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chapter 1

motor vehicle components

- Mechanical arrangements
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- The engine assembly
- Vehicle construction
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- Running gear
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A motor vehicle is made up of a large number of parts which are assembled together during manufacture.

Some parts are large and others are quite small. Many parts are fitted together to form larger components. Some parts are bolted together while others, such as the body panels and subframes, are welded together.

Motor vehicles vary greatly in design and body style, and the term *motor vehicle* can be used to include passenger cars, station wagons, vans, utilities, trucks, buses and coaches. In fact, any wheeled vehicle that operates on roads can be included.

In this book, most of the information will relate to passenger vehicles and light commercial vehicles. However, the basic principles involved apply to all motor vehicles and, in many instances, to vehicles that do not usually operate on roads, such as agricultural tractors and industrial and construction equipment.

Mechanical arrangements

There are two basic arrangements of the major mechanical components of passenger and light commercial vehicles: *front-wheel drive* and *rear-wheel drive*. These are shown in simplified form in Figures 1.1 and 1.2 with their parts identified. While the main difference is whether the front wheels or the rear wheels drive the vehicle, this can affect a number of other components, such as the mounting of the engine, the transmission, the drive line and the suspension.

In addition to these two basic arrangements, there are also four-wheel-drive vehicles. These have additional transmission and drive-line components that carry the drive to all four wheels of the vehicle.

In many four-wheel-drive vehicles, front-wheel drive is selected by the driver only when it is needed, but other vehicles, referred to as all-wheel drives, operate in four-wheel drive at all times.

Sections of a motor vehicle

A motor vehicle consists of a number of sections which, for convenience, can be considered as follows:

1. The engine assembly, which is the source of power.
2. The frame or chassis, which forms the basic structure to support the engine and the various mechanical components.
3. The drive train, which has gears and shafts to connect the engine to the driving wheels.
4. The running gear, consisting of the wheels, tyres, suspension, steering and brakes, which enables the vehicle to operate on the road.

