Chapter Eleven

DEFECT DIAGNOSIS

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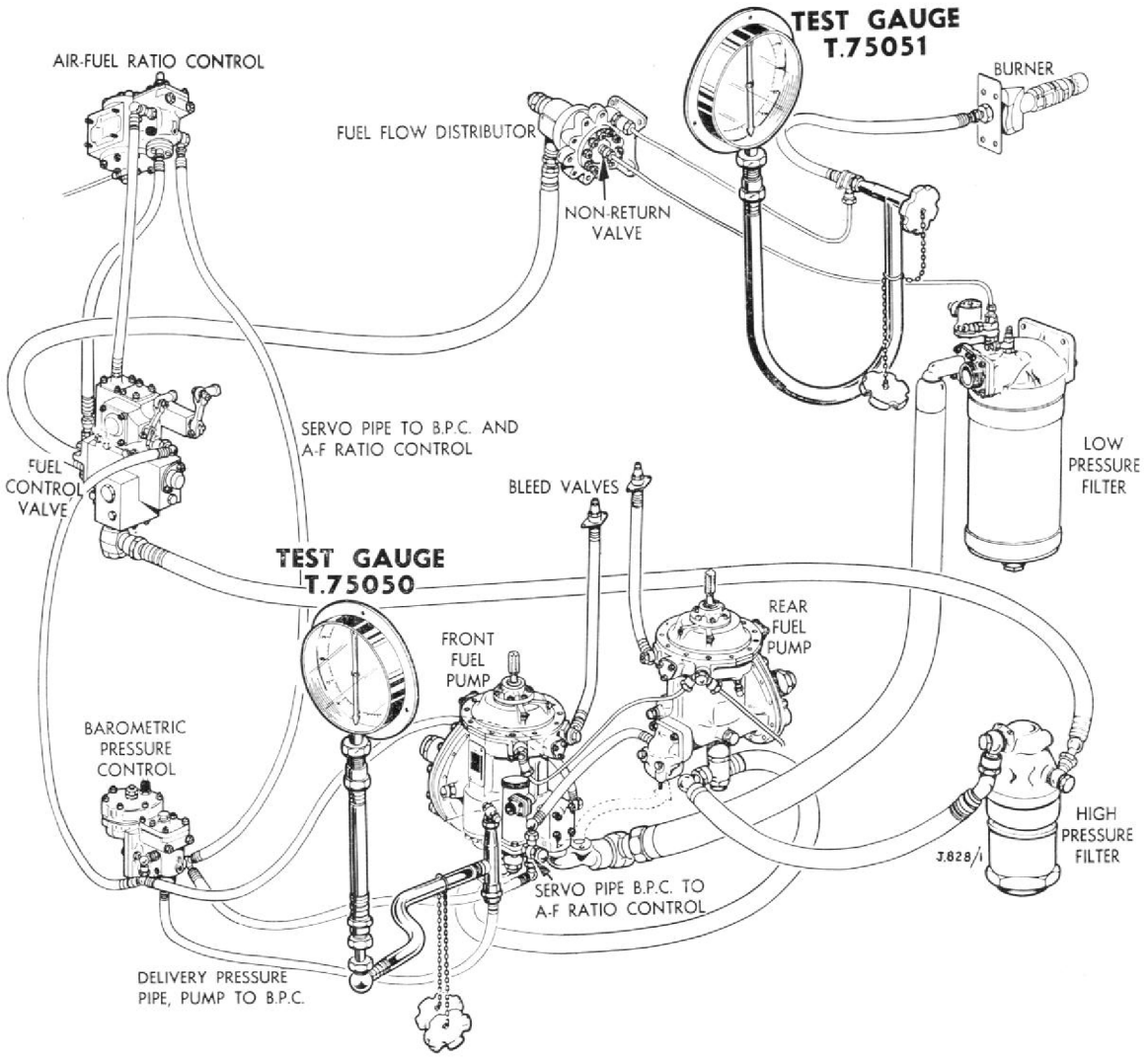

Fig. 1. Pictorial diagram of Ghost 48 Mk. 1 fuel system showing use of test gauges for defect diagnosis.

If the engine is conscientiously serviced and maintained, and it is operated correctly, running defects will be reduced to a minimum. When a running defect is encountered, systematic investigation may save much unnecessary work and pages 4 to 49 of this chapter contain Defect Diagnosis Tables which should assist the operator to diagnose, and to rectify, a defect quickly; although it is inevitable that on occasions some temporarily baffling defect will be encountered. Pages 4 to 15 cover the Ghost 48 Mk. 1, pages 16 to 29 the Ghost 48 Mk. 2, and pages 32 to 52 the Ghost 53 Mk. 1.

In compiling these tables it has been assumed that the engine has been operated and serviced correctly, and that the airframe equipment associated with the engine is serviceable. For these reasons factors such as visible leakages, insufficient or incorrect grades of fuel or oil, defective aircraft components such as tank booster pumps and instruments, closed cocks and incorrectly set switches and controls, and incorrect operating sequences have not been considered. If incorrect operation or inefficient servicing is suspected, these matters should be checked before investigating further. Similarly, before commencing to investigate any apparent defect based on an abnormal instrument indication ensure that the instrument itself is functioning correctly; possibly by changing the instrument for one which is known to be serviceable. When investigating electrical defects, the cause of any blown fuses should be discovered and rectified before any further action is taken.

In these defect diagnosis tables, it has been assumed generally that the fault under investigation has a single cause, for instance under "No light-up at starting" secondary Cause d.iii it has been assumed that either the pumps are faulty, or the barometric pressure control, or the air-fuel ratio control, and not two or all three of these components. If, however, the trouble persists after locating and rectifying one faulty component, it will be obvious that one or more of the remaining components is probably faulty also.

A thorough knowledge of the starting cycle and equipment will assist in the elimination and rectification of starting troubles, and reference to the text and illustrations in chapters 2 and 3 will assist when investigating lubrication and fuel system defects.

Although an attempt has been made to list all known and possible defects which may affect the running of the engine, it must not be assumed that all these defects are likely to occur; many of them may never be encountered. It is, of course, impossible to forecast the particular defects which may occur in individual engines, and, therefore, this table is not intended to supersede the knowledge of an experienced engineer but to assist those who are unfamiliar with these engines.

The actual method of rectifying defects is considered as coming within the category of servicing, maintenance, or repair, and, where a chapter reference is given in the right-hand column of the tables, the necessary information will be found in that chapter. Additional information may be found also in other chapters in this handbook, in the relevant aircraft handbook, and in the accessory manufacturers' publications, and reference should be made to these as necessary. Where the method of rectifying a defect is self-evident no entry has been made in the 'Refer to' column of the tables.

HOW TO USE THE DEFECTS DIAGNOSIS TABLE

To locate and rectify a defect it is not necessary to make all the investigations tabulated, as the tables are designed to lead the investigator from the known symptom, column by column, to the remedial action with the minimum of work.

If the engine is not functioning correctly the probable defect will be indicated by certain symptoms and these symptoms are the only point from which any investigation can commence. The first step, therefore, is to locate the observed symptom in the first (left-hand) column of the tables.

In practice it is found that more than one defect can produce the same symptoms, and, therefore, each probable defect with the method of investigaton is listed in the columns headed 'Primary cause' and 'Primary investigation'. The probable defects are listed so that either the most probable are investigated first or the first invesigations lead on to the others in a logical sequence. Therefore, the primary causes should be investigated in the order given. Once the primary cause has been identified it is unnecessary to proceed with any further primary investigation and attention should be transferred to the next two columns and any secondary cause identified in a similar manner. In each instance, the immediate remedial action is suggested in column six of the tables, and where appropriate, further instructions can be located from the cross references given in the last (right-hand) column.

UNSTABLE R.P.M. AT FULL THROTTLE, *Ghost 48 Mk. 1.*

If the H.P. fuel cock control is not rigged correctly, movement of the H.P. cock lever within its gate may cause a variation of up to 100 r.p.m. at full throttle. Where this trouble is experienced,

make a check to ensure that the H.P. fuel cock control is functioning correctly within its gate, and recheck by ground running that the full throttle r.p.m. does not fluctuate. If the r.p.m. still fluctuates, the aircraft control linkage should be shortened slightly. To do this, slacken the lock nuts at each end of the control rod which is adjacent to the fuel control valve assembly on the engine, and turn the rod the required amount to ensure that the fuel cut-off valve is in the fully open position when the lever in the cockpit is through the gate. Retighten the lock nuts.

INCORRECT IDLING SPEED, *Ghost 48, Mk. 1*

Should the idling speed deviate from the normal for no apparent reason, before re-adjusting the slow-running needle, make the following checks.

(1) Remove the slow-running needle and flush out the orifice, by switching ON the fuel tank booster pump. Hold a clean sheet of white blotting paper in front of the orifice in the fuel control valve assembly, so that the fuel issuing from the orifice passes through the blotting paper, which will trap any sediment or dirt, and so confirm, or disprove, its presence.

(2) Remove the low pressure fuel filter element, and check that it is clean and undamaged.

(3) Check the aircraft engine controls thus:— Place the throttle lever, in the cockpit, in the fully SHUT position. Remove the bolt which couples the throttle rod end to the throttle lever on the control valve assembly, as described in chapter 14, page 6. Check whether the bolt holes in the two components align correctly when both the cockpit lever and the lever on the control valve assembly are in the slow-running position.

A further check can be made, whilst the controls are disconnected, by holding the lever on the control valve assembly in the slow-running position, and starting the engine. Observe the r.p.m. and if it is incorrect, still holding the lever on the control valve in the slow-running position, re-adjust the slow-running needle as necessary.

When the results of these checks are satisfactory, refit the bolt, adjusting the aircraft control rod if necessary to align the bolt holes.

The first two checks apply mainly if the idling speed is too low ; the third applies if the speed is too high. Refer also to Symptom 5 on page 8.

TOOLS AND EQUIPMENT

In addition to the normal tool kit, spanners, etc., the defect investigation equipment should include the following.

A 0-24 voltmeter, and insulation and continuity testing equipment.

Pressure gauge assembly T.75051 i.e. 0-200 lb. per sq. in. pressure gauge.

Pressure gauge assembly T.75050 i.e. 0-2500 lb. per sq. in pressure gauge. Pressure gauge and pipe assembly T.75050 is filled with kerosene and, therefore, when connecting this gauge into the fuel system, it is important to remember that both ends of the T-piece must not be opened simultaneously ; i.e. having removed one hand nut to connect one branch of the T-piece to the system, do not remove the second hand nut until the first branch of the T-piece has been connected up.

Male and female adapters T.77097 and T.77098 which are required to convert $\frac{1}{8}$ in. B.S.P. gauges to $\frac{1}{4}$ in. B.S.P. when tapping into the B.P.C. pressure pipe.

If the pressure gauges T.75051 and T.75050 are not available a T-piece $\frac{1}{8}$ in. B.S.P. $\times$ $\frac{1}{8}$ in. B.S.P. $\times$ $\frac{1}{8}$ in. B.S.P. to connect a locally provided pressure gauge into B.P.C. delivery pressure or servo line will be required.

