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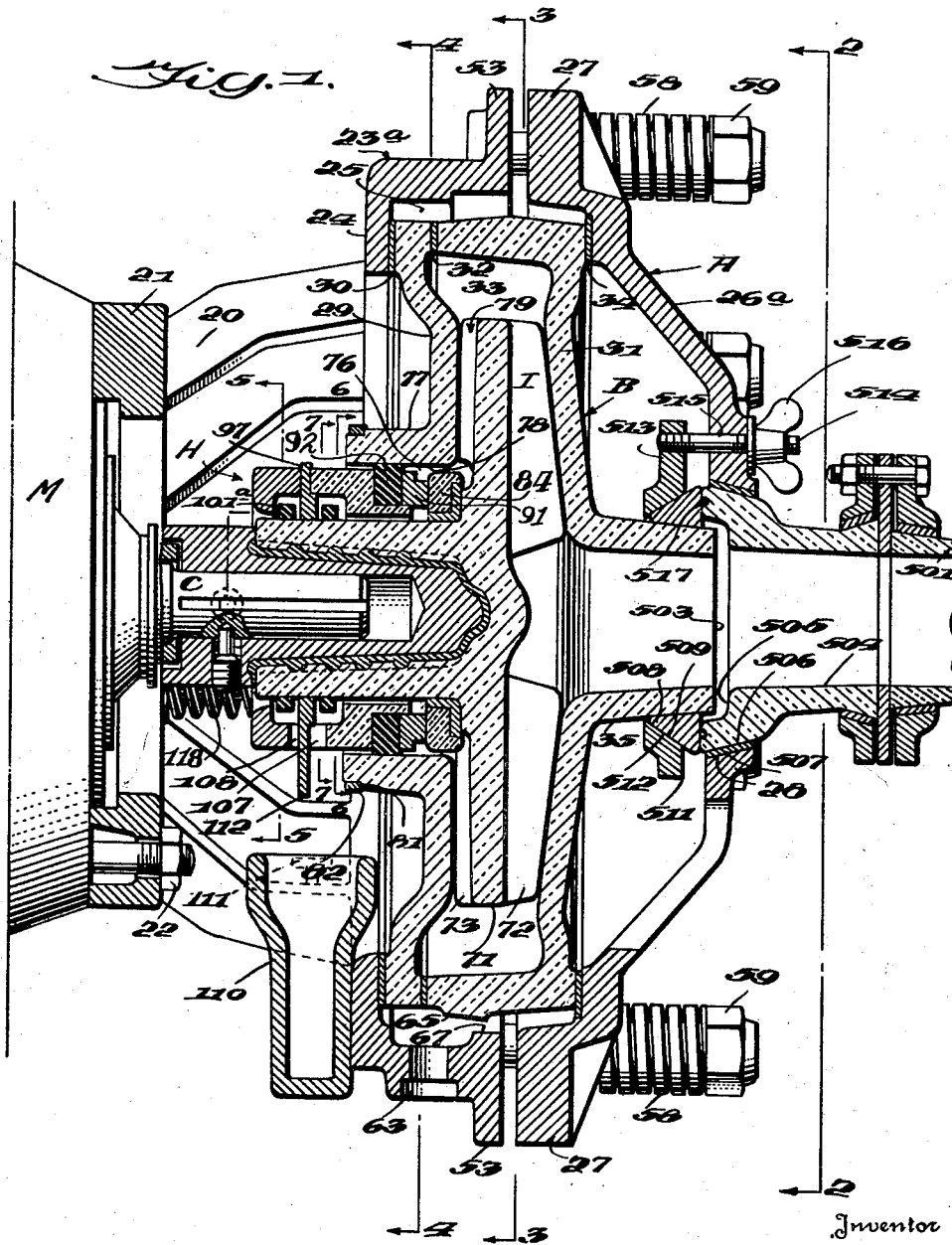
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2,433,589

PUMP

Original Filed May 25, 1939

5 Sheets-Sheet 1



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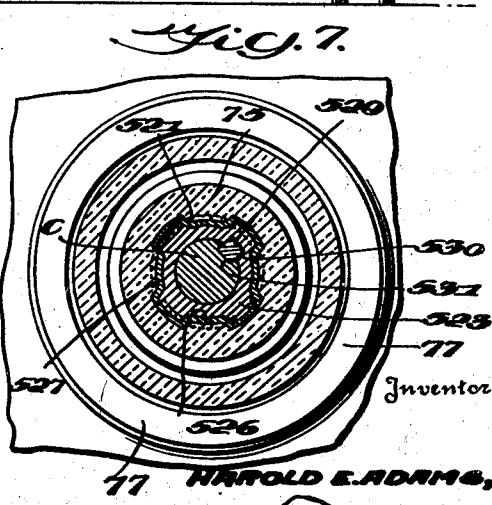
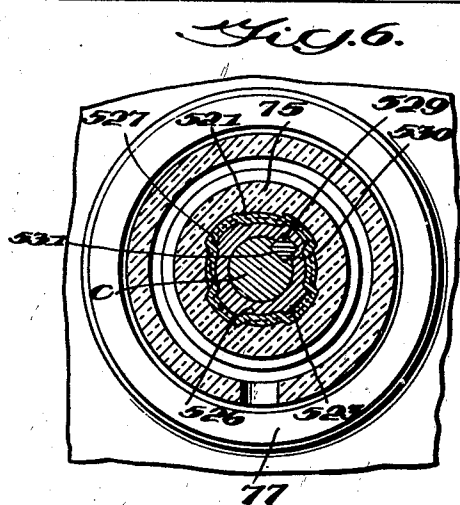
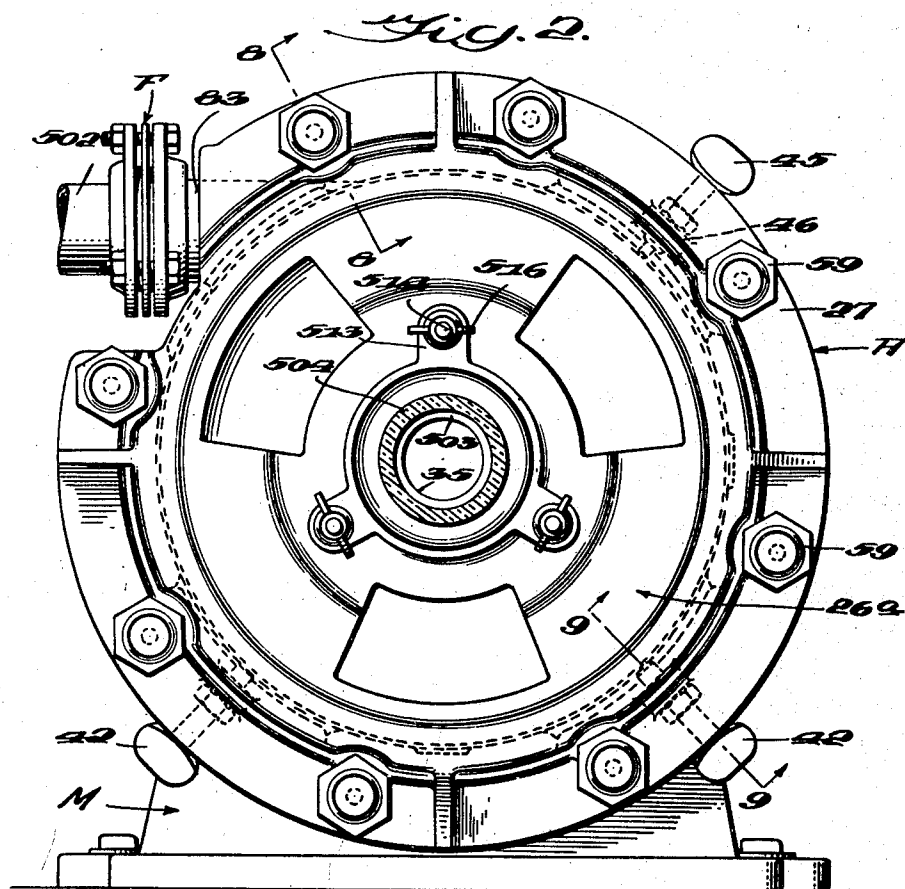
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2,433,589

