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Nov. 10, 1953 K. O. DONELIAN 2,658,452
ELECTROMAGNETIC PUMP
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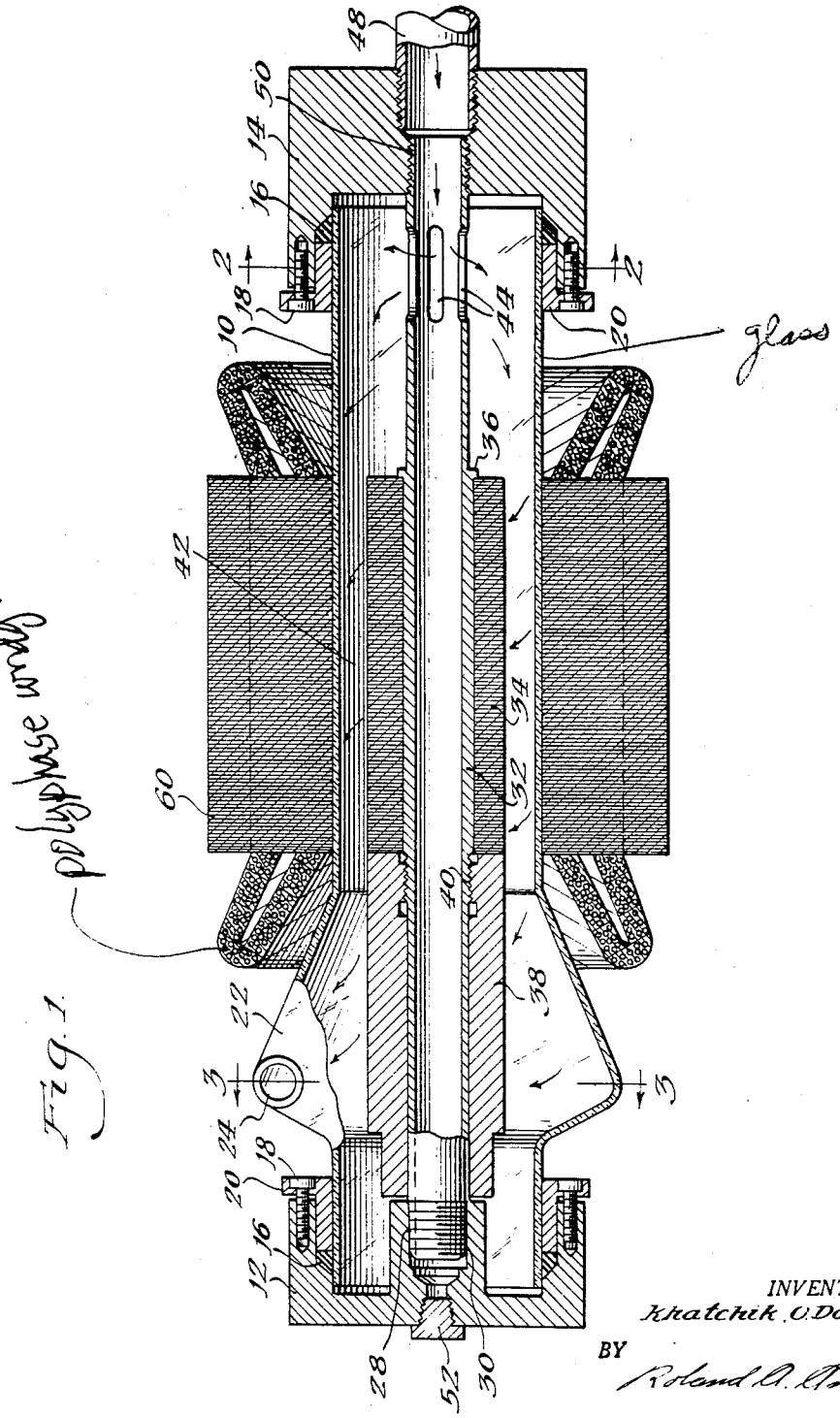


Fig. 1.

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Fig. 2.

