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IV/IV B.Tech (Regular/Supplementary) DEGREE EXAMINATION

April, 2023

Eight Semester

Time: Three Hours

Mechanical Engineering
Automobile Engineering

Maximum: 50 Marks

Answer Question No. 1 Compulsorily.

(10X1 = 10 Marks)

Answer **ANY ONE** question from each Unit.

(4X10=40 Marks)

1. a) Write the firing order of a six-cylinder engine. CO1(BL3)
1-5-3-6-2-4
- b) Mention the use of Muffler in an automobile. CO1(BL2)
To eliminate the noise in exhaust gases.
- c) Why are T-slots provided in a piston? CO2(BL1)
To allow the piston to expand into the slot, thereby keeping the heat away from the lower part of the piston.
- d) Why is generator required in the electrical system of an automobile? CO2(BL1)
Generator generates the electricity from the rotation of engine crankshaft to charge the battery.
- e) Why is condenser used in the primary circuit? CO2(BL1)
The condenser stores the excess current generated during arcing, while opening and closing of the contact breaker and sends the current to the secondary coil during break period.
- f) Give the list of main lights in a modern vehicle. CO1(BL1)
1. Head lights, 2. Fog lights, 3. Brake lights, 4. Emergency brake light, 5. Signal light, 6. Interior lights
- g) What is a constant velocity type universal joint? CO3(BL1)
A constant velocity joint is a universal joint where rotation of the input always produces the same rotation of the output for any misalignment angle between the shafts.
- h) List out the functions of a propeller shaft. CO3(BL1)
To transfer the engine power from gear box, which is in the front side, to the rear wheels of the vehicle.
- i) Define steering ratio. CO4(BL1)
It is the ratio between the angle turned by the steering wheel to the angle turned by the front wheels.
- j) Classify the different types of steering mechanism for cars. CO4(BL3)
1. Davis Steering Mechanism, 2. Ackerman's Steering Mechanism

Unit - I

2. a) Classify the automobiles based on various considerations. CO1(BL3) **5M**
Automobiles can be classified from the point of view of various considerations.

1. Use
 - a. Auto cycles
 - b. Motor cycles, Scooters
 - c. Cars, Jeep
 - d. Buses and Truck
2. Capacity
 - a. Heavy transport vehicles(H.T.V)
 - b. Light transport vehicles (L.T.V)
3. Make and Model
4. Fuel used:
 - a. Petrol vehicles
 - b. Diesel vehicles
5. Body style:
 - a. Closed cars
 - b. Open cars

- c. Special styles
6. Wheels:
 - a. Two wheelers
 - b. Three wheelers
 - c. Four wheelers
 - d. Six wheelers
7. Drive:
 - a. Left hand drive
 - b. Right hand drive
 - c. Front wheel drive
 - d. Rear wheel drive
 - e. All-wheel drive
8. Transmission:
 - a. Conventional
 - b. Semi-Automatic
 - c. Fully Automatic
 - d. Continuously variable e.g.: Audi with "Multitronic",
 - e. Automated manual: e.g.: Audi with 'DSGr'.

- 2 b) Name different types of piston rings. Explain an oil ring with the help of a sketch. CO1(BL1) 5M
Types of Piston rings: Compression and Oil control ring

Construction and working of Oil-Control Rings (2M)

- Oil control ring prevent the excessive amount of oil from passing:
 - Between the ring face and the cylinder wall
 - Through the ring end gap
 - Around behind the ring.
- When the piston moves up, the lower face of piston ring is pressed against the lower ring face which makes the outer ring face to slide over the oil on the cylinder wall and scrapes some oil and sends out through oil drain holes.
- As the piston moves down, the sharp edge of oil control ring scrapes the oil on the cylinder wall.
- The oil holes in the ring groove should be adequate to ensure free flow of oil to the sump or back pressure may build up in the groove causing the oil to move up into the combustion chamber and get burnt there.

