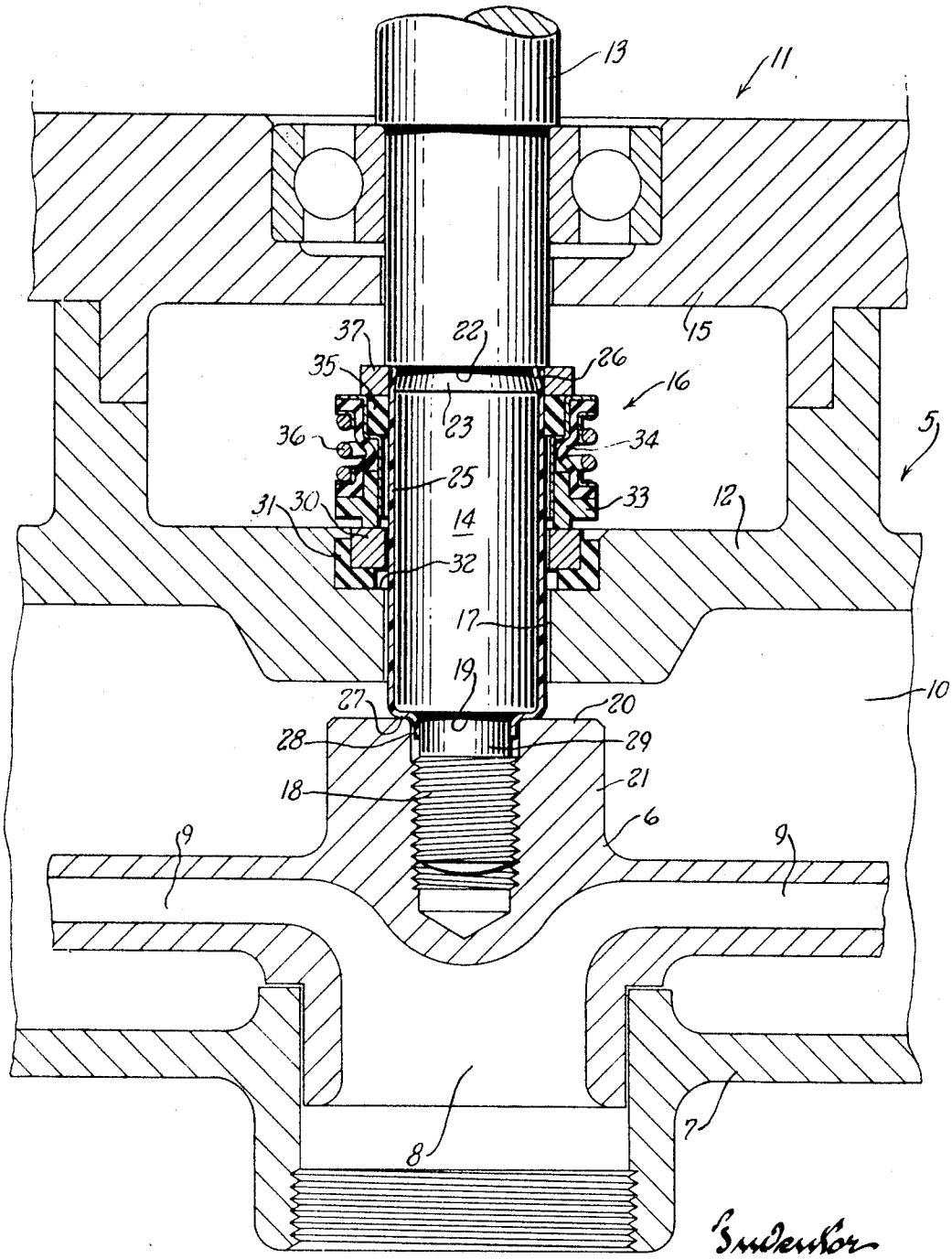
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PUMP

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ABSTRACT OF THE DISCLOSURE

A sleeve of heat shrinkable plastic tubing tightly encasing a portion of a drive shaft adjacent to its driving connection with the impeller of a pump prevents fluid being pumped from corrosive contact with the shaft.

This invention relates to pumps, and has more particular reference to electric motor driven pumps of the type known as jet pumps.

Such pumps comprise a housing, an impeller of the centrifugal type within the housing and an electric motor having a shaft to which the impeller is affixed to be driven by the motor, the motor in turn being rigidly fastened to the pump housing. Rotation of the impeller causes fluid to be drawn into an axial inlet in the impeller and then forcefully discharged through radial passages in the impeller into the interior of the housing, from whence the fluid under pressure issues through a delivery line communicating with an outlet in the housing.

Because the pump drive shaft must extend through an opening in a wall of the pump housing for connection to the impeller, a seal mechanism is ordinarily employed with jet pumps such as described to prevent escape of pressurized fluid from the interior of the pump housing along the exterior of the shaft and through the opening in said wall of the housing. One well-known seal mechanism used for this purpose is mounted at the exterior of the pump housing and comprises a stationary sealing ring loosely encircling the pump drive shaft and held in a synthetic rubber cup pressed into a recess in the pump housing, and a rotating assembly cooperating with the stationary sealing ring and driven by a synthetic rubber annulus tightly seated on the shaft at a location axially outwardly from the stationary ring.

