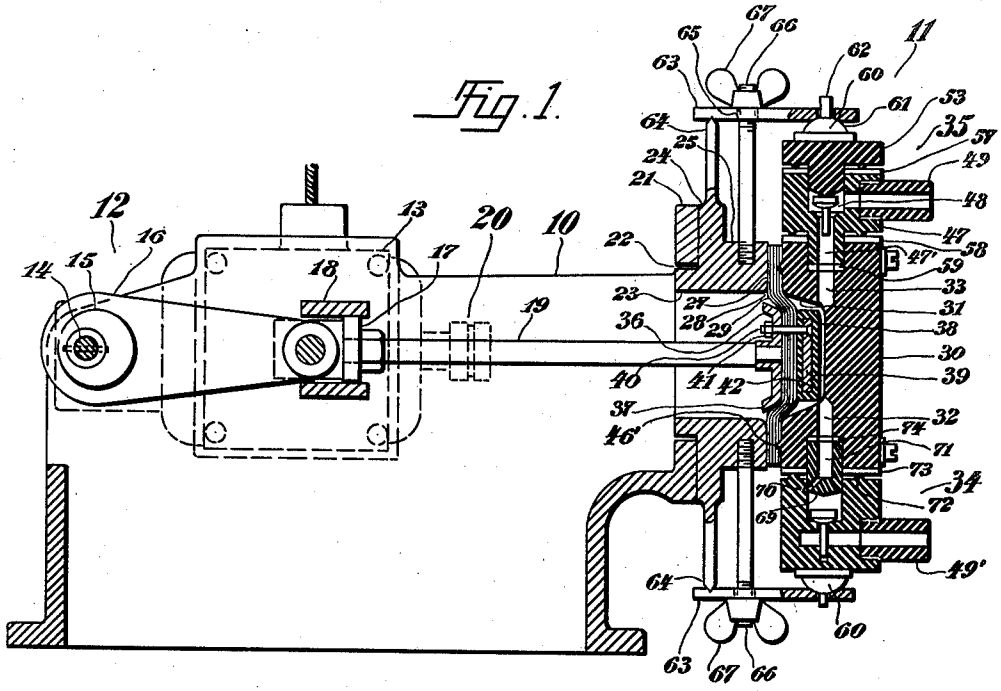
Jan. 31, 1939. J. CORYDON ET AL 2,145,566

PUMPING DEVICE

Filed June 7, 1935

Fig. 1.



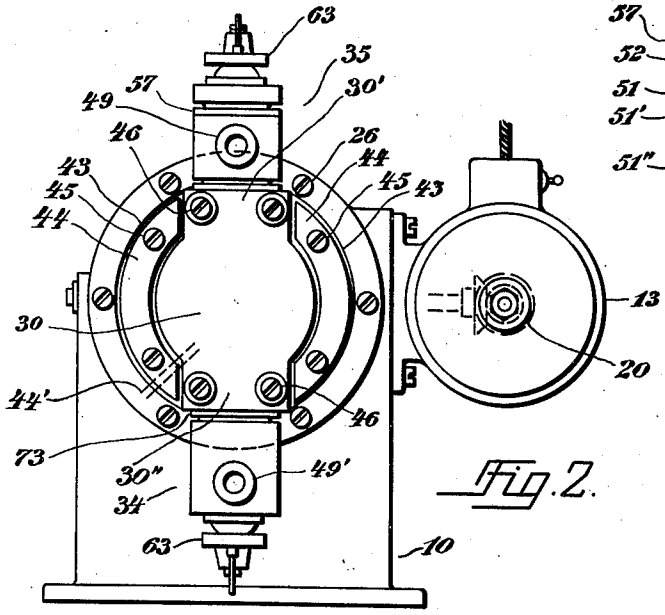


Fig. 2.

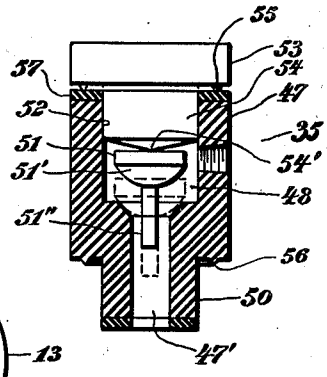


Fig. 3.

