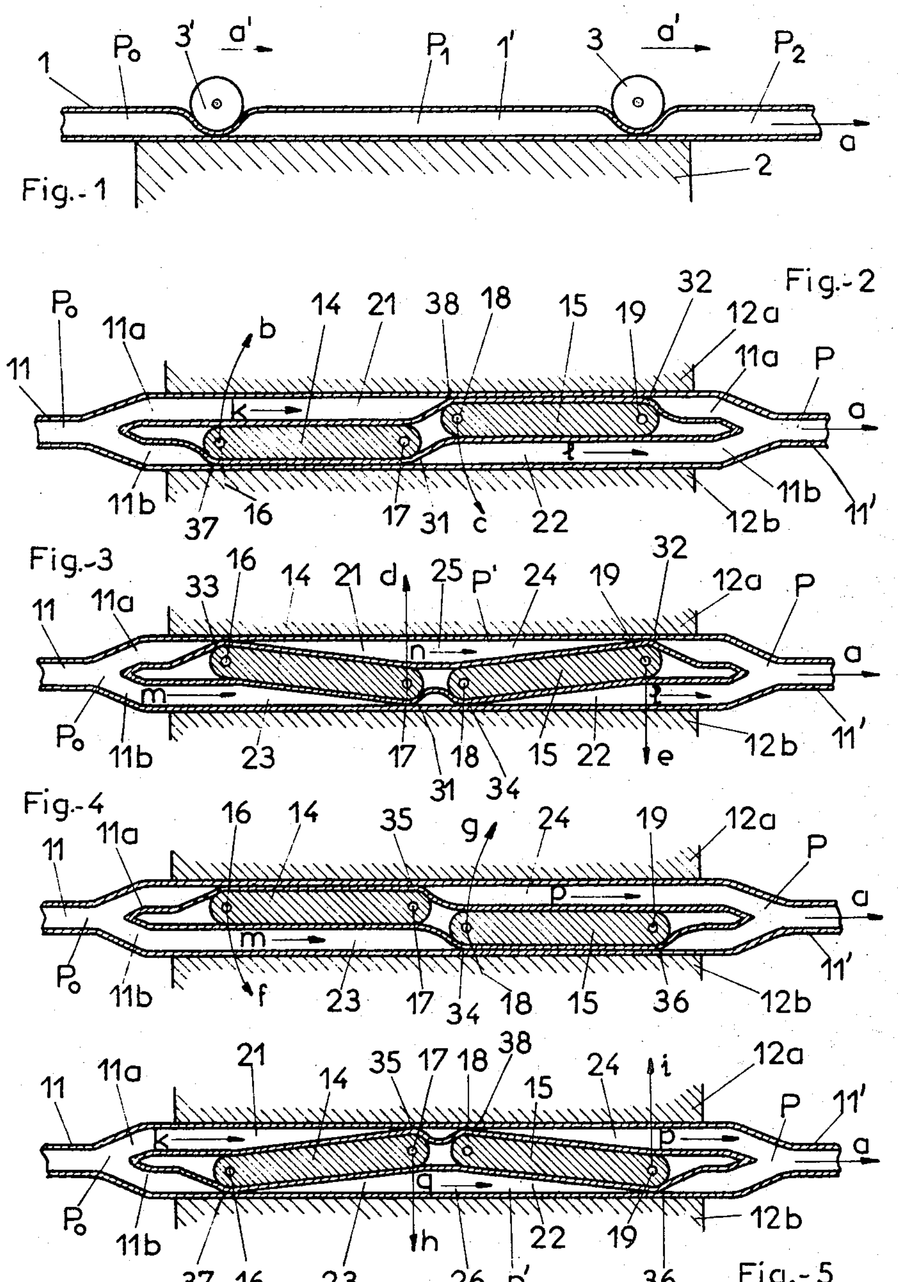
Dec. 24, 1968 J. ZIMMER 3,417,707

HOSE PUMP

Filed June 6, 1967 3 Sheets-Sheet 1

Prior Art



Inventor:
Joseph Zimmer
by Michael S. Striker,
Attorney

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Fig.-6

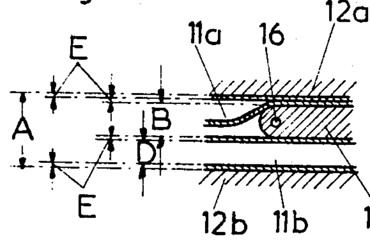


Fig.-7

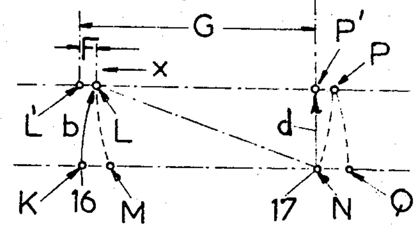


Fig.-9

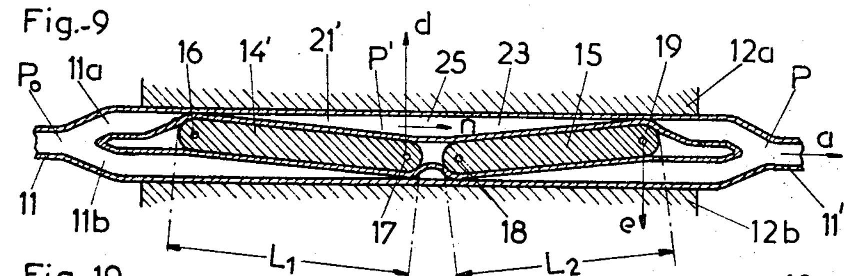
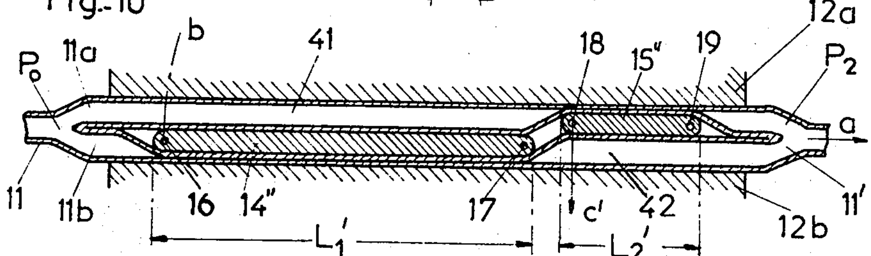


Fig.-10



