Design and Fabrication of Automatic Handbrake Using Pneumatic 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. In our paper we are developing pneumatic operated automatic hand brake when ignition is off for safety purpose. The engagement of hand brake using actuator, controller,motor,battery.

Keywords: *Hydraulic System, Mechatronic System, Braking System, Vehicle safety.*

I. INTRODUCTION

The most important part in the automobile is the handbrake which is also known as a latching brake. It is used generally when the automobile is parked, thus the alternative name that is parking brakes is used to keep the car stationary also called as automobile e-brakes. The most column used of a parking brake is to keep the vehicle motionless when it is parked. The main function of brake system are to decelerate the vehicle, to maintain vehicles speed during downhill operation and finally to park the vehicle stationary either on a flat or slope road condition. In cars the hand brake is a latching brake usually used to keep the car stationary. Automobiles e-brakes usually concist 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 other end of mechanism is often a hand operated lever, on the floor on either side of the driver, a pull handle located below and near the stearing wheel column, or a pedal located far apart from the other pedals.

A. PROBLEM STATEMENT

In automobile, handbrake (parking brake) is the system used for safety. Convectional system works by operating hand brake lever manually. In the system it is observed that due to manual errors sometimes the brakes remain disengage when vehicle is in steady condition. The condition causes safety hazards which may cause damage the system components.

B. OBJECTIVES

1. To design and fabricate the pneumatic hand brake system.
2. It can be used automate overall braking system in an automobile when vehicle is in steady condition and ignition is off.
3. To avoid manual errors when driver forgot to engage hand brake.
4. To replace convectional parking barking system with a completely pneumatic system.

II. LITERATURE REVIEW

Wang Hong-liang,(2014) Research on the hill start control of vehicles based on auto parking brake system. The hill start control of vehicles is a difficult driving skill which need the driver coordination control clutch, accelerator and handbrake, relatively the error probability of manipulation is high.

Sanjay B.S.(2017) Design and analysis of parking brake system of car. The main purpose of this paper is to ensure the drivers safety through a modified handbrake in car.

S.Thivagar(2016) Automatic handbrake system design factors and braking condition. In cars the handbrake is a latching brake usually used to keep the car stationary.

Jitendra B.Satpute(2017) In cars, the parking brake, additionally known as emergency brake, handbrake, e-brake is a latching brake sometimes used to keep the vehicle stationary.

A. SCOPE

I. A four wheeler application for safe parking of cars on slopes, when driver forgot or intentionally avoids the use of hand brake.

II. To provide automation for manually operated handbrake which will reduce human efforts band provides comfort in driving.

III. The electromechanical parking brake help with automatic parking brake application base on engine ignition condition.