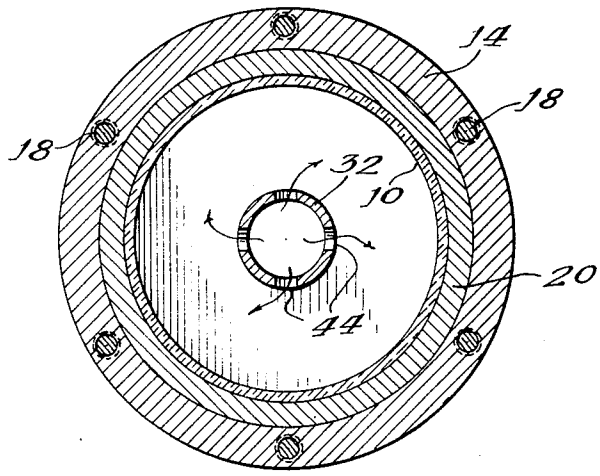
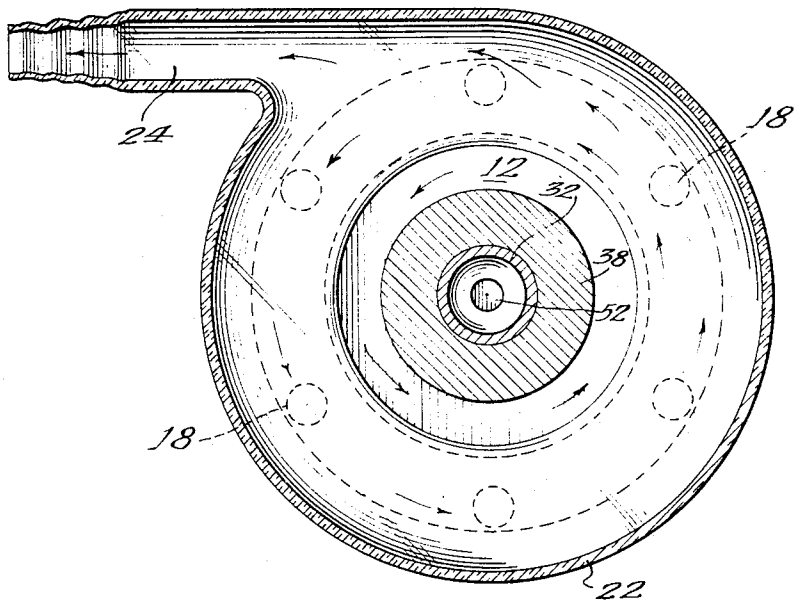


Fig. 3.



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2,658,452

UNITED STATES PATENT OFFICE

2,658,452

ELECTROMAGNETIC PUMP

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Application June 3, 1948, Serial No. 30,860

13 Claims. (Cl. 103—1)

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This invention relates to an improvement in pumps. More particularly the invention provides an improved electromagnetic pump for pumping electrically conducting liquids.

Electromagnetic pumps for pumping such liquids as mercury and liquid bismuth have been devised in the past. By the present invention there is provided an electromagnetic centrifugal pump. The pump of the present invention is particularly useful in pumping liquids which are extremely active chemically, such as alloys of sodium and potassium.

Generally, in the pump structure of the invention, the conducting liquid is whirled in the pump chamber by the action of a rotating magnetic field and is forced out by centrifugal force through an aperture in the periphery of the chamber. For a more complete understanding of the invention, reference is made to the drawing, illustrating a single embodiment thereof. In the drawing:

Fig. 1 is a central vertical sectional view of an electromagnetic centrifugal pump;

Fig. 2 is a cross sectional view of the pump of Fig. 1 taken along the line 2—2 in the direction indicated by arrows; and

Fig. 3 is a cross sectional view of the pump of Fig. 1 along the line 3—3 in the direction indicated by arrows.

A glass tube 10 has sealed to the respective ends thereof steel caps 12 and 14, the fastening and sealing being accomplished at each end by compression of an annular rubber gasket 16 around the tube 10 by means of bolts 18 compressing the gasket 16 between the respective cap 12, 14 and a collar 20 which likewise surrounds the tube 10. The tube 10 has a flared portion 22, of enlarged diameter, at the end adjacent the cap 12 and a tangential nozzle aperture 24 at the periphery of the flared portion 22. (As will hereinafter appear, the aperture 24 is the outlet aperture of the pump, and the flared portion 22 is at the outlet end of the tube 10.) The outlet end cap 12 is centrally bored and threaded at 28 to receive the threaded end 30 of a steel tube 32 which extends longitudinally through the pump. Mounted on the tube 32 are a large number of laminated disks 34 of iron which are centrally apertured to receive the tube 32 and are clamped between an annular shoulder 36 on the outer surface of the tube 32 and an internally threaded steel collar 38 which surrounds the outlet end of the outer surface of the tube 32 and cooperates with a threaded portion 40 thereon. The laminations 34 form a ferromagnetic

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core which is thus mounted axially of the tube 10 in the central region thereof.

The inner wall of the tube 10 and the outer surface of the core 34 thus serve to define an elongated circular annulus 42. The tube 32 is perforated at 44 near the inlet end and communicates with an inlet pipe 48 through a central bore 50 in the inlet end cap 14. The bore 50 has internal threads cooperating with external threads on the steel tube 32 at the inlet end thereof so that the tube 32 is rigidly mounted at both ends. A plug cap 52 communicating with the tube 32 is provided in the outlet end cap 14 to permit draining of the pump when desired. Surrounding the central region of the tube 10 is a three-phase stationary electromagnet 60. As illustrated, the electromagnet 60 is the stator of a conventional three-phase electric motor. The flux path of the magnetic field is across the annulus 42 between the magnet 60 and the core 34.

As indicated by flow arrows in the drawing, the liquid metal enters the pump through the inlet pipe 48 and the perforations at 44. The rotating field of the windings 60 whirls the liquid by interaction between the magnetic field and the currents induced in the liquid by the change of magnetic flux. The centrifugal force exerted by the rotation of the liquid in the annulus 42 forces the liquid out at the aperture 24 on the periphery of the flared outlet end 22. Although the flared portion 22 is not essential to minimum operation, its presence aids both in the centrifugal action and in the starting of the pump.

