SECTION B

THE IGNITION SYSTEM

GENERAL DESCRIPTION

The ignition system consists of two circuits—primary and secondary. The primary circuit includes the battery, the ignition switch, the primary or low-tension circuit of the coil, and the distributor contact breaker and capacitor. The secondary circuit includes the secondary or high-tension circuit of the coil, the distributor rotor and cover segments, the high-tension cables, and the sparking plugs.

The ignition coil, which is mounted on the dynamo, consists of a soft-iron core around which is wound the primary and secondary windings. The coil carries at one end a centre high-tension terminal and two low-tension terminals marked 'SW' (switch) and 'CB' (contact breaker) respectively.

The ends of the primary winding are connected to the 'SW' and 'CB' terminals and the secondary winding to the 'CB' terminal and the high-tension terminal.

The distributor is mounted on the right-hand side of the engine and is driven by a shaft and helical gear from the camshaft. Automatic timing control of the distributor is controlled by a centrifugal mechanism and a vacuum-operated unit each operating entirely independently of each other. The centrifugal mechanism regulates the ignition advance according to engine speed, while the vacuum control varies the timing according to engine load. The combined effect of the two mechanisms gives added efficiency over the full operating range of the engine. A micrometer adjuster is provided to give a fine timing adjustment to allow for the engine condition and the grade of fuel used.

A keyed moulded rotor with a metal electrode is mounted on top of the cam. Attached to the distributor body above the centrifugal advance mechanism is a contact breaker plate carrying the contact breaker points and a capacitor connected in parallel. A cover is fitted over the distributor body and retained by two spring clips attached to the body.

Inside the cover is a centre electrode and spring-loaded carbon brush which makes contact with the rotor electrode. The brush is of composite construction, the top portion being made of a resistive compound, while the lower portion is made of softer carbon to prevent wear of the rotor electrode. Under no circumstances must a short, non-resistive brush be used to replace this long, resistive type. A measure of radio interference suppression is given by this brush.

Spaced circumferentially around the distributor cap are the sparking plug high-tension cable segments.

The distributor is secured in position on the cylinder block by a clamp plate.

The sparking plugs are located on the right-hand side of the engine and have a 14-mm. thread with a $\frac{3}{4}$-in. reach.

When the ignition is switched on, the current from the battery flows through the primary circuit and a magnetic field is built up around the core of the coil. When the contact breaker points are opened by rotation of the distributor cam the current flow is interrupted, causing a high voltage to be induced in the secondary winding of the coil by the sudden collapse and consequent change in the magnetic field. The high-tension current thus generated in the secondary winding of the coil is conveyed by the coil high-tension cable to the centre terminal of the distributor cover. From here the current passes through the carbon brush to the rotor electrode, and is distributed to the segments and thence to the sparking plugs via the high-tension cables.

Section B.1

UNEVEN FIRING

To test with sparking plugs in position

(1) Start the engine and set it to run at a fairly fast idling speed.

(2) Short-circuit each plug in turn by placing a hammer head or the blade of a screwdriver with a wooden or insulated handle between the terminal and the cylinder head. No difference in the engine performance will be noted when short-circuiting the plug in the defective cylinder. Short-circuiting the other plugs will make uneven running more pronounced.

(3) Having located the cylinder which is at fault, stop the engine and remove the cable from the terminal of the sparking plug. Restart the engine and hold the end of the cable about $\frac{3}{16}$ in. (4·8 mm.) from the cylinder head.

(4) If the sparking is strong and regular the fault probably lies in the sparking plug. Remove the plug, clean it, and adjust the gap to the correct setting, or alternatively fit a replacement plug. See Section B.4.

(5) If there is no spark, or if it is weak and irregular, examine the cable from the sparking plug to the distributor. After a long period of service the insulation may be cracked or perished, in which case the cable should be renewed. Finally, examine the distributor moulded cap, wipe the inside and outside with a soft dry cloth, see that the carbon brush moves freely in its holder, and examine the moulding closely for signs of breakdown. After long service it may have become tracked, that is, a conducting path may have formed between two or more of the electrodes or between one of the electrodes and some part of the distributor in contact with the cap. Evidence of a tracked cap is shown by the presence of a thin black line in the places indicated. A replacement distributor cap must be fitted in place of one that has become tracked.

