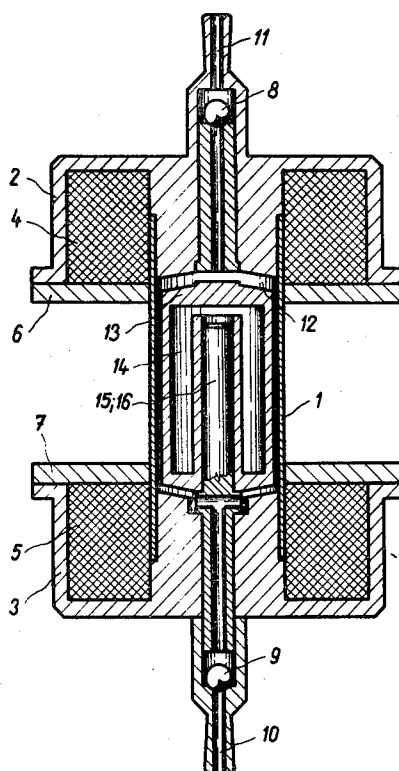


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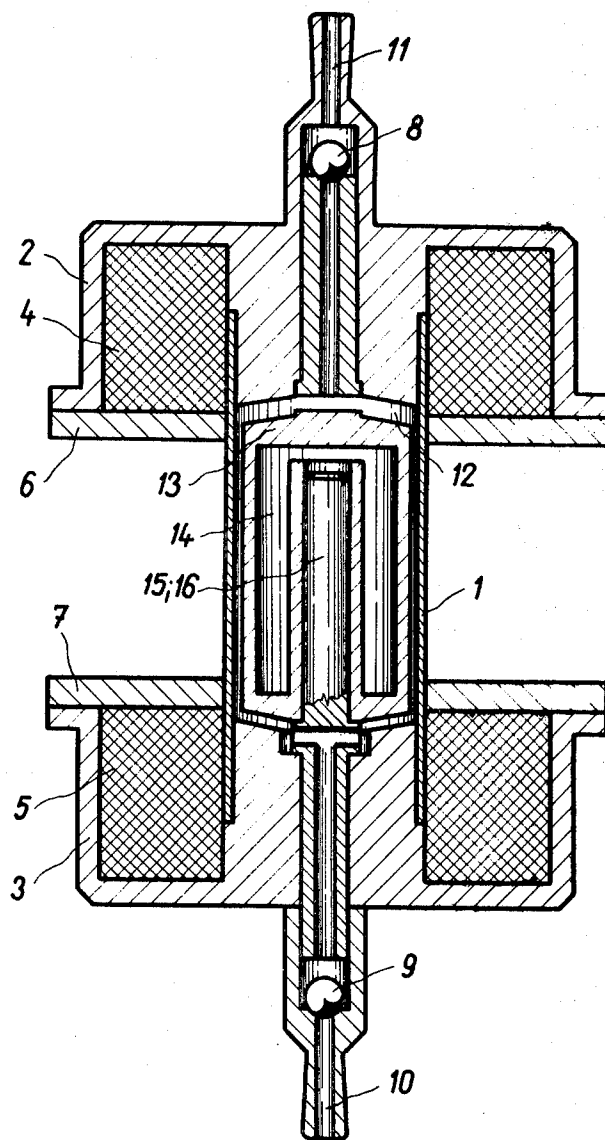
[54] **ELECTROMAGNETIC MICROPUMP FOR
PROCESSING AGGRESSIVE LIQUID SUBSTANCES**
5 Claims, 1 Drawing Fig.
[52] U.S. Cl. 417/417
[51] Int. Cl. F04b 17/04
[50] Field of Search 103/53;
230/55; 310/18, 24, 35; 417/417

ABSTRACT: An electromagnetic micropump for processing aggressive liquid substances detrimental for human health, such as, for example, radioactive solutions, or the like. The micropump, is fully compact, explosion proof and packingless. Its pumping element is constituted by an electromagnet core adapted to reciprocate along a stationary piston between a pair of jacketed alternately energized solenoids.



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ELECTROMAGNETIC MICROPUMP FOR PROCESSING AGGRESSIVE LIQUID SUBSTANCES

BACKGROUND OF THE INVENTION

The present invention relates to an electromagnetic micropump, and more particularly to a perfectly sealed or compact micropump for safely pumping strongly aggressive liquid substances detrimental for human health, which substances are currently processed in laboratories and chemical plants.

It is already known to use, to the aforementioned purposes, complicated pumps of diaphragm, bellows, or piston types which, in general, have to be equipped with chemically resistant packings or gaskets. All these pump types are, as a rule, driven from electric motors via gear mechanisms so that they are, on the one hand, bulky, and, on the other hand, they cannot be employed in explosive media without expensive adaptations. Moreover the packings the piston types of pumps are provided with, require permanent attendance, i.e. they have to be periodically tightened or even replaced, which operations, particularly in some specific radioactive solution treatments, are out of question.

The purpose of the present invention and the basic object of the same is to overcome the aforementioned disadvantages and to significantly improve the electromagnetic micropumps for processing aggressive liquid substances.

