March 17, 1942. C. A. CADWELL 2,276,823

RAIL BONDING APPARATUS

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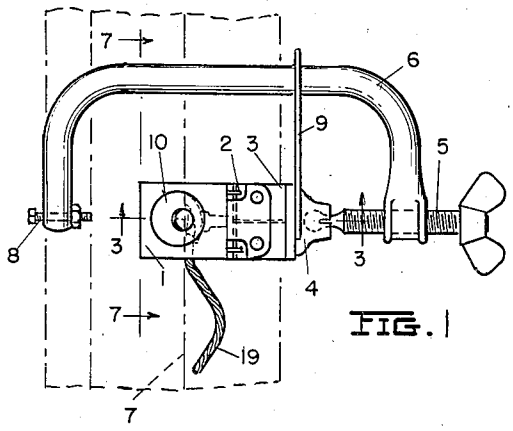


FIG. 1

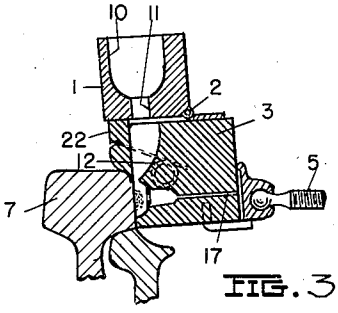


FIG. 3

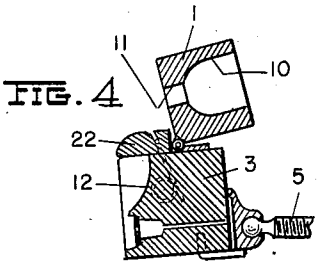


FIG. 4

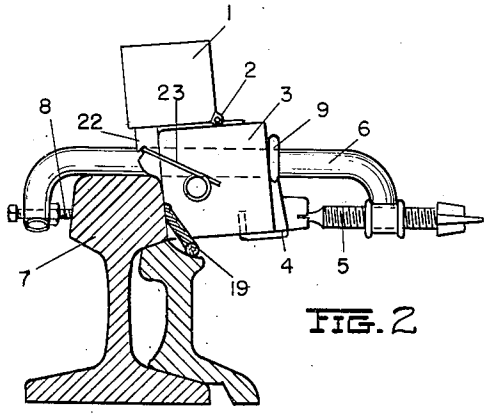


FIG. 2

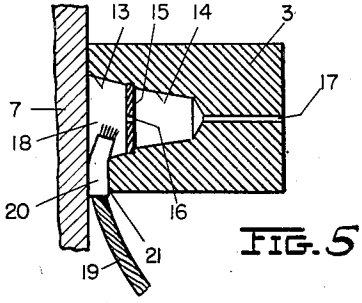


FIG. 5

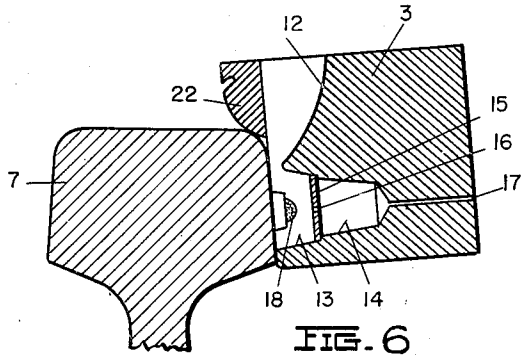


FIG. 6

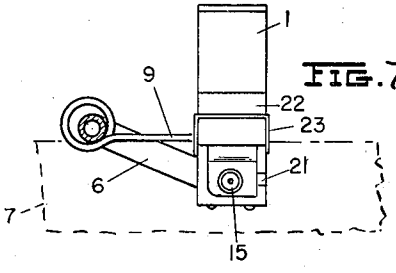


FIG. 7

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RAIL BONDING APPARATUS

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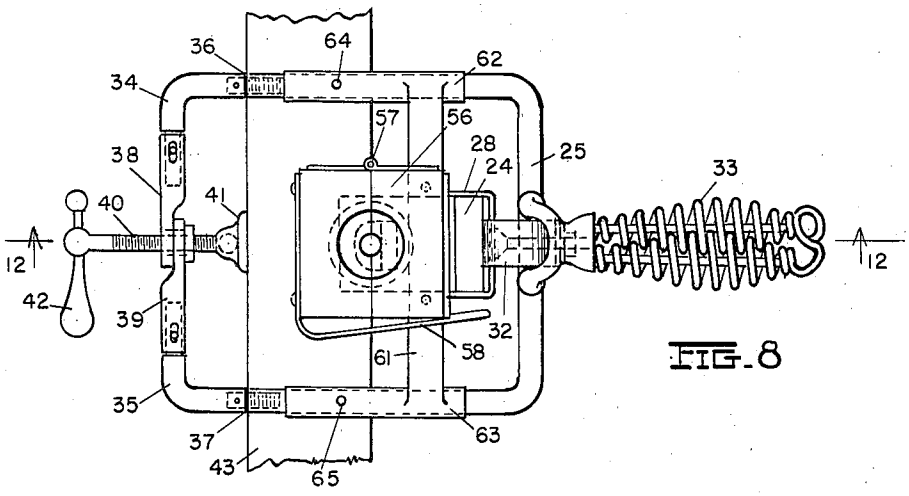


