SMITHS

SERVICE INSTRUCTIONS

IMPULSE ' TACHOMETER
(Original Equipment Types)

SMITHS

MOTOR ACCESSORY
DIVISION

SERVICE

The Service Technical Department of the Motor Accessory Division will be pleased to advise on any functional problem relating to instruments and equipment described in this brochure.

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CONTENTS Page

LIST OF ILLUSTRATIONS

LIST OF SPECIAL TOOLS & EQUIPMENT

Description	Code No.
Speedometer Test Apparatus	SR/D.221
Adaptor (for use with Apparatus SR/D.221)	SR/D.312
OR	
Speedometer Test Apparatus	AT.9034
Adaptor (for use with Apparatus AT.9034)	SR/D.313
Ignition Pulse Simulator	SR/D.347
Generator	TV.1100/00
Bridge Spanner	SR/D.360
Bezel Fixture	SR/D.140
Bezel Spinning Tool	SR/D.269
Support Pad	SR/D.269/13
Pressure Pad	SR/D.269/14

IMPULSE TACHOMETER - ORIGINAL EQUIPMENT TYPES

IMPORTANT There are two types of movements associated with the original equipment tachometer, the original equipment movement and the new rationalised movement which replaces the former. To distinguish between the instruments, those with the rationalised movement have a suffix letter A in the code number (Example: RVI.xxxx/xx/A). When servicing instruments with the rationalised movement refer to the last page in these service instructions.

GENERAL DESCRIPTION

The instruments are very similar in outward appearance to the universal type tachometers in the RVI.1000/series, but the original equipment types do not have the three point terminal block on the back of the instrument as they are not designed for general application. These impulse tachometers are designed to be fitted by the vehicle manufacturers during production of the car and consist of an indicator head and pulse lead. The pulse lead when connected in series between the vehicle ignition switch and the low tension terminal of the coil will transmit voltage pulses to the indicator head.

TECHNICAL DESCRIPTION (For component reference see circuit diagram on page S.23

The object of the circuit as shown on page S.23 is to provide a pulse of constant height and width to the coil of the meter every time the engine fires. The cycle of operation consists of a rest period followed by a pulse followed by a further rest period.

At rest, the collector-emitter, voltage of transistor TR1 is very low due to the base current flowing via resistors R4, R5 and R6. Under this condition transistor TR2 will not be conducting since its base is effectively shorted to earth by R2 and the conducting TR1. Capacitor Cl, C4 or C5 is charged to the zener voltage with its right hand plate negative with respect to earth. No current flows through the meter M.

The primary of the triggering transformer (T) is connected in series with the primary of the engine ignition coil, so that when the contact breaker in the engine distrubutor closes, the current flowing to feed the ignition coil passes through the primary of the transformer, energising the core. When the contact breaker opens to provide a spark to the engine, the flux in the transformer core collapses and appears as a short duration pulse across the secondary of the triggering transformer.

This pulse causes TR2 to conduct, which affectively brings the right hand plate of Cl to earth potential, so that the left hand plate is positive with respect to earth. Cl starts discharging through R5 and R4 driving the base of TR1 positive making it non-conducting. Simultaneously, the collector voltage of TR1 switches towards the zener voltage and TR2 conducts due to the base current flowing via R1 and R2. During this state, current flows through the meter via the conducting TR2 and the temperature compensating circuit thermister Thl and R7. This state continues until the charge in Cl is unable to maintain the positive potential on TR1 and the circuit reverts to the stable state.

The time taken for Cl to discharge is a function of Cl, R4, R5 and R6. Hence current pulses of constant charge are applied to the meter at a frequency depending on engine speed. The voltage applied to the circuit is stabilised by the zener diode Dz and C2. The capacitor C3 prevents the circuit being triggered by spurious voltages generated by auxiliary equipment or faulty contact breaker points.

TESTING PROCEDURE

(Using Speedometer Test Apparatus SR/D.221 or AT.9034)

PREPARATION OF THE TEST EQUIPMENT

Using the appropriate adaptor SR/D.312 or SR/D.313 couple a known good generator TV.1100/00 to the speedometer test appai.atus SR/D.221 or AT.9034. Using a suitable electrical cable connect the output terminals of the generator to the two left hand terminals of the ignition pulse simulator SR/D.347. (It is unimportant which way round these connections are made).