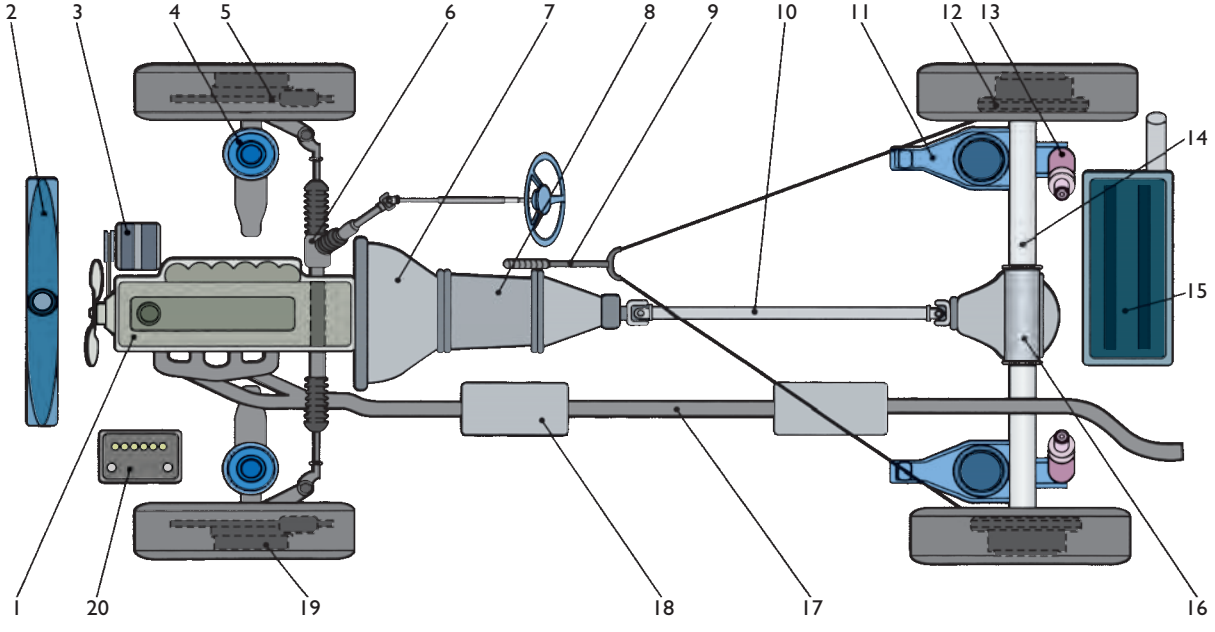

Figure 1.1 *Skeletal arrangement of a rear-wheel-drive vehicle*
1 *engine assembly,* ***2*** *radiator,* ***3*** *alternator,* ***4*** *front suspension,* ***5*** *front disc brake,* ***6*** *steering assembly,* ***7*** *torque converter,* ***8*** *automatic transmission,* ***9*** *handbrake,* ***10*** *propeller shaft,* ***11*** *rear suspension,* ***12*** *rear brake,* ***13*** *shock absorber,* ***14*** *rear-axle assembly,* ***15*** *fuel tank,* ***16*** *final drive,* ***17*** *exhaust system,* ***18*** *catalytic converter,* ***19*** *wheel hub,* ***20*** *battery*

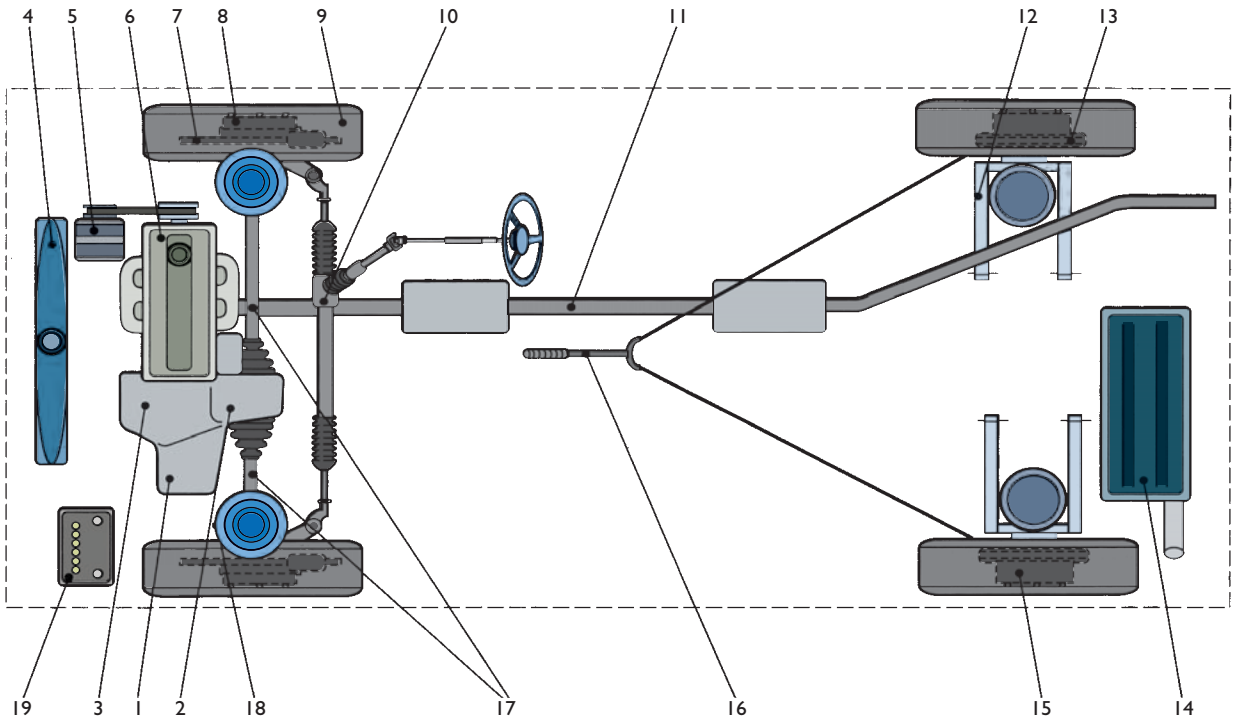

Figure 1.2 *Skeletal arrangement of a front-wheel-drive vehicle*
1 *manual transaxle,* ***2*** *final drive,* ***3*** *clutch,* ***4*** *radiator,* ***5*** *alternator,* ***6*** *engine assembly,* ***7*** *front disc brake,* ***8*** *hub,* ***9*** *wheel,* ***10*** *steering assembly,* ***11*** *exhaust system,* ***12*** *rear suspension,* ***13*** *rear brake,* ***14*** *fuel tank,* ***15*** *rear-wheel hub,* ***16*** *handbrake,* ***17*** *drive shafts,* ***18*** *suspension,* ***19*** *battery*