Section B.2

TESTING THE LOW-TENSION CIRCUIT

Testing in position

(1) Spring back the securing clips on the distributor and remove the moulded cap and rotor. If the

rotor is a tight fit it can be levered off carefully with a screwdriver.

(2) Check that the contacts are clean and free from pits, burns, oil, or grease. Turn the engine and check that the contacts are opening and closing correctly and that the clearance when the contacts are fully opened is between ·014 and ·016 in. (·36 and ·40 mm.). Correct the gap if necessary.

(3) Disconnect the cable at the contact breaker terminal 'CB' of the coil and at the low-tension terminal of the distributor, and connect a test lamp between these terminals. If the lamp lights when the contacts close and goes out when the contacts open the low-tension circuit is in order.

Locating a fault

(1) Having determined, by testing as previously described, that the fault lies in the low-tension circuit, switch on the ignition and turn the crankshaft until the contact breaker points are fully opened.

(2) Refer to the wiring diagram and check the circuit with a voltmeter (0–20 volts) as follows.

NOTE.—If the circuit is in order the reading on the voltmeter should be approximately 12 volts.

(3) *Battery to starter solenoid switch.* Connect a voltmeter between the starter terminal and a good earthing point. No reading indicates a damaged cable or loose connections.

(4) *Starter solenoid switch to control box terminal 'A'* (brown lead). Connect a voltmeter to the control box terminal 'A' and to earth. No reading indicates a damaged cable or loose connections.

(5) *Control box.* Connect a voltmeter to the control box terminal 'A1' and to earth. No reading indicates a broken or loose connection.

(6) *Control box terminal 'A1' and feed terminal of the ignition switch* (brown with blue lead). Connect a voltmeter to the feed terminal of the ignition switch and to earth. No reading indicates a damaged cable or loose connections.

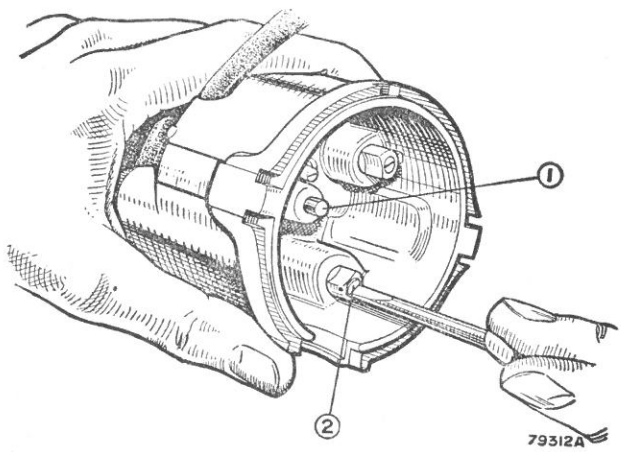

Fig. B.1

The method of connecting high-tension leads

1. Carbon brush. 2. Cable-securing screw.

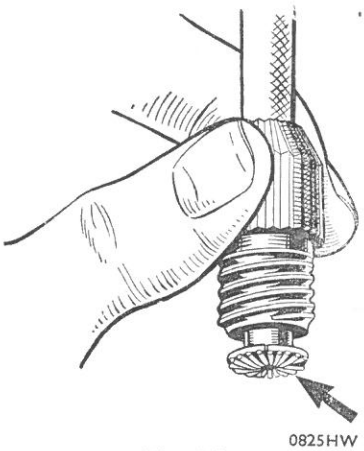

Fig. B.2

The correct method of fitting a high-tension cable to the ignition terminal nut

(7) *Ignition switch.* Connect a voltmeter to the ignition switch terminal marked '2' and to earth. No reading indicates a fault in the ignition switch.

(8) *Ignition switch to fusebox terminal 'A3'* (white lead). Connect the voltmeter to the fusebox terminal 'A3' and to earth. No reading indicates a damaged cable or loose connections.

