SPECTROMECH

9th Edition

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TECHNIQUE POLYTECHNIC INSTITUTE

DEPT: MECHANICAL ENGINEERING

Vision of the Institution

- To be a premier institute in pursuit of excellence in technical education and skill development committed to serve the society

Mission of the Institution

- To promote excellence in learning, teaching and technology transfer
- To improve the quality of skilled workforce through a structured programmed and professional skills training
- To inspire students to learn and facilitate their overall development with social orientation and values

Vision of the Department

- To be a centre of excellence in Mechanical Engineering to impart technical & professional skills to cater industrial requirements while considering environmental aspects fulfilling societal obligations

Mission of the Department

- To impart the necessary technical skills among students
- To enhance the interaction with industry
- To produce competitive& employable Diploma Engineers
- To inculcate ethical & professional values among students

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- **Successful career (PEO #1):** To provide students strong foundation of technological fundamentals, necessary to analyze, design, manufacture using modern technological tools to become successful professional in real life world
- **Adaptability with new learning environment (PEO #2):** To build up the aptitude for an understanding of requirement analysis, ability to adopt new working environment and solves complex problem especially in multidisciplinary in nature
- **Keeping pace with developing world (PEO #3):** To provide adequate exposure to promising radical change in technology, training and opportunity to work as teams in cross functions project with effective communication skill and leadership qualities
- **Integration with the society (PEO #4):** To promote student awareness on the life sustained learning by bringing them to their professional principles of practice based on professional ethics of codes so as to achieve the ability to integrate in to the world of practicing professionals for collaborations, mutual support and representing the profession to society.

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FOREWORD

Heartily welcome to our ninth edition of Mechanical Engineering Technical magazine 'SPECTRO MECH' in 2023. We excited to report that the Department of Mechanical Engineering continues to grow to meet our vision of the department which is analyze by Faculty Course Assessment Report (FCAR). Mechanical Engineering is one of the largest enrolled department in the collage with more than 567 under graduate student over the period of 2010-2023 more than 55 students are already placed at various companies as well as higher studies within the academic session 2022-23. All the initiatives are possible by the efficient contributions of alumni, friends, faculty members and staffs.

I would like to express my appreciation to all the authors of the article in this issue of the Magazine. Our goal is to create quality education for the student of the twenty first century. The success of 'SPECTRO MECH' depends on energetic and joint effort of all stake holders of the Institution. I would appreciate your feedback and any suggestion for improvement.

Soumendra Nath Basu
Academic & Administrative Advisor
Technique Polytechnic Institute

CONTENT

HYBRID VEHICLE

SUJIT KUMAR GARAI
Sr. Lecturer

History of (Electric Vehicles) EVs:

1) The first EV was built by Frenchman Gustave Trouvé in 1881. It was a tricycle powered by a 0.1-hp direct current (DC) motor fed by lead-acid batteries. The whole vehicle and its driver weighed approximately 160 kg.

2) The first commercial EV was Morris and Salom's Electro bat. This vehicle was operated as a taxi in New York City.

3). In 1966, General Motors (GM) built the Electrovan. American multinational automotive manufacturing company headquartered in Detroit, Michigan (US)

4) The modern EV era culminated in the 1980s and early 1990s with the release of a few realistic vehicles by firms such as GM with the EV and Peugeot Société Anonyme (PSA) (Automobile Company located in Paris France, Europe)

History of (Hybrid Electric Vehicles) HEVs

1) The first hybrid vehicles reported were shown at the Paris Salon of 1899.

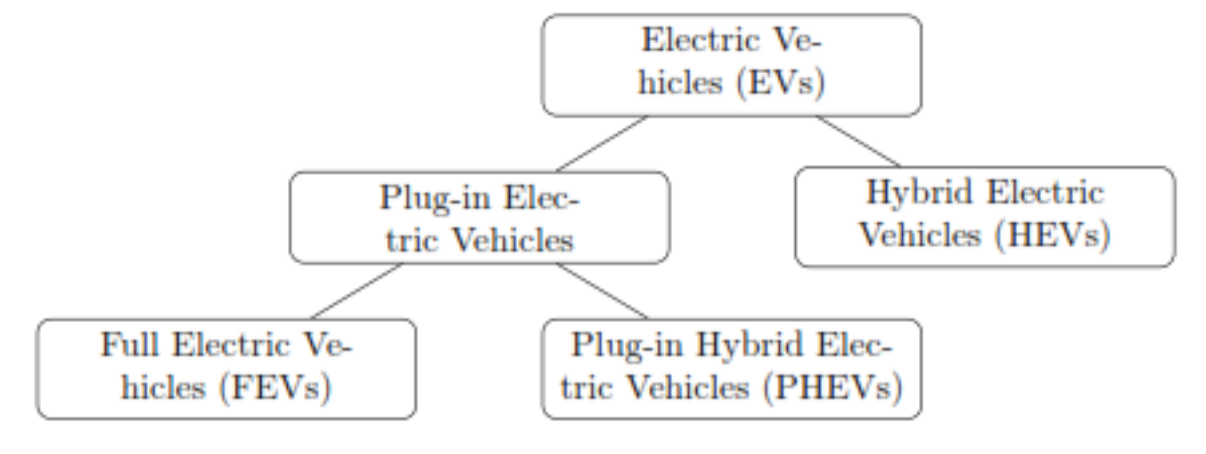
2) The HEV concept drew great interest during the 1990s when it became clear that EVs would never achieve the objective of saving energy. The Ford Motor Company initiated the Ford Hybrid Electric Vehicle Challenge, which drew efforts from universities to develop hybrid versions of production automobiles

3) The most significant effort in the development and commercialization of HEVs was made by Japanese manufacturers. In 1997, Toyota released the Prius sedan in Japan. Honda also released its Insight and Civic Hybrid

1. What is hybrid electric vehicle?

ANS: Hybrid electric vehicles are powered by an internal combustion engine and one or more electric motors, which uses energy stored in batteries.

2. Classification of EVs:



ELECTRIC VEHICLES: Electric Vehicle (EV) is a vehicle that no longer relies solely on an Internal Combustion Engine (ICE) as the only propulsion mechanism.

HYBRIDE ELECTRIC VEHICLE: A Hybrid Electric Vehicle (HEV) combines an ICE and an electric motor within the drive train. Mostly, the electric motor supports the ICE for fuel economy and/or performance. The vehicle is then either propelled by the combustion engine or the electric drive.

A Plug-in Hybrid Electric Vehicle (Plug-in Hybrid Electric Vehicle (PHEV)): It is a vehicle equipped, in general, with a larger battery compared to HEVs that allows recharging of the battery via home outlets or at charging stations. While in most cases both the electric drive and the ICE are able to propel the vehicle, some vehicles use solely the electric drive.

In this latter case the ICE can be used to recharge the battery or directly produce electricity for the electric drive. Also, in most cases PHEVs can be used in a full electric mode if there is enough energy stored in the battery. This allows one to select when and where to release pollutants

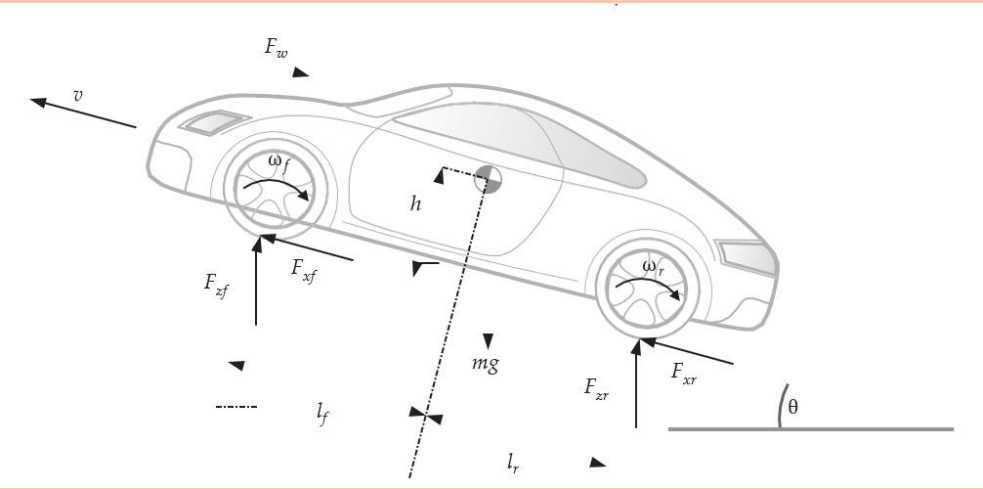
FEV: A Full Electric Vehicle (FEV) runs solely on an electric drive system. As with PHEVs their batteries are large and can be recharged in charging stations or at home. Since there are no pollutants released while driving, these vehicles are often marketed as zero-emission vehicles.

