SECTION 6

TEST STAND

LIST OF CHAPTERS

Chapter 1

TEST STAND

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LIST OF ILLUSTRATIONS

GENERAL DATA

Dimensions	
Overall length	5 ft. $1\frac{3}{4}$ in.
Overall width	2 ft. $9\frac{1}{4}$ in.
Overall height	3 ft. 10 in.
Fuel system	
Boost pump	Pulsometer P.D.C.20 Mk.1
Filter	Purolator MFF 10601
Fuel tank gauge	Smiths 2918 FG
Main fuel tank capacity	15 gal.
Inhibiting fuel tank capacity ...	1 gal. approx.
Inhibiting fuel	OM-11.

Electrical equipment

Batteries	One S.A.F.T.5J/3364 One S.A.F.T.5J/3483
Field rheostat	Cressal A5332
Sump heater relay	Rotax D6701/2
Igniter box	Rotax NB25/2-L
Starter panel	Rotax EXP.5504
Heater banks	48 Bray heater strips Type S.E.19
Total load applied by alternator	40 kW at 208 volts

Operating panel

Ignition switch	Rotax D5405/1
Oxygen supply switch	Rotax D5405/1
Starter button	Rotax D2210/2
H.P. cock switch	Rotax D5406/4
Boost pump switch	Rotax D5406/5
Oil cooler switch	Rotax D5406/4
Air bleed switch	Rotax D5506/8
Panel warning light	Rotax H2702
Sump heater warning light ...	Rotax H2701
Air bleed warning light amber ...	Rotax H2705
Air bleed warning light green ...	Rotax H2703
Oil temperature gauge	Sangamo-Weston 563 Form 4
Oil pressure gauge	Sangamo-Weston 563 Form 4
Excitation voltmeter	Sangamo-Weston S78-3.587
Inhibiting connection	Lockheed A V A.55B

Loading panel

Pyrometer	Foster 0.850°C. 932 CHK. V.SX.
Pyrometer transit switch ...	Rotax D5406/5
Pyrometer calibration switch ...	Rotax D5406/5
Frequency meter	Nalder Bros. & Thompson 380-420 c/s
Voltmeter	Nalder Bros. & Thompson 0-250 volt
Compressor pressure gauge ...	Budenberg 0-40 lb/in^2
Fuse	Slydlok X5344

Miscellaneous equipment

Fire extinguisher	Graviner Type 34H
Air intake filters	Purolator MF.309 Purolator MIC.12802

Introduction

1. The test stand is a self-contained equipment designed specifically to facilitate fault diagnosis and to function test the Rover Mk. 10301 A.A.P.P.

2. The test stand is provisioned at second line to permit a new power plant to be de-inhibited and tested prior to installation in an aircraft, or to allow the proof running of a power plant following the installation of a replacement fuel system. The stand may also be used by the second line servicing bay for power plant fault diagnosis.

General description (fig. 1 and 2)

3. The basis of the test stand is a steel tubular frame into which all the equipment and controls necessary to operate the power plant are assembled.

4. The power plant to be tested is installed, complete with its transit stand, on top of the test stand where cup-shaped brackets are provided.

5. An adjustable metal trunk links the power plant air intakes with a filter box mounted in the forward end of the test stand. The filter box also contains two heater banks which can be fed from the power plant alternator to simulate high ambient intake temperature.

6. The power plant alternator is controlled by a Cressal field rheostat mounted midway in the frame immediately above the fuel tank. This tank is equipped with an electrically driven boost pump and a contents gauge.

7. Two 24 volt batteries, which are mounted one above the other at the rear of the stand, provide all the electrical power required for the test stand control and excitation circuits.

8. The test stand has two instrument panels; an operating panel at the front, which simulates all the aircraft switching and instrumentation, and a loading panel at the rear, which enables all the power plant electrical and air bleed loads to be measured.

9. The stand equipment includes a number of loose items stowed or clipped within the frame, including an air bleed valve orifice plate, a fire extinguisher and an exhaust duct extension and clamp ring.

Test stand frame

10. The test stand frame is a welded structure fabricated from steel tubing reinforced at each corner by a triangular plate steel gusset.

11. At the four top corners of the stand, are dished mounting brackets for the power plant transit stand. Four brackets welded to the upper longitudinal frame members are steel bushed to serve as hoisting lugs. The four lugs together with their shackles are proof tested to carry a load of 2100 lb.

12. The test stand equipment is supported within the frame by a series of L-shaped brackets welded to the principal frame members.

Fuel system

13. The test stand fuel system consists of a fifteen gallon fuel tank, a boost pump, a Purolator fuel filter, a three-way fuel cock, a one gallon inhibiting fuel tank, and an inhibiting connection.

14. The main fuel tank is of lead coated sheet steel, and is retained by a metal strap midway between the two lower longitudinal frame members. A direct reading gauge mounted on the top right-hand side of the tank provides a visual indication of the fuel tank contents.

15. The Pulsometer, P.D.C.20, Mk. 1 boost pump, mounted in the base of the fuel tank, consists basically of an electrically driven impeller mounted directly on the armature shaft of a motor unit. From the impeller, the fuel is delivered into a spiral volute channel which in turn connects with the delivery line through a $\frac{3}{8}$ in. B.S.P. tapping.

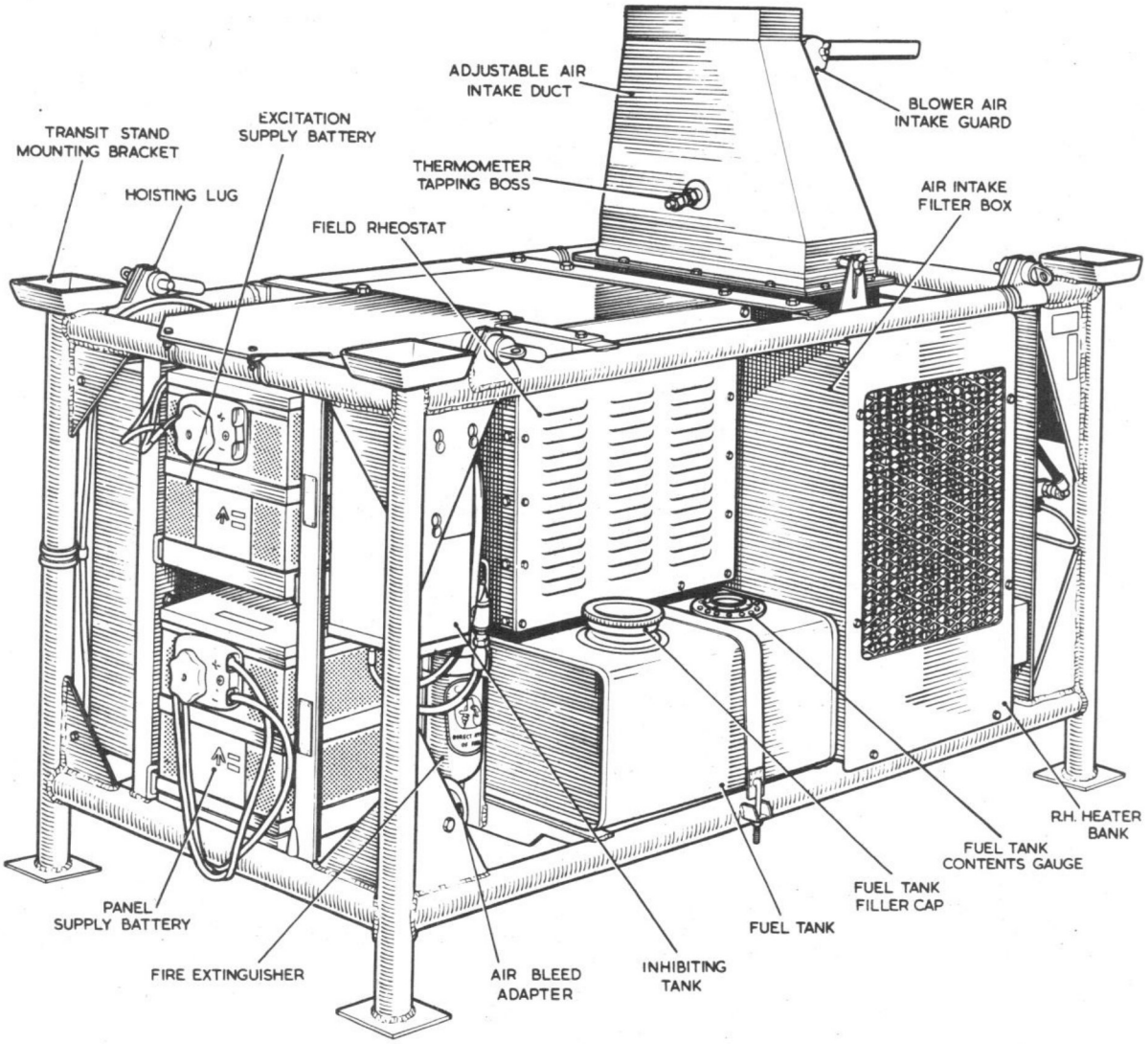


Fig. 1. Starboard view of test stand

16. A wire mesh filter surrounding the pump inlet prevents the entry of foreign matter into the impeller system which, in turn, is enclosed by a vapour baffle designed to assist in clearing air and fuel vapour.

17. The totally enclosed and flame-proof motor unit is a continuously rated 26 volt d.c. shunt wound machine with an output of 0.07 horse power. The armature shaft, supported at each end by ball bearings, is sealed at the pump end by a rotating carbon gland and a thrower arrangement mounted on the shaft.

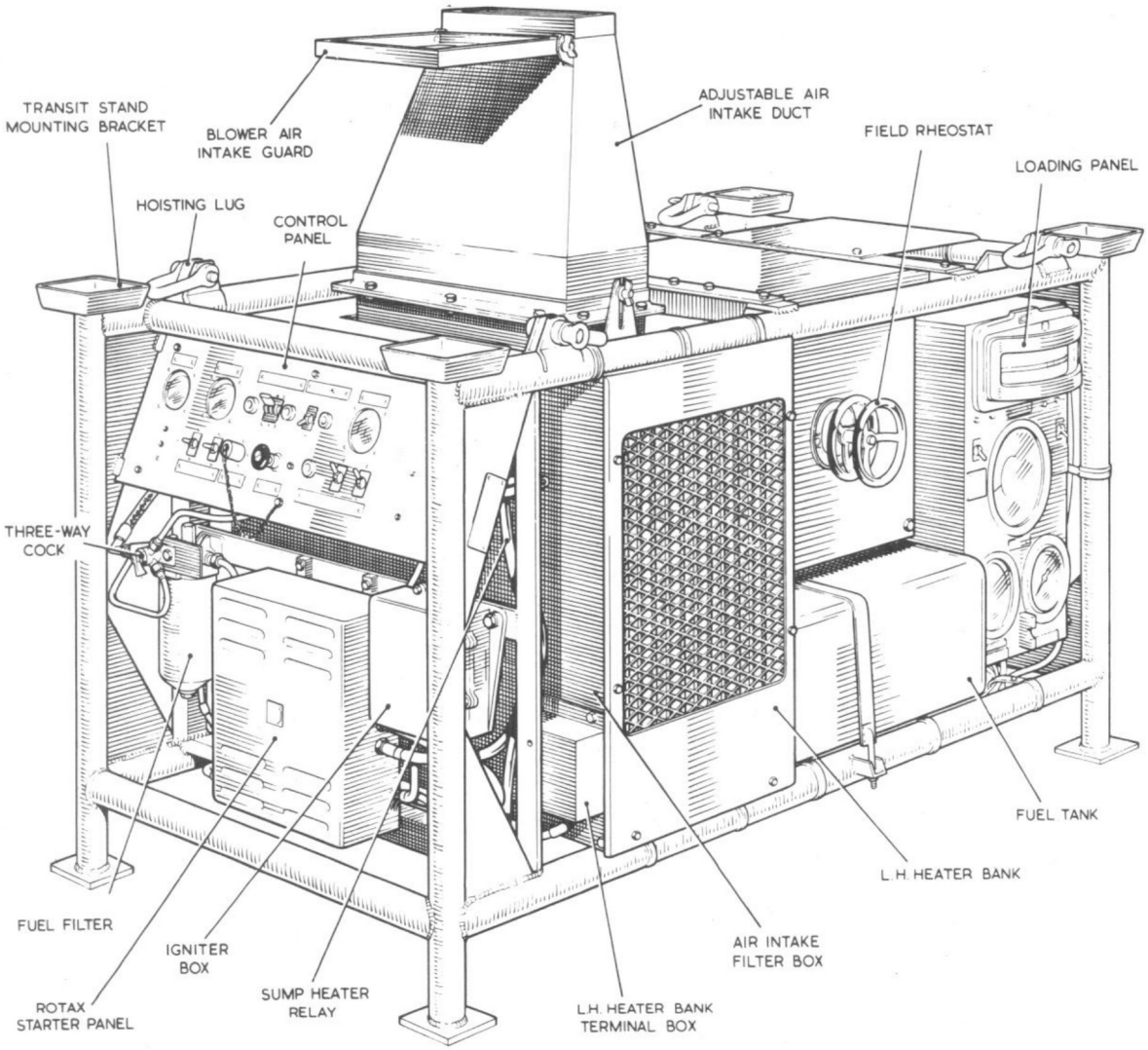


Fig. 2. Port view of test stand

18. The output of the fuel boost pump is fed via the Purolator fuel filter to a three-way cock mounted underneath the operating panel at the forward end of the stand.

19. At the three-way cock, which is labelled OFF, MAIN TANK, and INHIBITING, the fuel line divides into two branches; one branch leads through a flexible pipe to the low pressure side of the power plant fuel system, whilst the other is piped to the inhibiting connection on the operating panel.

20. The inhibiting connection on the operating panel is the male half of a Lockheed-Avery coupling which enables the detachable one gallon inhibiting tank to be connected into the test stand fuel system by a corresponding female half coupling and flexible hose.

