

LUCAS

TECHNICAL SERVICE

OVERSEAS TECHNICAL CORRESPONDENCE COURSE

Section 9 ELECTRICALLY CONTROLLED OVERDRIVE



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INTRODUCTION

With the ever increasing demand for higher cruising speeds with fuel and oil economy, the overdrive, which offers these advantages, is now becoming increasingly popular among British automobile manufacturers. In point of fact the overdrive, with which we are concerned in this section of the course, is fitted as standard equipment to several cars in the high performance range and is an optional extra to many others. The overdrive unit is basically the same on all cars, but the method of controlling it may differ, depending on the requirements of the individual manufacturer.

Lucas engineers have devised a variety of methods for operational control of the overdrive, and all are designed for driver comfort and ease of operation. These methods range from a simple manual control, to a fully automatic system with overriding manual control.

This section describes in detail the construction, operation and servicing of the Lucas overdrive equipment controlling the overdrive, together with circuit testing procedure, a study of which will impart sufficient knowledge of the equipment to enable you to carry out any servicing required, quickly and efficiently.

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The units described individually, including fitting instructions and methods of adjustment.

The different types of circuits used.

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Working Principles

APPLICATION

The Laycock de Normanville 'Overdrive' with Lucas Electrical Control is now being applied to an increasing number of British Cars.

The vehicles which come to mind at once are :
The Austin Healey — 100, The Standard Vanguard, Triumph Roadster and Renown, Jaguar Mark VII — XK 140, Triumph TR2, Bristol 405, Vauxhall Velox and Wyvern, Sunbeam Alpine Special and MkIII, Humber Hawk MkVI, Ford Zephyr and Consul, Swallow Doretta.

For those of us who are unfamiliar with the Overdrive, we shall explain the general functioning of the equipment and its electrical control.

THE OVERDRIVE ON THE CAR

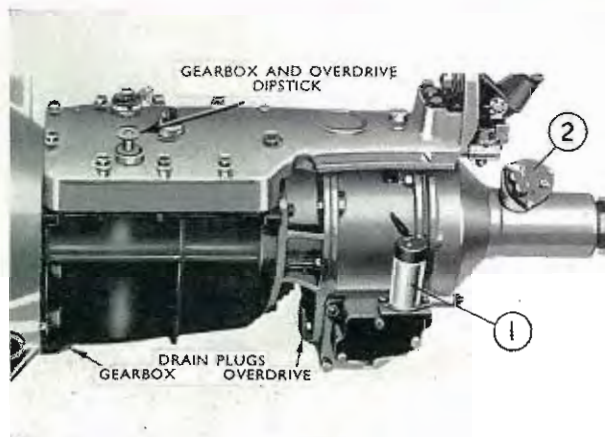
This picture shows the 'Overdrive' Gear Box in place behind the normal gear box. Two of the major electrical components are visible, the Main Operating Solenoid low down on the side (1) and the Centrifugal Switch mounted on top at the back of the gear box at point 2.

To give some general idea as to how this equipment works we cannot do better than briefly run over the manufacturer's own description of it.

As will be generally realised, a motor car engine depends partly for its power development on the number of revolutions per minute, hence the provision of intermediate gears enabling the engine to revolve at higher revolutions for a given road speed, and so provide the additional power required for acceleration and hill climbing.

In direct or top gear the only multiplication of engine revolutions in terms of the driving road wheels is through the rear axle, in which the crown wheel and pinion provide a reduction ratio to suit the particular vehicle.

Considerations of engine power available, the



weight of the vehicle, wind resistance and other factors, determine the actual ratios and top gear performance.

The direct top gear, whilst providing for high cruising speeds must remain sufficiently flexible to avoid frequent gear changes at lower road speeds.

It will be appreciated therefore, that the selection of such an axle ratio must be something of a compromise. To provide for flexible top gear performance at lower speeds, something must be sacrificed at the maximum. In other words, the engine revolves faster than is actually necessary at higher speed.

A means of overcoming this problem is to over-gear, or 'overdrive' the speed of the propeller shaft, and thus the road wheels, in relation to engine revolutions, or, vice versa, to reduce the speed of the engine in relation to the road speed.

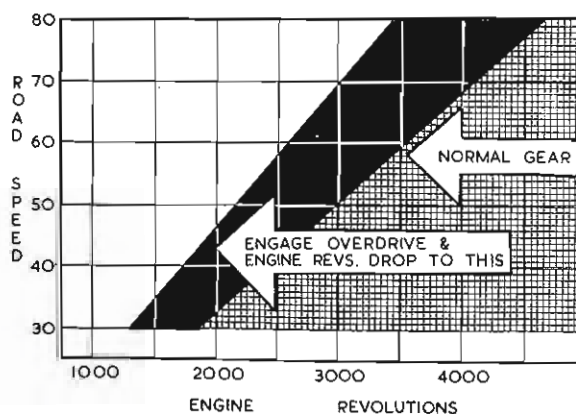
A very high top gear, possibly a fifth, could be incorporated in the ordinary gearbox. With such a gear, however, it would then be necessary to make far more frequent use of clutch, accelerator and gear lever to engage the next lower gear in order to meet any sudden power demand.

ROAD SPEED COMPARISONS

This diagram shows a typical example of engine speeds in top gear and overdrive in relation to road speed.

The vertical ordinate of the graph shows road speed, and the horizontal, engine revolutions. The hatched area shows the comparative road speeds and engine revolutions in normal gear, and the black section makes the same comparison with the car in overdrive. Let us take one example — that of 3,000 engine revolutions which you will see on the bottom line. If you carry your eye up to the inter-section of the hatched area and the black you will see that at 3,000 engine revolutions in normal gear we have a road speed of 50 miles per hour, with a corresponding road speed of 70 miles an hour when in overdrive at the same engine speed.

Converse^{ly}, if we take a road speed of 50 miles an hour it will be seen that in normal gear the engine is doing 3,000 revolutions for the



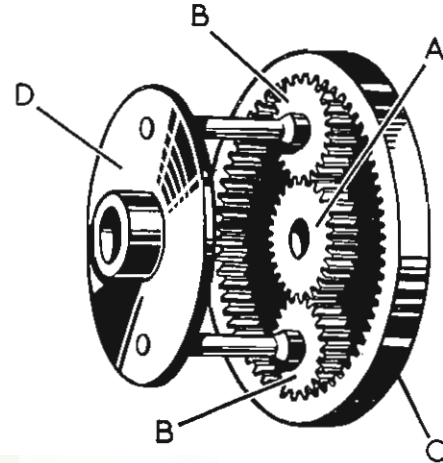
same road speed. We should therefore, anticipate a substantial improvement in petrol economy in overdrive.

