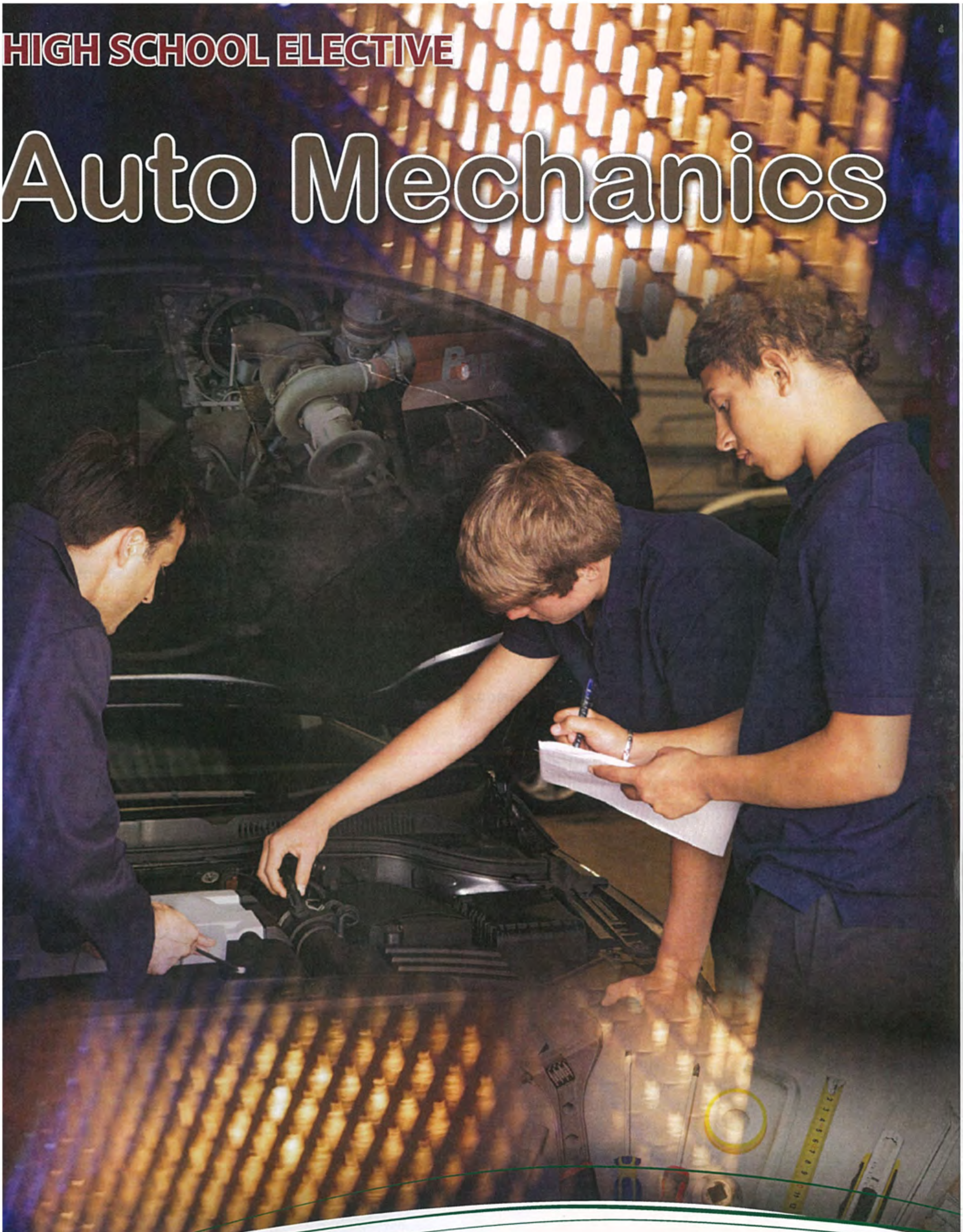
HIGH SCHOOL ELECTIVE

Auto Mechanics



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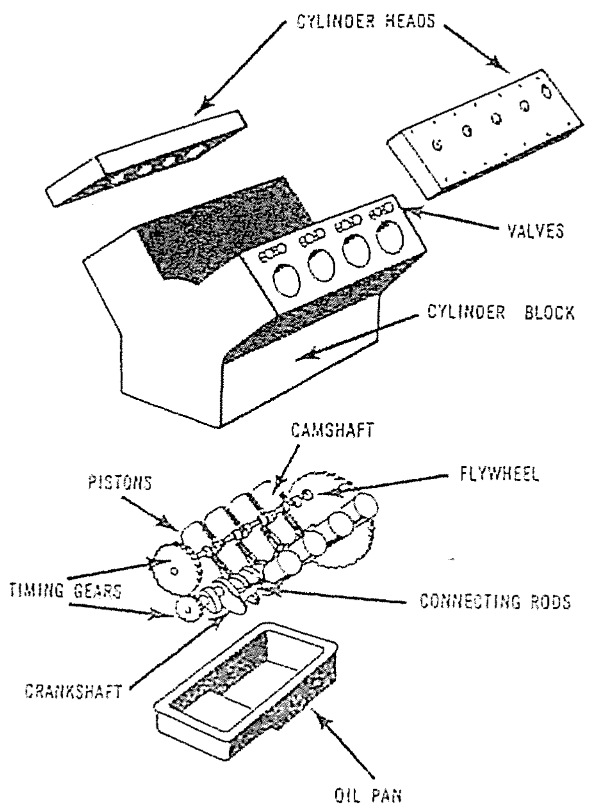
Basic Gasoline Engine



The basic parts of every gasoline engine are:

The cylinder block and the cylinder head or heads.

The pistons, connecting rods, crankshaft, flywheel, camshaft, valves, and oil pan.

A gasoline engine may have one cylinder or, in the case of an automobile engine, a number of cylinders, but the principle of operation is the same for each. A mixture of air and gasoline is compressed in the cylinder, then ignited by a spark.

The burning gases expand, forcing the piston down. As the piston is depressed, it acts through the connecting rod to turn the crankshaft and provide power.

When a gasoline engine has a number of cylinders, each one provides power to turn the crankshaft by the downward thrust of its piston and connecting rod.

Four-Stroke Cycle Engine

In order to produce a single one of these "power strokes," the following must occur:

1. A mixture of gasoline and air must be fed into the cylinder.
2. This mixture must be compressed and ignited.
3. The power stroke must be delivered.