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PUMPING DEVICE

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Application June 7, 1935, Serial No. 25,467

19 Claims. (Cl. 103—150)

Our invention relates generally to pumping devices and more particularly to such apparatus adapted for pumping a reagent having high corrosive properties.

An important object of the invention is to provide new and improved apparatus of this character so constructed as to be relatively compact in form, inexpensive so far as manufacture is concerned, and which is exceptionally rugged and accurate in use.

Another object is to provide pumping apparatus of this character constructed and arranged in a novel manner such that all metallic elements are protected from the action of the corrosive reagent by non-corrosive parts formed from a material such as rubber and arranged for convenient and effective manufacture and assembly.

Another object is to provide such apparatus wherein the pumping means is constructed without the use of a packing gland, thereby increasing its efficiency and simplifying its manufacture.

A further object is to provide a device of this character wherein the various hard rubber parts may be clamped together in liquid relation by equalized forces so as to avoid all tendency toward the production of leaky joints by subsequent distortion of the parts.

Another object is to provide, in such devices, a novel and efficient check valve structure formed from rubber so as to resist corrosion, and having a valve member formed from soft rubber to insure perfect closure of the valve and related to the valve casing in such a manner as to prevent sticking of the valve member in its open or released position.

Other objects and advantages will become apparent from the following description, taken in connection with the accompanying drawing, in which:

Figure 1 is a side elevation, partially in section, of the preferred embodiment of our invention.

Figure 2 is an end elevation of the device shown in Figure 1.

Figure 3 is a side view, partially in section, showing the essential details of the check valve shown in Figures 1 and 2.

In the form chosen for illustration herein, the invention is embodied in a construction adapted for use where electric operating power is the most readily available and desirable power for use in the actuation of the mechanism. In this embodiment the device comprises a base 10 carrying at one end thereof a reagent head or feeder 11 driven through a constant length feeding stroke by actuating mechanism 12 and a variable speed electric driving motor 13, mounted at the other end of the base 10, and through the medium of which the variations in motor speed are employed to obtain the desired rate of feed of the reagent.

In driving the pump or feeder 11, the motor 13, through suitable reduction gearing (not shown) rotates a horizontal shaft 14 journaled transversely on the base 10 and carrying a pinned eccentric 15 which serves to reciprocate a connecting rod 16 by means of an operative connection with one end thereof. At its other end the connecting rod 16 is pivoted to a cross-head 17, horizontally reciprocable in bearings 18 on the base 10 and connected by an actuating rod 19 to the feeder 11. The actuating rod 19 and, therefore, the feeder 11, are operated through a constant stroke, and variations in the ultimate feed rate of the reagent are attained by means of a conventional speed adjusting device 20 which controls the speed of the motor 13.

To provide for the mounting of the feeder 11 on the base 10, an upstanding end wall 21 is formed on the base, with a relatively large circular opening 22 therein to receive a sleeve-like extension 23 of a mounting member 24 which forms part of the feeder 11. The mounting member 24 preferably comprises a casting generally cylindrical in form with an outwardly extending securing flange 25 through which screws 26 (Figure 2) extend into the wall 21 to fasten the mounting member 24 in place on the end wall 21.

On its outer face (right-hand in Figure 1) the mounting member 24 has a flat surface 27 bordering one end of a relatively large bore 28 formed axially through the member 24. The flat surface 27 serves as a clamping surface against which one side of the periphery of a flexible diaphragm 29 is clamped by means of an opposed body member 30. The diaphragm 29 constitutes the movable part of the feeder 11 and cooperates with an opposed recess 31 in the adjacent side of the body member 30 to form the pumping chamber, the volume of which chamber is alternately increased and decreased by reciprocation of the diaphragm 29. At the bottom and the top respectively of the chamber 31 and in the body member 30 inlet and outlet passages 32 and 33 are provided, governed by suitable check valves designated generally by the reference numerals 34 and 35.