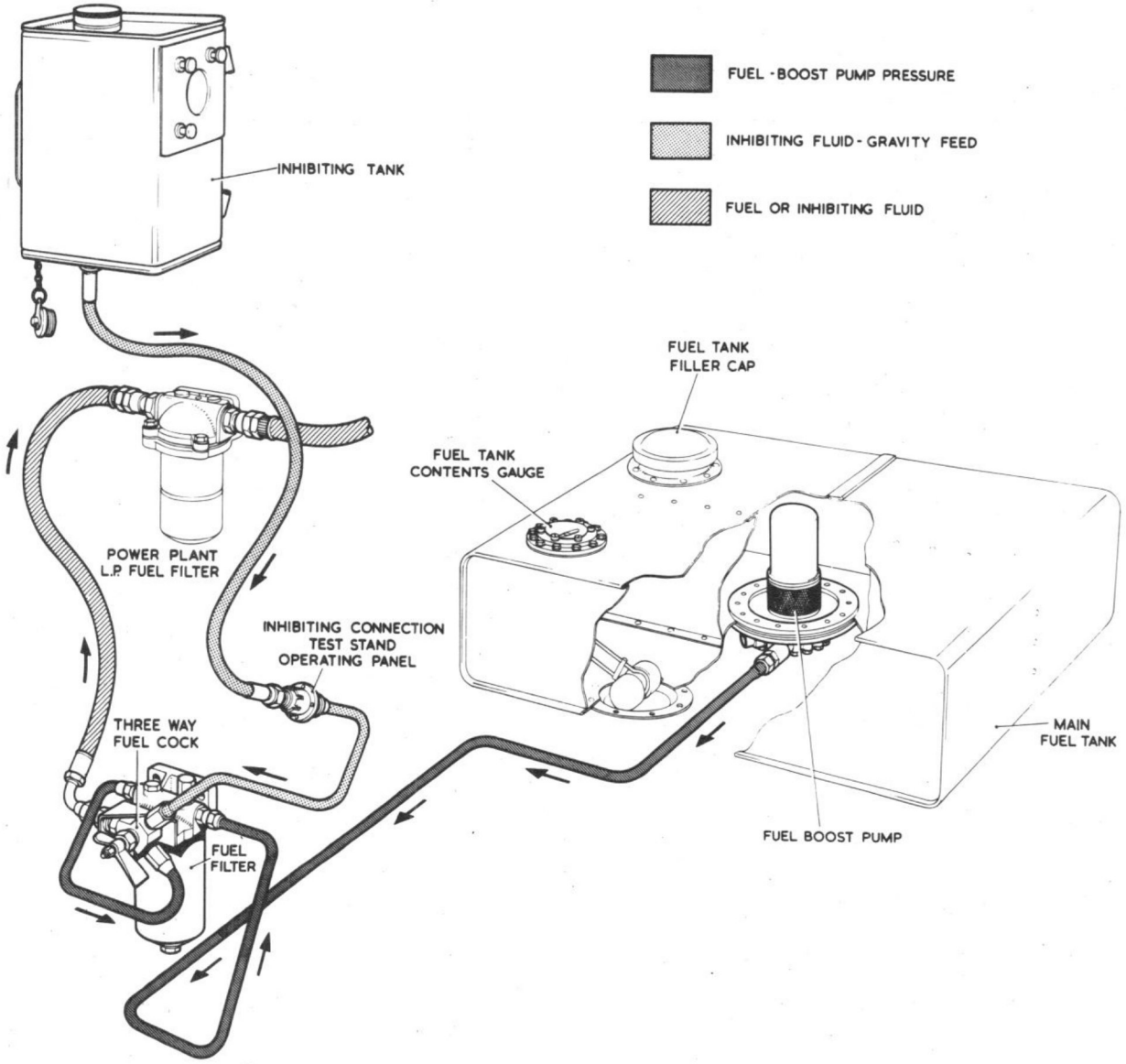


Fig. 3. Fuel system

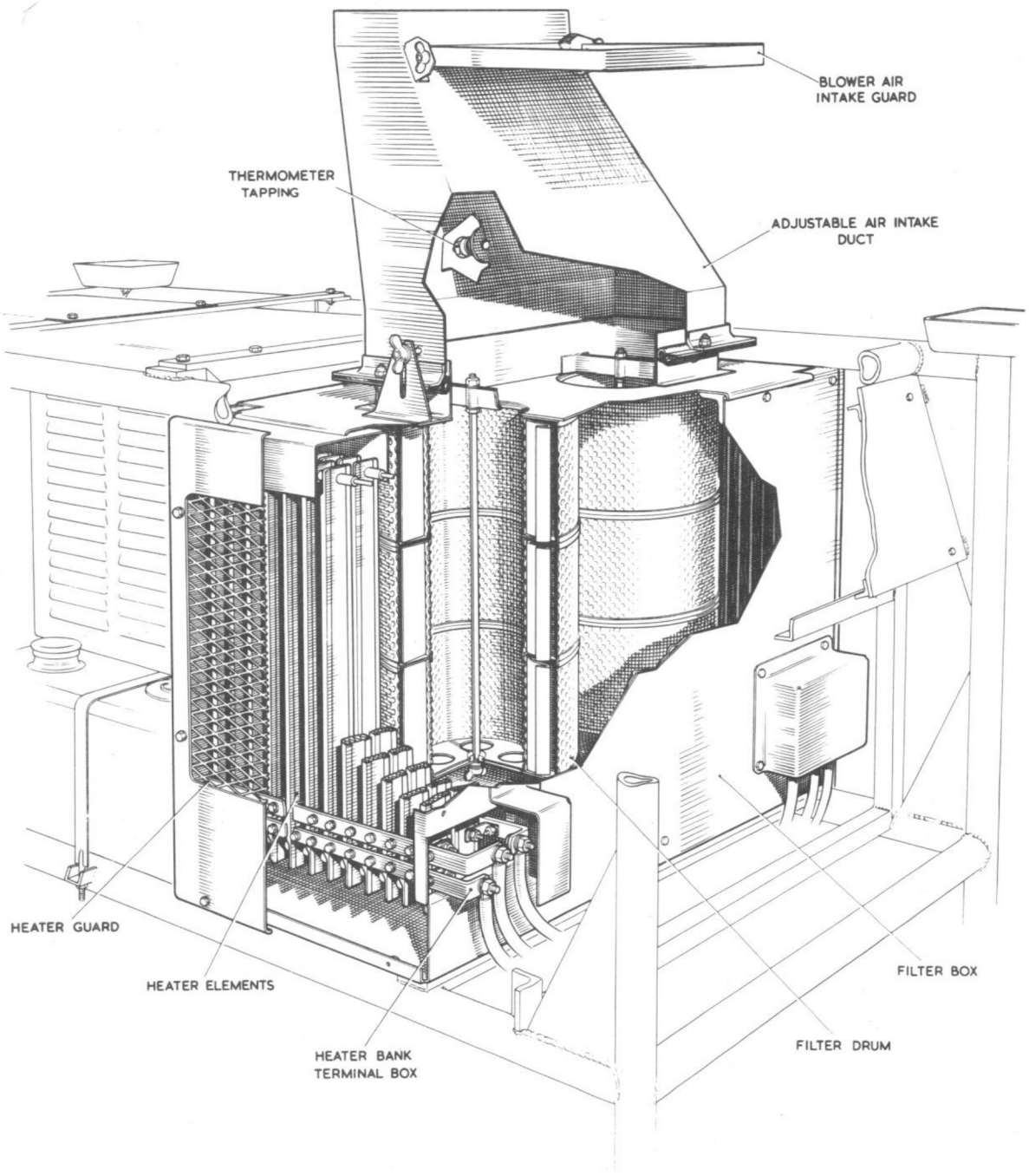


Fig. 4. Air intake system

21. The one gallon capacity inhibiting tank is designed to be suspended from the top of the power plant transit stand, the height of which is sufficient to allow the tank contents to be gravity fed into the power plant fuel system.

Air intake system (fig. 4)

22. The air intake system consists of a filter box, two air intake heaters and an adjustable intake duct; the system is mounted at the forward end of the test stand.

23. The filter box houses two drum shaped filter elements. Each filter drum consists of three renewable Purolator paper elements suspended from the filter box cover by a central rod, retaining plate and wing nut.

24. The purpose of the air intake heaters is to simulate the maximum load condition of the power plant by absorbing the alternator output and effectively raising the ambient air intake temperature.

25. Each of the two air intake heaters consists of two banks of twelve heater elements mounted on long studs in the filter box air intakes. Spacing washers on the studs correctly position the heater elements in relation to each other. Both intake heaters are protected by expanded metal guards.

26. Each heater element consists of a helical wound nickel chrome resistor embedded in a refractory material which in turn is enclosed by a chromium steel sheath. All the elements are linked in parallel by copper connecting strips to two separate terminal boxes on the forward face of the filter box.

27. The capacity of each individual heater element is 850 watts at 210 volts, while the combined capacity of the two air intake heaters, when supplied by the power plant alternator, is 40 kW at 208 volts.

28. The adjustable air intake trunking, located between the test stand filter box and the power plant air intakes, consists of a rectangular section duct of welded aluminium alloy sheet. The lower end of the duct seats loosely over a projecting spigot flange on the filter box cover to form a sliding joint, whilst the upper end of the duct is a slide fit in the power plant air intake aperture.

29. The lower sliding joint is sealed by a ring of bedding tape trapped between a double flange on the bottom edge of the duct. Two studded bosses complete with wing nuts positioned one on each side of the duct locate in slotted brackets on the filter box cover to enable the duct to be locked at the required height.

30. A tapped boss on the rear face of the duct provides an insertion point for an ambient temperature thermometer. The boss is normally sealed by a blanking nipple, union nut and split pin. The forward face of the duct carries a hinged expanded metal guard which, when swung into the horizontal position, forms a protective cover for the power plant blower air intake.

Air bleed valve outlet adapter (fig. 5)

31. The air bleed valve outlet adapter consists of a calibrated orifice plate clamped to a short aluminium alloy cylinder which in turn is clamped to the outlet side of the power plant air bleed valve. When not in use, the adapter is normally secured by one of its clamp rings to a circular

plate at the rear end of the test stand frame.

32. The air bleed adapter has two main functions. It prevents the engine being overloaded by limiting the amount of bleed air released from the engine; and secondly, through a calibrated union in the adapter body, it provides a means of measuring the air bleed output.

Electrical system (fig. 8)

33. The test stand electrical system can conveniently be considered in two parts, the operating circuit and the excitation circuit.

34. Each circuit is powered by its own 24 volt battery. The two batteries, labelled PANEL SUPPLY and EXCITATION SUPPLY respectively, are mounted one above the other at the rear end of the test stand frame. Each battery is linked to the appropriate circuit by an Elcon battery disconnect that serves as a master switch to the circuit.

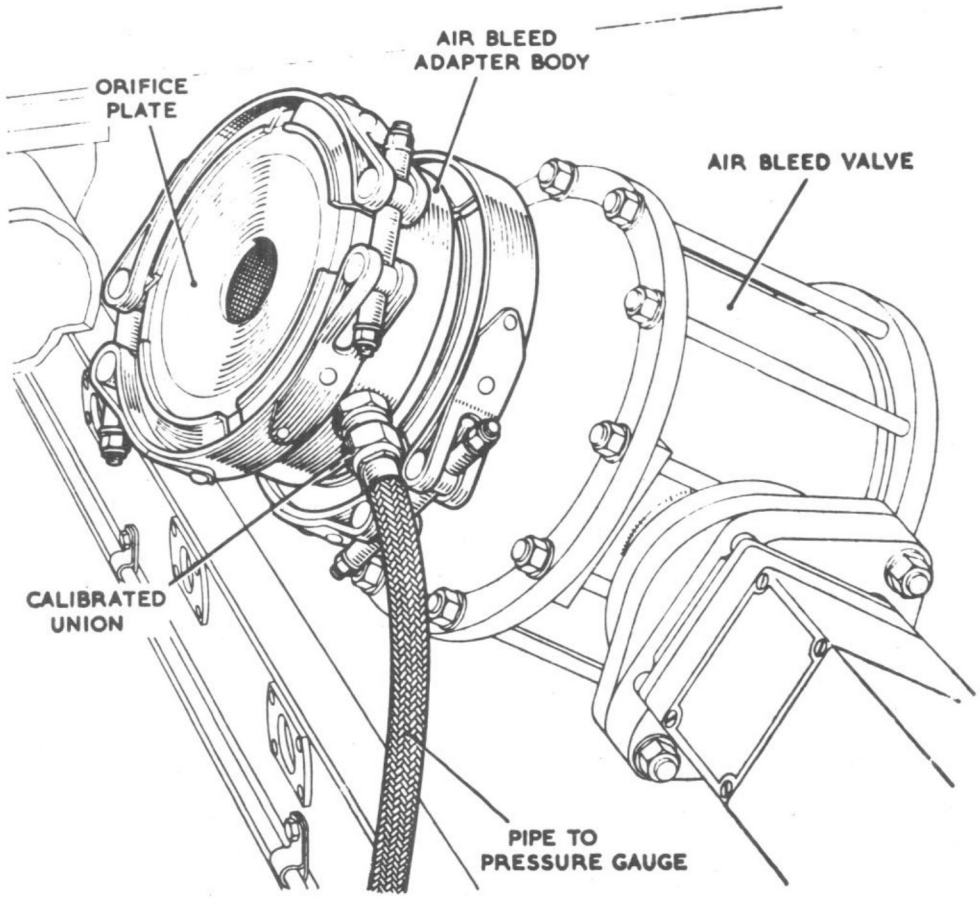


Fig. 5. Air bleed adapter

Operating circuit

35. The operating panel (fig. 6) located at the forward end of the test stand contains :-

(1) A 'panel live' warning light.

(2) The ignition ON switch.

(3) The oxygen supply switch.

(4) The starter solenoid switch.

(5) The H.P. cock actuator switch.

(6) The fuel booster pump switch.

(7) The oil cooler actuator switch.

(8) The sump heater warning light.

(9) The double pole air bleed switch with its two associated warning lights.

(10) The oil pressure and temperature gauges.

(11) The excitation voltage meter.

(12) The fuel system inhibiting connection.