PRINCIPLE OF OPERATION

Basically the 'Overdrive' consists of an epicyclic gear train, which comprises a SUN wheel A, a pair of PLANET Wheels B mounted on a PLANET CARRIER D, and an ANNULUS or outer ring C.

If the planet carrier is rotated whilst the sun wheel is locked to the annulus or the planet carrier, the whole gear train will rotate as a solid unit giving a direct through drive.

If on the other hand, the sun wheel is locked preventing it from rotating, and the planet carrier is turned, the annulus will be overdriven at a higher speed than the planet carrier.

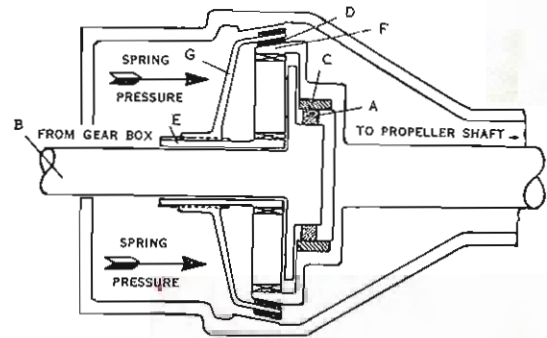


HOW IT WORKS

In addition to an epicyclic gear train similar to the one depicted in the last picture, there is also a hydraulic pump, a hydraulic accumulator or pressure storage chamber, a roller clutch and a sliding cone clutch.

When in direct gear the overdrive is inoperative. The drive is taken from the driving shaft B through the rollers A of the roller clutch to the annulus C. It will be realised that the roller clutch, being uni-directional can transfer power in one direction only, and that if the car were to over-run the engine, the roller clutch would act as a free wheel leaving the car without engine resistance to assist braking. It would also be impossible to reverse the car for the same reason. This problem is overcome by means of the cone clutch member G which slides on a splined extension E on the sun wheel and is pushed by eight compression springs so that the inner lining D engages with the corresponding cone on the outer rim of the

annulus F. This therefore, locks the sun wheel to annulus so that the entire gear train and cone clutch rotate as a solid unit with the drive being taken through the roller clutch, and overrun and reverse being taken through the cone clutch.



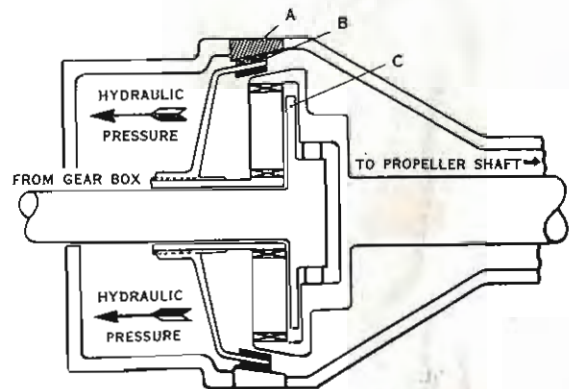
WITH OVERDRIVE ENGAGED

When the overdrive is engaged, a valve in the unit is opened, applying hydraulic pressure from the pressure accumulator to two pistons which work in cylinders formed in the unit housing. These pistons exert pressure against the cone clutch member, overcoming the spring pressure and pushing the cone clutch away from the annulus until the outer lining (B) presses against a conical brake ring (A) built into the main casing of the gear box.

The sun wheel, which carries on its splined extension the cone clutch, is free to rotate on the driving shaft, therefore, when the cone clutch comes into contact with the brake ring, both cone clutch and sun wheel are brought to rest and held stationary. The planet carrier (C) which is splined to the driving shaft is driven round the stationary sun wheel so that the planets rotate and overdrive the annulus at a higher speed than the driving shaft.

In overdrive, the outer member of the roller clutch

overruns the inner member. Engine braking is again provided by the cone clutch which holds the sun wheel from rotating in either direction.



METHOD OF OPERATION

The change into or out of overdrive is made without effort, and with perfect smoothness, only the rise or fall in engine note being noticeable, with resultant increase or decrease in engine noise and vibration.

The use of overdrive claims to provide considerable fuel economy, at least 10 per cent dependant upon usage and circumstances, with additional saving in oil and engine wear.

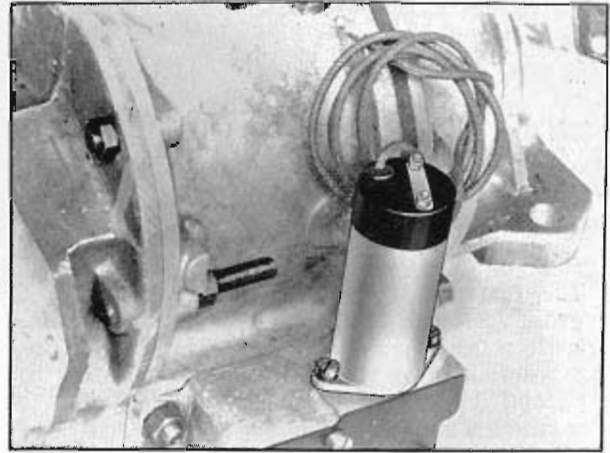
It is relevant to mention that the overdrive gear may operate on top gear only, or on top and second gear, or top and third — in a four speed box — as arranged in the original layout of the vehicle.

There are also a variety of ways of effecting the change into overdrive. One is direct through mechanical linkage, the others with which we shall now concern ourselves are the electrical control methods.

ELECTRICAL CONTROL

There are two forms of electrical control in use, manual or automatic.

In either case, the principal unit is a solenoid switch, which is featured in this picture, and is mounted on the side of the gear box. Its function is



simply to open and close the hydraulic actuating valve for the overdrive gear change.

The various other components used on either or both systems are concerned only with the control of this main solenoid.

We can now examine the simple form of manually operated electrical control.

