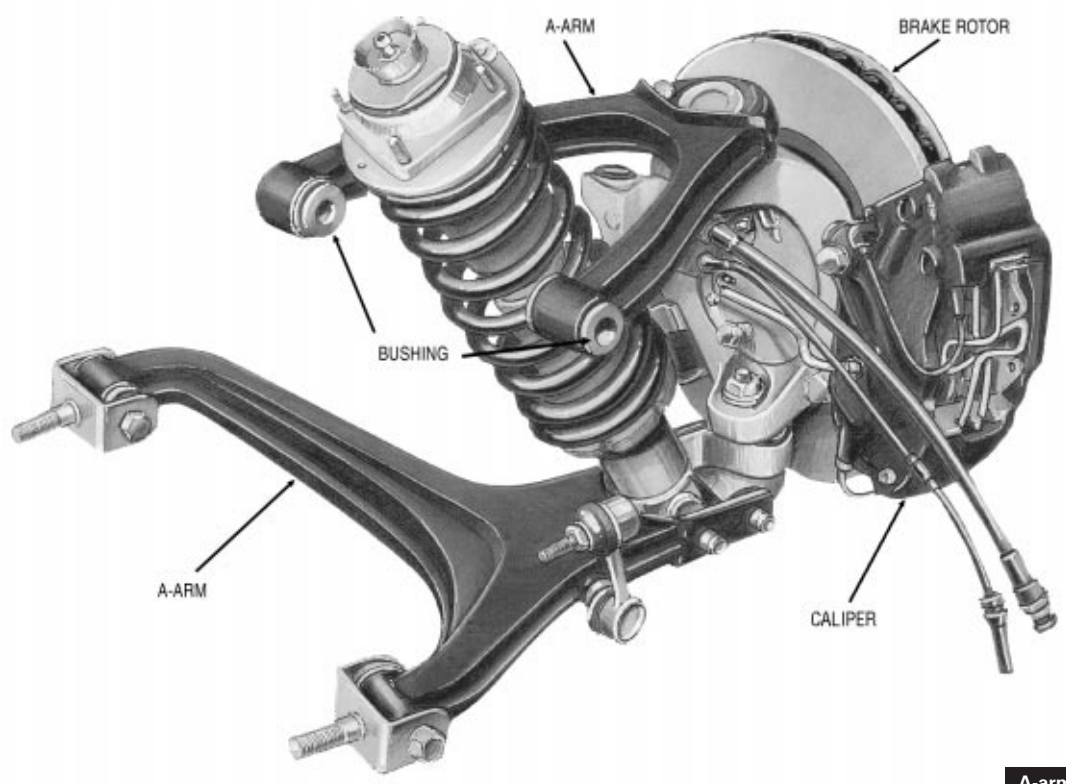
A

A-arm A lateral suspension locating link in the shape of the letter A. The two legs attach to the chassis by pivots and rubber bushings that allow the outboard top of the A (connected to the wheel assembly) to pivot up and down. Sometimes the A-arm is made up of two separate links. The system is widely considered to give excellent wheel-locating geometry, and it is used for the rear suspension of most racing cars and many high-performance road cars. Also called wishbone. Also see *unequal-length A-arms*.

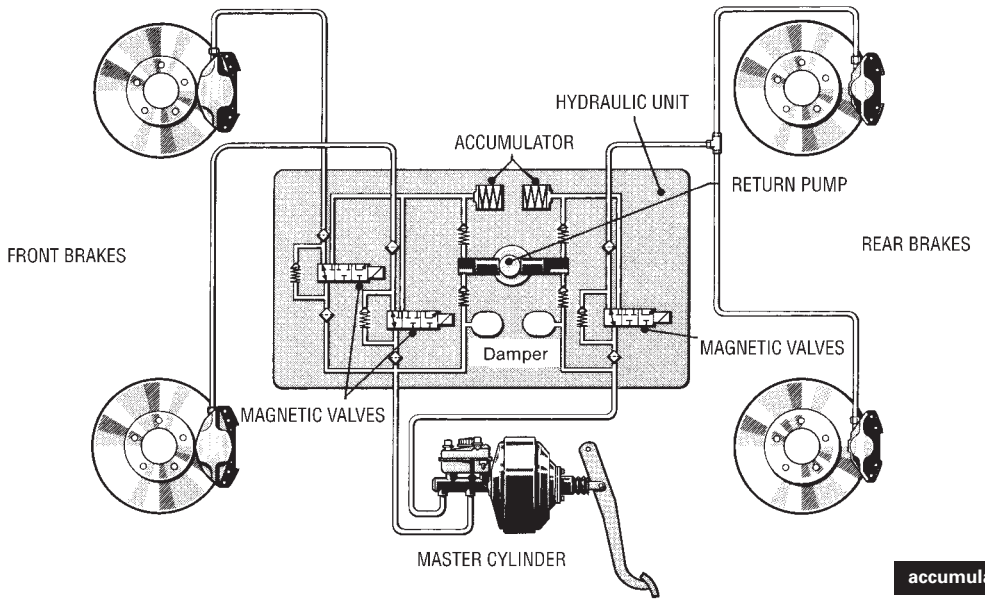
ABS See antilock braking system.

acceleration The rate of change of velocity in relation to time; measured in ft/sec/sec or ft/sec2.

accelerator A foot pedal linked to the throttle valve, controlling the flow of air and therefore, by means of the carburetor or fuel injection system, also the amount of fuel admitted to the engine. Also called the throttle.



A-arm



accumulator

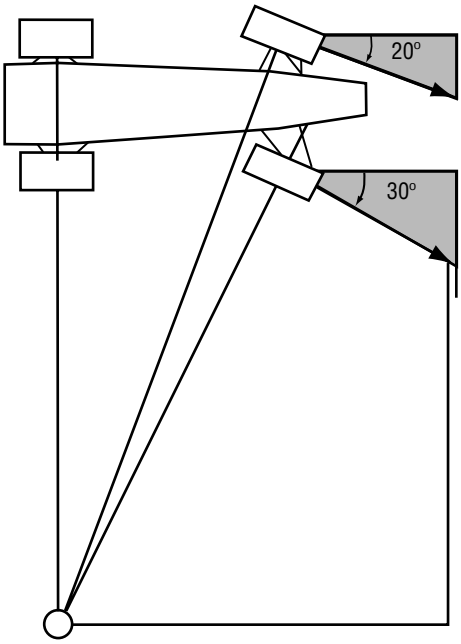
accelerator pump A carburetor device that enriches the fuel mixture for acceleration.

accelerometer A mechanical or electrical instrument for measuring and recording acceleration.

access panel See *hood*.

accumulator In a hydraulically assisted brake system, a reservoir filled with hydraulic fluid and kept under pressure during engine operation; in case of engine failure, this pressure provides reserve braking power that can stop the car several times with something approaching the degree of assistance available with the engine running.