Refer to the white pulse lead on the tachometer and connect the lead with the red marker to the red terminal on the simulator and connect the other lead with the black marker to the black terminal on the simulator. (It is important to connect these leads in the correct order).

Connect a well stabilised D.C. supply of 12 volts to the two right hand supply terminals on the simulator marked + and -. It is imperative that the correct polarity be observed while making this connection. Wrong connections will result in the transistors used in the simulator being instantly destroyed. Adjustment of the terminal locking nuts may also result in damage to the simulator.

Connect the impulse tachometer to a. 14.5 volt D.C. supply. It is important to use 14.5 volts as voltages less than this figure can result in errors of up to 400 rpm. being indicated on the tachometer.

TESTING

Switch ON the supply to the pulse simulator and the impulse tachometer and wait for two minutes to allow the units to warm up. Start the speedometer test apparatus and operate the tachometer throughout its range.

Check the calibration by running the speedometer test apparatus at 3,000 rpm., the impulse tachometer should read as follows according to the application:

READING	APPLICATION
6,000 rpm	4 cylinder 4 stroke
4,000 rpm	6 cylinder 4 stroke
3,000 rpm	8 cylinder 4 stroke

If the impulse tachometer is found to be out of calibration it should be re-calibrated as described on page S.20.

It should be noted that for all service purposes 2 cylinder 2 stroke applications can be considered as being the same as 4 cylinder 4 stroke and 3 cylinder 2 stroke and 6 cylinder 4 stroke.

Set the impulse tachometer to read 3000 rpm. and then switch the ignition pulse simulator OFF and ON. When the simulator is switched OFF check that the tachometer reading falls to zero and when switched ON the tachometer reads 3000 rpm. Finally, operate the tachometer throughout its range.

During the complete testing procedure it is most important to observe the behaviour of the pointer. The tachometer, when satisfactory, should read with little or no fluctuation between 500 rpm. and maximum; in this range there should be no tendency for the pointer to drop to zero.

If any unusual movement or fluctuation is observed, the tachometer should be regarded as suspect and in need of more detailed inspection.

1. Bezel.
2. Glass.
3. Rubber Ring (Internal).
4. Slip Ring.
5. Pointer.
6. Dial Screws.
7. Dial.
8. Screws (Securing circuit board to movement).
9. Printed Circuit Assembly.
10. Movement Assembly.
11. Magnet.
12. Pole Bridge Piece.
13. Pole Piece.
14. Foam Washer.
15. Base Plate.
19. Resistor.
20. 6BA Nut.
21. 6BA Spring Washer.
22. 6BA Plain Washer.
23. Coil Support Assembly.
24. Triggering Coil.
25. Triggering Coil Cushion.
26. Screw (Securing base plate to movement).
27. Case.
28. Rubber Ring (External).
29. Plastic Former.
30. Iron Core.
31. 6BA Spring Washer.
32. 6BA Thumb Washer.
34. Pulse Lead.
35. Marker Tag (Black).
36. Marker Tag (Red).
37. Movement Fixing Washer.
38. Movement Fixing Screw.
47. Fixing Strap.
48. Fixing Washer.
49. Fixing Thumb Nut.
50. Pole Guide.
A. Printed Circuit Board Complete.
B. Fixing Nut (Potentiometer).
C. Fixing Washer (Potentiometer).
D. Resistor.
E. Resistor.
F. Resistor.
G. Resistor.
H. Resistor.
J. Potentiometer.
K. Capacitor.
L. Capacitor.
M. Themister.
O. Zener Diode.
P. Transistor.