PUMP

Original Filed May 25, 1939

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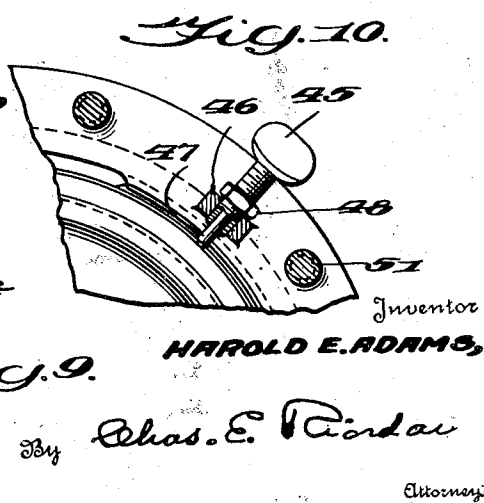
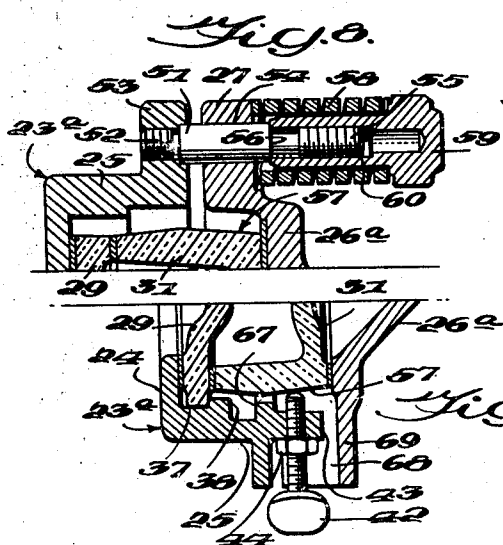
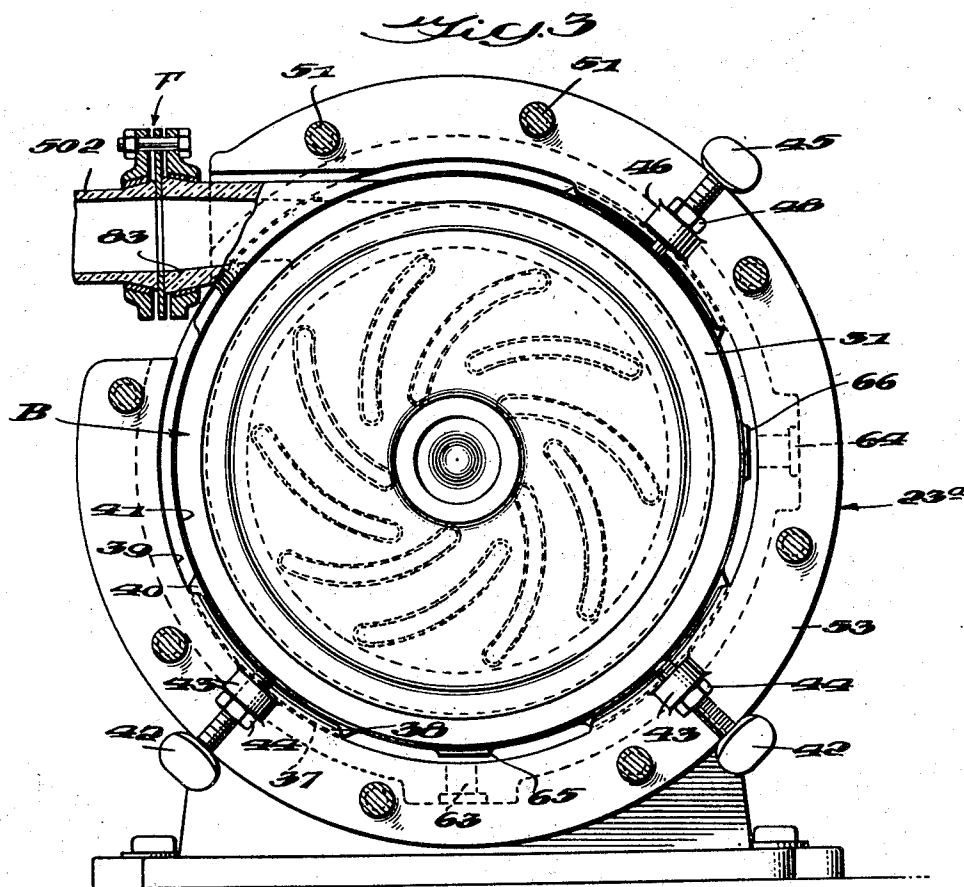
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Original Filed May 25, 1939

5 Sheets-Sheet 3



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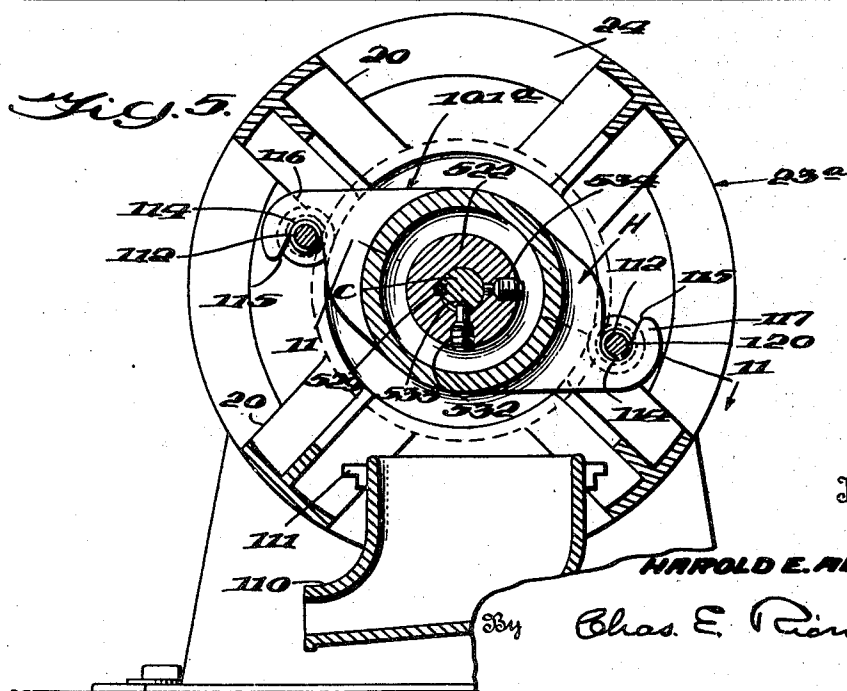
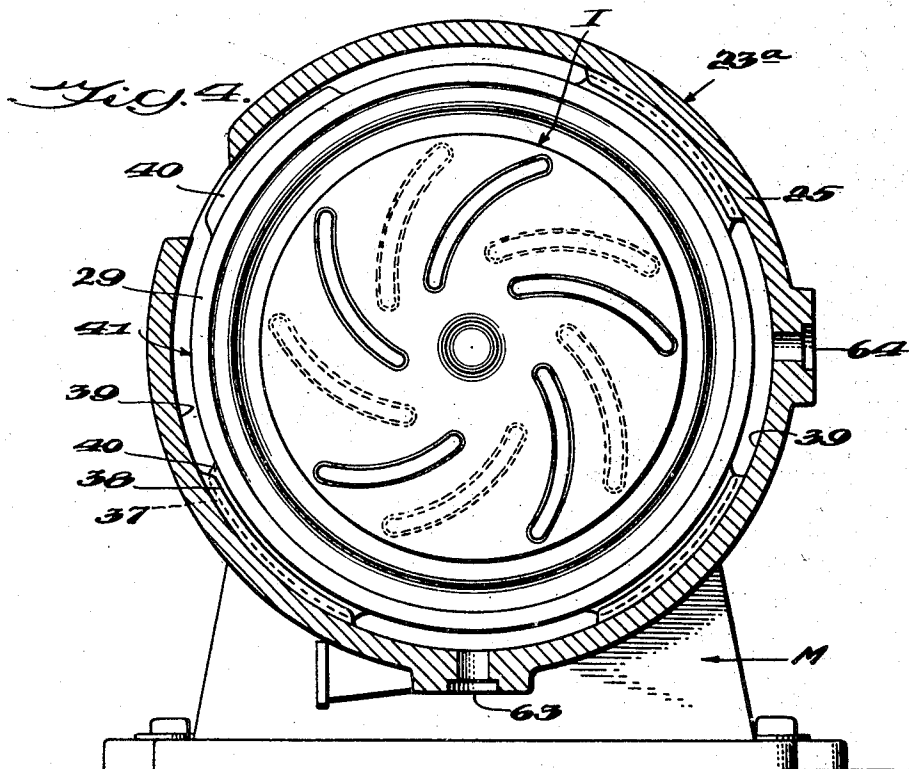
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Original Filed May 25, 1939

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Original Filed May 25, 1939

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Fig. 11.

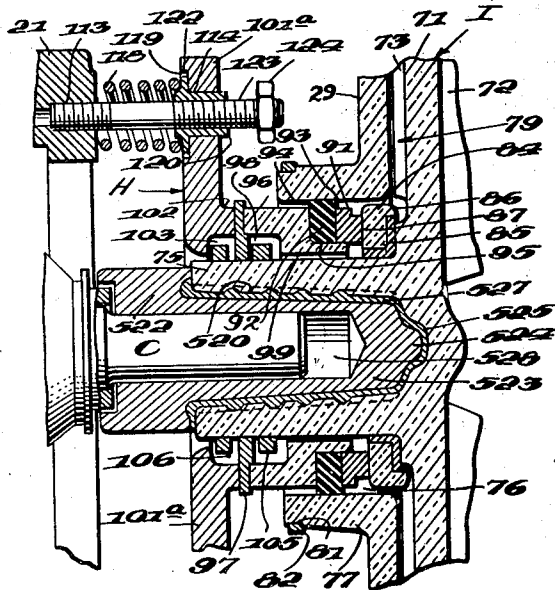


Fig. 12.

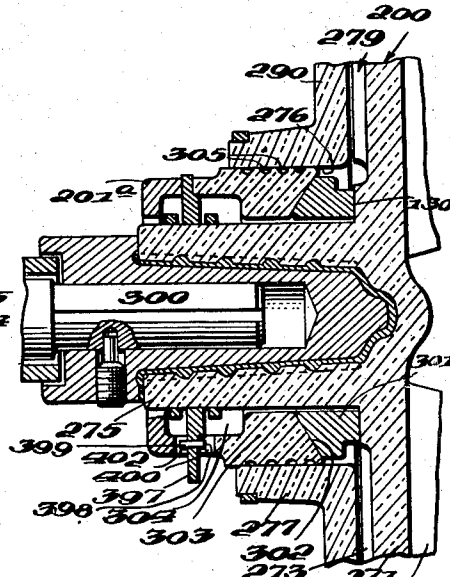


Fig. 13.