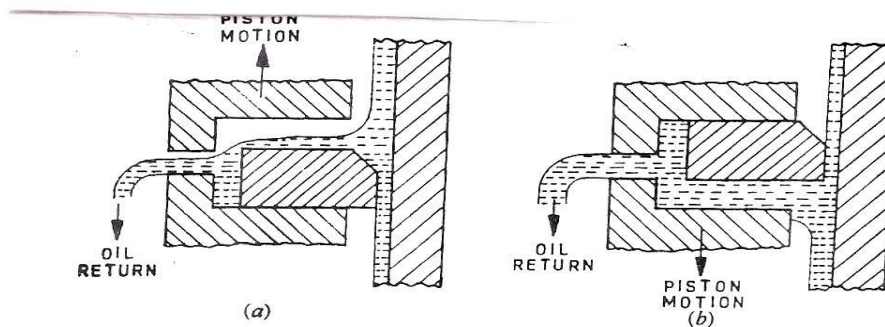
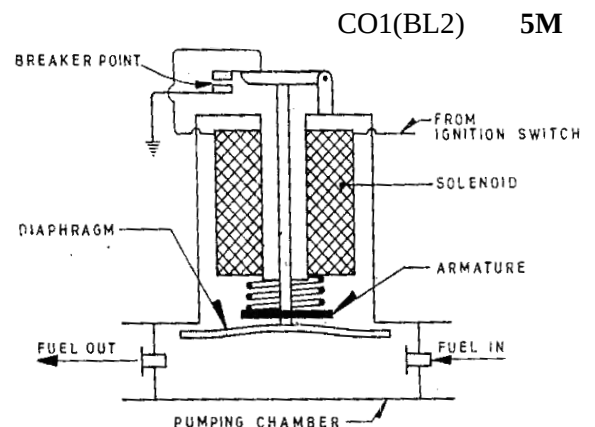


Fig. 2.61. Action of the oil control ring when the

(OR)

3. a) Sketch a S.U Electrical pump and describe it's working.
Diagram 2 ½ M + Working 2 ½ M



- 3 b) State the applications, advantages and disadvantages of air-cooling system. CO1(BL1) 5M
AIR COOLING

Applications:

The engines for aero planes snow mobiles, motor cycles, power lawn movers and chain saws are air cooled.

Advantages:

- Light weight
- Can be operated in extreme climate
- In certain areas where there is scarcity of cooling water

4. Easy maintenance
5. The engines get warmed up earlier than the water cooled engines

Disadvantages:

1. It is not easy to maintain even cooling all around the cylinder, so that the distortion of the cylinder takes place
2. The fan used is very bulky and absorbs considerable portion of engine power (5%) to drive it
3. Are noisier.
4. The cooling fins around the cylinders may vibrate under certain conditions due to which noise level increase considerably

Unit - II

4. a) Explain briefly splash lubrication system. What is petroil lubrication used in small CO₂(BL2) 5M
two stroke engines?

Splash Lubrication (Explanation + Diagram 3 ½ M)

It is employed for the engines of early motor cycles. One of the cheapest types of engine lubrication. It consists of a scoop at the end of big end bearing of connecting rod. It is placed such that when the piston reaches to bottom dead centre, the scoop submerges into the pan full of lubricating oil. When the piston moves from BDC, the scoop also rises but with some oil in it. As the connecting rod changes its direction when the piston reaches TDC, the scoop splashes the oil on to the cylinder walls.

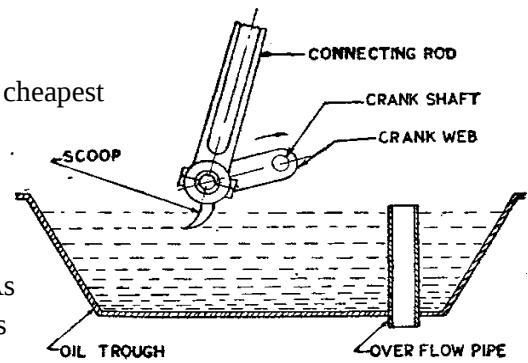


Fig. 6.7. Splash system lubrication. ✓

Petroil system (1 ½ M):

- Simplest of all lubricating systems
- Used for small two stroke engine
- The main requirements of lubricating oil for two stroke engine are which should readily mix with petrol and burn without leaving much residue

- 4 b) Explain briefly a cut-out relay as used in the battery generator circuit.

