

Aug. 8, 1944.

E. J. RUTHMAN

2,355,472

MOTOR

Filed Oct. 4, 1940

3 Sheets-Sheet 1

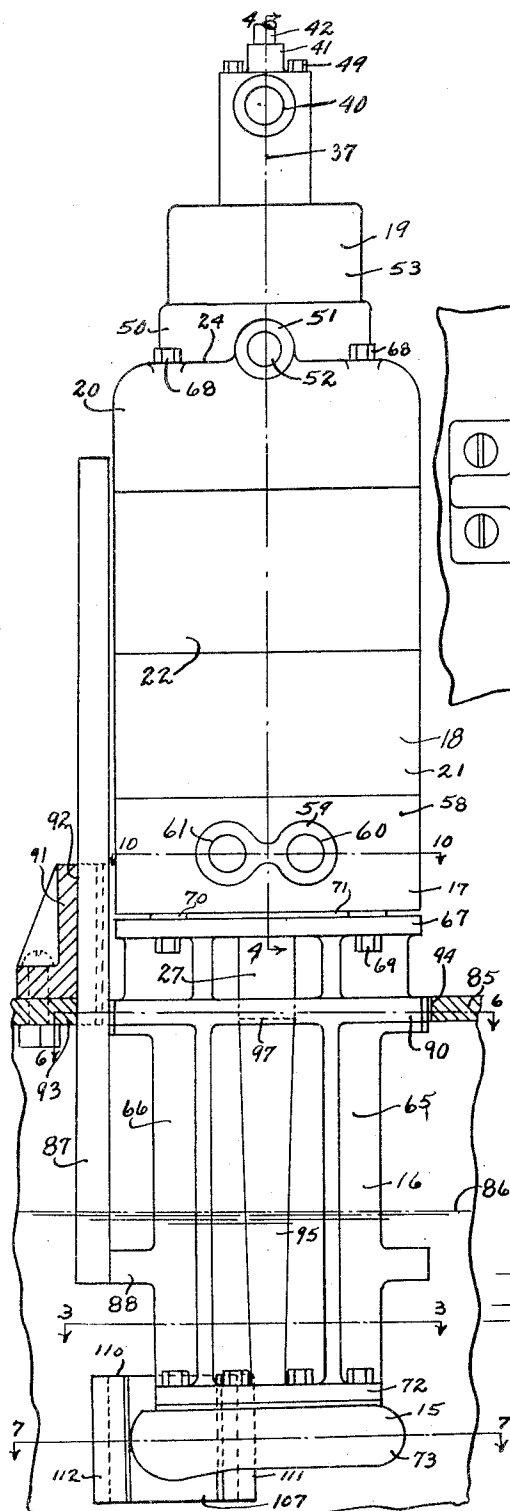


Fig. 1.

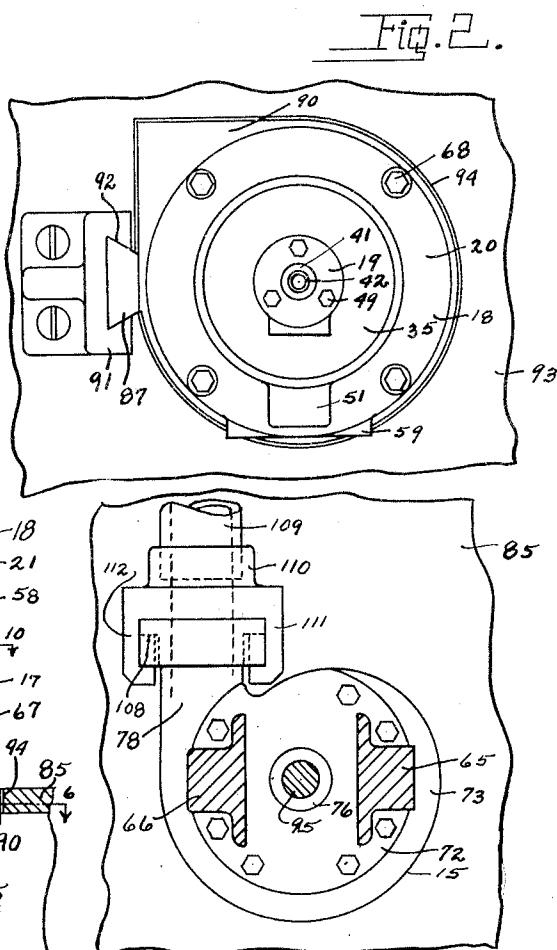


Fig. 2.

