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SYNCHROSCOPES, FOUR ENGINE, TYPE KSA 01 SERIES

GENERAL AND TECHNICAL INFORMATION

REPAIR AND RECONDITONING INSTRUCTIONS

BY COMMAND OF THE DEFENCE COUNCIL

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SYNCHROSCOPE, FOUR-ENGINE, TYPE KSA 0100 SERIES

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Chapter 1

SYNCHROSCOPES, FOUR-ENGINE, TYPE KSA 0100 SERIES

Introduction

1. Type KSA 0100 series synchrosopes, are used in four-engine aircraft to indicate the degree of synchronism existing between one engine designated 'master', and the remaining three engines. A typical synchroscope is shown in fig. 1.

2. Each engine, other than the master, is associated with a complete synchroscope unit housed within the instrument. Each unit consists basically of a three-phase star-wound stator and a rotor of similar type which actuates a double-ended pointer on the instrument dial. The stator is energized by a three-phase tachometer generator driven by the associated engine, and the rotor by a similar generator driven by the master engine. The output frequency of each generator is proportional to the speed at which it is being driven.

3. The function of each synchroscope unit is to compare the speed of the master engine and the associated engine by comparing the output frequencies of their respective tachometer generators. A diagrammatic arrangement of a typical synchroscope with 'Engine 1' designated as master is shown in fig. 3.

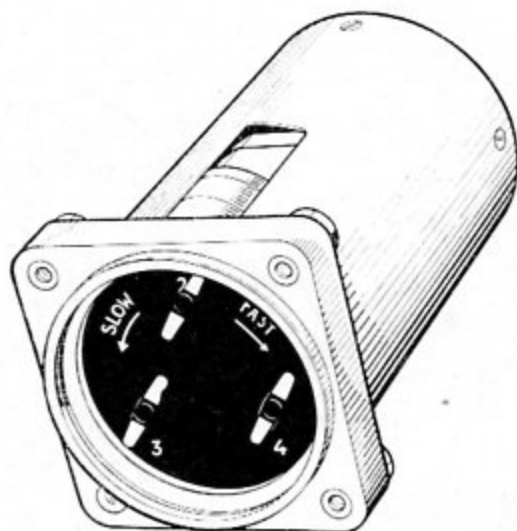


Fig. 1. Four engine synchroscope, Type KSA 01 series

DESCRIPTION

Case

4. The three synchroscope units are supported in an aluminium alloy case. External electrical connection is through a fixed plug located in the cover end plate or through a terminal housing and

a flying lead assembly, according to type. A flange at the front of the case incorporates four 4BA inserts to facilitate mounting on the instrument panel.

Dial and pointers

5. Three double-ended pointers, pitched 120 degrees apart, revolve to indicate a speed discrepancy between the master engine and the engine to which the particular synchroscope unit is connected. Two arrows at the top of the dial, together with the words FAST and SLOW indicate the interpretation of pointer rotation; i.e. engines faster or slower than the master. Numerals adjacent to the pointers indicate to which engine each pointer is related.

Mechanism

6. Each synchroscope unit is identical in construction as shown in the cutaway view, fig. 2. The stator lamination and coil assembly is contained in a brass shell, and the bore is lined with a cadmium-plated steel sleeve. The complete stator is clamped between front and rear end bells. The handstaff, an extension of the rotor shaft, protrudes through the front end bell.

7. Current is conducted to the rotor windings by brush assemblies connected to the terminals on the rotor terminal base. The brushes are in contact with silver slip rings mounted on the rotor shaft. A capacitor is connected between each rotor phase and the frame of the unit to extend brush life and minimize radio interference.

OPERATION

8. The rotor of each synchroscope unit is electrically connected to the three-phase tachometer generator on the master engine whilst the stator connected to the tachometer generator on the engine associated with the unit (fig. 3).

9. A rotating magnetic field is induced in the rotor windings at a frequency proportional to the speed of the master engine. Similarly, a rotating magnetic field is induced in the stator windings at a frequency proportional to the speed of the associated engine. Both fields rotate clockwise, when the instrument is viewed from the front, and interact when both rotor and stator are continuously energized by their respective generators.