THE MANUALLY OPERATED ELECTRICAL CONTROL

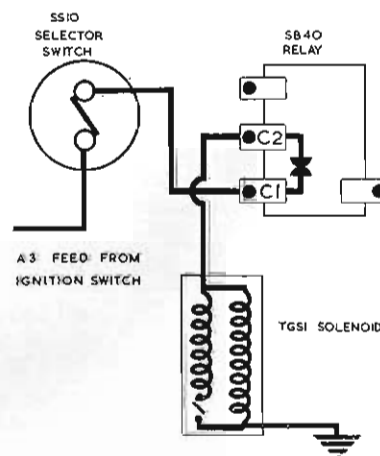
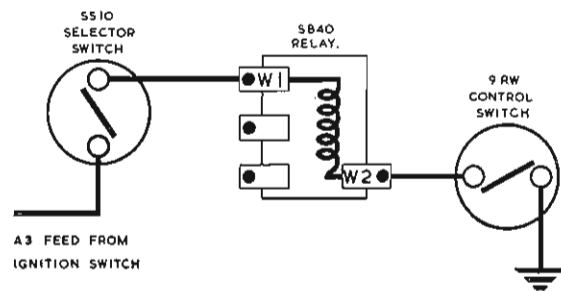
In this arrangement the main solenoid is operated through a relay switch type SB40 which is itself actuated by two separate switches.

The current supply which is generally under the master control of the ignition switch and is taken from the A3 terminal of the ignition switch is shown at the left of the picture.

A first requirement of the arrangement is that the overdrive must not operate in reverse gear or in the first or first and second gear of the 3 or 4 speed boxes respectively. The current supply is therefore taken direct to a plunger type switch SS10 as shown on the left of the picture, which may be installed in the side of the gear box, or alternatively linked to the gear change mechanism and operated by the gear selector lever. This switch ensures that the circuit for the overdrive solenoid is never complete unless the correct gear is selected.

From the other side of this switch the current is fed via terminal W1 and W2 of the relay windings through a simple ON-OFF switch to earth.

The comparatively heavy current required to operate the Solenoid itself, is switched by the main contacts of the relay at terminals C1 and C2. This current supply provides a feed for both windings in the solenoid which are earthed. We shall be dealing more fully with these 'Main' and 'Hold-on' windings later on.



ELECTRIC MANUAL CONTROL

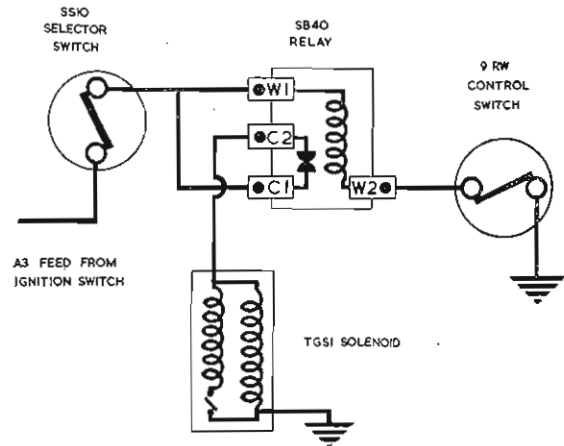
In this picture we have the complete circuit for the electrically operated manual control.

To allow the overdrive to become operative, the hand control switch 9RW shown on the right of the picture, must first be closed.

When top or the other prescribed gears are engaged, the selector switch SS10 will then also be closed, and current can pass through the relay windings W1 and W2 to earth.

The Relay will then close contact C1 and C2, allowing current to flow through the solenoid windings to earth; the solenoid plunger will then lift and open the hydraulic valve which will engage the overdrive gear, and it will remain engaged until either of the two switches are re-opened.

The current supply to C1 terminal of the relay is often taken direct from ammeter or main battery fuse.



THE AUTOMATICALLY OPERATED ELECTRICAL CONTROL

We can now deal with the Automatically Operated Electrical Control.

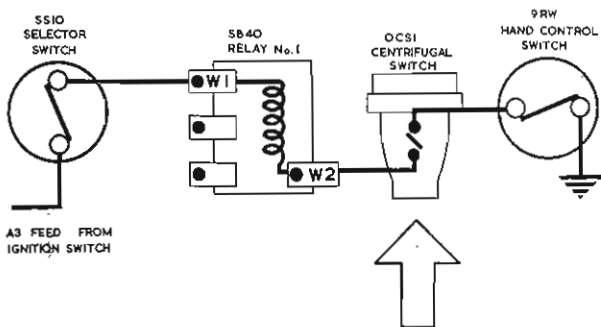
To achieve automatic changing into and out of overdrive it is necessary to install firstly, a centrifugal or governor type of switch which is driven from an extension of the Speedometer Drive Spindle.

In this component a single pair of contacts are opened and closed by a governor at pre-arranged road speeds. In general terms the governor closes the switch contacts at about 40 miles per hour and opens them at between 30-35 miles per hour.

As shown in our picture this switch is placed in the circuit between the W2 terminal of the No. 1 relay and the hand control switch.

Thus, with the hand control switch in the CLOSED position, the governor switch will operate the relay and engage and disengage automatically. That is: change into overdrive at about 40 miles an hour and change back to normal at about 30 miles an hour.

The centrifugal switch by itself will not fulfil all the requirements, and it is necessary to introduce a further relay operated by means of a switch linked to the accelerator pedal which we shall now consider.



LIGHT RUNNING CONDITIONS

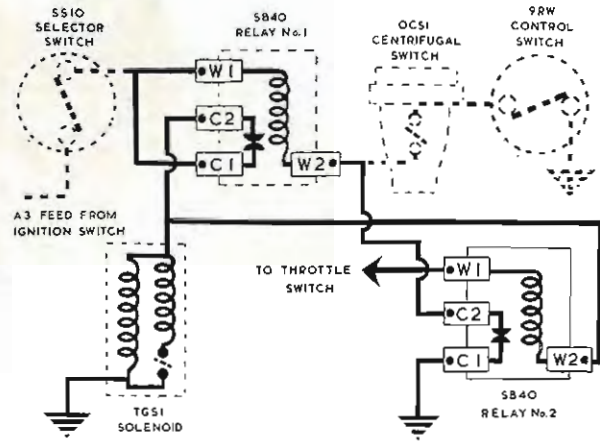
When coasting at small throttle openings, even at speeds below 30 miles per hour — when the centrifugal switch will be open — it is not desirable to come out of overdrive unless it is required to accelerate sharply, when the throttle will be opened up.