LONGITUDINAL VEHICLE MOTION:

Accelerating force:

$$ma = F_t - F_w - F_g - F_r$$

where m is the vehicle mass, a is the acceleration of the vehicle. F_t is the total tractive force acting upon the vehicle body, F_w is the aerodynamic drag force, F_g is the grading resistance force, and F_r is the rolling resistance force.



1. AERODYNAMIC DRAG:

As air travels over the body of the vehicle, it generates normal pressure and shear stress on the vehicle's body.Aerodynamic drag is a function of effective vehicle frontal area, A, and the aerodynamic drag coefficient, C_d, which are highly dependent on the design of the vehicle body:

$$F_w = \frac{1}{2}\rho A C_d (V + V_w)^2$$

where ρ is the air density, V is the vehicle longitudinal speed, and V_w is the wind speed.

2. GRADING RESISTANCE:

As a vehicle travels up or down an incline, gravity acting on the vehicle produces a force which is always directed downward.

$$F_g = mg\sin(\theta)$$

3. ROLLING RESISTANCE:

Rolling resistance force is a result of the hysteresis of the tire at the contact patch as it rolls along theroadway. In a stationary tire, the normal force due to the road balances the force due to the weight of the vehicle through the contact patch which is in line with the center of the tire. When the tire rolls, as a result of tire distortion or hysteresis, the normal pressure in the leading half of the contact patchis higher than that in the trailing half. The normal force due to the road is shifted from the centerof the tire in the direction of motion. This shift produces a moment that exerts a retarding torque onthe wheel. The rolling resistance force is the force due to the moment, which opposes the motion of the wheel, and always assists in braking or retarding the motion of the vehicle.

$$\boldsymbol{F_r = F_z f_r \cos(\theta)}$$

Rolling resistance force is a function of the normal load F_z and the rolling resistance coefficient f_r,

4. TOTAL TRACTIVE FORCE:

$$ma = F_t - F_w - F_g - F_r \Rightarrow ma = (F_{tf} + F_{tr}) - (F_w + F_g + F_{rf} + F_{rr})$$

Total tractive effort = sum of *Fzf* and *Fzr*

The total tractive force can be expressed as the tractive forces acting on each tire:

$$F_t = F_{xf} + F_{xr}$$

where *Fzf* and *Fzr* are the normal forces on the front and rear tires

$$\sum M_r = 0, \quad \sum M_f = 0$$

Therefore,

$$F_{zf}(l_f + l_r) + F_w h_w + (mg\sin(\theta)h) + (mah) - (mg\cos(\theta)l_r) = 0$$

and

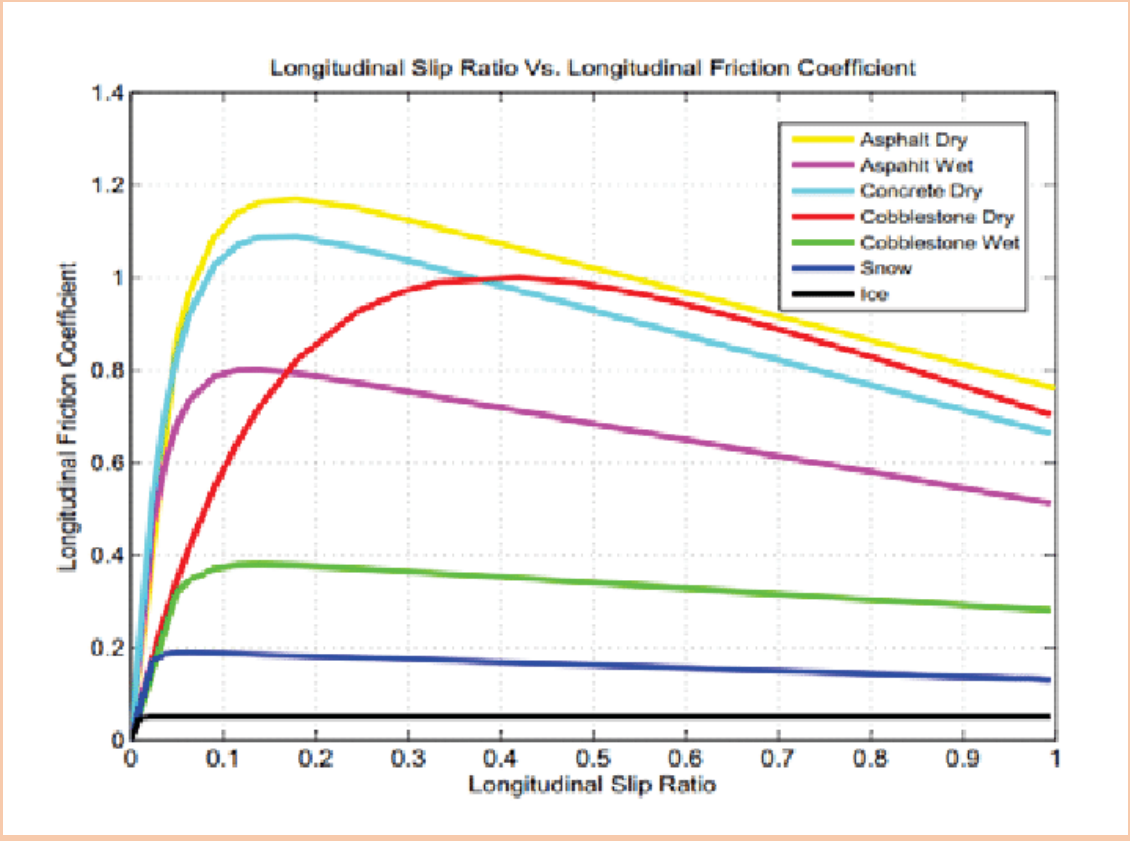
$$F_{zr}(l_f + l_r) - F_w h_w - (mg\sin(\theta)h) - (mah) - (mg\cos(\theta)l_f) = 0$$

5. Maximum Tractive Effort and Powertrain Tractive Effort:

The maximum tractive effort of the vehicle is proportional to the slip ratio of the tire, which represents the difference between the angular tire speed and the vehicle speed

$$\sigma_r = \frac{r_{wr}\omega_r - V}{r_{wr}\omega_r}, \quad \sigma_f = \frac{r_{wf}\omega_f - V}{r_{wf}\omega_f}$$

where *rwf* and *rwr* are the radii of the front and rear tires, and ωf and ωr represent their angular peed.Slip-friction coefficient characteristics of a tire have a nonlinear relationship and depend on the road surface conditions,



Relationship between slip ratio and friction coefficient Figure (4) shows the relationship between friction coefficient L and L on different road surface condition. It also represents how the friction coefficient increases

with slip ratio in the range 0.1 to 0.2 for all where it obtains maximum value of friction coefficient except cobblestone dry which reaches maximum at the value slip ratio 0.4. The driving force also reaches the maximum value corresponding to the friction coefficient. For slip ratio value greater than the value at peak point, the friction coefficient decreases to the minimum value where wheel is completely skidding. In order to control the slip ratio so that maximum driving force is obtainable, it is expected that slip ratio value should be at that range.

6. Maximum Speed of a Vehicle:

The maximum speed of a vehicle is the highest constant cruising speed that the vehicle can achieve at full power on a level road. The maximum speed of a vehicle is calculated with full torque from the traction source on a flat road when the tractive force and the resistive force are at equilibrium.

Since the vehicle acceleration and road gradient are zero at this point, the equilibrium can be represented as:

$$F_t = F_w + F_r$$

7. Gradeability:

The gradeability of a vehicle is the maximum gradient on which the vehicle can start climbing from stand-still with all the wheels of the vehicle on the gradient at the time of start. For a relatively small angle of θ, tan θ = sin θ. Using this approximation, the grade resistance can be approximated by *mg* tan θ, or *mgG*, *G* is the slope of the grade.

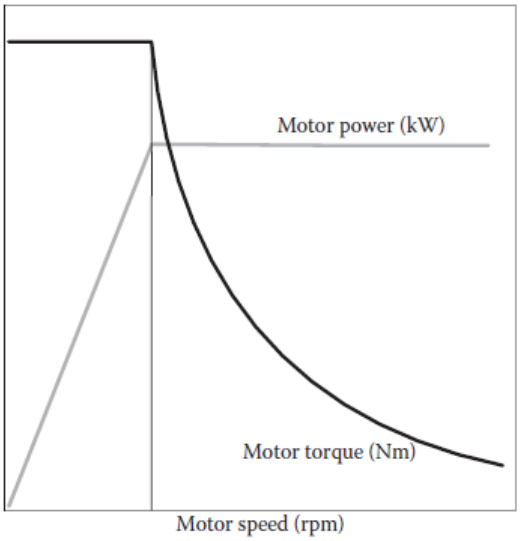
$$F_t = F_w + F_r + F_g$$

$$\frac{T_m i_t i_0 \eta_p}{r_r} = mgf_r + \frac{1}{2}\rho A C_d V^2 + mgG$$

$$G = \frac{((T_m i_t i_0 \eta_p)/r_r) - mgf_r - (1/2)\rho A C_d V^2}{mg}$$

8. Power Plant Characteristics:

For conventional vehicles, the ideal performance characteristic of a power plant is an unchanging power output across the entire operating range. At low speeds, motor torque is forced to maintain a constant value so as not to exceed the adhesion limit between the tire-ground contact area. After the constant torque low-speed range, the torque varies with speed steeply.



