

[54] **ELECTROMAGNETIC PLUNGER PUMP**
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[57] **ABSTRACT**
An electromagnetic plunger valve in which the pressure plunger is capable of moving smoothly in its cylinder, and the cylinder is allowed to shift in its position in the right and left direction, and said pump can be used satisfactorily even when the electromagnetic plunger and the pressure plunger are rigidly connected, and the lower spring that supports the electromagnetic plunger is supported by a cylinder.

4 Claims, 2 Drawing Figures

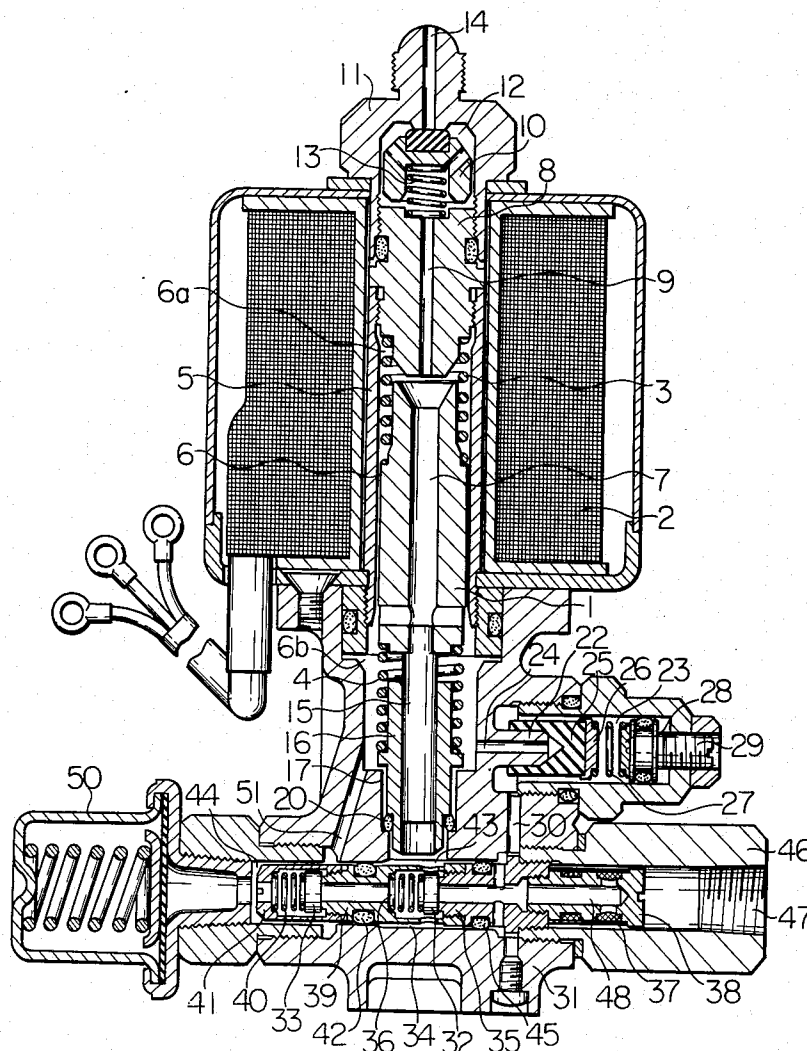


Fig. 1

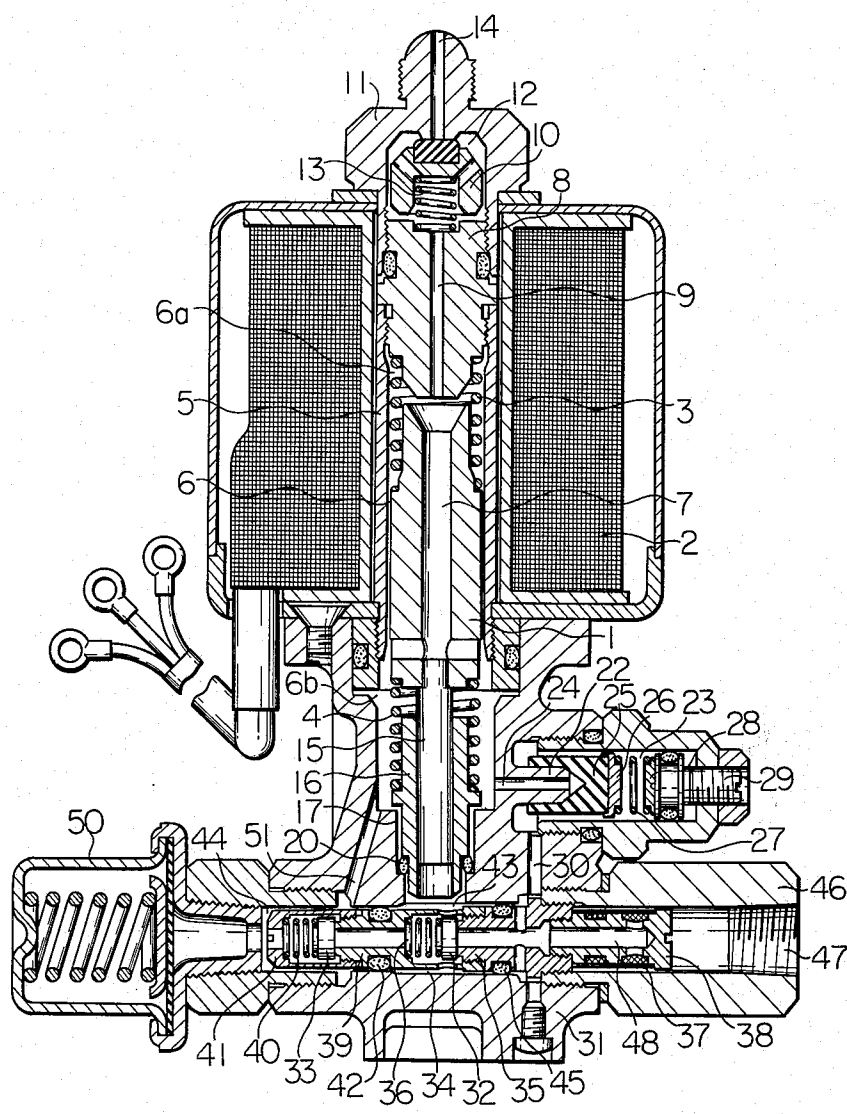
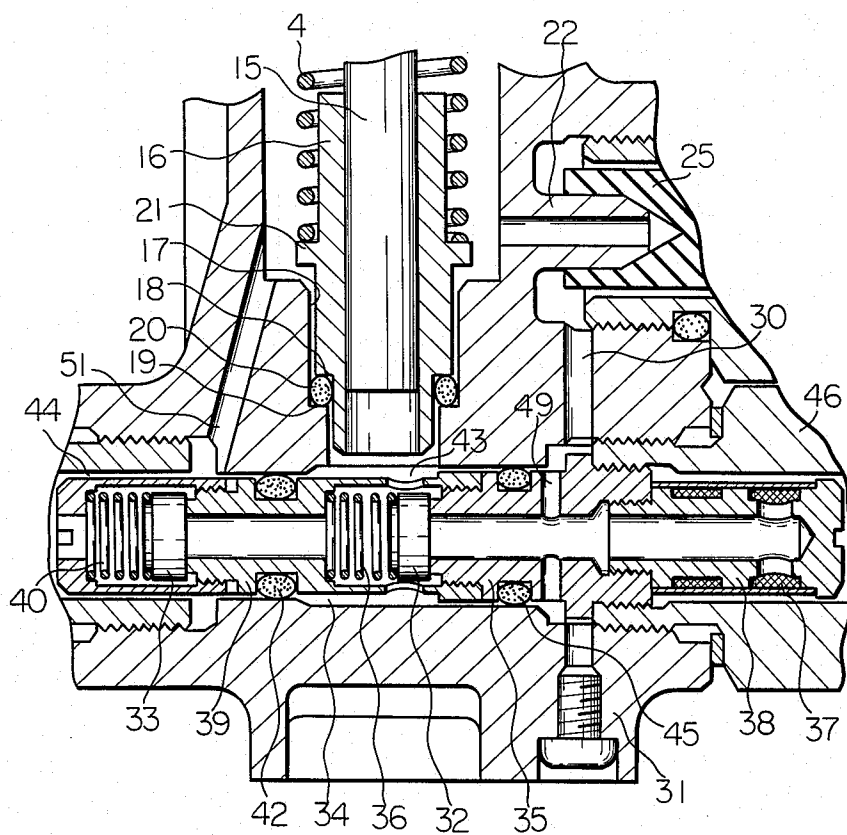


Fig. 2



ELECTROMAGNETIC PLUNGER PUMP

BACKGROUND OF THE INVENTION:

The present invention relates to an electromagnetic plunger pump, and more particularly to an electromagnetic plunger pump having such a construction that the pressure plunger driven in a reciprocating motion is allowed to perform its motion smoothly within the cylinder, and such that wear and noise is excluded.