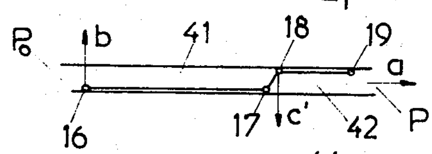


Fig.-11

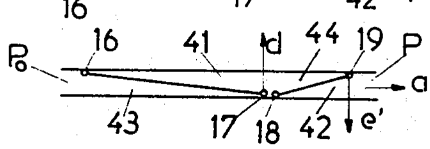


Fig.-12

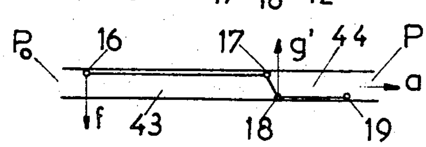


Fig.-13

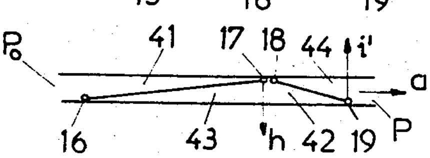


Fig.-14

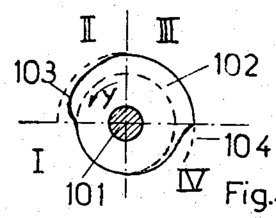


Fig.-8

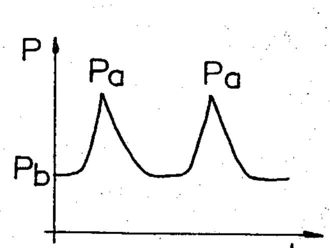


Fig.-15

Inventor;
Joseph Zimmer
by Michael S. Striker
Attorney

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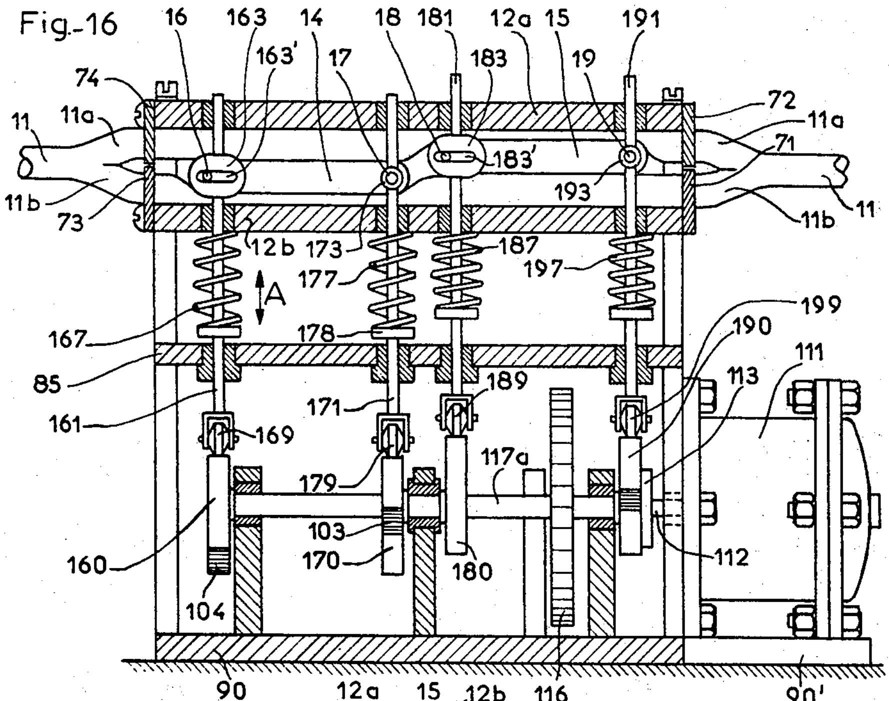
Fig.-16