5 The electrical system, which includes the battery, wiring, lights, starter, alternator and other electrical components.
6 The body of the vehicle, which provides seating for the driver and passengers and, in commercial vehicles, carries loads.

To service these various parts of a motor vehicle, it is necessary to know the names of the various components, their location on the vehicle, and their purpose or function.

It is also necessary to understand how components operate and to be familiar with their construction and design. A knowledge of adjustments and servicing requirements is also important, together with accepted methods of carrying out repairs.

Hybrid-drive vehicles

Hybrid vehicles have an internal combustion engine combined with an electric motor to provide the power to drive the vehicle. The reason for this is to improve fuel economy and to reduce exhaust emissions. The engine can be designed so that it is smaller than normal and as a result is more fuel efficient. The electric motor produces no emissions.

The basic hybrid arrangement is shown in Figure 1.3 on the following page with its main parts identified. Depending on driving conditions, power to drive the vehicle is delivered by the engine, by the electric motor, or by a combination of the engine and the electric motor.

It has a fuel tank to supply petrol to the engine and high-voltage batteries to provide power to the electric motor. The battery is recharged by a generator when the electric motor is not in use. More information on hybrid vehicles can be found in Volume 2.

The engine assembly

The engine is the source of power that provides the torque or turning force which is used to drive the vehicle. Engines in motor vehicles can be internal combustion, electric or a combination of the two (known as 'hybrid'). Internal combustion engines burn the fuel inside the engine using petrol, distillate or gas. Electric motors use electricity supplied from storage batteries fitted to the vehicle. The batteries can be charged using an internal combustion engine, fuel cell, solar cell, power regeneration and external charging.

Figure 1.4 on the following page is a drawing of a basic engine with its main parts identified. This is a

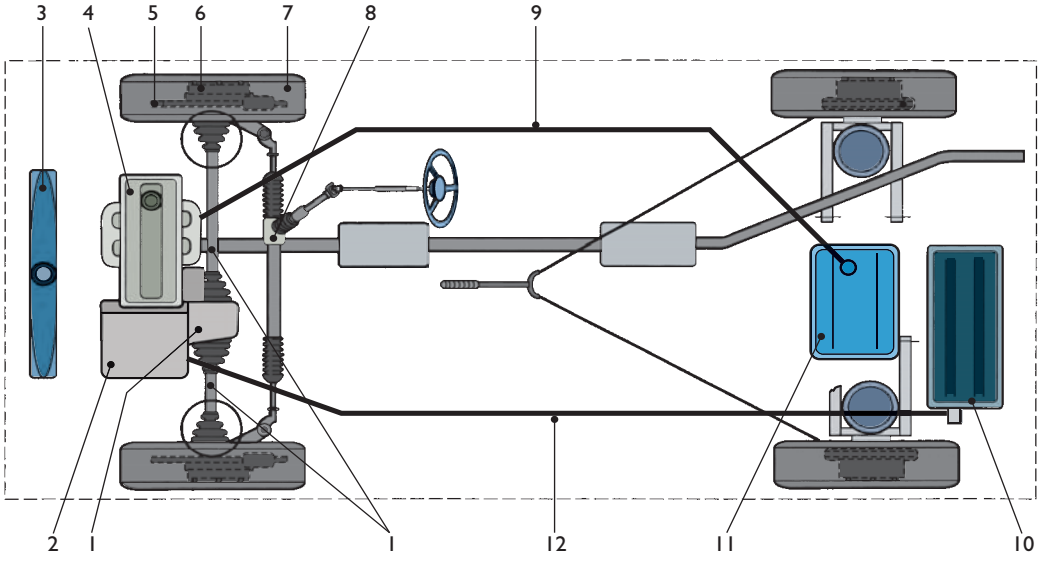

Figure 1.3 *Skeletal arrangement of a hybrid-powered vehicle*
1 *hybrid transaxle,* ***2*** *electric-motor assembly,* ***3*** *radiator,* ***4*** *engine,* ***5*** *front brake,* ***6*** *front hub,* ***7*** *wheel,* ***8*** *steering assembly,* ***9*** *fuel line,* ***10*** *high-voltage battery,* ***11*** *fuel tank,* ***12*** *power cable*