Normally, in an electromagnetic plunger pump, the magnetic axis of the electromagnetic plunger driven in a reciprocating manner by the electromagnetic coil, the mechanical axis of its guide member, and the magnetic axis of the electromagnetic coil are not always in sufficient alignment. Because of this lack of alignment, it was not possible to eliminate a partial friction between the electromagnetic plunger and its guide case and frictional loss and noise resulting from it. Also in a free plunger that is loosely connected with the electromagnetic plunger, because the mechanical axis of the pressure plunger and the magnetic axis of the electromagnetic plunger are not always in alignment, despite the fact that all distortion is removed at the loose contact portion, the pressure plunger is still subject to a radial thrust corresponding to the existing misalignment, on the cylinder, resulting in a partial wear and friction loss on the cylinder bore.

SUMMARY OF THE INVENTION

A first object of the present invention is to provide an electromagnetic plunger pump, in which the pressure plunger is capable of moving smoothly in its cylinder.

A second object of the present invention is to provide an electromagnetic plunger pump in which the cylinder is allowed to shift its position in the right and left direction.

A third object of the present invention is to devise an electromagnetic plunger pump which can be used satisfactorily even when the electromagnetic plunger and the pressure plunger are rigidly connected.

Furthermore, a fourth object of the present invention is to devise an electromagnetic plunger pump in which the lower spring that supports the electromagnetic plunger is supported by a cylinder.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to achieve these objects, in the electromagnetic plunger pump based on the present invention, effecting the pumping function by the reciprocating motion of a pressure plunger tied to an electromagnetic plunger, caused by the electromagnetic force of an electromagnetic coil; said cylinder in which said pressure plunger is inserted is supported in the pump body with an elastic member inserted therebetween, and is subjected to the pressure of the plunger supporting spring. An exemplary embodiment of the present invention will be explained in the attached drawings as well as in the detailed descriptions that follow.

It should be understood, however, that many minute modifications and variations on the details of the construction are possible within the scope of the claims given hereinafter.

FIG. 1 is a vertical sectional view of an electromagnetic plunger pump representing an embodiment of the present invention; and

FIG. 2 is an enlarged sectional view of an essential part of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In an electromagnetic plunger pump representing a preferred embodiment of the present invention shown in FIG. 1 and FIG. 2, an electromagnetic plunger 1 actuated by an electromagnetic coil 2 is supported, within an electromagnetic plunger actuation chamber 6 that is composed of a hollow guide case 5, between an upper spring 3 and a lower spring 4, and said electromagnetic plunger actuation chamber 6 is divided into an upper spring chamber 6a and a lower spring chamber 6b by said electromagnetic plunger 1.

Said electromagnetic plunger 1 is provided with an axial passage hole 7 connecting said upper spring chamber 6a and said lower spring chamber 6b.

Above said electromagnetic plunger 1, there is provided a magnetic force adjusting rod 8, being threadedly engaging in the upper part of said guide case 5. Through this magnetic force adjusting rod 8, an axial passage hole 9 is provided.

A movable valve 10 disposed within a chamber 12 provided inside a discharge fitting 11 is maintained under the tension of a spring 13 to close a discharge port 14.

A pressure plunger 15 that is firmly connected to said electromagnetic plunger 1 is inserted in a cylinder 16.

This cylinder 16 is supported within a cylinder insertion hollow 17 with a clearance by means of an annular elastic member 20 that is disposed between a shoulder portion 18 near the bottom of said cylinder 16 and the shoulder 19 of the hollow 17.

A portion of said cylinder 16 forms a spring seat 21 for seating said lower spring 4, in such a way that said cylinder 16 is acted upon by the tension of said spring.

A nozzle 22 projecting into a relief valve chamber 23 is provided with a central passage hole 24 that is in communication with said lower spring chamber 6b.

Said nozzle 22 is covered by a relief valve 25 made of an elastic material.

Said relief valve 25 is held in its place by a relief valve holding cap 26, and a spring 27 is disposed between this cap 26 and an adjusting screw 29 with a thrust spring seat 28 inserted therebetween.

A relief fluid outlet hole 30 is drilled through a pump body 31 providing a relief fluid outlet passage from said relief valve chamber 23 to the suction side.

A suction side check valve 32 and a discharge side check valve 33 are disposed within an integrally connected pair of valve seat members, which in turn is inserted within a valve insertion hole 34 in the pump body 31.