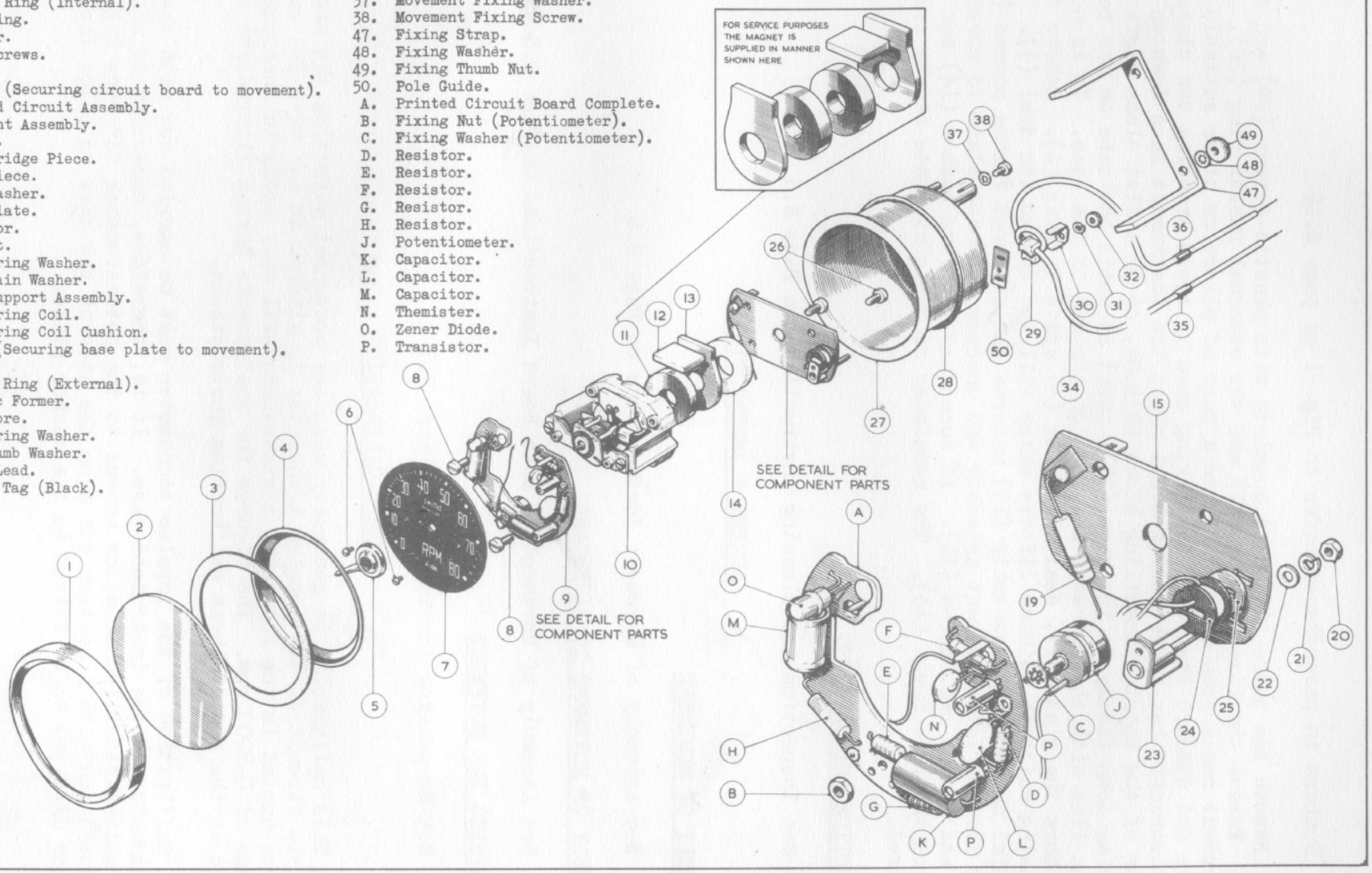


Fig.1 General Arrangement of Impulse Tachometer

DISMANTLING INSTRUCTIONS

Numbers in parentheses refer to Fig. 1 on page S.19

Remove the pulse lead (34) complete with plastic former (29) and iron core (30). Remove the fixing strap (47) and the external rubber ring (28). Where the instrument has a spun over bezel use a pair of pliers or other suitable tool and remove and discard the bezel (1) taking care to avoid breaking the glass (2). If the instrument has a tab fixing bezel place the instrument face down on the rubber of the bezel dismantling block SR/D.84, or on a flat clean surface and, pressing down firmly on the case (27), twist it until the tabs on the bezel (1) are in line with the cut-away sections on the rim of the case. It is now possible to remove the glass (2), sealing washer (3) and slip ring (4). Remove the pointer (5) using suitable pointer lifters which will not damage the dial (7). Supporting the dial and movement assembly (10) unscrew the movement fixing screws (38). Lift clear the complete movement assembly and unscrew the base plate to movement screws (26) and remove the magnet (11). If necessary the foam washer (14) can be detached from the pole piece (13). The remainder of the components can be removed as required.

