Chapter 7

CONTENTS GAUGE CONTROL UNIT (Part No. 1215X000)

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LEADING PARTICULARS

Ref. No.	6D/—
Dimensions (overall)	
Length	4·41 *in.*
Width	2·70 *in.*
Height	2·13 *in.*
Weight	1·0 *lb.*
Connection for co-axial cable	*Amphenol socket, Type TY27-12*
Connection for electrical services	*Plessey plug Mk. 6, Type 681ET-10-6P*
Electrical supply	28*V d.c.*

Introduction

1. The contents gauge control unit is an electronic device which operates in conjunction with a suitably calibrated milliameter to give indication of the contents of a liquid oxygen container.

DESCRIPTION

2. The unit consists of transistorised electronic circuits enclosed in a silver-plated case which incorporates a baseplate for mounting purposes. Two adjusters, located on the front of the unit and protected by wire-locked covers, permit adjustment when matching the unit to a container. The adjusters are slotted to enable adjustments to be made using a screwdriver, and should not be disturbed unless the matching procedure (para. 15) is being carried out.

3. Interconnection between the liquid oxygen container and the control unit is through a coaxial cable which connects with an Amphenol socket located on the front cover. The remaining electrical connections are taken through a 6-pole plug which is also on the front cover. An on/off switch is not fitted on the unit, hence the control unit is in operation when the aircraft 28V d.c. supply is switched on.

4. The unit is designed for operation with a capacitance of between 360 pF and 390 pF when the converter is empty; this is increased by between 70 pF and 80 pF when the converter is full. The indicator circuit may be of any impedance between 10 ohms and 3K ohms.

OPERATION

5. The circuit (fig. 2), which is in four parts, consists of an oscillator, a.c. amplifier, d.c. amplifier and the power supplies.

Oscillator

6. A simple oscillator circuit, consisting of a transistor VT1, a transformer T1, capacitors C2 and C2(a), and a resistor R4, generates an a.c. signal of constant frequency, and its amplitude is held constant at 4·9V r.m.s. by Zener diodes MR1 and MR2. A centre-tapped, secondary winding of the transformer feeds the a.c. signal to the capacitor in the liquid oxygen container from one end of the winding, and to the capacitors C3 and C4 from the other end. Thus, the capacitors form a bridge, and a balance is obtained at the empty condition of the liquid oxygen container by adjusting capacitor C3. The presence of liquid oxygen increases the capacitance of the container and an out-of-balance state is produced. This results in an a.c. current, proportional to the amount of out-of-balance, flowing from the centre-tap of the transformer; this current is fed to an a.c. pre-amplifier which forms part of an a.c. amplifier.

A.C. amplifier

7. The a.c. amplifier comprises transistors VT4 and VT5 and their associated components, and also incorporates the pre-amplifier consisting of transistors VT2 and VT3, together with their associated components.

8. The pre-amplifier converts the a.c. current input from the capacitor bridge to an output voltage of between 30 mV and 200 mV (approximately) corresponding to the respective empty and full states of the liquid oxygen container. This voltage is fed to the a.c. amplifier, which has a gain of about 7, and provides an output voltage of between 200mV and 1·4V (approximately) when the converter is empty and full respectively. Adjustment of the gain to obtain the correct output voltage at the full condition is by the variable resistor RV1.

9. Negative a.c. feedback in both parts of the a.c. amplifier ensures stability of the signal gain, and d.c. feedback through the same resistor network ensures stability of the d.c. working points. A positive voltage of 6·2V d.c. is provided by resistor R29 and Zener diode MR3 for the operation of the transistors VT2 and VT4, and for VT7 in the d.c. amplifier. Capacitor C5 prevents oscillation due to interaction between the pre-amplifier and the a.c. amplifier. Two capacitors back to back, C6(a) and C6(b), provide a signal earth while at the same time preventing any possibility of a d.c. flow through the aircraft frame.

D.C. amplifier

10. Signals from the a.c. amplifier are detected by diode MR4, and passed through an input resistor and smoothing network R17, C12 and R18, to the d.c. amplifier consisting of transistors VT6, VT7 and VT8. The output from transistor VT7 must be reduced in voltage before it can be fed to the base of the output transistor VT8, and two voltage dropping Zener diodes, MR5 and MR6, are therefore included in the circuit.

11. The amplifier gain is controlled by the ratio of the value of the negative feedback resistor R23 to the total value of the input resistors R17 and R18; by including the indicator in the negative feedback loop; indicator impedances of between 10 ohms and 3K ohms can be accommodated. Indicator currents range between 0·4mA for empty indication and 2·0mA for full indication. Indications outside this current range give warning of a fault. Temperature compensation is provided by a sensistor SE1 which is arranged to afford compensation for the complete unit.

