Chapter 4 Ignition system

Contents

Specifications

Contact breaker

Make	Marelli
Type	S311A
Gap:	
850T	0.42-0.48 mm (0.016-0.018 in)
All others	0.37-0.43 mm (0.014-0.017 in)

Ignition timing: BTDC

750S and S3	13° ± 1° retarded, 39° ± 3° advanced
850T and Le Mans	8° retarded, 34° advanced
850T-3	2° retarded, 33° advanced
V-1000 I-Convert	0°-2° retarded, 31°-33° advanced

Capacitor

Type	CE 36 N
Capacity	0.25 mfd

Ignition coil

Make	Marelli
Type	BM 200C
Resistance at 20°C:	
Primary winding	3.35 ohms ± 6%
Secondary winding	6.200 ohms ± 10%

Spark plugs

Gap: Standard 0.6 mm (0.023 in), high speed 0.5 mm (0.019 in)

Type:

	*Standard - normal touring *Marelli*	*Standard - high speed *Marelli*	*Alternative Motorcraft*
750S and S3	CW240L	CW275L	AG1
850T	CW240L	CW275L	AG23
850T-3	CW7L	–	AG2
V-1000 I-Convert	CW7L or CWLP	–	–
850 Le Mans	Champion N9Y	–	–

**original equipment*

1 General description

The ignition system fitted to the Moto Guzzi V-twin models consists of two duplicated circuits, each of which serves one or other of the two cylinders.

The two contact breaker units are contained within a housing between the cylinders, and are operated by a single cam driven from a gear pinion on the valve camshaft. Low tension current passing through the ignition coils is interrupted when the contact breakers separate and by mutual induction create a high tension current in the ignition coil secondary windings, which is delivered to the spark plugs.

The ignition coils are mounted below the petrol tank under the frame top tube.

An automatic ignition timing unit (ATU) is fitted below the contact breaker operating cam, which alters the point of contact breaker separation, and hence the moment the spark occurs, to suit the engine speed.

A condenser is fitted to each ignition circuit, connected in parallel with the contact breaker to minimise arcing across the points faces and so maintain the high tension current.

The starter motor is a series-wound pre-engaged unit, which operates on direct current from the battery. A solenoid mounted on the top of the starter motor engages the starter pinion with the flywheel mounted ring gear. On all but Le Mans models, a switch incorporated in the clutch cable prevents operation of the starter motor unless the clutch is disengaged. V-1000 models are fitted with a switch which prevents operation of the ignition system with the side-stand in the extended position.

2 Contact breakers: adjustment

1 In order to inspect and adjust the contact breakers, the housing cap, retained by two screws must be removed. To aid access for easy removal and subsequent attention the rear of the petrol tank should be raised a few inches after detaching the retaining strap and the petrol pipes. Support the tank on a bunch of rags or a wooden block.

2 Rotate the engine until one set of points is open and examine the contact faces. Slight irregularities in the faces may be removed using a fine Swiss file or a strip of emery paper backed by a piece of tin. If they are dirty, pitted or burnt, it will be necessary to remove them for further attention, as described in Section 3 of this Chapter. Repeat the process for the second set of points.

3 The correct contact breaker gap, when the points are in the full open position, is within the range 0.42-0.48 mm (0.016-0.018 in) for 850T models and 0.37-0.43 mm (0.014-0.017 in) for all other models. Adjustment is effected by slackening the two screws passing through the contact breaker fixed point plate and using a screwdriver inserted in the notch provided, moving the fixed contact nearer to or further away from the moving contact. Ensure that the points are in the fully open position when this adjustment is made or a false setting will result. Tighten the two screws and recheck the gap; the feeler gauge should be a light sliding fit between the faces.

4 Repeat the process on the other set of contact points. Before refitting the housing cap, clean the points faces using a clean rag dipped in methylated spirits. This will ensure that the points are perfectly clean and prevent the faces picking-up prematurely. Apply a few drops of thin oil to the cam lubricator wick. Do not over lubricate or the excess oil may find its way to the points, causing ignition failure.

3 Contact breakers: removal, renovation and replacement

1 If the contact breaker points are burned, pitted or badly worn, they should be removed for dressing. If it is necessary to remove a substantial amount of material before the faces can be restored, new contacts should be fitted.

2 To remove a contact breaker set, loosen the screw retaining the leads from the condenser and low tension circuit and pull the forked terminals from place. Remove the two screws passing through the fixed point baseplate and lift the complete contact breaker unit from position.

3 To separate the moving contact from the fixed contact plate remove the terminal screw completely and slide off the plastic insulator and cage to release the return spring end. Prise off the E clip from the top of the pivot post and remove the moving point from the pivot.

4 The points should be dressed with an oilstone or fine emery cloth. Keep them absolutely square during the dressing operation, otherwise they will make angular contact when they are replaced and will burn away rapidly as a result.

5 Replace the contacts by reversing the dismantling procedure, taking care to position the insulating washers in the correct sequence. Lightly grease the pivot post before replacing the moving contact and check that there is no oil or grease on the surface of the points. Place a few drops of oil on the lubricating wick that bears on the contact breaker cam, so that the surface is kept lubricated.

6 Readjust the contact breaker gap to the recommended setting, after verifying that the points are in their fully open position.

7 Repeat the whole procedure for the other set of contact breaker points.

4 Condensers: location, removal and replacement

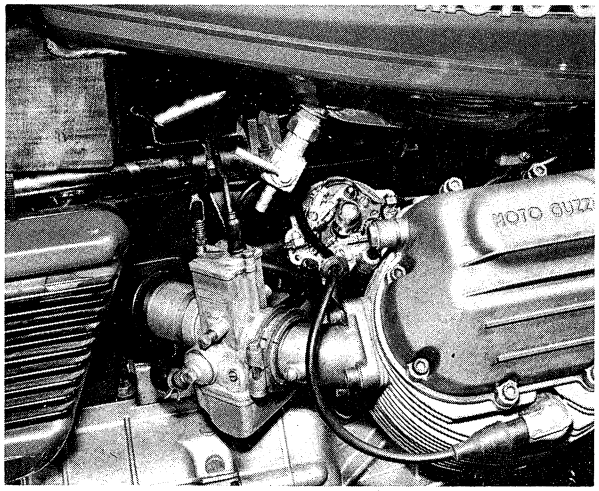
1 Condensers are included in the contact breaker circuit to prevent arcing across the contact breaker points as they separate. A condenser is connected in parallel with each set of contact points, and if a fault develops in either, or both condensers, ignition failure is liable to occur.