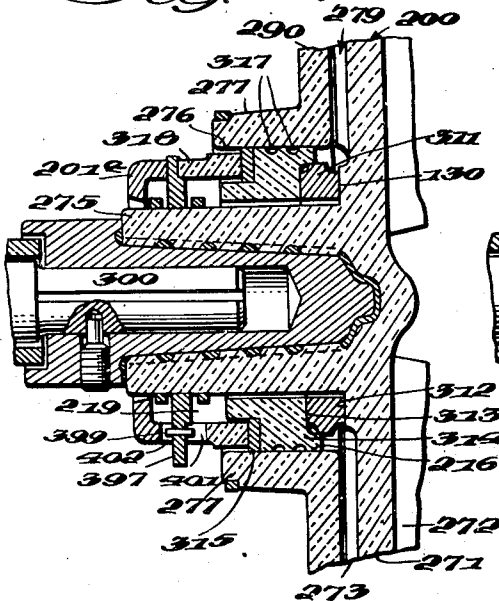
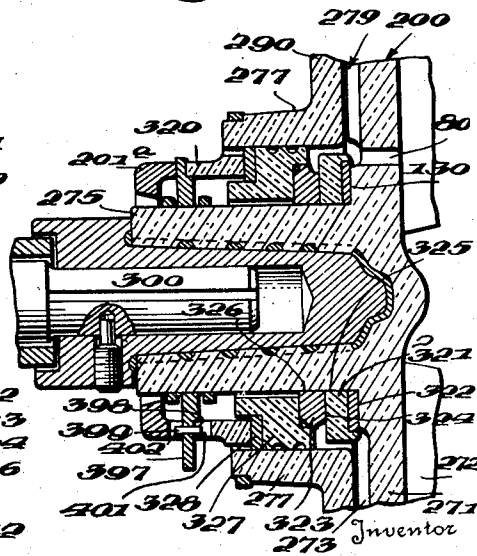


Fig. 14.



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UNITED STATES PATENT OFFICE

2,433,589

PUMP

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Original application May 25, 1939, Serial No.
275,755. Divided and this application August
21, 1943, Serial No. 499,561

26 Claims. (Cl. 103—97)

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This invention relates to fluid pumps.

An object of the invention is to provide a pump construction, where substantially all of the parts that contact with the fluid being pumped, are formed of corrosion resisting material.

Another object of the invention concerns a centrifugal liquid pump in which the pump elements that come in contact with the liquid are made of vitreous material, such as glass, or other refractory material. In this connection it has been found that glass is the most desirable because of its high resistance to corrosion from most acids, and also because of its adaptability in handling beverages containing acids, all of which may be accomplished under conditions which promote the most efficient sanitary conditions. While vitreous products such as glass, porcelain, and other refractory products are most readily adaptable to the construction of the pump elements of the present invention, it may be desirable to use elements made of ceramic or pottery material having glazed surfaces as in terra cotta finishes, in certain instances, where strength of the pump elements may be sacrificed.

In the use of all vitreous, ceramic, and pottery pump elements, their frangible nature is the greatest hazard. In constructing the pump of the present invention there is provided a strong metal housing which not only functions in the operation of the pump, but is devised to support the relatively brittle pump elements under a controlled pressure in a manner that minimizes crushing and breakage, and also protects operators from flying fragments in event the breakage occurs.

Although vitreous, ceramic, and pottery pump elements are desirable for their corrosion resisting properties, because of their brittle nature it is necessary to avoid the development of excessive pressures in the pump. In order to take the proper measures to insure predetermined pressures in the pump casing, in accordance with the present invention, there is devised a construction wherein it is possible to relieve the increment over a predetermined amount of pressure either through the stuffing box assembly or through the pump chamber, or simultaneously, in both locations. So as to permit the escape of excessive pressures in the pump chamber it is necessary to provide for a yielding construction in both the housing and the stuffing box assembly, and these results are obtained in a novel manner in the present invention.

Another feature of the present invention is the provision in the stuffing box assembly, where-

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in efficient construction might require the use of one vitreous member wiping against another vitreous member, for the control of heat developed by the friction of the parts whereby the resultant dangers from overheating are reduced to a minimum.

In a stuffing box assembly based on the invention at hand, it is necessary to provide for quick repair and replacement of worn parts, and toward this end there is devised a novel arrangement of the stuffing box elements which promotes ease and dispatch in the assembly and disassembly.

In order to obtain a proper seal for preventing the escape of pressure from the interior of the pump casing, it is necessary to provide a sealing surface where undue pressures may cause injury to the pump, and in the present invention the properly controlled pressure is placed on the seal elements that cannot be altered during the life of the pump.

In the present invention there is another meritorious feature residing in the novel design of the pump and stuffing box assembly that provides a high coefficient of heat transfer in at least one of the rubbing elements of the seal, and to dissipate and transfer the heat by a novel arrangement, to the liquid being pumped.

Owing to the novel design of the pump of the present invention, it was found necessary to devise a means of connection between the pump suction and the suction piping, which would transfer the piping strains to the metal casing, relieving the more fragile pump casing and yet providing a positive connection to the pump casing for the flow of the liquid. By the present invention, there is devised a construction utilizing an adapter pipe section having an easy and economical manner of joining the pipe line to the pump casing while the metal casing takes the strain.

Another feature of the present invention resides in cooperating devices on the housing and the vitreous pump casing which provide for temporarily supporting the frangible pump casing during the assembly or the disassembly of the pump.

Another feature of the present invention involves a novel arrangement of the gland and follower elements of the stuffing box assembly so as to control any seepage of corrosive liquids in a manner to avoid contact with the metal parts of the pump.

With the foregoing and other objects in view, it will be seen that there is devised a novel combination, construction, and arrangement of the

3 parts of a pump which is highly efficient in operation, thoroughly reliable for its proposed uses, and that is comparatively inexpensive to use and repair.

Although the construction and operation of the preferred form of the invention is illustrated and described, it will be understood that it is the intention to claim all reasonable variations of the invention that may be considered within the scope of the appended claims.

In the drawings wherein like characters of reference indicate like parts throughout the several views—

Fig. 1 is a side elevation of the motor showing a pump in detailed vertical section constructed in accordance with the present invention;

Fig. 2 is a section taken substantially on the plane of line 2—2 of Fig. 1, thereby showing the pump housing in front elevation;

Fig. 3 is a section through the pump housing taken substantially on the plane of line 3—3 of Fig. 1, showing the pump casing in front elevation and with the outer housing section removed;

Fig. 4 is a section through the pump housing taken substantially on the plane of the line 4—4 of Fig. 1 and with the volute section of the pump casing removed, showing the impeller and inner portion of the pump chamber in elevation;

Fig. 5 is a section taken substantially on the plane of line 5—5 of Fig. 1;

Fig. 6 is a vertical section taken substantially on the plane of line 6—6 of Fig. 1;

Fig. 7 is a section taken substantially on the plane of line 7—7 of Fig. 1;

Fig. 8 is a fragmentary section of the pump housing and casing taken substantially on the plane of line 8—8 of Fig. 2;

Fig. 9 is a detailed section through the pump housing and casing taken substantially on the plane of line 9—9 of Fig. 2;

Fig. 10 is a fragmentary elevation partly in section of the inner housing section showing the rubber headed clamping screw;

Fig. 11 is a fragmentary detailed section taken substantially on the plane of line 11—11 of Fig. 5;

Fig. 12 is a fragmentary section through the stuffing box assembly, showing a modified form thereof;

Fig. 13 is a view similar to Fig. 12 showing a further modification of the stuffing box assembly; and

Fig. 14 is a view similar to Fig. 12 showing a still further modification of the stuffing box assembly.

The main features of the invention include a sectional housing A made of metal or acid resisting metal; a sectional centrifugal pump casing B which may be made of corrosion resisting ceramic, or vitreous material such as glass; a driven member I, which in the form illustrated is an impeller made of the same material as the pump casing; a metal drive shaft C to which, by a unique coupling, set forth in the United States patent application, Serial No. 310,462, filed December 21, 1939, in the name of Harold E. Adams and Willard A. Kates, now Patent No. 2,283,348, is anchored to the driven member I; a prime mover in the form of an electric motor M; and a stuffing box assembly H, which, as will presently appear, includes a peculiar construction of gland and follower sleeve elements that retain special seal elements in position under a uniform and controlled pressure.

The sectional metal housing A provides a sup-

port for clamping the sections of the glass pump casing B together under a uniform predetermined spring pressure to prevent crushing of the frangible casing sections. The metal housing also furnishes a protective guard about the casing to prevent breakage, and prevent injury from flying glass in event the casing is broken. All of the outside metal parts of the present invention, including the metal housing, may be made of cast iron, or other metal, not necessarily highly resistant to acid, and acid vapors, and such metal parts may be cadmium plated or covered with rubber base paints and other acid resisting coatings.

The housing A is formed in two parts, or sections, the inner of which consists of a bracket cage composed of four spaced legs 20 which straddle the drive shaft C. At one end the legs 20 join with a ring 21 which may be bolted as at 22 to the motor M surrounding the shaft C. At the other end the legs 20 join with a circular ring member 23a which is angular in cross section. This ring member 23a is formed with a radially extending leg 24 and an axially extending leg 25.

The outer section of the housing A is formed of a bell-shaped cover 26a and is composed of a flange 27 around its periphery that merges with a crown in the center of which is a round opening, the walls 28 of which are inclined for a specific purpose of coacting with the adapter pipe as will presently appear.

The sectional glass pump casing B, which in the form illustrated, is for a centrifugal pump, has a round head section 29, detachably seated on the radially disposed leg or side 24 of the ring member 23a with a resilient gasket 30 in between to protect the glass.

