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FABRICATION OF AUTOMATIC HAND BRAKE USING PNEUMATIC CYLINDER

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ABSTRACT: One of the most important safety features in an automobile is brake. A typical automobile consists of two types of brakes, one for retarding the speed of vehicle while it is in motion and other is to hold the vehicle in its place when standing still or parked. Due to operator errors the conventional handbrake system remained engaged even when the vehicle was moving due to manual operation of the hand lever through which the handbrake is operated. This led the brakes to become ineffective and eventually they failed to serve their purpose. To overcome all the limitation of the conventional system we are using automatic handbrake engagement and release system. This system uses electro-pneumatically operated components using solenoid and pneumatic circuits. Hand brake is one of the most important component in vehicles. Conventional handbrake system works using a ratchet locking mechanism that will keep it engaged until a release button is pressed. Driver error can lead to accidents in which handbrake is not engaged. To overcome this, an Automatic Hand Brake engaging and disengaging system is proposed. The hand brake engagement and disengagement is done using a combination of rack & pinion arrangement and Solenoid Valve controller. An automatic brake system for a vehicle consists of an electric motor, related to the motor for transmission motion from the motor to a brake lever that pushes the restraint. This project provides a brand new idea style of the pneumatic parking brakes system that has straightforward and cheap characteristics. This project deals with coming up with and fabrication of pneumatic braking system.

I. INTRODUCTION

In cars the hand brake is a latching brake usually used to keep the car stationary. automobiles e-brakes usually consist of a cable directly connected to a brake mechanism on one end and to some type of mechanism that can be actuated by the driver on the otherend .the mechanisms is often a hand operated lever, on the floor on either side of the driver, 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 vat increase the likelihood of loss of control of a vehicle for example by initiating the rear wheel skid.

Additionally, the stopping force provided using the hand brake of or in addition to the footbrake is usually smal l and would not significantly aid in stopping the vehicle, again because it usually operates on rear wheel while braking .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 half before seeking service assistance 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 brake have a ratchet locking mechanism that will keep them engaged until a release button is pressed.

II. LITERATURE SURVEY

Design And Fabrication of electromechanical parking brake System, Sumant Ashok Nayak, Kiran G, Kushal P S, Madhu B V and Dr.Ravishankar M K [1]

An electromechanical brake system for a vehicle consists of an electrical motor, gear train related to the motor for sending motion from the motor to a lead screw that pushes the restraint. This project provides a brand new idea style of the EMPB system that has easy and cheap characteristics. This paper deals with planning, analysis and fabrication of EMPB system. Mechanical device brake system additionally observed as brake by-wire, replace typical parking braking systems with a very electrical part system. This happens by commutation typical linkages with electrical

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motor-driven units. The braking force is generated directly at every wheel by high performance electrical motors and equipment reduction, that square measure controlled by an ECU.

Design and testing of a new electrical parking brake actuator Chien-Tai. Huang, Chien-Tzu che, Shou-Yi Cheng, Bo-Rueichen and Ming-Hu Huang [2]

Electric parking brake (EPB) system provides the spacious area for vehicles compared with ancient handbrake system. Combining an impact unit realizes the intelligent functions, that build vehicles additional convenient and secure, and avoid the vehicle harm and danger caused by the negligence of drivers. This paper provides a brand new idea style of the EPB system that has easy and cheap characteristics. The testing results have proved the feasibleness of this style. 1st we have a tendency to describe the working rule of this new style, and so introduce the arrangement of the testing system, followed by the discussion of experimental knowledge.

Slide Mode control for integrated electric parking brake System BinWang, XuexunGuo, Chengcai Zhang, ZheXiong, Huan Xia, and Jie Zhang [3]

The rising integrated electrical brake (IEPB) system is introduced and studied. Through analyzing the varied operating stages, the stages switched IEPB system models square measure given with the thought of the friction and system idle inertia. The sliding mode management (SMC) methodology is adopted to regulate the clamping force by the wide used motor angle and clamping force relationship methodology. Supported the characteristics of the state equations, two sliding surfaces are engineered to regulate the motor angle and current, severally. And in each operating stage, the management stability is warranted by selecting the management parameters supported Lyapunov theory and SMC reachability. The effectiveness of the planned system has been valid in Matlab/Simulink.

