3 курс группа 3ТМ

2 семестр темы практических занятий

по дисциплине ОГСЭ.03 Иностранный язык

Практические занятия № 1-2

Тема: «Chassis. Transmission» (Шасси.Трансмиссия)

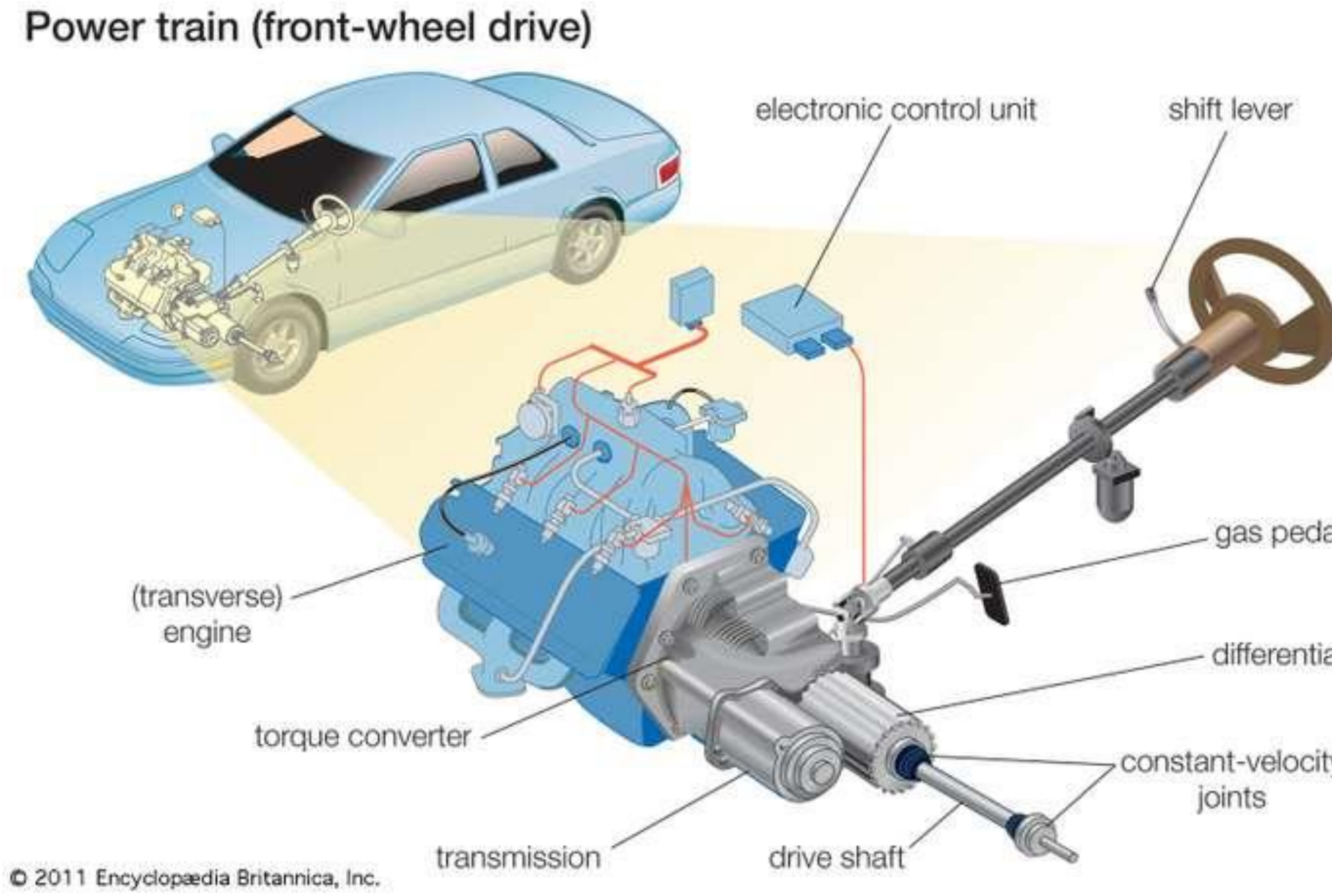
Chassis

In most passenger cars through the middle of the 20th century, a pressed-steel frame—the vehicle's chassis—formed a skeleton on which the engine, wheels, axle assemblies, transmission, steering mechanism, brakes, and suspension members were mounted. The body was flexibly bolted to the chassis during a manufacturing process typically referred to as body-on-frame construction. This process is used today for heavy-duty vehicles, such as trucks, which benefit from having a strong central frame, subjected to the forces involved in such activities as carrying freight, including the absorption of the movements of the engine and axle that is allowed by the combination of body and frame.

In modern passenger-car designs, the chassis frame and the body are combined into a single structural element. In this arrangement, called unit-body (or unibody) construction, the steel body shell is reinforced with braces that make it rigid enough to resist the forces that are applied to it. Separate frames or partial "stub" frames have been used for some cars to achieve better noise-isolation characteristics. The heavier-gauge steel present in modern component designs also tends to absorb energy during impacts and limit intrusion in accidents.

Transmission

The gasoline engine must be disconnected from the driving wheels when it is started and when idling. This characteristic necessitates some type of unloading and engaging device to permit gradual application of load to the engine after it has been started. The torque, or turning effort, that the engine is capable of producing is low at low crankshaft speeds, increasing to a maximum at some fairly high speed representing the maximum, or rated, horsepower.