2 If the engine is difficult to start, or if misfiring occurs, it is possible that a condenser is at fault. To check whether a condenser has failed, observe the points whilst the engine is running. If excessive sparking occurs across one set of points and they have a blackened or burnt appearance, it may be assumed the condenser in that circuit is no longer serviceable.

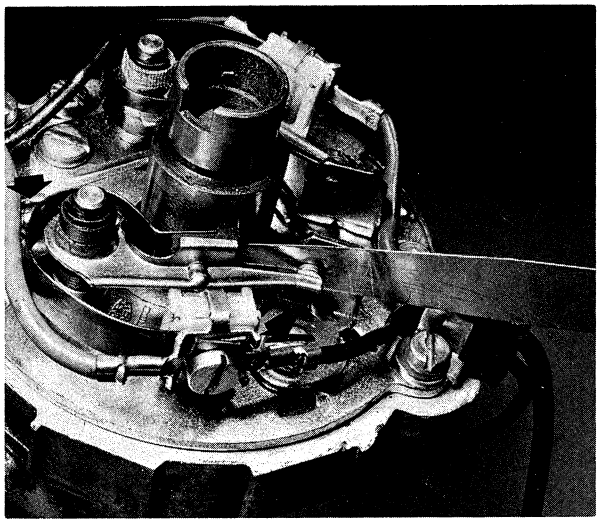
3 The condensers are mounted on the outside of the contact breaker housing. Each is retained by a single screw through the strap soldered to the body of the condenser and by the lead wire attached by the screw passing through the end of the moving contact return spring.

Loosen the screw slightly so that the forked terminal on the condenser wire can be detached.

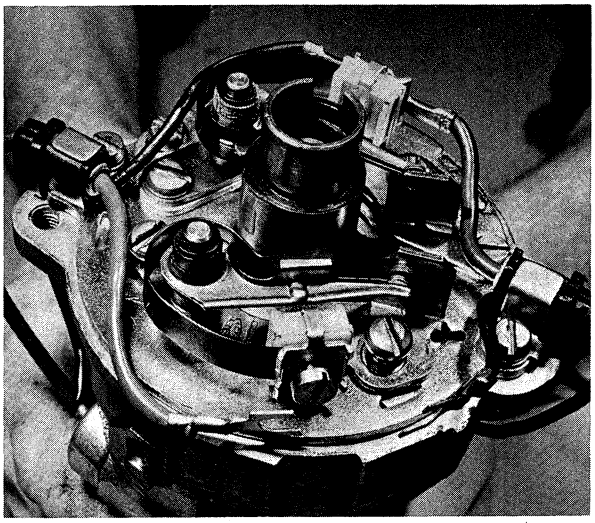
4 Because it is impracticable to repair a defective condenser, a new one must be fitted. Note that it is extremely unlikely that both condensers will fail in unison; if total ignition failure occurs the source of the trouble should be sought elsewhere.



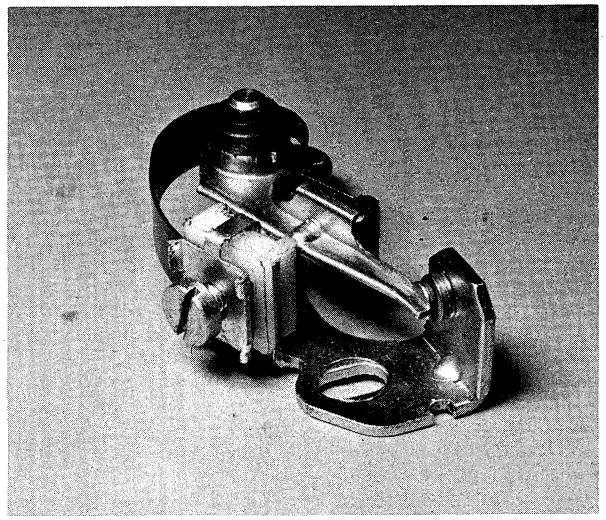
2.1 Raise the petrol tank for contact-breaker access



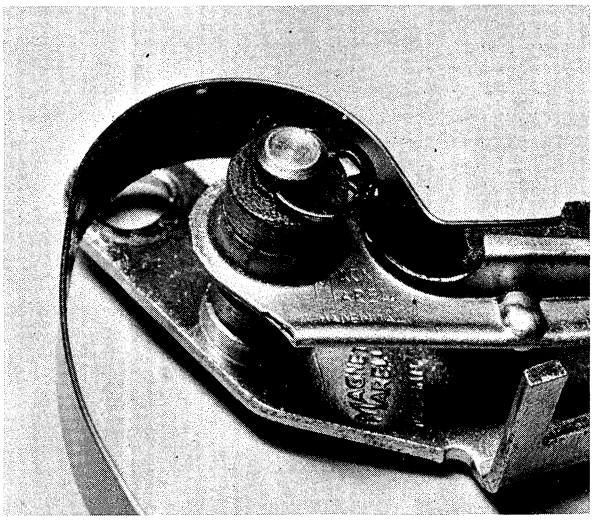
2.3 Point gap adjustment screws



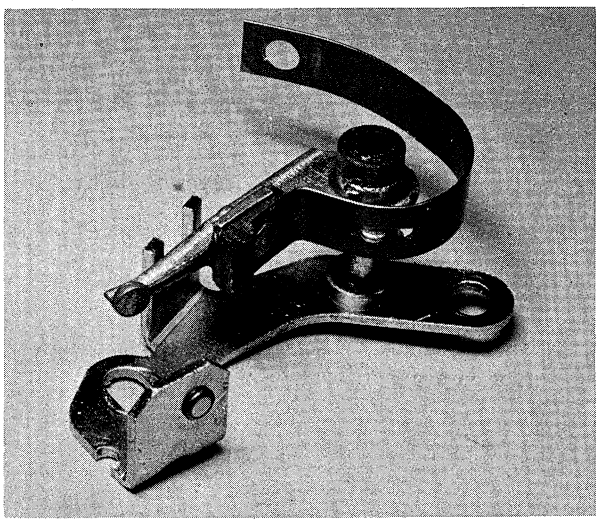
3.2a Remove both screws and detach wires ...



