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Integrated Automated Jacks for 4-Wheelers

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ABSTRACT

An Automobile hydraulic jack can be easily operated by a single push button provided on the dash board. The jack will be installed on both the sides of chassis according to the weight distributions of the car. Similarly it will be installed on the other side of the car. The system operates on hydraulic drive which consists of three main parts: hydraulic pump, driven by an electric motor, hydraulic cylinder to lift the vehicle. The hydraulic jacks actuate separately for either side of car as per the breakdown condition. The car gets lifted and load gets distributed on three point i.e., plunger or ram of hydraulic cylinder and two tires opposite to side which is lifted. This jack will be very useful for all the senior citizens and especially for females (ladies) who find it extremely difficult to operate the jack manually in any breakdown condition. The motive behind using hydraulic system instead of a pneumatic system is the more power produced by the system and simple in design as compared to a pneumatic design. As the hydraulic oil is incompressible so the lifting capacity is more in comparison with the pneumatic system which operates on air which is compressible.

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Introduction

The invention relates to hydraulic jack and more specifically to an automobile hydraulic jack system. In most of the garages the vehicles are lifted by using screw jack. This needs high man power and skilled labors

In the past both hydraulic and pneumatic jack has been utilized in combination with the structure of automobile. They have always utilized a separate jack for each of 4 wheels by having the jacks permanently installed on the vehicle. They are ready to operation at all time [1].

Lifting device has been installed on vehicle, such as air lifting device. Various types of jack or lift devices has been installed on vehicle which are turned in 1 fashion or another from a horizontal attitude into a vertical attitude and then extended for the purpose of lifting the vehicle. It is an object of the invention to provide a novel hydraulic jack system that only utilized 2 hydraulic jacks, one that is mounted on chassis on side of car between two wheels and 2 jacks that is mounted on side of automobile between its side wheels.

It is also an object of invention to provide novel jack system that can be operated by driver from inside the car. It is also an object of invention to provide a novel hydraulic system in which a pump supplies pressurized oil to the hydraulic actuator or say hydraulic cylinder which acts as a hydraulic jack which will lift the vehicle [2]. Now the project has mainly concentrated on this difficulty, and hence such that the vehicles can be lifted from the floor land without application of any impact force. By pressing the button in the dashboard, it activates the hydraulic jack automatically. A Patent numbered 4,993,688, was registered dated Feb. 19, 1991, of United States by Thomas L. Mueller on Built in Power Jack. In this, there was a front suspension pneumatic jack that is mounted centrally to the rear suspension of the automobile between its rear wheels. The system operated from a compressed air reservoir tank that has connections for front and rear jack[3,4].

Need of invention

It is believed that '*Necessity is the mother of invention*'. Here the necessity lies in reducing the human effort applied during manual operation of the jacks and hence the need of the invention. In day to day life it is very tedious job to operate the jack manually and it is also a very time consuming work as well. So to make it easier for everyone especially for aged person and for lady drivers. To provide a safe and simple automatic hydraulic jacking system without manual effort. To provide a novel jacking system that can be operated from within the vehicle by means of a dashboard control panel. There are certain mechanisms already available for the same purpose which has a definite capacity to lift the car on 2 wheels viz. a screw jack. But the general idea of the project is to minimize the human effort while operating the jack. To provide a novel hydraulic jacking system that is directly and permanently incorporated into the vehicle frame in such a way as to prevent the additional risk of damage or weathering.[5,6].

Hydraulic Basics

Hydraulics is the science of transmitting force /or motion through the medium of a confined liquid. In a hydraulic device, power is transmitted by pushing on a confined liquid. The transfer of energy takes place because a quantity of liquid is subject to pressure. To operate liquid-powered systems, the operator should have knowledge of the basic nature of liquids. [4]

Pascal's Law

Blasé Pascal formulated the basic law of hydraulics in the mid 17th century. He discovered that pressure exerted on a fluid acts equally in all directions. His law states that pressure in a confined fluid is trans-mitted undiminished in every direction and acts with equal force on equal areas and at right angle to a container's walls [7] as shown in fig [1].