The main elements of the power train of a front-wheel-drive automobile are the transversely mounted engine and the transmission, which transfers the torque, or turning energy, of the engine to the drive wheels through a short drive shaft.*Encyclopædia Britannica, Inc.*

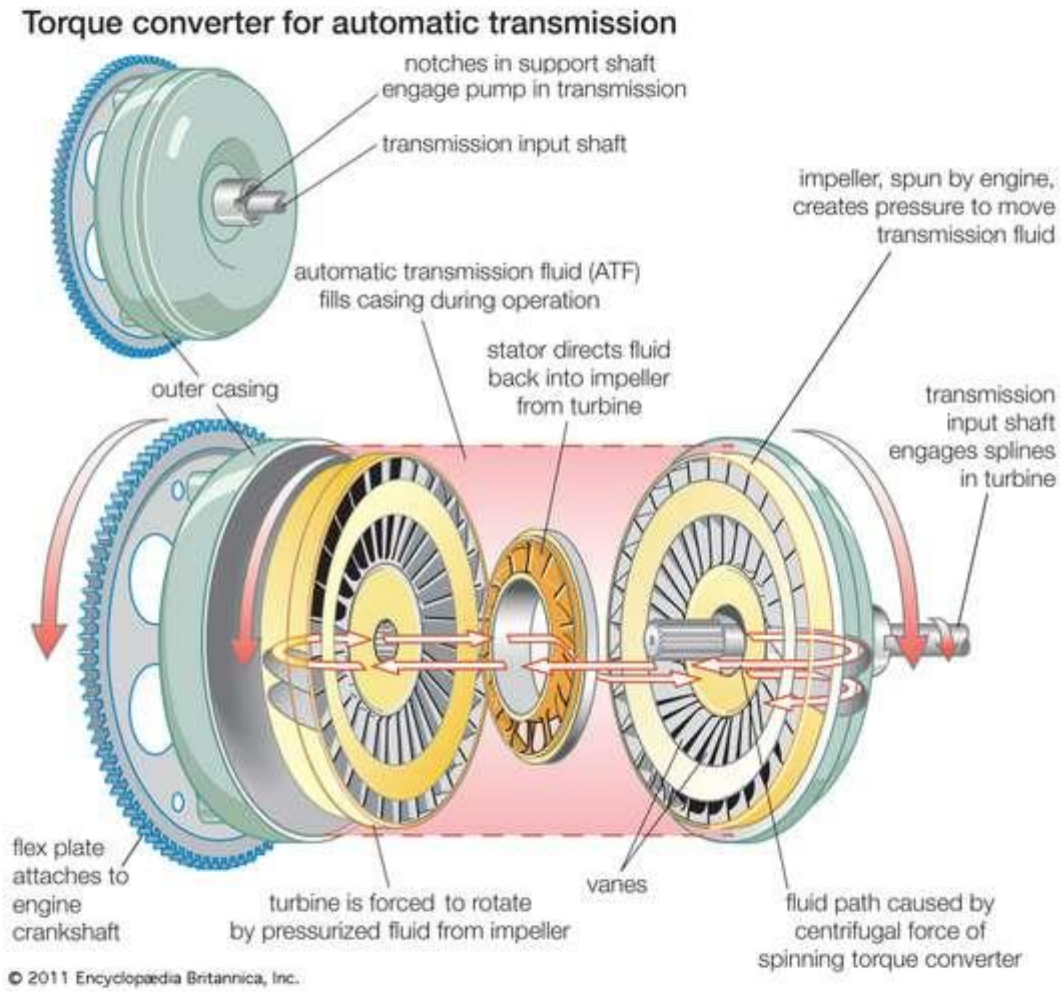
The efficiency of an automobile engine is highest when the load on the engine is high and the throttle is nearly wide open. At moderate speeds on level pavement, the power required to propel an automobile is only a fraction of this. Under normal driving conditions at constant moderate speed, the engine may operate at an uneconomically light load unless some means is provided to change its speed and power output.

The transmission is such a speed-changing device. Installed in the power train between the engine and the driving wheels, it permits the engine to operate at a higher speed when its full power is needed and to slow down to a more economical speed when less power is needed. Under some conditions, as in starting a stationary vehicle or in ascending steep grades, the torque of the engine is insufficient, and amplification is needed. Most devices employed to change the ratio of the speed of the engine to the speed of the driving wheels multiply the engine torque by the same factor by which the engine speed is increased.

The simplest automobile transmission is the sliding-spur gear type with three or more forward speeds and reverse. The desired gear ratio is selected by manipulating a shift lever that slides a spur gear into the proper position to engage the various gears. A clutch is required to engage and disengage gears during the selection process. The necessity of learning to operate a clutch is eliminated by an automatic transmission. Most automatic transmissions employ a hydraulic torque converter, a device for transmitting and amplifying the torque produced by the engine. Each type provides for manual selection of reverse and low ranges that either prevent automatic upshifts or employ lower gear ratios than are used in normal driving. Grade-retard provisions are also sometimes included to supply dynamic engine braking on hills. Automatic transmissions not only require little skill to operate but also make possible better performance than is obtainable with designs that require clutch actuation.

In hydraulic transmissions, shifting is done by a speed-sensitive governing device that changes the position of valves that control the flow of hydraulic fluid. The vehicle speeds at which shifts occur depend on the position of the accelerator pedal, and the driver can delay upshifts until higher speed is attained by depressing the accelerator pedal further. Control is by hydraulically engaged bands and multiple-disk clutches running in oil, either by the driver's operation of the selector lever or by speed- and load-sensitive electronic control in the most recent designs. Compound planetary gear trains with multiple sun gears and planet pinions have been designed to provide a low forward speed, intermediate speeds, a reverse, and a means of locking into direct drive. This unit is used with various modifications in almost all hydraulic torque-converter transmissions. All transmission control units are interconnected with vehicle emission control systems that adjust engine timing and air-to-fuel ratios to reduce exhaust emissions.