(9) *Fusebox terminal 'A3' to ignition coil terminal 'SW'* (white lead). Connect a voltmeter to the ignition coil terminal 'SW' and to earth. No reading indicates a damaged cable or loose connections.

(10) *Ignition coil.* Disconnect the cable from the 'CB' terminal of the ignition coil and connect a voltmeter to this terminal and to earth. No reading indicates a fault in the primary winding of the coil and a replacement coil must be fitted. If the correct reading is given, remake the connections to the coil terminal.

(11) *Ignition coil to distributor* (white with black lead). Disconnect the cable from the low-tension terminal on the distributor and connect the voltmeter to the end of this cable and to earth. No reading indicates a damaged cable or loose connections.

(12) *Contact breaker and capacitor.* Connect the voltmeter across the contact breaker points. No reading indicates a fault in the capacitor.

Section B.3

HIGH-TENSION CABLES

(1) The high-tension cables must be examined carefully and any which have the insulation cracked, perished, or damaged in any way must be replaced by the correct type of ignition cable.

(2) To fit the cable to the terminal of the ignition coil thread the knurled moulded terminal over the lead, bare the end of the cable for about ¼ in. (6 mm.), thread the wire through the brass washer

removed from the original cable, and bend back the strands over the washer. Finally, screw into its terminal.

To make the connections to the terminals in the distributor moulded cap first remove the cap and slacken the screws on the inside of the moulding till they are clear of the cables. Cut the new cables off to the required length, remove the old cables, thread the new cables through the rubber waterproof cover and push them home in the cable sockets in the cap. Tighten the screws. They will pierce the insulation and make good contact with the cable core.

(3) The cables from the distributor to the sparking plugs must be connected up in the correct firing order, which is 1, 3, 4, 2.

Section B.4

SPARKING PLUGS

Service procedure

To maintain peak sparking plug performance plugs should be inspected, cleaned, and regapped at the periods stated in the Passport to Service. Under certain fuel and operating conditions, particularly extended slow-speed town driving, sparking plugs may have to be serviced at shorter intervals.

Disconnect the ignition cables from all sparking plugs. Loosen the sparking plugs about two turns counterclockwise, using a deep socket wrench of the correct size.

Blow away the dirt from around the base of each plug. Remove the sparking plugs and place them in a suitable holder, preferably in the order they were in the engine.

Analysing service conditions

Examine the gaskets to see if the sparking plugs were properly installed. If the gaskets were excessively compressed, installed on dirty seats, or distorted, leakage has probably occurred during service which would tend to cause overheating of the sparking plugs. Gaskets properly installed will have flat, clean surfaces. Gaskets which are approximately one-half their original thickness will be satisfactory but thinner ones should be renewed.

Examine the firing ends of the sparking plugs, noting the type of the deposits and the degree of electrode erosion. Remember that if insufficient voltage is delivered to the sparking plug, no type of plug can fire the mixture in the cylinder properly.

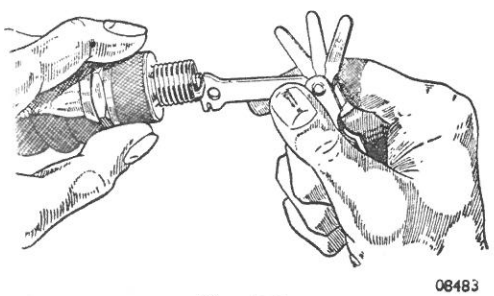

Fig. B.3

Reset the plug gap, using a Champion special gap setting tool as shown above

Normal condition—look for powdery deposits ranging from brown to greyish tan. Electrodes may be worn slightly. These are signs of a sparking plug of the correct heat range used under normal conditions—that is, mixed periods of high-speed and low-speed driving. Cleaning and regapping of the sparking plugs is all that is required. Watch for white to yellowish powdery deposits. This usually indicates long periods of constant-speed driving or a lot of slow-speed city driving. These deposits have no effect on performance if the sparking plugs are cleaned thoroughly at the correct intervals. Remember to 'wobble' the plug during abrasive blasting in the Champion service unit. Then file the sparking surfaces vigorously to expose bright, clean metal.

