Oct. 1, 1940. G. A. WAHLMARK 2,216,218

SEAL

Original Filed Feb. 27, 1936

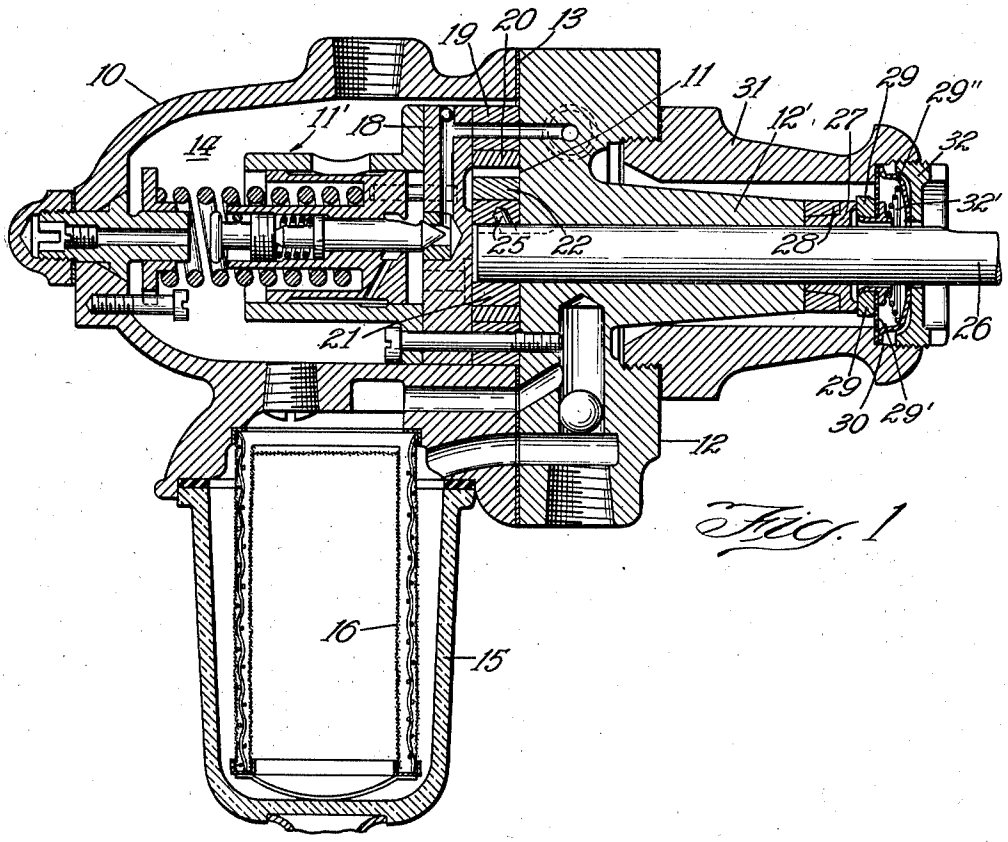


Fig. 1

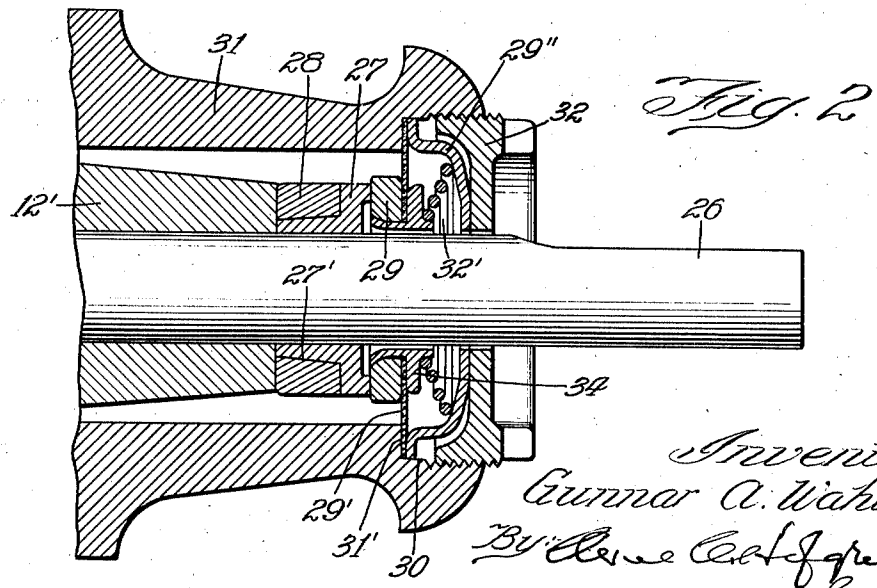


Fig. 2

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2,216,218

SEAL

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Original application February 27, 1936, Serial No. 66,009, now Patent No. 2,159,720, dated May 23, 1939. Divided and this application December 10, 1937, Serial No. 179,168

7 Claims. (Cl. 286—11)

The invention relates generally to fluid seals, and more particularly it relates to a mechanical seal construction which prevents leakage of fluids, either liquid or gaseous, along a rotary drive shaft.

