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MANUFACTURE OF STORAGE BATTERY UNITS

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Fig. 1

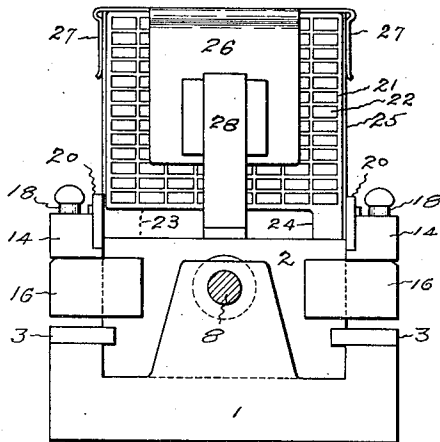


Fig. 4

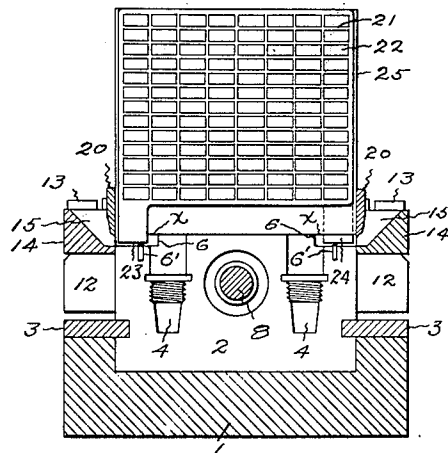


Fig. 2

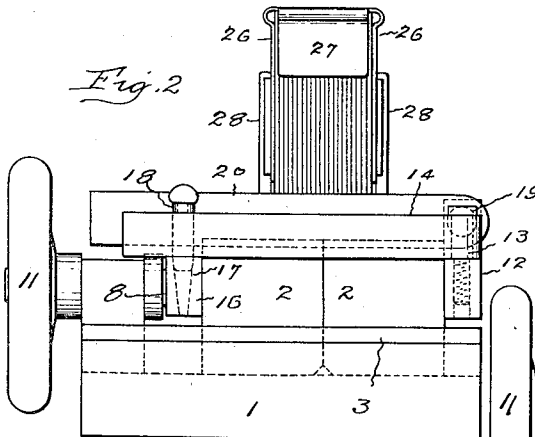


Fig. 5

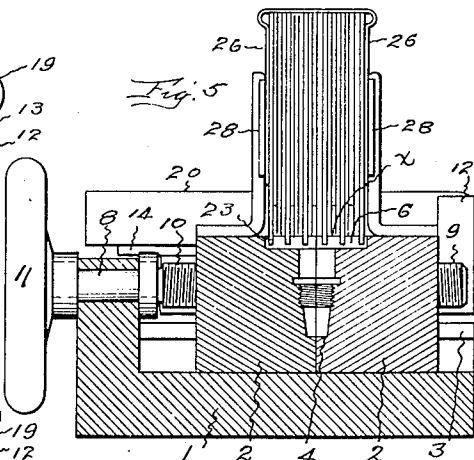


Fig. 3

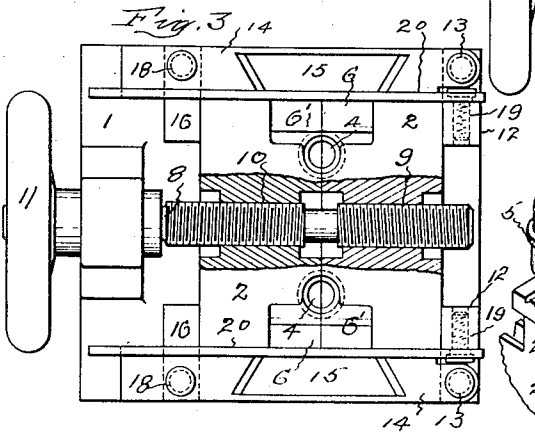


Fig. 6

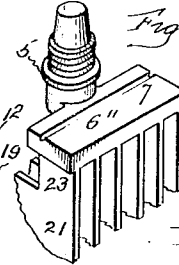
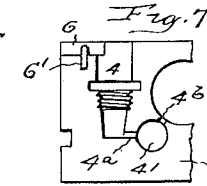


Fig. 7



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MANUFACTURE OF STORAGE BATTERY UNITS