9. Transmission Characteristics:

The term "transmission" refers to all of the systems or subsystems used for transmitting the engine power to the driven wheels or sprockets. The principal requirements for the transmission are to attain the desired maximum vehicle speed with an appropriate engine, to be able to move the vehicle on a steep slope as well as maintain speed on a gentle slope in high gear, and to properly match the engine characteristics to achieve the desired operating fuel economy and acceleration rate.

A) M**anual Transmission:** Manual transmissions were the first gearbox designs used in conventional vehicles and were used for decades before automatic transmissions were introduced. These transmissions are still popular due to their simplicity, low cost, and high efficiency. The term "manual" implies that the driver must perform the shifting from gear to gear manually. A manual gear transmission consists of a clutch, gearbox, final drive, and driveshaft. The gearbox provides a number of gear reduction ratios, between three and five for passenger cars, and more for heavy commercial vehicles.

B) **Automatic Transmission:** With an automatic transmission a driver no longer needs to actively change gears during driving, thus making the vehicle easier to drive. Automatic transmissions use fluid to transmit power in the form of torque and speed and are widely used in conventional passenger vehicles. In a conventional automatic transmission, the clutch is replaced with a fluid coupling or torque converter to eliminate engaging and disengaging action during gear changes. The torque converter's three major components,

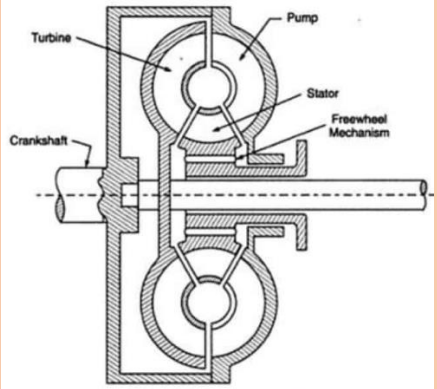


Fig: Torque converter

1. What's the difference between a plug-in hybrid and a battery electric vehicle?
a) There is no difference,
b) A plug-in hybrid only accepts AC power, while a battery electric vehicle accepts AC and DC power,
c) A plug-in hybrid can be powered by either the battery or the gasoline engine. A fully electric vehicle is powered only by the battery.
d) all
2. Which electric vehicle model is most popular in Minnesota (by vehicle registrations)?
a) Tesla Model 3, b) Nissan Leaf, c) Chevy Bolt, d) BMW i3
3. As of June 2021, how many electric vehicles are registered in Minnesota?
a) 5,000, b) 10,000, c) 15,000, **d) 20,000**
4. Which electric vehicle is featured in Avengers: Endgame?
a) Jaguar I-Pace, b) Tesla Model X, **c) Audi e-tron,** d) Porsche Taycan
5. Which of these companies is the only one WITH plans for an all-electric pickup truck?
a) Toyota, b) GMC, c) Ford, d) Ram, **e) All of the above**
6. Which of these years saw the most global electric vehicle sales?
a) 2016, b) 2017, c) 2018, **d) 2019**
7. On average, how much does it cost to operate an electric vehicle compared to a traditional car?
a) The same cost, b) Half the cost, c) ¾ the cost, **d) ¼ the cost**
8. An electric vehicle only needs one of the following maintenance jobs done. Which is it?
a) Oil change, b) Belt replacement, c) New spark plugs, **d) Brake pad inspections**
9. How many vehicles can a manufacturer sell before triggering the federal tax credit phase-out?
a) 50,000, b) 100,000, c) 200,000, **d) 300,000**
10. Which of the following is NOT a kind of DC fast charger plug?
a) J1772, b) CHAdeMO, c) SSA/CCS, d) Supercharger

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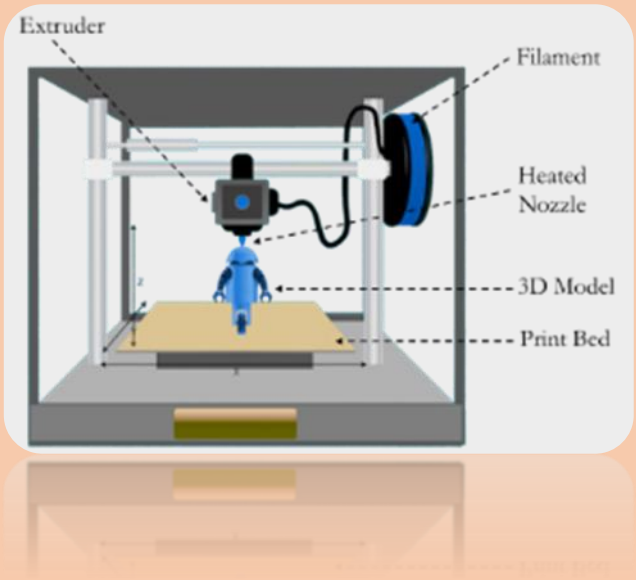
The Revolutionary Promise of 3D Printing Shaping the Future, One Layer at a Time

DEBJIT KUMAR
Lecturer

INTRODUCTION

Over the past few decades, 3D printing has emerged as a transformative technology with the potential to revolutionize various industries, from manufacturing and healthcare to aerospace and education. 3D printing allows for the creation of three-dimensional objects from digital designs, layer by layer. This article explores the fundamental aspects of 3D printing, its current applications, and the promising future it holds



THE BASICS OF 3D PRINTING

At its core, 3D printing is a process that builds physical objects layer by layer, contrary to traditional manufacturing, where material is removed from a solid block. Here's a simplified overview of how 3D printing works:

1. Digital Design: The process begins with the creation of a 3D model using computer-aided design (CAD) software. This digital blueprint serves as the foundation for the object to be printed.

2. Slicing: The 3D model is sliced into hundreds or thousands of thin, horizontal layers using slicing software. This step determines how the printer will deposit material to construct the object.

3. Printing: The 3D printer interprets the sliced design and starts depositing material layer by layer. Common materials include plastics, metals, ceramics, and even biological materials like cells and proteins.

4. Layer Bonding: Each layer is fused to the previous one, ensuring structural integrity. Various printing methods, such as Fused Deposition Modeling (FDM), Stereolithography (SLA), and Selective Laser Sintering (SLS), employ different techniques to achieve this.

5. Post-processing: Once the printing is complete, the object may require post-processing steps like sanding, painting, or assembly to achieve the desired finish.

CURRENT APPLICATIONS OF 3D PRINTING

The versatility of 3D printing has led to its adoption across a wide range of industries. Some of the most notable applications include:

1. Prototyping: 3D printing allows rapid and cost-effective prototyping, enabling engineers and designers to iterate designs quickly.

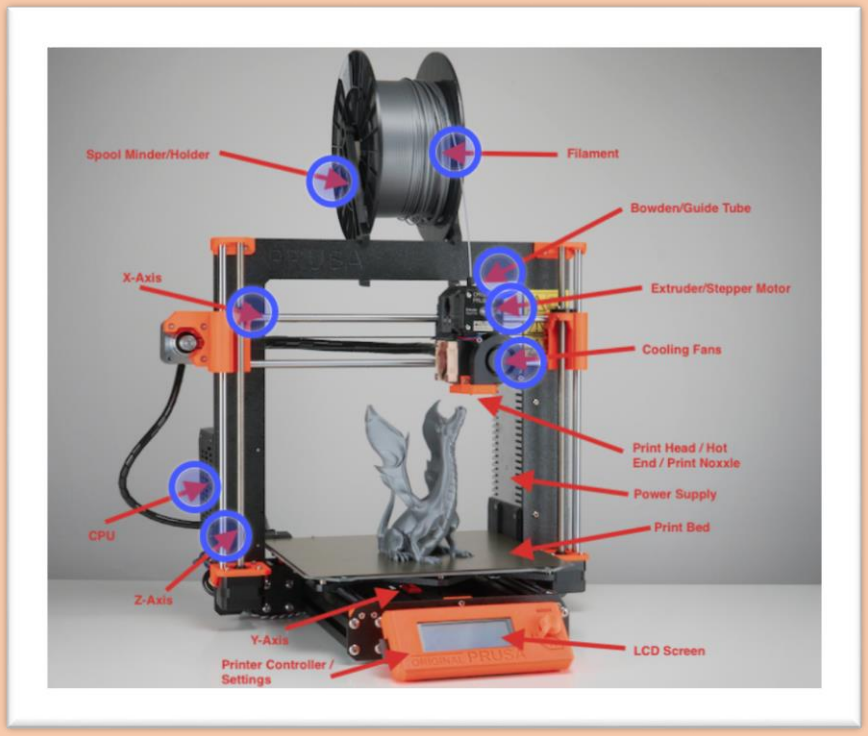
2. Customization in Medicine: In healthcare, 3D printing has been used to create personalized prosthetics, implants, and even organs for transplantation.