CO₂(BL2) 5M

- When the generator speed is very low, due to which the output is not sufficient to balance the battery voltage, the necessity to cutout the generator from the battery arises, because otherwise the battery would discharge into the generator
- The electromagnet consists of two coils, the shunt (voltage) and the series (current)
- When the generator is producing sufficient voltage so that the fields due to both the current and the voltage coils support each other, the electromagnet pulls down the armature.

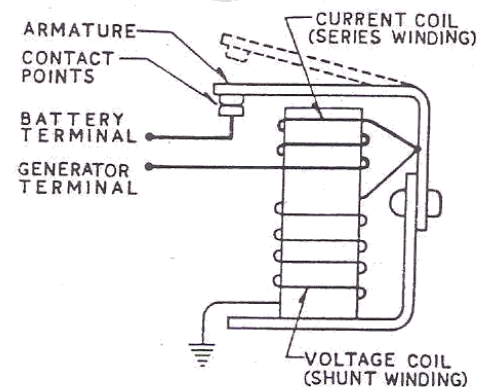


Fig. 15.16. Cut out relay.

(OR)

5. a) Explain the pressure lubrication system with the help of a sketch.

CO2(BL2)

5M

Pressure Lubrication systems. (Diagram 2 ½ M + Working 2 ½ M)

This system is used almost universally in modern cars. The oil pump takes the oil from the wet sump through a strainer and delivers it through a filter to the main oil gallery at a pressure of 200 to 400 kPa. The oil pressure is controlled by means of a pressure relief valve, situated in the filter unit or the pump housing.

From the main gallery, the oil goes through the drilled passages to the main bearings from where some of the oil, after lubricating the main bearings, falls back to the sump, some is splashed to lubricate the cylinder walls, while rest goes through a hole to the crank pins, from where a hole in the lubricating connecting rod web, leads to the gudgeon pin. After lubricating, the gudgeon pin, the oil falls back into the sump. From the crankshaft main bearings, the oil reaches to the cam shaft bearings and rocker shaft for lubricating the camshaft and valve tappets. After all the parts are lubricated, the oil falls into the sump.

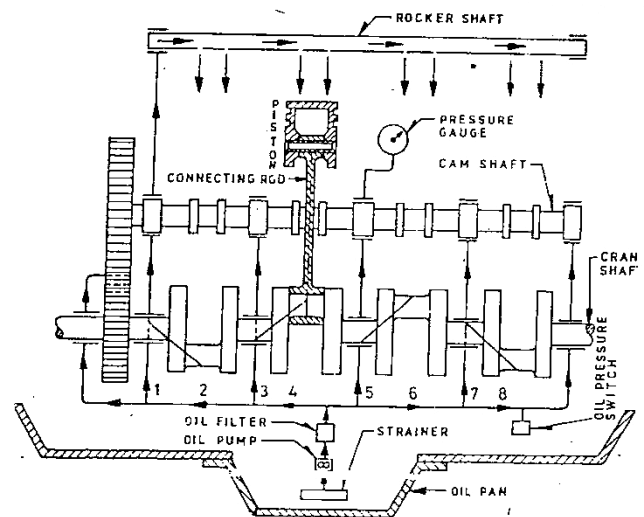


Fig. 6.8. Pressure system of lubrication.

- 5 b) Briefly discuss the Electronic Ignition system with a neat sketch.

CO2(BL2)

5M

-The conventional point type electrical ignition system though very common in use because of its simplicity

Disadvantage:

- The contact breaker points have to operate with a heavy current which causes them to get pitted
- contact breaker is only a mechanical device, it cannot operate precisely at higher speeds because of inertia.

