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Developement of Automatic Hand Break System

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Abstract: Hand brake is one of the most important components in vehicles. In general the hand brake is operated manually but in our project, we are developing automatic hand brake for safety purpose of vehicle The hand brake engagement and disengagement is done with the help of hydraulic system. When the ignition switch is turned on DCV and pump gets activated fluid flows the pump in to DCV and then thought the hydraulic system which disengages the Hand brake, the same is done when the ignition switch is turned off for engagement of hand brake.

Key words: Disengagement · DCV · Ignition switch

INTRODUCTION

In cars the hand brake is a latching brake usually used to keep the car stationary. Automobile e-brakes usually consist of a cable directly connected to the brake mechanism on one end and to some type of mechanism that can be actuated by the driver on the other end [1]. The mechanism is often a hand-operated lever, on the floor on either side of the driver, or a pull handle located below and near the steering wheel column, or a pedal located far apart from the other pedals.

Although sometimes known as an emergency brake, using it in any emergency where the footbrake is still operational is likely to badly upset the brake balance of the car and vastly increase the likelihood of loss of control of the vehicle, for example by initiating a rear-wheel skid. Additionally, the stopping force provided by using the handbrake instead of or in addition to the footbrake is usually small and would not significantly aid in stopping the vehicle, again because it usually operates on the rear wheels; they suffer reduced traction compared to the front wheels while braking [2]. The emergency brake is instead intended for use in case of mechanical failure where the regular footbrake is inoperable or compromised, hopefully with opportunity to apply the brake in a controlled manner to bring the vehicle to a safe, if gentle halt before seeking service assistance [3].

The most common use for an automobile emergency brake is to keep the vehicle motionless when it is parked, thus the alternative name, parking brake. Car emergency brakes have a ratchet locking mechanism that will keep them engaged until a release button is pressed. On vehicles with automatic transmissions, this is usually used in concert with a parking pawl in the transmission. Automotive safety experts recommend the use of both systems to immobilize a parked car and the use of both systems is required by law in some jurisdictions, yet many individuals use only the "Park" position on the automatic transmission and not the parking brake.

Working Operation: Hydraulic cylinders get their power from pressurized hydraulic fluid, which is typically oil. The hydraulic cylinder consists of a cylinder barrel, in which a piston connected to a piston rod moves back and forth. The barrel is closed on each end by the cylinder bottom (also called the cap end) and by the cylinder head where the piston rod comes out of the cylinder. The piston has sliding rings and seals. The piston divides the inside of the cylinder in two chambers, the bottom chamber (cap end) and the piston rod side chamber (rod end) [4]. The hydraulic pressure acts on the piston to do linear work and motion.

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Flanges are mounted to the cylinder body. The piston rod also has mounting attachments to connect the cylinder to the object or machine component that it is pushing [5].

A hydraulic cylinder is the actuator or "motor" side of this system. The "generator" side of the hydraulic system is the hydraulic pump which brings in a fixed or regulated flow of oil to the bottom side of the hydraulic cylinder, to move the piston rod upwards. The piston pushes the oil in the other chamber back to the reservoir. If we assume that the oil pressure in the piston rod chamber is approximately zero, the force F on the piston rod equals the pressure P in the cylinder times the piston area A:

$$F = P \cdot A$$

where,
F = Force
P = Pressure
A = Area of the piston

The piston moves instead downwards if oil is pumped into the piston rod side chamber and the oil from the piston area flows back to the reservoir without pressure. The pressure in the piston rod area chamber is (Pull Force) / (piston area - piston rod area) [6].

Parts of Hydraulic Cylinder

Cylinder Barrel: The cylinder barrel is mostly a seamless thick walled forged pipe that must be machined internally. The cylinder barrel is ground and/or honed internally.

Cylinder Bottom or Cap: In most hydraulic cylinders, the barrel and the bottom portion are welded together. This can damage the inside of the barrel if done poorly. Therefore some cylinder designs have a screwed or flanged connection from the cylinder end cap to the barrel. In this type the barrel can be disassembled and repaired in future.