4. The burned gases must be expelled from the cylinder.

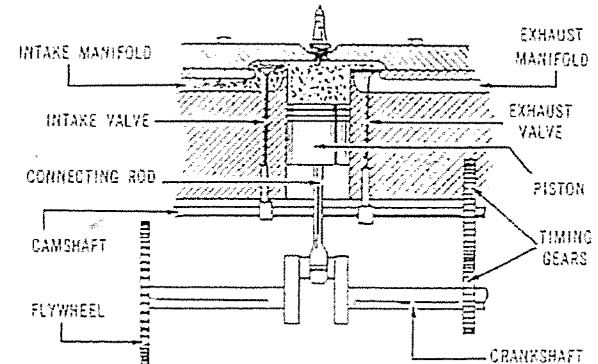
In certain types of gasoline engines, such as those used in some outboards, lawn mowers, and light motorcycles, all these things are accomplished in the cylinder in two strokes.

Automobile engines, however, use four strokes and are therefore known as "Four-Stroke Cycle" engines.

Here is what happens during each of the four strokes of a four-stroke cycle operation.

1. The Intake Stroke

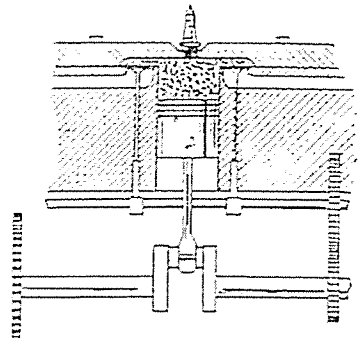
During this stroke the exhaust valve is closed and the intake valve is opened. The gasoline-air mixture is free to pass into the cylinder from the intake manifold. As the piston moves down, its downward motion creates a vacuum and the mixture is drawn into the chamber. At the bottom of the intake stroke the intake valve closes.



INTAKE STROKE

2. The Compression Stroke

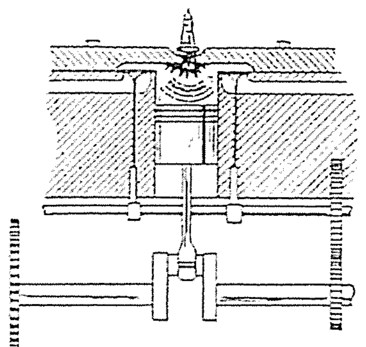
During this stroke both the intake valve and the exhaust valve are closed. The piston moves upward and the gasoline-air mixture is compressed. At the top of the stroke the spark plug "fires." The spark ignites the confined and compressed gases and they begin to burn.