So, in order to keep the gear in 'overdrive' under the Light Running Condition, a throttle switch linked to the accelerator pedal, together with an additional relay is introduced. We shall refer to this second relay, shown at the bottom right of the picture, as No. 2 relay.

The No. 2 Relay connected as shown — serves to keep the No. 1 relay points CLOSED after the centrifugal switch contacts have been opened.

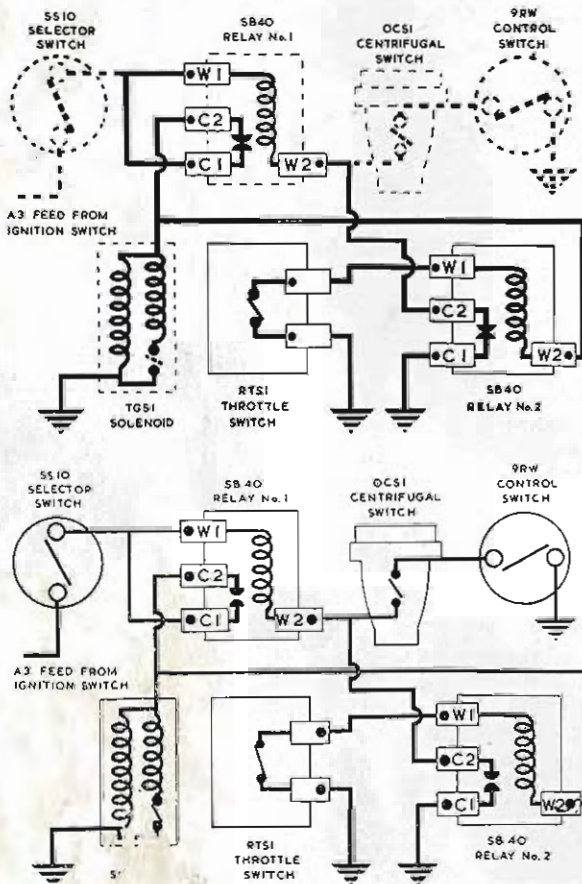
This No. 2 Relay will be energised when the throttle switch is CLOSED, but as soon as the throttle switch is opened, the earth side of the relay circuit is broken thus allowing the gear to change back to normal.

In brief, with the carburettor butterfly and the THROTTLE SWITCH closed, the car will remain in overdrive.



With the throttle more than one fifth open the switch will also be open and the car will return to normal gear until the centrifugal switch contacts again close and changes it back into overdrive.

Our picture shows quite simply how the No. 2 relay is added and connected to the No. 1 relay already in the circuit.



THE No. 2 RELAY AND THE THROTTLE SWITCH

This picture shows the throttle switch added to the No. 2, and relay placed in the circuit.

Now try to follow this circuit through: the conditions are that the car is run in overdrive at less than 30 miles per hour with the gear selector and the control switches closed, and the centrifugal switch open.

For this condition current is fed from the C2 main contact of the No. 1 relay direct to the W2 terminal of the No. 2 relay, as shown at the bottom right, through the windings of the throttle switch to earth.

In this condition the No. 2 relay is energised, the contacts C1 and C2 will be closed, thus keeping the No. 1 relay energised, and the hold-on current for the main operating solenoid will be maintained irrespective of the centrifugal switch being open.

This condition will remain until such time as the throttle is opened and the throttle switch contacts also opened, thus breaking the current supply to the solenoid when the overdrive will change back to normal.

AUTOMATIC OPERATION

Here we have the complete circuit of the automatic control which you may wish to study before commencing on the next part.

Description of Overdrive Control Units

THE ELECTRICAL COMPONENTS

So far, we have built-up our overdrive control, using the following components:—

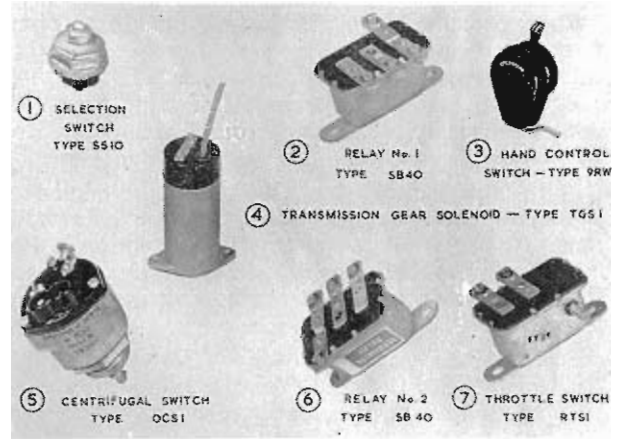
Commencing at the top left of the picture for the 'Manual Control' System there are four units.

1. The Gear Selector Switch, type SS10.
2. The Relay type SB40 Relay.
3. The 'Hand' or 'Overdrive' Control Switch type 9RW.
4. The 'Transmission Gear Solenoid' type TGS1.

For 'Automatic' Control there are three additional units :

5. The 'Centrifugal' Switch type OCS1.
6. An additional SB40 Relay.
7. The Rotary Throttle Switch type RTS1.

You will remember that the various switches exist only to make the No. 1 Relay actuate the transmission gear solenoid under differing conditions, and that this solenoid opens the hydraulic valve in order to change the gears from 'Normal' to



'Overdrive' and *vice versa*.

We can now examine these components individually.

GEAR SELECTOR SWITCH TYPE SS10

As previously mentioned this switch is usually the first component in the current supply line and may be installed in the side of the gear box.

Its function is to keep the overdrive gear out of engagement generally in first and reverse gears.

In construction it is a simple ON-OFF Plunger type switch. It is not a diaphragm switch and it is not oil proof.

At the same time oil passing through it will not generally affect its operation.

Service troubles with this switch are mostly due to incorrect setting of the external linkage, not providing sufficient plunger travel to properly close the contacts.

It can easily be tested on or off the vehicle by means of a Voltmeter or Lamp bulb across the contacts.

With Plunger 'out' switch should be open.

With Plunger 'down' the switch is closed.



