

[54] **PUMP HAVING MAGNETICALLY DRIVEN RECIPROCATING PISTONS**

[76] Inventor: **John F. Roesel, Jr.**, Rt. No. 2, Box 281-M, Upper Manatee River Rd., Bradenton, Fla. 33505

[22] Filed: **Dec. 23, 1971**

[21] Appl. No.: **211,183**

[52] U.S. Cl. **417/418, 417/488, 417/259**

[51] Int. Cl. ... **F04b 17/04, F04b 35/04, F04b 39/10**

[58] Field of Search ... **417/417, 418, 416, 486, 487, 417/488, 259; 310/24, 34**

[56] **References Cited**
UNITED STATES PATENTS

1,556,059	10/1925	Williams	417/416
1,978,866	10/1934	Konig	417/417
2,605,042	7/1952	Reutter	417/417
3,659,968	5/1972	Thomas et al.	417/417
3,196,797	7/1965	Marini	417/418
1,314,448	8/1919	Whitaker	417/488

Primary Examiner—William L. Freeh

Assistant Examiner—R. E. Gluck

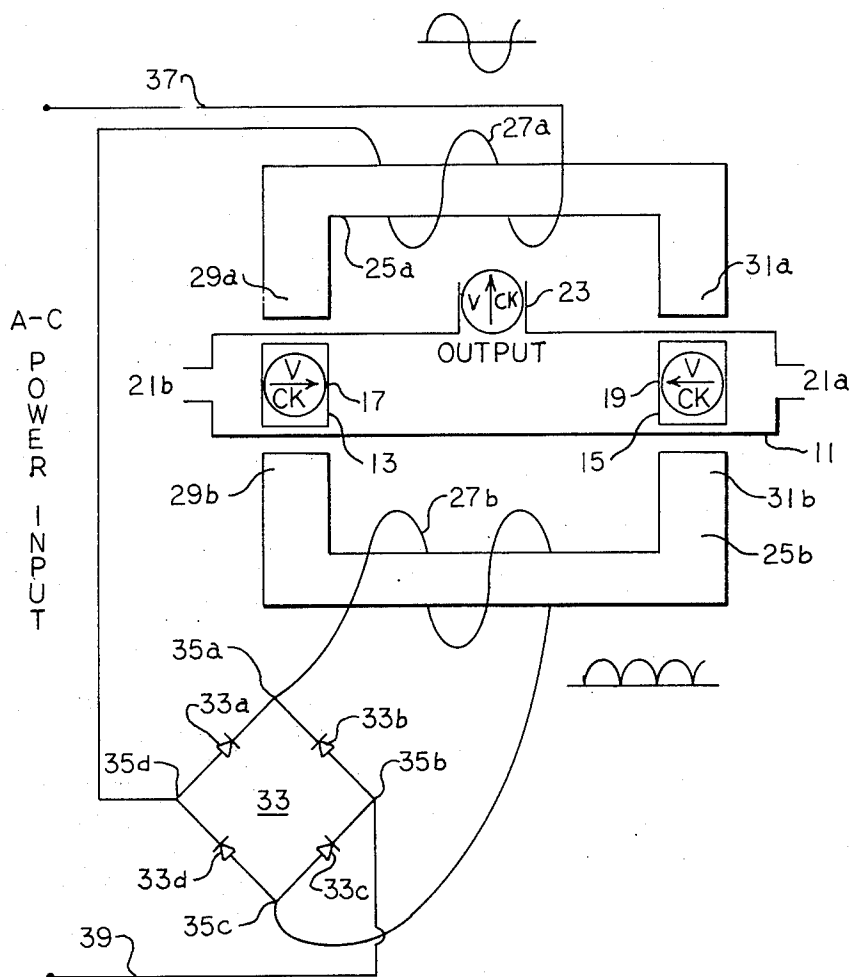
Attorney, Agent, or Firm—George B. Oujevolk

[57] **ABSTRACT**

A pump wherein the pumping takes place in an elongated chamber having first and second magnetic material piston members therein, at least one member being moveable and at least said one moveable member having check valve means therein so that liquid is flowed through the check valve means as the members are separating and the relative movement towards each other of the sections closes the check valve means. A unidirectional flow outlet between the members allows the liquid to be pumped out by the relative movement of the piston members. Facing each other on the outside of the chamber are first and second horseshoe electromagnets with first and second coils around each horseshoe. Connected to the first set of coils is an AC to DC converter to supply DC power to the coil, whereas the second coil has a line for connection to an AC source. The first coil, the converter and the second coil are in series so that the first horseshoe magnet presents alternating North and South poles, while the second horseshoe magnet has fixed North and South poles. When plugged into a line, the fixed poles are alternately presented with a similar and a different opposed pole. This causes the moveable piston members to be attracted to the poles on one cycle and be attracted to each other on the next cycle by virtue of the tendency of the pistons to move in the direction of maximum magnetic flux linkage, thus pumping the fluid.

