United States Patent

[11] **3,554,270**

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[54] **METAL CASTING APPARATUS AND METHOD**
11 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **164/108,** 164/111, 164/334, 164/337, 49/98, 249/90, 249/108
[51] **Int. Cl.** **B22d 19/00**
[50] **Field of Search** ..... 249/125, 129, 130, 84, 85, 98, 105, 108(Cursory), 999; 164/333, 334, 54, 335—337, 332(All), 111, 108

[56] **References Cited**

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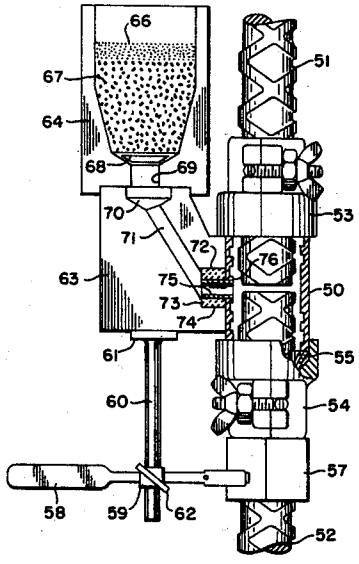
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ABSTRACT: Thermite casting apparatus particularly for joining reinforcing bar including a sleeve mold surrounding the bar ends into which metal is cast and having a generally central tap hold of a predetermined size; a crucible and pouring basin for introducing the cast metal into such sleeve, the latter including a disposable ceramic sleeve insert snugly fitted in the exit end of the pouring basin passage to maintain the exit aperture thereof in proper correspondence to the tap hole in the sleeve.



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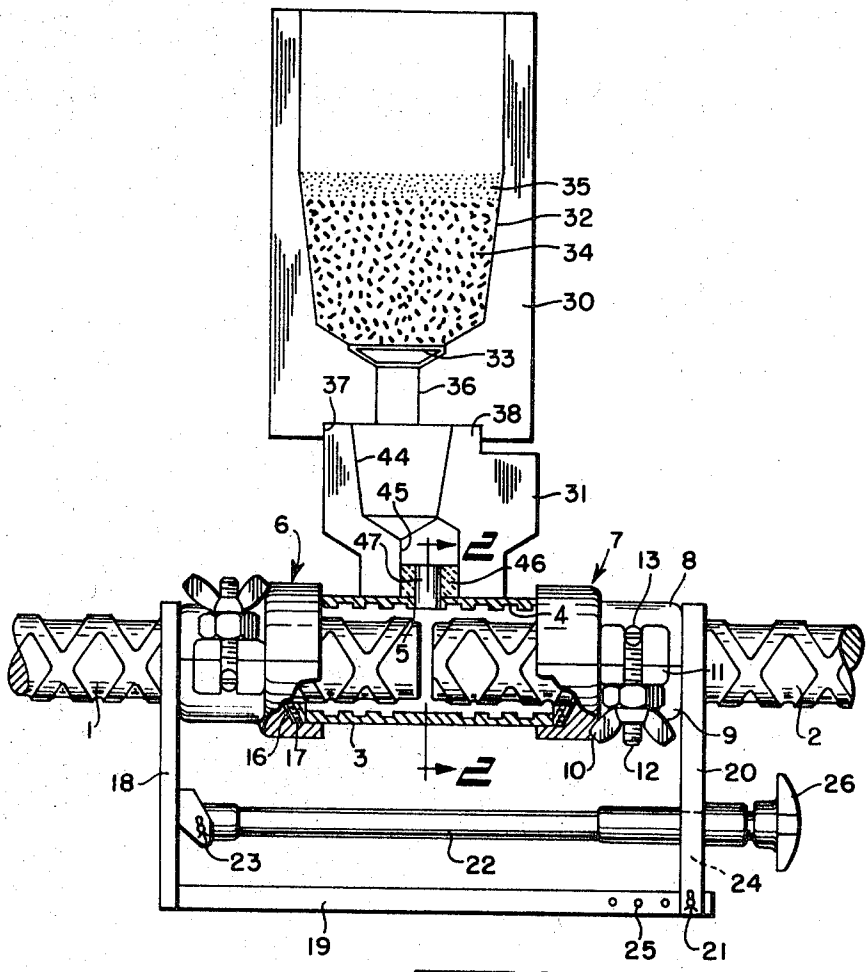


