THERMAL ENGINEERING LAB-I

LAB MANUAL

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EXPERIMENT NO.-1

AIM: - Study of working of four stroke petrol engine and four stroke diesel engine with the help of cut section models

APPARATUS:- Model of four stroke petrol engine and four stroke diesel engine.

THEORY:-

❖ ***Working of Four Stroke Petrol Engine:-***

The four stroke-cycles refers to its use in petrol engines, gas engines, light, oil engine and heavy oil engines in which the mixture of air fuel are drawn in the engine cylinder. Since ignition in these engines is due to a spark, therefore they are also called spark ignition engines.

SUCTION STROKE: In this Stroke the inlet valve opens and proportionate fuel-air mixture is sucked in the engine cylinder. Thus the piston moves from top dead centre (T.D.C.) to bottom dead centre (B.D.C.). The exhaust valve remains closed throughout the stroke.

COMPRESSION STROKE: In this stroke both the inlet and exhaust valves remain closed during the stroke. The piston moves towards (T.D.C.) and compresses the enclosed fuel-air mixture drawn. Just before the end of this stroke the operating plug initiates a spark which ignites the mixture and combustion takes place at constant pressure.

POWER STROKE OR EXPANSION STROKE: In this stroke both the valves remain closed during the start of this stroke but when the piston just reaches the B.D.C. the exhaust valve opens. When the mixture is ignited by the spark plug the hot gases are produced which drive or throw the piston from T.D.C. to B.D.C. and thus the work is obtained in this stroke.

EXHAUST STROKE: This is the last stroke of the cycle. Here the gases from which the work has been collected become useless after the completion of the expansion stroke and are made to escape through exhaust valve to the atmosphere. This removal of gas is accomplished during this stroke. The piston moves from B.D.C. to T.D.C. and the exhaust gases are driven out of the engine cylinder; this is also called **SCAVENGING.**

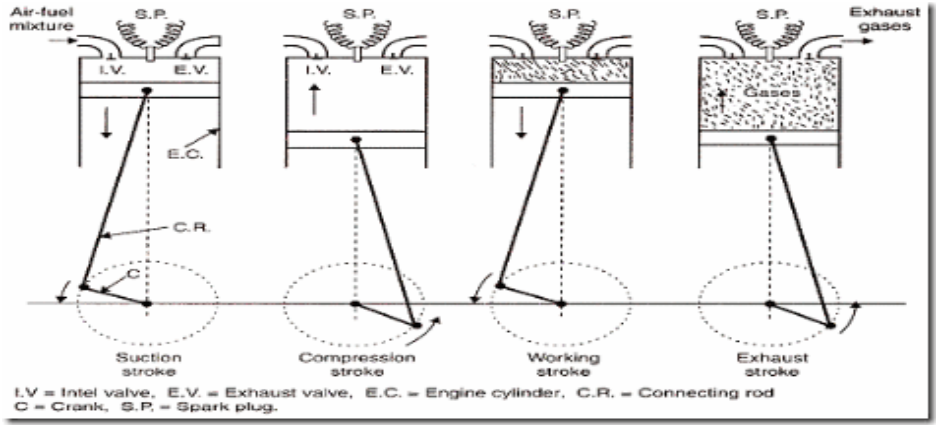

Fig.-Working of 4's Petrol Engine

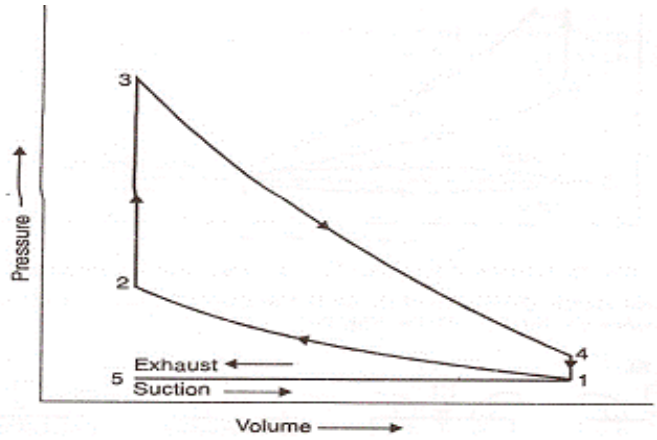

Fig.-Theoretical P-*V* diagram of a four-stroke engine

❖ ***Working of Four Stroke Petrol Engine:-***

SUCTION STROKE: With the movement of the piston from T.D.C. to B.D.C. during this stroke, the inlet valve opens and the air at atmospheric pressure is drawn inside the engine cylinder; the exhaust valve however remains closed. This operation is represented by the line 5-1

COMPRESSION STROKE: The air drawn at atmospheric pressure during the suction stroke is compressed to high pressure and temperature as the piston moves from B.D.C. to T.D.C. Both the inlet and exhaust valves do not open during any part of this stroke. This operation is represented by 1-2

POWER STROKE OR EXPANSION STROKE: As the piston starts moving from T.D.C to B.D.C, the quantity of fuel is injected into the hot compressed air in fine sprays by the fuel injector and it (fuel) starts burning at constant pressure shown by the line 2-3.

At the point 3 fuel supply is cut off. The fuel is injected at the end of compression stroke but in actual practice the ignition of the fuel starts before the end of the compression stroke. The hot gases of the cylinder expand adiabatically to point 4. Thus doing work on the piston.

EXHAUST STROKE: The piston moves from the B.D.C. to T.D.C. and the exhaust gases escape to the atmosphere through the exhaust valve. When the piston reaches the T.D.C. the exhaust valve closes and the cycle is completed. This stroke is represented by the line 1-5.