Ackermann steering Steering geometry that allows the outside wheel to turn fewer degrees than the inside wheel to compensate for the larger circle tracked by the outside wheel. The relationship between the angles of the inner and outer wheels is not fixed; the tighter the turn, the greater the disparity between the wheels' desired turning angles.



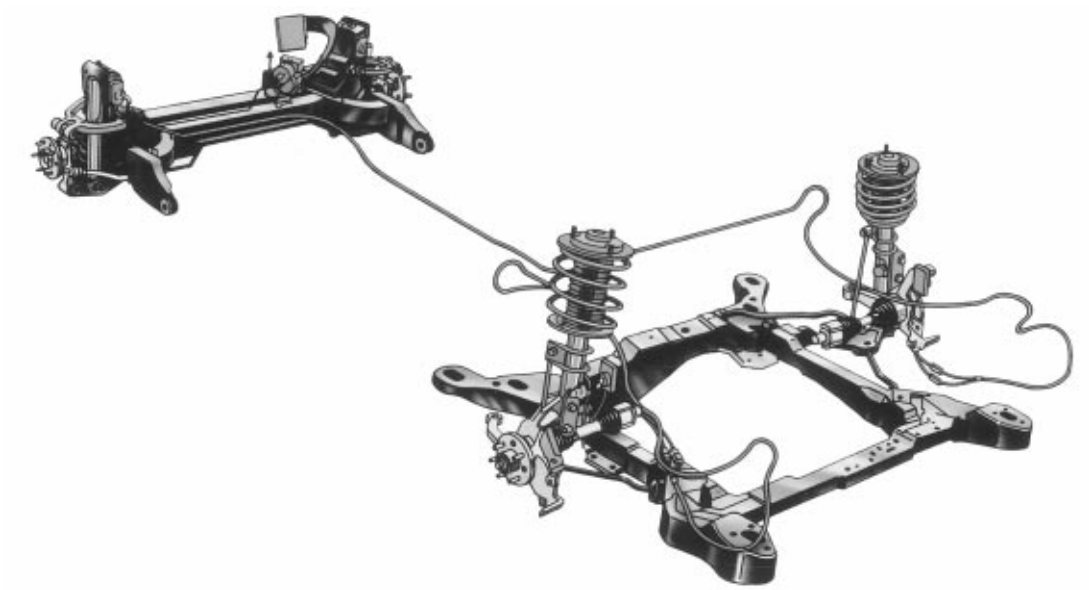
Ackermann steering

Steering geometry that does not give the ideal relationship in all types of turns results in tire scrub. Ackermann steering remains perfectly accurate only at very low speeds, before the nonlinear characteristics of the tires become a factor. However, Ackermann steering minimizes scrub in the vast majority of conditions encountered by production cars, though it is a design compromise that corrects for normal driving conditions rather than for all possible turns.

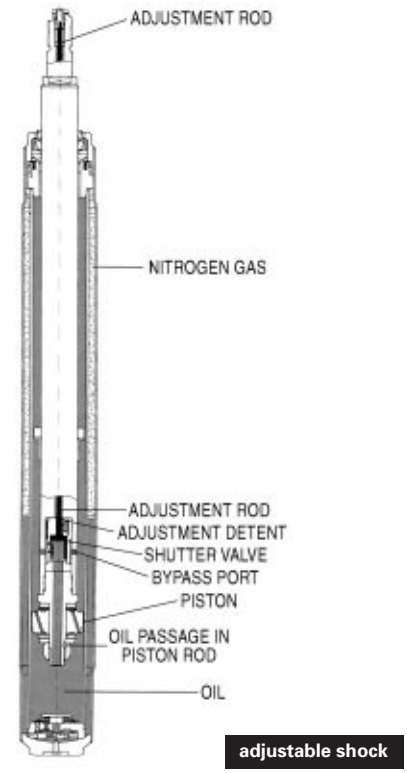
active-ride suspension See *active suspension.*

active safety Aspects of a car's engineering that affect its accident-avoidance capabilities, especially those under driver control. Includes such factors as steering, brakes, handling, and tires — in sum, a car's total roadholding and evasive capability. Also see *passive safety.*

active suspension A suspension system with a double-acting hydraulic actuator at each wheel, driven by a variable-rate hydraulic pump and controlled by an electronic control unit (ECU). The ECU monitors forward speed, body attitude, lateral-versus-longitudinal velocity when cornering, wheel/hub velocity, angular displacement, and load. It also controls an onboard hydraulic power source that supplies the internal pressure necessary to counteract the external forces and optimize the vehicle's body position. The main advantage of active suspension is superior body and suspension control under all conditions, including near roll-free cornering behavior and a virtual absence of bounce and pitch. An active suspension is truly an intelligent suspension that senses outside forces and generates its own internal forces to counter them, thereby controlling body position; conventional suspensions can only react to the forces influencing them, and are thus passive systems. Generally, an active suspension will still have conventional springs to support the car's static weight when the car is at rest and the engine is off. Also known as *active-ride suspension* or *full-active suspension.*



active suspension



adjustable shock

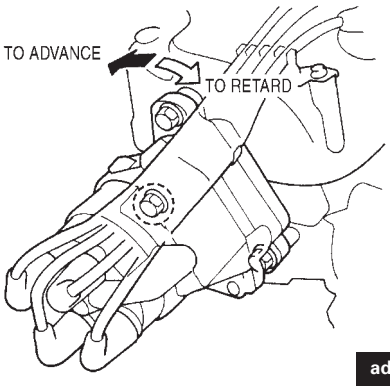
Modern electronic engine controls with the ability to "remember" major changes in environmental and operating conditions and adjust to them. An example is the adaptive feedback idle-speed control of certain engine-management systems, which shifts its adjustment range during the break-in period of a new engine and therefore needs no further attention for the car's life span, barring malfunctions.

adhesion The ability of a tire to remain in contact with a road surface without loss of traction. Also, the ability of an oil to remain in contact with a metal surface.

adiabatic engine An engine in which the heat of combustion remains within the combustion chamber and cylinder where it can be converted into power, making the engine more efficient and allowing it to operate without a cooling system.

adjustable shock A shock absorber whose jounce and rebound characteristics can be stiffened or softened, either manually or electronically, to compensate for wear or to fine-tune a suspension for rough roads, heavy loads, cornering, or racing. Manual adjustments are made on the shock absorber; some contemporary cars have shock absorbers that can be adjusted electromechanically via a switch inside the car.

advance To adjust the timing of a camshaft or distributor spark or valve operation, so that a valve opens or a spark plug fires earlier in the engine's cycle; also, the mechanism for doing this. The opposite of *retard*.