TYPE SB40 RELAYS

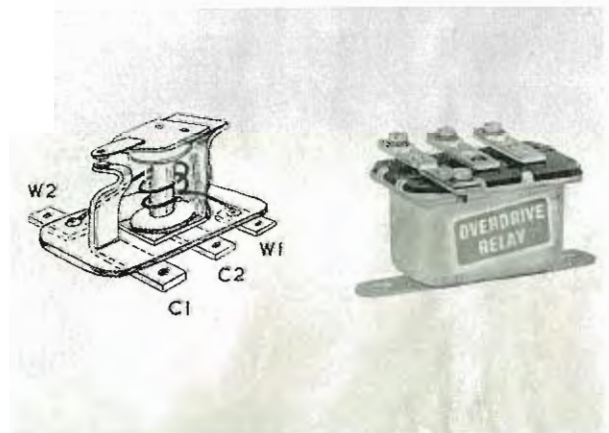
You may be aware that the general function of a relay switch is to enable a current, particularly a fairly heavy current, to be switched 'on or off' from a remote position, thus minimising the voltage loss, generally termed 'Volt Drop,' which may occur.

The SB40 relay shown is a typical example of this class of switch.

The main current supply is connected at the C1 and C2 terminals, and terminates at the contact points as shown.

When the armature is drawn down on to the bobbin core, the points close allowing a current to pass.

Terminals W2 and W1 are connected to the ends
continued



TYPE SB40 RELAYS — *continued*

of the relay coil winding as shown. A quite small current passing through this winding creates a strong magnetic field in the core and pulls down the armature, and so closes the main contacts which will remain closed for as long as the relay coil is energised.

This model of the SB40 has been built specially for the overdrive and the label 'Overdrive Relay' distinguishes it from the model SB40 generally used as a horn relay, which is not suitable for the overdrive, the main difference being that one is designed for continuous working and the other for intermittent service only. Both the SB40 Relays used on the overdrive are identical and interchangeable.

Normally these relays are practically foolproof other than when the points become overheated and damaged, as may result from an external short circuit.

They can be proved by two very simple continuity tests.

1. For the Relay Windings.
2. To check continuity under load across the main contacts.

THE OVERDRIVE CONTROL SWITCH

This is a plain ON-OFF Switch, lever actuated, and may be of various patterns according to the mounting position, which is generally on the steering column or facia panel.



THE TRANSMISSION GEAR SOLENOID

The transmission Gear Solenoid when energised is the unit which brings about the change into and out of overdrive.

As shown in the picture the solenoid itself has two windings. A heavy, or closing winding shown on the right (1), connected to EARTH through a pair of contacts (2).

The hold-on winding is connected directly to earth (3), as shown on the left. Both of these windings are in circuit when the current is applied.

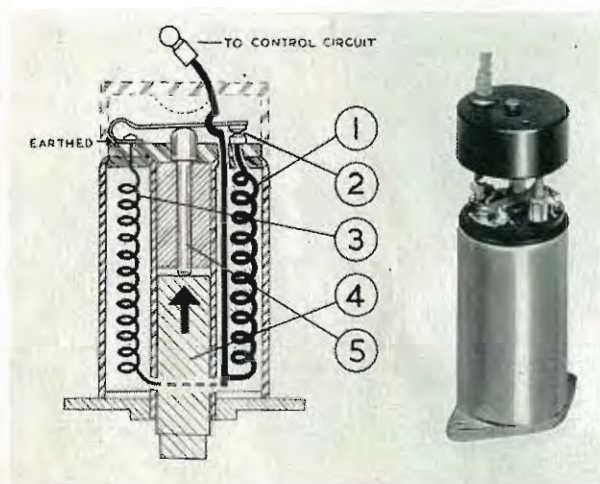
When the solenoid plunger (4) is pulled into the coil the end of the plunger lifts the striker pin (5), and opens the main winding contacts (2). These contacts remain open whilst the plunger is in the raised position thus keeping the main winding open circuited.

The heavy or closing winding requires 18 to 19 amperes and is only in circuit momentarily.

The hold-on-winding requires about 1 to 1½ amperes and is sufficiently powerful to hold-up the Solenoid Plunger indefinitely.

Point clearance and air gaps are pre-set and cannot be altered in service.

It will be realised at once that the ingress of metal, dust, dirt, water or oil into the solenoid assembly can seriously interfere with its operation and in the event of failure of this unit, wholly or in part, this is the first thing to look for.

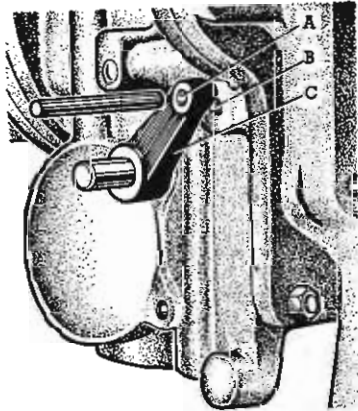
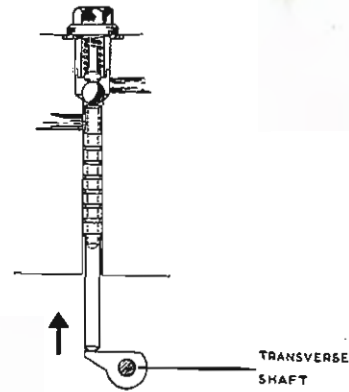


TRANSMISSION GEAR SOLENOID ATTACHMENT — THE HYDRAULIC ACTUATING VALVE

We next come to the attachment and set-up of the transmission gear solenoid to the gear box itself.

To ensure satisfactory operation, it is necessary that the set-up of the solenoid to the gearbox is correct, and in the event of trouble or during a re-setting operation this is the first thing to check.

The Hydraulic Valve shown here is actuated by a cam fixed to a transverse shaft running through the gearbox. The Solenoid plunger operates through a lever attached to the other end of this shaft. When the solenoid is operated this valve must be fully opened.



THE VALVE SETTING LEVER

With the solenoid energised, the setting of this valve can be easily checked at the offside of the gearbox shown in the picture.

The end of the valve actuating shaft carries a short lever (C) with a $\frac{3}{16}$ " hole at the outer end, which should register with a similar hole in the casting as shown at A and B. If it does so the valve setting is correct.

For the purpose of setting the solenoid plunger — which we shall deal with later — a $\frac{3}{16}$ " pin such as a drill shank — will be inserted to hold the valve in its correct open position whilst setting the solenoid lever at the other side of the gearbox.