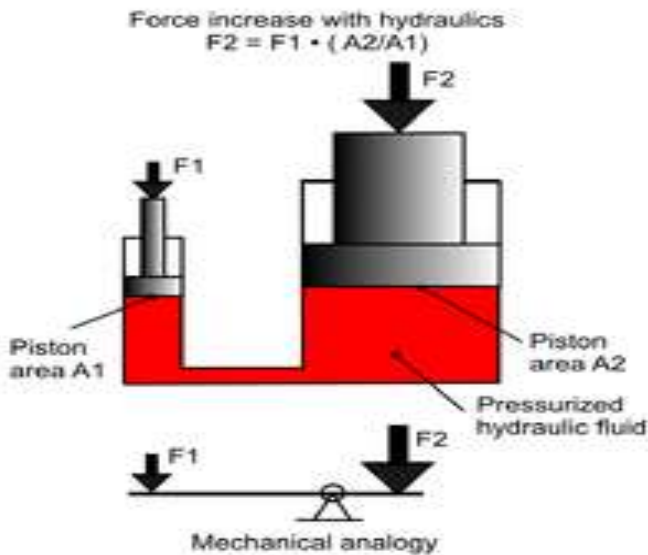


Figure 1. Application of Pascal Law

Hydraulic Systems

A hydraulic system contains and confines a liquid in such a way that it uses the laws governing liquids to transmit power and do work and components of a hydraulic system that store and condition the fluid. The oil reservoir (sump or tank) usually serves as a storehouse and a fluid conditioner. Filters, strainers and magnetic plugs condition the fluid by removing harmful impurities that could clog passages and damage parts. Heat exchangers or coolers often are used to keep the oil temperature within safe limits and prevent deterioration of the oil. Accumulators, though technically sources of stored energy, act as fluid storehouses.

Hydraulic Pressure, Force, and Motion

Although the force available to do work is increased by using a larger piston in one cylinder, the total movement of the larger piston is less than that of the smaller one. When output force increases, output motion decreases. If the 10-square-inch input piston moves 2 inches as it applies 50psi to the 100-square-inch output piston, that output piston will move only 0.2 inch as it applies 5000 pounds of output force. The ratio of input motion to output motion is the ratio of the input piston area to the output piston area, and you can use this simple equation to calculate it: The result from dividing the area of the input piston (A_1) by the area of the output piston is multiplied by the stroke of the input piston or $(A_1 \div A_2) \times S$ (the input stroke) = M (the output stroke) or 10 square inches (input piston) 100 square inches (output piston) = $10 \div 100 \times 2$ inches (input stroke) = 0.2 inch output motion. If the output piston is larger than the input piston, it exerts more force but travels a shorter distance. The opposite also is true. If the output piston is smaller than the input piston, it exerts less force but travels a longer distance. Apply the equation to the 5-square-inch output piston: 10 square inches (input piston) 5 square inches (output piston) = $10 \div 5 \times 2$ inches (input stroke) = 4.0 inches output motion. In this case, the smaller output piston applies only half the force of the input piston, but its stroke (motion) is twice as long. These relationships of force, pressure, and motion in a brake system are easily observed when you consider the force applied to the master cylinder's pistons and the resulting brake force and piston movement at the wheels. Wheel cylinder pistons move only a fraction of an inch to apply hundreds of pounds of force to the brake shoes, but the wheel cylinder piston travel is quite a bit less than the movement of the