FIG. 8

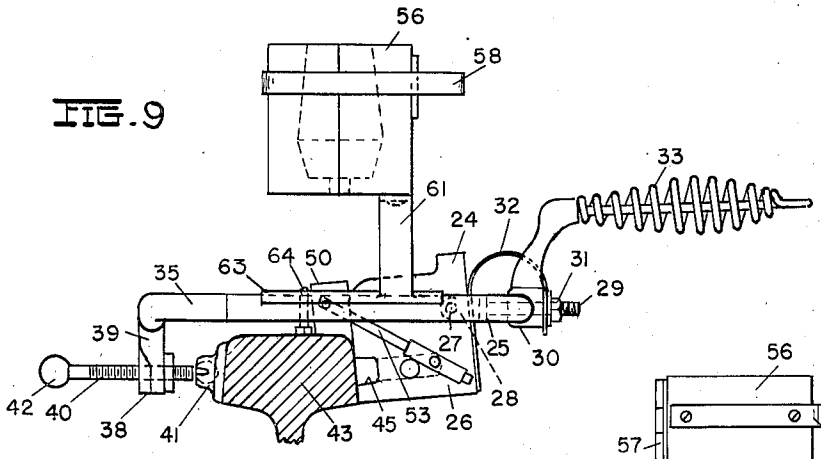


FIG. 9

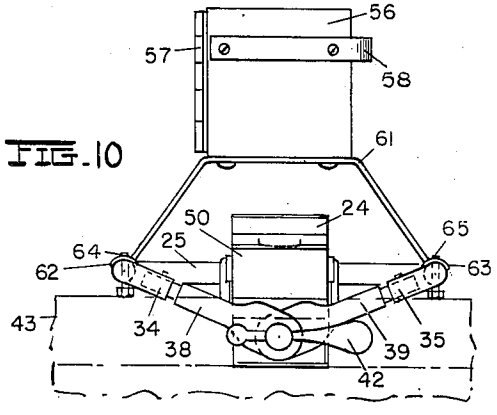


FIG. 10

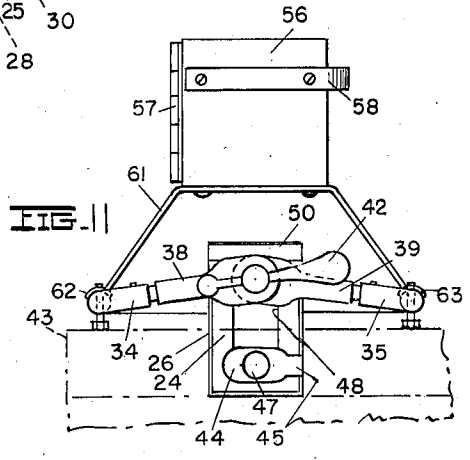


FIG. 11

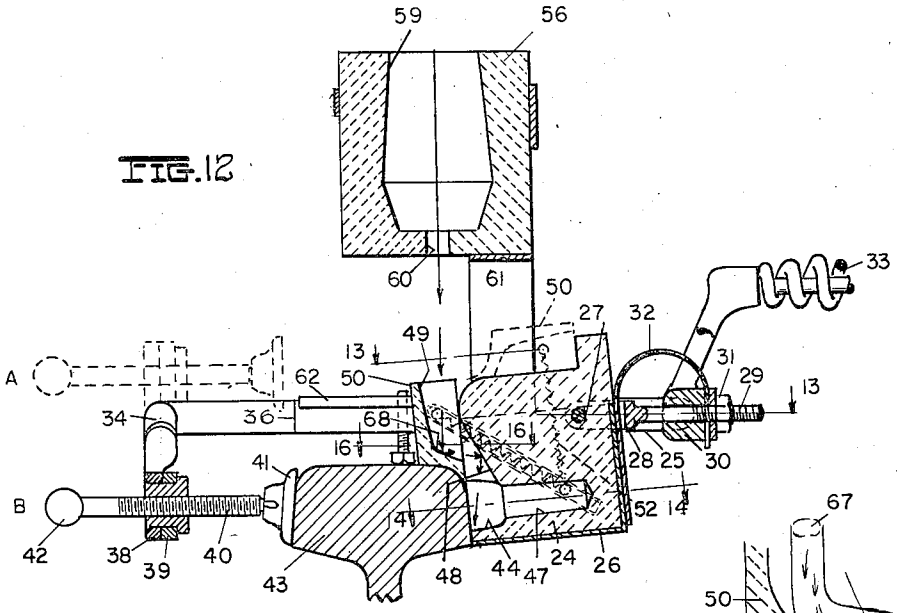
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RAIL BONDING APPARATUS

