavity, to a temperature within the range of approximately 600° to 750° F., introducing molten metal of said base magnesium alloy into the mold cavity and around said insert and while said insert is still at an elevated temperature, and while providing a taut condition of the insert of such magnitude that the insert is stressed beyond its yield point and is elongated as its temperature rises through contact with the molten metal, releasing said tension after the molten metal has at least begun to freeze around the insert, and allowing the insert to cool down simultaneously with the freezing of the metal around the insert for firmly bonding the insert to the casting.

4. The method of locating a long thin metallic insert within the body of a light metal casting and firmly bonding said metal to said insert, said insert having a higher melting point than the light metal, said method comprising providing a thin metallic 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, applying tension to said insert exerting a pulling force beyond its yield strength when at the highest temperature to which it is exposed to produce a taut condition, preheating said insert in the mold cavity by electrical resistance heating to a temperature higher than the temperature of the mold, introducing molten light metal into the mold cavity and around said heated insert, maintaining the taut condition of the insert and measurably elongating the insert as its temperature rises through contact with the molten metal, and releasing said tension after the molten metal has at least begun to freeze around the insert, whereby when cooled, said metal is firmly bonded to said insert in its elongated condition.

5. The method of locating a longitudinally disposed iron wire insert within and firmly bonding the insert to a body of a rod-shaped magnesium base alloy casting, said method comprising providing an iron wire of sufficient length to extend through the casting and protrude from opposite ends thereof, 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 an end of the insert in fixed position and the other end in axially movable position and moving said second end a sufficient distance to establish a predetermined tension in the insert greater than the yield strength of the insert at the maximum temperature to which said insert becomes heated by the molten metal being cast around the insert and by which tension said wire insert is firmly held in concentric position within the mold, substantially raising the temperature of said insert to a temperature within the range of approximately 600° to 750° F., while it is in said mold, then introducing molten metal of said magnesium base alloy into the mold cavity and casting it around said insert, while said insert is at an elevated temperature, maintaining the same tension of the insert as its temperature further rises through contact with the molten metal by causing further axial movement of said second end of said insert, and releasing said tension after the molten metal has at least begun to freeze around the insert, whereby when cooled said insert and said alloy casting are firmly bonded together.

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