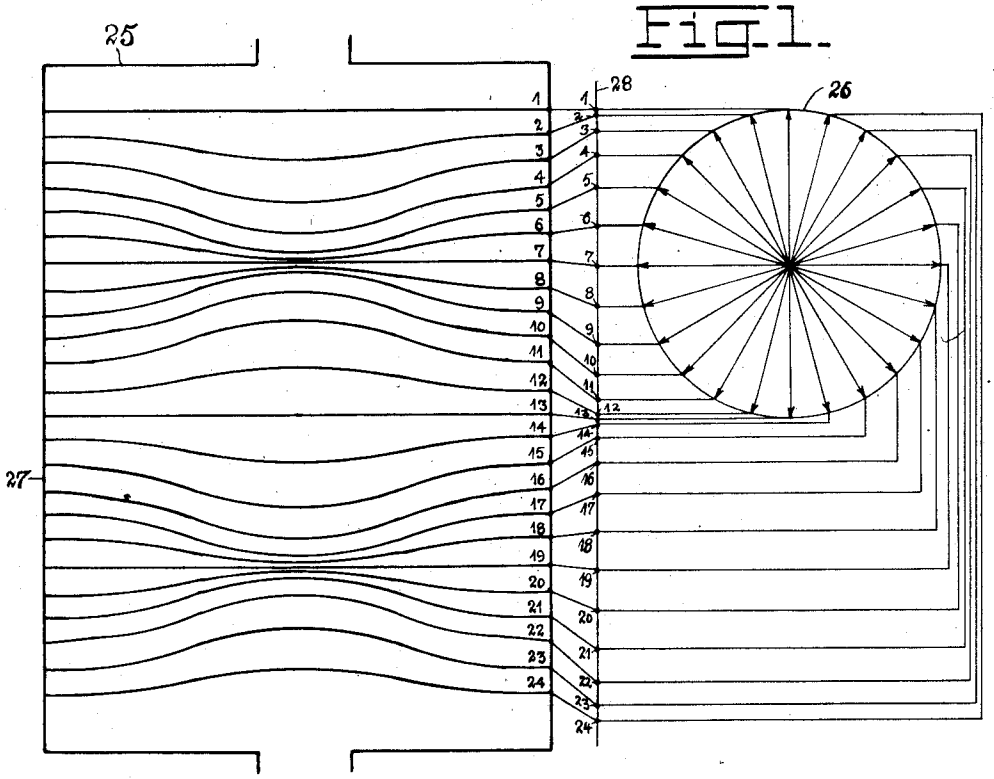
April 2, 1940. N. N. STRAATVEIT 2,195,792

MACHINE FOR ACTUATING FLUID

Filed Nov. 22, 1937 2 Sheets-Sheet 1

Fig. 1.



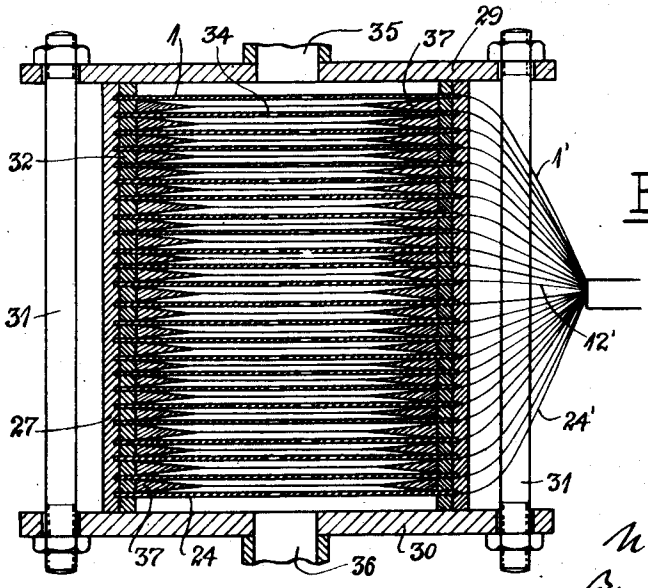


Fig. 2.

