current that may reinforce or reverse the galvanic cell that is causing corrosion. There is some truth to this so that in an operating negative earth car the steel body becomes the more cathodic and will corrode last, while the opposite is true in a positive earth car. Remember however that a vehicle – and hence also its electrical system – runs for relatively brief periods: a car designed for a 10 year, 100,000 mile (160,000km) life that runs at an average of 50mph (80km/h) will actually only be in use, with electrical current flowing, for a total of 2000 hours (about 12 weeks) or 2.3% of the time.

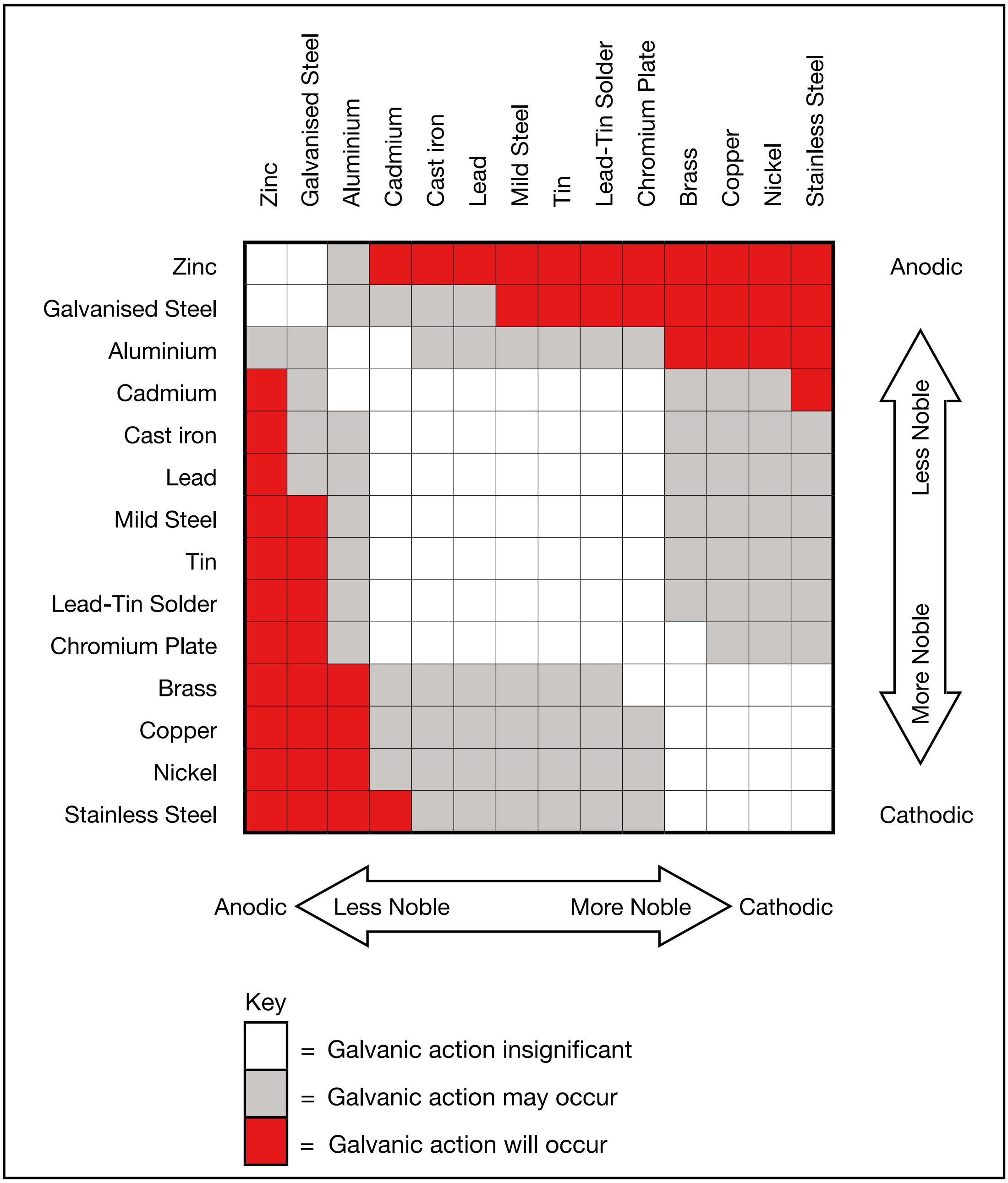

Table 3.3. Galvanic corrosion table.