From this it can be appreciated that liquid in the pump housing inevitably came into contact with the adjacent portion of the pump drive shaft, specifically that portion of the shaft extending between the synthetic rubber annulus of the seal mechanism and the impeller, which is ordinarily threaded onto the extremity of the shaft. This has long presented an annoying shaft corrosion problem which was particularly acute whenever the liquid pumped contained active chemicals in solution.

Various attempts have been made to solve this corrosion problem, as by the expedient of plating the pump drive shaft, or by the use of a shaft made entirely of stainless steel or other corrosion resistant material, or by fitting a stainless steel sleeve around the end portion of a plain carbon steel shaft. In some cases, the entire end portion of the shaft was provided by a stainless steel stub shaft coaxially affixed to a carbon steel main shaft portion. Of these expedients, the use of plating is the least expensive, but is generally inferior to shafts made from stainless steel. These, however, were not only quite costly, but more difficult to machine than plain carbon steel.

The present invention provides an inexpensive but thoroughly satisfactory solution to the above described corrosion problem, by the expedient of tightly encasing a substantial portion of a plain carbon steel pump drive shaft in a sleeve of heat shrinkable plastic tubing, which

sleeve not only extends toward the motor and beyond the synthetic rubber annulus of the seal mechanism, but also has an end portion which is clamped between the end of the impeller hub and a shoulder on the adjacent end portion of the drive shaft to act as a gasket in preventing liquid from contacting that part of the drive shaft having the impeller affixed thereto. This effectively prevents corrosion of the threaded shaft end and solves the attendant problem of difficulty in removing the impeller therefrom whenever necessary.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawing illustrates one complete example of the physical embodiment of the invention, constructed according to the best mode so far devised for the practical application of the principles thereof, and in which:

The single figure is a fragmentary sectional view of adjacent portions of a jet pump and drive motor close coupled to the pump, and illustrating how this invention protects the motor shaft against corrosion.

Referring now to the drawing, the numeral **5** generally designates a jet pump having an impeller **6** which rotates within the housing **7** of the pump. The inlet of the pump is coaxial with the throat **8** or inlet of the impeller, and passages **9** in the impeller radiating outwardly from its inlet force the liquid being pumped into the interior **10** of the housing during rotation of the impeller.

The impeller is driven by an electric motor **11** which, in the embodiment illustrated, is mounted on the top wall **12** of the pump housing with its shaft **13** vertical. The lower end portion **14** of the shaft projects downwardly from the bottom end bell **15** of the motor through a seal mechanism **16** and through an opening **17** in the top wall **12** of the pump housing, to have the impeller **6** drivingly connected to its extremity **18**. The extremity **18** of the shaft is reduced in diameter to provide a downwardly facing shoulder **19** at the end of the lower portion **14** of the shaft, which shoulder closely opposes the end **20** of an upwardly extending hub **21** on the impeller. The extremity **18** of the shaft is threaded and screwed into a tapped hole in the hub **21** to provide the driving connection between the shaft and the impeller.

The lower portion **14** of the drive shaft is also reduced in diameter to define a downwardly facing shoulder **22** at its upper end; and a circumferential groove **23** is cut in the shaft directly under the shoulder **22**.

According to this invention the entire outer or lower portion **14** of the drive shaft is protected by a tight fitting liquid proof sheath or sleeve **25** of plastic material, which loosely fits the opening **17** in the top wall of the pump housing. The purpose of the sleeve is to prevent corrosion of the shaft by contact therewith of the liquid being pumped.

The sleeve **25** is preferably provided by a length of heat shrinkable plastic tubing encircling the lower portion **14** of the shaft, and having its upper end portion **26** contracted into tight engagement with the bottom of the groove **23** under the upper shaft shoulder **22** to anchor the upper end of the sleeve axially to the shaft. The lower end portion **27** of the sleeve is contracted inwardly and under the bottom shoulder **19** and tightly clamped between the latter and the adjacent end **20** of the impeller hub to anchor the lower end of the sleeve to the shaft.

As shown, the lower end of the sleeve terminates in a short downwardly extending axial neck **28** which more or less snugly embraces the undercut portion **29** joining the threaded extemity **18** of the shaft to the shaft portion **14** thereabove.

The lower end portion **27** of the sleeve, being clamped between the shoulder **19** and the end of the impeller hub, acts as a gasket to prevent liquid in the interior of the pump housing from contacting the threaded extremity **18** of the shaft. The remainder of the sleeve **25** cooperates with the seal mechanism **16** in preventing liquid from contacting the shaft portion **14** above the impeller.