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FIG. 12



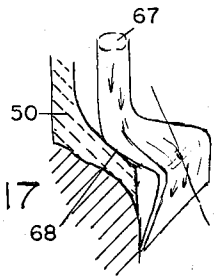


FIG. 17

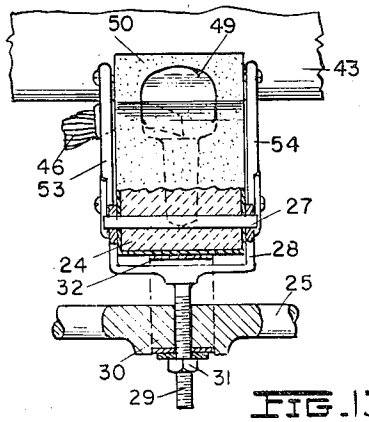


FIG. 13

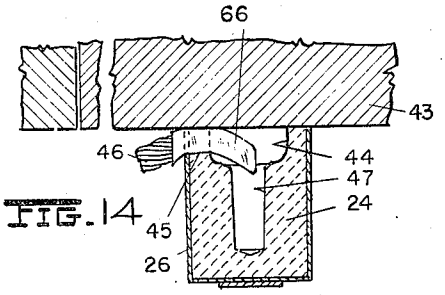


FIG. 14

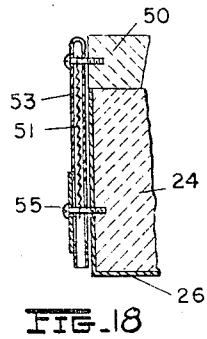


FIG. 18

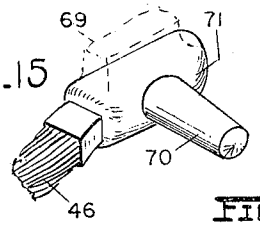


FIG. 15

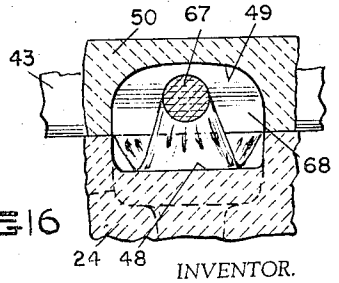


FIG. 16

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RAIL BONDING APPARATUS

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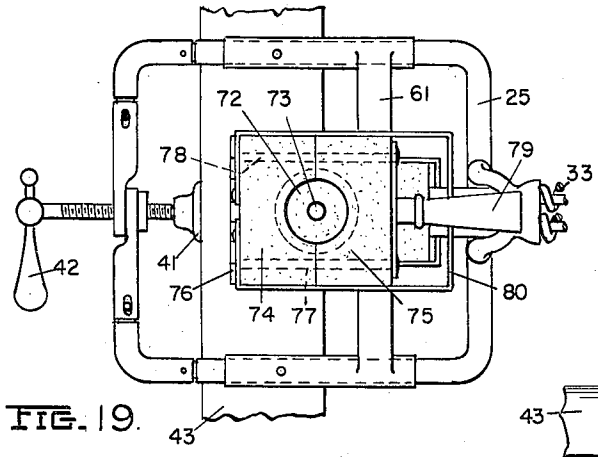


FIG. 19.

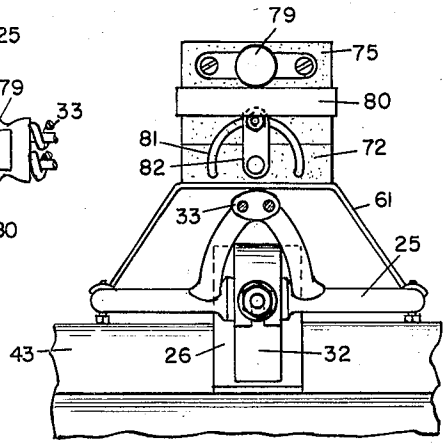


FIG. 20

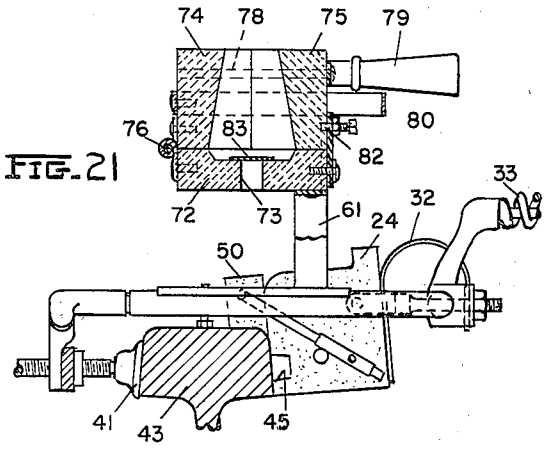


FIG. 21

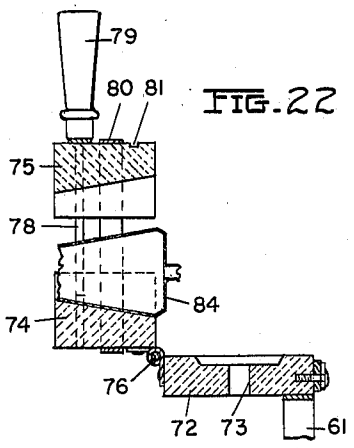


FIG. 22

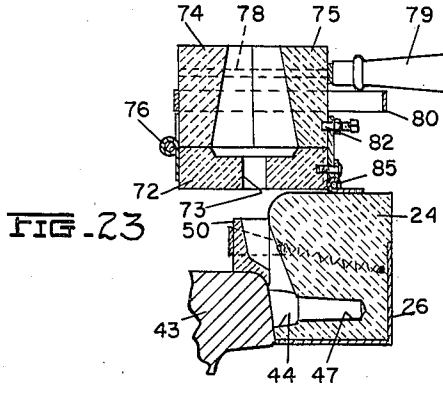


FIG. 23

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Patented Mar. 17, 1942

2,276,823

UNITED STATES PATENT OFFICE

2,276,823

RAIL BONDING APPARATUS

Charles A. Cadwell, Cleveland, Ohio, assignor to The Electric Railway Improvement Company, Cleveland, Ohio, a corporation of Ohio

Application December 13, 1940, Serial No. 370,015

21 Claims. (Cl. 22—116)

This invention relates as indicated to rail bonding apparatus, and more particularly to a form of apparatus designed for attaching railway signal conductors by cast welding the ends of such conductors to the rails. This application is a continuation in part of my co-pending application Serial No. 243,351, filed December 1, 1938, now Patent 2,262,755, dated Nov. 18, 1941 and also a continuation in part of application Serial No. 107,051, filed October 22, 1936, now Patent 2,238,926, dated Apr. 22, 1941.