the ignition is on, and they do so via a switch from ignition to the brake/turn lamps.

These three circuits all work well independently, but can interact with one another with strange results. In Figure 5.1 the situation is shown where the hazard flashers are on, the radio is switch on (but not operating because the ignition is off), and the driver happens to press the brake and, in doing so, closes the brake switch. Note how the shaded line shows the current path. Not only do the brake/turn lights flash but in concert with them, the radio pulses on and off too!

MGB SNEAK CURRENTS

Strange lamp behaviour is often due to sneak currents resulting from poor earths

The sneak currents described here can occur on MGBs but may also be evident on almost every other vehicle.

Stop/tail lamps

Figure 5.3. Stop/tail lamps almost universally use double filament bulbs, that is to say that the two separate lamp filaments are contained in the same glass envelope and share a common earth path in the form of the outer sleeve of the bulb cap.

Stop/tail circuit

In the stop/tail lamp circuit the right and left hand bulbs are connected together, each filament being connected to its respective circuit – brake or lighting switch. The common brake and tail light terminal, which is the bulb cap, is taken to an earth point physically close to each bulb location on the right and left of the car.

Figures 5.3 through 5.6 show how a double filament bulb with a common earthing cap can result in a sneak current that causes strange behaviour in a stop/tail lamp. The same thing occurs when other lamps share the

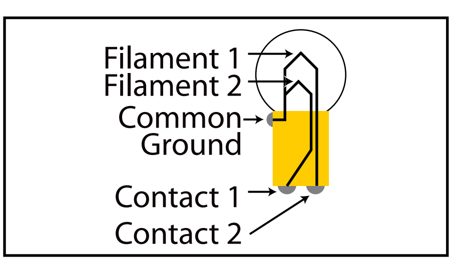

Figure 5.2. A typical dual filament lamp and a frequent conduit for sneak currents.

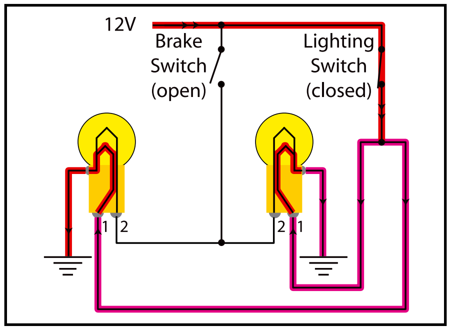

Figure 5.3. The lighting switch has been closed and current, indicated by the shaded line, can flow to the tail lamp filaments via the bulb terminals (1).

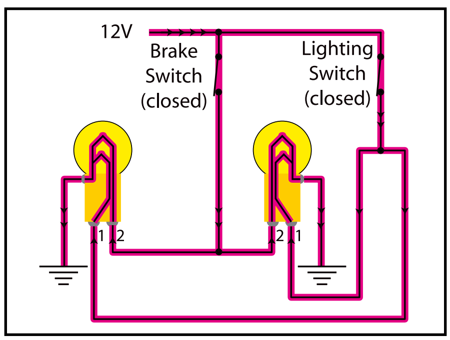

Figure 5.4. The brake switch has been closed, so current can now flow to the brake lamp via the bulb terminals (2).