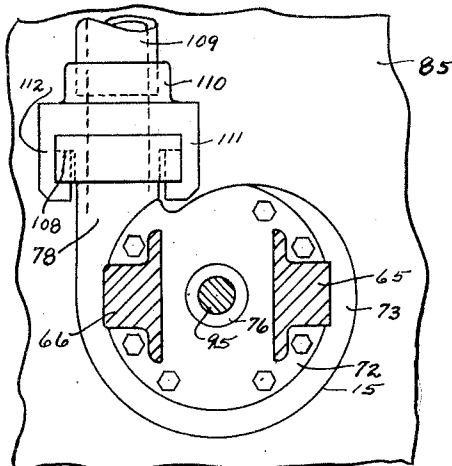


Fig. 3.

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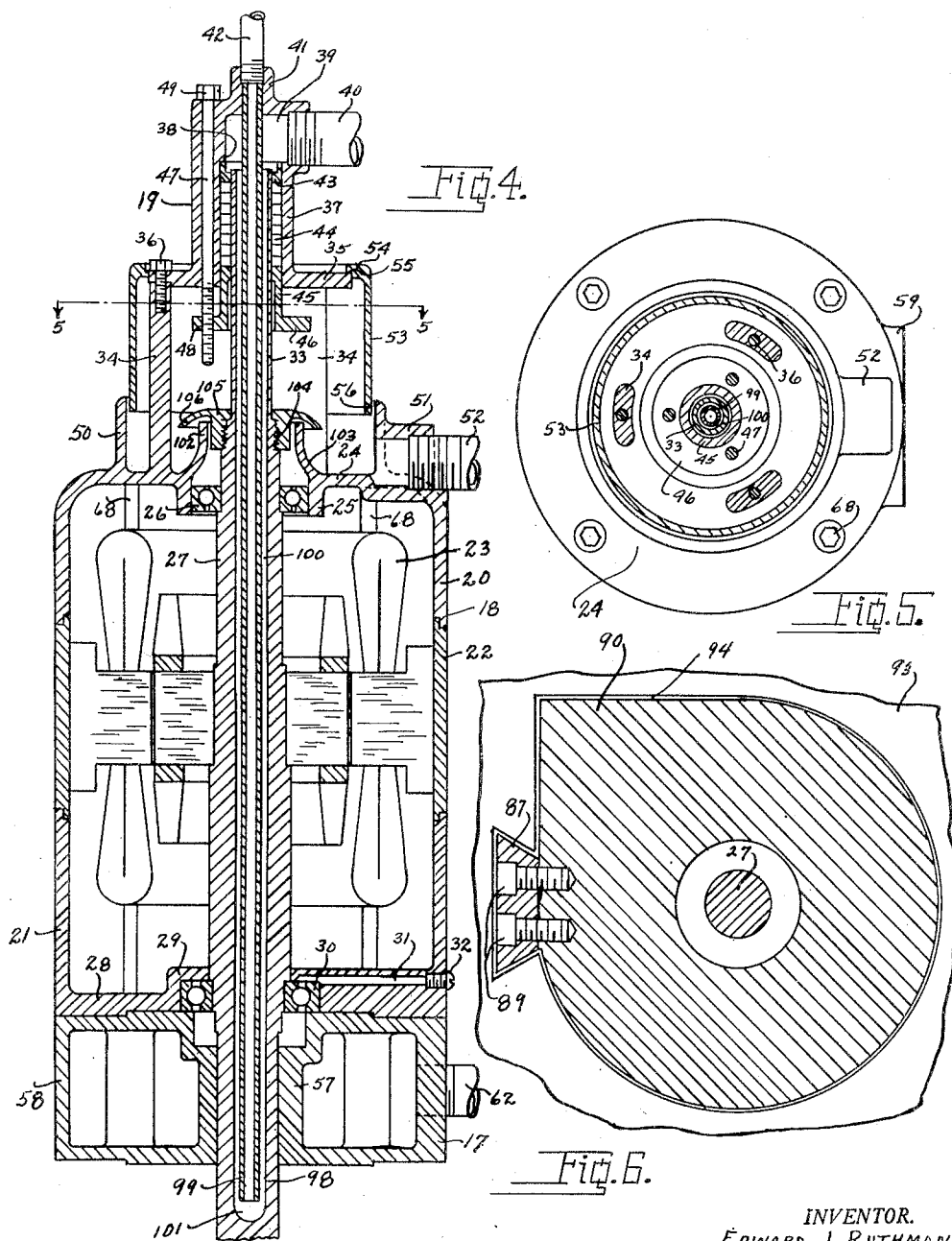
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