Oil in the housing is accelerated outward by rotating vanes in the pump impeller and, reacting against vanes in the turbine impeller, forces them to rotate, as shown schematically in the figure. The oil then passes into the stator vanes, which redirect it to the pump. The stator serves as a reaction member providing more torque to turn the turbine than was originally applied to the pump impeller by the engine. Thus, it acts to multiply engine torque by a factor of up to 2 $^{1}/_{2}$ to 1.



Torque converter.*Encyclopædia Britannica, Inc.*

Blades in all three elements are specially contoured for their specific function and to achieve particular multiplication characteristics. Through a clutch linkage, the stator is allowed gradually to accelerate until it reaches the speed of the pump impeller. During this period torque multiplication gradually drops to approach 1 to 1.

The hydraulic elements are combined with two or more planetary gear sets, which provide further torque multiplication between the turbine and the output shaft.

Continuously (or infinitely) variable transmissions provide a very efficient means of transferring engine power and, at the same time, automatically changing the effective input-to-output ratio to optimize economy by keeping the engine running within its best power range. Most designs employ two variable-diameter pulleys connected by either a steel or high-strength rubber V-belt. The pulleys are split so that effective diameters may be changed by an electrohydraulic actuator to change the transmission ratio. This permits the electronic control unit to select the optimum ratio possible for maximum fuel economy and minimum emissions at all engine speeds and loads. Originally these units were limited to small cars, but belt improvements have made them suitable for larger cars.

Практические занятия № 3-4.

Тема: «Frame» (Рама)

Vehicle frame

A vehicle's bare ladder frame

Proton Prevé with unibody construction

A **vehicle frame**, also known as its *chassis*, is the main supporting structure of a motor vehicle, to which all other components are attached, comparable to the skeleton of an organism.

Until the 1930s virtually every car had a structural frame, separate from its body. This construction design is known as *body-on-frame*. Over time, nearly all passenger cars have migrated to unibody construction, meaning their chassis and bodywork have been integrated into one another.

Nearly all trucks, buses, and most pickups continue to use a separate frame as their chassis.

Functions

The main functions of a frame in motor vehicles are:

1. To support the vehicle's mechanical components and body
2. To deal with static and dynamic loads, without undue deflection or distortion.

These include:

- Weight of the body, passengers, and cargo loads.
- Vertical and torsional twisting transmitted by going over uneven surfaces.
- Transverse lateral forces caused by road conditions, side wind, and steering the vehicle.
- Torque from the engine and transmission.
- Longitudinal tensile forces from starting and acceleration, as well as compression from braking.
- Sudden impacts from collisions.

Types of frame according to the construction:

- Ladder type frame
- X-Type frame
- Off set frame
- Off set with cross member frame
- Perimeter Frame

Frame rails

Pickup truck frame. Notice hat-shaped crossmember in the background, c-shape rails and cross member in center, and a slight arc over the axle.

Typically the material used to construct vehicle chassis and frames is carbon steel; or aluminum alloys to achieve a more light-weight construction. In the case of a separate chassis, the frame is made up of structural elements called the *rails* or *beams*. These are ordinarily made of steel *channel* sections, made by folding, rolling or pressing steel plate.

There are three main designs for these. If the material is folded twice, an open-ended cross-section, either C-shaped or hat-shaped (U-shaped) results. "Boxed" frames contain chassis rails that are closed, either by somehow welding them up, or by using premanufactured metal tubing.

C-shape

By far the most common, the C-channel rail has been used on nearly every type of vehicle at one time or another. It is made by taking a flat piece of steel (usually ranging in thickness from 1/8" to 3/16", but up to 1/2" or more in some heavy-duty trucks[2][3]) and rolling both sides over to form a C-shaped beam running the length of the vehicle.

Hat

Hat frames resemble a "U" and may be either right-side-up or inverted with the open area facing down. Not commonly used due to weakness and a propensity to rust, however they can be found on 1936–1954 Chevrolet cars and some Studebakers.

High performance custom frame, using boxed rails and tube sections

Abandoned for a while, the hat frame gained popularity again when companies started welding it to the bottom of unibody cars, in effect creating a boxed frame.

Boxed

Originally, boxed frames were made by welding two matching C-rails together to form a rectangular tube. Modern techniques, however, use a process similar to making C-rails in that a piece of steel is bent into four sides and then welded where both ends meet.

In the 1960s, the boxed frames of conventional American cars were spot-welded here and there down the seam; when turned into NASCAR "stock car" racers, the box was continuously welded from end to end for extra strength.

Design feature

Pickup truck chassis holding the vehicle's engine, drivetrain, suspension, and wheels

While appearing at first glance as a simple form made of metal, frames encounter great amounts of stress and are built accordingly. The first issue addressed is **beam height**, or the height of the vertical side of a frame. The taller the frame, the better it is able to resist vertical flex when force is applied to the top of the frame. This is the reason semi-trucks have taller frame rails than other vehicles instead of just being thicker.

As looks, ride quality, and handling became more important to consumers, new shapes were incorporated into frames. The most visible of these are arches and kick-ups. Instead of running straight over both axles, arched frames sit lower—roughly level with their axles—and curve up over the axles and then back down on the other side for bumper placement. Kick-ups do the same thing, but don't curve down on the other side, and are more common on front ends.