A slave distributor-to-burner pipe connection Part No. 29761 to enable a burner pressure gauge to be connected to any burner ; there is a permanent burner pressure gauge connection on No. 2 burner pipe.

Equipment for very accurate measurement of engine speed, such as a hand stroboscope, or hand tachometer, or a revolution counter and a stop watch.

To use a hand tachometer, such as Smiths A.T.H.7, remove the tachometer generator and apply the hand tachometer direct to the normal tachometer generator drive.

It is essential when using locally made equipment that the transmitting pipes are kept as short as possible.

GHOST 48 Mk. 2

The foregoing tools and equipment were originally provided for use on the Ghost 48 Mk. 1. Although they can be adapted for use on the Ghost 48 Mk. 2, additional gauges are required for use on the Dowty spill-burner fuel system which is fitted to the latter and, to meet this, a special portable test rig is being developed.

The table has been compiled on the assumption that the Dowty portable test rig will be available. This rig consists of a box containing the necessary gauges, hand pumps, connecting pipes, adapters and blanks. Where this equipment is not available, suitable gauges and pumps must be obtained locally, having regard to the pressures specified in the table ; and standard pipes, adapters and blanks utilized to connect the gauges and pumps to the system, and to blank off orifices as specified.

Symptom	*Primary Cause*	*Primary Investigation*
1. ENGINE DOES NOT ROTATE AT STARTING (TURBO STARTER FAILURE) (See also table in chapter 50, page 14)	a. Cartridge does not fire	Wait at least 15 seconds, select and fire second cartridge, or wait one minute and change cartridge
	b. Tripping of overspeed cut-off	Possibility of products of combustion, gritty in nature, lodging between cut-off plate and turbine ; this might cause excessive friction and trip cut-off
	c. Safety disc blown	This will be indicated by a heavy discharge of yellow smoke for an eleven second period
	d. Cut-off plate not reset	———
2. NO LIGHT-UP AT STARTING	a. Faulty or discharged aircraft batteries	Check the aircraft batteries and electric circuit
	b. (High energy ignition) Faulty surface discharge igniter plug	The simplest way to check this is to fit two surface discharge igniter plugs which are known to be serviceable and to make another attempt to start
	c. (High energy ignition) Faulty igniter circuit	Check igniter cable for continuity, insulation and good contact at each end
	d. Inadequate fuel supply to burners	Connect pressure gauge T.75051 to the union on No. 2 burner distributor pipe connection. Attempt to start the engine ; a build-up of pressure of at least 50 lb. per sq. in. should be observed

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
i. Electrical fault NOTE.—It has been considered that two defective cartridges will not occur together	Breech cap not correctly fitted Test the circuit at the firing pin, this can be done by removing both cartridges and replacing one breech cap. Check continuity by means of a 30 v. voltmeter, across the exposed pin and the barrel assembly. Replace other breech cap and repeat check, removing the first breech cap. It is essential to place the selector switch in the respective firing position	Wait 1 full minute and screw cap fully home Locate defect and rectify or change defective component	—
ii. Starter drive failure	———	Change starter	Chap. 19
———	———	———	—
———	———	Fit a new safety disc	Chap. 50
———	———	Re-set cut-off plate	Chap. 50
———	———	Change the batteries for ones known to be fully charged and without fault, or correct the defect in the electric circuit	Aircraft handbook
———	———	Fit two serviceable surface discharge igniter plugs	Chap. 15
———	———	Change defective ignition cable	Chap. 15
i. Fault in L.T. supply to H.E. condenser unit	Check circuit for continuity and insulation	Rectify defect or change defective component	Aircraft handbook
ii. Faulty high energy condenser unit	If the condenser unit can be heard operating but there is no high energy discharge, which is indicated by the discharge noise at the igniter plug, check the circuit from the battery to the condenser unit for an incorrect connection, i.e. the positive lead connected to a negative terminal or vice versa. If the wiring is correct, the serviceability of a suspect condenser may be checked by changing over the port and starboard units	———	Chap. 15
i. H.P. cut-off valve not opening fully	Ensure that the H.P. fuel cut-off valve lever, in the cockpit, is in the fully open position. Disconnect the control from the lever on the fuel control valve assembly, and check whether the H.P. cut-off valve can be moved any further towards the open position	Adjust the aircraft portion of the control circuit until full movement is obtained, and check also that, with the cockpit lever in the closed position, the H.P. cut-off valve closes fully	Aircraft handbook
ii. Distributor sticking	———	Change defective distributor	Chap. 14

Symptom	*Primary Cause*	*Primary Investigation*
2. NO LIGHT-UP AT STARTING (*contd.*)	d. Inadequate fuel supply to burners (*contd.*)	

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
iii. Faulty B.P.C., A-F ratio control, or fuel pumps	Check 1. To prove that the fault is as under iii. Disconnect the delivery pressure pipe from the fuel pump to the B.P.C. at the connection of the fuel pump and connect adapter T.77098 and pressure gauge T.75050 to the fuel pump and reconnect the delivery pipe to the T-piece. Repeat the attempt to start but keep the H.P. fuel cut-off valve lever in the CLOSED position to avoid flooding the engine. If there is a build-up of pressure of approximately 1350 lb. per sq. in., there is nothing wrong with the fuel system as under iii. Proceed to secondary cause iv.	———	—
	Check 2. To decide whether the fault is in the B.P.C. or A-F ratio control, or in the pumps. Disconnect and blank off the servo lines to the B.P.C. and A-F ratio control. Attempt to start the engine with the fuel pump isolating switch OFF.	———	—
	If the start is successful, the fault is in either the B.P.C. or the A-F ratio control. If the check 1 pressure gauge is still connected, a build-up of pressure of approximately 2000 lb. per sq. in. should be obtained NOTE.—If the engine starts under these conditions, a high idling speed is to be expected and the adjustment must not be altered	As it is more likely for the B.P.C. to be at fault, change the B.P.C., reconnect the servo lines, and repeat the attempt to start. If the engine still fails to start change the A-F ratio control	Chap. 14
	If the start is unsuccessful, either or both pumps may be faulty. In practice this trouble seldom occurs	To avoid lengthy investigation as to which pump is faulty, change both pumps. Alternatively, change the pumps one at a time, making a further attempt to start after each change	Chap. 14
iv. Incorrect slow-running adjustment	Open the throttle slightly and repeat the attempts to start the engine. If the engine starts but will not idle with the throttle fully closed, it suggests that the slow-running bleed has become blocked, or has been screwed in inadvertently	Carefully noting the number of complete turns the slow-running needle is unscrewed, remove the needle and examine for dirt on needle or in orifice. Screw in needle the same number of complete turns as it was unscrewed. If start is still unsuccessful, or if no blockage was discovered set needle one turn further open. When a successful start is made readjust the slow-running speed. Keep a note of all alterations made.	Chap. 14
v. Faulty burners in igniter combustion chambers	If all others checks are satisfactory, the difficulty may be due to faulty burners in combustion chambers No. 3 and 10	Change these burners	Chap. 14

Symptom	*Primary Cause*	*Primary Investigation*
3. FAILURE TO ACCELERATE AFTER LIGHT-UP	a. Internal resistance in engine	This would probably have revealed itself during the free running check when the engine was stopped previously
	b. Faulty starter	Low cranking r.p.m. by starter due to long service life of starter. Check starter log book for number of shots fired
	c. Inadequate fuel supply	Proceed as described under 2.c. in this table
4. FAULTY STARTING, JUDDERING	Insufficient or incorrect oil in starter gearbox	———
5. INCORRECT IDLING SPEED NOTE.—Idling speed varies slightly with atmospheric pressure and temperature.	a. Engine not warmed up	Run up slowly to maximum r.p.m., and return to idling; idling speed may then be correct
	b. Faulty B.P.C., or faulty A-F ratio control overriding the B.P.C. incorrectly	Connect adapter T.77098 and pressure gauge T.75050 to the delivery pressure pipe from the pump to the B.P.C. as described under 2.c.iii in this table. When the engine is idling, a pressure of 1350±100 lb. per sq. in. should be registered. If the pressure is outside this range the B.P.C. may be faulty
		If, after changing the B.P.C., the engine still does not run correctly and the pressure is still outside the range given, the A-F ratio control is probably faulty
	c. Incorrect adjustment of the slow-running bleed	Alter the adjustment of the slow-running needle as little as possible; keeping a careful rcord of all alterations made
	d. Faulty fuel pump	Proceed as described under 2.c.iii in this table
6. FULL THROTTLE R.P.M. EXCEEDS THE PERMITTED MAXIMUM NOTE.—One of the fuel pumps is set to govern at 50 r.p.m. more than the other pump and therefore, when the fuel pump isolating switch is ON the higher r.p.m. may be attained.	a. Governor mechanism incorrectly adjusted	———
	NOTE.—It should be understood that there is a tendency for the governed r.p.m. to burner pressure to fall as low as 500 lb. per sq. in., the governed speed will increase 1100 lb. per sq. in., then the governed speed will be approximately 10200 r.p.m. Provid governor adjustment.	
	b. Faulty fuel pump (i.e. governor mechanism)	Engine r.p.m. will not respond to any amount of governor adjustment

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
——	——	——	Chap. 9
Slipping clutch	——	Change starter	Chap. 19
——	——	——	—
——	——	Prime starter gearbox, if incorrect oil is suspected, remove starter, drain, and refill	—
Cold oil in engine-driven aircraft accessories	Run engine until all gas and oil temperatures have stabilized	——	—
——	——	Change B.P.C.	Chap. 14
——	——	Change A-F ratio control	Chap. 14
——	——	——	Chap. 14
——	——	——	Chap. 14
——	——	Readjust the governor mechanism. Before deciding that either of the fuel pumps is faulty, ensure that you are adjusting the governor which is controlling the r.p.m. and that neither governor will respond to adjustment. Turn the adjusting screw, on the fuel pumps, anti-clockwise to decrease the governed r.p.m.	Chap. 14

change with burner pressure (i.e., fuel flow). For instance, if the ambient temperature is high and causes the to approximately 10300 r.p.m., and if the ambient temperature is low, causing the burner pressure to be as high as ed that the variation of governed r.p.m. with burner pressure is within these limits, it is unnecessary to reset the

——	——	Change defective fuel pump	Chap. 14

Symptom	*Primary Cause*	*Primary Investigation*
7. FULL THROTTLE DOES NOT GIVE MAXIMUM PERMITTED R.P.M. (refer also to note under 6 in this table and to cold weather operation in chapter 10).	a. Throttle or H.P. fuel cut-off valve not opening fully	Check controls as described for H.P. fuel cut-off valve under 2.c.i in this table
	b. Governor mechanism in fuel pumps incorrectly set or faulty, or faulty B.P.C. or A-F ratio control	Disconnect the servo pipe from the front fuel pump to the B.P.C. and connect pressure gauge T.75050 to the servo outlet on the front pump, and blank off the third leg of the pressure gauge T-piece. Having thus blanked off the servo side of both pumps from both the B.P.C. and the A-F ratio control. Run the engine up to the maximum r.p.m. obtainable. If when this r.p.m. is reached, there is an appreciable drop in the pump delivery pressure (from about 2000 to about 1000 lb. per sq. in.) the governor mechanism in one of the fuel pumps is operating at too low an r.p.m.
	c. Inadequate fuel supply reaching burners	Connect pressure gauge T.75050 as above

