HYDRAULIC CLUTCH ACTUATION SYSTEMS
System Competence for Passenger Cars and Commercial Vehicles
Innovations for Future Mobility

DURABLE. ENVIRONMENTALLY FRIENDLY. EFFICIENT.

Drawing on more than 70 years of experience, FTE automotive is an established world leader and major force behind advances in safety, comfort, and driving fun on the road. Our milestone hydraulic clutch control systems are seen by the automotive world as an answer to important future challenges. We regard it as our responsibility to give our customers an innovative edge for controlling manual transmissions. At the same time, we work steadfastly to develop and improve our system competence and product quality to meet challenges such as tightening environmental regulations and the need for superior performance and more efficient manufacture.

Proven Technology

MANUAL TRANSMISSIONS

Clutch Actuation

Both passenger cars and commercial vehicles require a unit for regulating how the engine’s power is transmitted. This is the role of the clutch control system between the engine and transmission. It interrupts the mechanical connection between the engine and the rest of the powertrain so the gear can be changed.

Hydraulic Clutch Actuation

With a hydraulic clutch actuation system, power transmission is interrupted when the driver applies pressure to a pedal. Several components amplify this pressure and transfer it to the clutch itself. As soon as the pedal is released, the same process occurs in reverse order. Peak torque limiters (PTLs) prevent excessive torque during engagement, which helps prevent damage to the drive-line due to the clutch closing too fast. A frequency modulator keeps crankshaft vibrations from spreading to the pedal ensuring driver comfort.

The Challenge

Perfect functioning of the hydraulic clutch control system is a prerequisite for a manual clutch to work. The system must be both long-lasting and absolutely reliable. It is vital for the driver to have a good feeling for the correct amount of pressure to apply. Automotive manufacturers and OEM partners require systems that are quick and easy to install, and are increasingly insisting on the use of environmentally friendly, recyclable materials.

The Solution

Hydraulic clutch control is a proven technology with a long history in the automotive industry. The system is fully developed, which simplifies adaptation to new vehicle models. Considering that manual gearshift systems are also characterized by corrosion resistance, longevity and favorably affect fuel consumption, it is not surprising that they continue to be standard in small and mid-sized passenger cars and commercial vehicles.

Products

Committed to innovation: we develop technical solutions, handling everything from inception and design all the way to production. We subject our products to a process of continuous optimization. This includes performance, materials and design tools used, such as CAD, FEM, and FMEA. Function and durability tests across all phases from prototyping to series production ensure the high quality of our products.

Processes

Local logistics for greater efficiency: with 11 manufacturing sites on four continents, FTE automotive is present in all of the automotive industry’s major centers. This proximity to our customers enables our specialists to proactively respond to new developments in the market.

Partnership

Moving forward together: continually developing products and processes, FTE automotive emphasizes close cooperation with motor vehicle manufacturers. We jointly define targets to make sure that our innovative solutions consistently give our partners a competitive edge.

Overview of the Hydraulic Clutch Actuation System

External Clutch Slave Cylinder or Concentric Slave Cylinder to open and close the clutch.

Hydraulic Clutch Pipe transfers the pedal pressure to the external slave cylinder or concentric slave cylinder.

Clutch Master Cylinder transfers the pressure that the driver applies to the pedal.
The Challenge
Besides their basic function, modern clutch master cylinders must include various other functions. To improve safety, comfort and responsiveness, the cruise control system, start lock, electrical parking brake, torque adjustment and start-stop functions have to be realized. These additional functions need to be traded off against the need for weight reduction and easy time-saving installation.

The Solution
Clutch master cylinders from FTE automotive are characterized by low friction and low volume consumption, which makes them highly efficient. Their long service life is the result of a robust, burst-resistant design.

Any required displacement and switching point sensors can be easily integrated. A bayonet connection with snap lock, which additionally facilitates installation is possible. Their weight is minimized as a result. The entire unit is built from recyclable materials in order to conform to all environmental standards.

The Challenge
Because the clutch pipe acts as a bridge between the clutch pedal and the transmission, it could potentially also transmit engine vibrations. However, it is important to eliminate adverse influences like this to ensure comfortable operation of the clutch pedal and give the driver a good feeling for the right pressure to apply.