gated chamber having first and second magnetic material piston members therein, at least one member being moveable and at least said one moveable member having check valve means therein so that liquid is flowed through the check valve means as the members are separating and the relative movement towards each other of the sections closes the check valve means. A unidirectional flow outlet between the members allows the liquid to be pumped out by the relative movement of the piston members. Facing each other on the outside of the chamber are first and second horseshoe electromagnets with first and second coils around each horseshoe. Connected to the first set of coils is an AC to DC converter to supply DC power to the coil, whereas the second coil has a line for connection to an AC source. The first coil, the converter and the second coil are in series so that the first horseshoe magnet presents alternating North and South poles, while the second horseshoe magnet has fixed North and South poles. When plugged into a line, the fixed poles are alternately presented with a similar and a different opposed pole. This causes the moveable piston members to be attracted to the poles on one cycle and be attracted to each other on the next cycle by virtue of the tendency of the pistons to move in the direction of maximum magnetic flux linkage, thus pumping the fluid.

7 Claims, 5 Drawing Figures



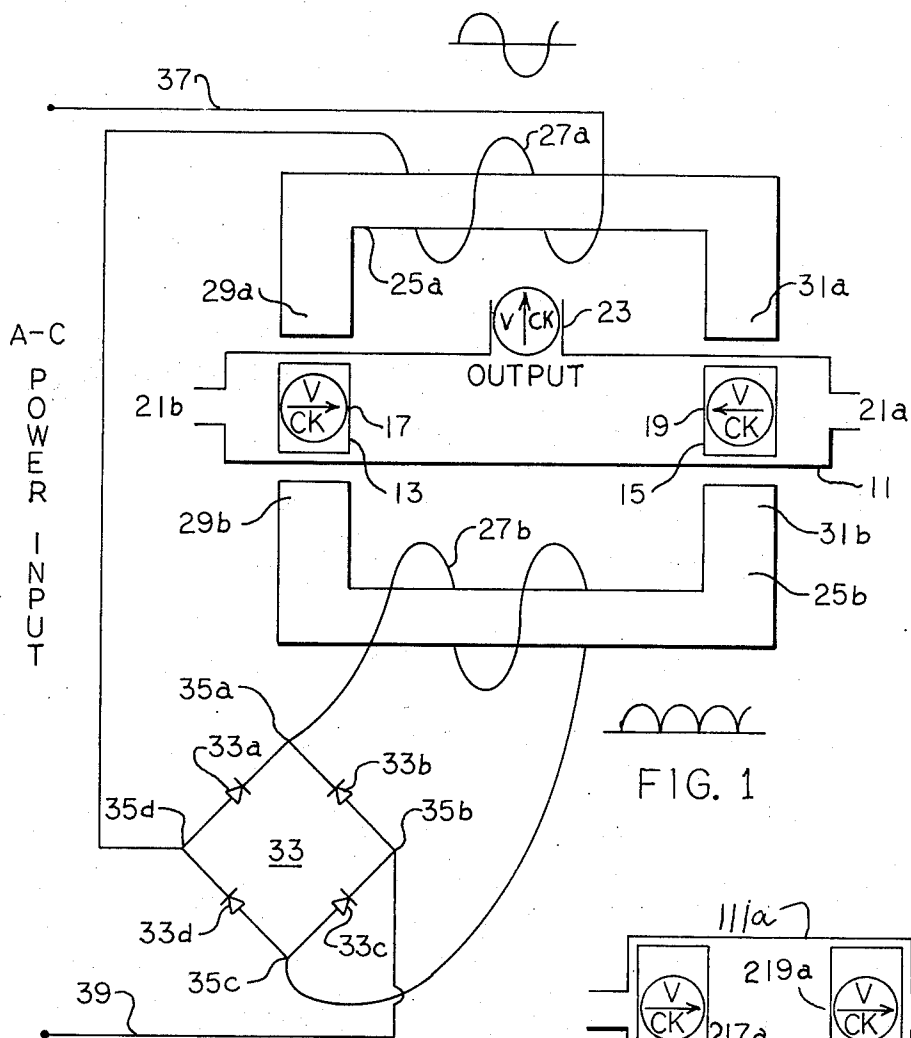


FIG. 1

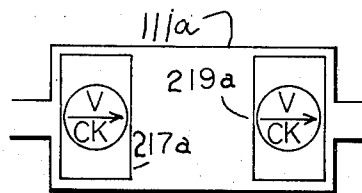


FIG. 5

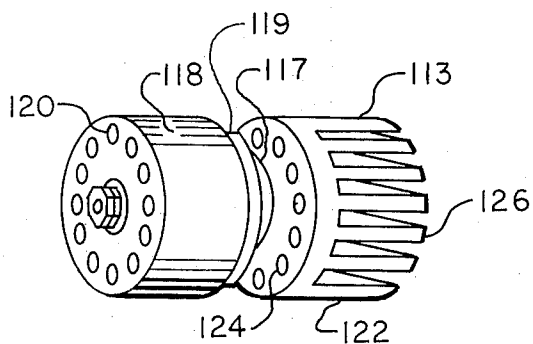


FIG. 3

JOHN F. ROESEL, JR.
INVENTOR.

BY GEORGE B. OUJEVOLK
ATTORNEY.

PUMP HAVING MAGNETICALLY DRIVEN RECIPROCATING PISTONS

BACKGROUND OF THE INVENTION

The present invention relates to a pump, and more particularly to a pump which can be readily controlled, can work under various temperature conditions, and is small, sealed, and compact, so as to be fitted into a small space.

BRIEF DESCRIPTION OF THE PRIOR ART

Magnetically driven pumps usually have a spring return. Since about one-half of the magnetic force is used to store energy in a spring, the efficiency of such pumps is low, and the piston return is dependent on the spring force.

Because of government incentives in the last few years, considerable efforts have been exerted by inventors to develop anti-pollution engines. Many of these engines are based on the so-called "Carnot Cycle" and derivatives thereof, such as the concepts of Diesel, Stirling, Brayton, Otto, and others. An example of such an engine is that described in the John F. Roesel, Jr., U. S. Pat. application No. 29,601, filed Apr. 17, 1970. Many of these engines require a pumping arrangement between phases, and in some cases, the pump may have to pump in succession a hot and a cold fluid. Heretofore, pumps for this type of work were of a laboratory type. However, if these engines are to be of any practical use, the pumps must be equal to the task and be long lasting. Furthermore, such pumps must be able to operate on a regularly available power source, such as a 60 cycle line or an automobile alternator. Because of the low efficiency of magnetic pumps, these pumps do not seem to be the type desired.

