

LUCAS

TECHNICAL SERVICE

OVERSEAS TECHNICAL CORRESPONDENCE COURSE

Section 8

**WINDSHIELD WIPERS – HORNS – SEMAPHORE AND
FLASHING LIGHT DIRECTION INDICATORS –
INTERIOR LIGHT CIRCUITS**



JOSEPH LUCAS (SALES & SERVICE) LTD · BIRMINGHAM 18

Printed in England



INTRODUCTION

The electrical components on the modern vehicle, loosely described as “Accessories” are in fact “Auxiliaries” and of such importance that a vehicle may be completely inoperative if for any reason one or other of them fail to function or, at the least, some of the pleasure and refinement of driving is lost. Accessories are really those units applied as after-sales fitments such as extra Lamps, Mirrors, etc. Considered individually the auxiliary units and their associate circuits are very simple, but in view of their frequently masked and inaccessible positions on the vehicle they are not fully appreciated.

One of the auxiliaries, of outstanding importance, is the windshield wiper. On the fast modern car it is frequently subjected to very heavy loads and sustained periods of working. The body contours and construction of a vehicle often make correct and frictionless alignment of the driving mechanism difficult. Occasionally too, it is subject to distortion on the vehicle assembly line. Some detailed attention has to be given to these obscure causes of unsatisfactory operation in service.

The auxiliaries are connected through fuses in two groups, firstly those which are required only when the engine and vehicle are in motion, being supplied with current through the ignition switch; the remainder being so connected to the current supply that they may be used when the vehicle and engine are stationary.

The reason for dividing the auxiliaries into two groups is primarily because all the components concerned with the running of the vehicle are only required when in motion, so by connecting them through the ignition switch they cannot be inadvertently left on when not required, whereas the remainder may be required at any time and consequently the supply is direct from the battery to their individual control switches.

Fuses are installed in the auxiliary circuits because, owing to their wide dispersal over the vehicle, they are more susceptible to wiring troubles than the main cable harness itself, and also because after-sales accessories are frequently wired in a haphazard manner which makes them vulnerable to short circuiting and other troubles.

All told, there is no single factor of more value in building customer goodwill, and increasing business, than that of the individual electrician, being looked upon as a competent expert by the customer. A careful study of the whole range of units covered in this book will do much to place you in this desirable category.

COPYRIGHT

*All rights reserved. AG part of this
publication may be reproduced
without permission.*

JOSEPH LUCAS (SALES & SERVICE) LTD., BIRMINGHAM, ENGLAND.

CONTENTS

PART 1.

C.W. Windshield Wipers

The C. W. motor — mounting application — Construction of the C.W. Wiper — Excessive overload device — The C.W. motor circuit — Gearing — Waterproofing — Fitting and maintenance — Service faults — Testing in situ.

C.R. Windshield Wipers

Switching and wheelbox arrangements — Wheelbox assemblies and methods of fixing — Opposed wiping arcs — Wiper arm fixing — C.R. motor and gear box assembly — Overload cutout switch — Thermostatic control — Armatures and field coils — Self-aligning bearings — Wiring circuits — Fault finding — Maintenance.

DR1 and DR2 Windshield Wipers

Mounting application and assemblies — Rack-drive assemblies — Wheelboxes — Wiper arm fixing — Gear mechanism — Eccentric cam — Self-parking mechanism — Arrangement of parking positions. DR motor circuits — Operating switches — High and low speed control — Circuit testing — Limit switch circuit — Fault finding — Maintenance.

PART 2.

Horns — High Frequency and Windtone types

Production of sound waves — Wave form — The diaphragm — Contact arrangement — Operation of the Windtone horn — H. F. horn circuit — Windtone horn circuit — Horn circuit with relay — Maintenance — Horn mountings — Circuit testing — Contact adjustment.

PART 3.

Trafficators (semaphore type, direction indicators)

Principles of operation — Mounting plates — Solenoid action — Self-locking device — External mounting type — Wiring circuits — Servicing — Maintenance — Switching arrangements — Self-cancelling assembly — Pneumatic time switch — Mechanical faults — Testing and fault finding.

PART 4.

Flashing Light Direction Indicators

Lucas flasher equipment — Circuit with independent rear indicator bulbs — Circuit employing D.B.10 relay — The flasher unit — D.B.10 relay assembly — Indicator bulbs — Circuit arrangements — Wiring — Service testing.

PART 5.

Interior Lamp Circuits and Door Operating Switches

Interior lamp and door switch circuits.

QUESTION AND ANSWER PAPERS

STUDENTS QUERY PAPER

AIR MAIL REPLY ENVELOPE

Windshield Wipers (Model C.W.)

THE CW WIPER — EXTERNAL VIEW WITH ARM AND BLADE

The type CW wiper is widely used as an accessory as well as initial equipment on certain models of vehicles.

Available in THREE models for both 12 and 6 volt working the model CW1 is supplied for top of screen mounting and the CW2 for BOTTOM screen mounting.

The CWX is built as a universal model for either top or bottom fixing and can be advantageously stocked as a general service replacement.

Control is obtained by means of an on-off switch and parking handle which form an integral part of the unit. Covers are designed to provide parking of the blades on either side of the screen.

The popular arrangement is a 'three' hole fixing. The spindle emerges centrally and the motor is held by two studs one on either side.

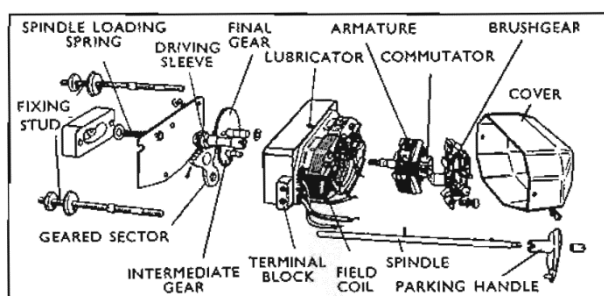
Packing pieces and adaptor blocks are available. The latter when fixed to the motor enables the assembly to become 'single' hole fixing.

The normal wiping angle may be either 130° or 150° but models with special angles have been produced to suit vehicle makers' requirements.



The wiper arm and squeegee are fixed to the spindle by means of a quickly detachable split collet incorporated in the boss of the wiper arm.

There is a range of both arms and squeegees, the latter varying from 6" to 9" in length to suit different size screens.



THE CONSTRUCTION OF THE CW WIPER

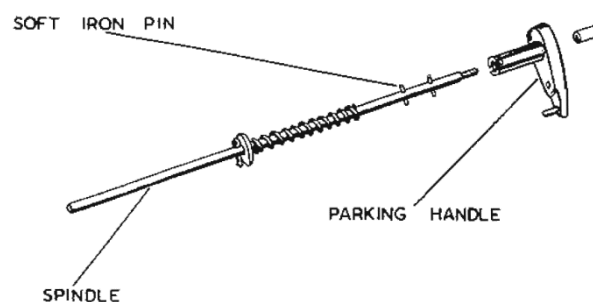
This illustration will give you an idea of the construction of the CW. The motor assembly is on the right and the gearing on the left.

We shall be examining both of these sections in greater detail later.

THE SAFETY DEVICE

One feature of the unit is not generally known, and that is that the motor is provided with a safety device against shock. A small soft-iron pin, passing through the motor spindle, forms the driving member. This pin shears if for some reason the spindle is prevented from turning with the motor still taking current. The shearing of the pin prevents the motor from burning out, or stripping some of the teeth in the gear wheels.

Now for a closer examination of the motor itself.



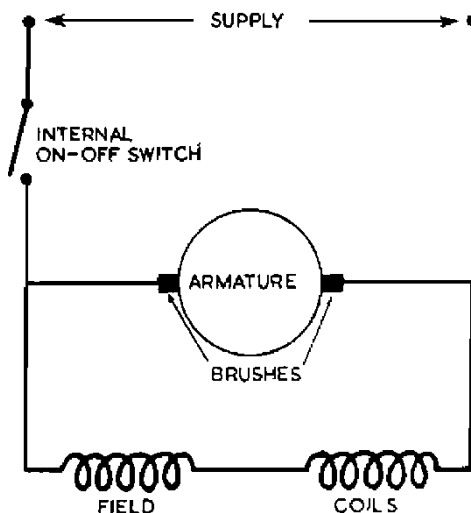
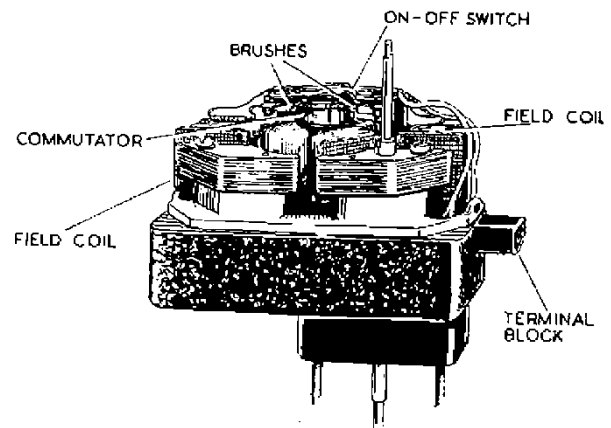
THE CW MOTOR

The motor consists of a three-pole armature running in a two-pole shunt wound field. The two field coils are wound on laminated iron formers and connected in series, producing two magnetic poles.

The armature comprises a laminated iron core carrying three windings, thus forming three magnetic poles.

Field and armature windings are in parallel with one another.

The ends of the windings are brought out to a terminal block on the right. The internal ON/OFF switch is built onto the brush gear, the operating lever being part of the cover assembly.



THE CW CIRCUIT

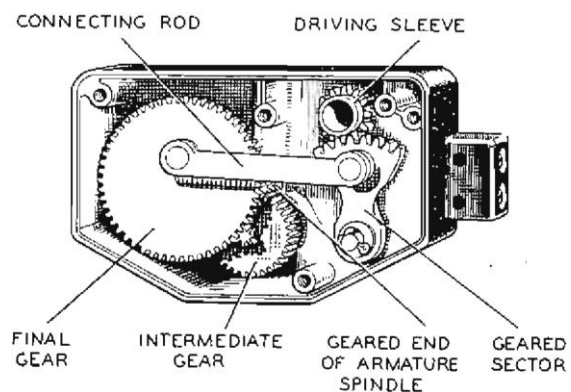
The current feed passes via this internal ON/OFF switch, through the brush gear to the commutator, round the armature windings and back to the other side of the supply. Both field coils are connected in parallel with the armature.

The supply will generally be taken from the A4 fuse to one side of the motor terminal block and from the other terminal on this block back to the E terminal at the Control Box.

THE GEARING

A small driving gear is fixed to the one end of the armature spindle. Let us now see how the drive is transmitted from this point to the wiper arm, which, in the driving position, is engaged to the driving sleeve.

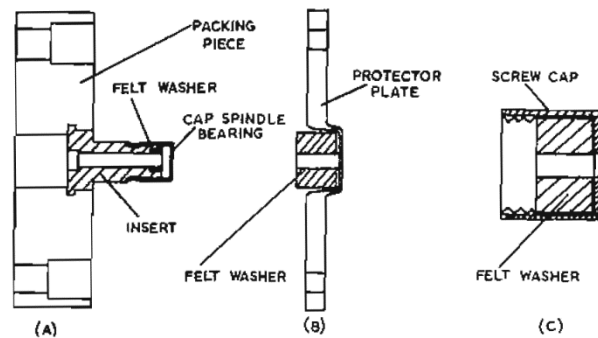
The drive is first taken up by the intermediate gear and transmitted by a pinion to the final gear. A connecting rod is pivoted eccentrically on this gear, converting the rotary movement with the help of the geared sector into the reciprocating movement necessary for the wiper arm. This drive is transmitted to the arm and blade when the parking switch is moved and the spindle engaged with the driving sleeve. The soft-iron pin we mentioned earlier is the actual engaging member.



WATERPROOFING

All wipers in the CW range are provided with adequate means for protecting the mechanism against the entry of water past the wiper spindle. The necessary felt and cork inserts are provided with the unit and must be used if the wiper is to give long and trouble free service.

We show several methods here of sealing the wiper spindle, and additional protective 'Langite' gaskets are available for waterproofing the fixing stud holes.



FITTING UP AND MAINTENANCE

No maintenance in the general sense is required in service. The gearbox is packed with Duckhams KEENAL Kg/25 grease at assembly. A spring ball lubricator is provided for the long armature bearing and a small quantity of oil may be inserted occasionally.

Care should be taken when setting up a new wiper to see that the water excluding devices are properly seated.

If water should gain ingress to the gearbox the emulsified grease must be cleared out and the gear box re-packed.

Also when fitting up a new wiper the current supply should be taken from the A4 fuse, or in any earlier type of car installation, from the Ignition Switch in order that the supply is automatically cut-off when the ignition is switched off.

SERVICE FAULTS

The most common faults in service will be sheared driving pins resulting from shock load such as fouling the blade when cleaning the screen and bent spindles, causing seizing and overheating of the motor. Noisy operation usually is caused by general wear and tear.

Ingress of water causes loss of lubricant by emulsification and usually results from incorrect fitting.

Low torque will be due to worn brushes or bearings.

Normal current consumption:

12v.	..	1.8—2.5 amps.
6v.	..	3.0—4.0 amps.

Stall current consumption:

12v.	..	2.7—4.0 amps.
6v.	..	4.4—5.5 amps.

Heavy current consumption will indicate internal binding, or this fault may also be due to excessive pressure on blade to screen or spindle binding in screen aperture.

Low current reading will probably be due to worn brushes, or dirty and greasy commutator.

If ammeter test readings are unsteady suspect defective armature windings or faulty commutator.

GENERAL METHOD OF TESTING IN POSITION

Connect ammeter in circuit and switch on the wiper, take current reading.

If no current flows check A4 fuse. Using a voltmeter across the leads, check the supply from the wiper terminal block.

If voltage supply is normal but no current flowing, remove wiper for examination and service.

If no voltage at terminal block, the supply or earth return circuit is defective.

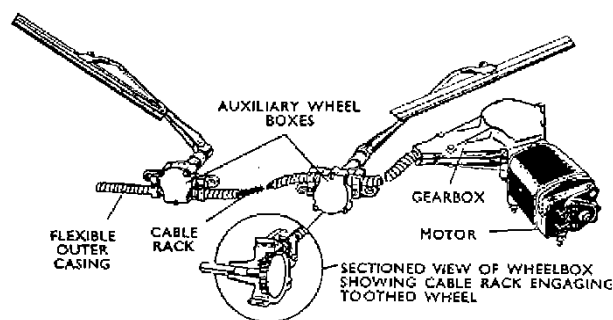
Windshield Wipers (Model C.R.)

CR WIPER AND WHEELBOX ASSEMBLY

This illustration gives a general view of the CR type wiper, showing how the drive from the motor is transmitted to the wiper blades by means of a flexible rack and wheelboxes. There are two models, CR and CRT. The CR series covered by Nos. 1-7 provide a variety of wheelbox and switching assemblies together with a range of varying angles of wipe. The model CRT is similar to the CR, but incorporates a thermostatic overload switch which functions to stop the motor if, for any reason, the maximum safe working temperature is exceeded as a result of prolonged overloading.

The motor and gear box are mounted under the bonnet, whilst the wheelboxes are fitted at the bottom of the screen.

The drive to the wiper arms is obtained by means of a cable rack, comprising Bowden type cable over wound with a wire helix. This wire helix acts in the same manner as the teeth in an ordinary rack, and engages with the gear



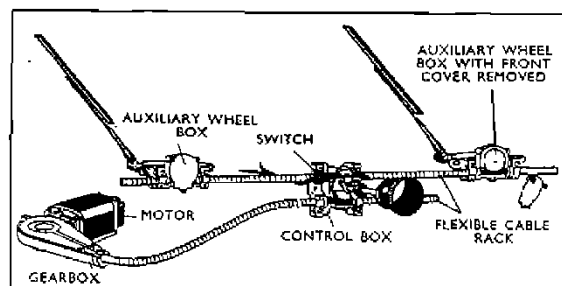
wheel attached to the wiper drive spindles mounted on the wheelboxes. The cable rack, as you can see is enclosed in a flexible metal outer casing.

These motors are made for both 12 and 6 volt working; the motor and its reduction gearing exerts a push of approximately 50 lbs. on the cable rack.

GENERAL ARRANGEMENT

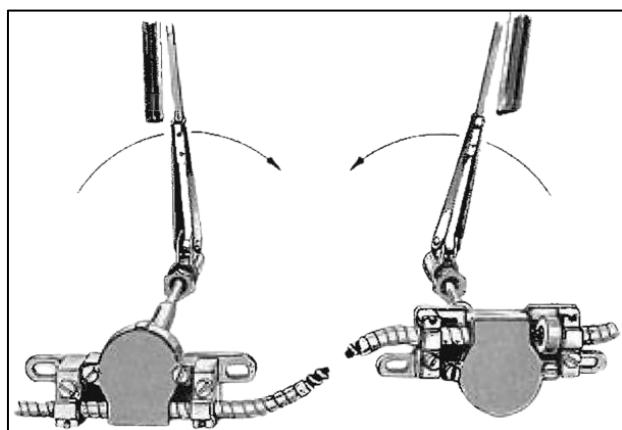
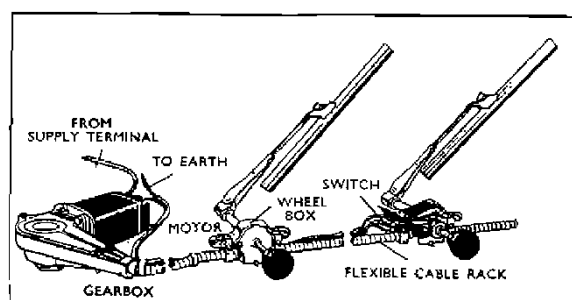
Sundry arrangements have been provided in order to fulfil the various requirements of the vehicle manufacturer.

In the one illustrated the control box is mounted centrally — or may be off-set if required. It performs the dual function of simultaneously switching the motor on and off, and parking the blades at either end of the screen as may be desired.



AN ALTERNATIVE ARRANGEMENT

The arrangement illustrated in this picture provides for hand wiping and parking of either blade independently, the 'on and off' switch being incorporated in the wheelbox on the driver's side.



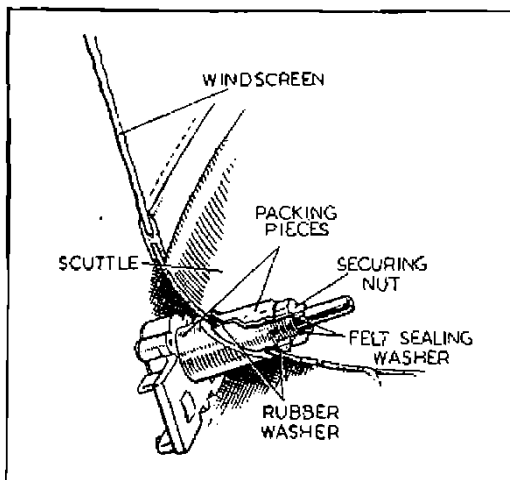
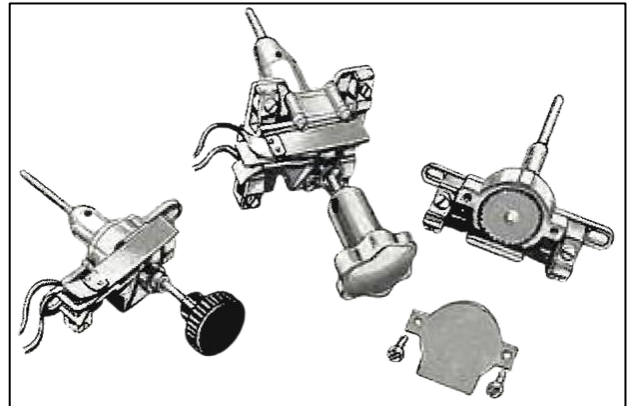
OPPOSED WIPING ARCS

In both the above arrangements the wheelboxes are mounted over the cable rack, thus producing a parallel motion of wiper blades. If it is required to operate the arms towards each other, i.e., 'Clap Hands' arrangement, one of the wheelboxes will be mounted above the rack and the other one below it. Then, in order to obtain the desired angle of sweep it may be necessary to install a crank wheel with a different throw in the motor itself.

WHEELBOXES — ASSEMBLIES AND METHODS OF FIXING

There are one or two other features of the CR and CRT wipers which might be of interest.

This illustration shows a close-up of one of the earlier type wheelboxes used. It should be noticed that the two slotted ears are used for the fixing screws to the scuttle of the car, and two half clamps are installed to locate and hold the ends of the flexible outer casing of the cable rack.



WHEELBOX — SINGLE HOLE FIXING

Another type of wheelbox assembly provides for single hole fixing by means of a securing nut as shown in this picture.

In order to make this arrangement adaptable to existing scuttle angles, several different sloping packing pieces and suitable rubber washers have been produced to suit individual vehicles.

WIPER ARM FIXING

This illustration shows a collet arrangement for fixing the wiper arm to the wheelbox spindle.

Several different versions of this system have been in use for many years.

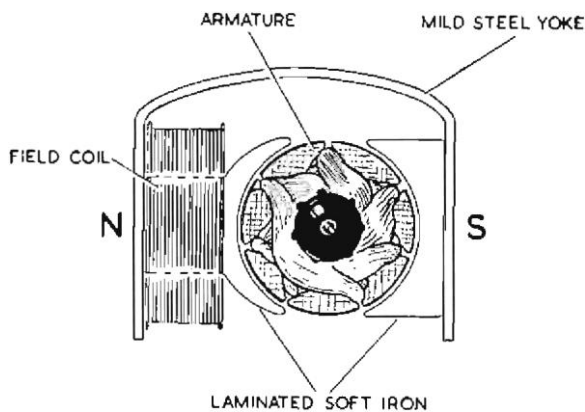
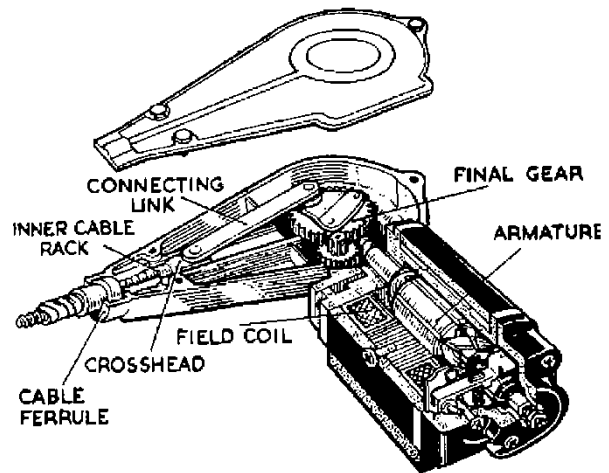


THE CR MOTOR AND GEAR BOX ASSEMBLY

The drive from the motor armature to the cable rack is obtained by means of a double reduction gear of approximately 72—1. The first stage reduction of 13 to 1 is obtained by means of a worm cut on the end of the armature spindle which engages with a worm wheel. This worm wheel is built integrally with a spur pinion; the pinion engages with the final drive gear wheel, as shown, at a ratio of 61 to 11. A crank pin and connecting rod then transmits the drive to the crosshead on the cable rack. The number of wipes per minute will be approximately 90—100.

It should be noted that, altogether, six different wiping angles ranging from 105° to 150° are now used on the different makes of vehicles. The varying length of stroke being obtained by altering the throw of the crank. Thus to alter the angle of wipe it is necessary to change the final gear wheel in the gear box.

The silent running of this gearing can be maintained if the correct type of grease is used; that is, Duckham's Keenol KG25.



THE ECCENTRIC TYPE SHUNT MOTOR- MAGNETIC CIRCUIT

Commencing with the magnetic circuit of the motor it will be seen that the 'field' is provided with one coil only situated on one side of the armature. The 'U' shaped yoke of mild steel which forms part of the body of the unit completes the magnetic circuit, bringing the opposite polarity, the south pole in our illustration, to the other side of the armature.

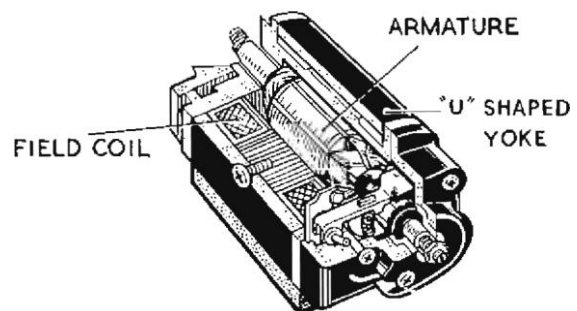
Incidentally, this type of construction is generally styled as an eccentric motor, the armature being offset from the centre as shown.

SECTIONED MOTOR

In this cut-away section the actual layout is clearly shown.

You can see that the armature is mounted eccentrically in the body with the field coil at the side of it, and the 'U' shaped yoke surrounding both components. Otherwise, the motor is of the plain shunt wound type, with the single field coil in parallel with the armature windings.

By contrast with the CW type wiper the 'on and off' switch is a separate unit.

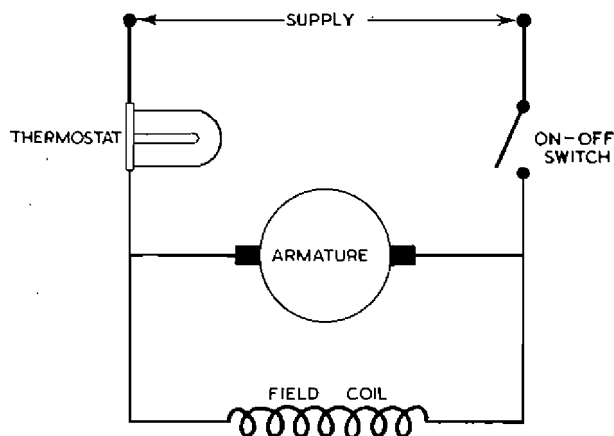
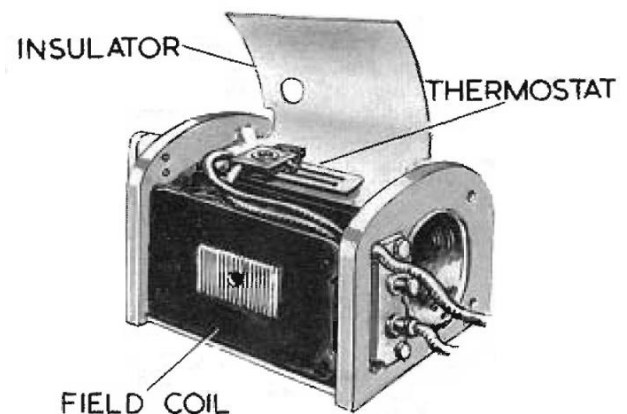


THE OVERLOAD CUT-OUT SWITCH

The CRT wiper incorporates a thermostatic cut-out switch as shown in this illustration, and this is the model now fitted to a great number of current production vehicles.