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In the art of welding metal to a homogeneous state, it is well known that if molten metal be deposited on or in contact with a plate, block, or other mass of similar metal in non-molten condition, unless the latter be raised to a temperature approaching a molten state, deposited molten metal will not effect a weld, because the chilling surface of the sheet or other mass of non-molten metal causes solidification of the static molten metal at the places of contact incident to the heat absorption by the sheet or other mass of non-molten metal from the molten metal, and distribution of heat from more remote portions of the molten metal than the contacting portions is not sufficiently effective to penetrate solidified parts of the formerly molten metal and to raise the temperature of the contacted parts of the sheet or other mass of non-molten metal to the requisite condition for entering a homogeneous state or perfect weld with the molten metal. To obtain a perfect weld and avoid heat and other losses, the present invention provides for increasing the time of exposure of the non-molten mass to the direct action of the molten metal for a period prolonged beyond the action obtained when solidification of the molten mass is permitted upon contact with the non-molten metal, or when the molten metal is flowed freely across the non-molten metal.

A specific application is found in the constructing of the lead parts of a secondary cell, commonly referred to as a storage battery. It is common practice to construct the positive and negative plates with upstanding tabs, which are commonly referred to as lugs, and when the plates are assembled in the relation arranged in a cell, a strap is fused to the several lugs of all of the positive plates, and likewise a similar strap is welded to the several lugs of the negative plates, and each strap is formed with an upstanding post to receive the respective lead connector. Prior to the present invention, it has been common to cast the post and strap as a unit, and then "burn" the strap to the upstanding plate lugs. The fusing or burning is accomplished by the use of a torch requiring the services of a skilled oper-

ator. Attempts have been made to cast the post and strap in contact with the plate lugs and to cause the heat of the molten metal during the cast to form a union with the lugs, but prior to the present invention such attempts have not been successful for the reason indicated above, and particularly because the temperature of the plate lugs is not raised to the requisite degree for producing a weld, and straps cast in contact with plate lugs in accordance with the known practice have invariably required subsequent use of the torch for effecting the requisite fusing.

It is one of the essential objects of the present invention to effect a fusing of molten metal with non-molten metal by the use of the temperature of the molten metal, and, more specifically, to effect welding to a homogeneous state of a metal part being cast to a previously formed and non-molten metal part.

A further object of the invention is the prolongation of contact of molten metal with non-molten metal for effecting the welding action stated.

Another object of the invention is the effective anchorage of the strap and post to the respective group of battery plates while the plates are assembled in that relation assumed in a battery whereby all the parts to complete a cell may be assembled with the exception of the posts and straps and the latter cast with the parts so assembled.

A still further object of the invention is the relative location of the parts such that gravity is taken advantage of in the exposing of the non-molten metal part to the maximum heat of the molten metal being cast.

Further, and more generally speaking, the objects of the present invention include the provision of a method of and apparatus for uniting the plate lugs and straps of storage batteries in a manner enabling the doing away with the implements and appliances commonly employed for "burning" straps to battery plate lugs and the elimination of the dangers and injurious effects of workmen incident thereto as well as to effect the saving in labor, time, and equipment incident to such burning, whereby battery units may be

produced more quickly, cheaper, and more satisfactory than previously.

With these and numerous other more detailed objects in view, as will in part hereinafter become apparent and in part be stated, the invention comprises the art of welding by the utilization of the temperature of molten metal as the sole temperature raising agent.

The invention also comprises in greater detail the rendering of metal parts homogeneous at a place of contact incident to prolongation of contact of flowing molten metal with a non-molten metal part.

In still greater detail, the invention comprises uniting the lead parts of a storage battery by the casting of one of such parts in contact with a previously formed part under conditions delivering sufficient heat from the part being cast to raise the temperature of the previously formed part to a molten state or a state sufficiently approximating a molten condition to cause the previously formed part and the part being cast to blend to a condition of homogeneity.

The invention also comprises certain other novel steps and combinations of steps and certain novel constructions, combinations, and arrangements of parts as will hereinafter become apparent.