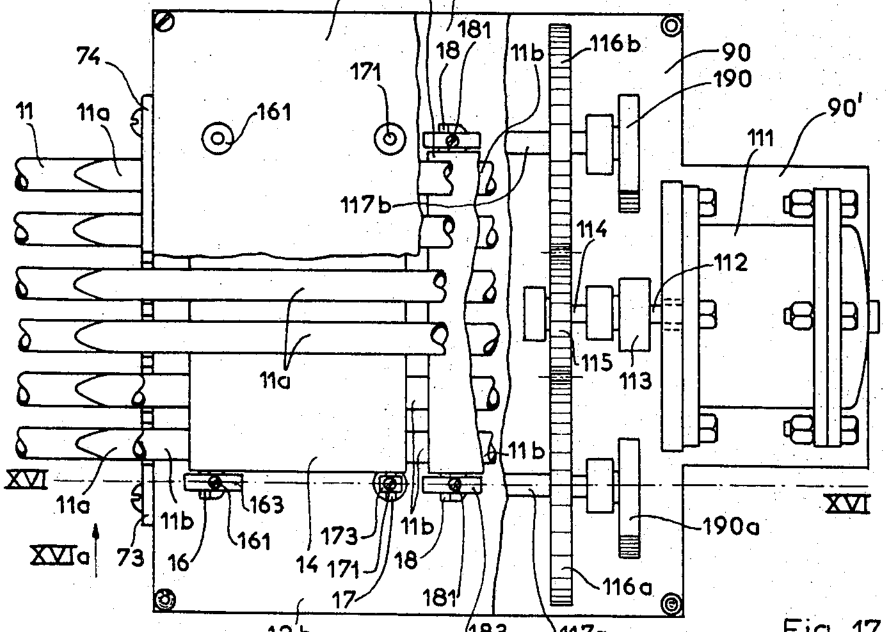


Fig.-17

Inventor;
Joseph Zimmer
by Michael S. Striker
Attorney

United States Patent Office

3,417,707
Patented Dec. 24, 1968

3,417,707

HOSE PUMP

Joseph Zimmer, 2 Rue du Canal, Illkirch-Graffenstaden, France

Filed June 6, 1967, Ser. No. 643,877
Claims priority, application France, June 15, 1966, 8,638
17 Claims. (Cl. 103—148)

ABSTRACT OF THE DISCLOSURE

A hose pump comprising a flexible hose having an inlet end and an outlet end and a pair of branches between the ends, the branches of the hose extending between a pair of fixed rigid abutment plates and a pair of movable plates are arranged spaced in longitudinal direction of the hose in the space between the branches. Upstream and downstream extremities of the plates are alternatingly moved to and fro in a predetermined sequence in a direction substantially normal to said abutment plates between a pair of end positions in which they press the engaged branch portions fluid-tightly against the respective abutment plates to thereby pump fluid from the inlet to the outlet end of the hose.

Background of the invention

The present invention relates to pumps for pumping fluid, preferably liquid, and more specifically, the present invention relates to a hose pump.

Hose pumps are known in the art which comprise at least one and preferably a plurality of substantially parallel hoses formed from flexible and elastic material. In order to pump the fluid, the hoses are at longitudinally spaced portions thereof tightly compressed by rollers or the like arranged spaced at a given distance from each other and moved in direction in which the fluid has to be pumped. Each of the rollers is moved in the aforementioned direction from a starting position to an end position and in reaching the end position it is disengaged from the hose and moved back again to the starting position. The fluid in the hose is thereby pumped in the desired direction.

This pump known in the art, has however the disadvantage that the flow of the fluid produced by the pump is irregular and under certain conditions intermittent. Such intermittent or uneven flow of fluid is highly undesirable in many applications, and while this known hose pump is of simple construction, the above mentioned disadvantages of the pump limit its field of application.

It is an object of the present invention to provide for a hose pump which overcomes the disadvantages of the hose pump known in the prior art mentioned above.

It is an additional object of the present invention to provide for a hose pump which during operation will produce a continuous flow of fluid in one direction.

Summary of the invention

With these objects in view, the hose pump according to the present invention mainly comprises at least one flexible hose having an inlet and an outlet end, and a pair of branches between the ends, the branches communicate with each other at the inlet and the outlet end and define between themselves an elongated space, a pair of fixed rigid abutment plates extending spaced from each other in longitudinal direction of the hose and the branches of the hose extending between the pair of abutment plates, a pair of movable plates extending in longitudinal direction of the hose and arranged spaced from each other in the aforementioned direction in the elongated space between the branches, and operating means

connected to the plates in the region of their upstream and downstream extremities for moving the upstream and downstream extremities to and fro in a direction transverse to the longitudinal direction of the hose and in a predetermined sequence such that the corresponding extremities of the pair of plates are always moved simultaneously between a first end position adjacent one of the pairs of the pair of abutment plates and a second end position adjacent the other of the pair of abutment plates, while the other extremity of each plate remains at rest in one of the end positions during this movement and each of the extremities in the end positions thereof fluid-tightly clamps the engaged branch against the abutment plate adjacent the respective extremity, whereby fluid is pumped from the inlet to the outlet end of the hose.

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 specific embodiments when read in connection with the accompanying drawing.