3. Aerospace: The aerospace industry uses 3D printing for lightweight and complex parts, reducing weight and improving fuel efficiency.

4. Automotive: Car manufacturers use 3D printing for rapid prototyping and producing custom components, enhancing vehicle design and performance.

5. Architecture and Construction: 3D printers can construct entire buildings, which may revolutionize the construction industry by reducing material waste and construction time.

6. Art and Fashion: Artists and designers utilize 3D printing to create unique sculptures, jewelry, and clothing items that would be challenging to make using traditional methods.



THE FUTURE OF 3D PRINTING

The future of 3D printing holds exciting possibilities that extend far beyond its current applications:

1. Mass Customization: 3D printing has the potential to revolutionize manufacturing by enabling mass customization, where each product can be tailored to the individual needs and preferences of the customer.

2. Space Exploration: 3D printing could play a vital role in future space missions, allowing astronauts to produce tools and spare parts on-demand during long-duration space travel.
3. Sustainability: With the ability to use recycled materials and reduce waste, 3D printing aligns with sustainability goals, making it an eco-friendly manufacturing option.
4. Bioprinting: Advancements in bioprinting could lead to the creation of functional human tissues, opening doors to organ transplants without the need for donors.
5. Education: 3D printing is becoming increasingly integrated into educational curricula, empowering students to learn about design, engineering, and manufacturing in a hands-on manner.

CONCLUSION

3D printing has already made significant strides in transforming various industries and has the potential to revolutionize how we design, manufacture, and consume goods in the future. As technology continues to advance and become more accessible, it will be exciting to witness the continued growth and innovation that 3D printing brings to our world, one layer at a time.

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WORKING OF STEAM POWER PLANT

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Lecturer

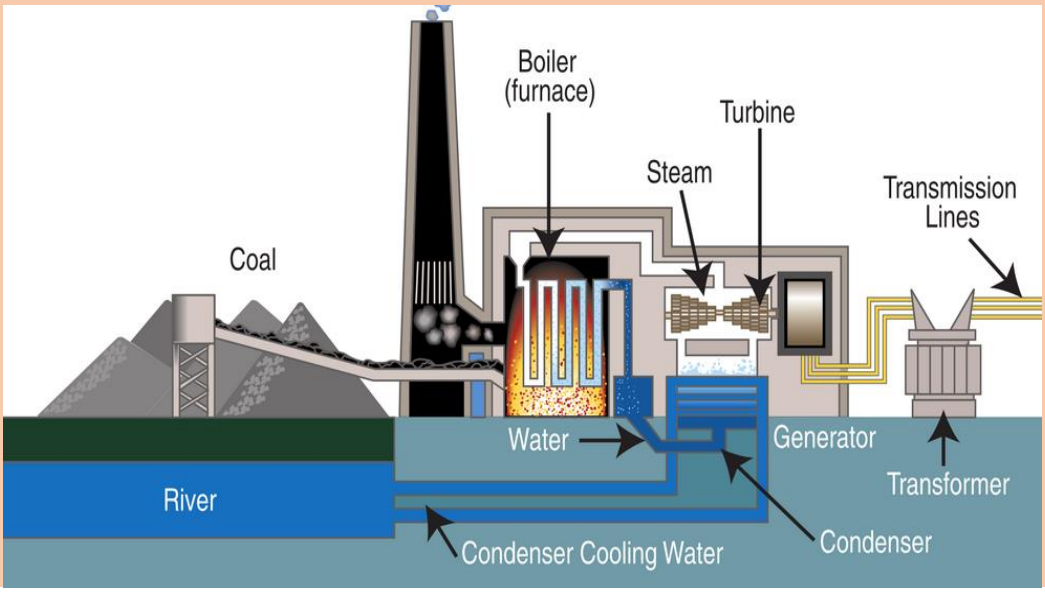
A steam power plant, also known as a thermal power plant, is a facility designed to generate electricity through the use of steam as the primary working fluid. It operates based on the principles of thermodynamics, utilizing the conversion of heat energy into mechanical work and subsequently into electrical energy. The primary components of a steam power plant include a boiler, a turbine, a condenser, and a generator.
Boiler: The boiler is responsible for heating water to generate steam. This is typically achieved by burning fossil fuels (such as coal, oil, or natural gas) or by using nuclear energy. The generated steam is at high pressure and temperature.

Turbine: The high-pressure steam from the boilers is directed into a turbine. The turbine is designed with blades that are turned by the force of the steam's high-speed flow. As the steam flows through the turbine, its high-pressure energy is converted into rotational mechanical energy.

Generator: The turbine is connected to a generator, which consists of coils of wire within a magnetic field. As the turbine spins, it turns the rotor of the generator, creating a moving magnetic field. This movement induces an electric current in the wire coils, ultimately producing electrical energy.

Condenser: After passing through the turbine, the steam is directed to the condenser. Here, the steam is cooled and condensed back into water, releasing its latent heat. This process allows for the efficient reuse of the water in the boiler, reducing water consumption and increasing overall efficiency.

Cooling System: Steam power plants require a cooling system to dissipate excess heat from the condenser. This can involve cooling water from nearby water bodies, cooling towers, or other heat exchange methods.



The electricity generated by the generator is then transmitted through power lines to homes, businesses, and industries, where it serves as a source of electrical power.

The electricity generated by the generator is then transmitted through power lines to homes, businesses, and industries, where it serves as a source of electrical power.

Factors to Determine the Site of Steam Power Plant

Steam-powered power stations keep on working very close to full efficiency for 24 hours a day. The following is a record of factors that affect the selection of a site for building a Steam power station:

Supply of fuel:

Steam power stations are a major source of electricity generation in many countries. They use coal, oil, or natural gas to heat water to produce steam, which drives a turbine generate electricity. The amount of fuel required by a steam power station varies depending on its size and efficiency, but it can be significant. For example, a large coal-fired power plant may consume up to 10,000 tons of coal per day.

The high volume of fuel required by steam power stations means that it is important to locate them close to sources of fuel. This helps to reduce the transportation costs of fuel, which can be a significant expense. In some cases, steam power stations may be located near coal mines, which can provide a reliable and cost-effective source of fuel.

The use of coal and oil as fuel for steam power stations has a number of environmental impacts. These include air pollution, water pollution, and greenhouse gas emissions. Air pollution from coal-fired power plants can cause a variety of health problems, including respiratory illnesses, heart disease, and cancer. Water pollution from coal-fired power plants can damage aquatic ecosystems and contaminate drinking water supplies. Greenhouse gas emissions from coal-fired power plants contribute to climate change.

There are a number of ways to reduce the environmental impacts of steam power stations. One way is to use cleaner fuels, such as natural gas or renewable energy sources. Another way is to improve the efficiency of steam power stations. This can be done by using newer technologies, such as combined cycle power plants.

Steam power stations are a major source of electricity generation, but they also have a number of environmental impacts. It is important to weigh the benefits and drawbacks of steam power stations when considering their use.

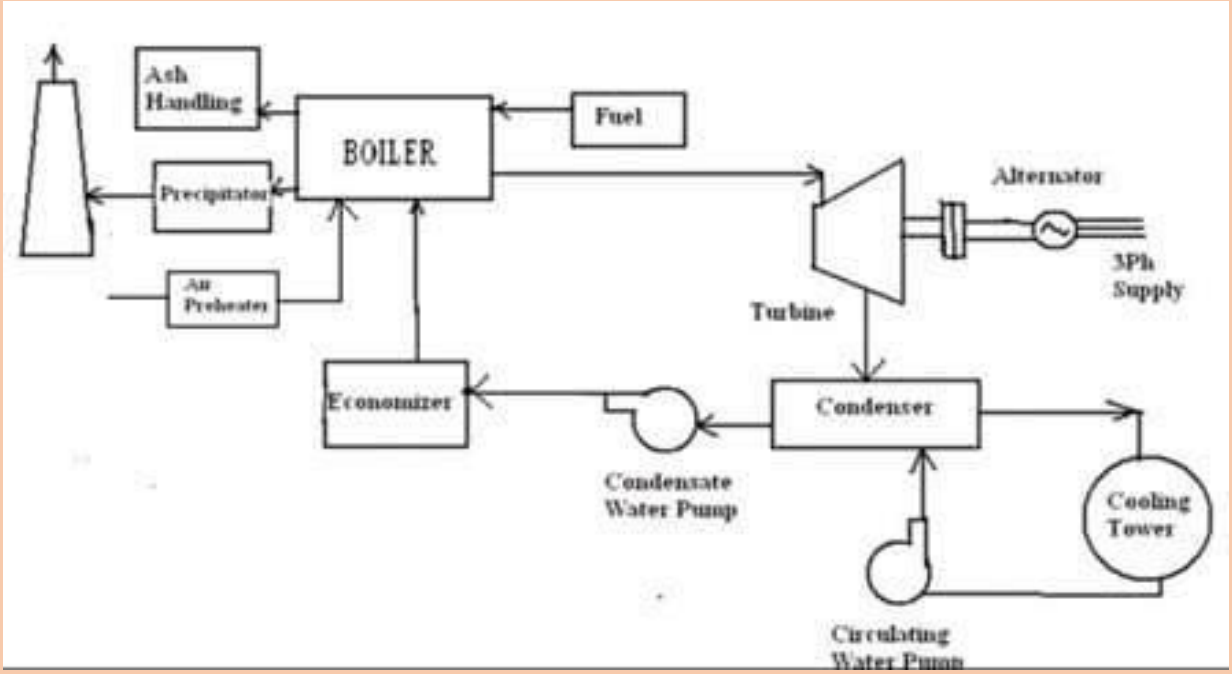
Availability of water:

The station must be positioned near a river bank or canal for constant water supply. The steam power plant utilizes water as a working solution throughout the year, which is regularly evaporated and condensed. It also wants about 2% of the steam produced as makeup water due to its loss.