The edge of the bowl-shaped volute section 31 of the pump casing has the inner edge bearing on the periphery of the head 29 with a resilient gasket 32 in between, thereby providing a centrifugal pump chamber 33 between the head and volute sections, in which chamber the impeller I rotates. The periphery of the volute part 31 bears against a ledge on the inside of the cover 26a with a resilient gasket 34 in between. At the center, the crown of the volute section 31 merges with an integral round suction nozzle 35 having a smooth surface on the outside. The nozzle 35 extends outwardly from the volute section 31 and provides the inlet port for the pump chamber 33.

On the inside face of the radially extending leg 24 is an interrupted ring 37 formed with outstanding tongues or lips 38 on the solid parts or segments of the ring. The interruptions or spaces between the segments are indicated at 39. Around the outer edge of the head 29 is a flange 40 which is likewise interrupted by spaces 41 to correspond with the length of the segments of the interrupted ring 27, and having solid parts or segments corresponding to the length of the interruptions or spaces 39 in the ring, allowing practical clearances for insertion and removal of the head 29. When the head 29 is positioned with the solid parts or segments of the flange 40 registering with the spaces 37 between the lips 38, and with the spaces 41 between the solid parts of the flange 40 registering with the lips 38, is pressed inwardly and turned on its axis, the flanges 40 are temporarily locked on the solid parts of the ring 37 behind the lips 38. It will thus be seen that the head 29, which is the first part of the pump casing assembled, is temporarily locked in position while subsequent parts are

mounted. In the completely assembled relation there will be a clearance (as shown in Fig. 9) between the ring 37, the lip 38 and the flange 40, when the parts are centered because vibration might occur in the operation of the pump and tend to break the head 29 if these parts were in normal contact.

To assemble the volute part 31, it is placed in position against the gasket 32 on head 29 and rests on two adjusting screws 42, which screws are spaced apart about a quadrant and these screws are mounted in threaded openings in lugs 43 (Fig. 9) formed on the radial side 25. These screws 42 serve to center the volute part 31, and in the centered position, the screws may be locked by screwing the nuts 44 against the lugs 43. After positioning the volute part 31 it is locked there during the balance of the assembly operations by means of a locking screw 45 (see Fig. 10), and this screw has a threaded shank engaged in a threaded opening on a lug 46, which lug extends outwardly from the side 25. The screw 45 has a rubber tip 47 imbedded in the shank and the tip bears against the rim of the volute part 31. (See Fig. 10.) In centered position, the screw 45 is locked by the nut 48 mounted thereon which bears against the face of the lug 46. It will be seen that by this arrangement the head 29, and the volute part 31 are held from dropping out of the ring member 23a while the operator makes ready to attach the cover plate 26a of the housing.

In order to secure the cover plate 26a in position, a plurality of equidistantly, circumferentially spaced studs 51 (see Fig. 8) have reduced threaded inner ends 52 anchored in threaded openings in the outset flange 53 on the outside of the leg 25 of ring 23a. The number of studs 51 used varies with the requirements of the installation, and for the purpose of illustration eight studs are shown. An intermediate portion of the studs is smooth and extends with clearance through openings 54 in the periphery of cover plate 26a, which openings correspond in number and position with the threaded openings on flange 53. A portion 55 at the outer end of the studs 51 is threaded. Between the threaded part 55 and the smooth part is the limiting shoulder 56. After the cover plate 26a is positioned on the studs 51, a spring 58, the function of which will appear later, is placed over each of the studs bearing on the cover plate 26a. Then a nut 59, having an integral threaded sleeve 60, is placed on the threaded portion 55, with the sleeve 60 inside the spring and no matter how the operator tries he cannot screw the nut and sleeve back farther than the shoulder 56 in consequence of which the springs 58 will all be placed under a uniform predetermined compression which insures against crushing and breakage. If it were left to the operator to select the pressure, it might provoke an error and result in applying too much pressure on the frangible parts 29 and 31 whereby they would be crushed and broken. It is also obvious that by selecting springs 58 with the proper tension to meet the requirements of the factors attendant with the glass casing, a predetermined pressure is exerted between ring 23a and cover plate 26a of housing A, which is translated to the sections 29 and 31 of the pump casing B. Should pressure in the pump casing exceed the predetermined amount, the housing sections will separate, and the casing sections will part along the gasket 32 whereby the increment of pressure is released. When the increment of

pressure escapes, the housing and casing return to closed position under the normal compression of springs 58.

It is pointed out that the outer periphery of the volute part 31 which is initially resting on the centering screws 42 and 45 inclines (see Fig. 9) inwardly as at 57, and when in the assembled relation the pressure of springs 58 is exerted, the compression of the gaskets 30 and 32 permits movement inwardly. This action causes the periphery of the volute to recede from the centering screws and provide a slight clearance between the tips of the screws and the periphery of the volute part 31.

Any acid or other liquid that escapes when the parts 29 and 31 of the pump casing part along the gasket 32, runs down the inside of the ring 23a to the lowest point where an opening 63 permits it to escape. It may happen that the pump casing sections 29 and 31 stick together, and to meet this contingency a second opening 64, spaced about a quadrant from opening 63, is made in the side 25 of housing section 23a, positioned to lie along the horizontal diameter when the opening 63 is at the bottom so as to obtain proper leverage. On the rim of the volute section 31 of the casing, in the vicinity of openings 63 and 64, raised cleats 65 and 66 respectively are molded so that a pry bar may be fulcrumed on either opening in engagement with a cleat to forcefully separate the sticking pump casing sections. A sump is made in the lower portion of ring 23a by placing a slightly raised ridge 67 (see Fig. 9) near the edge of side 25, and this ridge extends around a portion of the circumference. The drain opening 63 is at the lowest point of the sump, and the ridge does not extend outwardly far enough to interfere with the flange 40 on head 29 of the pump casing.

Since the respective lugs 43 and 46 which support the centering screws 42, and the clamping or locking screw 45, lie in the extended plane of the axial side 25 of the ring 23a, it will be necessary to modify the flange 27 at these points. To accommodate the lugs and the screws, the flange is cut away at 68 which corresponds in position to the screws, and surrounding the openings are skirts or arches 69 (see Fig. 9).

The glass impeller I that rotates in the pump chamber 33 is formed as a disc 71 having impeller blades 72 formed on its forward or suction face. These blades perform the pumping function. On the opposite face of the disc, and staggered with respect to blades 72 are formed the blades 73. The blades 72 and 73 are cast or molded integrally with the disc 71. It will be seen that the blades 73 are of materially less height than blades 72, and the former blades serve to lessen the pressure in the stuffing box and sealing area to reduce the leakage of liquid. The blades on both sides of the disc are designed to have a close clearance with the side walls of the pump casing confronting them. From the center of the disc 71 there projects rearwardly an integral hub 75 that extends entirely through the stuffing box or seal chamber 76 formed by the stuffing box neck or extension 77, in spaced relation to the walls 78. The hub 75 also projects beyond the end of the neck or extension 77. It is here pointed out that there are conduits or passages 79 between the blades 73 which form a communication between the pressure side of the pump casing and the stuffing box or sealing chamber 76 whereby liquid is permitted to enter the chamber 76 and absorb heat dissipated by

the sealing elements, as will presently appear. Owing to certain factors in various installations, it may be necessary under certain conditions to provide a direct connection communicating with the pressure side of the pump, and to meet this condition an opening 80 may be made in the disc (see Fig. 14) adjacent the hub, which opening is disposed in axial alignment with the stuffing box or seal chamber 76.

On the outside of the extension 77 near the end thereof is an inset seat 81 for receiving a rubber band 82 which latter grips the neck snugly. It is the purpose of the band to direct any stray acid that may escape from the stuffing box assembly into the funnel member to be presently described. This band 82 is furnished in lieu of molding a corresponding rim on the glass extension owing to the difficulties of molding practice. When acid encounters the band 82 it will be impeded in its progress, and it will run down the band to the lowest point and drip off as indicated.

In the area where the discharge nozzle 83 projects, the walls of the rim 23a and cover plate 26a are cut away sufficiently to allow for the projection of the nozzle without contact with the metal. The walls of the nozzle 83 are preferably molded or cast integrally with the volute part 31, so that it will move with this section when the cover plate 26a and the volute part 31 separate under excessive pump pressures.

Referring now to the form of the stuffing box assembly H, illustrated in Figures 1 and 11, there is shown one way of devising a unique shaft seal in a manner to dissipate and transfer frictional heat to the liquid being pumped, so as to avoid transmission of the heat to the glass impeller I, the glass covered drive shaft C, and the glass stuffing box extension 77. It will be seen that the extension 77 is formed integrally with the head 29 and would be likely to be broken from excessive heat. Should no provisions be taken to dispose of the frictional heat developed, by having glass wiping glass, it will be evident that the heat would break the glass casing B and impeller I.

Various attempts to make a satisfactory glass centrifugal pump have resulted in failure largely because of the difficulties encountered in the provision for a suitable stuffing box to prevent the outward leakage of corrosive fluids being pumped along the shaft. This difficulty revolved mostly about the inherent low coefficient of heat transfer of glass, together with the fragile nature of the glass itself. Any rubbing friction as would be occasioned by the conventional stuffing box construction would result in a localized heating of the hub 75 and this in turn would cause the cracking of the glass. In this invention there is provided a practically leak-proof seal which at the same time overcomes these difficulties. Owing to the low coefficient of heat transfer, or low conductivity of heat in glass, it will have different stresses and strains set up in a spot heated locally, from the unheated surrounding region. The lack of uniformity in the stresses and strains at the heated spot will be sufficient to rupture the glass and this characteristic is known as "heat shock."

