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(54) **POST MOUNTING ASSEMBLY AND METHOD FOR MOLTEN METAL PUMP**

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(52) **U.S. Cl.**

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(57) **ABSTRACT**

A molten metal pump apparatus that includes a base member, at least two (2) support members or posts, and a post socket. The lower end of each post is mounted to a mounting bore of the base member and forms a cement-less pump joint. The upper end of the post is connected to the post socket to form a cement-less pump joint. The post socket is defined by a first half and a second half that have an open or separated position for receiving the upper end of the post and a closed or joined position for securing the upper end of the post.

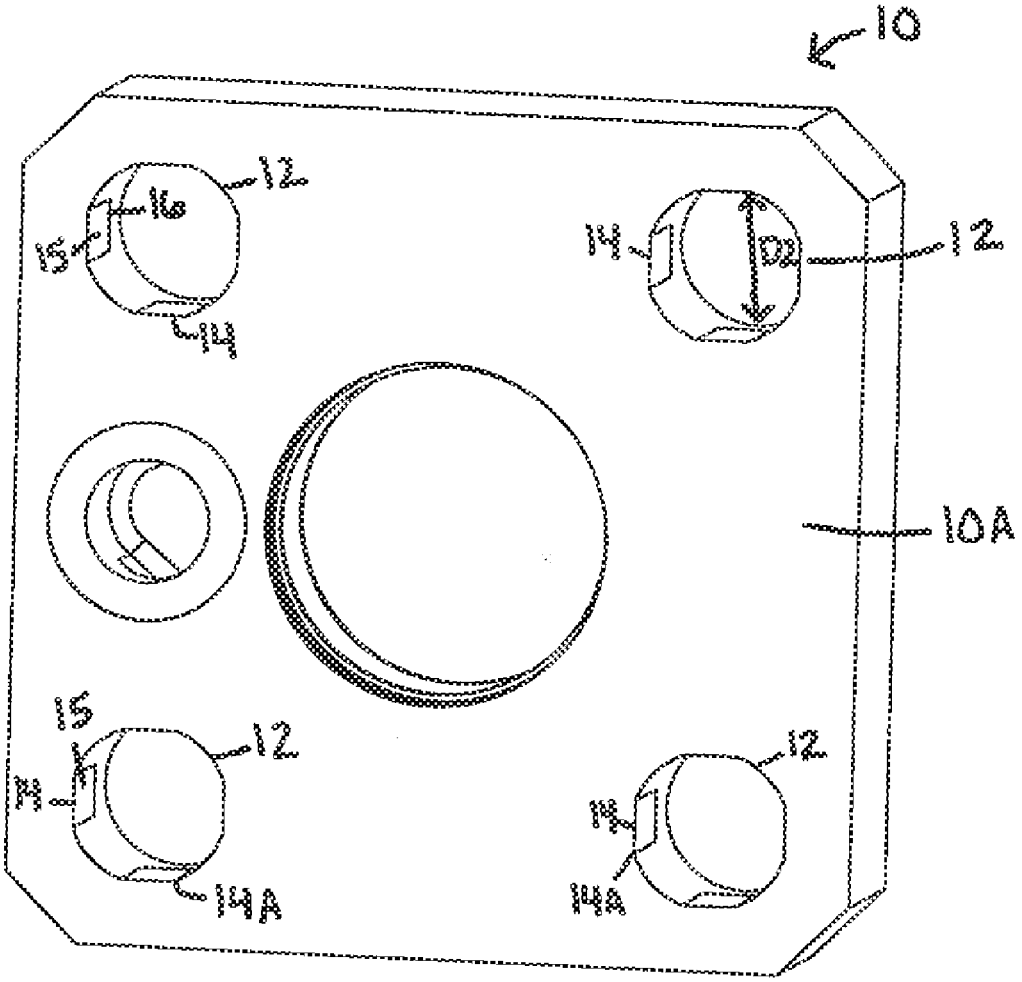