Transportation facilities:

The station must be well attached to important transport routes eg Rail or Road. A new steam power plant often needs the transportation of material and machinery. Therefore, sufficient transportation facilities must exist i.e. the plant should be well attached to other parts of the land by rail, or road. etc.

Cost & type of land:
The land must have a great bearing capacity for heavy machinery and yet be affordable enough to purchase. The steam power plant should be located at a point where the property is cheap and further expansion if needed, is possible. Furthermore, the carriage capacity of the area should be enough so that heavy machinery could be installed.



Advantages of Steam Power Plant
1. It needs low initial investment and less time to commission the plant.
2. The cost of the Steam power plant is lower than several power plants.

Disadvantages of Steam Power Plant
1. The life and effectiveness of the steam power plant are more concise when compared to Hydel power plant.
2. Transport of fuel is a major problem.
3. The cost of power generation is higher than hydropower.
4. Air pollution is a major difficulty.
5. Coal may be depleted by gradual use.

ANTI-LOCK BRAKING SYSTEM

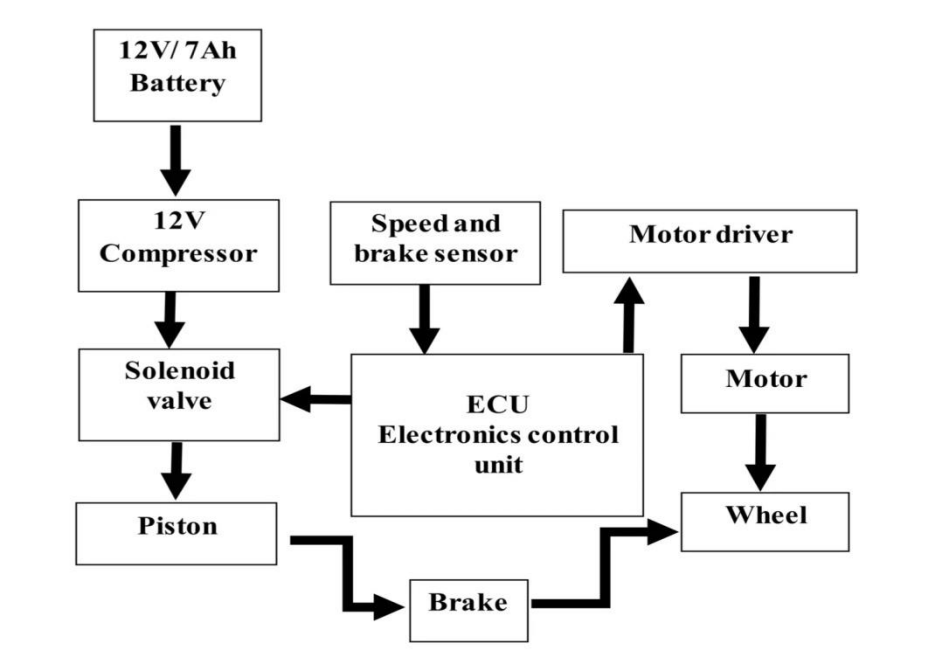
AVIK MONDAL
DME, 3rd YEAR

INTRODUCTION :-

A brake is one is one of the most important parts of any type of vehicle. Brake is used to retard or stop a vehicle. An **anti-lock braking system (ABS)** is a safety system on motor vehicles which prevents the wheels from locking while braking. A rotating road wheel allows the driver to maintain steering control under heavy braking, by preventing a locked wheel or skid, and allowing the wheel to continue to forward roll and create lateral control, as directed by driver steering input. This safety system allows the wheels on a motor vehicle to continue interacting attractively with the road surface.During panic braking when the wheels are about to lockup, sensors sense that the wheel has just begun turning slower than others on the vehicle. So they momentarily reduce braking force on the affected wheel. This prevents sliding of the wheels on the pavement. When the wheel resumes rolling, full braking force is again applied. ABS repeats the process until there is no longer any need for modulated braking. ABS acts faster than any driver could, pumping the brakes several times per second. Depending on the type of system, ABS adjusts the braking force at each wheel or set of wheels, whereas a driver's foot on the brake pedal operates all the brakes at once in normal braking.

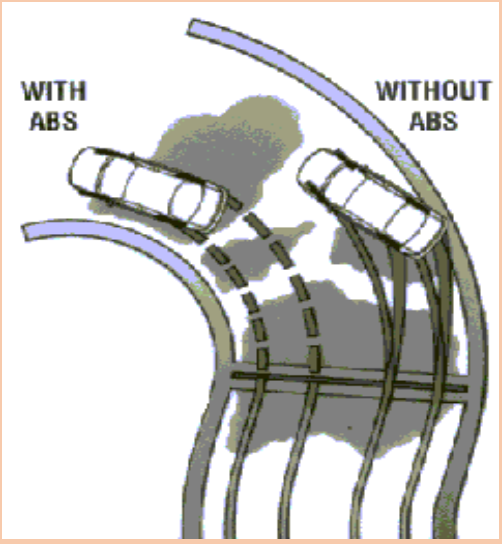
HISTORY OF ABS :-

Anti-lock braking systems were first developed for aircraft in 1929 by the French automobile and aircraft pioneer**, Gabriel Voisin**. A fully mechanical system saw limited automobile use in the 1960s in the Ferguson P99 racing car, the Jensen FF and the and Ford Zodiac, but the system proved expensive and in automobile industry somewhat unreliable. In 1964, a limited form of anti-lock braking utilizing a valve which could adjust front to rear brake force distribution when a wheel locked, was fittedon Austin 1800.then many automobile company introduced ABS on their upcoming vehicles in various names like 1971 Imperial, 1975 Lincoln Continental Mark III, 1971 Cadillac.In 1988 BMW became the world's first motorcycle manufacturer to introduce an electronic or hydraulic ABS system, this on their BMW K100. Then on 1992 Honda ST1100,1997 Suzuki GSF1200SA. Now days ABS is a common and also most important braking system on mid range motorcycles.

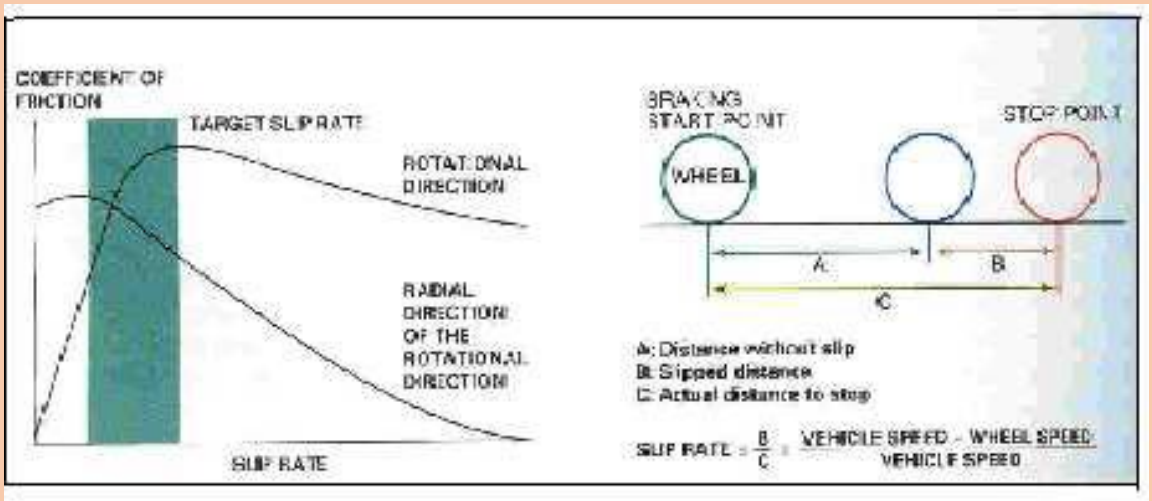


PRINCIPLE OF ABS :-

The brakes of vehicle not equipped with ABS will almost immediately lock the wheels, when the driver suddenly applies the brake. In this case the vehicle slides rather than rolls to a stop. The skidding and lack of control was caused by the locking of wheels. The release and reapply of the brake pedal will avoid the locking of the wheels which in turn avoid the skidding. This is exactly what an antilock braking system does. When the brake pedal is pumped or pulsed the pressure is quickly applied and released at the wheels. This is called pressure modulation. Pressure modulation works to prevent the wheel locking. ABS can modulate the pressure tothe brake As often as 15 times per seconds. By modulating the pressure to the brakes the friction between the tires and the road is maintained and the vehicle is able to come to the controllable stop.