Power supplies

12. The aircraft 28V d.c. supply is smoothed and stabilized at +16V d.c. by resistors R27 and R28, and a Zener diode MR7. Transient high, positive voltages are eliminated by capacitor C14, and reverse transients are by-passed by diode MR8.

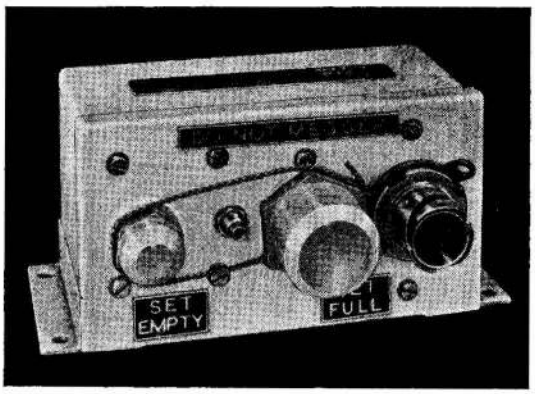

Fig. 1. Contents gauge control unit—

INSTALLATION

Caution . . .

It is essential to ensure that the liquid oxygen container is completely empty when the 'empty' indication is obtained. In the event of the SET EMPTY *control being incorrectly set to give an empty indication when the container contains liquid oxygen, further emptying of the container will result in an initial decrease in indication below 'empty' which may then be followed by an increase in indication of liquid oxygen contents.*

13. The following instructions are complementary to those given in the relevant aircraft air publication to which reference should be made.

(1) In the event of the control unit and the liquid oxygen container not being matched, the full matching procedure (para. 15) must be applied.

(2) Ensure that the co-axial cable is connected to the control unit, and the 6-pole plug is securely mated with its associated socket.

Post installation checks

14. Ensure that the indicator reads correctly when the liquid oxygen container is empty and full respectively, and that the pointer does not rest against the stops at either end of the scale.

SERVICING

WARNING . . .

Many materials, particularly oil and grease, are subject to spontaneous combustion when exposed to undiluted oxygen under pressure. Precautions must be taken, therefore, to exclude oil, grease, dust and metal particles from the control unit.

Matching the contents gauge control unit to the container

15. The procedure for matching the contents gauge control unit to the container is as follows :—

(1) Connect the co-axial cable to the control unit and connect the other end of the cable by a special adapter (Part No. 1058K000) to a variable air condenser (Ref. No. 6C/3039).

(2) Connect a 28V d.c. supply and a multimeter, Type 1 (Ref. No. 10S/16411) to the control unit as shown in fig. 3.

(3) Set the variable air condenser to a capacitance value equal to the 'empty' capacitance of the container less the capacitance of the special adapter. The capacitance values of the container and the adapter are inscribed on the respective units.

(4) Remove the cover of the SET EMPTY control on the contents gauge control unit, and adjust the control to obtain a reading of 0·4mA (d.c.) on the multimeter. The control unit has a 'dip' characteristic and, when adjusting the SET EMPTY control, the zero must be set on the correct side of the dip. The correct setting can be determined by observing the direction of movement of the gauge pointer when turning the SET EMPTY control clockwise; this should produce a counter-clockwise movement of the gauge pointer.

(5) Set the variable air condenser to the full capacitance value inscribed on the container, less the capacitance of the adapter.

(6) Remove the cover of the SET FULL control. Adjust the control to obtain a reading of 2·0mA (d.c.) on the multimeter.

(7) Reset the variable air condenser to the capacitance value stipulated in sub-para. (3) to obtain a reading of 0·4mA on the multimeter.

(8) Reset the variable air condenser to the capacitance value specified in sub-para. (5) to obtain a reading of 2·0mA on the multimeter.

(9) Repeat the procedures detailed in sub-para. (7) and (8) until the readings are correct for both settings without further adjustment.

(10) Assemble the covers to the SET EMPTY and SET FULL controls and wire-lock using locking wire (Ref. No. 30A/3339). Record the serial number of the container to which the unit has been matched.