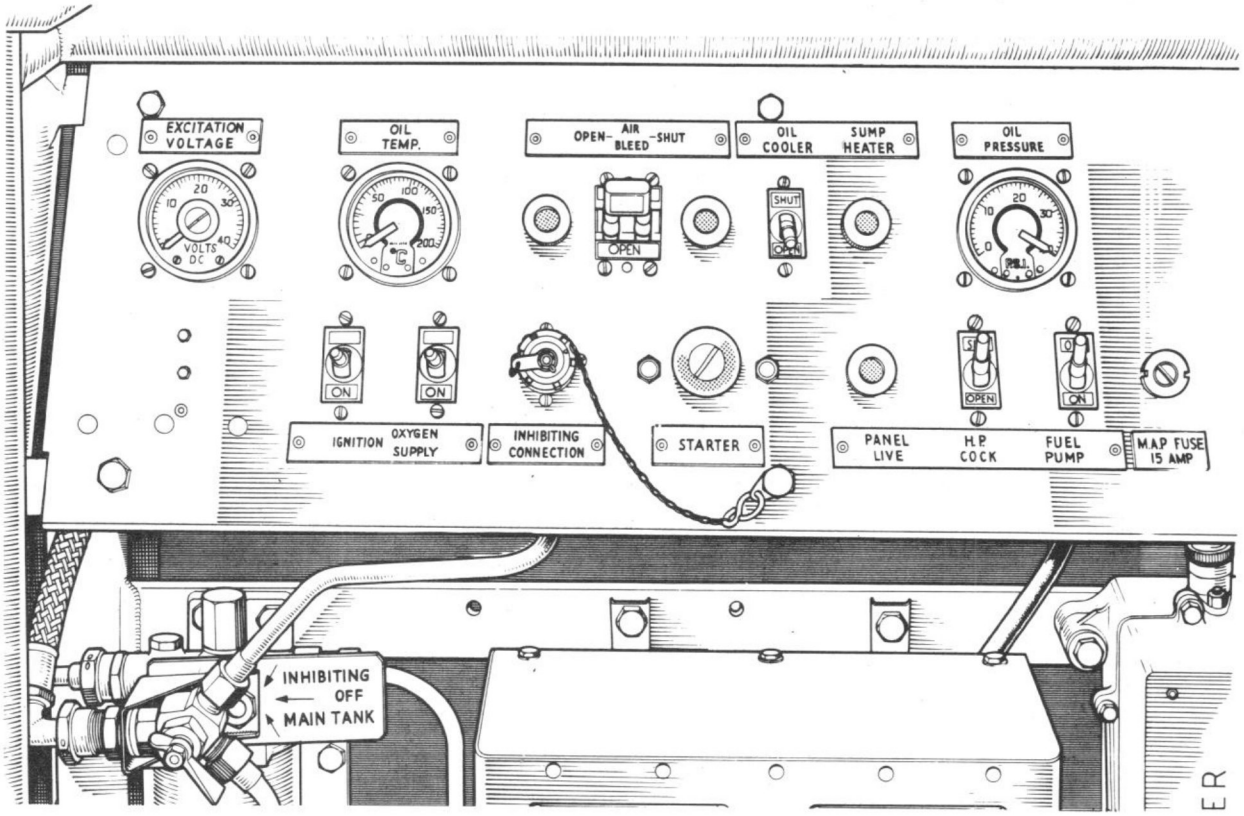


Fig. 6. Operating panel

36. The action of engaging the PANEL SUPPLY battery disconnect, which serves as a master switch for the operating circuit, allows a 24 volt supply to flow directly to the controls mounted on the operating panel. The red warning light on the panel gives a visual indication that the PANEL SUPPLY battery is in circuit.

Starting

37. A step-by-step circuit description of the starting sequence is given in the following paragraphs (fig. 8 refers).

38. Oil cooler switch. When the oil cooler switch is operated to OPEN, a positive supply is fed from the contacts of the switch through pin No. 5 in the power plant 1.B.3 bulkhead plug to the 'open' field winding of the oil cooler actuator. This circuit is disconnected at the contacts of the actuator limit switch when the oil cooler butterfly is fully open. The negative return is completed through pin number 3 of the 1.B.3 bulkhead plug.

39. Fuel boost pump switch. When the fuel boost pump switch is selected to the ON position, a positive supply is completed to terminal A of the boost pump. The negative return from the boost pump terminal B is routed through the negative terminal of the Rotax starter panel.

40. H.P. cock switch. When the H.P. cock switch is operated to OPEN, a positive supply is completed by way of pin number 2 in the power plant 1.B.1 bulkhead plug to the OPEN field sinding of the H.P. cock actuator. From the OPEN contacts of the H.P. cock switch, a positive supply is also extended to the power plant hours counter. The actuator field circuit is disconnected at the contacts of the actuator limit switch, when the H.P. cock is fully open. The negative return from the actuator is completed through pin number 1 in the 1.B.1 bulkhead plug.

41. Starter switch. When the starter push switch is depressed to close the positive terminal with terminal S.1, a positive supply is completed to terminal P.1 on the Rotax starter panel.

42. The Rotax starter panel is located immediately beneath the operating panel and consists of a light alloy panel on which are mounted an engaging relay, an overspeed relay, a time delay switch and a starting resistor. A louvred alloy cover, secured by six screws, protects the units when the panel is in position.

43. The positive supply obtained when the starter switch is depressed is fed from terminal P.1 through the number 1 contact of the time delay switch to the coil of the engaging relay. The relay operates and feeds the positive supply via the starting resistor to terminal ST which is connected to one side of the armature of the power plant starter motor.

44. The overspeed relay is energised by the armature current and closes, connecting the supply to the coil of the starter push switch, holding the switch in the operated position. The current is also extended to the supply and interrupter contacts and coil of the time delay switch, which then commences its run and after 30 seconds contacts 1 of the relay switch open, de-energising the engaging relay, the contacts of which break the circuit to the armature of the starter motor causing the overspeed relay to open. This, in turn, breaks the hold-on coil circuit of the push switch terminating the starting operation.

45. Should the power plant reach a self-sustaining speed in less than 30 seconds, the reduced starter motor armature current will fail to retain the overspeed relay in the closed position, and the starting operation will be automatically terminated.

46. Early termination of the normal starting sequence is achieved through the overspeed relay, which is current operated, opening and breaking the hold-on coil current of the starter push switch when the starter motor armature current, flowing through the overspeed relay winding, falls to a pre-determined value.

47. Ignition switch. When the ignition switch is operated to ON, the positive supply is extended to terminal B on the Rotax high energy igniter box, and the output of the igniter box is conducted through an armoured high tension cable to the power plant bulkhead connector. The ignition switch is spring loaded in the OFF position and must be held in the operated position until the starter push switch is released. The action of closing the ignition switch also extends the positive supply to the power plant starts counter, through pin D in the socket plug on the hours and starts counters assembly.

WARNING . . .

The energy stored in the capacitors incorporated in the high energy igniter can in certain circumstances be of a lethal nature. No servicing should be attempted until at least one minute has elapsed after disconnection of the L.T. supply to the input plug.

Oxygen switch

48. When the oxygen switch is operated to ON, a positive supply is extended from the contacts of the switch to the terminal block on the power plant oxygen equipment. The oxygen switch is spring loaded to the OFF position.

Caution . . .

The sole purpose of the oxygen switch is to enable the oxygen solenoid valve to be functionally tested, and under no circumstances must the oxygen be selected ON whilst the engine is running.

Air bleed operation

49. Air bleed switch in open position. The action of moving the air bleed switch to the OPEN position connects the positive supply, through pin number 5 in the power plant 1.B.4 bulkhead plug, to the OPEN field windings of the air bleed valve actuator.

50. From the air bleed actuator limit switch, a positive supply is fed to the OPEN warning light on the test stand operating panel.

51. Air bleed switch in shut position. When the air bleed switch is selected SHUT, a similar sequence is completed through pin number 4 in the bulkhead plug and the CLOSED field windings of the actuator. In neither case is the appropriate warning light energised until the actuator has completed the traverse.

Sump heater operation

52. From the PANEL SUPPLY battery disconnect, a positive supply is extended to the sump heater thermostat and pins 8 and 9 in the 1.B.2 bulkhead plug to energise the sump heater relay mounted at the rear of the test stand.

operating panel.

53. When energised, the sump heater relay permits an external 200 volt, 400 c/s 3 phase supply to flow to the sump heater elements via pins 2, 3 and 7 in the 1.B.2 bulkhead plug. When the sump temperature reaches approximately 50°C the thermostat breaks the supply energising the heater relay, which in turn disconnects the external supply to the sump heater elements.

54. The positive supply for the oil temperature warning light is routed through normally closed contacts IN.1 and IN.2 in the sump heater relay so that the warning light is normally energised when the thermostat operates and breaks the supply to the sump heater.

Excitation circuit

55. The principal components involved in the alternator control and excitation circuit are the field rheostat, the excitation supply battery and a loading panel.

Alternator field rheostat

56. The rheostat consists of a master switch, a fixed 0.05 ohm 40 amp. resistance and two manually operated variable resistances, rated at 8.3 ohm 40 amp. and 0.3 ohm 40 amp. respectively. All four components are connected in series. A 500 ohm 30 watt resistor shunted across the master switch prevents any tendency for a voltage surge to occur when the switch is operated.

57. The purpose of the rheostat is to control and the supply of energising current from the excitation supply battery to the power plant alternator field and thereby regulate the power output of the alternator. The two variable resistances mechanically controlled by two external handwheels provide a coarse and vernier regulation.

External load bank

58. The output of the alternator is normally delivered through terminals A, B, and C in the power plant terminal block to the two heater banks located in the air intake system, but the alternator output can also be linked through the same set of terminals with an external load bank.

59. The load bank used should ideally be capable of absorbing a total of 24 kW in increments of 1,1,2,4,4 and 12 kW or one to twenty-four kW in 1 kW steps. The circuit for the external load bank should also include a frequency meter, a kilowatt meter, a line ammeter and a line voltmeter.

Loading panel (fig. 7)

60. The test stand loading panel at the rear of the frame consists of a box shaped unit; this unit, with the exception of the excitation voltmeter, contains all the instruments required to measure the various forms of load that can be applied to the power plant.

61. The two instruments in the loading panel directly concerned with the alternator control circuit are an 380-420 c/s frequency meter and an 0-250 volt measuring line voltage. Both instruments, which are protected by a one amp. fuse in the base of the panel, are connected in series with the air intake heater banks.

62. The 0-850°C Foster pyrometer, mounted at the top of the loading panel,

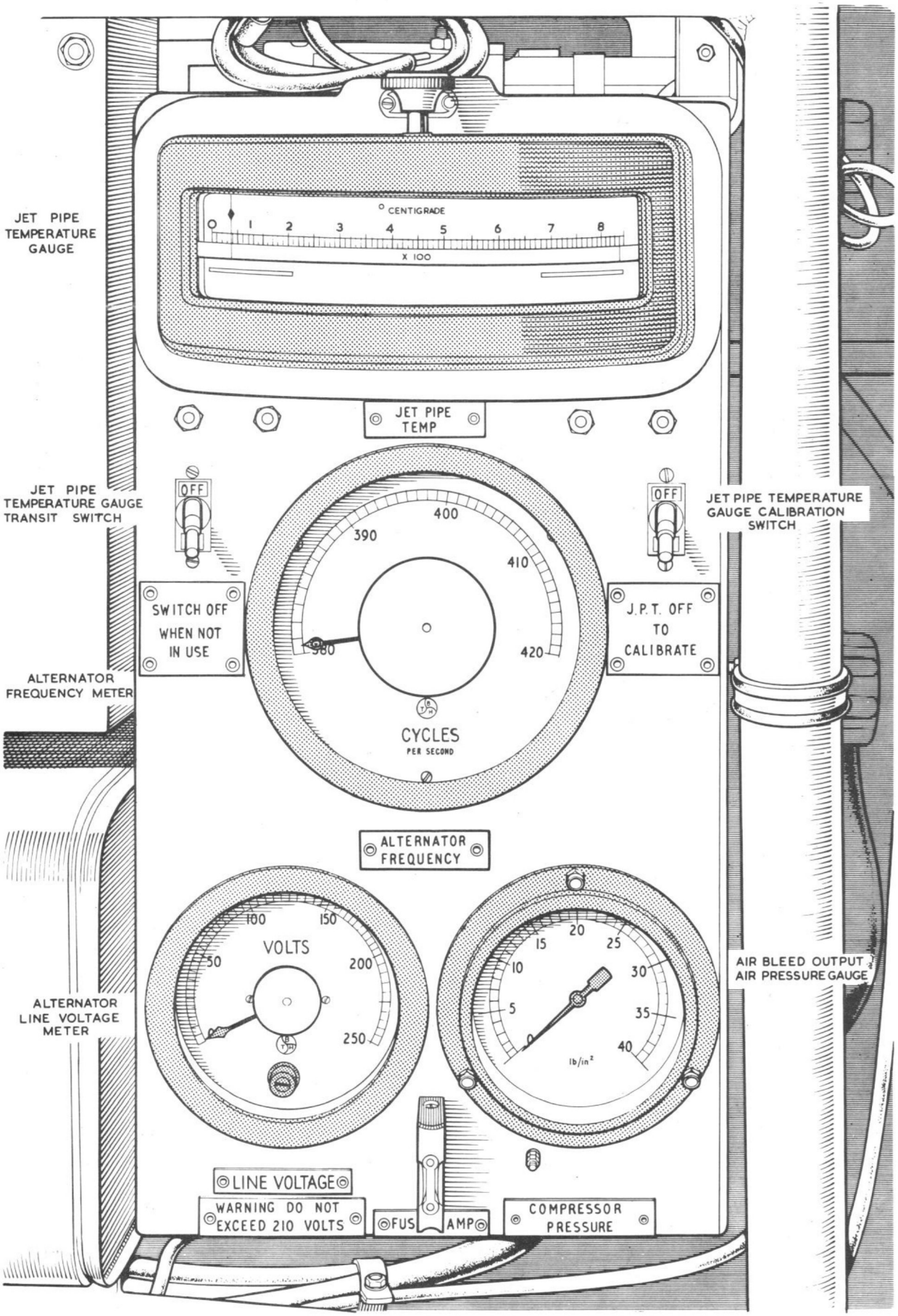


Fig. 7. Loading panel

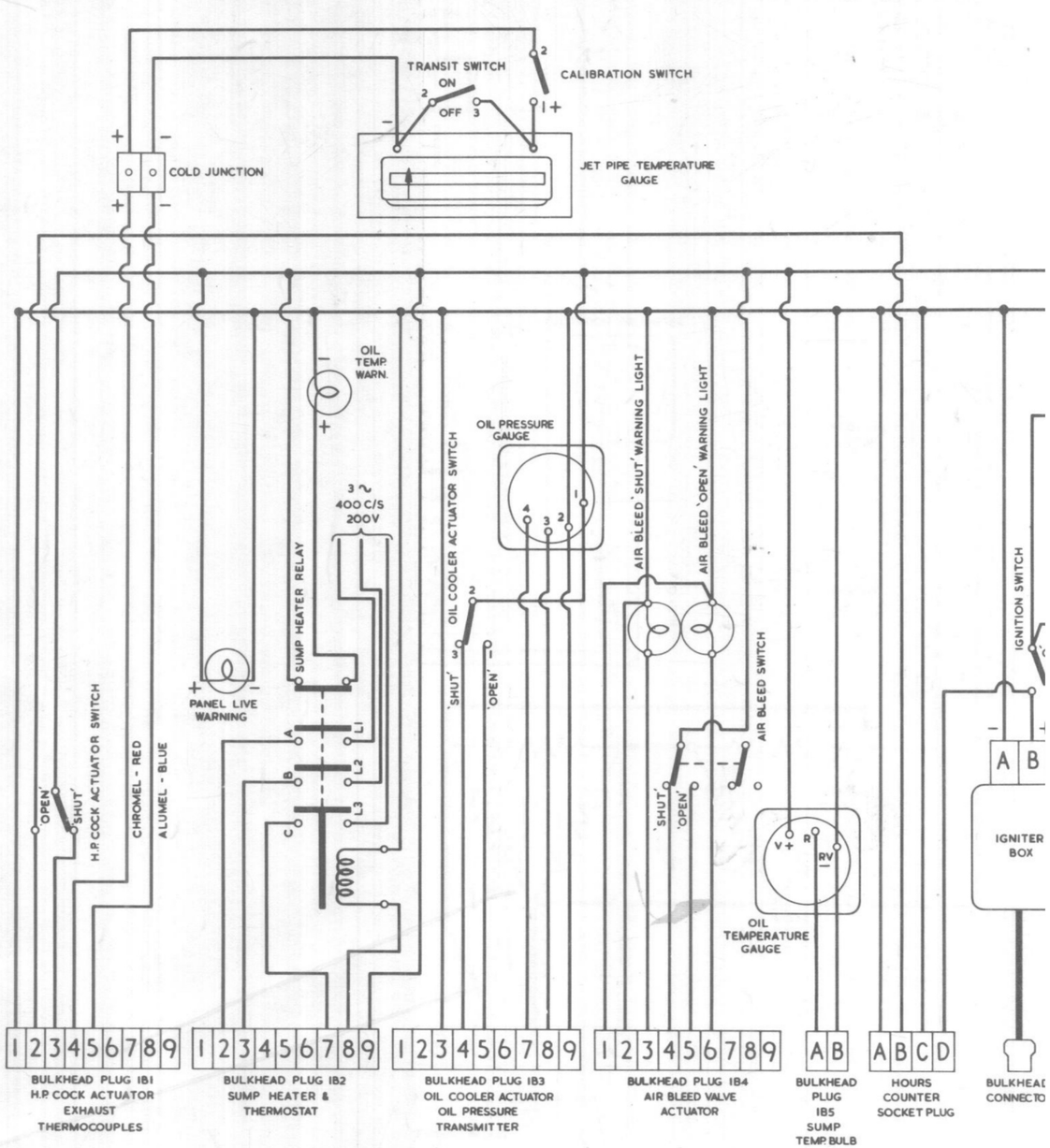
is linked through two copper extension leads to the cold junction at the rear of the operating panel. From the cold junction the circuit is extended, via a chromel-alumel harness and pins 4 and 5 in the 1.B.1 bulkhead plug, to the four thermocouples in the power plant exhaust cone.