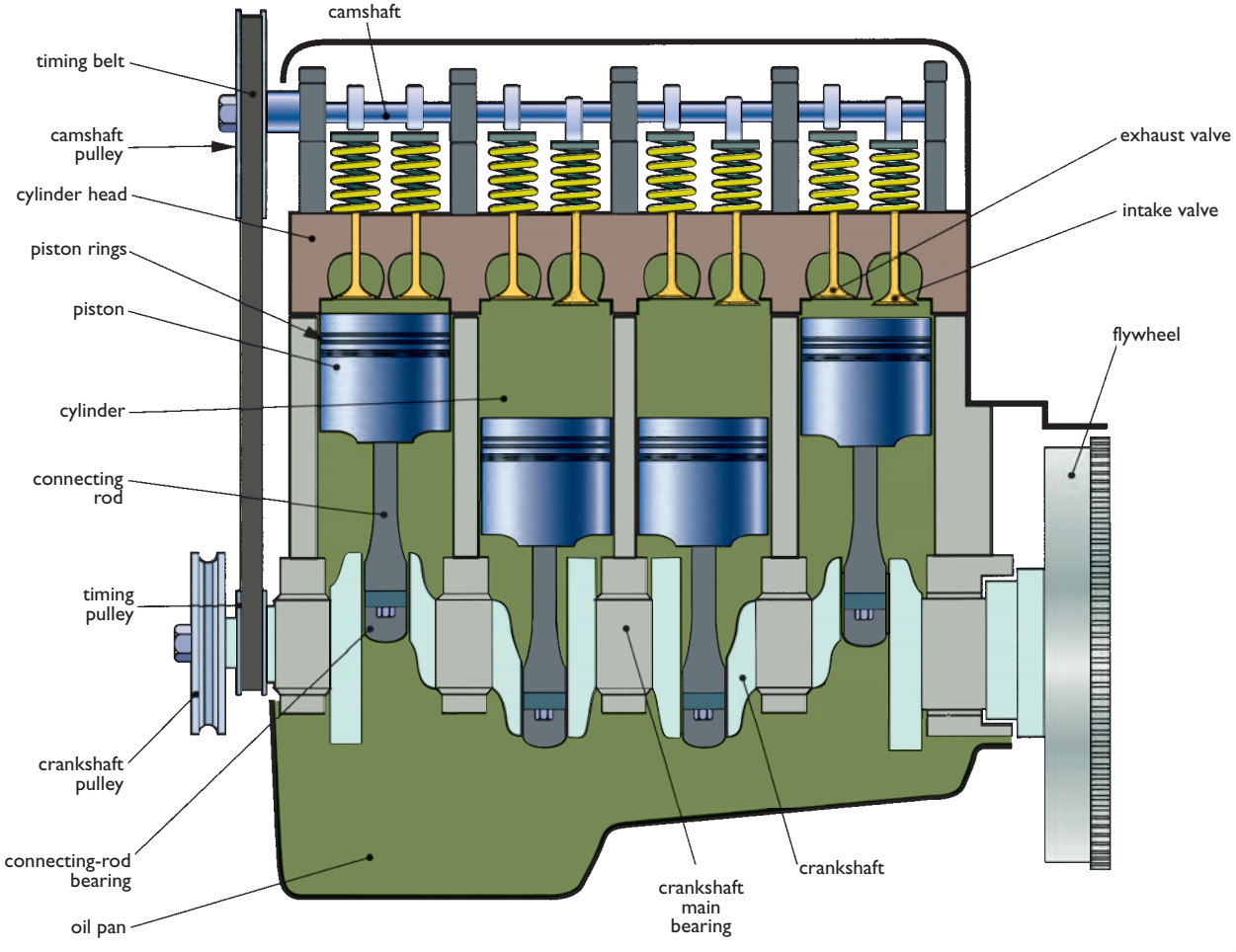

Figure 1.4 *Basic construction of a four-cylinder engine*

four-cylinder petrol engine of the type fitted to passenger cars and light commercial vehicles. More details of an engine of this type can be seen in Figure 1.5.