As hereinbefore pointed out, the feeder 11 is, in accordance with the present invention, constructed in such a manner that all of the parts exposed to the corrosive action of the reagent are

formed from a corrosive resistant material such as rubber, the rubber parts being so designed and interrelated as to permit adequate reinforcement thereof by metallic parts, which metallic parts are, in every instance, protected from the corrosive reagent by the rubber parts. In attaining this end, the parts are so designed as to take into account the tendency of hard rubber to distort and take a permanent distorted set under pressure.

Considering first the manner of attachment of the actuating rod 19 to the diaphragm 29, it will be observed that the rod extends axially through the opening or bore 28 in the member 24, and that it has fixed on its end a metallic push plate 36 which bears against the outer surface of the diaphragm; and that through the provision of a receding outer edge or flange 37, the plate 36 conforms exactly with the shaping of the diaphragm at the end of its forward or discharge stroke. Within the chamber 31 a hard rubber protecting plate 38 is positioned in opposed relation to the push plate 36, a metallic clamping ring 39 being molded in and protected by the rubber protecting plate 38. From the ring 39 a plurality of threaded clamping studs 40 extend through the diaphragm 29 and the push plate 36 to receive clamping nuts 41. In assuming proper protection of the metallic studs 40 it is important that the studs be spaced from the edge of the protecting plate 38 so as to insure an effective seal between the outer edge of the plate 38 and the diaphragm 29. Preferably an annular ridge 42 is formed on the outer edge of the plate 38 to provide for a concentrated annular zone of contact outside of the studs 40. This ridge is substantially the same distance from the axis of the disk 38 as the outer edge of the ring 39, thereby preventing undue distortion of the plate 38 in the clamping thereof, and avoiding impairment of the sealing function of the ridge 42.

In order that undue strain and wear on the diaphragm 29 may be avoided, the corners of all surfaces of the mounting member 24, the body member 30 and the protecting plate 38 are rounded at all points where contact with a shiftable portion of the diaphragm may take place.

As will be evident in Figures 1 and 2, the hard rubber body member 30 is generally cylindrical in form, with upward and downward extensions 30' and 30'' upon which the valves 35 and 34 are mounted, and side flanges 43 (Figure 2) intermediate said extensions for the purpose of securing the body in clamped relation against the diaphragm. Since the body member 30 is of hard rubber, provision is made for exerting clamping pressure substantially evenly about its edge. This is accomplished by providing arcuate, substantially rigid pressure bars 44 (Fig. 2), preferably of metal, one bearing against each side flange 43, with a plurality of headed clamping screws 45 extending through each pressure bar, through the flange 43 and the edge of the diaphragm, and into threaded engagement with the mounting member 24. Two clamping screws 46 are also provided in each of the extensions 30' and 30'', the screws being positioned to extend on opposite sides of and spaced from the inlet and outlet passages.

An effective seal between the body member and the diaphragm is insured in the present instance by the provision of an annular sealing ridge 46' formed on the clamping face of the body member 30, which ridge is pressed into the diaphragm as the body member is clamped in place. It will be noted that the annular ridge 46' is continuous or unbroken, and is of such a diameter that it lies radially inwardly of the clamping screws and in alinement with the inner edge surface of the pressure bars 44, whereby the clamping force is effectually transmitted to the ridge 46' and an unbroken annular seal provided between the pump chamber 31 and the clamping screws.

As shown in Figure 2, a drain opening 44' is provided from the bore 28 adjacent the diaphragm whereby failure of the diaphragm is immediately apparent to the attendant.

The inlet and outlet valves 34 and 35 are in most features similar in construction, and are mounted on the flat outer surfaces of the extensions 30'' and 30', respectively. In Figures 1 and 3 it will be evident that the outlet passage 33 extends upwardly through substantially the center of the flat upper surface of the extension 30' and that the valve 35 has a valve body or casing 47 forming a continuation of said passage. The valve body or casing 47 is preferably formed from hard rubber, cylindrical in horizontal cross section, with a valve chamber 48 therein. Screw threaded into a bore in one side of the casing 47 is an outlet coupling 49 of hard rubber over which a rubber discharge hose may be positioned. At its lower side the valve casing has a vertical passage 47' formed to provide the above mentioned continuation of the passage 33; and preferably a hard rubber sleeve 50 extending from the bottom of the casing 47 concentric with and forming a continuation of the passage, extends into a counter-bore in the body 30 to aid in forming an effectual seal between the valve casing and the body 30.