10. When the difference in speed between the master and the associated engine is brought within specified limits, magnetic interaction causes the rotor to rotate at a speed equal to this difference. The direction of rotation is clockwise or counter-

clockwise accordingly as the speed of the associated engine is greater or less than that of the master. When the engines are synchronized, the difference in generator output frequency is nil and the pointer remains stationary.

11. The interpretation of the pointer indication is as shown in Table 1.

TABLE 1
Pointer interpretation

Pointer movement	Interpretation
Irregular or oscillating movement	Difference in speed beyond the indicating limits of the instrument
Regular counter-clockwise rotation.	Engine slower than the master
Regular clockwise rotation	Engine faster than the master
Pointer stationary	Engines synchronized

SERVICING

12. Prior to installation, or at any time when the serviceability of the synchroscope is suspect sub-

sequent to a visual examination for damage, it must be subjected to the standard serviceability tests detailed in Chap. 2.

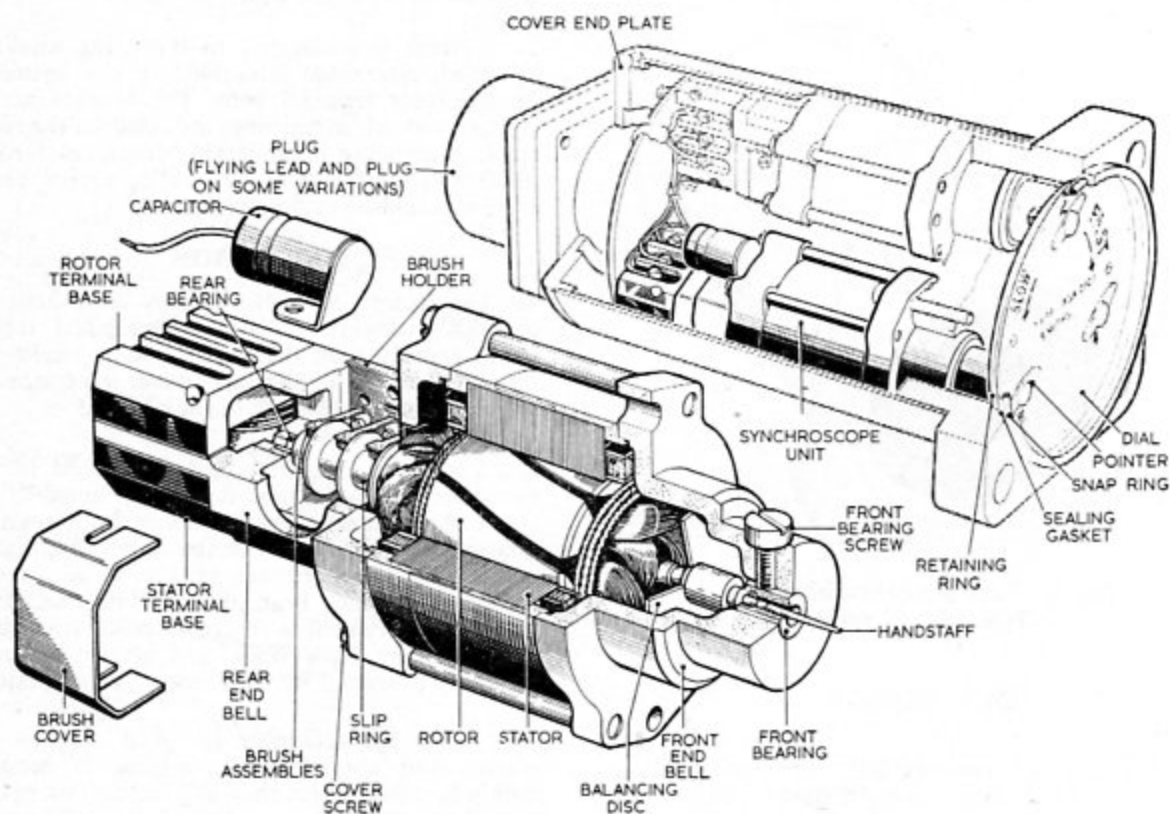


Fig. 2. Views of synchroscope unit

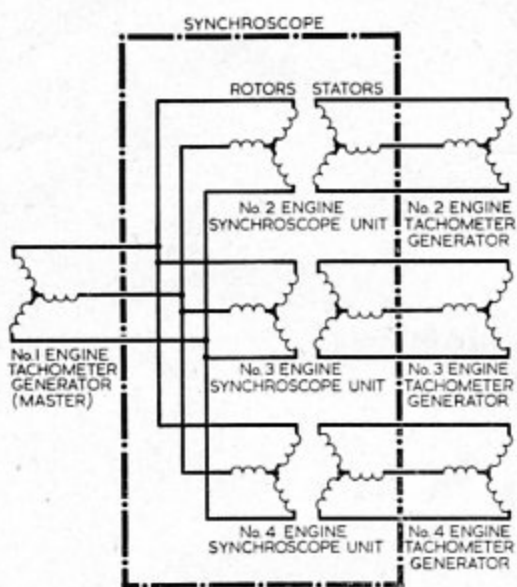
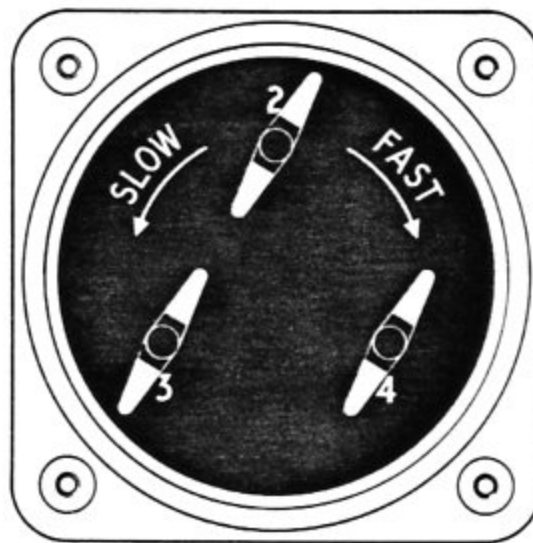


Fig. 3. Schematic diagram

Chapter 1-1SYNCHROSCOPE, FOUR-ENGINE, TYPE KSA 0101KIntroduction (fig.1)