Oil fouling is usually indicated by wet, sludgy deposits traceable to excessive oil entering the combustion chamber through worn cylinders, rings, and pistons, excessive clearances between intake valve guides and stems, or worn and loose bearings, etc. Hotter-type sparking plugs may alleviate oil fouling temporarily, but in severe cases engine overhaul is called for.

Fuel fouling is usually indicated by dry, black, fluffy deposits which result from incomplete combustion. Too rich an air/fuel mixture or excessive use of the mixture control can cause incomplete burning In addition, a defective coil, contact breaker points, or ignition cable can reduce the voltage supplied to the sparking plug and cause misfiring. If fouling is evident in only a few cylinders sticking valves may be the cause. Excessive idling, slow speeds, or stop-and-go driving can also keep the plug temperatures so low that normal combustion deposits are not burned off. In the latter case hotter-type plugs may be installed.

Burned or overheated sparking plugs are usually identified by a white, burned, or blistered insulator nose and badly eroded electrodes. Inefficient engine cooling and incorrect ignition timing can cause general overheating. Severe conditions, such as sustained high speed and heavy loads, can also produce abnormally high temperatures in the combustion chamber which necessitate the use of colder-type sparking plugs.

File the sparking surfaces of the electrodes by means of a points file. If necessary, open the gaps slightly and file vigorously enough to obtain bright, clean, parallel surfaces. For best results hold the plug body in a vice.

Reset the gaps, using the bending fixture of the Champion gap tool. Do not apply pressure on the centre electrode as insulator fracture may result. Use the bending fixture to obtain parallel sparking surfaces for maximum gap life.

Visually inspect all sparking plugs for cracked or chipped insulators. Discard all plugs with insulator fractures.

Test the sparking ability of a used spark plug on a comparator.

Clean the threads by means of a hand or power-driven wire brush. If the latter type is used the wire size should not exceed ·005 in. (·127 mm.) diameter. Do not wire-brush the insulator or the electrodes.

Clean the gasket seats on the cylinder head before installing sparking plugs to ensure proper seating of the sparking plug gaskets. Then, using a new gasket, screw in each plug by hand finger tight.

NOTE.—If the sparking plug cannot be seated on its gasket by hand clean out the cylinder head threads with a clean-out tap or with another used sparking plug having three or four vertical flutes filed in its threads.

Finally tighten the sparking plugs to the following value (pounds feet):

Size	*C.I. head*	*Turns*
14 mm.	30	½

The number of turns listed approximates to the correct torque values and should be used if a torque wrench is not available or cannot be used because of limited accessibility.

Connect the H.T. terminals after the plugs are installed.

Standard gap setting

The sparking plug gap settings recommended and listed under **'GENERAL DATA'** have been found to give the best overall performance under all service conditions. They are based on extensive dynamometer testing and experience on the road and are generally a compromise between the wide gaps necessary for best idling performance and the small gaps required for the best high-speed performance.

All plugs should be reset to the specified gap by bending the side electrode only, using the special tool available from the Champion Sparking Plug Company.

Section B.5

CONTACT BREAKER MECHANISM

Check the contact breaker at the periods stated in the Passport to Service as follows:

(1) Remove the distributor cap, and wipe the inside and outside with a soft dry cloth.

(2) Turn the crankshaft until the contact breaker points are fully opened and check the gap with a gauge having a thickness of from ·014 to ·016 in. (·36 to ·40 mm.). If the gap is correct the gauge should be a sliding fit. Do not alter the setting unless the gap varies considerably from the gauge thickness.

To adjust the setting keep the crankshaft in the position which gives maximum opening of the contacts and then slacken the two screws securing the fixed contact plate. Adjust the position of the plate until the gap is set to the thickness of the gauge and then tighten the locking screw.

Remember that the cam only keeps the contact points fully open over a very small angle and that care must be taken to ensure that the points are in the fully open position.