Novel design of the integrated electric parking brake system Yan-Sin liao, Chien-Tai Huang, Chien-Tzu chen, Shou-Yi Cheng, Bo-Rueichen and Fu-Yen Huang [4]

Automotive research & Testing Center (ARTC). A new style of integrated electric parking brake system, known as iEPB and integrated within the brake caliper, is introduced during this paper. It consists of AN electrically operated brake unit and a hydraulically ironed unit severally, and uses a special automatic mechanism rather than a screw device to extend the potency and the operating speed. With all typical EPB system's benefits, it additionally provides a stronger brake performance and a quicker latency. During this paper, we have a tendency to describe the working rule of this new design initially, and so introduce the arrangement of the testing system, followed by a discussion of experimental knowledge. The testing results prove the feasibleness of this design. The conclusion paragraph summarizes the key points concerning the design of the iEPB system.

III. COMPONENTS

SOLENOID VALVE

A solenoid valve is an electromechanically operated valve. Solenoid valves differ in the characteristics of the electric current they use, the strength of the magnetic field they generate, the mechanism they use to regulate the fluid, and the type and characteristics of fluid they control. The mechanism varies from linear action, plunger-type actuators to pivoted-armature actuators and rocker actuators. The valve can use a two-port design to regulate a flow or use a three or more port design to switch flows between ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high-reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

Fig. 1 Solenoid Valve

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Solenoid valves are also characterized by how they operate. A small solenoid can generate a limited force. An approximate relationship between the required solenoid force F_s, the fluid pressure P, and the orifice area A for a direct acting solenoid valve is: Where d is the orifice diameter. A typical solenoid force might be 15 N (3.4 lb_f). An application might be a low pressure (e.g., 10 psi (69 kPa)) gas with a small orifice diameter (e.g., $\frac{3}{8}$ in (9.5 mm) for an orifice area of 0.11 in^2 (7.1×10^{-5} m^2) and approximate force of 1.1 lbf (4.9 N)).

If the force required is low enough, the solenoid is able to directly actuate the main valve. These are simply called Direct-Acting solenoid valves. When electricity is supplied, electrical energy is converted to mechanical energy, physically moving a barrier to either obstruct flow (if it is N.O.) or allow flow (if it is N.C.). A spring is often used to return the valve to its resting position once power is shut off. Direct-acting valves are useful for their simplicity, although they do require a large amount of power relative to other types of solenoid valves.

Power consumption and supply requirements of the solenoid vary with application, being primarily determined by fluid pressure and orifice diameter. For example, a popular $\frac{3}{4}$-inch 150 psi sprinkler valve, intended for 24 VAC (50–60 Hz) residential systems, has a momentary inrush of 7.2 VA, and a holding power requirement of 4.6 VA.[5] Comparatively, an industrial $\frac{1}{2}$-inch 10,000 psi valve, intended for 12, 24, or 120 VAC systems in high-pressure fluid and cryogenic applications, has an inrush of 300 VA and a holding power of 22 VA. Neither valve lists a minimum pressure required to remain closed in the unpowered state.

A- Input side B-Diaphragm C-Pressure chamber D-Pressure relief passage E-Electro Mechanical Solenoid F- Output side

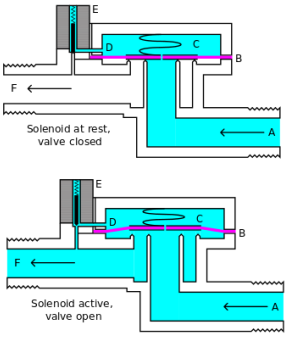

Fig. 2 Operation of Solenoid Valve

Pilot-operated

While there are multiple design variants, the following is a detailed breakdown of a typical pilot-operated solenoid valve. They may use metal seals or rubber seals, and may also have electrical interfaces to allow for easy control.