The fitting of the thermostatic switch in the original CR model was not necessary as the stall current of the motor was not so heavy. The CRT model, however, develops a much greater power with a correspondingly higher stall current.

Some form of temperature control was thus required to protect the windings against overload. Excessive current draw, with consequent overloading, can be caused by packed snow or ice on the windscreen, or by 'binding' of the wiper spindles due to bad fitting — in fact by anything which unduly strains the motor.



THE THERMOSTATIC-CRT WIPER

The thermostatic switch is connected in the supply line to the motor and automatically breaks the circuit when the temperature rises to between 90° and 95° C., 194—203° F.

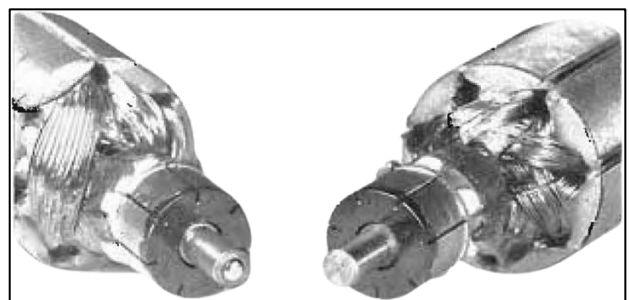
The switch will re-close automatically when the temperature of the motor falls to around 60° C. — 140° F. which is the ordinary running temperature.

Thus, operation of the thermostatic switch will stop the motor without warning and it might remain so stopped for several minutes, i.e., until the motor temperature drops, when it will re-start and continue at normal speed providing the main switch is left in the 'on' position.

CR AND CRT ARMATURES AND FIELD COILS

The armature illustrated on the left of this picture is that used on the original CR wiper and is built with a steel thrust ball inserted in the commutator end of the spindle as shown.

The armature of the CRT model has a greater number of turns of wire in each of the seven armature slots and provision for thrust is made in a slightly different way with the result that a plain end shaft is used, as shown on the right. Therefore, these armatures are NOT interchangeable. Also, the field coils are not interchangeable.

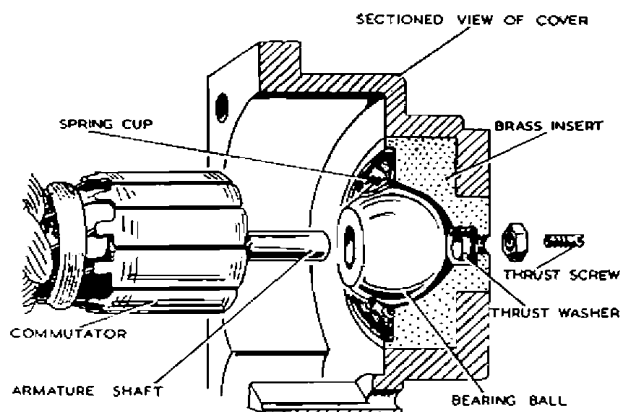


SELF ALIGNING BEARINGS

A novel feature of both the CR and CRT wiper motors is the self-aligning commutator end bearing as shown in the illustration.

The bearing itself is a ball, held in position by a spring cup as shown, thus ensuring that the armature is lined up with the front end bearing, and the thrust screw at the back.

This thrust screw is necessary by reason of the worm drive on the other end of the armature, and should be set so that the end float is just sufficient to allow the shaft to rotate freely.



WIRING CIRCUIT AND FAULT FINDING

It is general practice to wire the screenwiper circuit through the A4 fuse, thus providing master control from the Ignition Switch; the object of this is to prevent the wiper motor being left in the ON position when the vehicle is out of use, with the consequent danger of running the battery down.

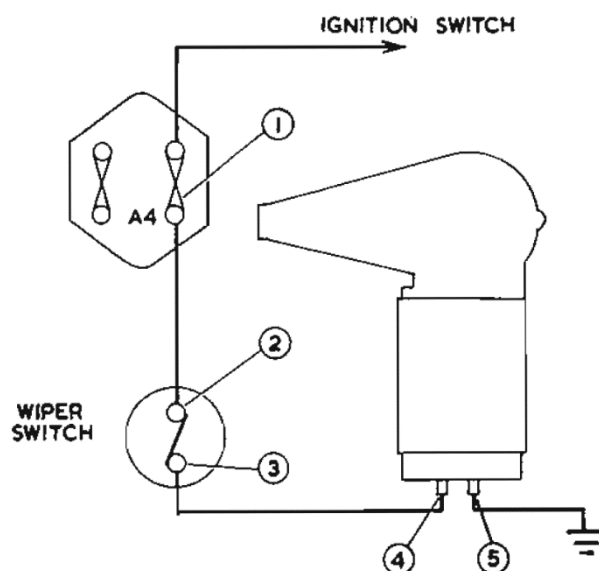
The typical circuit arrangement using a 14/012 strand green master colour cable is shown here.

Electrical faults may be easily located by means of a voltmeter, and overloading, with consequent sluggish operation, by means of an ammeter.

In every case testing should commence with the obvious external possibilities such as defective Fuse or Fuse Clips, loose connections or defective switch, loose connections at the wiper motor and defective earth connections.

The whole systematic check should proceed in the order given.

Start at point 1, the A4 fuse, one of the most likely trouble spots in the circuit. A quick check can be made by switching on first the ignition and then any other auxiliary fed from this fuse — for instance trafficators, stop lights, etc.



If none of these are operating, check the fuse. If this is intact, the supply to it can be checked with a voltmeter between the terminal and earth.

If a reading is obtained at A4, next check at the wiper switch. Voltage should be shown between either terminal and earth with the switch closed — i.e., at points 2 and 3 in our illustration.

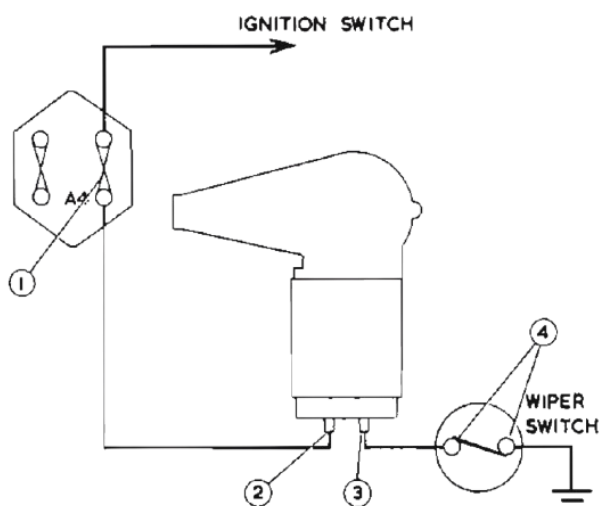
Point 4 is the next at which a voltage reading should be shown. A zero reading should be obtained between point 5 and earth. If any reading is shown, examine the earth connection.

WIRING CIRCUIT AND FAULT FINDING (2)

In the circuit we have just examined you will notice that the switch is on the 'live' side of the motor. Alternatively, and quite frequently, it may be installed in the earth side as shown in this picture.

The checking procedure is similar but the order of the voltage checks differs. The order in this case will be: point 1, the A4 fuse; point 2, the motor supply terminal — at both points voltage should be registered.

With the wiper motor switched on, there should be no voltage reading between point 3 and earth; nor between either of the switch contacts and earth.



CURRENT CONSUMPTION TEST

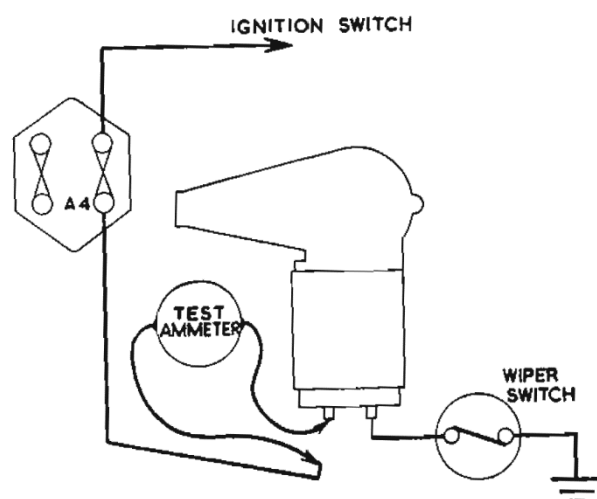
The normal running currents for these motors are a good guide to performance.

Excessive current readings will indicate that over-loading exists at one of the following points:

1. Excessive blade pressure on the screen.
2. Binding at the spindles and wheel-boxes.
3. Binding at the rack or outer casing.
4. Partial seizure or other fault in the motor assembly itself.

An ammeter placed in the wiper feed as shown will give an immediate indication of any of these troubles which may then be localised, firstly, by removing the arms and blades and lastly, by disconnecting the motor assembly from the rack and trying the unit by itself.

Abnormally low current readings will, if the voltage is properly maintained, indicate that the motor brushes are either worn out or sticking, or if a heavy reading is accompanied by excessive drop in voltage, a short within the motor itself will be indicated.



NORMAL

CURRENT CONSUMPTION

MOTOR COLD —DRIVING BOTH BLADES ON WET SCREEN.

	CR AMPS.	CRT AMPS.
6 VOLT.	3.5-60	4'0-65
12 VOLT.	1.75-3.0	2'0-3'25

NORMAL CURRENTS WITH COLD TEMPERATURE

The correct current readings with a cold motor driving both blades on a wet screen should be as shown in this tabulation.

Once the trouble is located to the motor assembly, an inspection can then be made, and any small faults such as dirty commutators, worn brushes, sticking brush levers or loose connections can be conveniently rectified without necessitating the exchange of any major components.

The opportunity should be taken to open the gear box cover and, if necessary, re-pack the wiper with the correct grease, Duckham's Keenol KG25.

After correction the motor should be re-tested. The current taken should then be back to normal and the specified speed of 90 to 100 oscillations per minute obtained.

MAINTENANCE POINTS

- ① MOTOR & WHEELBOX FIXING
- ② SPINDLE CLEARANCE
- ③ WIPER BLADE RUBBERS

MAINTENANCE AND FAULT FINDING

Very little maintenance is required to keep windscreen wipers in a serviceable condition.

All the moving parts are packed with grease before leaving the factory, and if periodic attention is paid to these other points, trouble-free service can be expected.

Make sure that the wiper motor fixing, and that of the wheelboxes is secure.

The next point follows from the previous one: if the wheelboxes have moved slightly, the spindles will tend to bind in the apertures, putting an undue strain on the motor.

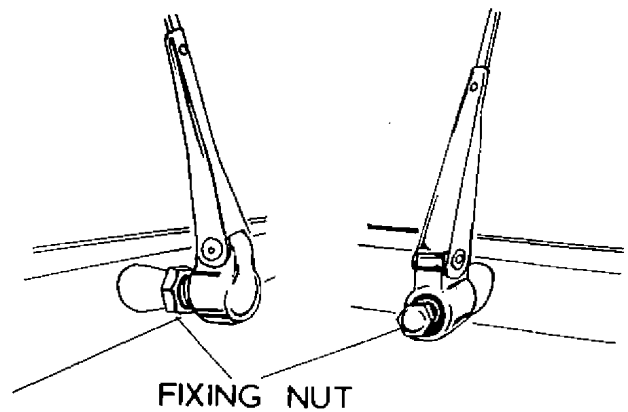
The next concerns the rubber of the wiper blades, which should be inspected occasionally, and the blades replaced after long service.

Dirt and grease tend to accumulate on the rubber and harden. This impairs the 'squeegee' action of the blade, making clean wiping of the screen impossible.

WIPER ARM FIXING

If slipping of the wiper arm occurs, the trouble can usually be traced to the collet fixing. The hexagonal nut should be firmly tightened after the blades have been set to give the correct wiping arc on the screen.

At the same time, check that the hinge spring in the arm is not weak or broken.

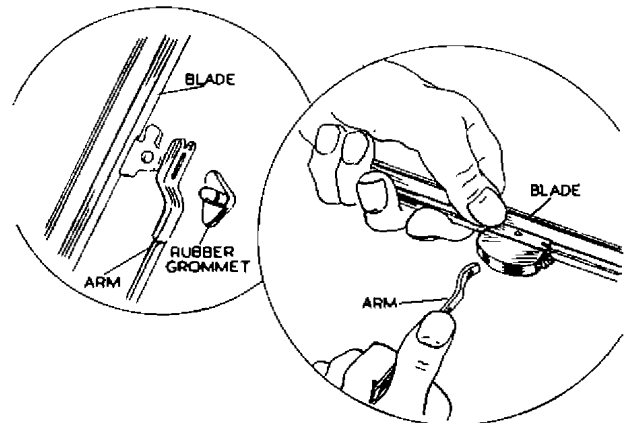


BLADE FIXING

And here are two of the usual methods in use for fitting the blades.

In the left-hand illustration, the rubber grommet secures the blade, whereas on the right it is held in position by a spring clip.

Both fixings permit side-movement or rocking of the blade, ensuring maximum contact with the screen over the full wiping angle.



Windshield Wipers (Models DR1 & DR2)

THE DR1 AND DR2 WIPER MOTOR ASSEMBLIES

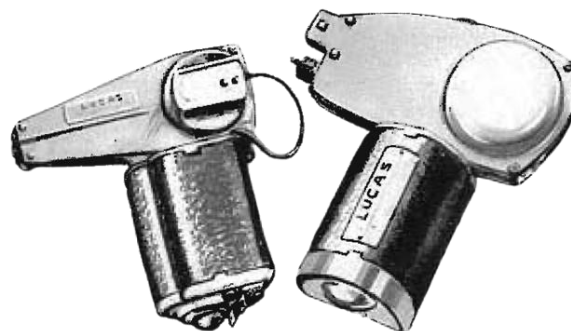
The DR series of complete Dual wiper assemblies are the latest addition to the Lucas range and are now being widely applied to current production vehicles of all makes.

There are two basic types, the DR1 which may be for either single or two speed working, and the DR2 single speed. Both models, which are made for 6, 12 or 24 volts are substantially more powerful than the earlier CR types.

The two-speed arrangement has been developed specially for high speed vehicles which may be subjected to any conditions up to the proverbial tropical downpour.

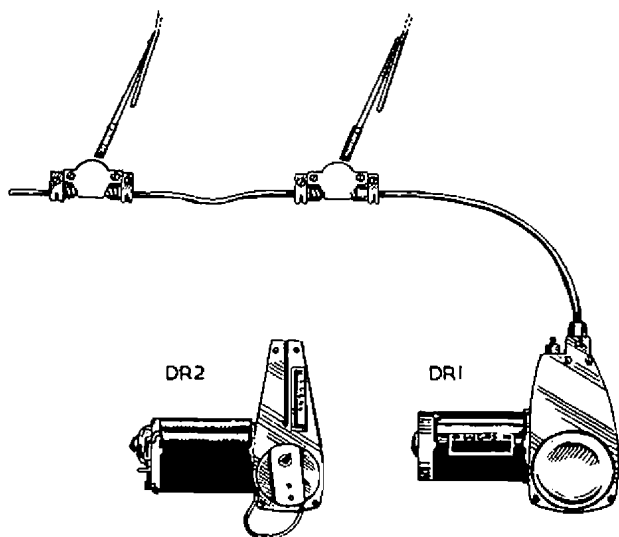
Both of these wipers are so far arranged for automatic self-parking and are controlled by means of switches mounted on the facia panel.

The DR1 uses a rotary 3-position switch, and the DR2 a simple push and pull, 'on and off' switch.



DR2

DR1



THE DR1 AND DR2 GENERAL ASSEMBLY

The layout of cable rack, casing, wheelboxes, arms and blades follow the general pattern of the CR with certain differences.

In order to provide for the increased power it has been necessary to substitute the flexible metallic outer casings by rigid steel 'Bundy' Tubes. This is a ductile steel tube with a coppered lining and is attached to the motor and wheelboxes by 'flaring' the ends, and connecting to the motor by means of a 'union' type connection, and to the wheelboxes by means of clamp plates.

The wheelboxes themselves are cast assemblies on the DR1 model, and steel pressings on the DR2.

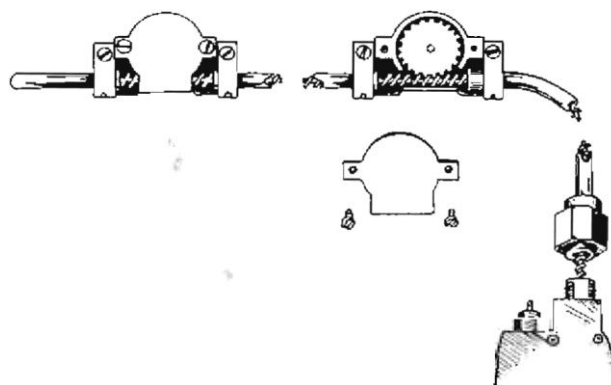
THE RACK DRIVE ASSEMBLY

A more detailed consideration of the wheel box, motor and outer casing assembly is desirable.

Trouble free service is contingent upon the free running of the rack within the wheelboxes and the tube.

This illustration of the Bundy Tube layout will show clearly how necessary it is to have correct alignment throughout. Flattened sections or kinks in the rigid tube will cause binding and consequent overloading of the motor and care must be exercised when fixing the assembly.

Misalignment of any of the components is also liable to cause binding, the junction of the motor assembly to the Bundy tube being one of the most vulnerable points.

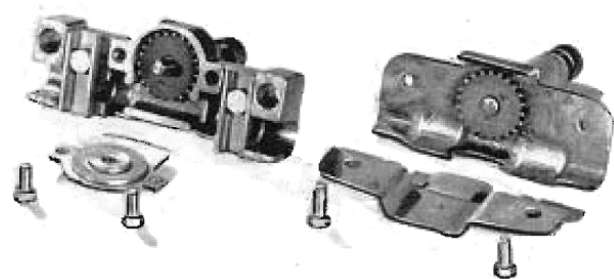
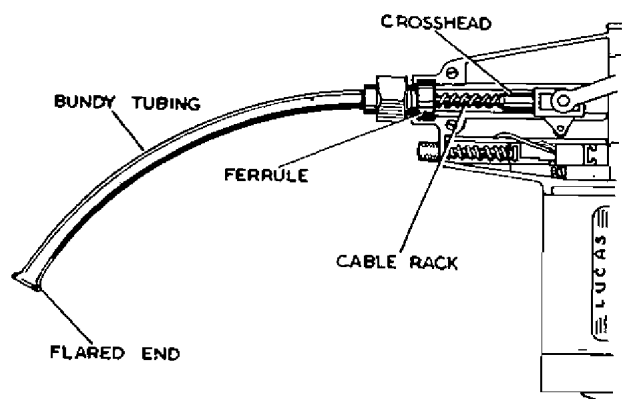


THE RACK DRIVE AND ATTACHMENT OF THE BUNDY TUBE

As seen on the left of the picture, the Bundy tube is 'flared' for attachment by the clamp plates to the wheelboxes. The drive-end fixing centre is a 'union' type attachment.

The flexible rack connects to the motor crank by means of the cross-head shown.

Parking adjustment is made by means of the limit switch with which we shall deal in detail at a later stage.



WHEELBOXES

Whilst following the general pattern of the CR type wheelboxes, the clamping arrangement varies in order to fix the Bundy tube properly.

The DR 1 wheelbox shown on the left is of die-cast construction, and, as you can see, the flared end of the Bundy tube is located in the special recesses positioned between the rack wheel and the clamping plates.

The DR2 pressed steel wheelbox, on the other hand, uses the cover for clamping the Bundy tube in position.

The DR1 wheelboxes may be single hole fixing similar to the CR type, or may be located by means of two separate fixing screws as shown on the left.

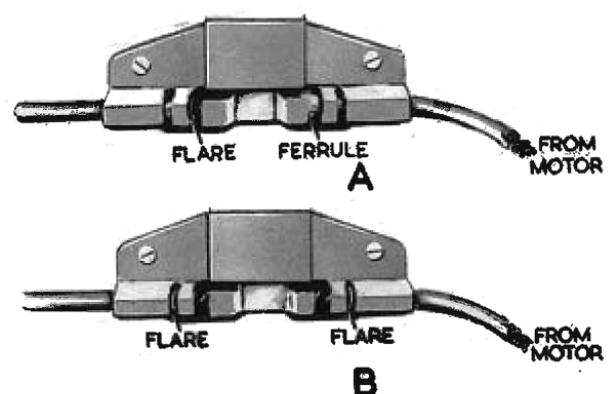
The DR2 wheelbox in the picture on the right is a one-hole fixing type only.

DR2 WHEELBOX BUNDY TUBE LOCATION

On the early production DR2's a ferrule brazed to the Bundy tube on the primary length from motor to wheelbox was arranged to locate in the space next to the rack wheel as shown at 'A' in the illustration.

On later production the use of the ferrule was discontinued and the end of the tube 'flared out'. The correct position of the flare is then in the narrow space as shown at 'B'.

In the lower picture it can be observed that the flare on the inter-connecting section of tube may also be located in the narrow space, but this is immaterial.



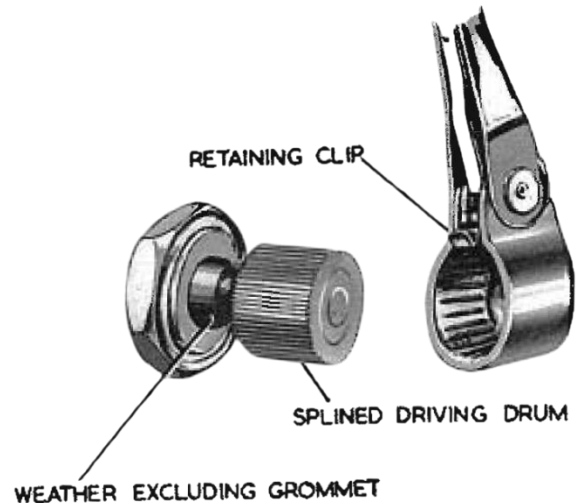
WIPER ARM FIXING

Another departure from the earlier CR arrangement is the method of locating and locking the wiper arm on to the wheelbox spindle.

In both the DR1 and DR2 a splined drum is pressed on to the wheelbox spindle, and mates with the splined hub of the wiper arm. The arm is locked by means of the retaining spring clip as shown. In order to remove the wiper arm it is only necessary to lift the spring clip by means of any small lever and withdraw the complete arm.

It should be noted that the splines are arranged at 5° intervals to enable the arm to be placed in any desired parking position.

It may also be noted that the wheelbox spindle is grease packed on assembly, and embodies a weather excluding grommet as shown.



THE DR1 MOTOR ASSEMBLY

We may now examine the DR1 motor and gearbox assembly.

To summarise the characteristics of this TWO speed arrangement.

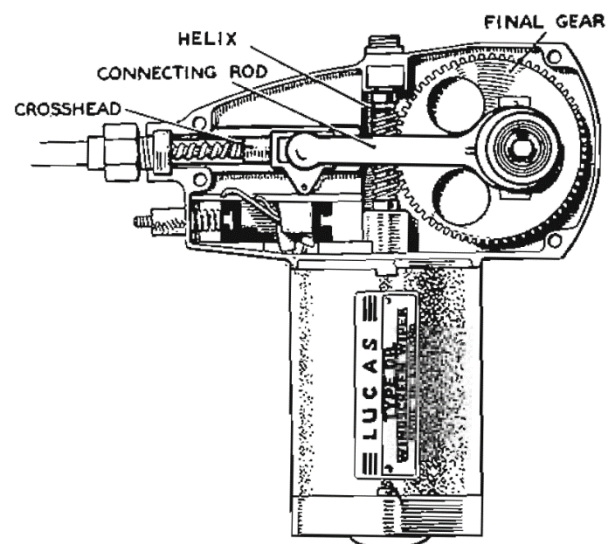
1. It is produced for 6, 12 and 24 volt working.
2. Has "NORMAL" wiping speed of 90—130 wipes per minute and in the "HIGH" speed 130—150 wipes per minute.
3. The high speed is obtained by weakening the motor field by means of a resistance inside the motor, and a combination switch mounted on the facia.
4. The angles of wipe will vary between 90° and 130° as specified by the vehicle manufacturer.
5. Parking is available at either end of the stroke as may be desired.
6. A thermostatic cut-out switch built into the motor is provided to prevent damage if persistently overloaded for any reason such as heavily packed snow or ice.

DR GEAR MECHANISM

This view of the inside of the DR1 gear box shows the gearing. In some ways it is simpler than either the CW or the CR wipers.

A worm cut on the end of the armature spindle engages with the worm wheel as shown, providing a reduction ratio of 42½ to 1. This worm wheel in turn mounts the crank pin which connects directly to the crosshead of the driving rack. A screw type adjustable Thrust Pad for the worm spindle will be seen at the top.

A self-parking switch is located at the bottom left and is adjustable for exact parking position by means of the screw and knurled nut shown on the extreme left. This parking switch is actuated by a striker fixed to the crosshead.



THE SELF-PARKING MECHANISM

Let us now make a closer examination of this self-parking device.

The requirements are that the wiper blades park automatically on whichever side of the screen may be determined by the vehicle manufacturers, and also they can be adjusted to stop at any desired position in relation to the bottom of the screen.

To do this, a simple blade type switch "A" is located in a slide as shown.

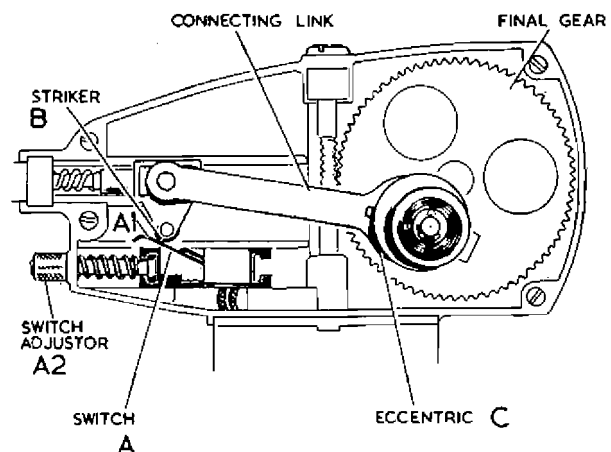
With the motor running normally the striker roller 'B' on the crosshead will NOT come into contact with the switch blade 'A'.

To stop and park the wiper blades the first operation is to reverse the direction of the motor by means of the main switch on the facia panel inside the car.

When reversal of the motor rotation commences an eccentric cam 'C' on the crank pin causes the driving rack to move further outwards than when running normally.

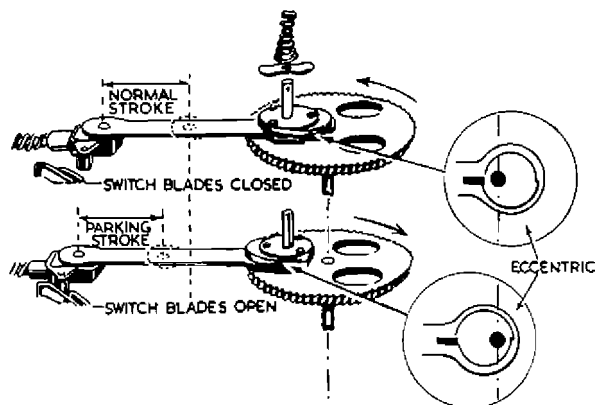
The striker roller 'B' on the crosshead then contacts the switch blade 'A' and stops the motor. This stoppage will always take place at the end of the stroke.