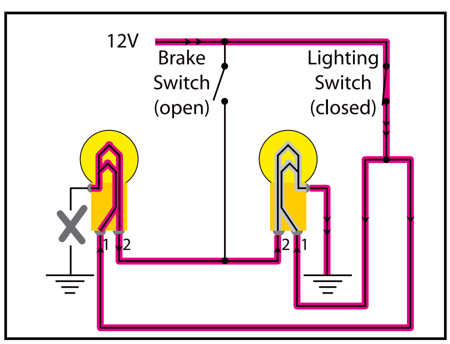

Figure 5.5 is similar to Figure 5.3 but the earth connection at point X has been broken to the left-hand bulb. Note, however, that the current which would normally go to earth through the left-hand tail light now "sneaks" up through the filament for the left-hand brake light, through the stop light wire connecting both lamps, and to earth via the right-hand stop light filament. The effect is that the left-hand lamp is somewhat dimmer than usual (two filaments running at reduced voltage on each), and the right-hand lamp a little brighter (one filament at full voltage, the other at reduced voltage).

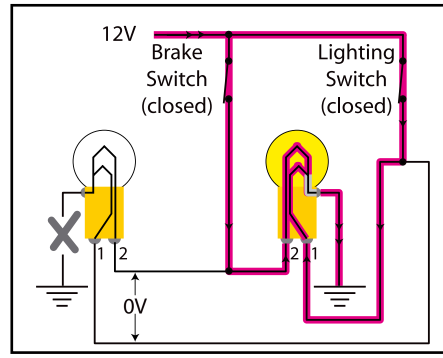

Figure 5.5. When the brake is operated the sneak current flowing between the left and right-hand lamps is opposed by the current flowing to the left-hand stop lamp, and the left tail light goes out. Remember that voltage is electrical pressure and with the earth open to the left-hand bulb and equal voltage being applied to both its filaments, there is zero voltage, or no pressure, differential between contacts 1 and 2 that can push any current through the bulb. The overall effect here is that the left tail light, which appeared to work nearly normally goes out when the brake is applied.

same earth path even though they may not be combined in the same light bulb. For example, the MGB rear turn signal bulb is earthed to the same metal lamp plate as the stop/tail lamps, and if the earth from it is rusted out, or otherwise poor, the turn signal lamp will also use a sneak path back through the stop/tail lamp on the other side. Here, the brake lights can often be seen to be flashing on the wrong side of the car and the turn rear signal fails to work at all when the brake pedal is pressed.

Engine run-on

In a real fault condition on an MGB, the engine would continue running at night until the driver switched the lights off. Although he didn't notice it at first, the driver was in the habit of keeping his foot firmly on the brake until the engine stopped. The problem was tracked down to a faulty earth on the stop/tail assembly as described above. With the lights on, current would flow into the filament of a tail light, and with no earth to go to, would then sneak its way back through the brake light filament, through the brake switch (because his foot was on the pedal) and so to the hot side of the ignition switch, which also feeds current to the ignition, keeping it alive.

Late cars with ignition relays need very little sneak current to keep the

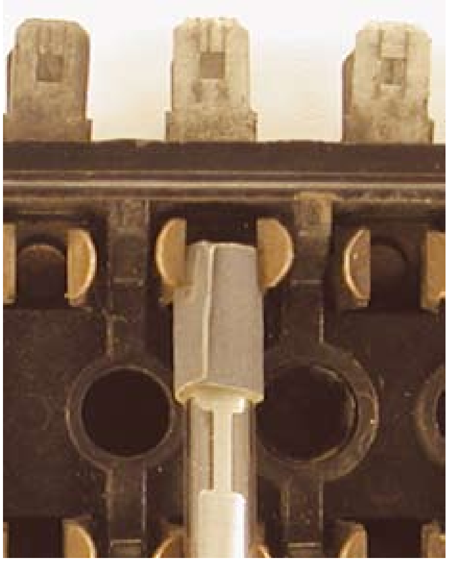

Figure 7.6. Abrasive paper wrapped around a fuse end, with the abrasive side outward, is an effective tool with which to clean the inside surface of the fuse clip.

clip in turn, turning and sliding it so that it cleans the inside of the clip as shown in Figure 7.6. Then take some pliers and gently squeeze the clips together so as to increase each one's grip on the fuse cap. Unfortunately, if the spring tension remains poor, the connection will not be gas tight and it will oxidize again over time. In fact failure is progressive. Bad spring tension causes both high resistance connections and allows in corrosive gas and moisture which, in the presence of an electric current, causes a galvanic reaction that further corrodes the connection. If that were not enough, the resulting high resistance connection results in local heating at the connection which accelerates chemical reaction and decreases the clip spring tension.