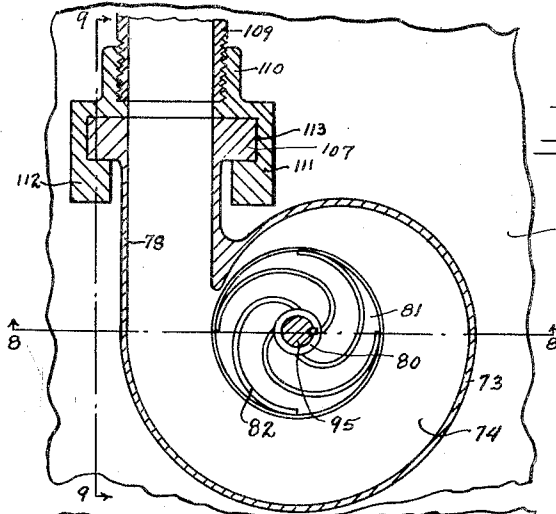


Fig. 7.

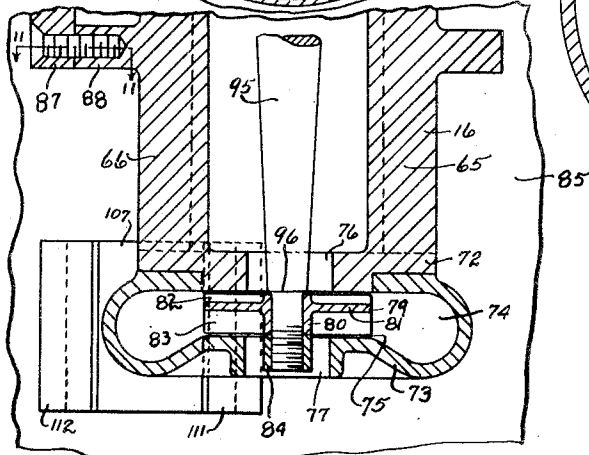


Fig. 8.

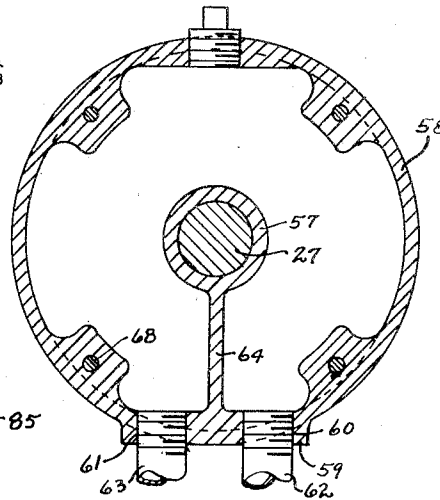


Fig. 10.

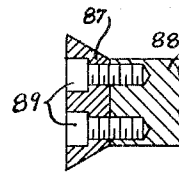


Fig. 11.

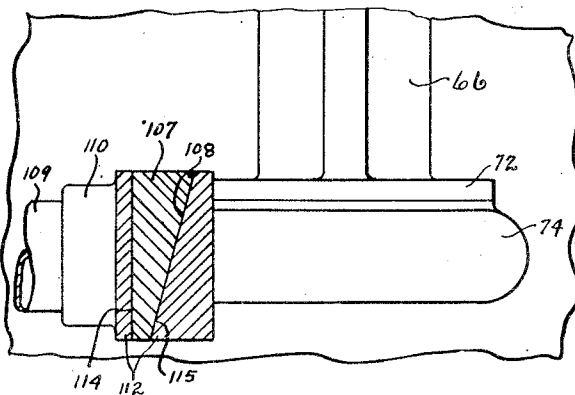


Fig. 9.

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UNITED STATES PATENT OFFICE

2,355,472

MOTOR

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Application October 4, 1940, Serial No. 359,762

7 Claims. (Cl. 172-36)

This invention relates to improvements in a centrifugal pump and particularly to such a pump for circulating molten metal with particular reference to the means for maintaining the motor and bearing thereof in a cool condition at all times.