The exact stopping position is determined by means of



the adjusting screw shown at 'A2' and this adjustment can be varied at any time in service.

If the wiper blades are to be parked on the opposite side of the windscreen two things are necessary. Firstly, the motor armature connections must be changed over and secondly the switch assembly 'A' must also be changed over. That is, with the blade 'A' facing inwards towards the final gear.



THE ECCENTRIC CAM

This illustration shows in some detail the eccentric cam between the crank pin and the connecting rod.

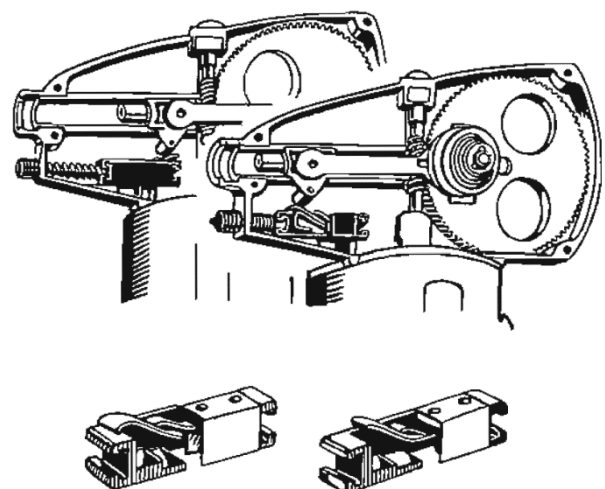
The top picture illustrates the normal stroke path of the connecting rod which is coupled to the driving rack.

When the panel switch is moved to the 'Park' position, the direction of rotation of the motor is reversed. The eccentric cam as shown in the lower picture moves through half a revolution, and the stroke path of the connecting rod will then be moved along sufficiently for the striker on the crosshead to open the contacts of the Limit Switch and thus stop the motor.

ARRANGEMENT OF OPPOSITE PARKING POSITIONS

The top illustration clearly shows the layout of the 'PARKING' or 'LIMIT' switches for stopping the wiper either on the left or right hand side of the screen, also the knurled nut for setting the final at-rest position in relation to the bottom of the screen.

The smaller illustration gives a fair idea of the switch assembly itself, the latest model on the left having the end of the blade extended by comparison with the early type.

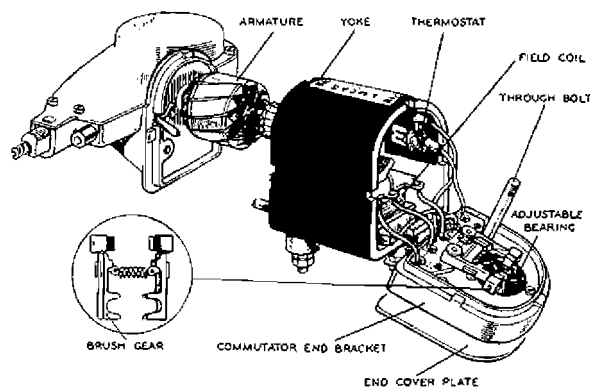


THE DR1 MOTOR

The main features of this motor, both magnetically and electrically are similar to that of the CRT model which has already been reviewed. It is an eccentric machine, the armature being offset from the centre. The field is provided with one coil only, located below the armature. The 'U' shaped yoke of mild steel, which forms part of the body of the unit completes the magnetic circuit, bringing the opposite polarity, the south pole, to the other side of the armature.

The armature itself is supported at the commutator end by a self-aligning bearing of the type used in the CR model. There is also a bearing bush between the motor and gear-box, and at the outer end of the shaft an adjustable stop is provided to control end movement.

A thermostat wired in series with the armature is mounted on the inside of the yoke near the second pole-piece. It consists of a bi-metal strip and contacts, which open when the temperature rise becomes excessive. In this way the motor is protected against overload.



An additional component is the resistance which is connected into the field to produce the speed increase for the High Speed wipe. This is over-wound on the motor field coil, and is brought out to the terminal board on the C.E. bracket as we shall see.

THE DR WIPER MOTOR CIRCUITS

As a simple commencement to a study of the circuits of the DR1 wiper arrangement we may trace through the motor circuits only.

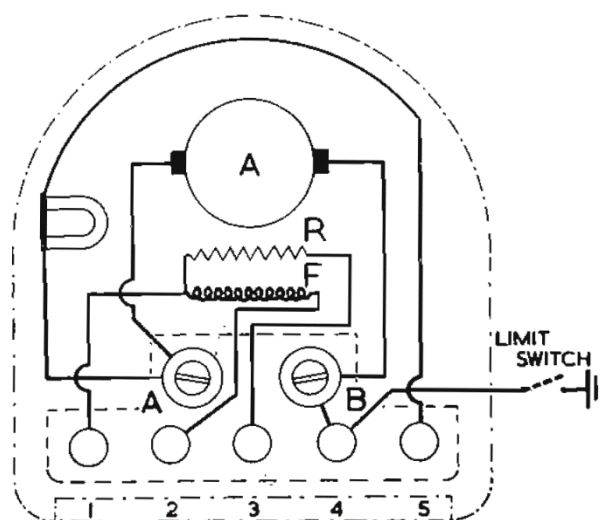
The motor itself may be considered to have four circuits: (1) The Armature Circuit; (2) The Field Circuit; (3) The Field with resistance in circuit, and (4) The Limit Switch circuit.

Commencing at the armature circuit the current path is from Terminal 5 through the thermostat switch to the brush terminal 'A' through the armature to brush terminal 'B', finishing at terminal 4.

The field circuit — from terminal 2 to one end of the Field Coil, through the field returning to terminal No. 1.

The field with resistance in circuit — from terminal 2 through the field coil to the junction point with the resistance, and from the other end of the resistance to terminal 3.

The gearbox limit switch is placed in the earth side of the motor circuit, and is as shown from terminal 4 through the switch contacts.



THE PRS5 SWITCH

A specially designed Rotary Switch arranged for single hole fixing — panel mounting — called the PRS5 provides three positions.

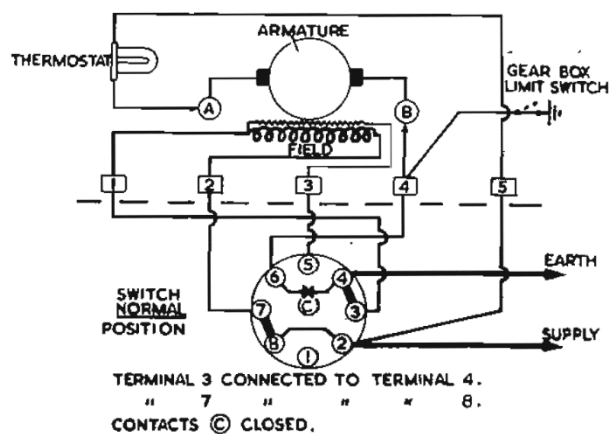
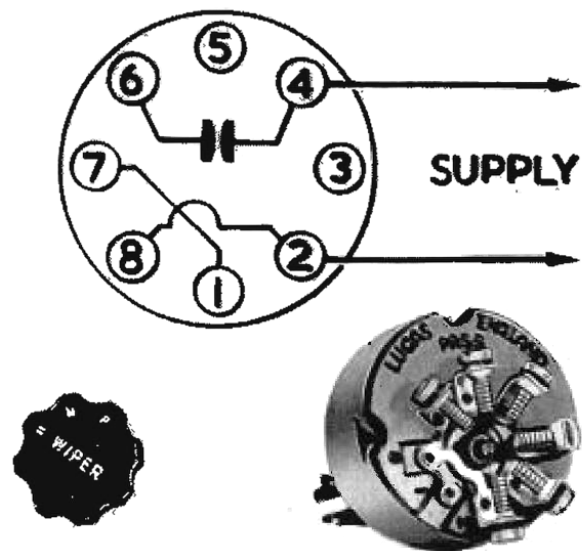
1. 'N' — 'ON' for normal running speed.
2. 'H' — 'HIGH SPEED' Wiping.
3. 'P' — The parking position.

This comprises two components:

Firstly, a rotor with two contact segments which select the various running positions, and secondly a cam actuated contact breaker — a pair of points — which makes and breaks the motor earth connection for starting and stopping.

We have already stated that the motor may be considered to have FOUR internal circuits, and we can now state that the motor, the switch, and the current supply and return comprise three circuits.

1. From the supply through the switch when in the 'N' position.
2. From the supply through a different combination of connections for the 'H' position.
3. From the supply through a further combination of connections for parking and stopping.



CIRCUIT No. 1 NORMAL RUNNING POSITION

Switching to the 'N' position starts the wiper with the blades moving at normal speed.

The current supply is connected to the No. 2 terminal at the control switch. Here it divides, one path to the armature, the other to the field. Remember it is a shunt-type machine, with the two circuits in parallel.

We will deal with the armature circuit first. The supply is taken from terminal 2 of the switch to terminal 5 at the wiper motor. Then it continues via the thermostat through the brush at (A) to the armature; the return is from the other brush at (B) to motor terminal 4, which connects to No. 6 at the switch. A pair of contacts, marked C, closed internally by the switch in the 'N' position, completes the circuit via terminal 4, to earth.

Now the field circuit:— Starting from terminal 2 at the control switch which is permanently linked to 8, the switch rotor position for normal running connects to 7; the circuit path is then to No. 2 on the motor through the field to No. 1. From No. 1 then to No. 3 on the switch, across the other rotor contact to No. 4 and then to earth.

This circuit provides for screen wiping at normal speed.

HIGH SPEED POSITION

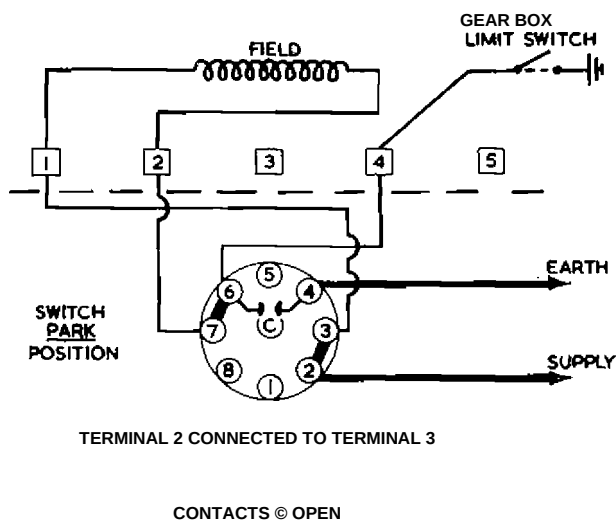
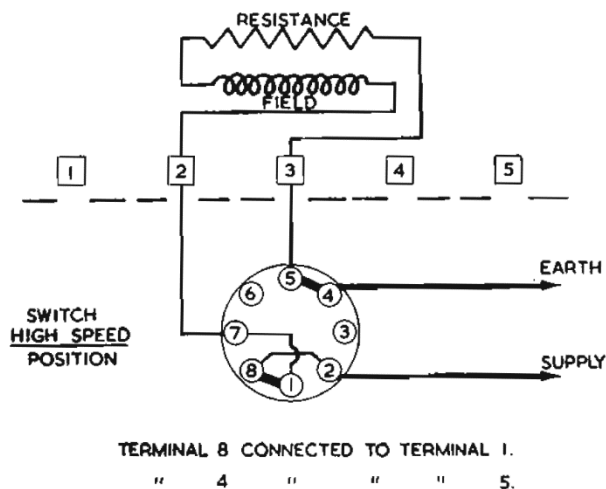
On switching to the 'H' position, high speed wiping is obtained.

This is brought about electrically by the insertion of a resistance in series with the field coil. You remember we pointed out this resistance winding on the field coil a few pages back. It has the effect of reducing the field current and hence the field strength of the motor. With the field strength reduced, the armature turns at a faster speed.

It should be realised that this increase of wiping speed is only obtained by a corresponding reduction in the motor torque. This in turn is compensated by a reduction in the wiper blade load due to the heavy flooding of the windscreen surface such as occurs in exceptionally heavy rain, tropical downpour, etc. If the high speed wipe is maintained under normal conditions of loading, the motor will eventually overheat and the thermostatic switch will finally stop it completely and it will remain stopped until the motor temperature again falls to normal.

Remembering that the armature circuit remains unchanged, now follow out the field circuit with its resistance in series.

Commence from the switch supply terminal No. 2. The current path is via the fixed link to (8), through the rotor segments to (1), through another fixed link to (7), direct to field terminal (2) on motor, through the field and its resistance to motor terminal (3). From there it passes to switch (5) through rotor segment to (4) direct to earth.



THE PARKING POSITION

This circuit shows the control switch turned to the 'P' or park position. The motor switches off, and the blades park automatically.

As far as the electrical side of the operation is concerned, the field circuit is momentarily reversed; that is, the feed is in the opposite direction. The supply is now switched via terminal 2 and 3 of the control switch to the No. 1 terminal of the field winding, as opposed to No. 2 for 'normal' running. Current will thus flow in the reverse direction through the field circuit, reversing the rotation of the motor, but current will only flow as long as the earth side of the circuit is complete. The contacts 'C' in the control switch are open in this position, the only available earth being provided through the gearbox limit switch. You can follow this from No. 2 terminal of the field winding, through switch terminals 7 and 6 and on via terminal 4 at the motor, to the limit switch and earth.

If this switch contact is now broken, the motor will stop.

CIRCUIT TESTING—STAGE 1.

The Normal Running Position

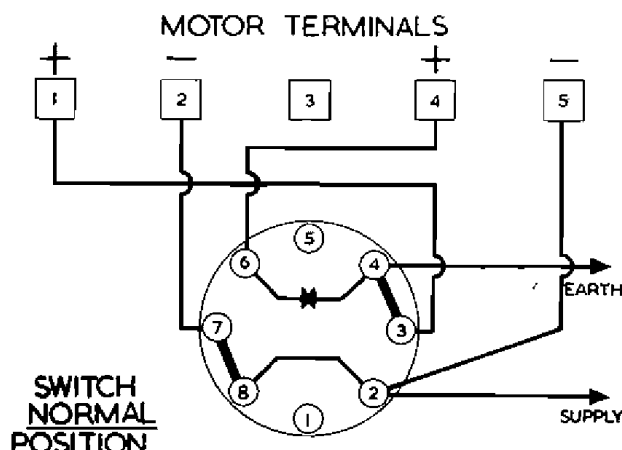
Having examined the motor and switch circuits, we can now formulate a simple routine for testing either or both.

Assuming that our problem is an electrical one, the first thing is to localise the trouble to either the motor, the switch, or the wiring.

To do this the following procedure is recommended:

1. Check the current supply to the circuit. Commencing from the A4 fuse, this can easily be checked with the voltmeter.
2. Turn the switch to NORMAL running position. With the voltmeter, take readings at the wiper motor terminal block. We should expect to find full voltage readings between terminals 1 and 2 (Field) and terminals 4 and 5 (Armature).

This will indicate that the switch itself and its wiring to the motor is in order in the 'N' position. If a LOW voltage reading is obtained at the Armature terminals 4 and 5 it suggests that the motor is taking excessive current and will generally necessitate its removal. If 'No Voltage' is obtained from terminals 1 and 2 or 4 and 5 we can assume that an open circuit exists either in the switch, or its wiring, which can be traced by following the circuit shown in this illustration.



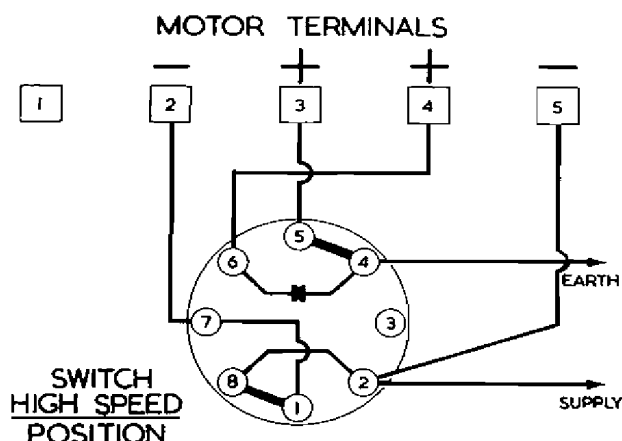
CIRCUIT TESTING—STAGE 2.

The High Speed Running Position

Having checked the wiring and switch for the normal running position, we can now move to the HIGH SPEED position of the switch.

For this condition we should have full voltage at terminals 2 and 3 (Field Resistance) and 4 and 5 (Armature) of the motor terminal block.

If NO VOLTAGE is obtained at either pair of terminals an open circuit exists in the switch or the wiring.



CIRCUIT TESTING—STAGE 3.

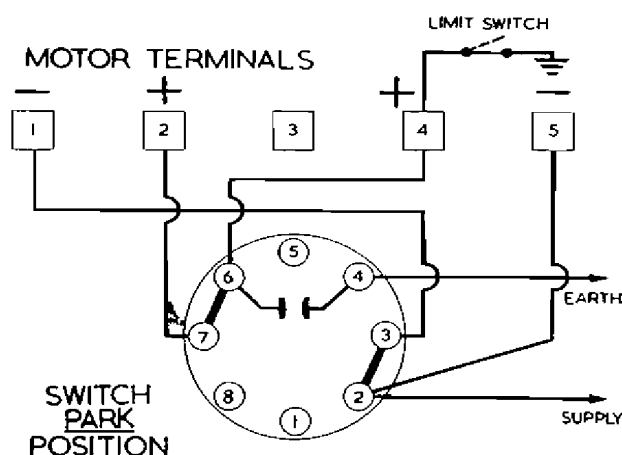
The Parking Position

We can now check the circuit with the switch in the PARK position, which will also check the operation of the limit switch:

1. Connect voltmeter to terminals 1 and 2 (Field) at motor terminal block.
2. Turn switch to NORMAL position — Voltage reading should be obtained.
3. Turn switch onwards to the PARK position when polarity at terminals 1 and 2 will be reversed, the motor rotation will reverse and then the wiper will PARK at the end of the stroke.

If upon changing the switch from NORMAL to PARK the motor stops with no voltage readings at terminals 1 and 2, check the LIMIT SWITCH circuit and the EARTH to the motor body itself.

The circuits we have just examined are applicable to the DR1 wiper motor only. We can now turn to the more recent type DR2 motor and its circuit.



THE DR2 EXTERNAL VIEW

The DR2 is the new model in the DR range, being basically similar to the DR1, and designed to give approximately the same performance. It is suitable for 6, 12 and 24 volt working, with varying angles of wipe from 90° to 130°.

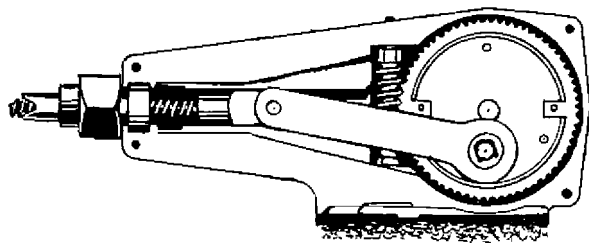
The models so far fitted to vehicles are constructed for single speed operation only.

The DR2 is not thermostatically controlled, since the motor is designed to withstand stall currents for a considerable time.

A different arrangement for self-parking allows a simple ON/OFF panel control switch to be used.



DR2 MOTOR

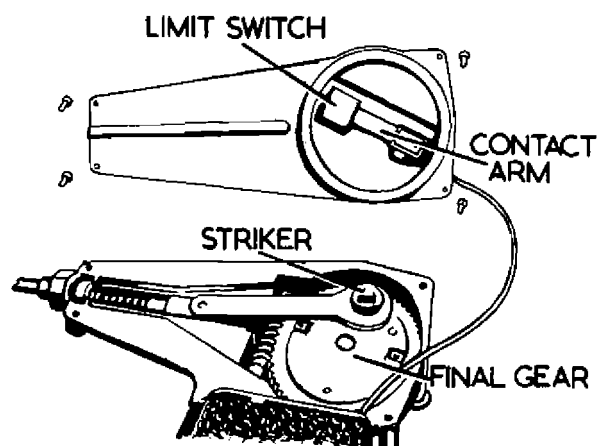


DR2 INTERNAL VIEW —VIEW GEAR BOX

Internally, the construction is very similar to the DR1. An eccentric type motor drives a single nylon final gear through a helix on the end of the armature shaft. Then the design becomes simpler than the DR1; there is no eccentrically mounted connecting link to give self-parking. Instead, a plain link transmits the reciprocating movement via the crosshead and cable rack to the wheelboxes. As with the DR1, the rack is housed in 'Bundy' tubing.

SELF-PARKING ARRANGEMENT

Self-parking of the wiper blades is brought about by moving a simple panel control switch to the ' OFF ' position. With the switch in this position, the motor stops at the end of the wiper arm stroke by virtue of the limit switch shown here, which as you can see is built into the detachable cover of the gearbox. The contact arm of this switch is operated by the head of the crank pin which is an integral part of the final gear. This striker opens and closes the contacts once every complete revolution of the gearwheel.



LIMIT SWITCH CIRCUIT

This diagram will serve to illustrate the method of operation of the Parking Switch.

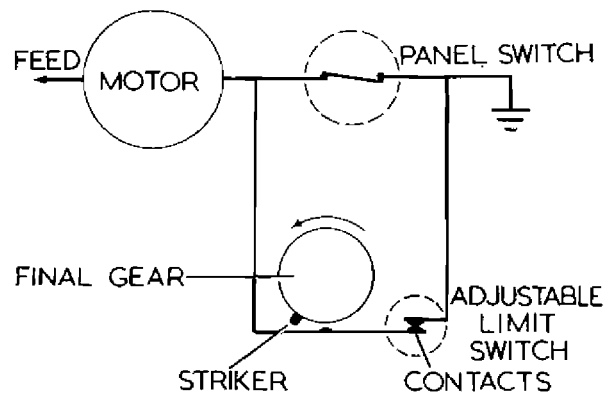
Consider the current path from the Motor to EARTH.

With the panel switch CLOSED the motor circuit is completed.

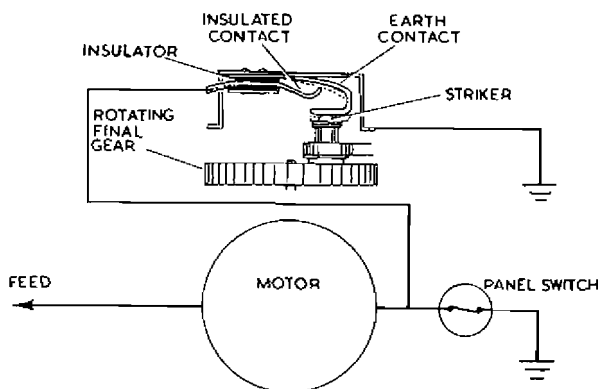
In order to park automatically a parallel current path and switch is placed in the circuit. To stop movement both of the switches must be open.

In order to stop the operation at any desired position of the stroke, the panel switch is first moved to the OFF position thus breaking one current path. At the end of the stroke a striker operates the blade of the limit switch, which will continue to open and close at each revolution of the crank; this will not interfere with the operation whilst the panel switch remains in the ON position.

The panel control switch, when in the 'OFF'



position, breaks the earth side of the motor circuit, the only remaining path to earth being a parallel one through the limit switch contacts. Thus the motor stops when these contacts are opened.



LIMIT SWITCH CONSTRUCTION

The construction and operation of the LIMIT switch will be apparent from this illustration.

Two spring blades are connected to the motor and the switch respectively as shown at the top, and are in contact until separated by the striker located in the head of the final drive wheel crank pin.

THE LIMIT SWITCH ADJUSTMENT

The limit switch is adjustable, enabling the correct parking position to be obtained.

The switch assembly is released by slackening off the four cover fixing screws. It should then be turned and set so that the motor switches off just after the blades have finished their downward travel and are starting the upward stroke.

It must, however, be remembered that this limit switch is correctly adjusted on the assembly line and re-adjustment should not normally be necessary.



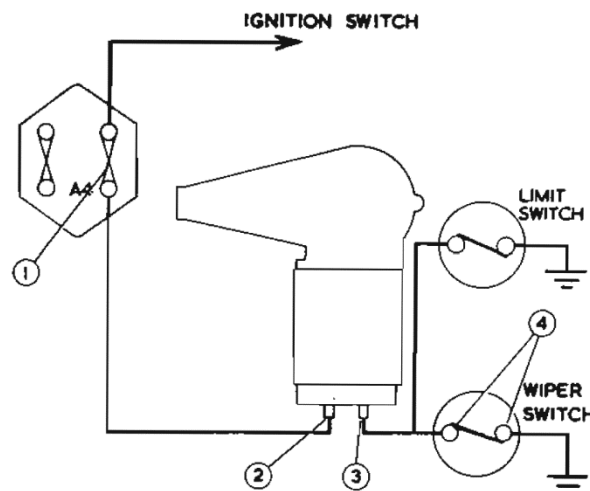
SERVICING THE DR2 WIPER

CIRCUIT TESTING—VOLTMETER TEST

Switch on the ignition and ascertain that current is available at the A4 fuse. This can be easily checked by the voltmeter. With the wiper motor switched OFF we should also have full voltage readings at the wiper motor terminals 2 and 3 in the picture. At the same time when the wiper switch (4) is moved to the ON position the voltage registered at (3) should disappear. If it does not, the wiper switch itself or the earth point is faulty.

If no voltage is registered at the points mentioned it is a simple matter to trace the open circuit by following the wiring sketch shown.

The voltage tests must be supplemented by current consumption tests as we shall now show.



NORMAL CURRENT CONSUMPTION		
MOTOR COLD — DRIVING BOTH BLADES ON WET SCREEN.		
	DR1 AMPS.	DR2 AMPS.
6 VOLT.	5.0 - 7.3	5.0 - 6.3
12 VOLT.	2.4 - 3.5	2.5 - 3.0
(NORMAL RUNNING)		
THERMOSTAT SWITCH	OPENS	135 - 150°C.
TEMPERATURES:	CLOSES	80°C. MIN.

DR1 AND DR2 PERFORMANCE DATA

The correct technical data as shown above will be a very good guide in the event of any unsatisfactory performance.

For instance, any mechanical overloading will be

reflected at once by abnormally heavy current consumption by the motor, with possible persistent, overheating which may cause damage.

Equally, the approximately correct voltage readings are an infallible guide to defective fuses, wiring, terminals or earth connections.

To take a simple example:— Full voltage test readings, and zero, or very low current readings, would indicate at once badly bedded brushes in the motor, burnt commutator, or worn out brushes.