Fig. 1

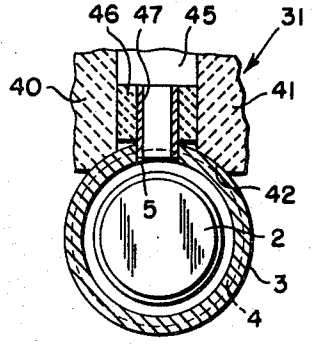


Fig. 2

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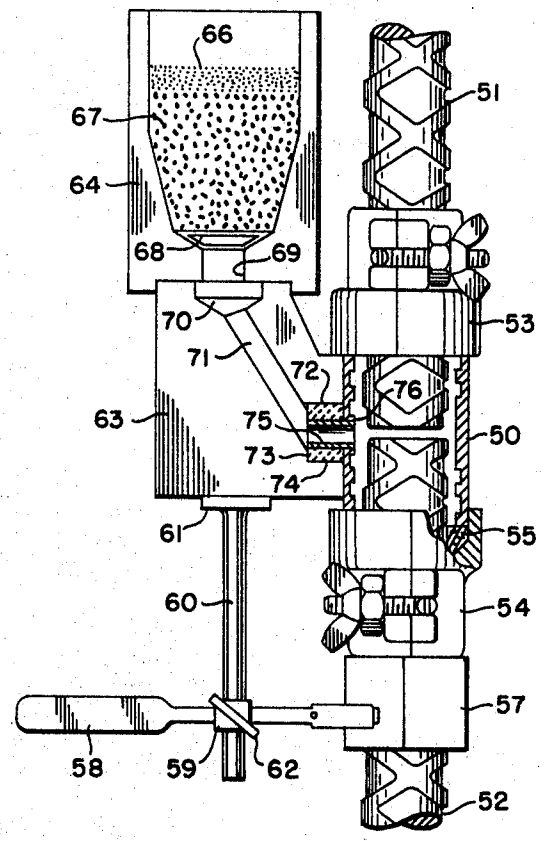


Fig. 3

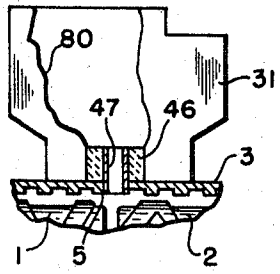


Fig. 4

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METAL CASTING APPARATUS AND METHOD

DISCLOSURE

This invention relates generally as indicated to metal casting apparatus and method and more particularly to certain improvements in the joining of metal reinforcing bars utilized in concrete construction and the like as in Leuthy et al. Pat. No. 3,234,603 and Leuthy et al. Pat. No. 3,255,498. In such patents, there is disclosed a method and apparatus for the joining of reinforcing bar by the introduction of cast metal into a sleeve surrounding the opposed spaced ends of the reinforcing bar to be joined. For introduction of the cast metal into the sleeve, there is provided a generally central tap hole of a predetermined size which must be maintained to maintain the tensile capability of the joint. Since the tensile capability of the joint is determined by the cross-sectional area of the steel sleeve or mold remaining after the casting, any erosion or melting of the sleeve about the tap hole can lower the tensile capability of the joint.

It has been found that excess burning away of the sleeve at the tap hole can become a problem with the use of graphite pouring basins which are severely dissolved by the flow of molten iron therethrough. For example, after approximately ten shots, a pouring basin tap hole may enlarge from about forty one sixty-fourths of an inch to approximately 1 inch in diameter and this in turn enlarges the tap hole in the sleeve beyond that which is permissible to maintain the required tensile capability of the joint. Accordingly, to maintain the required tensile capability a new pouring basin would be required approximately every eight shots.

It is therefore a principal object of the present invention to provide a metal casting apparatus and method which will maintain the exit aperture of the pouring basin at the required dimension despite repeated use.

Another principal object is the provision of a casting apparatus and method for joining reinforcing bar ensuring uniform tensile capability with repeated use of the apparatus.

Another important object is the provision of apparatus for joining reinforcing bar and the like wherein the useful life of the equipment is greatly extended.

