Adjustable Stroke Variable Displacement Pump

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ABSTRACT: Pump is device that moves a fluids by mechanical action.It can consume energy to perform mechanical work by moving the fluid.In hydraulic power systems, variable displacement pumps save power,increase the productivity or control the motion of load precisely,safely and in economical manner.The displacement varying mechanism and power to weight ratio of variable displacement piston pump makes them most suitable for high power levels.

1 INTRODUCTION

THE bent axis piston pump is preffered in most hydraulic power systems because of its high performance and efficiency. It is also capable of operating at variable conditions of flow, pressure , speed and torque. The piston pump offers following features that make it outstanding as compared to other positive displacement pumps:

Pressure: Piston pumps have the highest pressure capabilities of the other technologies, up to 7250 psi (500 bar) for those in common use, and as high at 10,000 psi (690 bar) for certain specialized units. Vane and gear pumps are commonly limited to pressures up to about 4000 psi (275 bar).

Input Speed: Piston pumps have the highest input speed capabilities.

Power Density: Hydraulic power density is directly related to operating pressure; the higher the pressure the greater the power density. Piston pumps offer the highest power density with vane and gear types following in that order

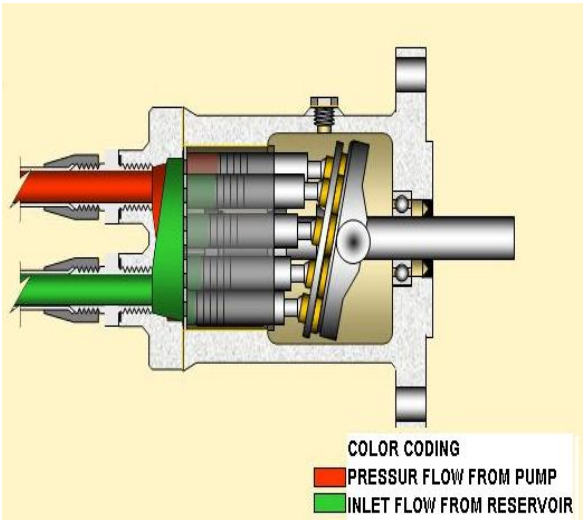
Conversion Efficiency: Like power density, the conversion ratio of input power to output power is directly related to operating pressure. Piston pumps offer the highest conversion ratio, followed by vane and gear pumps in that order. The ability of piston and vane pumps to be hydraulically balanced is also a factor in their greater conversion efficiency.

Inlet Vacuum Tolerance: Positive inlet pressure is always preferred in hydraulic pump applications to avoid wear and premature failure. Bent axis piston pumps offer good vacuum tolerant handling.

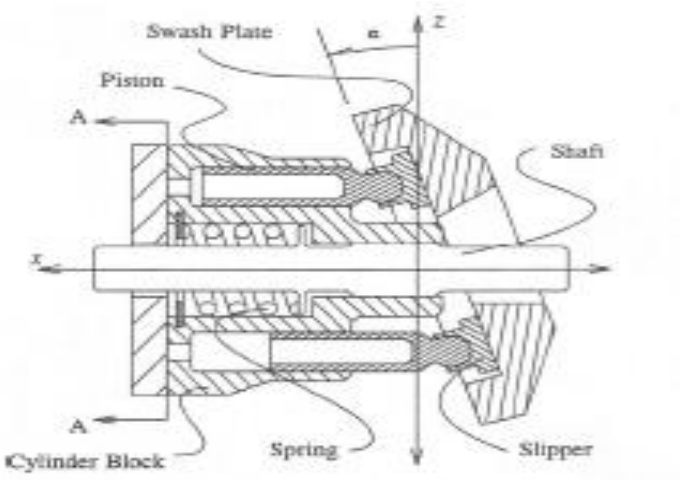
Fluid Compatibility: Piston pump tend to offer the greatest range of fluid compatibilities. Note that is it often necessary to de-rate a pump when it is used with non-petroleum fluids. Fluid compatibility depends on the type of seals, O-rings and materials used in the construction of a pump.