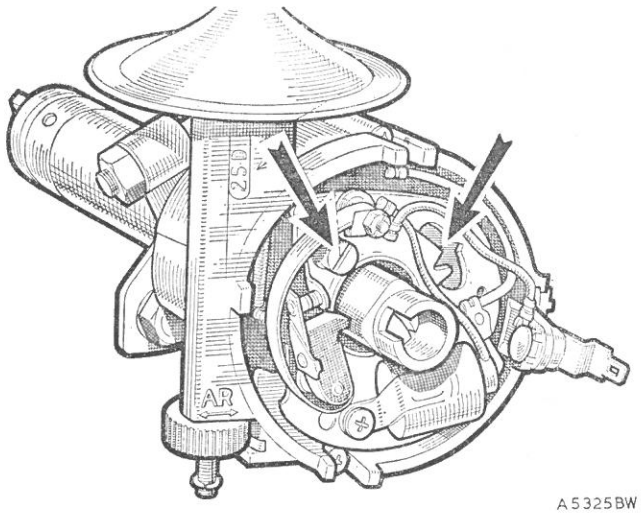

Fig. B.4

The distributor with the moulded cap and rotor arm removed, showing the contact breaker mechanism

(3) If the contacts are dirty or pitted they must be cleaned by polishing them with a fine carborundum stone and afterwards wiping them with a fuel-moistened cloth. The moving contact can be removed from its mounting in order to assist cleaning. Check and adjust the contact breaker setting after cleaning the contacts.

(4) Check that the moving arm moves freely on its pivot. If it is sluggish remove the moving arm and polish the pivot pin with a strip of fine emery-cloth. Afterwards clean off all trace of emery dust and apply a spot of clean engine oil to the top of the pivot.

The contact breaker spring tension should be between 20 and 24 oz. (567 and 680 gm.) measured at the contacts.

Section B.6

DISTRIBUTOR

Removal

(1) The distributor can be removed and replaced without interfering with the ignition timing provided the clamp plate pinch-bolt is not disturbed.

(2) To facilitate the replacement of the distributor turn the engine over until the rotor arm is pointing to the segment in the cover for No. 1 cylinder plug lead to provide a datum for replacement. Also, ascertain the approximate position of the vacuum unit in order to ensure correct connection of the vacuum pipe on replacement.

(3) Remove the distributor cover and disconnect the low-tension lead from the terminal on the distributor. Disconnect the suction advance pipe at the union on the distributor.