Brief description of the drawing

FIG. 1 is a schematic cross-sectional view of a hose pump according to the prior art;

FIGS. 2–5 are longitudinal cross-sections taken along the axis of the hose and illustrating the hose pump according to the present invention in four successive positions;

FIG. 6 is a schematic figure illustrating the conditions to determine a preferred distance between the abutment plates;

FIG. 7 is a diagram illustrating a preferred movement of the opposite extremities of each movable plate;

FIG. 8 is a side view of a control cam forming part of the operating means for moving the movable plates;

FIG. 9 is a longitudinal cross-section of an improved pump according to the present invention;

FIG. 10 is a longitudinal cross-section through a modification of a pump according to the present invention constructed to produce a fluid flow in which the pressure of the fluid pumped varies in a predetermined sequence;

FIGS. 11–14 are schematic views illustrating the operation of the pump illustrated in FIG. 10;

FIG. 15 is a diagram illustrating the pressure in the fluid pumped by the pump according to FIG. 10 as a function of time;

FIG. 16 is a sectioned view and showing the operating means of the pump according to the present invention in detail, the section being taken along the line XVI—XVI of FIG. 17; and

FIG. 17 is a top view of the pump arrangement shown in FIG. 16 with some parts broken away to show the parts beneath the same.

Description of the preferred embodiments

Before describing the embodiments of the pump according to the present invention, reference is had to FIG. 1 of the drawings in which a hose pump according to the prior art is schematically illustrated. As schematically shown in FIG. 1 the hose pump according to the prior art comprises at least one hose **1** of flexible elastic material which abuts at one side thereof with a portion of its length against a plane surface of a fixed support or abutment means **2.** The hose **1** is further engaged at the opposite side thereof by a pair of rollers **3** and **3'** or the like arranged spaced in longitudinal direction from each other and moved for instance by a pair of endless chains, not shown in the drawing, in the direction of the arrows *a'*. The rollers **3** and **3'** are pressed either solely by their weight, or by additional means not shown in the drawing, against the hose **1** respectively against the support **2** in such a manner to fluid-tightly close the engaged hose portion. Due to its elasticity the substantially circular hose will, after the respective roller has passed over a portion thereof, again snap back to its original circular position so that during movement of the rollers in the direction of the arrows *a'* the fluid coming in the illustrated example from the left, as shown in FIG. 1, will be sucked inwardly to the left of the roller 3'. The fluid enclosed in the portion **1'** of the hose **1** between the rollers 3 and 3' is thus transported in the direction indicated by the arrows *a'*. When the respective roller arrives at the right edge of the plate **2**, as viewed in FIG. 1, the roller is lifted in order to be returned by the endless chains not shown in the drawing to the other side of the plate **2**, that is the left side, as viewed in FIG. 1. The fluid ahead of the roller **3** is pushed in the direction indicated by the arrow *a*. The pressure P_1 of the fluid enclosed in the portion **1'** of the hose **1** between the rollers 3 and 3' is selectively equal to the pressure P_0 on the suction side, whereas the pressure P_2 of the fluid pushed in the direction of the arrow *a* is superior to this pressure, sometimes even considerably superior depending on the apparatus to which the fluid is transported. Therefore, at the moment at which the roller **3** leaves the hose **1** in order to return to its starting position, the pressure P_2, prevailing over the pressure P_1, will provoke a return shock so that the flow of the fluid will become irregular. Under certain conditions, the fluid flow may stop completely or even reverse itself during a short instant while causing a slight swelling of the portion **1'** of the hose **1**.

The above described apparatus according to the prior art has therefore, as mentioned above, the disadvantage to provide an irregular fluid flow.

Referring now to FIGS. 2–5 in which the acting elements of one embodiment of a hose pump according to the present invention are illustrated in successive positions, it will be seen that the hose pump illustrated in these figures mainly comprise at least one flexible hose having an upstream inlet end portion **11** and a downstream outlet end portion **11''** and a pair of branches **11*a*** and **11*b*** between the aforementioned end portions which communicate with each other at the inlet and outlet end portion while defining between themselves an elongated space. The branches **11*a*** and **11*b*** of the hose extend between a pair of fixed rigid abutment means or abutment plates **12*a*** and **12*b*** extending spaced from and substantially parallel to each other so that the facing surfaces thereof are in contact with outer portions of the branches **11*a*** and **11*b***. While FIGS. 2–5 illustrate only a single hose, the pump according to the present invention preferably comprises a plurality of hoses having each a pair of branches **11*a*** and **11*b***, which hoses extend parallel to and transversely spaced from each other as for instance clearly shown in FIG. 17, and the plurality of hoses may be connected to each other at the upstream and downstream side. It is mentioned that the term "upstream" and "downstream" are used in the specification only to indicate the direction of fluid flow that is the term "upstream" designates the side at which the fluid is sucked in, whereas the term "downstream" designates the side at which the fluid is transported. The terms are not used to indicate a level or pressure difference, and the pressure or the level of the fluid at the downstream side may be greater or higher than on the upstream side.

Each hose **11** is formed from flexible and elastic material so that the hose after being compressed in transverse direction, and after the pressure is relieved will resiliently snap back to its original configuration or cross-section, which may for instance be circular.

Two movable striker elements preferably in the form of plates **14** and **15** are arranged spaced from each other in direction of the elongation of the hose in the elongated space between the two branches **11*a*** and **11*b***. Rods **16**, **17**, **18** and **19** respectively extend through the plates **14** and **15** in the region of the extremities thereof substantially normal to the elongation of the hose, and each of the rods has a pair of opposite end portions projecting beyond the respective plate so as to be engageable by operating means, which will be described later on in detail, serving to move the plates in a predetermined sequence.