COMPRESSION STROKE

3. The Power Stroke

The heat from the burning fuel causes the gases to expand. The piston is forced down, turning the crankshaft and developing engine power. During the power stroke both valves are closed so that maximum pressure can be developed. At the end of the stroke the exhaust valve opens.

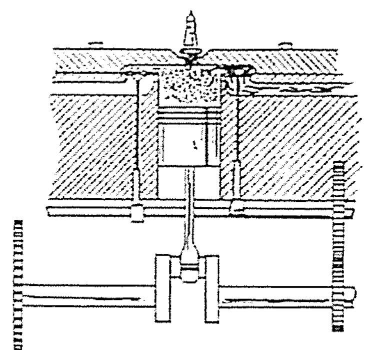


POWER STROKE

4. The Exhaust Stroke

The piston starts upward, forcing the burned-out gases up the cylinder and out through the open exhaust valve. As the piston reaches the top of its stroke the exhaust valve closes, the intake valve opens, and a new cycle begins.

These four strokes—intake, compression, power, and exhaust—form one complete cycle of a four-stroke cycle engine. This complete cycle takes place hundreds of times a minute in each cylinder.

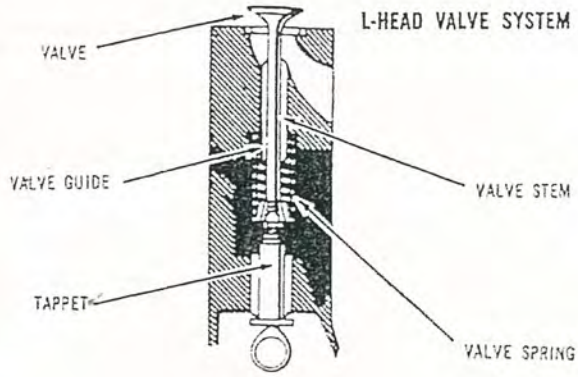


EXHAUST STROKE

Valve Seats and Clearance

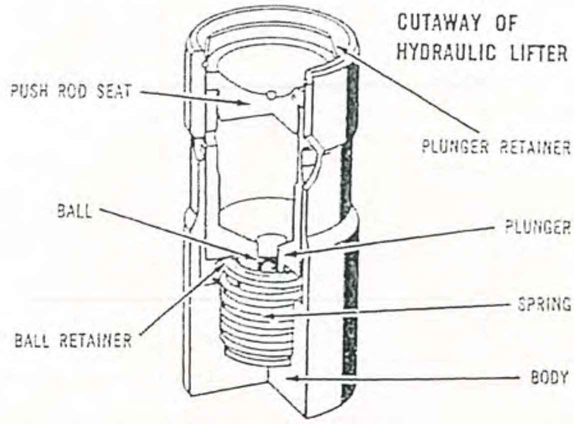
Valve seats are sometimes formed directly in the metal of the engine block or head. In other cases insert-type seats are used. Some manufacturers provide special alloy seat inserts for exhaust valves because these valves are subject to higher temperatures. Others use inserts for both intake and exhaust valves.

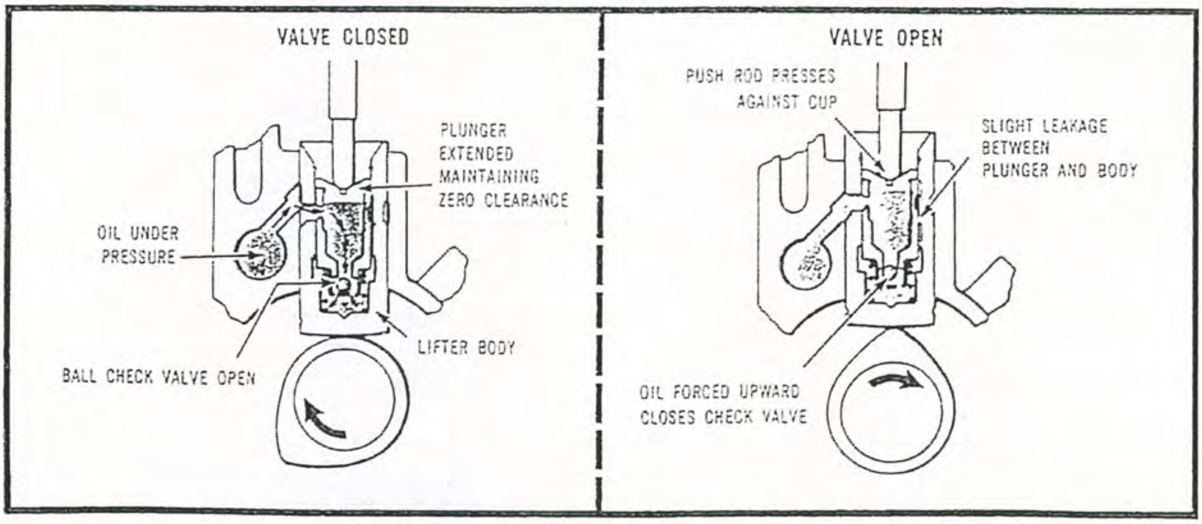
In a valve mechanism with "solid" valve lifters, clearance of a few thousandths of an inch must be provided between the valve stem and lifter, or tappet, in order to allow for heat expansion.



