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Cam-Driven Variable Displacement Linkage (20150323, Dr. James Van de Ven)

Technology No. 20150323

IP Status: Issued US Patent; **Application #:** 15/172,716

True Zero Displacement

This technology improves upon a previous variable linkage variable displacement machine technology, the high efficiency variable displacement pump, which has a crankshaft-driven adjustable six-bar linkage to vary the displacement of a piston. This new technology is a cam-driven adjustable linkage that also varies the displacement of a piston. This highly efficient mechanism reaches true zero displacement. Furthermore, the piston reaches the same top-dead-center position regardless of the displacement, minimizing the unswept volume and resulting compressibility energy losses. The linkages employs low friction pin joints, which further reduces energy losses during operation, and also reduces leakage due to the absence of hydrodynamic bearings. The design incorporates a crosshead bearing, which prevents side loading of the piston. Through design of the cam profile, the piston trajectory can be precisely controlled to minimize the flow and pressure ripple. Furthermore, the use of a multi-lobe cam allows multiple pumping strokes per revolution, creating high power density. A further innovation is a selectable piston chamber area, allowing operation across a wide variety of pressures and flow rates.

Higher Power Density

This new design shares all the advantages of the previous variable displacement pump linkage design but has a higher power density. The compactness makes this technology an excellent fit for mobile applications ranging from human power pumps to robotics to traction motors for construction or agricultural equipment. This improved cam-driven, adjustable linkage machine replaces the crank link and coupler link of the previous mechanism with a cam and follower that is more compact due to allowing multiple pumping strokes per shaft rotation and packaging in a radial configuration. This variable linkage machine uses a crosshead bearing to minimize the piston side loads. An innovative use of this crosshead bearing is to create two different piston areas that are selectable based on the required operating pressure and flow

rate of the pump, further extending the range of operation.

BENEFITS AND FEATURES:

- Compact design
- Low friction and leakage losses = higher energy efficiency
- Multiple strokes per revolution
- Precise piston displacement profile control to minimize flow ripple
- Selectable piston chamber areas based on operating pressure and flow
- Six-bar linkage varies stroke of a reciprocating engine
- Replaces crank link and coupler link of previous mechanism with cam-follower
- Reaches true zero displacement position
- Low compressibility energy losses
- Pin joints offer lower friction and energy savings
- Variable displacement machine

APPLICATIONS:

- Hydraulic pumps
- Center for Compact & Efficient Fluid Power (CCEFP) applications
- Human driven pumps
- Variable displacement hydraulic pumps and motors
- Other applications such as agriculture, construction, lawn equipment, hydraulic hybrid vehicles, hydrostatic wind power transmission and adjustable linkage applications (e.g., air/gas compressor and engines)

Phase of Development - Demonstration prototype

Researchers

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Licensing Terms

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