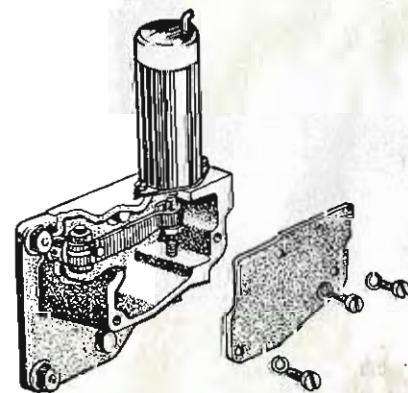
THE REPLACEMENT OF THE TRANSMISSION GEAR SOLENOID

If for any reason the solenoid has to be changed, the original Plunger may be left in position provided that it is clean and free from rust.

In this circumstance it will be necessary to check the setting for correct valve operation after fitting the new solenoid.

To do this the following operations are necessary :

1. Energise the solenoid.
2. Check the position of the valve setting lever — offside of box — by inserting the $\frac{3}{16}$ " pin and if the holes will not line-up the solenoid assembly must be re-set.



THE SETTING OF THE TRANSMISSION GEAR SOLENOID

A complete re-set of the Solenoid assembly is carried out in the following manner :

Commencing with the $\frac{3}{16}$ " pin in position on the valve setting lever to hold the valve open proceed to :

Remove the cover plate (1).

Loosen the lever clamping bolt (2).

Energise the solenoid (3) (Check that the plunger travels the full movement).

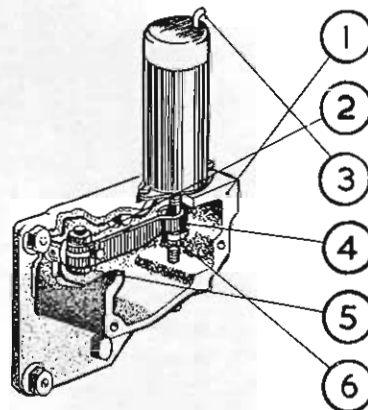
Hold the lever lightly against the plunger bolt head (4).

Re-tighten the lever clamping bolt (5) taking care to see that there is no end play in the cross shaft.

Check the REST stop clearance to $\frac{1}{4}$ " (6).

Remove the locating pin from the offside of the gearbox.

Operate the solenoid several times to check for correct working.



Note.—A simple way to energise the solenoid is to break the snap connector at the Solenoid terminal and connect with a short lead direct to battery negative.

THE CENTRIFUGAL SWITCH

Driven from the speedometer take-off spindle, this switch comprises two components :

An orthodox type of flyweight governor (1) actuating a plunger shown at 4.

A micro switch movement (2) opening and closing a single pair of contact points, shown at (3).

Increasing speed throws the weights outwards and lifts the plunger, which in turn closes the micro switch contacts. Thus switching ON the current to the Over-drive solenoid through the No. 1 Relay.

The points close at round about 800 governor r.p.m. This speed is pre-set and varies according to the model of vehicle.

With falling speed, the points re-open at 80 per cent of the closing speed.

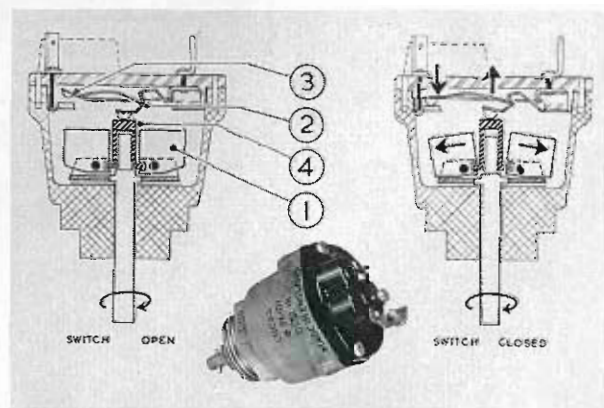
In practice this means that the vehicle generally changes to overdrive around the 40 miles per hour mark and returns to normal gear round about 30-35 miles per hour.

A figure giving the closing revolutions of the switch is stamped on one of the flats of the hexagon body.

If trouble is experienced in service, several points can be looked to :

Damaged or loose terminals which may result from contact with any external obstruction and may cause erratic operation.

Terminals becoming intermittently earthed, due to the tunnel casing.



After removal of the switch, check that it is being driven and for possible end float at the spindle. This should be without .002" and may cause erratic operation if excessive.

A further cause of erratic running may also result from excessive vibration at the gear box itself which the fitting of a replacement switch will not generally overcome.

These switches are all pre-set at the works and must not be altered *in situ*. Also the moulded top assembly should not be interchanged or the settings will be completely upset.

THE ROTARY THROTTLE SWITCH

You will remember that the function of this switch which is linked to the accelerator pedal, is to maintain current to the overdrive solenoid by means of the No. 2 relay. This applies when the vehicle is running in top gear below 30 miles per hour with the throttle CLOSED and the centrifugal switch OPEN.

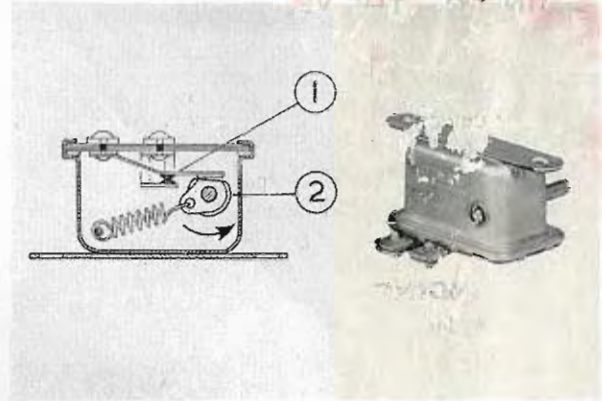
You will see in the picture that the switch comprises :

1. A pair of contacts on a spring blade.
2. A circular cam with a flat section, which is rotated by means of a lever linked to the accelerator pedal. A spring is incorporated to return the cam to its original position when the accelerator pedal is released.

With the throttle closed, the points will also be closed ; when the cam is rotated the points will open and remain so until the throttle is again closed.

It is a simple matter to check this switch :

1. See that the points are opening and closing.
This can be done by means of a voltmeter, or a Test Lamp connected in series with the two terminals.