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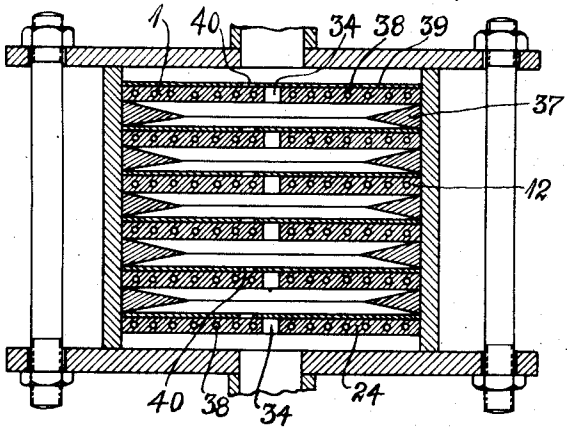

Fig. 3.

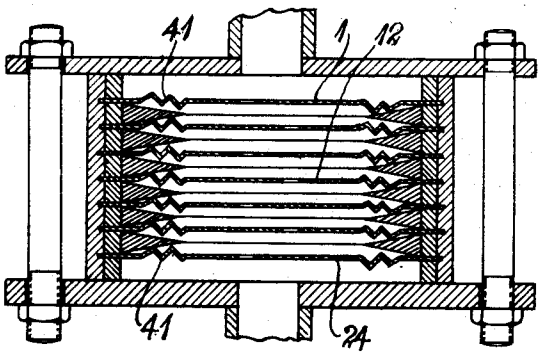

Fig. 4.

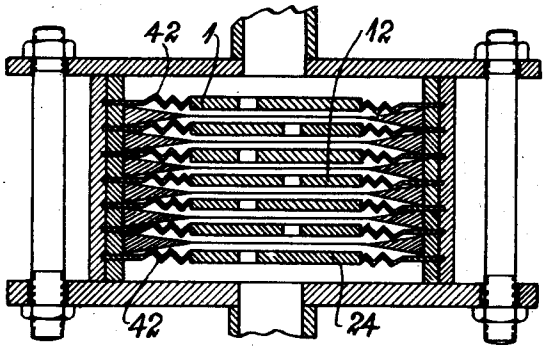

Fig. 5.

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UNITED STATES PATENT OFFICE

2,195,792

MACHINE FOR ACTUATING FLUID

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Application November 22, 1937, Serial No. 175,965
In Norway November 21, 1936

13 Claims. (Cl. 103—53)

(Granted under the provisions of sec. 14, act of March 2, 1927; 357 O. G. 5)

The present invention relates to a machine for actuating fluid of any kind, liquids as well as gases. The main object of the present invention is to provide a machine of this order, a pump or compressor, which will be adapted to actuate fluids without the means of rotating parts in the pump or compressor itself or in the means used as prime mover for the same. By constructing a machine according to the present invention, one will thus obtain a machine which can act as pump or compressor without having parts which must be oiled or which may be worn, and without parts which will cause noise. A machine according to this invention is very valuable in connection with refrigerating machinery, but may also be used for any other purposes where it is a question of establishing a high pressure or vacuum or to make a fluid move from one place to another.

The machine according to the present invention comprises for this purpose a hollow body with inlet and outlet openings and means between said openings for actuating the fluid within the same in the direction from the inlet to the outlet opening. The said means may be varied, but generally it comprises a plurality of relatively spaced disklike members, each covering the internal cross-sectional area of the said body, and each being provided with a passage for the fluid.

Further means are provided to subject the said disklike members in progressive succession to a movement in the axial direction in such a way that two or three of the said disklike members will come into close contact with each other, and that this contact between the disklike members in a caterpillar-like movement will travel from the inlet to the outlet end of the body, due to the fact that the rearmost disk will be released from the contact at the same time as a new disk will come into contact in the direction of the travel of the fluid through the body in such a way that the fluid will be forced from the inlet to the outlet end of the body in front of the disks, which at any time are contacting with each other.

According to one embodiment of this invention the said disks may be made of resilient metal plates, clamped in spaced relation to each other to the sides of the body and electrically insulated as well in relation to the body as to each other, said disks being adapted to be charged with A. C. E. M. F. of progressive different phase, so that the electrostatic action will tend to pull some of the plates together in a progressive way from the inlet to the outlet end, according to the changes in the A. C. power at any time.

According to another embodiment of the invention, the disks or plates may be made of resilient material, for instance rubber wherein electric coils are embedded, whereafter these coils are fed with electric current of different phase in the same progressive manner as above mentioned, whereas the same action will be obtained.

The non-return valve in the said disk may be constructed in a very simple manner by providing apertures in the disks, staggered in relation to each other in adjacent disks, so that the unapertured parts of one disk will cover the apertures of the adjacent disks when they are contacting with each other.