FIG. 1

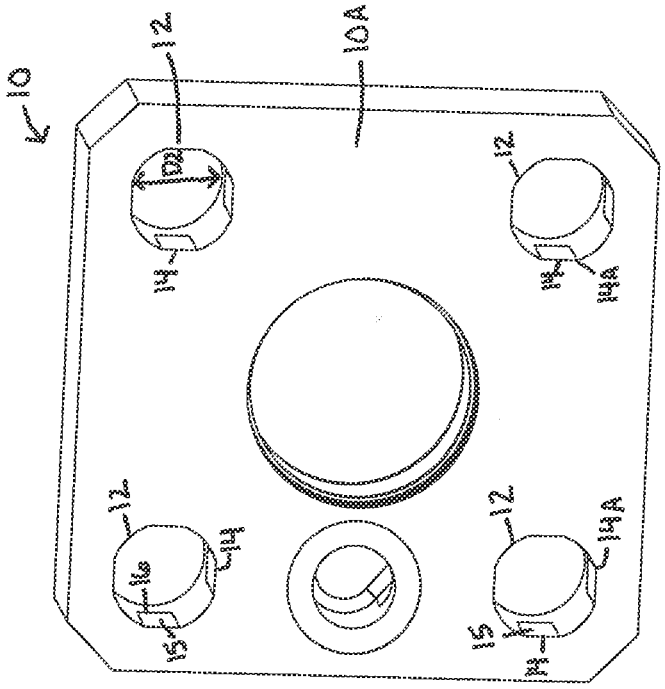


FIG. 2

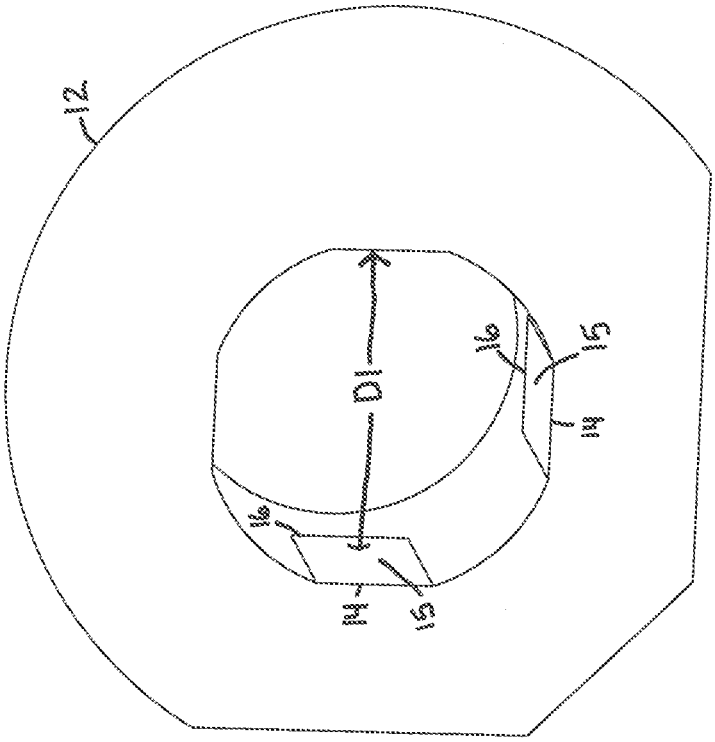


FIG. 3

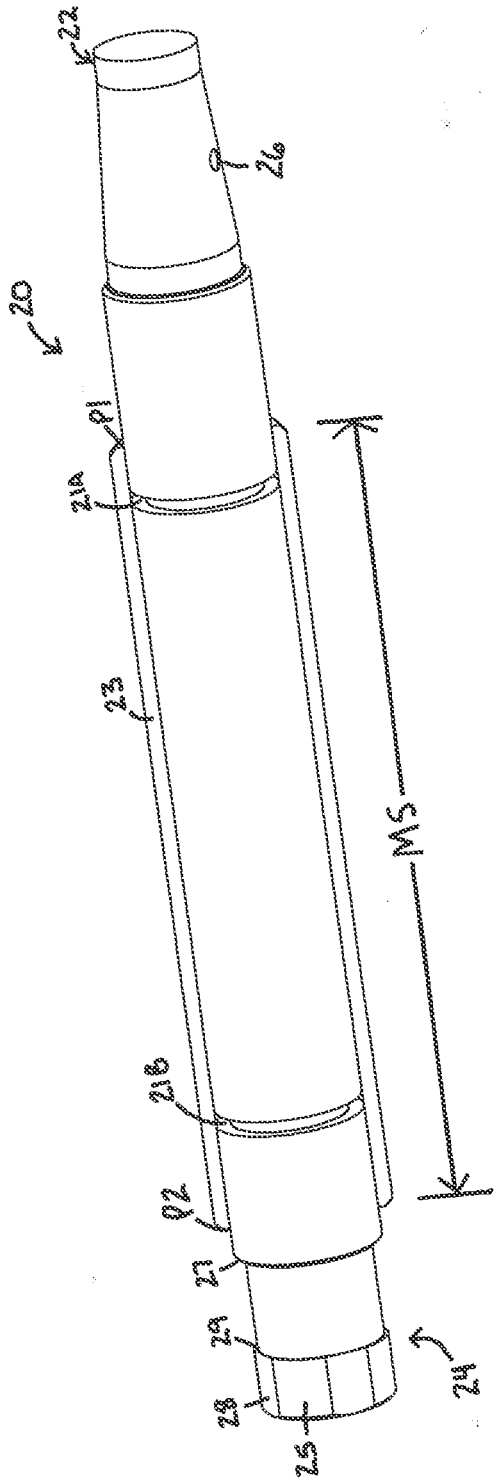


FIG. 4

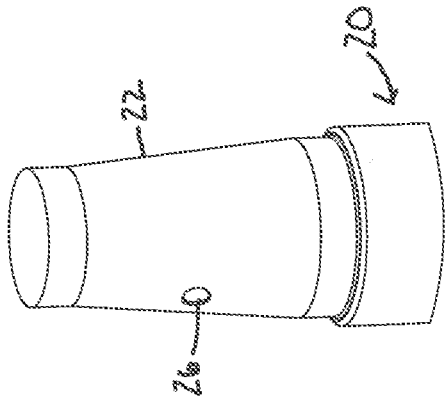


FIG. 5

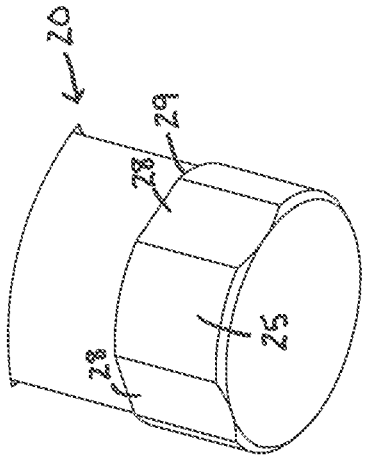


FIG. 6

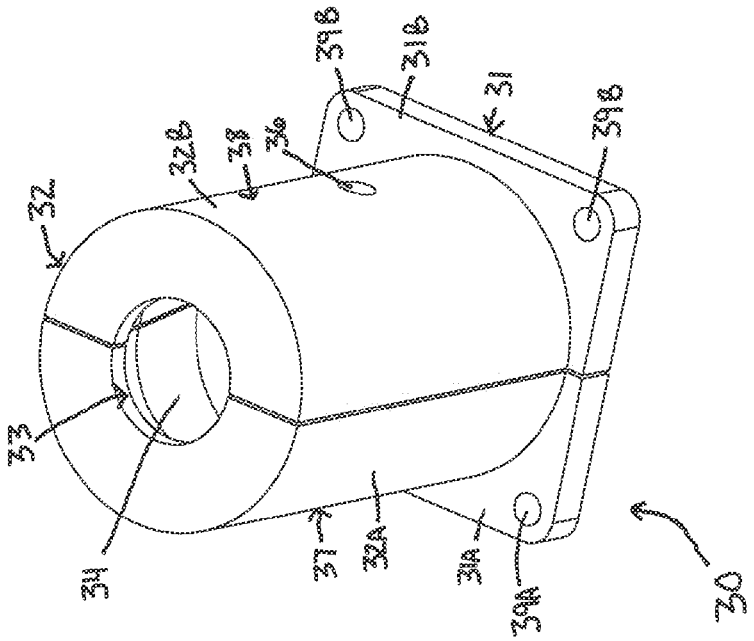


FIG. 7

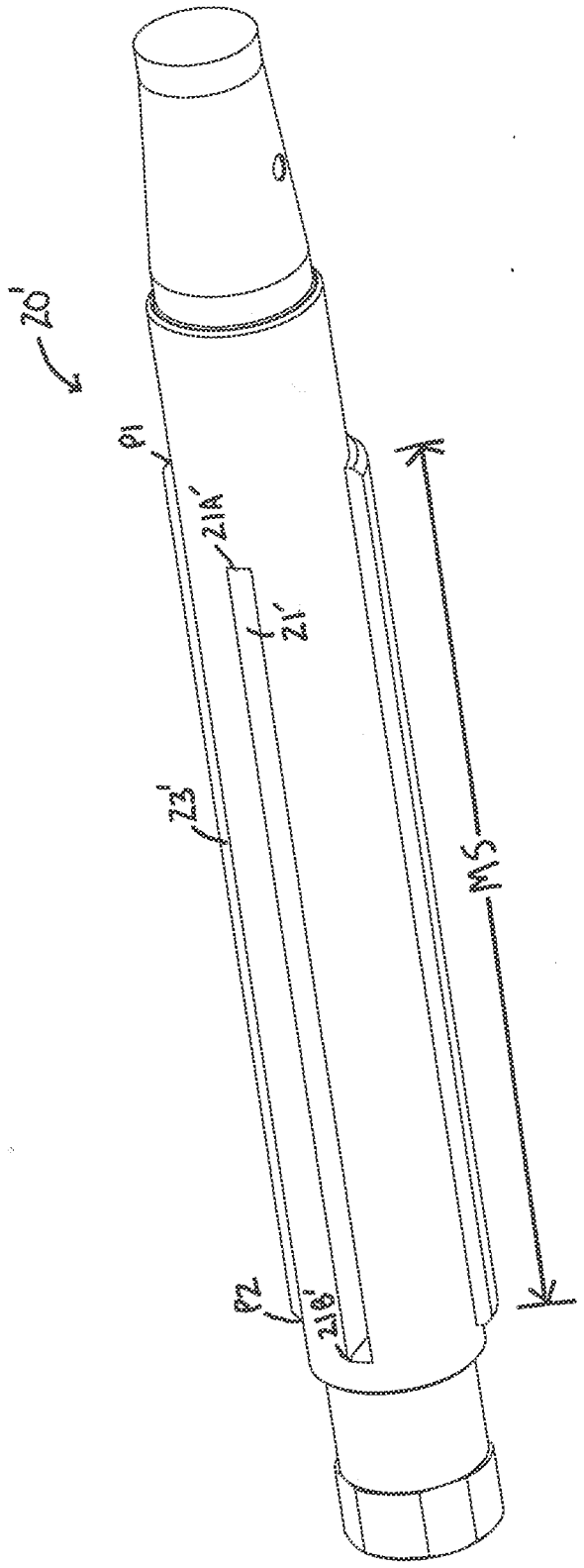
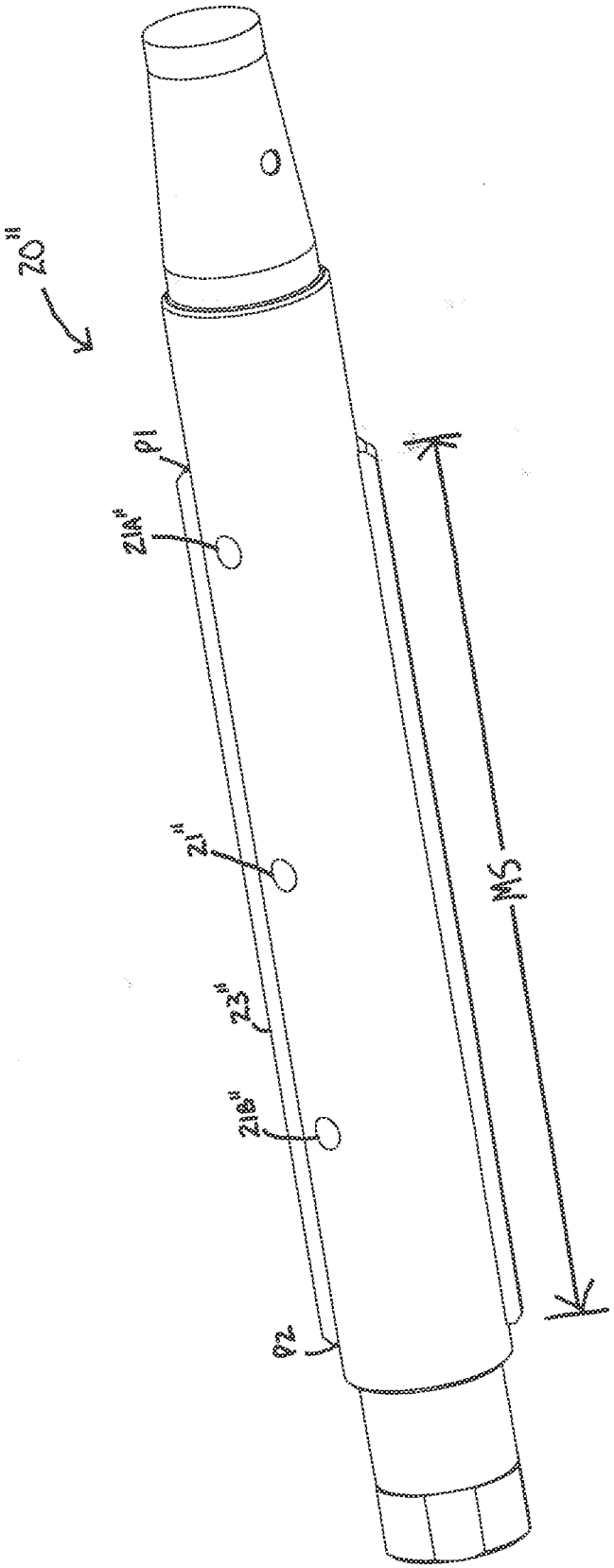