In devising the proper elements for the stuffing box, it is necessary to provide as one of the sealing elements an acid resistant seal in the chamber 76 to prevent acid seepage along the hub 75 of the impeller. Toward this end there is provided a rotating glass collar 84, which in the form of the invention shown in Figures 1 and 11,

forms one of the sealing elements. The rotating seal element 84 may be made of such acid resisting materials as high chromium and nickel steels, or compositions including phenolithic compounds and Micarta. The collar or seal element 84 is pressed on the glass hub so as to rotate therewith, and there is a flexible gasket 85 interposed between the collar 84 and the hub 75. This gasket is right angled in cross-section and supports the sealing element or collar 84 in spaced relation with respect to the inner face of the impeller and the hub 75 thereof. The gasket 85 is formed of rubber-like materials that are inert to most acids and other corrosive fluids, and at the same time this gasket furnishes the maximum heat insulation to prevent the exchange of heat between the glass collar 84 and the impeller I and the hub 75. On the outer periphery of the collar is a lip 86 which overhangs the radial leg of the gasket 85 and holds the gasket against distortion or swelling caused by centrifugal force. The free face 87 of the collar is flat and is provided with a highly polished surface which in the stuffing box assembly, illustrated in Figures 1 and 11 of the drawings, forms the movable or rotary part of a seal. This seal prevents the pump chamber 33 from communicating with the exterior of the casing when the cooperating parts of the seal function.

The flexible insulating element 85 serves to insulate the glass seal element 84 from the impeller I, so that any heat developed on the rotating sealing surface 87 will not be transmitted directly to the glass impeller itself. This flexible insulating element 85 also provides for the automatic positioning of the sealing surface 87 in a plane at right angles to the axis of rotation of the impeller, thus eliminating any leakage difficulties that might be caused by any run-out of this surface.

The stuffing box assembly H further includes another seal element in the form of a ring 91 positioned in the chamber 76 in spaced relation to the wall 78 and in spaced relation to the hub 75. This ring 91 does not rotate, but it is urged axially into a central position and bearing relation by the action of the gland and the follower parts of the stuffing box assembly H to be presently described, with the rotating sealing face 87 of the rotating seal element 84. It will be seen that this arrangement provides a predetermined required pressure for proper contact between ring element 91 and collar element 84 at the sealing surface 87. In actual practice, the ring 91 is made of carbon, graphited carbon, or graphite, although any other materials suitable for the acid service contemplated, that have a high coefficient of heat transfer, would be suitable.

It will be seen in the form of the invention shown in Fig. 11 that the element 84 and the ring 91 are spaced from the chamber wall 78 so that the liquid being pumped is free to circulate through the conduit 79 or 80 (in the form of the invention shown in Fig. 14) and contact the high heat transmitting element 91 and thereby dissipate the heat to the liquid being pumped. It is pointed out that the function of the ring 91 is to readily absorb the heat developed by the friction at the sealing surface 87 and dissipate it to the liquid being pumped and away from the glass parts that are likely to be injured by localized heating, or by "heat shock."

Next to the high heat transmitting ring 91 is

a resilient compensating ring 92, the inner periphery of which is supported in spaced relation to the glass hub 75. This compensating ring has the outer periphery thereof bearing against the wall 78 of the stuffing box or seal chamber 76, and the inner face bears against the high heat transmitting element 91. Ring 92 is so proportioned in the stuffing box assembly that it is completely confined except for a small annular section on two sides of the ring indicated at 93 and 94. This annular section is left unsupported on the sides so as to give some degree of freedom to the endwise movement of the ring 92, to compensate for any wear that might occur at the sealing surface 87, and which movement results from the spring pressed gland and follower elements, as will presently appear, wherein the springs are so proportioned as to give the required pressure for proper contact between the sealing surfaces 87. The compensating ring 92 is preferably made of a rubber-like resilient material. The sealing action caused by the expansion of the compensating ring 92 outwardly against the wall 78 is somewhat analogous to the "corking" obtained when a cork in a bottle swells under the influence of liquid contents.

The compensating ring 92 being resilient, accomplishes two functions when compressed by the gland and follower member to be described later, the said ring expands outwardly effecting a tight seal between the impeller hub 75 and the wall 78, by its engagement with the reduced portion 95 of the follower ring, and at the same time it permits a flexing caused by the pressure of the gland and follower ring, to be presently described, such that wear of the compensating ring is automatically taken up regardless of how tight a seal is being maintained against the wall 78.

It will be noted that it is not necessary to provide for the absolute concentric relationship of the seal elements 84 and 91. The centering that is provided by the stuffing box assembly shown, is entirely sufficient as there is no requirement for peripheral clearances or fits. The only requirement is that the seal surfaces at 87 operate in a plane perpendicular to the axis of rotation of the impeller 1. This perpendicular plane is obtained by the self-aligning features of the various component parts of the stuffing box assembly, principally the rotating flexible member or gasket 85 and the stationary flexible compensating ring 92.

In the form of the invention shown in Figures 1 and 11, the follower ring has a reduced part 95 surrounding the hub 75 in spaced relation and on this reduced part rests the compensating ring 92 and a portion of the high heat transmitting ring 91. The enlarged portion 96 of the follower ring projects out of the chamber 76 for engagement with the one side of the deflector gasket 97. This follower ring is preferably formed of glass and in the outer face of the enlarged part is a cavity 98. The shoulder formed between the reduced part 95 and the enlarged part 96 of the follower ring bears in the outer face of the compensating ring 92 and transmits pressure to the inner elements of the stuffing box. The inner periphery of the reduced part 95 of the follower ring is spaced at 99, from the hub 75 of the impeller and this space allows any seepage along the shaft to creep into cavity 98.

In addition to the follower ring, the stuffing box assembly H also includes the gland 101a and this gland is preferably made of acid resisting

metal. In the center, the gland 101a is formed with a cup-shaped part 102, the rim of which bears against the outer face of the deflector gasket 97. The cavity 103 in the cupped part 102 corresponds to the cavity 98 in the follower ring.

It will be seen that the deflector gasket 97 divides the cavity 98 from cavity 102, there being a central opening in the deflector gasket surrounding the hub 75. A rubber slinger band 105 is secured to the hub 75 in the cavity 98 and another slinger band 106 grippingly engages the hub 75 in the cavity 103. The slinger bands 105 and 106 being rotatable with the shaft 75, throw seepage along the hub out into the respective cavities 98 and 103 from where the seepage is drained. For the purpose of draining cavity 98 in the follower ring, a groove 107 is made in the outer edge, while a like groove 108, on the other side of the deflector gasket 97, made in the rim of the cup part 102 of the gland, drains the cavity 103. The grooves 107 and 108 are formed in the lowest segment of the follower ring and cupped part 102 respectively, and are located over the mouth of a lead funnel member 110. This funnel member has a pair of arms 111 fixed to the opposite sides and the arms rest upon opposed legs 20 of the lower pair of legs, the funnel extending between the legs. Seepage drips into the funnel member and is directed to any character of receptacle desired. The outlet grooves 107, 108 register with each other and through the opening formed thereby extends a tongue 112. The tongue 112 is formed as an extension on the bottom segment of the deflector gasket 97, which gasket is clamped in position between the confronting ends of the cupped part 102 and the follower ring. Any seepage along the hub 75 will be deflected by the gasket 97, run down the gasket to the tongue of the deflector 97 and drip into the funnel 110. It will thus be seen that there is created in the gland and follower members a collecting chamber composed of the confronting cavities 98 and 103 respectively, which collecting chamber is bridged by the novel arrangement of the deflector gasket 97 that when cooperating with the slinger bands 105, 106 and the outlet grooves 107, 108, affords a triple precaution against leakage of corrosive liquids from the stuffing box assembly. A pair of round guide posts 112 have their inner ends anchored in threaded openings 113 on the ring 21 of the inner housing section. The posts 112 extend outwardly of the ring 21 and axially of the drive shaft C. The posts are positioned to extend through rounded portion 114 at the inner end of slots 115, one slot being in the outer portion of each wing 116, 117 of the gland 101a. One slot 115 enters each rounded part 14, one from one side of the one wing, while the other slot enters from the opposite side of the other wing, and when spring tension, as will presently appear, is removed, the gland 101a may be separated and moved outwardly from the balance of the stuffing box assembly by simply turning the gland so that the wings slip away from the posts 112, since the slots 115 provide a space through which the posts may pass.

A controlled and predetermined pressure is exerted on the gland 101a and transmitted to the balance of the stuffing box assembly, by the tension afforded by the springs 118, one of which encircles an intermediate part of each post 112. Factors which determine this pressure may vary with each installation, but it should be sufficient to overcome the normal pump pressures reacting

on the elements 84, 91, 92, 87, and the follower ring. At their outer ends the springs bear against a flange 119 on a bushing 120 which extends through the rounded part 114 and slots 115 in the respective wings 116, 117. The flange 119 seats in a groove 122 about the rounded part 114 whereby the bushing is locked under tension. The bushings 120 slide on a threaded part 123 of the posts 112 and on the outer end of the threaded part of the posts, the nuts 124 are mounted. The outer end of each bushing projects above the face of the wing, as clearly shown in Fig. 11, so that when nut 124 is screwed tight against the projecting end the flange 119 will be forced out of the groove 122 so that pressure is removed from the gland when it is desired to disassemble the stuffing box assembly H.

One end of the control springs 118 bears against the flange 119 on the bushing, while the other end bears against the outer face of ring 21, all of which provides a resilient controlled pressure on the gland which is in turn transmitted to the successive elements of the stuffing box assembly.