Hydraulic Valve Lifters

In many modern engines hydraulic valve lifters are used. These valve lifters consist of a lifter body, a plunger which fits into it, and two oil chambers which are supplied by the engine lubricating system and connected by a passage or tube, with a ball check valve. The plunger is kept in constant contact with the valve or pushrod (regardless of heat expansion or contraction) by oil pressure and the light coil spring.





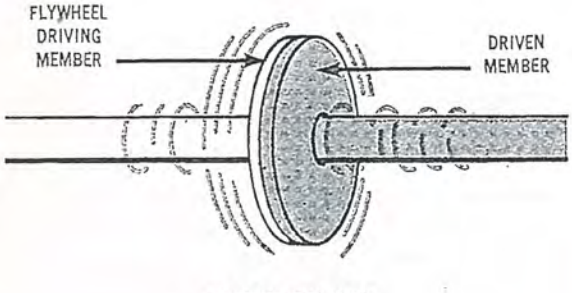
The figure on the left shows the lifter body riding on the base circle of the cam. In this position the plunger spring tends to push the plunger upward against the pushrod to take up any slack or clearance in the valve train. As this is done, the ball check falls off its seat allowing oil to flow through the ball check valve as shown.

Then as the cam rotates the lifter body is pushed up by the cam lobe as shown at the right.

Each of the units of the power transmission system is designed to harness the torque developed by the engine so that it can perform under the different conditions of speed, power, starting, stopping, and reversing which are required in operating the automobile.

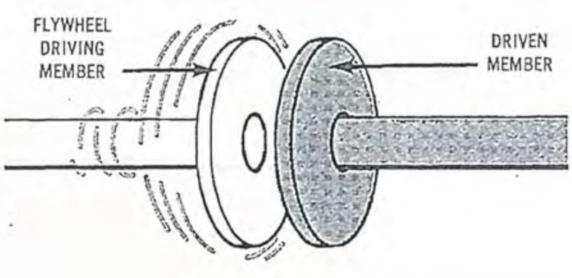
Clutch

The purpose and function of the clutch is to allow the engine to be connected with, or disconnected from, the rest of the system so that the car can be started or stopped or the direction and amount of power can be changed by shifting the gears. A clutch must also be designed to provide a gradual transfer of power from the engine to the transmission so that sudden shocks and jars are eliminated.



CLUTCH ENGAGED

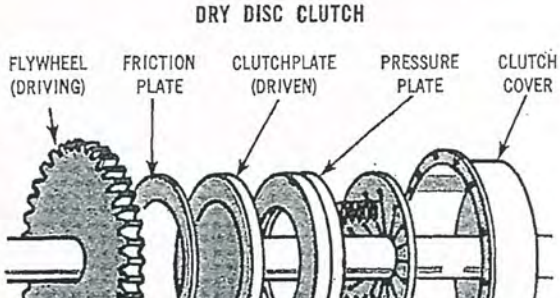
The general principles of clutch construction are quite simple. A plate or "driving member" is attached to the flywheel. Another plate or "driven member" is attached to the clutch shaft and then to the transmission. When the two plates are held firmly together the clutch shaft revolves with the crankshaft. When they are disengaged the flywheel rotates but the clutch shaft does not.



CLUTCH DISENGAGED

In a typical automobile clutch, the main "driving member" is the engine flywheel. The main "driven member" is the clutch plate which turns with, and also slides along, the clutch shaft. Normally, the clutch plate is held firmly against the flywheel by the clutch pressure plate which is equipped with strong springs. When you step on the clutch pedal, however, the pressure plate is pulled back by a series of levers, and the clutch plate slides back along its shaft. This breaks the connection between crankshaft and clutch shaft.