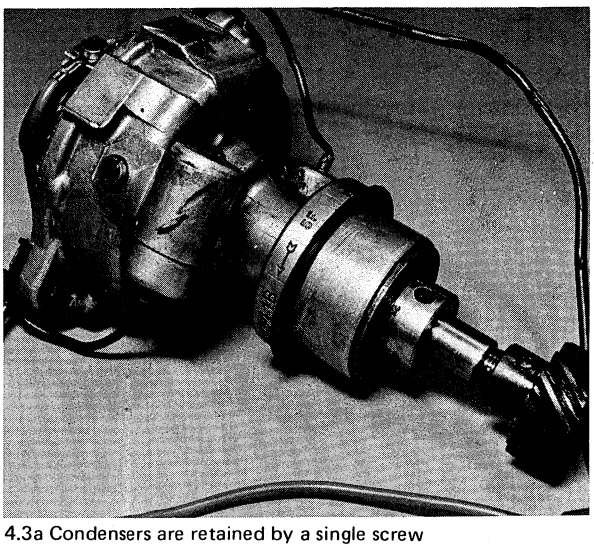
3.2b ... to free complete contact-breaker unit



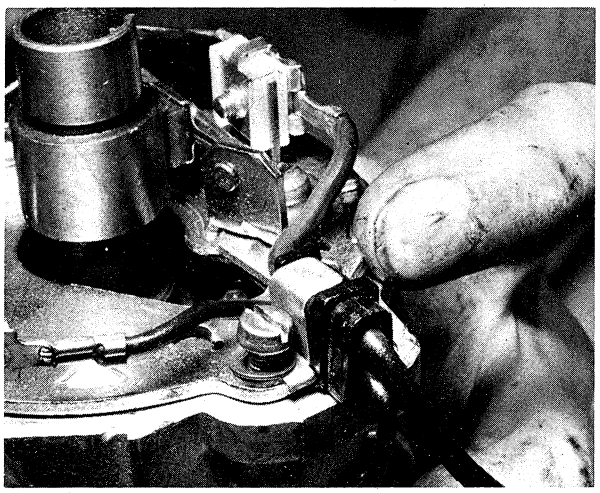
3.3a Prise off the 'E' clip to remove ...



3.3b ... the moving contact



4.3a Condensers are retained by a single screw



4.3b Remove clip to free condenser wires

5 Condensers: testing

1 Without the appropriate test equipment, there is no alternative means of verifying whether a condenser is still serviceable.
2 Bearing in mind the low cost of a condenser, it is far more satisfactory to check whether it is malfunctioning by direct replacement.

6 Ignition coils: checking

1 Each cylinder has its own ignition circuit and if one cylinder misfires, one half of the complete ignition system can be eliminated immediately. The components most likely to fail in the circuit that is defective are the condenser and the ignition coil since contact breaker faults should be obvious on close examination. Replacement of the existing condenser will show whether the condenser is at fault, leaving by the process of elimination the ignition coil.
2 A suspect ignition coil can be tested completely only using specialist equipment. It is possible, however, to gain some indication of the coil's condition as follows: Remove the contact breaker housing cap and the spark plug cap from the circuit in question. Switch the ignition on and turn the engine over until the points are fully closed. Hold the uninsulated HT cable end about 3.0 mm (1/8 in) away from a suitable part of the cylinder head. Using a screwdriver with an insulated handle 'flash' the contact breaker points open. If the spark produced at the HT lead end is able to jump a gap of 3.0-6.0 mm (1/8 - 1/4 in) it is probable that the coil is in good condition.
3 The ignition coils are sealed units and it is not possible to effect a satisfactory repair in the event of failure. A new coil must be fitted.
4 The two coils are fitted underneath the petrol tank, below the frame top tube, and are supported by straps and bolts. After removal of the tank disconnect the HT leads by unscrewing the connector ferrules and pull the low tension wires from the terminals. Note the position of the wires for easy reassembly. The coils will come away after removing the strap bolts.

7 Ignition timing: checking and resetting

1 The ignition timing should be checked at the period stated in the routine maintenance schedule or when the contact breakers have been adjusted or renewed. Do not retime the ignition unless the contact breaker points gaps have been checked first and if necessary readjusted.
2 Raise the rear of the petrol tank and remove the contact breaker cap as described in Section 2 of this Chapter. Detach the spark plug leads and remove the spark plugs. Remove the alternator cover, to gain access to the alternator centre bolt which can be used after fitting a socket key to rotate the engine. Prise the rubber inspection plug from the right-hand side of the gearbox housing so that the timing index marks may be viewed through the aperture.
3 The ignition timing for the right-hand cylinder should be checked first. To establish the moment at which the contact breaker points open, connect one lead from a lamp to the red lead of the contact breaker points and the other lead to a suitable earth point on the engine. A multi-meter or buzzer unit may be used in place of the bulb arrangement. Rotate the engine clockwise until the right-hand cylinder is on the compression stroke. This can be felt by placing a thumb over the spark plug hole. Rotate the engine further until the D mark on the flywheel can be seen through the gearbox bell housing inspection aperture. Continue turning until the next index line appears and is in *exact* alignment with the index mark at the edge of the aperture. The flywheel index line is marked 2 on all but Le Mans and most V-1000 models. On the latter models the line is either unmarked or marked AF. The indicator lamp should illuminate at the moment the two lines coincide exactly.
4 If the indicator light illuminates *before* the mark aligns, the ignition is too far advanced, and if the light comes on *after* the two marks align, the ignition is too far retarded. Rotate the engine back again and then clockwise once more until the marks align. Always rotate the engine in a clockwise direction when bringing the marks into line, to take up any backlash in the drive gear.

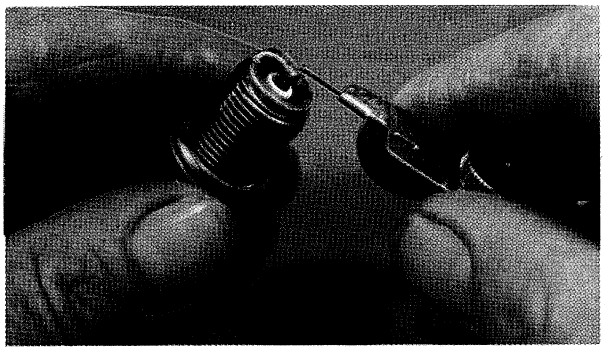
To adjust the timing on the right-hand cylinder, loosen the two bolts which retain the contact breaker housing clamp and rotate the housing until the contact breaker points open at exactly the right moment. After adjustment, tighten the screws and recheck by repeating the timing check procedure.