According to a further embodiment of this invention, the disks may be provided with a corrugated section along the circumference of the same, so that the resiliency thereby will be increased. The disks or plates may also be constructed of two parts fixed together, and then the middle part of the disk may be of stiff material, while the circumference is made of resilient plate, preferably corrugated.

When two adjacent disks due to the electromotive or electrostatic power therebetween or by any other means provided for the swinging action of the said disks are moved together so that they contact with each other, a space will naturally be formed along the inside edges of the hollow body. This space will be of no use, and in order to reduce the injurious effect of the space, the invention provides for the arrangement of a tapered web, extending from the inside of the hollow body towards the center, having a form corresponding to the form which the said disks will take when such bending action is present.

In order to explain the present invention, it will in the following be described with reference to the drawings which diagrammatically illustrate the invention and some embodiments for the same.

In the drawings,

Fig. 1 illustrates diagrammatically the principle which underlies this invention and a diagram of connection for the same to an electric source of power.

Fig. 2 illustrates one embodiment of the invention in longitudinal cross section.

Fig. 3 illustrates another embodiment in the same cross section and

Figs. 4 and 5 further embodiments.

In Fig. 1, 25 denotes the machine according to the invention and 26 the electric source of power. The machine 1 consists of a hollow body

27, wherein a number of diaphragms, disks or plates 1—24 are arranged. These disks may be of any desired shape, all corresponding to the cross sectional shape of the body 25, although it is natural that a circular shape under most circumstances will be used. The disks 1—24 are fixed to the sides of the body 27 and are electrically insulated in relation to this and to each other. The disks may for this purpose be covered by a thin insulated layer of rubber, shellac, enamel or the like. The electric source of power 26 is illustrated with the vectors of E. M. F. which it is adapted to supply.

The machine for supplying this power may very easily be constructed as a phase converter of the stationary type, i. e., a transformer which when fed with a one-, two- or three-phase power is adapted to convert this into the number of phases desired.

There is no reason for further describing a machine of this type, as it is generally well known to a man skilled in the art.

Each of the phases of the machine 26 is represented by an arrow, and the phase difference will be represented by the angle between the different arrows. When therefore the plates 1—24 of the machine 25 are connected to each one of the phases of the source of power as illustrated in Fig. 1, then the contracting action between the plates 1—24 will correspond to the phase difference between the two phases correspondingly connected to the plates which may be illustrated by the difference in distance between the points 1—24 on the line 28.

One will here see that the maximum contraction will be present between the plates 7, 8, 9 and 18, 19, 20. These plates will therefore be pulled together, and as the progression of the E. M. F. takes place in the transformer 26, then it may be illustrated as if the transformer 26 were rolling down the sheet, and the contracting power between the plates 6 and 7 will therefore be reduced, while the contracting action between the plates 8 and 9 will be increased; and in the next moment it will be the plates 7, 8, 9 which are contacting with each other, and in the following the plates 8, 9 and 10 and so on, whereby the said caterpillar movements will be produced.

In the plates or disks 1—24 there are non-return valves as already mentioned, which will be further described with reference to the practical embodiment of the invention which now will be described.

In the embodiment shown in Fig. 2, the body 26, 27 is held in a frame, comprising a head plate 29 and a bottom plate 30 and a number of bolts 31. The disks 1—24 are shown attached to the body 27 by being clamped between distance pieces 32 and are provided with apertures 34, arranged staggered in relation to each other. In the head plate 29 an inlet opening 35 is arranged, and in the bottom plate 30 an outlet opening 36 is arranged. Electric conducting means 1'—24' lead to each of the plates 1—24, which preferably are covered with electric insulating material, as for instance shellac, enamel, rubber or the like. Between each pair of plates 1—24, a wedgelike web 37 is arranged which is adapted to fill out the dead space which would be present, if two plates were bent towards each other and such wedge 37 were not present.

The action of the machine as above described will readily be understood from the description of the illustration in Fig. 1. E. M. F. of different phase is fed through the leads 1'—24', and as this power is changing, the plates 1—24 will be contracted in groups of two, three or more, whereby the holes 34 will be covered and the fluid in front of such group will be forced towards the outlet end 36, as this group is progressing from the inlet end to the outlet end.

The above example was described with reference to an electrostatic embodiment of the invention. In Fig. 3 the same machine is shown with means for electro-dynamic running of the pump. In this figure corresponding reference numerals correspond to the same parts as in Fig. 2. The plates 1—24 are here made of elastic material as for instance rubber and coils 38 are embedded in the same. When electric power is led to these coils from the transformer 26, Fig. 1, the same action will take place as described with reference to this figure. The plates 1—24 are here provided with apertures 34, arranged along the same line; therefore a thin diaphragm 39 also provided with a hole or aperture 40 is arranged on top of each of the plates 1—24, and this diaphragm being of elastic material will act as a valve and provide for the non-return action.

