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ELECTROMAGNETIC CENTRIFUGAL PUMP

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FIG. 1.

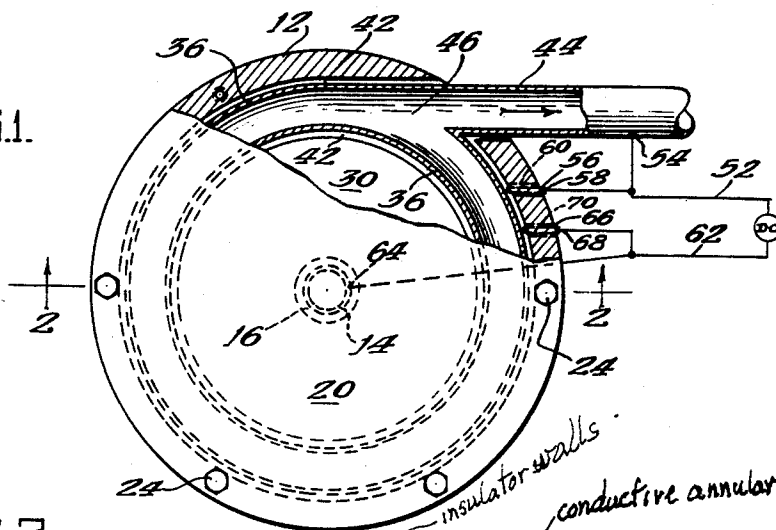


FIG. 2.

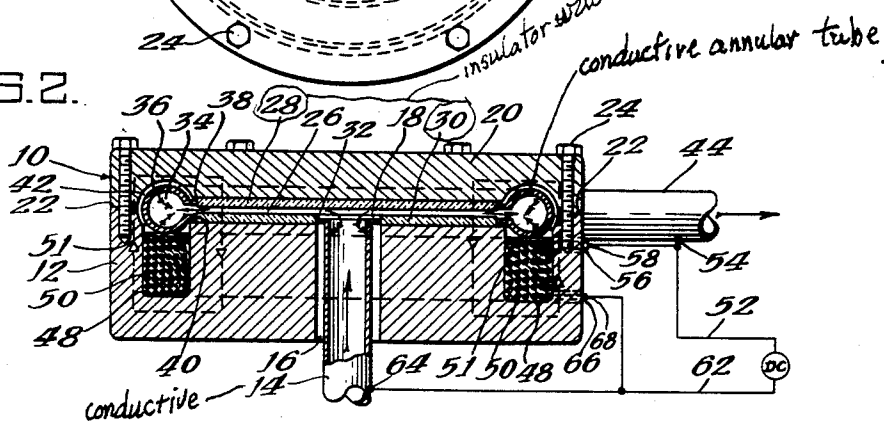
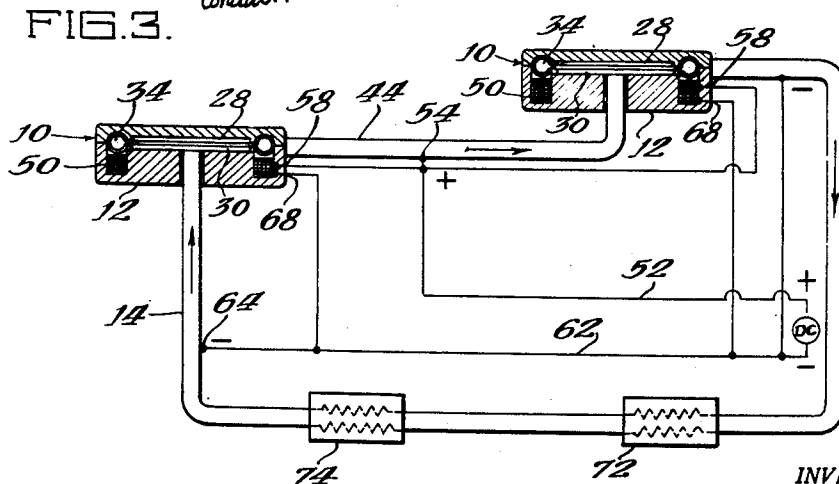


FIG. 3.



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The present invention relates to electromagnetic centrifugal pumps.

One of the problems in atomic power work is that of pumping liquid metal coolants through atomic reactors and associated heat exchangers. Mechanical centrifugal pumps present problems of bearings operating in the coolant and of seals for the pump shafts. In order to obviate these mechanical difficulties electromagnetic pumps may be used wherein there are no moving parts.