FIG. 8



POST MOUNTING ASSEMBLY AND METHOD FOR MOLTEN METAL PUMP

CROSS REFERENCES TO RELATED APPLICATIONS

[0001] U.S. Provisional Application for Patent No. 62/270,357, filed Dec. 21, 2015, with title "Post Mounting Assembly and Method for Molten Metal Pump" which is hereby incorporated by reference. Applicant claims priority pursuant to 35 U.S.C. Par. 119(e)(i).

STATEMENT AS TO RIGHTS TO INVENTIONS MADE UNDER FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT

[0002] Not Applicable

BACKGROUND OF THE INVENTION

[0003] 1. Field of the Invention

[0004] The invention relates to pumping molten metal and more particularly to molten metal pump apparatus and methods for assembling and disassembling such apparatus.

[0005] 2. Brief Description of Prior Art

[0006] A molten metal pump apparatus generally includes a motor mounted above a molten metal bath. The motor drives a rotatable impeller pump having one or more impellers submerged in the bath. In operation, the rotating impellers draw molten material from the bath and pump it through a conduit routed to a subsequent station for further processing.

[0007] The molten metal pump typically includes a base having inlet and outlet passages for intake and discharge of the molten metal being pumped. The pump base together with the impeller are submerged in the molten metal, supported on the bottom of the vessel containing the molten metal. The pump base is typically connected by refractory cement and/or mechanical arrangements to a plurality of vertically extending support posts which are also connected to a drive arrangement positioned above the level molten metal. In typical installations, these vertically extending posts may be several feet long, e.g. one to four feet in length or longer, in order to provide adequate clearance between the molten metal level.

[0008] The portions of the pump assembly submerged in the molten metal are directly contacted and exposed to the harsh conditions thereof, and are formed of refractory material such as graphite, silicone carbide, alumina, zirconia or hexalloy. The posts extend through a level of the molten metal and are connected to a motor mounting plate of the drive arrangement positioned above the level molten metal.

[0009] In prior art arrangements, downwardly opening post sockets are fixed to the motor mounting plate and receive the upper ends of the posts. One or more post sockets may be fixed to a post support plate, as by welding, and the support plate is secured to the motor mounting plate. In prior art arrangements, the posts may also be secured within the post's sockets by means of a refractory cement, bolts or other clamping devices.