The only long term fix may be a new fuse block, but some respite might be gained by the use of bulb grease. This silicone based material will help keep out moisture but is itself an insulator. When used with light bulbs, the high spring tension and sliding action when inserting the bulb removes the grease at the electrical contact points. When used in a fuse block in which clip spring tension is already light, then using this material requires some more deliberate twisting and sliding action to ensure that the grease does not prevent electrical conduction.

Other fuse connection problems might stem from the fact that the fuse block terminals are riveted to the fuse

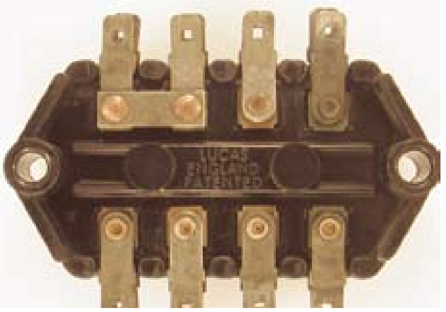

Figure 7.7. If the fuse block connector blades can be easily rocked from side to side they will not make good electrical connection to the fuse clip. They can be tightened by supporting the top side of the rivet and tapping the bottom side with a nail punch.

clip as can be seen in the underside view of Figure 7.7. If it is easy to 'wiggle' the terminal relative to the fuse block plastic housing, then it may be necessary to tighten the rivet. Care must be taken in doing this as the plastic used is not as resilient as that found today and it will have become even more brittle over time. Using a rod, such as a nail-set punch, working from the underside, support the top side of the rivet, which can be seen at the bottom of the fuse clip, and gently tap the bottom side, again using a suitable punch. Note the bar joining the left and right side-lamp fuses. Make sure that the block is reinstalled correctly with the link bar toward the front and top of the car.

ADDING ADDITIONAL FUSES

Fuses may be added to the MGB in order to protect auxiliary equipment such as driving lights, trailers and high-power entertainment systems or to enhance the meagre fuse protection of the original car. Some knowledge of fuse technology will help selection.

Selecting a fuse value and wire size

Fuses are protection devices and in most automotive applications what they protected is the harness wiring. Whether adding fuses to protect an existing unfused circuit or an add-on accessory, Table 7.4 can be used to determine the maximum fuse size from the wire size. If the wire is carrying less current than its maximum, then the circuit is protected if the fuse selected is sized to the system current.

For example, if a pair of driving lamps were being added, each of which had 60 Watt bulbs the total wattage would be 2 × 60 = 120W. At 13.5V (the normal car system voltage when the battery is charging) we could calculate the current as 120W ÷ 13.5V = 8.9A or simply go to the table and find the applicable row for 120W which in this case is that for 109W – 168W. This row indicates the minimum wire size that can be used is 18AWG (1mm^2) and that the maximum fuse size that should be used with that wire is 15A. Thus it would be quite safe to run these lamps through that wire and fuse.

However, reference to table 6.3

System current (amps)	System power (Watts)	Minimum wire size		Maximum fuse size (amps)
		AWG	mm^2	
0 – 1	0 – 14	22*	0.5	2
1 – 4	15 – 56	22*	0.5	5
4 – 6	57 – 70	22*	0.5	7.5
6 – 8	71 – 108	20	0.5	10
8 – 12	109 – 168	18	1	15
12 – 16	169 – 224	16	1.5	20
16 – 20	225 – 280	14	2.5	25
20 – 24	281 – 336	12	4	30
24 – 32	337 – 448	10	6	40

Table 7.4. Knowing either the system current or power, the correct minimum wire size and maximum fuse size to protect that wire, can be selected. *While smaller than 22AWG (0.35mm^2) wire could be used here, it is not recommended because the physical strength of such thin wire is not normally sufficient for automotive use.