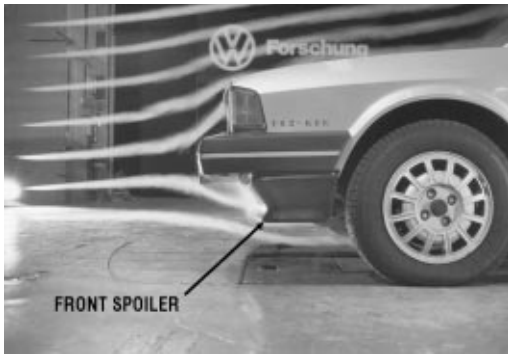
advance

aerodynamic drag The resistance of air to the forward movement of a body such as a car. It has three sources:

Drag resistance, a function of the body's shape. Protruding objects such as mirrors, mufflers, and license plates can increase drag resistance considerably at higher speeds. Of special importance is the shape of the rear part of the body, which determines the amount of turbulence in the vehicle's wake.

Air friction on the body's external surfaces (skin). For the more or less standardized surface finish of modern passenger cars, this amounts to about 10 percent of total air resistance.

Airflow through the car for cooling or ventilation. This can be resistance-increasing or -



aerodynamic drag

decreasing, depending on the function, location, and aerodynamic design of the air channels or orifices.

Aerodynamic drag, or air resistance, increases as the square of vehicle velocity; the power needed to overcome it varies as the cube of vehicle velocity. Also see *coefficient of aerodynamic drag* and *coefficient of aerodynamic lift*.

aggressive The French now describe a car as aggressive, or refer to its aggressivity, if its structural passive safety characteristics are such that it imposes excessive injury to a pedestrian, to an occupant of another vehicle, or to another vehicle in an accident. For example, the shape of the front end and the height of the bumper of an aggressive car would tend to throw a pedestrian under the car rather than up and onto its hood. Similarly, the front end structure would be capable of penetrating another vehicle upon impact rather than crushing progressively. Also see *crush zone* and *passenger cell*.

aggressivity See *aggressive*.

airbag A large deflated pillow or balloon concealed in the steering-wheel hub, instrument panel, or dash, designed for rapid inflation in a frontal impact to cushion and restrain front-seat occupants.

One or more deceleration sensors trigger inflation within milliseconds, typically by burning a solid chemical that converts to a gas

airbag

that inflates the bag; the bag then deflates, also very quickly.

Airbags are an example of a passive restraint mandated for fixed percentages of cars sold in the United States by all manufacturers beginning with model year 1987. Also see *Supplemental Restraint System*.

air bleed passage See *compensating jet*.

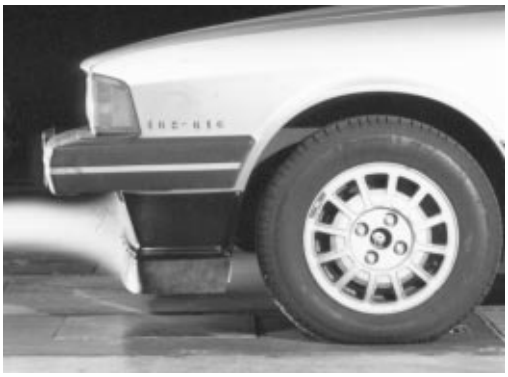
air capacity See *breathing capacity*.

air cleaner A device mounted on an engine's intake system that contains a wire mesh or paper filter to trap dust and dirt, preventing them from being drawn into the engine. Also called *air filter*.

air-cooled engine An engine cooled by the passage of air around external cylinder fins rather than by passage of a liquid coolant through internal water jackets.

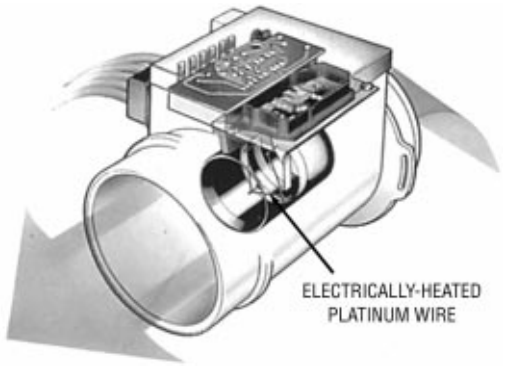
air dam, front and rear An aerodynamic device that reduces the amount of air flowing under, and directs airflow around, a car, thus reducing its aerodynamic drag and lift

Originally devised for racing, air dams have become a popular accessory and de rigeur for newer high-performance production models. Air dams are typically made of aluminum, fiberglass, or flexible plastic, the last being most practical for road use given their proximity to the ground and consequent vulnerability to scraping and bending. They're generally distinguished from front spoilers by being somewhat deeper. A recent development is the rear air dam, sometimes referred to as a *skirt* and generally seen with extensions of a car's rocker panels. Also see *ground effect*.



air dam (front)

air filter See *air cleaner*.