[0010] Despite the positive properties for this described application, graphite and ceramics still corrode and deteriorate over time. The vertical posts that extend through a level of molten metal begin to erode as a result of use and molten metal pumps must be more frequently maintained and replaced than other types of pumps. The replacement or servicing of a pump having operating components submersed in molten metal is a time consuming exercise. First, the pump must be removed from the molten metal which generally causes down time. Then the pump along with the molten metal contained thereon must be allowed to sufficiently cool to allow it to be disassembled. Once the deteriorated components are sufficiently cooled, the vertical posts that have sufficiently deteriorated are replaced, and the molten metal buildup on the various pump surfaces must be sufficiently removed to allow disassembly and/or re-use of the pump components. Then the pump must be reassembled with the combination of old components or parts, along with the replacement parts.

[0011] As previously described, there are certain components of the pump which are typically cemented together in order to achieve a balanced and sufficiently rigid pump structure to allow continuous operation of the pump. However, when the pump must be disassembled, the cemented joints can be very difficult to disassemble.

[0012] In the case of the vertical posts between the pump base and the motor mount structure, the posts have traditionally been cemented into bored holes within the base. In the case of the base for example, when the pump is disassembled, the cemented portion of the posts must normally then be chipped, dug or drilled out in order to allow a new post to be placed in the same bore. This makes the disassembly much more difficult. A most significant disadvantage to prior art arrangements is therefore the need to cleanly remove the post when it is necessary to replace the post.

[0013] Further, during assembly of the pump, it is important that the pump components be accurately aligned in order for the pump system to work efficiently once it is back in the molten metal. The combination of the components are very heavy, and once the posts for example are cemented in place as described above, it is then very difficult if not impossible to align if necessary.

[0014] As will be seen from the subsequent description, the preferred embodiments of the present invention overcome shortcomings of the prior art.

SUMMARY OF THE INVENTION

[0015] A post mounting assembly for assembling and disassembling a molten metal pump. The post mounting assembly includes a pump base, at least two (2) support members or posts, and post sockets. Each post may include a protective sleeve that surrounds the post's mid-section. The post socket having a first half and a second half that when joined defines a body portion for receiving an upper end of the post.

[0016] The assembly of the posts to the mounting base illustrates an embodiment of a cement-less pump joint which is an objective of the present invention. Further, the assembly of the post to the post socket illustrates an embodiment of a cement-less pump joint which is a further object of the present invention. As a result, a replacement post identical to posts of the present invention may be provided without the need to dig out a cement joint but instead can be more easily removed and replaced.

[0017] The base of the present invention includes at least two (2) mounting bores therethrough for receiving the lower end of the post. Each mounting bore includes at least one tab disposed substantially adjacent the upper surface of the base member. The at least one tab includes flat surfaces that align with flat surfaces disposed on the lower end of the posts such

that the lower end of the posts can be inserted in the mounting bores and rotating the posts within the mounting bores effectively secures the posts to the base member.

[0018] The upper end of the posts are shaped and sized to be received within the post socket. The post socket and the upper end of the posts include apertures for alignment and for receipt of a pin member that secures the upper end of the post to the post socket. The coupling configuration between the upper end of the post and the post socket provides very tight tolerances such that the joint connection as described does not require equipment to align the pump during assembly and installation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. **1** is a top perspective view of a pump base for a molten metal pump.

[0020] FIG. **2** illustrates one of the bored holes within the pump base for mounting a vertical post.

[0021] FIG. **3** illustrates a vertically extending post with a portion of the protective sleeve removed for illustration.

[0022] FIG. **4** illustrates an upper end of the post of FIG. **3**.

[0023] FIG. **5** illustrates a lower end of the post of FIG. **3**.

[0024] FIG. **6** is a top perspective view of a post socket.

[0025] FIG. **7** is an alternate embodiment of the vertically extending post with a portion of the protective sleeve removed for illustration.

[0026] FIG. **8** is a second alternate embodiment of the vertically extending post with a portion of the protective sleeve removed for illustration.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0027] In accordance with the present invention, a post mounting assembly and method for molten metal pump is disclosed. The post mounting assembly is directed to a molten metal pump apparatus and method for assembling and disassembling such apparatus. Specifically, it will be noted in the drawings that the post mounting assembly provides a pump assembly which does not require as many or any cemented joints as does prior art pumps. Further, the present invention provides a pump and assembly system which tends to self-align the pump during the assembly process thereby reducing or eliminating the need for alignment apparatuses. In the broadest context, the post mounting assembly for molten metal pump consists of components configured and correlated with respect to each other so as to attain the desired objective.

[0028] FIGS. **1-6** illustrate a preferred embodiment of a post mounting assembly made in accordance with the present invention. The assembly of the present invention includes a pump base **10** (shown in FIG. **1**), at least two (2) support members or posts **20** (shown in FIGS. **3-5**), and a post socket assembly **30** shown in (FIG. **6**).

[0029] A molten metal pump (not shown) generally includes a base having an impeller mounted therein. The impeller is secured to a driveshaft mounted for rotation within the base. The upper end of the driveshaft is connected to a motor.

[0030] The pump further includes at least two (2) identical vertical support members that are spaced apart to provide stability. Each of the vertical support members include an end for connection to a motor mounting plate. Each of the support members further include an end for connection to the base.