Another feature seen are tapered rails that narrow vertically and/or horizontally in front of a vehicle's cabin. This is done mainly on trucks to save weight and slightly increase room for the engine since the front of the vehicle does not bear as much of a load as the back. Design developments include frames that use more than one shape in the same frame rail. For example, some pickup trucks have a boxed frame in front of the cab, shorter, narrower rails underneath the cab, and regular C-rails under the bed.

On *perimeter* frames, the areas where the rails connect from front to center and center to rear are weak compared to regular frames, so that section is boxed in, creating what is known as *torque boxes*.

Практические занятия № 5-6.

Тема: «Clutch» (Сцепление)

A **clutch** is a mechanism for transmitting rotation, which can be engaged and disengaged. Clutches are useful in devices that have two rotating shafts. In these devices, one shaft is typically driven by a motor or pulley, and the other shaft drives another device. In a drill, for instance, one shaft is driven by a motor, and the other drives a drill chuck. The clutch connects the two shafts so that they can either be locked together and spin at the same speed (engaged), or be decoupled and spin at different speeds (disengaged).

Contents

Multiple plate friction clutch

This type of clutch has several driving members interleaved with several driven members. It is used in motorcycles and in some diesel locomotives with mechanical transmission. It is also used in some electronically controlled all-wheel drive systems. It is the most common type of clutch on modern types of vehicles.

Vehicular

There are different designs of vehicle clutch, but most are based on one or more friction discs, pressed tightly together or against a flywheel using springs. The friction material varies in composition depending on whether the clutch is dry or wet, and on other considerations. Friction discs once contained asbestos, but this has been largely eliminated. Clutches found in heavy duty applications such as trucks and competition cars use ceramic clutches that have a greatly increased friction coefficient. However, these have a "grabby" action and are unsuitable for road cars. The spring pressure is released when the clutch pedal is depressed thus either pushing or pulling the diaphragm of the pressure plate, depending on type, and the friction plate is released and allowed to rotate freely.

When engaging the clutch, the engine speed may need to be increased from idle, using the manual throttle, so that the engine does not stall (although in some cars, especially diesels, there is enough torque at idling speed that the car can move; this requires fine control of the clutch). However, raising the engine speed too high while engaging the clutch will cause excessive clutch plate wear. Engaging the clutch abruptly when the engine is turning at high speed causes a harsh, jerky start. This kind of start is necessary and desirable in drag racing and other competitions, where speed is more important than comfort.

Wet and dry

A 'wet clutch' is immersed in a cooling lubricating fluid, which also keeps the surfaces clean and gives smoother performance and longer life. Wet clutches, however, tend to lose some energy to the liquid. A 'dry clutch', as the name implies, is not bathed in fluid. Since the surfaces of a wet clutch can be slippery (as with a motorcycle clutch bathed in transmission oil), stacking multiple clutch disks can compensate for the lower coefficient of friction and so eliminate slippage when fully engaged.

Automobiles

In a car the clutch is operated by the left-most pedal using a hydraulic or cable connection from the pedal to the clutch mechanism. Even though the clutch may physically be located very close to the pedal, such remote means of actuation (or a multi-jointed linkage) are necessary to eliminate the effect of slight engine movement, engine mountings being flexible by design. With a rigid mechanical linkage, smooth engagement would be near-impossible, because engine movement inevitably occurs as the drive is "taken up." No pressure on the pedal means that the clutch plates are engaged (driving), while pressing the pedal disengages the clutch plates, allowing the driver to shift gears or coast.

A manual transmission contains cogs for selecting gears. These cogs have matching teeth, called dog teeth, which means that the rotation speeds of the two parts have a synchronizer, a device that uses frictional contact to bring the two parts to the same speed, and a locking mechanism called a blocker ring to prevent engagement of the teeth (full movement of the shift lever into gear) until the speeds are synchronized.

Clutch stages

A Stage 1 clutch is designed to match an automobile's stock clutch in performance and driveability. These are intended for stock vehicles with little or no performance upgrades or increased torque.

Stage 2 and 2+ clutches provide greater clamping and torque capability with mildly decreased driveability respectively. These are intended for automobiles with mild to moderate engine tuning or performance upgrades resulting in increased horse power and torque beyond that of the stock engine.

Stage 3 and 3+ clutches are designed to provide higher levels of clamping and torque handling. These are typically intended only for racing purposes where extreme heat conditions are generated. Note that some Stage 3 and 3+ clutches require significant warming before performing optimally.

Non-powertrain in automobiles

There are other clutches found in a car. For example, a belt-driven engine cooling fan may have a clutch that is heat-activated. The driving and driven elements are separated by a silicone-based fluid and a valve controlled by a bimetallic spring. When the temperature is low, the spring winds and closes the valve, which allows the fan to spin at about 20% to 30% of the shaft speed. As the temperature of the spring rises, it unwinds and opens the valve, allowing fluid past the valve which allows the fan to spin at about 60% to 90% of shaft speed depending on whether it's a regular or heavy-duty clutch. There are also electronically engaged clutches (such as for an air conditioning compressor) that use magnetic force to lock the drive and driven shafts together.

Практические занятия № 7-8.

