

June 9, 1942.

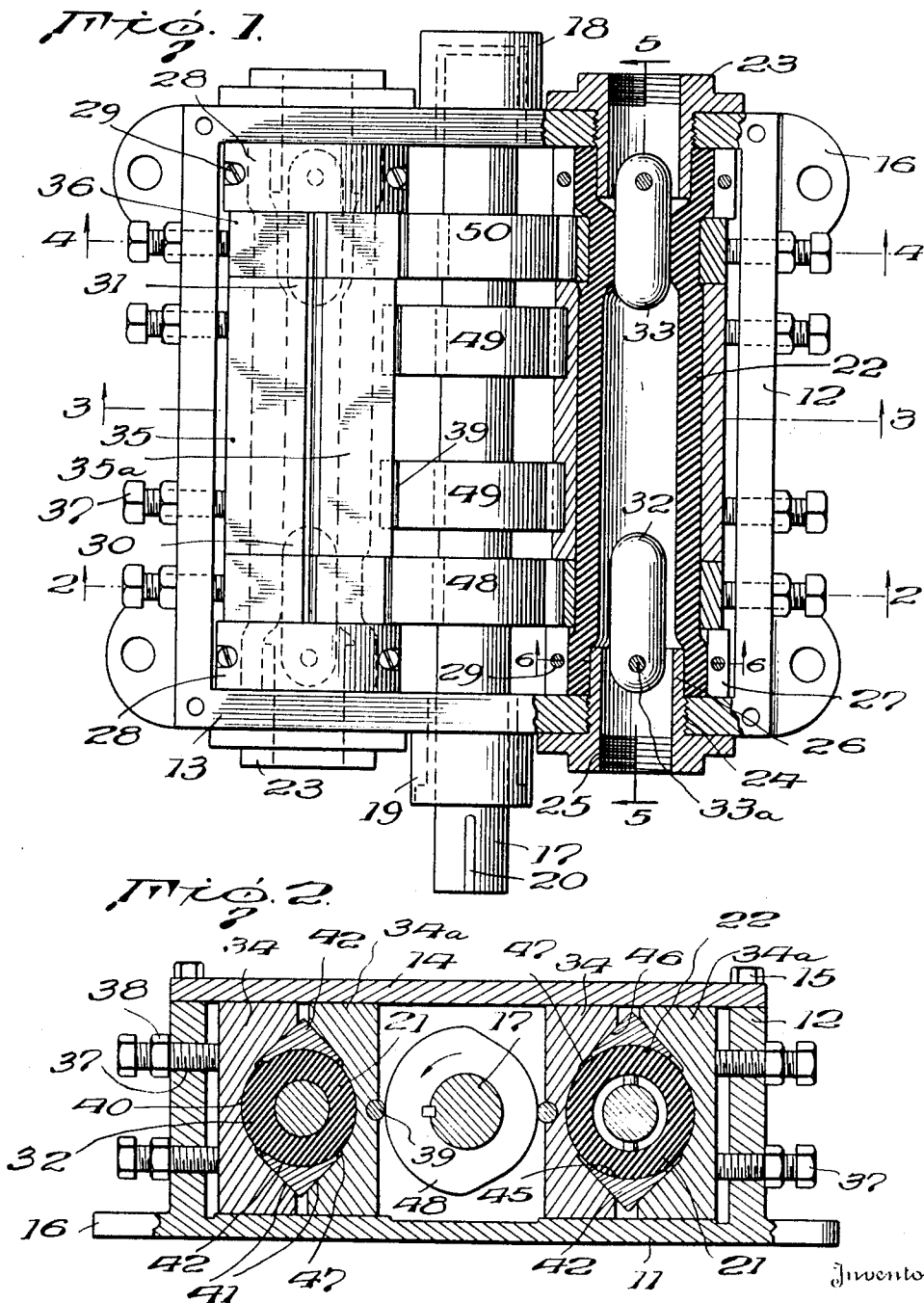
C. J. HUBER

2,285,974

PUMP STRUCTURE

Filed Jan. 8, 1941

2 Sheets-Sheet 1



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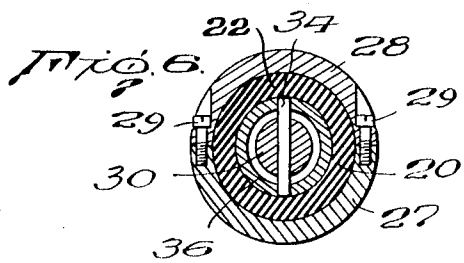
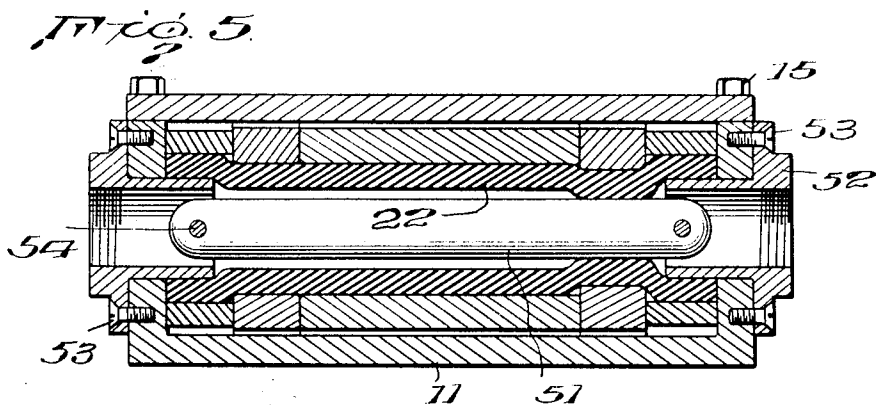
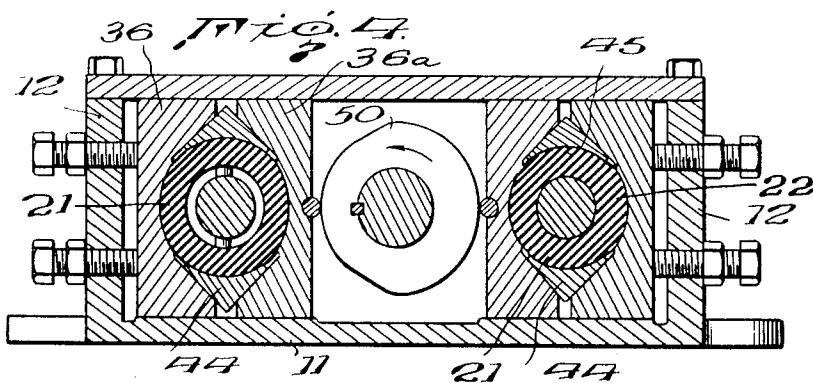
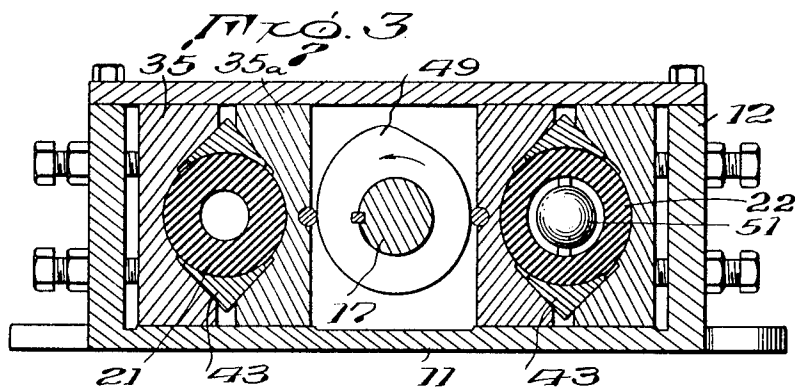
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PUMP STRUCTURE

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2 Sheets-Sheet 2



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PUMP STRUCTURE

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7 Claims. (Cl. 103—148)

This invention relates to a valve construction and to pumps involving such valve construction.

One of the objects of the invention is to provide a valve of utmost simplicity of construction, and a pump embodying such valve, in which sticking and clogging of parts and eddies in the current of the fluid passing therethrough will be substantially eliminated, and complete closing will be assured.