DRY DISC CLUTCH



Most clutches are the "dry disc" type. In a dry disc clutch, the driven clutch plate is faced on both sides with friction producing material—either granular, molded, or woven. The front end of the clutch shaft rests in a pilot bearing in the center of the crankshaft. The rear end carries the main driving gear of the transmission.

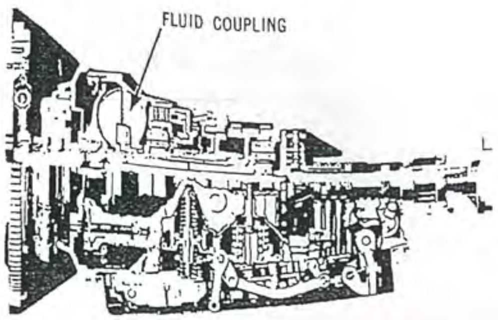
the driven member, forcing it to rotate. At first, the driven member does not rotate nearly as fast as the driving member, but once it has picked up speed, it turns at almost the same rate. The speed of the two members can never be quite equal, but the difference has little effect on the performance of the car.

The fluid coupling is an efficient, smooth method of transmitting power. However, it can only transmit power; it cannot increase torque.

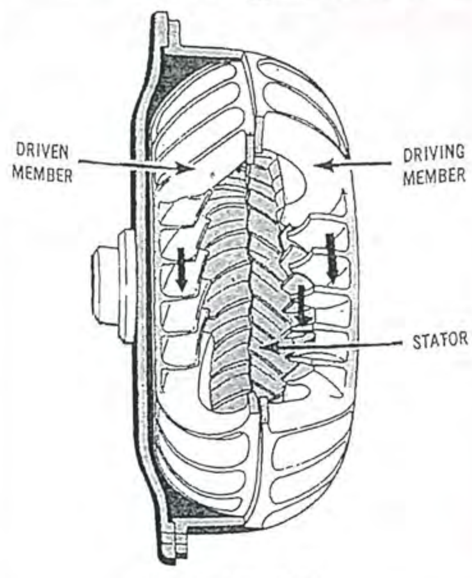
Some fluid couplings were used in the past in connection with, or as an addition to, a conventional clutch assembly. They are, however, most commonly employed in automatic transmissions; for example, the Hydramatic.

A torque converter differs from a fluid coupling in that, in addition to transmitting power, it also provides for changes in torque. It contains special parts—stators, not used in a fluid coupling—which redirect the oil so that it exerts more "push" on the blades, thus increasing the torque.

The action of the torque converter produces changes in torque, just as does a gear assembly. In an automatic transmission using a torque converter, some of the torque changing is done by the converter, and some by the gear section. As a result, the gear assemblies in these transmissions are usually smaller than in those using fluid couplings, when the gears must provide all of the torque conversion.

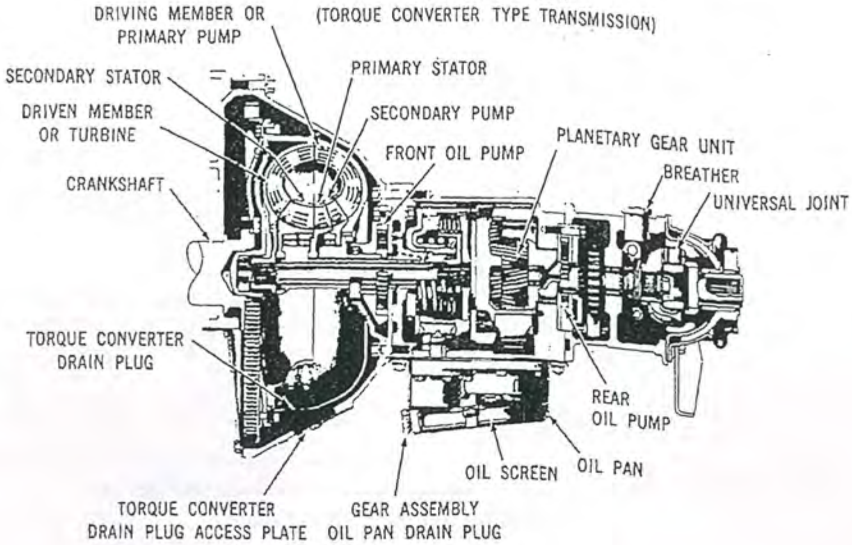


HYDRAMATIC TRANSMISSION
(FLUID COUPLING TYPE TRANSMISSION)