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
——	——	Adjust aircraft portion of control circuit	Aircraft handbook
——	——	Readjust the governor mechanism. Before deciding that either of the pumps is faulty, ensure that you are adjusting the governor which is controlling the r.p.m. and that neither governor will respond to adjustment. Turn the adjusting screw on the fuel pump clockwise to increase the governed r.p.m. If either pump will not respond to adjustment (below the setting of the other pump governor), change that fuel pump	Chap. 14
i. Faulty fuel pumps	If, although both pumps appear to respond to governor adjustment, maximum r.p.m. is still unobtainable and delivery pressure drops as the throttle is opened, both pumps are probably faulty.	Change both pumps	Chap. 14
ii. Faulty B.P.C.	Having obtained the required r.p.m. with the servo system blanked off (i.e. on pump stall pressure of 2000 lb. per sq. in.), connect the servo pipe to the third leg of the pressure gauge T-piece and disconnect the servo pipe from the B.P.C. to the A-F ratio control and blank off the connection on the B.P.C. If a delivery pressure of 1350 ± 100 lb. per sq. in. (since the gauge will be recording servo pressure, the actual reading will be proportionally lower than the actual delivery pressure) is NOT maintained, at all except governing r.p.m., the B.P.C. is faulty ; refer also to note below	Change B.P.C.	Chap. 14
iii. Faulty A-F ratio control	Reconnect the servo pipe from the B.P.C. to the A-F ratio control. If a delivery pressure of 1350 ± 100 lb. per sq. in. is NOT maintained, at all except governing r.p.m., the A-F ratio control is faulty	Change A-F ratio control	Chap. 14

NOTE.—If the stipulated delivery pressure is maintained at all except governing r.p.m., neither the fuel pumps, nor the B.P.C. or the A-F ratio control is faulty. It should be noted that low temperature conditions can make this pressure inadequate for reaching maximum r.p.m. ; this condition is best investigated in terms of burner pressure. For instance, if full throttle does not give maximum r.p.m., connect a pressure gauge to the union on No. 1 burner distribution pipe connection and check that the maximum burner pressure, for cold weather conditions (1050—1100 lb. per sq. in.), is being obtained. If this is correct, nothing more can be done.

iv. Faulty burners	Exceptionally high burner pressure, registered when pressure gauge is connected to pipes between distributor and burners	Change the burners. NO dismantling of the burners is permissible without approval and the necessary equipment, specialists, and test rigs	Chap. 14
v. Faulty distributor	If the results of the foregoing investigations are unsuccessful, the distributor is probably faulty	Change distributor	Chap. 14

Symptom	*Primary Cause*	*Primary Investigation*
8. UNSTABLE R.P.M. AT FULL THROTTLE	Incorrect rigging of high pressure fuel cut-off valve control linkage may cause a variation of up to 100 r.p.m. at full throttle	Ensure that the H.P. fuel cock lever is functioning correctly within its gate, and re-check by ground running that the full throttle r.p.m. does not fluctuate
9. INCORRECT OIL PRESSURE NOTE.—It has been assumed that the correct grade of oil is in use.	a. Insufficient oil	Check level of oil
	b. High or low ambient temperature	This will cause either low or high pressure respectively
	c. Faulty relief valve	Remove pressure relief valve, without altering its setting, and examine condition of valve and seat
	d. Incorrectly set relief valve	If other checks are satisfactory, setting of valve is faulty
10. SUSPECTED OIL LEAKAGE OR HIGH OIL CONSUMPTION	Rear Bearing.	An oily, sometimes carbonised, condition of the rear bearing housing. Check by ground running to ascertain whether the oil consumption is merely be the result of over priming.
	Front Bearing.	The Rockhard lacquer applied to the impeller gives the impression, before rejecting an engine for oil leakage from the front bearing
11. INCORRECT JET PIPE TEMPERATURE NOTE.—The engine should be run for as short a time as possible to carry out these investigations.	a. Faulty thermocouple leads and connections	This is usually shown by erratic temperature readings. Remove leads and check for continuity and insulation
	b. Faulty thermocouple	Fit new thermocouple and recheck
	c. Uneven burning	——

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
If r.p.m. still fluctuates, the aircraft control linkage requires adjustment	———	Adjust cut-off valve control rod sufficiently to ensure that the fuel cut-off valve is fully open when the lever in the cockpit is through the gate	Aircraft handbook
———	———	Refill as necessary. Check again after running when oil temperature has settled down	Chap. 9
———	———	Check again after running when oil temperature has settled down to normal	—
———	———	Renew faulty part and readjust	Chap. 13
———	———	Readjust	Chap. 13

insulating plate, and front face of the turbine disc is normal and of itself does not justify rejection of an engine. normal or is excessive. Also check the delivery of the rear bearing metering pump. Some of the oiliness may

particularly when the engine is new, or has been newly overhauled, of a thick film of fresh oil. Therefore, ensure that the apparent oil film is actually oil.

———	———	Fit new leads	Aircraft handbook
———	———	———	Chap. 18
i. Burners not functioning correctly due to damaged burners or clogged burner filters	Remove burners and examine without dismantling	Change burners as necessary	Chap. 14
ii. Cracked or damaged combustion chambers	If condition is not cured, combustion chambers may have been damaged by the excessive temperatures. Remove and examine for cracks, distortion, etc.	Change combustion chambers as necessary	Chap. 16
iii. Faulty distributor	———	Change distributor	Chap. 14

Symptom	*Primary Cause*	*Primary Investigation*
12. ABNORMAL VIBRATION	a. Unstable combustion at starting due to over-rich mixtures	This will die out as engine speed increases to idling
	b. Damaged impeller or turbine blades	Examine in situ for damage
	c. Defective engine-driven aircraft accessory	This type of vibration will become familiar to the operator, with engine running experience
	d. Contact between engine and airframe structure	This may occur only when the engine is running, or when it is hot, carefully examine all likely points for evidence of rubbing or contact
	e. Engine faulty	If vibration persists after removal of all accessories, or is encountered at other speeds, engine is faulty.
13. FUEL PRESSURE WARNING LIGHT COMING ON AT ALTITUDE FOR NO APPARENT REASON	The bore of the pressure union in the side of the switch body blocked with shellac or dirt	Examine the bore of the union for blockage

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
——	——	No action required	—
——	——	Remove engine and return for overhaul	Chap. 6
——	——	Determine cause and rectify	—
——	——	Rectify	Aircraft hand-book

Engines are frequently rejected, unnecessarily, on grounds of vibration ; subsequent examination revealing no engine defect but rub marks indicating that contact between engine and airframe components is the real cause of the vibration. In Venom aircraft, the most common points of contact are:—Diffuser casing and rear cover on cowlings and retaining buckles for cowling inspection doors, pre-mod. 704 and 914. No. 3 and 9 burner feed pipes on aileron controls. No. 8 burner shims on aircraft main fuel pipe, pre-mod. 983. Combustion chamber expansion chamber castings on high-rate-discharge fire extinguisher pipes. Cabin air supply on diffuser casing, No. 9 deflector cover stud. Turbo-starter fins on fireproof bulkhead. Turbo-starter fins on cable cover attached to fireproof bulkhead. Drain pipes generally. Engine controls at fireproof bulkhead and bolts adjacent to air-intake front. *Ghost 48 Mk. 2*, metering pump pipe to rear bearing on fuel manifold feed pipe bracket, pre-mod. 1117. Tungum pipe spill return and cowling ring attachment at bottom of engine. Hydraulic pump pipes, inlet and outlet, with port air-intake.

——	——	Remove engine and return for overhaul	Chap. 6
——	——	Remove shellac or dirt	—

DEFECT DIAGNOSIS TABLE
Ghost 48 Mk. 2
Based on Dowty Fuel Systems Ltd., table ENG. 220 Mk.2, issue 5, dated September 1955.

Symptom	*Primary Cause*	*Primary Investigation*
1. ENGINE DOES NOT ROTATE AT STARTING (TURBO STARTER FAILURE)	See page 4	
2. NO LIGHT-UP AT STARTING **WARNING—** Before repeated starting cycles are attempted, unless mod. 1170 has been embodied, make a check to ensure that the idling adjuster has not been screwed right home; if the idling adjuster is screwed in too far, excessive pressure in the system will result, and this may damage the flow control unit diaphragm and the supply pump. These conditions cannot arise where mod. 1170 has been embodied.	a. Faulty or discharged aircraft batteries	Check the aircraft batteries and electric circuit
	b. Faulty igniter circuit	Check ignition cable for continuity, insulation, and good contact at each end
	c. Faulty torch igniter	Fit two torch igniters which are known to be serviceable and attempt another start, or investigate as suggested in secondary cause iic
	d. Inadequate fuel supply to burners.	Remove the plug from the low pressure tapping on the valve head of the supply pump, insert adapter union S.T.5068-31 with the existing bonded seal and connect a 0-30 lb. per sq. in. pressure gauge to the union. Switch on the fuel tank booster pump and check that the static pressure is not less than 10 lb. per sq. in. If the static pressure is satisfactory, attempt to start the engine. If during this attempt the pressure does not fall below 6 lb. per sq. in. failure to start may have been due to low r.p.m. A pressure of less than 6 lb. per sq. in. is probably due to a dirty filter or a fault upstream of the filter If the engine still does not start, remove the blank from the manifold feed pipe elbow on the valve group unit. Connect a 0-100 lb. per sq. in. pressure gauge to the elbow.
		Attempt to start the engine; a peak pressure of 10 lb. per sq. in. should be observed. If the pressure is 10 lb. per sq. in. or greater, either the torch igniter or the torch igniter valve in the valve group unit, or both, are not operating correctly.

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
——	——	Change the batteries for ones known to be fully charged and without fault, or correct the defect in the electric circuit	
——	——	Change defective ignition cable	Chap. 15
i. Fault in L.T. supply to high energy ignition unit	Check circuit for continuity and insulation	Rectify defect	Aircraft handbook
ii. Faulty high energy ignition unit	If the ignition unit can be heard operating but there is no high energy discharge, which is indicated by the discharge noise at the igniter plug, check the circuit from the battery to the ignition unit for an incorrect connection; i.e. the positive lead connected to a negative terminal or vice versa. As a quick check, the serviceability of a suspect unit may be checked by changing over the port and starboard units	Change faulty ignition unit for one known to be serviceable	Chap. 15
——	——	Fit two serviceable torch igniters	Chap. 15
i. Faulty fuel tanks booster pump	If the static pressure is below the figure specified the booster pump is faulty	Change the booster pump	Aircraft handbook
ii. Faulty valve group unit	Disconnect L.T. supply from ignition unit. Remove the torch igniter assembly from the combustion chamber, but still keep the pipe to the torch igniter connected. Simulate a start and ensure that a spray of fuel issues from the torch.		