The seal mechanism **16** is of a conventional type, having a stationary annular seal face **30** loosely encircling the shaft portion **14** and clearing the sleeve **25** thereon. The seal face **30** is mounted in a rubber holder **31** of angle shaped cross section, pressed into an upwardly opening recess **32** in the top wall of the pump housing, concentric with the opening **17** therein. The rotating seal face **33** bears upon the stationary face **30** and provides a seat for one end of a bellows **34**. The other end of the bellows is seated upon an annulus **35** of synthetic rubber, which encircles the upper portion of the sleeve **25** in fluid tight relation thereto, just below the anchored end **26** of the sleeve. The annulus **35** thus rotates with the shaft and drives the rotating seal face **33**. A coiled compression spring **36** encircling the bellows yieldingly urges the seal faces **30–33** into fluid tight engagement with one another, and a washer **37** is interposed between the upper shoulder **22** on the shaft and the seal mechanism to hold the latter effective.

Liquid from the interior of the pump housing is free to flow upwardly through the opening **17** in the top wall of the pump housing and along the exterior of the plastic sleeve **25** to the interior of the seal mechanism **16**. The rubber annulus **35**, however, prevents leakage of liquid upwardly out of the seal mechanism, while the remainder of the seal mechanism prevents leakage of liquid radially outwardly from the space enclosed thereby.

The seal mechanism thus cooperates with the plastic sleeve **25** to prevent liquid from contacting any surface of the shaft **13**, while that portion of the shaft extending between the rubber annulus **35** and the impeller hub **21** is covered and protected by the plastic sleeve **25** alone. One of the features of this invention resides in the fact that the plastic sleeve **25** does not come into rubbing contact with any stationary part of the seal **16**, the pump, or the drive motor therefor.

Several advantages result from protection of the pump drive shaft by heat shrinkable plastic tubing in the manner described. It allows the shaft to be made of plain carbon steel which is relatively inexpensive and easily machinable; it provides long lasting protection for the shaft at lower cost than any other expedient offering equivalent protection against corrosion; it provides a gasket effect at the driving connection between the shaft and the impeller hub to prevent liquid from coming into contact with the threads on the extremity of the shaft; and by choice of the proper heat shrinkable plastic tubing, it enables the drive shaft to be "tailored" for trouble free operation in various corrosive environments, such as when chemicals or petroleum products are to be pumped.

The application of the heat shrinkable plastic tubing to the pump drive shaft can be accomplished in an exceedingly simple and efficient manner which entails supporting a group of identical motor shafts in vertical positions in a tray or fixture, with their threaded extremities uppermost. Pieces of heat shrinkable plastic tubing of the proper length and of a diameter only slightly larger than the intermediate diameter portion **14** of the shafts are then slipped over the threaded extremities of the shafts to bottom on their large diameter shoulders **22**. The tray containing the shafts can then be lowered into hot oil or other fluid at the temperature required to contract the heat shrinkable plastic tubing, and allowed to remain for the few minutes necessary to complete the shrinking step. This can be effected without immersing the plastic tubing in the hot oil or other liquid, as the required heat will flow upwardly into the shafts to initiate shrinkage of the tubes at their lower ends, where the tubing will anchor itself into the circumferential grooves **23** adjacent to the larger diameter shoulders **22**.

The shrinkage of the tubing to form the sleeve **25** will take place progressively from the shaft shoulder **22** toward the threaded extremity **18** of the shaft. Since there will be axial as well as diametral shrinkage of the tubing, allowance should be made for lengthwise shrinkage to assure that the resulting sleeve will always extend inwardly over the smaller shoulder **19** adjacent to the threaded extremity **18** of the shaft.

From the foregoing description, together with the accompanying drawing, it will be apparent to those skilled in the art that this invention provides an exceptionally simple but efficacious solution to the long standing problem of corrosion in the drive shafts of pumps.

What is claimed as my invention is:

1. In a motor driven pump of the type having a pump housing in which an impeller rotates to cause liquid to be drawn into and then expelled from the housing, and wherein the motor shaft has its extremity coaxially drivingly connected to a hub on the impeller and has a portion which projects from the end of the hub through an opening in one wall of the housing and through a seal mechanism at the exterior of the housing, said seal mechanism having a seal face fixed with respect to the housing and loosely encircling said portion of the shaft, and an annular elastic ring encircling the shaft at a location beyond the seal face and adapted to rotate with the shaft, the improvement which comprises:

(A) said portion of the motor shaft having a uniform diameter greater than that of said extremity thereof to define a shoulder from which the extremity projects, and which shouder is close to and opposes the adjacent end surface of the impeller hub;

(B) an elongated sleeve of plastic tubing tightly encircling said uniform diameter portion of the motor shaft to prevent liquid from contacting the same, said sleeve having one end portion directed inwardly over said shoulder and clamped between it and the adjacent end of the impeller hub to prevent liquid in the housing from contacting the extremity of the shaft at its connection to the hub, the sleeve extending loosely through said opening and the seal mechanism but having said elastic ring tightly seated on its end portion remote from the impeller;

(C) and means on the shaft engaged by said remote end portion of the sleeve at a location beyond said elastic ring, for anchoring said remote end portion of the sleeve to the shaft.

2. The motor driven pump of claim **1**, wherein said last named means comprises a circumferential groove in the shaft, and an annular inwardly directed flange on the sleeve tightly engaged with the bottom of said groove.

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