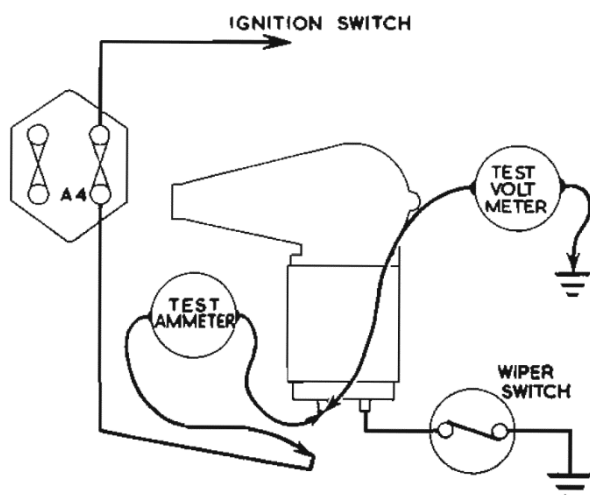
You will notice that the thermostatic switch is not fitted to the DR wiper.

On the DR1 this switch will cut out the operation if the motor temperature rises to between 135 and 150°C., and it will remain open until the motor temperature falls to 80°C., which may take several minutes according to under-bonnet and general prevailing conditions. It should be apparent that if the wiper switch is left in the ON position the motor will re-start automatically.

CIRCUIT TESTING — CURRENT CONSUMPTION

To measure the current consumption whether the motor in question is the DR1 or the DR2, an ammeter is inserted in the A4 feed (GREEN) to the wiper motor, as shown in our sketch. With the motor switched on, the reading shown will fluctuate slightly as the squeegee load varies, but a mean reading can be taken and checked against the chart already given.

It will be necessary at this stage, if the current consumption appears very high, to disconnect the rack from the motor and take a new set of figures. We shall discuss this in more detail.



SERVICING THE DR1 AND DR2 WIPER ASSEMBLIES

From the service point of view the following conditions of unsatisfactory performance may be met:—

1. Sluggish operation or complete seizure.

Of the several possible reasons for this condition the most likely one is that of a greasy and fouled screen.

Another is partial seizure of the driving rack resulting from misalignment of the assembly, or kinking or distortion of the Bundy tubing. Lastly, the trouble may rest in the motor and gearbox assembly itself.

In each case an excessive current will generally be taken

by the motor in its effort to drive the blades at normal speed.

2. Electrical Faults.

True electrical faults are very infrequent but if they do occur they must obviously be either in the motor assembly, the wiring, or the switch, as distinct from the external mechanical faults to which reference has just been made and which may be sufficiently serious to damage the motor electrically if allowed to persist.

A methodical approach to fault diagnosis is essential if the CAUSE of any unsatisfactory performance is to be tracked down.

TEST PROCEDURE AND FAULT FINDING

Sluggish operation or seizure, usually indicated by excessive current consumption may be caused by:—

- a. Low Voltage due to defective connections, particularly earth connections.
- b. Cable Rack bind in the Bundy Tubing.
This may result from flattening, kinking, or over sharp bends (should be 9" minimum radius).
- c. Excessive wiper blade loading due to fouled or greasy screen.
- d. Wheel-box misalignment or spindles seizing in the bearing housing.
- e. Mechanical or electrical faults in the motor and gearbox assembly.

To diagnose the cause of any of these troubles proceed as follows:—

1. Connect a test ammeter and voltmeter in circuit as shown in the last picture:—
 - a. Connect test ammeter in series with wiper feed lead. (Green)
 - b. Connect test voltmeter across the green lead terminal of wiper and earth.
2. Switch-on the motor and check for low voltage. Should be 11.5v minimum. If lower, examine the fuse, re-make main and earth connections as necessary.
3. Remove both wiper arm and blade assemblies.
4. Switch on the motor and test for current consumption and speed of stroke.

	<u>6 volt</u>	<u>12 volt</u>
DR1	5.0 – 7.3 amps	2.4 – 3.5 amps
DR2	5.0 – 6.3 amps	2.3 – 2.9 amps

c.p.m.

DR1	Normal speed	90-98 (15-16 in 10 secs)
	High speed	132-148 (22-25 in 10 secs)
DR2	Normal speed	90-100 (12-17 in 10 secs)

If the current take and the speed of operation is now correct the fault lies with a fouled screen. If the current reading remains excessive:—

5. Remove wiper motor gearbox cover and disconnect the driving crank from the crosshead as follows:—
 - a. On DR1 Motors, remove the cotter-pin securing the connecting rod to the final gear and withdraw the connecting rod complete with eccentric coupling, conical spring and friction plate.
 - b. With DR2 wipers, first remove the gearbox cover and secondly the circlip securing the connecting rod to the final gear. The connecting rod can now be lifted out.
6. With the cable driving rack now disconnected, switch on and test the motor independently, taking a current reading and also a re-count of the number of strokes of the crank pin.

If it is then found to be correct we can safely assume the trouble to be in the Rack and Bundy tube assembly, or the wiper spindles and wheelboxes.

If the speed is still low replace the motor assembly or check following points:—

- a. Armature binding due to thrust screw being out of adjustment.
- b. Commutator end bearing out of alignment.
- c. Short circuit on commutator due to carbon dust, etc.

TO CHECK THE BUNDY TUBE, DRIVING RACK AND WHEEL-BOX ASSEMBLIES

Sluggish operation or seizing in service is frequently caused by misalignment of the assembly or binding of the driving rack in the Bundy tube.

To test for correct cable rack clearance in the tube proceed as follows:—

If binding exists, the sections of the Bundy tube must be examined. To do this:—

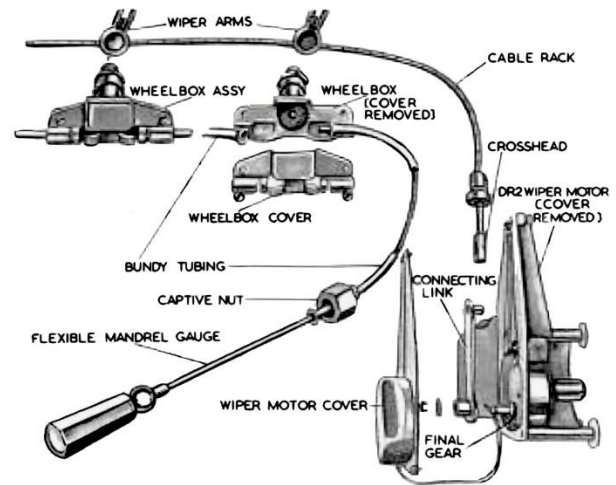
1. Remove arms and blades.
2. Remove wiper motor cover.
3. Extract connecting link between crosshead and final gear.
4. Withdraw cable rack.
5. Remove wheelbox cover.

Insert the Mandrel, which should move freely through each section of Tube.

If the bind is caused by flattening of the tube at a turn it may be possible to clear it by gently reforming the tube carefully in a vice.

If a 'kink' exists, the complete section of tube will have to be replaced.

In some cases an *emergency repair* can be carried



out by filing away the 'kinked' section by means of a suitable size half-round file. Care should be taken to remove frays from the cut-away edge of the bore and also to wash out all filings and lubricate all moving parts with Duckham's H.B.B. grease.

High Frequency Horns

WORKING PRINCIPLES

As the purpose of any horn is to produce an audible warning of approach, we must necessarily first spend a little time in examining the nature of sound and how it originates, before we discuss any of the modern production units.

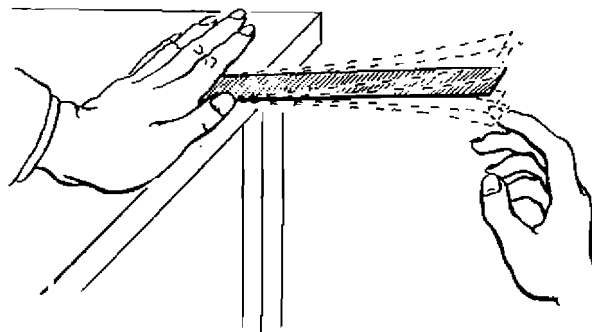
THE PRODUCTION OF SOUND WAVES

Sound, as we know it, is the result of disturbing the air. All of you at some time must have been familiar with the effect produced by flicking a strip of metal held at one end. All that we are doing is disturbing the air, setting it in rapid motion in the immediate vicinity of the strip. The disturbance set up by such mechanical vibrations are transmitted in wave form through the air. The human ear is capable of detecting these 'sound waves' rendering them audible.

EXAMINATION OF WAVE FORM

We can best illustrate how sound waves travel through the air by likening them to the waves produced on the surface of water when a stone is dropped into it.

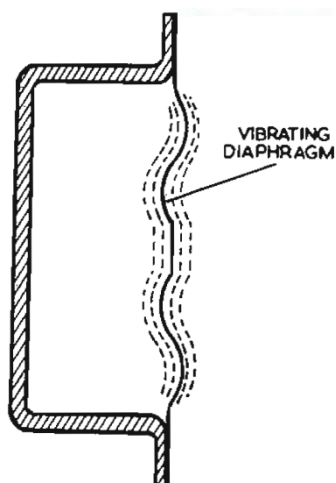
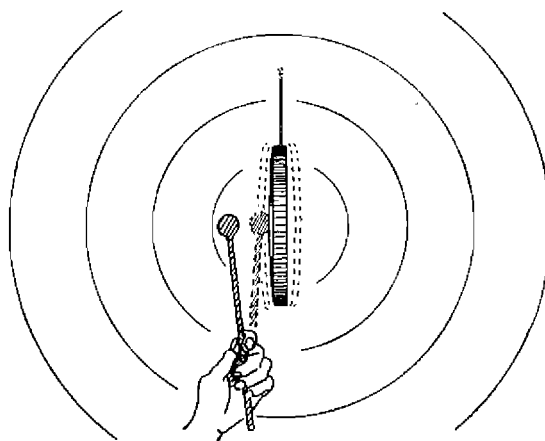
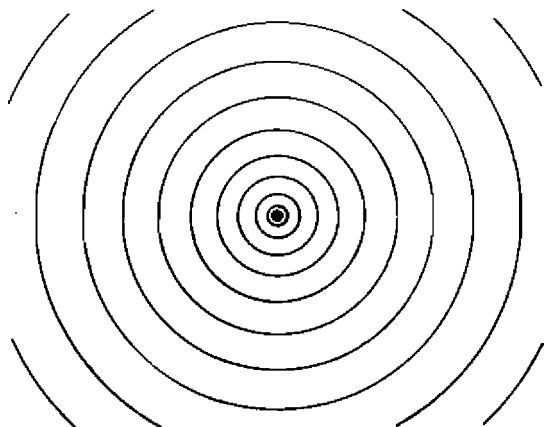
Waves or ripples travel out in a regular circular pattern from the source of disturbance, decreasing in effect as they move outwards.



STRIKING A GONG

Similarly, when a gong is struck, the mechanical vibrations set the air in motion and the resulting sound waves travel outwards in ever-increasing circles, diminishing in intensity the further they travel.

So, to produce sound, we must produce vibrations. How do we achieve this in the case of the modern electric horn?



THE DIAPHRAGM

In all Lucas horns, the rapid movement of a thin metal sheet or diaphragm disturbs the surrounding air, setting up sound waves which travel outwards in much the same way as they did from the gong.

The rate of vibration of the diaphragm will determine the pitch and frequency of the note, whilst its loudness or volume will depend upon the amount of movement of the diaphragm.

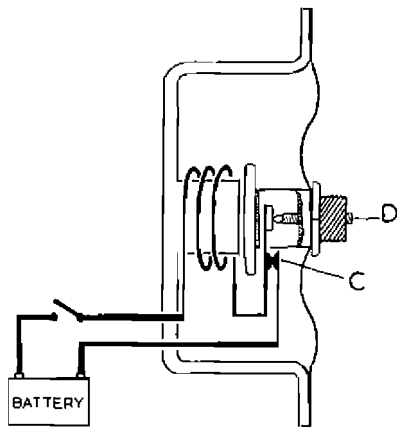
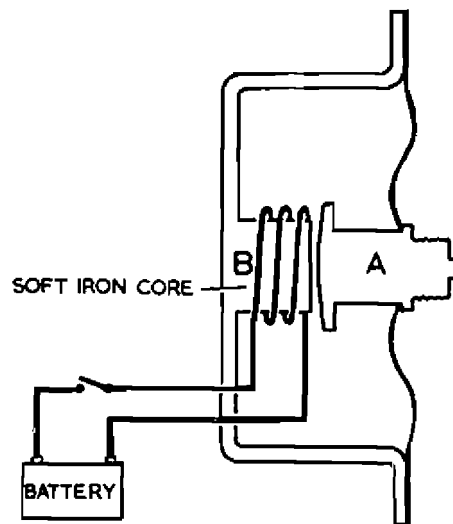
ELECTRO - MAGNETIC ATTRACTION OF THE DIAPHRAGM

Here you see the same diaphragm, now carrying at its centre an armature - A. At B, we have added a coil of wire, wound on a soft-iron core. This forms an electro-magnet which, if energised by current from a battery, will attract the armature, bringing with it the central area of the diaphragm.

The movement will continue until the armature strikes the core-face, unless it is restricted by the degree of flexibility of the diaphragm.

If the current in the coil were suddenly interrupted, causing the collapse of the magnetic field, the armature would be released.

Due to its own springiness, the diaphragm would return after a series of vibrations to its original position.



CONTACT ARRANGEMENT

In practice the current is interrupted by a set of contacts 'C' which are automatically opened as the diaphragm is attracted towards the core face. The point at which this happens is determined by the adjustable screw 'D'.

The pull of the electro-magnet collapses, releasing the diaphragm. As the latter returns towards its original position, the contacts will again close, re-energising the core, and once again attracting the diaphragm; thus the latter is kept in motion by a series of impulses, as long as the current supply is maintained.

This is the principle underlying all types of Lucas horns.

TWO MAIN GROUPS OF HORNS

There are two main groups of horn, the high frequency type, shown on the left of the picture, and the 'Windtone' shown on the right. These will be familiar to you all, and we shall describe each in detail.



HIGH FREQUENCY HORN



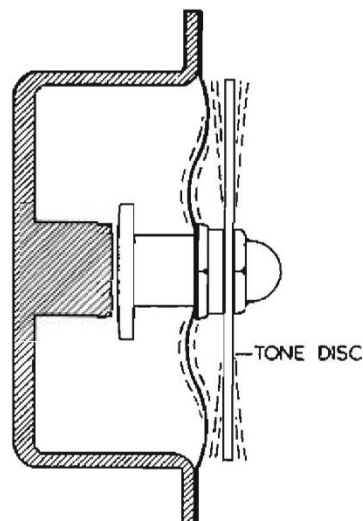
"WINDTONE" HORN

THE H.F. HORN

The high-frequency horn gives a relatively high-pitched and penetrating note. Its method of operation will be clear from the diagram.

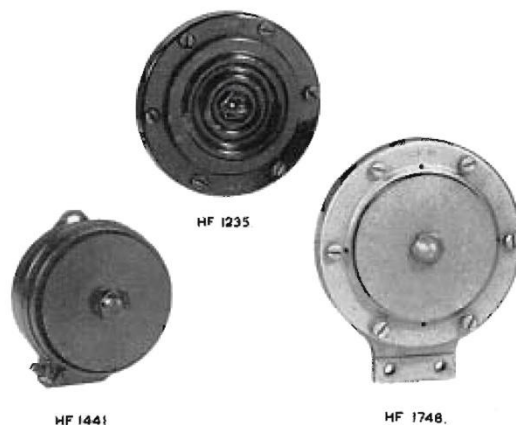
The armature is coupled to the flexible diaphragm which vibrates as we saw in our previous picture. The rate of vibration is relatively low, being in the region of 300-400 times per second. Attached to the centre of the diaphragm is a tone disc. Each impact of the armature on the core face is transferred to the centre of the disc, causing the free outer edges to vibrate at a faster rate. The rate or frequency is determined by the size, rigidity and material of the disc.

The vibrations of the diaphragm and those of the tone disc blend together, giving the horn its characteristic note.



THREE BASIC TYPES OF H.F. HORN

Here we show the three basic types of high frequency horn : on the left, the HF.1441, in the centre the HF. 1235, and on the right, the HF. 1748. All of these work on the principle we have just discussed, but vary in construction to cater for all specialised demands. We shall describe the main features of each of them in turn.



THE LIGHT-WEIGHT HORN.

HF.1440-1441-1444

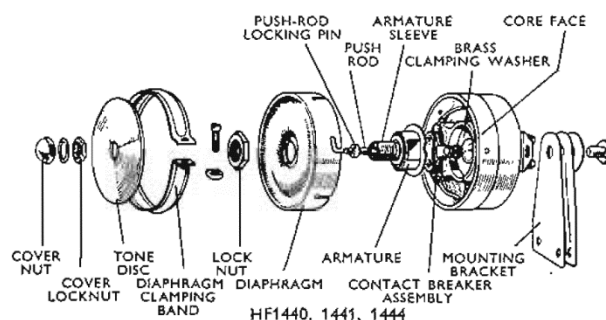
This type of horn has been fitted for several years to motor cycles, three variations of the basic model being marketed, the HF. 1440, 1441 and 1444. The differences are slight and external, and in no way affect the operation. Any adjustments we give later will apply equally well to all three models.

The general construction of the unit is visible from this photograph. The features already discussed as being part and parcel of every H.F. horn are readily recognisable. The diaphragm for instance, although slightly different in shape from the theoretical one we depicted, performs exactly the same function. It is positioned in this horn by a bayonet fixing. The clamping band on the left locks this diaphragm firmly in position.

The tone disc used with this horn is not fluted in any way, as is the case with some other models, and is relatively rigid, the actual thickness of the metal being approximately $\frac{1}{8}$ ". We have already mentioned how the shape, flexibility and thickness of this disc determines the final pitch of the horn note. In addition, we must consider, of course, the mounting position. As this particular horn is primarily designed for motor cycle work, it must stand up to rather rougher treatment than that to which it would be exposed under the car bonnet; a flimsy tone disc on such a horn would scarcely fill the bill, would it?

This horn, then, is generally robust in construction. The mounting bracket, too, consists of a strong yet flexible assembly of springy plates, which give a firm fixing, capable of withstanding any amount of engine or road vibration. Horn mountings really have to be good, otherwise the note will be seriously affected — but we won't labour this point here; it will be dealt with more fully when we come to 'Maintenance'.

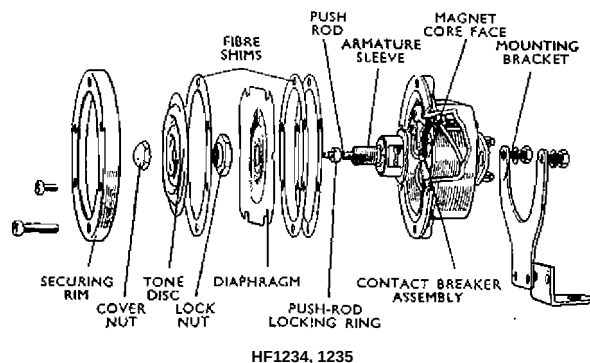
The armature is also visible here in one of its forms and so is the core face. The function of the rest of the components, including the push rod with its locking ring, the contact breaker assembly and the various locking nuts will be more easily understood when we are discussing the adjustment of the contact gap.



THE ALTETTE HF.1234-1235

This horn, generally known as the 'Altette' is similar to the previous one, but of heavier construction. This diaphragm is clamped to the cast metal body by means of a securing rim held by set-screws. This rim is chromium plated on the model HF.1234, whilst that on the H.F.1235 is black finished. Early models of this horn had a flat aluminium tone disc, and a similar armature and contact arrangement to the HF.1440 type.

Recently, however, the construction has been modified somewhat and the latest type is shown in this picture. The tone disc is now of corrugated pressed steel, whilst the earlier type adjustment screw has been replaced as you can see by a push rod. Provision for adjustment of the contact breaker is made at the rear of the horn body — but more about this later in the 'Maintenance' Section.

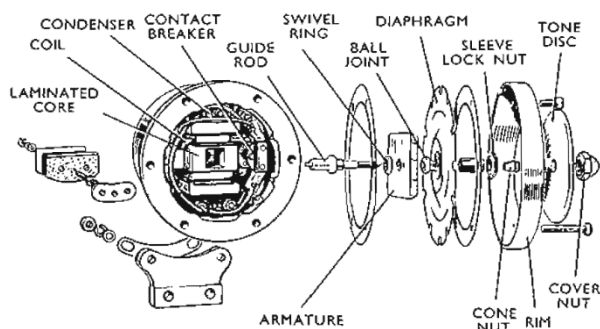


THE HF.1746, 1747, 1748 HORNS

Again, several models of the basic type are made, catering for individual requirements, but this breakdown is generally applicable to them all.

This horn is a high performance HF. horn made in both high and low note models, suitable for fitting in matched pairs.

It is designed to give an extremely powerful, arresting and penetrating note which will be audible



HF1746, 1747, 1748

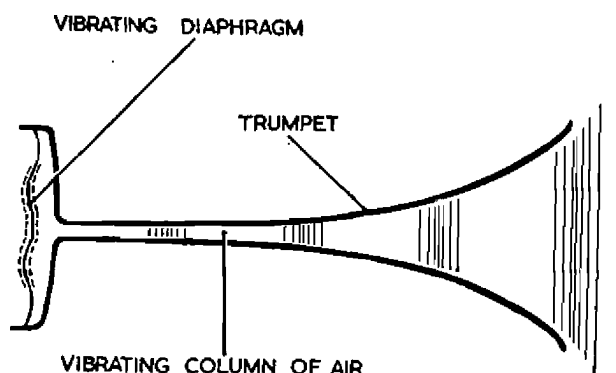
even under continental traffic conditions. The construction is very robust and the adjustment will remain constant over a wide voltage range, a particularly important characteristic of this type of horn.

Whilst the principle of operation is similar to the other HF horns, the construction is very different. This horn is of a completely new design, having a die-cast body with a laminated core and armature. Special provision is made for the internal alignment of the armature with the core face, which explains the presence of such additional components as the swivel ring, ball joint, guide rod and core nut. These parts are machined to very fine limits to permit an extremely accurate adjustment, which is carried out on the production line and normally needs no resetting in service. As with the other types of horn, all we shall consider in the way of adjustment is the contact setting as far as normal servicing is concerned.

You will notice that a condenser is fitted in this particular horn; it is connected across the contacts to prevent excessive sparking when the horn is operating.

WINDTONE HORN — PRINCIPLE OF OPERATION

The 'Windtone' which is the other main type of Lucas horn, works on rather a different principle than the HF type. The air is still set in motion by the electrically-produced vibrations of a diaphragm, seen here on the left of the picture, but this is now attached to one end of a trumpet. The vibrations will travel up the tube of the trumpet and, if their frequency is made to resonate with that of the tube, the sound will swell out and produce a musical note. In simple terms, the length of tube determines the pitch of the note, and its shape the overtones or quality. You will realise then, that in principle the Windtone horn is similar to an orchestral wind instrument, but with the air vibrations produced electromagnetically instead of by the mouth and lips.

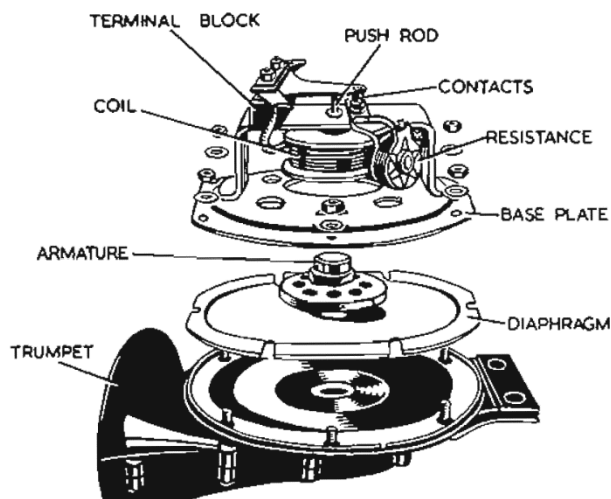


OPERATION OF THE WINDTONE HORN

This breakdown of a typical Windtone will help us to describe its operation. The actual build-up should be clear from the illustration. Two die-castings form the trumpet of the horn, at the same time providing a suitable platform for mounting the diaphragm. You can see that the latter is sandwiched between the trumpet casting and the base plate which carries the coil, contact set and terminal block. The whole is bolted together, the six screws firmly holding the diaphragm at its edges, leaving the centre free to vibrate. Notice that the armature is attached to the centre of this diaphragm.

Imagine that we energise the coil with battery current which passes via the contacts illustrated. The armature is immediately pulled into the centre of the coil. At a set point of its travel, it strikes against the push-rod, thus opening the contacts. The current interrupted, the armature is released and the diaphragm springs back towards its original position. The contacts close again, re-energising the core, and the whole cycle is repeated, the diaphragm being set into vibration.

These electro-magnetically created air disturbances occur at the orifice of the trumpet; the sound waves travel down the tubing, whose length is carefully calculated to coincide with the frequency of the diaphragm vibrations.



This causes the note to swell out of the trumpet flare.

The pellet type resistance mounted on the contact breaker serves to damp excessive sparking which would occur at the contacts during rapid make and break.

Let us now survey the present day range of Lucas Windtone horns.

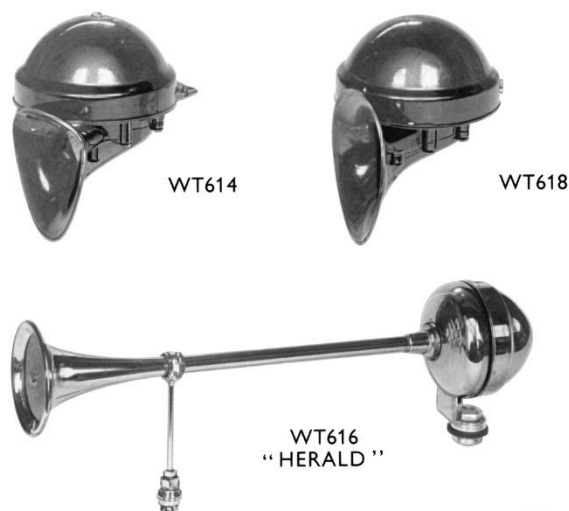
TYPES OF WINDTONE HORN

There are three types of Windtone in general use, the WT614, the WT616, and the latest addition the WT618.

The WT614 is an all black finished horn for under the bonnet mounting, and is fitted as standard equipment to most British cars. It is now replaced by the WT618. The difference between these two horns are not immediately visible from this photograph and we shall therefore leave them until we discuss each type individually.

The WT616, perhaps better known as the 'Herald', is an exceptionally powerful horn mainly designed for overseas use. It is available in chrome finish for external mounting or in black fitting under the bonnet.

All three horns are supplied in high and low note models and are primarily designed for use in matched pairs.



THE WT614

The popular WT614, of which you see two views here, is small and compact, and gives a note which although clear and distinctive, the first requisite of any horn, is by no means raucous or unpleasant. When used in blended pairs, one high note and one low, and operated simultaneously, WT614's give a pleasantly mellow and harmonious signal.