Attempts in the past have been made to provide a circulating centrifugal pump for molten metal but these attempts were for circulating molten lead and solder. These metals have a relatively low melting point and the problem of maintaining the motor in a cool state was relatively simple since circulating fans will frequently do the job together with a simple water jacket around the shaft at a point between the pump and its motor. The pump and associated mechanism of this invention is intended to circulate molten metals having a much higher melting point such as Babbitt metal which melts at approximately 1,000° F.

In order to maintain the motor and associated parts in a cool condition use was made in this invention of a cooling fluid such as water for cooling the motor from within as well as cooling the shaft by means of the water jacket.

It is therefore one of the principal objects of the present invention to provide a circulating pump for molten metal wherein the motor is maintained in a cool state regardless of the temperature of the atmosphere in which the pump and its motor is operated.

Another object of this invention is the provision of a pump for the purpose above set forth wherein the heat transmitted by induction axially of the shaft is removed from the center of the shaft by a cooling medium thereby preventing the heating of the motor, and its bearings, by radial radiation.

A further object of this invention is the provision of a motor for use in a heat super-charged atmosphere centrally of which is disposed a heat exchanger for carrying off heat from the center of the motor thereby maintaining the bearings in a cool working condition.

A still further object of this invention is the provision of a fluid metal circulating pump having combined therewith a motor mounted for movement relative to the tank or container for the fluid metal and wherein the coupling of the pump and discharge pipe are made and broken upon movement of the pump.

It is also an object of this invention to provide a coupling between a circulating pump and a discharge pipe which coupling may be disconnected and accurately connected upon the mere vertical

movement of the pump relative to the discharge pipe.

Specifically, the object of this invention is the provision of a self-contained motor-pump unit for circulating molten metal having high heat melting point wherein water is circulated centrally of the motor for cooling purposes, and wherein the said motor-pump unit is vertically movable to raise the pump out of the molten metal and including a readily make and break coupling between the pump and its discharge pipe, and wherein a shaft of a particular configuration and construction is employed between the pump and its motor for holding the transmission of heat by induction to a medium.

It is also a specific object of this invention to provide a shaft for a molten metal circulating pump so constructed as to hold down the transmission by induction of heat from the pump in the molten metal.

Other objects and advantages of the present invention should be readily apparent by reference to the following specification considered in conjunction with the accompanying drawings forming a part thereof and it is to be understood that any modifications may be made in the exact structural details there shown and described, within the scope of the appended claims, without departing from or exceeding the spirit of the invention.

In the drawings:

Fig. 1 is an elevational view of the self-contained pump and motor unit embodying the improvements of this invention.

Fig. 2 is a top plan view of the mechanism shown in Fig. 1.

Fig. 3 is a horizontal sectional view taken through the connecting housing above the pump.

Fig. 4 is a fragmentary vertical view on an enlarged scale through the motor taken on line 4-4 on Fig. 1.

Fig. 5 is a horizontal sectional view through the water jacket taken on line 5-5 on Fig. 4.

Fig. 6 is an enlarged sectional view taken on line 6-6 on Fig. 1 and illustrating a tank closure plate as a part of the connecting housing.

Fig. 7 is an enlarged horizontal view through the pump taken on line 7-7 on Fig. 1.

Fig. 8 is a fragmentary elevational view through the center of the pump taken on line 8-8 on Fig. 7.

Fig. 9 is a view partly in section and partly in elevation as seen from line 9-9 on Fig. 7.

Fig. 10 is an enlarged horizontal sectional view

through the shaft water jacket taken on line 10—10 on Fig. 1.

Fig. 11 is a fragmentary sectional view taken on line 11—11 on Fig. 8 and illustrating a detail of the invention.

Throughout the several views of the drawings similar reference characters are employed to denote the same or similar parts.

As illustrated in the drawings, the mechanism of this invention comprises in general a pump 15 to which is attached one end of a connecting housing 16 and having its other end connected to a shaft water jacket 17. The other end of the water jacket 17 is connected to the lower end of a motor 18 which in turn supports at its upper end the cooling mechanism 19.

Specifically, the motor 18 comprises the usual upper housing 20, lower housing 21 and connecting ring 22. The ring 22 has suitably attached thereto the fixed stator laminations for the motor field coil 23. The coil 23 extends into the space provided by the upper and lower motor housings 20 and 21.

