

Closed Coupled Pump

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Abstract— Close-coupled pumps are characterized by a common motor and pump shaft or by their motor shaft and pump shaft being rigidly connected in a pump casing. The pump casing is bolted to the drive flange rather than being installed on pump feet. This enables straightforward installation as the shafts and casings do not need to be aligned. This reason itself added by improper or no lubrication of bearings results in 80% of pump system problems and hence we have decided to give a thought to eliminate these major problems in our closed coupled pump.

Keywords: Pump, Coupled

I. INTRODUCTION

A. What is a pump?

A machine designed to move fluids from lower level to higher level by adding energy to it are called pumps.

B. What is a close coupled pump?

A type of pump that involves an impeller as the central element of the motor component. The pump doesn't have a separate coupling, and thus eliminate coupling alignment, one of the more expensive and time-consuming operations of pumps that aren't close-coupled.

C. How do they work?

In a close coupled pump, the impeller is on the same shaft as the electric motor that drives the pump. The motor has a machined face on one end, which matches the face on the pump casing that is mounted against the motor face. The bearings that are in the motor must handle the forces generated by the pump, since it doesn't have its own separate bearing housing.

D. What applications are they used?

The simplicity, versatility, and relatively low cost of this type of pump make them useful in many industries. They typically are used with relatively simple seals, so they are limited as to temperature and to relatively non corrosive liquids. Because the bearings are located in the motor, close couple pumps are limited in size to about 40-50 hp for most applications.

Other related Pump Types include: industrial pumps, horizontal split case pumps, process pump, chemical process pump.

II. PROBLEM DEFINITION

In pumps many problems occur which leads to the damage of pumps. The problem mainly are

Problem in PUMPS

- Misalignment of coupling which causes vibration in pumps.
- Bending of shaft due to misalignment of coupling.
- Mechanical seal leakage.
- Bearing damage.
- Problem in IMPELLER
- Closed impellers have many disadvantages like it cannot be used for slurry type application.

- chocking is the main problem.

III. OBJECTIVES

- To avoid bending of shaft by eliminating coupling and introducing male female shaft.
- To remove the vibration in pumps by proper aligning of shaft.
- To improve the life of bearing by introducing permanently grease packed bearing and proper aligning of shaft.
- Introducing open impeller for eliminating the problem of chocking.
- Introducing open impeller can help for slurry type applications.

IV. SCOPE

Pumps may have become more expensive in those places where maintenance plays an important role. Thus, in order to save energy, man, machine and time in the most appropriate ways we have designed the closed couple pump.

This project report presents a brief mention of our efforts. Project work has given us good exposure to the practical field which in the future is definitely going to help us.

V. CONSTRUCTION AND WORKING

A. The closed couple pump consists of the following parts:

1) Casing:

Casing receives liquid at higher velocity from the impeller and converts it into pressure energy. It guides liquid to the delivery pipe line with minimum loss of energy..

Types of casing:

- 1) Vane less guide ring
- 2) Annular delivery passage of constant cross section
- 3) Volute casing
- 4) Diffuser and return vanes

2) Pump shaft:

The pump shaft secures impeller and other rotating parts like shaft sleeves, sleeve nuts, etc, in position. The shaft is supported on bearings to reduce the friction. It is designed to transmit the required power without vibrations. The weight of rotor, axial thrust, radial thrust and torsional stresses are other important to be considered while designing the pump shaft.

3) Closed coupled pump shaft:

In monoblock construction the closed impeller is directly mounted on the motor shaft. The complete axial and radial thrust is transferred on the motor bearing, this increases the frequency of bearing failure and also there are limitations if we have to make any changes to fulfil the requirements of different process applications such as:

- 1) Change in material of construction of hydraulic parts and shafts.
- 2) This has led to the thought of developing a coupled pump. Further improved by spacer type coupled pump to bring the ease of maintenance of coupled pumps.

- 3) The motor shaft and pump shaft are separate and they are coupled by the coupling.
- 4) But this coupling eliminates the disadvantages of monoblock pumps has added new problems of maintaining and perfect alignment to the shafts.
- 5) If the alignment is not perfect then the pump unit leads to vibrations resulting in failure of rotating parts such as bearings, mechanical seals, etc.

This reason itself added by improper or no lubrication of bearings results in 80% of pump system problems and hence we have decided to give a thought to eliminate these major problems in our closed coupled pump.

In closed coupled pump while we have retained the benefits of monoblock and also of horizontal back pullout pump.

We have eliminated the major culprits of the failure of both the types of pumps by designing a special type of shaft and bearing housing.

In ccp even though the shaft of the pump and motor are separate, they are coupled by inserting the solid shaft of motor into the hollow pump shaft and the power energy is transmitted through the key common in both the shafts.

4) Impeller:

Impeller is a rotating body with number of blades or vanes which forces the liquid at higher pressure and velocity into the casing by impelling action. Impeller vanes are normally curved backwards and are called plain or radial if they are of single curvature. Wider impellers have vanes of double curvature the suction end being twisted. Such impellers are called mixed flow or Francis type.

Impellers have open semi-open or shrouded construction. When the liquid enters into the impeller from one end it is called a single suction impeller. If the liquid enters from both the ends then it is called a double suction impeller.