Further objects are to provide such a valve, and a pump embodying such a valve, which will be silent in operation, and which may be formed of such materials as will prevent contamination of, or attack by, the fluid passing therethrough.

A still further object is to provide a pump structure which is of simple and durable construction, the parts of which may be readily assembled and disassembled to facilitate cleaning, repair and replacement of the parts.

Additional objects of the invention and the novel features of construction will be apparent from the following specification when it is read with reference to the accompanying drawings, in which:

Fig. 1 is a plan view, partly in section, of a pump structure incorporating valves embodying the invention, the lid or cover of the pump structure being removed;

Figs. 2, 3 and 4 are views in transverse, vertical section of the structure shown in Fig. 1, including the lid or cover, taken on the line 2—2, the line 3—3 and the line 4—4, respectively, of Fig. 1, and showing, respectively, the inlet valve cam, the compression cam and the outlet valve cam;

Fig. 5 is a view in vertical, longitudinal section taken on line 5—5 of Fig. 1, but illustrating a modified structure in which a single core is substituted for the two separate end cores; and

Fig. 6 is a fragmentary view in cross section taken on line 6—6 of Fig. 1.

In general, the valve of the present invention comprises a conduit having a flexible wall which is compressed against an inner core that has the same general cross-sectional contour as the opening in the conduit and, in the embodiment illustrated, the flexible wall is in the form of a round tube of resilient, compressible material such as rubber having a wall of such thickness that after compression and release it will resume its normal size through its inherent resiliency. It is desirable that the compression of the tube be in a substantially radial direction and applied to substantially all points of the circumference of the tube, and to this end two outer members are forced together each of which has a curved inner

surface engaging the tube at an area extending for about one fourth of the circumference of the tube and each of which has inclined surfaces which engage and wedge toward each other two inner members which each have a curved inner surface engaging the tube at the intermediate areas, each extending for about one fourth of the circumference of the tube. It will be appreciated that any suitable means may be employed to force the pairs of compressing members toward each other. In incorporating the valve construction in the pump structure illustrated in the present embodiment one of the outer members is fixed while the other outer member is forced toward it by a cam, the distortion of the wall of the tube during compression compensating for the lack of uniform movement, but it will be apparent that if desired a cam may be provided to move each of the outer compressing members. The various cams are so shaped, of course, that when the inlet valve portion is closed, by compression of the tube against the core, and the outlet valve portion is open, a portion of the tube intermediate such valve portions is compressed, either against a core or not as desired, after which the outlet valve portion is closed, the inlet valve portion is opened and the intermediate portion is permitted to expand by its inherent resiliency to draw in additional fluid, after which the cycle is repeated.

In the embodiment illustrated two tubes are shown, operated alternately by a single cam-shaft located between them, and having separate inlets and separate outlets, but it will be apparent that, if desired, the two inlets may be connected by a manifold, or the two outlets may be connected by a manifold, or both an inlet manifold and an outlet manifold may be provided.

In the embodiment shown in the drawings a generally rectangular casing, having a base 11, side walls 12 and end walls 13, is provided with a flat, detachable lid or cover 14 secured thereto by screws 15, and perforated lugs 16 are preferably provided extending laterally from the base 11, to facilitate securing the casing as a whole to a suitable base or support.

A cam shaft 17 is mounted in the center of the casing, one end being mounted preferably in a closed bearing support extension 18 formed integrally with one end wall 13, while the other end of the shaft is mounted in, and extends through, a tubular extension 19 projecting from the other end wall 13, the shaft being preferably splined at 20 for connection to any suitable means for rotating such cam shaft.

Two tubes, 21 and 22 are provided on opposite sides of, and parallel to, the shaft 17, and are formed of resilient material such as rubber or any of the so-called "synthetic rubbers" or rubber substitutes, selected primarily with regard to their resistance to the particular gas or liquid that is to be pumped. The resiliency and compressibility of the material of each of such tubes and the thickness of its wall are such that, under compression, the external circumference of the tube will be decreased with an accompanying increase in the thickness of the wall but when the compression is relieved the tube will assume its normal contour and size by its inherent resiliency.