Cylinder Head: The cylinder head is sometimes connected to the barrel with a sort of a simple lock (for simple cylinders). In general however the connection is screwed or flanged. Flange connections are the best, but also the most expensive. A flange has to be welded to the pipe before machining. The advantage is that the connection is bolted and always simple to remove. For larger cylinder sizes, the disconnection of a screw with a diameter of 300 to 600 mm is a huge problem as well as the alignment during mounting.

Piston: The piston is a short, cylinder-shaped metal component that separates the two sides of the cylinder barrel internally. The piston is usually machined with grooves to fit elastomeric or metal seals. These seals are often O-rings, U-cups or cast iron rings. Piston seals vary in design and material according to the pressure and temperature requirements that the cylinder will see in service. Generally speaking, elastomeric seals made from nitride rubber or other materials are best in lower temperature environments while seals made of Vinton are better for higher temperatures. The best seals for high temperature are cast iron piston rings.

Piston Rod: The piston rod is typically a hard chrome-plated piece of cold-rolled steel which attaches to the piston and extends from the cylinder through the rod-end head. In double rod-end cylinders, the actuator has a rod extending from both sides of the piston and out both ends of the barrel. The piston rod connects the hydraulic actuator to the machine component doing the work. This connection can be in the form of a machine thread or a mounting attachment such as a rod-clevis or rod-eye. These mounting attachments can be threaded or welded to the piston rod or, in some cases; they are a machined part of the rod-end.

Fuel Pump: A fuel pump is a frequently essential component on a car or other internal combustion engine device. Many engines (older motorcycle engines in particular) do not require any fuel pump at all, requiring only gravity to feed fuel from the fuel tank through a line or hose to the engine. But in non-gravity feed designs, fuel has to be pumped from the fuel tank to the engine and delivered under low pressure to the carburetor or under high pressure to the fuel injection system. Often, carbureted engines use low pressure mechanical pumps that are mounted outside the fuel tank, whereas fuel injected engines often use electric fuel pumps that are mounted inside the fuel tank and some fuel injected engines have two fuel pumps: one low pressure/high volume supply pump in the tank and one high pressure/low volume pump on or near the engine.

Proportional Directional Control Valve

Description: The AMCA proportional directional control valves are pressure compensated and archieve an ideal control of force, speed, acceleration and deceleration, independent of the load and increased demands. The pressure compensator could be a pressure relief valve(MUV) or a pressure reducing valve (MDM), together with the throttling function of one or more directional control valve spools. The shape of the proportional directional control valve spool differs from the conventional one. The result is a progressive flow curve. To make optimal use of the maximum stroke of the spool, the flow angles of the A and/or B port can be defined for different flows. For a constant flow, the pressure drop over the orifice of the spool remains constant, independent of the load pressure.

Features:

- The load independent output flow is proportional to the input signal (control pressure).
- The pump pressure always corresponds to the user pressure, +3,6,8 or 12 bar (43, 86, 114 or 172 psi) compensator.
- The built-in pump-unloading valve results in:
- Very low power turned into heat;
- Minimum loading of the prime mover.
- User speed is precisely controlled under all load conditions.
- Progressive regulating curve; no pressure peaks when switching; sensitive control even for alternating pressures.
- Constant working speed of differential cylinders at the different regulating flow to the valve by grinding angle.
- Constant recirculation pressure independent of the number of units.
- Any limiting of flow for every user port.
- Proportional directional control valves also available as:
- Manual proportional series MHV and
- Electrical proportional series MEV.
- Any combination of these control options is possible.
- The sandwich and subplate system allows a construction up to 8 control valves.
- Electrical pressure cut off at port A, B or A and B, available on request.