The upper housing 20 is provided with a top 24 from which depends a hollow boss 25 for the anti-friction bearing 26. Mounted in the bearing 26 is the motor-pump shaft 27.

The lower motor housing 21 is likewise provided with a closure plate 28 having up-standing therefrom a hollow boss 29 in which is disposed an anti-friction bearing 30. The said upper and lower housings are respectively provided with means for supplying lubrication to their respective bearings such as the duct 31 of the lower housing 21 which is closed by a so called "oiling fixture" 32.

The motor-pump shaft 27 is journaled in the anti-friction bearings 26 and 30 and projects considerably above the motor housing 20 as a shaft extension 33.

The motor housing 20 has up-standing from its closed end or top 25 several posts 34, shown as three in number, to which is attached a circular flange 35 as by means of screws or bolts 36. Integral with the flange 35 is a sleeve 37 counterbored to provide a shoulder 38. Radially of the sleeve beyond the shoulder 38 is a duct 39 having its opening tapped to receive a pipe 40. The upper end of the sleeve 37 is closed and has a boss 41 up-standing therefrom tapped for a pipe 42.

The motor-pump shaft extension 33 projects centrally of the sleeve counterbore and has surrounding it, within the sleeve counterbore an upper gland 43, packing rings 44 and a lower gland 45. The gland 43 has its upper edge against the counterbore seat 38, and the lower packing gland 45 has a radial flange 46. Extending vertically of the sleeve 37 are three bolts 47 each having their lower threaded ends disposed in a threaded perforation 48 formed in the lower packing gland flange 46. The said bolts 47 have the under surface of their heads 49 contacting with the upper surface of the closed upper end of sleeve 37. By this construction and upon screwing the bolts 47 the lower packing gland 45 is urged toward the top packing gland 43 for compressing the packing ring 44 about the shaft extension 33. In other words the relatively compressible packing rings 44 are compressed around the shaft extension 33 to make a substantially water tight joint around the shaft extension 33 for a purpose later to be made clear.

Up-standing from the closed end or top 24 of the motor housing 20 is a circular flange 50 which

is located relatively near the perimeter of the upper motor housing 20. Projecting outwardly, at one point, from the flange 50 is a bored boss 51 having its outer end threaded for the reception of a pipe 52. Removably mounted on the sleeve flange 35 is an inverted cup-like member 53 having at its upper end an inwardly projecting flange 54. The flange 54 is counterbored to provide a seat 55 receiving the flange 35 and thereby providing the means for supporting the member 53 on the flange 35. The lower end 56 of the member 53 is arranged to be within the upper end of the flange 50 whereby communication is effectively cut off between the shaft extension 33 and the atmosphere and the purpose for which construction will be subsequently described in detail.

The shaft water jacket 17 is substantially a cylindrical casting having a sleeve 57 through which passes the motor-pump shaft 27. This casting 58 is provided at one point exteriorly thereof with an elongated boss 59 through which is provided tapped apertures 60 and 61 respectively receiving pipes or conduits 62 and 63. Interiorly of the casting there is provided a wall or partition 64 which extends from a point intermediate the tapped apertures 60 and 61 to the central sleeve 57 thereby providing a one way passage for a cooling fluid from one of the tapped apertures to the other.

The connecting housing 16 comprises a pair of ribs or posts 65 and 66 which are substantially T-shaped in cross section as illustrated most clearly in Fig. 3. At its upper end the connecting housing 16 is provided with a flange 67 through which it is attached to the shaft water jacket 17. In order to secure the parts to one another the upper motor housing 20, the lower motor housing 21, the water jacket 17 and connecting housing flange 67 are each provided with aligned perforations through which pass elongated bolts 68 having their heads contacting the upper surface of the upper motor housing and with nuts 69 screwed against the under surface of the flange 67. Between the flange 67 and water jacket 18 are washers 70 which are formed of chrome-nickel steel which is low in heat conductivity and thereby prevent transfer of heat from the connecting housing 16 to the water jacket casting 58, and at the same time provides an air space 71 between these parts. From the foregoing it will be noted that the parts are connected to one another by a single set of draw bolts.

The lower end of the connecting housing 16 is provided with a disc or plate 72 which forms the upper plate or closure member for the pump 15. The pump 15 as particularly illustrates in Figs. 7 and 8 comprises a pump housing or casting 73 having a passageway 74 and a pump chamber 75 interiorly thereof. Communicating with the pump chamber 75 are eyes 76 and 77 formed respectively through the pump closure plate 72 and bottom of the pump housing. The pump passage 74 terminates in a discharge pipe 78 which has its axis formed tangentially of the passage 75.