The embodiment shown in Fig. 4 illustrates another form for the disks 1—24. Here the disks are provided with corrugations 41 along the circumference of the same in order to facilitate the swinging action of the same when working.

In the embodiment shown in Fig. 5, the disks 1—24 are built up of a middle section of heavy non-resilient material and therearound a section 42 of thin elastic plate, provided with corrugations. In these two last figures, the remaining reference numerals correspond to the same parts as the reference numerals in Figs. 2 and 3.

I claim:

1. Improvement in a machine for actuating a fluid comprising a hollow body with inlet and outlet openings and means between said openings for actuating the fluid within the same in the direction from the inlet to the outlet opening, said means comprising a plurality of disklike members relatively spaced in the direction from the inlet to the outlet, and each covering the internal cross-sectional area of the said body and each being provided with a passage for the fluid and means for subjecting the said disklike members in progressive succession to a movement in the axial direction and into contact with the adjacent disk, all for the purpose of establishing a caterpillar movement of the disk assembly, whereby the fluid will be forced to flow from the inlet to the outlet end.

2. Improvement in a machine for actuating a fluid, comprising a hollow body with inlet and outlet openings and means between said openings for actuating the fluid within the same in the direction from the inlet to the outlet opening, said means comprising a plurality of resilient metal plates relatively spaced in the direction from the inlet to the outlet, and electrically insulated from each other and from the hollow body, each covering the internal cross-sectional area of the said body and each being provided with one or more apertures arranged staggered in relation to the corresponding apertures in the adjacent plates, said plates being adapted to be charged with alternating E. M. F. with a progressive phase displacement between adjacent plates in the direction from the inlet to the discharge end, so that the plates, when charged

in succession will move in the axial direction and into contact with an adjacent plate in a caterpillar-like progressive movement, whereby the said apertures in one plate will be covered by the adjacent plate and the fluid will be forced to flow from the inlet to the outlet end.

3. Improvement in a machine for actuating a fluid comprising a hollow body with inlet and outlet openings and means between said openings for actuating the fluid within the same in the direction from the inlet to the outlet opening, said means comprising a plurality of resilient disklike members relatively spaced in the direction from the inlet to the outlet, and each covering the internal cross-sectional area of the body and clamped to the sides of same, and each being provided with a passage for the fluid, and means for subjecting the said disklike members in progressive succession to a movement in the axial direction and into contact with an adjacent disk, tapered webs being arranged between each pair of disks shaped to correspond to the form of the disks from the sides of the hollow body and to the line of contact between two adjacent disks, all for the purpose of establishing a caterpillar movement of the disks, whereby the fluid will flow from the inlet to the outlet end.

4. Improvement in a machine for actuating a fluid comprising a hollow body with inlet and outlet openings and means between said openings for actuating the fluid within the same in the direction from the inlet to the outlet opening, said means comprising a plurality of metal plates, electrically insulated from each other and from the hollow body and relatively spaced in the direction from the inlet to the outlet, and each covering the internal cross-sectional area of the said body and each being provided with one or more apertures arranged staggered in relation to the corresponding apertures in the adjacent plates, said plates having corrugations along their circumference to provide resiliency, and being adapted to be charged with alternating E. M. F. with a progressive phase displacement between adjacent plates in the direction from the inlet to the discharge end, so that the plates, when charged in succession will move in the axial direction and into contact with an adjacent plate in a caterpillar-like progressive movement, whereby the said apertures in one plate will be covered by the adjacent plate and the fluid will be forced to flow from the inlet to the outlet end.

5. Improvement in a machine for actuating a fluid, comprising a hollow body with inlet and outlet openings and means between said openings for actuating the fluid within the same in the direction from the inlet to the outlet opening, said means comprising a plurality of resilient disklike members relatively spaced in the direction from the inlet to the outlet, and each covering the internal cross-sectional area of the said body and being fastened to same, each being provided with a passage for the fluid, said passage being in the form of a resilient diaphragm or the like in contact with the said disk, said disk and the said diaphragm being provided with apertures not corresponding with each other, and means for subjecting the said disklike members in progressive succession to a movement in the axial direction and into contact with the adjacent disk, said means comprising electric coils arranged within the said disks and being adapted to be fed with alternating current of progressive phase difference between each disk and the adjacent disk in the feed direction of the machine.

