Nov. 8, 1955 E. J. WEINFURT 2,722,891

ELECTROMAGNETIC PUMP

Original Filed Oct. 21, 1950 2 Sheets-Sheet 1

Fig. 1

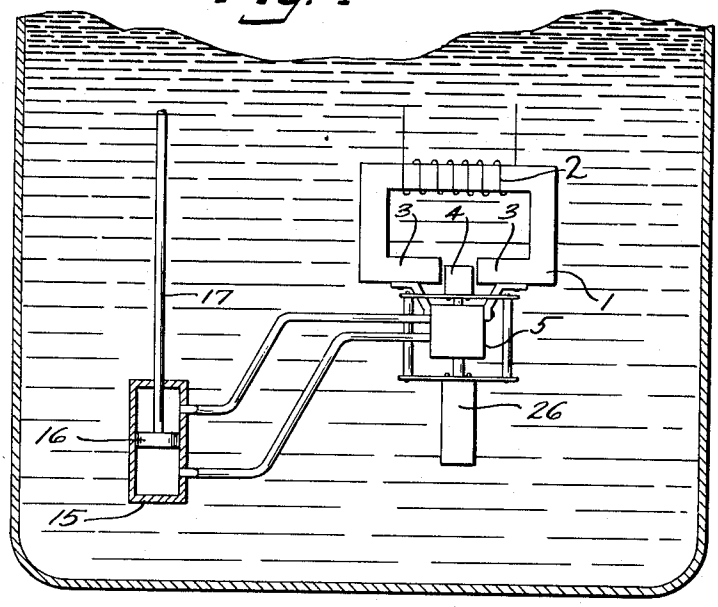
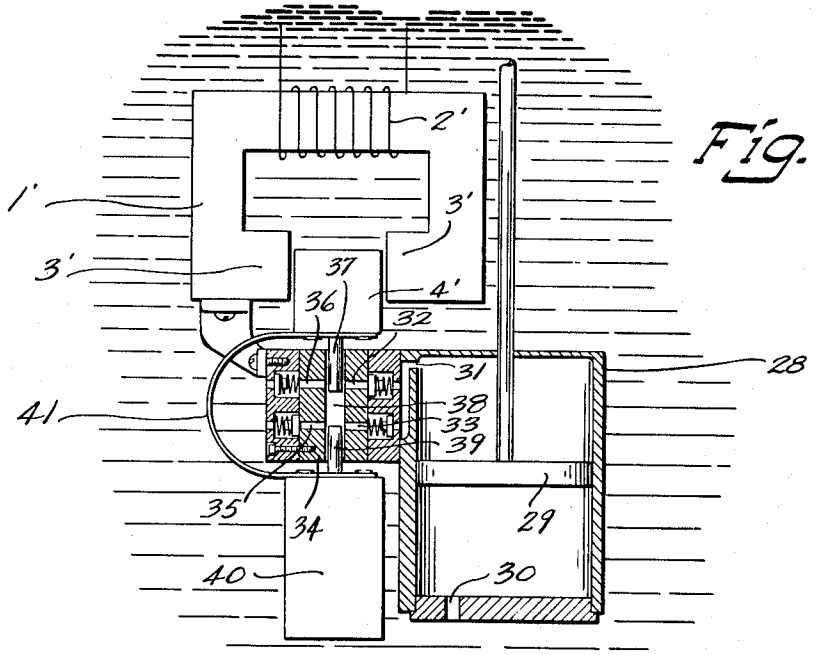