PRINCIPLE OF ELECTRONIC IGNITION: (Diagram 2 ½ M + Working 2 ½ M)

- In the electronic ignition system a timer is employed in the distributor instead of contact breaker

- this timer may be a pulse generator or a Hall-effect switch which triggers the ignition module, also called the electronic ignition control unit (E.C.U)

- This control unit primarily contains transistor circuit whose base current is triggered off and on by the timer which results in the stopping and starting of the primary current

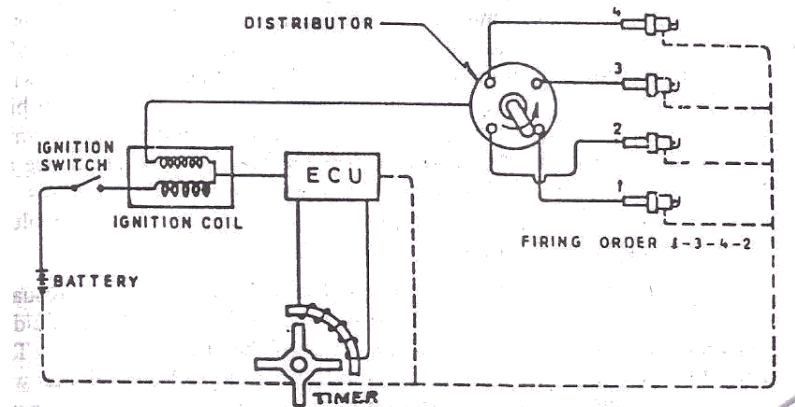


Fig. 13.10. Simplified diagram for an electronic ignition system.

Unit - III

6. a) Explain the various types of rear axles with neat diagrams.

CO3(BL2)

5M

(i) **Half/ Semi floating axle:**

(ii) **Full floating Axle:**

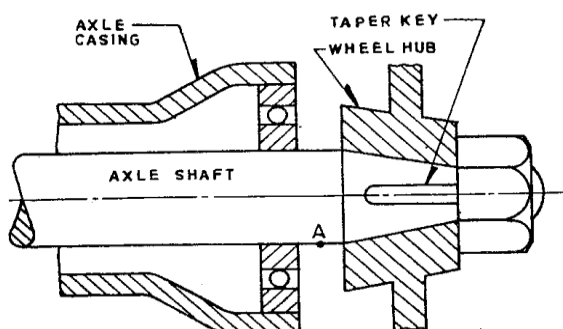


Fig. 6.44. Semi-floating axle.

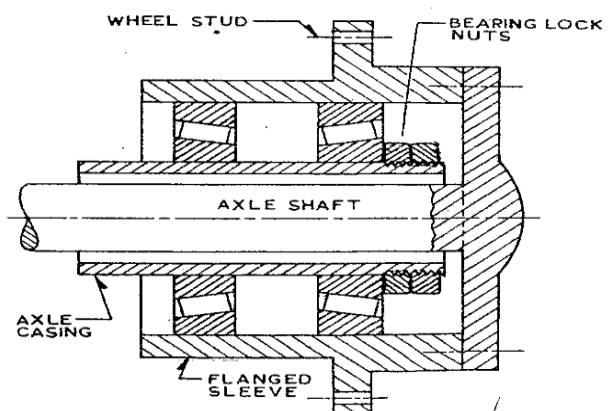


Fig. 6.45. Full-floating axle.

(iii) **Three-quarter floating Axle:**

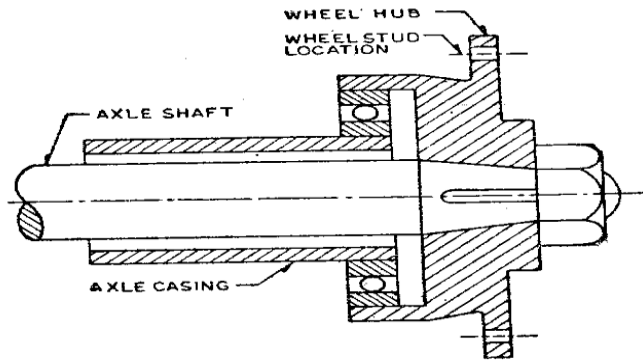


Fig. 6.46. Three-quarter floating axle. ✓

6 b) Describe the working of a synchromesh gear box with the help of neat sketches. Explain the construction and working principle of synchromesh type gear box.