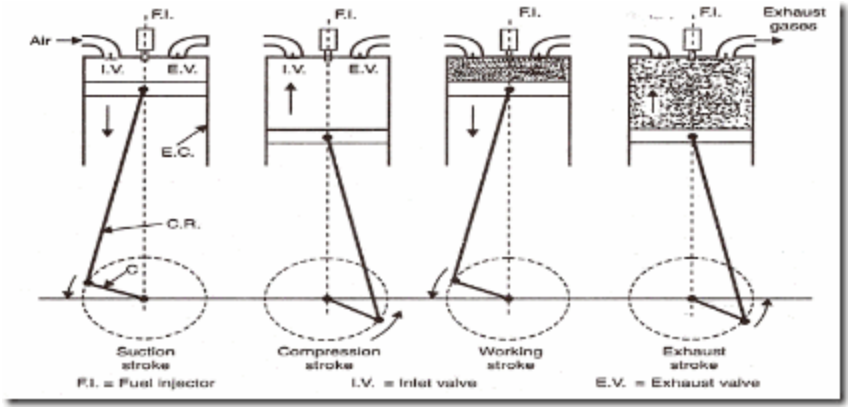

Fig.-Working of 4's Diesel Engine

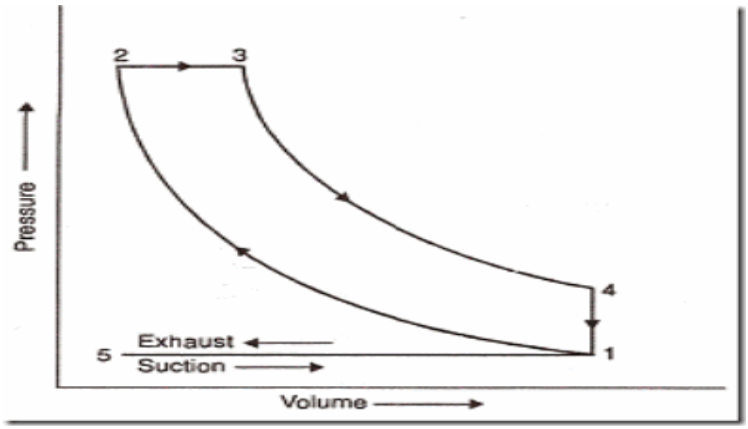

Fig.-Theoretical p- *V* diagram of a four-stroke Diesel Engine

Result:-……

LAB QUESTIONS

1. What is working principle of four stroke diesel engine?
2. What is working principle of four stroke petrol engine?
3. Explain difference between two stroke and four stroke engine?
4. What are the construction details of four stroke diesel and petrol engine?

EXPERIMENT NO.-2

AIM: - Study of working of two stroke diesel engine and two stroke diesel engine with the help of cut section models.

APPARATUS: - Model of two stroke petrol engine and four stroke diesel engine.

THEORY:

Working Principles of 2-Stroke petrol engine:-

The working principle of 2-Stroke petrol engine is discussed below:-

1) 1st Stroke: To start with let us assume the piston to be at its B.D.C. position. The arrangement of the ports is such that the piston performs two jobs simultaneously.

As the piston starts rising from its B.D.C. position it closes the transfer port and the exhaust port. The charge (mixture, of the air and petrol) which is already there in the cylinder, as the result of the previous running of the engine is compressed at the same time with the upward movement of the piston vacuum is created in the crank case (which is gas tight). As son as the inlet port is uncovered; the fresh change in sucked in the crank case. The charging is continued until the crank case and the space in the cylinder beneath the piston is filled with the charge. As the end of third stroke, the piston reached the T.D.C. position.

2) 2nd Stroke: Slightly before the completion of the compression stroke, the compressed charge is ignited by means of a spark produced at the spark plug.

Pressure is exerted on the crank of the piston due to the combustion of the piston is pushed in the downward direction producing some useful power. The downward movement of the will first close the inlet port and then it will compress the charge already sucked in the crank case.

Just the end of power stroke, the piston uncovered the exhaust port and the transfer port simultaneously the expanded gases start escaping through the exhaust port and the same time the fresh charge which is already compressed in the crank case, rushed into the cylinder through the transfer port and thus the cycle is repeated again.

The fresh charge coming into the cylinder also helps in exhausting the burnt gases out of the cylinder through the exhaust port. This is known as **scavenging.**

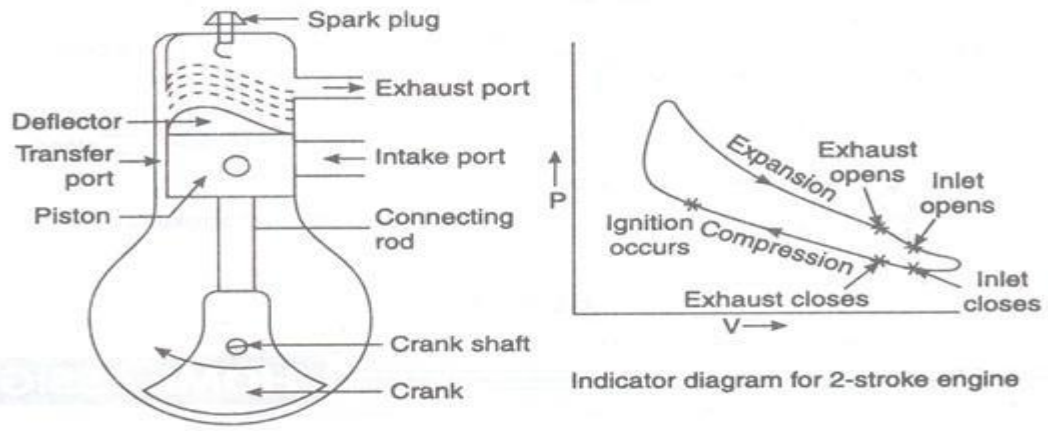

Figure: - Two stroke SI Engine

WORKING PRINCIPLE OF 2 STROKE DIESEL ENGINE

1. 1st Stroke – As the piston starts rising from its B.D.C. position, it closes the transfer and the exhaust port. The air which is already there in the cylinder is compressed. At the same time with the upward movement of the piston, vacuum is created in the crank case. As soon as the inlet port is uncovered the fresh air is sucked in the crank case. The charging is continued until the crank case and the space in the cylinder beneath the piston in filled with the air.

2. 2nd Stroke – Slightly before the completion of the compression stroke a very fine spray of diesel is injected into the compressed air (which is at a very high temperature). The fuel ignites spontaneously.

Pressure is exerted on the crown of the piston due to the combustion of the air and the piston is pushed in the downward direction producing some useful power. The downward movement of the piston will first close the inlet port and then it will compress the air already sucked in the crank case.

Just at the end of power stroke, the piston uncovers the exhaust port and the transfer port simultaneously. The expanded gases start escaping through the exhaust port and at the same time the fresh air which is alredy compressed in the crank case, rushes into the cylinder through the transfer port and thus the cycle is repeated again.