63. A single pole switch in one of the copper extension leads enables the pyrometer to be isolated for calibration, an external adjusting key being located above the instrument bezel for that purpose. A second switch connected between the negative and positive terminals of the instrument will, when closed, protect the indicator from damage during transit, by damping any tendency for the indicator needle to swing.

64. The loading panel is fitted with an 0-40 lb/in^2 pressure gauge connected to the air bleed outlet adapter (para 31). The gauge provides a visible reading of the bleed air outlet pressure.

Miscellaneous equipment

65. The test stand equipment is completed by a hand operated Graviner fire extinguisher clipped to the right-hand side of the frame, and an extension duct to carry the power plant exhaust efflux clear of the test area. The extension duct is secured to the power plant jet pipe elbow by a split clamping ring.



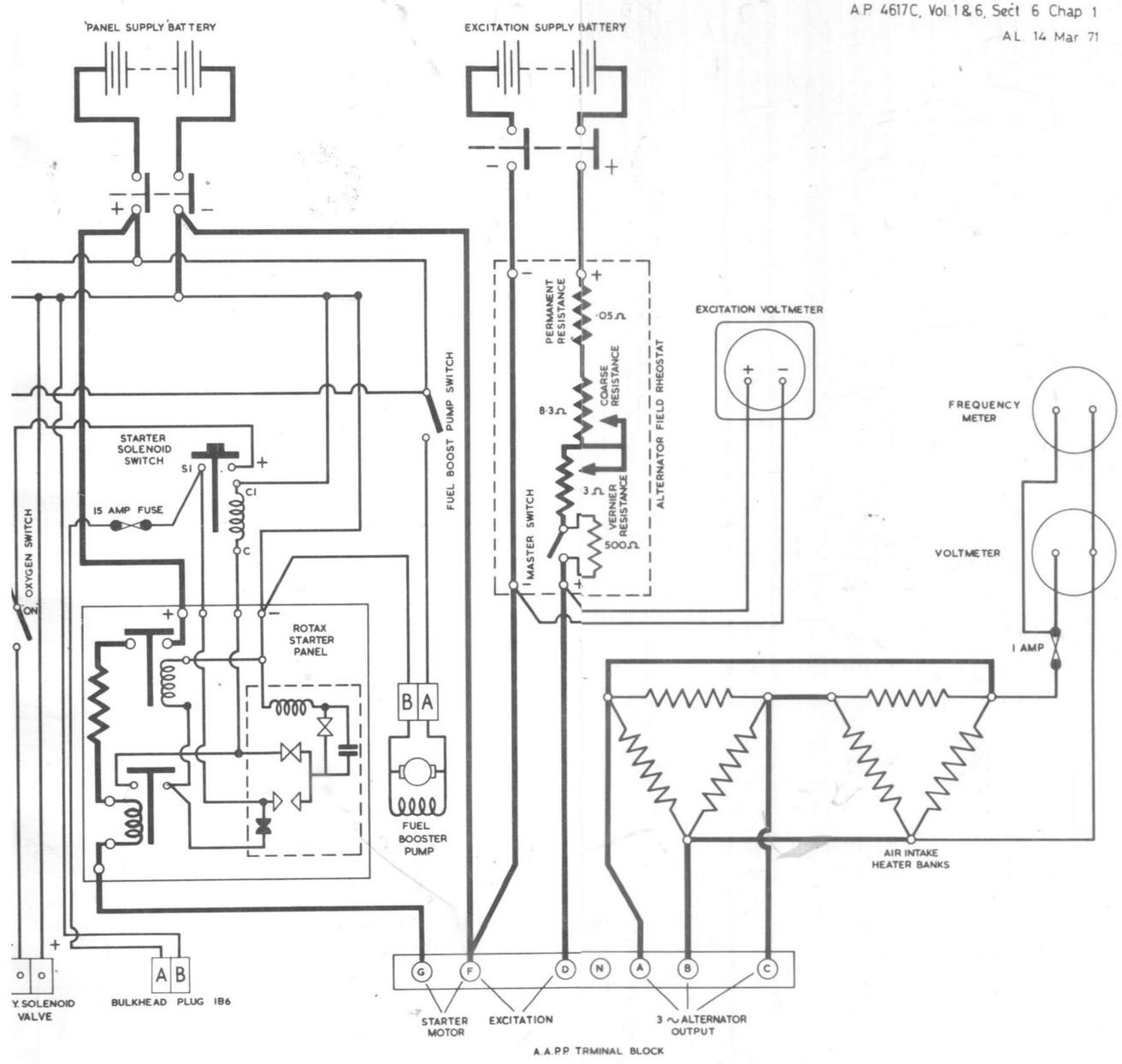


Fig.8

El trical circuit diagram

Fig.8

Chapter 2

GROUND RUNNING AND INHIBITING AN A.A.P.P. IN A TEST STAND

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. This chapter describes how to prepare the test stand for operation, how to install the power plant on the test stand, and the procedures to be adopted when running and testing the power plant.

Preparing the test stand for operation

2. The test stand does not require a specially prepared base, but care should be taken to ensure that the site chosen is firm and level, and that the rear of the stand is positioned so that when the power plant is installed the exhaust efflux is directed clear of personnel or flammable material.

3. The only other preparations necessary are to ensure that the fuel tank contains sufficient fuel for the duration of the test, and to install the panel and excitation supply batteries as described in the following paragraphs.

Filling the fuel tank

4. Remove the filler cap located on the right-hand side of the fuel tank, and fill the tank with one of the fuels listed in the Operating Limitations until the contents gauge registers FULL.

Note . . .

When the power plant is installed, the combined test stand and power plant fuel system must be bled before commencing operation (para. 10).

Installing the test stand batteries

5. Slide the two batteries into their respective angle iron brackets at the rear of the stand until the elongated slots in the battery covers engage with the vertical retaining studs; then secure each battery with two locknuts, plain and spring washers.

Caution . . .

The two battery disconnects serve as master switches for the test stand and should not be engaged until the power plant is ready to be run.

Installing the power plant

6. (1) Slacken the retaining thumb screws and push the adjustable air intake trunking on the test stand to its lowest position.

(2) Move the expanded metal blower air intake guard on the test stand intake trunking to the horizontal position.

(3) Using an approved four point sling, lift the power plant complete with its transit stand into position above the test stand.

(4) Check that each of the four castors on the power plant transit stand is locked in the UP position by its captive pip pin, then gently lower the power plant until the feet of the transit stand locate in the mounting caps on the four upright members of the test stand frame.

(5) Push the test stand air intake trunking upwards until it locates firmly in the air intake aperture in the power plant bottom rail, then lock in position with the two retaining thumb screws.

(6) Place the jet pipe extension in position on the power plant jet pipe elbow; fit the clamping ring halves over the flanges of the jet

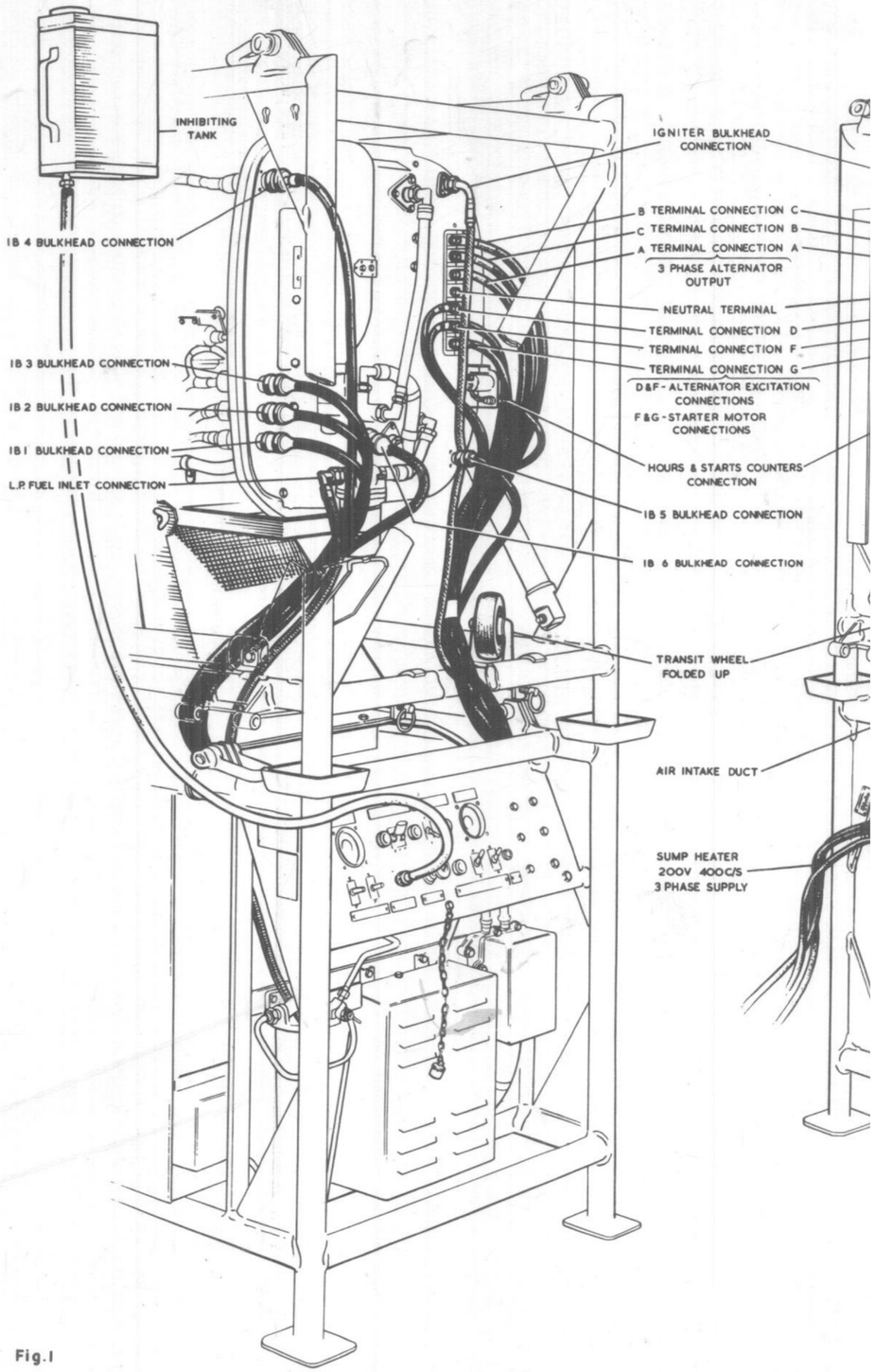

INHIBITING TANK
IB 4 BULKHEAD CONNECTION
IB 3 BULKHEAD CONNECTION
IB 2 BULKHEAD CONNECTION
IB 1 BULKHEAD CONNECTION
L.P. FUEL INLET CONNECTION
IGNITER BULKHEAD CONNECTION
B TERMINAL CONNECTION C
C TERMINAL CONNECTION B
A TERMINAL CONNECTION A
3 PHASE ALTERNATOR OUTPUT
NEUTRAL TERMINAL
TERMINAL CONNECTION D
TERMINAL CONNECTION F
TERMINAL CONNECTION G
D&F - ALTERNATOR EXCITATION CONNECTIONS
F&G - STARTER MOTOR CONNECTIONS
HOURS & STARTS COUNTERS CONNECTION
IB 5 BULKHEAD CONNECTION
IB 6 BULKHEAD CONNECTION
TRANSIT WHEEL FOLDED UP
AIR INTAKE DUCT
SUMP HEATER 200V 400C/S 3 PHASE SUPPLY