Another object is the provision in casting apparatus of a graphite pouring basin in combination with a disposable insert to maintain the tap hole of the basin at a predetermined diameter and to extend the useful life of the pouring basin.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

In said annexed drawings:

FIG. 1 is a side elevation broken away and in section illustrating, the application of the present invention to a horizontal reinforcing bar joint;

FIG. 2 is a fragmentary vertical section taken substantially on the line 2–2 of FIG. 1;

FIG. 3 is a view similar to FIG. 1 illustrating the application of the invention to a vertical or column splice reinforcing bar joint; and

FIG. 4 is a fragmentary view of a portion of the apparatus shown in FIG. 1 illustrating the condition of the pouring basin after a number os shots.

Referring now to the annexed drawings and more particularly to FIG. 1, there is illustrated a preferred form of the invention particularly useful in the forming of high tensile capability reinforcing bar joints. The reinforcing bars 1 and 2 to be joined have their ends fairly closely spaced within sleeve 3. The interior of the sleeve 3 is provided with irregularities illustrated as channel-shape annular grooves 4. A central tap hole 5 is provided in the sleeve which is adjacent the spaced ends of the reinforcing bars 1 and 2. To the ends of the sleeve 3 are clamped end alignment fittings 6 and 7, each of which comprises hinged halves 8 and 9 which are held together by wing clamp nut 10 bearing against shoulder 11 on the half 9, the nut being threaded on stud 12 pivoted at 13 to the half 8.

Each end alignment fitting is provided with a beveled shoulder 15 which receives asbestos packing 17 providing a molten metal seal between the end of the sleeve and the respective end of the reinforcing bar to be joined. Because of the irregular exterior surface of the reinforcing bar, the packing 17 will be sufficiently flexible to conform to the irregular surface. A horizontal support clamp is employed comprising end member 18 straddling and supporting the reinforcing bar 1 which is secured to bottom member 19. Opposite end member 20 straddling and supporting the reinforcing bar 2 is pivoted at 21 to the bottom member 19. A rod 22 pivots at 23 to the member 18 and fits within slot 24 in the member 20 to hold the end member 20 in proper position supporting and clamping the apparatus in place. The pivot 21 comprises a pin held in place by a cotter pin as noted and additional pivot apertures 25 are provided so that the end member 20 may be repositioned for different length sleeves. The effective length of the rod 22 may also be adjusted by the knob 26.

In order to place molten metal within the sleeve surrounding the ends of the reinforcing bars 1 and 2, there is provided a crucible 30 and a pouring basin 31. The crucible is of generally conventional construction and may comprise graphite half rounds held together at the top by a clamp, not shown. When the mating halves of the crucible are together, they form a chamber 32, the lower end of which is closed by steel disc 33 supporting alloy powder 34 with starting powder 35 on top. When the starting powder is ignited, the powder forms a molten metal alloy which then burns through the steel disc 33 and drops through tap hole 36 into the pouring basin 31. The lower end of the crucible is provided with an annular recess 37 which fits on top of annular projection 38 of the pouring basin 31.

The pouring basin 31 also comprises mating graphite halves 40 and 41 as seen in FIG. 2 held together by suitable clamps, not shown. Each of the halves is provided with a bottom radius indicated at 42 which fits the O.D. of the sleeve 3. The crucible includes a top funnel-shape passage 44 which intersects offset cylindrical passage 45, the latter being substantially larger in diameter than the tap hole 5 in the sleeve 3. The hole 45 may be made in the graphite block material by an end mill operation. Such hole 45 closely receives a ceramic sleeve 46 which in turn closely receives a copper, aluminum, or the like guide tube 47. The guide tube 47 fits closely within the ceramic sleeve 46 and also within the tap hole 5 of the joint sleeve 3. Accordingly, the I.D. of the ceramic sleeve 46 substantially corresponds to the I.D. of the tap hole 5.

The parts are assembled as shown and the starting powder 35 is ignited to form a charge of molten metal which then runs down through the passages 36, 44 and 45 and is funneled into the guide tube 47 by the ceramic sleeve 46 to enter the interior of the sleeve 3 surrounding the ends of the reinforcing bars 1 and 2. As the metal enters the sleeve 3, it will melt the guide tube 47 and will leave a sprue projecting upwardly through the ceramic sleeve 46. The apparatus may then be disassembled and the sprue knocked off including the ceramic sleeve or insert 46. As noted in the aforementioned patents, the molten metal within the sleeve 3 forms a mechanical lock with the irregular surface on the exterior of the reinforcing bar and the irregular surface on the interior of the sleeve 3 to impart to the joint a high tensile capability.

