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Device for Car Passenger Safety During Collision

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Abstract:
In automobiles especially car has a safety precaution system called air bags to avoid injury of passenger while collision. By this system head and neck are protected safely. But leg and hip get injured. To avoid this we have fixed a double acting hydraulic cylinder. One end is fixed with bumper and another end is fixed with seat frame. By this set up we can protect our hip and leg from injury while collision.

Key words: collision, impact, lowers extremity injury, hydraulic piston, fluid, seat frame, safety under pelvis, airbag.

I. INTRODUCTION

While a car collides the total body of the car will be crashed and the driver and passenger will be gotten into accident. So the passenger gets injured and sometimes unfortunately die. To avoid this or control this, the airbag system was implemented. Because head is the most important and not easily recoverable part in our body, it protects our head from severe injury while meeting an accident but lower parts of our body like pelvis, tibia and foot get injured.

NEED FOR THIS SAFETY DEVICE

As an engineer we have to think about safety of the car passenger's lower extremity injuries safety during occurring of accident. To avoid these lower extremity injuries of car passenger we implement this device in a car. Some reports indicate that lower extremity injuries in car crashes are quite infrequent, whereas others find lower extremity injuries in 50% of the injured occupants. The National Crash Severity Study (NCSS) provides a sample of accidents and injury data concerning passenger cars and their occupants. In this report the lower extremity injuries sustained in passenger car crashes are examined in order to place them in perspective relative to other crash injuries elsewhere in the body.

II. LITERATURE REVIEW

Although there are many case descriptions of extremity injuries in the medical literature, they are too numerous to list, and collectively would add little to the present review. A selected review of some of the more prominent statistical publications on this subject follows. A study by the German Motor Insurers [Anonymous, 1975] on 28,936 drivers and 14,954 front seat passengers in accidents involving an injury insurance claim indicates that the more severe (AIS- 3) lower extremity injuries are infrequent (thigh, 0.5%; knee; 0.4%; leg, 0.3% and foot, 0.1-0.2%). Nash (Australia), [1969] reported that 47% of the car occupants admitted to the hospital had some leg injury; the severity of these injuries was not reported. Nahum et al. [1968], reviewed the data of 190 crashes wherein at least one occupant sustained an injury of moderate (non- dangerous) or dangerous (non-fatal) degree (239 occur- pants, 496 significant injuries). Of these injuries, 13% were in the lower limb, with 60% of these caused by contact with the instrument panel, floor or toe pan area. Most of these injuries occurred at impact speeds above 30mph. A crash injury study by Nagel and States [1977(a)], indicated that most of the knee injuries resulted from impact with the dashboard. The authors concluded that degenerative arthritis will develop in the more seriously injured knees.

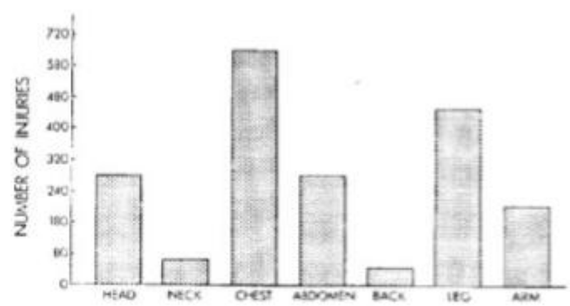


Fig. 1. Body region distribution of the more severe injuries (AIS-3 or 4) in the NCSS sample.

COMPONENTS AND DESCRIPTION

A-Frame stand
B-Seat frame
C-Hydraulic piston
D-Hydraulic hose pipe
E-Fluid
F-Bumper

A-FRAME STAND

This is made up of mild steel. This frame stand is acting here as a stand to seat frame. This frame stand bear the seat set up and move backward the whole seat setup during collision.

B-SEAT FRAME

A car seat is the seat used in automobiles. Most car seat frames are made up of good strength material and adjustable. The most common material is polyester. This seat frame was fixed on the frame stand.

C-HYDRAULIC PISTON

A hydraulic cylinder also called a linear hydraulic motor is a mechanical actuator that is used to give a unidirectional force through a unidirectional stroke. Here we are going to use two double acting hydraulic pistons. First cylinder was fully opened and fixed with bumper of a car and second piston was fully closed. Both the pistons were fixed in opposite direction.

Hydraulic cylinders get their power from pressurized hydraulic fluid, which is typically oil.

D-HYDRAULIC HOSE PIPE

A hose is a flexible hollow tube designed to carry fluids from one location to another. Here this hose pipe is used to connect two pistons. This hosepipe connects first piston's cap end with second piston's cap end.