In operation, burning fuel inside the cylinders of the engine produces a high pressure which forces the pistons to move down their cylinders. Piston movement is transferred to the crankshaft by the connecting rods, causing the crankshaft to rotate. This rotary motion is then carried by the drive train to the driving wheels and used to propel the vehicle along the road.

The engine assembly includes the engine itself as well as all the components and systems needed to make it start and run. These include the starting, charging, cooling, ignition, lubrication, fuel and the exhaust systems.

Vehicle construction

Passenger cars have a body of unitised construction. Reinforced panels and subframes are built into the body to provide the necessary strength and stiffness. A body of this type is shown in Figure 1.6 on the next page.

Subframes for supporting the engine and transmission, the front and rear suspensions and other mechanical parts are built into the reinforced underbody panels. Strengthened sections of panels are used for mounting other components.

The subframes provide mountings for the engine, the transmission, the suspension and the steering. The engine has rubber mountings to prevent noise and

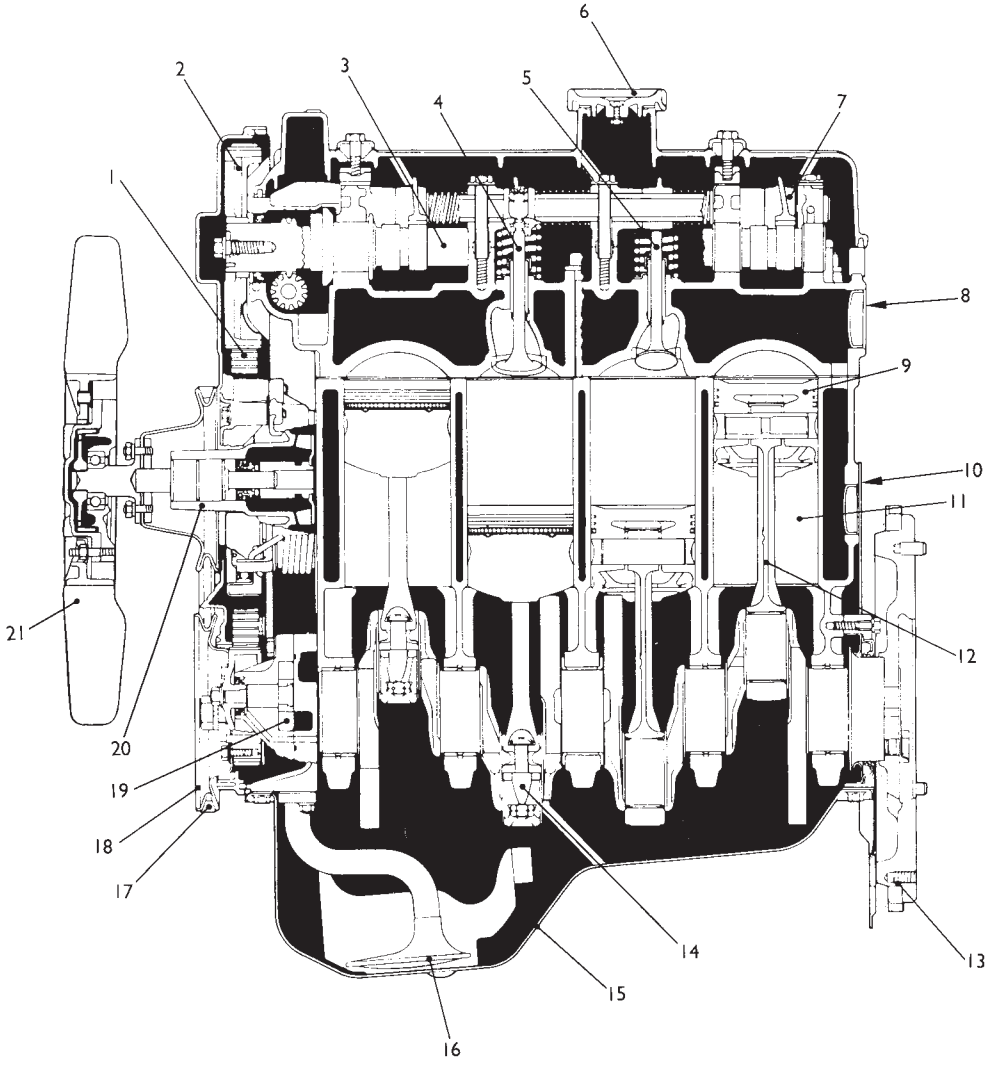

Figure 1.5 *Four-cylinder engine, sectional view*
1 *timing belt,* ***2*** *camshaft drive pulley,* ***3*** *camshaft,* ***4*** *intake valve,* ***5*** *exhaust valve,* ***6*** *oil filler cap,* ***7*** *valve rocker gear,* ***8*** *cylinder head,* ***9*** *piston in section,* ***10*** *cylinder block,* ***11*** *cylinder,* ***12*** *connecting rod,* ***13*** *flywheel,* ***14*** *connecting-rod big end and crankshaft,* ***15*** *oil pan or sump,* ***16*** *oil pump intake,* ***17*** *fan belt,* ***18*** *pulley on crankshaft,* ***19*** *oil pump,* ***20*** *water pump,* ***21*** *fan* MITSUBISHI