As shown in Figure 3, the upper end of the passage 47' is tapered to form a valve seat, upon which seat a valve member 51 may come to rest to control the passage 47'. The valve member is preferably formed of relatively soft rubber so as to insure effective closure of the passage, and it has a hemi-spherical head 51' tapered on its lower surface to make a line contact with the valve seat. From the lower end of the head 51' an integral positioning rod 51'' extends downwardly loosely in the passage 47' in all positions of the valve member.

To provide for access to the valve chamber for cleaning or replacement of the valve member 51, the valve chamber has a cylindrical opening 52 through the upper surface of the valve casing 47, this opening, of course, being large enough to permit withdrawal of the valve member. A cap plate 53 of hard rubber serves to close the opening 52, and preferably, an integral cylindrical plug 54 extends from the plate 53 into the opening 52 for the purpose of limiting the upward or unseating movement of the valve member.

By reason of the use of soft rubber for the valve member, the character of the contact between the valve member and the plug 54 is important, there being a tendency toward the formation of suction between these members acting to retain the valve member in its open position. This tendency is avoided through the use of substantially a point contact between the two members, the plug 54 having a point 54' at its lower end for substantially central engagement with a flat upper surface on the head of the valve member.

To insure a proper and effective seal between the valve casing and the body 30, and between the casing and the cap plate, annular sealing ridges 55 and 56 are formed integrally on the bottoms of the cap plate and the valve body, respectively. The ridge 55 is continuous, and is

concentric with the plug 54, and when in operative position, bears on a soft rubber washer 57 which surrounds the plug between the valve casing and the cap plate. The ridge 56 is similarly positioned about the sleeve 50 and bears on a similar soft rubber washer 58. As an added precaution, a soft rubber washer 59 is placed at the bottom of the counter-bore, the proportioning of the parts being such that the washer 59 is compressed when the parts of the valve casing 47 are clamped in position.

Such clamping of the valve casing 47 is effected by a metallic pressure plate 60, which is preferably of such an area that it extends at least into alinement with the sealing ridge 55. The plate 60 has a semi-spherical bearing surface 61 thereon and a positioning pin 62 centrally of said surface, whereby one apertured end of a clamping arm 63 may rest on the surface 61 with the pin 62 engaging the aperture in the arm so as to hold the two parts in the desired relationship. The other end of the arm 63 is notched so as to fit on a knife edge provided by the upper end of a standard 64, this standard being integral with the flange 25 of the mounting member 24.

Intermediate its ends the arm 63 has an aperture 65 through which a threaded bolt 66 extends to receive a wing nut 67 above the arm 63, the lower end of the bolt being anchored in the mounting member 24. Thus, when the wing nut 67 is tightened, the arm 63 swings about the standard 64 and the various parts of the valve 35 are clamped downwardly to form a tight seal at all joints as hereinbefore described.

The lower or inlet valve 34 is generally similar in form and function, but by reason of the fact that it is located below the body 30, certain differences in form are necessary. The valve chamber, of course, is connected to an inlet coupling 49', and the valve member has its positioning rod extending downwardly into a vertical portion of the passage thus formed.

The lower or outermost extremity of the valve casing may, therefore, be closed permanently by an integral portion of the casing, so as not to require a separate cap plate as in the upper valve 35. The upper side of the valve chamber is, however, open to receive a plug 69 which is pointed at its lower end to serve as an abutment for the valve member, the plug being arranged to rest on and be positioned by a shoulder in the valve chamber. The upper end of the plug 69 is reduced in size and fits into a counter-bore in the inlet passage 32. To provide for the passage of fluid from the valve chamber to the pump chamber, a plurality of angularly positioned bores 70 extend from points in the lower face of the plug, beyond the sealing range of the valve member, to a central bore 71 which connects with the inlet passage 32 of the pump chamber. A sealing ridge 72, washers 73 and 74, a clamping mechanism, similar to those described with relation to valve 35, are provided for fixing and sealing the valve 34.