Although attempts may have been made to provide such a magnetic pump, none, as far as I am aware, have been very successful in practice. Yet, the present invention is directed to a high efficiency magnetic pump free of the foregoing defects.

SUMMARY OF THE INVENTION

Briefly stated, the present invention contemplates a pump wherein the pumping takes place in an elongated chamber having first and second magnetic material piston members therein, at least one member being moveable and at least said one moveable member having check valve means therein so that liquid is flowed through the check valve means as the members are separating and the relative movement towards each other of the sections closes the check valve means. A unidirectional flow outlet between the members allows the liquid to be pumped out by the relative movement of the piston members. Facing each other on the outside of the chamber are first and second horseshoe electromagnets with first and second coils around each horseshoe. Connected to the first set of coils is an AC to DC converter to supply DC power to the coil, whereas the second coil has a line for connection to an AC source. The first coil, the converter and the second coil are in series so that the first horseshoe magnet presents alternating North and South poles, while the second horseshoe magnet has fixed North and South poles. When plugged into a line, the fixed poles are alternately presented with a similar and a different opposed pole. This causes the moveable piston members to be attracted to

the poles on one cycle and be attracted to each other on the next cycle by virtue of the tendency of the pistons to move in the direction of maximum magnetic flux linkage, thus pumping the fluid.

The invention, as well as other objects and advantages thereof will become more apparent from the following detailed description when taken together with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic electrical explanation of the inventive concept;

FIG. 2 is a perspective exploded view of a pump according to the concept of FIG. 1;

FIG. 3 shows a type of check valve and piston arrangement particularly useful with the pump contemplated herein;

FIG. 4 is a cross-sectional explanation of the check valve depicted in FIG. 3,

FIG. 5 is a schematic explanation of a modified version of the invention, and

DETAILED DESCRIPTION

Theoretical Device

Shown in the drawing is an elongated chamber 11 of non-magnetic material containing sealingly reciprocating paramagnetic piston members 13 and 15 at both longitudinal ends. These metal members are made of a magnetic material and have an aperture with a check valve 17, 19 therein. Towards the center of the chamber 11 is an output port with a check valve 23. At the ends of the chamber 11 are input ports 21a and 21b. On one side of the chamber 11 is a first laminated electromagnet assembly 25a with a coil 27a with poles 29a and 31a extending to both sides of the chamber.