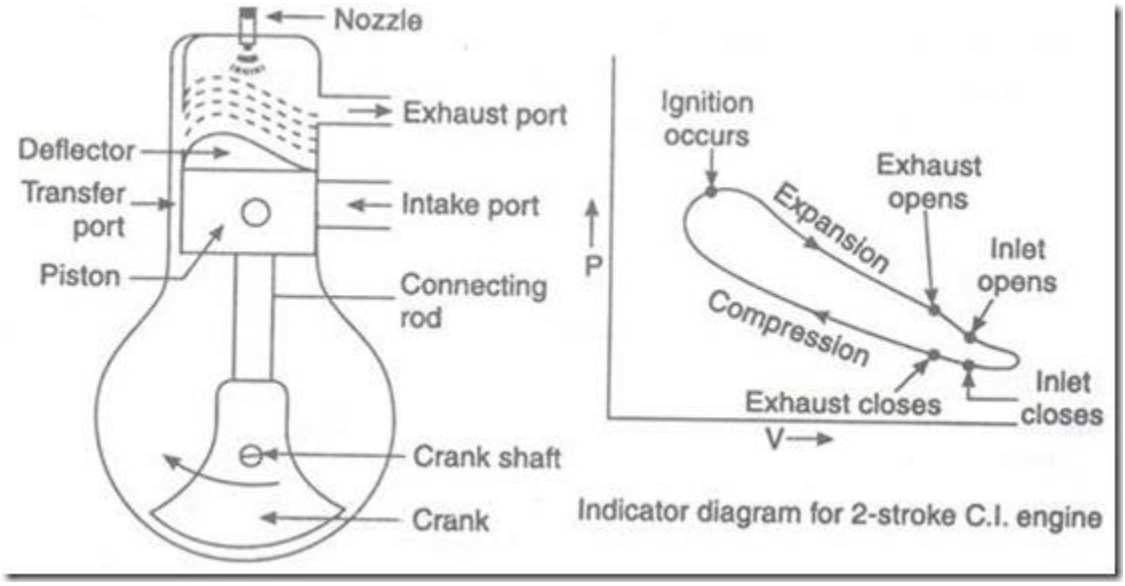

Figure: - Two stroke CI Engine

Results:-……..

LAB QUESTIONS

5. What is working principle of two stroke diesel engine?
6. What is working principle of two stroke petrol engine?
7. Explain difference between two stroke and four stroke engine?
8. What are the construction details of two stroke diesel and petrol engine?

EXPERIMENT NO.-3

AIM: - To draw valve timing diagram for a single cylinder diesel engine.

APPARATUS: - Model of cylinder diesel engine.

THEORY:-

In a four stroke engine opening and closing of valves and fuel injection do not take place exactly at the end of dead center positions. The valves open slightly earlier and close after that respective dead center position. The injection (ignition) also occurs prior to the full compression and the piston reaches the dead Centre position. All the valves operated at some degree on either side in terms of crank angles from dead center position.

INLET VALVE: During the suction stroke the inlet valve must be open to admit charge into the cylinder, the inlet valve opens slightly before the piston starts downward on the suction stroke. The reason that the inlet valve is open before the start of suction stroke is that the valve is necessary to permit this valve to be open and close slowly to provide quite operations under high speed condition.

INLET VALVE OPENS (IVO): It is done at 10to 250 in advance of TDC position.

INLET VALVE CLOSES (IVC): It is done at 25 to 500 after BDC position.

EXHAUST VALVE: As the piston is forced out on the outstroke by the expanding gases, it has been found necessary to open the exhaust valve before the piston reaches the end of the stroke. By opening the exhaust valve before the piston reaches the end of its own power stroke, the gases have an outlet for expansion and begin to rush out of their own accord. This removes the greater part of the burnt gases reducing the amount of work to be done by the piston on its return stroke.

EXHAUST VALVE OPENS (EVO): It is done at 30 to 500 in advance of BDC position.

EXHAUST VALVE CLOSES (EVC): It is done at 10 to 150 after the TDC position.

P**ROCEDURE**:

1. Keep the decompression lever in vertical position.

2. Bring the TDC mark to the pointer level closed.

3. Rotate the flywheel till the inlet valves moves down i.e., opened.

4. Draw a line on the flywheel in front of the pointer and take the reading.

5. Continue to rotate the flywheel till the inlet valve goes down and comes to horizontal position and take reading.

6. Continue to rotate the flywheel till the outlet valve opens, take the reading.

7. Continue to rotate the flywheel till the exhaust valve gets closed and take the reading.

OBSERVATIONS:

S. No.	Valve Position	Arc Length, S (mm)	Angle 'θ' in degrees
1	TDC – Inlet Valve open		
2	BDC – Inlet Valve Close		
3	TDC – Exhaust Valve Open		
4	BDC – Exhaust Valve Close		

CALCULATIONS:

1. Diameter of the flywheel, D =

2. $\Theta = S*360/D*\pi$

Where, S = Arc length, mm

Results:-……..

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LAB QUESTIONS

9. Differentiate valve and port?
10. Define valve timing?
11. Explain the importance of valve timing?
12. Define mechanism of valve operation?
13. Define the cam mechanism in IC engine?
14. Define crank mechanism?
15. What is the position of inlet vale opening and closing?
16. What are the exhaust valve opening and closing positions?
17. Indicate the ignition period in the diagram?

EXPERIMENT NO.-4

AIM: - Study of various types of boilers.

APPARATUS: - Model of various types of boilers.

THEORY:-

Classification of Boilers:

1. According to their Axis (Horizontal, Vertical or Inclined)

i. If the axis of the boiler is horizontal, the boiler is called as horizontal.

ii. If the axis is vertical, it is called vertical boiler.

iii. If the axis is inclined it is known as inclined boiler.

2. Fire Tube and Water Tube

i. In the fire tube boilers, the hot gases are inside the tubes and the water surrounds the tubes, Examples: Cochran, Lancashire and Locomotive boilers.

ii. In the water tube boilers, the water is inside the tubes and hot gases surround them, Examples: Babcock and Wilcox boiler.

3. Externally Fired and Internally Fired

i. The boiler is known as externally fired if the fire is outside the shell, Examples: Babcock and Wilcox boiler.

ii. The furnace is located inside the boiler shell, Examples: Cochran, Lancashire boiler etc.