While it will be obvious that the invention is capable of being carried out by the utilization of any of numerous forms of apparatus and numerous arrangements of parts, a specific application of the invention can be best disclosed by reference to a particular, preferred mode of procedure and arrangement of parts. To this end, while not limiting the invention to the specific illustration now to be stated, the objects above expressed with other objects which will become apparent may be attained by the employment of a matrix formed of separable parts and held together during the operation and provided internally with the required recess and passage for the casting of a strap and post with the post spaced at one side of the line of the row of plate plugs to be united. The battery plates are assembled in that relation which they will assume in the finished battery, and when and if desired, separators may be inserted therebetween, and the two sets of plates, positive and negative, may also be interlaced so that a complete cell unit is assembled, however without the receptacle in which the unit is to be placed. Whatever group or groups of battery plates is or are assembled, the lugs of such plates are alined as usual, and when both negative and positive plates are grouped together there will be two lines of plate lugs, one at each end of the assembled unit. The matrix or mold will, of course, be provided with an opening for the introduction therein of the tips of the plate lugs in position to extend across the path of travel of the molten

metal flowing into position to form the post strap. When the parts are thus assembled, the molten metal is poured into the matrix at that side remote from the recess for the formation of the post, so that all of the metal to form the post and strap must flow past and in contact with the tips of the plate lugs, and, under some conditions, as will be hereinafter specified, a flow in excess of that represented by the bulk of metal eventually incorporated in the post and strap may be utilized. Furthermore, the metal flowing past the row of tips of plate lugs is preferably retarded in its progress by providing in the matrix an obstruction or part restricting the cross sectional area of the flow of molten metal at the place of contact with the lug tips. This restriction may be accomplished by the provision in the matrix of a riffle or dam across which the molten metal must flow and due to which the molten metal may not flow as rapidly and with the same cross sectional area as it would if the passage were unobstructed. The delayed progress of the flowing metal affords a time factor providing increased opportunity for heat distribution from the flowing metal to the non-molten lug tips until the temperature of such lug tips is raised to the requisite degree to cause the lug tips to become molten or substantially molten and to blend into the molten metal in the passageway provided for the casting of the strap, so that, when the cast is completed, the strap and post will be formed and the strap will be found to be integral with the plate lug tips.

It has been found by experiment and satisfactory tests that the results just stated may be obtained more readily and more satisfactorily by inverting the battery unit, so that the lug tips project downward into the mold or matrix and the riffle lies across the path of the flowing metal at the bottom of the passageway provided for the strap, so that the flowing metal must rise over the riffle and flow past the lug tips in contact with the lower portions of the lug as considered in their inverted position.

In the accompany drawings,—

Figure 1 is a view in front elevation of a mold and battery unit assembled in position for practicing the present invention, the shaft of the mold separating screw being seen in section and the operating hand wheel accordingly omitted.

Figure 2 is a side elevation of the same including the hand wheel.

Figure 3 is a plan view thereof with the battery unit omitted and a portion of the central part of the mold being broken away and parts seen in section.

Figure 4 is a vertical, central section through the parts seen in Figure 1, the battery unit being seen in elevation.

Figure 5 is a similar section taken on a

plane at right angles to the plane of the section in Figure 4.

Figure 6 is a detailed, detached perspective view of the completed post and strap with the battery plates shown fragmentarily and their lugs united as the completed product of the practicing of the invention.

Figure 7 is a view similar to Figure 4 of a fragment of a slightly modified embodiment of mold.

The present invention, of course, is susceptible of expression in numerous ways and is applicable to various metals, but is more particularly efficacious when applied to semi-soft or soft metals, the latter including lead and its alloys.

To facilitate a specific illustration of the carrying out of one embodiment of the invention, reference will be had to the structure illustrated in detail in the accompanying drawings in which 1 is the bed of the matrix, which is movably surmounted by the separable sections of a mold or matrix 2 constructed to be moved toward and from each other from a closed condition in contact to an open condition sufficiently spaced to release the cast parts. The bed 1 has plates 3 at its sides that enter slots in the sides of the mold sections 2 for guiding and retaining the mold sections on the bed. Each mold section 2 has one-half of two recesses 4 that are shaped to form terminal posts 5, and one-half of the recesses or channels 6 that are shaped to form connecting straps 7. Each channel 6 has its available cross sectional area diminished at one place by a cross bar or riffle 6' adapted to function as a dam, requiring flowing metal passing along the respective channel 6 to rise about the pendent plate lugs hereinafter mentioned into contact therewith in a thinner stream than would occur if the channel 6 were left unobstructed. This gives a longer direct exposure to molten metal. The mold is divided so as to be separable on a plane which passes through the centers of these recesses 4 and 6. A spindle 8 extends through the mold from front to back and has a right thread 9 in one section and a left thread 10 in the other section. On the front end of the spindle is a hand wheel 11. By turning the hand wheel the mold sections may be closed together or opened from each other.