INSPECTION AND CLEANING

See Inspection and Cleaning Instructions on Page S.6

ASSEMBLY INSTRUCTIONS

ASSEMBLY OF MOVEMENT

See Assembly of Movement Instructions on Page S.6

ASSEMBLY OF MOVEMENT TO BASEBOARD

See Assembly of Movement to Base Board Instructions on Page S.6

RE-POISING THE MOVEMENT

See Re-poising Instructions on Page S.7

BASIC CALIBRATION

This calibration is necessary when any component affecting the magnetic or electric circuit of the impulse tachometer is altered in any way. The calibration figures quoted in the following instructions will only apply to instruments having a range of 08000 rpm. The figures for instruments having alternative ranges are quoted at the end of these calibration instructions.

Calibration of the impulse tachometer must be carried out with the movement mounted in the instrument case. It is, therefore, necessary to use a dummy case suitably drilled to allow access to the potentiometer "J" (See Fig. 1 on page S.]9) and with a section cut from the side of the case to allow the bridge spanner SR/D.360 to be fitted to the anchor plate.

4 CYLINDER 4 STROKE

Connect the impulse tachometer to the ignition pulse simulator and speedometer test apparatus as previously described in the Testing Procedure on page S.18. Switch on the supply to these units and run the speedometer test apparatus at 1,500 rpm. Using the potentiometer "J" (See Fig. 1 on page S.19) set the impulse tachometer to read 3,000 rpm and wait for two minutes to allow the equipment to stabilise. Reduce the speed of the speedometer test apparatus to 875 rpm and check that the impulse tachometer reads opposite the low calibration mark 1,750 rpm. If the impulse tachometer does not read 1,750 rpm fit the bridge spanner SR/D.360 to the hairspring anchor plate and rotate the plate in the desired direction until the pointer is in line with the calibration n mark. Care should be taken to avoid causing an electrical short circuit during this adjustment.

After the impulse tachometer has been checked at 1,750 rpm the speedometer test apparatus should be set at 3,475 rpm and the impulse tachometer should now read 6,950 rpm. If any adjustment is necessary at this point it can be made by adjusting the potentiometer "J" (See Fig. 1 on pageS.19) in the required direction but any adjustment of the potentiometer will make it necessary to re-check the calibration at the 1,750 rpm position. This cross checking should be carried out until accurate calibration is obtained at both positions. Finally, set the speedometer test apparatus to read 2,300 rpm and check the mid-calibration point on the impulse tachometer. Switch off the supply and remove the iron core, former and pulse lead.

The tachometer is now calibrated for 4 cylinder 4 stroke application.

6 CYLINDER 4 STROKE

First calibrate the instrument for 4 cylinder 4 stroke application to ensure that the movement is poised correctly and that the pointer reads opposite each of the calibration marks.

Set the speedometer test apparatus to run at 3,000 rpm and the impulse tachometer should be reading 6,000 rpm. Adjust the potentiometer "J" (See Fig. 1 cn pageS.19) to reduce the speed of the impulse tachometer until it reads 4,000 rpm and then switch off the supply and remove the iron core, former and pulse lead.

The impulse tachometer is now calibrated for 6 cylinder 4 stroke application.

8 CYLINDER 4 STROKE

First calibrate the instrument for 4 cylinder 4 stroke application to ensure that the movement is poised correctly and that the pointer reads opposite each of the calibration marks.

Set the speedometer test apparatus to run at 3,000 rpm and the impulse tachometer should be reading 6,000 rpm. Adjust the potentiometer "J" (See Fig. 1 on pageS.19) to reduce the speed of the impulse tachometer until it reads 3,000 rpm and then switch off the supply and remove the iron core, former and pulse lead.

The tachometer is now calibrated for 8 cylinder 4 stroke application.

CALIBRATION DATA FOR 0-5500 RPM, 0-6000 RPM AND 0-7000 RPM INSTRUMENTS 0-5500 RPM INSTRUMENTS

TEST APPARATUS SETTINGS		IMPULSE TACHOMETER READINGS
4 Cyl. Application	6 Cyl. Application	
575	862	1,150
1,375	2,060	2,750
2,125	3,187	4,250

8 CYLINDER APPLICATION

First calibrate the instrument for 4 cylinder 4 stroke application. Then set the speedometer test apparatus to run at 2,000 rpm and adjust the potentiometer "J" (See Fig. 1 on pageS.19) until the impulse tachometer also reads 2,000 rpm.