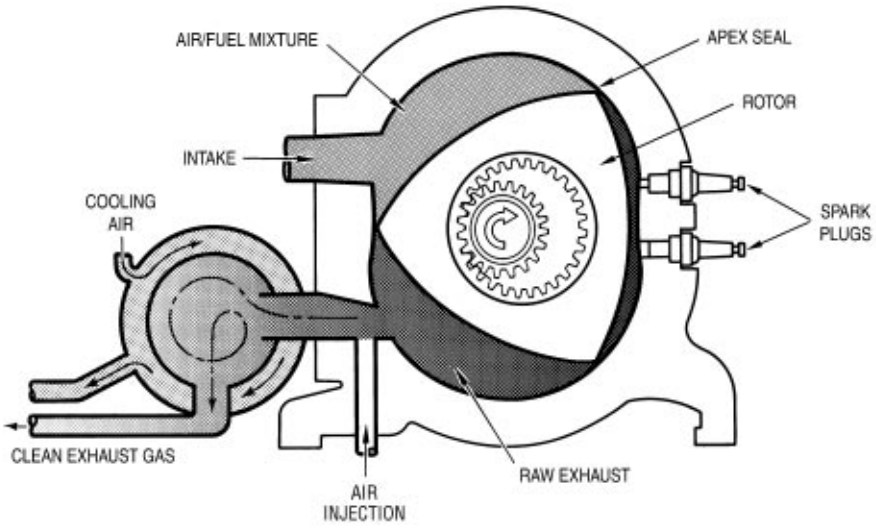


airflow sensor

airflow sensor The device in a fuel injection system that measures the flow of air through the intake manifold to determine the amount of fuel to be delivered; also called *mass airflow sensor*.

Bosch's mechanical K-Jetronic fuel injection system employs a mechanical sensor consisting of a plate ("flap") in the airstream, attached to a lever arm that in turn moves a plunger in the fuel distributor. The force of air on the plate moves the lever up and down, causing the plunger to open and close holes in the fuel distributor. The L-Jetronic system also uses a flap in the airstream; its movement creates voltage changes in a potentiometer (variable resistor) attached to it. These changes are relayed to the system's electronic control unit and, in turn, to the fuel distributor. Both these systems measure the volume of airflow.

In the Bosch LH-Jetronic system, the sensor is an electrically heated platinum wire. Air passing over the wire, which is part of a bridge cir-



air injection system

cuit, tends to cool it, thus altering its electrical resistance. An electronic amplifier detects these minute changes in resistance and regulates current to keep the wire at its original temperature. The current required is thus a measure of air mass, an even more fundamental indicator of how much fuel to supply than the volume measured by K- and L-Jetronic systems. Thus the heated wire is called an *air-mass sensor*.

air foil A device used to improve traction by increasing the aerodynamic downforce on either end of a car. In cross section, an airfoil is basically an inverted wing. Thus, instead of providing lift, as on an airplane, it causes air to push the car closer to the ground. The use of airfoils increases cornering capability and improves stability at speed, but at the expense of additional aerodynamic drag. Also called *wings*. Also see *downforce* and *ground effect*.

air-fuel mixture The blend of air and fuel supplied to an engine by the carburetor or fuel injection system.

air-fuel ratio The ratio of the mass of air to the mass of fuel supplied to an engine. The stoichiometric, or chemically correct, air-fuel ratio is the exact ratio necessary to burn all carbon and hydrogen in the fuel and produce carbon dioxide and water with no oxygen remaining.

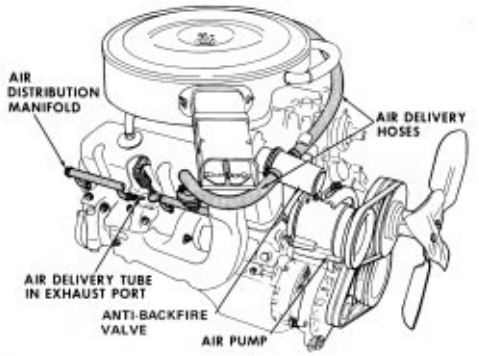
air injection system An emission control system that injects fresh air into the exhaust ports or a thermal reactor for conversion of carbon monoxide into carbon dioxide and for combustion of unburned hydrocarbons in the exhaust gases. Also called *pulsed air injection*.

air lock See *air pocket*.

air-mass sensor See *airflow sensor*.

air pocket A quantity of air that prevents the normal flow of a liquid. Air pockets sometime occur in brake and clutch hydraulic lines, oil lines, or in the cooling system. Also see *bleed*.

air pollution Unwanted particles, mist, or gases put into the atmosphere primarily as a result of motor vehicle exhaust or the operation



air pump

of industrial facilities. Also see *exhaust emission controls* and *exhaust emissions*.

air pump The device that supplies the fresh air needed by an air injection system.

air resistance See *aerodynamic drag*.

air scoop An opening in a body panel used to duct outside air for purposes of ventilation or cooling, generally to the engine, brakes, radiator, or an oil cooler. On the hood (or the roof or rear deck of a rear- or mid-engine car) an air scoop can be used to force ambient air into the intake system. Also called *scoop*.

air scoop

air suspension A suspension system using a type of airbag rather than metal springs to support a car and control its ride motions. Air suspension can result in excellent riding comfort over a wide range of vehicle loading because an air spring's natural frequency of vibration does not vary with load as does that of a metal spring. Air springs can be made very soft for a lightly loaded condition and their pressure automatically increased to match any increase in load, thus maintaining constant spring vibration characteristics for any load. Also called *air springing*.

air-to-air intercooler See *intercooler*.

air-to-water intercooler See *intercooler*.

air-valve carburetor A carburetor in which a spring- or weight-closed air valve opens in response to engine demand. Through suitable linkage, it varies the fuel opening to give the desired mixture ratio throughout the range of operation. SU, Stromberg CD, and Keihin CV carburetors operate on this principle. Also referred to as *constant-depression*, *constant-vacuum*, and *variable-venturi carburetor*.

alignment Generally refers to wheel alignment, the proper adjustment of a car's front or rear suspension for camber, toe, caster, and ride height.

all-indirect gearbox A manual transmission in which none of the forward gears has a direct (1:1) ratio.

alloy A metal composed of two or more elements; one or more elements is added to a pure metal to alter properties such as strength and elongation.

alloy wheel A generic term used to describe any lightweight road wheel. The usual alloys are aluminum or magnesium, the latter material having led to the common usage of the term mag wheel, often referring to any nonsteel wheel. Alloy wheels can be cast (formed by pouring liquid metal into a mold) or forged (formed by

alloy wheels

heating the metal and then hammering or pressing it into a specific shape). Forged wheels are generally stronger than cast alloy wheels.

