April 17, 1956 D. R. DISBROW 2,741,991

PUMP AND PACKING

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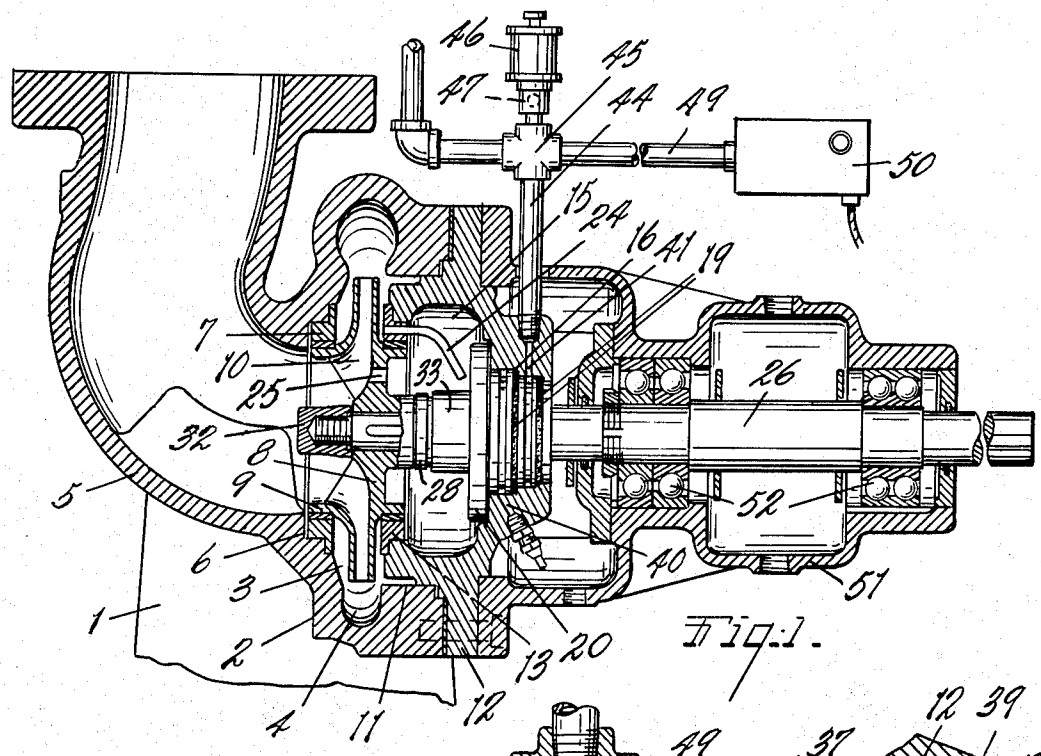


Fig. 1.

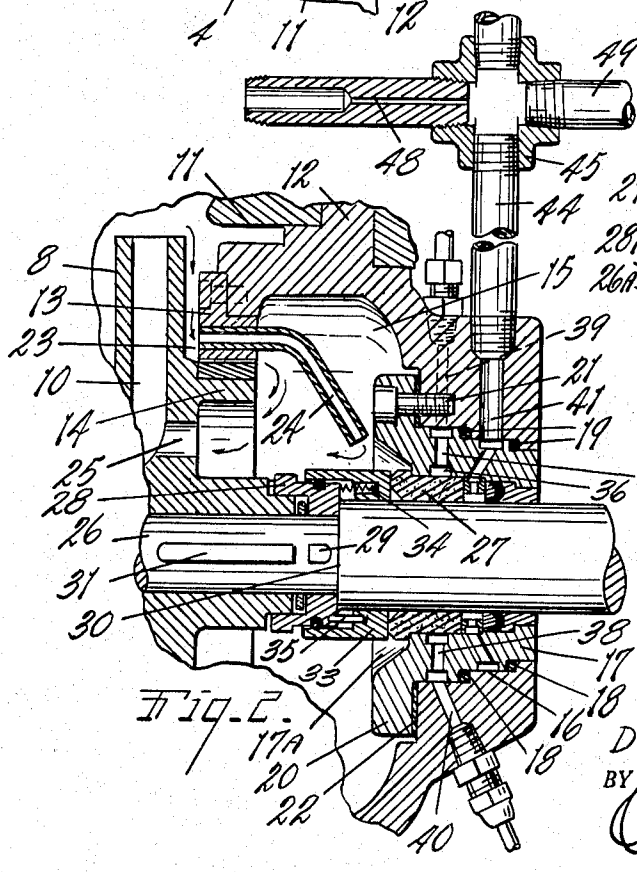


Fig. 2.