Against the suction side valve seat member 35, said suction side check valve 32 is forced by a spring 36, while on one end of said suction side valve seat member, a member 38 having a strainer 37 is connected, and on the other end is connected the discharge side valve seat member 39. Against this discharge side valve seat member 39, said discharge side check valve 33 is pushed by a spring 40, and also on this discharge side valve seat member 39, a valve cylinder 41 for holding said spring 40 is screwed on.

An O ring 42 disposed around said valve seat member 40 engages with the valve insertion hole 34 tightly to separate a pressure chamber 43 from a discharge chamber 44. Another O ring 45 is disposed around said valve seat member 35.

Through a suction port 47 provided through a suction side fitting 46 that is connected to said pump body 31 with a screw engagement, fluid is introduced, and, over the strainer 37 and through a duct 47, is led into said pressure chamber 43. This duct 47 is provided with a connecting passage 49 that is connected with said relief fluid outlet hole 30.

Said discharge chamber 44 is connected to the lower spring chamber 6b via a connection passage 51 and at the same time is provided with an accumulator 50 for smoothing out the discharge pressure.

Below, an exemplary functioning of the present invention is described.

When the electromagnetic coil 2 is energized, the electromagnetic plunger 1 is driven by it and is set in a vertical reciprocating motion. The pressure plunger 15, coupled thereto, is also driven reciprocally within the cylinder 16, thereby sucking fluid through the suction port 47, giving pressure to the fluid in the pressure chamber 43, sending the fluid over to the discharge chamber 44, smoothening the pulsive pressure by means of the accumulator 50, and forcing the smoothed fluid to flow to the lower spring chamber 6b via connecting passage 51. From there, the discharge fluid flows through the passage hole 7 in the electromagnetic plunger 1 to fill the upper spring chamber 6a and thence into the chamber 12 via the passage provided in the magnetic force adjusting rod 8. The fluid sent into the chamber 12 is then sent through the movable valve 10, which is kept open during the time the electromagnetic coil 2 is in an energized condition, to the outside via the discharge port 14.

During the operation of this pump, because the cylinder 16 is supported by means of the elastic member 20 and also because a clearance is provided in the hollow 17, even if the electromagnetic plunger 1 and the pressure plunger 15 should move up and down out of alignment of the cylinder 16, the latter can shift its position in conformity to the former. It follows therefore that even if the pressure plunger 15 should be displaced, it can smoothly perform a reciprocating motion within the cylinder 16. It follows further that a rigid connection between the electromagnetic plunger 1 and the pressure plunger 15 is permitted.

What is claimed is:

1. In a reciprocating electromagnetic pump including a cylinder, an electromagnetic plunger having a flow-passage therethrough and defining upper and lower chambers in combination with said cylinder and slid-

ably mounted in the cylinder, means for reciprocating the electromagnetic plunger including an electromagnetic coil coaxial to said electromagnetic plunger, a power source coupled to said electromagnetic plunger for selective activation thereof, a check valve operatively positioned in the fluid flow-passage and including a fixed valve seat and a movable valve member of magnetic material cooperating with the seat to close said passage, said movable member being so positioned as to be drawn away from its seat by the attraction of the electromagnetic coil during operation of the pump to allow fluid flow, and a pressure plunger operatively coupled to said electromagnetic plunger, the improvements comprising said pressure plunger being rigidly coupled to said electromagnetic plunger, a hollow cylinder member positioned about said pressure plunger within said cylinder, said cylinder having an inwardly stepped portion in the vicinity of said cylinder member but spaced therefrom, an elastic member positioned on said stepped portion of said cylinder and supporting said cylinder member and a spring member operatively coupled to said electromagnetic plunger and to said cylinder member, whereby said cylinder member can shift radially of said electromagnetic plunger such that friction between the plunger and the cylinder is eliminated.

2. An electromagnetic plunger pump according to claim 1, in which said cylinder member forms a spring seat portion on which to support the spring member.

3. The improved reciprocating electromagnetic pump of claim 1 further comprising a relief valve means communicating with said lower chamber.

4. The improved reciprocating electromagnetic pump of claim 3 further comprising a pump body having a passageway therein, one end of said passageway being a fluid inlet and an accumulator mounted at the other end thereof, a suction side check valve and a discharge side check valve positioned within said passageway and normally biased closed, said passageway communicating with said lower chamber in the vicinity of said suction side check valve, whereby the suction stroke of said pressure plunger opens said suction side check valve and draws fluid into said passageway, said fluid forcing open said discharge side of said check valve, said lower chamber also communicating with said passageway in the region thereof between said discharge side check valve and said accumulator, fluid being drawn into said lower chamber therefrom.

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