4. Forced Circulation and Natural Circulation

i. In forced circulation type of boilers, the circulation of water is done by a forced pump.

ii. In natural circulation type of boilers, circulation of water in the boiler takes place due to natural convention currents produced by the application of heat, Examples: Lancashire, Babcock and Wilcox boiler etc.

5. High Pressure and Low Pressure Boilers

i. The boilers which produce steam at pressures of 80 bar and above are called high pressure boilers, Examples: Babcock and' Wilcox boilers.

ii. The boilers which produce steam at pressure below 80 bar are called low pressure boilers, Examples: Cochran, Lancashire and Locomotive boilers.

6. Stationary and Portable

i. Stationary boilers are used for power plant-steam, for central station utility power plants, for plant process steam etc.

ii. Mobile boilers or portable boilers include locomotive type, and other small units for temporary use at sites (Large Ships).

7. Single Tube and Multi-tube Boilers

The fire tube boilers are classified as single tube and multi-tube boilers, depending upon whether the fire tube is one or more than one.

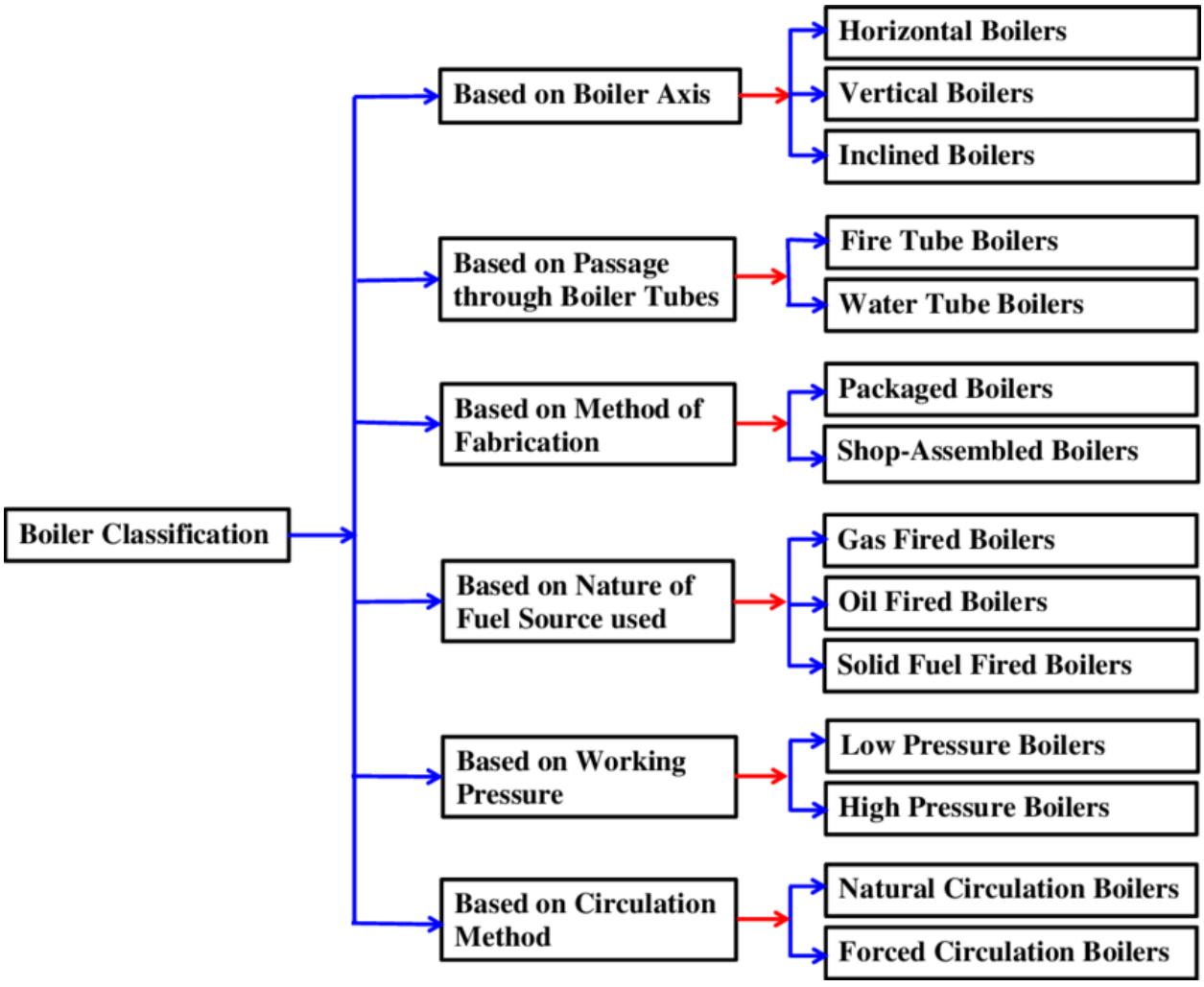


Fig:- Classification of boilers

Results:-……..

LAB QUESTIONS:

1. What is the function of boiler?
2. What are the different types of boilers?
3. Explain the terms used for boilers?
4. Differentiate water tube and fire tube boilers?

EXPERIMENT NO.-4

AIM: - Study of various types of mountings and accessories.

APPARATUS: - Model of boiler.

THEORY:-

Boiler Mountings: These are the fitting and devices which are necessary for the operation and safety of a boiler.

Boiler Accessories: These are auxiliary plants required for steam boilers for the proper operation and for the increase of their efficiency.

Types of Mountings:

- Safety valves
- Water level indicator
- A pressure gauge
- A steam stop valve
- A feed check valve
- A Fusible plug
- A blow-off cock

Types of Accessories:

- Feed pumps
- Injector
- Economizer
- Air pre heater
- Super heater
- Steam separator

Mountings:

1. **SAFETY VALVES**: It is use for release the excess steam when the pressure of steam inside the boiler exceeds the rated pressure. Types of safety valve are the following:

- Dead weight safety valve
- Lever safety valve
- Spring loaded safety valve
- Gravity safety valve

2. **WATER LEVEL INDICATOR**: It is use to indicate the level of water in the boiler constantly.
3. **PRESSURE GAUGE**: It is use to measure the pressure exerted inside the vessel.
4. **STEAM STOP VALVE**: It is use to regulate the flow of steam from the boiler to the steam pipe.
5. **FEED CHECK VALVE:** It is use to control the supply the water to the boiler and to prevent the escaping of water from the boiler when the pump is stopped.

