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Design & Development of Button Operated Electro Hydraulic Jack

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Abstract - Car jack is an important element in the maintenance and removal of car tyres. The conventional jacks in use are toggle jack, hydraulic jack, screw jack etc. Normally the jacks are operated manually. In case of commercial cars use the toggle jack for lifting the car for removal of tyres. The toggle jack is manually operated although motorized toggle jack are also available. The toggle jack is a spare element which can be placed under an individual tyre location that needs to be replaced. The toggle jacks are cuber some to operate especially to female drivers and hence a more simple to operate motorized hydraulic jack that will be compact, handy, with low storage space is required.

The need of an integrated hydraulic jack in the motorized form is needed where in the lifting capacity of the jack be at least 1 ton, the drive motor be suitable connected via linkage to the operating handle of the hydraulic jack pump and the power be delivered to the motor through suitable electric circuit with 12 volt DC power that can be taken from the car battery through the cigarette lighter socket below dash board.

The design of the hydraulic jack, motor drive and kinematic linkage to operate the pump is done using theoretical method and the 3-d model is developed using Unigraphix NX-8 and the analysis of the parts is done using Ansys 16.0

The testing has been done in suitable manner to demonstrate the capability of jack.

Key Words: Electro Hydraulic jack, Pascal Law, etc…

1. INTRODUCTION

OVERVIEW:

A Screw jack is a device which is used to raise part of a vehicle in order to facilitate vehicle maintenances or breakdown repairs. In normal Jack system a mechanical jack is used for lifting the vehicles. The most common form is a car jack, garage jack, floor jack which lifts vehicles so that maintenance can be performed. Car jacks generally used to increase mechanical advantage while lifting the vehicle. In general the weight of the vehicle is near about the 1 tons. A specified jack can hold up to 1000 kilograms, but tests taken by Consumer Affairs has revealed that is fails to work after lifting 250 kilograms and may physically break when it has a weight close to its 1000 kilograms capacity. Tests have proven that the jack has the tendency to buckle under the weight it is promoted to withstand. For this reason, we have to developed the system which can used with toggle jack is automatic in operation. That means with the help of the electric motor. For this motor we have to use the vehicle battery is as source. In this, vehicle battery should be a 12V DC motor with some torque which is required to overcome the thread friction and to raise the load.

1.1 NEED OF INVENTION:

In the world, the fact is that „necessity is the mother of invention" and the necessary condition is that, large effort is required for the manual operation of jacks, so for that reason, it is the need of invention. In the repair and maintenance of automobiles, it is often necessary to raise an automobile to change a tyre or access the bottom of the automobile. According to that, various car jacks have been developed for lifting an automobile from a ground surface. In that case, they are categorised as; Standard jack, pneumatic jack, farm jack, hydraulic jack. Normally the standard jack uses the power screw for lifting. This standard jack has limited degree of freedom with corresponding link members. In Hydraulic jack, incompressible fluid is used instead of screw for lifting. This is achieved by increasing the fluid pressure in cylinder to uplift the load. Available jacks are typically large, heavy and also difficult to store, transport, carry or move into underside of an automobile. Doing work in a bent or occupying position for a period of time is not ergonomic to human body, i.e. it is not completely desirable in ergonomics point of view. It may give back problem while continuous working with same. Engineering is preferred for making things simpler or improving and effective, for that Car jacks must be easy to use for pregnant women. The general purpose of the project is to minimize the human effort while operating the jack.

1.2 PRINCIPLE OF WORKING:

1.2.1 Standard Jack:

Standard jack is a mechanical device which is used to lifting device. Standard jack employs a screw thread for lifting heavy equipment. The most common used in cars as car jack, floor jack or garage jack which lifts vehicles for purpose of vehicle maintenance. Standard Mechanical jacks are usually rated for a maximum lifting capacity (for ex., 1.5 tons or 3.0 tons). For maximum load hydraulic or pneumatic power is used to lift the Vehicle.

Figure 1 Standard screw jack

1.2.2 Pneumatic Jack:

A pneumatic jack is a part of hydraulic jack that is actuated by compressed air - for example, air from a compressor - instead of human work. It saves the effort which excludes the need of the user to actuate the hydraulic mechanism, with potentially increasing speed. In certain circumstances, these jacks are also capable to be operated by normal hydraulic actuation mechanism, by that keeping possession ability, even when source of compressed air is not available

Figure 2 Pneumatic jack

1.2.3 Farm Jack:

The farm jack is also known as a Hi-Lift Jack. It is composed of a steel beam with a chain or series of equally spaced holes continuous with its length and a mechanism with hand operated which is moved from one end of the beam to the other through the use of a pair of climbing pins. The farm jacks are categorised as 1.2m, 1.5m and 1.8m.