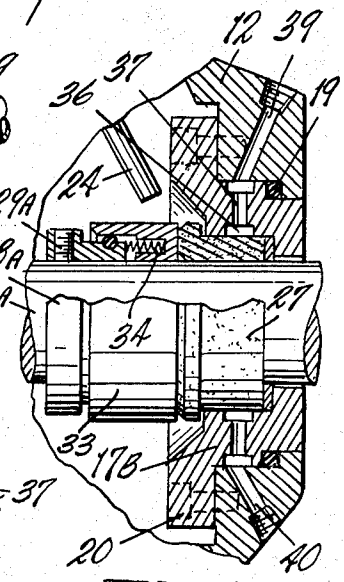


Fig. 3.

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PUMP AND PACKING

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This invention relates to improvements in pump and packing.

The principal objects of this invention are:

First, to provide a novel form of packing construction for the shaft of a high pressure centrifugal pump which construction functions to circulate a portion of the fluid being pumped across the sealing elements of the packing to keep the packing cool and prevent the formation of a gas pocket around the seal.

Second, to provide a centrifugal pump and shaft packing therefor with cooling fluid and pump fluid circulating passages which adapt the pump for high pressure and high temperature operation.

Third, to provide a packing structure for the shaft of a high pressure centrifugal pump which structure is retained in place by the pressure of the pump and is thus unlikely to blow out or be displaced and permit the pump to leak.

Fourth, to provide a pump with a packing structure and indicating system which will immediately indicate an excessive leakage or pressure loss through the packing.

Fifth, to provide a pump and shaft packing therefor which are well adapted for high pressure operation with volatile or dangerous fluids because of the resistance of the packing to leakage or failure.

Other objects and advantages of my invention will be apparent from a consideration of the following description and claims. The drawings, of which there is one sheet, illustrate a preferred and one modified form of my pump and packing.

Fig. 1 is a vertical longitudinal cross sectional view through the pump illustrating my improved packing and indicating system as incorporated therewith.

Fig. 2 is a fragmentary enlarged longitudinal cross sectional view through the packing illustrated in Fig. 1 and the adjacent portions of the pump.

Fig. 3 is a fragmentary longitudinal cross sectional view similar to Fig. 2 but illustrating a modified form of my packing.

My pump comprises a suitable base 1 on which the pump body 2 is rigidly supported. The body 2 forms a central impeller chamber 3 and an annular discharge chamber 4 extending radially outwardly from the impeller chamber. An intake throat or conduit 5 is formed integrally with the body 2 and opens coaxialy into the side of the impeller chamber 3. The radially inner edge of the impeller chamber 3 is annularly shouldered as at 6 around the intake conduit to form a seat for an inner impeller bearing 7. The impeller 8 mounted within the impeller chamber is provided with a journal portion 9 on its axially inner end coacting with the inner bearing 7. The impeller 8 forms a plurality of spoke-like radially extending passages 10 which open axially at their inner ends to the intake conduit 5 and open radially at their outer ends to the discharge chamber 4 as is common in centrifugal pumps of this type.

The outer end of the pump body 2 opposite the intake conduit 5 is provided with a coaxial circular opening 11 closed by the annular pump head 12. The inner edge of the pump head 12 is bored coaxially with the impeller 8 to receive an outer impeller bearing 13 and the outer end of the impeller is provided with an outer journal portion 14 rotatively mounted in the bearing 13. The pump head further defines a central shaft chamber 15 located axially outwardly of the bearing 13. The outer end of the pump head 12 is bored and counterbored as at 16 coaxially with the impeller 8 to receive the gland 17. The bored and counterbored portion 16 is shouldered inwardly toward the chamber 15 as at 18 to form annular seats coacting with outwardly facing annular shoulders on the gland 17. Packing rings 19 positioned against the shoulders 18 assist in sealing the periphery of the gland to the head 12. The inner end of the gland 17 is radially outwardly flanged as at 20 to overlie the inside of the head 12 and is secured thereto by screws 21. A gasket 22 may be provided between the flange 20 and the inner surface of the head.

