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SYNCHROSCOPE (FOUR ENGINE) TYPE KSA 0501W

GENERAL AND TECHNICAL INFORMATION

BY COMMAND OF THE DEFENCE COUNCIL

(Ministry of Defence)

FOR USE IN THE
ROYAL AIR FORCE

(Prepared by the Ministry of Aviation)

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Chapter 1

SYNCHROSCOPE (FOUR ENGINE)

TYPE KSA 0501W

Introduction (fig. 1)

1. The four engine synchroscope, Type KSA 0501W (Ref. No. 6A/8499), is used to show synchronism between No. 2 engine, called the master engine, and the other three engines. It is connected to the tachometer generator of each engine and indicates, by rotary pointer motion, the variation in frequency of three of the generators in comparison with that of the master engine. When an engine speed is faster than that of the master engine the respective pointer rotates clockwise, and when it is slower it rotates counter-clockwise. When the engines are running in synchronism with the master the pointers are stationary.

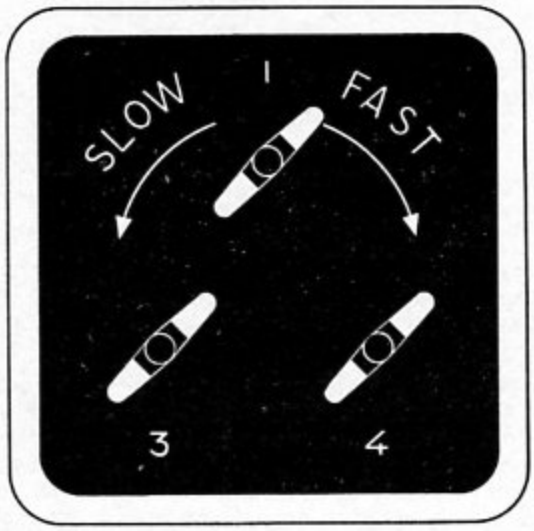

Fig. 1. Dial presentation

DESCRIPTION

General

2. The synchroscope consists of three small identical three-phase motors operating independently, and housed in a square flangeless case. At the front of the case toughened glass protects the pointers and dial, and at the rear a 13-pole plug connector is mounted on the mechanism end plate.

3. White-painted double-ended pointers, secured to the front ends of the motor shafts, indicate against a matt black dial. Numbers 1, 3, 4, on the dial adjacent to the pointers relate to the respective engines.

Mechanism (figs. 2 and 3)

4. The three motors, each of which is a synchroscope unit, are located symmetrically in a rigid frame which fits closely into the case.