Fig.1

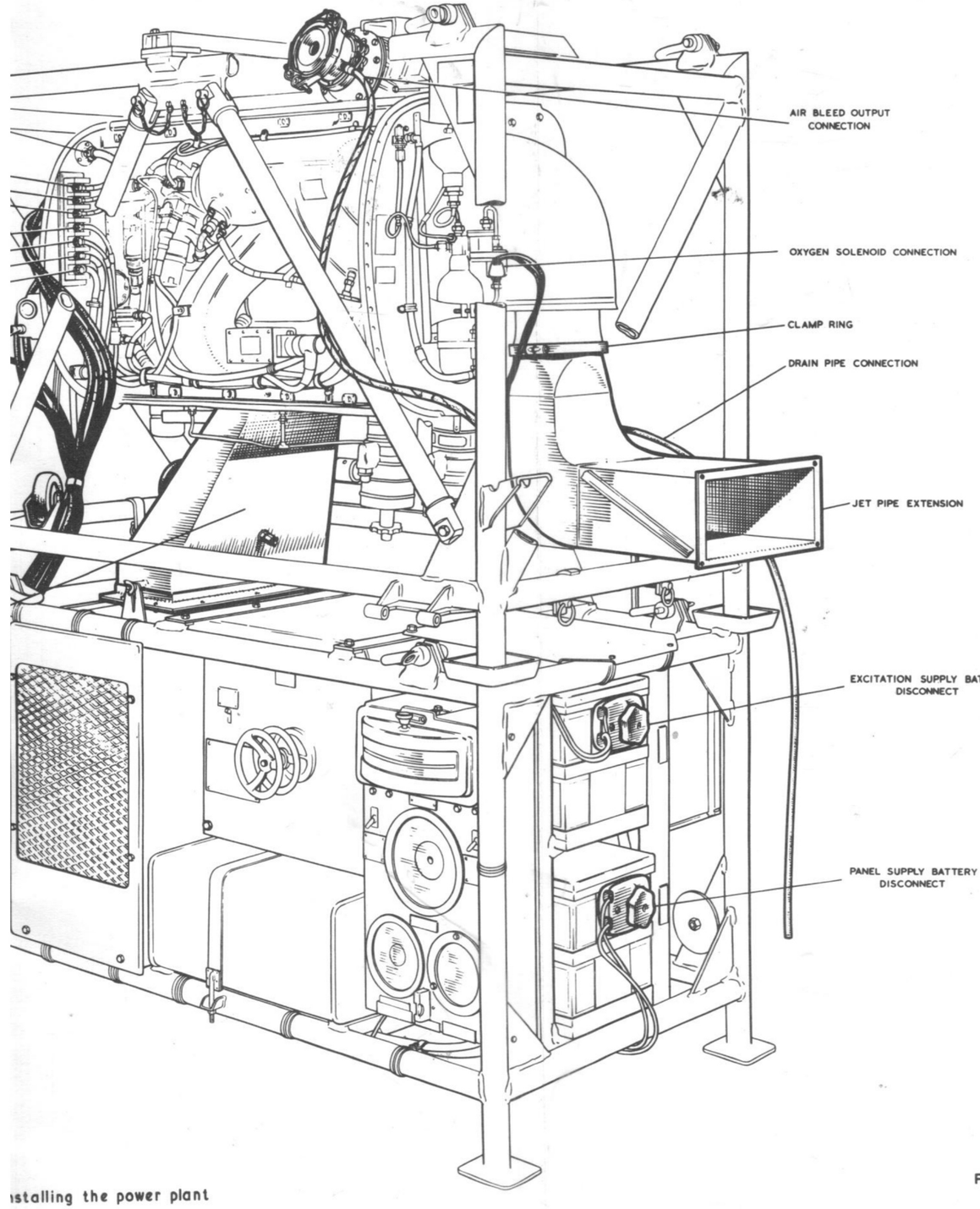

AIR BLEED OUTPUT CONNECTION
OXYGEN SOLENOID CONNECTION
CLAMP RING
DRAIN PIPE CONNECTION
JET PIPE EXTENSION
EXCITATION SUPPLY BATTERY DISCONNECT
PANEL SUPPLY BATTERY DISCONNECT

Fig.1

pipe elbow and the exhaust extension, then secure with two bolts, nuts and tabwashers.

(7) Release the clamp ring securing the air bleed adapter to its bracket at the rear of the test stand; position the adapter complete with orifice plate on the outlet flange of the power plant air bleed valve and securely tighten the retaining 'King' clamp.

Note . . .
When securing the air bleed adapter to the air bleed valve, ensure that the calibrated union in the adapter body is positioned within easy reach of the pipe from the pressure gauge in the loading panel.

Electrical and pipe connections

7. To complete the power plant installation make the following connections between the test stand and the power plant :-

(1) Electrical connections

Test stand	Power plant
1.B.1 Harness	1.B.1 Bulkhead plug
1.B.2 Harness	1.B.2 Bulkhead plug
1.B.3 Harness	1.B.3 Bulkhead plug
1.B.4 Harness	1.B.4 Bulkhead plug
1.B.5 Harness	1.B.5 Bulkhead plug
1.B.6 Harness	1.B.6 Bulkhead plug
Terminal lead A	Bulkhead terminal A
Terminal lead B	Bulkhead terminal B
Terminal lead C	Bulkhead terminal C
Positive terminal lead D	Bulkhead terminal D
Negative terminal leads F (two)	Bulkhead terminal F
Positive terminal lead G	Bulkhead terminal G
Igniter lead	Igniter bulkhead connector
Oxygen solenoid lead	Terminal box oxygen equipment
Hours and starts counters harness	Socket connector, hours and starts counters mounting bracket

Note . . .
If it is intended to functionally check the power plant sump heater and thermostat, an external 200V, 3 phase, 400 c/s supply should be connected to terminals L1, L2, and L3 of the sump heater relay mounted on the rear of the test stand operating panel.

(2) Pipe connections

Test stand	Power plant
Fuel Pipe	Inlet union L.P. fuel filter
Air pressure pipe	Air bleed adapter body
Drain pipe	Bottom rail drain manifold

Preparing the power plant and test stand for operation

8. Following initial installation of the power plant on the test stand, the combined fuel systems must be bled, the test stand jet pipe temperature gauge

calibrated, and the power plant and test stand electrical systems functionally tested before any attempt is made to start the power plant.

9. When testing new or replacement power plants it is assumed that prior to installation on the test stand, the unit has been externally de-inhibited as stated in Sect. 2. The process of bleeding the combined test stand and power plant fuel systems will automatically de-inhibit the power plant fuel system.

Caution . . .

Before attempting to start the power plant, always check that the engine oil sump level is correct as stated in Sect. 4. Particular care must be exercised in this respect when dealing with new or replacement power plants, which are normally stored without oil in the lubrication system.

Bleeding and de-inhibiting the fuel system

10. (1) Remove the A.A.P.P. port access door.

(2) Sever the locking wire and release the union nut securing the high pressure delivery pipe to the burner body. Blank the union in the burner body and place the open end of the pipe in a suitable receptacle with a capacity of not less than 2 pints.

(3) Sever the locking wire, release the drain plug in the base of the power plant L.P. fuel filter and position a suitable container beneath the drain orifice.

(4) Engage the PANEL SUPPLY battery disconnect.

WARNING . . .

The two battery disconnects serve as master switches for the test stand control and excitation circuits, and it is essential therefore to check and ensure before engaging either disconnect that all the test stand controls are correctly positioned (para. 12).

(5) Move the three-way fuel cock to the MAIN TANK position.

(6) Move the fuel boost pump switch to the ON position.

(7) Watch the fuel emitted from the base of the filter, and when the flow is completely free of air bubbles and inhibiting fluid, switch off the booster pump, then refit and wire-lock the drain plug.

(8) Select the appropriate controls on the test stand to wet cycle the power plant (para.22), and watch the fuel flow from the high pressure burner delivery pipe. When the flow is completely free of air and inhibiting fuel, reconnect the pipe whilst the fuel is still under pressure.

(9) The Rotax starter panel on the test stand will automatically terminate the wet cycle after thirty seconds, and in the event of the bleeding and de-inhibiting process not being completed within that period, a further thirty second cycle should be initiated.

WARNING . . .

After two consecutive dead cranks and one live start, a period of not less than thirty minutes must elapse before

any attempt is made to re-energise the starter, otherwise the motor may be seriously overheated.

(10) On completion of the wet cycle, move the fuel boost pump to the OFF position.

(11) Disengage the PANEL SUPPLY battery disconnect.

(12) Move the three-way fuel cock to the OFF position.

(13) Refit the port access door.

Calibrating the jet pipe temperature gauge

11. (1) Move the jet pipe temperature gauge transit switch located on the left-hand side of the loading panel to the ON position.

(2) Move the jet pipe temperature gauge calibration switch located on the right-hand side of the loading panel to the OFF position.

(3) Using a suitable clinical thermometer, measure and record the ambient air temperature at the thermocouple cold junction on the rear of the operating panel.

(4) Insert the jet pipe temperature gauge adjusting key into the keyway above the instrument bezel, then turn the key until the instrument reading corresponds with the measurement taken at the cold junction. To increase the instrument reading, turn the adjusting key in a clockwise direction and conversely to decrease the reading the key should be turned in an anti-clockwise direction.

(5) Return the transit and calibration switches to the ON and OFF positions respectively.

Note . . .
If necessary, the jet pipe temperature gauge may be zeroed for recalibration whilst the power plant is running, by moving the calibration switch to the 'off' position.

Checking the test stand and power plant electrical equipment

12. (1) Check and ensure that the test stand controls are in the following positions:-

Control	Position
Field rheostat control handwheels	Fully anti-clockwise
Field rheostat master switch	OFF
Jet pipe temperature transit switch	◀ ON ▶
Jet pipe temperature gauge calibration switch	ON
Fuel boost pump switch	OFF
H.P. cock actuator switch	SHUT
Oxygen solenoid switch	OFF
Ignition switch	OFF
Oil cooler actuator switch	SHUT
Air bleed switch	SHUT
Three-way fuel cock	OFF

(2) Engage the PANEL SUPPLY battery disconnect, and check that the red PANEL-LIVE warning light on the operating panel illuminates.

NOTE . . .

If it is intended to check the power plant sump heater and thermostat, the 200V, 3 phase, 400 c/s external supply must be connected to the terminals of the sump heater relay (para. 7) before engaging the panel supply battery disconnect.

(3) Check that the oil pressure and temperature gauges indicate on scale.

(4) Operate the test stand controls in the following sequence, and check that the associated equipment responds audibly :-

Control	Operation	Response
Fuel boost pump switch	Move to ON	Boost pump motor running
	Return to OFF	Motor stops
Oil cooler actuator switch	Move to OPEN	Actuator motor runs open
	Return to SHUT	Actuator motor runs closed
Air bleed switch	Move to OPEN	Air bleed valve actuator motor runs open. Green warning light illuminates.
	Return to SHUT	Air bleed valve actuator motor runs closed. Amber warning light illuminates.
H.P. cock actuator switch	Move to OPEN	Actuator motor runs open
	Return to SHUT	Actuator motor runs closed
Ignition switch	Move to ON	Igniter plug 'cracking'
	Release to OFF	Igniter plug 'cracking' stops
Oxygen switch	Move to ON	Oxygen solenoid opens
	Release to OFF	Oxygen solenoid closes

(5) Watch the oil temperature gauge on the test stand operating panel to check that the sump heater is functioning. When the oil temperature reaches 50 $\pm$ 10°C, the sump heater thermostat will de-energise the sump heater relay which in turn will disconnect the external supply to the sump heater and energise the CLEAR oil temperature warning light on the test stand operating panel. At normal ambient temperatures the sump heater thermostat will operate within approximately ten minutes of engaging the PANEL SUPPLY battery disconnect.

(6) Disengage the PANEL SUPPLY battery disconnect.

Precautions before starting

13. The following precautions must be observed before any attempt is made to start, and during any period of running. Failure to do so, may result in injuries to personnel and/or damage to the power plant.

(1) The area immediately outboard of the A.A.P.P. exhaust must be kept clear of personnel and equipment whilst the power plant is being started or run.

(2) Before attempting a start, make certain that the blower air intake is unobstructed and that the intake guard is securely locked in position.

(3) The blower drive shaft on the starboard side of the power plant is not equipped with a protective guard, and consequently no attempt should be made to carry out adjustments or service this side of the power plant whilst the unit is running. If possible, always fit the starboard access door before starting the power plant.

(4) It is vital that at all times a cartridge case complete with sealing O-ring is fitted in each of the two cartridge barrels, otherwise exhaust gases will pass from the turbine rotor through the breech assemblies and seriously damage both the barrel heater mats and the firing mechanism. If the sealing O-ring is omitted and the cartridge is live, the turbine exhaust gases may cause premature detonation.

Preliminaries before starting

14. Before starting a new or replacement power plant or one that has been inhibited or has had certain components removed for servicing, the procedure and checks described in para. 8 and 10 must be carried out. Particular care must be taken in this respect with regard to the lubrication system.

15. If the ambient temperature is below $0^{o}C$, an external supply must be connected to the sump heater, and any attempt to start delayed until the sump heater warning light is illuminated.

Starting procedure

16. (1) Check that the test stand controls are correctly positioned for the starting sequence (para. 12).

(2) Engage the PANEL SUPPLY battery disconnect and check that the red PANEL LIVE and the amber airbleed CLOSED warning lights are both illuminated.

(3) Turn the three-way fuel cock from the OFF position to the MAIN TANK position.

(4) Move the fuel boost pump switch to the ON position.

(5) Move the oil cooler actuator switch to the OPEN position.

(6) Move the H.P. cock actuator switch to the OPEN position.

(7) Push IN the starter solenoid push switch, and simultaneously depress and hold the ignition switch in the ON position. The starter switch will be retained magnetically.

(8) Normally the engine will achieve a self-sustaining speed within ten seconds and the starter switch will then be released automatically. If however the engine is slow to light-up, the starter switch will be

retained for a longer period. In the event of the engine failing to reach a self sustaining speed within thirty seconds, a time switch will release the switch and cut-out the starter motor.

(9) Immediately the starter push switch is released, return the ignition switch to the OFF position.

Subsequent attempts to start

17. After any failure to start, but particularly after a failure to light-up, a draining period of not less than three minutes must be allowed to elapse before attempting to re-start, otherwise the accumulation of fuel in the main air casing and combustion chamber may cause excessive jet pipe temperatures.

Failure to start

18. If after two attempts, the engine fails to start, a defect should be suspected and investigated in accordance with the fault diagnosis chart in Chap. 2.

Caution . . .

After two consecutive dead cranks and one live start, a period of not less than thirty minutes must elapse before any attempt is made to re-energise the starter otherwise the motor may be seriously overheated.

Routine attention whilst running

19. If the power plant is a new or replacement unit, or one that has had components removed for servicing, the initial run should be conducted with the access doors removed so that any leaks may be immediately detected and rectified.

(1) Check that the oil temperature and pressure gauge readings stabilise within the figures quoted in the Operating Limitations. If readings above or below the figures quoted in the Operating Limitations are obtained, the power plant should be shut-down immediately and the cause investigated.

(2) When the engine reaches its maximum governed speed check that the jet pipe temperature gauge stabilises within the maximum figure laid down in the Operating Limitations.

(3) Make a careful visual examination of the engine, looking particularly for evidence of gas, fuel, and oil leaks.

Stopping the engine

20. The procedure for stopping the engine is as follows :-

(1) Ensure that all electrical and airbleed loads are removed.

Caution . . .

Except in emergency conditions, the power plant must not be shut down until all electrical and airbleed loads have been removed, otherwise the subsequent thermal shock may severely damage the turbine rotor.

(2) Move the H.P. cock actuator switch to the SHUT position.

(3) Move the fuel boost pump switch to the OFF position.

(4) Move the oil cooler actuator switch to the SHUT position.

(5) Move the three-way fuel cock to the OFF position.

(6) Disengage the PANEL SUPPLY battery disconnect.

Dry cycling the engine

21. The dry cycling procedure detailed in the following instructions will isolate the H.P. cock actuator, the fuel boost pump, and the ignition system, and at the same time, energise the starter motor for thirty seconds. The procedure is normally utilised for compressor washing or to assist in drying out the engine following a wet cycle or a false start.

(1) Engage the PANEL SUPPLY battery disconnect.

(2) Check that the three-way fuel cock is in the OFF position.

(3) Push IN the starter solenoid push switch. The switch will be retained magnetically for thirty seconds, when the time switch in the Rotax starter panel will automatically terminate the sequence.

Wet cycling the engine.

22. The wet cycling procedure, consisting of the normal starting sequence with the ignition system isolated, is normally utilised for inhibiting and de-inhibiting the engine.