From the foregoing, it will be evident that the present invention provides pumping apparatus in which the basic units are capable of economical and effective use under the wide variety of fixed conditions met in commercial installations. Also, it will be clear that the device is so constructed as to insure accuracy of pumping, coupled with ruggedness in use.

The manner in which the various rubber elements of the pump are formed and inter-related to the various rigid elements of the device plays an important part in attaining this high standard of performance, since by the equalized application of the clamping forces thereto, breaking of parts and ineffectively sealed joints are avoided.

Accuracy of pumping is also promoted through the novel form and assembly of the check valve units, the construction being such as to prevent sticking of the valves in their open positions, and also providing for ease of inspection, repair of replacement.

We claim as our invention:

1. In a device of the character described, the combination of a rigid mounting member providing an opening and a flat annular surface bordering said opening, a rubber treated flexible diaphragm having the peripheral portion of one face thereof bearing against said annular face, a hard rubber body member having an annular flat surface, bearing against the other side of said diaphragm and opposed to said surface of the mounting member, said body member having a recess bordered by said annular flat surface thereof and cooperating with said diaphragm to form a pump chamber, means clamping said members upon said diaphragm to seal said pump chamber, said body member having inlet and outlet passages formed therein for said chamber, check valves for said passages, said check valves having hard rubber casings with soft rubber valve members therein, means acting between said mounting member and said valve casings to clamp said casings in operative relation to said inlet and outlet passages of the body member, an actuating rod, extending through said opening in the mounting member, and carrying a push plate abutting said diaphragm and formed on its abutting face to conform with the natural shape of the diaphragm when the same is at the limit of its discharge stroke, a hard rubber protecting plate positioned within said pump chamber in opposed relation to said push plate, said protecting plate having a metallic ring molded therein and protected thereby, a plurality of clamping studs extending from and fixed to said ring and spaced radially inwardly from the edge of said protecting plate, said studs extending through said diaphragm and said push plate, and means acting between said studs and said push plate to clamp said diaphragm between said plates with a liquid-tight seal radially outwardly of said clamping studs.

2. A device of the character described, comprising in combination, a rigid mounting member providing an opening and a flat annular surface bordering said opening, a rubber treated flexible diaphragm having the peripheral portion of one face thereof bearing against said annular surface, a hard rubber body member of generally cylindrical form with integral extensions at diametrically opposite points and having integral flanges at one end extending between said extensions, said extensions and said flanges forming an annular flat surface bearing against the other side of said diaphragm in opposed relation to said surface of the mounting member, said body member having a recess in said end bordered by said annular flat surface thereof and cooperating with said diaphragm to form a pump chamber, rigid arcuate clamping bars positioned on and substantially coextensive with the other sides of said flanges, means applying clamping pressure between said bars and said mounting member to clamp said diaphragm and seal said pump chamber, means acting between said ex-

tensions and said mounting member to complete the clamping of the periphery of the diaphragm, said body member having inlet and outlet passages for said chamber formed therein and opening through oppositely disposed outermost surfaces of said extensions, check valves for said passages, said check valves having hard rubber casings with soft rubber valve members therein, said valve casings being mounted on said surfaces of the extensions, means acting between said mounting member and said valve casings to clamp said valve casings in operative communicating relation to said inlet and outlet passages of the body member, and means for flexing said diaphragm.

3. In a device of the class described, the combination of a rigid mounting member providing an opening and a flat annular surface bordering said opening, a rubber treated flexible diaphragm having a peripheral portion of one face thereof bearing against said annular surface, a hard rubber body member having an annular flat surface bearing against the other side surface of the periphery of the diaphragm, and said body member having a recess bordered by said annular flat surface thereof and cooperating with said diaphragm to form a pump chamber, means clamping said members upon said diaphragm to seal the pump chamber, said body member having inlet and outlet passages formed therein for said chamber, and opening through oppositely facing flat surfaces formed on said body member, at diametrically opposite points with relation to the diaphragm, said last mentioned surfaces being parallel to each other, check valves for said passages, said valves having hard rubber casings with openings therein for registry with said passages, a clamping plate on each of said valve casings, a bar for clamping each plate, said bars being mounted for swinging movement with relation to said mounting member and acting in such movement to clamp the plate of its casing to clamp its valve casing in operative relation to the passage with which its casing is associated, and means acting between said mounting member and each of said clamping bars to impart clamping movement thereto.