0-6000 RPM INSTRUMENTS

TEST APPARATUS SETTINGS		IMPULSE TACHOMETER READINGS
4 Cyl. Application	6 Cyl. Application	
650	975	1,300
1,750	2,525	3,500
2,612	3,903	5,225

8 CYLINDER APPLICATION

First calibrate the instrument for 4 cylinder 4 stroke application. Then set the speedometer test apparatus to run at 2,000 rpm and adjust the potentiometer "J" (See Fig. 1 on pageS.19) until the impulse tachometer also reads 2,000 rpm.

0-7000 RPM INSTRUMENTS

TEST APPARATUS SETTINGS	IMPULSE TACHOMETER READINGS
4 Cyl. Application	
740	1,480
2,000	4,000
2,990	5,980

6 CYLINDER APPLICATION

First calibrate the instrument for 4 cylinder 4 stroke application. Then set the, speedometer test apparatus to run at 3,000 rpm and adjust the potentiometer "J" (See Fig. 1 on pageS.19) until the impulse tachometer reads 4,000 rpm.

8 CYLINDER APPLICATION

First calibrate the instrument for 4 cylinder 4 stroke application. Then set the speedometer test apparatus to run at 3,000 rpm and adjust the potentiometer "J" (See Fig. 1 on pageS.19) until the impulse tachometer also reads 3,000 rpm.

FINAL ASSEMBLY

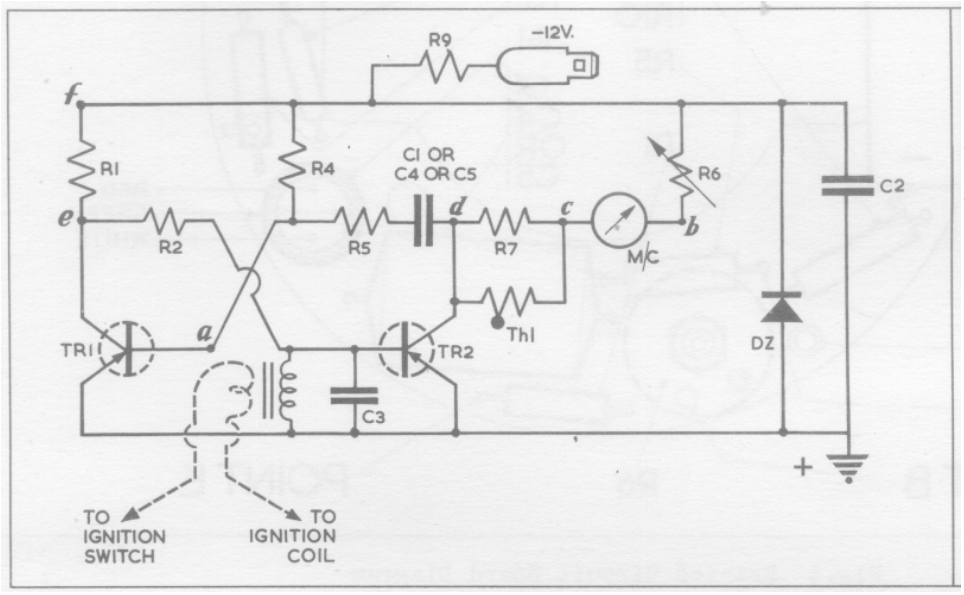
Carefully remove all dust particles from the assembled movement and base board, then place this sub-assembly into the case securing it in position with the shakeproof washers and screws. Carefully clean the dial and replace the slip ring, sealing washer, and clean dial glass. If the instrument has a spun over bezel fit a replacement bezel over the glass and spin in the manner described on page S.10. If the instrument has a tab fixing bezel the same bezel can be used again. Refit the bezel in the opposite order to the dismantling instructions.

INSTRUCTIONS FOR SPINNING THE BEZEL

See instructions for spinning the bezel on page

S.10 FITTING THE PULSE LEAD

Particular care should be taken when fitting the pulse lead assembly. It is essential that a good electrical connection be obtained at the iron core. Poor connection is liable to result in intermittent operation of the tachometer, particularly during high speed motoring when the tachometer is subject to increased vibration.