The two bolts holding the housing in place are partially obscured by the housing and the right-hand cylinder. To aid access, a special tool no 14-92-70-00 can be obtained. If this is not available, an existing spanner could be modified especially for this purpose.
5 The left-hand cylinder ignition timing can be checked using the same procedure after connecting an indicator lamp or buzzer to the left-hand contact breaker (green wire). Rotate the engine until the S mark appears and then until the line marked 3 (unmarked or marked AF on Le Mans and V-1000 models) is in exact alignment with the aperture mark. If the timing is incorrect, loosen the two screws which secure the contact breaker assembly baseplate and rotate it until the timing is correct. Tighten the screws and recheck.
6 Having checked and reset the ignition timing with the engine at rest (static timing) the ignition timing should then be checked by using a stroboscope, with the engine running. This will enable the correct functioning of the automatic advance unit to be checked.

Connect the strobe lamp up to the right-hand cylinder by following the manufacturer's instructions. Start the engine and allow it to run at tick-over. Aim the stroboscope at the flywheel through the viewing aperture. If the timing is correct, the marks should align as described in the static test. Raise the engine speed progressively to 6000-6200 rpm when the full advance mark should appear in the aperture. On all but Le Mans and most V-1000 models the advance mark is 4 on the right-hand cylinder and 5 on the left-hand cylinder. On Le Mans and most V-1000 models the scribed line representing the advance mark is marked either T or AT. If the ignition does not advance correctly, the automatic advance unit should be checked.

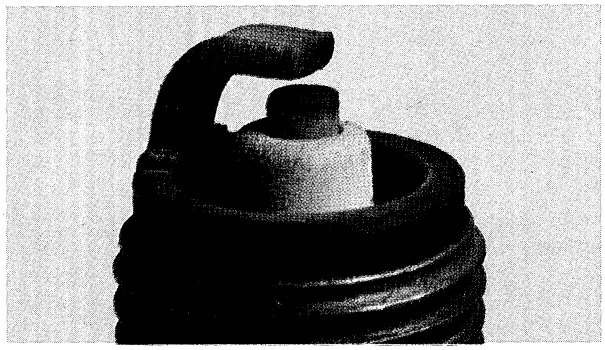
8 Automatic advance unit: dismantling and examination

1 If loss of power or engine roughness has been experienced, the automatic advance unit (ATU) should be examined. The



Spark plug maintenance: Checking plug gap with feeler gauges

Altering the plug gap. Note use of correct tool



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

White deposits have accumulated from excessive amounts of oil in the combustion chamber or through the use of low quality oil. Remove deposits or a hot spot may form

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

Wet, oily carbon deposits form an electrical leakage path along the insulator nose, resulting in a misfire. The cause may be a badly worn engine or a malfunctioning ignition system

A blistered white insulator or melted electrode indicates over-advanced ignition timing or a malfunctioning cooling system. If correction does not prove effective, try a colder grade plug

A worn spark plug not only wastes fuel but also overloads the whole ignition system because the increased gap requires higher voltage to initiate the spark. This condition can also affect air pollution

ATU may be inspected with the contact breaker housing in place on the engine, after removal of the contact breaker assemblies. Having detached the housing cap, mark the relative positions of the contact breaker assembly baseplate and the housing body with a centre punch, so that the plate may be refitted in exactly the same position for ease of retiming.

2 Detach the two condensers, each of which is secured by a single screw, and after removing the two baseplate screws lift off the complete assembly. Grasp the contact breaker operating cam and rotate it to left and right, checking that it moves smoothly and the bob weights open and shut against the pressure of the two return springs. The heavier of the two springs does not come into operation until the bob weights are approximately half open.

3 To dismantle the unit, prise the outer ends of the springs off the anchor pins on the bob weights. Lift the lubricator wick from position in the end of the cam and remove the centre screw. Before lifting the cam from place, note the position of the cam relative to the housing body. The cam must be refitted in the same position to maintain the ignition timing.

Tightness in the ATU mechanism can usually be overcome by lubrication. If the ends of the springs are damaged or the springs appear weakened, both springs should be renewed to restore the original advance-retard characteristics of the unit. If the cam appears worn or the bob weights and pivots are worn, the ATU complete with the contact breaker housing must be renewed as a unit. The component parts are not available as separate items.