The chamber 15 within the head 12 is constantly supplied with fluid under pressure from the discharge chamber 4 of the pump through an opening 23 forming in the outer impeller bearing 13 (see Fig. 2). Desirably a short tube or pipe 24 received in the opening 23 directs the fluid inwardly toward the center of the chamber 15 and against the inner end of the gland 17. The inner face of the gland 17 is recessed outwardly of the gland as at 17A and the discharge of the tube 24 is directed into this recess. Fluid under pressure may also leak through bearing connection between the impeller and the outer impeller bearing 13. In order to provide an outlet and return path for the fluid thus delivered to the chamber 15, the impeller 8 is bored as at 25 to return the fluid from the chamber 15 to the radially inner end of one or more of the impeller passages 10.

The impeller 8 is mounted on and driven by a shaft 26 which projects outwardly through the gland 17. A carbon or other wear resistant packing 27 is pressed into the inner end of the gland 20 and sealingly engages the periphery of the shaft 26. The inner end of the packing is thus located in the recess 17A and is provided with a radially extending flange lapped over the outer end wall of the recess. A coupling ring 28 is axially slidably received on the outer end of the impeller and is keyed to the shaft 26 by a short key 29 for rotation with the shaft. A shoulder 30 on the end of the shaft locates the ring 28. A long key 31 drivingly connects the propeller to the shaft and a nut 32 threaded on the end of the shaft clamps the impeller axially to the shaft. A cylindrical running seal member 33 has an outer annular end bearing against the inner end of the carbon packing 27. Springs 34 angularly spaced around the seal member engage the outer end of the ring 28 to bias the running seal against the fixed seal. Pins 35 drivingly connect the running seal with the ring. It will be noted that the tube 24 will direct a stream of the fluid being pumped radially inwardly over the abutting ends of the running seal 33 and packing 27 to maintain these parts relatively cool.

The interior of the gland 17 is annularly grooved as at 36 and opens to the exterior of the packing 27. Radially extending passages 37 and 38 extend from the groove 36 and communicate with a cooling fluid inlet passage 39 and outlet passage 40, respectively, to circulate cooling fluid over the outer surface of the packing 27. Axially outwardly of the packing 27, the gland 17 and head 12 define a radially extending pressure transmitting passage 41. Outer secondary packings 42 are held in axially spaced relationship with the main packing 27 by means of a radially bored spacing ring 43. The passage 41 opens between the packing rings 18 and 19 and is thus located to receive any fluid or pressure that may leak by the packing or between the gland and the packing

or between the gland and the head. The passage 41 extends to and communicates with a stand pipe 44 having a cross 45 on the open upper end thereof. An oil cup 46 positioned over the cross is provided with an outwardly closing check valve 47 so as to deliver oil to the passage 41 to lubricate the shaft. One branch of the T 45 opens through a restricted passage 48 to the atmosphere to bleed off any gases escaping at low pressure to the passage 41. The other side of the cross 45 is provided with a pipe 49 opening to a pressure operated signal device shown generally at 50 in Fig. 1.

Normal small amounts of leakage may thus escape through the passage 48 but should either the gland 17 or packing 27 leak abnormally the sudden increase in pressure will actuate the warning signal 50 to permit shutdown and repair of the pump before serious damage occurs.

Secured to the pump housing 2 along with the head 12 is a chambered bearing bracket 51 provided with roller bearings 52—52 for rotatively supporting the outer driving end of the shaft 26. The shaft may be driven in any desirable manner.

In the modified form of packing and seal illustrated in Fig. 3, the pump housing and head 12 are of the same general construction as that in Fig. 1 and Fig. 2. The gland 17*b* is slightly modified in that it is axially shortened and omits the pressure indicating passage 41 of the first form of the gland. The cooling fluid passage 37 functions in the same manner to deliver cooling fluid to the exterior of the carbon seal 27 and the cooling fluid is withdrawn through the same discharge passages 38 and 40. The same tube 24 directs a stream of the fluid being pumped over the adjacent ends of the fixed and running seals.