Various means have been suggested by workers in the art for cast welding the ends of rail bonds to rails but such means have not generally been conducive to rapid attachment of the bonds nor uniform in the results afforded. As disclosed in my co-pending applications Serial No. 245,954, filed December 15, 1938 now Patent 2,229,045, dated Jan. 21, 1941, and Serial No. 243,394, filed December 1, 1938, I have developed a new method of attaching rail bonds involving the use of an exothermic reaction for the production of the necessary weld metal, and it is a particular object of the present invention to provide apparatus adapted for use in connection with such method.

It is a further object of this invention to provide apparatus which will be substantially self-adjusting and will properly position the ends of the conductor for attachment to the rail.

Another object is to provide such apparatus which will be readily removable from the rail head after the terminal has been cast without interference from any excess metal and slag which may be solidified in the sprue leading to the mold cavity in which the terminal is cast.

A further object of this invention is to provide means whereby a stream of molten metal may be conducted to a mold cavity in which the terminal is to be cast in a manner best calculated to form a sound terminal and without injury to the rail.

Other objects of this invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims, the annexed drawing and the following description setting forth in detail certain means and one mode of carrying out the invention, such disclosed means and mode illustrating, however, but one of various ways in which the principle of the invention may be used.

In said annexed drawings:

Fig. 1 is a top plan view of one embodiment of the apparatus of my invention indicating the manner in which the same is positioned on the rail head which is shown in outline;

Fig. 2 is a side elevational view of the same apparatus with the rail shown in cross section;

Fig. 3 is a sectional view taken along the line 3—3 on Fig. 1, showing the arrangement of parts in position for casting of the terminal;

Fig. 4 is a similar sectional view but showing the parts arranged for removal of the apparatus from the rail head after casting of the terminal;

Fig. 5 is an enlarged horizontal sectional view taken through the mold cavity of the mold block showing the manner in which the conductor end is positioned therein;

Fig. 6 is an enlarged vertical sectional view through the mold cavity;

Fig. 7 is an elevational view of the apparatus taken along the line 7—7 on Fig. 1;

Fig. 8 is a top plan view of another embodiment of my invention showing a form of apparatus especially useful in constricted places, as adjacent switches, crossings, and the like;

Fig. 9 is a side elevational view of the apparatus of Fig. 8;

Fig. 10 is an end view of such apparatus showing the clamping means in rail engaging position;

Fig. 11 is a view similar to Fig. 10 but showing the clamping means in elevated position to permit withdrawal of the mold from the face of the rail;

Fig. 12 is a sectional view taken along the line 12—12 on Fig. 8;

Fig. 13 is a fragmentary top view showing the mold supporting means taken along line 13—13 on Fig. 12;

Fig. 14 is a sectional view through the mold cavity taken along the line 14—14 on Fig. 12;

Fig. 15 is a perspective view of a cast terminal prior to removal of the overflow lug;

Fig. 16 is a somewhat diagrammatic sectional view taken along the line 16—16 on Fig. 12, showing the flow of molten metal down the sprue passage;

Fig. 17 is a diagrammatic view illustrating the manner in which the stream of molten metal is spread or fanned out;

Fig. 18 is a fragmentary sectional view showing the construction of the means whereby the movable block is attached to the mold block proper;

Fig. 19 is a top view similar to Fig. 8 but illustrating another type of crucible;

Fig. 20 is an end view of the assembly including such crucible;

Fig. 21 is a side elevational view of such assembly with the crucible in cross-section;

Fig. 22 is a sectional view of the crucible opened to permit removal of slag; and

Fig. 23 is an elevational view in cross-section showing such crucible mounted on a mold block in the manner illustrated in Figs. 1–7.

Referring now more particularly to the drawings, and especially Figs. 1 and 2, one embodiment of the apparatus of this invention comprises a crucible block 1 attached by means of a hinge 2 to a mold block 3. This mold block is supported in an iron mount 4 pivotally carried on the end of a screw member 5 which is threaded in one end of a curved frame piece 6 spanning the rail head 7 and engaging the side of the rail head opposite to that contacted by the mold block. An adjustment is provided in the form of a screw 8 by which such frame piece may be adapted to varying widths of rail head so as to properly position the mold block. Undue rotation of such block on its pivotal mount is prevented by means of a cross brace 9, one end of which loosely encircles frame piece 6. The mold block is thus enabled to adapt itself to slight differences in inclination of the rail heads.

The crucible block, generally of graphite, is hollowed out to form the crucible 10 which is adapted to communicate by means of a hole 11 at its bottom with the sprue opening 12 which is hollowed in the face of the mold block 3. Such sprue opening communicates with the mold cavity 13 in which the bond terminal is to be cast. When metallic copper produced by an exothermic reaction is to be employed, for example, in the casting of the terminal, such mold cavity may desirably be extended to form a further inner cavity 14 separable from the mold cavity proper 13 by means of a graphite disk 15 perforated in its center to provide a small opening 16. A small hole 17 leads from the further extremity of such inner cavity to the outer air in a hollow space beneath the iron mount 4. These particulars of the mold cavity are best shown in Figs. 5 and 6 which also indicate the position of the conductor end 18 in the mold cavity, the body of the conductor 19 adjacent such end being enclosed in a metal sleeve 20. The rail contacting face of the mold block is suitably hollowed to form a smaller cavity 21 extending from the mold cavity to an adjacent end of the mold block and adapted to closely fit the sleeve portion of the bond.