Opposite electromagnet 25a is a second laminated electromagnet assembly 25b substantially identical to electromagnet 25a. Second electromagnet 25b also has a coil 27b and poles 29b and 31b. Interposed between one end each of coils 27a and 27b is a diode bridge 33 consisting of four diodes 33a, 33b, 33c, 33d. The output sides of diodes 33a and 33b each face a common midpoint 35a, whereas the input sides of diodes 33c and 33d each receive an input from a common midpoint 35c. Diodes 33a and 33d are poled in the same direction across a common midpoint 35d connected to the input side of diode 33a and the output side of diode 33d. Likewise, diodes 33b and 33c are poled in the same direction across a midpoint 35b, connected to the input side of diode 33b and the output side of diode 33c. Coil 27b is connected between midpoints 35a and 35c. The inner end of coil 27a is connected to the midpoint 35d. One side 37 of the AC line voltage is connected to outer end of coil 27a. The other side 39 of the AC line voltage is connected to midpoint 35b.

OPERATION OF THE PUMP

As sides 37 and 39 are plugged into a 60 cycle AC line, voltage in magnet 25a alternates at 60 cycles and poles a, 31a change in polarity. Meanwhile voltage flowing in magnet 25b is pulsating DC voltage, since it has been rectified in diode bridge 33. Therefore, the poles 29b and 31b in magnet 25b remain fixed while the polarity of poles 29a and 31a change in polarity. Thus, for example on one-half cycle of the 60 cycle AC North pole faces North pole and South pole faces South pole, while on the next one-half cycle the situation is re-

versed and North pole faces South pole, while South pole faces North pole. While applicant does not wish to be limited by the following analysis, it is theorized that since metal piston members 13 and 15 are paramagnetic, when the poles 29a and 29b, and 31a and 31b are aligned North-South and South-North respectively, the metal members tend to align themselves with the poles by virtue of lines of magnetic force being aligned generally between adjacent poles. When the pairs of opposite poles 29a and 29b, and 31a and 31b are the same polarity, the paramagnetic piston members tend to be attracted to each other by virtue of the lines of magnetic force being aligned generally between laterally spaced-apart poles, e.g., poles 29a and 31a, and 29b and 31b. The check valves 17, 19 on metal members 13, 15 allow fluid to flow towards the central output port 23 as the pistons 13 and 15 reciprocate, but not towards the inlet ports 21a, 21b. Thus, fluid is pumped between the inlet ports 21a, 21b through outlet port 23.

PRACTICAL EMBODIMENT

A practical embodiment of the inventive concept is depicted in FIG. 2. Here, the part numbers are in the hundred series, but generally the part number in the hundred series correspond to those in the tens series of FIG. 1. Thus, the cylindrical elongated chamber 111 of FIG. 2 corresponds to elongated chamber 11 of FIG. 1. Fluid, e.g., water is fed to both ends of chamber 111 by a pipe 112 connected to one inlet port 121a, which in FIG. 2 is above the chamber end. Pipe 112 is fastened to inlet port 121a by a joint or union 114. Also, fluid is carried to the other inlet port 121b by a curved duct 116 from the first inlet port. Within the cylindrical elongated non-magnetic chamber 111 are cylindrical paramagnetic piston members 113 and 115. These piston members 113 and 115 each have a fast acting check valve arrangement which consists of a non-paramagnetic drum section 118 having peripheral apertures 120. Thus, fluid entering inlet port 121a will flow through these apertures 120. On the inner side of the drum section 118 is a disk shim 119 mounted on a central axle (not visible) and held by a stop 117. As the pistons 113 and 115 move toward one another fluid trapped on the inner side between the pistons pushes the shim 119 against the apertures 120 thereby effectively providing for positive displacement of fluid outwardly through check valve 123. As the pistons 113 and 115 move away from one another fluid on the outer side will push through the apertures 120 against the shim 119 pushing the shim away from the apertures 120 thereby allowing fluid on the outward side of the pistons to flow inwardly thereof providing an intake stroke in preparation for the inward discharge stroke of pistons 113 and 115. On the inner side of paramagnetic piston members is a second paramagnetic drum section 122, also with apertures 124 corresponding somewhat to apertures 120 but shim 119 can not seat against apertures 124 on the intake stroke because of stop shoulder 117, see FIG. 4. However, much more important is the peculiar comb-like construction of second drum section 122. This drum is made of individual laminations 126, which may be made by slotting the solid pieces, and is tied to the drum base with air gaps in between and a vertical aperture 126a at the outer end. The slotting or lamination is to increase the magnetic permeability of this paramagnetic drum section so as to properly align this section up with the poles 129a and