The present device for pumping electrically conductive fluids embodies the interaction of a fixed magnetic field and a D. C. current flowing through the conducting field. Within the pump chamber a liquid metal is whirled in a spiral path about the axis of the chamber by means of the interaction of a fixed magnetic field and a D. C. current which flows through the fluid in a direction normal to the field and radially of the chamber, causing the liquid to move in a third direction which is normal to the directions of the field and current. As the liquid gains momentum, it is thrown outwardly from a central inlet to the periphery by centrifugal force.

The various structural features and advantages of this invention will become more apparent by reference to the accompanying drawings and the following description of a preferred embodiment thereof. In the drawings,

Figure 1 is a plan view partly in section of an electromagnetic centrifugal pump;

Figure 2 is a vertical sectional view, taken on the line 2—2 of Figure 1; and

Figure 3 illustrates two pumps connected in series in a closed system of the liquid metal.

As shown in Figure 2 the pump is generally indicated at 10. An annular magnetic member 12 constitutes the lower portion of the pump 10. In the central opening of the annular member 12 is an inlet pipe 14 which is separated from the annular member 12 by an air gap 16. The pipe 14 is open at its upper extremity and flared at 18. The top portion of the pump is a circular magnetic member 20 which rests on the annular magnetic member 12 at the peripheral interface 22 and which is secured thereto by means of bolts 24.

A flat circular chamber 26 is disposed horizontally between the magnetic members 12 and 20. The chamber 26 is insulated from said members 20 and 12 by means of walls 28 and 30, respectively, which are ceramic insulators. The upper wall 28 is a circular disk and the lower wall 30 is an annular body. At the center of the annular wall 30 is an opening 32 where the flared extremity 18 of the inlet pipe 14 is sealed to the wall.

About the periphery of the chamber 26 is an enlarged portion 34 which is formed by an annular housing 36 and which communicates with

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the chamber 26. The member 36 is composed of electrically conductive material and is sealed at 38 and 40 to the ceramic material of the walls 28 and 30, respectively. Surrounding the housing 36 is an air gap 42 which insulates it from the magnetic members 20 and 12. As shown in Figure 1, tangential outlet pipe 44 is attached at the periphery of the housing 36 at 46. Below the housing 36 is an annular channel 48 in the magnetic member 12. The channel 48 is a receptacle for windings 50, which are simply laid in place. Between the windings and the housing 36 is padding 51.

The electrical potential for the pump is supplied by a D. C. supply not shown in the drawings. Referring to Figures 1 and 2 a lead wire 52 contacts the outlet pipe 44 at a spot weld 54. The same lead contacts one end 56 of the windings 50 at 58, said lead 56 extending through an aperture 60 in the wall of the annular member 12. Another lead 62 contacts the inlet pipe 14 at the spot weld 64 and it contacts the opposite end 66 of the winding 50 at 68. Said end passes through an aperture 70 in the wall of the annular member 12.

The structure having been described, the operation will be readily understood. To start the pump it is primed by flooding the chambers 26 and 34 with liquid metal by methods conventional with centrifugal pumps. The electrical circuit is closed in order to energize the magnetic windings 50 and to apply the D. C. potential between the inlet pipe 14 and the annular housing 36. In this manner, a radial current is caused to flow between the inlet pipe 14 and the annular housing 36, as indicated by the double-headed arrows. Simultaneously the magnetic field, as indicated by the triangular-headed arrows is caused to flow through in a direction perpendicular to the chamber 26 and thus to the direction of the electrical current, said field being induced by the windings 50. The conducting metal is thus impelled by the interaction of the magnetic field and the current in a direction perpendicular to both. Within the chamber 26 the metal thus whirls about a path which is made spiral by centrifugal force until it is forced into the enlarged chamber 34 from which it flows through the outlet 44 which is tangentially disposed in the periphery of the chamber.

The foregoing description has been in reference to a single pump. The pump, however, is well adapted to series or cascade connection, as shown schematically in Figure 3. In such connection, the outlet of one pump leads directly to the inlet of the second pump, and in order to avoid short circuiting, the single electrical contact 54 is provided thereon. By the same token the inlet of the first pump and the outlet of the second pump are wired with a potential opposite

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to that at 54. In this manner, a liquid metal can be pumped through a closed system which includes a heat exchanger 72, illustrated schematically in Figure 3, and which includes a heat source 74, such as an atomic reactor, illustrated schematically in the same figure.