Between the top of the rail head and the crucible block 1 is a movable member 22 pivotally or swingably attached to such mold block by means of a resilient member in the form of a spring 23. As best shown in Fig. 4, this movable member, which is also of graphite, may be slid to the upper surface of the mold block after first swinging back the crucible block upon its hinge. As a result of the above-described construction, it will be seen that the sprue passage 12, in addition to having its lower portion open to the rail contacting face of the mold block, can be further opened or exposed by swinging or sliding the movable member or gate 22 from the position shown in Fig. 3 to that shown in Fig. 4, thereby facilitating removal of the mold from the rail upon completion of the welding operation after which any excess metal or slag which has solidified in the sprue may be conveniently removed from the main body of the bond terminal by a blow of a chisel.

When employing an exothermic charge of the type disclosed in my co-pending application Serial No. 245,954, a metal slug or gate is placed in the bottom of the crucible 10 and such exothermic charge and ignition material placed in the crucible. Upon ignition of the charge such metal gate is melted and the highly heated welding metal passes through sprue 12 into the mold cavity 13. When an inner cavity, such as 14, is provided, a portion of the molten metal will pass through the opening 16 in the graphite disk to fill such inner cavity. This has the effect of permitting the first portion of the charge to sufficiently heat the face of the rail head to ensure that it is properly interfused with such face. The mass of the thin graphite disk 15 is so small that a temperature approximately equal to that of the inflow metal is instantly acquired by the disk, and due to the position of the hole in the disk relative to the end 18 of the conductor the high velocity of the stream of metal flowing against and through the disk carries away from about the end of the conductor what would otherwise be relatively cold shot metal lying against the strands and permits fresh hot metal to fill the interstices between and join with the strands, and so produce the desired weld. The small opening 17 permits the escape of the air in the inner chamber and also the escape of gases given off by the molten weld metal and which would otherwise tend to render such metal spongy upon solidification.

The apparatus of this invention, and particularly the mold above described, has been found to be particularly advantageous when employed in the cast welding of stranded copper conductors to steel rails, such process having previously been attended with considerable difficulty in obtaining a terminal which was mechanically sound without injury to the rail head due to local overheating. Upon removal of the mold block in the manner above indicated, that part of the weld metal which has solidified in the inner overflow cavity may be readily removed by a sharp blow of a hammer since it is entirely separated from the main body of the weld by the graphite disk except for the slight amount of metal contained in the hole in said disk. A smooth bond terminal of minimum size is thus obtained.

The inner wall of the sprue passage 12 will desirably be somewhat inclined towards the face of the rail head so that the molten metal passing therethrough will be caused to impinge on the rail head at a distinct angle. It has been found that if superheated copper from an exothermic reaction be caused to impinge on a steel surface at an angle substantially normal to such surface, there is a distinct danger of overheating the steel and reducing the ability of the latter to sustain the stresses to which a rail is subjected in use. This is particularly true when the stream of metal is relatively narrow and strikes only a small localized area of the rail head. On the other hand, if the stream of molten copper is caused to enter the mold cavity in such a manner that it fails to impinge on the steel surface at all, insufficient interfusion of the two metals is likely to result. The mold of this invention has therefore been constructed so as to cause the molten copper to impinge at a slight angle on the face of the rail head.

This mold assembly comprising complementary elements of refractory material which cooperate to define the sprue opening leading upward from the main mold cavity permits of rapid removal

after casting of the terminal without damage to the apparatus. The removal of slag from the sprue and cleaning of the interior are also greatly facilitated.

Referring now to Figs. 8 to 18 inclusive and particularly Figs. 8, 9 and 12, another embodiment of my invention is here illustrated having certain elements further modified as will be explained below. This apparatus comprises a mold block 24 and a tubular supporting frame 25 operative to hold such mold block in clamping engagement with the face of the rail. The lower portion of such block will desirably be encased in a metal shell 26 which may be fitted or preferably cast in place, such shell serving to prevent possible fracture of the graphite block during use. A pin 27 passes through the block and the upper portion of such shell, supporting the same in clevis 28 which in turn is carried on the end of threaded rod 29 passing through a boss 30 in the frame 25. A nut 31 is employed to secure such rod in place and also secure the end of leaf spring 32 which is operative to bear on the rear of the block 24. A handle 33 attached to frame 25 is provided for ready manipulation of the device.

Means for clamping the mold to the rail comprise angular extensions 34 and 35 of frame 25 pivotally mounted in such frame at joints 36 and 37 and overlapping members 38 and 39 slidably held in the respective ends of such extensions. A rod 40 having a high pitched thread is inserted in similarly threaded holes in the overlapping portions of such members carrying a loosely pivotally mounted clamping foot 41 at its inner end and having an unbalanced handle 42 at its outer end. Upon depressing rod 40 as best shown in Figs. 9 and 10 the foot 41 is brought into position to engage the side of the rail head 43 and when it is desired to remove the apparatus from the rail such clamping means is elevated as shown in Fig. 11. (Also, see Fig. 12 where the dash line A position is that of Fig. 11 and the solid line B position corresponds to Fig. 10.) The mold may then be withdrawn from the face of the rail and the apparatus moved. It will be apparent from the foregoing that such apparatus may be employed in very constricted places since, when it is desired to remove the same, only the mold block is below the level of the rail head.

