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Review Paper on Application of Variable Displacement Linkage in Radial Piston Pump

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Abstract

Radial piston pumps are valve controlled with cylinders in a radial arrangement. The cylinder radials in one, two or several superimposed layers (stars) are driven by bearing fitted eccentrically on the drive shaft (piston pressure stroke), then being returned to their idle position by springs (piston intake stroke).The fluid being delivered by the various cylinders is collected via manifolds feeding one joint pressure port. The pump housing shells are load-bearing elements supporting the cylinders and shaft bearings. The pumps run very smoothly as the drive shaft is statically balanced via counter weights. With the exception of the single- and double-cylinder pumps, there is always an uneven number of pistons per cylinder radial, which minimizes any pulse effect on the pump deliver.

Keywords: Leaching; Microbes; Mining waste

Introduction

A pump is a device that moves fluids (liquids or gases), or sometimes slurries by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps. Pumps operate by some mechanism (typically reciprocating or rotary), and consume energy to perform mechanical work by moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power, come in many sizes, from microscopic for use in medical applications to large industrial pumps.

Mechanical pumps serve in a wide range of applications such as pumping water from wells, aquarium filtering, pond filtering and aeration, in the car industry for water-cooling and fuel injection, in the energy industry for pumping oil and natural gas or for operating cooling towers. In the medical industry, pumps are used for biochemical processes in developing and manufacturing medicine, and as artificial replacements. Reciprocating pumps are used for high pressure application.

Literature review

Marning et al [1] had given a concept in there paper "*The Improved Volumetric Efficiency of an Axial-Piston Pump Utilizing a Trapped-Volume Design"* about development in Swash-plate type axial-piston pumps are used as the fluid power-source for hydraulic circuitry. These devices are used to transmit power in many engineering applications such as aircrafts, earthmoving equipment, and shop tools. The advantages of these machines have been high effort and low inertia, flexible routing of power, and continuously-variable power transmission. Disadvantages of hydraulic systems have been fluid leaks, system flammability, contamination sensitivity, and lower operating efficiency.

Haggag, [2] proposed that the hydraulic power industry is traditionally divided into two different markets: a) mobile hydraulics and b) stationary hydraulics. Stationary hydraulics is often called industrial hydraulics. In industrial hydraulics, the size and weight of components are usually not major concerns. Mobile hydraulics requirements, on the other hand, are more complex. Operating conditions play a significant role in the design and performance of mobile systems. Weight and size requirements are naturally of much greater importance, since every component has to travel with the mobile equipment. The primary power source in a mobile application is typically one diesel engine per system, which limits the number of pumps for the system since they all have to be driven off the same shaft.

Bergada et al [3] were focused on understanding the flow losses and the resulting flow/pressure dynamics in a piston pump. Initially, equations to evaluate leakages in all piston pump gaps will be presented

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and tested against numerical models, later the equations will be linked to determine the general pressure/flow pump dynamic characteristics. The model will also provide the temporal pressure in each piston/cylinder chamber and the temp or all leakage in all pump clearances. A test rig able to measure the dynamic pressure inside a piston chamber was build and employed to evaluate pressure ripple dynamics as a function of turning speed, outlet pressure and swash plate angle. The comparison between experimental and simulated results is very good, giving confidence to the model presented. The advantage of using the analytical approach is that explicit equations allow a more direct understanding of the effect of dimension changes and operating conditions on pump dynamics.

Kemmetm **[6]** was work on fixed displacement pump is used, then the input speed of the pump can be utilized to change the output volume flow. In many applications, fixed displacement pumps are driven by electric motors which allow an easy control of the speed. The second possibility to control the volume flow of a pump is to change the displacement of the pump. In this context, variable- displacement axial piston pumps are often used, whereby the displacement of the pump (i.e. the volume flow) can be changed by tilting a swash plate. This can be done fast enough to meet the dynamical demands of many loads.

Bianchi **[7]** explain a concept in his united state patent "*Bent axis pump*." He proposed claim on bend axis pump comparing a front body having a shaft revolving relative to first axis of rotation operatively connective to pistons, a cylinder body associated to the front body and suitable for seating and guiding said piston, the cylinder body being arranged along a second axis of rotation bent relative to first axis of rotation and being integral in rotation with the shaft, a back body associated to the cylinder body and comparing a suction duct and a delivery duct for said pistons the back body being associated to the cylinder body by the interposition of a connecting pin , integral with the back body.

Guggemos et al. **[9]** was patented on claim of an axial piston fluid pump or motor of the swash plate or bent axis type having fix housing which includes two fluid flow passages which open through a support surface of the housing and including pistons reciprocating in chambers in the drum, and control the plate clamped between the rotatable drum. Also operating parameters are selected from the group consisting of displacement, speed of revolution, load, and operating fluid.

Wilhelm et al **[10]** have conducted an experimental study on variable Displacement linkage pump. If low friction roller element bearings are used in the pin joints of the linkage, the linkage based pump is expected to have efficiencies greater than 90% for displacements greater than 10% for the majority of operating conditions, not including valve related losses. The linkage based variable displacement pump as a viable solution to achieve high efficiency at low displacement.

Conclusion

Several studies have been reported on the improvement in pressure and efficiency of bent axis piston pump which work as variable displacement pump. Thease papers describes a synthesis technique to design a linkage for a variable displacement piston pump/motor that can go to zero displacement. Operating parameters are selected from the group consisting of piston displacement, speed of revolution, load and operating fluid.

On the above research the linkage based variable displacement pump as a variable solution to achieve high efficiency at low displacement which can further the potential of modern fluid power systems.

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