IGNITION CIRCUIT 1973-1980 (1973-1974 NORTH AMERICA)

Circuit description

In about 1973 the current sensing tachometer was replaced by a superior design that senses voltage pulses from the contact breaker. At about the same time, the coil was changed to one requiring a ballast resistor.

Referring to Figure 11.7, current flows from the batteries or battery on a large cross section area cable to the starter motor/solenoid (5) which is used as a securing point. There it connects to a thinner brown (N) wire that goes to the fuse block (19).

At the fuse block another brown wire takes current to the ignition switch (38). When the ignition switch is on, current can flow from the ignition switch on a white (W) wire and back to the fuse block. There a fuse connects to a green wire that provides power to the tachometer (95).

A white spurs off from the fuse block to supply current to the coil (39) + terminal via a ballast resistor (56) and white/light-green (WLG) wire. However, during cranking, the coil is supplied full voltage via a white/light-green wire from the starter/solenoid (5), effectively jumping the ballast resistor out of circuit. The ballast resistor may be either a length of resistance wire or a discreet electrically resistive component.

The – side of the coil is connected via a white/black (WB) wire to the distributor (40), which makes a connection to the contact breaker.

The high voltage connection from the coil goes to the centre of the distributor cap where the rotor arm 'distributes' the spark to each of 4 wires going to the spark plugs.