The rail engaging face of mold block 24 is hollowed out to provide the mold cavity 44 in which the terminal is cast, with a smaller cavity 45 communicating with an adjacent end of the mold block and adapted to fit the body of the conductor 46 as shown in Fig. 14. When employing molten copper from an exothermic reaction as the welding metal it is desirable to provide an overflow cavity 47 communicating with the main mold cavity 44 except in the case of the smallest sizes of signal bonds. The function of such overflow cavity is explained below. A sprue passage 48 is also provided leading upwardly from mold cavity 44, such passage being partly in the face of block 24 and partly formed by the complementary hollow 49 in the inner face of movable block 50. Springs 51 and 52 hold such movable block in close resilient engagement with the face of block 24 and permit such movable block to be slid up out of the way to the position illustrated in Figs. 11 and 12. Tubular metal shields 53 and 54 enclose and protect such springs, particularly from damage by molten metal, such shields being slidably mounted on pins such as 55 (see Fig. 18).

A crucible 56 is provided for use in cooperation with the above described mold, such crucible being vertically divided into two halves joined by a hinge 57. A snap spring 58 serves as a catch to keep the two halves in cooperative engagement. The inner wall 59 of the crucible tapers as shown in Fig. 12 to aid in avoiding spattering during the exothermic reaction. As a result, removal of the shell of slag usually left therein would be difficult if it were not for the fact that the crucible is thus split. A short sprue or tap hole 60 is provided in the bottom of the crucible which is closed in use with a metal gate which will be melted by the heat of the reaction. An arch or bridge 61 supports the crucible in position so that the stream of molten metal dropping from tap hole 60 will fall into the sprue passage formed by the hollow 49 in movable block 50. The arch is carried on semi-cylindrical feet 62 and 63 resting on frame 25 and positioned thereon by engagement of small pins 64 and 65 in holes through such feet. The heads of these pins are adapted to rest on the head of the rail.

Referring now particularly to Fig. 12, the operation of this form of apparatus may be explained as follows: The frame is rested on the rail head and the end of the conductor cable, suitably encased in a sleeve 66, is positioned in the mold cavity as illustrated in Fig. 14. Rod 40 is depressed and rotated to bring foot 41 into clamping engagement with the side of the rail head opposite to that engaged by the mold, as shown in solid line in Fig. 12, thereby firmly holding the conductor in place. Spring 32 permits the slight automatic adjustment necessary in order that the mold may accommodate itself to minor differences in inclination of the side of the rail head. Movable block 50 is positioned as shown in solid line in Fig. 12. In the meantime crucible 56 has been charged with the material for producing the exothermic reaction, a metal gate closing the tap hole, and supporting feet 62 and 63 are properly registered on frame 25. Upon ignition of the charge the gate is melted and the stream of molten metal drops into sprue passage 49, 48, and thence into the mold cavity 44. This molten stream 67 first strikes step 68 of block 50 where it spreads as diagrammatically illustrated in Figs. 16 and 17. The fanned out stream then strikes the inclined inner wall of sprue passage 48 and enters the mold cavity as a ribbon-like stream to impinge at an angle to the rail head. The major portion of the metal which first enters the mold cavity forces its way around the end 66 of the conductor into overflow cavity 47 so that the body of metal which forms the terminal finds the rail head, conductor end, and mold cavity well heated upon arrival and a homogeneous weld is produced without the occurrence of cold shot metal or incomplete coverage. A conductor of the type illustrated will desirably be employed having a recurved end adapted to terminate centrally of the entrance to the overflow cavity so that the metal passing into such overflow chamber must flow past the end of the conductor. After the casting of the terminal, block 50 is slid up into dotted line position and clamp 41 released and elevated to dotted line position (Fig. 12). The mold block is then withdrawn by a short horizontal movement to the right as viewed in such figure, leaving a terminal substantially as illustrated in Fig. 15. Some slag 69 will usually have accumulated above the metal and may easily be removed by a blow from a chisel. The stud 70 of overflow metal

may be detached from the body 71 of the terminal by nicking the same closely adjacent the point of juncture and giving it a sharp rap with a hammer.

It will be seen from the foregoing that apparatus has thus been provided which is quickly and conveniently applicable even in restricted places and which enables the employment of a method whereby a firm and solid terminal is obtained without danger of gouging or overheating the rail head. Various other advantages are fully apparent from the above description.

Referring now to Figs. 19 to 23 inclusive, the crucible employed in the apparatus assembly of this invention may be further modified as therein illustrated. Such crucible may be mounted on the bridge 61 as is crucible 56 and comprises a bottom portion 72 with a sprue opening or tap hole 73 and an upper portion separable along a vertical line into two wall portions 74 and 75. Wall portion 74 is connected to the bottom portion of the crucible by a hinge 76 and to wall portion 75 by pins 77 and 78 permitting relative lateral movement of such wall portions (see Fig. 22). A handle 79 is provided to facilitate manipulation of the crucible parts, and a metal band 80 attached to wall portion 74 encircles the crucible and prevents withdrawal of portion 75 from the pins. A catch comprising a semi-circular groove 81 in portion 75 and an arm 82 pivotally mounted on bottom portion 72 may be employed although not absolutely necessary since relative movement of the component parts may be made quite frictional.