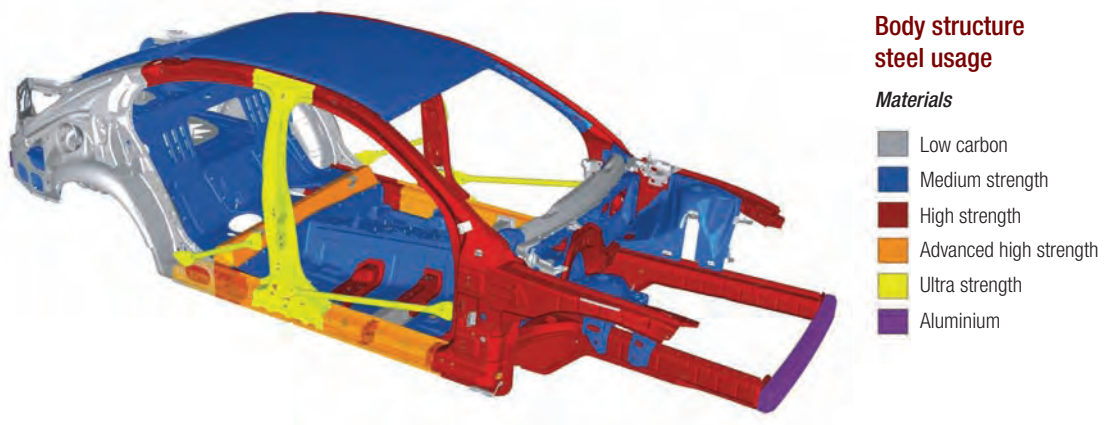

Figure 1.6 *Body structure with different metals used. These provide light weight and strength*

vibration being transmitted to the vehicle body. Rubber bushes between the various parts of the suspension and the subframe also insulate against the noise and vibration that originates at the road and tyres.

Some light commercial vehicles are designed with a cab and chassis. They have a driver's cab of unitised construction and a frame, or rear chassis, on which a tray-type body, or a commercial body of some other design can be built.

Larger commercial vehicles have a full frame or chassis to which the body, engine, suspension, steering and other mechanical components are fitted. The chassis is made of steel channel or box section for strength, with the parts being welded or riveted together. Cross-bracing is provided to make the frame rigid enough to withstand the shocks, twists and vibrations that it will be subjected to during operation.

The drive train

The drive train, also called the power train, includes all the components that carry drive from the engine to the driving wheels of the vehicle. Different arrangements are used for rear-wheel drive and front-wheel drive (refer to Figures 1.1 and 1.2).

With rear-wheel drive, the drive reaches the rear wheels through the clutch, transmission, propeller shaft, final drive, differential and rear axle.