4 Reassemble the unit, applying light engine oil to the working surfaces.

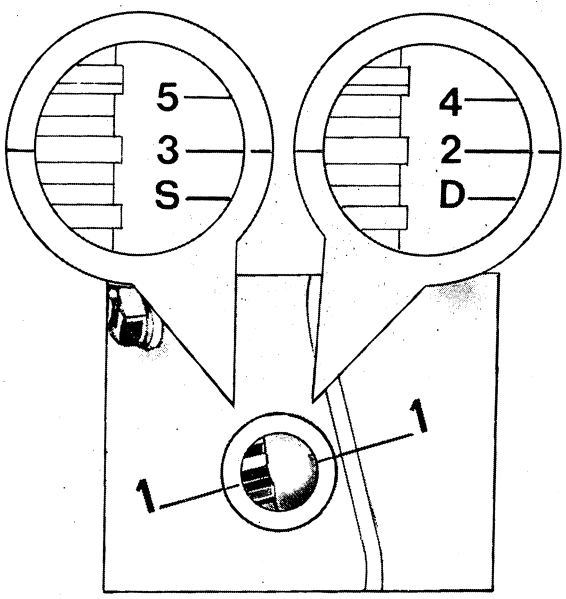
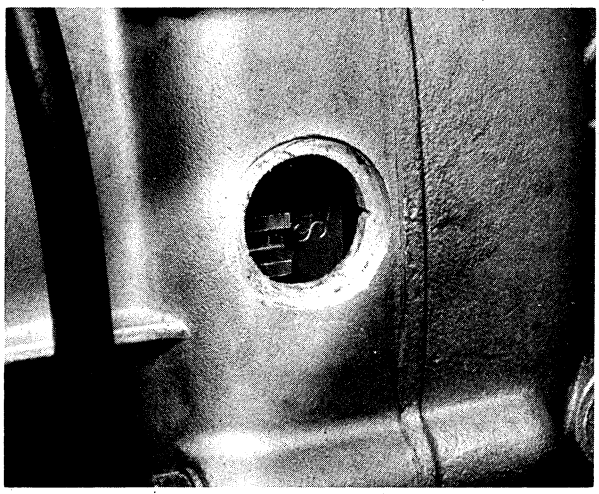
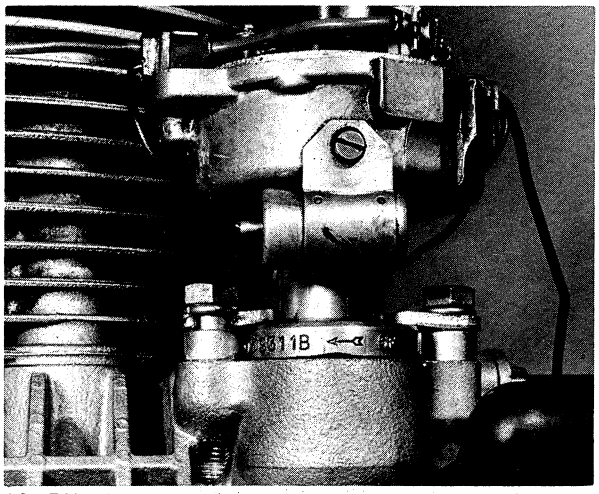


Fig. 4.1. Ignition timing marks

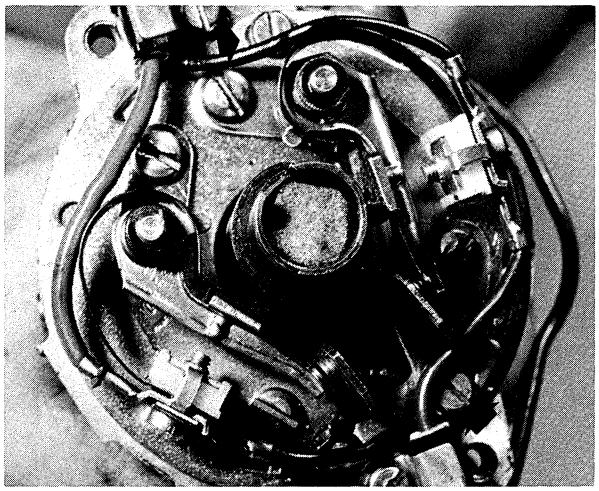
1 Datum marks on crankcase
D TDC on RH cylinder
2 Retarded timing mark RH cylinder
4 Advanced timing mark RH cylinder
S TDC on LH cylinder
3 Retarded timing mark LH cylinder
5 Advanced timing mark LH cylinder



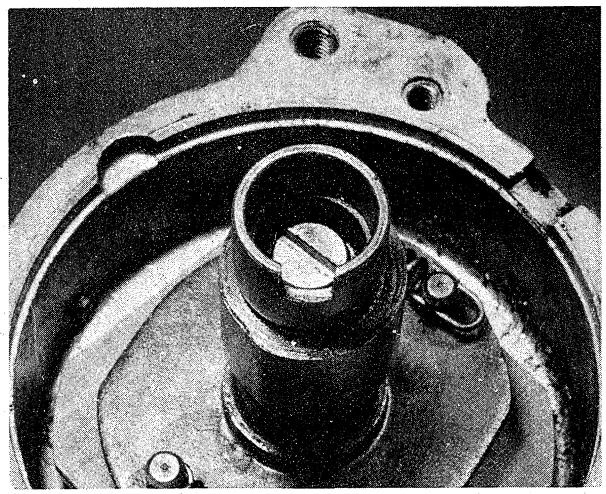
7.3a Timing mark inspection aperture; 'S' mark is TDC on LH cylinder



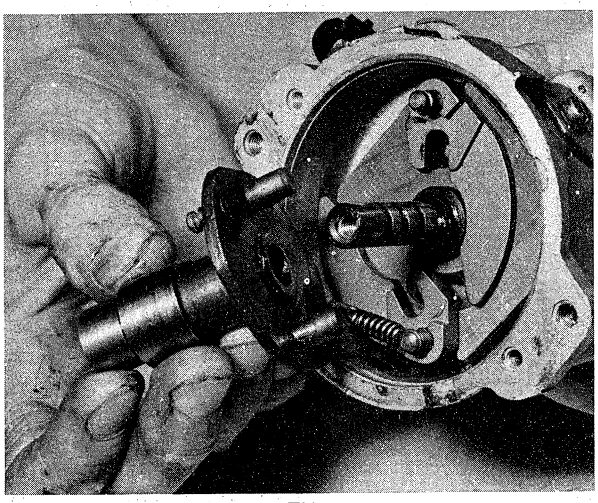
7.3b RH cylinder timing; clamp bolts



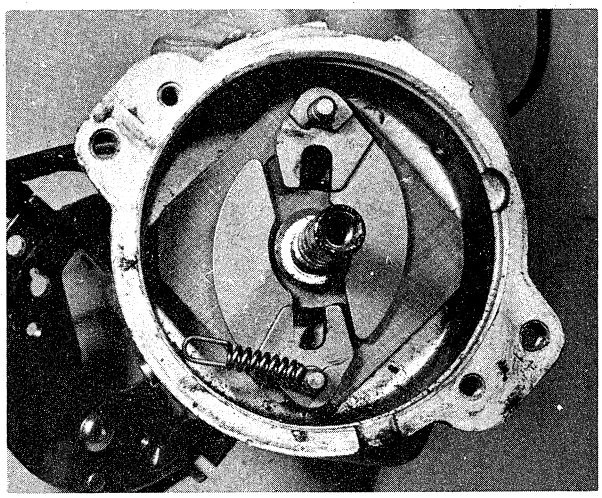
7.3c LH cylinder timing; base plate screws



8.3a Remove centre screw and ...