6. Improvement in a machine for actuating a fluid, comprising a hollow body with inlet and outlet openings and means between said openings for actuating the fluid within the same in the direction from the inlet to the outlet opening, said means comprising a plurality of disklike members relatively spaced in the direction from the inlet to the outlet, and having corrugations along their circumference to provide resiliency, each covering the internal cross-sectional area of the said body and being fastened to same and being provided with a one-way valve, and means for subjecting the said disklike members in progressive succession to a movement in the axial direction and into contact with the adjacent disk, said means comprising electric coils arranged within the said disks, and being adapted to be fed with A. C. current of progressive phase difference between each disk and the adjacent disk in the feed direction of the machine, all for the purpose of establishing a caterpillar movement of the disks, whereby the fluid will flow from the inlet to the outlet end.

7. Improvement in a machine for actuating a fluid, comprising a hollow body with inlet and outlet openings and means between said openings for actuating the fluid within the same in the direction from the inlet to the outlet opening, said means comprising a plurality of metal plates relatively spaced in the direction from the inlet to the outlet, and electrically insulated from each other and from the hollow body and clamped to the latter, each covering the internal cross-sectional area of the said body and each being provided with one or more apertures arranged staggered in relation to the corresponding apertures in the adjacent plates, tapered webs being arranged between each pair of disks shaped to correspond to the form of the disks from the sides of the hollow body and to the line of contact between two adjacent disks, said plates being adapted to be charged with alternating E. M. F. with a progressive phase displacement between adjacent plates in the direction from the inlet to the discharge end, so that the plates when charged in succession will move progressively in the axial direction and into contact with an adjacent disk, in a caterpillar-like movement, whereby the said apertures in one disk will be covered by the adjacent disk, and the fluid will be forced to flow from the inlet to the outlet end.

8. Improvement in a machine for actuating a fluid, comprising a hollow body with inlet and outlet openings and means between said openings for actuating the fluid within the same in the direction from the inlet to the outlet opening, said means comprising a plurality of disklike members relatively spaced in the direction from the inlet to the outlet, and each covering the internal cross-sectional area of the said body and each being provided with a one-way valve, and means for subjecting the said disklike members in progressive succession to a movement in the axial direction and into contact with an adjacent disk, said means comprising an electric phase converter, adapted to change the number of phase in an A. C., distributing system to a number corresponding to the number of plates in question, and means for distributing these phases of E. M. F. to the said disklike members, all for the purpose of establishing a caterpillar

movement of the disks, whereby the fluid will flow from the inlet to the outlet end.

9. Improvement in a machine for actuating a fluid, comprising a hollow body with inlet and outlet openings and means between said openings for actuating the fluid within the same in the direction from the inlet to the outlet opening, said means comprising a plurality of disklike members relatively spaced in the direction from the inlet to the outlet, and having a relatively stiff central portion and a corrugated elastic portion between this and the walls of the body, so that the internal cross-sectional area of the said body is covered, each of the disks being provided with a passage for the fluid, and means for subjecting the said disklike members in progressive succession to a movement in the axial direction and into contact with an adjacent disk, all for the purpose of establishing a caterpillar movement of the disks, whereby the fluid will flow from the inlet to the outlet end.

10. Improvement in a machine for actuating a fluid, comprising a working chamber and actuating means in said chamber, said means comprising a number of working members arranged in series in relation to the desired direction of movement of the fluid and means for subjecting said members to a progressive oscillating movement with a phase displacement in relation to each other.

11. Improvement in a machine for actuating a fluid, comprising a working chamber and actuating means in said chamber, said actuating means comprising a plurality of swinging plates arranged spaced from each other in the direction of the desired movement of the fluid adapted, when swinging in progressive recession, to contact face to face with each other and provided with in relation to each arranged apertures which will be covered by the unbroken face of the adjacent plates.

12. Improvement in a machine for actuating a fluid, comprising a working chamber and actuating means in said chamber, said means comprising a number of working members adapted to be subjected to a swinging movement and arranged in series in relation to the desired direction of movement of the fluid in such a way that they in progression will actuate the said fluid.

13. Improvement in a machine for actuating a fluid, comprising a working chamber and actuating means in said chamber, said means comprising a number of working members arranged in series in relation to the desired direction of movement of the fluid and adapted to be subjected to a swinging movement in progressive succession.

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