In operation, the upper portion of the crucible is pivoted as a unit on hinge 76 and a metal slug or gate 83 placed over the sprue opening. The crucible is then closed (see Fig. 21) and charged with the exothermic powder. Upon ignition of the powder the reaction takes place forming a mass of superheated metal which melts the slug and drops into the mold cavity. A layer or shell of slag 84 is left in the crucible which would be difficult of removal if it were not for the form of construction employed. The crucible is opened out as shown in Fig. 22, the slag shell removed, and a new slug placed over the sprue opening. It is much simpler to properly place such slug when the crucible is thus divided along a horizontal line adjacent its bottom than when the slug must be dropped into a crucible and positioned by means of a rod, pencil, or the like. It has also been found that metal produced in a crucible of this type forms a particularly homogeneous and non-porous weld without the occlusion of nitrogen gas as otherwise sometimes occurs. This beneficial effect is apparently due to the venting of gases during the reaction through the narrow passage left between the bottom portion and upper portion of the crucible as indicated by stains therein. The same benefit does not accrue when the crucible is merely split along a vertical line. Since the crucible tapers inwardly toward the upper opening or neck undue spattering is avoided during the rather violent reaction. When hinged directly to the mold block as by hinge 85 in the manner indicated in Fig. 23, the device may be operated in a manner generally similar to that of Figs. 1–7, the crucible being tipped back to permit the raising of movable block 50. It is then tipped back, opened up, the slag shell removed and a new slug placed in position. Obviously such crucible, while particularly desirable as a component part of the apparatus of this invention, is adapted for use generally where similar problems are encountered.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

1. A mold for cast welding the end of a rail bond conductor to a rail comprising a block of refractory material having a main cavity in one face thereof wherein the bond terminal is adapted to be cast and another cavity extending to an adjacent side of said block adapted to closely fit the body of the bond with the end of the latter extending into such main cavity, a sprue passage leading from the upper portion of said block to said main cavity, at least a portion of said passage being open to the rail contacting face of said block, and a movable member operative to enclose such open portion of said passage.

2. A mold for cast welding the end of a rail bond conductor to a rail comprising a block of refractory material having a main cavity in one face thereof wherein the bond terminal is adapted to be cast and another cavity extending to an adjacent side of said block adapted to closely fit the body of the bond with the end of the latter extending into such main cavity, a sprue passage leading from the upper portion of said block to said main cavity, at least a portion of said passage being open to the rail contacting face of said block, and a movable member operative to enclose such open portion of said passage, said member being swingably connected with said block.

3. A mold for cast welding the end of a rail bond conductor to a rail comprising a block of refractory material having a main cavity in one face thereof wherein the bond terminal is adapted to be cast and another cavity extending to an adjacent side of said block adapted to closely fit the body of the bond with the end of the latter extending into such main cavity, a sprue passage leading from the upper portion of said block to said main cavity, at least a portion of said passage being open to the rail contacting face of said block, and a movable member operative to enclose such open portion of said passage, said member being hingedly connected with said block about a horizontal axis.

4. A mold for cast welding the end of a rail bond to a rail, said mold comprising a block of refractory material having a recessed face conforming to the face of the rail to which the bond is to be attached, the recess in such mold face comprising a main cavity wherein the terminal is cast, and a smaller cavity extending to an adjacent end of the mold adapted to closely fit the body of the bond with its end extending into such main cavity, a sprue passage leading from above to said cavity, and a movable block adapted in one position to laterally close a portion of such passage and in another position to leave the same exposed.

5. A mold for cast welding the end of a rail bond to a rail, said mold comprising a block of refractory material having a recessed face conforming to the face of the rail to which the bond is to be attached, the recess in such mold face comprising a main cavity wherein the terminal is cast and a smaller cavity extending to an adjacent end of the mold adapted to closely fit the

body of the bond with its end extending into such main cavity, a sprue passage leading from above to said cavity, and a movable block swingably attached to said mold adapted in one position to laterally close a portion of such passage and in another position to leave the same exposed.

6. A mold for cast welding the end of a rail bond to a rail, said mold comprising a block of refractory material having a recessed face conforming to the face of the rail to which the bond is to be attached, the recess in such mold face comprising a main cavity wherein the terminal is cast and a smaller cavity extending to an adjacent end of the mold adapted to closely fit the body of the bond with its end extending into such main cavity, a sprue passage leading from above to said cavity, a movable block adapted in one position to laterally close a portion of such passage, and a resilient member swingably connecting said block with said mold, whereby such passage may be exposed.

7. A device for cast welding a rail bond conductor to a rail comprising a mold with an open cavity in its rail-engaging face adapted to hold an end of said conductor, a sprue opening to said mold cavity, said sprue opening also being open to the rail-engaging face of said mold, a crucible hingedly mounted above said sprue opening and communicating therewith by means of a hole in the bottom of said crucible, a slidable block closing the open side of said sprue opening, and clamping means whereby the open face of said mold may be held in engagement with the side of the rail head.

8. A device for cast welding a rail bond conductor to a rail comprising a mold with an open cavity in its rail-engaging face adapted to hold an end of said conductor, a sprue opening leading to said cavity, a further cavity at the back of said mold cavity proper and a small hole leading from said further cavity to the exterior of the mold block, a crucible hingedly mounted above said sprue opening and communicating therewith by means of a hole in the bottom of said crucible, a slidable block closing the open side of said sprue opening, and clamping means whereby the open face of said mold may be held in engagement with the side of said rail head.