Symptom	*Primary Cause*	*Primary Investigation*
2. NO LIGHT-UP AT STARTING (*contd.*)	d. Insufficient pressure at the supply pump inlet (*contd.*)	A pressure below 10 lb. per sq. in. on the 0-100 lb. per sq. in. pressure gauge could possibly mean that there is no priming flow in the spill line which is due to a faulty priming valve. Also if the circuit control valve is stuck in the running position there will be no pressure (refer to secondary cause iib)

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
iia. Faulty isolating valve or torch igniter valve	If there is no spray carry out the following investigation:—Ensure that the booster pump is switched off. Remove the plug from the end of the banjo bolt at the downstream throttle connection on the valve group unit. Insert adapter union AGS.1105-A with the existing bonded seal and connect the hand pump to it. Turn on the H.P. cock. Disconnect the pipe leading from the torch igniter valve to the igniters, apply a pressure up to 50 lb. per sq. in. to open the isolating valve; fuel should flow from the torch igniter valve connection. If there is no flow at this pressure, either the torch igniter valve or isolating valve is faulty.	Remove the torch igniter valve and check the movement of the valves to ensure that they are free. Reassemble and test again. If still unsatisfactory renew the complete torch igniter valve. Test again and if there is still no flow renew the complete isolating valve	Dowty handbook
	If there is a flow the torch igniter is faulty	Refer to secondary cause iic	
iib. Faulty circuit control valve	If no pressure is created, the circuit control valve is stuck in the running position	Disconnect the drain connection and attempt to release the valve. If this is unsuccessful remove the valve group unit and renew the complete circut control valve group	Dowty handbook
iic. Faulty torch igniter assemblies	Connect the hand pump to the pipe leading to the igniters at the torch igniter valve end and apply a pressure. If there is no spray at the torches either the pipe is blocked or the torch igniters are faulty	Disconnect the pipes at the torch igniter end and check that the pipes are not obstructed. If there is no obstruction renew the torch igniters	Chap. 15
iid. Faulty priming valve	The cause of not starting may be due to lack of priming, in which case the priming valve may be faulty To check this, disconnect the manifold feed and spill pipes at the valve group unit. With the ignition off simulate a start. Fuel should discharge from both pipes. If no flow is observed from the burner spill pipe, the priming valve is faulty	Renew the complete priming valve group and test again	Dowty handbook
iie. Faulty No. 4 non-return valve	If there is still no flow after testing the priming valve again, No. 4 non-return valve is faulty	Renew the complete No. 4 non-return valve group	Dowty handbook
iif. Faulty No. 1 non-return valve	If no flow is observed from the feed to manifold, No. 1 non-return valve is faulty	Remove the valve group unit and renew the complete No. 1 non-return valve group	Dowty handbook

Symptom	*Primary Cause*	*Primary Investigation*
2. NO LIGHT-UP AT STARTING (*contd.*)	d. Insufficient pressure at the supply pump inlet (*contd.*)	
3. FAILURE TO ACCELERATE AFTER LIGHT-UP	a. Internal resistance in engine	This should have revealed itself during the running down check at previous shut-down; listen for undue noise and check the rotor swing back during the run-down as it is undesirable to continue to attempt to start the engine if some mechanical failure has occurred
	b. Faulty starter	Low cranking r.p.m. caused by starter approaching end of permitted service life. Check total number of shots fired
	c. Inadequate fuel supply	———
4. FAULTY STARTING JUDDERING	See page 8	
5. INCORRECT IDLING SPEED N.B.—The idling speed will vary slightly with the ambient temperature, but if the speed is between 2800 and 3200 R.P.M. no adjustment is necessary.	Engine not warmed up	Run the engine above the idling speed for a short period and then return to the idling speed

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
iig. Faulty supply pump	Remove the plug from the high pressure tapping on the supply pump, insert adapter union S.T.5068-31 with the existing bonded seal, connect a 0-360 lb. per sq. in. pressure gauge to the union. With the ignition off and the throttle fully open simulate a start; check that the pressure on the 0-360 lb. per sq. in. pressure gauge is not less than 100 lb. per sq. in. at peak cranking speed. If it is less than 100 lb. per sq. in. the supply pump is faulty	Change the supply pump	Chap. 14
———	———	———	
———	———	Change starter Remove inspection plate and check cut-off	Chap. 19 Chap. 50
———	———	Refer to Symptom 2 Primary Cause d	
Incorrect setting of the idling adjuster	Check the idling adjustment If the idling speed is high, and the effect of screwing in the idling adjuster fails to reduce the engine r.p.m., remove the plug from the high pressure tapping on the supply pump and insert adapter union S.T.5068-31, using the existing bonded seal. Connect a 0-1000 lb. per sq. in. pressure gauge in the union. Check that the pressure is 280 to 330 lb. per sq. in. WARNING: If the idling adjuster is screwed in too far, excessive pressure in the system will result. This may damage the flow control diaphragm and the supply pump		
i. Faulty supply pump	If the pressure is above 330 lb. per sq. in. the minimum flow valve or the flow control unit is faulty To isolate the defective unit proceed as follows:—Remove the plug in the end of the servo pipe banjo bolt on the supply pump. Fit adapter union AGS.1105.A with the existing bonded seal in the banjo bolt and connect a 0-1000 lb. per sq. in. pressure gauge to the union If the servo pressure is virtually zero, the minimum flow device is faulty If the servo pressure is between 180 and 220 lb. per sq. in. the minimum flow device is satisfactory	Change the supply pump	Chap. 14

Symptom	*Primary Cause*	*Primary Investigation*
5. INCORRECT IDLING SPEED *(contd.)*		
6. FULL THROTTLE R.P.M. EXCEEDS MAXIMUM	Governor mechanism on supply pump incorrectly adjusted	——
7. FULL THROTTLE DOES NOT GIVE MAXIMUM PERMITTED R.P.M.	a. The governor mechanism on the supply pump incorrectly adjusted	Refer to symptom 13—Primary Investigation
	b. H.P. fuel shut-off and throttle not opening fully	Move H.P. fuel shut-off and throttle levers in cockpit to fully open position. Disconnect the control from each lever on the valve group unit and check whether the shut-off valves or the throttle can be moved further towards the open position

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
ii. Faulty flow control (F.C.) unit	If the pump pressure is 330 lb. per sq. in. or over, and idling r.p.m. and the servo pressure are high, the filter in the F.C. unit may be blocked	Remove the filter from the F.C. unit, clean, replace and test again	Dowty handbook
	If idling r.p.m. is high but with normal servo and supply pump delivery pressure the flow control unit diaphragm may be ruptured, proceed as follows:— Remove the banjo bolt from the upstream banjo connection at the valve group unit and fit adapter union S.T.5068-32. Connect the hand pump to the adapter union. Remove the banjo bolt from the downstream connection at the valve group unit and connect special banjo bolt S.T.5068-77. Attach a length of P.R. hose to this connection. Apply a pressure of 150 lb. per sq. in. with the hand pump and check for any leakage from the downstream connection. If there is any leakage the F.C. unit is faulty	Change the F.C. unit	Chap. 14
iii. Faulty circulating pump	If idling speed is in excess of 5000 r.p.m. and the pressures are normal, the circulating pump is faulty. Check as follows. Disconnect the return to tank fuel connection on the valve group unit and leave it open. Close the shut-off valves and check the quantity of fuel discharged from this connection. This should be at least 1½ pints. If less than 1½ pints is observed the circulating pump is faulty	Remove the valve group unit and renew the circulating pump complete	Dowty handbook
	If the pump delivery pressure is above 330 lb. per sq. in. and the idling speed is below 2800 r.p.m. the idling adjuster is faulty If the pressures are normal and the idling r.p.m. are low, screw out the idling adjuster and if the r.p.m. do not increase refer to Symptom 12 Primary Cause	Renew the idling adjuster assembly Ensure that the valve seat is not blown out when renewing the idling adjuster	Dowty handbook
———	———	Adjust governor	Chap. 14
———	———	———	
———	———	Adjust aircraft portion of control until full movement is obtained and then check that when the lever closes in the cockpit, the H.P. shut-off and the throttle fully closes in the valve group unit	Aircraft handbook
i. Faulty A-F ratio control (A-F.R.C.)	Refer to Symptom 12 Primary Investigation. Open the throttle slowly during this operation. If maximum r.p.m. are obtained the A-F.R.C. is faulty	Change the A-F.R.C.	Chap. 14

Symptom	*Primary Cause*	*Primary Investigation*
7. FULL THROTTLE DOES NOT GIVE MAXIMUM PERMITTED R.P.M. (*contd.*)		
8. INCORRECT OIL PRESSURE *Note.*—It is assumed that the correct grade of oil is in use.	See page 12	

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
ii. Faulty F.C. unit	With the servo pipes connected together as in Symptom 12 Primary Investigation, proceed as follows: Disconnect the spill pipe at the valve group unit and blank the connection on the valve group unit using outer sleeve A.G.S.904-BB, cone cap A.G.S.1159-BB and split pin A.G.S.166/2. Remove the plug from the downstream banjo connection on the valve group unit and insert adapter union A.G.S.1105-A with the existing bonded seal. Remove the plug from the upstream banjo connection, insert adapter union A.G.S.1105-A and connect a differential pressure gauge (250 lb. per sq. in.) to the unions. Start the engine and open the throttle fully		
	If fuel flows from the low pressure connection of the F.C. unit when there is a pressure differential of less than 80 lb. per sq. in. on the differential pressure gauge, the F.C. unit is faulty	Proceed as in Symptom 12 Secondary Investigation F.C. unit	
	Retest and if still unsatisfactory the F.C. unit is faulty	Change the F.C. unit	Chap. 14
iii. Faulty supply pump	If no flow is observed from the low pressure connection of the F.C. unit and there is a pressure drop of less than 80 lb. per sq. in. the supply pump is faulty	Remove the supply pump restrictor and filter. Clean the filter. Re-assemble the filter only at this stage	Dowty handbook
	Insert plug assembly S.T.5068-36. Connect the hand pump, with a 0-2000 lb. per sq. in. pressure gauge in the circuit, remove the servo connector from the by-pass valve cover and replace with blank connector S.T.5068-38. Replace the by-pass valve cover. Apply a pressure of 1000-1200 lb. per sq. in. to the half-ball valve. The re-seat pressure must not be less than 800 lb. per sq. in. Disconnect the hand pump, re-assemble the restrictor plug and restrictor, replace the servo connector and retest. If there is still no flow from the low pressure connection of the F.C. unit, the supply pump is faulty	Change the supply pump	Chap. 14
iv. Faulty circulating pump	If fuel flows from the spill pipe connection at the F.C. unit and the difference is 95 lb. per sq. in. or above the circulating pump is faulty NOTE If the pressure lies between 80 and 95 lb. per sq. in. the F.C. unit, valve group unit, and supply pump are satisfactory	Remove the valve group unit and renew the circulating pump complete	Dowty handbook