Steering is another important consideration. As long as a tire doesn't slip it goes only in the direction in hich it is turned. But once it is skid it has little or no directional stability.The Maneuverability of the vehicle is reduced if the front wheels are locked and the stability of the vehicle is reduced if the rear wheels are locked. ABS precisely controls the slip rate of the wheels to ensure maximum grip force from the tyre and it there by ensures maneuverability and stability of the vehicle. ABS control module calculates the slip rate of the wheels based on the vehicle speed and speed of the wheels, and then it controls the brake fluid pressure to attain the target slip rate. During ABS operation, the target slip rate can be from 10 to 30%. 0% slip means the wheel is rolling freely, while 100 % means the wheel is fully locked. A slip rate of 25 % means the velocity of a wheel is 25 % less than that of a freely rolling wheel at the same vehicle speed.



ABS COMPONENTS :-

Many different ABS are found on today's vehicles. These designs are varied by their basic layout, operation and components. The ABS components can be divided into two categories. 1. Hydraulic components 2. Electrical/electronic components

HYDRAULIC COMPONENTS

Accumulator :-

An accumulator is used to store hydraulic fluid to maintain high pressure in the brake system and provide the residual pressure for power assisted braking. Normally the accumulator is charged with nitrogen gas and is an integral part of the modulator unit

Antilock hydraulic control valve assembly :-

This assembly controls the release and application of the brake system pressure to the wheel brake assemblies. It may be of integral type and non integral type. In integral type the unit is combined with the power boost and master cylinder unit into one assembly.

Booster pump :

The booster pump is an assembly of an electric motor and pump. The booster pump is used to provide pressurized hydraulic fluid ABS. The pumps motor is controlled by systems control unit.

Booster/Master cylinder assembly :-

It is referred as the hydraulic unit, contains the valves and pistons needed to modulate hydraulic pressure in the wheel circuit during the ABS operations.

Fluid accumulator :-

Different than a pressure accumulator, fluid accumulator temporarily store brake fluid, that is removed from the wheel brake unit during ABS cycle. This fluid is then used by pump to build pressure for the brake hydraulic system.

Hydraulic control unit :-

This assembly contains solenoid valve, fluid accumulator, pump and electric motor. The unit may have one pump and one motor or it have one motor and two pumps.

Main Valve :-

This is a two position valve and is also controlled by ABS control module and is open only in the ABS mode. When open pressurized brake fluid from the booster circuit is directed into the master circuit to prevent excessive pedal travel.

Modulator unit :-

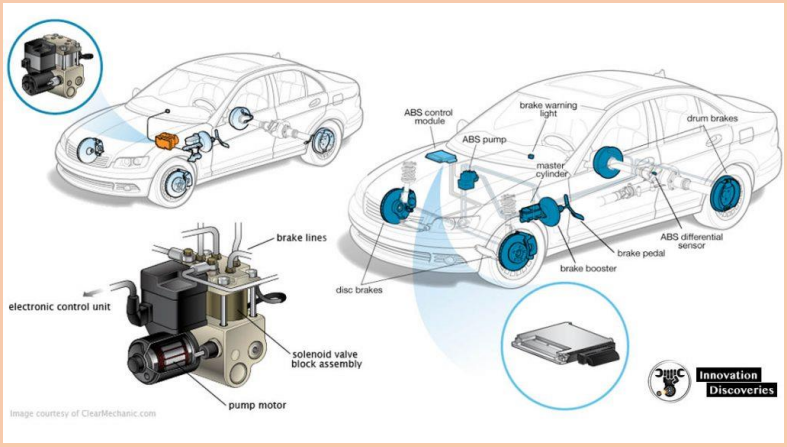
The modulator unit controls the flow of pressurized brake fluid to the individual wheel circuits. Normally the modulator is made up of solenoid that open and close valves, several valves that control flow of fluid to wheel brake units and electrical relays that activate or deactivate the solenoids through the commands of the control module. This unit may also be called the hydraulic actuator, hydraulic power unit or the electro hydraulic control valve.

Solenoid valves :-

The solenoid valves are located in the modulator unit and are electrically operated by signals from the control module. The control module switches the solenoids on or off to increase, decrease, or maintain the hydraulic pressure to the individual wheel units.

Wheel circuit valves :-

Two solenoid valves are used to control each circuit or channel. One controls the inlet valve of the circuit, the controls the outlet valve .the position is determined by the control module. Outlet valves are normally closed and inlet valves are normally open. Valves are activated when abs control module switches 12 volts to the circuit solenoids. During normal driving the circuits are not activated.



ELECTRICAL / ELECTRONIC COMPONENTS

ABS control module :-

This small computer is normally mounted inside the trunk on the wheelhousing, mounted to the master cylinder or is part of the hydraulic control unit. It monitors system operation and controls antilock function when needed. The module relies on input from the wheel speed sensors and feedback from the hydraulic unit to determine if the abs is operating correctly and to determine when the anti lock mode is required.

Brake pedal sensor :-

The antilock brake pedal sensor switch is normally closed. When the brake pedal exceeds the antilock brake pedal sensor switch setting during an antilock stop, the antilock brake control module senses that the antilock brake pedal sensor switch is open and grounds the pump motor relay coil. This energizes the relay and turns the pump motor on. When the pump motor is running, the hydraulic reservoir is filled with high pressure brake fluid and the brake pedal will be pushed up until antilock brake pedal sensor switch closes. when the antilock brake pedal sensor switch closes , the pump motor is turned off and the brake pedal will drop some with each abs control cycle until the antilock brake pedal sensor switch opens and the pump motor is turned on again .this minimizes pedal feedback during abs cycling.

Pressure differential switch :-

Relays are electromagnetic devices used to control a high current circuitwith a low current switching circuit. In abs relays are used to switch motorsand solenoids. A low current signal from the control module energizes the relays that complete the electrical circuit for the motor or solenoid.

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Toothed ring :-

It can be located on an axle shaft, differential gear or a wheels hub. This ring is used with conjunction with the wheel speed sensor. The ring has a number of teeth around its circumference. As the ring rotates and each tooth passes by the wheel speed sensor, an ac voltage signal is generated between the sensor and tooth.

Wheel speed sensor :-

It is mounted near the different toothed ring. As the rings teeth rotate past the sensor an ac voltage is generated. as the teeth move away from the sensor, the signal is broken until the next tooth comes close to the sensor .the end result is a pulsing signal that is sent to the control module. The control module translates the signal in to wheel speed. The sensor is normally a small coil of wire with a permanent magnet in its center.

TYPES OF ANTILOCK BRAKE SYSTE

One of the classifications of abs is integral and non integral type. Integral type they combine the master cylinder, hydraulic booster and abs hydraulic circuit in to single hydraulic assembly. In non integral type they use a conventional vacuum-assist booster and master cylinder. In addition they can be classified according to the control they provide.

Four channel, four sensors ABS :-

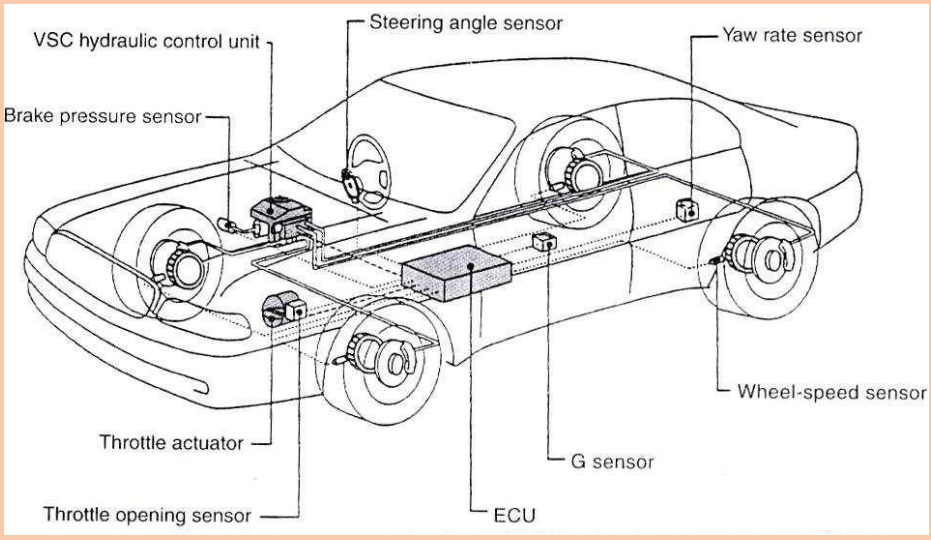
This is the best scheme. There is speed sensor on all four wheels and a separate valve for all the four wheels. With this set up the controller monitors each wheel individually to make sure it is achieving maximum braking force.