You will notice that the horn trumpet is coiled so as to obtain the desired length in the minimum of space.

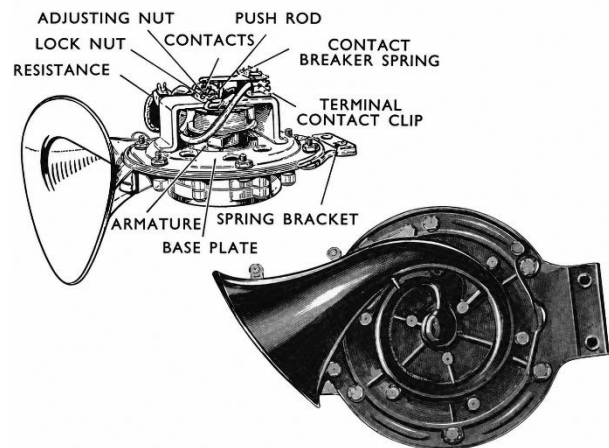
The high note model has the shorter coiled tube and the letter 'H' is imprinted inside the trumpet flare. The letter 'L' is used to distinguish the low note version.

Certain of the smaller cars fit one Windtone horn only as standard equipment, usually the low note one. The high note model to make the matched pair is then available as an optional extra.

As a point of interest to the musicians among you, the notes differ in pitch by the interval of a major third.

The fixing bracket of the horn is of interest and of considerable importance; it must be firm, yet at the same time flexible. The one used here is a spring bracket formed from two sections.

The remainder of the constructional details of this horn are shown in an earlier picture — we actually used the 614



as a general example. But the accompanying illustration shows the relative positions of the components when assembled. A feature not previously pointed out is the adjusting nut for setting the contacts. The significance of this will be further discussed in the 'Maintenance' section of this book.

THE WT618

These new WT618 horns, very similar in general appearance to the WT614 model we have just shown you, have been designed to supersede the latter. They have a much louder note and will give a much more audible warning signal under heavy traffic conditions. They are intended for use in matched pairs and will normally be fitted under the bonnet. As usual, both 6 volt and 12 volt models are produced.

The external modifications are not immediately obvious: the trumpet flare has actually been redesigned and the coiling of the trumpet tube somewhat altered. This slightly changes the characteristic of the low note.

The bottom picture shows the modified spring-steel fixing bracket.

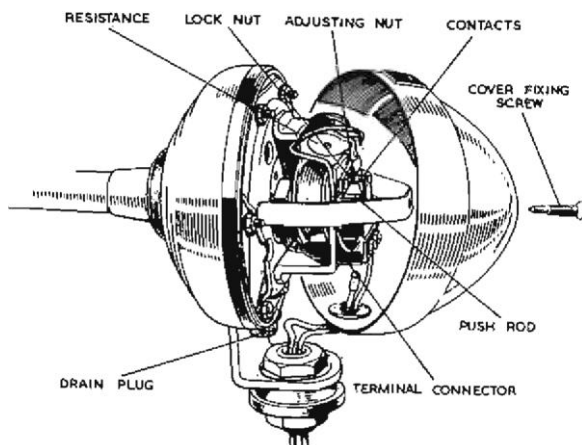
The main internal modification concerns the contact breaker assembly. The terminal block is now made of resistive material which does away with the earlier pellet type resistance used in the WT614.

The diaphragm too has slightly different characteristics.



THE HERALD HORN

The Herald horn, the largest and loudest of the Lucas range, fits a movement which looks identical to the WT614, having the same coil and contact breaker arrangement, with a points resistance in circuit. Here the similarity ends. The Herald has a very dignified looking, chromium plated trumpet, something like the old posthorn. Blended pairs are produced, the longer trumpet giving the low note. These large horns are designed for external mounting on the larger cars and long distance coaches, although a similar model finished in black is available for interior fitting.



WT616 MECHANISM

Here you see the WT616 with the cover removed. The similarity between this mechanism and that of the WT614 is evident. The only additional feature we need point out is the drain plug. This is provided so that the horn can be drained if for any reason the interior becomes filled with water — as may happen for instance during the hosing down of the car.

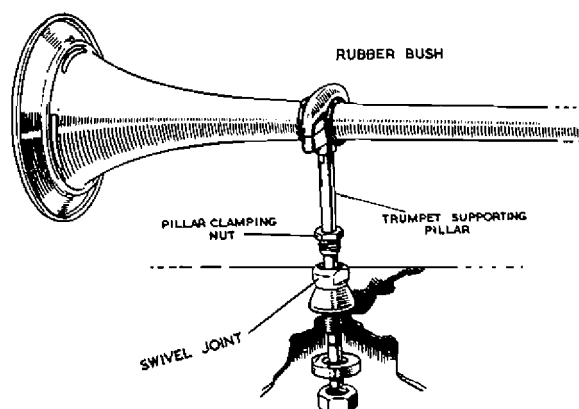
THE WT616 TRUMPET SUPPORT

The long trumpet of the Herald naturally needs supporting and here you see the type of chromium plated pillar we supply.

The pillar itself is extensible and possesses a swivel point, enabling the fixing position to be varied sufficiently to suit the contours of the car wing or bonnet, etc. This mounting facilitates fitting and avoids any strain on the trumpet.

You will notice that the trumpet clamp is rubber bushed against vibration.

We shall now discuss how the horns we have shown you are wired into the vehicle electrical circuit.

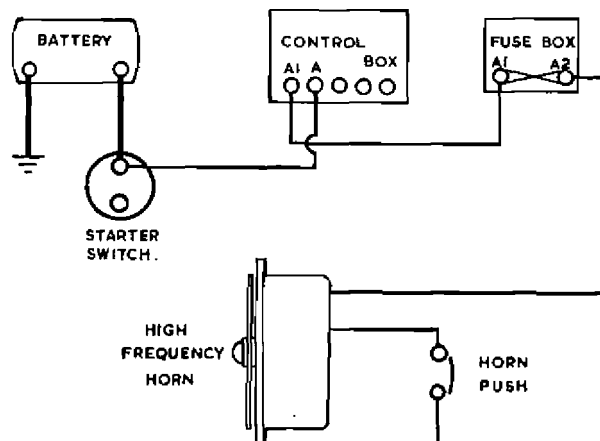


H.F. HORN CIRCUIT

This illustration shows a typical circuit used for a single H.F. horn, say of the 'Altette' type. You will notice that the horn obtains its current feed from the A2 terminal — which as you know may be situated on a separate fuse board, or else incorporated in the control box. In either case the circuit is protected by the 35 amperes A1-A2 fuse.

The horn operating push is usually in the earth line as we have drawn it here.

There is no rigidly set supply point for a horn of this type, it could equally well be fed direct from the battery or from the battery side of the ammeter. The A2 terminal is however generally the most convenient point. The voltage drop occurring at intermediate points in the circuit between the battery and this terminal is normally negligible with a horn of this type whose current consumption is relatively low. Where two H.F. horns are used, on the other hand, we advise that they should be fed either from the battery terminal itself, or from the battery side of the starter switch or ammeter. In this case, it would also be preferable to install a separate 35 ampere fuse in the circuit.



HIGH FREQUENCY HORN CIRCUIT

WINDTONE HORN CIRCUIT

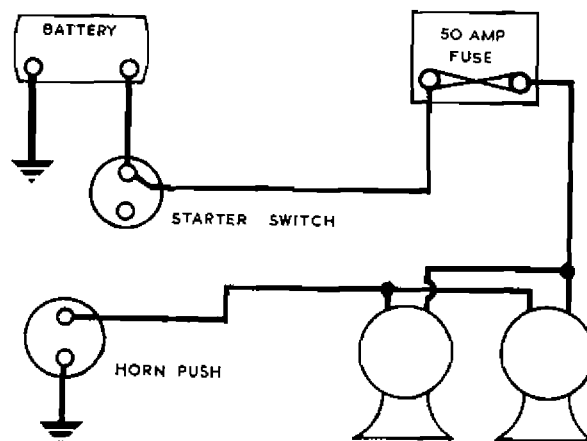
Windtone horns take much heavier currents than the H.F. type and it is normal practice to feed them direct from the battery line, either from the battery terminal, or as we show here from the battery side of the starter switch.

A separate 50 ampere fuse is recommended, though this precaution is not always taken.

The horn push is once again in the earth line.

This circuit is adequate for all cars where the cable run is not too long, especially when two 12 volt horns are installed. The voltage drop on the circuit in this case would be well within working limits. A serious voltage drop is soon noticeable, the horn note becomes rough and the power diminishes, although the pitch of the note will remain more or less the same.

Where such a heavy voltage drop would be experienced — say on some of the larger cars or light commercials, and especially when a pair of 6 volt horns is used — a relay



should be employed in the circuit.

We show this arrangement in the next picture.

TYPICAL HORN CIRCUIT WITH RELAY

Here you see a typical relay circuit, such as would be employed for the heavier current horns — the 6 volt Windtone, the 'Herald' models, etc.

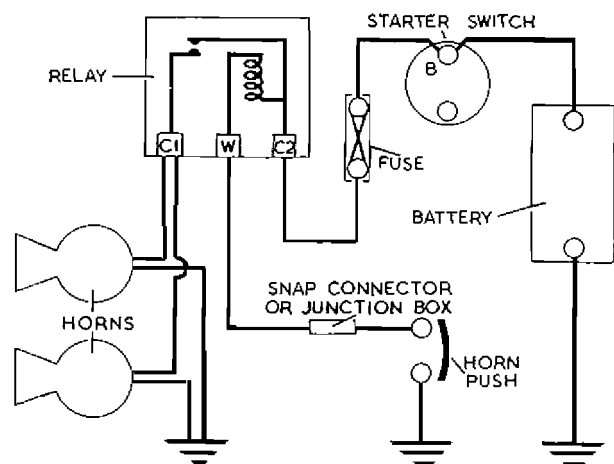
The relay possesses three terminals: C1, W and C2. The main supply cable from the battery is connected via a fuse to C2. Terminal W is joined by a cable passing up the steering column to the horn push. The other horn-contact is earthed.

When the horn push is pressed, the operating circuit for the relay is completed and battery current passes round the windings, energising the core, and thus closing the relay contacts. These contacts complete the horn operating circuit, allowing the main current to pass from the battery via terminal C2, through the relay contacts, then via C1 on to the horns. The circuit is completed by means of the horn and battery earths.

Continued.

This relay arrangement relieves the horn push and the usual long run of wiring to it, of carrying the main current taken by the horns. Two purposes are thus served: the horn push contacts have a much longer life, and any voltage loss which would occur if the heavy horn operating current passed through the low capacity column wiring has been avoided. The horns therefore receive their full voltage. What is more, the main circuit wiring can now be of any reasonable length as heavier gauge cable will normally be used, the steering column which limits the cable size having been by-passed.

This almost concludes what we have to say on the subject of horn circuits. You will have gathered that there is no hard and fast rule as to the precise method of connecting horns in circuit. The main recommendations we make are that they must be installed so that the voltage drop is absolutely at a minimum. The governing factor in this respect is the current consumption of the horn: the heavier the current, the greater will be the possibility of power losses. Very much part of this problem is the cabling itself. Certain sections of the horn circuit must of necessity be wired in cable of a low current carrying capacity; the lead inside the steering column for instance is normally part of a relatively narrow gauge multi-cored cable—no amount of persuasion can introduce a size 44/.012 cable where there is only room for a 14/.012. Hence you have seen that where a pair of heavy current Windtone horns are used we employ a relay in the circuit which bypasses the column wiring and horn push, thus avoiding voltage losses. The only current carried by this section of the circuit is that necessary to operate the relay, a mere 0.5 amps for the 12 volt set and 1.5 amps for the 6 volt. The main operating current, in the order of 13 amps for the 12 volt pair and 26 amps for the 6 volt takes the direct path from battery to horn, passing through a section of the circuit where it is convenient to install heavier cabling



capable of carrying such currents without undue loss.

Another recommendation is that the horn should be fused. You saw that in the case of a simple H.F. horn, taking a low current, we used the existing A2 fuse. But where two similar horns are fitted, we recommended that they should be fed from a point nearer to the battery, with a separate fuse in circuit. The Windtone horns as well should not be fed from the A2 fuse; if they are, the car ammeter in circuit will swing violently every time the horn button is pressed.

The above considerations then should be borne in mind when studying these horn circuits, and more particularly if you are called upon to fit new or additional horns to an existing installation.

Let us now see what maintenance and servicing is necessary to keep horns in good working condition on the vehicle.

MAINTENANCE POINTS

There are very few maintenance points which apply to horns—but the few are extremely important. Each horn is correctly adjusted before it leaves the factory and will generally give long and satisfactory service with the minimum of attention.

Here you see four maintenance points. It is our experience that by checking these you will cure most of the horn troubles that occur, without the need for removing and stripping the units, so often done unnecessarily.

Let us take each in turn, starting after the normal fashion with No. 1.

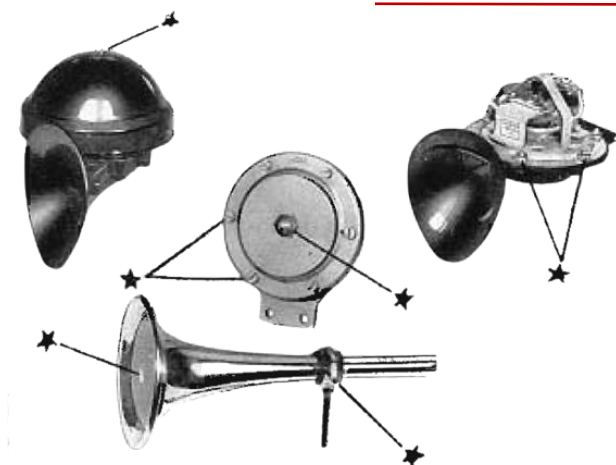
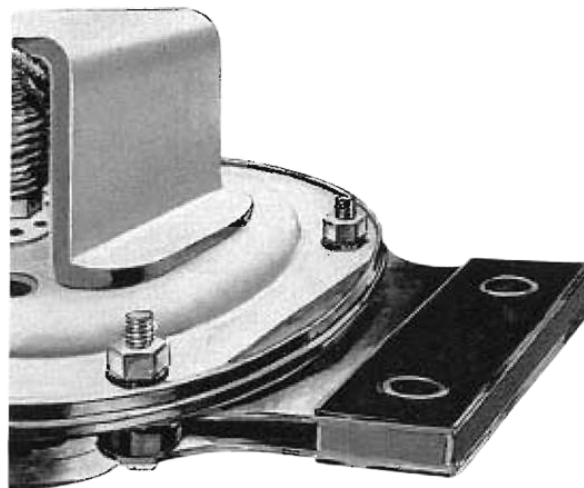
HORN MAINTENANCE POINTS

- (1) MOUNTING.
- (2) TIGHTNESS OF FLARE,
TONE DISC. & DIAPHRAGM.
- (3) VOLTAGE DROP IN WIRING.
- (4) CONTACT ADJUSTMENT.

HORN MOUNTING

Horns must always be mounted on the bracket provided, and it is important that this bracket is securely bolted to a rigid part of the vehicle, one that is free from vibration. Make sure too that the horn body is not touching anything. Unless the horn is securely mounted, it will not give its true, clear note.

If at any time imperfections in the horn note become apparent, check that the fixing bolts are correctly tightened, that the bracket is not cracked and that no other unit is loose and vibrating in the immediate vicinity.



LOOSE HORN COMPONENTS

If any part of the horn itself is loose, such as the cover, the diaphragm, the tone disc, horn flare or grill, etc., the horn note will be affected.

We have indicated all the likely trouble spots in this picture.

VOLTAGE DROP TESTS FOR HORN CIRCUIT

We have stressed throughout that the horn performance will be seriously affected by voltage losses in the circuit.

To localise this fairly common cause of trouble a four-stage voltage drop test may be simply applied.

TEST 1. Battery voltage underload — engine stopped.

Switch on all lights to load the battery.

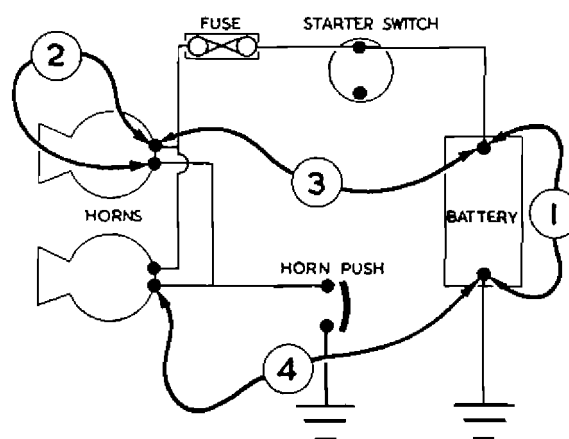
Take a battery voltage reading, which should not be less than 11 volts if the battery is in an adequate state of charge.

TEST 2. Repeat this operation at the horns.

Connect the voltmeter across the terminals of each horn in turn, press the horn push and note the reading. The voltage registered should be no more than 0.5 volts below the Test 1 reading.

TEST 3. If voltage drop is in excess of 0.5v.

Check the insulated line by connecting the meter between the insulated battery terminal and the feed terminal of one horn. Press the horn push. No voltage reading should be obtained; if there is, check all cable connections and junction points in the feed line for loose or dirty contacts.



TEST 4. Voltage drop due to defective earth.

The final test (Test 4) will locate any voltage loss due to a bad earth contact. The meter is connected between the battery earth terminal and the horn earth terminal (i.e., terminal connected to horn push), when full battery should register. On operating the horns the voltage reading should drop to zero - or 0.5 volts is considered as the permissible maximum.

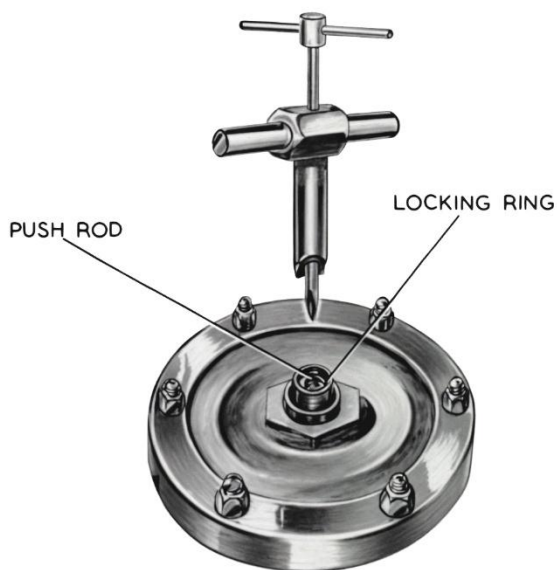
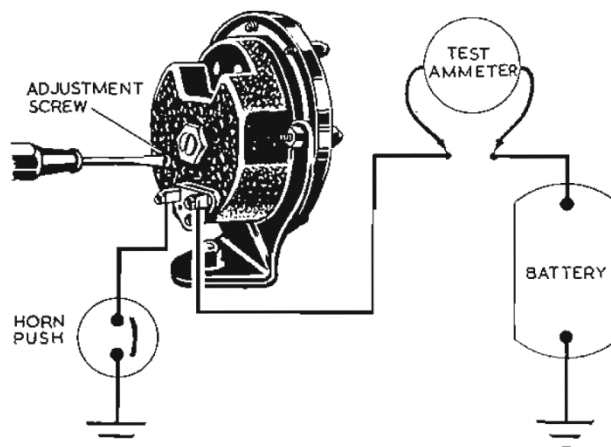
All earth connections should be examined if a reading in excess of this value is obtained.

HORN CONTACT ADJUSTMENT

The only adjustment to the horns normally necessary in service is the taking up of the contact wear.

After a lengthy period of service, the horn note tends to deteriorate slightly, both in volume and in purity of tone. The cure is simple enough: every horn is provided with an adjuster which compensates the normal service wear. The actual positioning of this adjustment varies with each type of horn and we shall need to run through them in turn. One point is common to all, the contact adjustment **MUST** be made with an ammeter in circuit as we show here. The contacts should be adjusted until the specified current reading is obtained.

We shall state the specified value for individual horns, and the figure quoted will be at normal battery voltage. This pre-supposes that the vehicle engine is stationary and the battery well charged.



CONTACT ADJUSTMENT. THE HF.1441 TYPE

The HF.1441 type, and earlier models of the HF1234 have no fine adjustment screw at the back of the horn. To gain access to the adjustment, the cover nut must first be removed. Using a combined tool similar to the one illustrated here, which holds the locking ring while the push rod is adjusted, the slotted end of the rod may be turned until the following readings are obtained on the ammeter in circuit:—

6v. model	12v. model
3 amps	2 amps

These are average figures and slight variations may be encountered.

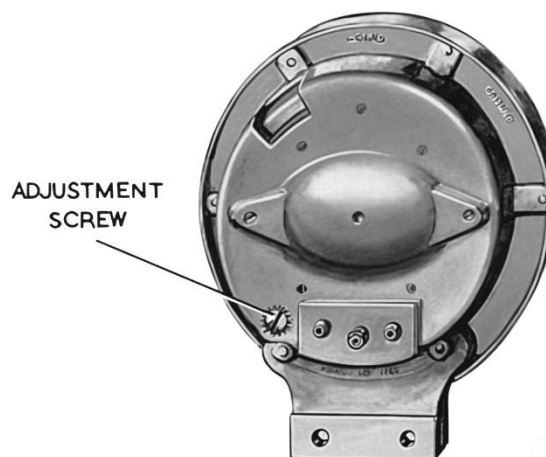
If the consumption is excessive, turn the push rod clockwise to decrease the current, or anti-clockwise to increase. Make only a small adjustment at a time, continuing until the correct setting is obtained.

CONTACT ADJUSTMENT THE HF1234, 35 AND HF.1746, 1748

These horns have a fine adjustment screw at the back of the body. With an ammeter in circuit, note the current when the horn is operated. Turn the screw in a clockwise direction to increase the current and anti-clockwise to reduce it. Adjust a quarter of a turn at a time until the reading is within the following prescribed limits and the maximum performance is obtained.

Current figures:—

	6 volt	12 volt
HF. 1234-35	3.5 amps MAX	2.5 amps MAX
HF.1746,47,48	5.0 amps MAX	4.0 amps MAX

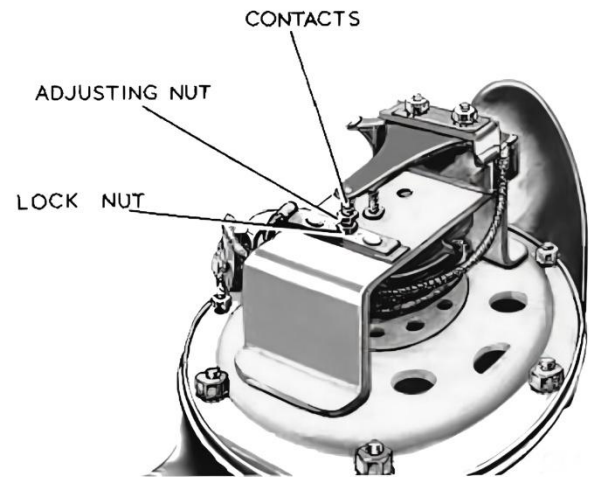


CONTACT ADJUSTMENT WT.614, 616 and 618

The following method of adjustment applies to all the present-day Windtone horns we have discussed.

First remove the cover. Then, slacken the lock nut on the fixed contact and turn the adjusting nut in a clockwise direction until the contacts are just separated, as indicated by the horn failing to sound. Turn the adjusting nut *half a turn* in the opposite direction and hold it while tightening the locking nut. Check the current consumption of the horn, which must not exceed the figure quoted below. If the current is incorrect, make further very fine adjustments to the fixed contact, turning the adjusting nut clockwise to decrease and anti-clockwise to increase.

Current figures :—	6 volt	12 volt
WT.614	13 amps	6 amps
WT.616	14 amps	8 amps
WT.618	—	8 amps

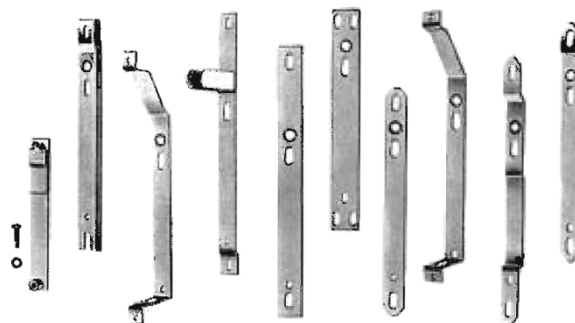


“Trafficator”—Semaphore Direction Indicators

THE CURRENT PRODUCTION SEMAPHORE INDICATOR

On current production cars TWO basic types of Trafficators, the SF80 and SE100, cover all the popular vehicles. Two other types known as the SF34 and 40, and now discontinued on new cars, have also been used in large numbers. These models are fitted on the vehicle assembly lines and are generally accommodated in recessed door pillars. For subsequent installation an external mounting unit, the SE100, is universally applicable. The same action assembly is used either for the recessed type or the box type external trafficator. The methods of switching vary, the most popular being the self-cancelling switch built in the steering-wheel hub. Another arrangement uses a self-cancelling switch mounted on the steering column and cancelled by an external cam.

A further arrangement may be a panel mounting, two-way and off switch with or without a warning light or alternatively a two-way and off switch combining a pneumatic time delay. Generally these units are for 12 volt working but are also available for 6 volt applications with a special 24 volt model for passenger carrying vehicles.



MOUNTING PLATES

For mounting on different types of vehicle bodies a range of adaptor plates are manufactured. These are attachable to the standard action assemblies and some examples are grouped together in this picture.

PRINCIPLE OF OPERATION

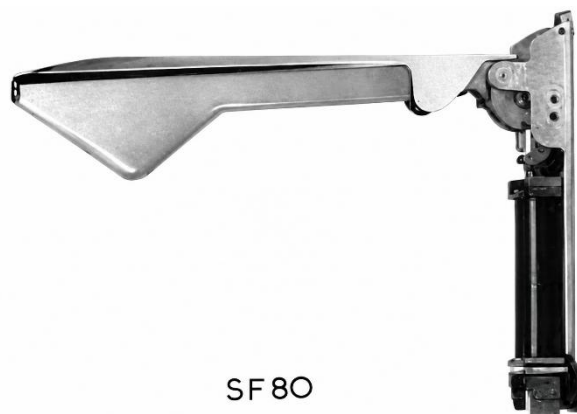
All types of trafficators follow the same principle. A solenoid is carried on a bracket and a plunger is attached to the pivoted semaphore arm. When current passes through the solenoid winding the plunger is drawn into the core thus raising the arm to the horizontal position where it will remain until the current is switched off.

A signal light in the form of a 3 watt Festoon type bulb is spring supported in the moulded arm and switched on by means of a sliding contact adjacent to the pivot part of the arm when the arm itself rises to the horizontal. Some earlier models had a continuous flexible lead to this signal.

All current production models which are made for both 6 and 12 volt working have a 7 $\frac{1}{4}$ " arm.