Life Expectancy and Repairability: Piston pumps offer longest service life of the other technologies and are repairable.

AXIAL PISTON OR SWASH PLATE PISTON PUMP



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.



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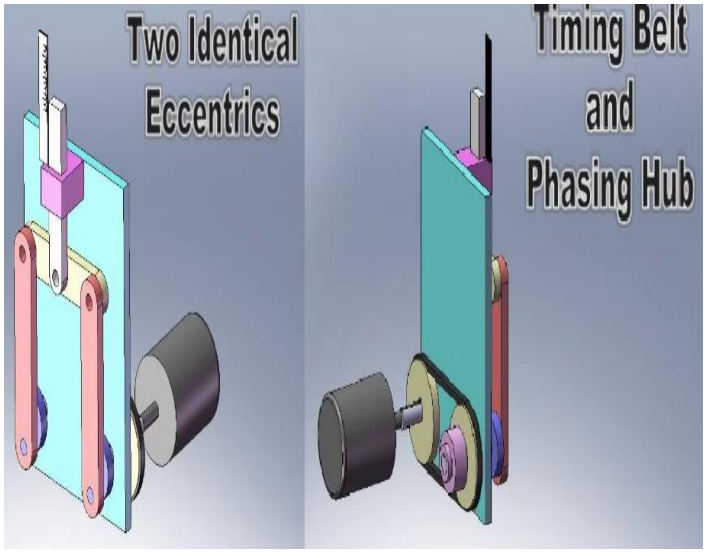
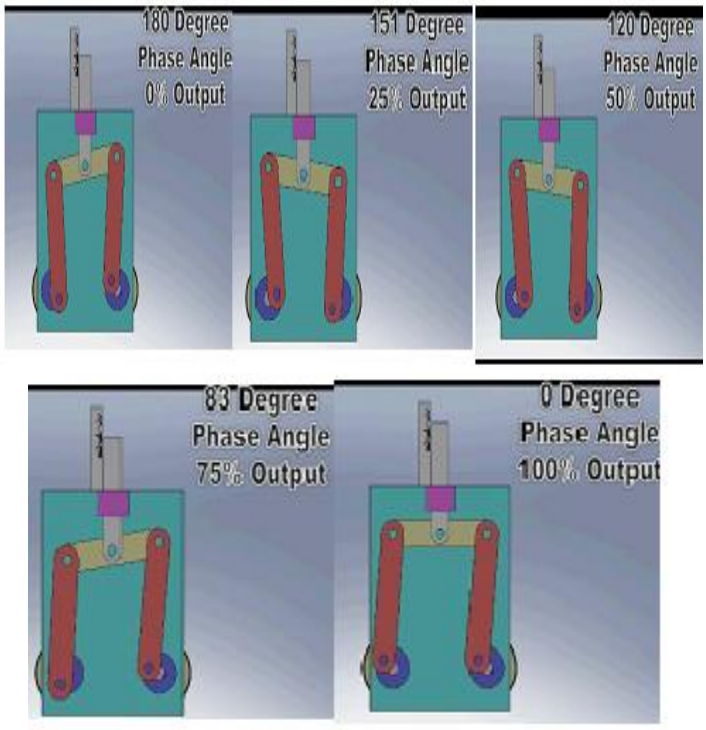
By varying the angle of swash plate it is possible to vary the stroke of the pistons hence the discharge can be varied in this configuration of pump.Disadvantages of bent axis piston pumps have been fluid leaks, system flammability, contamination sensitivity, and lower operating efficiency. Though the advantages of these machines are gaining a strong presence in the marketplace, the disadvantages must be minimized if fluid power is to remain a strong alternative among the various choices of power transmission.[6] The major obstacle in application of the bent axis piston pump is extremely high cost (minimum Rs90000/)- over that of the radial piston pump , it ranges in the range of 5 to 6 times the cost of radial piston pump. Hence there is a need to develop a modification in the radial piston pump design that will offer a variable discharge configuration in addition to the advantages of high efficiency and maximum pressure Axial piston pumps with constant pressure and variable flow have possibilities for controlling the flow by change of pressure. Owing to pressure feedback,so that volumetric control of the pump provides a wide application of these pumps in complex hydraulic systems,specialy in aeronautics and space engineering Thus objective is defined to develop a variable displacement linkage that will enable to vary the stroke of an single cylinder axial piston pump , thereby offering to vary the discharge of the pump using manual control.