The primary object of the invention is to provide, in connection with the projecting rotary shaft of a pump or the like, a new and improved mechanical seal of simple construction.

Another object is to provide a mechanical seal with a non-elastic diaphragm of great flexibility so that it is self-aligning and will not crystallize due to a slight runout on the seal face, together with novel means for clamping the stationary edge of the diaphragm.

This application is a division of my copending application Serial No. 66,009, filed February 27, 1936, now Patent No. 2,159,720, issued May 23, 1939.

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

Fig. 1 is a sectional view taken along the axis of a rotary pump embodying the features of the invention.

Fig. 2 is an enlarged portion of Fig. 1 showing the elements of the mechanical seal in central longitudinal section along the axis of the shaft.

For purposes of disclosure, the preferred form of the invention is illustrated in the drawing and will hereinafter be described in detail as applied to a particular form of pump, but it is to be understood that this disclosure is not intended as a limitation of the invention to pumps, nor to the particular type of pump illustrated, it being contemplated that various changes might be made by those skilled in the art to adapt the invention to other types of rotary apparatus and to other types of pumps without departing from the spirit and scope of the invention as defined by the appended claims.

As shown in the drawing, the invention is embodied in a pump of the rotary type having an elongated casing comprising a horizontally disposed cup-shaped member 10, forming one end of the casing, within which is disposed a pump chamber 11 and pressure actuated means designated generally as 11' for controlling the discharge from the pump. Secured over the open end of the cup-shaped member 10 is an end closure 12 completing the casing and having a tubular extension 12' which forms a bearing hub. A gasket 13 is interposed between the cup-shaped member 10 and the end closure 12 to make the joint fluid-tight so that the casing, in addition to housing the pumping and control means, constitutes an auxiliary reservoir 14. Depending from the cup-shaped member 10 and removably secured thereto in fluid-tight relation is a strainer cup 15 within which is supported a double screen strainer 16.

The pump chamber 11 has one end wall formed by the end closure 12, while the other end wall is formed by a plate 18 spaced from the end closure by an annular ring 19 constituting the periphery of the pump chamber. Housed within the pump chamber and operable to draw fluid into the chamber and forcibly discharge it therefrom are rotary pump elements of the general character disclosed and claimed in my copending applications Serial No. 675,218, filed June 10, 1933, now Patent No. 2,132,813, dated October 11, 1938, and Serial No. 14,017, filed April 1, 1935, now Patent No. 2,146,037, dated February 7, 1939, comprising an internally toothed rotor 20 rotatable within the annular ring 19. Positioned eccentrically within the rotor 20 and meshing therewith over a portion of the circumference only is a roller 21 and interposed in the space left by the eccentric mounting of the rotor and roller is a crescent-shaped element 22 completing the pump chamber. The axial dimensions of the rotor and roller are such that the end faces have a sliding but fluid-tight engagement with the end walls of the chamber. Here the roller 21 is the driving element and to that end is secured as by a key 25 to a shaft 26 journaled in the axial extension 12' and projecting outwardly thereof.

The preferred form of the invention is herein associated with the projecting end of the shaft 26 to prevent fluid from leaking out along the shaft. Referring particularly to Fig. 2 of the drawing, the seal comprises a bushing 27 fixed to and rotatable with the shaft 26 and engaged in an endwise direction by a non-rotatable seal ring 29 supported by a flexible diaphragm 29'. The outer edge of this diaphragm is secured in leak-proof relation to an elongated housing or casing member 31 and, as illustrated, is positioned in a recess 30 in the end of the housing 31 and is clamped against a shoulder 31' by means of a nut 32 and an apertured bell-shaped member or cap 29'' which is positioned intermediate the diaphragm 29' and the nut 32 with its outer peripheral edge bearing against the diaphragm to clamp it against the shoulder 31' and its inner edge bearing against the nut 32. The cap 29'' is preferably formed of a resilient or springy metallic material and with a some-

what convex shape adjacent the shaft so that the nut 32 engages the cap around its inner edge. An expansive coil spring 32' acts between the nut 32 and the ring 29 to press the ring axially and maintain contant contact between an annular lapped face on the ring and the adjacent annular end surface on the bushing 27. This spring is preferably in the form of an expanding helix with the turns spaced so that it may be compressed "flat" to afford a maximum deflection in a minimum space.

