KZ650F1 1980



Kawasaki 650 Four Owners Workshop Manual

by Pete Shoemark

Models covered

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Acknowledgements

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About this manual

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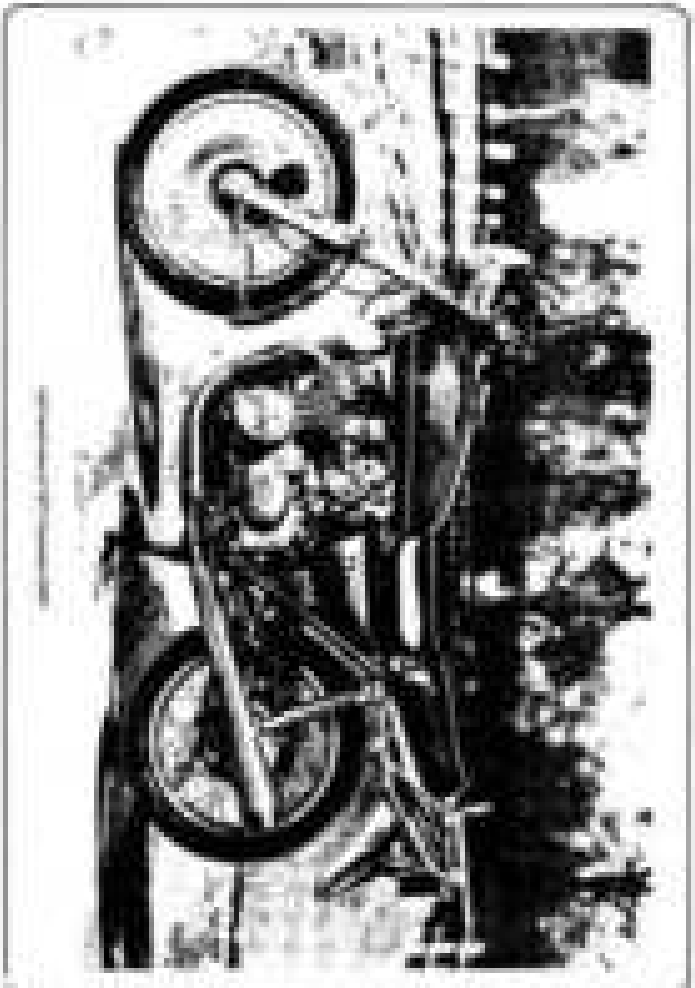
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Note: Chapters 4 to 8 are in Book 2 of this set, which is titled 'Electrical Principles for Technicians'.

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Introduction to the Kawasaki 650 Four

Dimensions and weight

Dimensions:	European models	USA models
Overall length	[illegible]	[illegible]
Overall width	[illegible]	
Overall height	[illegible]	
Wheelbase	[illegible]	
Ground clearance	[illegible]	[illegible]
Weight (dry)	[illegible]	

Ordering spare parts

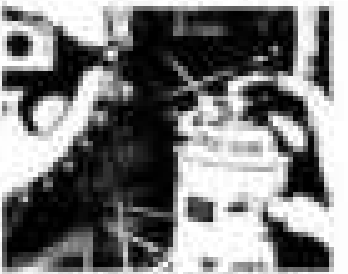




Routine maintenance









2 Cabinet scraper and burnisher

Cabinet scrapers are used to remove the fine shavings left by planing and to smooth tricky areas. They are also used to level out the slight hollows left by sanding. Burnishers are used to turn the edge of the scraper to form the cutting edge. Both tools are easy to make and to use.

3 Safety in wood

Even the smallest of cuts, burns, splinters or bruises can be painful. They can also become infected if not treated properly. Always keep a first aid kit in your workshop and make sure you know how to use it. Most accidents happen because of carelessness or lack of concentration. Always take your time and think about what you are doing.

4 Legal matters

Before you start work, make sure you have the correct insurance cover and appropriate [illegible].

Cleaning and repairing the wooden drawer handle

Cleaning the wooden drawer handle with sandpaper. The wood is scratched and dirty and needs cleaning. Use a fine-grade sandpaper (about 240 grit) and rub gently along the grain of the wood. Be careful not to round off the edges or corners. Wipe away the dust with a clean, dry cloth. Repeat if necessary until the wood is smooth and clean. Apply a thin coat of beeswax polish and buff to a shine with a soft cloth. This will help to protect the wood from moisture and dirt.

Repairing the wooden drawer handle. If the handle is broken or cracked, it will need to be repaired or replaced. For a small crack, you can glue it back together. Use a strong wood glue and clamp the pieces together until the glue is dry. If the handle is missing or beyond repair, you will need to make a new one. Measure the old handle carefully and transfer the dimensions to a piece of hardwood. Cut out the shape using a coping saw or bandsaw, then sand and shape it to match the original. Drill a hole for the screw and attach the new handle to the drawer front.

Replacing the wooden drawer handle. If you have replaced the handle, you will need to attach it to the drawer front. Position the handle where you want it and mark the screw holes with a pencil. Drill pilot holes slightly smaller than the screw diameter to prevent splitting the wood. Countersink the holes if you want the screw heads to be flush with the surface. Screw the handle in place, tightening the screws firmly but not overtightening them, which could strip the threads or crack the wood. Finish by applying a coat of wax or oil to protect the wood and give it a nice sheen.

5 Cleaning and repairing the wooden drawer handle

The wooden drawer handle is a functional and decorative part of your furniture, and it can add a touch of elegance to your drawers. However, it can also become dirty, scratched, or even broken over time. Fortunately, cleaning and repairing a wooden drawer handle is a relatively simple task that can be done with a few basic tools and materials.

Cleaning the wooden drawer handle. Over time, the handle may become dirty from handling, spills, or exposure to the environment. To clean it, start by removing any loose dirt or debris with a soft-bristled brush or a vacuum cleaner with a brush attachment. Next, mix a small amount of mild soap with warm water and dip a soft cloth into the solution. Wring out the cloth so that it is damp but not dripping, and gently wipe the handle, paying special attention to any crevices or corners where dirt may accumulate. Rinse the cloth with clean water and wipe the handle again to remove any soap residue. Finally, dry the handle with a clean, soft cloth.

If the handle is stained or discolored, you may need to use a stronger cleaning solution. One option is to mix equal parts of white vinegar and water and apply the solution to the handle with a cloth. Let it sit for a few minutes, then rinse and dry as before. Another option is to use a commercial wood cleaner or polish, following the manufacturer's instructions. Be sure to test any cleaning solution on a small, inconspicuous area of the handle first to make sure it does not damage the finish.

Repairing the wooden drawer handle. If the handle is cracked, chipped, or broken, you will need to repair it before it can be used again. For small cracks or chips, you can fill the damage with wood glue or a wood filler that matches the color of the handle. Apply the glue or filler with a toothpick or a small brush, and then clamp the handle together or hold it in place with tape until the glue or filler has dried. Sand the repaired area smooth with fine-grit sandpaper, and then clean and dry the handle as described above.

6 Repairing a broken drawer runner

If a drawer runner is broken, it will need to be replaced. To do this, you will need to remove the drawer from the cabinet. Start by opening the drawer and locating the screws that hold the runner in place. There will be one screw at the front of the runner and one at the back. Use a screwdriver to remove these screws, and then carefully slide the drawer out of the cabinet. Be careful not to damage the drawer or the cabinet as you do this.

Once the drawer is out, you can remove the broken runner. Use a screwdriver to remove the screws that hold it to the cabinet. Take the broken runner with you to the hardware store to find a replacement that is the same size and shape. When you have the new runner, position it in the cabinet and screw it in place. Make sure that the screws are tight, but not overtightened, as this could strip the threads or crack the wood.

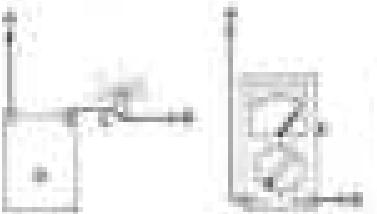
Finally, slide the drawer back into the cabinet and test it to make sure that it opens and closes smoothly. If the drawer is sticking or binding, you may need to adjust the position of the runner slightly. Once you are satisfied that the drawer is working properly, you can tighten the screws fully and replace the drawer front if you removed it earlier.



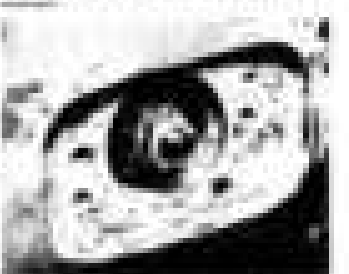
Figure 1: Cabinet scraper and burnisher in use



Figure 2: Repairing a broken drawer runner

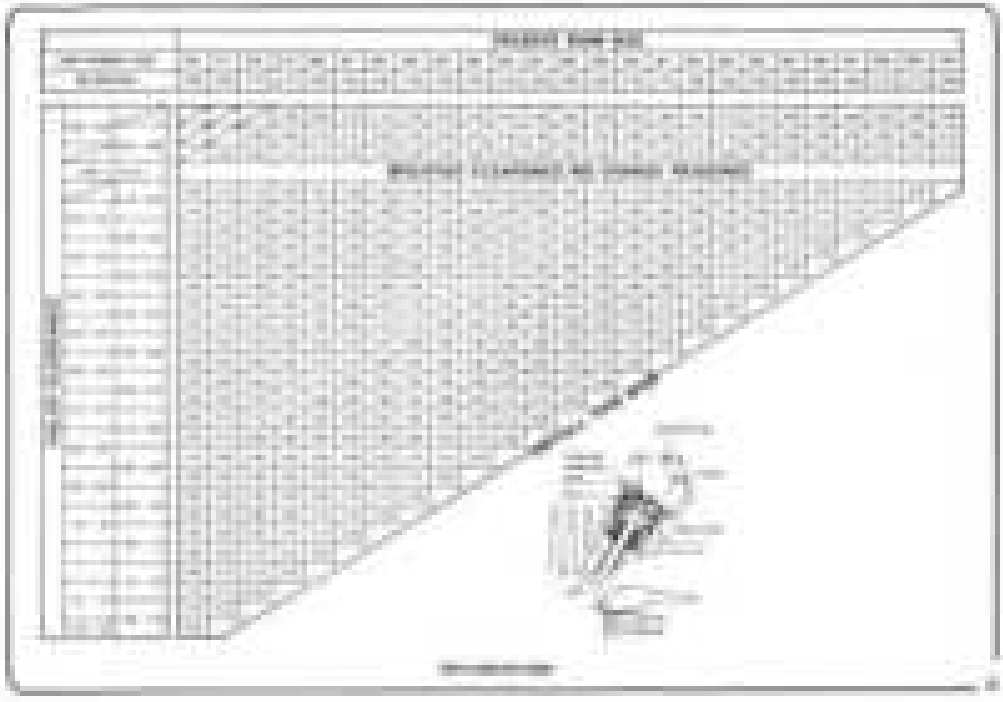












Zugang über die Fossa canina

Zugang: Der Zugang zur Fossa canina erfolgt über die Umschlagfalte des Vestibulums im Bereich zwischen Eckzahn und Prämolaren (Abb. 4.3).



Abb. 4.3 Zugang über die Fossa canina

Zugang über den Gaumen

Zugang: Der Zugang zum Gaumen erfolgt über einen Schnitt parallel zum Gaumenrand, der in einem Abstand von 1 cm zum Gaumenrand verläuft. Dabei wird die Arteria palatina durchtrennt. Die Blutung kann durch Kompression gestillt werden. Der Schnitt wird bis auf den Knochen geführt. Anschließend wird das Periost mit einem Raspatorium abgelöst. Dabei ist darauf zu achten, dass die Arteria palatina nicht durchtrennt wird. Nach Abschluss der Operation wird die Wunde durch Nähte verschlossen.

Zugang über den Sinus maxillaris

Zugang: Der Zugang zum Sinus maxillaris erfolgt über einen Schnitt in der Umschlagfalte des Vestibulums. Der Schnitt wird bis auf den Knochen geführt. Anschließend wird das Periost mit einem Raspatorium abgelöst. Dabei ist darauf zu achten, dass die Arteria palatina nicht durchtrennt wird. Nach Abschluss der Operation wird die Wunde durch Nähte verschlossen.

Zugang über den Sinus maxillaris

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Quick glance maintenance adjustments and capacities

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Recommended lubricants

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Working conditions and tools

Chapter 1 Engine, clutch and gearbox

Specifications

Engine

Pronouns

I	أنا (ʾanā)
We	نحن (naḥnu)
You (m. sg.)	أنت (ʾanta)
You (f. sg.)	أنتِ (ʾanti)
You (m. du.)	أنتما (ʾantumā)
You (f. du.)	أنتما (ʾantumā)
You (m. pl.)	أنتم (ʾantum)
You (f. pl.)	أنتن (ʾantunna)
He	هو (huwa)
She	هي (hiya)
They (m. du.)	هما (humā)
They (f. du.)	هما (humā)
They (m. pl.)	هم (hum)
They (f. pl.)	هن (hunna)

Present tense

I write	أكتب (ʾaktubu)
I read	أقرأ (ʾaqraʾu)
I go	أذهب (ʾadhhabu)
I eat	آكل (ʾākulu)
I drink	أشرب (ʾashrabu)
I sleep	أنام (ʾanāmu)
I work	أعمل (ʾaʿmalu)
I study	أدرس (ʾadrusu)
I speak	أتكلم (ʾatakallamu)
I live	أسكن (ʾaskunu)
I know	أعرف (ʾaʿrifu)
I want	أريد (ʾurīdu)
I have	عندي (ʿindī)
I am	أنا (ʾanā)

Negation

I am not	لست (lastu)
I do not write	لا أكتب (lā ʾaktubu)
I do not know	لا أعرف (lā ʾaʿrifu)
I do not want	لا أريد (lā ʾurīdu)
I do not have	ليس عندي (laysa ʿindī)
I did not write	لم أكتب (lam ʾaktub)
I did not go	لم أذهب (lam ʾadhhab)
I will not write	لن أكتب (lan ʾaktuba)
I will not go	لن أذهب (lan ʾadhhaba)
I cannot	لا أستطيع (lā ʾastaṭīʿu)
I never	لم أبدًا (lam ʾabadan)
I no longer	لم أعد (lam ʾaʿud)

Questions

Who?	من؟ (man?)
What?	ماذا؟ (mādhā?)
Where?	أين؟ (ʾayna?)
When?	متى؟ (matā?)
Why?	لماذا؟ (limādhā?)
How?	كيف؟ (kayfa?)
How much / How many?	كم؟ (kam?)
Which? (m.)	أي؟ (ʾayyu?)
Which? (f.)	أية؟ (ʾayyatu?)
Is it true that…?	هل؟ (hal?)
Isn't it?	أليس كذلك؟ (ʾalaysa kadhālika?)
Yes/No	نعم / لا (naʿam / lā)

Nouns

The book (m.)	الكتاب (al-kitābu)
The house	البيت (al-baytu)
The city	المدينة (al-madīnatu)
The school	المدرسة (al-madrasatu)
The teacher (m.)	المعلم (al-muʿallimu)
The student (m.)	الطالب (al-ṭālibu)
The water	الماء (al-māʾu)
The bread	الخبز (al-khubzu)
The food	الطعام (al-ṭaʿāmu)
The day	اليوم (al-yawmu)
The night	الليل (al-laylu)
The time	الوقت (al-waqtu)

Adjectives

Big	كبير (kabīrun)
Small	صغير (ṣaghīrun)
Good	جيد (jayyidun)
Bad	سيئ (sayyiʾun)
Beautiful	جميل (jamīlun)
New	جديد (jadīdun)
Old	قديم (qadīmun)
Hot	حار (ḥārrun)
Cold	بارد (bāridun)
Easy	سهل (sahlun)
Difficult	صعب (ṣaʿbun)

Phrases

Thank you	شكرًا (shukran)
You're welcome	عفوًا (ʿafwan)
Please	من فضلك (min faḍlika)
Excuse me	عذرًا (ʿudhran)
Sorry	آسف (ʾāsifun)
Hello	مرحبا (marḥaban)
Goodbye	مع السلامة (maʿa as-salāmati)
Peace be upon you	السلام عليكم (as-salāmu ʿalaykum)
And upon you peace	وعليكم السلام (wa-ʿalaykumu as-salām)



Receipts
Cash
Cash flow
Payments
Cash flow
Cash flow
Cash flow

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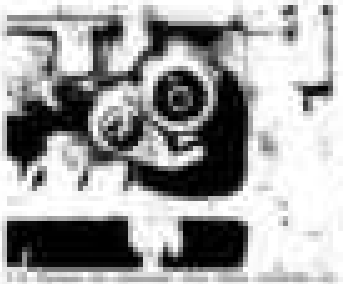