SUMMARY OF THE INVENTION

In accordance with one feature of our invention we provide an electromagnetic micropump for processing aggressive liquid substances, which comprises confining means for confining two opposite spaced electromagnetic elements connected to each other by tubular means and communicating via an axial bore terminated at either side of the micropump in nonreturn valves adapted to allow an unidirectional flow of the liquid to be pumped. The opposite ends of said axial bore constitute inlet and outlet openings for supplying and delivering the processed liquid into and from the micropump, respectively. In the cavity of said tubular means there is received a hollow movable electromagnet core adapted to reciprocate along a stationary piston arranged in the space between inner mouths of said inlet and outlet openings. The hollow movable electromagnet core is sealed at its upper end portion while its lower end portion is provided with an axial bore for said stationary piston to pass.

As follows from the foregoing, it is not necessary to use for driving the micropump an electric motor, or any lubricated parts, such as gear mechanisms, which latter are, in general, frequently the very source of failures. Thus both attendance and maintenance of the micropump are substantially simplified. The electromagnetic micropump according to the invention is compact, simple, small and packingless. Its dimensions are considerably smaller than that of well-known dosing pumps having the same output. It is safe in operation, can easily be attended, and even remote-controlled. Because of being fully compact, it prevents the ambient atmosphere from being contaminated with harmful substances so that it can preferably be employed in plants where explosion proof models of apparatuses are required.

The electromagnetic pump according to the present invention is designed to be utilized particularly for pumping and transporting radioactive solutions, for which purposes it is particularly suitable due to its tightness, reliability and possibility of being remote-controlled.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of a specific embodiment when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The drawing is a somewhat schematic vertical sectional view of an electromagnetic micropump for processing aggressive liquid substances.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Discussing now the drawing, it can be seen that the electromagnetic micropump for processing aggressive liquid substances consists of a thin-walled cylinder body 1 made of non-magnetic material, of an uppermost jacket 2 and a lowermost jacket 3 of ferromagnetic material, adapted to receive electromagnetic coils or solenoids 4 and 5, respectively, provided with plates or armatures 6 and 7, respectively, made of ferromagnetic material, of an upper and a lower nonreturn valve 8 and 9, respectively, and finally of an inlet opening 10 and an outlet opening 11. In the inner room 12 of the micropump confined by the thin-walled cylinder body 1 and the jackets 2 and 3, there is received a movable cylindrical core 13 having a cavity 14 therein and adapted to reciprocate along a coaxially arranged stationary piston 16 designed to pass through a cylindrical bore 15 provided in the core 13.

The micropump according to the invention operates as follows:

By alternately energizing the uppermost and the lowermost solenoids 4 and 5, respectively, the movable cylindrical core 13 is given an oscillating movement therebetween. During the upward stroke of the core 13 the liquid is forced out of the room 12 via nonreturn valve 8 through the outlet opening 11. The volume of the forced liquid equals to the solid volume of that part of the stationary piston 16 which has been exposed due this upward stroke of the movable cylindrical core 13. During the opposite or downward movement of the core 13, i.e. toward the jacket 3, there will be drawn in through the inlet opening 10 via the nonreturn valve 9 into the inner room 12 such a volume of the liquid corresponding to the solid volume of that part of the stationary piston 16 which is covered during this downward core stroke. Thus the movable cylindrical core 13 oscillating or reciprocating along the stationary piston 16 between the two solenoids 4 and 5, form together with the piston 16 a two-part or compound plunger arrangement. The pumped liquid volume is proportional to the diameter of the piston 16, to the stroke lift of the core 13, and to the frequency of oscillations. The suction lift depends upon the tightness of the micropump and on the solenoid capacity.

It will be understood that each of the elements described above, or two or more together may also find useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in an electromagnetic micropump for processing aggressive liquid substances, it is not intended to be limited to the details shown, since various modification and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that from the standpoint of prior art clearly constitute essential characteristics of the generic or specific aspect of this invention and therefore, such adaptations should and are intended to be comprehended within the meaning and range of the equivalence of the following claims.

We claim:

1. An electromagnetic pump comprising a cylinder having opposite closed ends; fluid inlet and outlet passage means respectively communicating with said opposite ends of said cylinder; a hollow electromagnetic core arranged with clearance in said cylinder for reciprocating movement in axial direction, said core having a closed end and being formed with

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a bore extending in axial direction from the other end into said core; a pair of one way valves located outside of said core respectively in said inlet and outlet passage means; a stationary piston slidably received in said bore; and electromagnet means cooperating with said core for reciprocating the same in said cylinder so that during reciprocation of said core fluid will flow exclusively through the clearance between said cylinder and said core from said inlet to said outlet passage means, said pump performing its pumping stroke during movement of said core in a direction in which a portion of said stationary piston moves out of said bore and its suction stroke during movement of said core in the opposite direction in which said portion of said stationary piston moves again into said bore.

2. A pump as defined in claim 1, wherein said bore in said core, said stationary piston, said inlet and said outlet passage

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means are aligned along a common axis coinciding with the axis of said cylinder.

3. A pump as defined in claim 2, wherein said bore in said hollow core is constituted by the inner surface of a tube integral at one end with said other end of said core, said tube communicating at the other end thereof with the interior of said hollow core.

4. A pump as defined in claim 2, wherein said electromagnet means comprise a pair of solenoid means arranged spaced in the direction of said axis in the region of opposite ends of said cylinder.

5. A pump as defined in claim 4, wherein said inlet and outlet passage means extend respectively through said pair of solenoid means.

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