1 The four-engine synchroscope, Type KSA 0101K (Ref. No. 6A/3117), is identical to that described in Chap.1. The numerals 2, 3 and 4 appear adjacent to the separate pointers indicating the engine to which each pointer is associated. The pointers, directional arrows and words FAST and SLOW are treated with fluorescent compound.



13049

Fig.1 Dial presentation

2 A nine pole plug is fitted to the rear of the instrument to connect each synchroscope unit to the generators. Table 1 details the plug pin connections and the engine to which these are associated.

Testing

3 The instrument must be tested immediately prior to installation, or if serviceability is suspect, in accordance with instructions given in Chap.2. Table 2 gives the relevant testing speeds and tolerances for this type.

Modifications

4 The modifications applicable to this type of synchroscope are detailed in Table 3.

TABLE 1 PLUG PIN CONNECTIONS

Pin No.	Engine No.	Synchroscope unit	Phase colour
1	Master Eng. rotor	ABC	green
2	Master Eng. rotor		blue
3	Common	ABC*	red
4	Engine 2 stator	A	blue
5	Engine 2 stator		green
6	Engine 3 stator	B	blue
7	Engine 3 stator		green
8	Engine 4 stator	C	blue
9	Engine 4 stator		green

* Rotor and stator red phase

TABLE 2 TEST SPEEDS AND TOLERANCES

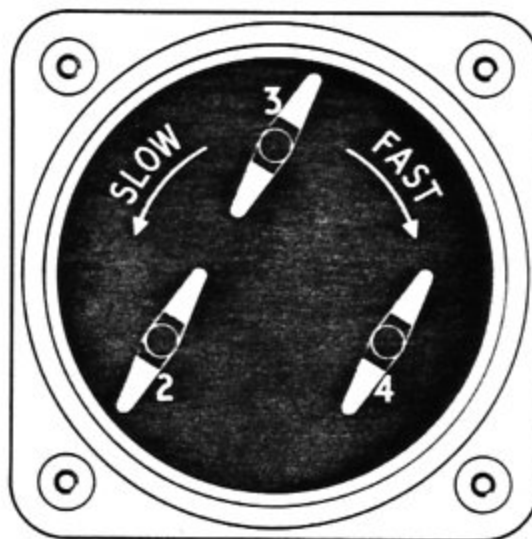
No. 1 Generator speed rev/min	No. 2 Generator speed difference rev/min
1400	100
2000	150
3000	300