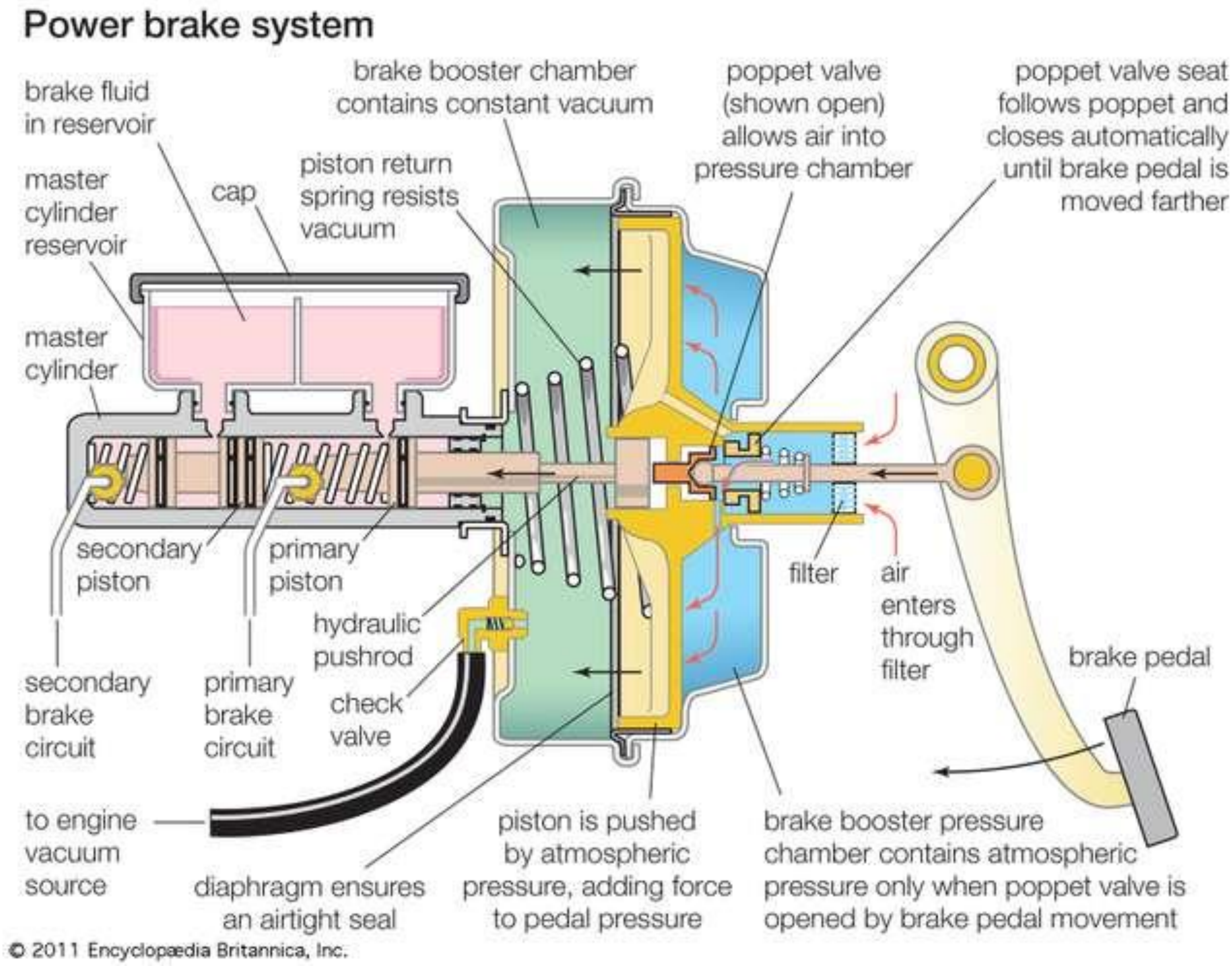
Тема: «Brakes» (Тормоза)

Brakes

Originally, most systems for stopping vehicles were mechanically actuated drum brakes with internally expanding shoes; i.e., foot pressure exerted on the brake pedal was carried directly to semicircular brake shoes by a system of flexible cables. Mechanical brakes, however, were difficult to keep adjusted so that equal braking force was applied at each wheel; and, as vehicle weights and speeds increased, more and more effort on the brake pedal was demanded of the driver.

Mechanical brakes were replaced by hydraulic systems, in which the brake pedal is connected to pistons in master cylinders and thence by steel tubing with flexible sections to individual cylinders at the wheels. Front and rear hydraulic circuits are separated. The wheel cylinders are located between the movable ends of the brake shoes, and each is fitted with two pistons that are forced outward toward the ends of the cylinderby the pressure of the fluid between them. As these pistons move outward, they push the brake shoes against the inner surface of the brake drum attached to the wheel. The larger diameter of the piston in the master cylinder provides a hydraulic force multiplication at the wheel cylinder that reduces the effort required of the driver.

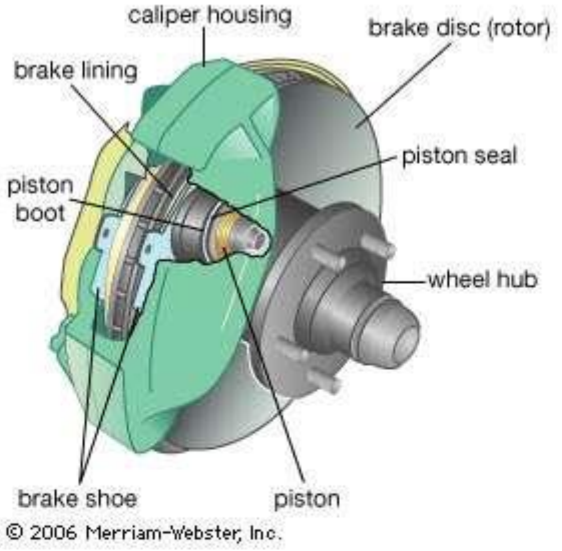
Further increases in vehicle weights and speeds made even hydraulic brakes difficult for drivers to operate effectively, and automobiles consequently were equipped with power brake systems. These are virtually the same as the hydraulic system except that the piston of the master cylinder is multiplied by power assists of several types instead of by foot pressure on the pedal.