With front-wheel drive, the drive is carried by the clutch, transaxle and drive shafts to the front wheels of the vehicle. There are similar components, but they are arranged differently and are more compact.

Vehicles with automatic transmissions have similar drive trains to those with manual transmissions, but they have a torque converter instead of a clutch. Automatic transmissions for front-wheel drive are known as automatic transaxles.

Handy hint: The term *drive* is one that is commonly used, although what is actually being transmitted is *torque*, or twisting force.

Clutch

The clutch is a friction-type coupling that enables the engine to be connected or disconnected from the transmission. It consists basically of a large disc held against the engine's flywheel by spring force. The disc is released by the driver pressing down the clutch pedal. This allows the gears to be engaged and gearshifts to be made. The clutch also enables the load to be applied gradually when starting the vehicle from rest.

A simplified clutch arrangement is shown in Figure 1.7. The clutch disc is normally held against the face of the flywheel by the diaphragm spring, but is released by the movement of the pedal being transferred through the cable to the release fork.

A mechanically operated clutch is shown. Its operation depends on the action of levers. Other clutches are operated hydraulically.

Rear-wheel drive

In rear-wheel-drive vehicles, a drive shaft, called the propeller shaft, carries the drive from the transmission to the rear-axle assembly. It has universal joints and a sliding spline which allows the shaft to change its length and 'angle' so that it can adjust to rear-axle and suspension movement.

Names of components and parts

For identification purposes, all the parts of motor vehicles have names, and replacement parts also have part numbers.

The names are given for various reasons. Some names relate to the location of the part, and the word *upper* or *lower* is often used in conjunction with the part name. Other part names include the words *left* or *right*, or *front* or *rear*. Examples of this are *upper radiator hose* and *right front wheel*.

Some parts are obviously named according to their function, such as *filter*, *spring* or *shock absorber*.

The connection of some other parts with their names is a little harder to find, as they can relate to the name of a person. For example, the *diesel* engine takes its name from Dr Diesel, who developed the engine.

Names of components and parts can vary from country to country, as can the spelling. For example, *clutch disc* can be spelt *disc* or *disk*. However, with a little thought, the reason for the names which have been given to various parts can be understood. This will also assist in remembering their names.

Larger components

Larger components consist of a number of small parts: for example, the gearbox can be considered as a component and the gears which are fitted inside the gearbox as parts. Many components that contain other parts are referred to as *housings* or *boxes*, such as the *clutch housing* and *gearbox*.

In other cases, parts can be considered to form a system, which consists of a number of components or parts; for example, the fuel system includes the fuel tank, fuel pump, fuel lines and fuel injection components.

The diagrams in Figures 1.1 and 1.2 show the components in simple form and enable various components which make up the mechanical section of a motor vehicle to be identified.

Handy hint: The terms components, parts, units and items are all used in relation to motor vehicle parts.

Technical terms

Motor vehicle, front-wheel drive, rear-wheel drive, four-wheel drive, all-wheel drive, internal combustion, diesel, unitised, subframe, chassis, cross bracing, suspension, drive, drive train, power train, clutch, hydraulic, transmission, gear, gear ratio, manual transmission, housing, automatic transmission, torque converter, disc brake, drum brake, rack, pinion, worm, starter, alternator, electronic, electronic control unit, component, safety glass, body panels, body hardware, laminated, trim, mouldings, anticorrosive.

Review questions

1. Name the main sections of a motor vehicle.
2. Why is the engine referred to as an internal-combustion engine?
3. What types of fuel are used in automotive engines?
4. What is the purpose of the shock absorbers?
5. Why are tyres necessary?
6. What are the parts of the power train?
7. Why is a clutch necessary?
8. Why is a transmission fitted to a vehicle?
9. What is a transaxle?
10. What is the function of the universal joints?
11. What does the differential do?
12. What are the two designs of brakes?
13. What is the purpose of the suspension?
14. Name some of the parts in a rear-axle assembly.
15. Name some of the electrical parts of a vehicle.
16. How is the alternator driven?
17. What are the main differences between a front-wheel-drive and a rear-wheel-drive vehicle?
18. Name the main body parts of a passenger car. Refer to the appropriate illustration.