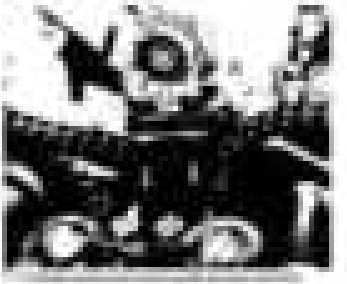




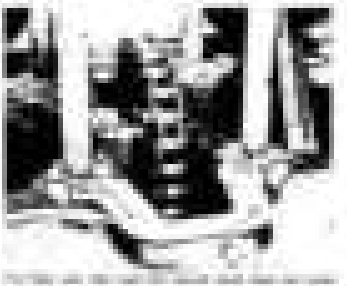






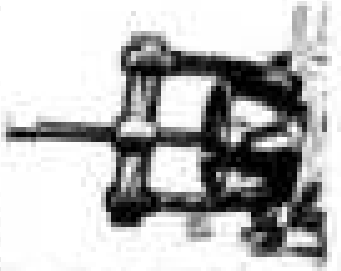








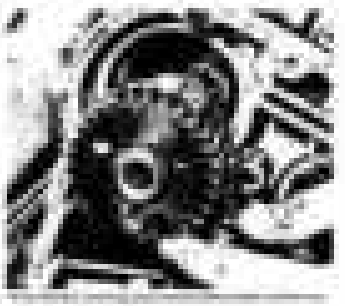








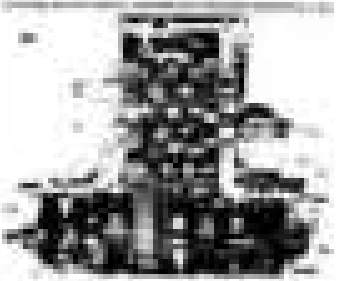














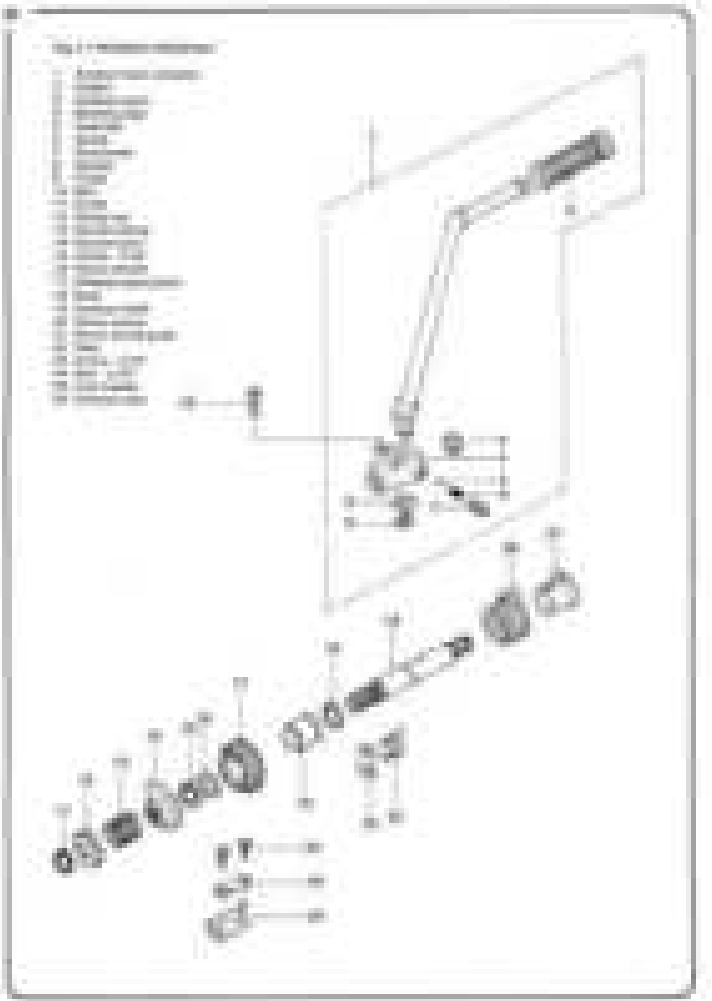






















3.1 Electric motors and generators – principles and practice

A motor has the fundamental function of converting electrical energy into mechanical energy, and a generator does the opposite. Both machines rely on the interaction between a magnetic field and a current-carrying conductor to produce force or voltage. Understanding this relationship is essential before examining any specific machine type.

When a conductor carrying current is placed in a magnetic field, it experiences a force perpendicular to both the field and the current. This is the basis of motor action. Conversely, when a conductor moves through a magnetic field, a voltage is induced in it. This is the basis of generator action. The same physical principle operates in both cases; only the direction of energy flow differs.

The mechanical complexity of an electric machine depends largely on how the magnetic field is produced. Permanent magnet machines use magnets fixed to the rotor or stator, while wound field machines use coils of wire energised by a separate supply. Each approach has advantages and disadvantages that affect cost, efficiency, and control.

Commutation is the process by which the direction of current in the armature is reversed at the correct moment to maintain torque in a single direction. In a brushed machine, this is achieved mechanically by a split ring and carbon brushes. In a brushless machine, it is achieved electronically by switching the phase windings in sequence. Commutation is one of the most common sources of failure in brushed machines.

The efficiency of an electric machine is the ratio of useful mechanical power output to electrical power input. Losses arise from copper resistance in the windings, iron losses in the magnetic core, and friction and windage in the bearings. Efficiency is highest when the machine operates near its rated load and falls off at very light or very heavy loads.

Rated power is the continuous output a machine can deliver without exceeding its temperature limit. Exceeding rated power for short periods is acceptable, but sustained overload will shorten insulation life. Duty cycle describes how the load varies over time and is used to select a machine that will not overheat in service.

Speed control is straightforward in principle but varies in practice between machine types. Shunt-wound machines maintain near-constant speed under varying load, while series-wound machines slow down as load increases. Modern drives use electronic controllers to vary voltage or frequency and so control speed precisely.



Fig. 3.1 Cutaway of a small brushed DC motor showing the armature, commutator and brushes

3.2 Internal combustion engines – principles and practice

The internal combustion engine converts the chemical energy of fuel into mechanical work by burning it inside a sealed cylinder. The expanding gases push a piston, which turns a crankshaft through a connecting rod. Almost all road vehicles use this principle, and understanding it is the starting point for any work on engines, fuel systems, or emissions.

Most engines operate on a four-stroke cycle: intake, compression, power, and exhaust. The intake stroke draws a mixture of air and fuel into the cylinder. The compression stroke squeezes it to a small volume, raising its temperature and pressure. The power stroke begins when the mixture is ignited, driving the piston down. The exhaust stroke pushes the burnt gases out. Two-stroke engines combine these functions in fewer strokes and are simpler but less efficient.

Ignition is provided by a spark plug in petrol engines and by the heat of compression in diesel engines. In a petrol engine, a coil or electronic ignition module raises the battery voltage to several thousand volts and delivers a spark at the correct moment. In a diesel engine, fuel is injected into air that is already hot enough to ignite it, so no spark is needed.

The fuel system delivers the right amount of fuel at the right time. Carburettors mix fuel and air mechanically using the flow of air through a venturi. Fuel injection systems use electronically controlled injectors and are more precise, more efficient, and easier to meet emissions standards with. Modern engines are almost all fuel injected.

Cooling is essential because only about a third of the energy in fuel becomes useful work; most of the rest is heat. Water-cooled engines circulate coolant through passages in the block and head, carrying heat to a radiator where it is dissipated to the air. Air-cooled engines rely on fins and airflow alone and run hotter.

Lubrication reduces friction and wear between moving parts and also helps carry away heat. Oil is pumped from a sump through filters to the bearings, cylinder walls, and valve gear. Oil pressure and oil level are the two most important things to check on any engine.

Exhaust gases contain pollutants as well as heat. Catalytic converters reduce nitrogen oxides, carbon monoxide, and unburnt hydrocarbons to less harmful substances. They require unleaded fuel and a hot engine to work properly, and they are damaged by oil burning or by misfiring.

Engine speed is measured in revolutions per minute and is limited by friction, valve float, and the strength of moving parts. Power rises with speed up to a point, then falls off as the engine struggles to breathe. Torque, the twisting force, is usually highest at a lower speed than power.

Fuel economy depends on how the engine is driven as much as on how it is built. Smooth throttle inputs, steady speeds, and timely gear changes all reduce consumption. Idling for long periods wastes fuel and should be avoided.

3.3 Propulsion systems – principles and practice

Propulsion is the conversion of energy into thrust that moves a vehicle through a fluid or across a surface. Whatever the energy source, the engineer must match the power available to the resistance the vehicle will meet, and must do so over the full range of speeds the vehicle is expected to travel.

Resistance to motion has several components. Rolling resistance arises from the deformation of tyres and the surface they run on. Aerodynamic drag grows with the square of speed and dominates at highway speeds. Gradient resistance appears whenever the road climbs. Acceleration requires extra force to change the kinetic energy of the vehicle. A propulsion system must overcome the sum of these at every point in its duty cycle.

Power and torque are related but distinct. Torque is the twisting force at the wheels; power is torque multiplied by rotational speed. A gearbox trades torque for speed so that the engine can operate near its most efficient point while the vehicle moves at a useful road speed. Without gearing, a vehicle would either stall on hills or waste fuel on the flat.

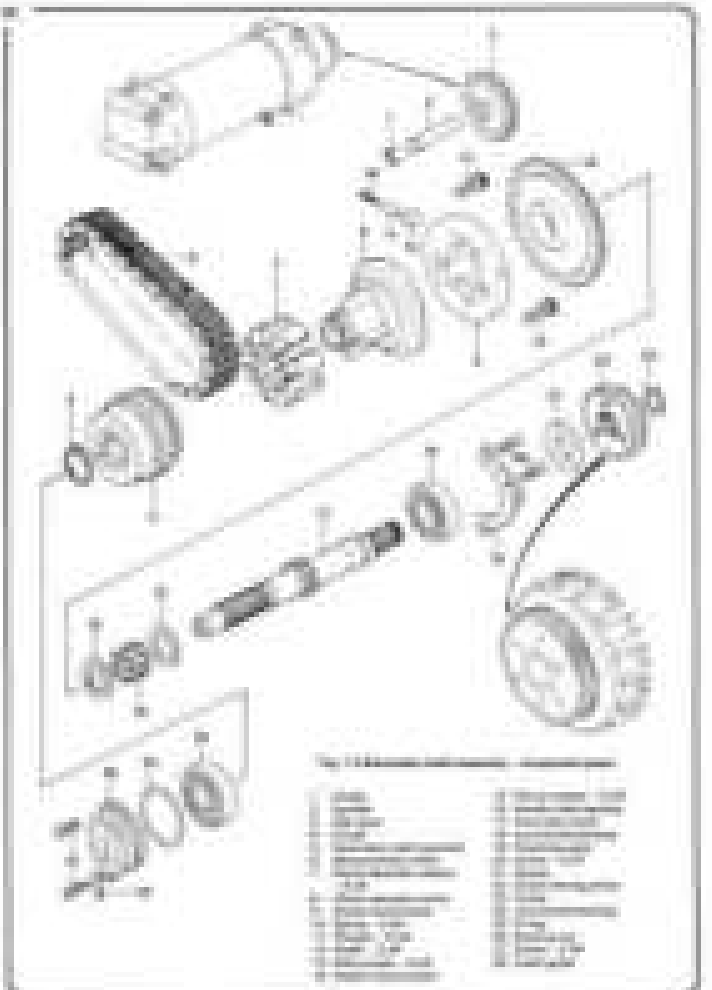
Traction is limited by the grip between the tyres and the road. Applying more torque than the tyres can transmit causes wheelspin rather than forward motion. Driven wheels, weight distribution, and tyre choice all affect how much traction is available, and a propulsion system is only as good as the traction it can use.

Energy storage is the main constraint on range. Liquid fuels store a great deal of energy per unit mass and can be refilled in minutes, which is why they remain dominant. Batteries store far less energy per unit mass and take much longer to recharge, so battery vehicles must be designed around a smaller usable range.

Regenerative braking recovers some of the energy that would otherwise be lost as heat in the brakes. When the driver slows down, the motor is run as a generator and the kinetic energy of the vehicle is returned to the battery. The amount recovered depends on how often the vehicle brakes and on the efficiency of the whole drive chain.

Control of propulsion is now largely electronic. The driver's pedal position is read as a demand, and the controller decides how much power to draw from the energy source and how to apply it. Smooth, progressive control is easier to achieve electronically than with mechanical linkages, and it can be tuned for economy or for performance.

Reliability and maintenance differ between propulsion types. Engines need oil changes, filters, and cooling system attention. Electric drives have few moving parts but depend on the health of the battery, which is usually the most expensive component to replace. Choosing a propulsion system means choosing which maintenance burden to accept.







1.1 The orbit and adnexa

1.1.1 Bony orbit

The orbit is a pyramidal bony cavity with its base at the orbital rim and its apex at the optic canal. The orbital rim is formed by the frontal bone superiorly, the zygomatic bone laterally, and the maxilla inferiorly. The medial wall is formed by the lacrimal bone, the ethmoid bone, and the body of the sphenoid bone. The roof is formed by the orbital plate of the frontal bone and the lesser wing of the sphenoid bone. The floor is formed by the maxilla, the zygomatic bone, and the orbital process of the palatine bone.

The orbital volume in adults is approximately 30 cc. The axial length of the orbit is about 45 mm. The optic canal transmits the optic nerve and the ophthalmic artery.

1.1.2 Eyelids

The eyelids are thin, mobile folds of skin, muscle, and connective tissue that protect the anterior surface of the eye. The upper eyelid is larger and more mobile than the lower eyelid. The palpebral fissure is the space between the upper and lower eyelids. The medial canthus is the angle where the upper and lower eyelids meet medially. The lateral canthus is the angle where they meet laterally.

The eyelid margin contains the openings of the meibomian glands, which secrete the lipid layer of the tear film. The gray line is a landmark between the anterior and posterior lamellae of the eyelid margin. The mucocutaneous junction is the line where the eyelid skin meets the conjunctiva.

The levator palpebrae superioris muscle elevates the upper eyelid. It is innervated by the oculomotor nerve (CN III). Müller's muscle, a smooth muscle, also contributes to upper eyelid elevation. It is innervated by sympathetic fibers. Ptosis can result from damage to either muscle.

The orbicularis oculi muscle closes the eyelids. It is innervated by the facial nerve (CN VII). The tarsal plates are dense connective tissue structures that provide support to the eyelids. They contain the meibomian glands.

The eyelid skin is the thinnest skin in the body. It is loose and elastic, allowing for rapid swelling. The eyelid margin is the site of many common lesions, including chalazion, hordeolum, and basal cell carcinoma.

1.1.3 Lacrimal system

The lacrimal gland is located in the superotemporal orbit. It secretes the aqueous component of tears. The lacrimal gland is innervated by parasympathetic fibers from the facial nerve (CN VII).

Tears drain through the lacrimal puncta, which are small openings on the medial aspect of the upper and lower eyelids. The puncta lead to the lacrimal canaliculi, which drain into the lacrimal sac. The lacrimal sac is located in the lacrimal fossa, formed by the lacrimal bone and the frontal process of the maxilla.

The nasolacrimal duct drains tears from the lacrimal sac into the inferior meatus of the nose. The nasolacrimal duct opens into the inferior meatus under the inferior turbinate. Obstruction of the nasolacrimal duct causes epiphora (tearing).

The tear film has three layers: the lipid layer, the aqueous layer, and the mucin layer. The lipid layer is secreted by the meibomian glands. It reduces evaporation of the aqueous layer. The aqueous layer is secreted by the lacrimal gland and the accessory lacrimal glands of Krause and Wolfring. It provides oxygen and nutrients to the cornea. The mucin layer is secreted by conjunctival goblet cells. It helps the tear film spread evenly over the ocular surface.

The tear film breakup time (TBUT) is the time it takes for dry spots to appear in the tear film after a blink. A TBUT of less than 10 seconds is abnormal. Dry eye disease is a common condition characterized by tear film instability, ocular surface inflammation, and symptoms of discomfort.

1.1.4 Conjunctiva

The conjunctiva is a thin, transparent mucous membrane that lines the inner surface of the eyelids and covers the anterior sclera. It is divided into the palpebral conjunctiva, the bulbar conjunctiva, and the fornix conjunctiva.

The palpebral conjunctiva lines the inner surface of the eyelids. It is tightly adherent to the tarsal plates. The bulbar conjunctiva covers the anterior sclera. It is loosely adherent to the underlying tissue, allowing for movement of the eye.

The fornix conjunctiva is the transitional zone between the palpebral and bulbar conjunctiva. It forms the superior, inferior, and lateral fornices. The fornices allow for movement of the eyelids relative to the eye.