8.3b... lift cam unit from the ATU



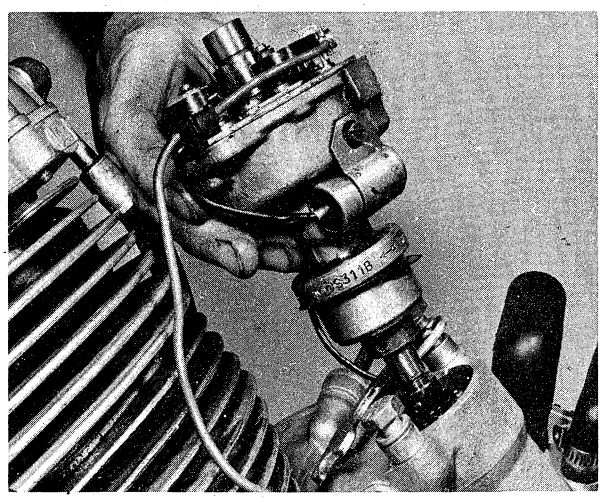
8.3c Check the condition of the bob-weights and springs

9 Contact breaker housing: removal and replacement

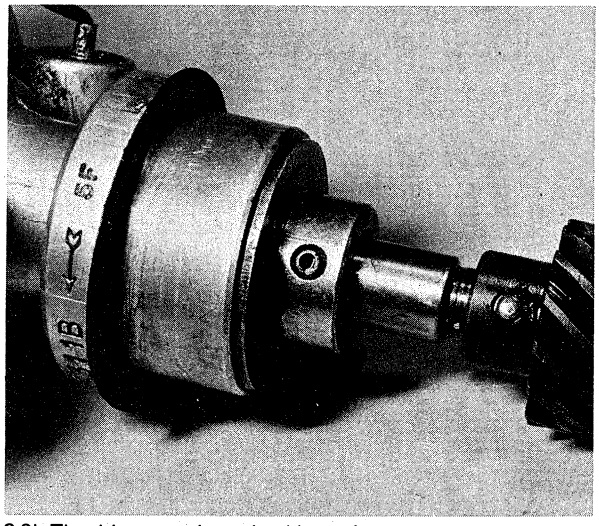
1 Removal of the contact breaker housing can take place only after the engine/gearbox unit is free from the frame or after the frame has been lifted up sufficiently so that the housing will clear the right-hand frame top tube as it is withdrawn.
2 Before removing the contact breaker housing, place the engine at TDC and mark the relative positions of the following components: crankcase, housing, contact breaker, baseplate and cam. If, on reassembly, the engine is again placed at TDC, and the punch marks are realigned, the contact breaker housing may be refitted with greater ease, without having to resort to retiming the camshaft and contact breaker cam driveshaft relationships.
3 To remove the housing, loosen both clamping bolts and then remove the forward bolt. Swing the clamp around to clear the housing boss and pull the housing from position. With the exception of the contact breaker components and the ATU springs, the only part of the contact breaker housing that may be renewed as a separate item is the driven gear pinion on the lower end of the shaft. The pinion is secured by a roll pin passing through the pinion boss and the shafts. The pin maybe drifted from place and a new pinion fitted. If wear of the pinion has developed, it is probable that the drive gear on the camshaft is also badly worn. If this is the case, the two components should be renewed as a pair.
4 Refit the contact breaker housing by reversing the dismantling procedure. If alignment marks were not made on dismantling, replace the housing as follows: Place the engine so that the right-hand cylinder is on the compression stroke and the static timing mark is aligned with the aperture mark on the gearbox bellhousing. Rotate the contact breaker camshaft in a clockwise direction (viewed from above) until the right-hand cylinder points are just opening. Hold the cam in this position and insert the housing into the crankcase so that the drive gears mesh. The housing must be replaced so that the right-hand cylinder contact breaker set (red wire) is on the left-hand side of the machine. Fit the clamp and partially tighten the two bolts. The ignition timing should be carried out as described in Section 7 of this Chapter.

10 Starter motor: removal

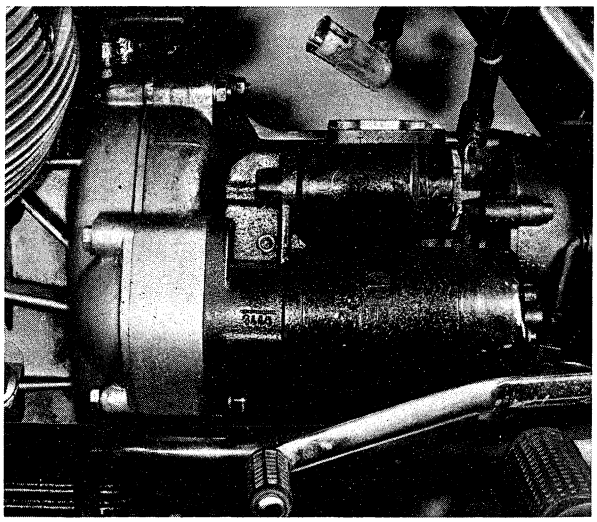
1 Note the positions of the leads running to the starter motor and then remove them. As when dismantling or detaching any electrical component the battery should be disconnected first.
2 The starter motor is retained on the engine casing by two bolts. Support the weight of the motor and remove the bolts. Lift the motor out towards the rear.