(1) With the ignition switch remaining in the OFF position, carry out the starting procedure detailed in para. 16.

Note . . .

Following a wet cycle, a draining period of not less than three minutes must be allowed to elapse before attempting a start, otherwise the accumulation of fuel in the main air casing and combustion chamber may cause excessive jet pipe temperatures.

Checking the engine stall point

23. The engine stall point is the jet pipe temperature at which the fuel system temperature control will operate to reduce the fuel flow to the engine, and consequently, the jet pipe temperature. When replacement fuel systems are fitted to the engine, the temperature control units must be individually adjusted so that the engine stalls at a jet pipe temperature of $720 \pm 5^{\circ}C$.

24. The test stand is equipped with two air intake heater banks, which are described in Chapter 3; these banks when used in conjunction with the air bleed facility on the A.A.P.P. will simulate maximum load and consequently engine stall temperature, by absorbing the power plant alternator output and concurrently effectively raising the ambient air intake temperature.

Note . . .

Air bleed must only be selected with the 0.654 in diameter orifice fitted.

25. The procedure for checking the engine stall point is as follows :-

(1) Engage the PANEL and EXCITATION SUPPLY battery disconnects.

(2) Check that both the field rheostat control handwheels are in the

fully anti-clockwise position.

(3) Start the power plant (para. 16).

(4) Move the field rheostat master switch to the ON position.

(5) Select the air bleed switch to OPEN.

(6) Turn the coarse or MAIN hand control wheel on the rheostat slowly in a clockwise direction, carefully observing the jet pipe temperature gauge and alternator frequency meter. When the engine reaches its stall point, the frequency meter will sit-back quite sharply indicating a fall in engine speed. If the movement of the MAIN hand control wheel does not provide sufficient power to induce a stall, the VERNIER wheel should be used to increment the alternator output.

(7) Note the jet pipe temperature at which the stall condition occurs, if it is not within the tolerance quoted, shut down the engine and adjust the temperature control unit fine adjustment. Clockwise rotation of the adjuster decreases the stall temperature, whilst anti-clockwise increases.

CAUTION . . .

Do not increase the stall setting by more than one quarter of a turn on the adjuster screw before re-checking.

Note . . .

The calibration of the frequency meter is such that it will not provide an accurate indication of engine speed when the excitation voltage is below 190 volts, but the frequency sit-back described in operation (6) may be taken as a reliable witness of the engine stall point regardless of the excitation voltage.

(8) After satisfactory stall setting is achieved, shut down the power plant in accordance with para. 20.

Checking the engine power output

26. The engine power output can be assessed using a suitable load bank as described in Chap. 3, a barometer, a 12 in. mercury thermometer calibrated from -20 to +40°C, a 30 in. mercury manometer, and the graph. fig. 2.

27. The procedure for checking the engine power output is as follows :-

(1) Disconnect the test stand terminal leads 'A', 'B', and 'C' at the power plant terminal block.

(2) Position the load bank at a convenient point in relation to the test stand and connect the three corresponding leads from the load bank to terminals A, B, and C in the power plant terminal block.

Note . . .

The load bank instrumentation should include a kilowatt meter, a frequency meter, a line ammeter and a line voltmeter.

(3) Engage both the PANEL and EXCITATION SUPPLY battery disconnects.

(4) Start the power plant (para. 16).

(5) Check that both field rheostat hand control wheels are fully anti-clockwise, then move the rheostat master switch to the ON position.

(6) Slowly turn the rheostat hand control wheels until they are both in the fully clockwise position.

(7) Switch in the elements of the load bank in increments of 1 kW, until the power plant alternator is supporting a load of 24 kW; then trim the line voltage, until the load bank voltmeter is reading approximately 200 volts, by turning one or both of the rheostat hand control wheels in an anti-clockwise direction.

WARNING . . .
Do not under any circumstances, attempt to select air bleed when the power plant alternator is supporting more than a 3 kW electrical load, otherwise the engine will stall.

Note . . .
The figure of 24 kW at 200V represents 20 kW useful load plus the 2 kW normally absorbed by the aircraft transformer rectifier unit.

(8) When the power plant is running with a steady 20 kW load, remove the blanking split pin, union nut and nipple from the tapping orifice in the rear face of the test stand air intake ducting, insert the 12 in. mercury thermometer, and measure and record the engine air intake temperature.

(9) Withdraw the thermometer and then with a suitable length of tubing connect one branch of a 30 in. mercury manometer to the air intake tapping orifice, and measure and record the engine air intake depression.

(10) Carefully record the power plant jet pipe temperature, indicated on the test stand jet pipe temperature gauge. An opportunity should also be taken at this point to record the engine oil pressure and temperature.

(11) Finally with a suitable barometer, measure and record the local barometric pressure.

(12) Using the readings obtained in the previous paragraphs and the graph, fig. 2, an assessment can now be made of the engine power output.

(13) The following calculations are for a typical test :-

(a) Test Results

Nett load	24 kW at 200V
Engine air intake temperature	30°C
Barometric pressure	28.8 in. Hg
Engine air intake depression	0.8 in. Hg
Jet pipe temperature	577°C
Oil temperature	98°C
Oil pressure	15 lb/in^2

Caution . . .
If the engine oil temperature and pressure fail to stabilise within limits laid down in the operating limitations, the power plant must be immediately shut-down and the cause investigated.

(b) To establish the absolute air intake pressure, represented on the

graph in inches of mercury, subtract the engine air intake depression from the local barometric pressure; for example; Barometric pressure -28.8 in. Hg minus engine air intake depression 0.8 in. Hg, equals air intake pressure -28 in. Hg abs.

(c) From the group of curves marked 'B' on the graph, fig. 2, which represent world-wide conditions, find the maximum jet pipe temperature permissible for the given engine load, the air intake temperature and pressure; for example;
Air intake pressure 28 in. Hg versus engine air intake temperature 30°C at 24 kW 200V equals maximum jet pipe temperature 580°C. As in this instance, the jet pipe temperature achieved (577°C) is lower than the maximum value indicated by the graph (580°C), the power plant can be classified as suitable for world-wide conditions.

(d) Should the engine record a jet pipe temperature higher than the maximum value permissible for world-wide conditions, re-calibrate the test results using the group of curves marked 'A'. If the jet pipe temperature falls within the maximum value permitted by the second set of curves, assuming the same air intake temperatures and pressures, the power plant may be classified as suitable for operation in arctic and I.C.A.O. standard ambient temperature conditions.

(14) In the event of the engine jet pipe temperature failing to meet the requirements of either set of curves, wash the engine compressor rotor as stated in Sect. 4 of this publication, and carry out a further power check. If the compressor washing fails to bring the jet pipe temperature within the limits of either set of curves, the power plant must be classified as unserviceable.

(15) On completion of the test, switch off the load bank elements.

(16) Wind both rheostat hand control wheels until they are in the fully anti-clockwise position and move the rheostat master switch to the OFF position.

(17) Shut-down the power plant (para. 20).

Caution . . .
Except in emergency conditions, the power plant must never be shut down until all electrical and air bleed loads have been removed, otherwise the subsequent thermal shock may severely damage the turbine rotor.

(18) If it is intended to complete the assessment with an air bleed test, the load bank should be left in circuit; but if not, disconnect the leads marked A, B, and C, at the power plant terminal block and reconnect the appropriate leads from the test stand.

Checking the engine air bleed performance

28. To assess the engine air bleed performance, a suitable load bank, a 12 in. mercury thermometer calibrated from -25 to +50°C a suitable barometer, and the graph, fig. 3, will be required.

29. The procedure for assessing the engine air bleed output is as follows :-

(1) Connect the load bank to the power plant terminal block as stated in para. 27, sub-para. (1) and (2).

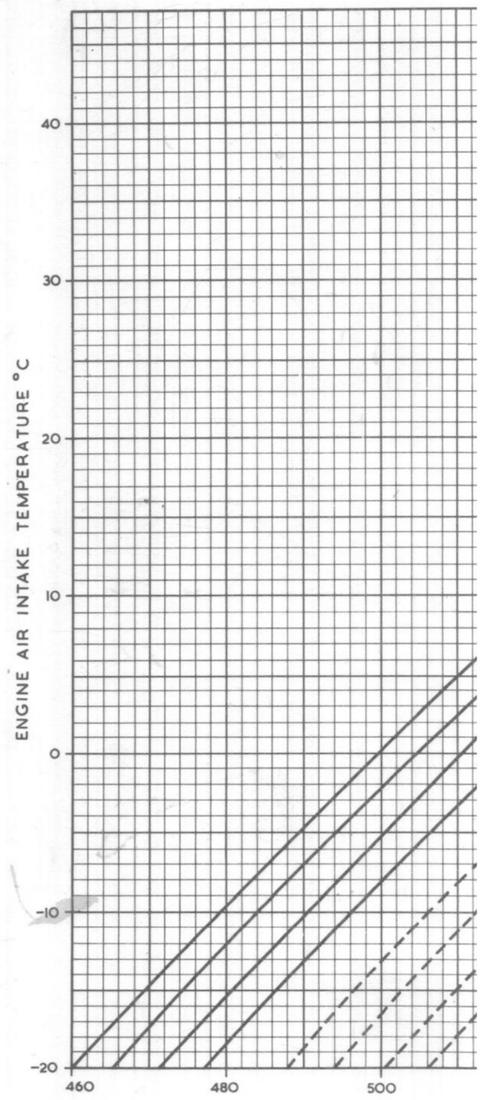
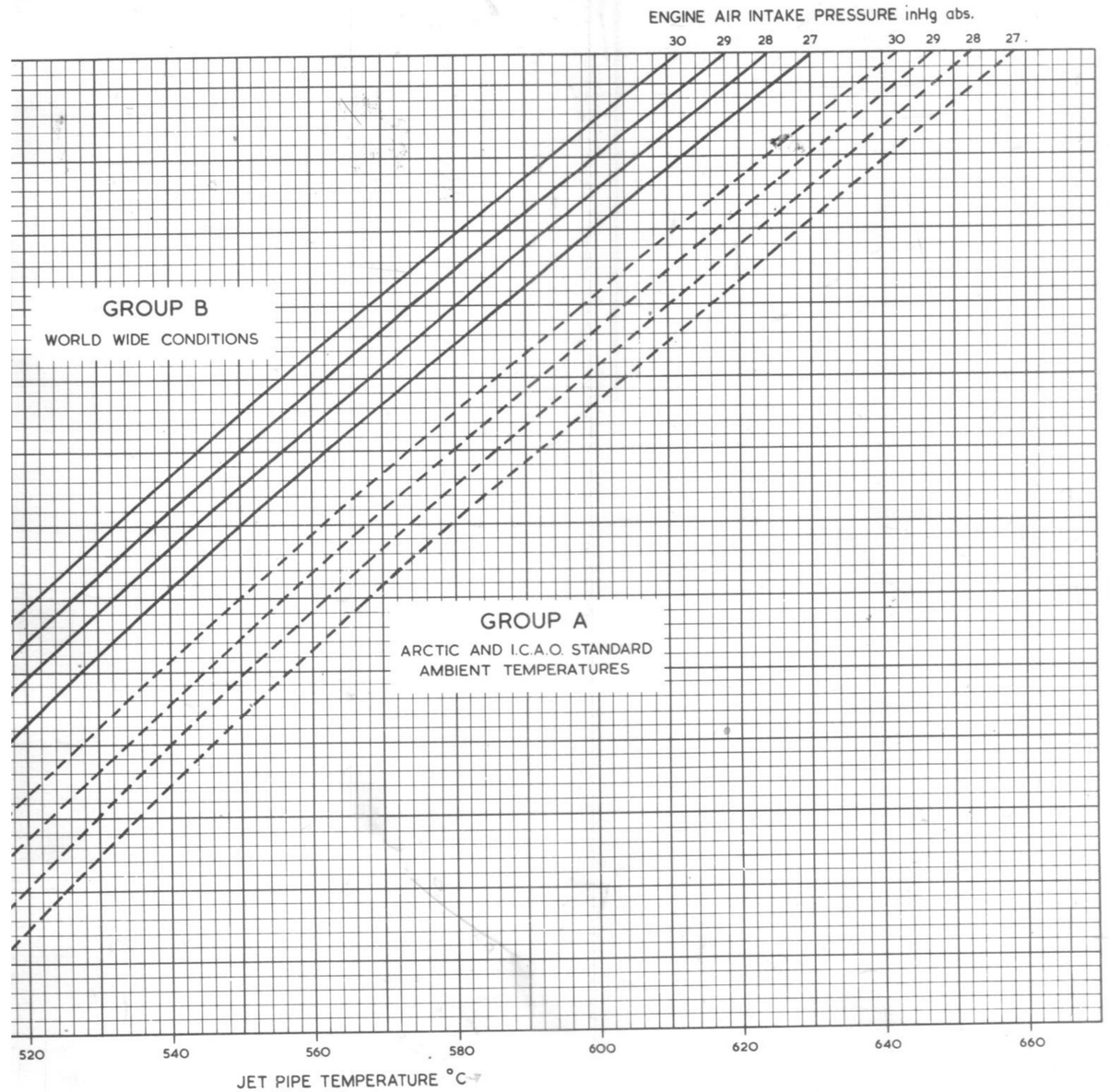


Fig.2



Power output performance chart at 24 kw 200V

Fig.2

(2) Check that the air bleed outlet adapter and orifice plate are securely clamped to air bleed valve outlet, and that the pipe linking the outlet adapter to the pressure gauge in the test stand loading panel is properly connected.

WARNING . . .

Do not under any circumstances attempt to move the air bleed switch to the 'open' position whilst the engine is running, unless the outlet adapter and orifice plate are securely clamped to the air bleed valve, otherwise the engine will go into 'surge'.

(3) Engage both the PANEL and EXCITATION SUPPLY battery disconnects.

(4) Start the power plant (para. 16).

(5) Check that both rheostat hand control wheels are fully anti-clockwise and move the rheostat master switch to the ON position.

(6) Slowly turn the rheostat hand control wheels until they are both in the fully clockwise position.

(7) Switch in the elements of the load bank in increments of 1 kW until the power plant alternator is supporting a load of 3 kW; then trim the line voltage, until the load bank voltmeter is reading approximately 200 volts, by turning the rheostat hand control wheel in an anti-clockwise direction.

Note . . .

The 3 kW load simulates the condition of the power plant in the aircraft during air bleed operation, when a 1 kW basic load is applied and a further 2 kW are absorbed by the transformer rectifier unit.

(8) When the power plant is running with a steady 3 kW load, remove the blanking split pin, union nut and nipple from the tapping orifice in the rear face of the test stand air intake duct; then insert the 12 in. mercury thermometer and measure and record the engine air intake temperature.

(9) Remove the thermometer and refit the blanking cap.

(10) With a suitable barometer, measure and record the local barometric pressure.

(11) Move the air bleed switch on the test stand operating panel to the OPEN position and check that the air bleed OPEN warning light is illuminated.