The above description and accompanying drawings present a single embodiment of this invention.

What is claimed is:

1. An electromagnetic pump for electrically conductive fluids comprising, in combination, a partitionless disk-shaped chamber having side walls composed of insulating material and having an enlarged peripheral portion with side walls composed of conducting material and with an outlet suitably disposed therein, an inlet centrally disposed in the disk-shaped chamber with side walls composed of conducting material, a direct potential source between the peripheral portion and the inlet extending radially within the disk-shaped chamber, and means for creating a magnetic field perpendicular of the chamber.

2. An electromagnetic pump for electrically conductive fluids comprising, in combination, a partitionless disk-shaped chamber having side walls composed of insulating material and having an enlarged peripheral portion with side walls composed of conducting material with an outlet suitably disposed therein, an inlet centrally disposed in the disk-shaped chamber with side walls composed of conducting material, a direct potential source between the peripheral portion and the inlet extending radially within the disk-shaped chamber, and means for creating a magnetic field perpendicular of the chamber consisting of a magnet disposed on both sides of the disk-shaped chamber adjacent to the insulating material of the side walls.

3. An electromagnetic pump for electrically conductive fluids, comprising, in combination, a disk-shaped chamber having side walls composed of insulating material, an annular conduit peripherally disposed about said chamber composed of conducting material and having an outlet suitably disposed therein, the disk-shaped chamber having an inlet centrally disposed with side walls composed of conducting material, a direct potential source between the annular conduit and the inlet extending radially within the disk-shaped chamber, and means for creating a magnetic field perpendicular of the chamber consisting of a magnet which surrounds the entire chamber, except for the inlet and the outlet, and which is separated from the annular conduit and from the central inlet by air gaps, and consisting of means for inducing the magnetic field therein.

4. An electromagnetic pump for electrically conductive fluids comprising, in combination, a disk-shaped chamber having side walls composed of insulating material, an annular conduit peripherally disposed about said chamber composed of conducting material and having an outlet suitably disposed therein, the disk-shaped chamber having an inlet centrally disposed with side walls composed of conducting material, a direct potential source between the annular conduit and the inlet extending radially within the disk-shaped chamber, and means for creating a magnetic field perpendicular of the chamber consisting of a magnet which surrounds the entire chamber, except for the inlet and the outlet, and which is separated from the annular

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conduit and from the central inlet by air gaps, and consisting of an annular channel for field windings within said magnet directly adjacent to the annular conduit, whereby said magnetic field is induced.

5. An electromagnetic pump for electrically conductive fluids comprising, in combination, a disk-shaped chamber having side walls composed of insulating material, an annular conduit peripherally disposed about said chamber and communicative therewith composed of conducting material and having an outlet suitably disposed therein, the disk-shaped chamber having an inlet centrally disposed with side walls composed of conducting material, a direct potential source between the annular conduit and the inlet extending radially within the disk-shaped chamber, and means for creating a magnetic field perpendicular of the chamber consisting of a magnet which surrounds the entire chamber, except for the inlet and the outlet, and which is separated from the annular conduit and from the central inlet by air gaps, and consisting of an annular channel for field windings within said magnet directly below the annular conduit, whereby the interaction of the radial current in the transverse magnetic field moves the conducting fluid in a direction normal to both the electric current and magnetic field, thereby whirling the fluid within the disk-shaped chamber until centrifugal action forces the fluid into the annular conduit and out the outlet.

6. An electromagnetic pump for electrically conductive fluids comprising, in combination, a disk-shaped chamber having side walls composed of insulating material, an annular conduit peripherally disposed about said chamber and communicative therewith composed of conducting material and having an outlet suitably disposed therein, the disk-shaped chamber having an inlet centrally disposed with side walls composed of conducting material, a direct potential source between the annular conduit and the inlet extending radially through the chamber, which source is supplied to the walls of the outlet and discharged from the wall of the inlet, and means for creating a magnetic field perpendicular of the chamber consisting of a magnet which surrounds the entire chamber, except for the inlet and the outlet, and which is separated from the annular conduit and from the central inlet by air gaps, and consisting of an annular channel for field windings within said magnet directly below the annular conduit, whereby the interaction of the radial current in the transverse magnetic field moves the conducting fluid in a direction normal to both the electric current and magnetic field, thereby whirling the fluid within the disk-shaped chamber until centrifugal action forces the fluid into the annular conduit and out the outlet.

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