9.3a Mark the housing before removal to aid reassembly



9.3b The driven gear is retained by a pin



10.1 Pre-engagement type starter motor

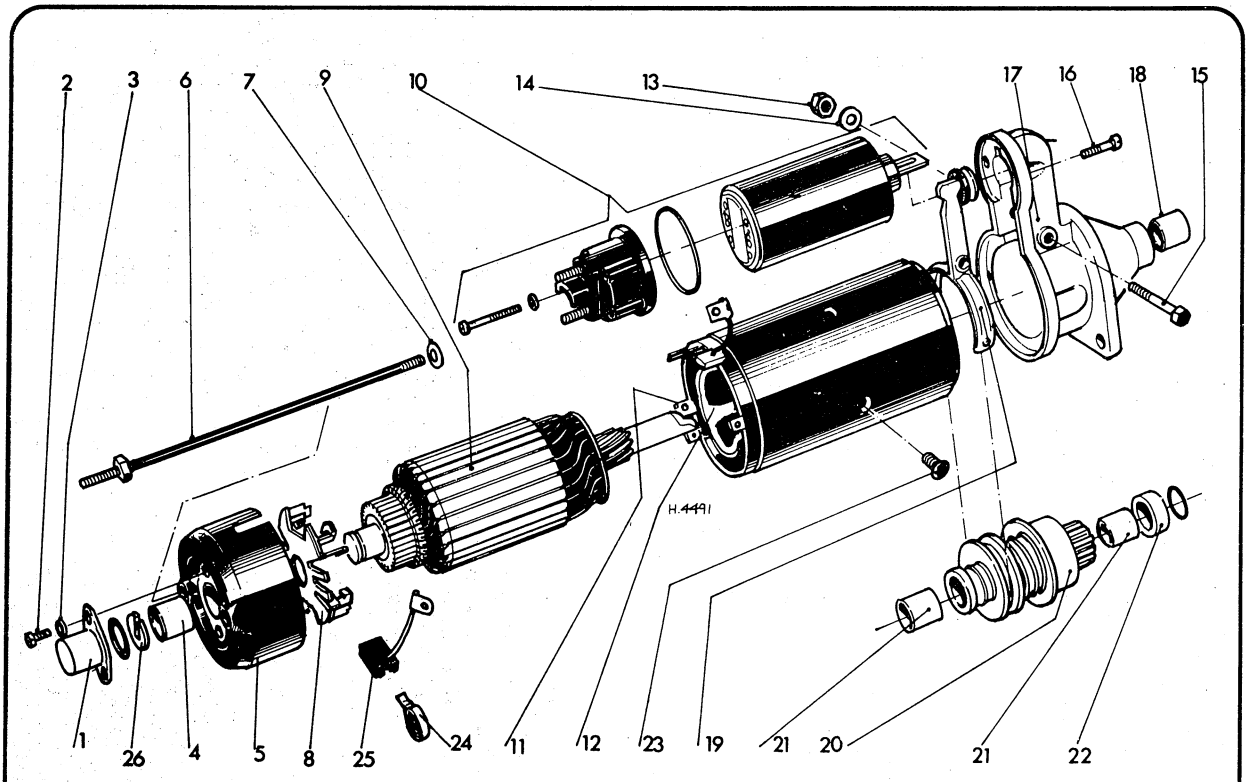


Fig. 4.2. Starter motor - except 750S model

1 *End cap - 1 off*
2 *Screw - 2 off*
3 *Spring washer M4 - 2 off*
4 *Bush - 1 off*
5 *Commutator cover - 1 off*
6 *Starter stud - 2 off*
7 *Spring washer M5 - 2 off*
8 *Brush carrier - 1 off*
9 *Armature - 1 off*
10 *Starter solenoid - 1 off*
11 *Insulating strip - 1 off*
12 *Field coil - 1 off*
13 *Hex. nut - 1 off*
14 *Spring washer - 1 off*
15 *Pivot bolt - 1 off*
16 *Countersunk screw - 1 off*
17 *Drive housing - 1 off*
18 *Bronze bush - 1 off*
19 *Lever - 1 off*
20 *Starter pinion - 1 off*
21 *Bush - 1 off*
22 *Stop ring - 1 off*
23 *Countersunk screw - 1 off*
24 *Brush spring - 4 off*
25 *Brush set - 1 off*
26 *Circlip - 1 off*

11 Starter motor: overhaul

1 Two entirely different types of starter motor are fitted to the range of Moto Guzzi models covered in this manual. All 750S models are fitted with a Bosch inertia type starter motor, the pinion of which is engaged on the Bendix principle. In this system the pinion is thrown into engagement with the starter ring gear on the flywheel by the rotating armature. All later models have pre-engagement starter motors, where the pinion is moved into mesh by a pivoted arm operated by a solenoid mounted on the starter motor body. In this way the two gears may be fully meshed before the starter motor starts rotating.

Pre-engagement type

2 To renew the brushes, remove the two screws and washers which secure the small dust cap. Remove the cap and prise off the circlip and washer. Remove the two long screws which retain the starter motor end cap and then lift the cap away. Examine the brushes and check that they move freely. Sticking brushes will prevent correct functioning of the motor as electrical continuity between the brushes and the segmented commutator will be impossible.

3 Pull up the springs of the two brushes attached to the brush holder, partly withdraw the brushes and wedge them in raised position with the springs. Pull up the springs of the remaining two brushes attached to the field coils and remove the brushes completely. Remove the brush holder backplate.

4 If the brushes have worn to half their original length, they may be unsoldered. When renewing them, do not allow solder to run up the copper brush tails, towards the brushes.

5 Clean the commutator with fine glass paper, not emery. Ensure that the commutator segments are undercut, that is the insulation between each segment should be 0.5 mm (0.020 in) below the commutator surface. Use a hacksaw blade ground to the correct thickness to undercut the insulation. If the commutator is badly scored, it must be skimmed to a fine surface finish. Do not reduce the diameter below 33 mm (1.299 in). Note the washer and insulating washer on the armature shaft.

6 When refitting the commutator cover, position the brush holder backplate so that the long screws pass through the two slots in the edge of the plate.

7 To remove the starter pinion, first detach the field coil lead from the solenoid. Unscrew the retaining screws and remove the solenoid, disengaged from the pinion engaging lever.

8 Remove the brush holder plate as previously described. Pull the armature with pinion and pinion housing out of the starter body.

9 Unscrew the engaging lever pivot screw and take out the armature with engaging lever.

10 Push the thrust ring clear of the wire circlip and remove the circlip. Take off the starter pinion assembly.

11 A new pinion housing bush may be pressed into place, after soaking it in engine oil for 30 minutes. The end of the bush should be flush with the housing.

12 Inspect the field coils for scorching or charring. Electrical checking of the armature and field coils and renewal of the field coils, has to be left to a specialist.

13 Before reassembly, coat the quick thread and the engaging ring with the recommended grease. Check the armature end-float, which is adjusted by means of shims.

Inertia type

14 After removal of the end cover and dust cover the starter motor may be inspected as described for the pre-engagement type of unit. Brushes worn below 11.5 mm (0.4527 in) should be renewed. When attending to the commutator it should be noted that the minimum permissible diameter is 31.2 mm (1.228 in).

15 To remove the pinion push the end collar back towards the starter motor, against the pressure of the pinion return spring. Prise out the circlip and then pull off the collar, spring and pinion.