R. Resistor

C. Capacitor

TR. Transistor

Th. Thermistor

Dz. Zener Diode

M. Meter

a-e Reference Points

Fig.2 Circuit Diagram of Impulse Tachometer

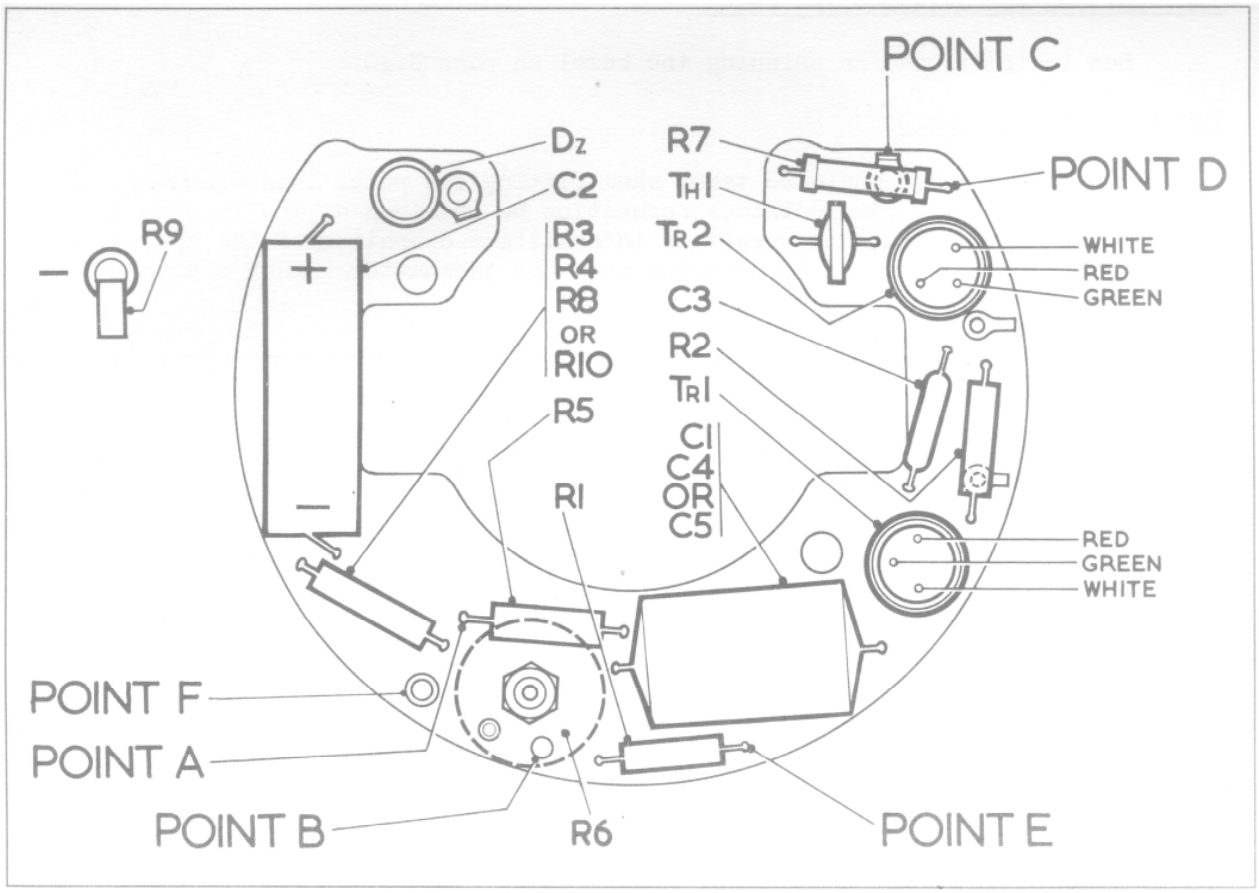


Fig.3 Printed Circuit Board Diagram

SYMPTOMS, FAULTS AND TREATMENT

It is possible by using these instructions to eliminate any single defective component in the tachometer and to assist this a schematic circuit diagram with the points lettered A - F is shown.

In addition to the special recalibrating equipment a good quality voltmeter suitable for reading voltage and resistance value will be necessary to locate most faults.

