June 11, 1935. L. M. PATTERSON 2,004,340

CASTING METHOD AND APPARATUS

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Fig. 5.

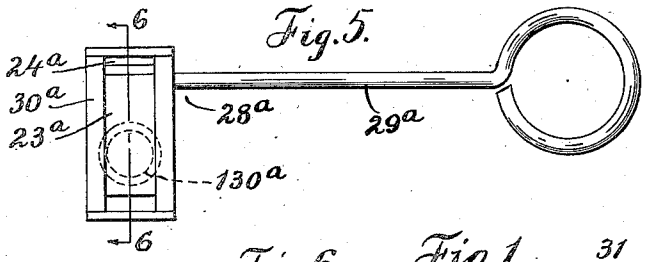


Fig. 6.

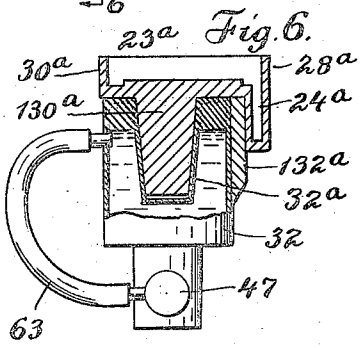


Fig. 1.

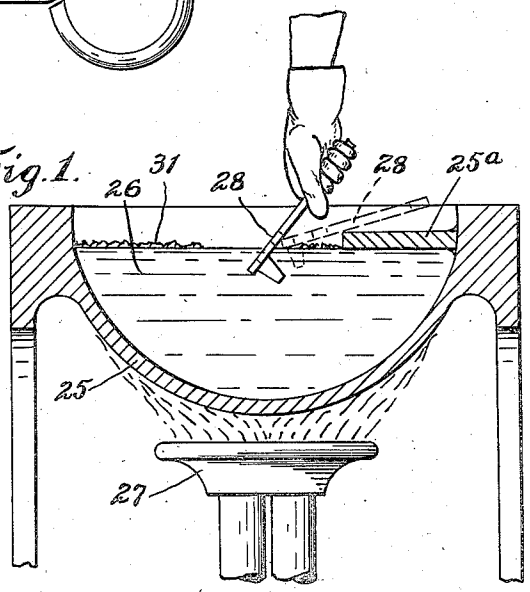


Fig. 2.

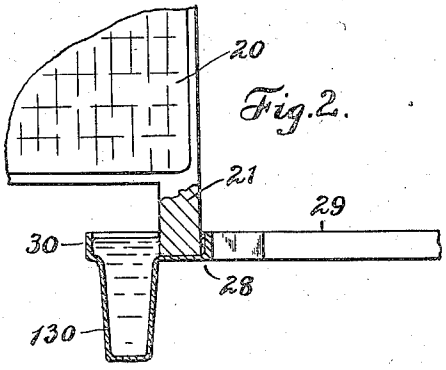


Fig. 3.

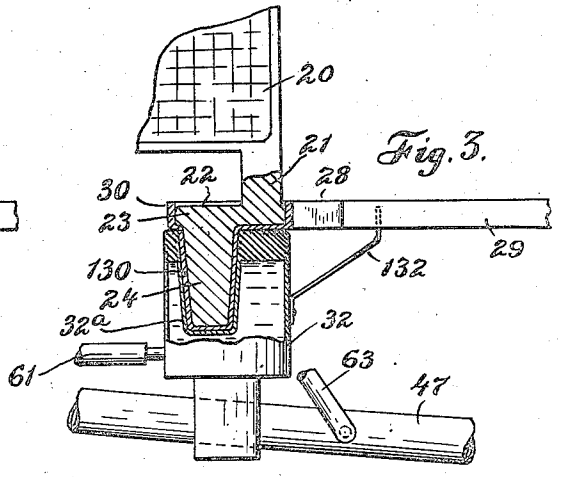
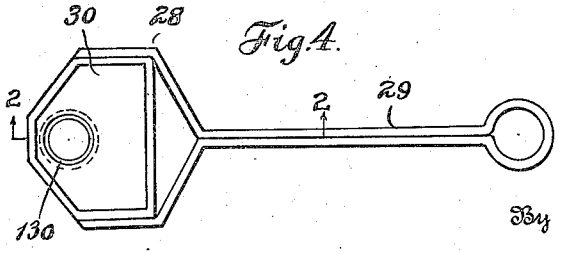


Fig. 4.