TABLE 3 MODIFICATION DETAILS

Manufacturer's Mod. No.	Type	Description
01	KSA 0101	Introduction of radio suppression
02	KSA 0101	Introduction of gold brushes
03	KSA 0101	Change of brush material to silver graphite

Chapter 1-2SYNCHROSCOPE, FOUR-ENGINE, TYPE PW 01061 KSA/1Introduction (fig.1)

1 The four-engine synchroscope, Type PW 0106 KSA 1 (Ref. No. 6A/9764), is similar to that described in Chap.1. The numerals 3, 2 and 4 appear adjacent to the pointers indicating the engine to which each pointer is associated. The pointers, directional arrows and numerals are painted white against a matt black dial background.



13060

Fig.1 Dial presentation

2 Electrical connection to the synchroscope units is achieved through a flying lead and plug connector. Table 1 details the plug pin connections and the engine to which these are associated.

Testing

3 The instrument must be tested immediately prior to installation, or at any time that serviceability is suspect, in accordance with instructions given in Chap.2. Table 2 gives the relevant testing speeds and tolerances for this type.

Modifications

4 The modifications applicable to this type of synchroscope are detailed in Table 3.

TABLE 1 PLUG PIN CONNECTIONS

Pin No.	Engine No.	Synchroscope unit	Phase colour
A	Master Eng. rotor	ABC	green
B	Master Eng. rotor		blue
C	Common	ABC*	red
D	Engine 2 stator	B	blue
E	Engine 2 stator		green
F	Engine 3 stator	A	blue
G	Engine 3 stator		green
H	Engine 4 stator	C	blue
J	Engine 4 stator		green

* Rotor and stator red phase

TABLE 2 TEST SPEEDS AND TOLERANCES

No. 1 Generator speed rev/min	No. 2 Generator speed difference rev/min
2900	150
4200	200

TABLE 3 MODIFICATION DETAILS

Manufacturer's Mod. No.	Type	Description
01	PW 0106 KSA/1	Introduction of radio suppression
02	PW 0106 KSA/1	Introduction of gold brushes
03	PW 0106 KSA/1	Change of brush material to silver graphite

Chapter 2

STANDARD SERVICEABILITY TESTS

for

SYNCHROSCOPES, FOUR ENGINE, TYPE KSA 01 SERIES

Introduction

1. The tests detailed in this chapter must be applied to the above-mentioned equipment immediately prior to installation or at any time when serviceability is suspect. The tolerances specified must not be exceeded.

Test equipment

2. The following test equipment will be required:-

(1) Two compatible tachometer indicators and generators, the indicators to be capable of a 5 rev/min. read out between 1 000 and 4 500 rev/min.

(2) Dual tachometer tester (Ref.No. 6C/3 000).

Method of test

3. During the tests the synchroscope is to be mounted in the normal position, i.e. with the dial upright and in a vertical plane. Light tapping or vibration is permissible prior to observing readings.

4. One generator is arranged to represent that fitted to the master engine, whilst those on the other three engines are represented by the second generator (fig.1). This is achieved by connecting the rotors of the three synchroscope units in parallel to generator, GEN 1, and generator, GEN 2, to the stator phases of each unit in turn. In this manner the tests are applied to each synchroscope unit. The tachometer tester should be used to drive generator, GEN 1.

TEST PROCEDURE

Caution . . .

Insulation resistance tests are not to be attempted on this instrument, which incorporates suppressor units. Failure to observe this instruction may result in damage to the instrument.