Materials

Solenoid valves are used in fluid power pneumatic and hydraulic systems, to control cylinders, fluid power motors or larger industrial valves. Automatic irrigation sprinkler systems also use solenoid valves with an automatic controller. Domestic washing machines and dishwashers use solenoid valves to control water entry into the machine. They are also often used in paintball gun triggers to actuate the CO_2 hammer valve. Solenoid valves are usually referred to simply as "solenoids."

Solenoid valves can be used for a wide array of industrial applications, including general on-off control, calibration and test stands, pilot plant control loops, process control systems, and various original equipment manufacturer applications.

PNEUMATIC CYCLINDER

Pneumatic cylinders (sometimes known as air cylinders) are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion. Like hydraulic cylinders, something forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved. Engineers sometimes prefer to use pneumatics because they are quieter, cleaner, and do not require large amounts of space for fluid storage. Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement. For example, in the mechanical puppets of the Disney Tiki Room, pneumatics are used to prevent fluid from dripping onto people below the puppets. Once actuated, compressed air enters into the tube at one end of the piston and imparts force on the piston. Consequently, the piston becomes displaced.

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TYPES

Although pneumatic cylinders will vary in appearance, size and function, they generally fall into one of the specific categories shown below. However, there are also numerous other types of pneumatic cylinder available, many of which are designed to fulfill specific and specialized functions.

Single-acting cylinders

A single-acting cylinder (SAC) has one port, which allows compressed air to enter and for the rod to move in one direction only. The high pressure of the compressed air causes the rod to extend as the cylinder chamber continues to fill. When the compressed air leaves the cylinder through the same port the rod is returned to its original position.

Double-acting cylinders

Double-acting cylinders (DAC) use the force of air to move in both extend and retract strokes. They have two ports to allow air in, one for outstroke and one for instroke. Stroke length for this design is not limited, however, the piston rod is more vulnerable to buckling and bending. Additional calculations should be performed as well.

Multi-stage, telescoping cylinder

Fig. 3 Multi Stage & Telescoping cylinder

Telescoping cylinders, also known as telescopic cylinders can be either single or double-acting. The telescoping cylinder incorporates a piston rod nested within a series of hollow stages of increasing diameter. Upon actuation, the piston rod and each succeeding stage "telescopes" out as a segmented piston. The main benefit of this design is the allowance for a notably longer stroke than would be achieved with a single-stage cylinder of the same collapsed (retracted) length. One cited drawback to telescoping cylinders is the increased potential for piston flexion due to the segmented piston design. Consequently, telescoping cylinders are primarily utilized in applications where the piston bears minimal side loading.

IV. HAND BRAKE

HAND BRAKE

In road vehicles, the parking brake, also known as a handbrake or emergency brake (e-brake), is a mechanism used to keep the vehicle securely motionless when parked. Parking brakes often consist of a cable connected to two wheel brakes, which is then connected to a pulling mechanism. In most vehicles, the parking brake operates only on the rear wheels, which have reduced traction while braking. The mechanism may be a hand-operated lever, a straight pull handle located near the steering column or a foot-operated pedal located with the other pedals.

While most automatic transmission vehicles have parking brakes, it is often not engaged by drivers when parking. However, it is recommended to use it, as the parking pawl in the gearbox could fail due to stress or another vehicle striking the car, causing the car to roll. Also, regular use of the parking brake reduces the chance of corrosion by keeping the cables in-motion. In manual transmission vehicles, the parking brake can be engaged to help keep the vehicle stationary. When parking on an uphill gradient, it is recommended that the front wheels face away from the curb. This would prevent the car from rolling into the roadway by using the curb to block the front passenger tire in the event of a parking brake failure. Similarly, on a downhill gradient, the front wheels should face the curb for the same reason, and the wheels should face to the right on an uncurbed road regardless of orientation. In a manual transmission, leaving the car in first gear (or in reverse if pointing downhill) is also advised, as the engine will prevent the car from rolling if the parking brake fails.

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Fig. 4 Hand Brake

The parking brake in most vehicles is still completely mechanical. Traditionally engaged by pulling a lever, the cables manually engage part of the car's braking system, usually the rear disk or drum brakes. The mechanical nature allows the driver to apply the brake even if the main hydraulic brake system fails. Pictograph symbols and/or lights may be used to indicate the location of a parking brake, its application or release.