The indicator arm should return to the 'at rest' position by its own weight when the current is switched off. Wind pressure against the arm surface tends to keep it in the raised position and the top surface is given an aerodynamic contour whereby a downward thrust is produced to return the arm.

To prevent the arm being raised or 'thrown up' when not in use, a locking device is incorporated. Unless the plunger itself is moved, some force must be exerted upon the arm before the action of this device is overcome.



SF 80

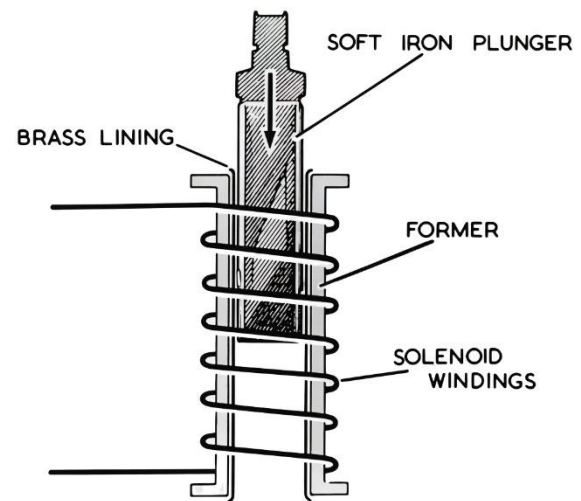
THE SOLENOID ACTION

This picture illustrates the solenoid with its hollow iron centre, around which is a winding of enamel covered wire.

A characteristic of this kind of electro-magnet is that, with the current switched on, its pulling power is at maximum when the armature is fully inserted in the core and advantage is taken of this characteristic because the pull required increases as the arm is raised from the vertical towards the horizontal position.

It may be observed that the hollow core of the solenoid has a brass lining, the object of which is to prevent 'Magnetic cling' between the surface of the plunger and the wall of the core.

The current required to operate the solenoid lies between 2 and 3 amperes.



SELF-LOCKING DEVICE

A self-locking device to hold the arm in the 'at rest' position is an essential feature of the arrangement to prevent the arm from bouncing out when the vehicle is swaying, bumping or heeling over at an acute angle. Several devices have been applied at various times and this picture shows the very simple arrangement provided on current production trafficators.

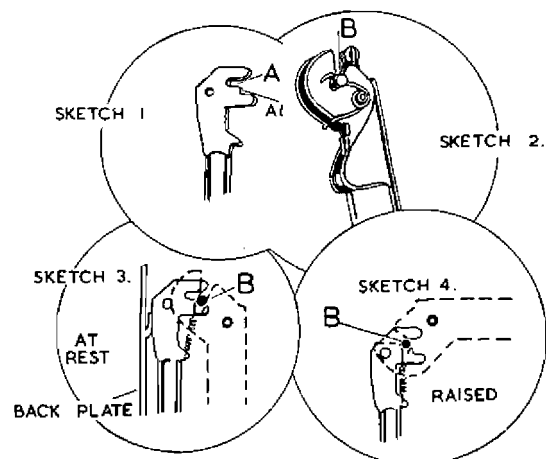
The locking device operates in the following manner:—

Sketch 1. The flattened head of the plunger is recessed to accommodate a catch pin in the positions shown at (A) when the arm is raised and (A1) when the arm is down.

Sketch 2. The plunger head fits into the slotted top of the signal arm and a catch pin (B) is located in the recess shown and retained by means of a hairpin spring.

Sketch 3. With the signal arm in the 'at rest' position, the solenoid plunger is fully raised and the catch pin (B) will be in the position shown. The plunger head then forms a block between the back plate and the pivoted arm which prevents the arm from moving outwards.

Sketch 4. When the plunger is drawn down into the solenoid, the first part of the movement releases the



the lock and the continued downward movement of the plunger raises the arm into the horizontal position ; the catch pin will then be in the position shown.

Referring to sketch 2, the location of the catch pin (B) by means of the hairpin spring also acts as a safety device, allowing the pin to rise in the recess when the arm is forced up by hand, thus preventing it becoming damaged.

SF80 TRAFFICATORS

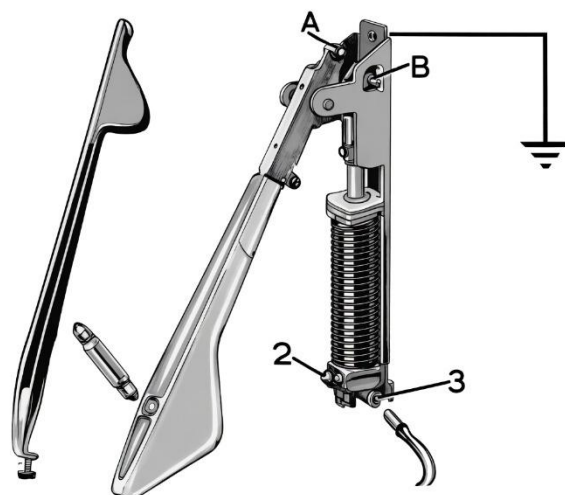
This illustration shows the current production SF80 type trafficator made for both 6 and 12 volt working, now being fitted to practically all vehicles taking trafficators as initial equipment.

This is an exceptionally compact unit and is very narrow ($\frac{3}{4}$ ") and shallow ($1\frac{1}{2}$ ") thus enabling it to be accommodated conveniently in restricted door pillars.

Another development is the quickly removable arm assembly, which permits a broken arm to be replaced in a few moments without taking out the assembly from the door pillar.

From the picture the following features should be noted:-

- (1) The button contact 'A' for the signal light which connects with the blade 'B' when the arm is raised.
- (2) The rubber buffer stop which supports the arm in the down position and prevents rattle.
- (3) A thimble type of connector for the current supply at the bottom.



- (4) The earth return obtained through the mounting plate and the body of the vehicle.



SE100 TRAFFICATOR FOR EXTERNAL MOUNTING

For external mounting the SF80 movement which we have just described is accommodated in a metal box as shown here.

Two holes in the back plate allow the assembly to be fastened directly on to a flat surface and a detachable right angle bracket will accommodate side fixing where required.

The unit is available for both 6 and 12 volt working. It has an exceptionally wide field of application for vans and commercial vehicles as an after-sales fitment.

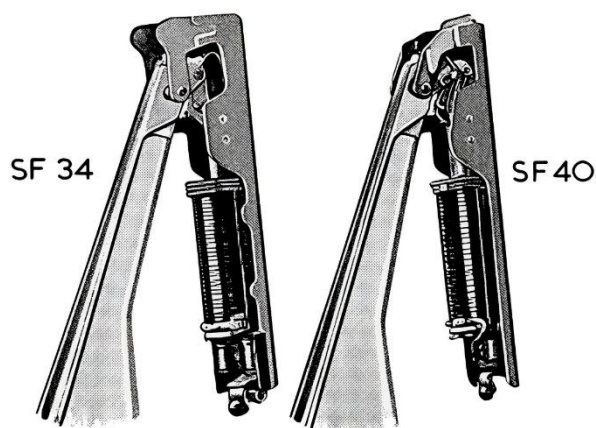
SF34 AND SF40 TRAFFICATORS

Prior to the introduction of the SF80, the two most popular trafficators in use were the SF34 and SF40 as illustrated here.

The feature of the SF 34 Trafficator was its particularly narrow construction; it was also made with both $7\frac{1}{4}$ " and $8\frac{1}{4}$ " arm.

The leading feature of the SF40 was its extreme shallowness from back to front.

Several models of these trafficators were made with various angles of lift between 80° and 90° and others with special contacts for panel warning-light circuit arrangements.



WIRING CIRCUIT USED ON CURRENT PRODUCTION EQUIPMENT

Numerous circuit arrangements have been installed on earlier production cars to meet special requirements and at a later stage they will be included as a matter of general interest.

An extremely simple circuit is now employed for the SF80 and SE100 trafficators as shown in this picture.

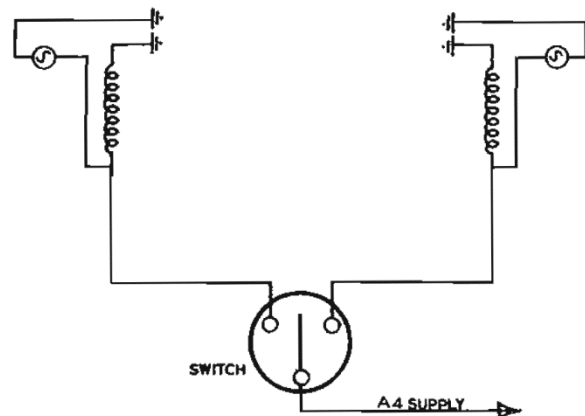
The current supply is taken from the A4 fuse by means of a GREEN cable 14/012 to the centre contact of the switch, usually via snap connector at the bottom of the steering column assembly.

GREEN and WHITE and GREEN and RED 14/012 cables are then connected, also by means of snap connectors, to each trafficator.

As shown in the diagram, it will be observed that the solenoid is connected directly to earth and the signal light forms a parallel circuit to it.

As previously mentioned, the earth return is through the frame of the trafficator to the body of the vehicle and, unless these earth connections are sound, considerable trouble may be experienced in service.

TRAFFICATOR WIRING CIRCUIT I



SERVICING TRAFFICATORS — ARM REPLACEMENT

In order to renew a broken arm on any of the early type trafficators it was necessary amongst other operations, to drill out the hinge pin. On the SF80 and SE100 models the new type, quickly-detachable arm is used.

The left-hand illustration shows how the exchange may be carried out:—

- OP. 1. Remove the screw and take off the arm cover.
- OP. 2. Lift out the bulb and its contact spring.
- OP. 3. Loosen off the arm clamping screw and withdraw the arm moulding.

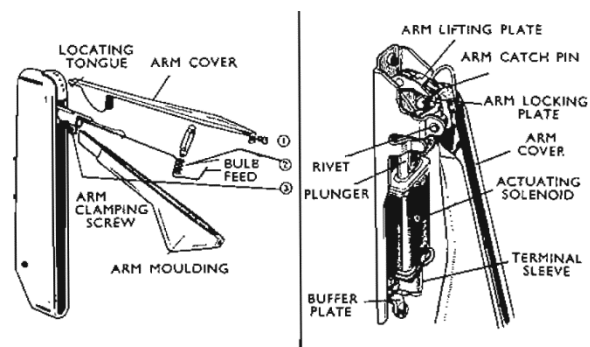
Reverse the operations and fit a new arm moulding.

On the earlier types shown on the right proceed as follows:—

Remove the trafficator from the car, take off the arm cover and remove the bulb. If the old cable and contacts are to be used, open the clip securing the cable to the arm; otherwise slacken the screw securing the terminal assembly, remove the terminal plate and un-solder the cable, temporarily replacing the screw to hold the solenoid in position.

Drill out the rivet securing the arm.

Place the new arm in position so that the catch pin locates correctly between the lifting plate and the locking plate, and secure by fitting a new rivet. Solder the free end



of the braided cable to the tag on the terminal plate, and refit the plate in position. Before finally tightening the securing screw, fit the cable neatly between the coil and the insulating strip, so that, although held firmly, there is no danger of the insulation being damaged by sharp edges. There must be sufficient slack to allow the arm to move freely without either straining the cable or bending it sharply.

Finally, fit the bulb into the arm and replace the cover.

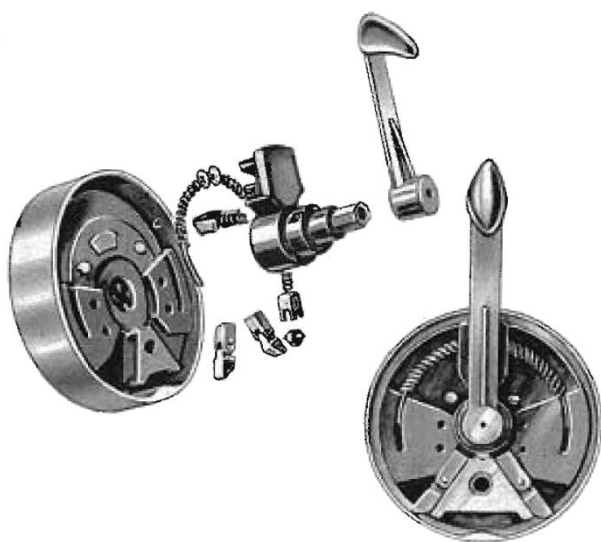
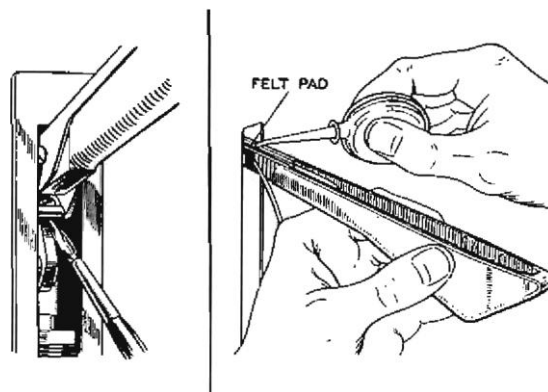
LUBRICATION AND MAINTENANCE

SF80 and SE100. The only lubrication required on these trafficators is *one drop* of S.A.E. 30 oil on the pivot-bearing of the arm occasionally.

SF34 and SF40. There are two lubrication points on these trafficators, and both should be lubricated occasionally.

(a) Lift the trafficator arm and apply one drop of thin machine oil to the catch pin between arm and operating mechanism.

(b) Withdraw the screw at the end of the arm and slide off the arm cover. Move the bulb connecting lead to one side and apply a drop of thin oil to the felt lubricating pad at the top of the arm.



SWITCHING ARRANGEMENTS

A variety of switch arrangements have been developed and are available to meet the vehicle manufacturers' demands, in particular to suit the varying types of steering-column controls in general use.

The most popular arrangement on current production cars is the 'Self-cancelling' switch shown in this picture.

The self-cancelling switch assembly, built into the hub of the steering wheel, is very simple if regarded as comprising two elements: an electrical element, the switch itself, and a mechanical element, being the actuating and self-cancelling device. The operation is that the current supply is switched on by the hand lever and switched off automatically when the steering wheel is returned to the straight ahead position after a turn has been completed.

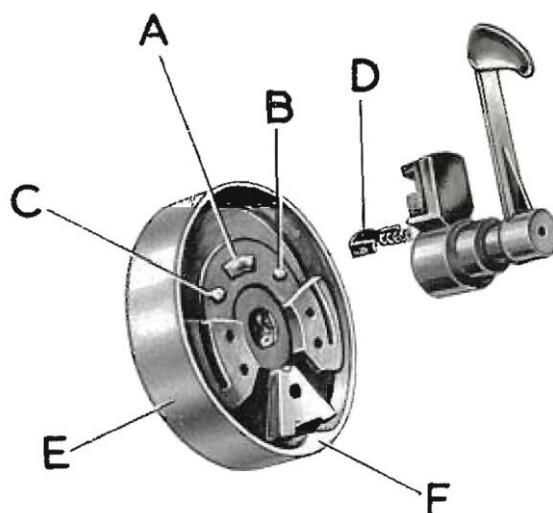
The right hand illustration in the picture shows the complete assembly as it rests in the centre of the steering wheel, and on the left shows an exploded view of the components.

THE SELF-CANCELLING SWITCH ASSEMBLY. THE SWITCH ONLY

The switch itself is of the standard TWO way type with a central OFF position. The supply contact is shown at (A) and the trafficator contacts at B and C. The rotor to which the hand lever is connected contains a spring loaded bridging contact D. Movement of the lever to the left or right connects the respective trafficator; centralising the lever switches the current off.

The switch base, rotor and lever assembly are mounted on a stator tube and held stationary by a clamp at the bottom of the steering column.

An outer ring E with a cam F is turned with the steering wheel and actuates the self-cancelling mechanism.



THE SELF-CANCELLING ACTION

Sketch 1. The Rotor Lever (1) is centralised by means of the two coil springs (G) and is firmly held in this position by the spring loaded Roller (H), locating in the notch as shown.

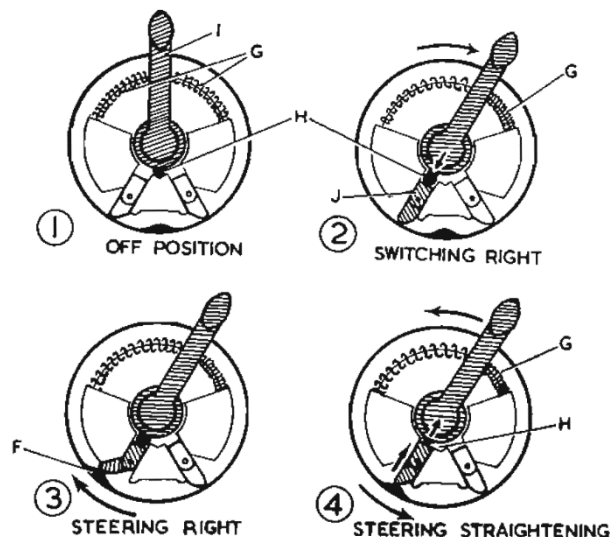
Sketch 2. Movement of the Rotor Lever — say to the right — switches on the current to the right hand trafficator and at the same time compresses the spring (G) on that side.

The Roller (H) will then be in the position shown over the pawl (J) and will hold the switch in this position.

Sketch 3. When the steering wheel is then turned in the same direction — right — the cam (F) will override the pawl.

Sketch 4. When the steering wheel is moved back again to the left to straighten up after the turn has been made, the cam forces the pawl upwards, pushing the roller into the boss of the rotor lever.

The compressed spring G then returns the lever to the central position, when the roller (H) re-engaging with the notch, positions it in readiness for the next operation.



TYPICAL ARRANGEMENT WITH PANEL MOUNTING SWITCH AND WARNING LIGHT

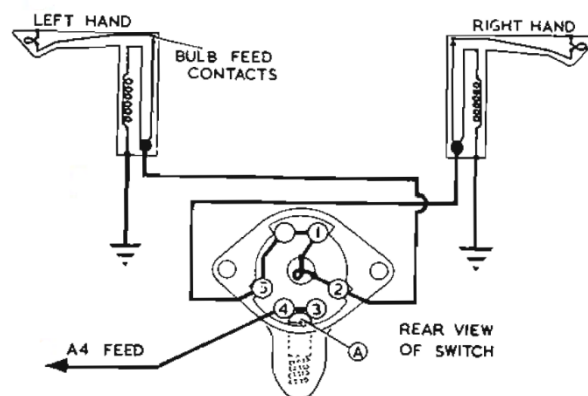
A popular type of switch for this arrangement is the type SD84 incorporating a warning light. The circuit arrangement is as shown in the illustration.

The SD84 two-way and off switch (centre picture) has a group of four main terminals, 2, 3, 4, 5, of which the centre pair 3, 4 are permanently linked. These terminals act as switch contacts and are linked in pairs by a roller on the switch arm 'A'.

Centre position of the switch is OFF and by moving the rotor to left or right, terminals 2/3 or 4/5 are linked, thus feeding current to either trafficator.

The Warning Light is connected between terminals 2 and 5 as shown.

If the switch is moved to link terminals 4 and 5, i.e., the **right-hand** trafficator, the warning lamp circuit will then be from terminal 5 through the lamp bulb filament to terminal 2 and from this point its circuit is completed through the **LEFT-hand** trafficator to earth. In this condition the very small current passing through the warning lamp bulb is not sufficient to cause any movement of the **LEFT-hand** trafficator.



If the switch is moved over to link terminals 2 and 3 to operate the **LEFT-hand** trafficator, the warning lamp circuit will then be completed through the **RIGHT-hand** trafficator.

The Warning Light is of the screw-in type, and connected between terminals 2 and 5 as shown.

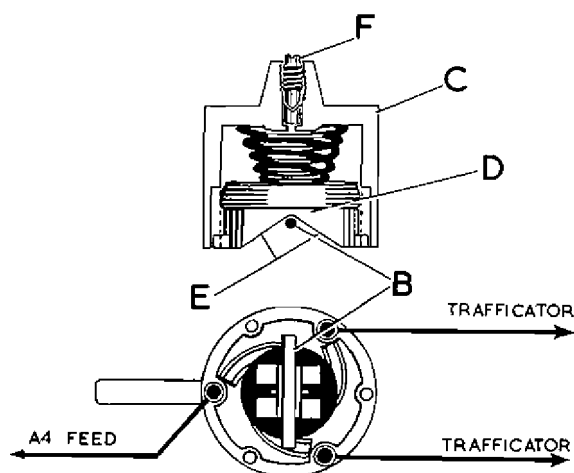
THE PNEUMATIC TIME SWITCH

An alternative to the layout we have just examined is the Pneumatic Time Switch, which will provide a self-cancelling arrangement for a vehicle not so fitted originally and which incidentally avoids the necessity for a warning light.

The switch itself is a plain TWO WAY-OFF type as generally used. The complete assembly comprises an air chamber C with a piston D on the skirt of which is formed of cams E together with a loading spring and an air regulating screw F. The switch rotor is fitted with a horizontal pin B which registers with cams E and is normally held in the central or OFF position.

During the return movement of the piston, the cam face pressing on the pin B turns the switch rotor to its original central and off position.

Movement of the switch lever to right or left through about 60° switches on the current supply to the trafficator and at the same time raises the piston through the rotation of pin (B) moving over the cam face (E), the air from the cylinder escaping around the sides of the bucket piston. Since all the air has been expelled from the cylinder, the spring can only return the piston to its original position as air is allowed to re-enter the cylinder.



An adjustable air leak (F) is provided to enable this return movement to be delayed over a period of from 10 to 12 seconds. During the return movement of the piston, the cam face pressing on the pin (B) turns the switch rotor to its original central and off position.

A snap action in finally opening the switch contacts is obtained by means of a spring loaded ball in the switch rotor assembly.

TRAFFICATOR MECHANICAL TROUBLES

Trafficators occasionally get bent or damaged in service, resulting in binding or stiffness which will prevent the trafficator from rising fully or returning to the correct parked position.

If the supply line is in order the trafficator should be examined to make certain that it is not binding or sticking through faulty adjustment or lack of lubrication.

It may be necessary to remove a trafficator from the vehicle to ease or adjust it, in which case it should be tested as detailed.

The minimum voltage required to lift the trafficator arm to the horizontal should be measured at the terminals of

the unit and should read as follows:— 12v unit no less than 9 volts; 6v unit no less than 4.5 volts.

During the test, the trafficator should be tilted backwards at an angle of 5° to the vertical. The bulb should also be in circuit.

The arm must return to the locked position and not rattle when released from any position of making an angle of 60° to the vertical.

The current taken by the trafficator is:

- 12 volt models approx. 3 amps.
- 6 volt models approx. 6 amps.

SERVICE TESTING THE TRAFFICATOR SYSTEM

Where a trafficator fails to operate or is sluggish, the fault may not necessarily be confined to the trafficator movement.

Due to the unavoidably long lengths of cables and numerous connections in the circuit, high resistance may be the cause of considerable voltage loss.

The recommended cable size is 14/.012; voltage loss will occur if a smaller size of cable is used. Trafficators should operate efficiently down to 9 volts on the 12 volt system and 4.5 volts with 6 volt system.

A systematic series of checks may be carried out on the entire circuit to localise a fault.

After switching on the Ignition, the sequence of operations should be as follows:

1. Test the battery.
2. Operating voltage at the battery.
3. Operating voltage at the trafficator.
4. Voltage drop on the insulated line.
5. Voltage drop on the earth line.

Continued

TEST 1 – THE BATTERY

Test the battery to ensure serviceability and state of charge; this can most conveniently be carried out by switching on the Head Lights and taking a voltage reading across the battery terminals.

If the battery is serviceable and in a reasonable state of charge, apply test 2.

TEST 2 – OPERATING VOLTAGE AT THE BATTERY

Connect the voltmeter between positive and negative terminals of the battery.

With ignition switched on, move the indicator switch over to supply the faulty trafficator and note the voltage reading.

TEST 3 – OPERATING VOLTAGE AT THE TRAFFICATOR

Next connect the voltmeter, as shown in Test 3 between the insulated terminal and the frame of the trafficator. Check the voltage-reading.

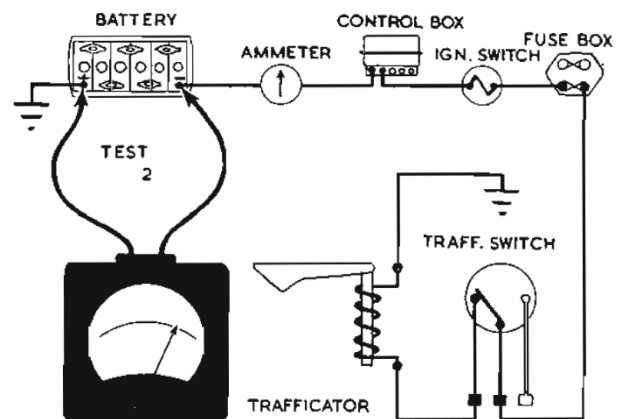
The difference between this and the previous reading should not exceed 0.5 volts. Should the difference be greater, it will indicate high resistance in the circuit.

TEST 4 – TESTING THE INSULATED LINE

For the next test, connect the voltmeter to the insulated terminal of the trafficator and the negative battery lug.

When the supply is switched on the reading should not exceed 0.5 volts; if a higher voltage is registered it will indicate a high resistance somewhere along the line.

The high resistance can then be traced by testing across the snap connectors and across the indicator switch contacts. Where the switch is located at the top of the steering column, the test can most conveniently be made at the snap connectors, located at the base of the column. In all tests there should be no reading on the voltmeter.

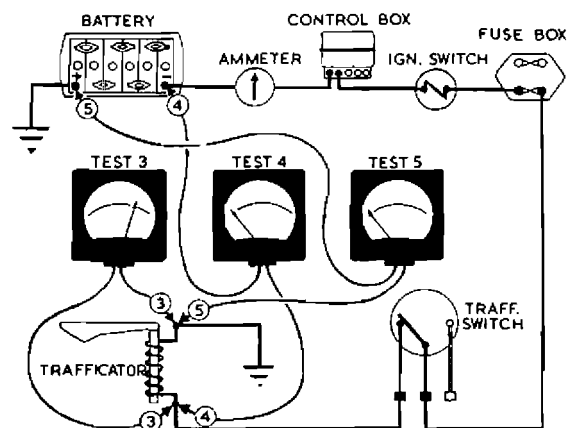


TEST 5 – VOLTAGE LOSS ON EARTH LINE

Connect the voltmeter between the frame of the trafficator and the positive battery lug and with the supply switched on, there should be no reading on the voltmeter. Any voltage reading will be due to high resistance.

One of the most likely causes will be a defective earth connection for the trafficator. Check by connecting the voltmeter between the trafficator frame and in close proximity to the earth connection.

If a reading is obtained, remake the connection and retest.