6. **FUSIBLE PLUG:** It is use to protect the boiler against damage due to overheating for low water level.
7. **BLOW-OFF COCK:** It is use to discharge a portion of water when the boiler is empty when necessary for cleaning, inspection, repair, mud, scale and sludge.

Accessories:

1. **FEED PUMPS**: It is used to deliver feed water to the boiler by the pump.
2. **INJECTOR**: The water is delivered to the boiler by steam pressure; The Kinetic energy of steam is used to increase the pressure and velocity of feed water.
3. **ECONOMISER:** It is a device in which the waste heat of flue gases is utilized for heating the feed water.
4. **AIR PREHEATER**: It is use to increase the temperature of air before it enters the furnace.
5. **SUPERHEATER:** It is use to increase the temperature of steam above it saturation point.
6. **STEAM SEPARATOR**: It is use to separate the water particles from the steam to the steam engine or steam turbine

Results:-……..

LAB QUESTIONS:

1. Define Boiler mountings??

2. Explain function of different boiler mountings??

3. Define boiler Accessories?

4. Explain function of different boiler accessories?

EXPERIMENT NO.-6

AIM: - Study of braking system with specific reference to types of braking system, master cylinder, brake shoes.

APPARATUS: - Model of braking system.

THEORY:-

Braking System :-

Functions of Brake There are two distinct functions of the brake**:**

1. To stop or slow down the vehicle in the shortest possible distances in emergencies.

2. To control the vehicle to be retained when descending a hill.

Classification of brakes:-

A. From construction point of view

1. Drum brakes

2. Disc brakes

B. By method of actuation

1. Mechanical brakes

2. Hydraulic brakes

3. Electric brakes

4. Vacuum brakes

5. Air brakes

DRUM BRAKES:-

In this type of brakes, a brake drum is anchored concentric to the axle hub whereas on the axle casing is mounted a back plate. In case of front axle, the back plate is bolted to the steering knuckle. The back plate is made of pressed steel sheet and is ribbed to increase rigidity and to provide support for the expander, anchor and brake shoes. It also protects the drum and shoe assembly from mud and dust. Moreover, it absorbs the complete torque reaction of the shoes due to which reason it is sometimes also called 'torque plate'. Two brake shoes are anchored on the back plate. Friction linings are mounted on the brake shoes. One or two retractor springs are used which serve to keep the brake shoes away from the drum when the brakes are not applied. The brake shoes are anchored at one end, whereas on the other ends Force F as applied by means of some brake actuating mechanism, which forces the brake shoe against the revolving drum, thereby applying the brakes. An adjuster is also provided to compensate for wear of friction lining with use. The relative braking torque obtained at the shoes for the same force applied at the pedal varies depending upon whether the expander (cam or toggle lever) is fixed to the back plate or it is floating; whether the anchor is fixed or floating and whether the shoes are leading or trailing.

DISC BRAKES:-

The disc brake has a metal disc instead of a drum. It has a flat shoe, or pad, located on each side of the disc. To slow or stop the car, these two flat shoes are forced tightly against the rotating disc or rotor. The shoes grip the disc. Fluid pressure from the master cylinder forces the pistons to move in. This action pushes the friction pads of the brake shoes tightly against the disc. The friction between the shoes and the disc slows and stops the disc.

Dual brake system:-

The dual brake system uses two master cylinders. One brake line from the master cylinder goes to one set of wheel brakes. The other brake line from the master cylinder goes to the other set of wheel brakes.

Parking brake:-

The parking brake holds the vehicle stationary while it is parked. Since the parking brake is independent of the service brakes, it can be used as an emergency brake if the service brakes fail. When the parking brake is operated by a hand lever, some manufacturers call it the hand brake.

Material:-

The brake linings are either of solid woven type or molded type. The asbestos base non-metallic linings have an average coefficient of friction of 0.4 up to about 260°C. Their maximum temperature resistance is about 350°C. Zinc wire lining have better resistance to wear than the non-metallic type. Also zinc serves to conduct some heat away from the working surface. Molded type linings are prepared directly from the mix which contains asbestos fibers, together with resin powders and fillers. These linings have good wear resistance. Their maximum temperature resistance is about 450°C. The average coefficient of friction is 0.4. The brake linings are attached with the brake shoes either by riveting or by synthetic resin adhesives. The second method is preferable, due to the absence of riveting holes, more contact surface, free from scoring action and more effective wearing thickness.

HYDRAULIC BRAKE SYSTEM:-

These types of brakes consist of master cylinder, which contains hydraulic brake fluid. Master cylinder is operated by the brake pedal and is further connected to the wheel cylinder in each wheel through pipelines, unions and flexible lines. The system is so designed that even when the brakes are in the released position, a small pressure of about 50kpa is maintained in the pipelines to ensure that the cups of the wheel cylinder are kept expanded. This prevents the air entering the wheel cylinders when the brakes are released. Besides this pressure also serves the following purposes:

1. It keeps the free travel of the pedal minimum by opposing the brake shoe retraction springs.

2. During bleeding, it does not allow the fluid pumped into the line to return, thus quickly purging air from the system.

MASTER CYLINDER:-

It consists of fluid reservoir and compression chamber in which piston operates. The fluid in the reservoir compensates for any change in the fluid volume in the pipelines due to temperature variations and to some extent due to leakage. To prevent leakage there are rubber seals on both sides of the piston in the compression chamber. The fluid always surrounds the reduced diameter region of the piston. A rubber boot covers the push rod and of the master cylinder to prevent the dirt entering inside. Towards the brake lines side of the compression chamber, there is fluid check valve with a rubber cup inside. It serves to retain the residual pressure in the brake lines even when the brakes released. There are a number of holes in the

piston head on the primary (high pressure) seal side. Two holes connect at the reservoir to the compression chamber.

The smaller one out of these is about 0.7 mm diameter and is called the bypass or compression port. The second hole is called the intake or recuperation port. Besides, there is a vent in the cap, to keep the brake fluid always at atmospheric pressure. The push rod is operated with the foot brake pedal through the linkage. As the pedal is pressed, push rod moves to left against the force of the spring, till it covers the bypass port. Further movement of the push rod causes building up of pressure in the compression chamber. Finally, when sufficient pressure has built up, the inner rubber cup of the fluid check valve is deflected, forcing the fluid under pressure in the lines. This fluid enters the wheel cylinder or the caliper and moves the pistons thereby applying the brakes.