The tubes may be mounted in the casing in any suitable manner, and in fact each tube may be merely a part, located within the casing, of a tube which extends from a source of supply through the casing to a discharge point, and may even be slidable endwise relative to the casing. However, it is generally preferable, as shown, to provide tubular coupling members 23, each of which has a screw-threaded engagement 24 with an end wall 13 of the casing, is threaded internally at 25 for connection to a suitable supply or discharge pipe and has a portion 26 extending within the casing upon which an end of the tube 21 or 22 may be secured. The ends of the tubes 21 and 22 are secured to such internally-extending portions 26 by a clamp, as shown in Fig. 6, having a bottom portion 27 to which an upper portion 28 is connected by screws 29, thereby compressing the end of the tube against the portion 26. Each of the internally-extending portions 26 has a core member 30, 31, 32 and 33, respectively, anchored thereto by a pin 33a which extends diametrically through such portion and core member. Such core members are formed of any suitable material which is preferably relatively hard and non-compressible, and each core member is preferably of cylindrical shape with rounded ends, as shown, its diameter being somewhat less than the normal internal diameter of the tubes but of such size and shape that the tube will be compressed into contact with it throughout its entire circumference.

For each of the tubes 21 and 22 three pairs of outer blocks are provided, each such pair having a corresponding pair of inner blocks. The outer blocks 34 and 34a at one end of the tube 21 are preferably identical with the outer blocks 36 and 36a at the other end of the tube, while the intermediate blocks 35 and 35a are of the same cross-sectional shape as the other blocks but preferably of greater length. Each of these outer blocks is of such height as to be slidable between, and be guided by, the bottom 11 and the lid 14 of the casing. As shown, screws 37 each having a lock-nut 38, are mounted in the side walls 12 of the casing by means of which that outer block of each pair which is adjacent to such side wall may be adjustably positioned. The other block of each pair is preferably provided with a hardened roller or wear piece 39 for engagement by a cam, as will be later described. Each of the outer blocks is formed with a curved surface 40 of a radius approximately the same as, but preferably slightly less than, that of the outer surface of the tube 20 or 21 and engaging the tube through slightly less than one fourth of its circumference, and is also formed, at each side of said curved surface, with an inclined surface 41 for wedging engagement with the corresponding pair of inner pressure blocks 42, 43 and 44, respectively. Each of such inner pressure blocks

is of roughly triangular shape in cross-section, having a curved surface 45 generally conforming to and engaging approximately one-fourth of the circumference of the tube 20 or 21, the other surfaces 46 being flat and in sliding engagement with the inclined surfaces 41 of the corresponding outer blocks. It will be apparent that as any pair of the outer blocks are forced laterally toward each other, by movement of one or both of such blocks, the corresponding inner blocks 42, 43 or 44 will be wedged toward each other in a vertical direction and thus the tube will be compressed radially from four directions, the pressure being effective on surfaces each only slightly less than one fourth of its circumference. As best shown in Figs. 2, 3 and 4, the outer blocks are each formed with recesses 47 between its curved surface 40 and its inclined surfaces 41 to receive the corner portions of the inner pressure blocks during the compressing movement.

The details of construction and operation of the means for compressing tube 21 are identical with those for compressing tube 20, and in the present embodiment compression of both tubes is effected by a single cam shaft, although it will be understood that similar cam shafts could be used to move the outer blocks 34, 35 and 36, if desired. Upon the shaft 17 there are provided a plurality of cams, comprising an inlet-valve cam 48 co-operating with pressure blocks 34 and 34a, one or more intermediate cams 49 cooperating with pressure blocks 35 and 35a, and an outlet-valve cam 50 cooperating with pressure blocks 36 and 36a. As will be apparent from Figs. 2 and 4 the inlet-valve cam 48 and the outlet-valve cam 50 are of identical shape but are circumferentially displaced by 180°, the shape being such that in operation they hold the valve closed through half of a revolution of the shaft, the valve being fully open for approximately one quarter of a revolution. The intermediate cam or cams 49 are preferably so shaped that they have no compressing effect through 180° of revolution, gradually move the pressure blocks 35a toward the block 35 during the succeeding 135° of revolution and rather abruptly relieve the pressure during the remaining 45° of revolution. The shaft 17 is rotated in a counter-clockwise direction, and it will be evident that for each revolution flow will be effected from tube 20 during 135° of revolution and, after a further 45° of revolution for valve operation, from tube 21 during a further 135° of revolution.