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Fig. 7.

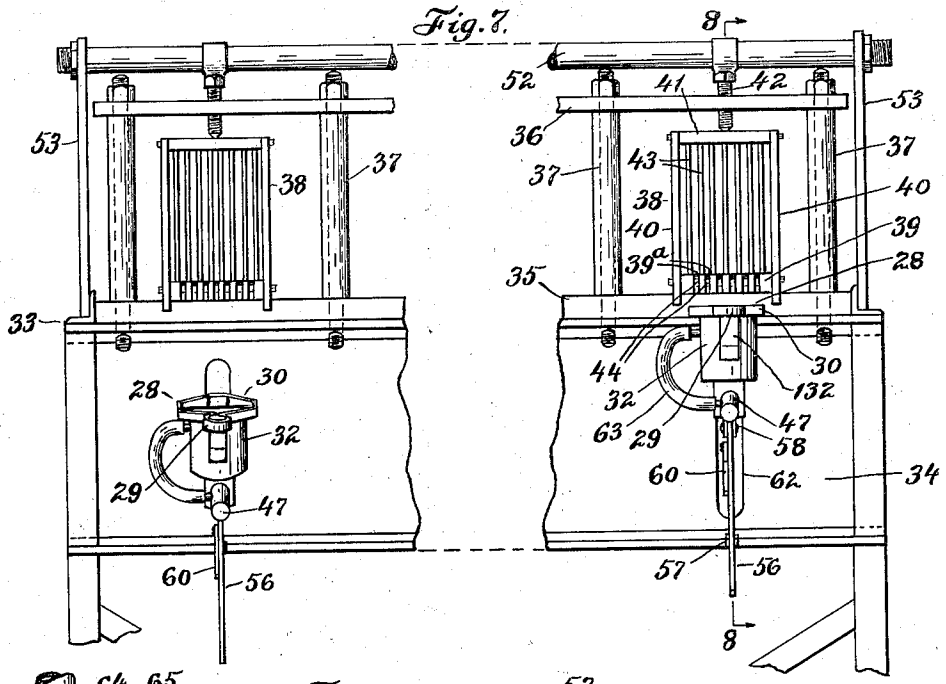


Fig. 10.

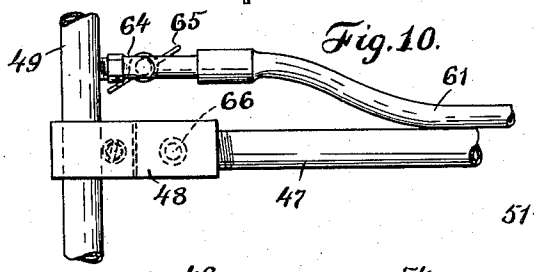
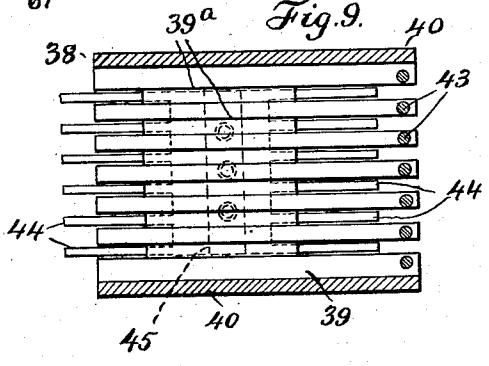


Fig. 8.

Fig. 9.



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UNITED STATES PATENT OFFICE

2,004,340

CASTING METHOD AND APPARATUS

Luther M. Patterson, New Philadelphia, Ohio

Application August 3, 1933, Serial No. 683,465

12 Claims. (Cl. 22—203)

This invention relates to the art of metal founding, and particularly to methods and apparatus for casting a composite article wherein one metal is solid and the other applied thereto in a molten condition.