Accuracy test

5. Generator GEN 1 should be run at the lowest speed given in the relevant chapter for the particular type under test. Generator GEN2, connected to the green and blue phases of synchroscope unit A stator and the commoned red phase, should then be driven at gradually increasing speed until the pointer of the synchroscope unit rotates smoothly counter-clockwise. The synchroscope must commence smooth rotation when the difference in speed between GEN 1 and GEN 2 is greater than the figure given in Table 2, Chap. 1-1, or 1-2 as applicable. ▶

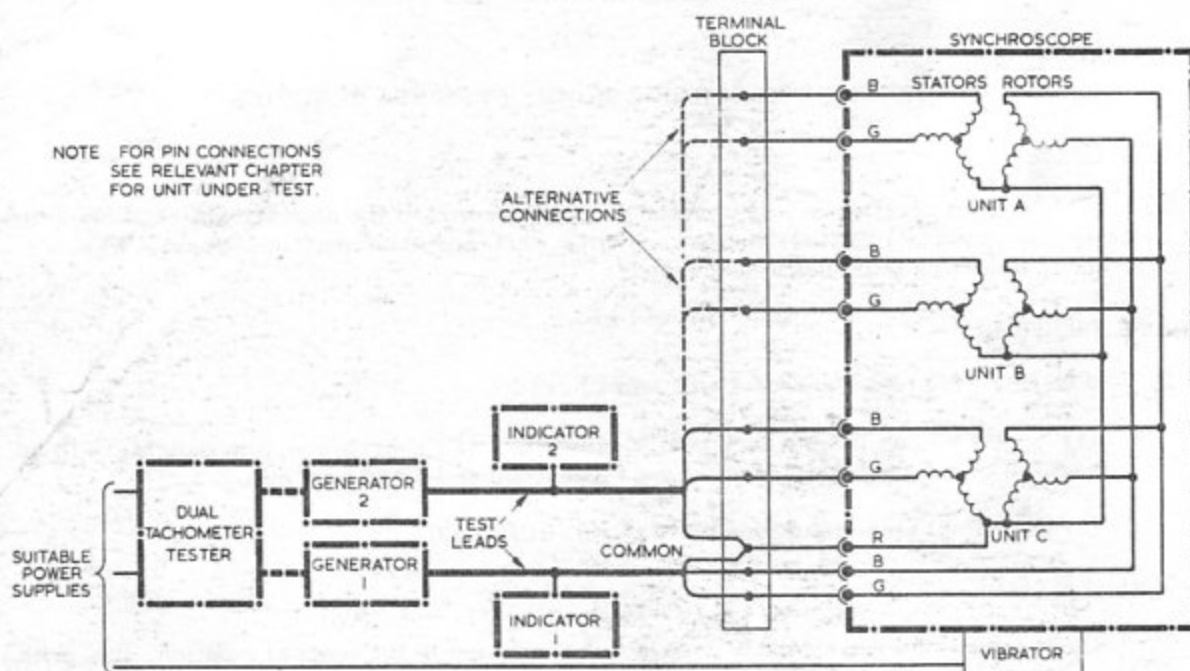


Fig.1. Layout of test circuit

6. GEN 2 should then be brought into synchronism with GEN 1. In this condition the speed difference is zero and the pointer of the unit must be stationary.
7. The speed of GEN 1 is then varied above and below the synchronizing speed, and the pointer of synchroscope unit A must commence smooth rotation in the appropriate direction when the speed of GEN 1 is 5 rev/min above or below the synchronizing speed.
8. Repeat the procedure detailed in para. 5, 6 and 7 at each of the remaining test speeds tabulated in the relevant chapter for the instrument under test. Reduce the speed of both generators to zero and switch off.
9. Disconnect the test leads from the blue and green stator phases of unit A at the terminal block and connect them to the blue and green stator phases of unit B at the terminal block. Apply the complete procedure detailed in para. 5, 6, 7 and 8 on unit B.
10. Disconnect the test leads from the blue and green stator phases of unit B at the terminal block and connect them to the blue and green stator phases of unit C at the terminal block. Apply the complete procedure detailed in para. 5, 6, 7 and 8 on unit C.
11. On completion of tests, remove the instrument from the test rig.

Chapter 4

REPAIR AND RECONDITIONING INSTRUCTIONS

LIST OF SUB-CHAPTERS

- 4-1 Introduction**
- 4-2 Tools, test equipment and materials**
- 4-3 Dismantling**
- 4-4 Servicing**
- 4-5 Assembly**
- 4-6 Testing**