4. In a device of the character described, the combination of a rigid mounting member, a rubber treated flexible diaphragm and a hard rubber body member cooperating to form a pump chamber, said body member having inlet and outlet passages formed therein for said chamber, and opening through flat outer surfaces on said body member, check valves for said passages, said valves having hard rubber casings with openings therein for registry with said passages, a clamping plate for each of said valve casings, a clamping bar for each of said casings mounted for movement about a rigid part of said mounting member and operable upon the clamping plate of its casing to clamp its casing in operative relation to the passage with which its casing is associated, and means acting between the mounting member and each of said clamping bars to impart clamping movement thereto.

5. In a device for feeding corrosive fluids, the combination of means including a flexible rubber treated diaphragm and a hard rubber body member cooperating to form a pump chamber, said body member having inlet and outlet openings formed therein for said chamber, said openings at their outer ends opening through flat outer surfaces of said body member and having counter-bores at said outer ends, check valves for said openings, said check valves having hard rubber casing members each providing a connecting nipple adapted to fit into the counter-bore of said openings in said body member, said nipples having bores therein to connect with said openings and having flat annular surfaces about said nipples, said casing members being mounted with their outer flat surfaces about said nipples against and opposed to the flat surfaces of said body member to form joints between said members, one of said members at each joint having a continuous integral sealing ridge formed on its flat surface substantially centered on said nipple of the joint, a soft rubber sealing washer between said surfaces about each joint, a soft rubber sealing washer at the bottom of each counter-bore, and means acting to apply equalized clamping forces to each of said valve casings to clamp the same in a sealed relation to said openings of the body member.

6. In a device of the character described, the combination of means including a flexible rubber treated diaphragm and a hard rubber member cooperating to form a pump chamber, said body member having inlet and outlet passages formed therein for said chamber, said passages opening through flat outer surfaces of the body member, check valves for said passages, said check valves having hard rubber casing members each with an opening therein bordered on the outside of the casing member by a flat annular surface, said casing members being mounted with said flat annular surfaces opposed to said outer flat surfaces of the body member to form joints for said passages between said members, one of said members at each joint having a continuous integral sealing ridge formed on its flat surface about the opening therein, a soft rubber sealing washer between said members about each joint and opposed to the sealing ridge of its joint, and means acting to apply equalized clamping forces to each of the valve casing members to clamp the same in sealed relation to the passages of the body member.

7. Apparatus of the character described comprising, in combination, means including a flexible rubber treated diaphragm and a hard rubber body member cooperating to form a pump chamber, said body member having inlet and outlet passages formed therein for said chamber, check valves for said passages, said check valves having hard rubber casings and being mounted on flat outer surfaces of the body member, means acting to apply equalized clamping forces to each of said valve casings with said forces equalized and counter-balancing each other to clamp said valve casings in operative communicating relation to said passages without distorting said body member, and means for flexing said diaphragm.

8. A device of the character described comprising, in combination, a mounting member providing an opening and a flat annular surface bordering said opening, a rubber treated diaphragm having a peripheral portion of one face thereof bearing against said annular surface, a hard rubber body member having an annular flat surface bearing against the other side of said diaphragm in opposed relation to said surface of the mounting member, said body member having a recess in one side bordered by said annular flat surface and cooperating with said diaphragm to form a pump chamber, means applying an equalized clamping pressure between said body member and said mounting member to clamp the

periphery of said diaphragm and seal said pump chamber, said body member having inlet and outlet passages for said chamber extending in diametrically opposite directions and opening through oppositely disposed outer surfaces thereof, check valves for said passages formed with hard rubber casings, and having openings in said casings registered with said inlet and outlet passages of the body member, said casings being mounted on said oppositely disposed surfaces with broad annular sealing faces about said openings opposed to said oppositely facing surfaces of the body member, and means acting independently of said body member to apply clamping pressure to said valve casings to force the same into sealing relation to said body member.