Fig. 3



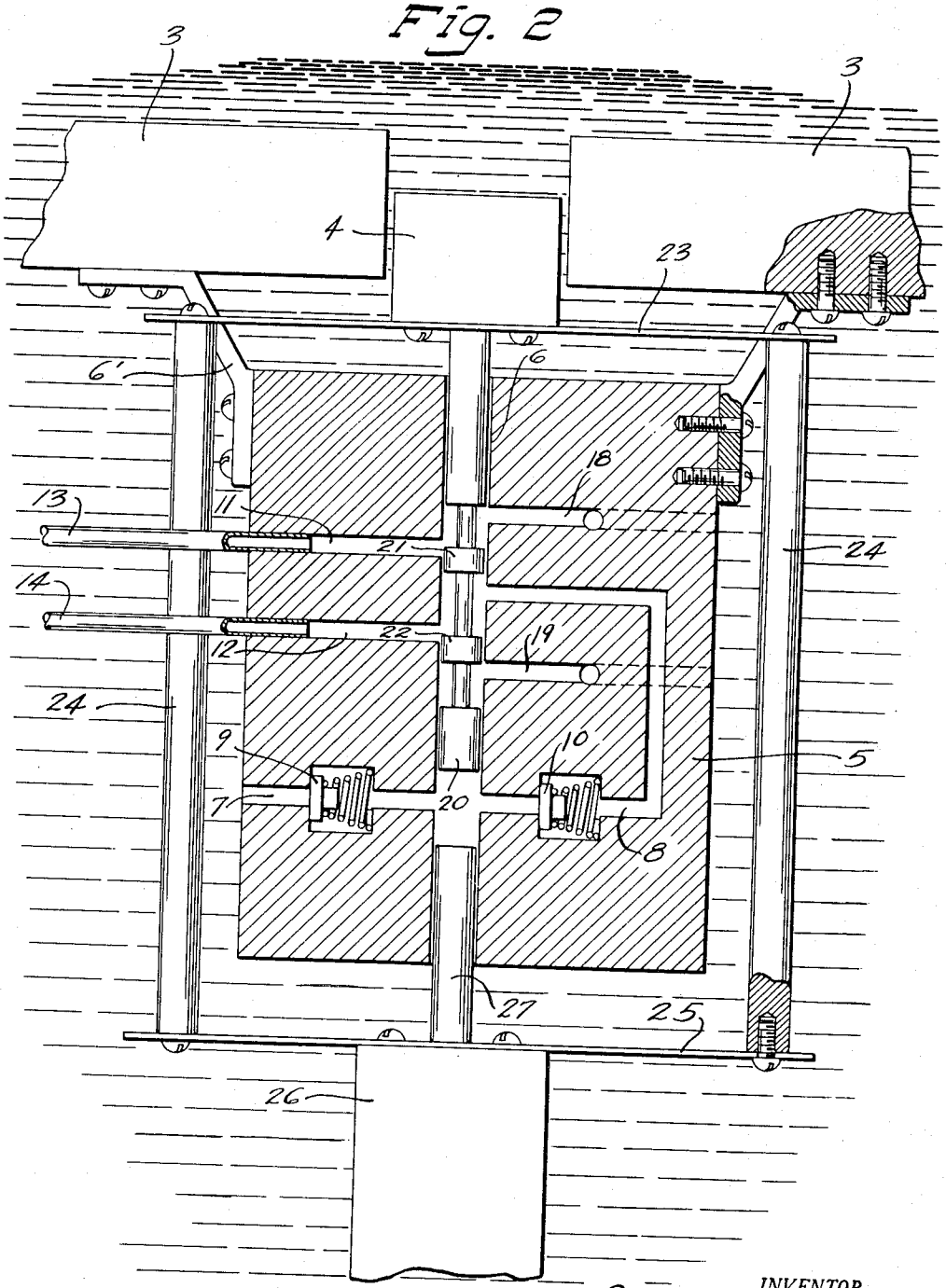
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Fig. 2



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ELECTROMAGNETIC PUMP

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Continuation of abandoned application Serial No. 191,459, October 21, 1950. This application February 8, 1954, Serial No. 408,911

8 Claims. (Cl. 103—53)

This invention relates to a vibratory, alternating current electromagnetic pump.

This application is a continuation of my prior application, Serial No. 191,459, filed October 21, 1950, for electromagnetic pump, now abandoned.

Objects of this invention are to provide a voltage sensitive device which takes the form of a pump and which is so constructed that it will not only pump fluid but also will control the direction of discharge of the fluid in accordance with variation of voltage above or below normal, so that the fluid may be selectively discharged to either end of a work cylinder or other motor means, or may be discharged into a work cylinder and drawn therefrom and which is further so arranged that there is no flow of fluid when the voltage is normal.

More specifically, objects of this invention are to provide an electromagnetic, alternating current pump which has a vibratory operating piston working in a cylinder and provided with an armature which floats between the poles of a field structure and is so arranged that it occupies different, mean axial positions depending on the voltage impressed on the energizing coils of the field structure, the armature also being operatively connected to valve means to control the direction of discharge or to selectively control the ports at which discharge of liquid pumped by the pump takes place.