Referring now more particularly to FIG. 3, there is illustrated an embodiment of the invention which is utilized in the formation of a column splice where again the tensile rating of the joint may be highly important. A sleeve 50 surrounds the slightly spaced ends of upper and lower reinforcing bars 51 and 52, the upper being supported by a small spacer key, not shown, so that there is a slight gap between the ends of the bar generally centrally within the sleeve 50. End alignment fittings

53 and 54 are clamped to the ends of the sleeve 50 and asbestos packing indicated at 55 is provided at least in the lower end alignment fitting 54 sealing the end of the sleeve 50 against the associated end of the lower bar 52. A support clamp 57 is secured to the lower bar 52 and includes clamp operating handles 58 which are provided with a boss 59 through which slidably moves a support rod 60. Such rod is provided with a head 61 and vertical adjustment is obtained by thumb screw 62. The rod 60 supports adjustably graphite pouring basin 63 which in turn supports the graphite crucible 64.

As in the FIG. 1 embodiment, both the pouring basin and crucible are comprised of mating graphite blocks held together by suitable clamps, not shown. The crucible in its center chamber 65 includes starting powder 66, the main alloy powder 67 and a supporting steel disc 68. When the starting powder is ignited, the molten metal formed by the ignition of the powder 67 burns away the steel disc 68 and the molten metal runs through the tap hole 69 of the crucible and into the pouring basin 63. The latter includes an enlarged upper passage 70, an inclined runner 71 and a relatively short horizontal passage 72. The vertical face of the pouring basin adjacent the aperture of passage 72 may be provided with a radius to conform to the O.D. of the sleeve 50. The passage 72 may be formed by an end mill and the depth tolerance is closely held. The diameter of the passage 72 may be substantially greater than the diameter of the passage 71 providing a positive bottom or seat indicated at 73 for the insertion of ceramic sleeve 74. Again, a copper, aluminum, or like metal guide tube 75 is provided extending from the central tap hole 76 in the joint sleeve 50.

The ceramic sleeve 74 has an I.D. substantially corresponding to the I.D. of the tap hole 76 in the sleeve 50. Accordingly, when the molten metal flows through the pouring basin, it will be funneled through the ceramic sleeve 74 to pass into the joint sleeve 50 to form a mechanical lock between the reinforcing bars utilizing the irregularities on the exterior surface of the bars in conjunction with the designed irregularities on the interior surface of the sleeve.

In setup, the operator will put the clamp 57 in its proper position on the bar 52 and then assemble the end alignment fittings against and around the ends of the sleeve 50 with packing at least at the lower end of the sleeve. The guide tube 75 is inserted in the sleeve laterally to project therefrom. In the horizontal embodiment seen in FIG. 1, the operator may then place the ceramic sleeve on the projecting guide tube. In the vertical arrangement seen in FIG. 3, the ceramic sleeve may be inserted in the aperture 72 of the pouring basin and the entire assembly then mounted on the projecting guide tube. The support rod 60 will be vertically adjusted so that the pouring basin will then be supported from the clamp 57. The pouring basin assembly is secured against the side of the sleeve by a clamp mechanism, not shown. The crucible is then positioned to create the molten metal charge which then flows through the passages of the pouring basin and is funneled by the ceramic sleeve 74 into the sleeve 50. After the joint is completed, the crucible and pouring basin are disassembled and the projecting sprue as well as the ceramic sleeve 74 is cutoff.

It will be appreciated that in lieu of an annular disposable ceramic sleeve two semicircular sleeve halves could be employed which could then be used again. However, it has been found that the problem of handling ceramic sleeve halves exceeds the economic cost thereof and accordingly a disposable one-piece sleeve insert is preferred.