CONCEPT & IMPLEMENT OF ADJUSTABLE STROKE MECHANISM

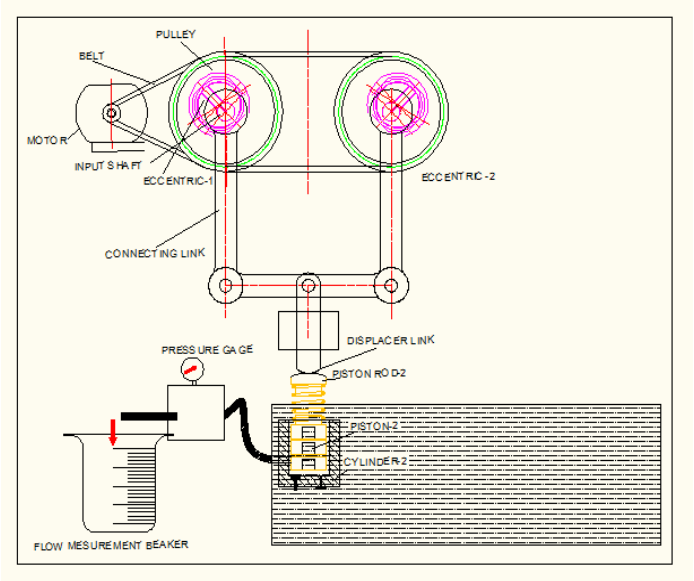


This mechanism shown above is to convert rotary motion of eccentrics into reciprocation of slider near scale, note that this reciprocation of the slider is input to the piston pump …thus if we are able to vary the displacement of piston then we can vary the discharge from the pump thus converting a fixed displacement piston pump to variable discharge pump at a very very low cost as compared to the bent axis piston pump available in market.

HOW OUTPUT FROM ADJUSTABLE MECHANISM CHANGED FROM ZERO TO MAXIMUM



SETUP AND EXPERIMENTATION:



EXPERIMENTAL ANALYSIS:

A]Discharge V_S Speed

B]Volumetric efficiency V_S Speed

TEST AND TRIAL ON VARIABLE DISPLACEMENT LINKAGE PUMP:

OBSERVATION SET-1: Control link at 0^0 position-

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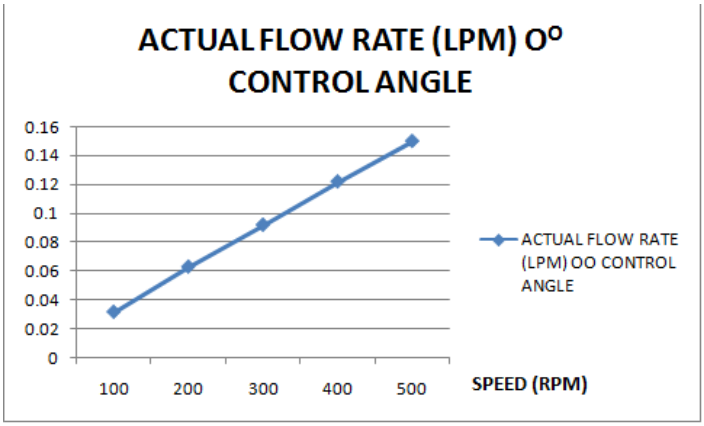
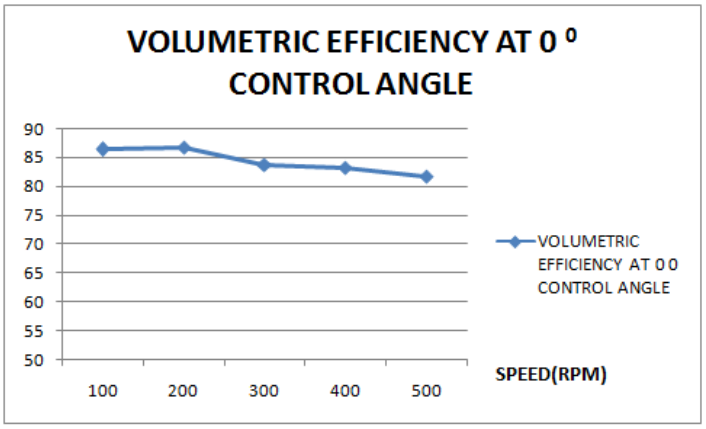
SR. NO.	SPEED (RPM)	VOLUME IN BEAKER (ml)	TIME (SECONDS)	FLOW RATE (LPM)
01	100	100	189	0.0317
02	200	100	94	0.063
03	300	100	65	0.092
04	400	100	49	0.122
05	500	100	40	0.15