Center or stick lever

The most common placement of the parking brake is in the center console of the vehicle, in between the driver and front passenger seats. Operating the brake is performed by pulling the lever up (which is connected to a ratchet) until there is tension. To disengage the brake, the button is held while simultaneously pulling the lever up to disengage the ratchet and then pushed all the way down with the button still held. In older vehicle models, a stick lever may be used instead which is located under the instrument panel.

Pedal or pull handle

Some vehicles have the parking brake operated by a small foot pedal, located by the other pedals. Depressing the foot pedal would engage the brake and pressing it again will release it. A pull handle variation also exists; by pulling or releasing the handle, this engages and releases the parking brake, respectively. Many vehicles have a combination of the two; a pedal to engage the brake and a handle to release it.

AC POWER

An AC power supply is a type of power supply used to supply alternating current (AC) power to a load. The power input may be in an AC or DC form. The power supplied from wall outlets (mains supply) and various power storage devices is oftentimes incompatible with the power needed by the load. To address this problem, AC power supplies transform and fine-tunes AC power from the electrical source to the voltage, current, and frequency needed by the device. It is accomplished by stepping up or stepping down the voltages, followed by filtering. Therefore, the electrical power is supplied to the device in a correct and controlled manner.

AC power supplies also can regulate the voltage supplied to the load and/or bring the current drawn by the load to safe levels.

Alternating current (AC) is a form of electricity in which the flow of electric current periodically reverses direction. As a result, the voltage also changes polarity with time. It is created by an AC generator through the principle of electromagnetic induction; an AC generator consists of a conductor which rotates over stationary magnetic poles.

Applications of Alternating Current

Electrical power in the form of AC is produced by most power plants and distributed by a majority of electrical grids. It is the typical form of electricity delivered to our homes, businesses, and industries. This is because AC is much cheaper and more efficient to generate and transmit compared to DC. The voltage of an AC can be stepped up and stepped down by transformers to minimize power losses during transmission. Also, transformers only work on AC because they are dependent on the reversing nature of AC.

Electronic devices and equipment such as radios, lamps, motors, televisions, and other home appliances directly use AC power for their operation. Meanwhile, DC power is commonly used in consumer electronics.

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V. WORKING

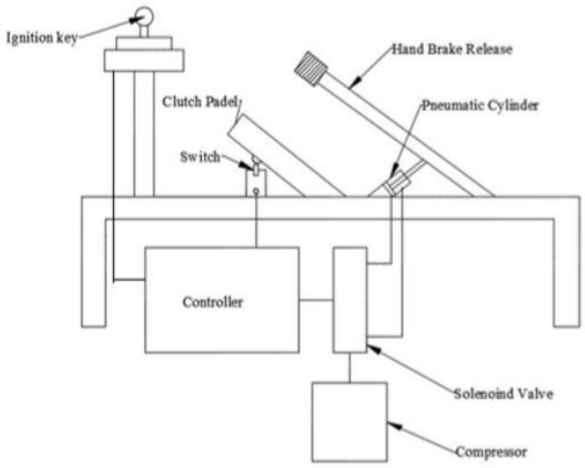

Fig. 5 Construction of Pneumatic Hand Brake System

Many hydraulic and pneumatic cylinders use them where it is needed to produce a force in both directions. A double-acting cylinder has a port at each end, supplied with pneumatic for both the retraction and extension of the piston. A double-acting cylinder is used where an external force is not available to retract the piston or it can be used where high force is required in both directions of travel. When the key is made to OFF mode, the brake will be engaged and when it is made ON the brake will be disengaged back. This engage and disengagement is done by pneumatic operated valve.

VI. ADVANTAGES

- Improves parking experience in hills
- Simple in construction
- Manual errors will be avoided and it prevents from accidents
- Installation is simplified

VII. CONCLUSION

The automatic parking brake system can be easily implemented in all 4 wheeler without any appreciable changes in the existing system of manually operated brakes. The operation of the system is very simple and can be successfully implemented in existing braking systems. Human error and accidents can be avoided with the help of this project and in further the AI based control also can be done.

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