When the brakes are released, the spring pressure in the master cylinder moves the piston to the right extreme position. This same force of the spring keeps the fluid check valve pressed on its seat for some time and thereby delays the return of fluid from the lines into the compression chamber again. Some delay is also caused by the inertia of the fluid in the lines. This produces a vacuum in the compression chamber and unless this is destroyed immediately, there are all chances of air leakage into the system. Even a very small amount of air will render the brakes unless, the air being compressible. Having intake port as shown in figure solves this problem. As soon as some vacuum is formed, the atmospheric pressure in the fluid reservoir forces the fluid through intake port and holes in the piston, which deflects the rubber, cup and enters the compression chamber, destroying the vacuum.

But by the time, the vacuum is destroyed; the fluid from the lines comes back into the reservoir by lifting the fluid check valve off its seat. This extra fluid now has to be accommodated somehow, because compression chamber is already full. If this is not done, the pressure in the lines will not be relieved fully and there are chances of brake shoe rubbing with the drum. Once this happens, there will be more heat generated at the drum, which when transmitted to the wheel cylinders would cause the fluid to expand and exert still more pressure, causing the shoes to move still further towards the drum. In this way, a vicious circle will start, causing the brakes to jam ultimately. This is avoided by means of bypass port. The extra fluid coming from the lines passes to the fluid reservoir, where pressure is maintained atmospheric by providing an air vent. Wheel Cylinder: The construction is very simple. The brake fluid under pressure forces the piston apart, thereby applying the brakes.

Vacuum assisted system:-

With vacuum assisted brakes, only a relatively light pedal force is required to break the vehicle. When the brake pedal is pushed down, a vacuum operated booster takes over and furnishes most of the force for pushing the pistons into the master cylinder. The hydraulic booster is operated by oil pressure from the power steering pump. The vacuum comes from the engine intake manifold. The system includes a cylinder in which a tight-fitted piston can move. When vacuum is applied to one side of piston, atmospheric pressure causes the piston to be pushed to the right. This movement pushes the piston rod into the master cylinder. In the vacuum assisted brake system, the brake pedal does not act directly on the master cylinder. Instead, brake pedal movement operates a vacuum valve, which then admits vacuum to the power cylinder.

Antilock Braking System:-

The most efficient braking takes place when the wheels are still moving. If the brakes lock the wheels so that the tires skid, kinetic friction results, and braking is much less effective. To prevent skidding and provide maximum effective braking, several antilock devices have been developed. Some provide skid control at the rear wheels only. Others provide control at all four wheels. Control means that as long as the wheels are rotating, the antilock device permits normal application of the brakes. But if the brakes are applied so hard that the wheels tend to stop turning and a skid starts to develop, the device comes into operation. It partly releases the brakes so that the wheels continue to rotate. However, braking continues, but it is held to just below the point where a skid would start. The result is maximum braking

RESULTS: - We Study various types of brake successfully.

EXPERIMENT NO.-6

AIM: - Study of transmission system includes clutches, gear box assembly and differential box.

APPARATUS: - Model of transmission system and different type of clutches, gear box assembly and differential box.

THEORY:-

Introduction:-

The power developed by the engines is delivered to the driving wheels of the automobile by the power train. The transmission is the major part of the power train. In the manual transmission, clutch is a device used to connect and disconnect engine power flow to the transmission the will of the driver. The driver operates the clutch via a clutch pedal inside the vehicle.

When the clutch pedal is depressed, the three main clutch assembly components – flywheel, friction disc and pressure plate are disengaged, interruption of the power flows. As the clutch is release, the pressure plate moves closer to the clutch disc.

Functions of Clutch:-

- To permit the engagement or disengagement of a gear when the vehicle is stationary and engine is running.
- To transmit the engine power to the road wheels smoothly without shock / jerk to the transmission system.
- To permit the engaging of gears when the vehicle is in motion without damaging the gear wheels.

WORKING PRINCIPLE:-

The working principle of clutch is based on friction .When the two friction surfaces re brought in contact with each other and pressed they are united due to friction between them.

.If now one is resolved, the other will also resolve. One surface is considered as a driving member and other as driven member. The driving member is kept rotating .When the driven member is brought in contact with the driving member, it is also starts rotating .When the driven member is separated from the driving member, and it stops revolving. The driving member of clutch is the flywheel mounted on crankshaft, the driven member is a pressure plate mounted on the transmission shaft.

SINGLE PLATE CLUTCH:-

This is the common type of clutch used in automobile. It consists of two member flywheel and pressure plate. The flywheel is mounted on engine crankshaft and rotates with it. The pressure plate is bolted to the flywheel through clutch springs and is free to slide on the clutch shaft when the clutch pedal is operated. Single plates clutch has only one clutch plate, mounted on the splines of the clutch shaft. The clutch pedal is used to engage or disengage the clutch

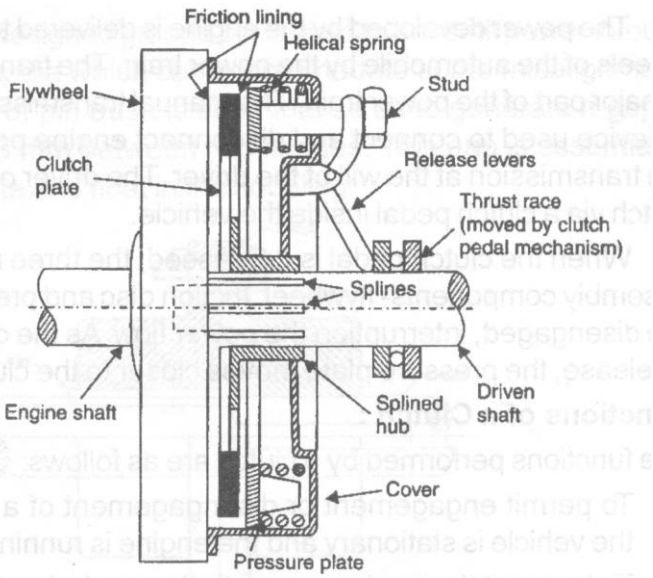


Fig. Single Plate Clutch

When the clutch is engaged, the clutch plate is gripped between the flywheel and pressure plate. The friction linings are provided on both sides of the clutch plate. Due to friction between the flywheel, clutch plate and pressure plate, the clutch plate revolves with the flywheel. As the clutch plate revolves, the clutch shaft also revolves, which is connected to the transmission. Hence, the engine power is transmitted through the crankshaft to the clutch shaft. When the clutch pedal is pressed, the pressure plate moves back against the force of the springs and the clutch plate becomes free between the flywheel and the pressure plate. Thus the flywheel keeps rotating as long as the engine is running. As soon as the clutch pedal is pressed, the clutch is said to be disengaged, otherwise it remains engaged due to the spring forces.