Vacuum-assisted power brake for an automobile. A constant vacuum is maintained in the brake booster by the engine. When the brake pedal is depressed, a poppet valve opens, and air rushes into a pressure chamber on the driver's side of the booster. The pressure exerted by this air against the vacuum pushes a piston, thus assisting the pressure exerted by the driver on the pedal. The piston in turn exerts pressure on the master cylinder, from which brake fluid is forced to act on the brakes.*Encyclopædia Britannica, Inc.*

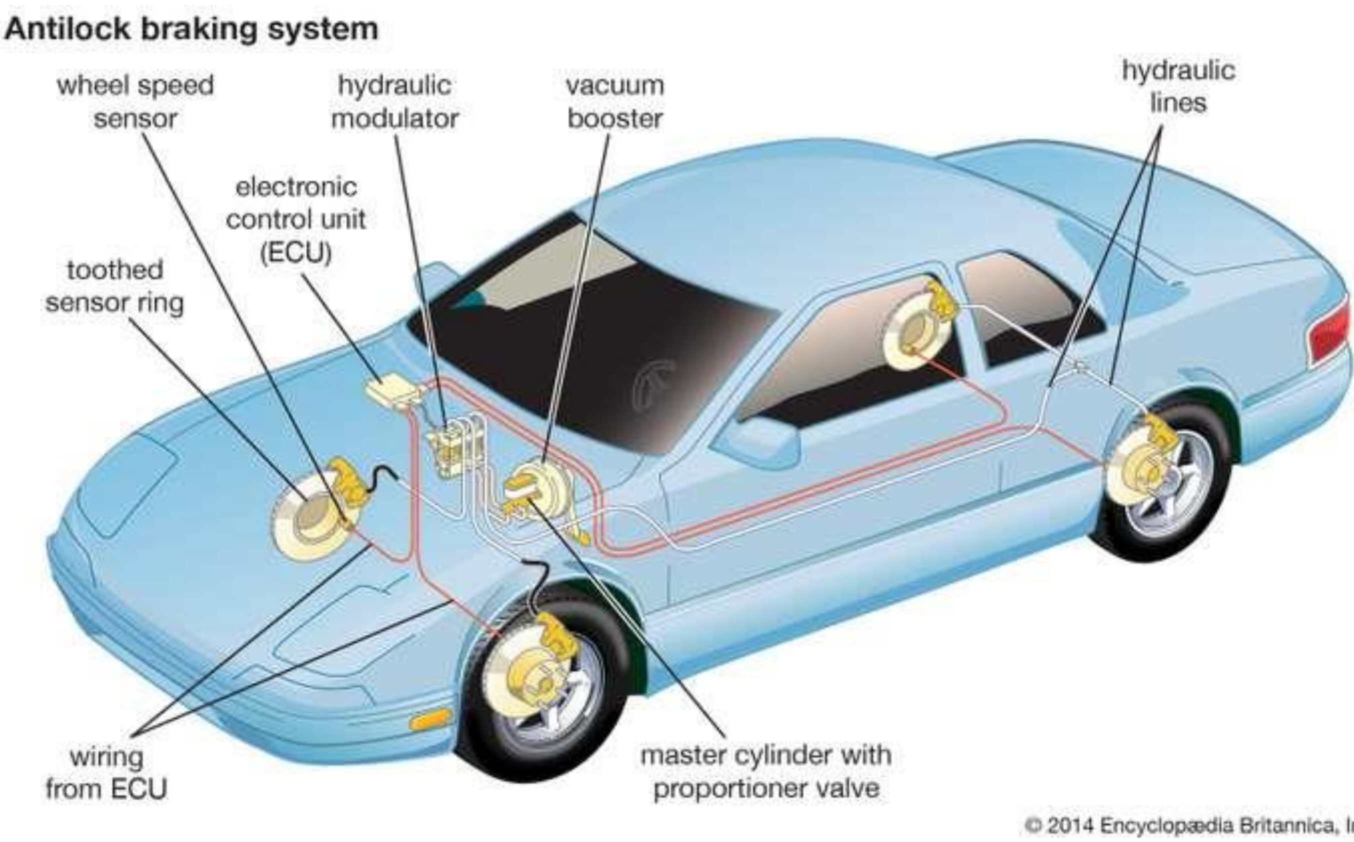
Overheating of the brake drums and shoes causes the brakes to fade and lose their effectiveness when held in engagement for a considerable length of time. This problem has been attacked by the use of aluminum cooling fins bonded to the outside of the brake drums to increase the rate of heat transfer to the air. Vents in the wheels are provided to increase the air circulation for cooling.

Disc brakes, originally developed for aircraft, are ubiquitous, in spite of their higher cost, because of their fade resistance. Although there are some four-wheel systems, usually discs are mounted on the front wheels, and conventional drum units are retained at the rear. They have been standard on most European automobiles since the 1950s and most American models since the mid-1970s. Each wheel has a hub-mounted disc and a brake unit or caliper rigidly attached to the suspension. The caliper employs two friction-pad assemblies, one on each side of the disc. When the brake is applied, hydraulic pressure forces the friction pads against the disc. This arrangement is self-adjusting, and the ability of the discs to dissipate heat rapidly in the open airstream makes them practically immune to fading.