Disposed within the pump chamber 75 is the pump impeller 79 comprising a hub 80 having the pump body or disc 81 integral therewith and provided on opposite sides thereof with similar impeller blades 82 and 83. The impeller 79 is secure to the lower end of the motor-pump shaft 27 by means of a suitable nut or the like 84.

The pump and its motor are adapted for vertical movement relative to a molten metal storage

tank 85 and which tank has its high line 86 at a point below the top of the tank a distance sufficient to have the pump thereabove when the same is not operating to circulate the molten metal. In order to guide the pump-motor unit use is made of a dovetailed guide bar 87 which has its lower end bolted or secured to a lug 88 projecting laterally of the connecting housing ribs or posts 66 or 67 by means of bolts or screws 89 as illustrated in Fig. 11. The guide bar or gib 87 is in addition bolted to a plate 90 integral with the connecting housing posts 65 and 66. The guide bar or gib 87 passes through a guide block 91 having formed therethrough a dovetailed guide-way 92 which is suitably secured to the tank top 93 at a point adjacent an opening 94 in said tank top. When the pump-motor unit is in its operative position the opening 94 in the tank top is substantially closed by the plate 90 which has a configuration and area substantially equal to the opening 94 and which in turn is determined by the configuration of the pump which passes therethrough. Any suitable means may be provided for effecting the raising and lowering of the motor-pump unit, such for example as that disclosed in copending application Serial No. 334,007, filed May 8, 1940, in the name of Edward J. Ruthman.

The portion of the motor-pump shaft 27 between the pump impeller 19 and the shaft water jacket may be referred to as the pump extension of said shaft and is indicated in the drawings by the reference character 95. This pump shaft 95 at its lower end 96 where it is connected to the pump impeller has a relatively small cross sectional area which gradually increases toward the shaft water jacket where the cross sectional area is relatively large as at 97 in Fig. 1. In other words the pump shaft 95 is tapered outwardly, upwardly from the impeller to the shaft water jacket. By this construction, in effect, the contiguous surfaces up the shaft are of different area thereby causing the heat of the smaller area to be more rapidly dissipated by the larger contacting area and thereby reducing the rate and amount of heat transfer from the lower end of the pump shaft to the upper end thereof.

In order to dissipate the heat in the motor shaft the said motor shaft 27 and its extension 33 is bored from its upper end downwardly to a point just below the shaft water jacket 58 as illustrated at 98. Extending centrally of said bore 98 is a tube 99 which has its upper end secured in the sleeve boss 41 so as to have its bore in axial alignment with the pipe 42. The tube 99 is of less external diameter than the diameter of bore 98 thereby providing a channel or space 100 entirely around the exterior of the tube 99. The tube 99 is suspended within the bore 98 to have its lower end spaced above the end of the bore and thereby provide a space 101 between the said end of the tube and the said bottom of the bore.

The motor housing 20 has projecting upwardly from its closed end or top 24 a ring like flange 102 which has its walls 103 outwardly curved toward the circular flange 50. This flange 102 is directly above the anti-friction bearing 26 and is substantially at the upper end of the motor shaft proper where the said shaft is threaded as at 104 to receive a slinger 105. The slinger 105 is in effect saucer shaped with the outer end 106 extending beyond the flange 103.

In order to couple and uncouple the pump dis-

charge outlet with a discharge pipe use is made of a novel coupling mechanism. This coupling mechanism comprises the forming on the pump outlet 78 a block 107 which has the vertical inner edges 108 inclined downwardly and outwardly to form in effect a wedge on the front and back sides of said block 107. The discharge pipe 109 has threaded to its end a coupling member 110 having its end adjacent the pump outlet a U-shaped yoke providing arms 111 and 112. Each of the yoke arms 111 and 112 is provided with a guide way 113 the forward edge of which is vertical while the rear edge is inclined to correspond with the inclination 108 and which passageway surfaces are illustrated respectively at 114 and 115 in Fig. 9. It is to be understood that the discharge pipe 109 and parts carried thereby are secured against displacement to the bottom (not shown) of the tank.