WARNING . . .

Before selecting air bleed, always check and ensure that the area in the immediate vicinity of the test stand is clear of loose debris.

(12) Carefully observe the jet pipe temperature gauge and the air bleed pressure gauge on the test stand loading panel, and record the figures obtained.

(13) From the figures obtained in the foregoing paragraphs it is now possible to assess the power plant air bleed performance using the graph, fig. 3.

(14) The following calculations are for a typical test :-

(a) Test results

Engine air intake temperature	+30°C
Jet pipe temperature	559°C
Air bleed pressure	28 lb/in^2
Barometric pressure	27 in. Hg

(b) From the graph, it is possible to establish for a given engine air intake temperature and pressure, the minimum air bleed pressure permissible against a maximum jet pipe temperature.

Note . . .

The maximum jet pipe temperature curve on the graph, assumes a standard engine nacelle intake pressure of 30 in. Hg. When intake pressures of a lower order are encountered, the maximum jet pipe temperature permissible may be increased by 10°C for every inch of mercury below the standard pressure.

(c) For example, using the test figures quoted, the graph shows that with an air intake temperature of +30°C, the air bleed pressure should not be less than 25.5 lb/in^2 and that, for this output the jet pipe temperature must not exceed 570°C. However, since the barometric pressure recorded is 3 in. Hg below the standard pressure, the corrected maximum permissible jet pipe temperature should read 600°C.

(d) In this instance, both the air bleed pressure and the jet pipe temperature recorded fall within the limitations, and the power plant air bleed performance can therefore be considered satisfactory.

Caution . . .

The assessment described in the foregoing paragraphs is only an approximation, and the results should always be interpreted in the light of the full power assessment (para. 26).

(15) On completion of the test, move the air bleed switch to the SHUT position, and check that the air bleed SHUT warning light is illuminated.

(16) Switch off the load bank elements.

(17) Wind both rheostat hand control wheels until they are in the fully anti-clockwise position, and move the rheostat master switch to the OFF position.

(18) Shut-down the power plant (para. 20).

Caution . . .

Except in emergency conditions, the power plant must never be shut down until all electrical and air bleed loads have been removed, otherwise the subsequent thermal shock may severely damage the turbine rotor.

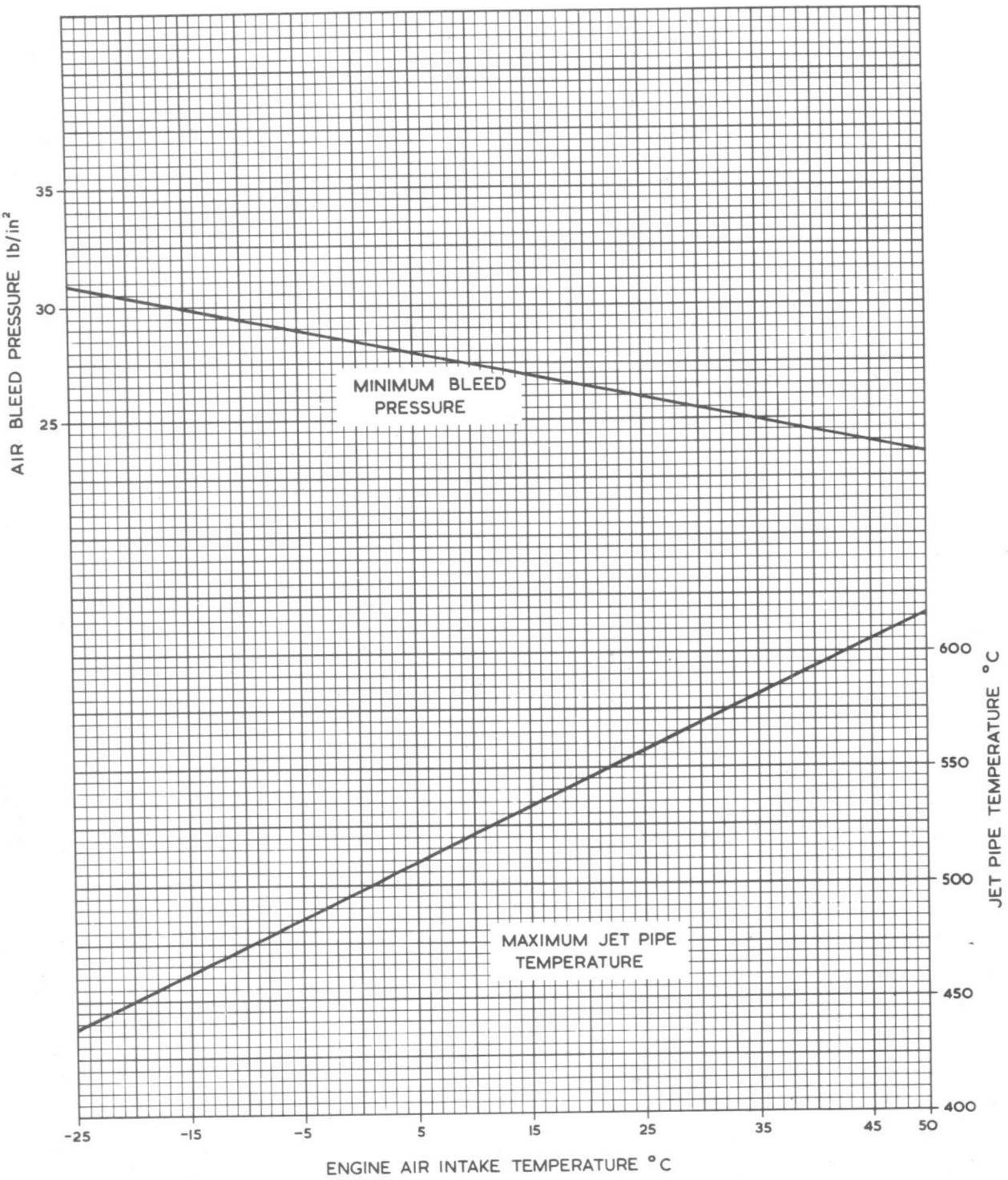


Fig. 3. Air bleed performance chart at 30 in. Hg air intake pressure

(19) Disconnect the leads from the load bank at the power plant terminal block, and reconnect the appropriate leads from the test stand.

Inhibiting the power plant fuel system

30. (1) Remove the inhibiting tank from the test stand; uncoil the delivery pipe from the clips on the side of the tank, and completely fill the tank with inhibiting oil, Ref. No. OM-11.

(2) Suspend the tank on the starboard side of the power plant transit stand; remove the dust caps from the delivery pipe and the inhibiting connection on the test stand operating panel; check that the three-way cock on the test stand is in the OFF position, then connect the delivery pipe to the inhibiting connection.

(3) Engage the PANEL SUPPLY battery disconnect.

(4) Move the three-way cock to the MAIN TANK position.

(5) Start the engine (para 16).

(6) When satisfied that the engine is running satisfactorily, move the three-way cock to the INHIBITING TANK position for precisely five minutes, and simultaneously move the fuel boost pump switch to the OFF position.

(7) At the end of the five minute period, shut-down the engine (para. 20), and move the three-way cock to the OFF position.

Caution . . .

As the inhibiting tank is not equipped with a contents gauge, it is essential to use a stop watch during the preceding operation; otherwise, in the event of the inhibiting tank being completely emptied, air will be admitted into the fuel system which will necessitate bleeding and re-inhibiting the complete system.

(8) Disengage the PANEL SUPPLY battery disconnect.

(9) Disconnect the L.P. fuel supply pipe at the inlet side of the power plant L.P. filter and blank both the pipe and the filter.

(10) Disconnect the inhibiting tank delivery pipe at the inhibiting connection on the operating panel, then blank the pipe and the connection with their respective dust caps.

(11) Remove the inhibiting tank from the power plant transit stand; coil the delivery pipe on the clips provided and stow the tank on the test stand.

Removing the power plant from the test stand.

31. (1) Disconnect all the electrical and pipe connections linking the power plant to the test stand (para. 7).

(2) Release the clamp ring securing the air bleed adapter and orifice plate to the outlet flange of the air bleed valve; then using the same clamp ring, secure the adapter to its mounting bracket on the test stand.

(3) Knock down the ears of the locking tabwashers, and release the two bolts and nuts securing the jet pipe extension clamping ring halves. The extension can now be lifted clear of the power plant.

(4) Unscrew the two locking thumbscrews retaining the test stand adjustable air intake; then push the intake firmly downwards until it is clear of the power plant air intake.

(5) Using an approved four point sling, lift the power plant complete with its transit stand clear of the test stand.

Caution . . .

Never attempt to lift the power plant and its transit stand by means of the hoisting lug on the power plant.

Chapter 3

SERVICING A TEST STAND

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LIST OF ILLUSTRATIONS

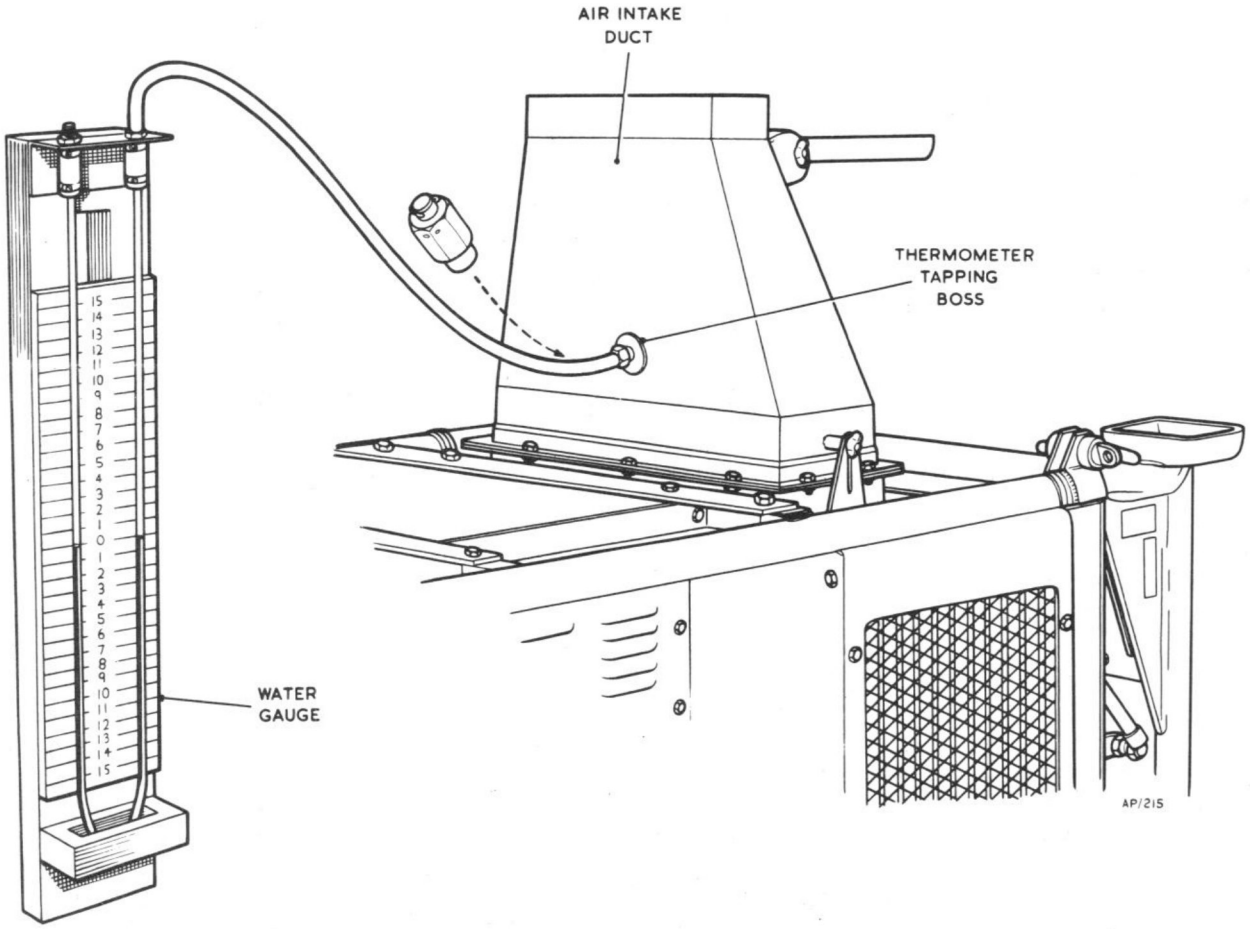

Fig. 1. Checking the pressure drop across the air intake filters

SERVICING CHECKS AND PERIODS

Servicing before operating a test stand

1. (1) Check that the Graviner Type 34H fire extinguisher is fitted to the stand.

(2) Check the stand for security and leaks

(3) Check that the air intakes and the exhaust are free from obstruction.

Servicing at three monthly periods

2. (1) Weigh the fire extinguisher; the weight must be within 1 oz. of that stamped on the operating head, otherwise the extinguisher must be exchanged for a serviceable unit.

(2) Check that the air intakes and the exhaust are free from obstruction.

(3) Check the pressure drop across the air intake filters, and renew the filters if the pressure drop exceeds 2 in. on the water gauge (fig.1).

(4) Examine the fuel tank and pipes for leaks and security.

(5) Clean the fuel tank inlet filter.

(6) Remove and service the batteries. Check the battery storage and connectors. (A.P.4343A, Vol. 1 gives instructions on how to service batteries).

(7) Check the test stand harness insulation for chafing, wear, and damage caused by oil.

Servicing at six monthly periods

3. (1) Carry out all the checks listed for the three monthly period.

(2) Examine the fuel filter element and renew it if it is excessively dirty.

Servicing at twelve monthly periods

4. (1) Carry out all the checks listed for the three monthly period and the six monthly period.

(2) Remove and calibrate the test stand instruments.

(3) Check the starting panel engaging relay, the overspeed relay, and the time delay switch for cleanliness and wear.

(4) Lubricate the field rheostat controls and check for freedom of movement.

(5) Remove and service the fuel boost pump (para. 9).

(6) Check the air intake heater banks for continuity and resistance (para. 11).

SERVICING OPERATIONS

Checking the pressure drop across the air intake filters (fig. 1)

5. The pressure drop across the air intake filters must be checked with a power plant installed on the test stand; proceed as follows :-

(1) Remove the union nut and blank nipple from the thermometer tapping boss.

(2) Connect the water gauge to the thermometer tapping boss.

(3) Start the power plant (Chap. 4) and check that the pressure drop at maximum rev/min does not exceed 2 in. of water. If the pressure drop exceeds this figure, renew the filter elements (para.6).

(4) Stop the power plant (Chap. 4) and remove it from the test stand.

Renewing the air intake filter elements (fig. 2)

6. (1) Loosen the two wing nuts and detach the air intake duct.

(2) Release the three cable clips on the top rail.

(3) Remove the four bolts and plain washers and lift off the filter box cover, easing the cables on the top rail to one side.