131a, and 129b and 131b of the electromagnets 125a and 125b respectively. The vertical aperture 126a allows the pumped fluid to rapidly enter the pump outlet. These horseshoe electromagnets 125a, 125b, have each of their two poles 131a and 131b encircled by a pair of coils 127a, and a pair of coils 127b respectively. The poles 131a, 131b having a curved pole face 128 whose radius of curvature corresponds to the outer wall of chamber 111. The laminar electromagnets 125a and 125b are held together in assembled relation by bracket pieces 130 and screws 132 and the cylindrical chamber 111 is sealed with end walls 134, only one of which is shown held to the chamber wall by screws 136, only one of which is shown. The end walls 134 have springs 138 tending to impel the metal members 113, 115 inwards. The object of these springs is merely to keep the metal members from striking and possible sticking to the chamber closures 134. The pump outlet is through a central pipe 140 having a check valve 123 therein. This check valve 123 can be similar to that shown in FIG. 3. Thus, in practice, the check valve is a free floating disk guided by a cylindrical section through a center aperture in the disk of such length as to allow surface movement from the seating surface to a stop which restricts the disk movement to a designed maximum open position. The seating surface of the disk is on a low friction, self lubricating guide containing appropriate passages for fluid flow contained within the outer periphery of the disk.

Also, as hereinbefore pointed out, magnetically driven spring return pumps cannot supply a pumping pressure equal to the magnetic force, as approximately one-half of the force is used to store energy in a spring to return the piston to the starting position for the next magnetically driven stroke. However, the maximum pressure available in the pump herein described, which is limited only by the magnetic flux that can be produced, is approximately twice the pressure that is available in a pump where the piston or diaphragm is returned by spring action.

As shown in the alternate embodiment of FIG. 5, the two check valves 217a and 219a can allow passage in the same direction. Thus, the input is at one end and the output at the other end of the chamber 111a.

I claim:

1. A pump comprising in combination:

- a. a chamber of non-magnetic material defining a cylinder for at least one reciprocating paramagnetic piston therein;
- b. a pair of paramagnetic piston members, at least one member being reciprocally moveable therein;
- c. at least one check valve means integral with said one moveable member;
- d. first and second horseshoe electromagnets each with first and second armature ends comprising poles, an electrical coil wound about each armature end, said magnets being adapted and disposed to that the first and second armature ends of said first and second electromagnets and said poles are juxtaposed from each other across said chamber; and,
- e. a DC power supply connected to one of said electromagnets; an AC power supply connected to said other of said electromagnets whereby AC current flows through one electromagnet and DC current through the second electromagnet causing said pair of paramagnetic piston members to tend to either

5

be aligned with and repelled by said poles on alternate half-cycle of said AC power, so as to pump liquid flowing through at least said one check valve.

2. A pump as claimed in claim 1, wherein said chamber is an elongated chamber.

3. A pump claimed in claim 1, wherein each of said pair of paramagnetic piston members are reciprocally moveable.

4. A pump as claimed in claim 1, said chamber being an elongated cylindrical chamber, said electromagnets having curved pole faces which hug the outer wall of the cylindrical chamber.

5. A pump as claimed in claim 3, wherein each paramagnetic piston is provided with a paramagnetic -free check valve allowing fluid flow towards each piston, and a discharge outlet in said chamber between said members.

6. A pump as claimed in claim 3, wherein each para-

6

magnetic piston is provided with a paramagnetic -free check valve allowing fluid flow toward one end of said chamber, and a discharge outlet at said one end.

7. A pump as claimed in claim 4, said at least one check valve means comprising a first drum section with openings therein, said first drum section having an inner side; a disk shim on said inner side disposed for short inward movement away from said first drum; a second drum section of paramagnetic material axially aligned with said first drum section also with openings therein, said second drum section having a plurality of laminated pieces parallel to the drum axis serving to increase permeability of this section and a stop between said second drum sections openings and said shim preventing said shim from closing said second drum section openings.

* * * * *

20

25

30

35

40

45

50

55

60

65