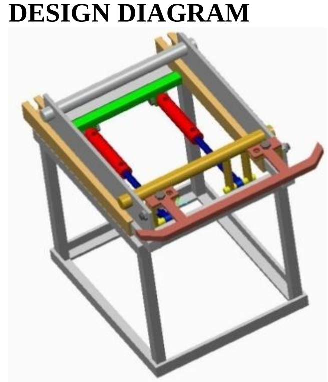
E-FLUID

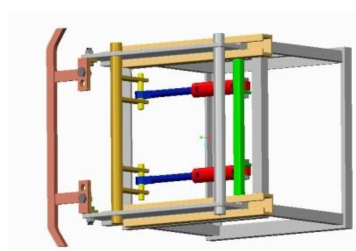
Here we are going to use 'mineral oil 46' because of its high viscosity. A hydraulic fluid is the medium by which power is transferred in hydraulic machinery. By this fluid we can control the impact energy and move the piston in backward direction. Common hydraulic fluids are based on mineral oil or water. Hydraulic systems like the ones mentioned above will work most efficiently if the hydraulic fluid used has zero compressibility.

F-BUMPER

A bumper is a structure attached to with the front end of a car. Bumper is used to absorb impact in a collision. Here we have connected the bumper with hydraulic piston and that hydraulic piston was connected with another hydraulic piston. That hydraulic piston was connected with frame stand.

DESIGN DIAGRAM





WORKING PRINCIPLE

Here we choose two double acting hydraulic cylinder.one hydraulic cylinder is fully opened and another one is fully closed. We selected mineral oil 46 as working fluid here because of its high viscosity and high bearing temperature. We filled up the cylinder with that mineral oil 46 and connected the piston through a hose pipe. Then we fixed the opened hydraulic piston with bumper and the closed hydraulic piston is fixed with the seat frame. While the vehicle collides, the bumper gets collapsed and also piston is pushed forcibly in backward direction so the seat is also moved backwards.

DESIGN CALCULATION

Force calculation

Work = Energy

$$F \times d = 0.5 \times m \times v^2$$
$$F = \frac{0.5 \times m \times v^2}{d}$$

At 120 km/h ,

$$F = \frac{0.5 \times 1615 \times 33.33}{0.75}$$
$$F = 1196.057\ kN$$
$$F = 268884.3\ lb$$

At 80 km/h,

$$F = \frac{0.5 \times 1615 \times 22.22}{0.75}$$
$$F = 528.289\ kN$$
$$F = 11874.1\ lb$$

Pressure calculation

$$r_1 = 5\ inch\ and\ r_2 = 10\ inch$$

At 120 km/h,

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$
$$\frac{F_1}{78.53} = \frac{1196.057}{314.159}$$
$$F_1 = 298.977\ kN$$
$$F_1 = 30487.17\ kg$$
$$F_1 = 67212.7\ lb$$
$$P_1 = 855.88\ psi$$
$$P_1 = 59\ bar$$

At 80 km/h,

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$
$$\frac{F_1}{78.53} = \frac{528.289}{314.159}$$
$$F_1 = 132.055\ kN$$
$$F_1 = 31465.86\ kg$$
$$F_1 = 29687.15\ lb$$
$$P_1 = 380\ psi$$
$$P_1 = 26.2\ bar$$

Byreducing cylinder diameter to $r_1 = 2.5\ inch\ and\ \ r_2 = 5\ inch$

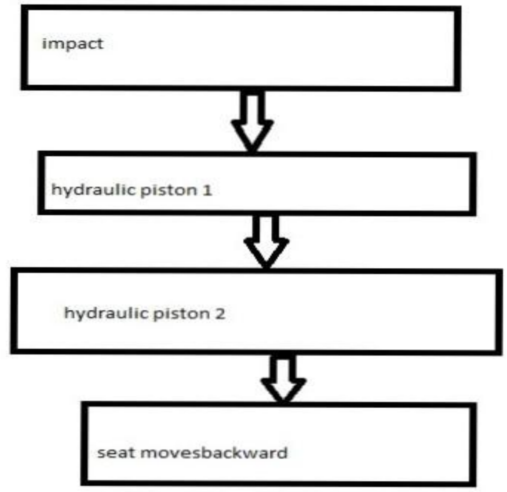
At 120 km/h

$$\frac{F_1}{A_2} = \frac{F_2}{A_2}$$
$$\frac{F_1}{19.63} = \frac{1196.051}{78.53}$$
$$F_1 = 298.977\ kN$$
$$F_1 = 30487.17\ kg$$
$$F_1 = 67212.7\ lb$$
$$P_1 = 3423.96\ psi$$
$$P_1 = 236.07\ bar$$

At 80 km/h

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$
$$\frac{F_1}{19.63} = \frac{1196.057}{78.53}$$
$$F_1 = 132.055$$
$$F_1 = 13465.86\ kg$$
$$F_1 = 29687.15\ lb$$
$$P_1 = 1512\ psi$$
$$P_1 = 104.24\ bar$$

FLOW CHART



ADVANTAGES

- Passenger is protected from impact on his body parts like leg and hip
- Vehicle damage will be reduced due to reduction in the impact by hydraulic action.

II. CONCLUSION

- By implementing this system we can protect our legs and hip. It is an additional system to airbag system. It is cheap and best.

III. REFERENCE

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