(4) Grasp the retaining bracket at the top of the two filter drums and lift the drums and the filter box cover out of the filter box.

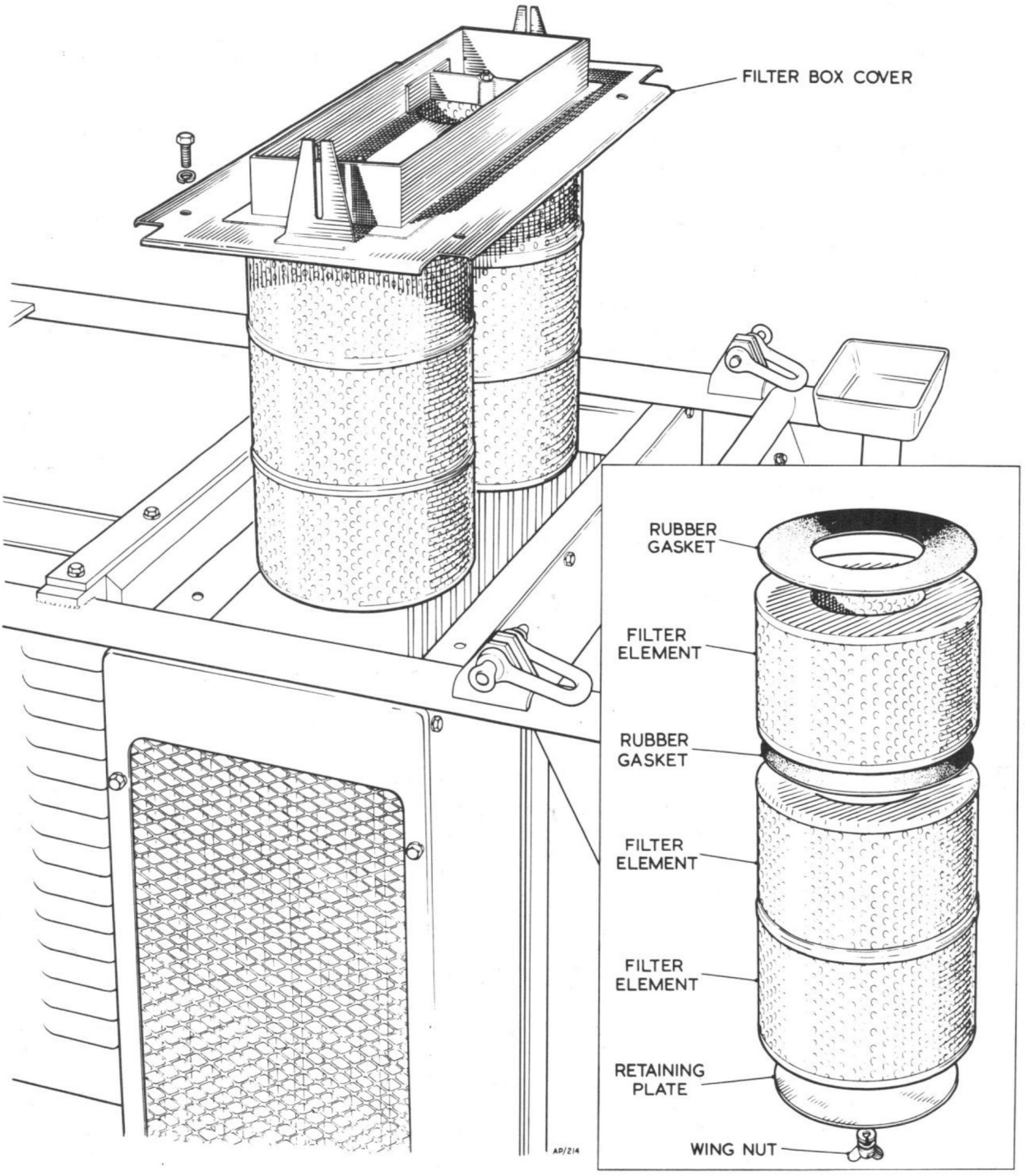

Fig. 2. Air intake filter elements and air intake duct

(5) Release the wing nut, plain and spring washer at the lower end of each central rod, then remove the retaining plate; discard the filter elements and the rubber gasket.

(6) Position a single drum replacement filter element, with a new rubber gasket at each end, over each of the central rods.

(7) Fit the double drum replacement elements with the end plates facing the wing nut end of the central rods.

(8) Locate the retaining plates, and assemble the plain and spring washers and the wing nuts. Ensure that the rubber gaskets are correctly positioned before finally tightening the wing nuts.

(9) Insert the filter box cover and the filter drums into the filter box easing the cables on the top rail to one side. Fit and tighten the four bolts and plain washers.

(10) Assemble the air intake duct with the thermometer tapping facing rearward on the filter box cover spigot. Tighten the two wing nuts.

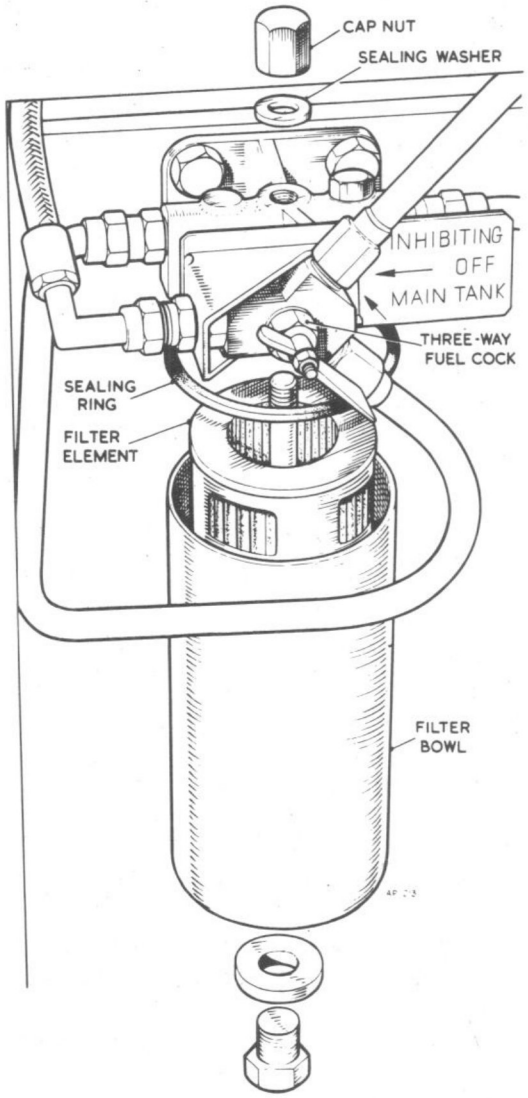

Fig. 3. Fuel filter bowl and element

Renewing the fuel filter element (fig. 3)

7. (1) Close the three-way cock adjacent to the fuel filter in the main supply line.

(2) Remove the drain plug at the base of the filter bowl and allow the bowl to drain.

(3) Remove the capnut on the filter head, then withdraw the filter bowl with the element.

(4) Remove and discard the element and clean the bowl in fuel; then refit the drain plug and its washer.

(5) Remove the sealing ring from the filter head, and fit the new ring supplied with the element.

(6) Insert the new element in the filter bowl and fit the bowl to the filter head; ensure that the bowl seats correctly on its sealing ring and that a sealing washer is fitted under the capnut on the head.

Bleeding the fuel filter

8. (1) Open the three-way cock in the main supply line.

(2) Remove the hexagon headed vent plug above the outlet port in the fuel filter head.

(3) Wait until the fuel flowing from the vent hole is free from air bubbles, then tighten the plug.

Removing the fuel boost pump (fig. 4)

9. (1) Remove the drain plug to drain the fuel tank.

(2) Disconnect the boost pump delivery pipe and the electrical lead.

(3) Remove the outer ring of bolts and spring washers that secure the boost pump to the fuel tank.

(4) Withdraw the boost pump and discard the gasket.

Fitting the fuel boost pump

10. (1) Place a new gasket on the boost pump mounting ring; then fit the boost pump to the fuel tank with the bolts and spring washers, taking care to align the boost pump delivery connection with the fuel delivery pipe.

(2) Connect the delivery pipe and the electrical lead to the boost pump.

Checking the air intake heater bank elements for continuity and resistance.

11. (1) Remove the three bolts and spring washers that secure the heater bank terminal covers on each of the air intake filter boxes.

(2) Disconnect the heater cables at the element banks.

(3) Check the resistance between terminals 'A' and 'B', 'A' and 'C', and 'B' and 'C' on each element bank. The resistance value must be 4.5 ohms. If this figure is not obtained, the faulty element bank must be changed.

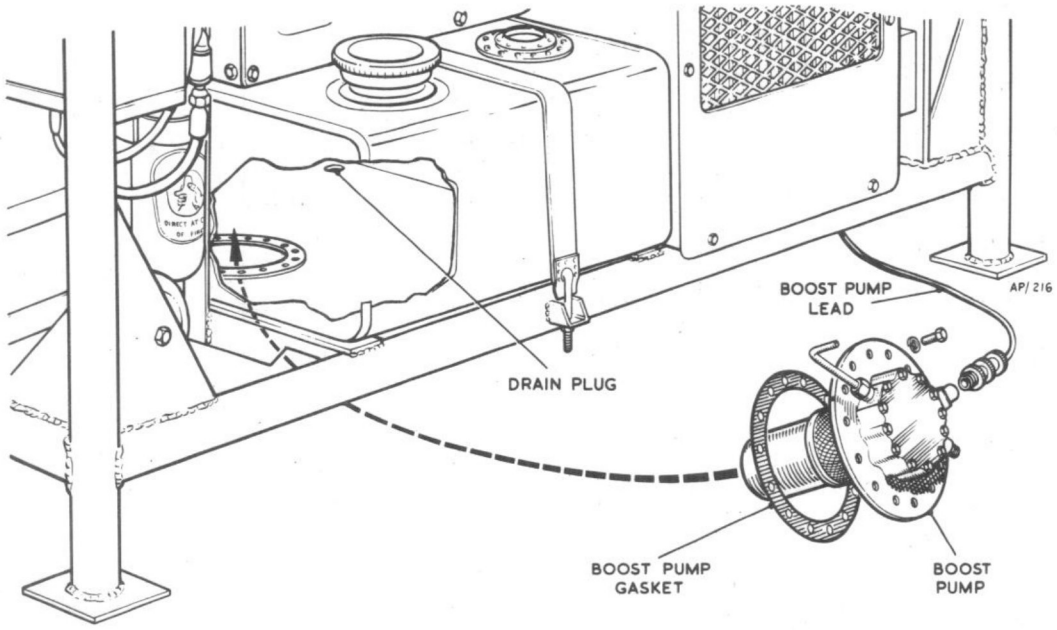

Fig. 4. Removing the fuel boost pump

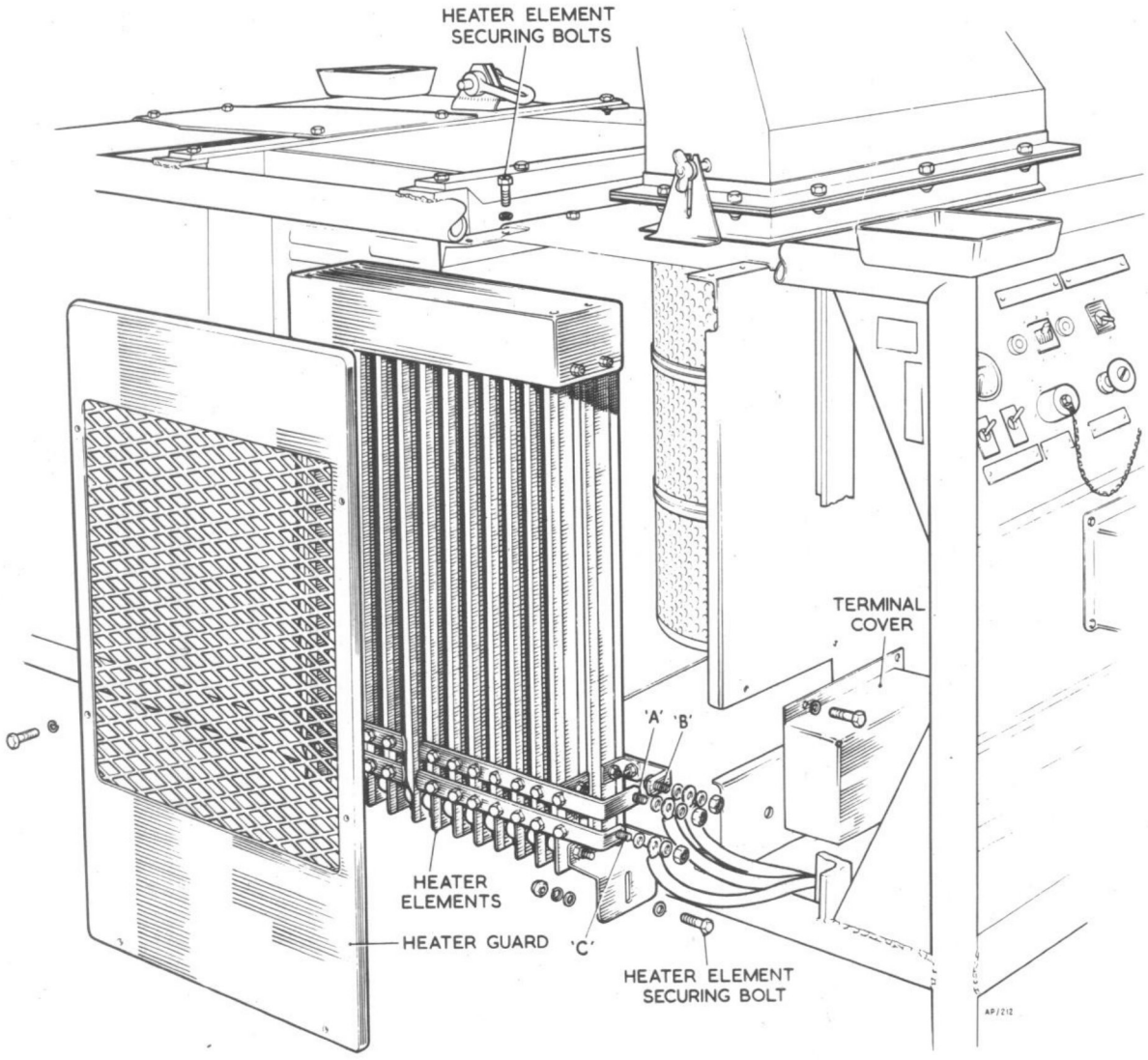

Fig. 5. Checking the continuity and resistance of an element in the air intake heater bank

Renewing a heater element bank

12. (1) To change an element bank, remove the six bolts and plain washers that secure the heater guard, and the four bolts and plain washers at the top of the air filter box, and the bolt and plain washer at the lower ends of the air filter box sides. Withdraw the element bank and return for servicing.

(2) Locate the replacement element bank, fit the six bolts and plain washers and repeat the test given in para. 11.