Further objects are to provide a vibratory, alternating current, electromagnetic pump in which the armature executes a multitude of very rapid vibrations of small amplitude due to the cyclic variations of the alternating current, and in which, in addition to the above operation of the armature, such armature also settles down or rises above a mean position depending on the voltage impressed on the energizing coil of the field structure, and in which this armature is magnetically suspended and carries not only the pumping piston but also the control valves for controlling the direction of the output of the pump and for stopping all flow of fluid when the voltage is normal.

Embodiments of the invention are shown in the accompanying drawings, in which:

Figure 1 is a view showing the pump submerged in oil and showing a work cylinder connected thereto, such view being partly in section and partly broken away.

Figure 2 is an enlarged view of the pump, such view being partly in section and partly broken away.

Figure 3 is a view corresponding to Figure 1 showing a further form of the invention.

Referring to the drawings, it will be seen that the vibratory, alternating current, electromagnetic pump comprises a field structure 1 which is composed of laminated magnetic material. This field structure is provided with an energizing coil 2 and with a pair of opposed pole pieces 3 between which the magnetic armature 4 is positioned.

The pump is provided with a body portion 5 which is rigidly attached as indicated at 6' to the poles 3 of the field structure. This body portion is provided with a

cylinder 6 consisting of a cylindrical aperture extending therethrough and open at both ends. It is also provided with an inlet passage 7 and an outlet passage 8 provided, respectively, with spring pressed inlet and outlet valves 9 and 10. The outlet passage 8 communicates with an intermediate portion of the cylinder as shown in Figure 2 and may communicate with either one of a pair of delivery passages 11 and 12. These delivery passages are connected by means of pipes 13 and 14 with opposite ends of a work cylinder 15 provided with a work piston 16, such piston being connected by means of a piston rod 17 in any suitable manner to any device which it is desired to operate from the pump.

The body portion is also provided with discharge passages 18 and 19 which communicate with the cylinder 6.

The magnetic armature 4 is attached rigidly to the pumping piston 20 and to an upper and a lower valve 21 and 22, respectively. The armature 4 is also attached to a leaf spring 23 which, in turn, is connected by means of posts 24 to a lower leaf spring 25. The lower leaf spring is rigidly attached to a weight 26. The weight, in turn, is rigid with a lower piston 27, which latter extends into the lower portion of the cylinder 6.

The entire device is preferably submerged in oil or other liquid as indicated in Figure 1, though it is of course within the province of this invention to connect the passages 7, 18 and 19 with a sump or other supply of liquid.

In the operation of the device, it is apparent that when alternating current is supplied the energizing coil 2 of the field structure, the armature 4 will be suspended magnetically between the pole pieces 3 as indicated in Figure 2 and will thus support the entire assembly consisting of the armature 4, the pumping piston 20, the valves 20 and 21, and the weight 26. The pumping piston 20 will have imparted thereto rapid vibrations due to the armature 4 but the lower piston 27 will not vibrate in this manner due to the mass or weight 26. If desired, the armature 4 and the spring 23 and the parts suspended directly from the armature including the pumping piston 20 and the valves 21 and 22, may be so proportioned as to resonate with the cyclic variations of the alternating current, allowance of course being made for the fact that the device is submerged in oil.

The stroke of the pumping piston is minute and only a minute quantity of liquid is pumped at each stroke. However, the strokes occur in rapid succession and it has been found that an amply sufficient volume of liquid can be pumped at adequate pressure to operate a suitable motor means as described. The motor means, in turn, may be used to actuate any device desired, such as a tap changer, for instance.

It is to be noted further that when the voltage is normal the parts are so designed that the valves 21 and 22 block the passages 11 and 12 and consequently no oil is pumped from the apparatus and consequently the tap changer is not operated. However, if the voltage drops slightly, the entire assembly of armature 4, with its attached parts and weight 26 settles downwardly a slight distance, for example as shown in Figure 2, and remains at some mean position determined by the voltage. Under these conditions, it is apparent that oil delivered from the discharge passage 8 will pass to the passage 12 and to the lower portion of the cylinder 15, see Figure 1. Oil from the upper portion of the cylinder will be discharged through the passage 11 and through the exhaust passage 18. On the other hand, if the voltage should rise above normal, the passage 11 would be connected with the passage 8 and the passage 12 would be connected with the exhaust passage 19. Consequently, oil would then be pumped to the top of the cylinder as viewed in Figure 1.