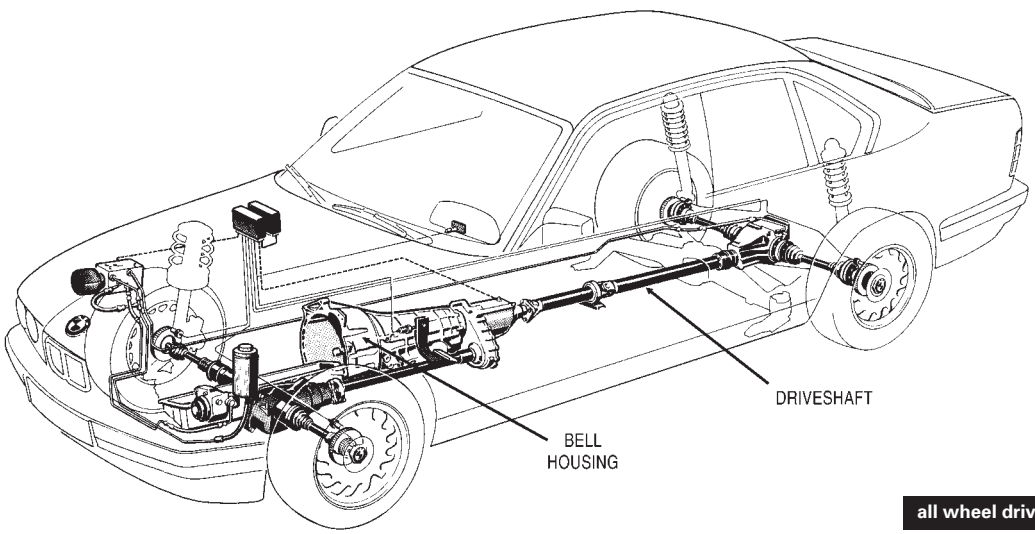
all-wheel drive (AWD) A drive system in which the transmission is connected by the driving axle(s) to both the front and the rear wheels. For off-road vehicles it is usually termed *four-wheel drive* (4WD). Also see *four-wheel drive*.

all-wheel steering (AWS) See *four-wheel steering*.

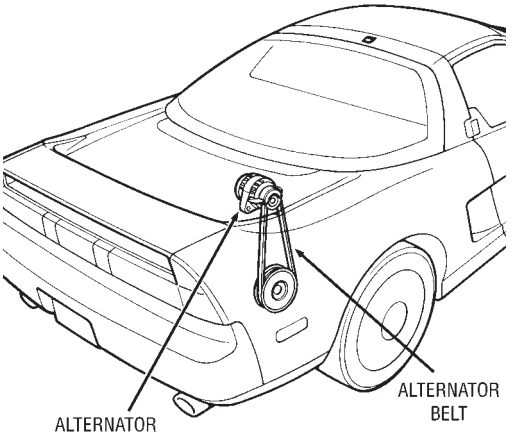
alphanumeric rating system For tires; dating from 1968, this system is based on the load-carrying capacity of a tire rather than on a direct measurement of the section width. The capacity and size of the tire are indicated by letters ranging from A through N, with N representing the largest tire with the highest load-carrying capacity. A typical alphanumeric tire size is BR78-13, where B is the load/size relationship and R represents radial construction. If the R is missing, the tire is of bias construction. The number 78 is the aspect ratio and 13 is the wheel diameter in inches.

alternating current (AC) Electrical current that reverses its flow in a circuit at regular intervals. The reversal typically occurs between 60 and 120 times per second, expressed as cycles per second (CPS). Compare with *direct current*. Also see *alternator*.

alternator The part of a car's electrical system that converts mechanical energy from a drive



all wheel drive



alternator

belt into electrical energy to operate the ignition and electrical accessories and charge the battery. An alternator generates alternating current (AC) and then transforms it into the direct current (DC) used by automotive electrical systems. The alternator has replaced earlier DC generators, which are less efficient.

aluminum A relatively soft silvery metal used where lightness is required. In cars, aluminum is always found as an alloy because in its pure form it lacks strength and rigidity and is difficult to machine. Aluminum alloys can be cast, formed into sheets, or forged. Uses include body panels, wheels, engine blocks, radiators, transmission and differential housings, suspension members, and chassis.

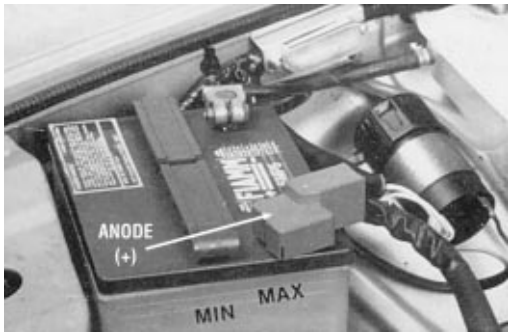
ammeter An instrument that measures the amount, or number of amperes, of current flowing in an electrical circuit.

ampere A unit of electric current. The number of amperes is equal to the voltage divided by the resistance (in ohms) of the electrical circuit.

analog instrumentation Gauges that use a symbolic representation, typically a pointer moving along or around a scale, to display information such as engine speed, miles per hour, oil pressure, voltage, fuel supply, or time (the "hands-and-face" clock); contrasts with digital instrumentation, in which information is expressed by numerals (digits). Traditionally, analog-gauge pointers operated by purely mechanical means such as a cable drive, but these have increasingly given way to electronic operation. Even newer are electronic graphic displays, where small liquid crystal or vacuum-fluorescent elements form a band that performs the same function as a pointer.

annular gear A ring gear. See *ring* and *pinion.*

analog instrumentation



anode

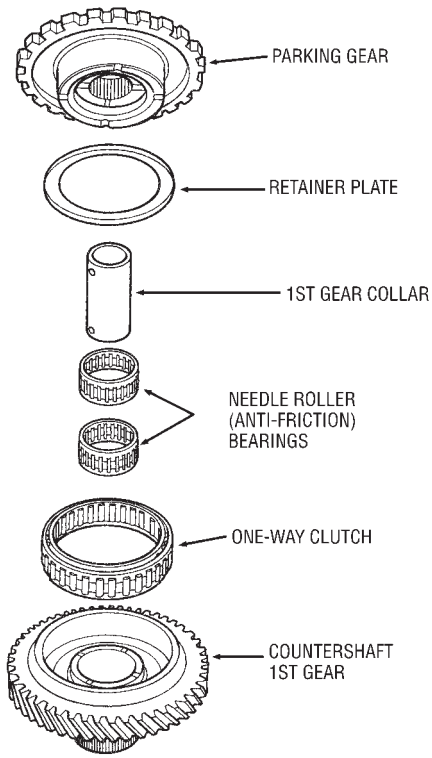
anode The positively charged electrode in an electrolytic cell. An automotive battery consists of electrolytic cells. Also see *electrolyte*.

anodize To coat or plate a metal (typically aluminum) with a protective material by electrolytic action.

anti-backfire valve A part of the air injection system that diverts air from the air pump away from the exhaust ports for a brief time when the accelerator is first released during deceleration. This prevents fuel-rich unburned exhaust gases from mixing explosively with fresh air and causing a backfire.

anti-dive The characteristics of a car's suspension intended to resist unwanted motion during braking. To achieve anti-dive reactions in a front suspension featuring unequal-length A-arms, the upper arm is angled upward toward the front and the lower arm is angled downward. The angling produces lift components in reaction to brake torque that "hold up" the front end. Also see *dive*, *lift*, and *anti-lift*.

antifreeze Any of several substances (commonly liquids and typically ethylene glycol) mixed with water and added to a car's cooling system to lower the freezing point of the coolant and to inhibit formation of rust and other deposits that could clog the radiator and coolant passages and reduce cooling efficiency.