A disc brake assembly. Wheel rotation is slowed by friction when the hydraulic pistons squeeze the caliper, pressing the brake pads (shoe and lining assemblies) against the spinning disc (rotor), which is bolted to the wheel hub.© *Merriam-Webster Inc.*

Antilock braking systems (ABS) became available in the late 1980s and since then have become standard on a growing number of passenger cars. ABS installations consist of wheel-mounted sensors that input wheel rotation speed into a microprocessor. When wheel rotation increases because of tire slippage or loss of traction, the control unit signals a hydraulic or electric modulator to regulate brake line pressure to forestall impending wheel lockup. The brake continues to function as the system cyclically releases and applies pressure, similar to but much faster than a driver rapidly pumping the brake pedal on a non-ABS-equipped automobile. The wheels continue to roll, retaining the driver's ability to steer the vehicle and stop in a shorter distance.



antilock braking system*Encyclopædia Britannica, Inc.*

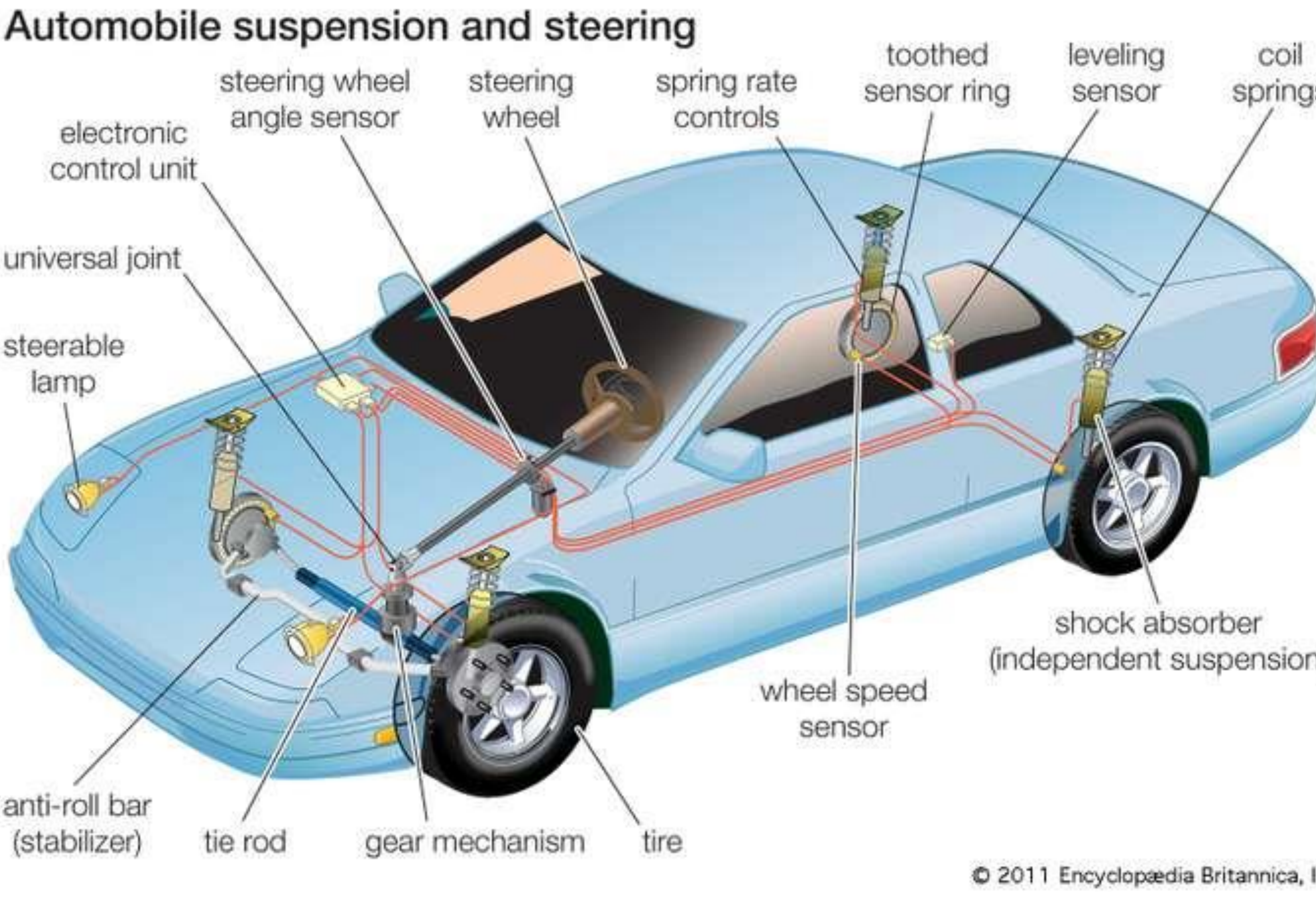
Parking brakes usually are of the mechanical type, applying force only to the rear brake shoes by means of a flexible cable connected to a hand lever or pedal. On cars with automatic transmissions, an additional lock is usually provided in the form of a pawl that can be engaged, by placing the shift lever in the "park" position, to prevent the drive shaft and rear wheels from turning. The service brake pedal must be applied to permit shifting the transmission out of the park position. This eliminates the possibility of undesired vehicle motion that could be caused by accidental movement of the transmission control.

Практические занятия № 9-10.

Тема: «Steering System» (Рулевое управление)

Steering

Automobiles are steered by a system of gears and linkages that transmit the motion of the steering wheel to the pivoted front wheel hubs. The gear mechanism, located at the lower end of the shaft carrying the steering wheel, is usually a worm-and-nut or cam-and-lever combination that rotates a shaft with an attached crank arm through a small angle as the steering wheel is turned. Tie rods attached to the arm convey its motion to the wheels. In cornering, the inner wheel must turn through a slightly greater angle than the outer wheel, because the inner wheel negotiates a sharper turn. The geometry of the linkage is designed to provide for this.