CO3(BL1)

5M

(Working 2 ½ M + Diagram 2 ½ M)

- The gear on the layshaft are fixed to it while those on the main shaft are free to rotate on the same
- The parts which ultimately are to be engaged are first brought into frictional contact which equalizes their speed, after which these may be engaged smoothly
- for direct gear, member G1 and hence member f1 is slid towards left till cones M1 and M2 rub and friction makes their speed equal.
- Further pushing the member G1 to left causes it to override the balls and get engaged with dogs K1.
- Now the drive to the main shaft is direct from B via F1 and the splines.
- If the member G1 is pushed too quickly so that there is not sufficient time for synchronization of speeds, a clash may result.
- for second gear the members F1 and G1 are slid to the right so that finally the internal teeth on G1 are engaged with L1. then the drive to main shaft will be from B via U1, U2, C F1 and splines
- For this type of gear box, it is very necessary for the smooth operation that sufficient time is allowed for the equalization of the speeds before the gears are finally brought into mesh
- A synchronizer ring is provided between the dog teeth k1 and member F1.
- To push this synchronizer ring in the desired direction, three guide bars equally spaced along the circumference are provided.
- These are retained in place by means of circlips.
- The synchronizer ring has dog teeth at its outer circumference and is cut at three places to provide space for the guide bars.

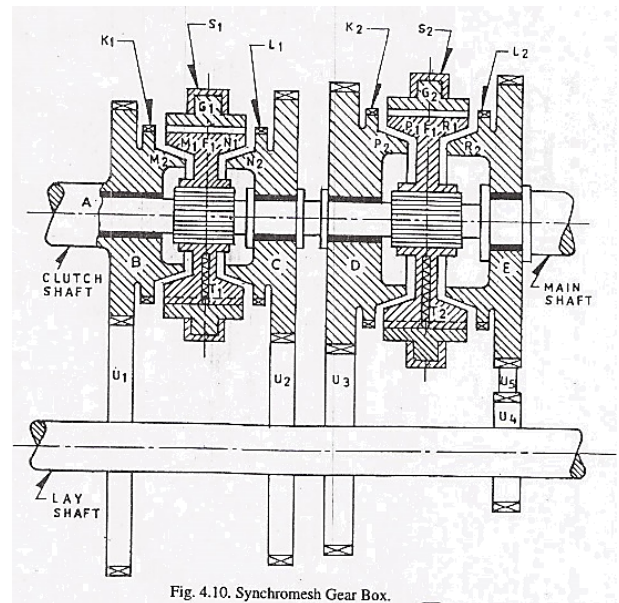


Fig. 4.10. Synchromesh Gear Box.

(OR)

7. a) Briefly explain the construction and working of a differential with the help of neat sketch. CO3(BL2) 5M

Differential: (Working 2 ½ M + Diagram 2 ½ M)

- When the car is taking a turn, the outer wheels will have to travel greater distance as compared to the inner wheels in the same time.