The amount of pressure necessary with each application may be controlled through the springs 118 and for this reason the springs are selected to supply a predetermined pressure. The amount of pressure to be supplied, and consequently the strength of the springs, will depend upon the necessary pressure required at the sealing face 87, and also the normal pump pressure in the pump chamber 33. Thus there will be a uniform and controlled pressure at the sealing surface 87, that is insured because the controlled pressure cannot be altered. In the event pressures are developed in the pump chamber 33 in excess of the pressure for which the pump was designed, the springs 118 will permit any or all of the elements 84, 91, 93 and the follower ring and the gland elements to move outwardly and permit the increment of pressure to escape.

In the stuffing box assembly H there is provided the elements making up the seal including the intermediate elements 84 and 91 which are separated from the glass of the hub 75 and the extension 77 by the heat insulating layers in the form of the rubber-like gasket 85 and the flexible rubber-like compensating ring 92. The intermediate members 84 and 91, aside from forming a seal at the contacting surface 87, are selected to provide characteristics to prevent the exchange of heat with the glass pump casing and the drive shaft which has the glass hub 75 surrounding it. If both members 84 and 91 were made of a material having a low coefficient of heat transfer, like glass, the heat developed by the friction at the sealing surface 87 will not be dissipated to the liquid being pumped rapidly enough to prevent a burning or scorching of one or both surfaces. If one or the other of the members 84 and 91 does not have a high coefficient of heat transfer and at the same time is operating in conjunction with a glass rotating member 84, the heat developed will be sufficient to crack this glass member 84. As long as one or the other of these two members 84 or 91 is a high conductor of heat, it will prevent the concentration and building up of heat at the sealing face 87 because the heat will be freely transmitted to the liquid being pumped. In the stuffing box assembly shown in Figures 1 and 11, the graphite seal ring 91 is the element that has the property of conducting heat from the sealing surface 87 and transmitting the same freely to the

liquid in the seal chamber 76 which surrounds this ring.

Up to this point in the specification the elements 85 and 92 of the stuffing box assembly H have been defined as being formed of rubber-like material. It has been found that such material as neoprene, chloroprene and vinyl chloride serves satisfactorily for the construction of these elements inasmuch as they are highly resistant to the acid service for which the pumps are designed.

In the application of the centrifugal pump of the present invention there are certain conditions such as handling high solvents, and other hot liquids, where the temperature is higher than safely can be withstood by the molded flexible rubber-like materials used in the gasket 85 and the compensating ring 92 of the stuffing box assembly shown in Figures 1 and 11. To accommodate the higher temperature, in a range that would soften, and make tacky, these rubber-like materials, it is necessary to modify the stuffing box assembly H shown in Figures 1 and 11, and as disclosed in Figures 12, 13 and 14.

In the forms of the invention illustrated in Figures 12, 13 and 14, the impeller 200 is constructed the same as the impeller I shown in Figures 1 and 11 of the drawings, having blades 272 and 273 formed integrally with a disc 271, which blades and discs are formed like the disc 71 and blades 72 and 73, except there is shown an opening 80 in the disc which provides an additional conduit from the high pressure side of the pump to the seal chamber to insure a circulating liquid. In the forms of the invention shown in Figures 12, 13 and 14 there is a conduit 279 between the blades 273 to furnish the stuffing box chamber or seal chamber 276 with the liquid being pumped for the purpose of dissipating frictional heat. The conduit 279 and stuffing box chamber 276 are alike in all respects with the conduit 79 and the seal or stuffing box chamber 76 as shown in the form of the invention illustrated in Figures 1 and 11.

It is also pointed out that the construction shown in Figures 12, 13 and 14 provide a radial shoulder 130 on the impeller 200 which is similar to a shoulder on the impeller I and in these forms of the invention the hub 275 is formed similarly to the hub 75, the hub being coupled to the drive shaft 300 through a metal quill and solder or cementitious bond, as will be hereinafter described. In the form of the invention shown in Figures 12, 13 and 14 the head 290 of the pump casing is formed like the head 29 illustrated in Figures 1 and 11, having the stuffing box neck or extension 277, the stuffing box chamber 276 defined by the wall 278 similar to the extension 77 and chamber 76 in the form of the invention shown in Figures 1 and 11; and likewise the gland 201a is similarly placed under the tension of springs similar to the springs 118 in the form of the invention shown in Figures 1 and 11 of the drawings.

In Figure 12 there is a rotating ring 301 made of graphite, graphited carbon or carbon, which surrounds the hub 275, and one side of this ring abuts the shoulder 130 on the impeller 200. The outer periphery of this seal element 301 is spaced from the wall of the stuffing box chamber 276 whereby liquid being pumped is in contact with the outer periphery. It will be seen that any heat developed on the sealing faces will be transmitted by this ring to the liquid. The other side of the seal ring element 301 is provided with

a convex highly polished spherical surface 302 and rotates in rubbing contact with a correspondingly concaved face on the glass member 303. The member 303 is in the nature of a piston which is free to move in the stuffing box chamber 276. The inner periphery of the piston member 303 surrounds the drive shaft C in spaced relation, while another portion flares outwardly to provide a cavity 304 similar in structure and function to the cavity 98 in the follower ring disclosed in Figures 1 and 11 of the drawings. This cavity 304 forms the inner part of the collecting chamber that is constructed like the collecting chamber shown in Figures 1 and 11.

The outer periphery of the glass follower ring or piston 303 is formed with labyrinth grooves 305 confronting the chamber wall 276 so as to be free to move in the chamber, but at the same time to prevent excessive leakage at the joint between the chamber wall and the outer periphery of the ring. There is not a great pressure difference at this joint mentioned above because of the provision for maintaining substantially atmospheric pressure in the chamber 276 created by the counteraction of the blades 271, explained in connection with blades 71 in Figures 1 and 11 of the drawings. Because of the spherical seat 302 the ring 301 will automatically adjust itself so as to completely engage and seal the impeller hub 275. Leakage of liquid from the interior of the pump along the joint between the labyrinth grooves 305 can, therefore, be minimized or stopped by the sealing surface 302. All of the materials used in this particular stuffing box assembly shown in Fig. 12, are resistant to much higher temperatures than in the assemblies shown in Figures 1 and 11, due to the elimination of the rubber-like elements 85 and 92, and although a slight leakage may occur, this leakage will be held to a minimum with a satisfactory seal resulting.

The stuffing box assembly shown in Fig. 13 has a ring 311 formed of graphite, graphited carbon, or carbon, that encircles the drive shaft in spaced relation thereto. This ring 311 has a radial face 312 and another radial face 313 which maintains a seal between the interior and the exterior of the casing. The surface 312, and 313 can both be polished, together with their mating surfaces 130 on the impeller 200, and the confronting end of the glass piston-like element 314, so as to provide a differential rotation of the ring 311, said ring assuming a rotational speed of approximately half of the impeller 200. No provision is made for a self-alignment of the ring or element 311 in the assembly shown in Fig. 13, like the spherical surfaces 302 in the form of the invention shown in Fig. 12.

The glass piston-like element 314, shown in Fig. 13, has a reduced end on which an acid resistant, high temperature gasket 315 is seated to reduce possible leakage at the joint 316 where the outer periphery has a clearance with the wall of the stuffing box chamber 276. There are labyrinth grooves 317 similar to the grooves 305 on the glass element 303 in Fig. 12 of the drawings. A glass follower ring 318 holds the gasket 315 in place and also forms a closure or cover for the inner portion 219 of the collecting chamber. This cavity or chamber 219 functions similarly to cavity 98 in the form of the invention shown in Figures 1 and 11 of the invention. The material from which the gasket 315 is made is preferably asbestos, and the gasket can be cut

from sheet material and does not have to be molded, or formed of thermoplastic material.

In Fig. 14 there is shown another variation of the stuffing box assembly closely resembling the stuffing box assembly shown in Fig. 13, except for the addition of a rotating glass sealing ring 321 having a ring insulation gasket 322 seated in a recess or pocket in one face, and this gasket is held tightly to the shoulder 130 on the impeller 200. Like the gasket 315 in Fig. 13, the gasket 322 is designed to be cut from flat pieces, or sheet material from stock, which is easily obtained in acid-resistant, high temperature resisting materials, such as asbestos or woven glass. The rotating seal ring 321 provides a construction which allows it to be replaced when it becomes worn, and is desired above the assemblies shown in Figures 12 and 13, inasmuch as the wear occurs on these latter constructions against the shoulder 130 of the impeller. In the construction shown in Fig. 14, the carbon ring 323, bears on the outer polished face of the rotating glass seal ring 321 to provide the radial seal 324. While the insulating ring gasket 322 provides a certain degree of insulation against the transfer of heat to the impeller 200, the glass ring 321 is not as fully insulated as the glass ring element 84 in Figures 1 and 11, in that there is more contact between the impeller hub 275 and the inner peripheries of the glass ring 321 and the carbon or graphite ring 323 respectively at 325 and 326.

In Fig. 14, the piston-like sleeve element 327, the gasket ring 328 and glass follower ring 329 are constructed like the corresponding parts 314, 315, and 318 respectively, in Fig. 13, and their functions are the same as said corresponding parts.

In the forms of the invention shown in Figures 12, 13 and 14, a means is provided to prevent the member abutting the inside of the deflector gasket 397 from turning, and this gasket is similar to the gasket 97 in Figures 1 and 11, except as hereinafter indicated. Toward this end a pin has an intermediate portion secured transversely in the gasket 397 with opposite ends 398 and 399 projecting outwardly of this deflector gasket. The one end 398 engages in a slot 400 in the glass element 303 in the assembly shown in Fig. 12. In the structure shown in Figures 13 and 14, the end 398 of the pin is engaged in the slot 401 in the follower rings 318 and 329, respectively. The other end 399 of the pin engages in a slot 402 in the hub of the gland 201a. By the engagement of the end 398 of the pin in the slots 400 and 401 respectively, the respective elements 303 and 318, 329 are definitely positioned and at the same time they are prevented from turning.