The conjunctiva is composed of stratified columnar epithelium with goblet cells. The goblet cells secrete mucin, which is a component of the tear film. The conjunctiva is highly vascular, which is why it appears red when inflamed.

Conjunctival lymphatics drain into the preauricular and submandibular lymph nodes. This is why infections of the conjunctiva can cause tenderness of these nodes.

1.1.5 Cornea

The cornea is the transparent, avascular tissue that covers the anterior surface of the eye. It is the primary refractive surface of the eye, contributing about two-thirds of the eye's total refractive power. The cornea is approximately 0.5 mm thick centrally and 0.7 mm thick peripherally.

The cornea has five layers: the epithelium, Bowman's layer, the stroma, Descemet's membrane, and the endothelium. The epithelium is a stratified squamous epithelium that is continuous with the conjunctival epithelium. It has a high regenerative capacity.

Bowman's layer is an acellular layer of condensed collagen fibrils. It is not present in all species. The stroma is the thickest layer of the cornea. It is composed of regularly arranged collagen fibrils and keratocytes. The keratocytes maintain the stroma by producing collagen and proteoglycans.

Descemet's membrane is a thick basement membrane produced by the endothelium. It is composed of type IV collagen and laminin. The endothelium is a single layer of cells that pumps fluid out of the cornea. It is essential for maintaining corneal transparency.

The cornea is avascular and receives its nutrients from the tear film, the aqueous humor, and the limbal vessels. The limbus is the transitional zone between the cornea and the sclera. It contains the limbal stem cells, which are responsible for corneal epithelial renewal.

The cornea is innervated by the ophthalmic division of the trigeminal nerve (CN V). The corneal nerves enter the cornea at the limbus and lose their myelin sheaths as they cross Bowman's layer. This makes the cornea extremely sensitive to touch, pain, and temperature.

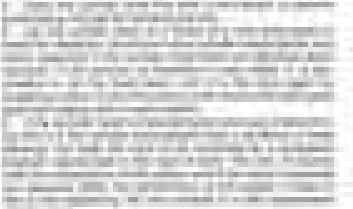
1.1.6 Sclera

The sclera is the white, opaque, fibrous outer coat of the eye. It is composed of dense irregular collagen fibers and fibroblasts. The sclera is continuous with the cornea at the limbus and with the dura mater of the optic nerve at the lamina cribrosa.

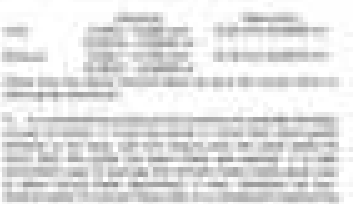
The sclera is thickest posteriorly, where it is about 1 mm thick, and thinnest at the equator, where it is about 0.4 mm thick. The sclera is relatively avascular. Its blood supply comes from the episcleral vessels and the posterior ciliary arteries.

The episclera is a thin layer of vascular tissue that overlies the sclera. It is separated from the sclera by a loose connective tissue layer. Episcleritis is inflammation of the episclera. It is usually self-limiting and does not affect vision.

The sclera is innervated by the ophthalmic division of the trigeminal nerve (CN V). Pain fibers in the sclera are responsible for the deep, boring pain of scleritis. Scleritis is a more severe inflammation of the sclera that can threaten vision.





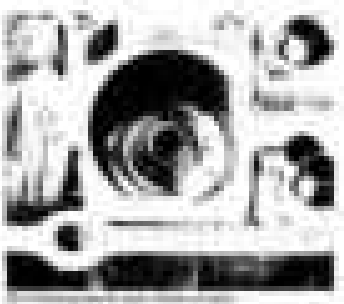


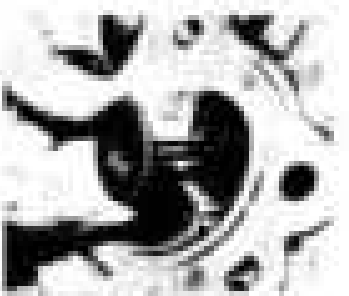


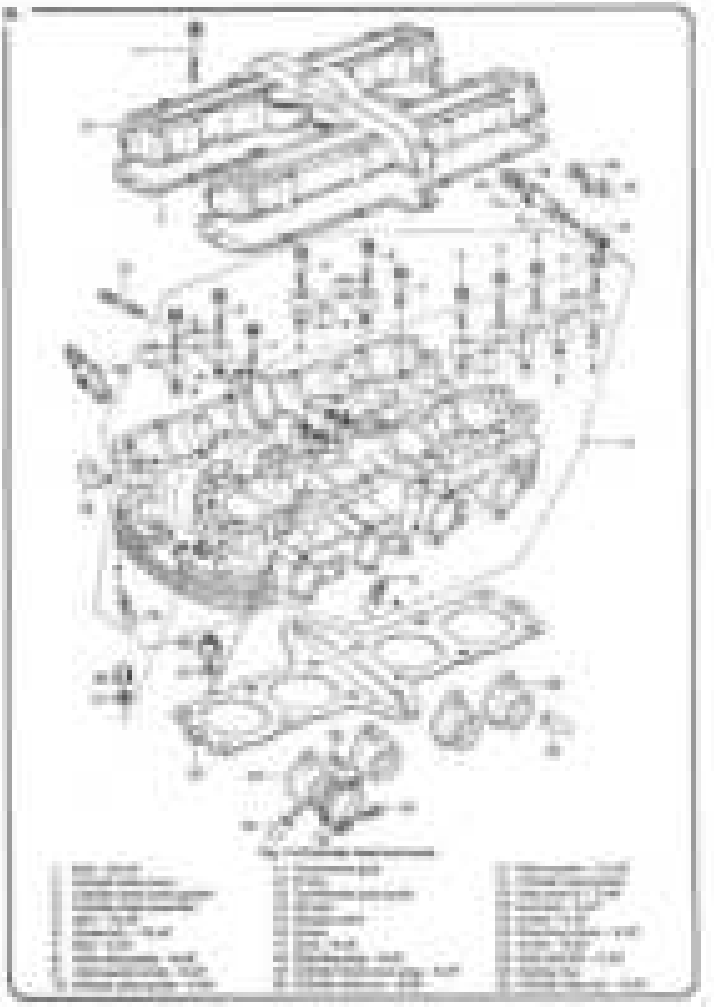


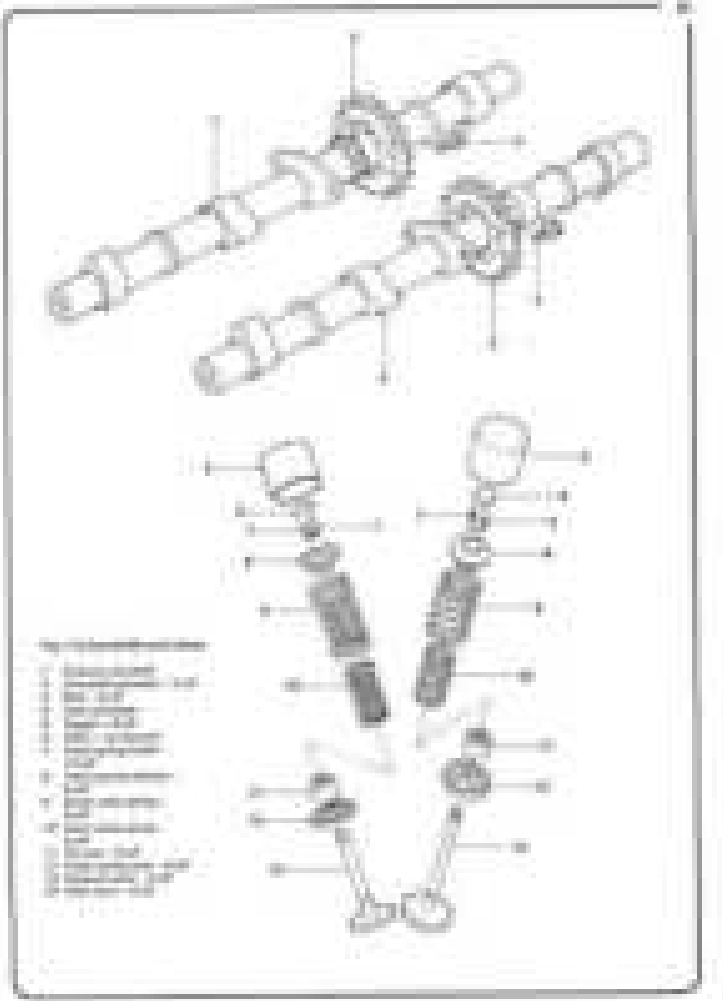








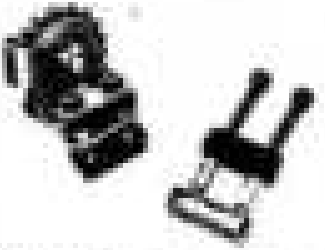




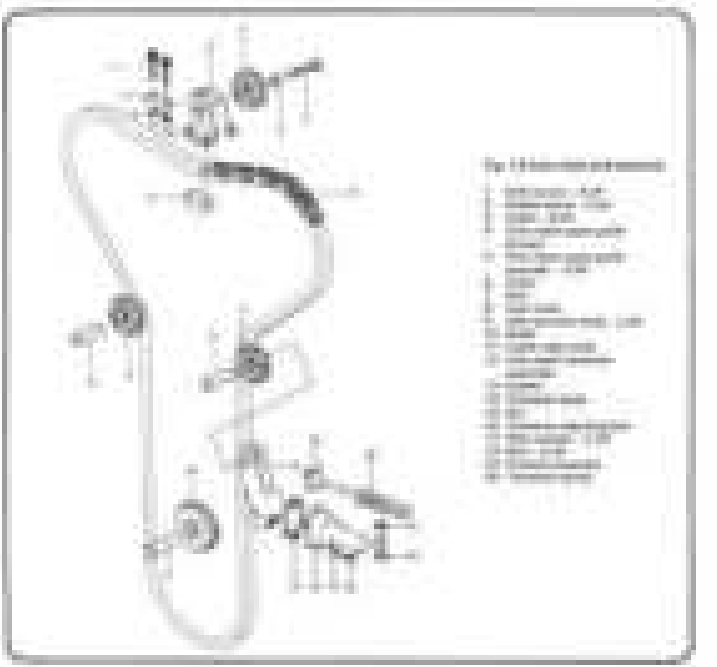












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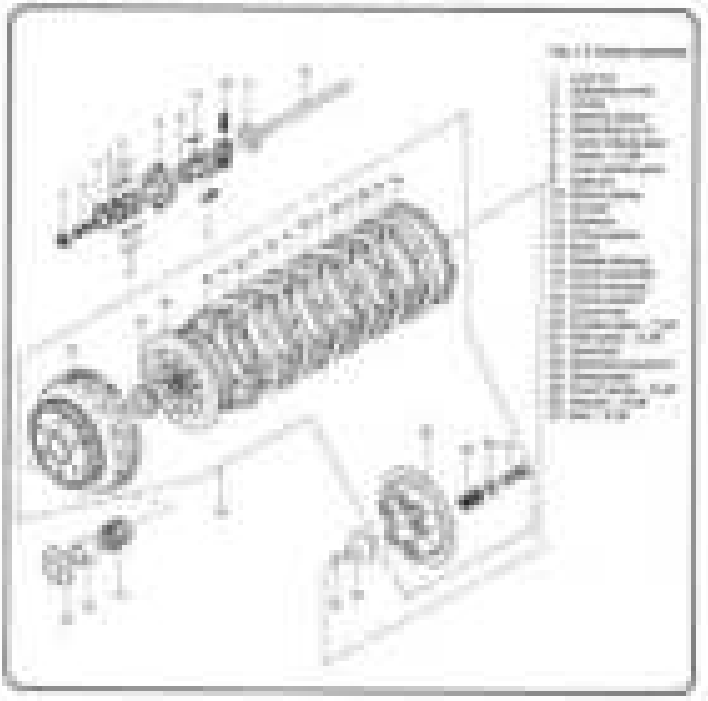
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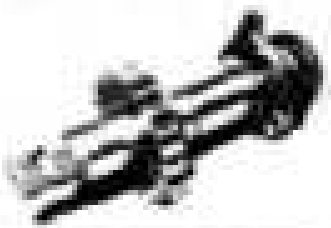
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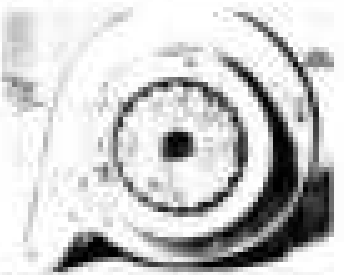
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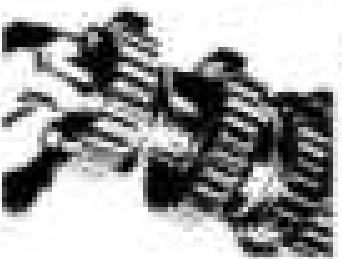










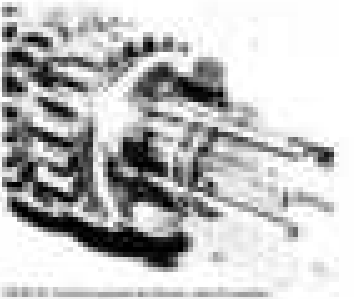






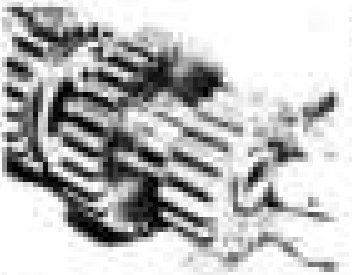




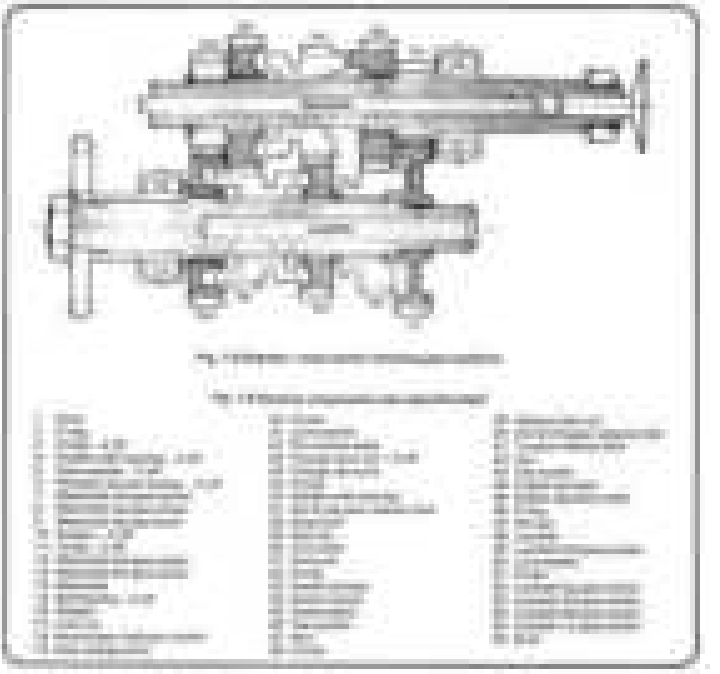


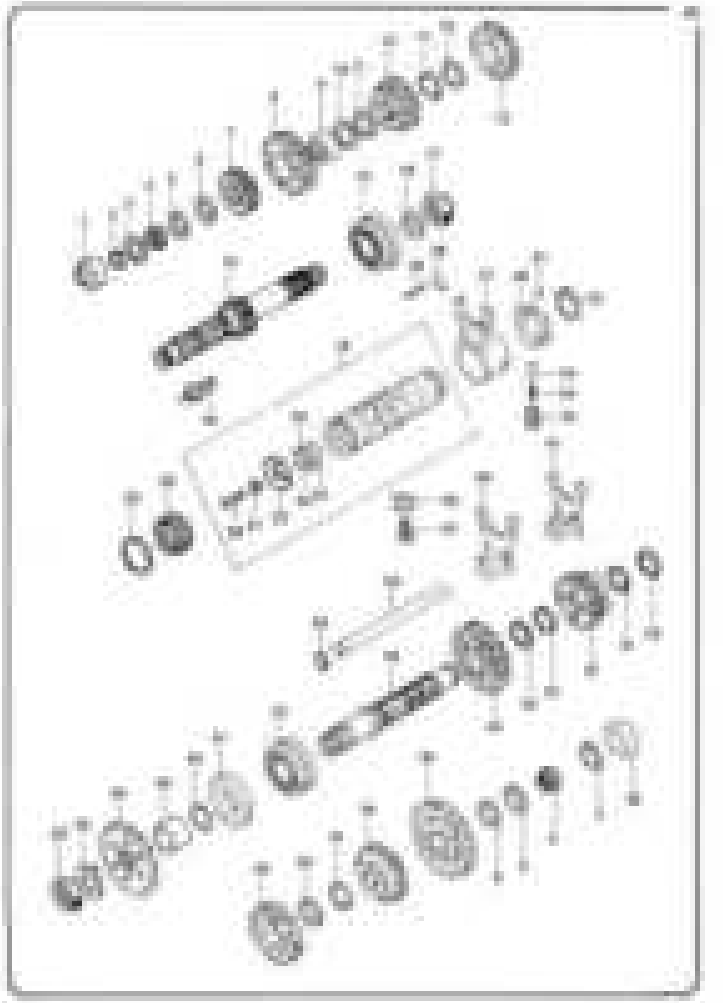














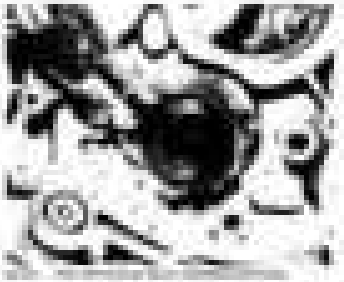























An Engine and capacitor start/run induction motor (single-phase)

The operating characteristics of a capacitor start/run induction motor are similar to those of a capacitor start induction motor except that the capacitor remains in the circuit during normal operation. Capacitor start/run induction motors are usually built for hermetic refrigeration compressor applications where the starting torque requirements are relatively high.