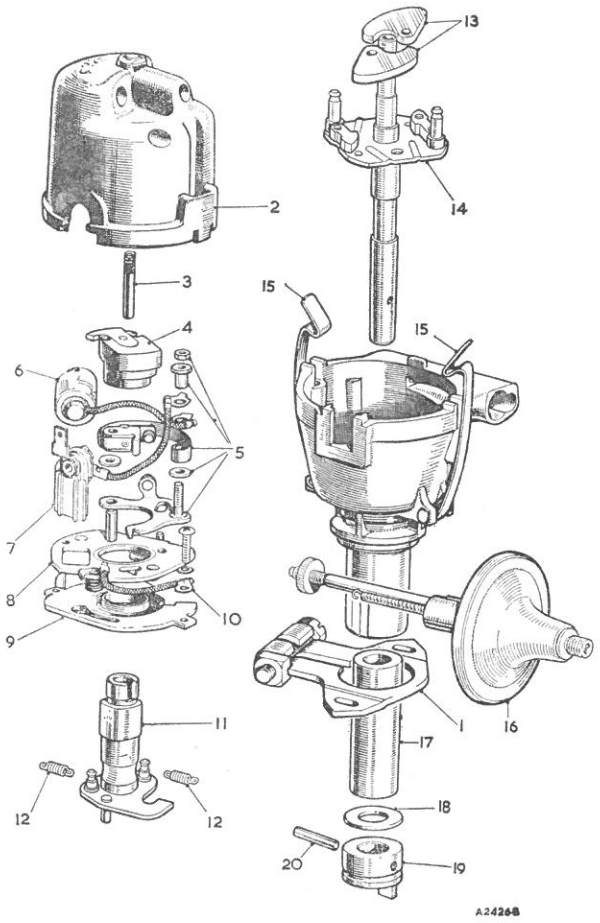

Fig. B.5

The components of the distributor

1. Clamping plate.
2. Moulded cap.
3. Brush and spring.
4. Rotor arm.
5. Contacts (set).
6. Capacitor.
7. Terminal and lead (low-tension).
8. Moving contact breaker plate.
9. Contact breaker base plate.
10. Earth lead.
11. Cam assembly.
12. Automatic advance springs.
13. Weight assembly.
14. Shaft and action plate.
15. Cap-retaining clips.
16. Vacuum unit.
17. Bush.
18. Thrust washer.
19. Driving dog.
20. Taper pin.

(4) Extract the two bolts securing the distributor clamp plate to the distributor housing and withdraw the distributor.

Dismantling

The contact breaker plate may be removed as an assembly to give access to the centrifugal weights without completely dismantling the distributor. To do this first remove the rotor arm and then withdraw the nylon low-tension terminal insulator from its slot in the distributor body.

Take out the two screws which secure the plate assembly to the distributor body, ease up the plate, and unhook the flexible actuating link connected to the contact breaker plate.

The following procedure is necessary if the distributor is to be completely stripped. Before dismantling, make a careful note of the positions in which the various components are fitted in order that they may be replaced correctly.

(1) Spring back the retaining clips and remove the moulded cap.

(2) Lift the rotor off the top of the spindle. If it is a tight fit it must be levered off carefully with a screwdriver.

(3) Remove the nut and washer from the moving contact anchor pin. Withdraw the insulating sleeve from the capacitor lead and low-tension lead connectors, noting the order in which they are fitted. Lift the moving contact from the pivot pin and remove the insulating washers from the anchor pin and pivot pin, noting that the larger diameter washer is fitted to the pivot pin.

(4) Take out the screw and spring and flat washers securing the fixed contact plate and remove the plate.

(5) Take out the securing screw and remove the capacitor.

(6) Extract the two screws securing the base plate to the distributor body, noting that one also secures the earthing lead, and lift out the base plate.

Unhook the flexible actuating link connecting the diaphragm in the vacuum unit with the moving contact breaker plate.

IMPORTANT.—Note the relative positions of the rotor arm drive slot in the cam spindle and the offset drive dog at the driving end of the spindle to ensure that the timing is not 180° out when the cam spindle is engaged with the centrifugal weights during assembly.

(7) Take out the cam retaining screw, unhook the springs, and remove the cam spindle.

(8) Take out the centrifugal weights. These may be lifted out as two assemblies, each complete with a spring.

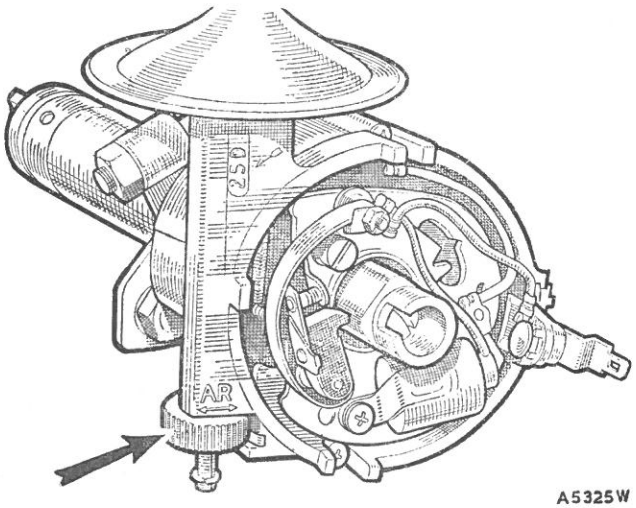

Fig. B.6

The distributor with the cap removed, indicating the ignition firing point adjusting nut

(9) To release the vacuum advance unit remove the circlip, adjusting nut, and friction spring. Withdraw the unit. Take care not to lose the adjusting nut lock friction spring.

(10) To release the spindle from the body drive out the parallel pin passing through the collar of the driving dog at the lower end of the spindle.