FIG. 2 illustrates the pump in a position in which the plate **14** at the upstream side is pressed over its whole length against the hose branch **11*b***, respectively against the abutment plate **12*b*** so that the branch **11*b*** is complete and fluid-tightly compressed over the whole length of the plate **14**. At the same time, the plate **15** on the downstream side compresses the branch **11*a*** against the abutment plate **12*a***. From the position as shown in FIG. 2, the rod **16** arranged at the upstream side of the plate **14** is moved by the operating means of the pump in the direction indicated by the arrow *b*, whereas simultaneously the rod **18** arranged at the upstream side of the plate **15** is moved in the direction indicated by the arrow *c*. During this movement the downstream extremities of the two plates are maintained in abutment against the branches of the hose to compress the same respectively at **31** and **32** so as to interrupt fluid flow at these locations. Due to this movement of the plates which brings the same to the position as indicated in FIG. 3, the fluid located in the portion **21** of the branch **11*a*** is in part displaced, in the direction as indicated by the arrow *k*, towards the portion **24** of the branch **11*a***, which portion increases as the portion **21** decreases. At the same time, the fluid in the portion **22** of the branch **11*b*** is moved in part in the direction indicated by the arrow *l* and pushed out through the downstream end portion **11'** in the direction indicated by the arrow *a*, while at the upstream side the fluid is sucked into the portion **23** of the branch **11*b***, in the direction of the arrow *m* as the portion **23** increases during displacement of the plate **14**.

After the plates **14** and **15** have taken up the positions as shown in FIG. 3, the rods **16** and **18** are maintained in position so as to respectively press the extremities of the plates through which they extend tightly against the branches **11*a*** and **11*b*** to compress these branches at the locations **33** and **34** during the following part of the cycle of movement of the plates in which the rod **17** at the downstream side of the plate **14** is moved in the direction indicated by the arrow *d*, and the rod **19** arranged at the downstream side of the plate **15** is simultaneously moved in the direction indicated by the arrow *e* until the plates **14** and **15** arrive at the position illustrated in FIG. 4. Due to this movement, the remainder of the fluid in the portion **22** of the branch **11*b*** is moved in the direction indicated by the arrows *l* toward the downstream outlet end portion **11'**, whereas the remainder of the fluid from the portion **21** of the branch **11*a*** is pushed in the direction of the arrow *m* through the intermediate portion **25** into the portion **24** of this branch. The portion **23** of the branch **11*b*** continuously increases and it is filled with sucked in fluid from the upstream side flowing in the direction of the arrow *m*.

During the following part of the cycle of operation of the pump the rod **16** of the plate **14** is moved in the direction of the arrow *f* and the rod **18** of the plate **15** is moved in the direction of the arrow *g*, whereas the downstream extremities of the plates remain pressed against the branches **11*a*** and **11*b*** to compress the same in fluid-tight manner respectively at the locations **35** and **36**. The plates thus moved will reach the position as indicated in FIG. 5. A certain amount of fluid which is located in the portion **24** of the branch **11*a*** is pushed in the direction of arrow *p* toward the downstream outlet end **11'**, whereas fluid is sucked in at the upstream end in the direction of the arrow *k* into the increasing portion **21** of the same branch. The fluid in the portion **23** of the branch **11*b*** is displaced in part in the direction of the arrow *q* through the intermediary portion **26** into the portion 22 of the same branch, which last mentioned portion increases as the plate 15 is displaced.

After the plates have reached the position as illustrated in FIGURE 5, the downstream extremity of the plate 14 is displaced by means of the rod 17 and in the direction of the arrow *h* whereas the corresponding extremity of the plate 15 is displaced by means of the rod 19 at the same time in the direction of the arrow *i*. During this movement the upstream extremities of the plates compress the branches 11*a* and 11*b* tightly and respectively at the locations 37 and 38.

The rest of the fluid located in the portion 24 of the branch 11*a* is thereby pushed in the direction of the arrows *p* towards the downstream end portion 11′ to be further transported in the direction of the arrow *a*. The fluid contained in the portion 23 of the branch 11*b* passes through the intermediary portion 26 in the direction of the arrow *q* into the portion 22. Finally, the portion 21 of the branch 11*a* which increases as the plate 14 is displaced remains fluid-tightly compressed at 38 and continues to suck fluid from the upstream side. At the end of this phase of operation, the plates are again in the position as illustrated in FIG. 2 and the four steps of the cycle above described are repeated.

While not absolutely necessary, it is advantageous to choose the distance between the facing surfaces of the abutment plates 12*a*, 12*b* in a manner as will be explained with reference to FIG. 6. In FIG. 6, the inner diameter of each branch 11*a* and 11*b* of the hose is designated with D, the wall thickness of the branches is designated with E, whereas B designates the thickness of the plates 14 and 15, of which only the upstream end portion of the plate 14 is shown in FIG. 6. The distance A is preferably chosen to correspond exactly or at least approximately to

$$A=B+C+4E$$

but of course, it is also possible to choose the distance A in special cases smaller or larger. When the distance between the abutment plates is chosen as indicated in the above formula, the pump can be easily adapted for different outputs, whereby only the hoses with their two branches have to be exchanged against hoses having branches of an inner diameter according to the desired output and the dimensions and properties of which will correspond to the above formula.