Symptom	*Primary Cause*	*Primary Investigation*
9. INCORRECT JET PIPE TEMPERATURE *Note.*—The engine should be run for as short a time as possible to carry out these investigations.	a. Faulty thermocouple leads and connections	This is usually indicated by erratic temperature readings. Remove leads and check for continuity and insulation
	b. Faulty thermocouple	———
	c. Burners not functioning correctly	Examine engine for possible local hot spots at root of combustion chambers, and check for correct position of biased burners
10. ABNORMAL VIBRATION	See page 12	
11. FAST (*i.e.*, less than 4 sec.) ACCELERATION OF ENGINE FROM 5000 to 10100 ENGINE R.P.M.	Faulty A-F.R.C.	Fast acceleration may be due to a collection of foreign matter in the external servo filter in the A-F.R.C. Test again and if this test is unsatisfactory the A-F.R.C. is faulty
12. SLOW OR NO ACCELERATION, (*i.e.*, more than 8 secs.) TO ACCELERATE THE ENGINE from 5000 to 10100 R.P.M. WHEN OPENING THE THROTTLE RAPIDLY	Faulty A-F.R.C.	Disconnect and remove the two servo connections from the A-F.R.C. and connect the two servo pipes together using elbow union S.T.5068-28 Disconnect the spill pipe at the valve group unit and blank off the banjo union using outer sleeve AGS. 904-BB, cone cap AGS.1159-BB and split pin AGS.166/2. Start the engine. Accelerate through the range quoted. If the acceleration time is less than 5 seconds the A-F.R.C. is at fault, which may be due to an obstructed filter After replacing the filter and restrictor connect the A-F.R.C. to the system and accelerate the engine. If the engine again fails to accelerate repeat the above investigation and if the engine then accelerates the A-F.R.C. is faulty

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
——	——	Fit new leads	
——	——	Fit new thermocouple and recheck	
Faulty A-F ratio control	Disconnect air pressure pipe from A-F.R.C. Start booster pump. If fuel drips or flows from air pressure connection A-F.R.C. is faulty The above only applies if overheating takes place in No. 5 combustion chamber at idling speed	Change the A-F.R.C.	Chap. 14
——	——	Remove and clean the external servo filter. Renew the 'O' ring seal in the filter	Dowty handbook
——	——	Change the A-F.R.C.	Chap. 14
——	——	Remove the restrictor and filter of the internal servo circuit. Clean the filter. Renew the 'O' ring seal on the restrictor. Replace the assembly	Dowty handbook
——	——	Change the A-F.R.C.	Chap. 14
i. Faulty F.C. unit	If, with the A-F.R.C. isolated, the acceleration takes more than 5 secs., with fuel flowing freely from the spill connection of the F.C. unit during acceleration and below 10000 r.p.m., the F.C. unit is faulty. Proceed as follows: Disconnect the servo connection at the F.C. unit, fit adapter union S.T.5068-33 to the servo connection and connect the hand pump, with a 0-2000 lb. per sq. in. pressure gauge in the circuit, to the union adapter Apply a pressure of 1500 lb. per sq. in. to the half-ball servo valve. This pressure must be maintained. Check for leakage, which will be indicated by a loss of pressure shown on the 2000 lb. per sq. in. pressure gauge. If 1500 lb. per sq. in. is not maintained the F.C. unit is faulty. If there is a leakage, connect the hand pump and up stream and servo connections of the F.C. unit together as follows:—	Change the F.C. unit *Continued overleaf*	Chap. 14

Symptom	*Primary Cause*	*Primary Investigation*
12. SLOW OR NO ACCELERATION (*i.e.*, more than 8 secs.) TO ACCELERATE THE ENGINE from 5000 to 10100 R.P.M. WHEN OPENING THE THROTTLE RAPIDLY (*contd.*)	Faulty A-F.R.C. *(cont.)*	
13. INCONSISTENT GOVERNING	Ambient temperature conditions	Variations between plus 30 and minus 50 r.p.m. from the normal governed speed may be ignored unless they are habitual, in which instance adjust the governor mechanism to meet the different operating conditions. Variations greater than this must be investigated and remedied. Refer to Symptoms 6 and 7
14. FUEL PRESSURE WARNING LIGHT COMING ON AT ALTITUDE FOR NO APPARENT REASON	See page 12	

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
i. Faulty F.C. unit *(cont.)*	Remove the banjo belt from the upstream banjo connection on the valve group unit and insert special banjo bolt ST. 5068-32. Disconnect the servo pipe from the F.C. unit and fit adapter union assembly ST.5068-33. Connect flexible hose assembly ST.5068-78 to the special banjo bolt and adapter union, and the hand pump to the remaining connection on the hose assembly. Apply a pressure of approximately 100 lb. per sq. in. which will lift the diaphragm and allow a flow of fuel to clear any obstruction under the half-ball servo valve. Repeat the previous test by running the engine. If there is virtually no flow, i.e. a drip rather than a steady flow, from the spill connection when running at idling speed, and acceleration is still slow, the supply pump or circulating pump is faulty		
ii. Faulty circulating pump	Reconnect the servo pipe to, and disconnect the compressor pressure pipe from the A-F.R.C. Blank the compressor pressure pipe using cone plug A.G.S.1143B. The A-F.R.C. will then limit the flow to 300 gall. per hr. With the throttle fully open the r.p.m. should be above 7000 If it does not reach 7000 r.p.m. fuel is being lost downstream of the unit and the circulating pump is faulty	Remove the valve group unit and renew the circulating pump complete	Dowty handbook
iii. Faulty supply pump	If the speed is 7000 r.p.m. or greater the supply pump is not performing correctly at maximum r.p.m.	Remove the supply pump restrictor and filter. Clean the filter; re-assemble the filter only at this stage	
	Insert the plug assembly S.T.5068-36. Connect up the hand pump, with a 0-2000 lb. per sq. in. pressure gauge in the circuit. Remove the servo connector from the by-pass valve cover and replace with blank connector S.T.5068-38. Replace the by-pass cover. Apply a pressure of 1000-1200 lb. per sq. in. to the half-ball valve. The re-seat pressure must not be less than 800 lb. per sq. in. Disconnect the hand-pump and re-assemble the restrictor plug, restrictor, servo connector and test again for acceleration. If this is still unsatisfactory, the supply pump is faulty	Change the supply pump	Chap. 14

Note :— Pages 30 and 31 will be issued by a later amendment ; if they are required to carry any additions to the Ghost 48 mk. 2 table.

DEFECT DIAGNOSIS, GHOST FIFTY-THREE Mk. 1

Defect investigation in respect of the Ghost 53 Mk. 1 follows the same pattern, and uses the same test equipment, as for the Ghost 48 Mk. 1 in so far as it concerns the mechanical aspects of the basic fuel system components which are common to both Marks. The electric max. r.p.m. control fitted to the Ghost 53 Mk. 1 is separate from the basic system; it obtains its controlling data from sources outside the fuel system, and only enters directly into the system at the servo throttle by which it exercises the master control of the flow of fuel to the burners. The Ghost 53 Mk. 1 system components can be divided into three groups :—

1. The electric, "sensing", group of the electric max. r.p.m. control; consisting of the altitude compensating unit, and the magnetic amplifier unit which receives its operative signal from the engine-driven tachometer generator; and its power supply from the aircraft flight instruments' inverters.

2. The electro-mechanical, "action", group of the electric max. r.p.m. control which links the purely electrical (1) with the purely mechanical (3) groups, and varies the fuel flow independently of the pilot's throttle setting; thus performing the actual control of maximum engine r.p.m. This group consists of the line pressure control unit, and the servo throttle.

3. The basic fuel system.

The approach to defect investigation differs in each of these groups. In the first group the electric current output from the magnetic amplifier to the line pressure control unit is measured and recorded at various engine r.p.m., and the readings are plotted as a graph. In the second, a known, controllable and independent D.C. electric current is applied to the line pressure control unit and the consequent effect on engine r.p.m. is recorded and plotted. In the third group it is the hydraulic pressures within the basic fuel system which are measured and recorded. In each case it is the characteristics of the results so obtained which lead to diagnosis of the defect and its correction.

TEST EQUIPMENT FOR DEFECT DIAGNOSIS

Two sets of electric test equipment are required for the diagnosis of defects in the electric max. r.p.m. control equipment. These are :—

1. That required to measure the output of control current from the magnetic amplifier to the line pressure control unit. This equipment is known as the Routine Test Set, and is described on page 50. The test which it is used to apply is called the Gain Check.

2. That required to apply a known, controllable, and independent D.C. current to the line pressure control unit. This equipment also is described on page 52. For the purposes of this Table it is known as the D.C. Test Set, and the test for which it is used is called the D.C. Check.

Equipment required for carrying out pressure and other checks of the basic fuel system is that listed on page 3 with the addition of three special adapters T.79447, T.79450, and T.79474 which enable the existing pressure test equipment to be connected into the Ghost 53 Mk. 1 fuel system. Instructions for the use of these adapters are given in the table where appropriate. It should be noted that in the case of the Ghost 53 Mk. 1 whilst the hand-held tachometer—Smiths A.T.H.7—can be used for accurate measurement of r.p.m. for setting the hydraulic governor mechanism or for calibrating the cockpit engine r.p.m. indicator, this can be done only when the electric max. r.p.m. control equipment is inoperative, because this control operates upon a continuous electric signal from the tachometer generator the drive for which, therefore, cannot be made available to operate the hand-held tachometer.

DEFECT DIAGNOSIS CHECKS, CHECK RECORDS, AND THEIR INTERPRETATION

Gain check

The Gain Check is carried out as follows:—

1. Ensure that the controlled max. r.p.m. is set correctly at 10350 r.p.m.

2. Plug the Routine Test Set into the test socket in the electric max. r.p.m. control system, and turn the Test Set control switch to No. 1 position. The test socket which is provided in the aircraft cockpit taps into the circuit between the magnetic amplifier unit and the line pressure control unit.

3. Open the throttle slowly and record the current indicated by the Test Set microammeter at idling, at about 10000 r.p.m., at 10300 r.p.m., and at full throttle. Observe particularly the r.p.m. at which the indicated current starts to increase; this will normally become clearly perceptible over a range of 10 r.p.m. Close the throttle. The current flowing in the circuit between the magnetic amplifier unit and the line pressure control unit is in milliamps; that indicated by the Test Set meter is in microamps; but if the Test Set has been calibrated correctly the numerical values of both currents will be the same. Thus, 20 microamps indicated by the Test Set meter will indicate that 20 milliamps is the actual current flow in the circuit between the magnetic amplifier unit and the line pressure control unit.