III. DESIGN

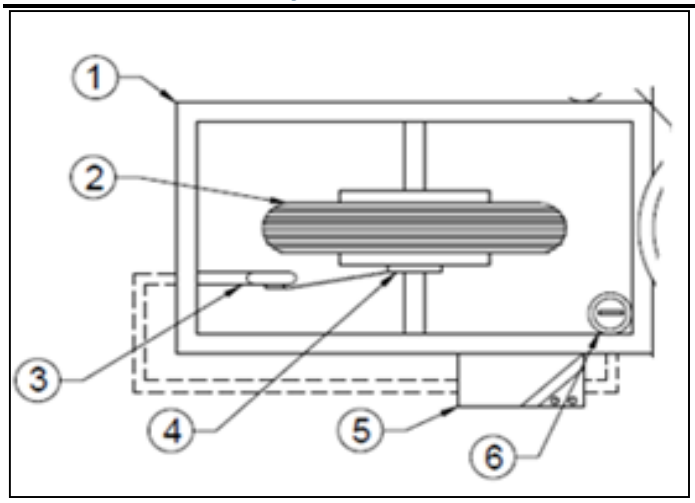

Fig.1 Design of Automatic Hand brake using pneumatic system

1. Frame
2. Wheel
3. Pneumatic cylinder
4. Breaking system
5. Battery
6. Ignition key

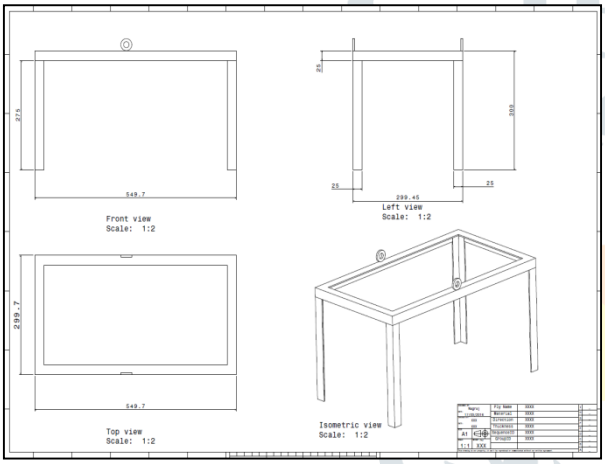

Fig.2 Base frame design

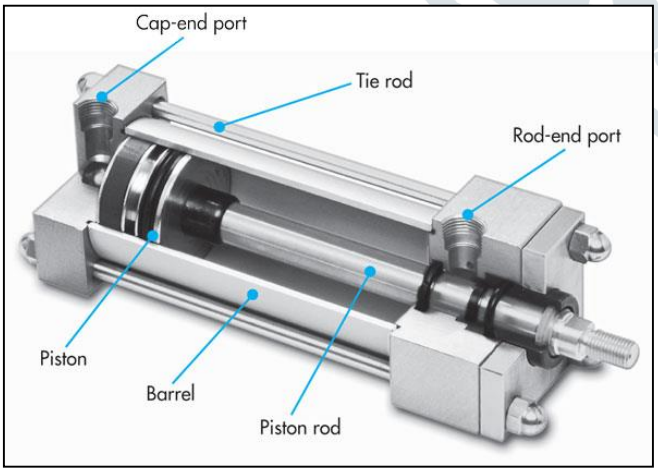

Fig.3 Pneumatic Actuator

Fig.4 Wheel

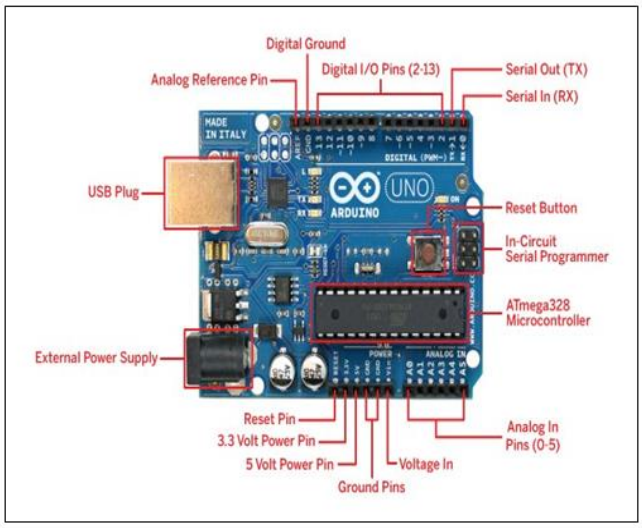

Fig.5 Microcontroller

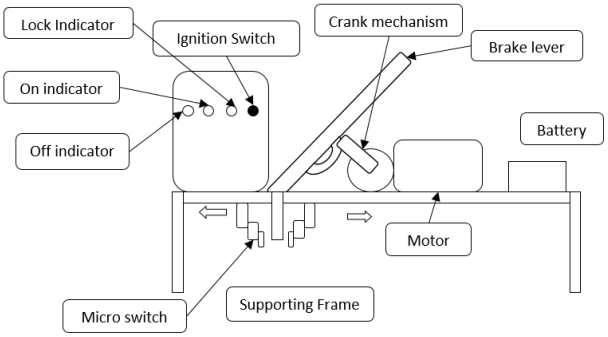

Fig.6. Block diagram

Working of parking brake

Initially the switch is ON i. e. vehicle is running condition. At that time the brake lever is at its released position i. e. at downward position.When the ignition switch is off then the electrical circuit is completed by ignition switch itself. Therefore the electrical power is supplied to the motor and motor starts rotating. Thus the pneumatic cylinder get extend brake lever starts moving towards the extreme outward position. When it reaches to extreme end the brake is fully engaged.

Table. 2 Specification of 12V Lead acid battery.

Voltage:	12 Volt
Capacity:	2 Ah
Type:	Sealed Lead Acid Battery
Length:	5.95"
Width:	2.56"
Height:	3.71"

Wheel:

Moped wheel (Honda Activa)

Tyre size 90/100-10

Rim size 10 inchBrake type & size Drum 130mm.

Table.1 Technical Specifications of Arduino uno.

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-9V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) (0.5 KB used by boot loader)
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

IV. DESIGN PROCEDURE

Force Calculation Foot brake :

by lever principle

F*8=32*1.9

F=60.8/8

F=7.6 kg

F=74.556 N

Hand brake calculation:

Now for handbrake lever

We assume pull force applied on lever during applying hand brake is appro.30 N

By concidering force F=74.556N from above equation, we will calculate

F_{hb}=

Considering dimension of hand lever

La= 25 cm=0.25m

Lb=8cm=0.08m

Fc=93.75N.

For hand brake generally 60% of hand brake. We use which braking instead of total brake so force is req. for hand brake is 60% of total force.

0.6*74.55=44.75N

Pneumatic cylinder calculation assuming max. press. 2N/mm^2

By using trial and error method calculate dia. of piston rod

(1) Calculate press. To check feasibility of actuator

P=F/A = 100/(3.14/4)*7^2= 2.598 N/mm^2

(2) P=F/A = 100/(3.14/4)*8^2=1.989N/mm^2

Hence actuator 8 mm dia. is selection from manufacture catalogue. All cylinder double acting cylinder Dia.32-100mm as per ISO 15552/VDMA24562 Std.

Force calculation for braking :

Mass of wheel=4 kg

Ang. Vel. Of tilting is 100 rpm =(100/60)rps

Wheel outer dia=400mm=0.4m

Amount of torqe req. to apply brakes

$T=Mgr \sin\emptyset+\mathcal{I}\alpha$

Mg=weight of tiltinf mechanism

I= moment of inertia

$I=mk^2$

α= angular acc. of tilting mechanism

For rectangular object the radious of gyration of can be obtained as

K_2=1/3(D/2)2

=0.1154 m

=115 mm

To calculate moment of inertia of tilting mechanism

$I=mk^2$

=4*0.115^2

=0.0529 kg.m^2

Angular velocity is given by

W=2πN

α=2πN/t

=2π*100/60

=1.74 rad/sec.

$T=Mgr \sin\emptyset+\mathcal{I}\alpha$

=(4*9.81*0.2*sin90)+(0.0529*1.74)

=38.84 N-m.

Amount of force req. for braking

T=fr

38.84=F*0.2

F=194.24 N

V. Advantages, and Application

A. *ADVANTAGES*

1. Reduce the manual work
2. Less skill technicians is sufficient to operate.
3. Installation is simplified very much.
4. Improves parking experience in hills.

B. *APPLICATION*

1. Four-Wheeler application.In all 4 wheelers as well as in heavy vehicles if this system is installed it will be very useful

VI. 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.

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