master cylinder piston. Disc brake caliper pistons move only a few thousandths of an inch but apply great force to the brake rotors. This demonstrates how the use of hydraulics provides a mechanical advantage similar to that provided by the use of levers or gears. Although hydraulic systems, gears, and levers can accomplish the same results, hydraulics is preferred when the size and shape of the system are of concern. In hydraulics, the force applied to one piston will transmit through the fluid, and the opposite piston will have the same force on it. The distance between the two pistons in a hydraulic system does not affect the force in a static system. Therefore, the force applied to one piston can be transmitted without change to another piston located somewhere else. A hydraulic system responds to the pressure or force applied to it. The mere presence of different-sized pistons does not always result in fluid power. The force or pressure applied to the pistons must be different in order to cause fluid power. If an equal amount of pressure is exerted onto both pistons in a system and both pistons are the same size, neither piston will move; the system is balanced or is at equilibrium. The pressure inside the hydraulic system is called **static pressure** because there is no fluid motion. When an unequal amount of pressure is exerted on the pistons, the piston receiving the least amount of pressure will move in response to the difference between the two pressures. Likewise, the fluid will move if the size of the two pistons is different and an equal amount of pressure is exerted on the pistons. The pressure of the fluid while it is in motion is called **dynamic pressure**. [8,9]

Hydraulic circuit

If we consider a hydraulic system which is used in earth moving equipments like hydraulic excavators use one and only one power, i.e. hydraulic power. The excavators control such as bucket lifting arm swiveling, boom swiveling and extension all these actions are controlled by hydraulic circuits. To know more about the hydraulic system we will see it with closer view. First comes an oil tank or reservoir in which hydraulic oil is stored. The oil passes through various pipelines and after doing useful work in an actuator the oil returns back to the oil tank. Then filter that filters oil before going to next element, i.e. pump. Hydraulic pump which creates the flow of oil under pressure through entire hydraulic system. Hence assist transfer of power from which we get useful work. The valves which are fluid control element are of different types, direction control valves, flow control valves, pressure relief valves. These valves drive the flow of oil in the system. In actuators (linear) the pressurized oil acts. The oil gives or transmits its power to actuators to carry out work. The pipeline which is the functional connection for oil flow in the hydraulic system. [4]

Now applying the system to lift the car from one side so that wheel will be resting on the three points, one is the piston rod of the hydraulic actuator and the two tires. The position of each element of hydraulic system is to be arranged in a proper manner so that it should not cause a drastic change in the four wheeler, which is now made by the car manufacturer. The position of the hydraulic actuator is fixed. The cylinder will be permanently mounted on the chassis centrally between two wheels on either side of the car. The oil tank or reservoir, motor and pump could be arranged away from the cylinder as fluid is used for the transfer of the power and motion. System is represented by fig [2].

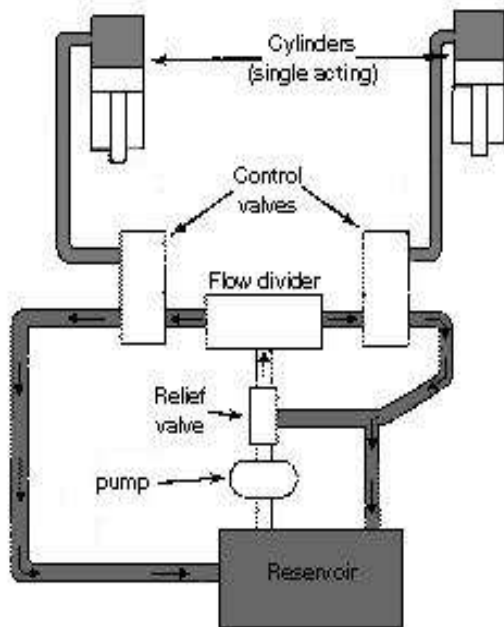


Figure 2 Hydraulic systems.

Working

The actual working of hydraulic system that lifts the car takes place by single press of the button provided on dashboard. When the switch is turned on the motor starts running which is powered by a battery already available in the car. This motor facilitates the flow of oil which is pressurized by the pump provided. This pressurized oil is then directed to the control unit which in turn directs the flow. Distribution of the pressurized oil is controlled by a switch on the dashboard. As the oil proceeds into the hydraulic cylinder, it exerts a certain amount of pressure on the plunger or the ram inside the cylinder. This exerted pressure of the oil is converted into a linear force which in turn causes the plunger in the cylinder to move out of the cylinder. Thus ultimately the exerted pressure of the oil is converted into linear motion of the plunger. As the plunger downwards out of the cylinder linearly, after a definite travel of the plunger in the downward direction and once it touches the ground it starts lifting the car.