4. Plot the readings obtained as a graph—Fig. 2 is a typical example.

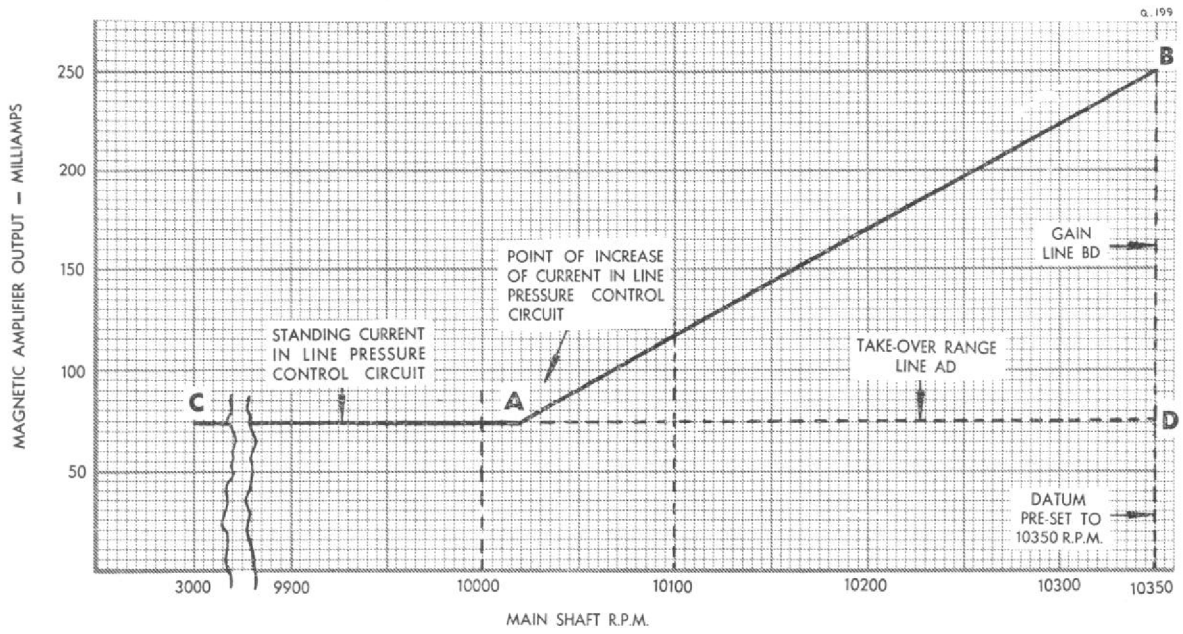

Fig. 2. Gain Check. Magnetic amplifier gain, typical curve.

Fig. 2 illustrates a typical curve obtained by applying the Gain Check. The interpretation of the various aspects of the curve are as follows :—

1. *Datum.* The line BD represents the maximum full throttle r.p.m. attained by the engine when under the control of the electric max. r.p.m. control equipment. This r.p.m. is adjustable by means provided within the electric control equipment, and the correct pre-setting of this adjustment, so that the maximum controlled r.p.m. of engine does not exceed the permissible limit for the engine type, is essential to the correct functioning of the engine. The r.p.m. to which the engine is so controlled is known as the " datum ", and for the Ghost 53 Mk. 1 this datum is 10350 r.p.m. Adjustments to the datum r.p.m. are made on the Datum control, marked ' D ' on the magnetic amplifier unit ; adjustments so made have the effect of moving the line BD bodily along the horizontal scale.

2. *Standing current.* The steady line pressure control controlling current depicted by the line CA is called the " standing current ". This should be approximately 75 milliamps but may vary up to approximately 100 milliamps when the engine is first started and until the system has warmed up. The standing current is adjusted by the Bias control, marked ' B ' on the magnetic amplifier unit, this adjustment being permissible only when the magnetic amplifier unit is being bench calibrated prior to issue for service. No adjustment of the Bias control is permissible during routine servicing.

3. *Magnetic amplifier gain.* The increase in controlling current output of the magnetic amplifier unit from the "standing current" at point A, the beginning of operation of the electric max. r.p.m. control, to the maximum at point B, the point of maximum controlled engine r.p.m., is called the magnetic amplifier gain. The value of the gain is given by the line BD.

4. *Take-over range.* The line AD represents the range of engine r.p.m. over which the electric max. r.p.m. control operates to assume full control of the maximum engine r.p.m. This is known as the " take-over range ".

5. *Rate of gain.* The efficiency of the electric max. r.p.m. control system is directly affected by the rate of gain of the magnetic amplifier output of controlling current, that is to say the variation of the line BD relative to the line AD, or, the variation of the angle BAD. Provided that the line BD is fixed correctly by the pre-setting of datum before the Gain Check is carried out, then the position of the point A along the line CD provides a direct indication of the value of the magnetic amplifier gain. For correct functioning of the system, the point A should be between 10000 and 10100 r.p.m. and be as near 10000 r.p.m. as possible. Adjustment of the position of point A is made on the Gain control, marked ' G ' on the magnetic amplifier unit, this adjustment being permissible only when the magnetic amplifier is bench calibrated prior to issue for service. Any adjustment of the gain setting will alter the amplifier datum setting, which will require re-adjustment accordingly. No adjustment of the amplifier gain is permissible during routine servicing.

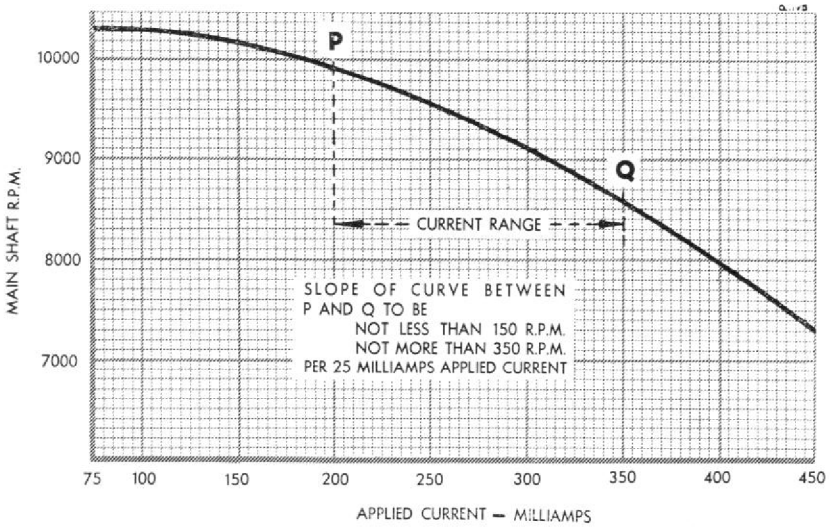

Fig. 3. Direct Current (D.C.) Check. Line pressure control/servo throttle group characteristic, typical curve.

D.C. Check

The D.C. Check is carried out as follows:—

1. Disconnect the Breeze connector from the line pressure control unit, and connect in its place the connector of the D.C. Test Set.

2. Taking care not to overspeed the engine, and with the test set applied current at zero, open the throttle to 10350 r.p.m. **Do not forget that there is no governor to control the max. r.p.m. attainable and that control relies solely on the operator's manipulation of the throttle lever.**

3. With the throttle locked in this position, increase the applied current in 25 milliamp stages to a maximum of 450 milliamps, recording at each stage the indicated engine r.p.m. Close the throttle.

4. Plot the readings obtained as a graph—Fig. 3 is a typical example.

Fig. 3 illustrates a typical curve obtained by applying the D.C. Check. The interpretation of the various aspects of the curve is as follows:—

1. The curve depicts the actual effectiveness of the line pressure control unit in conjunction with the servo throttle in controlling the flow of fuel to the burners and, therefore, the engine r.p.m. The whole curve is called the characteristic of the line pressure control/servo throttle group.

2. The slope of the curve between the points P and Q, that is over an applied current range of 200 to 350 milliamps, is particularly important and should be not less than 150 r.p.m. and not more than 350 r.p.m. per 25 milliamp applied current. There is no direct adjustment provided for varying the slope of the curve.

3. The curve should be smooth, and free from "steps".

Negative Rate Check

The Negative Rate Check is made during a full throttle climb to altitude, readings of engine r.p.m. being recorded at intervals of about 3000 ft. altitude from about 7000 ft., these being plotted as a curve on return to base.

Fig. 4 illustrates a typical curve obtained by a Negative Rate Check. It is interpreted as follows:—

1. The curve records the actual effectiveness of the whole electric max. r.p.m. equipment in controlling the maximum engine r.p.m. at all heights.

2. From L to M the basic datum setting of the electric equipment is operative and the maximum r.p.m. is controlled to a steady 10350. The curve should be level, free from irregularities, and within $\pm \frac{50}{30}$ r.p.m. of the datum—see also page 33, sub-para. 1.

3. At point M the altitude compensating unit comes into operation and from then the maximum engine r.p.m. is controlled to a value decreasing progressively with increasing altitude.

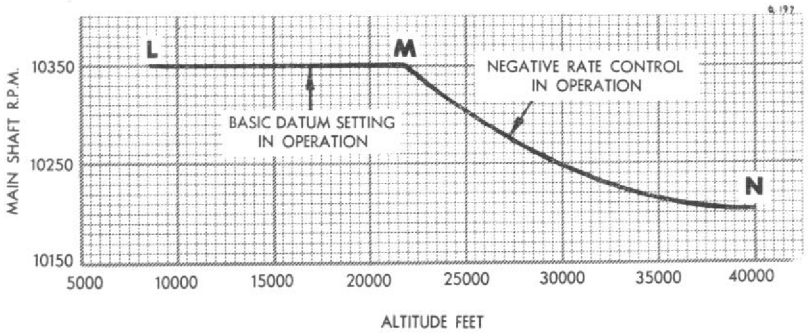

Fig. 4. Negative Rate Check. Full throttle climb to height, typical curve.

This negative acceleration of engine r.p.m. is called the " negative rate ". The point M should occur at about 23000 ft. At point N, 40000 ft., the controlled max. r.p.m. should be approximately 10200 r.p.m.

4. The curve from M to N should be smooth and free from steps and irregularities. There is no adjustment provided for varying the position of point M, this being governed by the setting of the altitude compensating unit aneroid capsule during manufacture. The angle of the curve MN, that is the negative rate, is adjusted on the Negative Rate control spindle, marked " N.R.", on the magnetic amplifier unit.

MISCELLANEOUS ADJUSTMENTS

The following adjustments are provided in the magnetic amplifier unit in addition to those already described:—

1. *Anticipation.* This term is applied to that aspect of the magnetic amplifier electrical design whereby the tendency for engine r.p.m. to mount rapidly to overspeeding during rapid accelerations is anticipated and corrected. A direct adjustment of Anticipation is provided, marked 'A' on the magnetic amplifier unit, and this should be set to give the minimum overshoot of r.p.m. when the throttle is opened rapidly from 9800 r.p.m. to full throttle: clockwise rotation of the spindle increases the effect. This adjustment is set correctly when the magnetic amplifier is bench calibrated prior to issue for service, and no adjustment is permitted during routine servicing—see Velocity Feed Back, below.

2. *Velocity Feed Back.* This term describes the rate of response of the magnetic amplifier control current to an overspeed signal from the tachometer generator. Direct adjustment of this rate of response is provided at spindle " V.F.B." on the magnetic amplifier unit; clockwise rotation of this spindle slows the magnetic amplifier response, gives greater stability under steady running conditions, but reduces the response of the system to momentary changes in r.p.m. and thus tends to result in overshooting of r.p.m. during accelerations. This control should, therefore, be set as far anti-clockwise as is consistent with steady running stability. This adjustment is set correctly prior to the issue of the magnetic amplifier unit for service, and no adjustment is permitted during routine servicing. The Anticipation and Velocity Feed-Back controls have a slightly inter-related effect, and adjustments should be made conjointly.

3. *Isolating Compensation.* This term describes the adjustment provided in later design magnetic amplifiers,—Type 390/1—by which the normal variation in engine r.p.m. resulting from the operation of the fuel pump isolating switch can be reduced to a minimum.

GOVERNOR ADJUSTMENTS

Whenever it is necessary to change the magnetic amplifier unit in the electric max. r.p.m. control equipment it is important to remember that the datum, isolating compensation, and negative rate adjustments must be checked and, if necessary, corrected.