Figure 3 Farm Jack

1.2.4 Hydraulic Jack:

Incompressible Fluid is uses in hydraulic jack that is forced into a cylinder by a pump plunger. Oil is used which is self-lubricating and stable. At the time, when the plunger goes into the reservoir, it get return with oil by means of a suction check valve into the pump chamber. When the plunger goes toward the reservoir, it presses the oil into the cylinder by means of discharge check valve. Due to action of suction valve ball, the valve is open by to and fro motion of plunger which is fitted inside the chamber and same action also done when is moved out but in that condition discharge valve ball is fitted out of the chamber. At this stage the suction ball inside the chamber is pressurized by external work which helps to increase pressure in the cylinder.

Figure 4 Hydraulic Jack

Fig -1: Figure

2. PROBLEM STATEMENT:

The conventional jacks in use are toggle jack, hydraulic jack, screw jack etc. Normally the jacks are operated manually. In case of commercial cars use the toggle jack for lifting the car for removal of tyres. The toggle jack is manually operated although motorized toggle jack are also available. The toggle jack is a spare element which can be placed under an individual tyre location that needs to be replaced.
The toggle jacks are difficult to operate especially to female drivers and hence a more simple to operate motorized hydraulic jack that will be compact, handy, with low storage space is required
The need of an integrated hydraulic jack in the motorized form is needed where in the lifting capacity of the jack be at least 1 ton, the drive motor be suitable connected via linkage to the operating handle of the hydraulic jack pump and the power be delivered to the motor through suitable electric circuit with 12 volt DC power that can be taken from the car battery through the cigarette lighter socket below dash board.

3. OBJECTIVES

- To design and develop motor drive for operating jack system.
- To minimize human effort.
- To save time.

4. DESIGN METHODOLOGY:

Design consists of application of scientific principles, technical information and imagination for development of new or improvised machine or mechanism to perform a specific function with maximum economy &efficiency.

Hence a careful design approach has to be adopted. The total design work, has been split up into two parts

- System design
- Mechanical Design.

System design mainly concerns the various physical constraints and ergonomics, space requirements, arrangement of various components on main frame at system, man + machine interactions, No. of controls, position of controls, working environment of machine, chances of failure, safety measures to be provided, servicing aids, ease of maintenance,

scope of improvement, weight of machine from ground level, total weight of machine and a lot more.

In mechanical design the components are listed down and stored on the basis of their procurement, design in two categories namely,

- Designed Parts
- Parts to be purchased

For designed parts detached design is done & distinctions thus obtained are compared to next highest dimensions which are readily available in market. This amplifies the assembly as well as postproduction servicing work. The various tolerances on the works are specified. The process charts are prepared and passed on to the manufacturing stage

The parts which are to be purchased directly are selected from various catalogues & specified so that anybody can purchase the same from the retail shop with given specifications.

5. SCOPE OF THE PROJECT

- The developed automatic car jack must be operated on a flat surface.
- The developed jack car is only a prototype and not readily functioning as commercial product.
- The developed automatic car jack can only withstand below.
- The design is based on current hydraulic jack & cars in the market.

6. SCHEME OF IMPLEMENTATION

PHASE 1: DATA COLLECTION

Data collection phase involves the collection of reference material for project concept; the idea is taken from book HMT handbook.

PHASE 2: SYSTEM DESIGN

The system design comprises of development of the mechanism so that the given concept can perform the desired operation. The mechanism is basically an inversion of four bar kinematic linkage, hence the mechanism is suitably designed using Grashoff's law and the final outcome is shown in the figure shown before.

PHASE 3: MECHANICAL DESIGN

The parts mentioned above in the part list will be designed for stress and strain under the given system of forces, and appropriate dimensions will be derived. The standard parts will be selected from the PSG design data handbook.

PHASE 4: PRODUCTION DRAWING PREPARATION

Production drawings of the parts are prepared using Auto Cad, with appropriate dimensional and geometric tolerances. Raw material sizes for parts are also determined.

PHASE 5: MATERIAL PROCUREMENT & PROCESS PLANNING

Material is procured as per raw material specification and part quantity. Part process planning is done to decide the process of manufacture and appropriate machine for the same.

PHASE 6: MANUFACTURING

Parts are produced as per the part drawings.

PHASE 7: ASSEMBLY –TEST & TRIAL

Assembly of device is done as per assembly drawing ,and test and trial is conducted on device for evaluating performance.

7. OUTCOME

The button operated hydraulic jack is a device used to carry vehicle loads with the application of small force. Here we fabricated a hydraulic jack which is operated using a DC window winding motor which gets 12V dc supply from the battery of the vehicle without application of man force with cigarette lighter socket arrangement. Quick lifting is one of the main advantage of this electro hydraulic system.

It will also reduce the human effort and loaded vehicle can be lifted. Arrangement is also very useful for commercial vehicles and a person can go solo on a long drive.

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