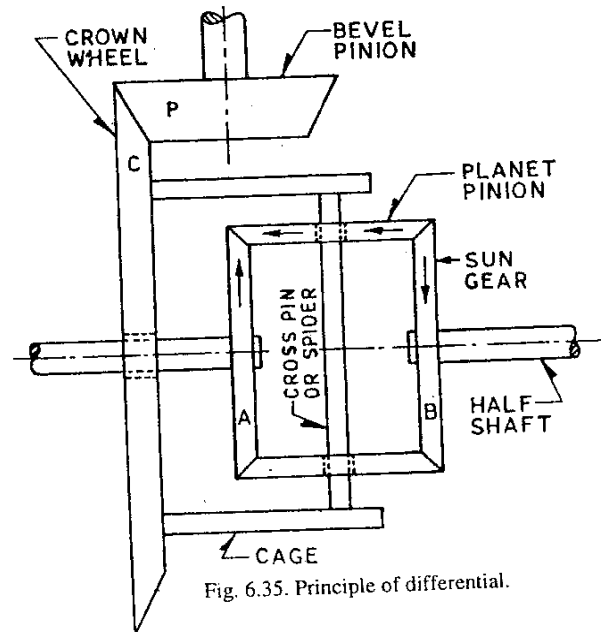
- For avoiding skidding of the wheels, differential mechanism is employed. This should reduce the speed of the inner wheels and increase the speed of the outer wheels when taking turn.

- When the vehicle is going straight the cage and the inner gears rotate as a single unit and the two half shafts revolve at the same speed.

- When the car is taking turn, and the cage is stationary, one sun gear will cause the other to rotate in the opposite direction.

- this rotation is super-imposed on the normal wheel speed when the vehicle is taking turn.

- consider a vehicle with wheel speed N rpm going straight, when it takes a turn toward right.



- 7 b) With the help of neat sketch describe the working of Telescopic type shock absorber. CO3(BL1) 5M

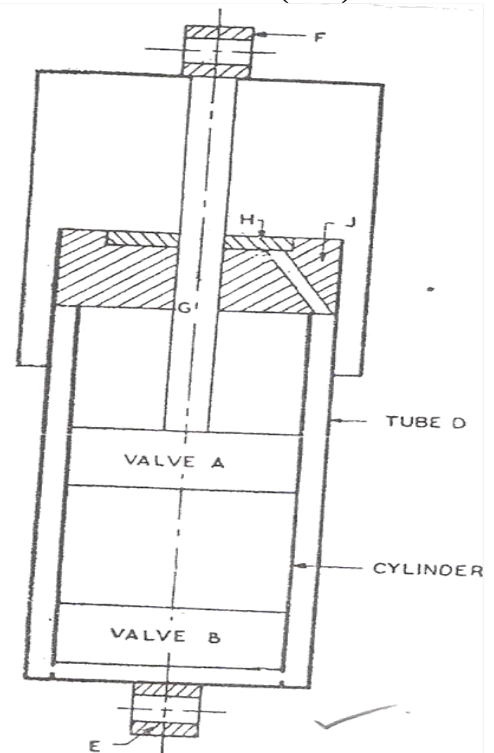
Telescopic Shock absorber: (Working 2 ½ M + Diagram 2 ½ M)

- Rod G is attached to the two way valve A, while another similar two-way valve B is attached at the lower space between cylinder C and tube D, which is connected to the space below the valve assembly B as shown.

- H is gland in the head J and any fluid scrapped off by rod G is brought down into the annular space through the inclined passage shown in the head.

- The eye E is connected to the axle, while the eye F is attached to the chassis frame.

- The fluid generally used in shock absorbers is a mixture of 60 percent transformer oil and 40 percent turbine oil.



Unit - IV

8. a) Explain the necessity of power steering in an automobile. Sketch any power steering system and explain its working. CO4(BL2) 5M

Power Steering (ANY ONE): (Working 2 ½ M + Diagram 2 ½ M)

- Larger amount of torque is required to be applied by the driver for steering of medium and heavy vehicles

- The power steering system provides automatic hydraulic assistance to the turning effort applied to the manual steering system.

- The power system is designed to become operative when the effort at wheel exceeds a predetermined value, say 10N. The system is always so designed that in the event of the failure of the power system, the driver is able to steer the vehicle manually although with increased effort.

Hydraulic Power Steering:

- the power steering systems are operated by fluid under pressure. The fluids usually used are oils of viscosity rating

SAE 5 W or SAE 10 W or higher depending upon atmospheric conditions.