The annular coupling ring 28*a* which radially supports the running seal 33 is secured to the shaft 26*a* by means of a set screw 29*a* instead of a key. Since the set screw 29*a* locates the ring both rotatively and axially there is no need for the shoulder 30 on the shaft and the shaft 26*a* is of constant diameter between the impeller and the seal 27.

In both forms of the gland and seal structure illustrated, the gland is pressed against the pump head by the pressure developed in the pump so leakage around the glands is unlikely. The fixed and running seal elements in each form of packing are both cooled from two sources of cooling fluid so that there is little likelihood of the seals becoming overheated and breaking and thus permitting the pump to leak. Also in each form of the packing, a circulation of the fluid being pumped is maintained through the pocket or chamber 15 at the inner end of the gland. This prevents the formation of a gas pocket around the seal when the pump is operating at a temperature near the vaporization point of the fluid being pumped. It is therefore possible to use this pump with volatile or poisonous fluid and to operate the pump at high pressure and high temperature without danger of having fluids or gases escape from the pump.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a centrifugal pump having a casing and an impeller mounted therein, and a shaft connected to rotate the impeller, a chambered head plate embracing said shaft and closing one end of said casing, a journal bearing for the end of said impeller carried on said head plate, a gland received in the end wall of said head plate around said shaft and having a flange overlying the inner side of said head plate, a passage opening from the pressure side of said pump to the space between said gland and the journal bearing on said head plate, a fixed seal carried in said gland and around said shaft, a running seal carried by said impeller around said shaft and spring pressed into engagement with the end of said fixed seal, registering inlet and outlet passages formed in said gland and said head plate and opening to the exterior of said fixed seal to circulate cooling fluid therearound, and a pressure indicating passage opening through said gland and head

plate to the surface of said shaft outwardly out of said seals, said pressure indicating passage being connected to a restricted vent passage and a pressure operated alarm device, said impeller having a passage opening axially therethrough and spaced radially inwardly from said first passage to form a fluid return for fluid discharged from said pump to the low pressure side of said pump.

2. In a centrifugal pump having a casing and an impeller mounted therein with a shaft connected to rotate the impeller, an end wall on said casing through which said shaft extends, said end wall forming an interior chamber around said shaft and opening to the side of said impeller, a journal bearing coacting with said impeller carried on said end wall at the inner end of said chamber, a gland positioned around said shaft and sealingly seated in an opening provided therefor in said end wall, said gland overlying an inwardly facing surface of said end wall whereby pressure in said chamber operates to seat said gland against said end wall, a tube opening from the pressure side of said pump to said chamber and directed radially inwardly of said chamber to discharge toward the center of said gland, said impeller having an axially extending opening formed therein and spaced radially inwardly from the periphery thereof to open into the low pressure side of said pump, a cylindrical fixed seal mounted in said gland and around said shaft and located at the inner end of said gland, an annular coupling member rotatively driven by said shaft within said chamber, a cylindrical rotating seal element slidably mounted around said shaft, means drivingly connecting said element to said member for rotation therewith, and a spring compressed between said element and said member and urging said element into sealing engagement with the end of said fixed seal.

3. Seal structure for the shaft of a centrifugal pump comprising, a wall embracing said shaft and open on its inner side to the pressure of said pump, said wall defining an opening with axially and radially inwardly directed shoulders located at axially spaced positions around said shaft, a radially stepped gland positioned around said shaft with stepped portions thereof opposed to the shoulders of said wall, sealing elements positioned between said shoulders and said stepped portions, a fixed seal mounted in said gland and around said shaft and having a portion radially overlapping an inner surface of said gland, a cooling fluid passage formed in said wall and said gland and around said fixed seal, a packing between said shaft and said gland and spaced axially outwardly from said seal, a radially perforate spacer ring positioned between said fixed seal and said packing, said gland and said wall forming a passage opening to the space between said fixed seal and said packing and extending between said sealing elements, a pressure responsive signaling device connected to said last passage to indicate abnormal increase in pressure in said space, and a rotating seal element carried by said shaft cooperative with the inner end of said fixed seal.