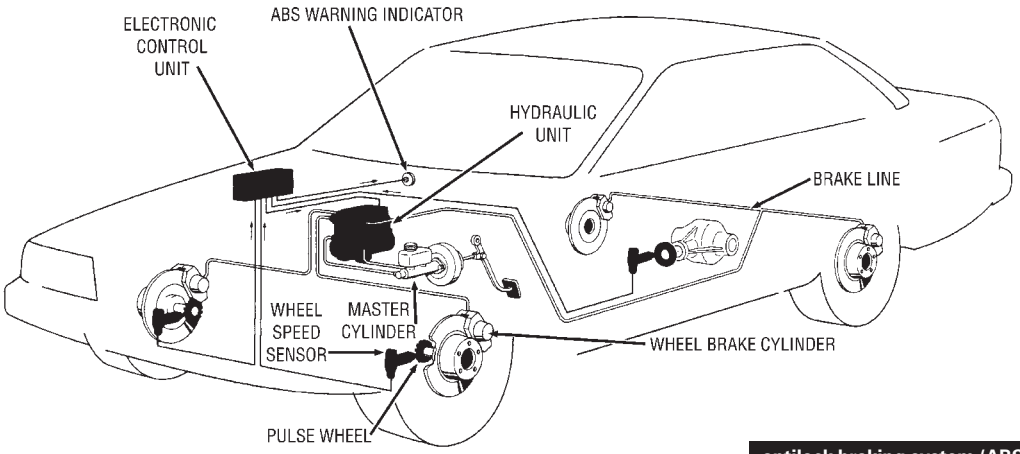


anti-friction bearing

anti-friction bearing Any bearing in which moving parts are in rolling contact. Also see *ball bearing*, *roller bearing*, and *needle bearing*.

anti-knock agents Substances (such as tetraethyl lead or ethanol) added to gasoline to raise the octane number and reduce the gasoline's tendency to knock or ping. Also see *detonation*.

anti-lift The characteristics of a car's suspension intended to resist unwanted motion during hard acceleration. Trailing arms and semi-trailing arms are often used in rear suspension systems because they provide strong resistance to lift. Also see *lift*, *dive*, and *anti-dive*.



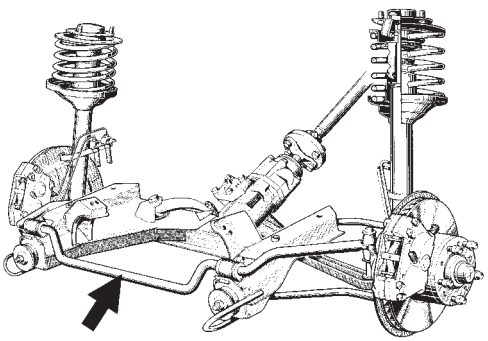
antilock braking system (ABS)

antilock braking system (ABS) A system that provides rapid, automatic cadence braking in response to signs of incipient wheel lockup by alternately increasing and decreasing hydraulic pressure in the brake line(s) of the affected wheel(s). This action prevents wheel lockup, thereby preserving steering control and reducing stopping distances on some road surfaces.

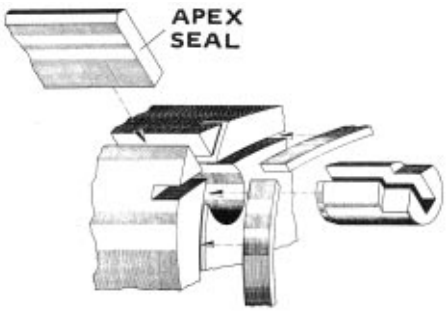
Under braking, an electronic control unit (ECU) receives signals from electronic sensors monitoring wheel rotation. If a wheel's rate of rotation suddenly decreases, the ECU orders a hydraulic control unit to reduce line pressure to that wheel's brake. Once the wheel resumes normal rotation, the controls restore pressure to its brake. Depending on the system, this cycle of "pumping" or cadence braking can occur up to fifteen times per second. Also see *Stop Control System.*

anti-percolation valve A carburetor vent used to prevent vapor lock by releasing hot, expanding fuel vapors. In emission-controlled engines, vapors are not released to the atmosphere but are routed into an evaporative-emission-control canister, where they are stored and then metered to the engine the next time it is started. Also see *evaporative emission control* and *vapor lock.*

anti-roll bar A transverse bar linking both sides of a suspension system; generally, a torsion bar with rubber bushings mounted on the chassis that allow it to turn freely. The bar's ends are connected to or shaped as lever arms, with attachments to the suspension linkages at each side via ball-joint links, rubber-bushed pivot links, or, on race cars, spherical rod ends called Heim joints. When both wheels take a bump equally, the wheels move the same amount without twisting the anti-roll bar. Individual wheel movement or body roll will force the bar to twist as the lever arms are variously moved, thereby adding the bar's own spring rate to that



anti-roll bar



apex seal

of the car's springs. Although an anti-roll bar's main function is to reduce body roll in cornering, it also influences overall handling. Installing or enlarging a front anti-roll bar tends to increase understeer; fitting or enlarging a rear bar increases oversteer tendencies. Also called *stabilizer bar* or, erroneously, *sway bar* and *anti-sway bar*.

anti-skid See *antilock braking system*.

anti-slip See *anti-wheelspin*.

anti-spin See *anti-wheelspin*.