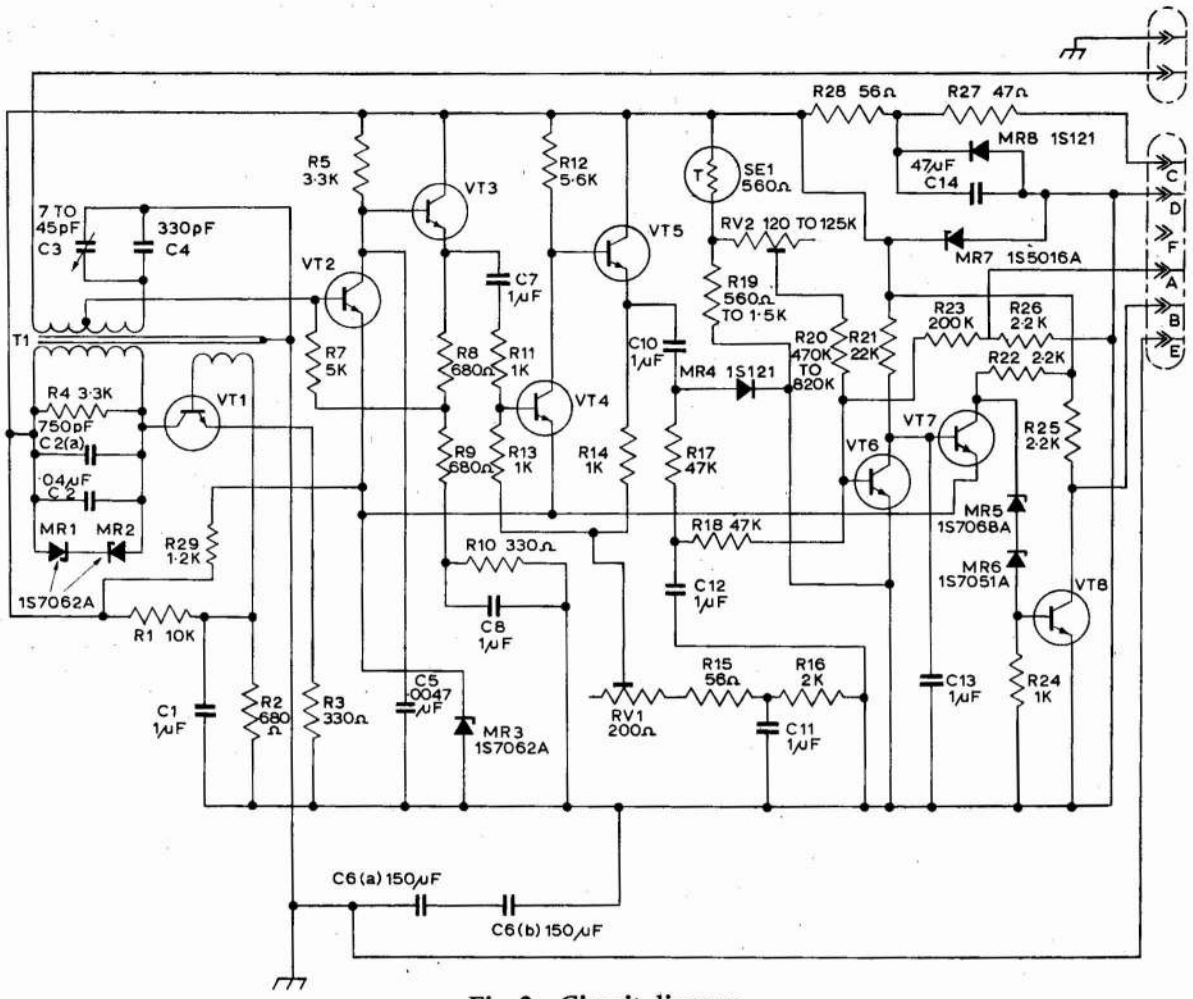

Fig. 2. Circuit diagram

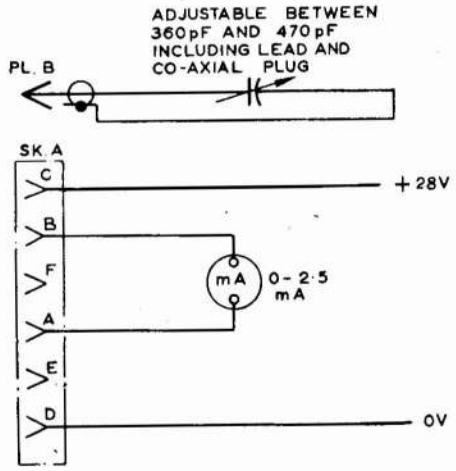

Fig. 3. Circuit diagram for matching procedure

Appendix 1

STANDARD SERVICEABILITY TESTS for CONTENTS GAUGE CONTROL UNIT (Part No. 1215X000)

Introduction

1. The tests detailed in this appendix should be applied before the unit is matched to a container prior to installation in an aircraft, when the serviceability of the unit is in doubt and at the appropriate examination periods at Equipment Depots.