2. See that the rotating cam is correctly timed to the accelerator pedal.

The correct setting of the cam is as follows :

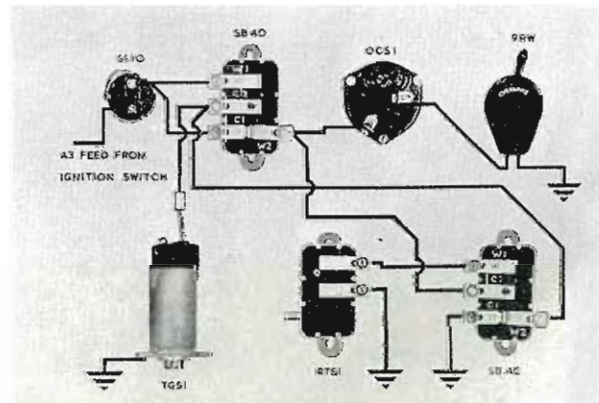
Referring to the extreme right of the picture, the screw-driver slot in the end of the shaft should be horizontal with the switch in the rest position,

The total movement of the cam is 90° and the contacts should remain closed for the first 15° to 35° of rotation.

THE COMPLETE AUTOMATIC CONTROL

Finally here is the pictorial diagram of the complete Automatic Control from which it may be seen how simple the whole arrangement is.

You may perhaps like to study this and make a copy of it for future reference.



TESTING ON THE VEHICLE

Checking and testing of this equipment *in situ* on the vehicle may be simply and easily carried out if the following instructions are carefully followed when any defective unit or wiring will show-up.

A quick overall test can be carried out almost in a single operation without any special tools.

A full diagnosis test can be done with a simple test voltmeter and ammeter.

FAULT FINDING GUIDE

We shall deal primarily with faults which may develop on the vehicle in service. The chart shown here lays out the kind of symptoms which may be met and, as you will see, those concerning the electrical equipment are a minority.

From the chart it will be seen that there are five main items :

No. 1. OVERDRIVE DOES NOT ENGAGE.

Electrically this may be due to the solenoid operating lever adjustment or any other electrical defect.

No. 2. OVERDRIVE DOES NOT RELEASE.

Electrically this may also be due to incorrect solenoid plunger and operating lever adjustment, or some other electrical defect.

No. 3. CLUTCH SLIP IN OVERDRIVE.

Again this may be due to incorrect adjustment of the solenoid operating lever.

No. 4. As auto-electricians we are not concerned.**No. 5. OVERDRIVE ENGAGES.**

With excessive braking effect when returning to normal gear with the throttle CLOSED.

This trouble will be primarily due to incorrect setting of the throttle switch lever, or it might be a faulty relay for example.

The test routine that we shall specify will cover in a few simple operations anything that can happen to the electrical equipment under all of the headings shown, which is all that the electrician is concerned with.

NO. 1 — OVERDRIVE DOES NOT ENGAGE.

Insufficient oil in unit.

CHECK SOLENOID OPERATING LEVER ADJUSTMENT.**CHECK ELECTRICAL SYSTEM.**

Check operating valve.

No oil pressure.

NO. 2 — OVERDRIVE DOES NOT RELEASE.

Check operating valve.

CHECK ELECTRICAL SYSTEM.**CHECK SOLENOID PLUNGER AND OPERATING LEVER ADJUSTMENT.**

Check for sticking cone clutch.

NO. 3 — CLUTCH SLIPS IN OVERDRIVE.

Check oil in unit.

CHECK SOLENOID OPERATING LEVER ADJUSTMENT.

Check for low hydraulic pressure.

NO. 4 — CLUTCH SLIP IN REVERSE OR FREE WHEEL CONDITION IN OVERDRIVE.

Check restriction valve jet causing sluggish operation of cone clutch.

NO. 5 — OVERDRIVE ENGAGES AND EXCESSIVE BRAKING EFFECT WHEN RETURNING TO NORMAL WITH THROTTLE CLOSED.**CHECK FOR CORRECT SETTING OF ROTARY THROTTLE SWITCH LEVER.****CHECK ELECTRICAL SYSTEM.**

CHECKING THE MANUALLY OPERATED ELECTRICAL CONTROL

Let us first deal with the hand operated electrical control — the simpler of the two. Irrespective of any specific complaint which may be made, a quick and simple overall test of workability can be carried out in three operations, after removing the floor casing to gain access :

Switch ON the ignition (1).

Close the hand control switch (2) and engage top gear, thus closing the gearbox switch contacts (3).

If the system is working the solenoid will immediately operate and open the hydraulic valve.

Check this visually by observing the movement of the valve setting lever on the offside of the gearbox, when the two $\frac{3}{16}$ " pin holes should register.

This proves immediately that :

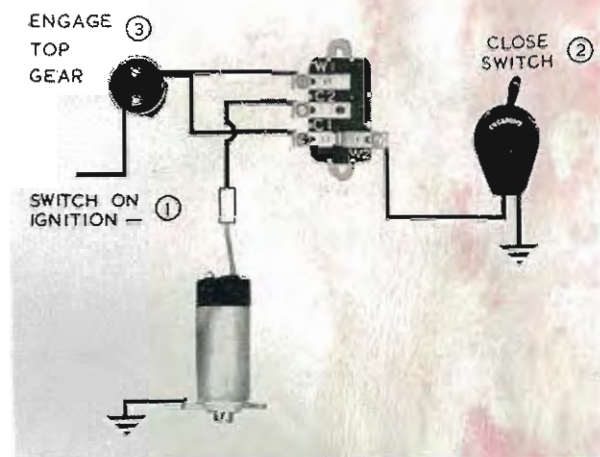
The current supply is on.

The gearbox switch is closing properly.

The hand control switch is closing properly.

The relay main contacts and operating windings are both working.

That the main solenoid is also operating.



Lastly, from an observation of the valve setting lever we shall know that the Hydraulic Valve is being fully opened.

CHECKING THE AUTOMATIC CONTROL SYSTEM

We can next apply a similar check to the automatic system in four operations.

With the vehicle stationary and the engine stopped, Proceed to :—

Switch on the ignition.

Close hand control switch and engage top gear.