An important application lies in the casting of a low-melting metal, such as lead or a lead alloy, upon a preformed plate of a similar metal, such as a storage battery plate in a group of such plates, where a terminal connection or strap is to be joined to the lugs or projections formed upon the battery plates.

The practice prevailing prior to my invention has been to precast the terminal post or connection, either without its strap or with a slotted strap, assemble it with the plate lugs in a mold, and then fuse said connection to the lugs with added metal melted from a stick by means of an oxy-acetylene gas flame, or solder the lugs in strap slots with such flame. This requires separate post-casting apparatus and operations and the use of relatively expensive gas.

While attempts have been made to form the complete terminal connection upon the plate lugs by pouring or flowing the molten metal into a mold surrounding the plate lugs, with the plates either in an upright, an inverted or an intermediate position, difficulties have been encountered in manipulating the casting metal, maintaining it at the proper casting temperature and solidifying the casting, and such methods have not been generally successful.

The object of my invention is to overcome the objections to prior casting processes and apparatus of this class and to provide a simple and reliable procedure and apparatus for the purpose mentioned, thereby dispensing with the precasting of the terminal connection and with the use of soldering means and obtaining a better quality of work with less labor. These purposes are accomplished by means of the improved ladle casting expedients hereinafter described.

Of the accompanying drawings, Fig. 1 is a vertical sectional view illustrating the mold-heating and ladling steps employed in carrying out my invention.

Fig. 2 is a detail vertical section illustrating the casting step, the ladle mold being in section on the line 2—2 of Fig. 4.

Fig. 3 is a similar section illustrating the cooling step.

Fig. 4 is a top plan view of the ladle mold employed in Figs. 1, 2 and 3.

Fig. 5 is a top plan view showing a modified form of ladle mold.

Fig. 6 is a section on the line 6—6 of Fig. 5, showing also a modified ladle cooler.

Fig. 7 is a front elevation, partly broken away, showing a multiple-unit casting machine constructed in accordance with my invention.

Fig. 8 is a vertical section thereof on the line 8—8 of Fig. 7, partly in elevation.

Fig. 9 is a horizontal section of the plate holder on the line 9—9 of Fig. 8, omitting the battery plates.

Fig. 10 is a detail plan view on a larger scale, showing a portion of the water-circulating means as viewed from the plane 10—10 of Fig. 8.

In the preferred mode of practicing this process, as illustrated in Figs. 1 to 4, in the casting of terminals upon storage-battery plates, the preformed pasted positive or negative plates 20 of lead or lead alloy are assembled side by side in inverted positions in a suitable rack or holder with the ends of their downwardly-projecting lugs 21 exposed in position to receive the casting which, in its finished form, is a terminal 22 composed of the usual strap or flat bar 23 connecting the plate lugs and having a lug 24 for connection with the external circuit, said lug in this instance being a tapered post as illustrated in Fig. 3. Lead or lead alloy for the casting is melted in a pot 25 to form a lead pool 26 by heat supplied to the exterior of said pot, as by means of a gas flame from a burner 27. The pot has a shelf 25a for supporting the handle of a ladle while its bowl is being preheated. Said pot is supported on the work-room floor near the casting station.

28 is a dipping and casting ladle having a handle 29 and a bowl 30 in the form of a mold whose cavity has the shape to be imparted to the terminal 22 which is to be cast, the bowl having a downward extension 130 for casting the terminal post.

The operator carries an empty ladle 28, which has been cooled during a previous casting operation, to the lead pot, and preheats the bowl 30 of said ladle by resting its handle on the shelf 25a and allowing the bowl to float on the molten lead pool while he is exchanging a united plate group for fresh plates in the casting rack. Then, to obtain a cleared surface of the lead, he may use the ladle bowl to push aside the layer of oxide dross 31 upon the upper surface of the molten lead. The ladle bowl is then dipped into the lead to obtain a casting charge, and the ladle and contents are carried to the casting station. The operator brings up the ladle from below in a horizontal position until the ends of the plate lugs 21 are submerged in the molten body of lead in the mold 30, the heat of said molten body causing fusion of

the lugs thereto, such fusion involving a preliminary melting of the lower ends of the lugs by contact with the hot mold bottom and a melting of the submerged portions of the lugs into the strap metal. At the same time, the casting metal is losing its heat to the plates and through the mold and ultimately solidifies, leaving the terminal 22 as a solid casting upon the plate lugs.