Three channel, three sensor ABS :-

This scheme is commonly found on pick up trucks with four wheels ABS, has a speed sensor and a valve for each of the front wheels, with one valve and one sensor for both rear wheels. The speed sensor for the rear wheel is located in the rear axle.

One channel, one sensor ABS :-

This scheme is commonly found on pick up trucks with rear wheel abs .it has one valve ,which controls both rear wheels , and one speed sensor, located in the rear axle . This system operates the same as the rear end of the rear channel system. The rear wheels are monitored together and both have to start to lock up before the abs kicks in. in this system is also possible that one of the rear wheels will lock reducing brake effectiveness.



- **ADVANTAGES OF ABS :-**
  - It allows the driver to maintain directional stability and control over steering during braking.
  - Safe and effective.
  - Automatically changes the brake fluid pressure at each wheel to maintain optimum brake performance.
  - ABS absorbs the unwanted turbulence shock waves and modulates the pulses thus permitting the wheel to continue turning under maximum braking pressure.
- **DISADVANTAGES OF ABS :-**
  - It is very costly
  - Maintenance cost of a car equipped with ABS is more.

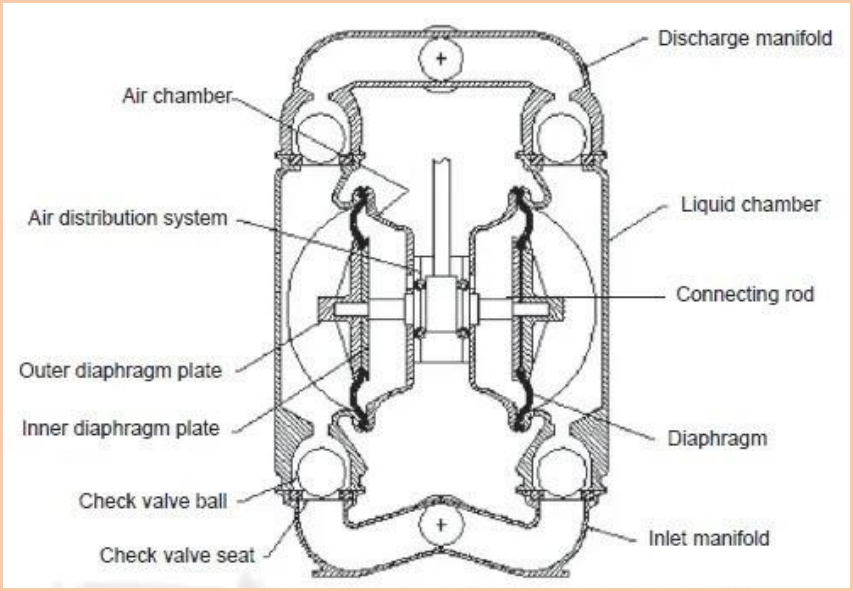
Diaphragm Pump

Arnab Sengupta
DME 3nd Year

A diaphragm pump, also knows as a membrane pump, is a positive displacement pump that enables users in industries to standardize on a pump type that is suitable for a wide variety of fluids. The only requirement is compressed air supply.

Working principle of a diaphragm pump

A diaphragm pump is a positive displacement pump which utilizes two flexible diaphragms that reciprocate back and forth, creating a temporary chamber.



Air Operated Double Diaphragm Pump

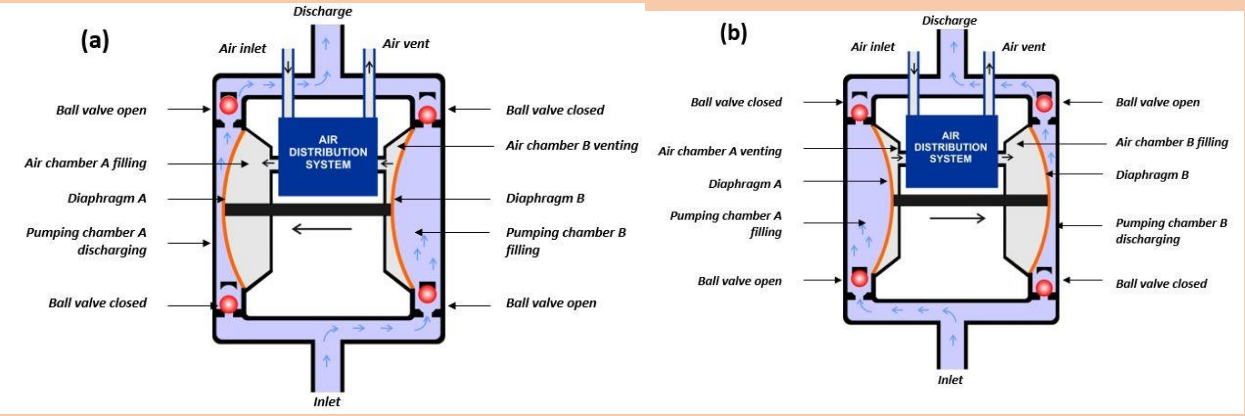
A double diaphragm is a positive displacement pump which utilizes two flexible diaphragms that reciprocate back and forth, creating a temporary chamber, which both draws in and expels fluid through the pump. The diaphragms work as a separation wall between the air and the liquid.

a) The first stroke

The two diaphragms that are connected by a shaft through the centre section where the air valve is located. The purpose of the air valve is to direct the compressed air to the back of diaphragm number one causing it to move away from the centre section. The number one diaphragm causes a press stroke moving liquid out of the pump. At the same time diaphragm number two is performing a suction stroke. The air behind diaphragm number two is being pushed out to the atmosphere causing atmospheric pressure to push the liquid to the suction side. The suction ball valve is pushed away off its seat allowing the fluid to flow past the ball valve into the liquid chamber.

b) The second stroke

When the pressurized diaphragm number one has reached the end of its stroke, the movement of the air is switched from diaphragm number one to the back of diaphragm number two by the air valve. The compressed air pushes diaphragm number two away from the centre block resulting in diaphragm number one being pulled toward the centre block. In pump chamber number two the discharge ball valve is pushed off its seat, whilst in pump chamber number one the opposite occurs. Upon completion of the stroke the air valve leads the air again to the back of diaphragm number one and restarts the cycle.

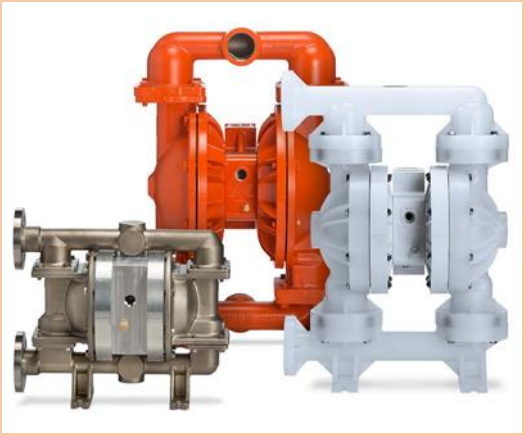


Where Can Diaphragm Pumps Be Used?

Diaphragm pumps are a common site in many industries. There is an extensive number of construction materials available to produce a bewildering number of configurations to accommodate difficult fluids such as - **Corrosive chemical, Volatile solvents, Viscous, sticky fluids, Shear-sensitive foodstuffs and pharma product, Dirty water and abrasive slurry, Smaller solids, Creams, gels and oils, Paint industry**

Conclusion

Air diaphragm pumps are versatile and reliable pumps that can handle a variety of fluids with varying viscosities, corrosiveness, and abrasiveness. They are easy to operate and maintain, and can be used in various industries such as chemical processing, food and beverage, pharmaceuticals, and mining. Air diaphragm pumps are also safer to use compared to other types of pumps as they do not have any rotating parts that can cause accidents. However, they may not be suitable for high-pressure applications or for pumping fluids with high temperatures. Overall, air diaphragm pumps offer a cost-effective and efficient pumping solution for many industrial applications.