TEST EQUIPMENT

2. The test equipment required for the tests is as follows :—

(1) Variable air condenser (Ref. No. 6C/3039), equipped with a special adapter (Part No. 1058K000)
(2) A co-axial cable assembly (Part No. OP.7140) terminating in an Amphenol plug, Type TY27-7
(3) Multimeter, Type 1 (Ref. No. 10S/16411)
(4) Plessey socket, Type 691ET-10-6S
(5) 28V d.c. supply.

PARTICULARS OF TESTS

3. The SET EMPTY control of this unit has a 'dip' characteristic. It is essential that the multimeter indication is on the correct side of the 'dip'; this will be revealed when, on turning the SET EMPTY control clockwise, the multimeter indication decreases.

4. Insulation resistance tests must not be applied to this unit.

TEST PROCEDURE

WARNING . . .

Many materials, particularly oil and grease, are subject to spontaneous combustion when exposed to undiluted oxygen under pressure. Precautions must be taken, therefore, to exclude oil, grease, dust and metal particles from the control unit and test equipment.

Setting

5. (1) Connect the control unit to the test circuit as shown in fig. 1.

Caution . . .

The control unit will be damaged if the polarity of the supply is reversed.

(2) Remove the covers from the SET EMPTY and SET FULL controls.
(3) Set the multimeter to the 1mA (d.c.) range and the variable air condenser to a capacitance value of 375pF. Switch on the 28V d.c. supply.
(4) Adjust the SET EMPTY control as necessary and verify that an indication of 0·4mA can be obtained on the multimeter.
(5) Reset the multimeter to the 10mA (d.c.) range and adjust the variable air condenser to 450pF.
(6) Adjust the SET FULL control as necessary and verify that an indication of 2·0mA can be obtained on the multimeter.
(7) Owing to interaction between the SET EMPTY and SET FULL controls, the instructions detailed in sub-para. (3) to (6) must be repeated alternately until no further adjustment is needed to obtain the readings.

Maximum and minimum inputs.

6. (1) Repeat the tests (para. 5(3) to 5(7) inclusive) using 360pF setting on the air condenser for SET EMPTY capacitance, and 430 and 440pF, consecutively, for the SET FULL capacitance. In each instance it must be possible to obtain 0·4mA and 2·0mA.
(2) Repeat tests (para. 5(3) to 5(7) inclusive, using 390pF for SET EMPTY capacitance and 460 and 470pF, consecutively, for the SET FULL capacitance. In each instance it must be possible to obtain 0·4mA and 2·0mA
(3) Reset the contents gauge control unit to the conditions specified in para. 5(3) to 5(7) inclusive.

Open circuit failure

7. (1) Disconnect the air condenser and check that the multimeter indication rises to not less than 2·5mA.
(2) Switch off the electrical supply and disconnect the unit from the test circuit. Replace the covers on the SET EMPTY and SET FULL controls and wire-lock using locking wire (Ref. No. 30A/3339).

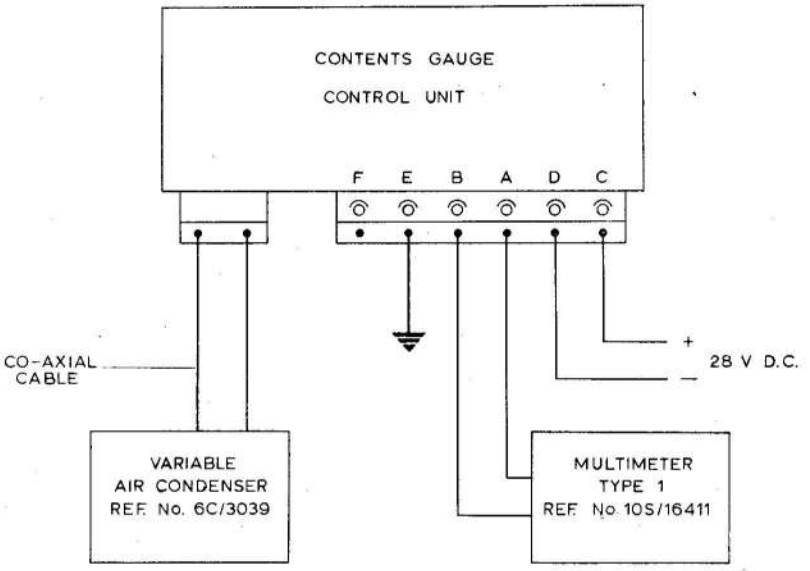

Fig. 1. Contents gauge control unit test circuit