Q: What are the hydraulic functions in modern machining centers and lathe machines?
A: Machining centers and lathes are commonly referred to as machine tools. These machine tools require hydraulics to rotate a workpiece on its axis to perform operations such as cutting, sanding, drilling, facing, etc. Common functions of machining centers and lathe machines are clamping and unclamping of tools, workpieces, axis and turrets, pallet changer, spindle index, and tailstock and chuck control. They use both single- and double-acting hydraulic cylinders to complete these functions.

Q: When working with machining centers and lathe machines, what are the common deficiencies found in the traditional hydraulic systems?
A: Traditional machining centers and lathe machines rely on hydraulics, which comes with inherent deficiencies. These typically are leakages from actuators and, more commonly, leakage from the spool valves used in the machine. Traditional machining centers and lathe machines take up a large amount of space due to their external pumps and motors as well as external power units. To move the necessary flow for operations, the units are required to stay on for long periods of time. Large units also produce excess heat and create more noise for the surrounding environment.

Q: How can you improve on these deficiencies?
A: To improve on current designs, one can implement a compact power unit designed with a submerged pump and motor. This compact power unit dissipates heat more efficiently, which allows for smaller motors. Improved heat dispersion is achievable via a finned housing design and external blowers while the submerged pump and motor reduces noise level. Design improvements also come from the use of high-efficiency radial piston pumps compared to vane or axial piston pumps. Better-designed units use a smaller tank for less fluid consumption. Accumulator charging operation (on/off) in combination with seated valve technology (avoiding leakage caused by spool valves) will save energy. The accumulator is pre-charged with a gas pressure. The power unit fills the accumulator to an upper pressure and switches off or into an idle circulation mode. Hydraulic volume for the actuators is taken from the accumulator, and at a lower pressure the unit recharges the accumulator. The use of seated valves offers no internal leakage when compared to spool valves. This results in saving energy and lower heat production while being more tolerant of contamination.

Q: What are the benefits of using these alternate designed hydraulic systems?
A: The overall benefits of using these design alternatives result in higher efficiency and energy savings. Smaller motors can be used, which result in cost reduction. Higher permissible exploitation of the motor output is due to the intensive cooling effect of the surrounding oil. Noise pollution for the work environment is reduced by the lower operating noise. This is because of the absence of directly emitted operation noise from the fan and motor as well as by the muffling effect of the submerged motor design. Newer-designed machine centers have smaller space requirements due to the new compact designs. Pumps and motors are mounted, without any coupling, onto one another and for that reason better mechanical power efficiency can be achieved.
The use of accumulators also allows for the reduction of installed power. The faster cycle time of the accumulator charging circuit helps reduce maintenance.

The more compact design produces less heat, limiting the power usage for cooling systems to only 5-10%. Radial piston pumps can offer an estimated 10% increase in efficiency over gear pumps and vane pumps. Radial piston pumps also work at high pressure which reduces the mass of oil needed to be accelerated and moved.

Q: What industries could benefit from more efficient and compact hydraulic systems?

A: Industries that benefit from the use of more efficient machining centers are typically the ones that require a fast turnover rate and high product flow. Plastic machinery and automotive manufacturing can both benefit from these designs. Their product lines have tight space requirements due to amount of other parts being assembled and produced. Hydraulic tools such as torque wrenches, handling systems, presses, and rivets and clinching equipment can also benefit from the higher efficiencies that these compact power unit and seated valve hydraulic systems provide.

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