Solidification of the molten casting metal is accelerated by artificial chilling of the mold by a suitable agency such as a holder 32 in the form of a chambered casing constituting a water-jacket for contact with the mold 30, said packet having suitable inlet and outlet connections for circulating water therethrough. The mold and cooling jacket are preferably associated as shown in Fig. 3 before the ladle is carried into the casting position indicated in Fig. 2, the two together being then raised into the casting position, so that the fusion of the lugs to the casting metal and the chilling of said metal which results in its ultimate solidification can be proceeding concurrently. The shrinkage of the casting in reaching its solid state loosens it from the mold and the latter can then easily be withdrawn downwardly, with the aid of a tapping pin if necessary, upon depressing the holder 32, and used for another preheating, dipping and casting operation.

It will be seen that this method not only dispenses with separate precasting of the terminals and the use of flame welding, with all its attendant apparatus, for uniting terminals to the plate lugs, but, as compared with previously proposed modes of casting terminals upon the plate lugs by means of permanently mounted molds into which the casting metal is poured or flowed, it provides manipulative and temperature conditions which render this method successful where other casting methods have failed, and produces reliable castings in a minimum of time. The preheating of the molds by contact with the pot metal, avoidance of premature chilling of the casting metal by pouring it into a cold mold or carrying it through passages, the use of a casting ladle for this purpose and the final chilling of the ladle mold at the proper time, all contribute to the successful working of this method.

The cooling member 32 is formed with a socket 32a into which the post-casting portion 130 of the ladle bowl fits as a dowel to provide the best heat-transmitting conditions and also to locate the ladle in proper casting position with reference to said cooling member and to the plate group. For fixing the ladle and cooling member in proper position rotatively, when said ladle is of the form shown in Figs. 1 to 4, there is further provided on the front side of the cooling member 32 a registering or bracket plate 132 having a notched upper end on which the stem of the ladle handle 29 rests.

Figs. 5 and 6 illustrate a modified form of ladle 28a having a handle 29a and a dipping and casting bowl 30a whose cavity includes a horizontal portion 23a for forming a terminal strap, and a connecting vertical portion 24a at one end thereof for forming a vertical lug on said strap adapted to the type of buried intercell connector disclosed in my Patent 1,892,962 of January 3, 1933. The ladles and terminals of this type are made in rights and lefts for positive and negative plate groups respectively. The cooling member 32 for a ladle of this type I prefer to form with a lateral extension 132a having a flat vertical face for heat-transmitting and registering engagement with the ladle-bowl portion 24a, and I provide the bottom of the ladle bowl with a downwardly-extending, heat-transmitting and bowl-centering, solid dowel 130a to fit in the socket 32a of the cooling member.

Figs. 7 to 10 inclusive represent a casting machine or apparatus including some of the instrumentalities above mentioned for carrying out my improved method. In this apparatus, a frame 33 having suitable legs or standards is provided on its upper portion with a suitable number, such as six, of casting units, of which the two end ones are shown in Fig. 7. This multiple-unit casting apparatus may handle all the plate groups, positive and negative, for one six-volt battery, and may be operated by one man, allowing about three minutes for completing each terminal casting, from the time of inserting the filled ladle to the time of stripping it from the casting.

The frame includes a horizontal I-beam 34 with its web set vertically, a lower horizontal bar 35 of rectangular section over said I-beam and an upper horizontal bar 36 connected with the bar 35 by vertical posts 37. Each of the casting units includes a holder or rack 38 for holding a group of the battery plates 20 in inverted positions. The rack includes a bottom plate or block 39, vertical side plates 40 attached by screws thereto, and a top plate 41 attached by screws to the side plates and engaged by a clamping screw 42 on the bar 36, whereby the rack may be held in fixed position and adjusted horizontally when desired to accommodate the spacing of different plate groups.