TORQUE CONVERTER

BUICK DYNAFLOW
(TORQUE CONVERTER TYPE TRANSMISSION)

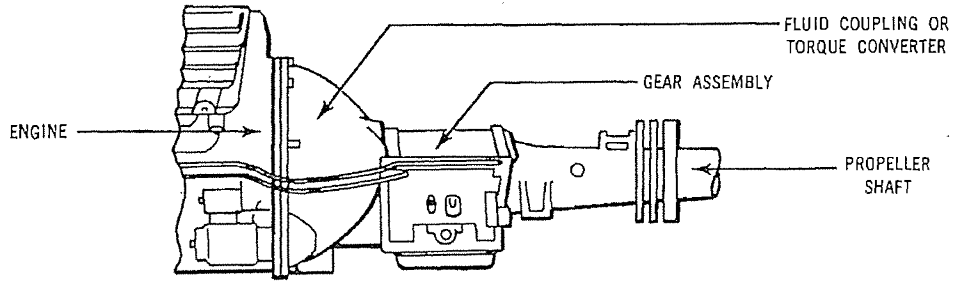


With an automatic transmission, of course, the driver usually merely selects the general operating condition he desires—neutral, forward, or reverse. This may be done by the use of either a lever or push button type selector.

The work usually performed by the clutch pedal and gear shift lever is accomplished automatically by a special, hydraulically-operated system of valves, which are carefully balanced to maintain a precise relationship between the speed of the car and the position of the accelerator.

Automatic transmissions are highly complex and there are many makes in use on today's cars. A detailed discussion of each of them would be out of place in this book. But it will help you to understand the servicing of these transmissions if you understand the basic principles of their operation.

Fluid Couplings and Torque Converters



TYPICAL AUTOMATIC TRANSMISSION

Every type of automatic transmission has two main parts—a forward section containing a fluid coupling or torque converter, and a rear section containing the gear assembly.

The fluid coupling or torque converter takes the place of the conventional clutch. Both the fluid coupling and the torque converter operate on the same scientific principle, the action of a liquid.

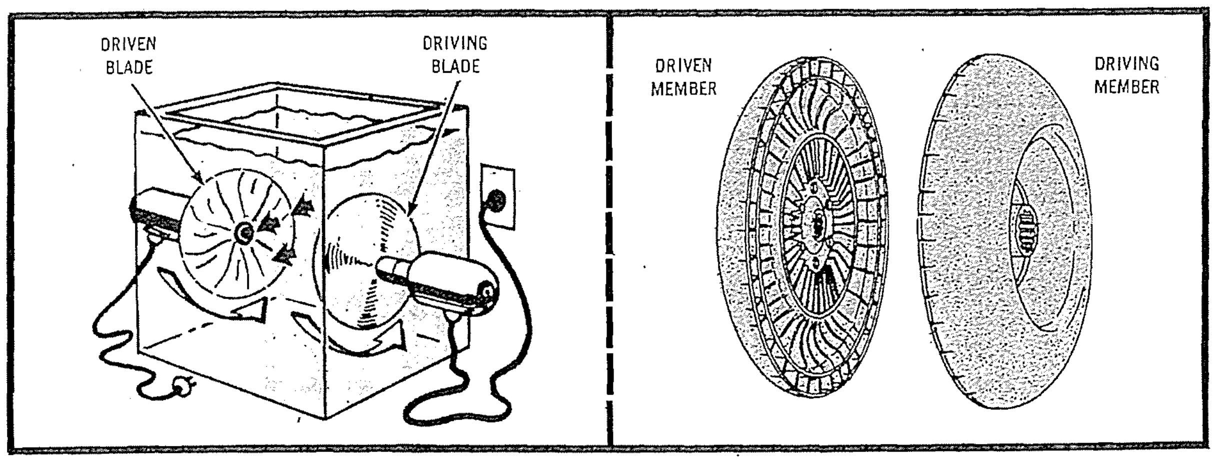
To understand this principle, imagine two propellers placed in a tank of water. If one is turned, the motion created in the tank will turn the other. In the fluid coupling or torque converter, the fluid is oil rather than water, but the principle remains the same.

A fluid coupling unit consists of two sections, each shaped somewhat like half of a hollow doughnut cut lengthwise. One of these is the "driving member," attached to the crankshaft, the other is the driven member. Each contains fins, or vanes, on its inner surface, which provide the "fan" action.