To prevent leakage of fluids, either liquid or gaseous, between the bushing 27 and the shaft 26, the bushing is preferably formed from relatively soft metal with a tapered outer surface 27' along which the internally tapered ring 28 of stronger metal may be driven axially to distort the bushing inwardly into leak-proof relation to the shaft.

In accordance with the present invention, the diaphragm 29' is constructed from an extremely flexible non-elastic material such as a cloth or textile fabric which is more or less limp as compared with diaphragms of metallic or semi-rigid materials, so that the material in itself does not materially resist movement or oscillation of the seal ring. Being of a non-metallic character, such a diaphragm is free from internal stresses which tend to cause failure when the diaphragm is distorted at various angles. The material employed for the diaphragm is preferably a textile fabric devoid of any rubber and is neither elastic nor resilient. The fabric is, in fact, known as airplane cloth, impregnated and otherwise treated so as to be fluid-proof, and is of such a character as to resist the harmful actions of the various liquids or gases with which the device is to be used. The diaphragm is necessarily non-elastic because friction tends to rotate the seal ring and would thus distort an elastic diaphragm to a greater or lesser extent as the friction varied. This would cause oscillation of the seal ring 29 resulting in a chattering and breaking of the seal. If desired, the fabric may be relatively thin, and a plurality of laminations thereof employed to form the diaphragm.

The fabric of the diaphragm is centrally apertured to conform with the inner diameter of the seal ring 29, and is secured at its inner edge to the ring 29 in leak-proof relation by means such as a clamping bushing 34. The bushing 34 as shown herein has a flange which is positioned between the diaphragm and the spring 32' and has a tubular portion which extends through the seal ring in spaced relation to the shaft, and is interlocked with the ring as by outward bending or riveting to hold the flange and the ring firmly clamped to the fabric of the diaphragm.

It is believed readily apparent that the invention overcomes difficulties which may arise due to inaccuracies in the manufacture of the parts of the device, and particularly the housing 31 and the nut 32. In the manufacture of threaded parts such as the nut and housing, it is difficult to obtain an assembled structure in which the end surface of the nut is perfectly parallel to the shoulder 31'. The cap member 29'' compensates for variations in these surfaces and serves as an equalizing means transmitting the clamping force of the nut uniformly to the periphery of the diaphragm. Furthermore, due to the resiliency of the cap, it serves as an automatic take-up means and efficiently secures the periphery of the diaphragm against the shoulder 31'.

I claim as my invention:

1. In a pump, in combination, a housing having an opening and an annular shoulder at one end thereof, a rotary shaft extending through said opening, and a sealing means for the opening comprising a collar secured in fluid-tight relation on the shaft, an annular sealing member positioned to bear against said collar, an annular flexible diaphragm secured at its inner edge to said sealing member and at its outer periphery against said annular shoulder, an apertured cap having its peripheral edge positioned against said diaphragm to maintain the diaphragm in contact with said shoulder and an annular resilient portion adjacent said shaft, and an apertured nut device threaded on said housing and having an annular surface surrounding said aperture and spaced substantially inwardly from the peripheral edge of the cap for engaging the resilient portion of said cap to maintatin the cap in uniform engagement with said diaphragm throughout its periphery.

2. In combination, a housing having an opening and an annular surface at one end thereof, a rotary shaft extending through said opening, and a sealing means for the opening comprising a collar secured in fluid-tight relation on the shaft, an annular sealing member positioned to bear against said collar, an annular, flexible diaphragm of substantial width secured at its inner edge to said sealing member and at its outer periphery against said annular surface, an apertured spring metal cap having a flange on its peripheral edge positioned against said diaphragm to maintain the diaphragm in contact with said surface and having an inner edge closely adjacent and surrounding said shaft, and a nut device threaded on said housing for engaging the portion of said cap adjacent said shaft to maintain the cap in uniform engagement with said diaphragm throughout its periphery.