9. A device for cast welding a rail bond conductor to a rail comprising a mold with an open cavity in its rail-engaging face adapted to hold an end of said conductor, a sprue opening leading to said cavity, said sprue opening also being open to the rail-engaging face of said mold, a further cavity at the back of said mold cavity proper and separated therefrom by a thin graphite disk with a hole in its center, a small hole leading from the extremity of said further cavity to the exterior of the mold block, a crucible hingedly mounted above said sprue opening and communicating therewith by means of a hole in the bottom of said crucible, a slidable block closing the open side of said sprue opening, and clamping means whereby the open face of said mold may be held in engagement with the side of said rail head.

10. A device for cast welding a rail bond conductor to a rail comprising a mold with an open cavity in its rail-engaging face adapted to hold an end of said conductor, a sprue opening leading to said cavity, a further cavity at the back of said mold cavity proper and separated therefrom by a thin graphite disk with a hole in its center, a small hole leading from the extremity of said further cavity to the exterior of the mold block, and clamping means whereby the open face of said mold may be held in engagement with the side of said rail head.

11. A mold assembly for cast welding the end of a rail bond conductor to a rail comprising complementary elements of refractory material, one of such elements having a main cavity in that portion of its principal face adapted to engage the rail wherein the bond terminal is adapted to be cast, the other of said complementary elements being in contact with another portion of such principal face of said first-named element and defining therewith a sprue opening leading upward in said assembly from said main cavity.

12. A mold assembly for cast welding the end of a rail bond conductor to a rail comprising complementary elements of refractory material, one of such elements having a main cavity in that portion of its principal face adapted to engage the rail wherein the bond terminal is adapted to be cast, the other of said complementary elements being removably held in contact with another portion of such principal face of said first-named element and defining therewith a sprue opening leading upward from said main cavity.

13. In combination, a device for cast welding a rail bond conductor to a rail comprising a mold with a cavity in its rail-engaging face adapted to hold an end of such conductor, a sprue opening leading to such cavity, a further cavity communicating with such first-named cavity and adapted to receive weld metal in excess of that required for the bond terminal; said cavities being so disposed that an end of such rail bond conductor held in said first-named cavity will block a portion of the entrance to said further cavity, and clamping means whereby to hold said mold in engagement with the rail.

14. In combination, a mold comprising a block of refractory material having a rail engaging face, a main cavity in such face wherein the bond terminal is adapted to be cast, a smaller cavity extending to an adjacent end of the mold block adapted to closely fit the body of a bond with the end of such bond extending into said main cavity, a sprue passage leading from above to said main cavity; and a crucible adapted to communicate at its lower end with said sprue passage, said crucible being separable into two component parts.

15. In combination, a mold comprising a block of refractory material having a rail engaging face, a main cavity in such face wherein the bond terminal is adapted to be cast, a smaller cavity extending to an adjacent end of the mold block adapted to closely fit the body of a bond with the end of such bond extending into said main cavity, a sprue passage leading from above to said main cavity; and a crucible adapted to communicate at its lower end with said sprue passage, said crucible being vertically separable into two component parts.

16. A mold for cast welding a rail bond conductor to a rail comprising a block of refractory material with a cavity in its rail-engaging face adapted to hold an end of such conductor, a movable block in one station abutting against the face of said first-named block above such cavity, and a sprue passage leading upwardly from such cavity partly in said first-named block and partly in said movable block.

17. A mold for cast welding a rail bond con-

ductor to a rail comprising a block of refractory material with a cavity in its rail-engaging face adapted to hold an end of such conductor, a movable block in one station abutting against the face of said first-named block above such cavity, a sprue passage leading upwardly from such cavity partly in said first-named block and partly in said movable block, and inclined faces in said passage adapted to spread a stream of molten metal passing therethrough.

18. A mold for cast welding a rail bond conductor to a rail comprising a block of refractory material with a cavity in its rail-engaging face adapted to hold an end of such conductor, a movable block in one station abutting against the face of said first-named block above such cavity, a sprue passage leading upwardly from such cavity partly in said first-named block and partly in said movable block, and inclined faces in said passage adapted to spread a stream of molten metal passing therethrough and cause such spread stream of metal to impinge against the surface of the rail at an angle thereto.

19. A crucible for use with exothermic reactions having a sprue opening in the bottom thereof, said crucible comprising two complementary portions together defining a cavity having walls tapering inwardly toward the upper opening of said crucible, said complementary portions being separable along a substantially vertical line passing through such sprue opening.

20. In combination, a mold comprising a block of refractory material having a rail engaging face, a main cavity in such face wherein the bond terminal is adapted to be cast, a smaller cavity extending to an adjacent end of the mold block adapted to closely fit the body of a bond with the end of such bond extending into said main cavity, a sprue passage leading from above to said main cavity; and a crucible having a sprue opening at its lower end positioned to communicate with said first named sprue passage, said crucible being vertically separable into two component parts along a line passing through such sprue opening in the lower end thereof.

21. A device for cast welding a rail bond conductor to a rail comprising a mold block with an open cavity in its rail-engaging face adapted to hold an end of said conductor, a movable block in contact with the face of said mold block above said cavity and defining therewith a sprue opening leading upward from said cavity, a crucible mounted above said mold block and communicating with said sprue opening by means of a hole in the bottom of said crucible, and clamping means operative to hold the open face of said mold in engagement with the side of the rail.

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