Once the car is lifted to a desired height the tires can be changed. It is the specialty of a simple hydraulic jack that it possesses a self-locking system i.e. once the car is lifted to a certain height and even if the power to the jack is cut off the jack can still hold the entire part of car that is lifted by it. And thus, the driver can easily change the tire.

Once the tire is changed, now the concern is to release the pressure in the jack which is in the form of pressurized oil. Thus a relief valve is provided on the jack for this purpose. But since it is impossible to actuate this valve manually when this jack is installed on the chassis, this valve is then provided on the dashboard of the car in form of a switch which controls the relief valve provided on the control unit of the system. Once the relief valve is opened the oil in the cylinder which has lost its pressure energy, starts returning to the control unit. Once the oil starts returning the control unit then sends the accumulated oil back to the oil sump. And in this way the entire system efficiently works.

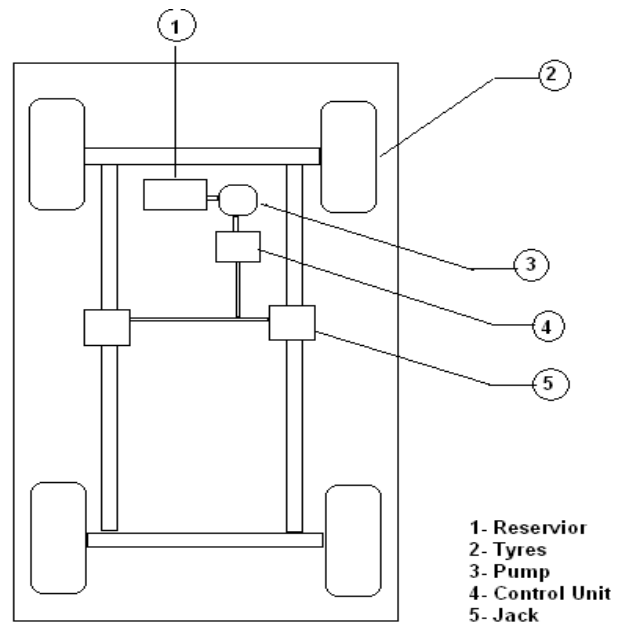


Figure 3- Working of Integrated automated Jack

Advantages

The advantages of hydraulic systems are as below-

- Simpler design. In most cases, a few pre-engineered components will replace complicated mechanical linkages.
- Flexibility. Hydraulic components can be located with considerable flexibility. Pipes and hoses in place of mechanical elements virtually eliminate location problems.
- Smoothness. Hydraulic systems are smooth and quiet in operation. Vibration is kept to a minimum control.
- Control of a wide range of speed and forces is easily possible.
- Cost. High efficiency with minimum friction loss keeps the cost of a power transmission at a minimum.
- Overload protection. Automatic valves guard the system against a breakdown from overloading.
- It requires simple maintenance cares
- The moving parts of this system are cooled by the oil itself used. Thus this project does not require any cooling arrangements.
- Checking and cleaning are easy.
- Repairing is easy.
- Replacement of parts is easy.
- The loaded light vehicles can be easily lifted.
- Manual power not required.
- Handling is easy.
- No Oil wastage.

Disadvantages

The possible disadvantages of this invention may be as below, but if compare with effective it is negligible.

- Elements of hydraulic system to be applied in the car have to be machined to a high degree of precision which increases the manufacturing cost of the system.
- Leakage of hydraulic oil during its flow in the system causes heavy pressure drop or may not lift car.
- In cold climate hydraulic oil freezes.
- The main disadvantage of a hydraulic system is maintaining the precision parts when they are exposed to bad climates and dirty atmospheres.
- Protection against rust, corrosion,
- Dirt, oil deterioration, and other adverse environment is very important.

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