9. Apparatus of the character described comprising, in combination, means including a rubber covered diaphragm and a hard rubber body member cooperating to form a pump chamber, means applying an equalized clamping pressure between the body member and the periphery of the diaphragm to seal the pump chamber, said body member having inlet and outlet passages for said chamber opening through flat outer surfaces thereof, check valves for said passages formed with hard rubber valve casings, and having openings in said casings registered with said inlet and outlet openings, said casings being mounted on said flat surfaces with broad annular sealing faces about said openings opposed to said surfaces of the body member, and means to clamp said members together with forces exerted substantially normal to said surfaces.

10. Apparatus of the character described comprising, in combination, means including a flexible rubber treated diaphragm and a hard rubber body member cooperating to form a pump chamber, said body member having inlet and outlet passages formed therein for said chamber, check valves associated with said passages, each check valve having a hard rubber casing member providing a valve chamber and having a soft rubber valve member in said valve chamber, said casing providing a substantially pointed abutment in the path of the valve member in its unseating movement and said valve member having a relatively broad flat surface positioned to engage the point of said abutment, and means for guiding said valve member in its movement to insure such engagement of the broad flat surface with the pointed abutment.

11. Apparatus of the character described comprising, in combination, means including a flexible diaphragm and a hard rubber body cooperating to form a pump chamber, said body having inlet and outlet passages formed therein for said chamber, check valves associated with said passages, each check valve having a hard rubber casing providing a valve chamber and having a soft rubber valve member in said chamber, means for guiding said valve member in its movement to insure proper operation thereof, said casing providing an abutment member in the path of the valve member in its unseating movement, one of said members having a relatively broad flat surface and the other of said members having a substantially pointed end arranged to engage the pointed end of the other member to limit the unseating movement of the valve member.

12. A pumping device comprising, in combination, a flexible rubber treated diaphragm, a hard rubber body member having a recess formed in one side to provide a pump chamber and bordered about the recess by a continuous flat surface, said diaphragm being positioned with one side surface of its peripheral border against said bordering flat surface of said member to cooperate with said recess in forming a pump chamber, said body member having inlet and outlet passages formed therein each opening through and bordered by a flat surface of said body member, a check valve for one of said passages having a hard rubber casing with a duct opening through one side thereof and adapted to be positioned in communication with said one of said passages, means operable to clamp the border of said diaphragm and said check valve casing in operative relation to said body without distortion of said body member or said casing, and means for flexing said diaphragm.

13. A pump comprising, in combination, a plurality of rigid metallic clamping members arranged in spaced relation to each other and having flat clamping faces disposed in opposed parallel relation, one of said members having an opening therein bordered by one of said flat clamping faces, a flexible rubber diaphragm positioned between said members with its bordering edge face against said one of said clamping faces, a hard rubber body member having a flat face on one side with a recess formed in said face bordered by the flat surface of its face, said body member being positioned with said recess opposed to said diaphragm and with its bordering flat surface against the opposite bordering edge face of said diaphragm, and a plurality of bolts extending between said clamping members and perpendicular to said clamping faces to securely clamp said body member with equalized and non-distorting forces against the bordering edge of said diaphragm, and means operable through said opening for flexing said diaphragm.

14. In a device of the character described, the combination of a rigid metallic member having an opening therethrough and a flat annular surface bordering said opening on one side of said member, a rubber treated flexible diaphragm having the peripheral portion of one face thereof bearing against said annular face, a hard rubber body member having an annular flat surface bearing aginst the peripheral portion of the other face of said diaphragm, said body member having a recess therein bordered by said annular flat surface thereof and cooperating with said diaphragm to form a pump chamber, said body member having other flat surfaces thereon parallel to and facing in the opposite direction from said annular flat surface thereof, rigid metallic clamping means engaging said other flat surfaces, and plurality of bolts extending between said rigid metallic member and said rigid metallic clamping means to clamp said body member against said diaphragm.