[0031] Referring to FIG. **3**, the at least two (2) support members or posts illustrated as numeral **20** for the present invention include an upper end **22** for connection to the motor mounting plate, and a lower end **24** for connection to the base member **10**. Each upper end **22** of the posts **20** are connected to the motor mounting plate using the post socket **30**. The post socket assembly **30** is described below in greater detail.

[0032] Referring to FIGS. **1-2**, the base member **10** includes at least two (2) mounting bores **12** therethrough for receiving the lower end **24** of the post **20**. As stated, the mounting bores **12** define a void completely through the base member **10**. As shown, the mounting bores **12** have a substantially circular configuration and each mounting bore **12** includes at least one tab member **14** that is vertical the upper surface **10**A of the base member **10**. As illustrated, a top edge **14**A of each tab member **14** is substantially adjacent the upper surface **10**A. Each tab member **14** further defines a flat surface **15** within the mounting bore **12** (best shown in FIG. **2**), and a lower edge **16**.

[0033] As shown in FIG. **2**, each of the mounting bores **12** include a first distance designated as "D1" which is the diameter of the bore **12** with the at least one tab member **14**, and a second distance designated as "D2" (shown in FIG. **1**) which is the diameter of the bore **12** below the lower edge **16** of the at least one tab member **14**. The first distance D1 is less than the second distance D2 of the mounting bore **12**.

[0034] FIG. **5** best shows the lower end **24** of the posts **20**. The lower end **24** sized and shaped to be received within the mounting bore **12** of the base **10**. More particularly, the lower end **24**, like the mounting bore **12** includes at least one flat surface **25** and a surface **28** adjacent each of the at least one flat surface **25**.

[0035] In application, aligning the at least one flat surface **25** of the post's lower end **24** with the flat surface **15** of the mounting bore **12** enables the lower end **24** of the posts **20** to be inserted in the mounting bore **12** until the upper surface **10**A is in contact with a stop **27** of the lower end **24**. Further, once the stop **27** is in contact with the upper surface **10**A as described, the post's lower end **24** will be disposed within the mounting bore **12** and below the lower edge **16** of the at least one tab member **14** such that a ledge **29** of the lower end **24** is in abutting communications with the lower edge **16**. As illustrated, the ledge **29** is adjacent the surfaces **25**, **28**. In this position, the post **20** can rotate within the bore **12**.

[0036] Once the lower end **24** is inserted in the mounting bore **12** as described, rotating the post **20** within the mounting bore **12** effectively secures the post **20** to the base member **10**.

[0037] As should be understood, further rotating the post **20** within the mounting bore **12** until the surfaces **15** and **25** are aligned releases the post **20** from the mounting bore **12**.

[0038] The assembly of the lower end **24** of the posts **20** to the mounting base **10** as described illustrates an embodiment of a cement-less pump joint which is an objective of the present invention. Therefore a replacement post identical to post **20** may be provided without the need to dig out a cement joint but instead can be more easily removed and replaced.

[0039] Referring to FIG. **6**, a post socket assembly **30** generally includes an upper plate **31** and a body portion **32**.

In application, the upper plate **31** is secured to the pump's motor mounting plate (not shown) in any convenient manner, such as, threaded fasteners. The body portion **32** having an opening **33** to access an interior **34**. The opening **33** and interior **34** are sized for receipt of the upper end **22** of the post **20**.

[0040] As will be further described, the upper end **22** of the post **20** is secured within the interior **34** of the body portion **32** with a pin member (not shown) known in the art that in application, is inserted through a post aperture **26** (see FIG. **4**) that extends through the upper end **22** of the post and a socket aperture **36** that extends through the body portion **32** of the socket **30**. More particularly, the pin member secures the upper end **22** of the post **20** to the post socket **30**. The pin member is inserted through the aligned apertures **26**, **36** when the upper end **22** of the post is positioned within the interior **34** of the body portion **32** of the post socket **30**. A retainer (not shown) known in the art secures the pin member within the apertures **26**, **36**.

[0041] After the upper end **22** of the post **20** is received in the interior **34** of the body portion **32**, and the apertures **26**, **36** aligned as described, the pin member is inserted through the apertures **26**, **36** and retained. The pin member is dimensioned such that it fits snugly but slidingly in the passageway defined by the apertures **26**, **36** having the substantially same diameter, and is of a length such that it extends through the body portion **32**.

[0042] Accurate positioning of the vertical posts **20** is permitted prior to inserting the pin member. Thus, the pin member when filled through the apertures **26**, **36**, will set the posts **20** at a precise position. The result is a precise positioning of the posts and results in precise axial position of the pump's components.

[0043] As illustrated, the assembly **30** including the upper plate **31** and body portion **32** are defined by a first half **37** (as illustrated first half **37** includes half **32**A of the body portion **32** and half **31**A of the upper plate **31**) and a second half **38** (as illustrated second half **38** includes half **32**B of the body portion **32** and half **31**B of the upper plate **31**). In application, the assembly **30** can be separated or opened (not shown) for inserting or removing the upper end **22** of the posts **20**, or in the closed position as shown in FIG. **6** for retaining the upper end **22** of the posts **20** as described.