Blocks 12 are fastened to the back of the rear mold section, and pivoted on these blocks by screw studs 13, so that they may be swung horizontally toward and from the sides of the mold, are gates 14. These gates have mouths 15 that open at their lower ends to the outer end of the respective strap recess or channel 6 in the mold. Blocks 16 are fastened to the front mold section and these blocks are provided with holes 17 for receiving pins 18 that may be used for retaining the gates in position. When the pins are re-

moved, the gates may be swung horizontally away from the sides of the mold.

Pivoted to the rear blocks 12 by screw studs 19, so as to be swung in a vertical plane across the mouths of the gates, are cutting blades 20. These blades, when the gates are swung out after the posts and straps have been cast, may be driven down so as to sever the excess metal from the edges of the straps.

In practicing one preferred specific application of the invention, the battery plates, comprised of grids 21 with the active material 22, are assembled with the lugs 23 of one group alined on one side and the lugs 24 of the other group alined on the other side in the usual way and with the separators 25 inserted between them. The plates and separators are then fastened together by a spring clip that has wings 26 which extend down the faces of the plates and wings 27 that extend down the edges of the plates. This clipped assembly of plates and separators is then placed in an inverted condition between arms 28 that are fastened to and extend up from the mold sections. In this position the plate lugs extend into the strap recesses or channels 6, as illustrated in Figures 1, 4 and 5. With the parts in this relation, the metal for forming the posts and the straps is poured into the mouths 15 of the gates 14. As this molten metal flows into the mouth 15, it enters the respective recess or strap channel 6 through a relatively narrow passage between the cutting edge of the respective bar 20 and the spaced material of the gate 14, which restricted opening limits the speed of flow of the molten metal and affords a proportionally greater opportunity for distribution of heat from such molten metal to contiguous parts. The molten metal moves along the recess or channel 6 until it strikes the riffle or dam 6', and then backs up until it rises and overflows the riffle 6'. In overflowing the riffle 6', the molten metal is caused to be delayed in its progress and also caused to move slowly across and in contact with contiguous surfaces of the respective plate lugs pendent into the channel 6. The flow continues until a sufficient quantity of the molten metal has passed beyond the inner terminal of the strap channel 6 into the post recess 4 to fill said recess. When this is done, sufficient molten metal is still admitted to the channel 6 to fill the channel, and then the supply of molten metal to the respective mouth 15 is discontinued. The gates 14 are then swung away, the knives 20 lowered to shear off the projecting flange of metal, and the mold sections 2 moved apart to release the newly cast parts. When this is done and the unit is removed, it will be found to be complete with the finished post 5 and strap 7 in each instance integral both between themselves and with the lugs of the battery plates, as clearly seen in Figure 6. A groove 6'' will also be found to exist in the strap 7

due to the presence of the riffle 6', but said groove 6'' is only an incident.

During the course of the flow of molten metal along the respective channel 6, as the melting point of the metal of the plate lugs 23 and the metal from which the post and strap is formed varies but little, the ends of the lugs are heated to the desired degree by the metal slowly passing the plate lugs on the way to the post cavity and by the time the inflowing metal fills the recesses and reaches the lines X on Figures 4 and 5, the tips of the lugs become fused and homogeneously unite with the metal which forms the connecting straps.

By this method of procedure and by the use of this mold the plates and the separators may be assembled in final relation and the terminal posts and connecting straps quickly cast and coincidentally united with the lugs of the plates, so that the unit is completed by simply casting the metal into the mold. This is accomplished in a minimum of time and at a minimum cost, and a battery unit produced which can be guaranteed as free from defective separators and loose connections.

While the assemblage illustrated in the accompanying drawings is that of a complete battery cell unit of plates and separators, and the parts are shown in an inverted position, all of which is the preferred practice and is, therefore, specifically set forth above, it is important to observe that the invention is not limited to the number of plates united or the relative location thereof or angular relation or disposition with respect to the parts of the matrix. Inversion of the plates is preferable for obtaining the best results with least inconvenience, but effective results may be produced with the plates otherwise located.