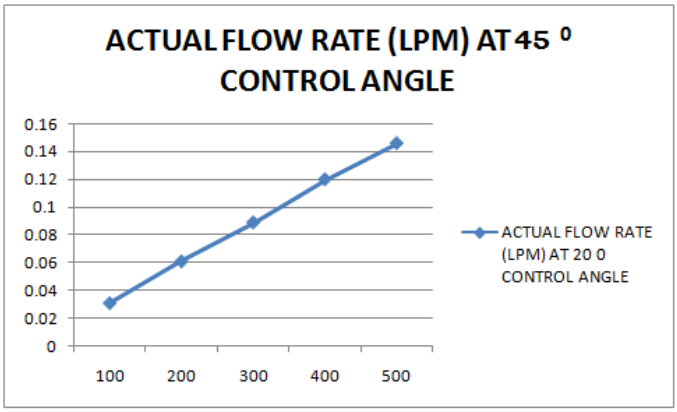
SR. NO.	SPEED (RPM)	ACTUAL FLOW RATE (LPM)	THEORET-ICAL FLOW RATE	VOLUMETRIC EFFICIENCY
01	100	0.0317	0.036	86.35
02	200	0.063	0.073	86.82
03	300	0.092	0.11	83.7
04	400	0.122	0.147	83.2
05	500	0.15	0.183	81.65

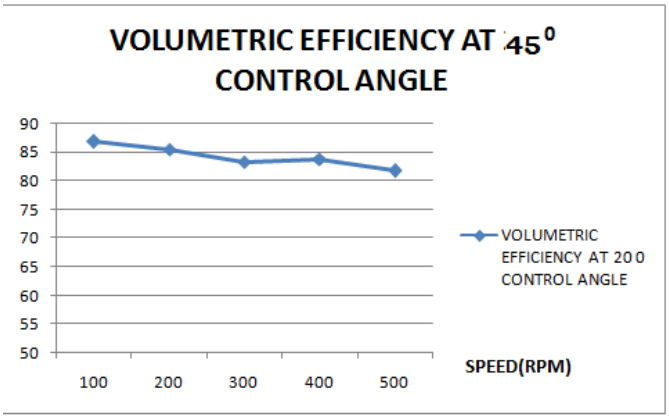


OBSERVATION SET-2: Control link at 45^0 position-

SR. NO.	SPEED (RPM)	VOLUME IN BEAKER (ml)	TIME (SECONDS)	FLOW RATE (LPM)
01	100	100	193	0.031
02	200	100	98	0.061
03	300	100	67	0.089
04	400	100	50	0.12
05	500	100	51	0.146

SR. NO.	SPEED (RPM)	ACTUAL FLOW RATE (LPM)	THEORETICAL FLOW RATE	VOLUME-TRIC EFFI-CIENCY
01	100	0.031	0.035	86.76
02	200	0.061	0.071	85.4
03	300	0.089	0.107	83.3
04	400	0.12	0.143	83.7
05	500	0.146	0.179	81.68





RESULT

From the above experiment,by changing the phase angle,flow rate will change so that volumetric efficiency is also increases.

Conclusion

By varying the stroke of single cylinder axial piston pump we develop variable displacement linkages, therefore we can vary the discharge of pump using manual control.

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