[0044] In application, the upper plate of the first half **37** is appropriately attached to the pump's motor mounting plate with bolts (not shown) for example through apertures **39**A. The upper end of the post is then positioned with the interior **34** of the body portion of the first half. The pin member can then be partially inserted through the socket aperture in the first half **37** and partially through the aperture **26** of the post. The second half **38** of the body portion is now positioned with the upper end of the post such that the pin member can pass through the socket aperture of the second half **38** and retained. The upper plate of the second half **38** can then be appropriately attached to the pump's motor mounting plate with bolts (not shown) for example through apertures **39**B.

[0045] As should be understood, once the first and second halves **37**,**38** are positioned as described with upper end **22** retained with pin member as disclosed, and the halves **37**,**38** are attached to the motor mounting plate as described, the halves **37**, **38** are effectively joined with one another with the upper end **22** properly aligned and affixed therein.

[0046] The assembly of the upper end **22** of the post **20** to the post socket **30** as described illustrates an embodiment of a cement-less pump joint which is an objective of the present invention. Therefore a replacement post identical to posts **20** may be provided without the need to dig out a cement joint but instead can be more easily removed and replaced.

[0047] This coupling configuration between the upper end **22** of the posts **20** and the post socket **30** provides very tight tolerances such that the joint connection as described does not require other jigs or equipment in order to align the pump during assembly and installation.

[0048] It should be appreciated that according to the post mounting assembly and method as described, the posts **20** can be mounted to the base member **10** and the post socket **30** without requiring cement. As a result, disassembling the pump becomes much less difficult. Further, the present invention provides a pump and assembly system which tends to self-align the pump during the assembly process.

[0049] As shown in FIG. **3**, the post **20** may further include a first groove **21**A and a second groove **21**B that each horizontally extend around a mid-section designated as "MS" of the posts **20**, with the first groove **21**A being just below an upper point P1 of the mid-section MS, and the second groove **21**B being just above point P2 of the mid-section MS. It should be understood that the mid-section MS of the posts **20** represents an area on the posts that commonly corrodes and breaks due to use.

[0050] The posts **20** may further include a protective sleeve **23** or wrap for holding and protecting the mid-section MS of the posts **20**. More particularly, the sleeve is a protective sleeve that is configured for providing protection, e.g., to slow down the corrosion and erosion process that naturally occurs due to extending submersion in the molten metal.

[0051] In the preferred embodiment, the protective sleeve **23** is in surrounding relationship to the mid-section MS of the posts **20** as shown, e.g., substantially from point P1 approximately above the first groove **21**A towards a point P2 approximately below the second groove **21**B. The sleeve **23** may extend a slightly greater or lesser distance than the illustrated and described distance from P1 to P2.

[0052] The purpose of the sleeve **23** is to separate the molten metal from the mid-section MS of the posts **20** during application. By limiting or lessening the extent of communication between the molten metal and the mid-section of the posts **20**, the Applicant has found the extent and speed of corrosion is minimized during use.

[0053] During manufacture, a fill composition (not shown) for the protective sleeve **23** is poured into a mold between the sides of the mold and the mid-section MS of each post **20**. The fill composition intersperses around the mid-section MS and forms a wall surrounding the post **20**. As should be understood, the fill composition further fills the grooves **21**A, **21**B during the pouring process. The term "pour" is used for the introduction of the fill composition into the mold, and is intended to encompass any method of introducing a fill composition into the mold in a liquid or other fluent form. It is important that the fill composition be fluent because otherwise, the fill composition will not intersperse around that area defined as the mid-section MS and the grooves **21**A, **21**B.

[0054] FIG. **7** shows an alternate embodiment of pouring the protective sleeve **23'** to the mid-section MS of the posts **20'** as described. In FIG. **7**, post **20'** includes at least one groove **21'** that vertically extends the approximate length of the mid-section MS, where an upper end **21**A' of the groove

being just below an upper point P1 of the mid-section MS, and the lower end of the groove **21**B' being approximately adjacent or just above point P2 of the mid-section MS. The sleeve **23**' may extend a slightly greater or lesser distance than the illustrated and described distance from P1 to P2.

[0055] FIG. **8** is a second alternative embodiment illustrating a post **20**" having a plurality of vertically aligned notches **21**" with the upper most notch designated as **21**A" being just below an upper point P1 of the mid-section MS, and the lower most notch designated as **21**B" being just above point P2 of the mid-section MS. As with the other described embodiments, the sleeve **23**" may extend a slightly greater or lesser distance than the illustrated and described distance from P1 to P2.

[0056] Although the description above contains many specificities, these should not be construed as limiting the scope of the invention but as merely providing illustrations of some of the presently preferred embodiments of this invention. Thus the scope of the invention should be determined by the appended claims in the formal application and their legal equivalents, rather than by the examples given.