SIMPLIFIED TRAFFICATOR CIRCUIT

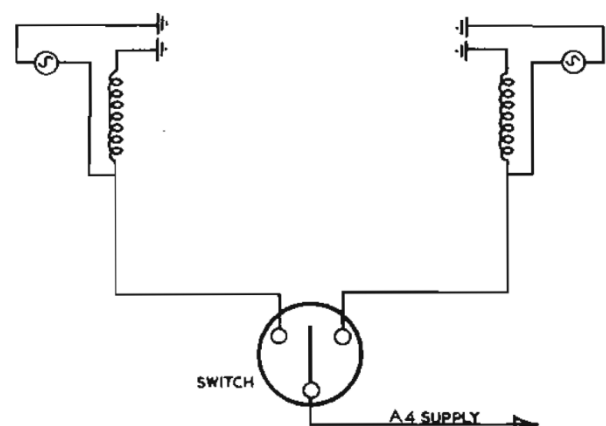
As used on current production vehicles this circuit was also used on earlier vehicles without trafficator warning light. The control is by a self-cancelling switch located on the steering column and equally suitable for facia mounted switch.

The trafficator supply is via the ignition switch and fed to control box A3, across the fuse to A4 and connected to the centre terminal of the switch-

From each of the side terminals of the switch, a wire is taken to the corresponding trafficator.

Where it is desired to incorporate a warning light on an existing installation, the assembly may be connected as shown in the following illustration.

TRAFFICATOR WIRING CIRCUIT 1



TRAFFICATOR WIRING CIRCUIT WITH WARNING LIGHT

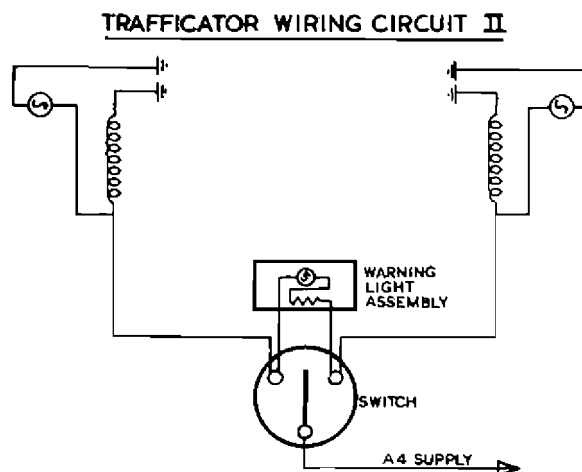
The circuit shown here is in use where trafficators are fitted together with an indicator warning light. The supply to the indicator switch is from the A4 terminal protected by a fuse and directly controlled by the ignition switch. When installed on the vehicle, a GREEN cable is run from the A4 fuse terminal direct to the switch main terminal.

A GREEN and RED cable to the left hand, and GREEN and WHITE cable to the right hand trafficator complete the circuit.

The warning light is connected across the trafficator feed terminals of the switch.

When either trafficator is switched on, the warning light makes a parallel circuit to earth via the solenoid of the other trafficator.

The current taken by the warning light will only be small and insufficient to operate the trafficator.



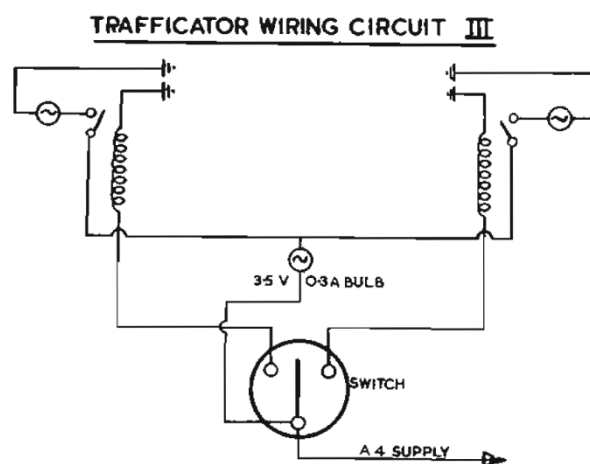
TRAFFICATOR WIRING CIRCUIT USED ON EARLIER JAGUAR AND ROVER CARS

The special feature of this arrangement is the warning light circuit. This can only be completed by the switch and arm bulbs when the trafficators are in the fully raised position.

The advantage of this circuit is that with either an arm bulb fracture or the arm sluggish and not attaining the fully raised position, there would be no illumination of the warning light.

The trafficator and warning light supply wires are taken off the A4 terminal on the control box.

A BLUE and BLACK cable from the warning light is connected to an extra terminal on one trafficator, with a cross feed to the opposite trafficator.

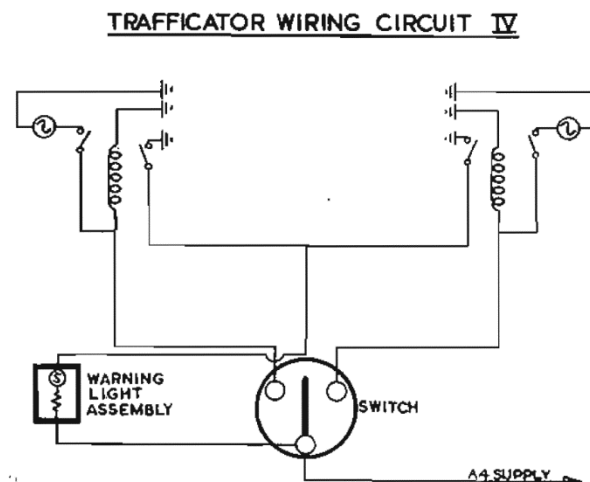


SPECIAL CIRCUIT FOR JAGUAR AND ROVER CARS

This arrangement had special features.

The trafficators incorporated two switches; the warning light circuit was only completed when the signal arm was in the fully raised position. The cable from the warning light was connected to an additional terminal on the trafficator, then to a special earthing switch built into the unit and earthing on the plunger in the fully raised position. An additional switch in the trafficator is for the arm bulb only, which completes the circuit in the fully raised position.

It will be observed that when the ignition is switched on, the supply is to the centre terminal and connected also to one side of the warning light. The other side of the assembly is connected to the earthing switch on the trafficator. This necessitates an additional cable to either trafficator.



Flashing Lamp Direction Indicators

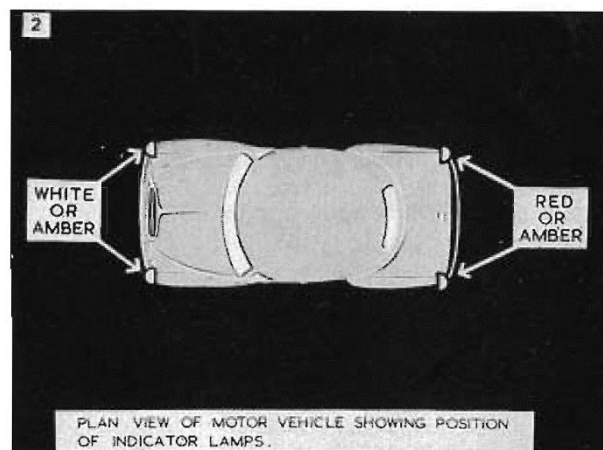
GENERAL

Four Light Direction Indicators or Flashing Light Indicators are a method of indicating change of direction widely used on American cars and now being fitted to some British cars as an alternative to the Trafficators.

The arrangement consists of a pair of lights at the front and rear of the vehicle, actuated by a switch and a flasher. Alternatively, a suitable amber coloured unit may be placed on each side of the vehicle.

The general design and layout of the arrangement as applied to the popular car conforms to the following principal recommendations:—

1. Two white or amber lights at the front of the vehicle and similar amber or red lights at the rear.
2. The lamps must be mounted between 17" and 90" from the ground and not more than 16" inwards from the side of the vehicle.
3. They must not be less than 3½ square inches — vehicles over 2 tons 12 square inches — in area and the light shall be diffused by frosted glass or other adequate means.
4. The power of the lamp shall not be less than 15 or more than 36 watts.
5. The Flashing indicators may be combined with the vehicle's existing 'Side and Stop Tail' lights, providing that a separate circuit and separate bulbs or bulb filaments are used.
6. The flashing rate of the lights must lie between 60 and 120 per minute.
7. The indicators shall be fitted so as to enable the driver to observe that they are operating; or alternatively a warning light must be installed.



VEHICLE SHOWING POSITION OF INDICATOR LAMPS

With such an indicator system we need four lamps, one at each corner of the vehicle, two facing forward and two to the rear.

All four lamps may show an amber light, or those at the front may be white and those at the rear red.

To give a visible and unmistakable signal, the lamps should show an intermittent light; in other words they are made to flash or wink.

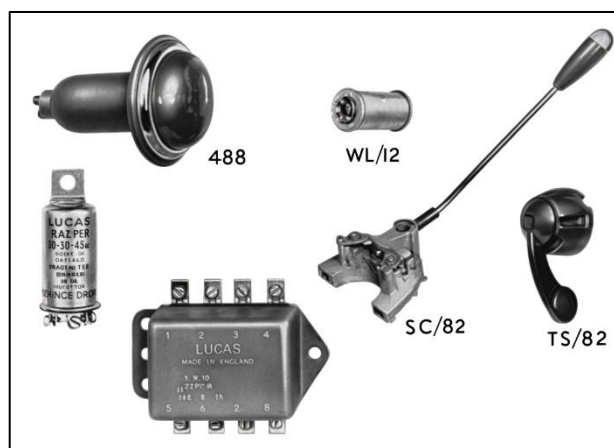
COMPONENTS OF THE "FLASHER" EQUIPMENT

Here you see the typical possible units of a flasher circuit.

In the simplest arrangement, however, only FOUR components are required:—

1. Four separate lamps (or Double Filament Bulbs in the side lamps) and separate rear lamps.
2. A Warning light mounted inside the vehicle.
3. The Flasher Unit.
4. An Indicator Switch. Two types of switch are shown, the one on the right being the SC82, a non-cancelling switch recommended for use when the Flasher Set is supplied as an accessory. The switch shown on the left is the self-cancelling type, the return being actuated by a cam on the steering column. It incorporates a warning light in the amber knob on the end of the arm.

A popular variation of this arrangement — dependent upon the choice of the vehicle manufacturer — is to use the Brake Stop Lights for the rear indicators.



This requires a 'Relay' in addition to the other components, and incidentally complicates the wiring quite considerably.

CIRCUIT WITH INDEPENDENT REAR INDICATOR BULBS

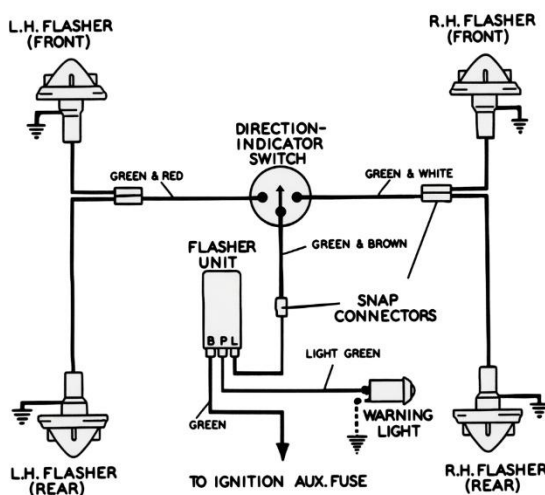
The simple layout and circuit using the side lamps at the front end and separate lamps at the rear is shown in this picture.

Looking at the lower centre, we see that the feed is taken from the ignition auxiliary fuse Terminal A4 at the Control or Fuse box directly to terminal B on the flasher unit. Current passes through the unit and out to terminal L, which is connected to the centre point of the direction indicator switch.

Here the circuit divides, leading to the left or right hand lamps, according to the position of the switch.

Looking at one side only, say the right, we see that the front and rear lamps are connected in parallel; the circuit to earth is completed through the lamp filaments.

The indicator warning lamp is connected between terminal P of the flasher unit and earth.



CIRCUIT EMPLOYING DB10 RELAY

If, as is frequently the case, the Brake Stop Lamps are used as Rear Indicators, this picture shows the general arrangement.

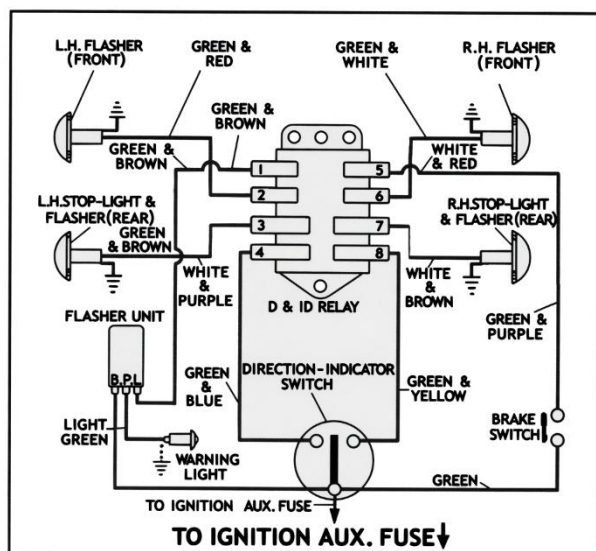
It comprises the same units as before with the addition of a Relay as shown at top centre. The sole purpose of this is to put the Brake Stop Lights out of circuit whilst it is functioning as a direction indicator.

Now to clarify this circuit, note carefully that the Indicator Switch — centre picture — is used to operate the Relay only.

The current feed from A4 terminal as before supplies separate circuits.

1. The Indicator Switch to operate the Relay.
2. The Stop Lamp Switch and then through the Relay to the Stop lamp bulb filaments.
3. A feed to the Flasher unit. From this unit to the Relay and from separate contact points in the Relay to the filaments in the Sidelamp and Stop Lamp bulbs.

Lastly, there is the Indicator Warning Light which is fed directly from the Flasher Unit — terminal P through the lamp to earth.



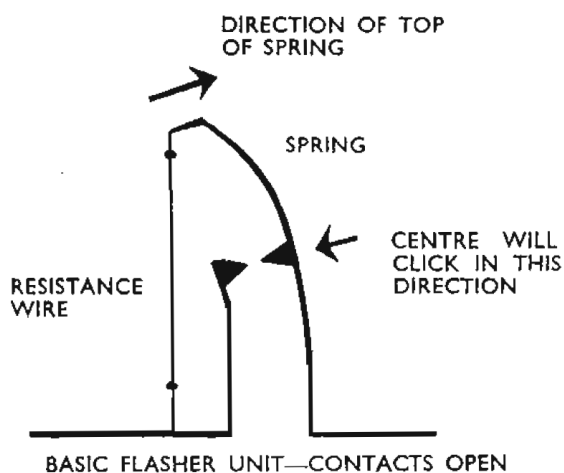
THE FLASHER UNIT — OPERATION OF THERMAL SWITCH

The Flasher unit is basically a Thermal switch for interrupting the current at a pre-determined rate per minute; in other words, it switches the lamps on and off. The rate of flash is between 60 and 120 times per minute. This and the following diagrams will make the operation clear.

On the left of the picture on the next page we see a piece of resistance wire, anchored at the bottom end to the frame of the unit, and at the top to a spring, so that it is always kept under tension. The spring is a piece of thin metal, so shaped that when it is bent, a 'buckling' or 'click' action takes place in the centre. The centre of the spring carries one of a pair of contact points.

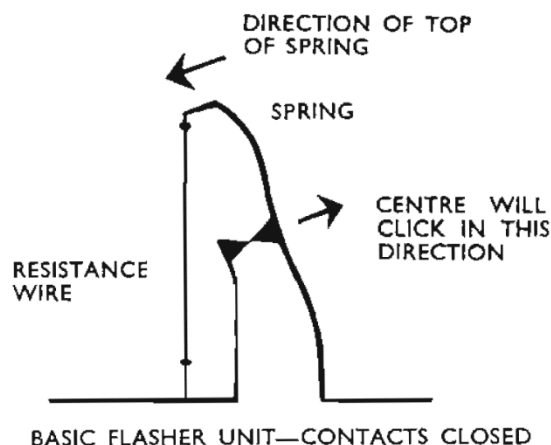
These are normally open. When current passes through the wire it will get hot and expand.

The top of the spring will move in the direction shown in the diagram. Because of the click action the centre will move in the opposite direction to the top. In practice, the points will be snapped closed when the top of the spring has travelled a pre-set distance. In simple terms this so-called "Click" action is produced by distorting a specially shaped strip of metal in the vertical plane whilst it is already under stress in the horizontal plane. This principle is widely used in the construction of micro switches. It ensures a quick positive action for a very small movement.



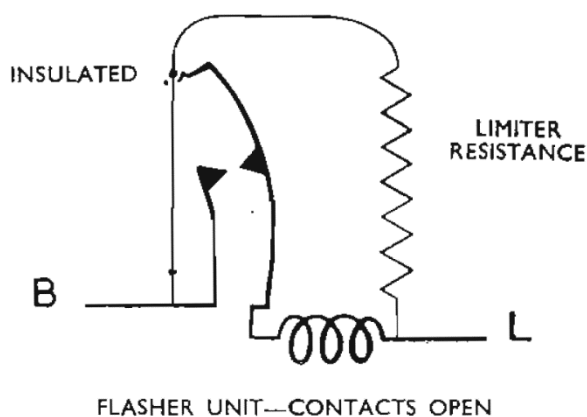
The closing of the points by-passes the hot wire and current will no longer flow through it. It immediately begins to cool, and contracts, consequently reversing the action.

As we see in the second illustration, the points are now closed, by-passing the resistance wire. The latter is thus contracting. The top of the spring will be pulled back to the left and, at a critical point, the contacts will click open.



The resistance wire is again in circuit and current will pass through it; the heat will cause it to expand and the points on the blade will 'click' closed again.

We will point out that current will continue to pass through the resistance wire when the contacts are open, as we do not completely break the circuit — however let us look at the next picture.

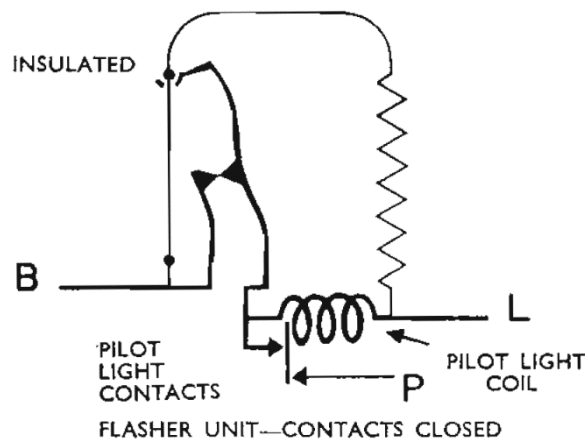


THE LIMITER RESISTANCE

Here we see what happens in the complete unit. Our hot-wire is shown on the left and in the centre the click spring and contacts. But we now show a resistance in series with the hot wire. This serves two purposes: it limits the amount of current passing through the flasher bulbs to below that at which they will light. It also prevents any sudden surge of current from damaging the wire when the indicators are switched on. Current passing through the wire will cause it to expand; the spring will click over once again, and the contacts close.

OPERATION OF THE PILOT LIGHT

Having produced the Flashing light, provision has to be made for the Dashboard Warning Light. This is done by means of what is termed a 'Pilot Light Coil'.



When the main contacts close, the current to the lights, now passes through this coil. As soon as the coil is energised, it moves a small armature which closes a pair of contacts in the base of the unit. This completes the lead to the pilot lamp, causing it to flash in sympathy with the main bulbs.

However, the pilot coil is so designed that it will operate the Pilot light contacts when 36 to 40 watts are being consumed. Should less current flow, for example if one bulb failed, the contacts will not close and the pilot light will not flash, thus warning the driver that one of his direction indicators is not working.

Three leads marked 'B', 'P' and 'L' are brought out to terminals in the base of the unit. The one marked 'B' for battery will normally be connected to the A4 terminal on the control box. The centre terminal 'P' is wired to the Pilot Lamp. The terminal marked 'L' will feed the indicator lights, via the indicator switch or a relay if fitted.

THE FLASHER UNIT — FITTING

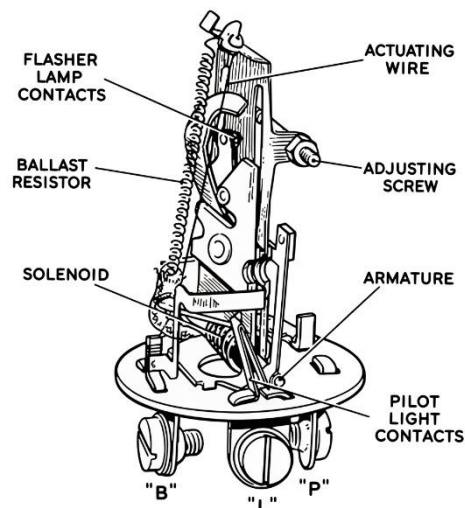
Here we have the complete Flasher with the cover removed.

As in most Thermal Switches this unit is susceptible to damage by the ingress of dust or moisture. Additionally, the temperature must be kept uniform to maintain the correct rate of Flash. For these reasons the unit is hermetically sealed by means of an aluminium cover. This of course, precludes the possibility of any adjustment in service, but in any case this is a tricky business that can only satisfactorily be done in an instrument Repair Shop.

The following precautions are necessary to ensure satisfactory performance from the flasher:

- 1 The mounting position must be vertical, with the terminals at the bottom. A position free from engine vibration should be chosen.
- 2 The correct bulbs must be used, i.e., originally TWO 18 watt, now TWO 21 watt filaments on each side.
- 3 Not more than 4 amps should pass through the unit at 12 volts, i.e., 48 watts. Damage may be caused if this is exceeded.
- 4 Less than 36 watts will not operate the Warning Light.

Testing can be carried out by applying 12 volts to the 'B' terminal and connecting a pair of 21 watt lamp bulbs



to the 'L' terminal and a 12 volt 2.2 watt Ignition Warning bulb to the 'P' terminal.

The Flash rate 60-120 per minute can be checked by counting the Flashes over 10 seconds and multiplying by SIX.

Care must be taken with this lightly-built unit both in Transit and Storage to prevent it becoming damaged.

THE DB10 RELAY

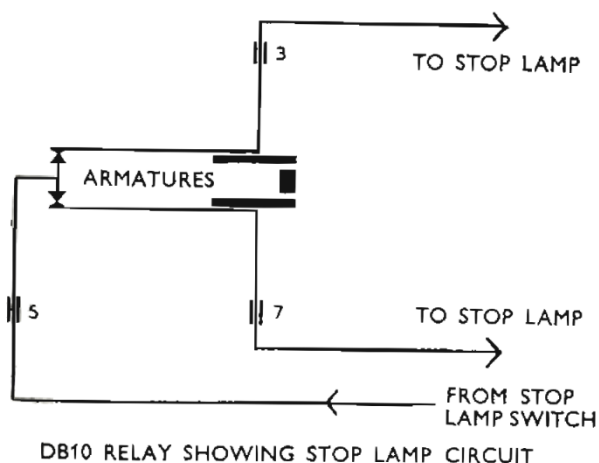
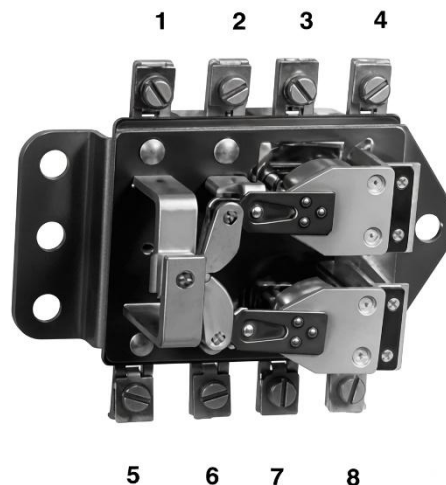
The Relay which has to be fitted when the Stop Lamps are used as direction indicators is the type DB10.

This is an EIGHT terminal Relay with the following layout:

- | | |
|---|------------------------------------|
| 5 | Feed from Stop Lamp Switch |
| 1 | Lead to 'L' terminal on Flasher |
| 2 | To Left and Right Front Indicators |
| 3 | To Left and Right Rear Indicators |
| 4 | To Direction Indicator Switch |

Simply connect the correct wires in this order and all will be well.

The function of this unit is to interrupt the current supply to either stop lamp when it is to be used as a direction indicator light.



THE DB10 RELAY IN THE REST POSITION

The electrical operation of this Dual Relay is quite simple if we follow it through in stages.

This diagram shows the current carrying component of the Relay when it is not being used for indicating purposes, i.e. at the rest position.

The two armatures — centre of picture — are then making contact with two points which are connected together left; the current feed is through terminal 5 from the Stop lamp switch.

Each armature at its fixed end is connected to a stop lamp through terminals 3 and 7.

With the relay in this position, both lamps will light when the stop lamp switch is closed by the action of the brake-pedal.

OPERATING SOLENOID AND CONTACT SETS

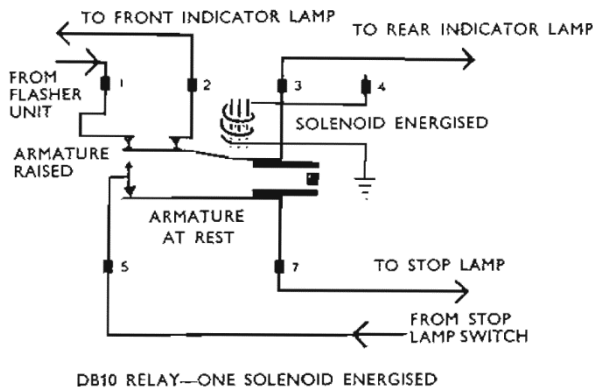
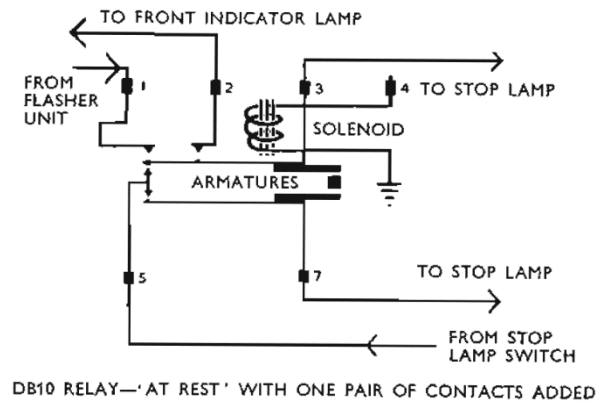
In this diagram we see that the two armatures are still at rest, and the stop lamps will operate as we described in the last figure.

We said that the unit is actually two relays mounted together, and the armatures we show form part of them.

Next we have added two contacts above the top armature, which is operated by the solenoid.

One contact is connected to the flasher unit through terminal 1, whilst the other carries current to the front indicator lamp on one side of the vehicle via terminal 2.

One end of the single *operating* Solenoid shown is earthed to the frame of the relay, and the other is brought out at terminal 4. This terminal connects to one side of the indicator switch.



TURNING TO THE RIGHT

When the indicator switch is moved to the right, the solenoid shown is energised. This lifts the armature and closes the pair of points.