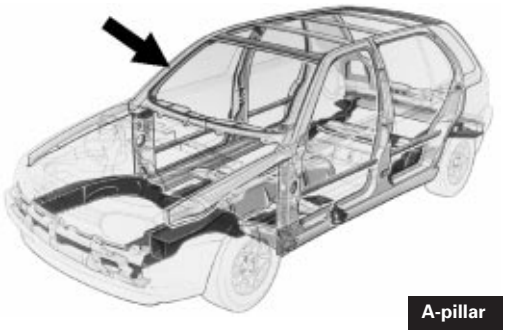
anti-squat The characteristics of a car's suspension intended to resist unwanted motion during hard acceleration. Trailing arms and semi-trailing arms are often used in rear suspension systems because they provide strong resistance to squat. Also see *squat*, *anti-dive*, and *anti-lift*.

anti-sway bar See *anti-roll bar*.

anti-wheelspin Electronic controls that maintain vehicle traction by automatically applying the brakes and/or reducing engine power during acceleration when the system detects one or more wheels spinning. As in electronic anti-lock braking, sensors monitor wheel rotation; in this case, though, a sudden increase in a wheel's rate of rotation signals the anti-spin controls to effect gradual application of the brakes, reduce the throttle opening or turbocharger boost, or perform a phased shutdown of engine cylinders until power to the wheel is sufficiently reduced that it resumes normal rotation. Also called *anti-spin*, *anti-slip*.

apex seal In the Wankel or rotary engine, the equivalent of a reciprocating engine's piston ring. Fitted to each of the three apexes on a rotor, the seals serve to prevent compressed-gas leakage and blowby of combustion gases, and also to release part of the heat captured by the rotor into the wall of the housing. Also called *tip seal*. Also see *Wankel engine*.

A-pillar A car's foremost roof pillars, supporting the windshield and front portion of the roof. Also called *A-post*.



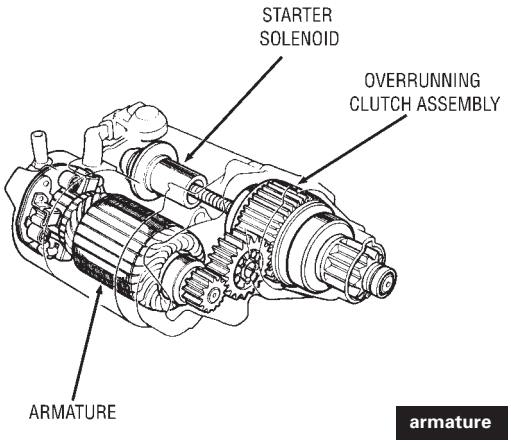
A-pillar

A-post See *A-pillar*.

aquaplaning A tire's tendency to ride on a layer of water instead of maintaining direct contact with the road surface. Generally more pronounced in low-profile tires with relatively large contact patches, aquaplaning can lead to loss of control. For this reason, virtually all road tires have grooves designed to channel water away from the tread. Also known as *hydroplaning*.

ARI See *Automatic Radio Information*.

armature A wire-wrapped iron or steel core forming a movable coil within the starter motor.



armature

When it revolves in the magnetic field between the poles, an electric current is induced.

aspect ratio The ratio of a tire's cross-sectional height to its width, usually used with the expression "-series." The lower the number, the lower the tire profile. Thus, a 50-series tire (section height of 50 percent of width) has a lower profile than a 60-series tire.

asymmetrical tread

aspiration The method by which an engine breathes; used mainly to express whether the air-fuel mixture is delivered at or above atmospheric pressure. An engine without a turbocharger or a supercharger is said to be *naturally* or *normally aspirated*, while one so equipped may be said to be *hyperaspirated* or *blown*. Also see *atmospheric pressure*, *supercharger*, and *turbocharger*.

assisted steering See *power steering*.

asymmetrical tread A tire tread in which the shape and size of the grooves vary across its width. The purpose is to provide an optimum combination of braking, ride, handling, and wet- and dry-road characteristics.

atmosphere A unit of measure of air pressure at sea level; sometimes used for the pressure of air forced into an engine by a turbocharger or supercharger. One atmosphere equals 14.7 lbs/in2 (psi) or, in the metric system, approximately 1.01 bar.

atmospheric pressure The weight of air pressing downward per unit area. The average pressure at sea level is 14.7 lbs/in2 (psi).

autocross See *slalom*.

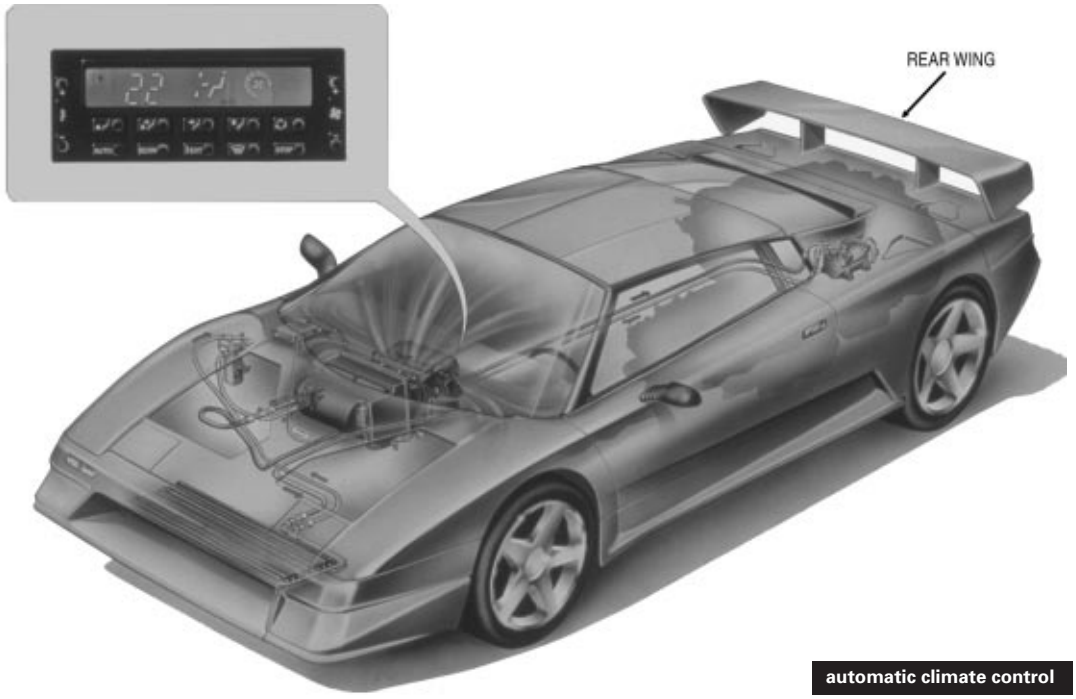
autoignition Rapid burning of the air-fuel mixture not caused by an external ignition source such as a spark, flame, or hot surface. Also see *detonation* and *dieseling*.

automatic choke See *choke*.

automatic climate control A combined heating/ventilation/air-conditioning system that automatically balances heating and cooling to maintain interior temperature at a set level. Also called *automatic temperature control*.

automatic level control See *automatic leveling*.