A certain problem arises due to the alternating displacement of the two extremities of the plates in direction transverse to the elongation of the plates. In principle the extremities of the plates will always pivot alternatingly about the axis of the rod maintained at rest during the respective phase of operation and the extremities of the plates will follow a circular course, so that the plates will have the tendency to be displaced toward the downstream side of the pump as indicated by the dotted lines in FIG. 7 in which the rod 16 follows a path K–L–M, whereas the rod 17 follows a course N–P–Q. In order to overcome this disadvantage, the rods 16 and 17, 18 and 19 may be guided in the manner as schematically illustrated in FIG. 7 for the rods 16 and 17. During the first part of the above-described cycle the plate 14 turns about the axis of the rod 17 which is maintained in place and the rod 17 will follow a circular path indicated by the arrow *b* and move from K to L. During the second part of the cycle the rod 17 which is displaced in the direction indicated by the arrow *e* is guided along a straight line perpendicular to the facing surfaces of the abutment plates 12*a* and 12*b* so as to move from the point N to the point P′. During this movement, the rod 16 has to be displaced, in the direction parallel to the plate 12*a* as indicated by the arrow *x* so as to move from L to L′. The distance between the axes of the rods 16 and 17 is designated with G and the distance between the points L and L′ corresponding to the movement of the rods 16 parallel to the plane of the abutment plates is designated with F. The movements during the third and fourth part of the above described cycle will take place in the same manner but in the opposite direction, that is the rods 16 will describe a circular path while turning about the point P′ and it is then displaced parallel to the abutment plate until it reaches the point of its departure K, while the rod 17 is guided along the same straight line from the point P to the point N.

Various constructions are possible which will permit movement of the rods 16 and 17 in the manner as described above, and one of the various possible constructions will be described later on in further detail. The rods 18 and 19 of the plate 15 are guided in the same manner. Of course, it is to be understood that instead of guiding the rods at the downstream end of each plate, along a substantially straight path it is also possible to guide the rod at the upstream end of each plate along a straight path, whereas the rod at the downstream end of each plate will in this case describe a circular movement and be then displaced in direction parallel to the abutment plate.

In FIGS. 2–5 the pressure of the fluid at the upstream side is designated with P_0 and the pressure at the downstream side is designated with P; the pressure of the fluid which is enclosed in the positions of the plates shown in FIGS. 3–5 between the point of compression 32 and 33 that is in the portions 21, 24 and 25 of the branch 11*a*, or between the points of compressions 36 and 37, that is in the portions 22, 23 and 26 of the branch 11*b* is designated with P′. During the first part of the above described cycle in which the plates move from the position indicated in FIG. 2 to the position indicated in FIG. 3, the portion 21 of the branch 11*a* communicates with the upstream end 11 of the hose in which the pressure P_0 is maintained, whereas the portion 22 of the branch 11*b* communicates with the downstream end 11′ in which the pressure P_1 is maintained, which pressure P_1 is superior to the pressure P_0. When the position according to FIG. 3 is reached the pressure P′ will be equal to the pressure P_0. At this moment the plate 15 will start its movement indicated by the arrow *e* establishing thereby, at the location 32, communication between the portion 24 of the branch 11*a* with the downstream end 11′. Since the pressure P′ is inferior to the pressure P, there could be produced a momentary variation of the pressure P which would provoke an irregularity in the flow. To avoid such an irregularity, it is possible to give, at the start of the second part of the cycle, to the rod 17 a pronounced acceleration in the direction of the arrow *d* while retarding the movement of the rod 19 and in order to produce this effect it is for instance possible to form cams which control the movement of the aforementioned rods with an appropriate cam face. In this way the pressure P′ will rise rapidly, whereas slow opening of the passage at the location 32 will prevent a brisk return shock. During the third and fourth part of the above mentioned cycle the same measures may be adapted in the inverse sense.

FIG. 8 illustrates, by way of an example a control cam which may be used for moving the rods. The shaft 101 of the control cam turns in the direction indicated by the arrow *y*. The four phases of the above described cycle are designed with I, II, III, IV. It is assumed that the cam illustrated in FIG. 8 will control the movement of the rod 17. The cam 102 will maintain the rod 17 in place during the first part of the cycle by its small diameter portion, and the cam will produce at the start of the second part of the cycle a pronounced acceleration of the rod movement due to the rapid rise of its cam face portion 103. Subsequently it will maintain the rod in place during the third part of the cycle by its large diameter portion of constant radius, to finally impart to the rod an acceleration pronounced in the inversed direction at the start of the fourth part of the cycle due to the rapid decline of the flank portion 104. For the rod 19 opposite movements are obtained by reversing the portions of the cam.

When the difference between the upstream and the downstream pressure is considerable it is possible that the above described means will not be sufficient to avoid an irregularity of the fluid flow. This disadvantage may be overcome according to a further characteristic of the invention by providing two movable plates of different length and by arranging the longer plate at the upstream end of the pump, while using cam discs as described above in order to obtain increased, respectively reduced accelerations for the rods **17** and **19**.

