Car Collision Physics and Newton's Laws Analysis

Posted on September 30, 2019

View this essay online:
https://academic-master.com/car-collision-physics-and-newtons-laws-analysis/

Car collisions are an everyday occurrence across the globe. Millions of people get hurt or die in accidents. Accidents have been branded with the epithet 'inevitable.' However, irrespective of the cause of the accident, one factor is always at play: physics. So, physicists are making an earnest endeavour to understand car collisions, make practical sense of them, and use the knowledge to address the problem with the aim of preserving lives. That quickly takes one's mind to the laws of motion coined by Isaac Newton. Newton designed three laws of motion that have been quite pivotal in addressing the problem of car collisions. So, this paper aims to discuss how physicists have addressed the issue of car collisions using the laws of motion.

Laws Of Motion

Vehicle accidents depend on two primary factors: force and motion, which Isaac Newton was keen to theorize. So, it is essential to understand the laws of motion first.

The first law states that a body will always remain at rest or in motion unless it is acted upon by another force (Kuehn, 2015). This is the law of inertia. Inertia maintains a body's motion or resting position. For instance, if you put a bowl of food on the table and then abruptly pull the table mat away, the bowl will remain right where it was. In the automobile industry, this is a typical experience. When a vehicle starts to move, passengers lean backwards because their bodies still assume the resting position. In the same manner, when a moving car stops suddenly, passengers fly forward at the speed of the vehicle. It is this forward flight that results in fatal head injuries, bone fractures, and soft tissue affliction.

Newton's second law states that the force acting on an object is equivalent to the change in the object's momentum per unit time. This implies that momentum is a term that's only applicable to moving objects like a speeding car because stationary objects have zero velocity, which gives zero momentum. But then, speed per unit of time provides the object's acceleration (a). Therefore, Newton was justified in saying that force is equivalent to the object's mass times the acceleration thereof (Kuehn, 2015). That explains why a vehicle accelerating down the steep slope of a hill has a very high likelihood of causing an accident because it has uncontrollable force.

The third law is simple but quite consequential in the practical realms. The law holds that there is

always an equal and opposite reaction for every action.

How Science is Applied in Addressing Vehicle Collisions.

First, vehicles are designed to crumple at the bonnet. A moving car has enormous energy from the burning fuels that propel it. For instance, a car moving at 60 km/h has energy equivalent to that of an elephant dropping from the top of a three-story building. That's a lot of energy which has to go somewhere to stop the car. When the brakes are applied, the energy is lost through friction and heat on the tyres. However, in the event of a collision, the power is lost in the bending of the body of the car. According to Lemov (2015), designing cars to crumple when they crash lengthens the duration of the impact so that it requires less impact to stop the vehicle. It is important to remember that a sharp deceleration over a short period is very dangerous for the human brain and internal organs. Vehicles have steel rails in the bonnet, which deform and bend to absorb the impact and slow the vehicle down.

Next, cars are fitted with airbags on the steering wheel. All credit goes to John Hedrick, who invented the excellent airbag idea in 1952. The scientific idea behind the use of airbags is that when a vehicle stops suddenly during a collision, the driver's body moves forward at the original speed of the car, which leaves the driver with fatal injuries on the chest and face. You can imagine what would happen to the driver when a car at 100 km/h crashes and the driver knocks the steering wheel at the same speed. The airbag acts as a cushion, neutralizing the speed of the driver's body to zero over a considerable duration of time and minimizing possible injuries.

The third remedy is safety belts. Seat belts restrain the body movement of the vehicle occupants so that they do not suddenly fly forward during a collision (Lemov, 2015). This idea is also based on Newton's first law of motion. Additionally, seat belts ensure that the driver is in the right position for the airbag to act.

Benefits

The aforementioned remedies have numerous benefits. The first and most important one is that the solutions save the lives of millions of people who would otherwise be dead from accidents. Data from the National Highway Traffic Safety Administration (NHTSA) indicates that seat belts save over 15 thousand lives per year (Litman & Fitzroy, 2015). The same database shows that the airbag has saved more than 28 thousand lives in America alone. Curtain airbags have dramatically reduced head injuries by 45% since their invention. Crumple zones have also reduced fatalities significantly.

Limitations

Sometimes, vehicle sensors and airbag mechanisms may fail for various reasons, jeopardizing the safety of drivers and passengers. However, the failure rates are very minimal due to the meticulous design that goes into them. In the same breath, seat belts and all the other safety measures promote careless driving and unscrupulousness, which lead to more fatal accidents than ever before.

References

Kuehn, K. (2015). Newton's Laws of Motion. In *A Student's Guide Through the Great Physics Texts* (pp. 261-264). Springer, New York, NY.

Lemov, M. R. (2015). *Car Safety Wars: One Hundred Years of Technology, Politics, and Death*. Rowman & Littlefield.

Litman, T., & Fitzroy, S. (2017). *Safe travels*. Victoria Transport Policy Institute.