- the systems operate under fairly high pressure which may be as much as 7 MPa

- The principle of working of all the power steering systems is same. The slight movement of the steering wheel actuates a valve so that the fluid under pressure from the reservoir enters on the appropriate side of a cylinder, thereby applying pressure on one side of a piston to operate the steering linkage, which steers the wheel in the appropriate direction.

- In electro – hydraulic power steering systems, the fluid pump is driven electrically by a motor.

- Pump speed is regulated by an electric controller to vary pump pressure and flow, providing steering efforts suited for different driving situations.

- Direct electric steering uses an electric motor attached to the steering rack via a gear mechanism

- there is no pump or fluid . A microprocessor controls steering dynamics and driver effort.

- the power steering are classified into two categories viz., the integral type and the linkage type.

- In the former the power steering assembly is an integral part of the steering gear whereas in the linkage type it is a part of the linkage.

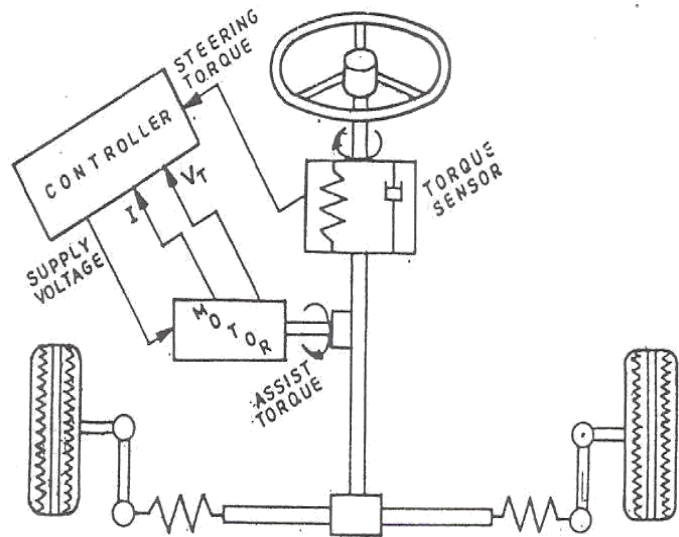
- The main components of an integral power steering system consists of a hydraulic pump assembly and a steering gear assembly connected by means of hoses.

- A rotary valve power steering gear for the integral system using recirculating ball type worm and wheel steering gear.

Electric Power steering:

Electric power steering (EPS) is the model in today's new cars. It is the most advanced type of power steering system. In this, the hydraulic system is fully restored with electric motors and sensors from hydraulic power steering.

Rather than using hydraulic force, the motor powered by the vehicle's battery uses the force on the steering gear. The steering gear and torque provided by the motor are controlled by the sensor detecting the position of the steering column.



8 b) Make a comparison between a hybrid and an electric car.

CO4(BL1)

5M

1. Pure-Electric Vehicles (Pure-EVs):

- They are electric vehicles powered only by a battery.
- At present, most manufacturers of standard performance cars offer pure-electric cars with a range up to about 100 miles.

2. A hybrid vehicle is powered by a battery and/or an ICE.

- The power source is selected automatically by the vehicle, depending on speed, engine load and battery charge.
- This battery cannot be plugged in, so charge is maintained by regenerative braking supplemented by ICE-generated power.

(OR)

9. a) Draw a layout diagram of an air brake system with all units. Explain its working.
Air Brake: (Working 2 ½ M + Diagram 2 ½ M)

CO4(BL2)

5M

The simplest system consists of an air compressor, a brake valve, a series of brake chambers, an unloader valve, a pressure gauge governor and a safety valve. These are all connected by lines of tubing. The air compressor, governor, pressure gauge, safety valve and the reservoir constitute the compressing and the control units whereas the rest of them are termed as application units.

The compressed air available on the vehicle is also used for the operation of additional assemblies of the vehicle such as horn, windshield wipers, etc.