Figure 1.27 shows a capacitor start/run induction motor. Note that the capacitor is connected in series with a centrifugal switch and the auxiliary winding. When the motor is started, the centrifugal switch is closed, connecting the capacitor in series with the auxiliary winding. When the motor reaches approximately 75% of its rated speed, the centrifugal switch opens, but the capacitor remains in the circuit during normal operation.

Figure 1.27 Capacitor start/run induction motor

Two Capacitor start/run induction motor (single-phase)

Figure 1.28 shows a capacitor start/run induction motor with two capacitors connected in parallel. One capacitor remains in the circuit during normal operation, while the other capacitor is connected in series with a centrifugal switch. When the motor is started, the centrifugal switch is closed, connecting both capacitors in parallel with the auxiliary winding. When the motor reaches approximately 75% of its rated speed, the centrifugal switch opens, disconnecting the capacitor in series with the switch. The capacitor that remains in the circuit during normal operation is usually designed for continuous operation.

Figure 1.28 Two capacitor start/run induction motor

Shaded-pole induction motor (single-phase)

Figure 1.29 shows a shaded-pole induction motor. Note that the auxiliary winding is a single copper loop around one side of the pole piece. The auxiliary winding is usually made of copper bars that are welded together. The auxiliary winding is called a shading coil. The shading coil causes the magnetic field to be distributed unevenly across the pole face. This uneven distribution of the magnetic field produces a rotating magnetic field that causes the rotor to turn.

Figure 1.29 Shaded-pole induction motor

Universal motor

A universal motor can be operated on either AC or DC voltage. The speed of a universal motor is determined by the load and the voltage applied to the motor. The speed of a universal motor can be controlled by varying the voltage applied to the motor.

Figure 1.30 shows a universal motor. Note that the field winding is connected in series with the armature. The armature is connected to the commutator. The commutator is connected to the brushes. The brushes are connected to the power source.

Figure 1.30 Universal motor

Synchronous motor

A synchronous motor runs at a constant speed. The speed of a synchronous motor is determined by the frequency of the power source and the number of poles in the motor. The speed of a synchronous motor can be controlled by varying the frequency of the power source.

Figure 1.31 shows a synchronous motor. Note that the field winding is connected to a DC power source. The armature is connected to the AC power source. The field winding is energized by the DC power source. The armature is energized by the AC power source. The interaction between the magnetic field produced by the field winding and the magnetic field produced by the armature causes the rotor to turn.

Figure 1.31 Synchronous motor

Stepper motor

A stepper motor is a type of motor that moves in discrete steps. The speed of a stepper motor is determined by the frequency of the pulses applied to the motor. The direction of a stepper motor is determined by the sequence of the pulses applied to the motor. The position of a stepper motor is determined by the number of pulses applied to the motor.

Figure 1.32 shows a stepper motor. Note that the stepper motor has a rotor and a stator. The stator has windings that are energized by the pulses applied to the motor. The rotor has permanent magnets. The interaction between the magnetic field produced by the stator windings and the magnetic field produced by the permanent magnets causes the rotor to turn.

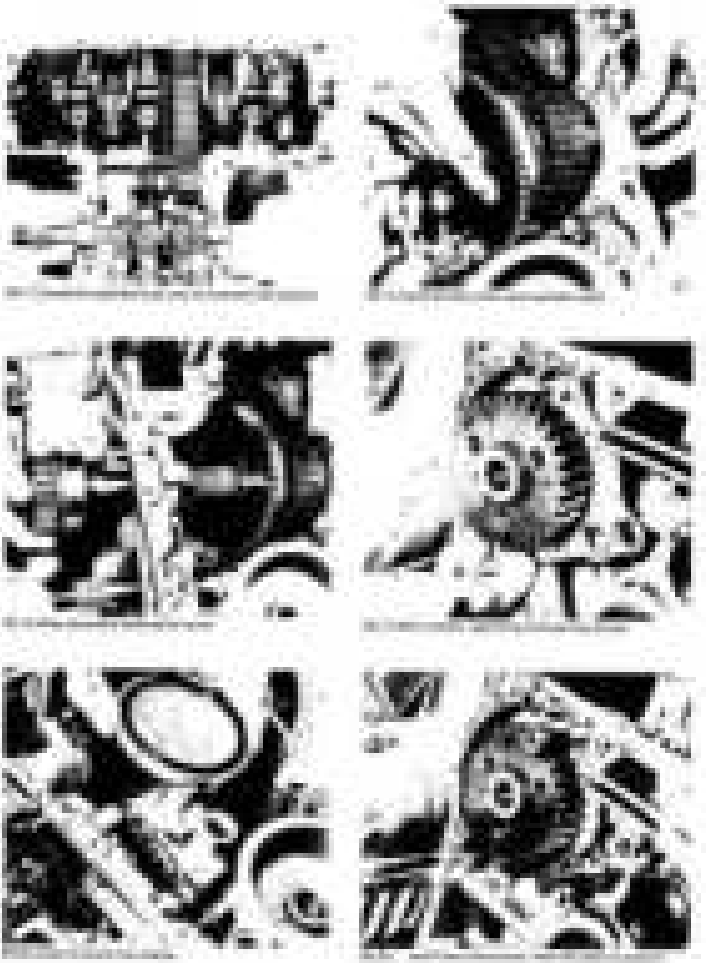
Figure 1.32 Stepper motor

Servo motor

A servo motor is a type of motor that is used in applications where the position of the motor must be controlled. The speed of a servo motor is determined by the load and the voltage applied to the motor. The position of a servo motor is determined by the feedback signal.

Figure 1.33 shows a servo motor. Note that the servo motor has a rotor and a stator. The stator has windings that are energized by the power source. The rotor has permanent magnets. The interaction between the magnetic field produced by the stator windings and the magnetic field produced by the permanent magnets causes the rotor to turn. The feedback signal is used to control the position of the rotor.

Figure 1.33 Servo motor



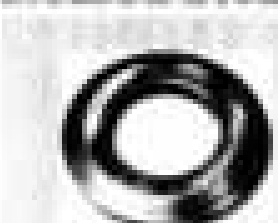








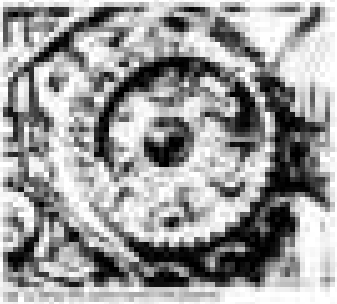


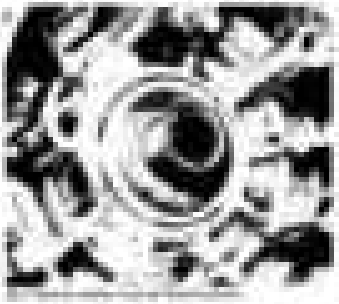










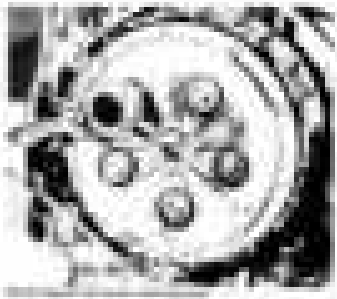


















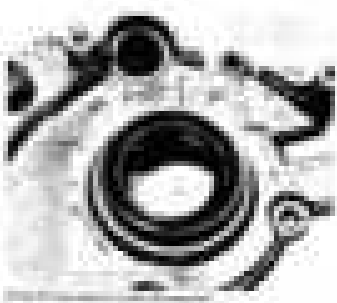




Fig. 1.8 Anatomy and dynamics of the temporomandibular joint (TMJ)

a Sagittal section through the TMJ. The articular disc (1) divides the joint into an upper and a lower joint space. The lower joint space is the primary site of translation (anterior movement of the condyle). The upper joint space is the primary site of rotation (hinge movement). The articular disc is attached to the joint capsule anteriorly and posteriorly. The posterior attachment is richly innervated and vascularized. The articular disc is divided into three zones: the anterior band (2), the intermediate zone (3), and the posterior band (4). The posterior band is attached to the posterior wall of the glenoid fossa (5) by the bilaminar zone (6). The bilaminar zone consists of an upper and a lower lamina. The upper lamina is attached to the roof of the glenoid fossa (7). The lower lamina is attached to the posterior surface of the condylar neck (8). The articular eminence (9) is the anterior boundary of the glenoid fossa. The condyle (10) articulates with the glenoid fossa. The condylar head is covered by fibrocartilage. The condylar neck (11) is the constriction between the condylar head and the ramus of the mandible. The lateral pterygoid muscle (12) is attached to the anterior surface of the condylar neck and to the articular disc. The retrodiscal tissue (13) is the loose connective tissue between the posterior band of the articular disc and the bilaminar zone. The retrodiscal tissue contains blood vessels and nerves. The temporal bone (14) forms the roof of the glenoid fossa. The external auditory meatus (15) is the opening of the ear canal. The mandibular ramus (16) is the vertical part of the mandible. The coronoid process (17) is the anterior process of the mandibular ramus. The temporalis muscle (18) is attached to the coronoid process. The masseter muscle (19) is attached to the lateral surface of the mandibular ramus. The parotid gland (20) is the largest salivary gland. The facial nerve (21) passes through the parotid gland. The auriculotemporal nerve (22) passes behind the condylar neck. The superficial temporal artery (23) passes in front of the tragus. The superficial temporal vein (24) passes in front of the tragus. The transverse facial artery (25) passes below the zygomatic arch. The transverse facial vein (26) passes below the zygomatic arch. The zygomatic arch (27) is formed by the temporal process of the zygomatic bone and the zygomatic process of the temporal bone. The mandibular fossa (28) is the depression in the temporal bone that receives the condyle. The articular tubercle (29) is the anterior boundary of the mandibular fossa. The petrotympanic fissure (30) is the opening through which the chorda tympani nerve passes. The styloid process (31) is the bony process that gives attachment to the stylohyoid ligament. The stylomandibular ligament (32) is the ligament that connects the styloid process to the angle of the mandible. The sphenomandibular ligament (33) is the ligament that connects the spine of the sphenoid bone to the lingula of the mandible. The lateral pterygoid plate (34) is the lateral plate of the pterygoid process of the sphenoid bone. The medial pterygoid muscle (35) is attached to the medial surface of the mandibular ramus and to the lateral pterygoid plate. The inferior alveolar nerve (36) passes through the mandibular foramen. The lingual nerve (37) passes medial to the third molar. The buccal nerve (38) passes lateral to the second molar. The mylohyoid muscle (39) is attached to the mylohyoid line of the mandible. The submandibular gland (40) is the second largest salivary gland. The hyoid bone (41) is the U-shaped bone in the neck. The digastric muscle (42) has an anterior belly and a posterior belly. The anterior belly is attached to the digastric fossa of the mandible. The posterior belly is attached to the mastoid process of the temporal bone. The stylohyoid muscle (43) is attached to the styloid process and to the hyoid bone. The internal carotid artery (44) passes through the carotid canal. The internal jugular vein (45) passes through the jugular foramen. The vagus nerve (46) passes through the jugular foramen. The accessory nerve (47) passes through the jugular foramen. The hypoglossal nerve (48) passes through the hypoglossal canal. The sternocleidomastoid muscle (49) is attached to the sternum and to the clavicle. The trapezius muscle (50) is attached to the occipital bone and to the spine of the scapula. The levator scapulae muscle (51) is attached to the transverse processes of the cervical vertebrae and to the scapula. The scalenus anterior muscle (52) is attached to the transverse processes of the cervical vertebrae and to the first rib. The scalenus medius muscle (53) is attached to the transverse processes of the cervical vertebrae and to the first rib. The scalenus posterior muscle (54) is attached to the transverse processes of the cervical vertebrae and to the second rib. The brachial plexus (55) passes between the scalenus anterior and scalenus medius muscles. The subclavian artery (56) passes between the scalenus anterior and scalenus medius muscles. The subclavian vein (57) passes in front of the scalenus anterior muscle. The phrenic nerve (58) passes in front of the scalenus anterior muscle. The thoracic duct (59) passes behind the esophagus. The esophagus (60) passes behind the trachea. The trachea (61) is the windpipe. The thyroid gland (62) is the endocrine gland in the neck. The parathyroid glands (63) are the four small glands behind the thyroid gland. The recurrent laryngeal nerve (64) passes behind the thyroid gland. The superior laryngeal nerve (65) passes behind the thyroid gland. The external carotid artery (66) passes behind the internal carotid artery. The internal carotid artery (67) passes behind the external carotid artery. The common carotid artery (68) is the artery that divides into the internal and external carotid arteries. The internal jugular vein (69) is the vein that receives blood from the brain. The external jugular vein (70) is the vein that receives blood from the face and scalp. The anterior jugular vein (71) is the vein that receives blood from the anterior neck. The subclavian vein (72) is the vein that receives blood from the arm. The brachiocephalic vein (73) is the vein that receives blood from the head and neck. The superior vena cava (74) is the vein that receives blood from the brachiocephalic veins. The right atrium (75) is the chamber of the heart that receives blood from the superior vena cava. The pericardium (76) is the sac that surrounds the heart. The diaphragm (77) is the muscle that separates the thoracic cavity from the abdominal cavity. The liver (78) is the largest gland in the body. The gallbladder (79) is the sac that stores bile. The pancreas (80) is the gland that produces digestive enzymes and hormones. The duodenum (81) is the first part of the small intestine. The jejunum (82) is the second part of the small intestine. The ileum (83) is the third part of the small intestine. The cecum (84) is the first part of the large intestine. The appendix (85) is the vermiform appendix. The ascending colon (86) is the part of the large intestine that ascends. The transverse colon (87) is the part of the large intestine that crosses the abdomen. The descending colon (88) is the part of the large intestine that descends. The sigmoid colon (89) is the part of the large intestine that forms an S-shape. The rectum (90) is the last part of the large intestine. The anus (91) is the opening of the rectum. The urinary bladder (92) is the sac that stores urine. The ureter (93) is the tube that carries urine from the kidney to the bladder. The kidney (94) is the organ that filters blood and produces urine. The adrenal gland (95) is the endocrine gland on top of the kidney. The spleen (96) is the largest lymphoid organ. The stomach (97) is the organ that digests food. The esophagus (98) is the tube that carries food from the mouth to the stomach. The liver (99) is the largest gland in the body. The gallbladder (100) is the sac that stores bile. The pancreas (101) is the gland that produces digestive enzymes and hormones. The duodenum (102) is the first part of the small intestine. The jejunum (103) is the second part of the small intestine. The ileum (104) is the third part of the small intestine. The cecum (105) is the first part of the large intestine. The appendix (106) is the vermiform appendix. The ascending colon (107) is the part of the large intestine that ascends. The transverse colon (108) is the part of the large intestine that crosses the abdomen. 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Fig. 1.8 Anatomy and dynamics of the temporomandibular joint (TMJ)