12 Spark plugs: checking and setting the gap

1 Use only spark plugs of the correct reach and heat range, as recommended in the Specifications. Check the electrode gap at the recommended mileage, and when replacing plugs.

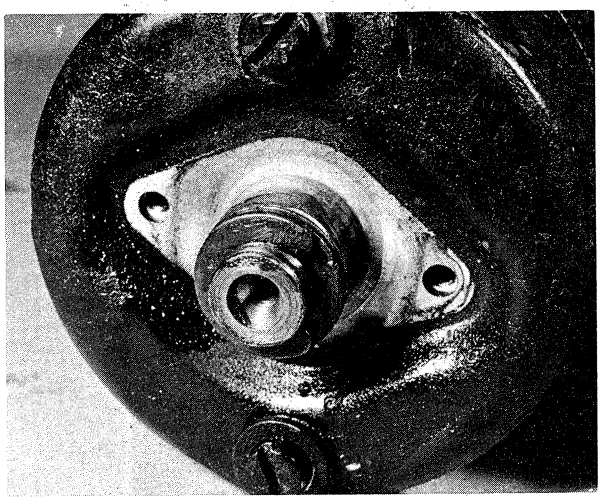
2 Use a plug spanner that is a good fit, otherwise an insulator may be broken. The plug should be tightened only sufficiently to provide a good gastight seal. If a plug is overtightened, the cylinder head threads could be damaged. Although they can be reclaimed with a 'Helicoil' wire thread insert, the cylinder head will need to be removed.

3 Check each plug gap with a feeler gauge. To reset, bend only the outer electrode. Clean the electrodes with a wire brush. Examine the insulation around the central electrode for cracks. Smear the threads with graphite grease before replacing. If the electrodes are badly eroded, the spark plug must be replaced.

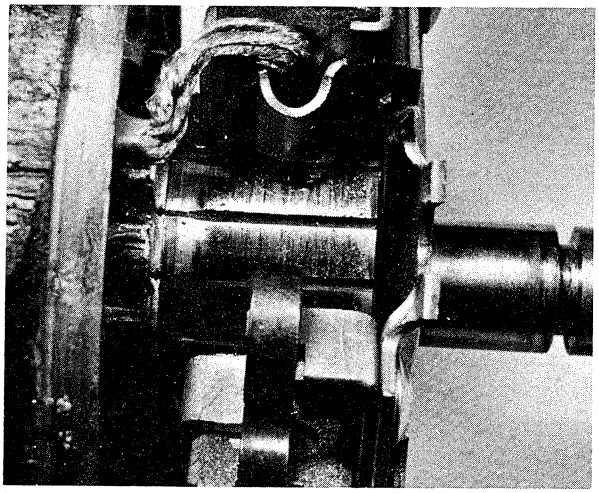
4 The condition of the spark plug electrodes gives a good guide to engine operation. See accompanying diagrams.

5 Examine the spark plug caps and leads for cracks, scorching, or damage and ensure that they make good contact with the plug.

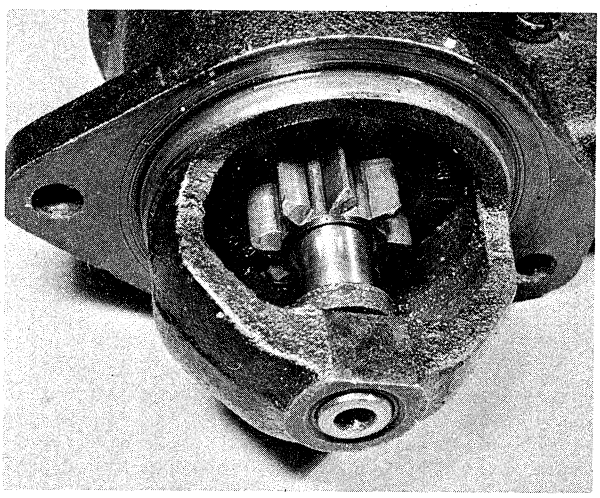
11.2a Remove the end cap and ...



11.2b ... prise off the circlip and washer



11.5 Check brush length and inspect commutator for scoring



11.7 Inspect starter pinion and flywheel ring gear teeth for damage

13 Fault diagnosis: ignition system

Symptom	Cause	Remedy
Engine refuses to start	Break or short circuit in ignition system	Switch off and check wiring.
	Contact breaker not opening, or gap too large	Adjust contact breaker.
	Contact breaker points dirty	Clean.
	Plugs wet due to condensation or excess fuel	Remove and clean plugs.
	Plug gaps too wide	Adjust gap.
	Flat battery	Recharge battery.
Engine will not idle	Faulty capacitor	Renew capacitor.
	Incorrect timing	Adjust timing.
	Fouled or wrong grade plugs	Check or clean plugs.
	Centrifugal advance springs weak	Renew springs.
	Unit jammed on full advance	Free bob weights.
	Plug gaps too large or fouled	Adjust or clean plugs.
	Plug leads wet or defective	Dry or renew leads.
	Plug caps shorting (recognisable by sooty burn marks)	Dry or renew caps.
Engine lacks response, overheats, or runs on after ignition is switched off	Contact breaker points gap too small	Check points gap.
	Centrifugal advance jammed in retard position	Free bob weights.
	Timing retarded	Check timing.
	Wrong grade plugs	Renew plugs.
Engine 'pinks' under load	Pre-ignition; timing incorrect	Renew plugs and check timing.

14 Fault diagnosis: starter motor

Symptom	Cause	Remedy
Starter fails to turn when button is pressed	Switch on lighting switch - if lights do not work, suspect flat battery or disconnected battery lead	Recharge battery. Check leads and terminals.
	If lights fade, battery needs charging	Recharge battery.
	If lights come on, but go out as soon as the starter is operated - suspect poor battery connections	Clean terminals and earth connection.
	Brushes too short or stuck	Renew or release brushes.
	Inadequate brush pressure	Replace brush springs.
	Dirty commutator	Clean commutator.
Starter will not turn engine	Commutator dirty	Clean commutator.
	Faulty armature or field coil	Renew armature or coil.
Starter turns at high speed, but engine turns jerkily or not at all	Drive pinion worn	Renew drive pinion.
	Flywheel spur gear worn	Renew flywheel.
	Drive pinion thread fouled or damaged	Repair or clean thread.