In Figure 7 is illustrated a slightly modified embodiment of mold corresponding in structure and operation in every particular with that illustrated in the other figures of the drawings, except that the mold sections 2' are provided with overflow recesses 4', each communicating by a port 4^a with the respective post forming recess. An air exhaust port 4^b leads from the overflow chamber 4' through the walls of the mold section 2' to the atmosphere to permit exhaustion of air with the incoming of molten metal. This modified structure possesses the capacity of having a greater quantity of molten metal poured into and passed along the strap forming channel than required for the formation of the post and strap, and with this provided excess flow of metal it is practicable to weld the finished cast strap to the plate lug tips without resorting to the retardation incident to the use of the riffle 6', but the said riffle 6' is preferably used as a further precaution. Furthermore, with the excess or overflow recess, it is entirely feasible to effectively weld

to a homogeneous mass a strap being cast and plate lugs extending into the strap channel even though such lugs be of greater thickness than average. It will be understood, of course, that the amount of heat required for effecting the desired welding will vary according to the bulk of the non-molten metal past which the molten metal must flow, and with increased bulk there must be an increase in the heat penetration to which the increased bulk is subjected to properly affect the same, which is obtained by an increase in the time element of exposure to the flowing molten metal. Therefore, when the overflow recess 4' is employed, there will be that additional exposure of the lugs to flowing molten metal represented by the amount of metal required to flow along the strap forming channel sufficient to fill the overflow recess 4', and then the regular exposure will occur incident to the additional flow required to form the post and strap. While Figure 7 illustrates only one of the post recesses as communicating with an excess or overflow recess 4', such an overflow recess will, of course, be provided for both posts when required for either.

In each instance, the practicing of the instant invention includes fusing parts formed of the same kind of metal by casting the molten metal at substantially the temperature of melting without added or superheated intensity, and the molten metal is not of a substantially different or appreciably higher melting point from that of the non-molten part.

The superheating of lead to cause fusing with a lead plate has been proposed, and it has also been proposed to fuse copper to cast iron by the heat of the molten iron; and it has further been proposed to fuse dissimilar metals by using as the molten metal a metal having a higher melting point than the non-molten metal; but in each instance undesirable conditions or results are to be found from the expense and extreme nicety of the operation or the uncertainty of uniformity in results. The present invention is characterized by enabling fusing of the same metal without superheating the molten metal, and affording uniform and dependable results whereby a perfect electrical and mechanical connection or union is invariably produced.

What is claimed is:—

1. The art of uniting metal parts, comprising flowing molten metal at substantially normal melting temperature of such metal in the course of casting the same to form a part and directing the path of flow to cause contact of the molten metal with a non-molten part of like metal, retarding the velocity of the flowing metal for prolonging maximum heat delivery from the molten metal to the non-molten part until fusion occurs between the formerly non-molten part and the molten

metal, and solidifying the parts in the fused condition.

2. The art of uniting metal parts, comprising flowing molten metal at substantially normal melting temperature of such metal in the course of casting the same to form a part and directing the path of flow to cause contact of the molten metal with a non-molten part of like metal, restricting the cross sectional area of the flowing metal at a place in its path of contact with the non-molten part for causing prolongation of maximum contact and heat delivery from the molten metal to the non-molten part until fusion occurs between the formerly non-molten part and the molten metal, and solidifying the parts in the fused condition.

3. In the art of assemblage of storage battery parts, locating a non-molten part of a battery in position for receiving a part to be added, casting the part to be added and, during the casting operation, deflecting the molten metal aside from its normal path to a fusing relation with a non-molten part, the deflecting action serving to prolong the period of heat transference from the molten metal to the non-molten part.

4. The art of assemblage of storage battery parts, comprising casting two parts of a storage battery in properly assembled relation to a third part of a storage battery, and during said casting operation causing the molten metal forming one of the cast parts to flow past and in contact with the third part more slowly than the normally free flowing of the molten metal and thereby raising the temperature of said third part for fusing with the second cast part, and continuing the flow of the molten metal until the cast of said second part is completed and fused to said third part.

5. The method of manufacturing storage battery units, comprising assembling battery plates in properly spaced relation, supporting the assembled group with the plate lugs in the path of casting metal, and casting a terminal post and connecting strap in a homogeneous junction with said strap and impeding the flow of molten metal from its normal rate for prolonging the fusing action of the cast.

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