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Free Piston Engines for Mobile Fluid Power Equipment

IP Status: Pending US Patent; **Application #:** 15/607,937

Improved Efficiency of Fluid Power Sources

A systematic control method can significantly improve the efficiency of fluid power sources. The algorithm calculates piston trajectory for hydraulic free piston engine (FPE) operation based on the associated hydraulic force and combustion force. This desired piston trajectory is then used as a reference signal for piston motion tracking control so that the load pressure and output flow rate of the FPE can be independently controlled, in real-time, according to required loads. In addition, the piston trajectory reference can be varied digitally in each stroke, so the response time of the FPE for variable loads occurs within just milliseconds.

Licensing Terms

MN-IP Try and Buy
Center for Compact and Efficient Fluid Power (CCEFP) Try and Buy – Available to CCEFP member companies

Try

- Trial period is up to 12 months
- Trial fee is $0; In place of Try fee, a business plan for the Try period is required
- No US patent fees during Try period[1]

Buy

- In place of a conversion fee, a post-Try period business plan is required[2]
- First $1M cumulative sales are royalty-free
- Sublicense freely
- Royalty rate: 2% of Net Sales
- Patent(s) expenses paid by licensee
- Qualified startups: 5% of equity of startup is allocated to University at formation[3]
- Transfer fee for transferring license to a third party - $25,000

Please contact us for detailed term sheet for a Try & Buy agreement as well as guidelines for Try[1] and post-Try period[2] business plans as well as qualified startups[3]

Independent Control of FPE Output Flow Rate and Pressure

Fluid power sources are currently sized for a maximum load, maximum pressure and flow rate, but most duty cycles only require a partial load. Consequently, using relief valves and throttling valves to reduce output flow rate and adjust pressure compromises system efficiency due to throttling loss. This technology offers a way to significantly improve such fluid power efficiency by independently controlling the output flow rate and pressure of the FPE by implementing the desired piston trajectory reference. Using this algorithm seamlessly matches the output power

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Category
Engineering & Physical Sciences/Instrumentation, Sensors & Controls
Engineering & Physical Sciences/Transportation

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to the required load, reducing throttling loss and improving system efficiency.

BENEFITS AND FEATURES:

- Improved efficiency
- Ability to adjust power output in real-time, within milliseconds
- Can compensate for load changes
- Novel approach not yet disclosed by others

APPLICATIONS:

- Any hydraulic free piston engine or fluid power source
- Mobile applications (hybrid on-highway vehicles, off-road vehicles (agriculture and heavy-duty construction machinery such as excavators, wheel loaders), distributed power generation units

Phase of Development - Modeled design. Validated with numerical simulations. The algorithm has been tested as a computer simulation.

Researchers

Zongxuan Sun, PhD
Professor, Mechanical Engineering
External Link (www.me.umn.edu)

Publications

Free Piston Engine Based Mobile Fluid Power Source
http://proceedings.asmedigitalcollection.asme.org/proceeding.aspx?articleid=2604432, 2016
ASME Proceedings

External Links

Center for Compact and Efficient Fluid Power
Automotive Propulsion Control Laboratory