The Solution
Clutch pipes from FTE automotive can be equipped with additional vibration-dampening components such as Frequency Modulators. They absorb unwanted vibrations and adjust the transferred volume to provide the driver with excellent tactile feedback whilst operating the clutch. Our compact design is backed by decades of experience. It is highly efficient and can be very quickly adapted to meet new requirements. For plastic clutch pipes, FTE automotive only uses renewable raw materials in order to comply with the strictest environmental standards.

**Technical Specifications**

**Pipe-Hose-Assembly**
- Operating pressure: 50 bar max.
- Vacuum resistance: 2 mbar absolute min.
- Temperature range: -40 to +130°C
- Peak temperature: +150°C
- Pipe outside diameter: 4.75 mm or 6.0 mm
- Hose inner diameter: 3.2 mm or 6.0 mm
- Operating medium: brake fluid or mineral oil

**Plastic Pipe**
- Operating pressure: 50 bar max.
- Vacuum resistance: 2 mbar absolute min.
- Temperature range: -40 to +130°C
- Peak temperature: +150°C
- Outside diameter: 8 mm
- Wall thickness: 2.15 mm
- Operating medium: brake fluid or mineral oil
Servo-assisted clutches include an additional component to facilitate operation. The servomotor supports the driver when starting the car and shifting gears by reducing the effort that must be applied to the pedal.

The Solution

External slave cylinders and concentric slave cylinders from FTE automotive are easy to install and are highly reliable. Because of their low hysteresis, very little force needs to be applied to the pedal, resulting in high efficiency. Both components feature automatic adjustment for offsetting the unavoidable wear of the clutch facing. Driving comfort can be maximized by integrating a peak torque limiter (PTL).

Concentric slave cylinders from FTE automotive feature a lightweight release bearing with a special lubricant for superior heat resistance. Their design allows for the integration of a radial shaft seal for the transmission input shaft. Because a concentric slave cylinder acts directly on the clutch with an integrated release bearing it does not require a release lever, thus minimizing weight and resulting in compact designs.

Technical Specifications

<table>
<thead>
<tr>
<th>External Clutch Slave Cylinder</th>
<th>Concentric Slave Cylinder</th>
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<tbody>
<tr>
<td>Operating pressure: 50 bar max.</td>
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<td>Vacuum resistance: 2 mbar absolute, min.</td>
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</tr>
<tr>
<td>Temperature range: -40 to +140°C</td>
<td>Temperature range: -40 to +160°C</td>
</tr>
<tr>
<td>Peak temperature: +150°C</td>
<td>Peak temperature: +200°C</td>
</tr>
<tr>
<td>Diameter range: 15.87 to 38.1 mm</td>
<td>Max. release load: up to 7000 N</td>
</tr>
<tr>
<td>Operating medium: brake fluid or mineral oil</td>
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</table>

Invisible Helping Force

The concentric slave cylinder transfers the pressure applied through the clutch pipe to open and close the clutch directly by applying pressure to a diaphragm spring on the clutch. This is accomplished with a piston that is moved forward or backward by the hydraulic fluid. Depending on the direction of its movement, the clutch is either opened or closed. An external slave cylinder together with a release lever serves the same purpose.

The Challenge

The inevitable wear and tear on the clutch needs to be automatically compensated to avoid compromising the safe functioning. A compact design, high performance and efficiency, have to be taken into account during development of the external clutch slave cylinder and concentric slave cylinder.

The Solution

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<td>Temperature range: -40 to +160°C</td>
<td>Temperature range: -30 to +120°C</td>
</tr>
<tr>
<td>Peak temperature: +200°C</td>
<td>Dimensions: 200x65x120 mm (LxWxH)</td>
</tr>
<tr>
<td>Max. release load: up to 7000 N</td>
<td>Housing material: plastic</td>
</tr>
<tr>
<td>Operating medium: brake fluid or mineral oil</td>
<td>Pressure amplification factor: up to 2.5</td>
</tr>
<tr>
<td>Weight: 1.2 kg</td>
<td>Max. shifting volume: 8.5 cm³</td>
</tr>
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<td>Min. reaction: 150 ms</td>
<td>Operating temperature: -30 to +120°C</td>
</tr>
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<td>Operating medium: brake fluid or mineral oil</td>
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FTE automotive – Innovation drives

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