The driving and usually the driven members fit inside a housing that is attached to the crankshaft and revolves with it. This housing is filled entirely with oil.

When the driving member is turned by the crankshaft, its pressure on the oil is transmitted to

FLUID COUPLING



the driven member, forcing it to rotate. At first, the driven member does not rotate nearly as fast as the driving member, but once it has picked up speed, it turns at almost the same rate. The speed of the two members can never be quite equal, but the difference has little effect on the performance of the car.

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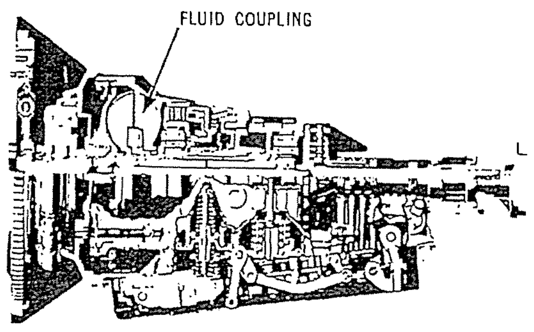
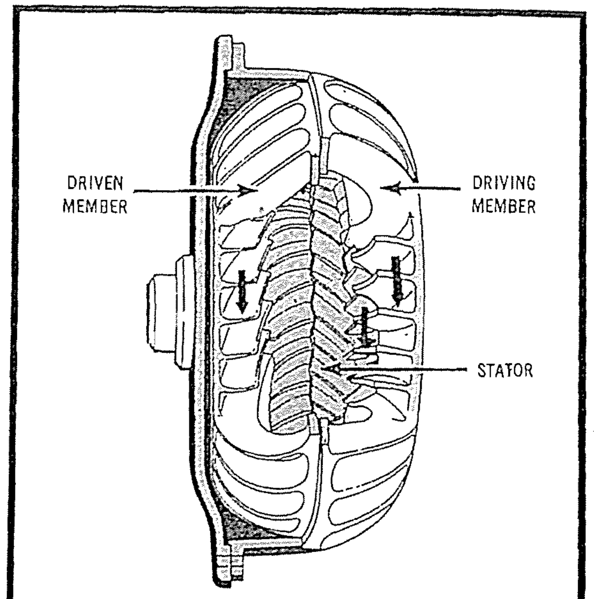


HYDRAMATIC TRANSMISSION
(FLUID COUPLING TYPE TRANSMISSION)



TORQUE CONVERTER

BUICK DYNAFLOW
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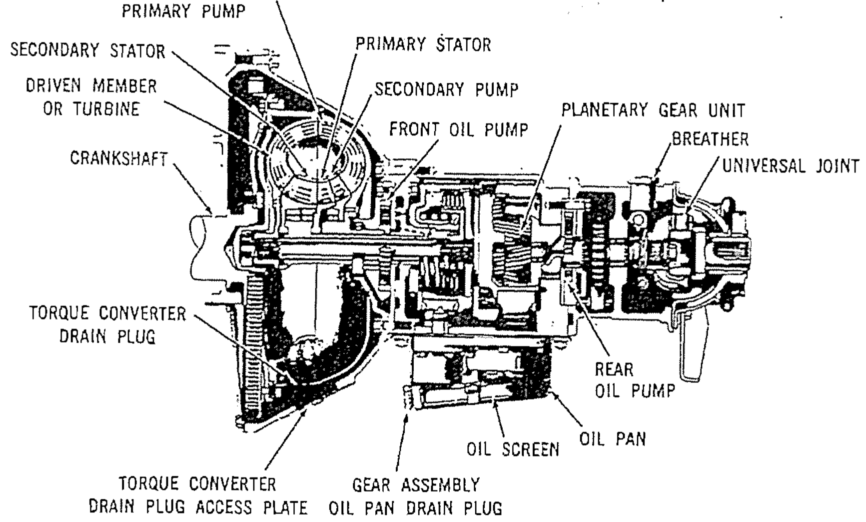
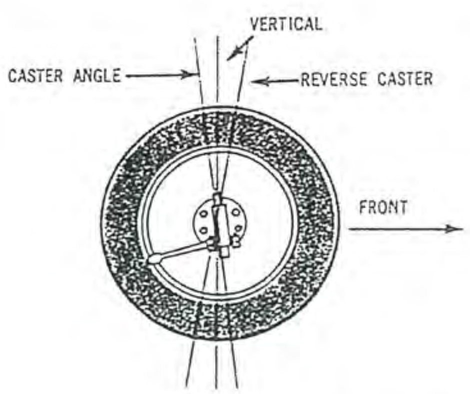