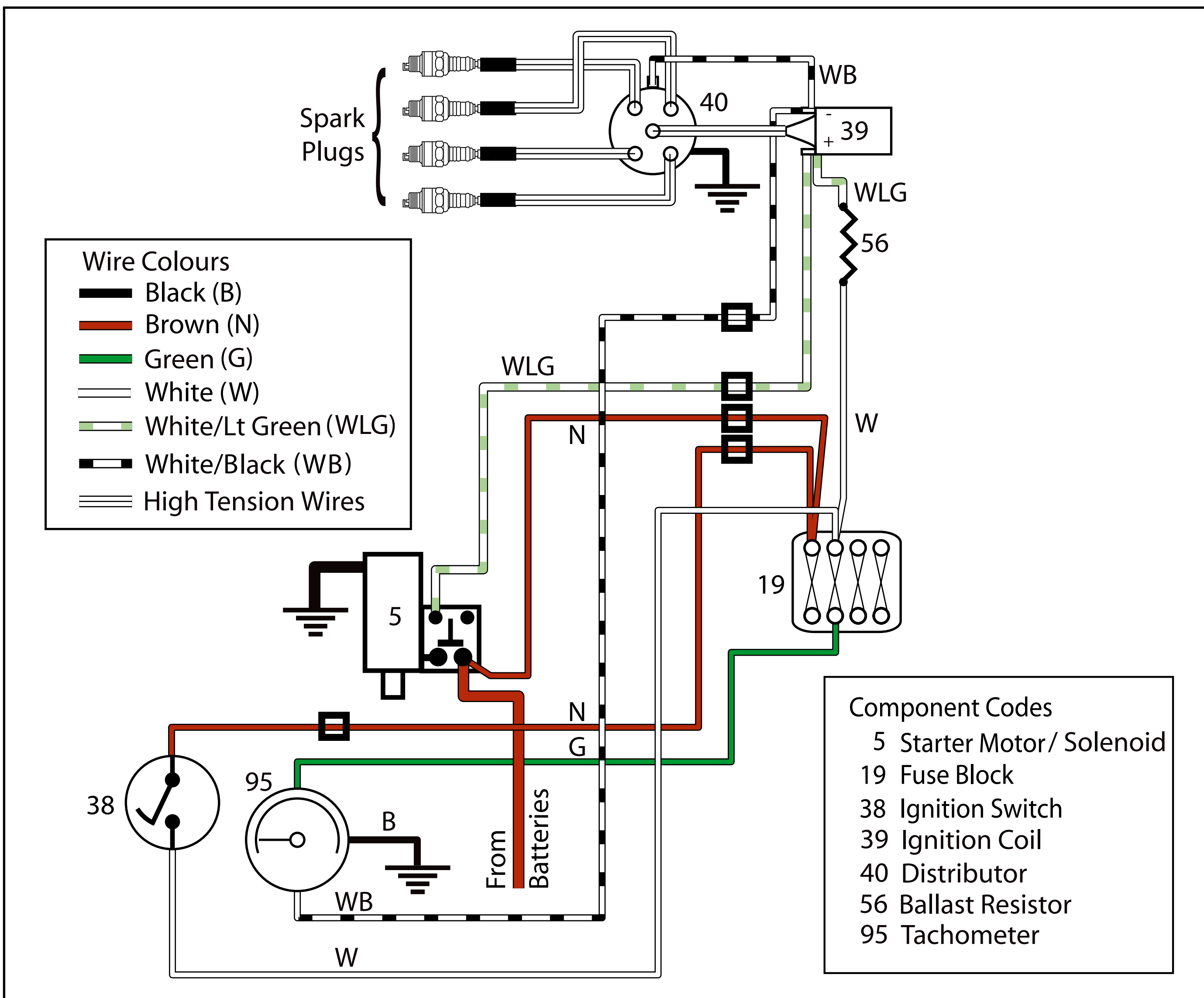

Figure 11.7. In this iteration of the ignition circuit the MGB gained a ballast resistor to improve starting and spark performance at high engine speeds. The tachometer changed to a superior design that uses voltage, rather than current, pulses.

Figure 17.2. A typical pre-1975 horn. The adjustment screw is arrowed.

Post 1974 horns are earthed via the casing and have a single terminal.

HORN CIRCUIT – PRE-1975

Figure 17.3 shows the horn circuit for pre-1975 cars. Strictly speaking the drawing shows pre-1970 wiring. From 1971 to 1975 the fuse block (19) will be a 4-fuse type, like that in Figure 17.4. In cars built after 1978 there is no separate control box (2) to which the brown power wires are anchored.

Current flows from the batteries via the anchor points of the starter solenoid (4) and control box (2) to the fuse block (19). From the fuse block, a purple (P) wire takes power to both horns (23). When the horn switch (24) is pressed, current can flow through the horns, out on purple/black (PB) wires and to earth via the switch.

From 1962 until 1967, the horn push switch was located in the centre of the steering wheel. This required a method of making an electrical connection to the rotating hub. To achieve this a brush contact, part of the turn signal switch, makes electrical contact to a slip ring that is connected to the horn switch, see Figure 17.4. The earth connection from the switch relies on continuity between the steering inner steering shaft and the metal

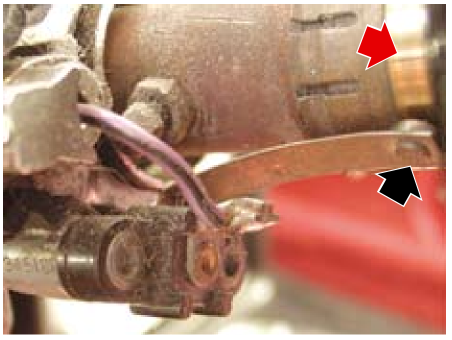

Figure 17.4. The pre-1968 horn brush contact (black arrow) and slip ring (red arrow).

components with which it is in contact such as the outer shaft and the steering rack.

From 1968, the horn switch was re-located to the end of the multi-function switch that also operates the turn signals and headlamp beams.