(11) Clean the distributor cover and examine it for signs of cracks and evidence of 'tracking', i.e. a conducting path may have formed between adjacent segments. This is indicated by a thin black line between the segments; when this has occurred the cover should be renewed.

(12) Ensure that the carbon brush moves freely in the distributor cover.

(13) Examine the attachment of the metal electrode to the rotor moulding. If the electrode is slack or abnormally burned, renew the rotor.

(14) The contact face of the contact breaker points should present a clean, greyish, frosted appearance. If burned or blackened, renew the contact set or polish the contact face of each point with a fine oil-stone, working with a rotary motion. Care should be taken to maintain the faces of the points flat and square, so that when reassembled full contact is obtained. Clean the points thoroughly in fuel.

(15) Check that the movable contact arm is free on its pivot without slackness.

(16) Check the centrifugal timing control balance weights and pivot pins for wear, and renew the cam assembly or weights if necessary.

(17) The cam assembly should be a free sliding fit on the driving shaft. If the clearance is excessive, or the cam face is worn, renew the cam assembly and/or shaft as necessary.

(18) Check the fit of the shaft in the body bearing bush. If slack, renew the bush and shaft as necessary. To renew the bush, proceed as follows.

Press out the old bush. The new bush should be allowed to stand completely immersed in thin engine oil for 24 hours, or alternatively for two hours in oil which has been heated to 100° C. (212° F.), before pressing it into the distributor body.

Reassembling

Reassembly is a direct reversal of the dismantling procedure, although careful attention must be given to the following points:

(1) As they are assembled, the components of the automatic advance mechanism, the distributor shaft, and the portion of the shaft on which the cam fits must be lubricated with thin, clean engine oil.

(2) Turn the vacuum control adjusting nut until it is in the half-way position when replacing the control unit.

(3) When engaging the cam driving pins with the centrifugal weights make sure that they are in the original position. When seen from above, the small offset of the driving dog must be on the right, and the driving slot for the rotor arm must be in the six o'clock position.

(4) Adjust the contact breaker to give a maximum opening of ·014 to ·016 in. (·36 to ·40 mm.)

(5) Check the oil sealing ring on the mounting shank and fit a new seal if necessary (later models only).

Refitting

Carefully insert the distributor into its housing to avoid damage to the mounting shank oil seal (if fitted). Engage the driving dog lug with the slot in the driving spindle (both of which are offset) by slowly rotating the rotor arm. Turn the distributor body to align the clamping plate holes with those in the housing. The remainder of the assembling is now in the reverse order to that of removal.

Provided that the crankshaft has not been turned, the rotor arm will be opposite the segment for No. 1 plug lead. The high-tension leads can then be replaced on their respective plug terminals in the order of firing, i.e. 1, 3, 4, 2, remembering that the distributor rotation is anti-clockwise when viewed from above.

Normal ignition adjustment is given in Section B.8.

NOTE.—If the clamping plate has been removed, or even slackened, resulting in lost timing, the procedure given in Section B.7 should be undertaken to reset the distributor.

Section B.7

TIMING THE IGNITION

Where the ignition timing has been lost the following procedure should be undertaken to reset the distributor to its correct firing position:

(1) Remove the distributor and make quite certain that the distributor driving spindle has been refitted correctly as in Section A.16.

(2) Turn the crankshaft in the direction of rotation and watch the valves of No. 4 cylinder. When the valves are 'rocking' (i.e. exhaust just closing and the inlet just opening) on No. 4 cylinder, then No. 1 piston is approximately at T.D.C. on its compression stroke. If the crankshaft is now rotated until the 1/4 mark on the flywheel is in line with the pointer in the aperture on the clutch cover (see Fig. B.7) the piston is exactly at T.D.C. Turn the crankshaft from this position until the pointer indicates the correct setting.

The static ignition timing for Mk. I engines fitted with a distributor suitable for operating with premium grade fuel is at T.D.C. In countries where the engine is required to operate on regular grade fuels of 90 octane and below an alternative distributor is fitted, and can be identified by the letters 'Fa' included in the engine serial number. The static ignition timing for Mk. I engines fitted with this distributor is 7° B.T.D.C.