It will be seen that a novel form of voltage sensitive

device has been provided by this invention which does not rely on auxiliary relays or any other equipment but which is complete in itself and furnishes pressure fluid and, at the same time, controls the direction of flow of the fluid to and from a work cylinder or other motor means and does not allow any flow of fluid either to or from the motor means when the voltage is normal.

The invention may take other forms. For example, as shown in Figure 3, the work cylinder may have pressure fluid pumped into only one end and sucked from such end as required. The work cylinder is indicated by the reference character 28 and the work piston by the reference character 29. The lower end of the work cylinder has an opening 30. The upper end of the work cylinder communicates by means of an opening 31 with either one of two passages 32 or 33 formed in the body portion 34 of the pump. This body portion 34 is rigid with the pole pieces 3' between which the armature 4' is positioned, the field structure and the energizing coil being indicated, respectively, by the reference characters 1' and 2'. The passages 32 and 33 are provided with reversely spring pressed valves and are in alignment with passages 35 and 36 also provided with reversely spring pressed valves. The armature 4' is provided with a plunger 37 which extends into the upper portion of the cylinder 38 formed in the body portion 34. A lower piston 39 is rigid with a weight 40 and the weight 40 is suspended from the armature 4' by means of a spring 41.

When the voltage drops the parts assume the position shown in Figure 3 as the entire assembly, consisting of the armature 4', the weight 40, and their respective pistons settle downwardly to a mean position and are suspended magnetically in such position. The piston 37 executes rapid vibrations as previously described, while the piston 39 remains substantially stationary due to the mass of the weight 40. Pumping, therefore, occurs and pressure fluid is pumped from the upper end of the work cylinder 28. On the other hand, if the voltage rises, the lower piston 39 will close the lower passages 33 and 35 and the upper piston 37 will uncover the passages 32 and 36. Consequently, fluid will be pumped into the upper end of the cylinder 28. When the voltage is normal, all of the passages 33, 35, 32 and 36 are closed and no pumping of fluid either to or from the work cylinder occurs. It will be seen that in both forms of the invention very simple mechanisms are used and yet these mechanisms are so arranged that fluid under pressure is pumped, when there is a voltage variation from normal due to the minute and rapid vibrations of the magnetically suspended armature. Also it will be seen that the direction of the flow of the pressure fluid is controlled in accordance with the mean position of the assembly consisting of the armature, the upper piston, the weight, and the lower piston.

Although this invention has been described in considerable detail, it is to be understood that such description is intended as illustrative rather than limiting, as the invention may be variously embodied and is to be interpreted as claimed.

I claim:

1. A vibratory alternating current electromagnetic pump comprising a pole structure, an energizing winding on said pole structure, an armature suspended magnetically from said pole structure and arranged to vibrate due to the cyclic variations of the alternating current, a body portion rigid with said pole structure, said body portion having a vertical cylinder therein and having inlet and outlet valves for said cylinder, a first piston rigid with said armature and located within the upper portion of said cylinder, a second piston in the lower portion of said cylinder, yielding connecting means between said pistons, a weight secured to said second piston and having sufficient mass to prevent said second piston from vibrating, and direction controlling valve means secured to said armature and controlling the direction of flow of liquid in accordance with the mean position of said armature.

2. A vibratory alternating current electro-magnetic pump comprising a pole structure, an energizing winding on said pole structure, an armature suspended magnetically from said pole structure and arranged to vibrate due to the cyclic variations of the alternating current, a body portion rigid with said pole structure, said body portion having a cylinder therein and having inlet and outlet valves for said cylinder operative in the pumping action, a piston rigid with said armature and located within said cylinder, said piston and armature being arranged to vibrate about a mean position determined by the voltage impressed on said winding and being arranged to cause pumping independently of said mean position, said body portion having delivery passages, and direction-controlling valve means operatively connected to said armature and selectively controlling said delivery passages in accordance with said mean position to thereby determine the delivery passage into which fluid is pumped.