Although there is described above only a single embodiment of the invention, it is obvious that many pumps embodying the teachings of the invention may readily be devised. As an obvious example, the windings producing the magnetic field may be on the core rather than outside the chamber, and the tube may be of a ferromagnetic material such as iron. Likewise means other than a polyphase electromagnet may be used for generating the rotating magnetic field; although such an embodiment is not preferred, permanent magnets may be mechanically rotated. Many other modifications of the embodiment described above will be immediately apparent.

What is claimed is:

1. A pump for electrically conducting liquids comprising, in combination, a tube of glass, an elongated core comprising laminated iron disks, means for mounting the core within the tube and along the axis thereof to form a partitionless annulus between the core and the inner wall of the

tube, a polyphase electromagnet surrounding the tube to produce in the annulus a magnetic field rotating about the axis of the tube, a liquid inlet at one end of the tube centrally of the tube, and a peripheral liquid outlet at the other end of the tube, said outlet end being flared to a diameter greater than that of the remainder of the tube, whereby an electrically conducting liquid is admitted through said inlet, rotated in the annulus by the action of the rotating field and forced out at the periphery by centrifugal force.

2. A pump for electrically conducting liquids comprising, in combination, a tube of electrically insulating material, an elongated ferromagnetic core, means for mounting the core within the tube and along the axis thereof to form a partitionless annulus between the core and the inner wall of the tube, magnet means surrounding the tube adapted to produce in the annulus a magnetic field rotating about the axis of the tube, an axial liquid inlet at one end of the tube, and a peripheral liquid outlet at the other end of the tube, whereby an electrically conducting liquid is admitted through said inlet, rotated in the annulus by the action of the rotating field and forced out at the periphery by centrifugal force.

3. A pump for electrically conducting liquids comprising, in combination, a tube, a stationary core, means for fixedly mounting the core within the tube and along the axis thereof to form a partitionless annulus between the core and the inner wall of the tube, magnet means on the tube adapted to produce in the annulus a magnetic field rotating about the axis of the tube, at least one axial liquid inlet at one end of the tube, and at least one peripheral liquid outlet at the other end of the tube, whereby an electrically conducting liquid is admitted through said inlet, rotated in the annulus by the action of the rotating field and forced out at the periphery by centrifugal force.

4. The apparatus of claim 3 wherein the magnet means comprises a polyphase magnet winding.

5. The apparatus of claim 3 wherein the outlet end of the tube is flared to a diameter larger than the remainder of the tube.

6. A pump for electrically conducting liquids comprising, in combination, a circular container, a circular ferromagnetic core, means to mount the core within the tube and along the axis thereof to define a partitionless annular liquid flow path, polyphase magnet windings on the container adapted to produce a circumferentially rotating magnetic field across the annulus, a liquid inlet into the inner surface of the annulus, and a liquid outlet at the periphery of the annulus, whereby an electrically conducting liquid is admitted through said inlet, rotated in the annulus by the action of the rotating field and forced out at the periphery by centrifugal force.

7. A pump for electrically conducting liquids comprising, in combination, walls defining a partitionless annular liquid flow path, magnet means around the walls adapted to produce a circumferentially rotating magnetic field across the annulus, at least one liquid inlet centrally of the annulus, and at least one liquid outlet at the periphery of the annulus, whereby an electrically conducting liquid is admitted through said inlet, rotated in the annulus by the action of the rotating field and forced out at the periphery by centrifugal force.

8. The apparatus of claim 7 wherein the magnet means is a stationary polyphase electromagnet.

9. A pump for electrically conducting liquids comprising a partitionless chamber having its interior free of mobile solid members and having an axial liquid inlet and a liquid outlet on the periphery thereof, and magnet means around the chamber for rotating a magnetic field around the axis of the chamber, whereby an electrically conducting liquid is admitted through said inlet, rotated in the chamber by the action of the rotating field and forced out at the periphery by centrifugal force.

10. A pump for electrically conducting liquids comprising, in combination, walls defining a substantially circular closed flow path free of mobile solid members, magnet means around the walls adapted to produce a rotating magnetic field across the flow path, at least one inlet aperture to the flow path, and at least one outlet aperture radially outward from the inlet aperture, whereby an electrically conducting liquid is admitted through said inlet, rotated in the flow path by the action of the rotating field and forced out at the periphery by centrifugal force.

11. The apparatus of claim 10 wherein the inlet aperture is connected centrally of the circular flow path.

12. The apparatus of claim 11 wherein the magnet means is a stationary polyphase circular electromagnet.

13. A pump for electrically conducting liquid comprising, in combination, a partitionless cylindrical chamber having its interior free of mobile solid members and having an inlet centrally disposed thereof and an outlet disposed peripherally thereof, and means on the chamber for inducing a rotating magnetic field through the chamber and about the axis of the chamber, whereby an electrically conducting liquid is admitted through said inlet, rotated in the chamber by the action of the rotating field and forced out at the periphery by centrifugal force.

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