The front side of the rack 38 is or may be provided with a series of vertical separating rods 43 fixed in its top and bottom plates, and the bottom plate 39 is formed with horizontal grooves 39a on its upper side, extending from front to rear in alignment with the spaces between the bars, to receive the lower edges of the battery plates. When a bottom plate or block 39 is employed, thicker than that illustrated and having deeper plate-receiving grooves, the separating rods 43 are sometimes omitted. The bottom plate 39 is also formed with longitudinally-extending vertical grooves at both ends, continuous with the horizontal grooves, below which are located a series of laminated spring fingers 44 formed by slotting the ends of a series of spring plates which are centrally held to the under side of the bottom plate by a transverse clamping bar 45. These fingers act as equalizing springs engaging the lower edges of the battery plates 20 whose upper edges abut against the top plate 41 of the holder as seen in Fig. 8, to compensate for any slight inequalities in the height of said plates. On inserting the battery plates in this rack, their rear edges abut against a stop-bar 46 on the rack and their lugs 21 project downwardly at the front in position for receiving the terminal casting.

A dipping and casting ladle 28 with its forwardly-projecting handle 29 and mold 30 at the rear end is seen in casting position in Fig. 8 and in the right-hand unit in Fig. 7 and in a depressed position in the left-hand unit in Fig. 7. Each unit includes a water-jacketed lower holder 32, whose upper end is suitably recessed, as described, to receive the downwardly-projecting portion of the mold 30 as seen in Fig. 3, for engaging the under side of the casting ladle in heat-transmitting relation thereto, and coacting therewith to maintain said ladle in casting position.

Said jacketed holder 32 is adapted to be raised and lowered into and out of operative position, and for this purpose, it is shown as mounted near

the forward end of a hollow bar or arm 47 which is pivotally supported at its rear end, said arm being screwed into a hub fitting or bracket 48 which turns about a fixed horizontal pipe 49 and is held thereon by a retaining hub block 50. The bar is yieldingly held in its upper position by a helical spring 51 suspended from a horizontal frame bar 52, whose ends are supported by vertical frame standards 53 mounted on rearwardly-extending bars 54 of the frame which support the rod 49 and are rearwardly supported from below by frame bars 55. For holding the arm 47 in depressed position against the tension of spring 51, there is provided a latch 56 guided in an open-ended slot 57 which is formed in the front foot flange of the I-beam 34, said latch being pivoted at its upper end at 58 to a collar on the arm and having a shoulder 59 for taking under the foot of the I-beam, and a handle 60 for releasing the latch.

Water is supplied to the jacket or holder member 32 through a rubber tube 61 mounted alongside of and bound by adhesive tapes to the arm 47 and is returned through the arm. Said arm and tube extend through a vertical slot 62 in the web of the I-beam. The delivery end of the tube 61 is connected into the lower end of the jacket member 32, and from the upper end of said member leads a short rubber U-tube 63 connecting with the interior of arm 47. The supporting pipe 49 acts as a trunk supply conduit for the cooling members 32 of the several casting units, connecting with the inlet end of each tube 61 through a fitting 64 provided with a hand-operated valve 65 for regulating the water flow to the member 32. Discharge from the interior of arm 47 is led off through a connecting tube or pipe 66 to a horizontal trunk discharge pipe 67 suspended at its ends by hangers 68 from the pipe 49.

In the working of this apparatus, after the operator has removed the casting ladle 28 from a completed assemblage of battery-plate group and terminal cast upon the lugs of the plates, has depressed the cooling element 32 for that group and held its arm down with the latch 56 as indicated for the left-hand unit in Fig. 7, and has returned the cooled, empty ladle to its preheating position in the lead pot as shown in broken lines in Fig. 1, he then removes the assemblage from the plate rack or work holder 38, lays it aside, inserts the proper number of fresh pasted and dried battery plates, one by one, in the rack, dips the ladle into the molten lead pool to obtain a charge of casting metal, brings it to the casting machine, fits it on the depressed cooling element 32 with one hand while the arm latch 56 is being released and the arm grasped with the other hand, and raises the cooling element and ladle into casting position in which the plate lugs 21 are immersed in the casting charge, whereupon the lugs become fused to the terminal metal in the ladle. The casting is then left to solidify while the operator proceeds with the finished assemblage in the next unit and so on through the series.