4. Seal structure for the shaft of a centrifugal pump comprising, a wall embracing said shaft and open on its inner side to the pressure of said pump, said wall defining an opening with axially and radially inwardly directed shoulders located around said shaft, a radially stepped gland positioned around said shaft with the stepped portions thereof seated against the shoulders of said wall, a fixed seal mounted in said gland and around said shaft and having a portion radially overlapping an inner surface of said gland, a cooling fluid passage formed in said wall and said gland axially inwardly of said shoulders and around said fixed seal, a packing between said shaft and said gland and located axially outwardly from said fixed seal, and a rotating seal element carried by said shaft cooperative with the inner end of said fixed seal.

5. Seal structure for the shaft of a centrifugal pump comprising, a wall embracing said shaft and open on its inner side to the pressure of said pump, said wall defining

an opening with axially and radially inwardly directed shoulders located around said shaft, a radially stepped gland positioned around said shaft with the stepped portions thereof seated against the shoulders of said wall, a fixed seal mounted in said gland and around said shaft, a cooling fluid passage formed in said wall and said gland axially inwardly of said shoulders and around said fixed seal, and a rotating seal element carried by said shaft cooperative with the inner end of said fixed seal.

6. Seal structure for the shaft of a centrifugal pump comprising, a wall embracing said shaft and open on its inner side to the pressure of said pump, said wall defining an opening with axially and radially inwardly directed shoulders located around said shaft, a radially stepped gland positioned around said shaft with the stepped portions thereof seated against the shoulders of said wall, a cylindrical fixed seal mounted in said gland and around said shaft and having a portion radially overlapping an inner surface of said gland, a packing between said shaft and said gland and spaced axially outwardly from said seal, said gland and said wall forming a passage extending radially between said shoulders and opening to the space between said seal and said packing, and a pressure responsive signaling device connected to said last passage to indicate abnormal increase in pressure in said space.

7. Seal structure for the shaft of a centrifugal pump comprising, a wall embracing said shaft and open on its inner side to the pressure of said pump, a gland positioned around said shaft and seated in said wall, a fixed seal mounted in said gland and around said shaft, a packing between said shaft and said gland and spaced axially outwardly from said seal, said gland and said wall forming a passage opening to the space between said seal and said packing, and a pressure responsive device connected to said last passage to indicate abnormal increase in pressure in said space.

8. In a centrifugal pump including an impeller provided with a shaft and a casing therefor provided with an inlet and a discharge, said casing defining a chamber having an end wall provided with an opening receiving said impeller shaft, said end wall having an inwardly facing packing gland seat surrounding said opening, said chamber being in restricted communication with the pressure discharge of the impeller, said impeller having a pressure equalizing port opening directly to said chamber, and a packing for said shaft including a packing gland disposed within said chamber on said packing seat, the pressure within said chamber acting to urge said packing gland to its seat.

9. In a centrifugal pump including an impeller provided with a shaft and a casing therefor provided with an inlet and a discharge, said casing defining a chamber having an end wall provided with an opening receiving said impeller shaft, said end wall having an inwardly facing packing gland seat surrounding said opening, said chamber being in communication with the pressure discharge of the impeller, said chamber having a pressure opening communicating directly with the intake of the impeller and a packing for said shaft including a packing gland disposed within said chamber on said packing seat, the pressure within said chamber acting to urge said packing gland to its seat.

10. In a centrifugal pump including an impeller provided with a shaft and a casing therefor provided with an inlet and a discharge, said casing defining a chamber having an end wall provided with an opening receiving said impeller shaft, said chamber being in communication with the pressure discharge of the impeller, said chamber having a pressure opening communicating directly with the intake of the impeller and a packing for said shaft including a packing gland disposed within said chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

1,737,870	Telfer	Dec. 3, 1929
1,909,410	Klosson	May 16, 1933
2,077,011	Robinson	Apr. 13, 1937
2,136,799	MacLean	Nov. 15, 1938
2,190,670	Mann	Feb. 20, 1940
2,240,782	Jacobsen	May 6, 1941
2,250,714	LaBour	July 29, 1941
2,259,361	Vorkauf	Oct. 14, 1941
2,375,085	Curtis	May 1, 1945
2,418,258	Harlamoff	Apr. 1, 1947
2,425,209	Snyder et al.	Aug. 5, 1947
2,481,888	Stratford et al.	Sept. 13, 1949

FOREIGN PATENTS

515,616	France	Apr. 5, 1921
641,183	Great Britain	Aug. 9, 1950
649,863	Great Britain	Feb. 7, 1951
843,360	France	July 3, 1939