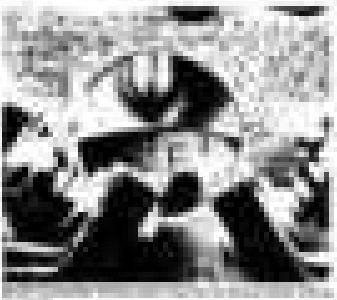


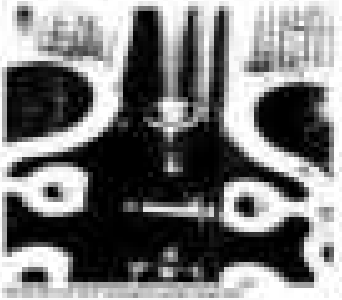


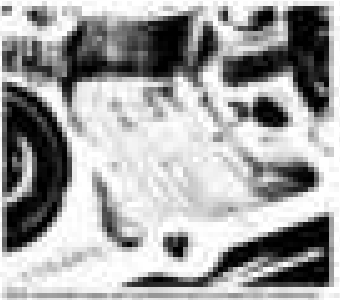


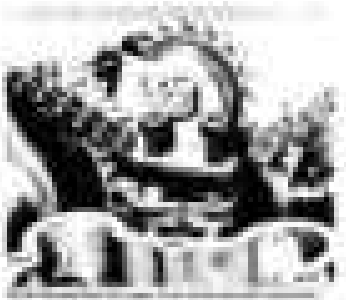








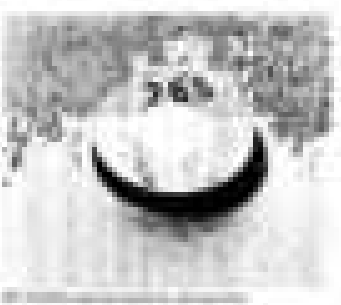











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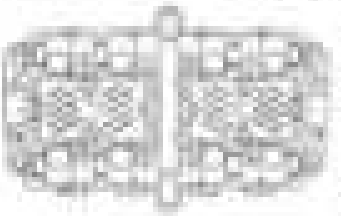


Fig. 1.14 Exploded view of engine/gearbox mountings

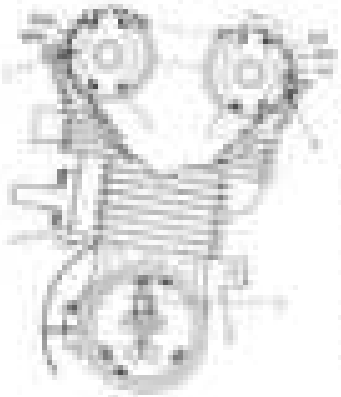
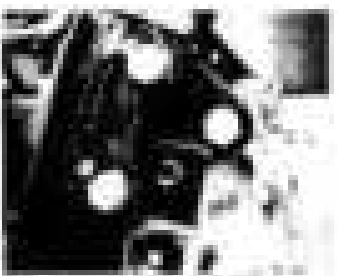


Fig. 1.15 Gearchange

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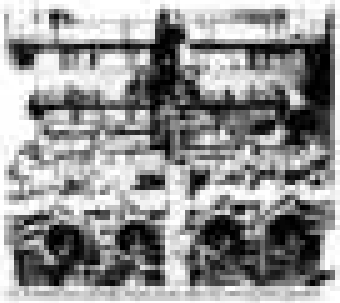






















19 Some diagnostic checks

Symptom	Cause	Remedy
Engine will not start	Battery discharged/wrong type	Recharge, fit, charge, refit, and check as the paragraph below.
	Battery terminals loose or corroded	Check all battery leads and terminals for tightness and corrosion. Remove corrosion with a solution of bicarbonate of soda.
	Battery leads broken internally (insulation serviceable)	Check with a multimeter or by substituting a known good lead.
	Engine earth lead broken or loose	Check earth lead from battery to engine.
	Starter motor (pinion not engaging flywheel)	Remove starter motor and check.
	Starter motor (armature or field windings faulty)	Remove starter motor and check.
	Starter motor (jammed)	Remove starter motor and check.
	Starter solenoid faulty	Check solenoid.
	Ignition/no-start switch faulty	Check switch.
	Major mechanical failure (eg, camshaft drive)	Check camshaft drive.
	Water in fuel	Check fuel system.
	No fuel in tank	Check fuel system.
	Fuel not reaching carburettor	Check fuel system.
	Excessive choke	Check fuel system.
	Fuel not getting to injectors	Check fuel system.
	Fuel injection system faulty	Check fuel system.
	Fuel filter blocked	Check fuel system.
	Fuel pump faulty	Check fuel system.
	Fuel pump wiring faulty	Check fuel system.
	Fuel tank vent blocked	Check fuel system.
	Carburettor needle valve sticking	Check fuel system.
	Carburettor needle valve worn	Check fuel system.
	Carburettor incorrectly adjusted	Check fuel system.
	Choke cable incorrectly adjusted	Check fuel system.
	Ignition components damp	Check ignition system.
	Ignition HT lead faulty	Check ignition system.
	Spark plug lead wet	Check ignition system.
	Spark plug lead broken	Check ignition system.
	Spark plug lead incorrectly routed	Check ignition system.
	Coil faulty	Check ignition system.
	Ignition amplifier unit faulty	Check ignition system.
	Ignition pick-up faulty	Check ignition system.
	Ignition timing incorrect	Check ignition system.
	Contact breaker points dirty, burnt or pitted	Check ignition system.
	Contact breaker points incorrectly gapped	Check ignition system.
	Ignition timing wrong	Check ignition system.
	Ignition timing too far advanced	Check ignition system.
Low compression	Spark plugs fouled, oxidised or incorrectly gapped	Check spark plugs, clean and regap.
	Cylinder head gasket blown	Check cylinder head gasket.
	Valve clearances incorrect	Check valve clearances.
	Valve sticking or burnt	Check valve sticking or burnt.
	Valve seats worn or burnt	Check valve seats worn or burnt.
	Piston rings worn, sticking or broken	Check piston rings worn, sticking or broken.
	Cylinder bores worn	Check cylinder bores worn.
Poor mid-range performance	Carburettor needle valve sticking	Check fuel system.
	Carburettor needle valve worn	Check fuel system.
	Carburettor incorrectly adjusted	Check fuel system.
	Fuel filter blocked	Check fuel system.
	Fuel pump faulty	Check fuel system.
	Fuel pump wiring faulty	Check fuel system.
	Fuel tank vent blocked	Check fuel system.
	Fuel not getting to injectors	Check fuel system.
	Fuel injection system faulty	Check fuel system.
	Ignition timing incorrect	Check ignition system.
	Contact breaker points dirty, burnt or pitted	Check ignition system.
	Contact breaker points incorrectly gapped	Check ignition system.
	Ignition timing too far advanced	Check ignition system.
	Ignition timing too far retarded	Check ignition system.
	Ignition amplifier unit faulty	Check ignition system.
	Ignition pick-up faulty	Check ignition system.
	Spark plug lead wet	Check ignition system.
	Spark plug lead broken	Check ignition system.
	Spark plug lead incorrectly routed	Check ignition system.
	Coil faulty	Check ignition system.
	Ignition HT lead faulty	Check ignition system.
	Spark plugs fouled, oxidised or incorrectly gapped	Check spark plugs, clean and regap.
	Valve clearances incorrect	Check valve clearances.
	Valve sticking or burnt	Check valve sticking or burnt.
	Valve seats worn or burnt	Check valve seats worn or burnt.
	Piston rings worn, sticking or broken	Check piston rings worn, sticking or broken.
	Cylinder bores worn	Check cylinder bores worn.
	Cylinder head gasket blown	Check cylinder head gasket.

20 Fault diagnosis – clutch

Symptom	Cause	Remedy
Clutch slipping (increase in engine speed does not result in increase in road speed)	Clutch cable	Check clutch adjustment. Cable may be stretched or frayed. Renew cable if necessary.
Difficulty in engaging gears (clutch pedal not returning correctly) (jerky take-up of drive) (knocking noise when clutch pedal released) (difficulty in selecting neutral)	Clutch hose	Check hydraulic hose for signs of leakage or damage. Renew hose if necessary. Bleed clutch system.
Judder when taking up drive	Worn engine or gearbox mountings	Renew engine or gearbox mountings.

21 Fault diagnosis – gearbox

Symptom	Cause	Remedy
Difficulty in engaging gears	Clutch cable Gear lubricant level or type incorrect	Check clutch adjustment. Drain, refill with correct lubricant.
Noise in neutral with engine running	Worn bearings in the input shaft or layshaft	Renew worn bearings.
Noise when gear is selected (after clutch has been disengaged)	Worn synchromesh units	Renew synchromesh units.
Jumping out of gear	Worn selector forks	Renew selector forks.
Difficulty in engaging reverse gear	Selector rod or selector fork bent or worn Reverse idler gear incorrectly installed	Renew selector rod or fork. Check that reverse idler gear is installed with the chamfered end of the teeth facing the gearbox.

Chapter 2 Fuel system and lubrication

Specifications

Petrol tank capacity

Fuel specifications

Oil capacities

Lubrication

Natural Ecosystems

Most land ecosystems are characterized by a single dominant form of vegetation. Vegetation is the most obvious component of an ecosystem, and it is largely responsible for the appearance of the landscape. Plants are also responsible for much of the animal life found in a given ecosystem. Primary producers, such as trees and other plants, are the basic source of food energy for all other organisms. Secondary consumers, such as insects and other animals, depend on plants for food and habitat. Tertiary consumers, such as predatory birds and mammals, depend on the secondary consumers for food. Decomposers, such as bacteria and fungi, recycle the remains of dead plants and animals.

Each of these organisms has a characteristic role in the ecosystem, and each is adapted to the environment in which it lives. The type of vegetation that grows in an area is determined largely by the climate and soil conditions. Plants have developed various strategies for obtaining water, nutrients, and sunlight. Some plants have deep roots to reach groundwater, while others have shallow roots to absorb rainfall quickly. Some plants have thick, waxy leaves to reduce water loss, while others have large leaves to capture more sunlight.

The animals that live in an ecosystem are also adapted to their environment. Herbivores have teeth and digestive systems suited to eating plants. Carnivores have sharp teeth and claws for catching prey. Omnivores can eat both plants and animals. Many animals have camouflage to help them hide from predators or prey. Others have bright colors to warn predators that they are poisonous.

The interactions between organisms in an ecosystem are complex. Predators control the populations of their prey, and prey species have evolved various defenses against predation. Competition occurs when two species need the same resource, such as food or space. Symbiosis is a close relationship between two species in which both benefit. Mutualism is a symbiotic relationship in which both species benefit, while parasitism is a relationship in which one species benefits at the expense of the other.

Ecosystems are not static; they change over time. Succession is the process by which one community of organisms is replaced by another. Primary succession occurs on bare rock or newly formed land, while secondary succession occurs after a disturbance such as a fire or flood. Climax communities are relatively stable communities that persist for long periods of time.



Figure 4.1: Temperate deciduous forest in autumn, showing the characteristic layered structure of trees, shrubs, and ground cover.

Human Impact on Ecosystems

Human activities have had a profound impact on ecosystems around the world. Deforestation, the clearing of forests for agriculture, logging, and development, has destroyed habitat for countless species and contributed to soil erosion and changes in local climate. Agriculture has converted vast areas of natural ecosystems into fields and pastures, replacing diverse communities of plants and animals with a few domesticated species.

Pollution is another major threat to ecosystems. Air pollution can damage plants and contribute to acid rain, which acidifies lakes and streams. Water pollution from industrial waste, agricultural runoff, and sewage can kill aquatic organisms and make water unsafe for drinking. Soil pollution can reduce the fertility of land and contaminate the food chain.

Climate change is perhaps the most significant long-term threat to ecosystems. Rising temperatures are causing shifts in the ranges of plants and animals, as species move to cooler areas or higher elevations. Changes in precipitation patterns are affecting the availability of water in many regions. Ocean acidification, caused by the absorption of carbon dioxide, is harming coral reefs and other marine ecosystems.

Conservation efforts aim to protect ecosystems and the species that live in them. Protected areas, such as national parks and wildlife reserves, set aside land where human activities are restricted. Restoration ecology seeks to repair damaged ecosystems by planting native species and removing invasive species. Sustainable practices in agriculture, forestry, and fishing aim to meet human needs without depleting resources or causing long-term damage.

Wetlands: Marshes, Swamps, and Bogs

Wetlands are areas where water covers the soil or is present near the surface for at least part of the year. They include marshes, swamps, bogs, and fens, each with distinct characteristics. Wetlands are among the most productive ecosystems on Earth, supporting a high diversity of plants and animals. They also provide important services to humans, such as flood control, water purification, and groundwater recharge.

Marshes are wetlands dominated by herbaceous plants such as grasses, sedges, and cattails. They are typically found along the edges of lakes, rivers, and coastal areas. Marshes can be freshwater or saltwater, depending on the salinity of the water. Freshwater marshes are common in the interior of continents, while saltwater marshes are found in coastal estuaries and salt flats.

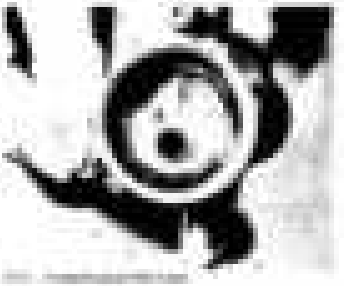
Swamps are wetlands dominated by woody plants such as trees and shrubs. They are often found in low-lying areas where water accumulates. Swamps can be freshwater or saltwater, and they support a diverse community of plants and animals. Cypress swamps in the southeastern United States are famous for their knobby cypress trees and Spanish moss.

Bogs are wetlands that receive water primarily from rainfall rather than from groundwater or surface water. They are typically acidic and nutrient-poor, and they support a specialized community of plants adapted to these conditions. Sphagnum moss is the dominant plant in most bogs, and it can grow to form thick layers of peat. Carnivorous plants such as pitcher plants and sundews are also common in bogs.

Fens are wetlands that receive water from groundwater as well as from rainfall. They are less acidic and more nutrient-rich than bogs, and they support a more diverse community of plants. Fens are often found in areas where groundwater discharges to the surface, such as at the base of hillsides or along the edges of lakes.



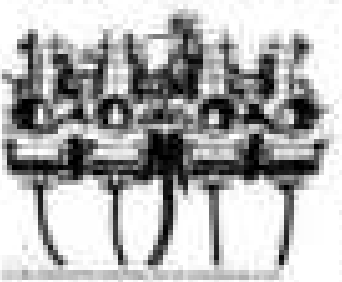
Figure 4.2: Freshwater marsh with cattails and open water, typical of shallow lake margins.















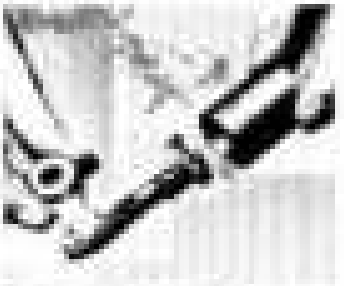


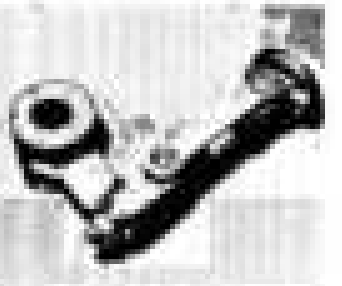




















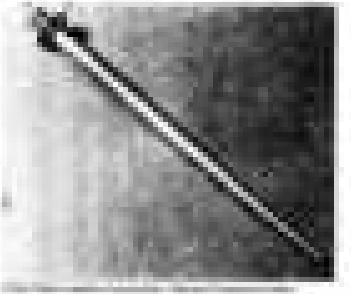












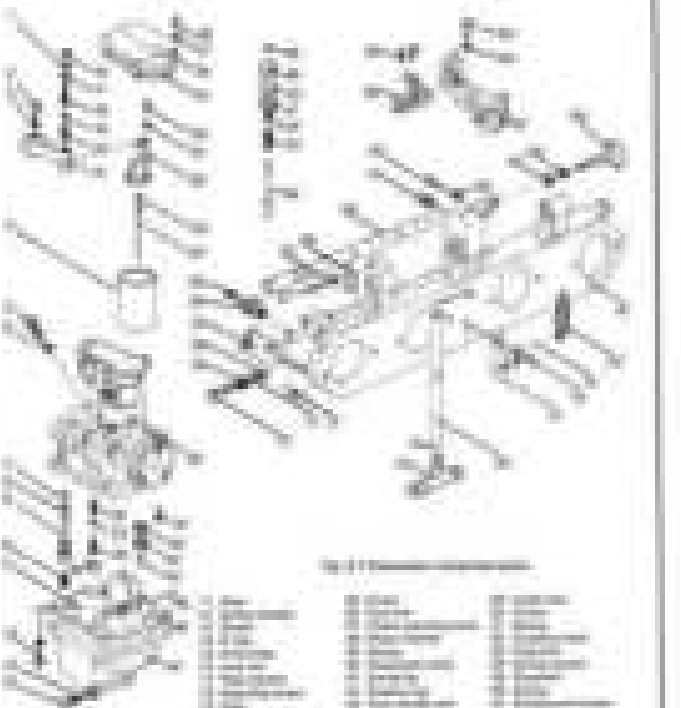




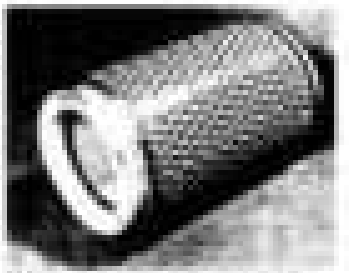
Bild 3.4 Lascaux: Schwarzer Stier und Pferde (Ausschnitt)