Advantages:-

- Gear changing is easy.
- It is mire reliable.

Disadvantage:-

- It requires more force by the driver to disengage since the springs are very stiff.

MULTIPLE CLUTCHES:-

A multiplate clutch consists of more than one clutch plate. As the numbers of clutch plates are increased, the friction surface also increases. The increased number of friction surfaces increases the capacity of the clutch to transmit torque.

The plates are alternately fitted to the engine shaft and gear box shaft. They are firmly pressed by the strong coil springs and assembled. Each of the alternate plate slides on splines on the pressure plate

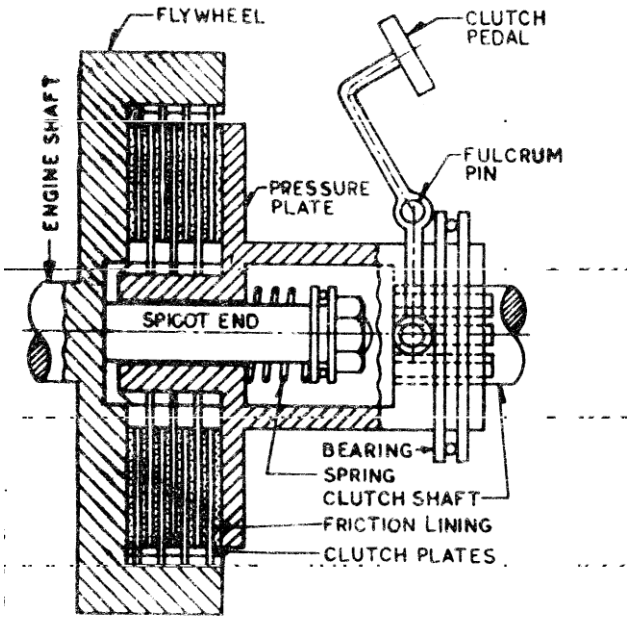


Fig. 3.21 Multiplate Clutch.

A multiplate clutch works in the same way as a single plate clutch while the flywheel is rotating, the pressure plate rotate and press against the friction plate. This causes the clutch plate to rotate, which in turn rotate the clutch shaft. When the pedal is pressed, the flywheel continues to rotate but the clutch plate is released. This happens because they are not fully pressed by the pressure plates. Thus the clutch shaft also stops rotating.

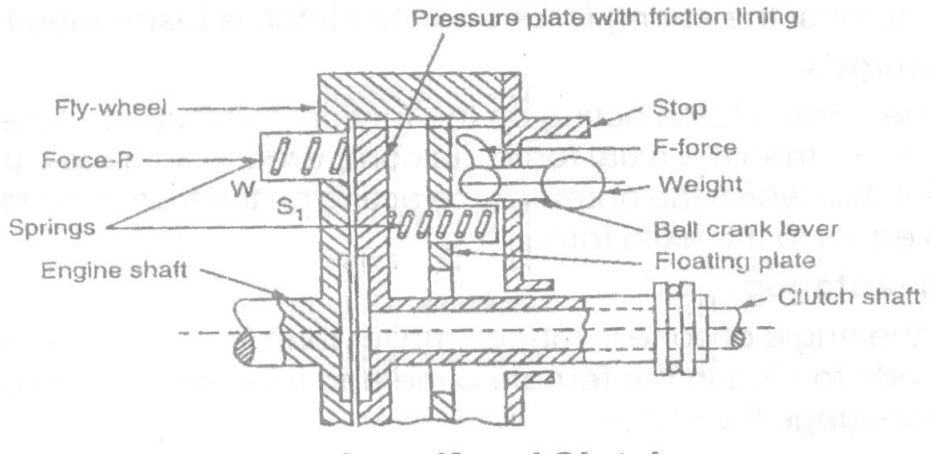
A multiplate clutch may be dry or wet. When the clutch is operated in an oil bath, it is called as a wet clutch. When the clutch is operated dry, it is called dry clutch.

Advantages:

- The number of friction surfaces increases the capacity of the clutch to transmit torque. Therefore, considering the same torque transmission the overall diameter of the multiplate clutch is reduced when compared to a single plate clutch.
- It is used in scooters, motorcycles, where there is space problem.
- As it can transmit more torque, it can be used in heavy vehicles and racing cars.

CENTRIFUGAL CLUTCH:-

This clutch is centrifugal force instead of spring force for keeping the clutch in engaged position. It does not require clutch pedal to operate the clutch. The clutch is operated automatically depending upon the engine speed.



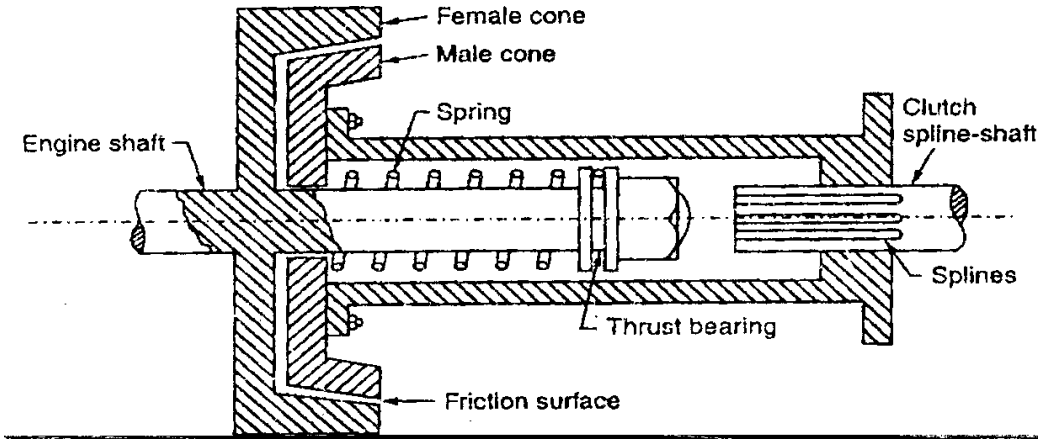
It consists of weight which flies off due to centrifugal force when the speed increases. It operates the bell crank lever which presses the floating plate. The movement of the spring which then presses the clutch plate on the flywheel against the spring thus engaging the clutch. The spring keeps the clutch disengaged at low speed of about 500 rpm. The stop above the weight, limits the amount of the centrifugal force.