Technical Data:

- Assembly system sandwich or subplate design
- Operating pressure (P,A,B) ...350 bar (5000 psi)
- Maximum return pressure (T): 30 bar (428 psi)
- Δp compensator 3; 6; 8 or 12 bar (43; 86; 114 or 172 psi)
- Pressure setting range 5...350 bar (72...5000 psi)
- Flow range ...800 l/min (...211 USgpm)- with 32 cSt at 40°C
- Fluid Mineral oil according to DIN 51524/51525
- Fluid temperature range -35...+80°C (-31°...+176°F)
- Viscosity range 2,8...380 cSt, optimal 30 cSt
- Contamination level max. according to NAS 1638 Class 9 or ISO 18/15
- Mounting position optional
- Control characteristics 3 - 12 bar (43 - 172 psi) or
- 6 - 22 bar (86 - 315 psi)
- Size working ports:
- MOV12: 1/2" BSP (SAE optional)
- MOV16: 3/4" BSP (SAE optional)
- MOV20: 1" BSP (SAE optional)
- MOV25: 1 1/4" BSP (SAE optional)
- MOV32: 1 1/2" BSP (SAE optional)

Control Valve: Directional control valves route the fluid to the desired actuator. They usually consist of a spool inside a cast iron or steel housing. The spool slides to different positions in the housing, intersecting grooves and channels route the fluid based on the spool's position.

The spool has a central (neutral) position maintained with springs; in this position the supply fluid is blocked, or returned to tank. Sliding the spool to one side routes the hydraulic fluid to an actuator and provides a return path from the actuator to tank. When the spool is moved to the opposite direction the supply and return paths are switched. When the spool is allowed to return to neutral (center) position the actuator fluid paths are blocked, locking it in position. Directional control valves are usually designed to be stackable, with one valve for each hydraulic cylinder and one fluid input supplying all the valves in the stack. Tolerances are very tight in order to handle the high pressure and avoid leaking; spools typically have a clearance with the housing of less than a thousandth of an inch (25 μm). The valve block will be mounted to the machine's frame with a three point pattern to avoid distorting the valve block and jamming the valve's sensitive components. The spool position may be actuated by mechanical levers, hydraulic pilot pressure, or solenoids which push the spool left or right. A seal allows part of the spool to protrude outside the housing, where it is accessible to the actuator.

The main valve block is usually a stack of off the shelf directional control valves chosen by flow capacity and performance. Some valves are designed to be proportional (flow rate proportional to valve position), while others may be simply on-off. The control valve is one of the most expensive and sensitive parts of a hydraulic circuit.

- Pressure relief valves are used in several places in hydraulic machinery; on the return circuit to maintain a small amount of pressure for brakes, pilot lines, etc... On hydraulic cylinders, to prevent overloading and hydraulic line/seal rupture. On the hydraulic reservoir, to maintain a small positive pressure this excludes moisture and contamination.
- Pressure regulators reduce the supply pressure of hydraulic fluids as needed for various circuits.
- Sequence valves control the sequence of hydraulic circuits; to ensure that one hydraulic cylinder is fully extended before another starts its stroke, for example.
- Shuttle valves provide a logical or function.
- Check valves are one-way valves, allowing an accumulator to charge and maintain its pressure after the machine is turned off, for example.
- Pilot controlled Check valves are one-way valve that can be opened (for both directions) by a foreign pressure signal. For instance if the load should not be hold by the check valve anymore. Often the foreign pressure comes from the other pipe that is connected to the motor or cylinder.
- Counterbalance valves are in fact a special type of pilot controlled check valve. Whereas the check valve is open or closed, the counterbalance valve acts a bit like a pilot controlled flow control.
- Cartridge valves are in fact the inner part of a check valve; they are off the shelf components with a standardized envelope, making them easy to populate a proprietary valve block. They are available in many configurations; on/off, proportional, pressure relief, etc.
- Hydraulic fuses are in-line safety devices designed to automatically seal off a hydraulic line if pressure becomes too low, or safely vent fluid if pressure becomes too high.
- Auxiliary valves in complex hydraulic systems may have auxiliary valve blocks to handle various duties unseen to the operator, such as accumulator charging, cooling fan operation, air conditioning power, etc. They are usually custom valves designed for the particular machine and may consist of a metal block with ports and channels drilled.