3. In combination, a housing having an opening and a shoulder about the opening, a rotary shaft projecting through the opening in the housing, a collar secured in fluid-tight relation on said shaft and a rotary seal cooperating with said collar to prevent leakage along the shaft comprising an annular sealing member positioned to bear against said collar, an annular flexible diaphragm for supporting said sealing member having the inner periphery secured to said sealing member and its outer periphery disposed against the shoulder on said housing, a bell-shaped cap of springy metal centrally apertured to be received over the shaft and throughout its periphery bearing against said diaphragm to clamp the same against the shoulder on said housing, a nut threaded onto the housing and having an annular edge engaging said cap along the edge of its central aperture adjacent the shaft to tension the same to exert clamping force on said diaphragm, and a compression spring interposed between said cap and said sealing member urging the latter into contact with said collar.

4. In a machine having an apertured casing and a rotary shaft projecting through said aperture, the combination of a mechanical seal between said shaft and said casing comprising an exteriorly tapering bushing formed from relatively soft metal and encircling said shaft, a clamping ring forced endwise along said tapered surface of the bushing to fix the same to the shaft and prevent leakage of fluid between the shaft and the bushing, a seal ring encircling the shaft in spaced relation thereto and adapted for annular flat surface contact with said bushing

in an endwise direction, an annular flexible diaphragm of impregnated fluid-proof fabric, a bushing for securing the inner edge of said diaphragm in leak-proof relation to said seal ring having a radial flange adapted to be disposed on one side of the diaphragm and a tubular portion extending through the diaphragm and the seal ring and securing the seal ring on the opposite side of the diaphragm to clamp the same therebetween, a spring urging the seal ring into contact with the bushing secured to the shaft, and means for securing the outer circumference of the diaphragm in the casing comprising a bell-shaped cap of spring metal having a central aperture through which the shaft extends when the periphery of the cap bears against the diaphragm to clamp it against the casing, and means detachably secured to the casing and engageable with the cap along the entire edge defining said central aperture to lock the cap in place.

5. In a machine having an apertured casing and a rotary shaft projecting through said aperture, the combination of a mechanical seal between said shaft and said casing comprising a bushing fixed about and rotatable with the shaft and fitted to the shaft to prevent leakage of fluid therebetween, a seal ring encircling the shaft in spaced relation thereto and adapted for annular surface contact with said bushing in endwise direction, an annular flexible diaphragm of impregnated fluid-proof fabric, a bushing having a tubular portion extending through said diaphragm and into engagement with said seal ring and a radial flange disposed on the side of said diaphragm opposite said seal ring to clamp the diaphragm therebetween in leak-proof relation, means urging said seal ring into engagement with the bushing on the shaft, and means for securing the outer periphery of the diaphragm in leak-proof relation against an annular shoulder formed on the casing comprising a bell-shaped cap of spring metal disposed in said recess centrally apertured to be received over the shaft and throughout its periphery having a flange bearing against said diaphragm to clamp the same against the shoulder in said housing, a nut threaded onto the housing and having an annular portion engaging said cap along the face thereof adjacent its central aperture to tension the same to exert clamping force on said diaphragm, and a compression spring interposed between said cap and said sealing member urging the latter into contact with said collar.

6. In combination, a housing having an opening forming an annular shoulder, a rotary shaft projecting through the opening in the housing, a collar secured in fluid-tight relation on said shaft and a rotary seal cooperating with said collar to prevent leakage along the shaft comprising an annular sealing member positioned to bear against said collar, an annular flexible diaphragm for supporting said sealing member having its inner periphery secured to said sealing member and its outer periphery disposed against the shoulder on said housing, an annular resilient member centrally apertured to be received over the shaft and throughout its outer periphery bearing against said diaphragm to clamp the same between the shoulder on said housing and the said annular resilient member, and a nut threaded onto the housing and engaging said annular resilient member along its inner edge and closely adjacent the shaft to tension the same to exert clamping force on said diaphragm.

7. In a pump, in combination, a housing having an opening and an annular shoulder at one end thereof, a rotary shaft extending through said opening and a sealing means for the opening comprising a collar secured in fluid-tight relation on said shaft, an annular sealing member positioned to bear against said collar, an annular flexible diaphragm secured at its inner edge to said sealing member and at its outer periphery against said annular shoulder, an annular metal cap having its outer peripheral edge positioned against said diaphragm to maintain the diaphragm in contact with said shoulder and having an inner edge portion closely adjacent said shaft, and an apertured nut device threaded on said housing and having an annular portion closely adjacent said shaft engaging said cap along its inner edge and acting to maintain the cap in uniform engagement with said diaphragm throughout its periphery.

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