In the modified structure illustrated in Fig. 5 a single core member 51 is provided in each tube instead of separate core members 30 and 31 or 32 and 33. The coupling members 52 are identical with the coupling members 23 shown in Fig. 1 but instead of being in threaded engagement with the end walls 13 they are secured thereto by screws 53, or similar means, and the core member 51 is anchored in place by pins 54 each of which passes through one end of the core member 51 and the corresponding coupling member. Inasmuch as in the structure shown in Fig. 5, the intermediate blocks 35 and 35a, together with their corresponding inner pressure blocks 43 force all of that portion of the tube that is between the end or valve portions into contact with the core member 51, no reservoir of fluid is left between the valves so that as a result all fluid that has entered through the inlet valve will be discharged from the outlet valve, which of course is particularly desirable in pumping compressible fluids such as gases.

It will be evident that the valve structure shown is capable of use for many purposes other than as part of a pump structure, and that by its incorporation in a pump structure as shown in the present embodiments a flow of fluid can be effected in a straight line without any great mixing effect or danger of contamination.

What I claim is:

1. In a pump, the combination of a conduit comprising a tube of resilient, compressible material, a body within said tube having a cross-sectional shape conforming generally to that of the opening in said tube, means for compressing a portion of said tube into contact with the periphery of said body and means for compressing another portion of said tube while said first portion is in contact with said body.

2. In a pump, the combination of a conduit having a flexible wall, a body within said conduit of less cross-sectional area than the normal cross-sectional area of the opening in said conduit, means for compressing a portion of the wall of said conduit against said body at one point to close said conduit, and means for compressing another portion of said conduit to reduce the cross-sectional area of its opening at a point spaced longitudinally of said conduit from said first portion.

3. In a pump, the combination of a tube having a wall of compressible material, a body within said tube of less cross-sectional area than the normal cross-sectional area of the opening in said tube, means acting against the outer surface of a portion of said tube to decrease the cross-sectional area of said portion and force said tube into contact with said body throughout its periphery to close said portion of said tube, and means for compressing a portion of said tube longitudinally spaced from said first portion while said first portion is closed.

4. In a pump, the combination of a structure having an inlet opening and an outlet opening, a straight conduit connecting said openings and having a flexible wall, a body within said conduit of less cross-sectional area than the normal cross-sectional area of the opening in said conduit, means for compressing the wall of said

conduit against said body at one point, and means for compressing a portion of said conduit between said point and said outlet.

5. In a pump, the combination of a conduit comprising a tube of resilient, compressible material, a body within said tube having a cross-sectional shape conforming generally to that of the opening in said tube, means for compressing a portion of said tube against said body comprising a plurality of members spaced about said tube and means for forcing said members toward the center of said tube, and means for compressing a second portion of said tube while said first portion is held in compressed condition.

6. In a pump, the combination of a casing, a conduit extending through said casing and comprising a tube of resilient compressible material, a body within said tube having a cross-sectional area less than that of the opening in said tube, a pair of members on opposite sides of a portion of said tube, at least one of said members being slidably mounted in said casing, a cam shaft mounted in said casing and having a cam thereon operative to move one of said members toward the other of said members, to compress said tube in one direction, additional members operated by movement of said first member to compress said tube in another direction, and means for compressing a second portion of said tube while said first portion is held in compressed condition.

7. In a pump, the combination of a conduit comprising a tube of resilient, compressible material, a body within said tube having a cross-sectional area conforming generally to that of the opening in said tube, means for compressing intermittently a first portion of said tube into contact with said body to close said first tube portion, means for compressing intermittently a second portion of said tube spaced longitudinally from said first portion to close said second tube portion, and means for compressing into contact with said body that portion of said tube intermediate said first tube portion and said second tube portion while said first tube portion is closed and said second tube portion is unclosed.

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