ELECTRIC VEHICLE

ASHIS PAL
DME 2nd Year

INTRODUCTION

An Electric Vehicle includes both a vehicle that can only be powered by an electric motor that draws electricity from a battery (all-electric vehicle) and a vehicle that can be powered by an electric motor that draws electricity from a battery and by an internal combustion engine (plug-in hybrid electric vehicle). One of the most significant advantages of EVs is their impact on our environment. Pure EVs have zero tailpipe emissions, which reduces air pollution. Since the electric motor of the EV operates on a closed circuit, it does not emit any harmful gases. Electric cars are quieter, emit no exhaust, and have fewer overall pollutants than combustion engine (ICE) vehicles. Electric cars have minimal expenditures since they have fewer parts to maintain, and they are also very eco-friendly because they consume no carbon fuels (petrol or diesel).

System Architecture of 4 types of electric cars is as follows

- Battery Electric Vehicles (BEVs) BEVs are also known as All-Electric Vehicles (AEV).
- Hybrid Electric Vehicle (HEV): HEVs are also known as series hybrid or parallel hybrid.
- Plug-in Hybrid Electric Vehicle (PHEV):
- Fuel Cell Electric Vehicle (FCEV):

There are three types of electric vehicles available on the market

- Battery Electric Vehicles (BEVs).
- Plug-In Hybrid Electric Vehicles (PHEVs).
- Fuel Cell Electric Vehicles (FCEVs).
- Also in This Section.
- Next Section.

Future of Electric Vehicles in 2023

The future of electric vehicles global market is expanding at a CAGR of 21.7%, which is expected to continue. Growth from 8.1 million units is anticipated to reach 39.21 million by 2030. Multiple factors, including worries about pollution, are driving this rapid expansion. Electric cars produce zero tailpipe emissions, meaning that they don't contribute to air pollution the same way gas-powered vehicles do. They also are very energy efficient and can travel four times as far as a traditional car given the same amount of energy. Most of today's all-electric vehicles and PHEVs use lithium-ion batteries, though the exact chemistry often varies from that of consumer electronics batteries.

Robert Anderson Electric cars produce zero tailpipe emissions, meaning that they don't contribute to air pollution the same way gas-powered vehicles do. They also are very energy efficient and can travel four times as far as a traditional car given the same amount of energy. The electric traction motor is the main component of an electric vehicle. The motor converts electrical energy into kinetic energy. This energy rotates the wheels. An electric motor is the main component that differentiates an electric car from a conventional car.

India also announced that EVs will represent at least 30% of all road traffic by 2023. Though a modest target, a 30% adoption rate will have global ripple effects, both environmentally and economically. All-electric vehicles—also referred to as battery electric vehicles (BEVs)—plug-in hybrid electric vehicles (PHEVs), and hybrid electric vehicles (HEVs) all use electricity to improve vehicle efficiency.

A Lithium-ion (Li-ion) battery is a type of rechargeable battery used in electric vehicles and a number of portable electronics. They have a higher energy density than typical lead-acid or nickel-cadmium rechargeable batteries. How Many EVs Are on the Road in the US? The number of electric vehicles you can spot on US roads has increased exponentially in the last decade. Given their rapid adoption as luxury and eco-friendly vehicles, statistics show that more than 2.5 million battery and plug-in hybrid vehicles are in use all over the country. There are basically three different kinds of electric vehicles: hybrid electric vehicles, plug-in hybrid electric vehicles and battery electric vehicles. There are two types of motors that are most commonly used: alternating current (AC) motors and direct current (DC) motors. AC motors are the most commonly used in electric cars, as they offer better efficiency and are easier to control.

FUTURE OF ELECTRIC VEHIVLE IN INDIA

Propelling electric vehicles for the future is a dream that is gradually taking shape not just globally, but also in India. The Economic Survey 2023 predicts that India's EV market will grow with a CAGR of 49% between 2022 and 2030, with 10 million annual sales by 2030. As per the data provided by the Union Minister and sourced from the government's Vahan website, there are over 2.8 million registered electric vehicles (EVs) – 28,30,565 units – on Indian roads as of August 8, 2023.The types of battery, the type of traction motor and the motor controller design vary according to the size, power and proposed application, which can be as small as a motorized shopping cart or wheelchair, through pedelecs, electric motorcycles and scooters, neighbourhood electric vehicles, industrial fork-lift trucks and including many hybrid vehicles.

ENERGY SOURCES

EVs are much more efficient than fossil than fuel vehicles and have few direct emissions. At the same time, they do relay on electrical energy that is generally provided by a combination of non-fossil fuel plants and fossil fuel plants. Consequently, EVs can be made less polluting overall by modifying the source of electricity. In some areas, persons can ask utilities to provide their electricity for renewable energy. Fossil fuel vehicle efficiency and pollution standards take years to filter through a nation’s feet of vehicles. New efficiency and pollution standard rely on the purchase of new vehicles, often as the current vehicles are already on the roads reach their end-of-life. Only a few nations set a retirement age for old vehicles, such as Japan or Singapore, forcing periodic upgrading of all vehicles already on the road. An Electric Vehicle battery is addition to the traction battery specially systems used for industrial vehicles, are batteries used to power the propulsion system of a battery electric vehicle. These batteries are usually a secondary battery and are typically lithium-ion batteries. Traction batteries, specifically designed with a high ampere-hour capacity, are used in forklifts, electric golf carts, riding floor scrubbers, electric motorcycle, electric cars, trucks, vans, and other electric vehicles. EVs convert over 59-62% of grid energy to the wheels. Conventional gasoline vehicles converts around 17-21%.

TOTAL COST

As of 2021 the purchase price of an EV is often more, but the total cost of ownership of an EV varies wildly depending on location and distance travelled per year in parts of the world where fossil fuels are subsidized, lifecycle costs of diesel or gas powered vehicle are sometimes less than a comparable EV. European car makers

face significant pressure from more affordable Chinese models and price cuts by US-based Tesla Motor. From 2021 to 2022, the European market share of Chinese EV manufacturers doubled to almost 9%, prompting the CEO of stellantis to describe it as "invasion".

HEATING OF ELECTRIC VEHICLE

In cold climates, considerable energy is needed it heat the interior of a vehicle and to defrost the windows, With internal combustion engines this heat already exists as waste combustion heat diverted from the engine cooling circuit. This process offsets the greenhouse gases external costs If this is done with battery EVs, the interior heating requires extra energy from the vehicle batteries. Although some heat could be harvested from the motor or motors and battery, their greater efficiency means there is not as much waste heat available as from combustion engine.

THERMAL MECHANICS

ISHIKA DAS
DME 2nd Year

Abstract

Thermal mechanics is a fundamental branch of physics that deals with the behavior of matter under the influence of temperature. This report provides a comprehensive overview of thermal mechanics, covering its principles, key concepts, and applications. Topics discussed include heat transfer mechanisms, thermodynamics laws, and various thermal processes. The report also explores practical applications in engineering and everyday life.

Introduction

Thermal mechanics is the study of how heat energy is transferred and transformed within a system. It plays a crucial role in various scientific, engineering, and everyday scenarios. This report aims to elucidate the fundamental principles and applications of thermal mechanics.

Heat Transfer Mechanisms

1. Conduction: The transfer of heat through direct molecular collision within a solid. 2. Convection: Heat transfer through the movement of fluids (liquids or gases) due to density differences. 3. Radiation: The emission of electromagnetic waves, such as infrared radiation, to transfer heat energy through a vacuum.

Laws of Thermodynamics

1. Zeroth Law: If two systems are in thermal equilibrium with a third system, they are in equilibrium with each other.

2. First Law (Conservation of Energy): The total energy of a closed system remains constant; energy can neither be created nor destroyed, only transferred or converted.

3. Second Law (Entropy): Heat naturally flows from hot to cold objects, and systems tend to increase in entropy over time.

4. Third Law: As temperature approaches absolute zero, the entropy of a perfect crystal approaches a minimum value.

Thermal Processes

1. Adiabatic Process: A process where no heat is exchanged with the surroundings, 2. Isothermal Process: A process that occurs at constant temperature, 3. Isobaric Process: A process that occurs at constant pressure, 4. Isochoric Process: A process that occurs at constant volume.

Practical Applications

1. Heat Engines: Devices like steam engines and internal combustion engines that convert thermal energy into mechanical work, 2. Refrigeration and Air Conditioning: Utilizing the principles of thermal mechanics to control temperature and maintain comfort, 3. Heat Exchangers: Devices that efficiently transfer heat between fluids, 4. Solar Panels: Utilizing solar radiation for electricity generation and heating, 5. Thermoelectric Devices: Converting temperature differences directly into electricity.

Future Developments

Thermal mechanics continues to evolve with advancements in materials and technology. Emerging areas include nanoscale heat transfer, quantum thermodynamics, and the development of more efficient energy conversion systems.

Conclusion

Thermal mechanics is a vital field of physics with applications spanning from basic science to everyday life and advanced technology. Understanding heat transfer mechanisms and the laws of thermodynamics is essential for solving practical engineering problems and optimizing energy usage.