Current then flows from the Flasher unit through terminal 1, across the armature and to the front indicator lamp via terminal 2. The rear indicator is fed via terminal 3. This lamp can no longer act as a Stop Light because the current supply from terminal 3 is now broken.

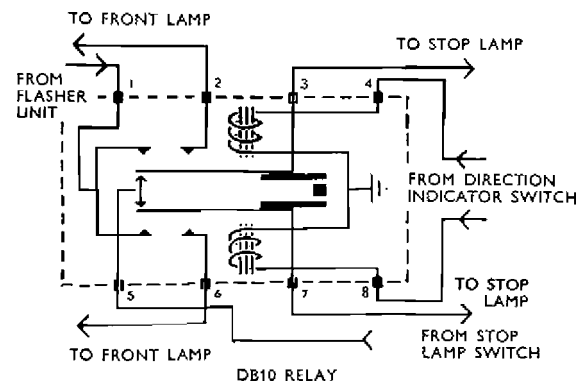
The other armature is still at rest and you will notice that the feed from the stop-lamp switch remains intact to the stop lamp. This means that the stopping signals can still be given on the lefthand side of the vehicle when the turning signals are in use on the right-hand side or vice versa.

THE COMPLETE RELAY ASSEMBLY

Here we have the complete assembly. We agree that the diagram makes this simple piece of equipment look complicated.

However, you can see that it is quite ingenious and compact.

The unit is fully sealed to prevent ingress of dirt and moisture and, even if the mechanism were easily accessible, it would be a time-wasting proposition to attempt adjustment or repair.



THE LAMPS

When separate lamps are fitted to a vehicle, there are two types available: the type 488 seen on the left of the picture and the 556 seen on the right.

Type 488 Lamp. This is a flush-fitting lamp consisting of a moulded rubber body holding a fluted glass and chromium plated rim. When used for direction indication it can be supplied with a white, red or amber glass, and either single or double filament bulbs (6 or 12 volt).

The models fitted with white or red glasses used for giving indication signals as well as the side or rear lighting are fitted with two pole bulb-holders having off-set slots to take a double filament bulb of the popular types No. 361 or 380.

The flasher set supplied as an accessory consists of four of these lamps with amber glasses, each having single filament 12 volt 21 watt bulbs No. 382.

Type 556 Lamp. This lamp has been specially designed for commercial vehicles. It has a moulded diakon plastic lens, amber in colour, with an area of 12 square inches. It is held in position by two screws. The body is moulded rubber fitted over a steel baseplate and a single filament bulb holder takes a 21 watt bulb.



The WARNING LIGHT is the type WL/12, also used as a Headlamp Main Beam Warning Light. It has a die-cast body, with small amber polystyrene lens in a chrome bezel. A miniature screw type bulb is used, fitting in a standard bulb holder.

THE BULBS

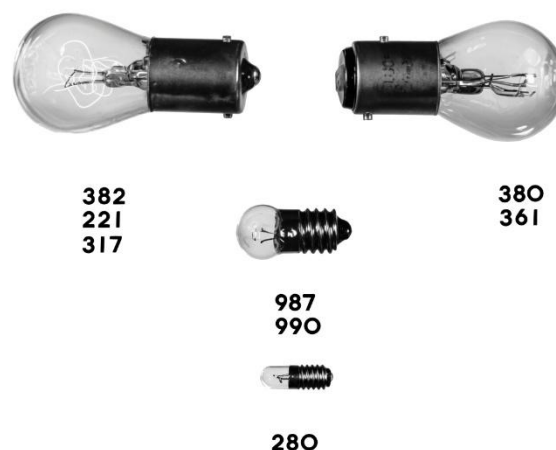
Separate Indicator Lamps. The correct bulb is No. 382. This is a 12 volt 21 watt single-filament bulb with a single contact cap. The original bulb used was the No. 221 (12 volt 18 watt). The corresponding 6 volt bulb is No. 317 (6 volt 18 watt).

The Combined Stop Tail and Indicators use Bulb No. 380. This is the 12 volt bulb with 6 and 21 watt filaments. It has a small bayonet cap (9/16" dia.) with off-set pins to ensure that the bulb is correctly positioned.

The 6 watt filament is used for the side or rear light and the 21 watt filament for the Indicator or Stop Light.

The stop lamp filament was originally 18 watts but was subsequently increased to 21 watts to increase the brilliance. This increase is noticeable when the indicator is used in strong sunlight. If the 6-18 watt bulb is required as a replacement in one of the earlier installations, the correct number is 361.

Warning Light. The bulb used is No. 987, 12 volt 2-2 watts, with a Miniature Edison Screw Cap (M.E.S.) This is the same type of bulb as used in the ignition warning lights where no resistance is fitted; it is also used



extensively for instrument panel illumination. For the 6 volt system a similar bulb No. 990 (6 volt 3 watts) is used.

A new type of warning light bulb, known as a Lilliput Bulb is shown at the extreme bottom of the picture. It is No. 280, fitted to the TC82 Direction Indicator Switch and is only available in 12 volt.

THE FLASHER SET AS AN ACCESSORY

A Flasher Indicator Set is now available as an accessory for vehicles not already fitted with this type of indicator. This is fully described and detailed in our Sales Leaflet No. 1100.

The set consists of FOUR Type 488 Lamps, a Flasher Unit and a Warning Light. No Direction Indicator Switch is supplied as generally the existing self-cancelling switch on the steering column will be used. For vehicles where this is not so, an Indicator Switch No. TS82 is available.

A Fitting Instruction Leaflet is supplied with each set, the wiring circuit being that which we examined on page 49.

The correct size cable for either the 12 or 6 volt layout is 14 strand/.012 auto-cable. The colours we recommend for new car installations are:—

1. Ignition Auxiliary fuse A4 to Terminal B on the Flasher Unit — GREEN.
2. Terminal P on the Flasher to the warning light — LIGHT GREEN.



3. Terminal L on the Flasher to the centre terminal on the Direction Indicator Switch — GREEN and BROWN.
4. Direction Indicator Switch to the lamps on the near-side of the vehicle — GREEN and RED; and to the off-side, GREEN and WHITE.



L559 FLASHER INDICATOR SET

A TWO Lamp Set is also provided for 'after sales' fitment and is available for both 6 and 12 volt working. It is mainly applicable to earlier types of cars, vans, taxis, etc., and as an interesting and profitable Service Sales line is worthy of some detailed examination.

The set comprises the components shown in the picture which it will be noticed does not include a switch.

Where a trafficator switch is already installed this will be quite suitable. In the event of a switch being required the most popular suitable model is the TS82 Panel mounting TWO-WAY and OFF Switch as illustrated on the right.

THE CIRCUIT ARRANGEMENT

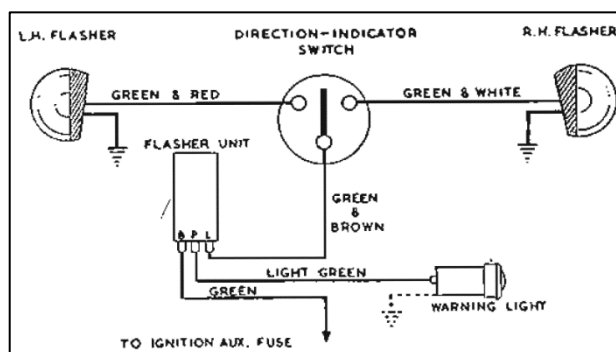
The very simple circuit arrangement shown in this illustration can be easily followed.

Current supply from the A4 terminal at the control box or fuse panel connects directly to terminal B (battery) on the Flasher unit and from terminal L (Lamps) to the centre contact of the TWO WAY and OFF panel mounted switch.

From each side of this switch the supply is wired directly through the lamp bulbs to earth.

As with the FOUR Lamp Sets the warning lamp bulb is wired directly from terminal P (Pilot) on the Flasher unit through the warning lamp to earth.

The cable required for installation will be size 14/.012, Master Colour Green and for convenience in subsequent service, the tracer colours as shown in the diagram should be used if possible.



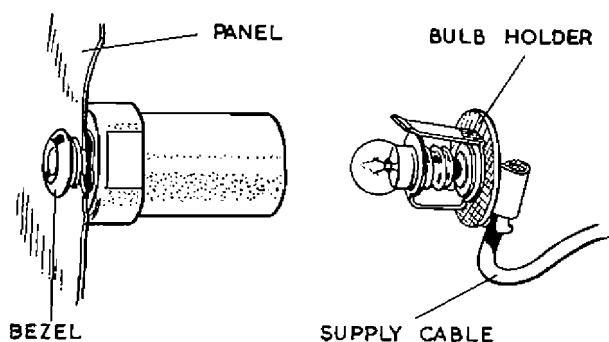
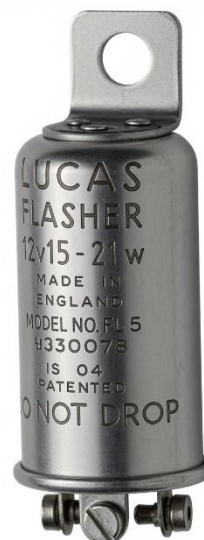
THE TYPE FL3 FLASHER UNIT

This unit is special for the TWO lamp set and whilst having the standard flash rate of 60-120 per minute is designed for a current of 15-21 watts only. This unit is part number 35007 for the 12 volt and 35008 for the 6 volt model.

When installing a set it is important that the Flasher unit should be positioned where it will not be affected by engine vibration or exposure to the weather and mounted upright with the wiring terminals pointing downwards.

As a point of interest it may be noted that the Flasher Unit for the Four Lamp Set carrying 42 watts is FL3 Part No. 35003 for the 12 volt and Part No. 35005 for the 6 volt.

It will be appreciated at once that the TWO and FOUR Lamp Flasher Units are not interchangeable.



THE WARNING LAMP TYPE WL12

The Warning Light shown should be installed in a prominent position on the fascia panel directly in the driver's line of vision as far as possible.

This lamp is a single hole fixing model and the bulb is installed from the rear as shown.

The correct bulbs are as follows:—

12 volt sets: Lucas 987 2.2 watts MES

6 volt sets: Lucas 990 3.0 watts MES

(Miniature Edison Screw)

THE No. 559 LAMPS

These should be installed in a conspicuous position at the widest part of the vehicle not more than 7' 6" from the ground or less than 1' 5" and not more than 6.0" behind the windscreen. They should also be mounted upright in order that the maximum amount of light be projected towards oncoming traffic.

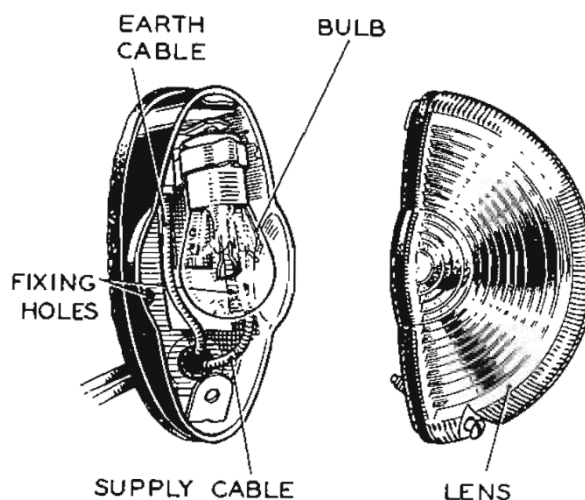
In the detailed Instruction Leaflet No. 1210 supplied with each set a drilling template is provided for convenience of installation.

The general arrangement of the lamp is clearly shown in the illustration, and on the back is shown the flexible rubber mounting pad which is supplied with it.

To ensure satisfactory operation it is essential that lamp bulbs of the correct wattage are used, and the replacement numbers specified below will be useful to note, particularly in the event of any service trouble being encountered with the Flasher Unit, in which case the first thing to do will be to check the bulbs.

12 volt sets Lucas No. 382 21 watt SCC

6 volt sets Lucas No. 317 18 watt SCC

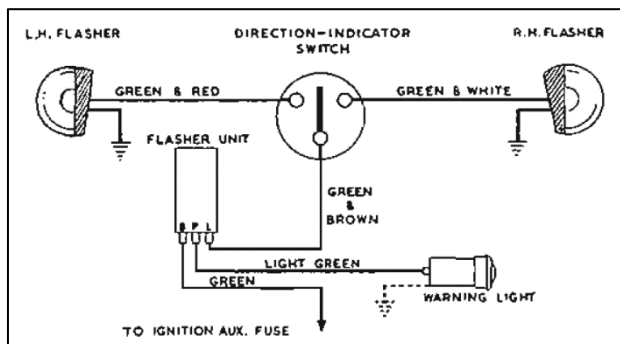


THE SWITCH

If the vehicle has been previously fitted with direction indicators the existing switch can of course be used.

When installing a new switch, care in choosing a position of maximum convenience and accessibility to the driver's hand is of value.

One of the most popular and readily available switches for panel mounting is the model TS82 as illustrated, but any other type of TWO WAY and OFF switch capable for carrying 3 amperes may be used.



THE WIRING

The wiring up of the TWO Lamp Indicator set will be as laid out in this diagram and is an operation which may frequently be simplified by the use of snap connectors.

If the vehicle has no convenient fuse point available from which to take the current supply it may be connected from a point on the Ignition switch circuit such as the coil terminal on the ignition switch or the SW terminal of the ignition coil itself. This will preclude the possibility of the Indicators being left ON when the engine is stopped prior to getting out of the vehicle.

Care should be taken to provide an effective earth from each Indicator lamp and also the warning lamp, by installing separate earth wires wherever necessary.

A particular useful hint is to test out the wiring after installation with the Flasher unit itself out of circuit. To do this, before connecting the feed to the fuse disconnect the three flasher unit connections and join them all together. Connect the feed wire to the current supply terminal and then operate the indicator switch, if anything is incorrect it will immediately show up and can be rectified without risking damage to the Flasher Unit itself.

SERVICE TESTING. THE FLASHER INSTALLATION - SEPARATE INDICATORS

Having told you all about the indicator equipment, we can now consider how to test this equipment in Service. To do this, we will divide the procedure into the two basic circuits.

We start with the simple circuit first, i.e., that employing four separate indicator lamps.

1. With the ignition switch on, check for a voltage reading at the following points:—

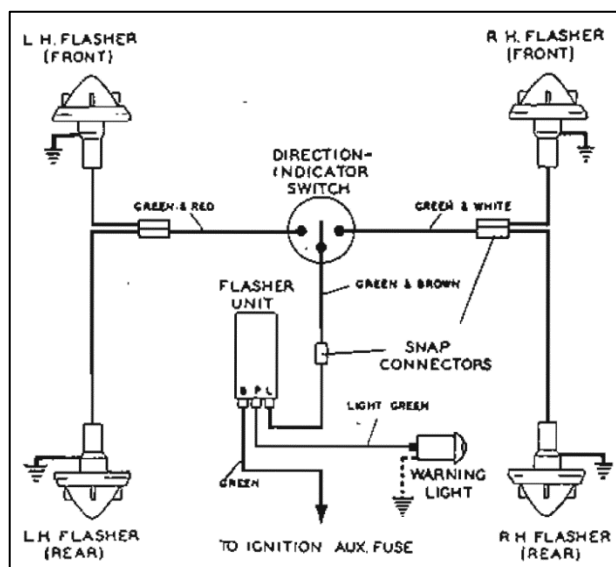
- A4 Fuse.
- 'B' Terminal of the Flasher Unit.
- 'L' Terminal of the Flasher Unit.

A reading at both these terminals of the Flasher unit proves continuity of the flasher unit itself. If there is a reading at one terminal only, the unit should be changed.

- The Feed Terminal of the Direction Indicator Switch.

2. To check the remainder of the wiring and system.

Turn the indicator switch to either side, when both lamps (one rear and one front) will 'flash'.



If any one lamp does not light, it is an easy matter to check through the wiring with a voltmeter for an open circuit or blown bulb, etc.

SERVICE TESTING THE FLASHER INSTALLATION - INCORPORATING DB10 RELAY

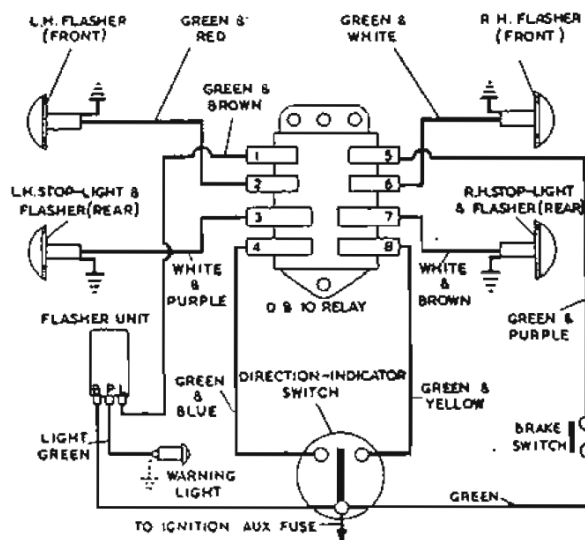
Service testing is slightly more complicated when a DB10 relay is incorporated in the circuit.

The procedure then would be as follows:—

1. Switch on the Ignition.

Battery voltage should be registered between earth and the following points

- A4 terminal on fuse board** — if no reading is obtained, check fuse and A3 supply.
- Direction indicator switch feed terminal** — if inaccessible, check at nearest possible point, e.g., base of steering column, snap connector, etc.
- Flasher Unit feed terminal B** — if letter 'B' is not visible, reference to test (d) below shows that voltage should be registered at the two directly opposite terminals.
- Flasher Unit terminal 'L' (opposite 'B')** — reading proves continuity through the unit. No reading indicates a faulty unit.



- DB10 relay No. 1 terminal** — voltage registered only if a reading was obtained at 'L'.

Continued

2. Connect a temporary feed wire from the A4 terminal, in turn, to the following terminals of the DB10 relay.

(a) No. 3 and No. 7.

Both stop lamps should light each time.

If the *same* lamp does not light in either test, the fault must be in the wiring to that lamp, or in the bulb, the holder, earth, etc. If *alternate* lamps light individually during both tests, the fault will be in the relay.

(b) No. 2 and No. 6.

Each front indicator lamp should light. If not, check bulb, holder, lamp earth and wiring (from relay to lamp).

(c) No. 4 and No. 8.

Each relay should operate in turn, accompanied by flashing of one front and one rear indicator lamp.

If neither relay operates, first check that the unit is earthed. If it is, the DB10 is faulty.

If one relay does not operate — internal fault in the DB10.

If one relay operates and front and rear indicator lights on that side flash, but both lamps do not flash on the other side, even though their relay can be heard closing, the DB10 is faulty.

If both relays close, but none of the lights flash, the fault can be in either the DB10 or the flasher unit. In which case, eliminate one or the other by linking terminals 1 and 3 of the DB10.

If the flasher now operates, the DB10 is faulty. No change indicates a faulty flasher.

3. To check the remainder of the wiring and the indicator switch.

Turn the switch first to one side and then to the other. Each relay will be heard to close and all lights should flash. If this is not so, check wiring between switch and DB10 relay (Terminals 4 and 5). If wiring is in order, check switch itself.

4. Final checks.

(a) Pilot Light — This should flash in sympathy with indicators.

If it is not operating, check with voltmeter between earth and terminal 'P' flasher unit. A reading should be obtained at every flash of the indicators. No reading proves flasher unit faulty. If correct reading is obtained, check pilot light bulb and wiring.

(b) Rate of flash.

N.B. If flashing rate is not within the prescribed limits, do not suspect the flasher unit before ascertaining that the *indicator lamps* are of the *correct wattage*.

Incorrect bulbs will also seriously affect the operation of the pilot light.

Additional Test for Stop Lamps.

This test need only be carried out if the flasher system is in order, but the stop lamps do not operate.

Voltage should be registered at the following points:—

(i) Stop lamp switch, feed terminal — if this is inaccessible depress the brake pedal and check at (ii) below:—

(ii) DB10 Relay No. 5 terminal — no reading indicates a fault in the wiring from the stop-lamp switch, a faulty switch or an incorrectly adjusted brake linkage.

Interior Lamp Circuits and Door Operating Switches

GENERAL

On several recent saloon cars the lamps required for interior illumination and which are generally operated by a plain ON-OFF switch, have been fitted up with supplementary plunger switches operated by the opening and closing of the doors.

Generally the arrangement is that upon opening either door the switch will be ON and one or more interior lamps will light up. When the door is closed — presumably after the entry of the passengers — the switch will again be OFF and the lights will go out.

If for any reason the lights are still required after entry they can be switched ON and OFF by means of a separate lever type switch usually built into the lamp itself.

As these individual wiring arrangements may be

difficult to follow out when seen *in situ* on the vehicle, they will be illustrated and described separately.

In all the different arrangements it should be noted that the current supply is taken from the A2 fuse terminal and connected directly to the lamp bulb and the switch and switch wire is on the earthed side.

The cable used for these circuits is usually 14/012 BROWN and GREEN from the fuse, and BLACK on the earth side.

Various types of lamps are installed, and altogether some FOUR models of lamp bulbs are in use. A particular type can most conveniently be obtained by reference to the Lucas parts list for that model, or the bulb replacement list if the lamp fitted is not of Lucas manufacture.

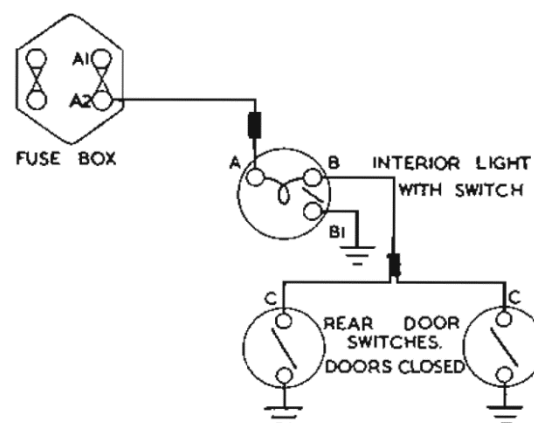
INTERIOR LIGHT CIRCUIT WITH TWO DOOR SWITCHES AS FITTED ON AUSTIN A40, A50 and A90 MODELS FOR 1954-55

The current supply from the A2 fuse is junctioned through a 'Snap' connector directly to the light bulb in the interior lamp at (Terminal A).

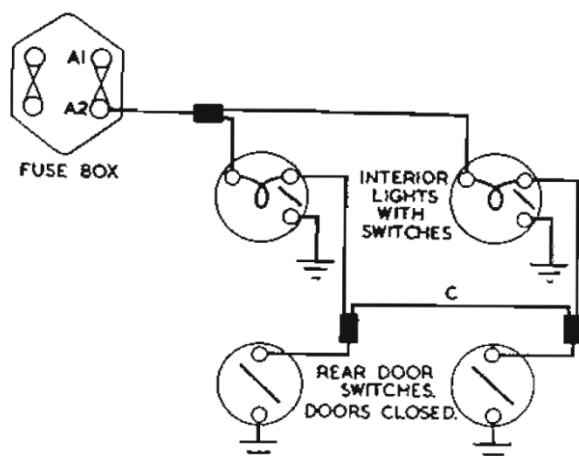
For local operation the Switch B1 is connected direct to earth.

When fitted with TWO door switches as shown an additional cable is wired from the bulb connection at B, by means of a snap connector to one side of each door switch C and C1, the other switch terminals connecting directly to earth.

With the doors closed both switches will be OFF, but when either door is opened the switch will be ON and the interior lamp will remain alight until either or both doors are re-closed. Optional control of the lamp is still available from the local switch B1.



DOOR SWITCH CIRCUIT FOR AUSTIN A40 A50 A90. 1955.



DOOR SWITCH CIRCUIT FOR WOLSELEY 6/90 1955.

INTERIOR LAMP AND DOOR SWITCH CIRCUIT — WOLSELEY 6/90, 1955

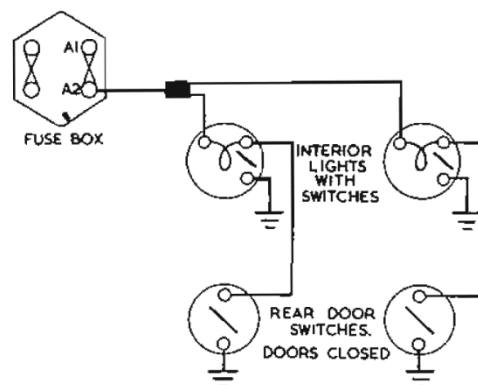
On this model using two interior lights it should be observed that whilst the circuit is basically the same as the one just examined, for convenience the wiring arrangement is slightly different.

The lamp on each side is connected directly to its nearest door switch through a snap connector and to enable both lamps to be brought on when either door is opened an inter-connecting cable (C) is looped between the two snap connectors.

Local control is obtained by the individual switches on each light.

INTERIOR LAMP AND DOOR SWITCH CIRCUIT — HUMBER MK. VI AND RILEY PATHFINDER MODELS

Although there are Two Interior Lamps with their independent switches on these cars, the circuit is so arranged that each interior lamp is connected independently to its own door switch.



DOOR SWITCH CIRCUIT FOR RILEY PATHFINDER & HUMBER MKVI 1955.

INTERIOR LAMP AND MAP READING LAMP CIRCUIT WITH PANEL AND DOOR SWITCHES 1955 MK. VII. JAGUAR

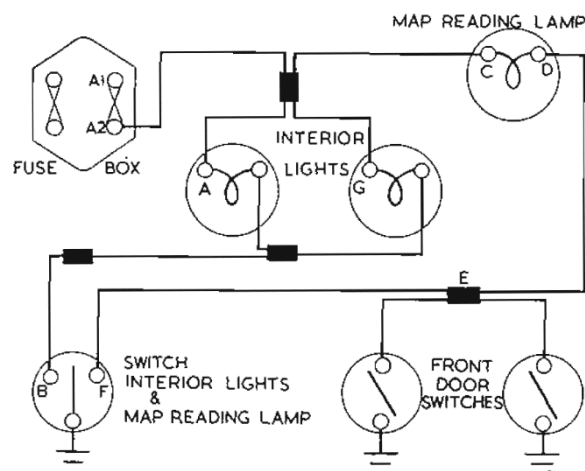
On this model TWO interior lamps are supplemented by a 'Map Reading' lamp and the control for all three is provided by means of a panel mounted TWO WAY and OFF switch. Additionally, DOOR switches are installed in the FRONT doors only.

Following the circuit through, it will be seen that the current supply from A2 is taken via a snap connector direct to one side of both interior lamps and also the map reading lamp, as shown at A, G and C.

The return from both interior lamps is joined by a snap connector to terminal B of the panel switch. The centre or common terminal C of this switch being connected to earth.

The return from the map reading lamp D is via the snap connector E to the other terminal F of the panel switch.

Now for the Door switches. The return from the map reading lamp only is connected by the snap connector E to one side of each door switch and across both switches to earth. Thus, if either door is opened the switch will, bring



DOOR SWITCH CIRCUIT FOR JAGUAR MK VII 1955.

on the map reading lamp only, which will again be automatically switched off when the door is closed.