5) Bearing Housing Assembly:

Bearing housing assembly supports rotating parts firmly and with least frictional loss. Bearing housing provides enclosure to the sensitive bearing element. It retains the lubrication for long duration. Bearing end covers locate the bearing in position and protect the bearing from foreign particles. Oil ring is provided to carry the lubrication up to the bearing race and thus ensure the presence of lubricant all the time. Grease cup, grease nipple, constant oil leveler, oil level indicator are other important fittings provided in the bearing housing assembly. Deflectors are fitted on the shaft to deflect the liquid away from the bearing assembly, so that the liquid will not enter and get mixed with the lubricant. Bearing housing design depends on the type of bearing used.

The bearing types are:

- 1) Sleeve Bearing
- 2) Antifriction Bearing
- 3) Tilting Pad type Bearing

The shape of bearing housing is decided by the type of lubrication and the method adopted for cooling the bearing. The types of lubrication are:

- 1) Grease lubrication
- 2) Oil bath lubrication
- 3) Forced oil lubrication
- 4) Pumping liquid itself used as lubrication.

The methods of cooling the bearing are:

- 1) Air cooling
- 2) Water cooling by cooling coil or cooling jacket

The selection of proper bearing with correct lubrication is very important.

- 1) sleeve
- 2) logging ring
- 3) gland packing
- 4) sleeve nut
- 5) gland

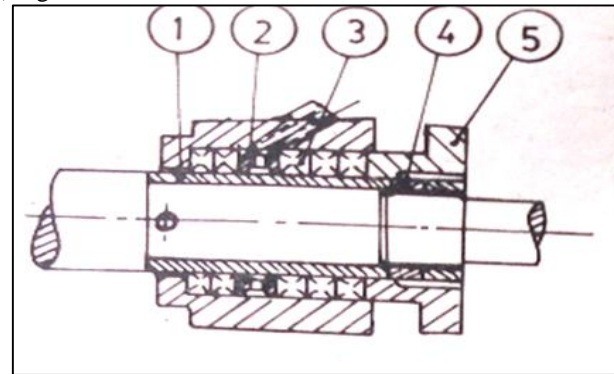


Fig. 1: Stuffing box assembly.

B. Concept of Bearing Housing in CCP:

It is made suitable where the location of flange mounted motor exactly matches with the connecting flange of bearing housing in such a way that there is automatic and permanent alignment.

The bearing stored in the bearing housing is of factory filled grease lubricated and sealed from both the sides 6307 2RS. This bearing doesn't need any lubrication as the grease is filled and sealed from both the sides.

These combined features of hollow shaft, bearing housing, bearing and impeller would eliminate major maintenance problem in the process industry.

C. Casing wearing and Impeller Wearing Ring:

These are the renewable parts fitted on casing and impeller respectively. They increase the lift of casing and impeller. It is convenient to replace the rings than to replace the valuable component itself.

D. Suction Cover / Suction Bell Mouth:

Suction cover is fitted on suction side of single suction impeller. In case of vertical pump this cover has got bell shape, so it is called as suction bell mouth. The suction cover guides the liquid to the impeller eye.

E. Stuffing Box Cover:

The stuffing box cover seats on the rear side of end suction impeller. It may have a provision of renewable wearing ring or wear plate depending on the design of pump. It has got a counter bore for stuffing box assembly.

F. Delivery Cover:

Delivery cover guides the liquid into the delivery pipe line with minimum losses. Flanged or screwed connection is provided in the delivery cover to connect the delivery pipe line.

G. Stuffing Box Assembly

The stuffing box assembly is provided where the shaft comes out of the pump. It seals the liquid with moderate friction loss when the pump is working.

H. Motor:

The motor is a three phase AC, totally enclosed fan cooled (TEFC) 3HP and 2900 rpm. The motor can be run in clockwise or in anticlockwise direction suitable for 415 volts $\pm 5\%$ variation, 50 hertz $\pm 5\%$ F class insulation flange cum foot mounted.

I. Advantages

- The pump shaft and motor shaft of the closed coupled pump are separate..
- A hollow shaft coupling is used instead of time to time alignments.
- The maintenance of each and every part is very simple and almost cost free.
- As the impeller is not mounted on the motor shaft, the frequency of the bearing failure is eliminated.

J. Applications

- Closed coupled pumps are generally used for chemical industries.
- Closed coupled pumps can be used for water, slurries, chemicals, liquids with sediments, etc.
- Closed coupled pump can be used for large scale displacement purposes.
- Closed coupled pumps can be used for higher head displacements.

VI. CONCLUSION AND FUTURE SCOPE

The main problem arises in centrifugal pump is the miss alignment of pumps coupling after a period of time, due to this the bearings, mechanical seal, bending of shaft and friction between impeller and casing occurs. This leads to the failure of the total pump.[1]

To avoid all such problems elimination of coupling was important because main source of problem starts with the misalignment of the coupling, hence we have decided to eliminate the coupling and make a male female step in shaft from which automatic alignment of pump shaft and motor was introduced, Due to this there will be no issue of misalignment and the pump working will be smooth.[2]

Horizontal back pull out pumps need lots of maintenance and observations such as bearing lubrication, but in this pump we will change these bearings into permanently grease lubricated bearings hence does not need to lubricate these bearings with oil.[3]

The pumps close impeller will be changed into open impeller and due to this clear liquid plus slurry applications could be covered with this pump. [4]

Pumps may have become more expensive in those places where maintenance plays an important role. Thus, in order to save energy, man, machine and time in the most appropriate ways we have designed the closed couple pump.[5]

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