The purpose of the ceramic insert or sleeve is to maintain the proper tensile capability of the joint formed while at the same time extending the useful life of the pouring basin which is a fairly expensive machined block of graphite. As seen in FIG. 4, the graphite pouring basin has become severely dissolved by the flow of molten iron through the passages thereof. This is a particular problem with the use of molten iron since the iron seems to dissolve the carbon in the graphite and the pouring basin passage enlarges substantially as indicated at 80 on continued use. This is, of course, not true with the ceramic insert which is in any event disposed of after each shot. The dissolution of the carbon of the graphite into the molten iron may be similar to the dissolution of rock salt into water which would flow therethrough. It has been found that the continued use of the pouring basins when using molten iron compositions will cause excess burning away of the passage in the pouring basin adjacent the tap hole of the sleeve which forms the joint and this in turn burns away the sleeve at the tap hole when the matching hole in the pouring basin is larger than the tap hole. For example, after approximately ten shots wherein the exit aperture of the pouring basin was originally forty one sixty-fourths inch in diameter, it had been worn to approximately 1 inch in diameter. This then would cause a 1 inch hole in the rolled steel sleeve 3 or 50 whereas the normal sleeve hole would be approximately forty-one sixty-fourths. This then results in less cross-sectional area of the base steel sleeve remaining after the splice sleeve has been filled and this in turn causes a lower tensile capability. The effective cross section of the joint sleeve is used in rating the joint.

The funneling effect of the ceramic insert sleeve, while permitting slight flashing between the sleeve and the surrounding pouring basin, effectively holds the exit aperture tolerance of the pouring basin to substantially that of the tap hole of the joint sleeve.

The use of the disposable insert to maintain the exit apertured tolerance of the pouring basin not only maintains the proper tensile capability of the joint, but also substantially extends the pouring basin life. For example, it has been found that a pouring basin which heretofore had a useful life of approximately eight shots can now be successfully used for as many as thirty shots. Thus substantial savings in equipment cost can be realized while joint tensile capabilities are maintained from shot to shot.

Other modes of applying the principles of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I claim:

1. In combination, a graphite pouring basin and a mole having a predetermined size of tap hole therein, and a disposable insert in said pouring basin operative to maintain the exit aperture thereof in substantial correspondence with the tap hole in said mold, said insert comprising a ceramic sleeve operative to the funnel the molten metal passing through said pouring basin therethrough.

2. In combination, a graphite pouring basin and a mold have a predetermined size of tap hole therein, and a disposable insert in said pouring basin operative to maintain the exit aperture thereof in substantial correspondence with the tap hole in said mold, a crucible mounted on said pouring basin operative to provide a charge of molten metal, said mold comprising an elongated steel sleeve with the tap hole therein generally centrally located, and a guide tube projecting from the tap hole in said sleeve and closely fitting within said disposable insert.

3. In combination, a graphite pouring basin and a mold having a predetermined size of tap hole therein, and a nonmetallic disposable refactory insert in said pouring basin operative to maintain the exit aperture thereof in substantial size and pouring correspondence with the tap hole in said mold.

4. The combination set forth in claim 1 wherein the I.D. of said ceramic sleeve corresponds generally to the I.D. of the tap hole in said mold.

5. The combination set forth in claim 4 including a guide tube within said ceramic sleeve projecting into the tap hole in said mold operative to align the same.

6. The combination set forth in claim 3 including a crucible mounted on said pouring basin operative to provide a charge of molten metal.

7. The combination set forth in claim 6 wherein said mold comprises an elongated steel sleeve and the tap hole therein is generally centrally located.

8. The combination set forth in claim 1 wherein said pouring basin includes a generally vertically extending passage therethrough with said disposable insert being snugly fitted within said passage at the bottom thereof.

9. The combination set forth in claim 1 wherein said pouring basin includes an inclined passage terminating in a horizontal passage of larger internal diameter than said inclined passage, said horizontal passage being of predetermined depth, and said disposable insert being inserted in said horizontal passage.

10. A method of joining reinforcing bar and the like comprising the steps of enclosing the ends of such bar with a sleeve having a tap hole therein of predetermined size, placing a low melting point metal guide tube in such tap hole and surrounding such tube with a nonmetallic disposable refractory insert fitted within a graphite pouring basin, and funnelling a castable molten metal through such insert thereby to maintain the exit aperture adjacent such sleeve at substantially the size of the tap hole in such sleeve.

11. A method as set forth in claim 10 wherein such disposable insert comprises an annular ceramic sleeve fitted closely within the passage through such pouring basin.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,554,270 Dated January 12, 1971

Inventor(s) Leonard Gelfand

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the specification:

Column 1, line 67, change "os" to --of--.

In the claims:-

Column 4, line 43, change "mole" to --mold--;

line 48, delete "the" (first occurrence);

Column 5, line 1, change "1" to --3--;

line 5, change "1" to --3--.

Signed and sealed this 11th day of May 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

WILLIAM E. SCHUYLER
Commissioner of Pat