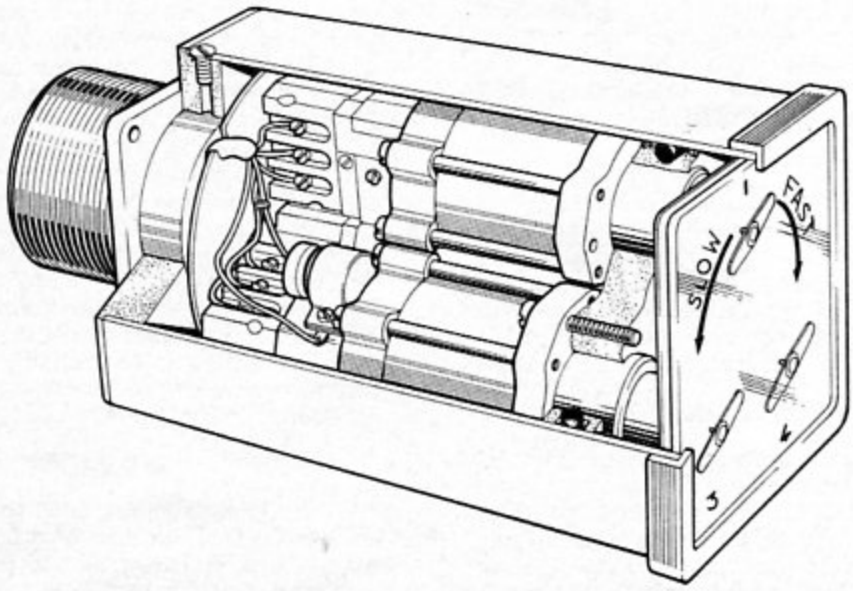

Fig. 2. Mechanism

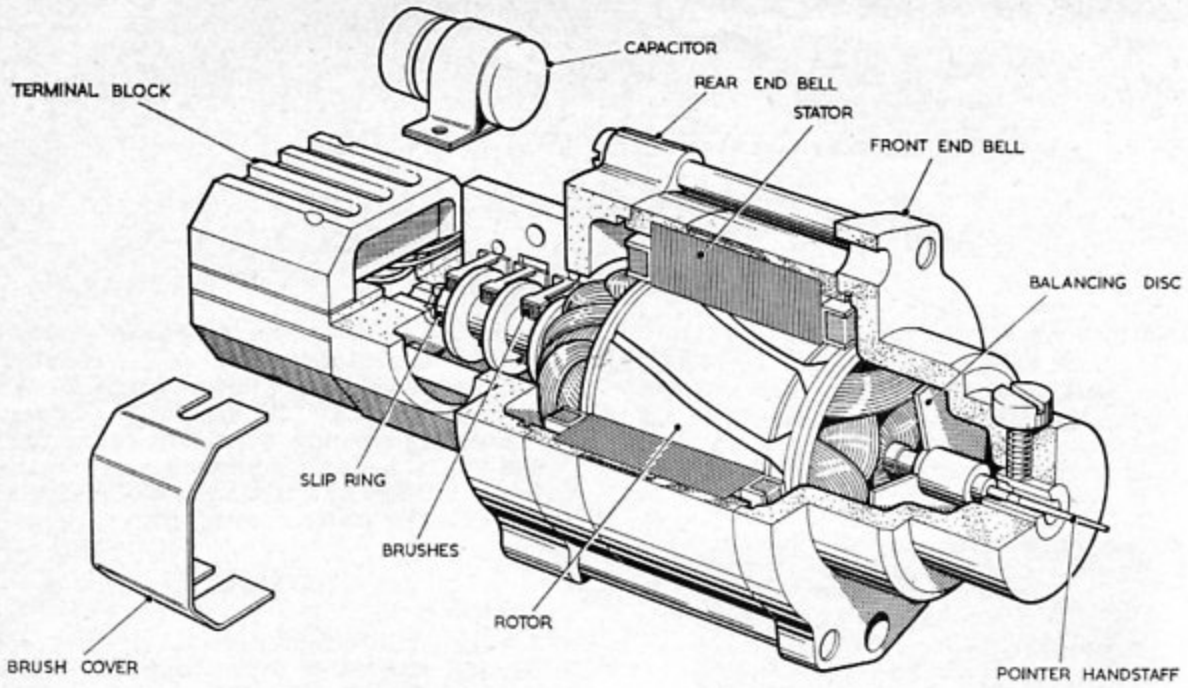

Fig. 3. Synchroscope unit

5. The stator lamination and coil assembly is contained in a brass shell and clamped between front and rear end bells. The rotor shaft is fitted with hardened steel pivots supported in jewelled bearings located in the end bells. An extension of the front pivot, through the end bell, carries the pointer. A balancing disc is mounted on the front end of the shaft, and at the other end of the shaft three slip rings are electrically connected to the rotor windings. Two brushes contacting each slip ring are carried on U-shaped spring strips mounted on a moulded base and connected to a terminal block at the rear end of the unit. The stator windings are also connected to the terminal block but on the opposite side from the rotor connections.

Electrical circuit (fig. 4)

6. The plug connector pins are connected to the terminal blocks of the three synchroscope units. The rotors are connected in parallel to pins B, M, N, and an earthed capacitor is fitted in each phase to extend brush life and minimize radio interference. The stator windings are each connected to a separate pin, and pin E is unconnected.