Advantages:-

- No clutch pedal is required to operate the clutch
- It is operated automatically depending upon the engine speed.

CONE CLUTCH:-

A cone clutch consists of friction surfaces in the form of cones. A female cone is mounted on the engine shaft while a male cone is mounted on the splined clutch shaft as shown in figure. The male cone has friction surface on the conical portion and it can slide on the clutch shfaft.When the clutch is engaged the friction surfaces of the male cone are in contact with that of the female cone due to the forced of spring .When the pedal is pressed against the spring force and the clutch is disengaged .



Advantages:-

- The normal force acting on the friction (contact) surfaces is greater than the axial force, as compared to the single plate clutch in which the normal force acting on the friction surfaces is equal to the axial force.

Disadvantages:-

- If the angle of cone is made smaller than 20°, the male cone tends to bind in the female cone and it becomes difficult to disengage the clutch.
- A small amount of wear on the cone surfaces results in a considerable amount of axial movement of the male cone which it will be difficult to allow.

Differentials: The purpose of the differential assembly is to allow the two drive wheels to turn at different speeds when the car goes around a corner. This is necessary because when cornering, the wheel on the inside of the turn goes through a smaller arc or corner than the wheels on the outside. If the wheels were not allowed to turn at different speeds, they would tend to skip around the corner and steering would be very difficult.

Differentials are used in:

i) The rear drive axle of front engine, rear wheel drives vehicles.
ii) The transaxles of front engine, front wheel drive and rear engine, rear wheel drive vehicles.
iii) The front drive axle and rear drive axle of four wheel drive vehicles.
iv) The transfer case of some four wheel drive vehicles.

Both the front drive and rear drive differential have the same job to do. They also have many of the same parts. The basic difference is the way in which engine torque is delivered to the differential assembly.

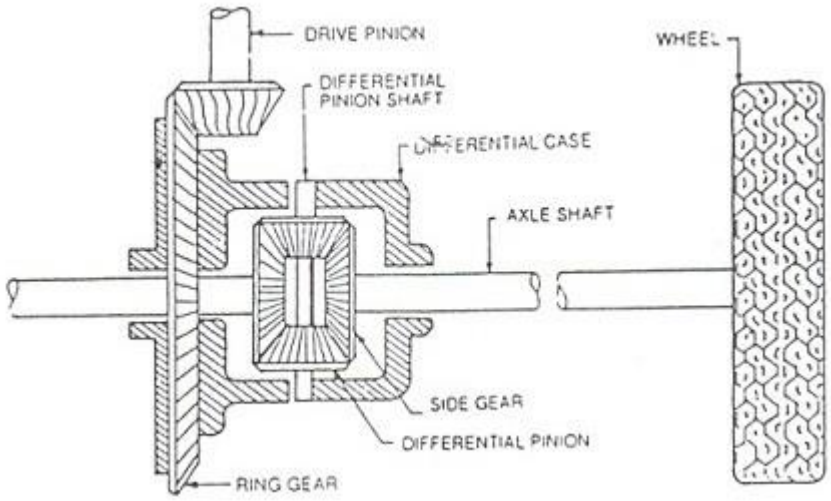
Power enters the rear axle assembly from the final drive which consists of bevel pinion connected through a rear universal yoke to the propeller shaft. The bevel pinion is meshed with the crown wheel, which is bolted to the case. This arrangement allows the bevel pinion to turn the crown wheel.

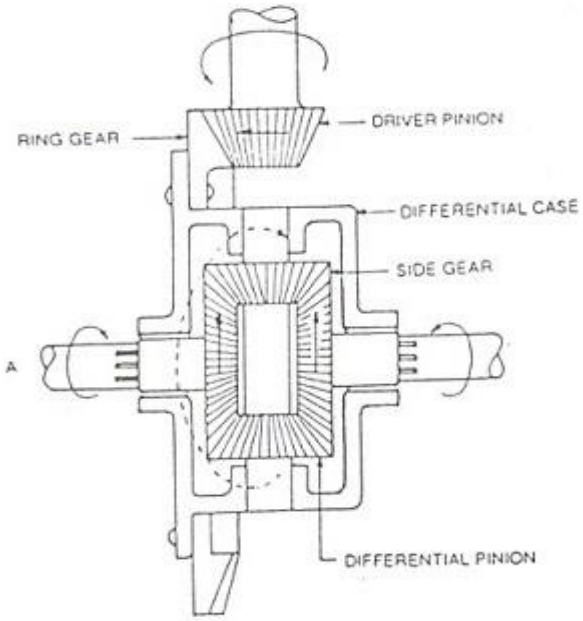
As the crown wheel turns, the case attached to it also turns. A shaft through the case also goes through the middle of two small pinion gears. As the case turns, this shaft turns the small pinion gears, each of which meshes with a side gear. Each side gear is attached to a shaft called an axle, which on a rear drive system runs through housing to one of the rear wheels.

When the automobile is travelling in a straight line, the power flow through the system is fairly simple. The crown wheel turns the case. The case, through its shaft and pinion gears, turns each of the side gears at the same speed. The axles or drive shafts turn the drive wheels, which drive the vehicle.

When the vehicle makes a turn, however, the power flow becomes more complicated. If the automobile is making a left turn, the left drive wheel must go through a sharper corner or travel through a shorter distance than the right drive wheel. The crown wheel turns the case.Since the left wheel is going through a sharp corner, the left axle is slowed or stopped momentarily. The pinion gears in the case still turn with the case but they also rotate on the case shaft. Thus they can walk around the slowed or stopped left side gear and provide all the power to the right side gear so the right wheel will turn faster than the left wheel.

During a right turn there is more resistance on the right axle, because the right wheel must turn through a sharper corner than the left. The pinions in the case walk around the right side gear and drive the left axle gear.





RESULTS: - We Study transmission system includes clutches, gear box assembly and differential box. successfully.