It is pointed out that in all other respects not specifically mentioned in describing the construction shown in the modifications in Figures 12, 13 and 14 of the drawings, the construction is similar in all respects to the structure shown in Figures 1 and 11 of the drawings.

It has not been considered practical or expedient to use, in the suction line 501 (see Fig. 1), the customary glass pipe line fitting, as indicated at F in the discharge line 502, and as a result it is necessary to devise a special fitting. It will be observed that the end of the suction nozzle 35 terminates at, or short of, the crown of cover plate 26a in a male end 503 in alignment with the opening defined by wall 28. An adapter pipe member 504 provided with a female end 505 receives the male end 503, and this member 504 extends through the opening in the crown of the

cover plate 26a. The outer end of the adapter member 504 is joined by the conventional glass pipe fitting, similar to that indicated at F, to the suction line 501.

It will be understood that all of the metal to glass joints, as F, and at the suction line 501, will be equipped with suitable packing, in a conventional manner.

Surrounding the female end 505 is a flange having the surface provided with an inward incline 506, which coincides with the corresponding incline of the wall 28 of the opening in cover plate 26a. This wall 28 has a split rubber lining, insert or washer 507 secured thereto, so that when the fitting is drawn tight the metal wall 28 will not crush the adapter. Adjacent the male end 503, there is a rubber ring 508 pressed on the nozzle. The ring is of right triangular cross section, so the base will abut the edge of the flange of the adapter, and the hypotenuse side 509 inclines upwardly and outwardly from the apex. The incline at 509 is about the same pitch as the incline at 506. With respect to the incline 506 on the flange, the side 509 on ring 508 forms an anti-clinal surface all around the joint, an intermediate part of which surface is interrupted or divided by the joint between the nozzle and the adapter.

A collar 511 is disposed on the ring 508. The wall 512 about the opening in the collar is inclined in a plane that substantially coincides with the incline 509 on ring 508. The wall 512 and the wall 28 of the opening in the cover plate 26a, form an interrupted synclinal surface with respect to the collar 511 and cover plate 26a considered conjointly, all round the respective openings. The openings which these synclinal surfaces surround are neither of them as large in diameter as the apex of the anticlinal surface on the flange and ring. Such being the case, when one of the synclinal faces move toward the other a wedging action is applied to the anticlinal surfaces 509-506, and the reverse movement releases the wedging action.

On the outer periphery of the collar 511, there are ears 513, preferably three in number. Anchored in threaded openings, one in each ear, is an outwardly projecting stud 514, an intermediate portion of which extends through openings 515 in the cover plate 26a. On the projecting end of each stud 514 there is a wing nut 516, which, when the parts are assembled as shown in Figure 1, supplies the force to wedge the parts together and make a tight fitting between the adapter and the nozzle. A tight seal is provided between the edge of the flange on the female end of the adapter and the altitude side of the rubber ring 508, and a groove 517 is molded around the edge of the adapter to provide an additional sealing means.

When these component parts of the fitting are assembled in the position shown, the collar 511 is pulled into position by means of the wing nuts 516. In tightening up all these wing nuts, it will be observed from the drawing that this provides for the compression of the resilient ring 508 so as to tightly grip the cylindrical surface of the nozzle 35 and at the same time to come up hard against and tightly seal off the end of the suction adapter pipe 504.

Invention is not claimed for these various elements per se, as many of them are used in connection with glass piping practice but what I believe is novel is the use of these devices as indicated so as to provide more or less rigid means

of connection of the suction pipe to the glass suction nozzle of the pump, in a manner so as to remove the pipe strains from the glass pump member itself. In this connection it will be noted from the drawing that the adapter pipe 504 is held rigidly in position through the medium of the metal cover plate 17a. This provision removes any strain of the suction piping from the glass parts of the pump itself. Such strains would, of course, be liable to break the expensive volute portion 31 which at this point would otherwise be relatively unsupported and, furthermore, strains at this point would be liable to interfere with the working clearance of the impeller.

Considerable difficulty has been experienced in making a rotary joint between a metal drive shaft C, and a rotary driven member such as the impeller I. The rotary joint hereafter described is the subject of the above mentioned application and for the purposes of the present invention, it is sufficient for an understanding that the rotary joint between the shaft C and impeller I is made by forming a socket 520 in the hub 75 of the impeller I. The wall of the socket is formed with irregular cavities 521. A hollow spindle or quill having an enlarged head 522 is formed with a reduced inner part 523 (see Fig. 11) which terminates in a tang 524 that registers with a cavity 525 in the end wall of the socket 520. The surface of the reduced inner part 523 is irregular as at 526. (See Figs. 6 and 7). There is a space between the irregular cavities 521 in the socket wall and the irregular surface 526 on reduced part, and this space continues between tang 524 and cavity 525, and in this space is a hard solder or cementitious bond 527 which has the property of expanding while congealing from the liquid or plastic phase to the solid phase. The bond 527 forms a mechanical lock with the irregular surfaces that prevents longitudinal and rotary movement between the impeller and the quill.

The stub drive shaft C fits in a socket 528 in the quill. The quill is keyed to the drive shaft C by a key 529 (see Figures 6 and 7), one half of which seats in keyway 530 in the wall of the socket 528, and the other half seats in a keyway 531 in the drive shaft C. A positioning set screw 532 (see Figure 5) is threaded in an opening in the enlarged part 522 of the quill, and the inner end of the set screw seats in an opening 533 in the shaft. A second set screw 534 is mounted in a threaded opening in the enlarged part 522 of the quill at about ninety degrees from the set screw 532 and the inner end of this set screw bears against the periphery of the drive shaft C. This second set screw 534 applying force to the shaft C at right angles to set screw 532, reduces to a minimum any play between the shaft and metal quill.

This application is a division of my co-pending application, filed May 25, 1939, Serial No. 275,755, now matured into Patent No. 2,347,386 of April 25, 1940.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a vitreous pumping unit having a vitreous pump casing and a vitreous pumping means therein both of which are sensitive to heat shock, seal elements disposed between the casing and pumping means, means for maintaining said seal elements in rubbing sealing contact during normal running operation of the pumping

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unit whereby frictional heat is developed, heat insulating elements of material substantially more resistant to heat shock than the material of said pump casing and said pumping means, to prevent heat shock in the casing and pumping means, one heat insulating element being in contact with the casing and one seal element during normal running operation of the pumping unit, and another heat insulating element being in contact with another seal element and the pumping means during normal running operation of the pumping unit.

2. In a vitreous pumping unit having a vitreous pump casing and a vitreous pumping means therein both of which are sensitive to heat shock, seal elements disposed between the casing and pumping means, means for maintaining said seal elements in rubbing sealing contact during normal running operation of the pumping unit whereby frictional heat is developed, heat insulating elements of material substantially more resistant to heat shock than the material of said pump casing and said pumping means, to prevent heat shock in the casing and pumping means, one heat insulating element being in contact with the casing and one seal element during normal running operation of the pumping unit, and another heat insulating element being in contact with another seal element and the pumping means during normal running operation of the pumping unit, and one of said seal elements being formed of material having a higher coefficient of heat transfer than the parts sensitive to heat shock.

3. A rotary liquid pump comprising a glass pump casing providing a pump chamber, said casing being further provided with a stuffing box chamber, a rotary glass impeller in the pump chamber having a glass hub extending into the stuffing box chamber in spaced relation to the wall thereof, seal elements between the hub and the stuffing box chamber wall, at least one of said seal elements having a higher coefficient of heat transfer than glass, and means establishing a conduit between said seal elements and the pump chamber whereby heat may be transmitted to the liquid being pumped.

4. In a pump having a pump casing and impeller therein and driving means for said impeller, a stuffing box assembly between the driving means and the casing, one member of said assembly cooperating with said driving means to form a seepage collection chamber surrounding the driving means, and other elements of said assembly cooperating with the driving means to form a second seepage collection chamber, means in said seepage chambers to centrifugally deflect seepage from the driving means into said chambers, one of said second mentioned elements forming a partition separating the seepage chambers from each other, and said partition providing a path for capillary flow of the deflected seepage away from said chambers, and drain means adjacent said last mentioned element for escape of seepage from the chambers.

5. In a pump having a pump casing and impeller therein and driving means for said impeller, a stuffing box assembly between the driving means and the casing, one member of said assembly cooperating with said driving means to form a seepage collection chamber surrounding the driving means, and other elements of said assembly cooperating with the driving means to form a second seepage collection chamber, means in said seepage chambers to centrifugally deflect

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seepage from the driving means into said chambers, one of said second mentioned elements forming a partition separating the seepage chambers from each other, and said partition providing a path for capillary flow of the deflected seepage away from said chambers, drain means adjacent said last mentioned element for escape of seepage from the chambers, and means on said partition forming element to hold an adjacent element of the assembly from rotary movement.

6. In a pump having a pump casing and impeller therein and driving means for said impeller, a stuffing box assembly between the driving means and the casing, one member of said assembly cooperating with said driving means to form a seepage collection chamber surrounding the driving means, and other elements of said assembly cooperating with the driving means to form a second seepage collection chamber, means in said seepage chambers to centrifugally deflect seepage from the driving means into said chambers, one of said second mentioned elements forming a partition separating the seepage chambers from each other, and said partition providing a path for capillary flow of the deflected seepage away from said chambers, drain means adjacent said last mentioned element for escape of seepage from the chambers, and means on said partition forming element to hold an adjacent element of the assembly from rotary movement, and a funnel member below said drain means and partition means for draining the seepage chambers adapted to direct the seepage into a receptacle.