It will be understood that the form of apparatus above described may be rather widely varied without departing from the scope of my invention as defined in the claims.

I claim:

1. A casting method which comprises preheating a ladle mold and dipping therewith from a pool of molten metal a body of said metal having the form of the casting to be made, bringing said body in the ladle mold from the pool and applying it from below onto a preformed metal article, fusing the two together by the heat of the molten body, and solidifying said body.

2. The method of casting terminals upon storage-battery plates which comprises preheating a metallic terminal mold upon a pool of molten lead, then charging the mold by dipping from said pool, immersing the lugs of preformed battery plates in the metal in said mold, thereby fusing said lugs into the molten terminal metal, and freezing the terminal metal by chilling the mold.

3. Casting apparatus comprising a portable ladle having a bowl formed as a mold and a laterally projecting handle by which the ladle may be supported on a melting pot while said bowl is floated on heavier molten metal in said pot prior to dipping a casting charge therefrom, means for supporting a preformed metal article in casting position, and a holder movable away from said article-supporting means into ladle-receiving position and toward the same into operative position for detachably holding the charged ladle in casting relation to the article thus supported.

4. Casting apparatus comprising an upper holder for an article to be cast upon, a lower holder formed as a water jacket and mounted for retraction to a mold-receiving position and projection into casting position, and a portable ladle mold formed to detachably interfit with said lower holder, for casting upon the article held in the upper holder a member having the form of the cavity in the ladle mold and chilling the casting through the agency of the lower holder.

5. Casting apparatus comprising a holder for a group of inverted battery plates, said holder including a casing having means defining individual plate compartments, and being formed to expose the ends of the plate lugs downwardly in position to receive a casting, a spring plate slotted to form series of equalizing leaf-spring fingers in line with the respective compartments for engaging the lower edges of the plates, and a clamping bar under said plate for detachably securing the latter to said holder.

6. Casting apparatus comprising an upper holder for a preformed article, and a lower mold holder pivotally mounted to swing in a vertical plane upwardly into casting position and downwardly into mold-receiving position, said lower holder in its elevated position being separated from the upper holder by a space for accommodating a ladle mold carried by said lower holder.

7. Casting apparatus comprising an upper holder for a preformed article, a lower holder pivoted to swing in a vertical plane and adapted, in its upper position, to maintain a mold in casting position, means for yieldingly elevating said lower holder, and latch means for holding it depressed in an inoperative position.

8. Apparatus for casting terminals on battery plates comprising an upper rack for holding a group of the plates in inverted position, a ladle mold for casting the terminal upon the exposed ends of the downwardly-extending plate lugs, a lower holder mounted for movement in a vertical plane and formed as a water-jacket for said mold, and means for circulating water through said lower holder.

9. Casting apparatus comprising a water-jacketed cooling member, and a ladle having a bowl formed as a casting mold, said member and mold having separable, interfitting contact walls including a lug-forming portion on the mold.

10. Battery-terminal casting apparatus comprising a cooling member and a mold separably

mounted thereon, said member being formed with a socket, and said mold having a post-lug forming portion acting as a dowel in said socket.

11. Battery-terminal casting apparatus comprising a water-jacketed mold holder having an end socket and an external mold-engaging side face, and a terminal-casting mold separably mounted thereon and having a dowel in said socket and a lug-forming portion fitting said side face.

12. Casting apparatus comprising an upper holder for supporting in casting position an article to be cast upon, and a lower holder formed as a water-jacket having a cavity for receiving a portable ladle mold, said lower holder being mounted for movement away from the upper holder, into mold-receiving position, and for movement toward said upper holder, into operative position.

LUTHER M. PATTERSON.