15. In a device of the character described, the combination of a rigid metallic member having an opening therethrough and a flat annular surface bordering said opening on one side of said member, a rubber treated flexible diaphragm having the peripheral portion of one face thereof bearing against said annular face, a hard rubber body member having an annular flat surface bearing against the peripheral portion of the other face of said diaphragm, said body member having a recess therein bordered by said annular flat surface thereof and cooperating with said diaphragm to form a pump chamber, said body member having other flat surfaces thereon, at least some of which are par-

allel to and face in the opposite direction from said annular flat surface, said body member having inlet and outlet passages for said pump chamber each opening through one of said other flat surfaces, check valve means for said passages including check valve members and hard rubber valve casing means therefor, said valve casing means having openings bordered by flat surfaces and positioned in registry with said passages, clamping means operable to apply equalized clamping pressure to said body member and to said valve casing means to clamp said diaphragm between said body member and said rigid metallic member and to clamp the flat surfaces of said valve casing means securely against the opposed flat surfaces of said body member, and means acting through said opening in said rigid metallic member for flexing said diaphragm.

16. A device of the character described comprising, in combination, a mounting member providing an opening and a flat annular surface bordering said opening, a rubber treated diaphragm having a peripheral portion of one face thereof bearing against said annular surface, a hard rubber body member having an annular flat surface bearing against the other side of said diaphragm in opposed relation to said surface of the mounting member, said body member having a recess in one side bordered by said annular flat surface and cooperating with said diaphragm to form a pump chamber, means applying an equalized clamping pressure between said body member and said mounting member to clamp the periphery of said diaphragm and seal said pump chamber, said body member having inlet and outlet passages for said chamber extending in diametrically opposite directions and opening through oppositely disposed outer surfaces thereof, check valves for said passages formed with hard rubber casings, and having openings in said casings registered with said inlet and outlet passages of the body member, said casings being mounted on said oppositely disposed surfaces with broad annular sealing faces about said openings opposed to said oppositely facing surfaces of the body member, and means including screw threaded tightening members acting to apply equalized clamping forces to each of said valve casings with said forces on the two casings acting in opposition to each other on opposite sides of the body member to clamp said casings in operative communicating relation to said passages without distortion of said body member, and means for flexing said diaphragm.

17. Pumping apparatus comprising, in combination, means including a flexible diaphragm and a hard rubber body cooperating to form a pump chamber, said body having inlet and outlet passages therein formed to open respectively through flat lower and upper faces of said body member and bordered at their ends by said faces, check valves associated with said passages, each check valve having a hard rubber casing member and providing a valve chamber and having a rubber valve member in said valve chamber, each casing having a connector duct opening into said valve chamber and each casing also having another passage communicating with said valve chamber and opening through a flat outer face of its casing, said valve casings being positioned with their passages registering with the inlet and outlet passages of said body, and said casings being formed with clamping faces substantially perpendicular to said passages and located on the sides remote from said body member, rigid clamping plates positioned against said clamping faces of the casings, and means for applying clamping pressure to said plates including clamping bolts rigidly related to each other and extending upwardly and downwardly in parallel closely spaced relation to said passages and perpendicular to said surfaces.

18. Apparatus of the character described comprising, in combination, means including a flexible rubber treated diaphragm and a hard rubber body member clamped together and cooperating to form a pump chamber, said body member being formed to provide inlet and outlet passages for said chamber, said outlet passage opening through a flat upper face of said body member, and a check valve for said outlet passage, said check valve having a hard rubber casing formed to provide a valve chamber, said valve casing having a passage registering with said outlet passage and bordered flat surfaces to engage said flat upper surface of said body member, said casing being formed with a removable cap plate for said valve chamber separable from the lower portion of said casing in a plane substantially parallel to said flat upper face of the body member and having a top surface substantially parallel to said plane, a rigid clamping plate positioned on said top surface of the cap plate, and means for applying equalized downward clamping pressure to said clamping plate.

19. Apparatus of the character described comprising, in combination, means including a reciprocably movable pumping member and a hard rubber body member cooperating to form a pump chamber, said body member having inlet and outlet passages formed therein for said chamber, check valves for said passages, said check valves having hard rubber casings and being mounted on flat outer surfaces of the body member, means acting to apply equalized clamping forces to each of said valve casings with said forces equalized and counter-balancing each other to clamp said valve casings in operative communicating relation to said passages without distorting said body member, and means for reciprocating said pumping member.

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