The operation of this mechanism is as follows:

The combined pump-motor unit is positioned as shown in Fig. 1 with the pump unit 15 within the molten metal in tank 85. The pipe 42 and either of pipes 62 and 63, pipe 62 for example, connected to a cold water source and with pipes 40 and 63 connected to a sump. Pipe 52 may likewise be connected with the sump by preferably to have its end visible to the operator. Reference is made to pipes but these members will preferably be flexible armored conduits so that they will be unaffected by the heated atmosphere and flexible enough to permit movement of the motor-pump unit without uncoupling same.

When the motor is turned on the flow of cooling water through pipes 42 and 62 begins. The flow of water or other cooling medium from the pipes 62 is downwardly through the center of the tube 99 to the space 101 at the bottom thereof whereupon the said water or cooling medium is directed by the base 98 of the bore 97 upwardly through the channel 100 around the tube 99. The water or cooling medium leaves the channel 100 and flows into the port 39 where it is directed to the pipe or conduit 40 and carried to a sump (not shown).

By this construction a continuous flow of a cooling medium centrally of the shaft 27 carries off all heat at the center of the motor whether developed by the motor or transmitted through the shaft from the metal. The maintaining of the motor shaft in a cool condition enables the bearings 26 and 30 to function properly and at the same time prevents the transmission of heat from the molten metal to the motor parts.

The packing rings 47 are intended to prevent any leakage around the motor shaft extension 33 and these packing rings may be adjusted or tightened by the bolts 47 from the exterior of the unit. However, in the event of leakage past said packing rings this leakage will be intercepted by the slinger 105 which through centrifugal action throws the collected leakage against the inner walls of the cup 53 and inner wall of the flange 50 from which it drains to the closed upper or top 24 of upper motor housing 20 to the pipe or conduit 52. In the event the motor shaft is not running when the leakage occurs the said leakage will be collected by the slinger from which it will flow along the down turn upper surface thereof to the outwardly directing wall of the flange 102 to the closed end or top 24 of the motor housing 20 and the pipe or conduit 52. As was noted above this pipe or conduit may be connected with a sump but preferably has its end visible to the operator so that he may observe any flow there-

through and thereby be advised of leakage past the packing rings and tighten same.

From the foregoing it will now be appreciated that there has been provided a circulating pump for high heat molten metal that is kept in a cool state for preventing injury to the electric motor associated therewith and whereby such a motor and pump unit may be readily coupled with and uncoupled from a discharge pipe upon the mere movement of same, and that the objects initially set forth are accomplished.

What is claimed is:

1. In a mechanism of the class described the combination of an electric motor, a shaft centrally thereof, bearings for the shaft, means for circulating a cooling medium centrally of said shaft to maintain the motor and shaft bearings in a cool state, comprising a bore centrally of the shaft, and a tube centrally of the bore, thereby providing reverse travel of a cooling medium relative to the shaft bore, means for packing the shaft against flow exteriorly thereof, means on said shaft for intercepting any leakage past the packing and to discharge same away from the shaft, and a water jacket around the shaft below the motor.

2. In a mechanism of the class described the combination of a motor including an inclosing housing, a hollow casting secured to the lower end of the motor housing, a motor shaft extending through the motor and hollow casting to a point below the casting, said shaft being bored throughout the portion thereof extending through the motor and casting but not being bored through the end of the shaft below the casting, a tube centrally of the shaft bore stopping short of the bottom thereof and having its walls spaced from the walls of the bore, means for effecting a circulation of a cooling medium in reverse direction through the tube and shaft bore for carrying off heat generated by the motor, and means for circulating a cooling medium through the hollow casting and forming a water jacket around the shaft thereby.

3. In a cooling mechanism for an electric motor of the class described the combination of an electric motor having end closing members, posts extending from one of the closing members, a sleeve having its upper end closed carried by and projecting from said posts, a motor shaft centrally of the motor and extending beyond the closing members, said shaft having a bore centrally thereof from its one end but stopping short of the other end and having its one extending end projecting into the sleeve to a point below the closed end of the sleeve, a tube carried by the closed end of the sleeve and projecting into the shaft bore to a point short of the bottom thereof and being of a diameter less than the diameter of the bore whereby a passageway is formed between the outside of the tube and inside wall of the shaft bore, packing around the shaft extension within the sleeve, and a pair of conduits carried by the sleeve, one connecting a source of cooling medium with one end of the tube and the other connected with the end of the shaft bore for carrying off the cooling medium after it has circulated through the tube and passage therearound.