I claim:

1. A post mounting assembly for a molten metal pump, said post mounting assembly comprising:

a pump base to be submerged in molten metal,

a post socket assembly including a plate member supported above a level of the molten metal by at least two (2) vertical support posts, each of said at least two (2) vertical support posts having a longitudinal length that extends from said pump base to said post socket assembly,

wherein each of said at least two (2) vertical support posts include an upper end for connecting to said post socket assembly and a lower end for connecting to said pump base,

wherein said pump base includes at least two (2) mounting bores that each define a void that extends completely through the pump base, said void having a length, and wherein each of said mounting bores configured for receiving said lower end of said post and having a substantially circular configuration and including at least one (1) tab member that defines a flat surface and a lower edge, said at least one (1) tab member having a vertical length, and wherein said length is greater than said vertical length, and wherein each mounting bore further defines a first distance that equals the diameter of the mounting bore at a point that includes the at least one (1) tab member, and a second distance that equals the diameter of the mounting bore below the lower edge that does not include the at least one (1) tab member, and

wherein said lower end includes at least one (1) flat surface configured to mate with said flat surface of said at least one (1) tab member, and said lower end further includes a stop and a ledge,

said upper end is sized for receipt within an interior of a housing of said post socket assembly and wherein said plate member and housing are defined by a first half and a second half that have an open or separated position and a closed or joined position.

2. The assembly of claim **1**, wherein each of said at least two (2) vertical support posts include a protective sleeve configured for protecting a defined mid-section of each of said posts.

3. The assembly of claim **2**, wherein each of said at least two (2) vertical support posts include a first groove that horizontally extends around said post and is disposed within said defined mid-section.

4. The assembly of claim **3**, wherein each of said at least two (2) vertical support posts include a second groove that horizontally extends around a lower portion of said defined mid-section, and wherein said first groove horizontally extends around an upper portion of said defined mid-section.

5. The assembly of claim **2**, wherein each of said at least two (2) vertical support posts include at least one (1) groove that vertically extends an approximate length of said defined mid-section.

6. The assembly of claim **2**, wherein each of said at least two (2) vertical support posts include a plurality of notches that include a first notch disposed at a lower portion of said defined mid-section and a second notch disposed at an upper portion of said defined mid-section.

7. A post mounting assembly for a molten metal pump, said post mounting assembly comprising:

a pump base,

a post socket assembly that includes a plate member and a housing, said plate member configured for attaching to a pump's motor mounting plate, and

at least two (2) vertical support posts, each of said posts having a longitudinal length that extends from said pump base to said post socket assembly,

wherein said pump base includes at least two (2) mounting bores that define a void, and wherein said void having a length, and said bores including at least one (1) tab member that defines a flat surface and a lower edge, and wherein said tab member having a vertical length, and wherein said length is greater than said vertical length, and wherein each mounting bore defines a first distance that equals the diameter of the mounting bore at a point that includes the at least one (1) tab member, and a second distance that equals the diameter of the mounting bore below the lower edge that does not include the at least one (1) tab member, and

wherein a lower end of each of said at least two (2) vertical support posts include at least one (1) flat surface configured to mate with said flat surface of said tab member, said lower end further includes a stop and a ledge, and

wherein an upper end of each of said two (2) vertical support posts is sized for receipt within an interior of said housing, and wherein said plate member and housing are defined by a first half and a second half that have an open or separated position and a closed or joined position.

8. The assembly of claim **7**, wherein each of said at least two (2) vertical support posts include a defined mid-section, and includes a protection sleeve that substantially covers said defined mid-section.

9. The assembly of claim **8**, wherein each of said at least two (2) vertical support posts further include a first groove that horizontally extends around said post and is disposed within said defined mid-section.

10. The assembly of claim **9**, wherein each of said at least two (2) vertical support posts include a second groove that horizontally extends around a lower portion of said defined mid-section, and wherein said first groove horizontally extends around an upper portion of said defined mid-section.

11. The assembly of claim **8**, wherein each of said at least two (2) vertical support posts include at least one (1) groove that vertically extends an approximate length of said defined mid-section.

12. The assembly of claim **8**, wherein each of said at least two (2) vertical support posts include a plurality of notches that include a first notch disposed at a lower portion of said defined mid-section and a second notch disposed at an upper portion of said defined mid-section.

13. A method for assembling a post mounted assembly for a molten metal pump comprising the steps:

aligning at least one (1) flat surface of a support post's lower end with a flat surface of a mounting bore disposed in a pump base,

inserting said lower end in said mounting bore until a stop on said lower end is in abutting contact with a top surface of said pump base,

rotating said lower end within said mounting bore until said support post is in locking engagement with said pump base,

attaching a first half of a post socket to a pump's motor mounting plate,

positioning an upper end of said support post within a defined interior portion of said first half,

aligning a first aperture in said first half with an aperture in said upper end of said support post,

inserting a pin member through said first aperture and partially through said aperture of said upper end,

positioning a second half of said post socket with said upper end of said post and with said first half aligning a second aperture in said second half with said aperture in said upper end,

urging said pin member through said aperture in said upper end and through said second aperture,

securing said pin member with a retainer, and

attaching said second half to the pump's motor mounting plate.

14. The method of claim **13**, including the step of pouring a fill composition into a mold between a side of the mold and a defined mid-section of said support post.

15. The method of claim **14**, wherein said support post includes a first groove that horizontally extends around said support post and is disposed within said defined mid-section.

16. The method of claim **15**, wherein said support post includes a second groove that horizontally extends around a lower portion of said defined mid-section, and wherein said first groove extends around an upper portion of said defined mid-section.

17. The method of claim **14**, wherein said support post includes at least one (1) groove that vertically extends an approximate length of said defined mid-section.

18. The method of claim **14**, wherein said support post includes a plurality of notches that includes a first notch disposed at a lower portion of said defined mid-section and second notch disposed at an upper portion of said defined mid-section.

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