The static ignition timing for Mk. II engines is 5° B.T.D.C.

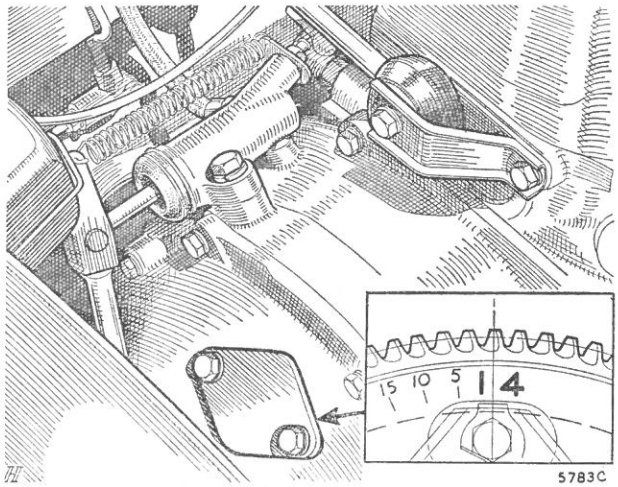

Fig. B.7

The timing marks on the flywheel, and the indicator, may be seen with the aid of a mirror after removing the inspection plate on the clutch cover. T.D.C. position is indicated by the mark 1/4, *and, in addition,* 5°, 10°, *and* 15° *B.T.D.C. marks are also provided*

(3) Set the contact breaker points to ·014 to ·016 in. (·36 to ·40 mm.) when in their position of maximum opening. Carefully insert the distributor into its housing to avoid damage to the mounting shank oil seal (if fitted). Engage the driving dog lug with the slot in the driving spindle (both of which are offset) by slowly rotating the rotor arm.

(4) Screw in the two set screws to secure the distributor clamp to the distributor housing. Tighten up the clamp plate pinch-bolt to ensure correct alignment before tightening the set screws down in the centre of the elongated holes of the clamp plate.

(5) To obtain an accurate setting the electrical method should be used to determine the actual position at which the points must break, and the following procedure should be adopted.

Slacken the clamp pinch-bolt and rotate the distributor body in an anti-clockwise direction until the points are fully closed.

With the low-tension lead connected to the distributor, turn on the ignition switch and connect a 12-volt lamp in parallel with the contact breaker points (i.e. one lead from the distributor low-tension terminal and the other to earth) and rotate the distributor clockwise until the lamp lights, indicating that the points have just opened. Secure the distributor body in this position by tightening up the clamp plate pinch-bolt.

Finally, check that the rotor arm is opposite the correct segment in the distributor cap for the No. 1 cylinder.

Reconnect the vacuum advance pipe.

Should a stroboscopic lamp be used, care must be taken that with the engine running the engine speed is low enough to ensure that the centrifugal weights are not in operation. When the vacuum advance take-off is direct from the induction manifold this should be disconnected before attempting the timing check, otherwise the engine timing will be set retarded.

Section B.8

IGNITION ADJUSTMENT

Adjustment is provided for the ignition point to enable the best setting to be attained for varying fuels. The adjustment nut is indicated by the arrow in Fig. B.6; turning the nut clockwise retards, and anti-clockwise advances, the ignition. Each graduation on the adjusting spindle barrel represents approximately 5° timing movement and is equal to 55 clicks on the knurled adjuster nut. The range of adjustment provided by this micrometer adjuster is normally ample to deal with any variation encountered.

Do not disturb the pinch-bolt unless absolutely necessary. Should the ignition timing have been lost, retiming should be undertaken as given in Section B.7.

Section B.9

CAPACITOR

The best method of testing the capacitor is by substitution. Disconnect the original capacitor and connect a new one between the low-tension terminal of the distributor and earth.

Should a new capacitor be necessary, it is advisable to fit a complete capacitor and bracket, but should a capacitor only be available, use a hot iron to soften the solder securing the defective capacitor to the bracket. Care must be taken not to overheat the new capacitor when soldering it in position. The capacity of the capacitor is ·2 microfarad.