Symptom	*Primary Cause*	*Primary Investigation*
1. ENGINE DOES NOT ROTATE AT STARTING (TURBO STARTER FAILURE)	Refer to Symptom 1 on page 4	
2. NO LIGHT-UP AT STARTING	Refer to Symptom 2 on page 4	
3. FAILURE TO ACCELERATE AFTER LIGHT-UP	Refer to Symptom 3 on page 8	
4. FAULTY STARTING, JUDDERING	Refer to Symptom 4 on page 8	
5. INCORRECT IDLING SPEED	Refer to Symptom 5 on page 8	
6. FAILURE TO GOVERN	a. Electric max. r.p.m. control datum setting too high	Check datum adjustment, marked 'D', in magnetic amplifier
	b. No L.P.C. controlling current	Apply Gain Check (refer to page 32) and record L.P.C. control current at idling and 10350 r.p.m. Current at idling should be about 75 m.A. If current at 10350 r.p.m. is adequate, i.e., exceeds about 200 m.A., refer to Primary Cause c.
	c. Failure of L.P.C./servo throttle group	Apply D.C. Check (refer to page 34). This should result in a reduction of engine speed to about 7000 r.p.m. at 450 m.A. applied current. If the r.p.m. does not fall below 8000 proceed as described in col. 4, 5, and 6.

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
—	——	Reduce datum setting. Anti-clockwise rotation of spindle reduces governing r.p.m	
i. No such standing current indicates failure of power supply, or circuits from aircraft inverter to magnetic amplifier, or magnetic amplifier to L.P.C.	Check inverter output. Test electric circuits	Change inverter Rectify wiring defects	Aircraft hand-book
ii. Presence of standing current but failure of current to increase with r.p.m. indicates failure of electric circuit within magnetic amplifier, or of output from tachometer generator	Test electric circuit Check tachometer generator output	Rectify wiring Change tachometer generator	Aircraft hand-book
iii. Faulty magnetic amplifier	——	Change magnetic amplifier	Aircraft hand-book
—	——	Change the L.P.C./servo throttle group, and repeat the D.C. Check.	

IMPORTANT

If either the line pressure control (L.P.C.) or the servo throttle is to bé changed, or renewed, BOTH units must be removed and a MATCHED PAIR of units fitted.

This instruction affects those given on pages 39, 41, 43, 45, 47, and 49, and in each instance the instructions in the " Remedial Action " column " change L.P.C. ", " change servo throttle ", must be regarded as being instructions to **change the L.P.C./servo throttle group,** and to apply the D.C. Check after the replacement matched pair of units has been fitted.

Symptom	*Primary Cause*	*Primary Investigation*
7. CONTINUOUS R.P.M. FLUCTUATION i.e., ELECTRIC MAXIMUM R.P.M. CONTROL IS UNSTABLE	Before undertaking any of the following checks, ensure that the trouble is not caused by incorrect rigging of control circuit between the H.P. cock lever in the cockpit and the H.P. fuel cut-off valve in the control valve assembly. Refer to "Unstable r.p.m. at full throttle" on page 12.	
	a. Hydraulic governor operating too close to electric max. r.p.m. control	Check hydraulic governor adjustment
	b. Too high a magnetic amplifier gain	Apply Gain Check (refer to page 32)
	c. Insufficient rate in the L.P.C./servo throttle group	Apply D.C. Check (refer to page 34). The curve should show a minimum slope of 6 r.p.m. per milliamp between 250 and 350 m.A. applied current
	d. Unstable current supply to magnetic amplifier	——
	e. Insufficient magnetic amplifier damping	——
	f. Unstable basic fuel system	——
8. GOVERNED R.P.M. DECREASE STARTS AT WRONG ALTITUDE	a. Faulty altitude compensation	If practicable, plug in Routine Test Set, and, during a climb to height, record L.P.C. current against altitude. If the control current progressively decreases with height, then the basic fuel system is more likely to be at fault—see Primary Cause b
	NOTE.—Should the altitude compensating unit be connected in error to the aircraft total unit cut-in point by 2000 to 3000 feet dependent upon the airspeed. At altitudes higher A similar effect would result should a leak occur from the cockpit pressure line to the	

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
i. Incorrectly set hydraulic governor	——	Adjust hydraulic governor	
ii. Faulty hydraulic governor mechanism	——	Change fuel pump	
If the point of rise of controlling current occurs outside the limits 10000 r.p.m. to 10100 r.p.m. the amplifier gain setting is incorrect.	——	Change magnetic amplifier	Aircraft handbook
——	——	Suspect, and change, in this order:— L.P.C. unit Servo throttle Fuel flow distributor. Apply D.C. Check after each change	
i. Unstable 110 V. inverter output	Check inverter output	Change inverter	Aircraft handbook
ii. Unstable tachometer generaor signal to magnetic amplifier	Check wiring	Rectify wiring Change tachometer generator	Aircraft handbook
i. Wrongly set "VFB" and 'A' controls on magnetic amplifier	——	Change magnetic amplifier	Aircraft handbook
ii. Faulty magnetic amplifier	——	Change magnetic amplifier	Aircraft handbook
i. Faulty B.P.C.	——	Change B.P.C.	
ii. Faulty fuel flow distributor	——	Change fuel flow distributor	
Faulty altitude compensating unit	Fit a vacuum pump to the altitude compensating unit in place of the flight instruments' static pressure pipe, with an altimeter in the circuit. Run the engine at full throttle and slowly depress the A.C.U. static pressure and check the indicated height at which the engine speed starts to decrease. This should occur between 22000 and 23000 ft. If faulty, change the altitude control unit		Aircraft handbook

head pressure in place of the "static" pressure, this would result in delaying the altitude compensating than the cut-in point the controlled engine speed would vary proportionately with the forward speed. altitude compensating unit static pressure line.

Symptom	*Primary Cause*	*Primary Investigation*
8. GOVERNED R.P.M. DECREASE STARTS AT WRONG ALTITUDE *(contd.)*	b. Inadequate fuel supply to burners giving the impression that the negative rate compensation starts too soon	——
9. GOVERNED R.P.M. TOO HIGH		
9·1. ENGINE R.P.M. CANNOT BE REDUCED BY MEANS OF DATUM ADJUSTMENT	a. Inadequate magnetic amplifier datum range	Apply Gain Check. Record L.P.C. control current at 10350 r.p.m. If control current is less than 300 m.A., the probable cause is i, ii, or iii If control current is appreciably higher than 300 m.A., the fault is probably in the fuel system ; iv
9·2. TEMPORARY EXCESS OVER-SHOOT OF R.P.M. ON OPENING THE THROTTLE FROM ABOUT 10000 R.P.M. (i.e., GREATER THAN 150 R.P.M.)	NOTE.—This symptom can be caused by an over-sensitive r.p.m. indicator b. Faulty magnetic amplifier	——
9·3. IF AT ALTITUDE	c. Wrongly set negative rate control on magnetic amplifier	——

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
i. Faulty B.P.C.	———	Change B.P.C.	
ii. Faulty A-F.R.C.	Disconnect the compressor delivery pressure line to A-F.R.C. Disconnect pipe control valve assembly to A-F.R.C. at the control valve assembly: fit adapter T.79474 to the control valve assembly in place of the pipe: connect pressure gauge T.75050 to the adapter, and reconnect the pipe line to the other end of the pressure gauge T-piece, using adapter T.77097. Run the engine at full throttle: the pressure recorded should be not less than 550 lb. per sq. in.	Change A-F.R.C.	
iii. Faulty fuel flow distributor	———	Change fuel flow distributor	
i. Defective datum adjustment in magnetic amplifier ii. Defective datum adjustment in altitude compensating unit	With the engine throttled to an r.p.m. well below max. permissible, exercise each datum control in turn	If still unsatisfactory change magnetic amplifier or altitude compensating unit as appropriate	Aircraft book hand-
iii. Faulty magnetic amplifier internal circuit	———	Change magnetic amplifier	Aircraft handbook
iv. Too flat a L.P.C./servo throttle group control characteristic	Apply D.C. Check. The results, when plotted, should show a minimum slope of 6 r.p.m. per milliamp between 250 and 350 m.A. applied current	Suspect, and change in this order:— L.P.C. Servo throttle Fuel flow distributor Apply D.C. Check after each change	
i. Incorrectly set 'Velocity Feed Back' and 'Anticipation' controls on magnetic amplifier		Change magnetic amplifier	Aircraft handbook
ii. Too high a magnetic amplifier gain setting		Change magnetic amplifier	Aircraft handbook
iii. Over-sensitive magnetic amplifier internal circuits		Change magnetic amplifier	Aircraft handbook
iv. Over-sensitive fuel system		Suspect, and change, in this order:— L.P.C. Servo throttle	
———	———	Adjust negative rate control spindle marked "NR" on magnetic amplifier. One quarter turn of the control spindle clockwise will give approximately 20 r.p.m. decrease at altitude	

Symptom	*Primary Cause*	*Primary Investigation*
9·3. IF AT ALTITUDE *(contd.)*	d. Faulty altitude compensating unit, or faulty wiring between altitude compensating unit and magnetic amplifier	Fit a vacuum pump to the altitude compensating unit, in place of the flight instruments' static pressure pipe, and with an altimeter in the circuit. Run the engine at full throttle and slowly depress the altitude compensating unit to about 40000 ft. indicated. This should result in a reduction of the controlled r.p.m. by about 200 r.p.m.
	e. Faulty magnetic amplifier	——
	f. Too high a basic fuel system flow	——
10. GOVERNED R.P.M. TOO LOW	a. Incorrect hydraulic governor setting	Switch off the electric max. r.p.m. control, by switching off the aircraft inverters, and determine whether the electric system is in control
10·1. R.P.M. CANNOT BE INCREASED BY DATUM ADJUSTMENT	b. Faulty electrics	Apply Gain Check and note the L.P.C. controlling current at full throttle. If the current does not rise from the standing current then refer to Primary Cause c below. If, however, the current rises above the standing current then the cause is electrical.
	c. Inadequate fuel supply to burners This defect could result from the H.P. fuel cut-off valve in the control valve assembly not opening fully. Before undertaking the following tests refer to page 4 — Symptom 2, d, i.	——