OPERATION

7. The output from the master engine (No. 2) tachometer generator induces a rotating magnetic field in the rotors of all three synchroscope units, and the stators are separately excited by the respective tachometer generators on the other three engines. The rotor field rotates at a speed proportional to the master engine speed, similarly the rotation of the stator fields is proportional to the other respective engine speeds. Both rotor and stator fields rotate clockwise, as viewed from the front of the synchroscope, and interact when rotor and stator are continuously energized by their respective generators. The rotor speed is the difference between the two generator speeds.

8. When an engine is in synchronism with the master the outputs of the associated tachometer generators are at the same frequency, and the magnetic fields in the rotor and stator of the synchroscope unit are rotating at the same speed. There is thus no movement of the rotor, or of the pointer attached to the shaft. When the frequency of the stator field is slower than the frequency of the rotor field, which is excited by the master engine generator, the pointer rotates counter-clockwise, and when the frequency of the stator field is faster than that of the rotor the pointer rotates clockwise. The speed of rotation of the pointer is equal to the difference in speed between the associated engine and the master, except that when the difference becomes excessive the rotor torque weakens and the pointer oscillates instead of rotating.

SERVICING

9. Prior to installation, or at any time when the serviceability of the synchroscope is suspect, it should be subjected to the standard serviceability tests detailed in Chapter 2.