Symptom	Fault	Treatment
Incorrect Reading	Poor connections	Check all connections for dry joints and also the pulse lead and iron core assembly.
	Incorrect Calibration	Check the calibration of the tachometer as described under calibration instructions on page S.20.
	Out of Poise	Check poising as described on page S.7.
	Pointer sticking	Check positioning of pointer on spindle and refit if necessary. Poise and recalibrate.
	Movement Assembly	Remove suspect movement and replace with a good one and check the tachometer. Poise and recalibrate.
No Reading	Poor Connections	Check all connections and in particular the pulse lead and iron core assembly.
	Pointer Loose	Refit the pointer. Poise and recalibrate the movement.
	Polarity of Meter Coil	With the supply ON check that the meter coil is not connected the wrong way round by feeling the force returning pointer to stop.
	Test for Meter Supply Circuit Dz, C2, R9, R6 (Pot) Meter, TR1, R7, TR2	With the supply ON short point A to earth. If meter reads components are satisfactory.

Symptom	Fault	Treatment
No Reading (contd.)	R9, C2, Dz, R4	With the supply ON measure voltage across Dz or C2. This should be 7.0 - 8.5 volts. If more than 8.5 volts replace Dz. If less than 7.0, test R9, C2, Dz and R4 individually.
	R9	Should be warm with the supply ON, if not possibly faulty. Switch OFF supply and measure R9. Should be 100 ohms.
	C2	Disconnect one side of C2 and with supply ON measure volts across Dz. If 7.0 - 8.5 volts C2 is faulty.
	Dz	Disconnect one side of Dz and with supply ON measure volts across C2. If more than 7.0 volts Dz is faulty.
	R4	Switch supply OFF and measure resistance of R4 between points A and F. Positive probe on F and negative probe on A should be 20 ohms.
	R6, Meter, R7 and Th1	With the supply ON short point D to earth. If meter does not read test R6, meter, R7 and Thl individually.
	R6	With supply ON measure volts at point B. Voltage reading will depend on setting of potentiometer. If no reading on voltmeter replace R6.
	Meter	With supply ON short point C to earth. If meter does not read the fault is in R7. Replace R7.
	TR2	With the supply ON short point D to earth. Meter should read. Short point A to earth if meter does not read replace TR2.

Symptom	Fault	Treatment
No Reading (contd.)	Triggering Coil	With the supply OFF put positive probe on red coil lead and negative probe on black coil lead. Resistance should be 120 ohms. Reverse the primary loop and switch supply ON. If meter now reads coil is wrongly connected. If meter still does not read replace primary loop.
	R2	With supply OFF measure resistance. Should be 200 ohms.
Permanent Reading	Earthing of point C	Check that point C is not earthed by the tag touching the case.
	TR1, R1 and R4	With the supply ON measure voltage at point E with respect to earth. If it is more than 0.2 volts test TR1, Rl and R4 individually. If the voltage is less the components are satisfactory.
	R1	With the supply OFF place the negative probe on point E and positive probe on point F. The resistance should be greater than 400 ohms.
	R4	With the supply OFF place the negative probe on point F and the positive probe on point A. The resistance should be between 18K ohms and 22K ohms.
	TR1	If Rl and R4 are satisfactory replace TR1.
	TR2	With the supply ON short the trigger-ing coil (or C3). If meter reads unsolder white lead of TR2. If it then does not read replace the white lead and recheck TR1, Rl and R4.

ORIGINAL EQUIPMENT IMPULSE TACHOMETER

(With the Rationalised Movement)

This impulse tachometer is of the standard original equipment design, but uses a rationalised movement in place of the previous original equipment movement. The two instruments are completely interchangeable.

The rationalised movement is similar to that used in the impulse tachometer (RV1.1000 series), but with the following exceptions to the circuit:-

a) Resistance R6 is replaced by a single piece of wire.

b) The value of the potentiometer R8 is changed from 15K ohms to 22K ohms.

c) The value of R5 is changed from 5.1K ohms to 3.3K ohms.

d) The instrument is not provided with a negative 6 volt terminal.

e) The instrument has a special earthing strip on the base plate.

When servicing these instruments the instructions for the universal type impulse tachometer (RV1.1000 series) on page S.1 should be followed, taking into account the exceptions quoted above.