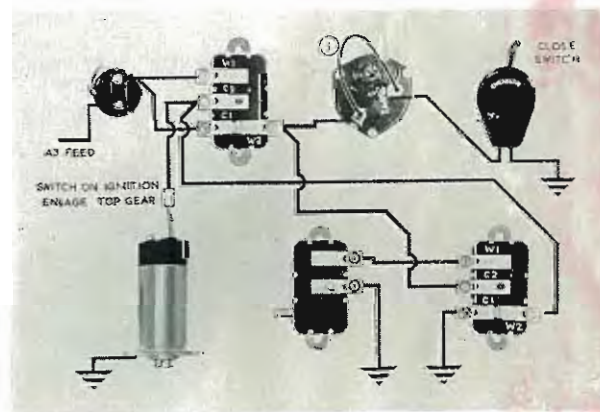
Link the terminals of the centrifugal switch as shown at (1). Then:—

If the system is operative, the main solenoid will be raised and will remain in this position.

Check the correct 'Open' position of the valve setting lever on the offside of the gearbox.

This simple operation of linking the terminals of the centrifugal switch proves :

1. The current supply is ON.
2. The gearbox switch is closing properly.
3. The hand control switch is closing.
4. That the main solenoid is operating.
5. That the hydraulic valve is opening fully.



If, when the link is removed, the solenoid plunger is still held, we also prove :

6. The main contacts and relay winding of *both* relays are operative.
7. That the throttle switch is closed.

TEST PROCEDURE

If the equipment fails to operate when the foregoing checks have been carried out, it will be necessary to make a methodical fault diagnosis.

This can most easily be done in three stages :

Stage 1. The circuit comprising — the SS10 switch, the hand control switch, the No. 1 relay and the main solenoid.

STAGE 1 TEST

To Test the SS10, the Hand Control Switch, the No. 1 Relay and the Main Solenoid.

(A)

This test is carried out in six operations as follows :
With the engine stopped and the car stationary.
Switch on the ignition.

Select top gear, thus closing the SS10 gearbox switch.

Bridge the terminals of the centrifugal switch (if automatic control).

Close the hand control switch. If the current is O.K. the main solenoid will come into operation and remain in the raised position.

Check the position of the valve setting lever (off-side Gearbox).

(B)

If the Solenoid fails to operate, proceed to :

Break the snap connector at the Solenoid and energise it repeatedly by means of a jump lead direct from the battery negative.

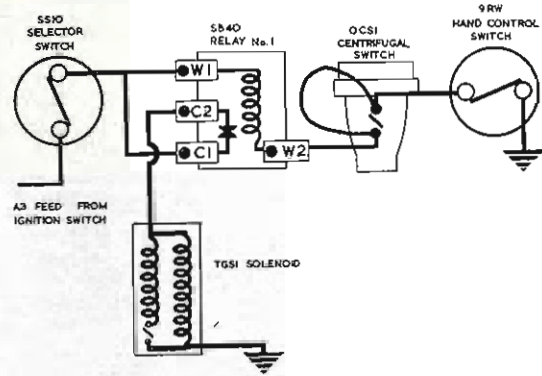
If the solenoid proves to be in order :

Open the hand control switch and check through for full voltage readings with the negative voltmeter at the following points :

Stage 2. The circuit including the No. 2 relay and the throttle switch.

Stage 3. A test for the centrifugal switch and the main solenoid.

This is equally applicable to the manual circuit and represents the complete test for it.



Across both terminals of the SS10.

Between — W1, W2 and C1 terminals of the No. 1 relay respectively and earth.

Between live side of the hand control switch and earth.

Close hand control switch when the voltage reading should fall to zero if the switch and earth line are O.K.

The No. 1 Relay should then close and a voltage reading should be obtained at Contact C2 (No. 1 relay) and also at the end of the solenoid feed wire. If no voltage is obtained at C2, the relay is defective.

STAGE 2 TEST

The part circuit, comprising the No. 2 relay and the throttle switch.

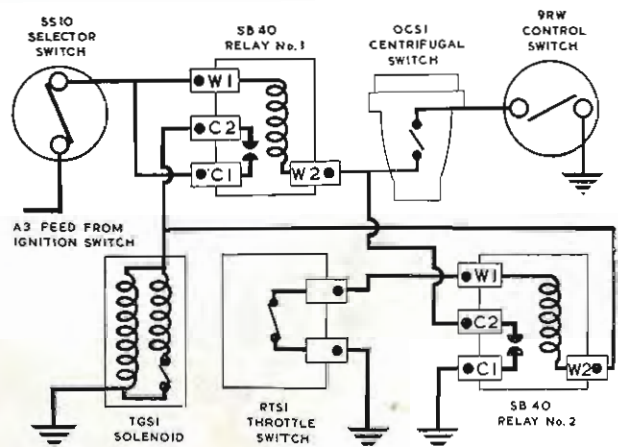
Still with the ignition switch on and top gear engaged, remove the bridged lead from the centrifugal switch.

Link terminals C1 and C2, of the No. 2 relay when the solenoid should come into operation and remain in the raised position.

If no operation when the C1 and 2 terminals are linked, check relay No. 2 for a good earth connection to C1 terminal, or for a broken wire between the W2 terminal of No. 1 relay and C2 terminal of No. 2 relay — put in order.

On the removal of the link between C1 and C2 terminals after the solenoid has closed, the solenoid should remain raised and return to

continued



STAGE 2 TEST *— continued*

normal rest position when the accelerator pedal is depressed.

If, when removing the link, the solenoid returns immediately to the rest position and does not hold, check the throttle switch setting also link the C1 and C2 terminals again then with a voltmeter check for a voltage at the W2 terminal

of the No. 2 relay. If in order transfer the voltmeter lead to W1 terminal and with the throttle SW open voltage will be registered if the relay winding is O.K. and voltage reading will disappear when the throttle SW is closed proving the switch circuit is complete to earth. If not put in order.

STAGE 3 TEST — CONTROL SWITCH AND SOLENOID

To check the operation of the Centrifugal Switch and the solenoid.

Jack-up the back wheels.

Open the push-in connector adjacent to the solenoid and insert the test ammeter in this line.

Start up the car and engage top gear.

Increase engine speed and the centrifugal switch should close at slightly above 40 m.p.h. The main solenoid should then close with a surge of current and the ammeter should remain at 1-1½ amps. showing that the 'hold-on' coil is operative and the main winding cutting out. If a heavy current about 20 amps registers continually, it will probably be necessary to check the solenoid which will have become overheated. Immediately check the valve setting lever as shown on page 14.