Bild 3.5 Lascaux: Schwarzer Stier und Pferde (Ausschnitt)





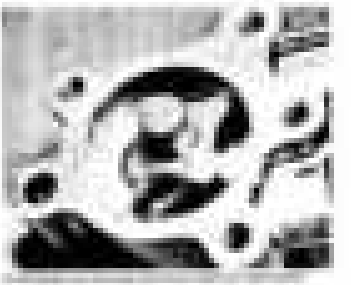




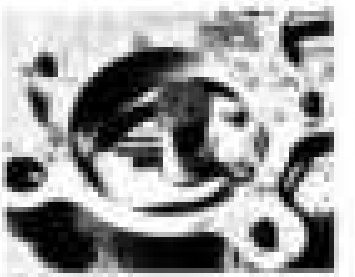






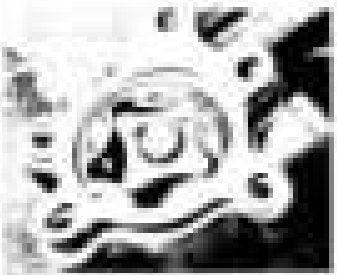






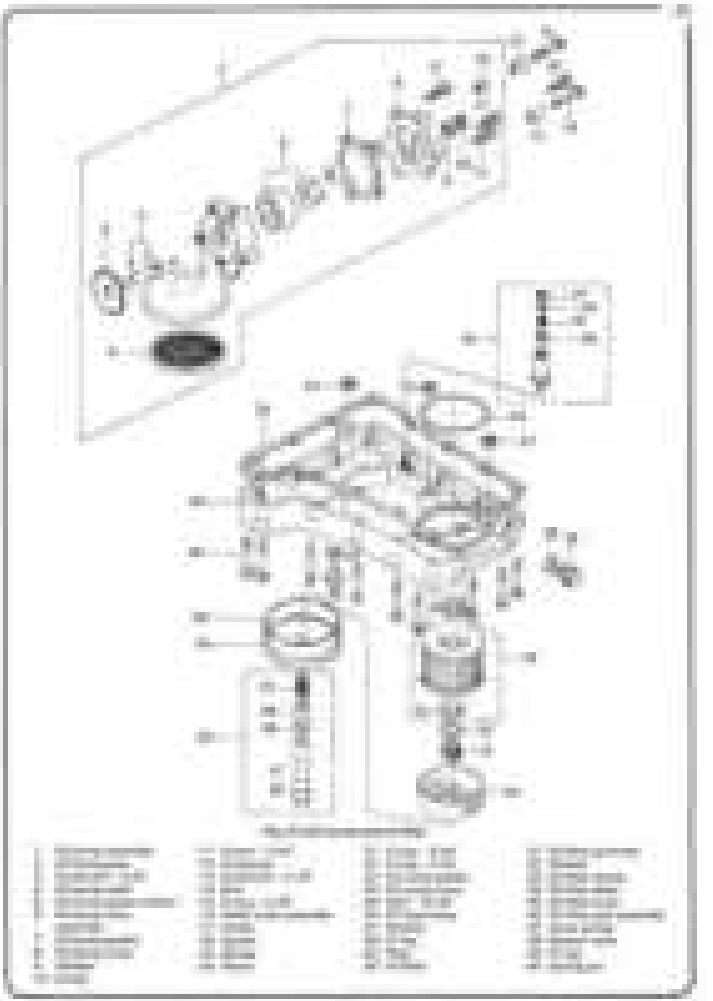
















Chapter 3 Ignition system

Contents

Alternator check
Alternator - removal and refitting
Alternator brushes - removal, inspection and refitting
Alternator drive belt - check, adjustment and renewal
Alternator drive belt pulley - removal and refitting
Alternator rectifier - testing
Charging system - general information and precautions
Crankshaft position sensor - removal and refitting
Electronic control unit (ECU) - removal and refitting
Fault finding - ignition system
Ignition coil - removal and refitting
Ignition system - general information and precautions
Ignition timing - checking and adjustment
Spark plug check and renewal
Starter motor - overhaul
Starter motor - removal and refitting
Starter motor - testing in vehicle
Starter motor and solenoid - testing off vehicle
Starter motor brushes - inspection and renewal
Starter motor drive pinion - inspection and renewal
Starter motor solenoid - removal and refitting

Specifications

Alternator

Type	
Rated output	
Regulated voltage	
Minimum brush length	
Maximum brush spring pressure	
Minimum diameter of slip ring surface	
Maximum run-out	
Minimum resistance	
Maximum resistance	
Minimum resistance between slip rings	

Crankshaft

Reluctor	Fitted to rear of crankshaft

Ignition coil

Type	
Make	
Model	
Primary winding resistance	
Secondary winding resistance	

Electronic control unit

Type	
Make	
Model	
Part number	
Supply voltage	

Spark plugs

Type	
Make	
Electrode gap	
Thread size	
Reach	

Starter motor

Type	
Make	
Model	
Rated output	
Minimum brush length	
Maximum brush spring pressure	
Minimum commutator diameter	
Maximum run-out	
Minimum resistance	
Maximum resistance	

1 Refer to the Vehicle Identification Numbers Section of this Manual for the location of the engine number.

2 The ignition timing is set by the ECU and cannot be adjusted. Refer to the Specifications Section of Chapter 4 for the ignition timing data.

3 Refer to the Specifications Section of Chapter 4 for the ignition timing data. The ignition timing is set by the ECU and cannot be adjusted.

4 Refer to the Specifications Section of Chapter 4 for the ignition timing data. The ignition timing is set by the ECU and cannot be adjusted.

5 Refer to the Specifications Section of Chapter 4 for the ignition timing data. The ignition timing is set by the ECU and cannot be adjusted.





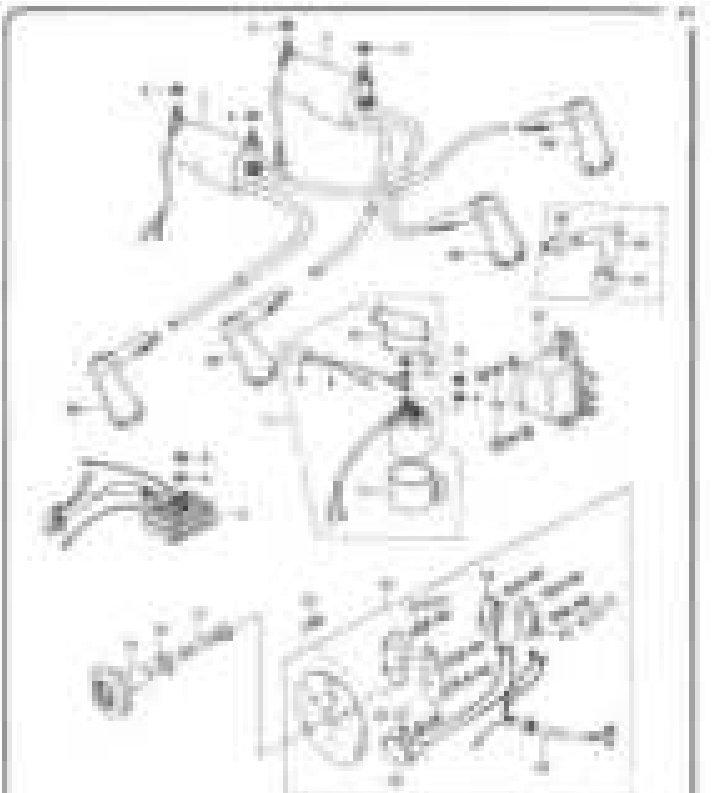






Fig. 3.41 Complex Synthesis Approaches







Spark plug maintenance. Checking plug gap with feeler gauge.



Adjusting the plug gap. Bend side of ground type.



Spark plug conditions. A brown, tan or gray firing end is indicative of correct engine running conditions and the selection of the appropriate heat rating plug.



White deposits have accumulated from excessive amounts of oil in the combustion chamber or through the use of low quality oil. Replace with a hot type plug.



Black sooty deposits indicate an over-rich fuel/air mixture, or a malfunctioning ignition system. If no improvement is observed, try one grade hotter plug.



Wet, oily engine deposits from an electrical leakage path along the insulator body, resulting in a misfire. This could also be a faulty valve engine or a malfunctioning ignition system.

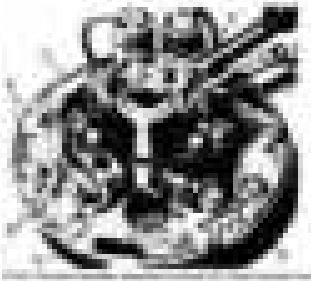


A blistered white insulator or melted electrode indicates overadvanced ignition timing or a malfunctioning cooling system. If corrective steps are unsuccessful, try a cooler grade plug.



A worn spark plug will only waste fuel but also overload the whole ignition system because the increased gap requires higher voltage to operate the spark. This condition can also affect an oscilloscope.









2.1 Vowel sequences: spelling conventions

Sequence	Words	Remarks
[illegible]	[illegible]	[illegible]
	[illegible]	
	[illegible]	
	[illegible]	
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Chapter 4 Frame and forks

Contents

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Specifications

[illegible]

Frame

Fork

Front brake

Rear brake

Rear suspension (RS)

Shock

Wheel/tyre set

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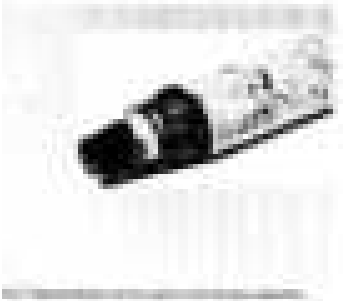






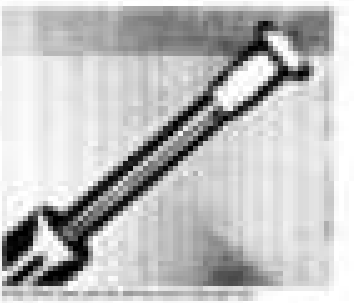






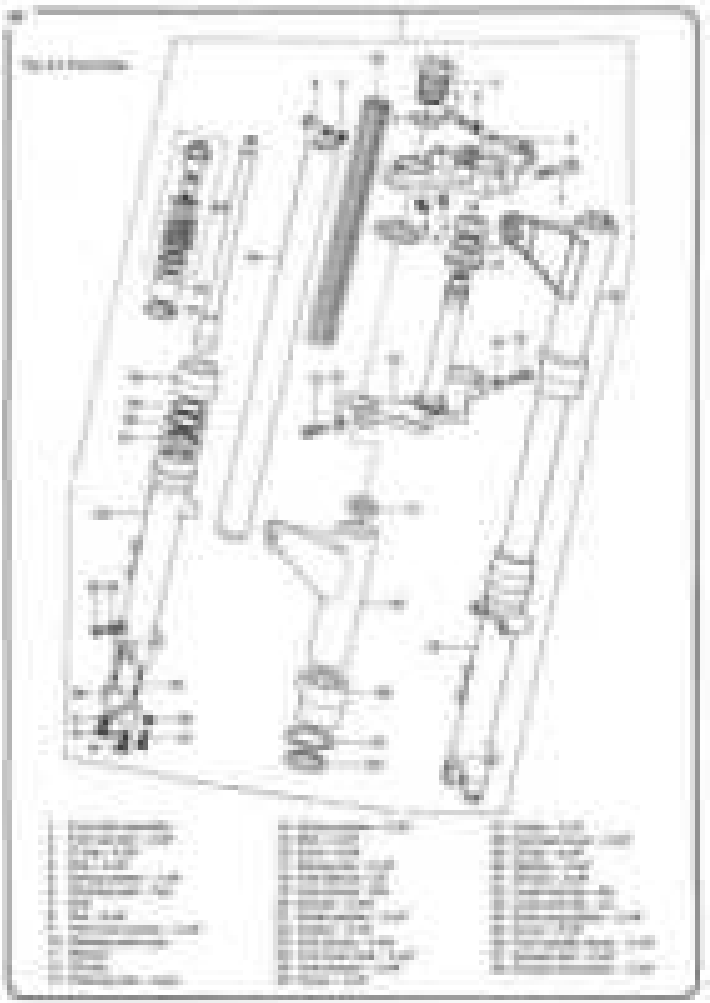










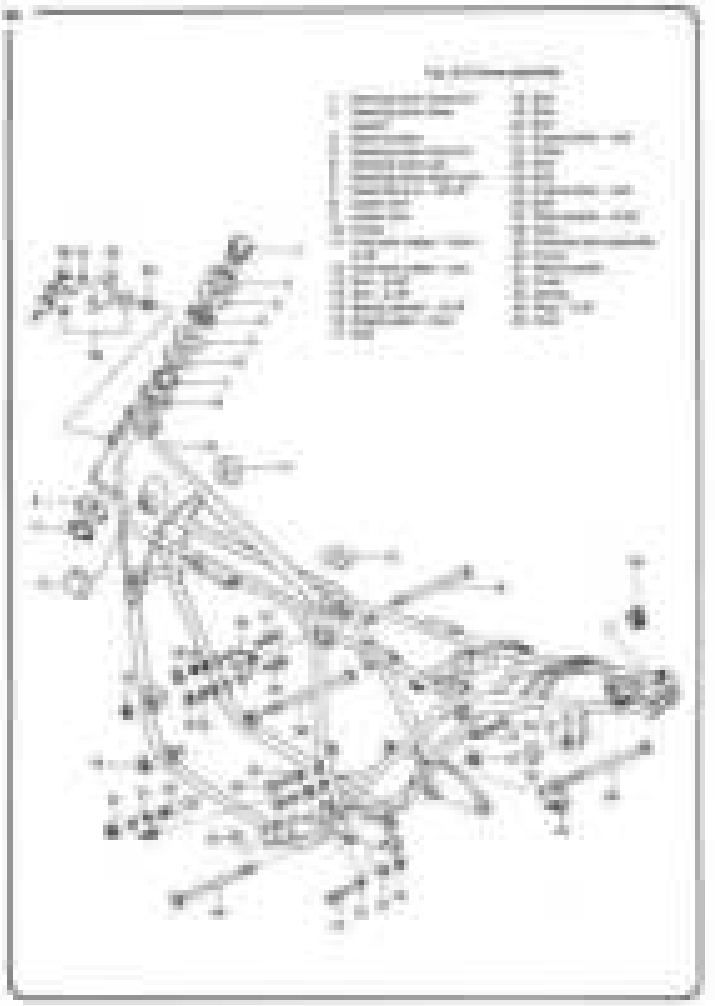












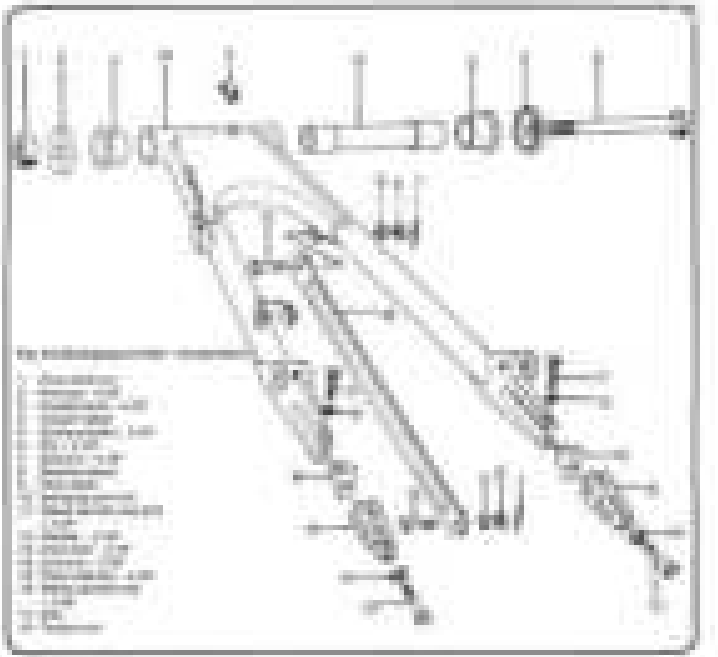




























Fig. 6.1 Example of a photograph of a subject performing the Tolerance Test by the Instrumented Glove and Cuff

6.2 Questionnaire and Questionnaire Design Guidelines

6.2.1 Questionnaire

6.2.2 Questionnaire Design Guidelines

6.3 Questionnaire and Questionnaire Design Guidelines for Rehabilitation Engineering

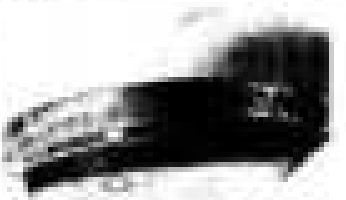
6.3.1 Questionnaire

6.3.2 Questionnaire Design Guidelines

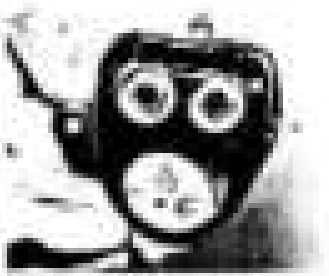
2.8 Further investigations: data for practice

Description	Variables	Questions
Observational study of 1,314 adults aged 18–74 years in Australia [1]	Physical activity (categorical) Gender (categorical) Waist circumference (numerical)	Is physical activity and gender associated? Is waist circumference associated with physical activity? Which is a better predictor of waist circumference: gender or physical activity?
Observational study of 1,314 adults aged 18–74 years in Australia [1]	Waist circumference (numerical) Height (numerical)	Is there a relationship between waist circumference and height? If so, what is the nature of the relationship?
Observational study of 1,314 adults aged 18–74 years in Australia [1]	Waist circumference (numerical)	Is there a difference between the mean waist circumference of males and females?
Survey of 1,000 students from University of Sydney [2]	Exercise hours per week (numerical) Time spent on social networking (numerical)	Is there a relationship between exercise hours per week and time spent on social networking?
Survey of 1,000 students from University of Sydney [2]	Exercise hours (numerical)	Is there a difference between the mean exercise hours per week for males and females?
Fish species catch	Fish species (categorical) Mass of fish (g) (numerical) Mean length of fish (cm) (numerical)	Which fish species are typically caught in the largest numbers? Is there a relationship between the mean length and mass of fish caught? Is there a difference between the mean length of fish caught in different fish species?
Observational study of 1,314 adults aged 18–74 years in Australia [1]	Height (cm) and weight (kg) (numerical) Gender (categorical)	Is there a relationship between height and weight? Is there a difference between the mean height of males and females?