4. In a cooling mechanism for an electric motor of the class described the combination of an electric motor having end closing members, posts extending from one of the closing members, a sleeve having its upper end closed carried by and projecting from said posts, a motor shaft centrally of the motor and extending beyond the

closing members, said shaft having a bore centrally thereof from its one end but stopping short of the other end and having its one extending end projecting into the sleeve to a point below the closed end of the sleeve, a tube carried by the closed end of the sleeve and projecting into the shaft bore to a point short of the bottom thereof and being of a diameter less than the diameter of the bore whereby a passageway is formed between the outside of the tube and inside wall of the shaft bore, packing around the shaft extension within the sleeve, a pair of conduits carried by the sleeve, one connecting a source of cooling medium with one end of the tube and the other connected with the end of the shaft bore for carrying off the cooling medium after it has circulated through the tube and passage therearound and a water jacket carried by the other motor closing member and encircling the adjacent extension of the motor shaft.

5. In a cooling mechanism for an electric motor of the class described the combination of an electric motor having end closing members, posts extending from one of the closing members, a sleeve having its upper end closed carried by and projecting from said posts, a motor shaft centrally of the motor and extending beyond the closing members, said shaft having a bore centrally thereof from its one end but stopping short of the other end and having its one extending end projecting into the sleeve to a point below the closed end of the sleeve, a tube carried by the closed end of the sleeve and projecting into the shaft bore to a point short of the bottom thereof and being of a diameter less than the diameter of the bore whereby a passageway is formed between the outside of the tube and inside wall of the shaft bore, packing around the shaft extension within the sleeve, a pair of conduits carried by the sleeve, one connecting a source of cooling medium with one end of the tube and the other connected with the end of the shaft bore for carrying off the cooling medium after it has circulated through the tube and passage therearound, a flange extending from the motor closure member and encircling the posts to form a collector for the cooling medium leaking through the packing, and a drain conduit carried by the motor closing member and extending through the flange.

6. In a cooling mechanism for an electric motor of the class described the combination of an electric motor having end closing members, posts extending from one of the closing members, a sleeve having its upper end closed carried by and projecting from said posts, a motor shaft centrally of the motor and extending beyond the closing members, said shaft having a bore centrally thereof from its one end but stopping short of the other end and having its one extending end projecting into the sleeve to a point below the closed end of the sleeve, a tube carried by the closed end of the sleeve and projecting into the shaft bore to a point short of the bottom thereof and being of a diameter less than the diameter of the bore whereby a passageway is formed between the outside of the tube and inside wall of the shaft bore, packing around the shaft extension within the sleeve, a pair of conduits carried by the sleeve, one connecting a source of cooling medium with one end of the tube and the other connected with the end of the shaft bore for carrying off the cooling medium after it has circulated through the tube and passage therearound, a flange extending from the motor clo-

sure member and encircling the posts to form a collector for the cooling medium leaking through the packing, a drain conduit carried by the motor closing member and extending through the flange, and a slinger on the shaft adjacent the closing member for intercepting leakage past the shaft packing for throwing same against the flange for delivery to the drain conduit.

7. In a cooling mechanism for an electric motor of the class described the combination of an electric motor having end closing members, posts extending from one of the closing members, a sleeve having its upper end closed carried by and projecting from said posts, a motor shaft centrally of the motor and extending beyond the closing members, said shaft having a bore centrally thereof from its one end but stopping short of the other end and having its one extending end projecting into the sleeve to a point below the closed end of the sleeve, a tube carried by the closed end of the sleeve and projecting into the shaft bore to a point short of the bottom thereof and being of a diameter less than the diameter

of the bore whereby a passageway is formed between the outside of the tube and inside wall of the shaft bore, packing around the shaft extension within the sleeve, a pair of conduits carried by the sleeve, one connecting a source of cooling medium with one end of the tube and the other connected with the end of the shaft bore for carrying off the cooling medium after it has circulated through the tube and passage therearound, a flange extending from the motor closure member and encircling the posts to form a collector for the cooling medium leaking through the packing, a drain conduit carried by the motor closing member and extending through the flange, a slinger on the shaft adjacent the closing member for intercepting leakage past the shaft packing for throwing same against the flange for delivery to the drain conduit and an inverted cup like guard depending from the sleeve toward the motor closing member for inclosing the motor shaft extending portion and cooperating with the leakage collecting flange.

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