FIG. 9 illustrates such a pump in which the plates are shown in positions they will attain during the second part of the above described cycle. The length L_1 of the plate **14'** is superior to the length L_2 of the plate **15** so that the volume of the portion **21'** of the branch **11***a* is superior to that of the portion **23**. It is evident that in this way a rapid rise of the pressure P' at the beginning of the second part of the cycle may be obtained, especially when using the special cam form above described, since a quantity of fluid corresponding to the volume of the portion **21'** of the branch **11***a* is pushed toward the portion **23** of smaller volume.

Based on the above described principle it is also possible to construct a pump which produces a fluid flow which is not constant but in which the pressure and the flow will vary in a predetermined manner as a function of the time, without however risking a stoppage of the fluid or a momentary flow in the opposite direction. In order to obtain this effect the pump may be provided, according to another feature according to the present invention, with two movable plates having greatly different length and in which the longer plate is arranged upstream.

FIG. 10 illustrates a pump of this type. The length L'_1 of the upstream plate **14''** is considerably greater than the length L'_2 of the downstream plate **15''** so that the volume of the portion **41** of the branch **11***a* is much greater than that of the portion **42** of the branch **11***b*. FIGS. 11–14 illustrate in a very schematic manner the function of this pump. The pump illustrated in FIG. 10 will operate in a four phase cycle corresponding to the cycle described in connection with FIGS. 2–5, with the sole difference that the volumes of the portions **41** and **43** of the two branches are greatly superior to the volumes **44** and **42** of the same branches, so that the speed of the fluid expelled during the scond part of the cycle (volume **41**) and during the fourth part of the cycle (volume **43**) rises rapidly, as compared with the speed obtained during the first part (volume **42**) and the third part (volume **44**) of the cycle.

The pressure P at the downstream side will thereby vary according to the diagram of FIG. 15, showing the peaks P*a* which follow each other in a sequence resulting from the operation of the pump, without however, dropping below a certain minimum value P*b*. Such a pump is adapted to imitate exactly the beat of a heart, provided the pump is operated in an appropriate time sequence. On the other hand, the pump according to the present invention permits to obtain a fluid flow of absolute constant speed and pressure. The pump according to the present invention may be used therefore for various applications especially in scientific laboratories, for example for carrying out rheological measurements or as aid during surgery. While the pump according to the present invention is preferably used for pumping liquids it can, evidently, also serve for pumping or compressing gases.

FIGS. 16 and 17 more completely illustrate a pump according to the present invention, and these figures especially illstrate the operating means for moving the plates **14** and **15** of the pump in the above described manner. As shown in FIG. 17 the pump may comprise a plurality of hoses **11** arranged parallel and spaced from each other at a certain distance to permit compression of the branch portions **11***a* and **11***b* of each hose in the above described manner. The branches **11***a* and **11***b* of all hoses are located between the abutment plates **12***a* and **12***b* which are supported on a frame schematically illustrated in FIGS. 16 and 17 and which includes a base plate **90** and an intermediate plate **85** located between the base plate and the abutment plate **12***b*. A drive motor **111** is mounted on an extension **90'** of the base plate and the drive shaft **112** of the motor **111** is preferably coupled by a flexible coupling **113** to a coaxial shaft portion **114** supported on appropriate bearing blocks on the base plate **90**. A pinion **115** keyed to the shaft portion **114** meshes at opposite sides thereof with gears **116***a* and **116***b* respectively keyed to a pair of parallel shafts **117***a* and **117***b* turnably mounted on appropriate bearing blocks on the base plate. Each of the shafts **117***a* and **117***b* carries four cams **160**, **170**, **180** and **190** arranged on the respective shaft spaced from each other as best shown in FIG. 16, and respectively cooperating with the rods **16**, **17**, **18** and **19** of the plates **14** and **15**. The aforementioned cams preferably have a configuration as shown in FIG. 8. Rollers or cam followers **169**, **179**, **189** and **199** respectively engage the peripheral surfaces of the cams **160**, **170**, **180** and **190** and the aforementioned rollers are turnably carried respectively in the lower forked ends of guide rods **161**, **171**, **181** and **191** which are respectively guided for reciprocating motion in the direction of the arrows A in guide bushings provided in the abutment plates **12***a*, **12***b* and in the intermediate plate **85**. Each of the rods is provided intermediate the abutment plate **12***b* and the intermediate plate **85** with a fixed collar and compression coil springs **167**, **177**, **187** and **197** are respectively wound about the aforementioned rods abutting with their lower ends on the respective collar and at the upper ends against the bottom surface of the plate **12***b*, to thereby press the rollers respectively carried by the rods against the corresponding cam surfaces.

The pairs of guide rods **161**, **171**, **181** and **191** are respectively connected to opposite ends of the rods **16**, **17**, **18** and **19** to move the latter as described in connection with FIG. 7. For this purpose, the opposite ends of the transverse rod **17** are respectively pivotally connected at **173** to the guide rods **171**, whereas the opposite ends of the transverse rod **19** are respectively pivotally connected at **193** to the guide rods **191**. The guide rods **161** and **181**, on the other hand, carry, respectively, intermediate the abutment plates **12***a* and **12***b*, plates **163** and **183** respectively provided with elongated transverse slots **163'** and **183'** in which the opposite ends of the transverse rods **16** and **18** are respectively guided so that while the rods **161** and **181** are reciprocated in the direction as indicated by the arrows A, the transverse rods **16** and **18**, while following the movement of the guide rods **161** and **181** may move also in direction transverse to the elongation of the rods due to the guiding of the end portions of the rods **16** and **18** in the transverse slots **163'** and **183'**. The plurality of hoses and the branches thereof are held in place by appropriate end plates **71**, **72** fixed in any convenient manner to the right ends, as viewed in FIG. 16 of the abutment plates **12***a* and **12***b* and corresponding end plates **73**, **74** fixed to the left ends of the plates.