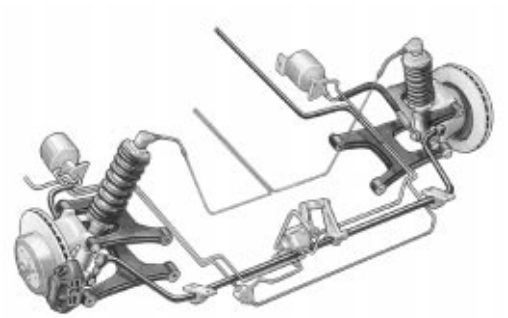
automatic leveling A suspension system that compensates for load variations at the front, rear, or both ends of a car, positioning it at a pre-



automatic climate control

designated level (zero pitch) regardless of load. Also called *automatic level control.*

Automatic Radio Information (ARI) A car audio system that automatically interrupts radio or cassette listening with reports on local traffic conditions so a driver can take an alternate route to avoid delays. Though national in scope, the ARI network is divided into regions, each with its own assigned VHF frequency. First developed in Germany, ARI is now available in parts of the United States.



automatic leveling

automatic seat belt A passive restraint device, normally a front-seat shoulder belt that fits diagonally across the wearer and is anchored at both ends, with one end feeding out from an inertia reel. When a door is closed, the belt moves into the correct position for restraining the wearer without manual fastening.

Automatic seat belts may be either mechanical or electric. The former typically mounts the inertia reel and outboard belt end on the door, with the inboard end anchored to a fixture between the seats; as the door closes, the inertia reel takes up slack in the webbing to tension the belt. In the electric type, a small motor runs the outboard end rearward along a track above the door when the door is closed (and forward when the door is opened); the inertia reel is combined with the inboard anchorage.

Automatic seat belts can be used in lieu of or in addition to airbags under the U.S. government mandate that specified some type of passive restraint on a fixed percentage of all cars sold in the United States beginning with model year 1987. They are simpler and therefore less expensive than airbags, and must be worn in conjunction with a manually fastened lap belt for optimum restraint.

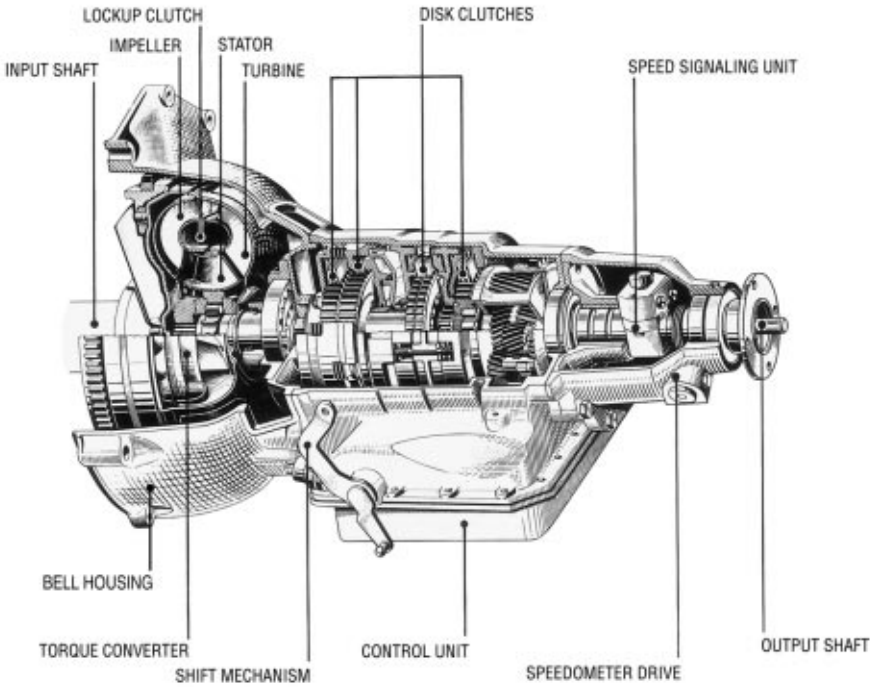
automatic temperature control See *automatic climate control*.

automatic transmission A mechanism in the drivetrain with gearsets to vary the power and torque delivered to the driven wheels as a function of engine load and speed, usually incorporating a fluid coupling or torque converter to allow stopping and reversing without a foot-operated clutch. Also see *fluid coupling*, *infinitely variable transmission*, and *torque converter*.

autothermic piston An aluminum piston in which steel or alloy inserts are cast to control expansion of the skirt.

auxiliary lighting An additional driving light, fog light, or spotlight used in conjunction with normal high or low beams.

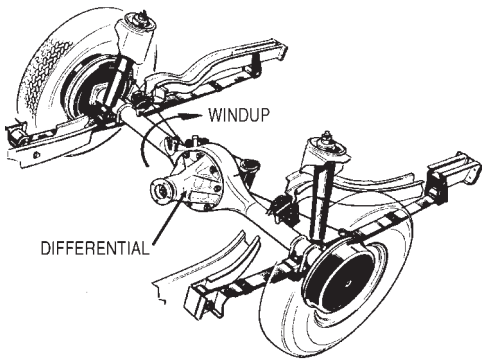
axle A shaft on which a wheel revolves or which revolves with a wheel. Also a beam, usually solid but sometimes hollow, connecting the two wheels at one end of a car. A live axle transmits power, as in a front-engine/rear drive car. A beam or rigid or dead axle supports but does not drive the wheels, as at the rear of a front-wheel-drive car. Also see *half shaft*.



automatic transmission

axle shaft See *half shaft*.

axle windup Phenomenon in which the torque being transmitted by the axle shafts to the wheels produces a reaction that rotates the live axle about its own centerline. Obviously a greater problem in cars with very high torque, axle windup can produce tramping of the rear wheels or wheel hop as the axle winds and unwinds. Also called *wheel tramp*. Also see *wheel hop*.



axle windup