HORN CIRCUIT FROM 1975

From 1975 on the horn was changed to one with a single external terminal, the other connection being made through the horn body to earth. Having earth connections already at the horns themselves, the horn push switch had now to provide a power feed to them rather than an earth return.

Figure 17.5 shows the later car's horn circuit. Current flows from the batteries (3) via the anchor point of the starter solenoid to the fuse block (19). From there a purple (P) wire takes power to the horn push switch (24). When the horn switch is pressed, current can flow to the horns on a purple/black (PB) wire, through them and to earth.

HORN VOLUME

The horn in Figure 17.2 was one of a pair that exhibited poor volume. The author works in the automotive industry and was able to have them examined at the laboratories of the largest horn producing company in the world. This company can tune horns in a special

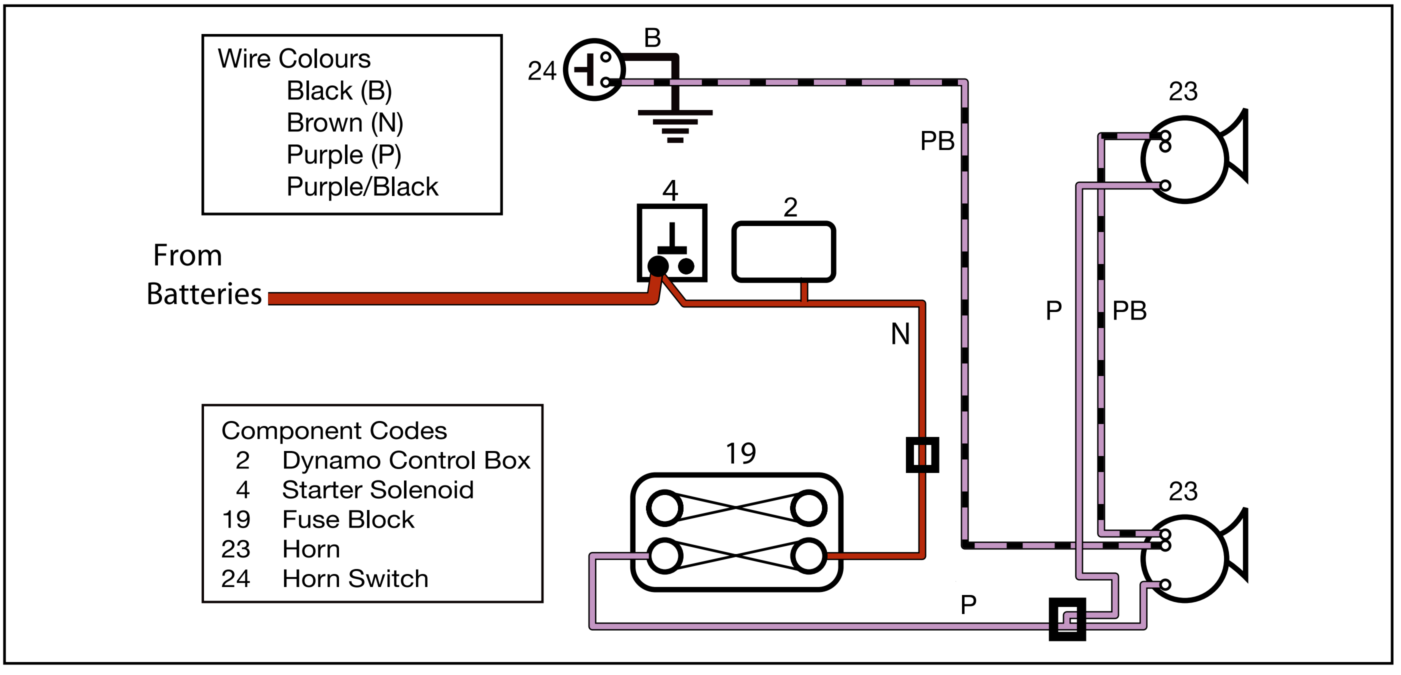

Figure 17.3. The pre-1975 horn circuit.