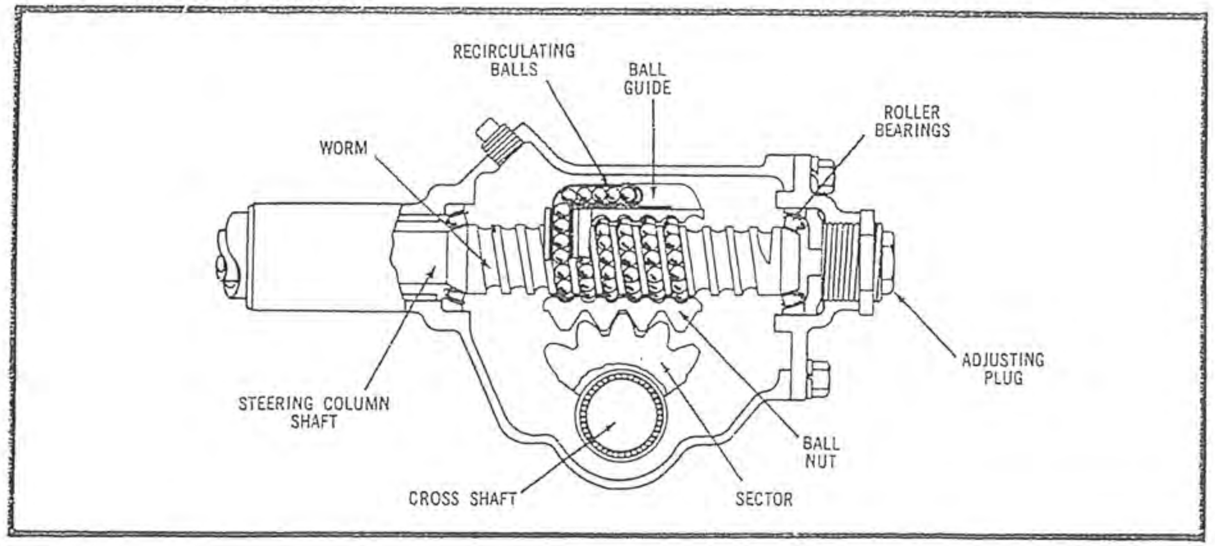
Caster is a slight tilting of the kingpin so that its lower end is slightly before its upper end. The purpose of caster is to provide a trailing action for the wheels. In effect, they "follow" the kingpin, as do the wheels of furniture casters, and steering is made easier. Sometimes, depending on front end design, caster is reversed. This is called "reverse caster."

Steering Mechanism

The steering wheel, at the driver's end of the steering column, turns a long shaft which runs to the steering gear unit. At the end of this shaft is a worm gear or similar type of gear which moves a lever, balls, or pins, that are set at right angles to the column.

Through this mechanism, a system of arms and levers moves the main steering arm on its pivot. This action pulls on one tie rod and pushes on the other, forcing the steering knuckles to turn the wheels in the desired direction.

Steering mechanisms are usually adjusted to give a certain amount of "play"—so that small bumps, pebbles, and other obstacles on the road that cause momentary changes in direction do not have to be steered around by the driver. Play in the steering mechanism also permits small and sometimes unintentional movements of the steering wheel without needlessly turning the wheels themselves.



Power Steering

In power steering units, the actual turning of front wheels is accomplished by much the same type of mechanisms shown above. However, with power steering, a hydraulic system is used to *help* move the steering assembly after the driver moves the wheel.

Power steering units are somewhat complicated but, in general, all are operated by a valve that moves when the driver turns the steering wheel. This valve allows oil pressure to be applied to a piston. Movement of the piston helps move the main steering arm. Oil pressure for this job is supplied by a pump that is run by the engine.

Two general types of power steering are in use today. In one, the driver must apply about three pounds of pressure to the wheel before the valve opens. In other words, he gets no hydraulic "assist" until he has done some of the work on his own. Maximum effort required is limited to about six pounds at the steering wheel as compared to about 50 pounds maximum with the ordinary manual steering system. In the second type of power steering, the valve opens as soon as the steering wheel is moved, giving an immediate assist to the steering mechanism. In both types of power steering when the engine is not operating and the power unit is not operating, the steering is entirely manual and requires about the same effort as a manual steering gear.