Chapter 5 Wheels, brakes and tyres

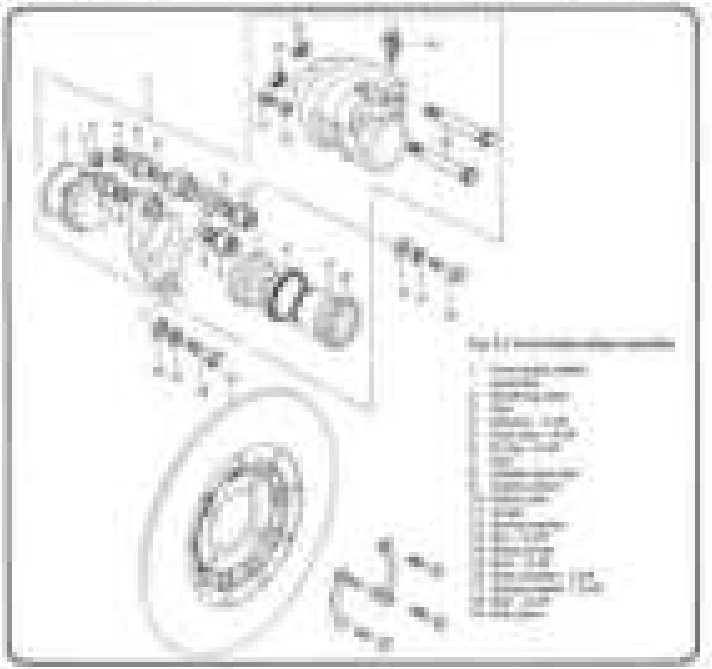












Hydraulic Brake Line and Hose Assembly Service

Brake lines and hoses are used to transmit hydraulic pressure to the brakes. Brake lines are made of steel tubing and are used for long, straight runs. Brake hoses are made of flexible rubber and are used where the brake line must flex with suspension movement. Brake hoses are also used to connect the brake lines to the brakes. Brake lines and hoses must be replaced if they are damaged or corroded. Always use the correct type of brake line or hose when replacing them. Never substitute fuel line or other types of tubing or hose for brake lines or hoses.

Brake lines are usually replaced in sections. Tubing nuts, sleeves, and brake line fittings are available separately. Brake line tubing is sold in coils of various lengths. Tubing is available in different diameters. Use the correct diameter tubing when replacing brake lines. Most brake lines are made of steel and are coated to prevent corrosion. Some brake lines are made of copper-nickel alloy. Copper-nickel alloy brake lines do not require a protective coating. Brake lines made of copper-nickel alloy are available in coils that can be cut to length. Brake lines made of steel are available in precut lengths with the ends already flared. Precut brake lines are more convenient to install than coils of tubing.

Brake Line and Hose Assembly Inspection

Brake lines and hoses should be inspected whenever the brakes are serviced. Brake lines should be inspected for dents, kinks, and corrosion. Dents and kinks can restrict the flow of brake fluid. Corrosion can cause brake line failure. Brake hoses should be inspected for cracks, abrasion, and leaks. Cracks in brake hoses can cause brake failure. Abrasion can cause brake hose failure. Leaks in brake hoses can cause a loss of brake fluid and brake failure.

To inspect brake lines and hoses, raise the vehicle on a hoist. Visually inspect the brake lines and hoses for damage. Look for dents, kinks, corrosion, cracks, abrasion, and leaks. Replace any brake lines or hoses that are damaged or corroded.

Brake Line and Hose Assembly Replacement

To replace a brake line, raise the vehicle on a hoist. Clean the area around the brake line fittings. Place a drain pan under the brake line fittings. Use a flare nut wrench to loosen the brake line fittings at both ends of the brake line. Remove the brake line from the vehicle. Install the new brake line in the reverse order of removal. Tighten the brake line fittings to the specified torque. Bleed the brake system after installing the brake line.

To replace a brake hose, raise the vehicle on a hoist. Clean the area around the brake hose fittings. Place a drain pan under the brake hose fittings. Use a flare nut wrench to loosen the brake line fitting at the end of the brake hose. Remove the brake hose clip from the bracket. Remove the brake hose from the vehicle. Install the new brake hose in the reverse order of removal. Tighten the brake line fitting to the specified torque. Bleed the brake system after installing the brake hose.

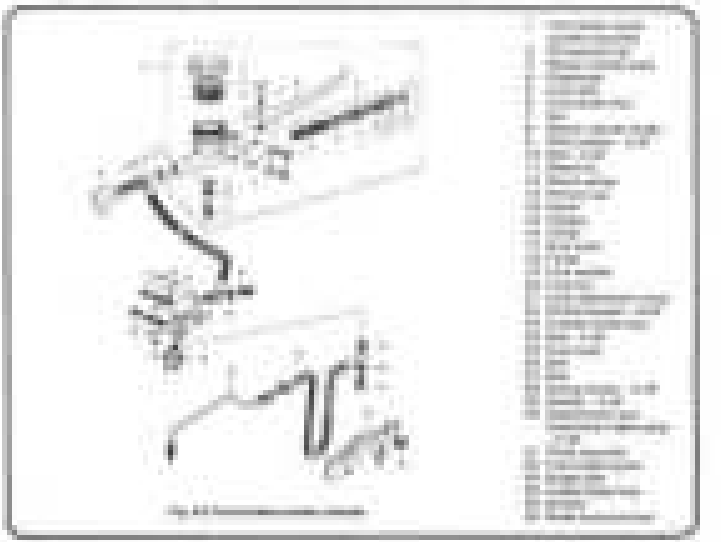
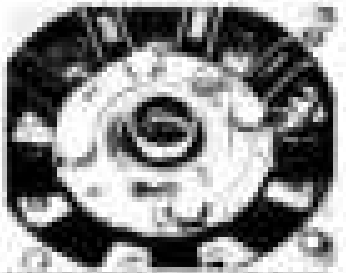


Fig. 6-3 Front disc brake assembly exploded view



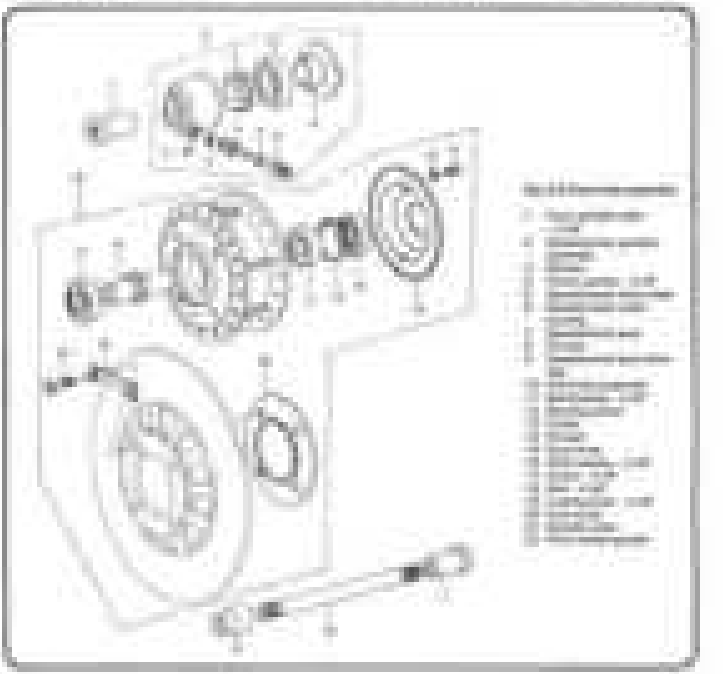


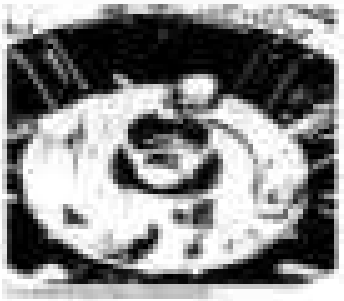




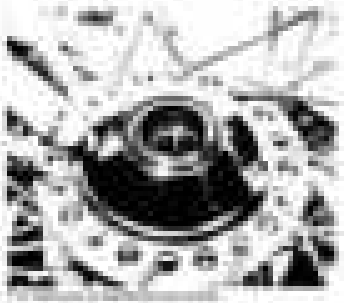








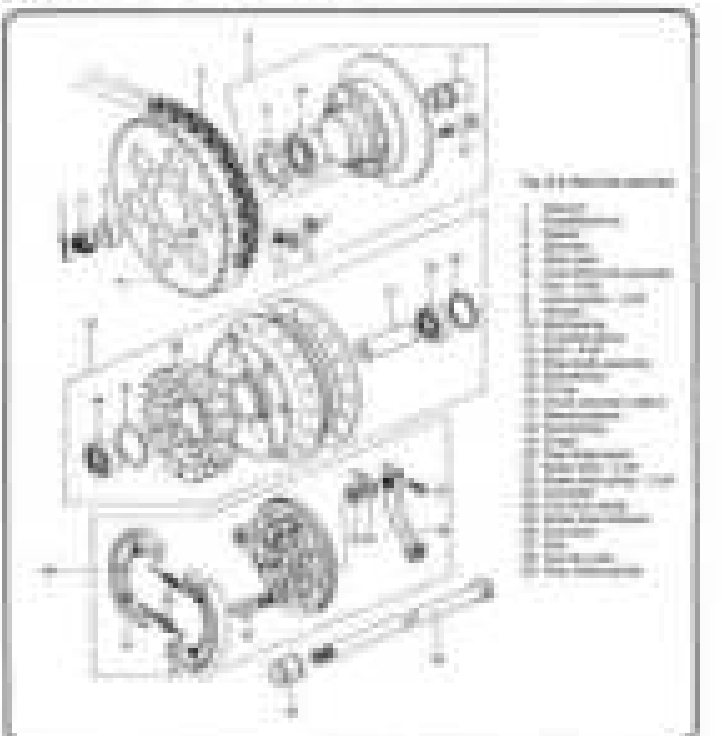


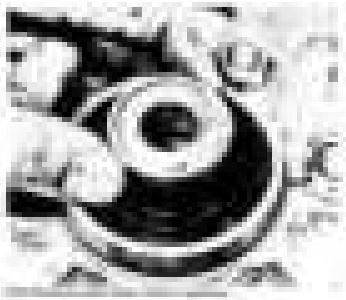




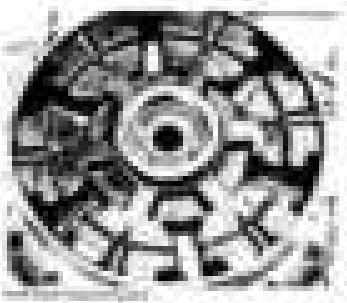










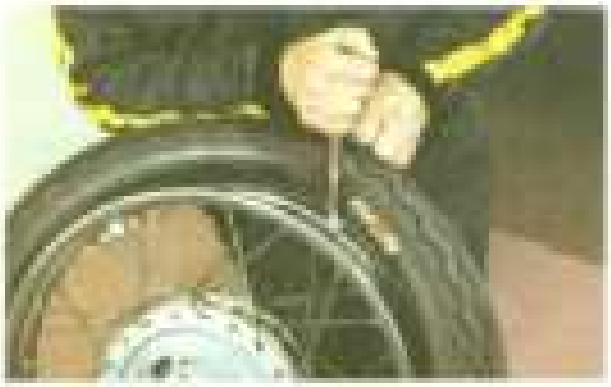





Tyre removal. Partially insert tube and inject lever in close proximity to tyre valve



Use two levers to work bead over the edge of rim



When bead is in centre, remove tyre as shown



Tyre fitting. Inflate inner tube and insert in tyre



Lay tyre on rim and feed valve through hole in rim



Work first bead over rim, using lever in final section



Use another tyre lever to ease bead over rim



Push valve and tube up into tyre when fitting final section, to avoid trapping









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Chapter 6 Electrical system



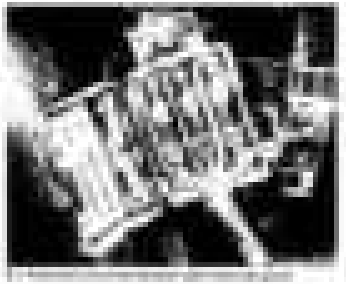


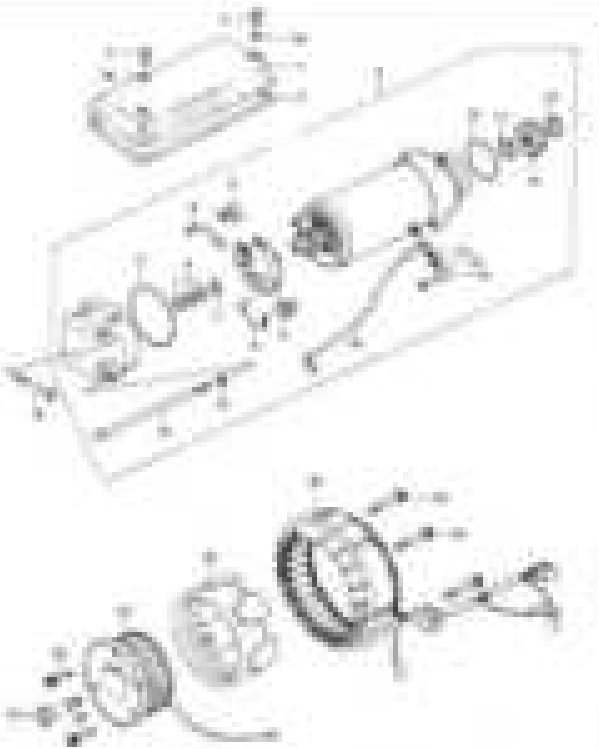






























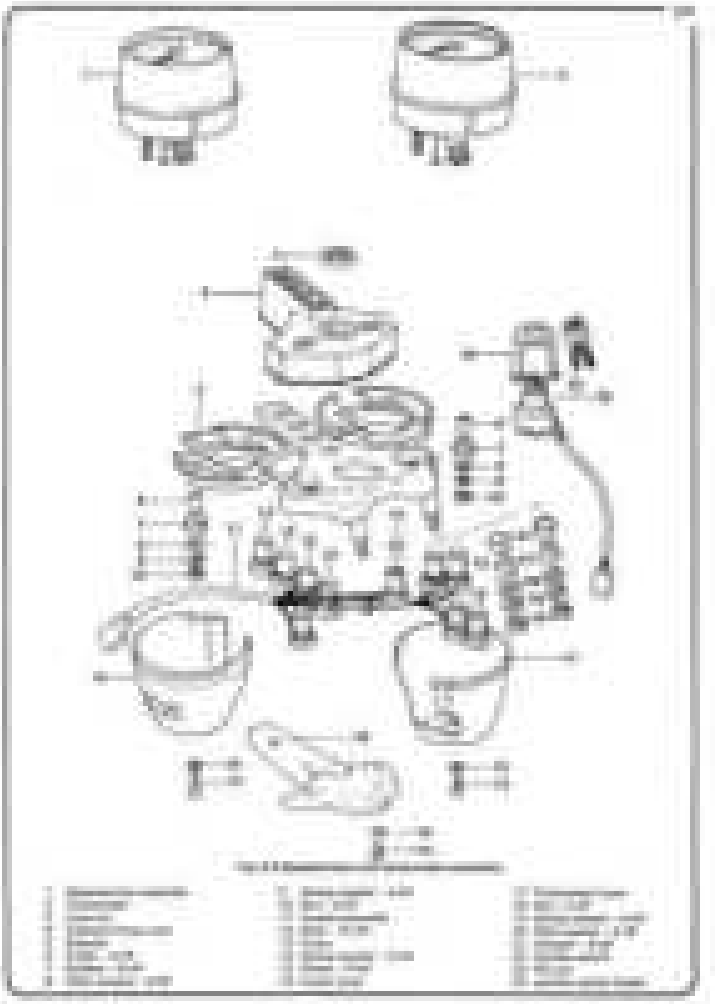
8.1 Structure of the eye – supporting structures

The eye is an almost spherical structure with a diameter of approximately 24 mm. Its wall consists of three layers: the outer fibrous layer, the middle vascular layer, and the inner neural layer. The fibrous layer is composed of the cornea and the sclera. The cornea is transparent and forms the anterior one-sixth of the fibrous layer. The sclera is opaque and forms the posterior five-sixths of the fibrous layer. The vascular layer is composed of the choroid, ciliary body, and iris. The neural layer is composed of the retina. The cornea is continuous with the sclera at the limbus. The optic nerve pierces the sclera at the lamina cribrosa. The sclera is continuous with the dura mater of the optic nerve.