The component parts of an automobile's suspension and steering systems.*Encyclopædia Britannica, Inc.*

When the front wheels are independently suspended, the steering must be designed so that the wheels are not turned as the tie rods lengthen and shorten as a result of spring action. The point of linkage attachment to the steering gear must be placed so that it can move vertically with respect to the wheel mountings without turning the wheels.

As the engine and passenger compartment in automobiles beginning in the 1930s in Europe and the United States were moved forward to improve riding comfort and road-handling characteristics, the distribution of weight between the front and rear wheels was shifted toward the front. The weight carried on the front wheels increased to more than half of the total vehicle weight, and consequently the effort necessary to turn the wheels in steering increased. Larger, heavier cars with wider tires and lower tire pressure also contributed to drag between tires and road that had to be overcome in steering, particularly in parking. Considerable reduction in the work of steering resulted from increasing the efficiency of the steering gears and introducing better bearings in the front wheel linkage. Additional ease of turning the steering wheel was accomplished by increasing the overall steering gear ratio (the number of degrees of steering-wheel turn required to turn the front wheels one degree). However, large steering gear ratios made high-speed maneuverability more difficult, because the steering wheel had to be turned through greater angles. Moreover, steering mechanisms of higher efficiency were also more reversible; that is, road shocks were transmitted more completely from the wheels and had to be overcome to a greater extent by the driver. This caused a dangerous situation on rough roads or when a front tire blew out, because the wheel might be jerked from the driver's hands.

Power steering gear was developed to solve the steadily increasing steering problems. Power steering was first applied to heavy trucks and military vehicles early in the 1930s, and hundreds of patents were granted for devices to help the driver turn the steering wheel. Most of the proposed devices were hydraulic; some were electrical and some mechanical. In hydraulic systems, a pump driven by the engine maintains the fluid under pressure. A valve with a sensing device allows the fluid to enter and leave the power cylinder as necessary. Speed-sensitive systems are available to provide larger ratios for reduced effort at low speeds and lower ratios for steering at high speeds. Four-wheel steering systems in which the rear wheels turn in the opposite direction of the front wheels have had limited commercial use.

Suspension

The riding comfort and handling qualities of an automobile are greatly affected by the suspension system, in which the suspended portion of the vehicle is attached to the wheels by elastic members in order to cushion the impact of road irregularities. The specific nature of attaching linkages and spring elements varies widely among automobile models. The best rides are made possible by independent suspension systems, which permit the wheels to move independently of each other. In these systems the unsprung weight of the vehicle is decreased, softer springs are permissible, and front-wheel vibration problems are minimized. Spring elements used for automobile suspension members, in increasing order of their ability to store elastic energy per unit of weight, are leaf springs, coil springs, torsion bars, rubber-in-shear devices, and air springs.

The leaf spring, although comparatively inelastic, has the important advantage of accurately positioning the wheel with respect to the other chassis components, both laterally and fore and aft, without the aid of auxiliary linkages.

An important factor in spring selection is the relationship between load and deflection known as the spring rate, defined as the load in pounds divided by the deflection of the spring in inches. A soft spring has a low rate and deflects a greater distance under a given load. A coil or a leaf spring retains a substantially constant rate within its operating range of load and will deflect 10 times as much if a force 10 times as great is applied to it. The torsion bar, a long spring-steel element with one end held rigidly to the frame and the other twisted by a crank connected to the axle, can be designed to provide an increasing spring rate.

A soft-spring suspension provides a comfortable ride on a relatively smooth road, but the occupants move up and down excessively on a rough road. The springs must be stiff enough to prevent a large deflection at any time because of the difficulty in providing enough clearance between the sprung portion of the vehicle and the unsprung portion below the springs. Lower roof heights make it increasingly difficult to provide the clearance needed for soft springs. Road-handling characteristics also suffer because of what is known as sway, or roll, the sidewise tilting of the car body that results from centrifugal force acting outward on turns. The softer the suspension, the more the outer springs are compressed and the inner springs expanded. In addition, the front end dives more noticeably when braking with soft front springs.

Air springs offer several advantages over metal springs, one of the most important being the possibility of controlling the spring rate. Inherently, the force required to deflect the air unit increases with greater deflection, because the air is compressed into a smaller space and greater pressure is built up, thus progressively resisting further deflection.

A combination hydraulic-fluid-and-air suspension system has been developed in which the elastic medium is a sealed-in, fixed mass of air, and no air compressor is required. The hydraulic portion of each spring is a cylinder mounted on the body sill and fitted with a plunger that is pivotally attached to the wheel linkage to form a hydraulic strut. Each spring cylinder has a spherical air chamber attached to its outer end. The sphere is divided into two chambers by a flexible diaphragm, the upper occupied by air and the lower by hydraulic fluid that is in communication with the hydraulic cylinder through a two-way restrictor valve. This valve limits the rate of movement of the plunger in the cylinder, since fluid must be pushed into the sphere when the body descends and returned when it rises. This damping action thus controls the motion of the wheel with respect to the sprung portion of the vehicle supported by the spring.

So-called active suspensions incorporate a microprocessor to vary the orifice size of the restrictor valve in a hydraulic suspension or shock absorber (a mechanical device that dampens the rate of energy stored and released by the springs). This changes the effective spring rate. Control inputs may be vehicle speed, load, acceleration, lateral force, or a driver preference.

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