Actuators:

- Hydraulic cylinder
- Swash plates are used in 'hydraulic motors' requiring highly accurate control and also in 'no stop' continuous (360°) precision positioning mechanisms. These are frequently driven by several hydraulic pistons acting in sequence.
- Hydraulic motor (a pump plumbed in reverse)
- hydrostatic transmission

Reservoir: The hydraulic fluid reservoir holds excess hydraulic fluid to accommodate volume changes from: cylinder extension and contraction, temperature driven expansion and contraction and leaks. The reservoir is also designed to aid in separation of air from the fluid and also work as a heat accumulator to cover losses in the system when peak power is used. Design engineers are always pressured to reduce the size of hydraulic reservoirs, while equipment operators always appreciate larger reservoirs. Reservoirs can also help separate dirt and other particulate from the oil, as the particulate will generally settle to the bottom of the tank.

Some designs include dynamic flow channels on the fluids return path that allow for a smaller reservoir.

Accumulators: Accumulators are a common part of hydraulic machinery. Their function is to store energy by using pressurized gas. One type is a tube with a floating piston. On one side of the piston is a charge of pressurized gas and on the other side is the fluid. Bladders are used in other designs. Reservoirs store a system's fluid.

Examples of accumulator uses are backup power for steering or brakes, or to act as a shock absorber for the hydraulic circuit.

Hydraulic Fluid: Hydraulic fluid is the life of the hydraulic circuit. It is usually petroleum oil with various additives. Some hydraulic machines require fire resistant fluids, depending on their applications. In some factories where food is prepared, water is used as a working fluid for health and safety reasons. In addition to transferring energy, hydraulic fluid needs to lubricate components, suspend contaminants and metal filings for transport to the filter and to function well to several hundred degrees Fahrenheit or Celsius.

Filters: Filters are an important part of hydraulic systems. Metal particles are continually produced by mechanical components and need to be removed along with other contaminants.

Filters may be positioned in many locations. The filter may be located between the reservoir and the pump intake. Blockage of the filter will cause cavitations and possibly failure of the pump. Sometimes the filter is located between the pump and the control valves. This arrangement is more expensive, since the filter housing is pressurized, but eliminates cavitations problems and protects the control valve from pump failures. The third common filter location is just before the return line enters the reservoir. This location is relatively insensitive to blockage and does not require a pressurized housing, but contaminants that enter the reservoir from external sources are not filtered until passing through the system at least once.

Hydraulic Oil 68

Classification:

ISO HL 68

Application: Zinc-free hydraulic oil, suitable for hydraulic systems with nominal pressures up to 16MPa, also applicable for the lubrication of bearings and lowly loaded gears.

Specifications:
DIN 51524/1(HL), DIN 51517/2(CL),DIN EN ISO 6743:HL

Hydraulic Fluid: Hydraulic fluids, also called hydraulic liquids, are the medium by which power is transferred in hydraulic machinery. Common hydraulic fluids are based on mineral oil or water. Examples of equipment that might use hydraulic fluids include excavators and backhoes, brakes, power steering systems, transmissions, garbage trucks, aircraft flight control systems, elevators and industrial machinery.

Hydraulic systems like the ones mentioned above will work most efficiently if the hydraulic fluid used has low compressibility.

Functions and Properties: The primary function of a hydraulic fluid is to convey power. In use, however, there are other important functions of hydraulic fluid such as protection of the hydraulic machine components. The table below lists the major functions of a hydraulic fluid and the properties of a fluid that affect its ability to perform that function:

Other Components: Hydraulic fluids can contain a wide range of chemical compounds, including: oils, butanol, esters (e.g. phthalates, like DEHP and adipates, like bis(2-ethylhexyl) adipate), polyalkylene glycols (PAG), phosphate esters (e.g. tributylphosphate), silicones, alkylated aromatic hydrocarbons, polyalphaolefins (PAO).