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

While the invention has been illustrated and described as embodied in a hose pump for providing a continuous flow of fluid, it is not intended to be limited to the details shown, since various modifications 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 eadily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

I claim:

1. A hose pump comprising, in combination, at least one flexible hose having an inlet end and an outlet end and a pair of branches between said inlet and said outlet end, said branches communicating with each other at said inlet and said outlet end and defining between themselves an elongated space; a pair of fixed rigid abutment means extending spaced from each other in longitudinal direction of said hose, and said branches of said hose extending between said pair of abutment means; a pair of movable striker elements extending in longitudinal direction of said hose and being arranged spaced from each other in said direction in said elongated space between said branches; and operating means connected to said striker elements in the region of the upstream and downstream extremities for alternatingly moving the upstream and downstream extremities to and fro in a direction transverse to the longitudinal direction of said hose and in a predetermined sequence such that corresponding extremities of said pair of striker elements are always moved simultaneously, but in opposite directions, between a first end position adjacent one of said pair of abutment means and a second end position adjacent the other of said pair of adjustment means while the other extremities of said striker elements during this movement remain at rest in one of said end positions and each of said extremities in said end position fluid-tightly clamping the engaged branch against the abutment means adjacent thereto.

2. A hose pump as defined in claim **1**, wherein said abutment means are constituted by a pair of rigid substantially parallel abutment plates, and wherein said movable striker elements are constituted by movable plates.

3. A hose pump as defined in claim **2**, wherein the distance between the facing surfaces of said abutment plates is equal to the sum of the thickness of a movable plate, plus the inner diameter of one of said branches, plus four times the wall thickness of a hose branch.

4. A hose pump as defined in claim **2**, wherein said movable plates have equal length.

5. A hose pump as defined in claim **2**, wherein one of said movable plates is longer than the other of said movable plates.

6. A hose pump as defined in claim **5**, wherein said longer movable plate is arranged upstream of the other movable plate.

7. A hose pump as defined in claim **2**, and including a rod for each extremity of each movable plate, each rod extending substantially normal to the elongation of the respective plate through the respective extremity and projecting with opposite end portions thereof laterally beyond the movable plate, said operating means engaging said end portions of each rod.

8. A hose pump as defined in claim **7**, wherein said operating means include first guide means cooperating with one rod of each movable plate for guiding the respective extremity during its to and from movement along a rectilinear path substantially normal to said abutment plates, and second guide means cooperating with the other rod of each movable plate and permitting said other rod to move substantially parallel to said abutment plates.

9. A hose pump as defined in claim **7**, wherein said operating means comprise a plurality of cams, one for each end portion of each rod, and each having a cam face, a single drive motor connected to said cams for rotating the same about their axes, and a plurality of transmission means respectively engaging the cam faces of said cams and being connected to said end portions of said rods.

10. A hose pump as defined in claim **9**, wherein each of said transmission means comprises a guide rod, a cam follower carried at one end of each guide rod and engaging the cam face to the respective cam, spring means connected to each guide rod and pressing the cam follower carried thereby against the respective cam face and means guiding each of said guide rods for rectilinear movement in a direction substantially normal to said abutment plates.

11. A hose pump as defined in claim **10**, and including connecting means connecting the opposite end portions of one rod of each plate to the respective guide rods for pivotal movement about the axis of said one rod and for movement with the respective guide rods in longitudinal direction of the latter and second connecting means connecting the opposite end portions of the other rod in each plate to the respective guide rods for movement with the latter in longitudinal direction and for movement in direction transverse to said longitudinal direction.

12. A hose pump as defined in claim **1**, wherein said operating means are constructed and arranged to displace the downstream extremities of said striker elements with a speed varying as a function of their displacements.

13. A hose pump as defined in claim **1**, wherein said operating means are constructed and arranged to displace the downstream extremities of one of the striker elements very fast at the beginning of its movement and to move it very slowly at the end of its movement.

14. A hose pump as defined in claim **1**, wherein said operating means are constructed and arranged to displace the downstream extremity of one of the plates very slowly at the beginning of its movement and very fast at the end of its movement.

15. A hose pump as defined in claim **1**, wherein said pump comprises a plurality of said flexible hoses extending spaced from and substantially parallel to each other between said pair of abutment means, and said pair of movable striker elements extending through the elongated space between the branches of said plurality of hoses.

16. A hose pump as defined in claim **1**, wherein said branches and said inlet and outlet ends of the hose have substantially the same inner diameter.

17. A hose pump as defined in claim **1**, wherein said hose is made from flexible and elastic material.

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FRED C. MATTERN, Jr., *Primary Examiner.*

WILBUR J. GOODLIN, *Assistant Examiner.*