7. A rotary liquid pump comprising a glass pump casing providing a pump chamber, said casing having a stuffing box chamber, a glass impeller operable in the pump chamber and provided with a glass hub extending into the stuffing box chamber, in spaced relation to the wall thereof, seal elements between the hub and the stuffing box chamber wall, at least one of said seal elements having a higher coefficient of heat transfer than glass, means establishing communication between said seal elements and the pump chamber whereby heat may be transmitted to the liquid being pumped, and means to maintain a reduced pressure in said communication means.

8. A rotary liquid pump comprising a glass pump casing providing a pump chamber, said casing having a stuffing box chamber, a glass impeller operable in the pump chamber and provided with a glass hub extending into the stuffing box chamber, in spaced relation to the wall thereof, seal elements between the hub and the stuffing box chamber wall, at least one of said seal elements having a higher coefficient of heat transfer than glass, means establishing communication between said seal elements and the pump chamber whereby heat may be transmitted to the liquid being pumped, said impeller having blades on its face adjacent the hub, positioned within said communication means, and effective, during a normal pumping operation, to reduce the pressures within said communication means.

9. A rotary liquid pump comprising a glass pump casing providing a pump chamber, said casing having a stuffing box chamber, a glass impeller operable in the pump chamber and provided with a glass hub extending into the stuffing box chamber, in spaced relation to the wall thereof, seal elements between the hub and the stuffing box chamber wall, at least one of said seal elements having a higher coefficient of heat transfer than glass, said impeller having a face adjacent and parallel to the wall of the casing,

and forming therewith a means of communication between said seal elements and the pump chamber whereby heat may be transmitted to the liquid being pumped, the impeller also having blades on said face, within the communication means, effective to reduce the pressures in said communication means.

10. A rotary liquid pump comprising a glass pump casing providing a pump chamber, said casing having a stuffing box chamber, a glass impeller operable in the pump chamber and provided with a glass hub extending into the stuffing box chamber, in spaced relation to the wall thereof, seal elements between the hub and the stuffing box chamber wall, at least one of said seal elements having a higher coefficient of heat transfer than glass, said impeller being perforated adjacent its hub, to establish communication between said seal elements and the pump chamber whereby heat may be transmitted to the liquid being pumped, and being further provided with blades on the face adjacent the hub, effective during a normal pumping operation to reduce the pressures in the region about said perforations.

11. A rotary liquid pump comprising a glass pump casing providing a pump chamber, said casing having a stuffing box chamber, a glass impeller operable in the pump chamber and provided with a glass hub extending into the stuffing box chamber, in spaced relation to the wall thereof, seal elements between the hub and the stuffing box chamber wall, at least one of said seal elements having a higher coefficient of heat transfer than glass, said impeller being perforated adjacent its hub, to establish communication between said seal elements and the pump chamber whereby heat may be transmitted to the liquid being pumped, and effective during a normal pumping operation to reduce the pressures in the region about said perforations.

12. In a vitreous pumping unit having a vitreous pump casing and a vitreous pumping means therein, both of which are sensitive to heat shock, stuffing box elements disposed between the vitreous casing and the vitreous pumping means including frictional seal surfaces consisting of glass and carbon, heat insulating elements isolating the stuffing box frictional surfaces from the vitreous pump casing and vitreous pumping means, and means establishing a conduit between said frictional surfaces and the pump chamber whereby heat may be transmitted to the liquid being pumped.

13. A pump including a fixed wall defining part of the pump chamber and having a shaft opening, a shaft passing through said opening, and a stuffing box between said wall and said shaft, including a pair of sealing members with respective annular surfaces in sealing contact blocking passage of fluid between peripheral opposite sides of said surfaces, said surfaces being in communication on one peripheral side with the pump chamber and on the other peripheral side with an outlet under substantially reduced pressure, one of said sealing members being axially movable, and normally urged by working pressure from the pump chamber axially away from the other sealing member, a follower having a tubular projection embracing said shaft extending into the bore of the box in bearing relationship with respect to one of said sealing members, and spring means acting on said follower to urge said movable sealing member axially into sealing contact with the other sealing member and against

the action of said working pressure during normal working operation of the pump, said spring means permitting said movable sealing member to be shifted axially away from the other sealing member when the pressure on the peripheral side of said surfaces in communication with the pump chamber becomes excessive, whereby release of the excess pressure is effected through the space between said surfaces to the reduced pressure side of said surfaces.

14. A pump as described in claim 13, in which one of said sealing members is frangible, and in which release of the excess pressure is effected to prevent injury to said frangible member.

15. A pump as described in claim 13, in which said outlet is open to the atmosphere and is of substantial area, and an open passageway of substantial cross-sectional area is provided between one peripheral side of said sealing surfaces and said outlet, whereupon release of excess pressure is effected almost instantaneously upon the pressure spacing of said sealing members.

16. A pump including a pump chamber having a fixed wall and a tubular extension, a rotary shaft passing through said extension, and a stuffing box between said extension and said shaft, including a pair of sealing members with respective annular surfaces in sealing contact blocking passage of fluid between peripherally opposite sides of said surfaces, said surfaces being in communication on their outer peripheral sides with the pump chamber and on their inner peripheral sides with an outlet under substantially reduced pressure, one of said sealing members being axially movable and normally urged by working pressure from the pump chamber axially away from the other sealing member, a piston-like follower extending into said extension and around said shaft and engaging said axially movable sealing member, and coil spring means disposed outside of said extension and acting on said follower to urge said movable sealing member axially into sealing contact with the other sealing member, and against the action of said working pressure, during normal working operations of the pump, said spring means permitting said movable sealing member to be shifted axially away from the other sealing member when the pressure on the outer peripheral sides of said surfaces becomes excessive, whereby release of the excess pressure is effected through the space between said surfaces to the reduced pressure side of said surfaces.

17. In a pumping unit, the combination comprising a pump casing and a pumping member, both made of a material which is non-corrosive to the action of the fluid pumped, but which is frangibly sensitive to heat shock, and sealing means between said casing and said pumping means comprising a pair of sealing members, means for maintaining said sealing members in sealing rubbing contact during normal pumping operations, a heat insulating element which is disposed between one of said sealing members and said casing and in contact with said casing during normal pumping operations, and which is made of a material substantially more resistant to heat shock than the material of said pump casing and said pumping member, said insulating element and said latter sealing member being held in contact with each other and against rotation during normal pumping operations, and a heat insulating element which is disposed between the other sealing member and said pump-

ing member and in contact with said pumping member during normal pumping operations, and which is made of a material substantially more resistant to heat shock than the material of said pump casing and said pumping member, said latter insulating element and said latter sealing member being held in contact with each other and mounted for rotation with said pumping member during normal pumping operations.

18. In a pumping unit as described in claim 17, in which one of said heat insulating members is of flexible material, whereby said sealing members are self-aligned into sealing contact.

19. In a pumping unit as described in claim 17, in which spring means are provided for pressing said sealing members into sealing contact, and both of said heat insulating members are of elastic material, whereby said sealing members are self-aligned into sealing contact.

20. A stuffing box for sealing a pump opening, comprising a follower, guide posts passing through said follower, bushings axially slidable on said posts respectively and bearing axially inwardly on said follower, and coil springs encircling said guide posts respectively and bearing against corresponding bushings to spring-press said follower inwardly towards said opening into sealing position.

21. A stuffing box as described in claim 20, in which each of said guide posts has a threaded portion carrying a nut on the inner side of the corresponding bushing adapted to be moved outwardly against said bushing to release the spring pressure on said follower.

22. A stuffing box for a pump opening, comprising a follower, a plurality of coil springs spaced from the axis of said opening and arranged around said axis for urging said follower inwardly towards said opening into sealing position, and means operable upon a single manipulation for freeing said follower from the action of all of said springs while maintaining said springs in stressed condition.

23. A stuffing box for a pump opening, comprising a follower, a plurality of coil springs urging said follower axially inwardly towards said opening into sealing position, and means for releasing said follower from the action of all of said springs simultaneously upon rotation of said follower.

24. In a stuffing box for a pump opening, the combination comprising a follower, a fixed post, a coil spring encircling said post, a bushing slidable on said post and disposed between said follower and said spring, said spring axially urging said bushing in one axial direction against said follower to urge said follower in a corresponding direction inwardly towards said opening into sealing position, and means carried by said post and operable to move said bushing axially in the opposite direction against the action of said spring

to release said follower from the action of said spring.

25. In a stuffing box for a pump opening, the combination as described in claim 24, comprising releasable locking means between said follower and said bushing, whereby said follower may be freed from the action of said spring, while maintaining said spring in stressed condition.

26. In a stuffing box for a pump opening, the combination comprising a follower, a plurality of fixed posts spaced from the axis of said opening, coil springs encircling said posts respectively, bushings slidable on said posts respectively and disposed between said follower and said springs, said springs axially pressing said bushings in one axial direction against said follower to urge said follower in a corresponding direction inwardly towards said opening into sealing position, and nuts carried by said posts respectively and adapted to engage respective bushings and to move said bushings axially in the opposite direction against the action of said springs to release said follower from the action of said springs, while maintaining said springs in stressed condition, said follower having catch conformations adapted to be moved into catch position with respect to said bushings respectively upon rotation of said follower in one direction, and adapted to be moved out of catch relationship with said bushings upon rotation thereof in the opposite direction.

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