Biodegradable Hydraulic Fluids: Environmentally sensitive applications (e.g. farm tractors and marine dredging) may benefit from using biodegradable hydraulic fluids based upon rapeseed (Canola) vegetable oil when there is the risk of an oil spill from a ruptured oil line. Typically these oils are available as ISO 32, ISO 46 and ISO 68 specification oils. ASTM standards ASTM-D-6006, Guide for Assessing Biodegradability of Hydraulic Fluids and ASTM-D-6046, Standard Classification of Hydraulic Fluids for Environmental Impact are relevant.

Safety: Because industrial hydraulic systems operate at hundreds to thousands of PSI and temperatures reaching hundreds of degrees Celsius, severe injuries and death can result from component failures and care must always be taken when performing maintenance on hydraulic systems.

Working Principle: When the ignition switch is turned on the power will be supplied to both DCV & Pump. The pump will suck the oil from the reservoir, the fluid then passes through the DCV & hydraulic system.

When the I.G switch is turned on the DCV & Pump gets activated the DCV movement is controlled with the help of a solenoid. In the mean time the pump suck the oil from the reservoir. The oil then flows through the DCV which allows the fluid to flow in the hydraulic system.

When the fluid flows in the BDC to TDC which releases the hand brake the oil present in the cylinder hear the TDC flows to the reservoir.

Hydraulic System Parts of above Diagram:

- Line of reservoir
- Filter or Strainer
- Pump single fixed displacement
- Proportional directional valve (indicated by horizontal valve)
- Pilot pressure
- Sequence valve directly operated extremely drained
- Check valve
- Cylinder double acting

Directional Control Valve: Directional control valves are one of the most fundamental parts in hydraulic machinery. They allow fluid flow into different paths from one or more sources. They usually consist of a piston inside a cylinder which is electrically controlled. The movement of the cylinder restricts or permits the flow, thus it controls the fluid flow.

Directional control valves are mainly two types:

- Hydraulic and
- Pneumatic.

Hydraulic directional control valves are for a liquid working fluid (e.g. water, hydraulic oil) and pneumatic directional control valves are for a gaseous (usually air) working fluid.

Specification: They are generally specified using the number of ports and the number of switching positions. It can be represented in general form as n_p/n_s, where n_p is the number of ports connected to the direction control valve and n_s the number of switching positions.

In addition, the method of actuation and the return method can also be specified. Considering the valve in the given figure, it will be specified as 4-way, 3-position direction control valve or 4/3 DCV since there are four ports and three switching positions for the valve.

Spool Valves: The most common sliding-action valve is the spool-type valve, Fluid is routed to or from the work ports as the spool slides between passages to open and close flow paths, depending on spool position. Spool valves readily adapt too many different spool-shifting schemes, which broadens their use over a wide variety of applications.

Many mobile applications require metering or throttling to enable the operator to slowly or gently accelerate or decelerate a load. In these instances, the spool may be modified with V notches, for example, so that a small displacement of the spool gradually permits increasing or decreasing fluid flow to gradually speed or slow actuator and load movement. This technique is also used in valves for industrial equipment. A beveled or notched edge on the spool is commonly referred to as a soft-shifting feature.

Directional Valve Operators: Valve operators are the parts that apply force to shift a valve's flow-directing elements, such as spools, poppets and plungers. The sequence, timing and frequency of valve shifting is a key factor in fluid power system performance. As long as the operator produces enough force to shift the valve, the system designer can select any appropriate operator for the conditions and type of control under which the system will operate.

Operators for directional-control valves are either mechanical, pilot, electrical and electronic, or a combination of these. Different types of actuators can all be installed on the same basic valve design. A common directional valve often is used that makes provision for mounting a variety of different operators on its body.

CONCLUSION

In our project we have hydraulic is driven by pump with the help of battery. The reservoir supply oil to the pump from that hydraulic is operated. When the ignition switch is turned on DCV & Pump gets activated. The DCV moment is controlled with the help of solenoid [4-10].

Oil flows through the pump in to DCV and then thought the hydraulic system which disengages the Hand brake, the same is done when the ignition switch is turned off for engagement of hand brake So that hand brake is operated.

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