The Compressed Air Brake System is a different air brake used in trucks which contains a standard disc or drum brake using compressed air instead of hydraulic fluid. Most types of truck air brakes are drum units, though there is growing trend to the use of disc brakes. The compressed air brake system works by drawing clean air from the environment, compressing it, and hold it in high pressure tanks at around 120 PSI.

Whenever the air is needed for braking, this air is directed to the functioning cylinders on brakes to activate the braking hardware and slow the vehicle. Air brakes use compressed air to increase braking forces. The large vehicles also have an emergency brake system, in which the compressed air holds back a mechanical force using springs which will otherwise engage the brakes. If air pressure is lost for any reason, the brakes will hold and vehicle is stopped.

9 b) Explain the working of fuel cell with a neat sketch. Mention its advantages and disadvantages. CO4(BL1) 5M

Fuel Cell: (Working 2 ½ M + Diagram 2 ½ M)

A fuel cell is a galvanic cell in which the chemical energy of a fuel is converted directly into electrical energy by means of electrochemical processes. The fuel and oxidizing agent are continuously and separately supplied to the two electrodes of the cell, where they undergo a reaction. An electrolyte is necessary to conduct the ions from one electrode to the other. Fuel is supplied to the anode or positive electrode, where electrons are released from the fuel under catalyst. The electrons, under the potential difference between these two electrodes, flow through the external circuit to the cathode electrode or negative electrode where combining positive ions and oxygen, reaction products, or exhaust are produced.

The chemical reaction in a fuel cell is similar to that in a chemical battery. The thermodynamic voltage of a fuel cell is closely associated with the energy released and the number of electrons transferred in the reaction.

Advantages:

- High Efficiency- when utilizing co-generation, fuel cells can attain over 80% energy efficiency
- Good reliability- quality of power provided does not degrade over time.
- Noise- offers a much more silent and smooth alternative to conventional energy production.
- Environmentally beneficial- greatly reduces CO₂ and harmful pollutant emissions.
- Size reduction- fuel cells are significantly lighter and more compact

Disadvantages:

- Expensive to manufacture due the high cost of catalysts (platinum)
- Lack of infrastructure to support the distribution of hydrogen
- A lot of the currently available fuel cell technology is in the prototype stage and not yet validated.
- Hydrogen is expensive to produce and not widely available

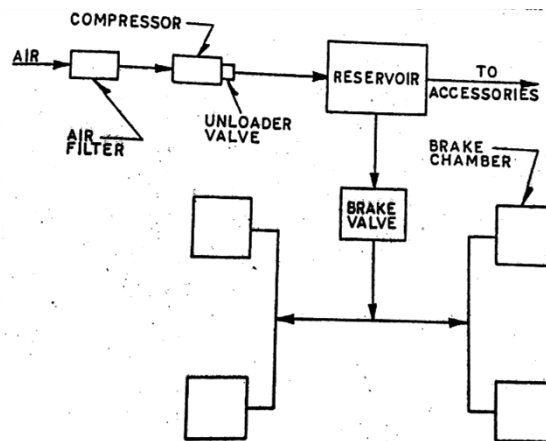
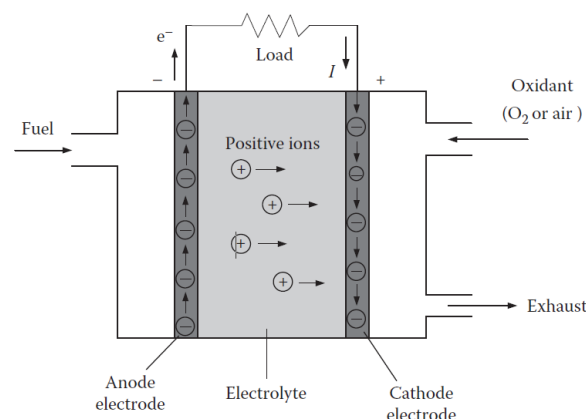


Fig. 11.14. Layout of air brake system.



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