The eye is divided into the anterior segment and the posterior segment. The anterior segment includes the cornea, iris, and ciliary body. The posterior segment includes the lens, vitreous body, retina, choroid, and optic nerve. The anterior segment is filled with aqueous humor, and the posterior segment is filled with vitreous body.


WPG!





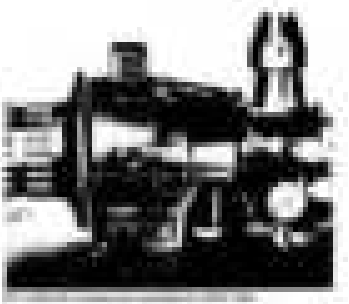


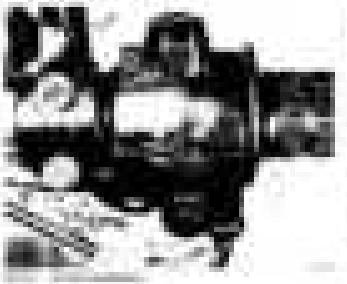










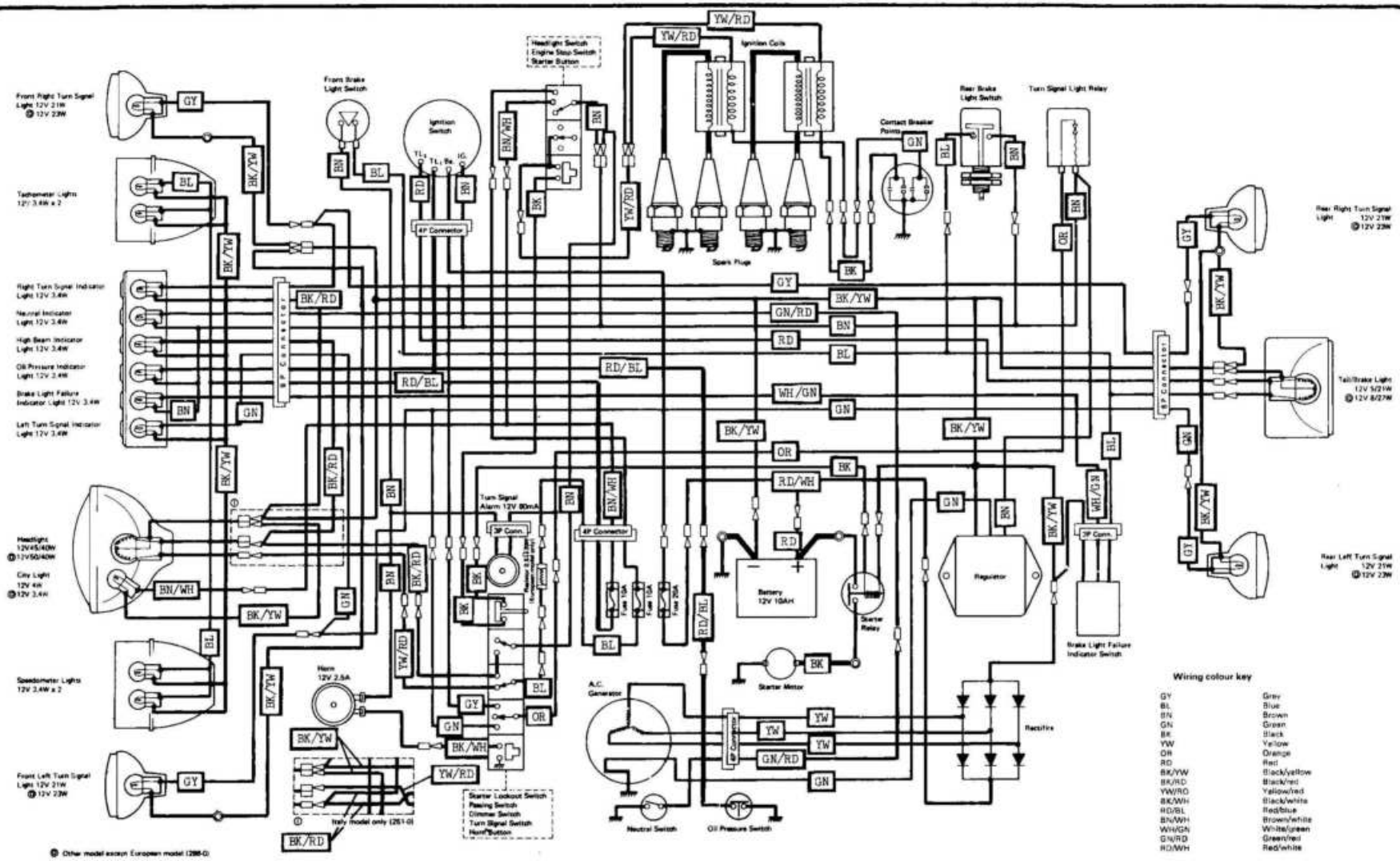






Tabula B. 9. Abbreviationes nominum

Abbreviatio	Nomen	Memoria
Cn. Domitius Calvinus	Gnaeus Domitius Calvinus	Consul anno 53 a. Chr. n., proconsul Asiae anno 40 a. Chr. n.
	Domitia Lepida	Mater Messalinae, uxoris Claudii imperatoris
M. Antonius Primus	Marcus Antonius Primus	Dux partium Vespasiani, anno 69 p. Chr. n. consulatum gessit
Ser. Sulpicius Galba Maximus Lentulus	Servius Sulpicius Galba	Frater Galbae imperatoris
M. Aemilius Lepidus	Marcus Aemilius Lepidus	Consul anno 6 a. Chr. n., Augusti amicus
	Aemilia Lepida	Filia Lepidi, uxor Drusi Iulii Caesaris
	Aemilia Lepida	Filia Lepidi, uxor Rubellii Blandi



Wiring colour key

GY	Grey
BL	Blue
BN	Brown
GN	Green
BK	Black
YW	Yellow
OR	Orange
RD	Red
BK/YW	Black/yellow
BK/RD	Black/red
YW/RD	Yellow/red
BK/WH	Black/white
RD/BL	Red/blue
BN/WH	Brown/white
WH/GN	White/green
GN/RD	Green/red
RD/WH	Red/white

Left Handlebar Switch Connections

Passing Switch			Starter Lockout Switch			Dimmer Switch				Turn Signal Switch				Horn Button		
Color	Brown	Bk/R	Color	Bk	Br	Color	Bk/R	Blue	R/Y	Color	Green	Orange	Slate	Color	Bk/W	yellow
ON	●	●	ON	●	●	HI	●	●		Left	●	●		ON	●	●
						LO		●	●	Right		●	●			

Ignition Switch Connections

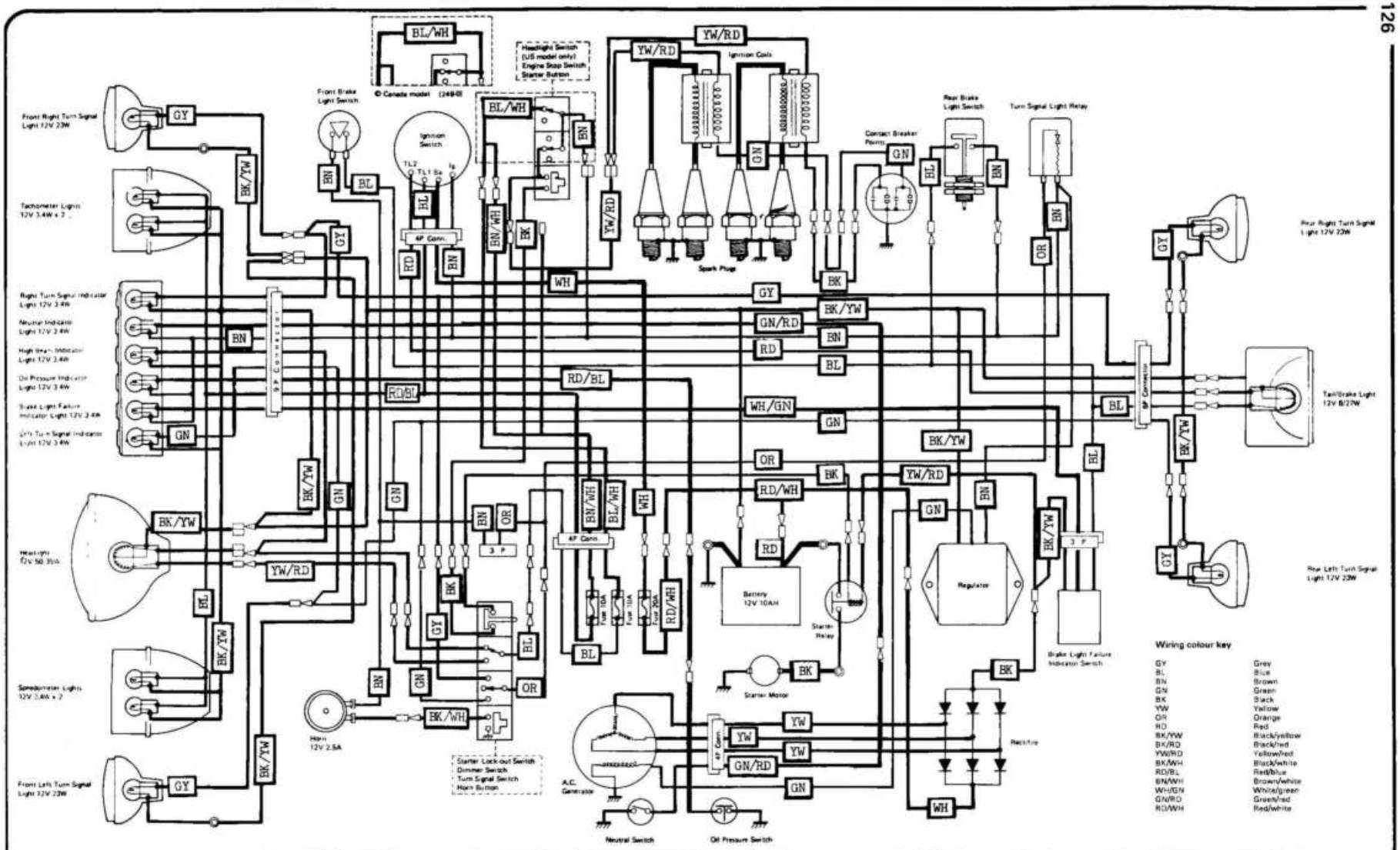
	Battery	Ignition	Tail 1	Tail 2
Color	White	Brown	Blue	Red
OFF				
ON	●	●	●	●
PARK	●		●	●

(260-0)

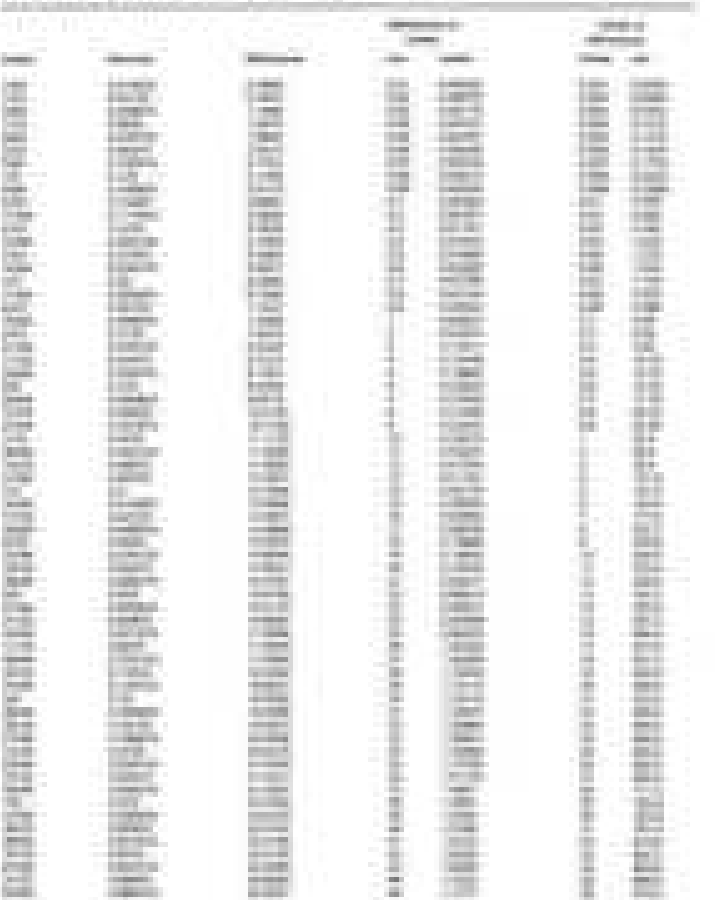
Right Handlebar Switch Connection

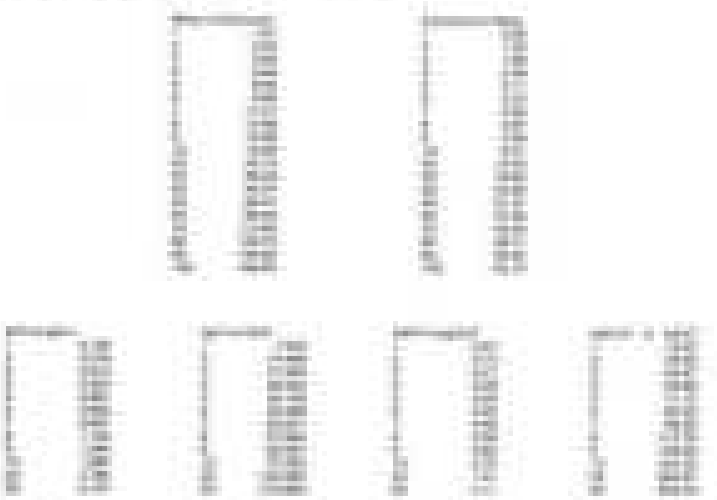
Headlight Switch				Starter Button		Engine Stop Switch		
Color	Brown	Bl/W	Br/W	Color	Black	R/Y	Color	Brown	R/Y
OFF							OFF		
PO	●	●	●	ON	●	●	RUN	●	●
ON	●	●	●				OFF		

Wiring diagram Z650 model (UK)


Wiring colour key
GY Grey
BL Blue
BN Brown
GN Green
BK Black
YW Yellow
OR Orange
RD Red
BK/YW Black/yellow
BK/RD Black/red
YW/RD Yellow/red
BK/WH Black/white
RD/BL Red/blue
BN/WH Brown/white
WH/GN White/green
GN/RD Green/red
RD/WH Red/white
Left Handlebar Switch Connections
Starter Lock-out Switch
Dimmer Switch
Turn Signal Switch
Horn Button
Ignition Switch Connections
Battery
Ignition
Tail 1
Tail 2
Right Handlebar Switch Connections
Headlight Switch
Starter Button
Engine Stop Switch
Wiring diagram KZ650 model (USA)

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