3. A vibratory alternating current electro-magnetic pump comprising a pole structure, an energizing winding on said pole structure, an armature suspended magnetically from said pole structure and arranged to vibrate due to the cyclic variations of the alternating current, a body portion rigid with said pole structure, said body portion having a cylinder therein and having inlet and outlet valves for said cylinder, a piston rigid with said armature and located within said cylinder, and valve means rigid with said armature, said armature and piston and valve means constituting a unitary assembly arranged to vibrate about a mean position determined by the voltage impressed on said winding, said body portion having delivery passages selectively controlled by said valve means in accordance with the mean position of said valve means.

4. A vibratory alternating current pump comprising a pole structure, an energizing winding on said pole structure, a body portion rigid with said pole structure and having a cylinder provided with inlet and outlet passages, inlet and outlet valves in said passages, an armature suspended magnetically from said pole structure, an upper piston in said cylinder rigidly connected to said armature, a lower piston in said cylinder connected to said armature by spring means, and a weight rigid with said lower piston, said upper and lower pistons being spaced above and below said inlet and outlet passages, said armature and upper and lower pistons constituting an assembly adapted to occupy a mean position determined by the voltage impressed on said winding and said upper piston being arranged to vibrate due to the cyclic variations of said alternating current and said weight having sufficient mass to prevent said lower piston from vibrating.

5. A vibratory alternating current pump comprising a pole structure, an energizing winding on said pole structure, a body portion rigid with said pole structure and having a cylinder provided with inlet and outlet passages, inlet and outlet valves in said passages, an armature suspended magnetically from said pole structure, an upper piston in said cylinder rigidly connected to said armature, a lower piston in said cylinder connected to said armature by spring means, a weight rigid with said lower piston, said upper and lower pistons being spaced above and below said inlet and outlet passages, said armature and upper and lower pistons constituting an assembly adapted to occupy a mean position determined by the voltage impressed on said winding and said upper piston being arranged to vibrate due to the cyclic variations of said alternating current and said weight having sufficient mass to prevent said lower piston from vibrating, said body portion having a pair of delivery passages, and valve means rigid with said armature for selectively connecting said delivery passages with said outlet passage in accordance with said mean position.

6. An alternating current electromagnetic pump comprising a pole structure, an energizing winding on said pole structure, an armature positioned within said pole structure and responsive to said alternating current for

energy delivery and having a neutral position and positions on opposite sides of neutral position and varying its position in accordance with the magnitude of the magnetic flux in said pole structure, a body portion mechanically connected to said pole structure, a pump carried within said body portion and having an operative movable energy delivery member driven from said armature, said alternating current electromagnetic pump including direction-controlling means controlled by the position of said armature for selectively controlling the direction of energy output from said pump.

7. An electromagnetic drive means comprising a pole structure, an energizing winding on said pole structure adapted to be connected to a source of electrical power, an armature positioned within said pole structure and continuously responsive to the magnetic flux induced in said pole structure for energy delivery, said armature having a neutral position within said pole structure determined by a nominal voltage of said power source and varying its position within said pole structure in accordance with changes in the voltage of said source, energy delivering means driven from said armature for delivering output energy, and means controlled by the position of said armature for controlling the direction of said output energy, the direction controlling means being adapted to direct said output energy in one direction when the voltage of said source is above said nominal value and to direct said output energy in a second direction when said voltage is below said nominal value, said energy delivering means being in continuous operation whenever said armature is in operation.

8. An alternating current electromagnetic vibratory pump, comprising a pole structure, an energizing winding on said pole structure, an armature suspended magnetically within said pole structure in a mean position determined by the magnitude of the magnetic flux in said pole structure and being arranged to vibrate about said mean position due to the cyclic pulsations in said magnetic flux, a body portion rigid with said pole structure, said body portion having a vertical cylinder therein and having delivery passages registering with said cylinder, opposed pistons within said cylinder yieldingly connected together, one of said pistons being rigid with said armature, the second of said pistons being secured to a weight of sufficient mass to prevent vibration thereof in response to said flux pulsations, and valve means rigid with one of said pistons for selectively controlling said delivery passages in accordance with the mean position of said armature.

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