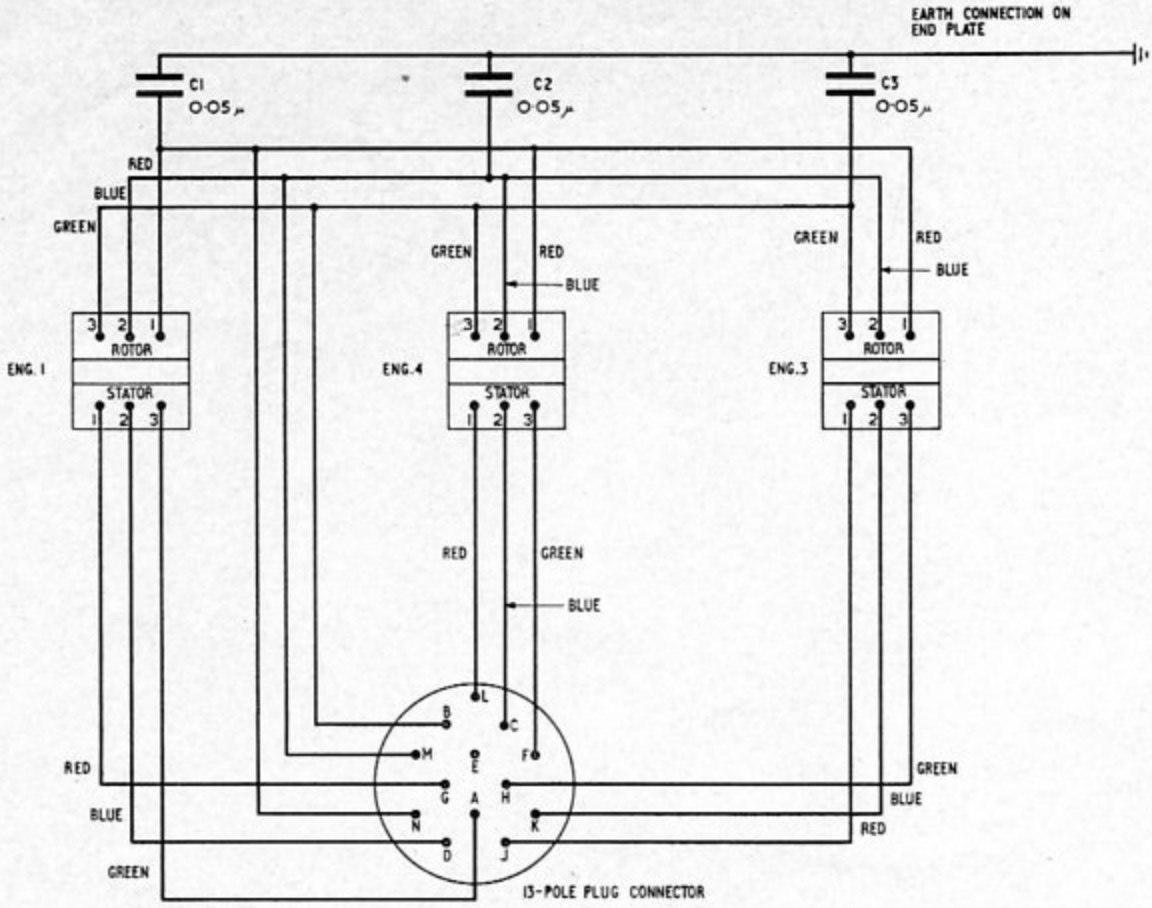

Fig. 4. Internal connections

Chapter 2

STANDARD SERVICEABILITY TESTS

FOR

SYNCHROSCOPE (FOUR ENGINE), TYPE KSA0501W

Introduction

1 The tests detailed in this chapter must be applied to be above named equipment prior to installation in aircraft and at any time when its serviceability is suspect. The tolerances specified must not be exceeded.

Test Equipment

2 The following test equipment is required:-

► 2.1 Two serviceable tachometer generators Type 2701KGA/CP/1 (Ref.No. 6A/1993616). ◄

2.2 Two serviceable tachometer indicators PW/2010KTD/BU/1 (Ref.No. 6A/1082402).

2.3 Dual tachometer tester (Ref.No. 6C/6365770 or 6C/6598644).

Method of test

3 The instrument is to be mounted in the normal position during the test, i.e. with the dial upright and in a vertical plane.

4 One generator should be arranged to represent that fitted to the master (No. 2) engine and connected to the synchroscope rotor circuit, while the other is to be connected in turn to No. 1 , 3 and 4 synchroscope stator circuits. Each generator is to be loaded with a tachometer indicator and is to be driven in a counter-clockwise direction of rotation as viewed from the drive shaft end.

TEST PROCEDURE

► CAUTION ... ◄

Insulation resistance tests are not to be applied to the synchroscope, which incorporates suppressor units. Failure to observe this warning may result in damage to the instrument.

5

5.1 Start the dual tachometer tester and set the speed of the master generator to a steady 2900 rev/min.

5.2 Set the speed of the secondary generator to a steady 2900 rev/min.

5.3 Observe the indicated speed of each generator, and check that the pointer of the synchroscope unit under test is satisfactory.

5.4 Slowly decrease the speed of the secondary generator until the synchroscope pointer rotates smoothly in a counter-clockwise direction. Check that the pointer commences to rotate when the indicated generator speeds differ by 0.5 per cent or less.

5.5 Decrease the speed of the secondary generator progressively down to ► 2750 rev/min. and check that rotation of the synchroscope pointer continues ◄ in a counter-clockwise direction, and that its speed increases proportionally.

5.6 Restore the speed of the secondary generator to 2900 rev/min. and check that the synchroscope pointer again comes to rest.

5.7 Slowly increase the speed of the secondary generator until the synchroscope pointer rotates smoothly in a clockwise direction. Check that the pointer commences to rotate when the indicated generator speeds differ by 0.5 per cent or less.

5.8 Increase the speed of the secondary generator progressively up to ► 3050 rev/min. and check that rotation of the synchroscope pointer continues ◄ in a clockwise direction, and that its speed increases proportionally.

5.9 Increase the speed of the master and secondary generators to 4200 rev/min. and check that the synchroscope pointer again comes to rest.

5.10 Repeat tests 5.3 to 5.8 with secondary generator speeds ranging from 4000 rev/min. to 4400 rev/min. As before, the synchroscope pointer must commence to rotate smoothly in each direction with an indicated change of secondary generator speed of 0.5 per cent or less.

5.11 Decrease the speed of both generators to zero and switch off the electrical supply.