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
———	———	Change altitude compensating unit Rectify wiring	Aircraft handbook
i. Faulty negative rate adjustment	Adjust negative rate control	———	
ii. Too low an amplifier gain	Apply Gain Check	Change magnetic amplifier	Aircraft handbook
iii. Faulty internal negative rate circuit	———	Change magnetic amplifier	Aircraft hand-hand-
i. Faulty L.P.C. / servo throttle group characteristic	Apply D.C. Check. The slope of the resultant curve should be not less than 6 r.p.m. per m.A. between 250 and 350 m.A.	If unsatisfactory, suspect, and change, in this order:— L.P.C. Servo throttle Fuel flow distributor Apply D.C. Check after each change	
ii. Too high B.P.C. setting at altitude condition	———	Change B.P.C.	
———	Check hydraulic governor setting	Adjust hydraulic governor	
i. Faulty datum adjustment in magnetic amplifier	Re-set datum adjustment on magnetic amplifier	———	
ii. Faulty amplifier internal circuit	———	Change magnetic amplifier	Aircraft handbook
iii. Speed signal to magnetic amplifier from the wrong phase of tachometer generator	———	Rectify incorrect connection	
i. Faulty L.P.C.	Blank off the pipe line servo throttle to L.P.C. at the servo throttle. If the engine can now be overspeeded, then the L.P.C. is faulty.	Change L.P.C.	
ii. Faulty servo throttle	Remove the banjo pillar from the top of the high pressure fuel filter and in its place fit pressure test adapter T.79447. To this attach pressure gauge T.75050, keeping the blank on the other end of the pressure gauge T-piece. Remove the banjo pillar from the servo throttle pipe connection at the base of the control valve assembly and substitute pressure gauge adapter T.79450. To this attach a second pressure gauge T.75050, keeping the blank on the other end of the T-piece. Switch off the electric max. r.p.m. by switching off the aircraft inverters, open the throttle to max. permissible r.p.m. and measure the pressure drop across the servo throttle. If this drop exceeds 100 lb. per sq. in. the servo throttle is defective.	Change the servo throttle	

Symptom	*Primary Cause*	*Primary Investigation*
10·1. R.P.M. CANNOT BE INCREASED BY DATUM ADJUSTMENT *(contd.)*		
10·2. ENGINE ACCELERATION SLUGGISH AT HIGHER R.P.M.	d. Over anticipation by magnetic amplifier	———
	e. Inadequate fuel supply to burners	Refer to c. on page 42
	f. Faulty L.P.C./servo throttle group	———
10·3. R.P.M. LOW AT ALTITUDE ONLY	g. Negative rate adjustment wrongly set	———
	h. Insufficient negative rate adjustment in system	Plug in Routine Test Set and record the control current during a full throttle climb to height. If the control current progressively decreases with height, this indicates an inadequate fuel supply to the burners—refer to c. on page 42.

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
iii. Faulty fuel pump	With the pressure gauge T.75050 still in place in the high pressure fuel filter banjo pillar, blank off the servo pressure lines to the B.P.C. and A-F.R.C. and switch on the electric max. r.p.m. control by switching on the aircraft inverters. Run the engine at full throttle and note the pump delivery pressure. If this falls off to about 1000 lb. per sq. in., either the pump hydraulic governor is set too low or the fuel pump output is low.	Increase the governor setting, and if the pump delivery pressure still falls off, change the pump	
iv. Faulty B.P.C.	Reconnect the servo pipe line from pump to B.P.C. Disconnect the delivery pressure pipe line fuel pump to B.P.C. at the fuel pump connection, fit pressure gauge T.75050 with adapter T.77098 to this pump connection and reconnect the pipe to the pressure gauge T-piece. With the engine running slowly a pressure of 1350 ± 100 lb. sq. in. should be recorded. If this pressure is not maintained at all engine r.p.m. except governing, the B.P.C. is faulty	Change B.P.C.	
v. Faulty A-F.R.C.	Reconnect the fuel pump servo line to the A-F.R.C. With pressure gauge T.75050 still fitted in the high pressure fuel filter banjo pillar, open the throttle fully and record fuel pump delivery pressure. If this falls off on approaching max. r.p.m. then either the A-F.R.C. is faulty or the compressor delivery pressure line to the A-F.R.C. is leaking.	Check the compressor delivery pressure line to A-F.R.C. for leaks. If there are no leaks change the A-F.R.C.	
vi. Faulty burners	High burner pressure	Change burners	
vii. Faulty fuel flow distributor	———	Change fuel flow distributor	
i. Incorrectly set "Anticipation" control on the magnetic amplifier	———	Change magnetic amplifier	Aircraft handbook
ii. Faulty magnetic amplifier	———	Change magnetic amplifier	Aircraft handbook
Refer to c. above	———	———	
———	———	Change in this order:— L.P.C. Servo throttle	
———	———	Adjust control "NR" on magnetic amplifier	
i. Faulty altitude compensating unit	———	Change unit	Aircraft handbook
ii. Faulty wiring between altitude compensating unit and magnetic amplifier	———	Rectify wiring	Aircraft handbook
iii. Faulty magnetic amplifier	———	Change unit	Aircraft handbook

Symptom	*Primary Cause*	*Primary Investigation*
11. GOVERNED R.P.M. INCREASES WITH FORWARD SPEED	a. Too low an amplifier gain	Apply Gain Check. If the gain is correctly set, refer to b. below.
	b. Too high a basic fuel system flow	——
12. GOVERNED R.P.M. FALLS EXCESSIVELY WITH FORWARD SPEED	a. Faulty hydraulic governor setting	Check hydraulic governor setting
	b. Insufficient fuel system compensation with forward speed	——
	c. Too great a fuel operating pressure increase with forward speed	——
	d. Inadequate fuel pressure	——
13. ELECTRIC MAX. R.P.M. CONTROL DATUM DIFFICULT TO SET	a. Faulty controls within the magnetic amplifier	Check, by individual manipulation of the datum control spindles, whether the symptom is applicable to the adjustment located in the altitude compensating unit, or that in the magnetic amplifier itself
	b. Uneven L.P.C. / servo throttle group characteristics; i.e., steps in the characteristic curve	Apply D.C. Check but increasing the input current in very small stages. The result should be a smooth curve
14. TOO GREAT A VARIATION OF R.P.M. ON OPERATING THE ISOLATING SWITCH	a. Incorrectly set isolation trim adjustment	——
	b. Incorrect rates in the speed control equipment	Disconnect from the isolating switch the compensating current from the magnetic amplifier, and check the engine r.p.m. response on switching the isolating switch ON. This should be about 50 r.p.m. increase.

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
———	———	Change magnetic amplifier	Aircraft handbook
i. Too flat an L.P.C./servo throttle group characteristic	Apply D.C. Check. The slope of the curve between 250 m.A. and 350 m.A. should not be less than 6 r.p.m. per m.A.	Suspect, and change:— L.P.C. Servo throttle in that order, repeating D.C. Check after each change	
ii. Faulty B.P.C.	———	Change B.P.C.	
iii. Faulty fuel flow distributor	———	Change fuel flow distributor	
———	———	Adjust as necessary	
i. Inadequate B.P.C. total head air pressure	Check for blockage or leaks	Rectify. Ensure that Aircraft Modification Venom 840 is incorporated	Aircraft handbook
ii. Faulty B.P.C.	———	Change B.P.C.	
i. Faulty fuel flow distributor	———	Change fuel flow distributor	
ii. Low flow number burners, or blocked burner filters	Check burner pressure	Change burners. NO dismantling of burners is permissible without approval and the necessary equipment, specialists, and test rigs.	
i. Faulty compressor delivery supply to A-F.R.C. or faulty A-F.R.C.	Check compressor delivery pressure line to A-F.R.C. for leaks	If compressor line is satisfactory, change A-F.R.C.	
ii. Low fuel pump output	———	Change fuel pump	
i. If confined to the fine datum control in the altitude compensating unit	———	Change altitude compensating unit	Aircraft handbook
ii. If peculiar to the main datum control in magnetic amplifier	———	Change magnetic amplifier	Aircraft handbook
iii. If common to both adjustments	———	Change magnetic amplifier	Aircraft handbook
—	———	Suspect, and change in this order:— L.P.C. Servo throttle Fuel flow distributor Fuel pump Apply D.C. Check after each change until corrected	
—	———	Re-adjust isolation trim control in magnetic amplifier	
If the engine r.p.m. rise exceeds 50 r.p.m., then the following are likely causes: i. Too high or too low an amplifier gain	Apply Gain Check	If the gain is outside the stated limits, change magnetic amplifier	Aircraft handbook

Symptom	*Primary Cause*	*Primary Investigation*
14. TOO GREAT A VARIATION OF R.P.M. ON OPERATING THE ISOLATING SWITCH *(contd.)*		
	c. Faulty electrics in the isolator compensating circuit	Connect Routine Test Set and switch on aircraft inverters, With test set switch at position No. 1 there should be a current increase of 30/40 m.A. on switching ON the isolating switch with the engine static
15. INCORRECT OIL PRESSURE	Refer to Symptom 9 on page 12	
16. SUSPECTED OIL LEAKAGE OR HEAVY OIL CONSUMPTION	Refer to Symptom 10 on page 12	
17. INCORRECT JET PIPE TEMPERATURE	Refer to Symptom 11 on page 12	
18. ENGINE VIBRATION	Refer to Symptom 12 on page 14	
19. FUEL PRESSURE WARNING LIGHT COMING ON AT ALTITUDE FOR NO APPARENT REASON	Refer to Symptom 13 on page 14	

Secondary Cause	*Secondary Investigation*	*Remedial Action*	*Refer to*
ii. Too high or too low a line pressure control/servo throttle characteristic	Apply D.C. Check. The resultant curve slope should be not less than 6 r.p.m. and not more than 14 r.p.m. per m.A. applied current	Change, in this order:— L.P.C. Servo throttle Fuel flow distributor Apply D.C. Check after each change	
iii. Faulty B.P.C. or A-F.R.C.	Check fuel system pressures as described in Symptom 10, c, iv, and v. Note that variation of 100 lb. per sq. in. operating pressures will only result in 10/15 r.p.m. change	Change B.P.C. or A-F.R.C. as appropriate	
i. Faulty cables or connections in the isolator current supply to magnetic amplifier	This would result in a rise in r.p.m. on isolation	Rectify wiring and connections	
ii. Wrong polarity of the isolator current supply to the magnetic amplifier	There would be no compensating current and the speed would rise on isolation	Correct the polarity	
iii. Incorrect voltage of the isolator current supply to magnetic amplifier	Invariably a low voltage would give a rise in r.p.m. and a high voltage a drop in r.p.m.	Rectify voltage of the current supply to magnetic amplifier	
iv. Faulty magnetic amplifier internal isolator compensating circuit	The result could be either a rise or a drop in r.p.m. dependent upon the precise nature of the failure	Change magnetic amplifier	Aircraft hand book

ASSEMBLY AND CALIBRATION OF TEST EQUIPMENT FOR GHOST 53 Mk. 1 ELECTRIC MAX. R.P.M. CONTROL EQUIPMENT

Operators should improvise this equipment from local resources, on the following lines.

ROUTINE TEST SET

To make up a suitable Routine Test Set, the following materials, or their equivalents will be required :—

Quantity	*Description*	*A.M. Ref.*
1	4-pole plug, Mk. 4 Cable unit (Code 43)	Inter-services Z560290
1	Wire-wound potentiometer, 0–500 ohms, 1 watt, normal spindle, tropicalised, R.C.L.121 ..	Inter-services Z271506
1	Moving coil microammeter, 0–500 μA, $2\frac{1}{2}$ in. scale, resistance 75 ohms, flush mounting, tropicalised (or a similar meter having a resistance of not more than 200 ohms)	5Q/152
1	Single-pole, 2-way, toggle switch, Rotax 0 5401, R.C.L.151	5CW/4197
2	Fixed resistors, 10 ohms ± 1% 3 watt, tropicalised	Inter-services Z113272
1	Fixed resistor, 100 ohms ± 1%, 3 watt, tropicalised	Inter-services Z113296
1	A suitable panel and a shallow box	Locally made

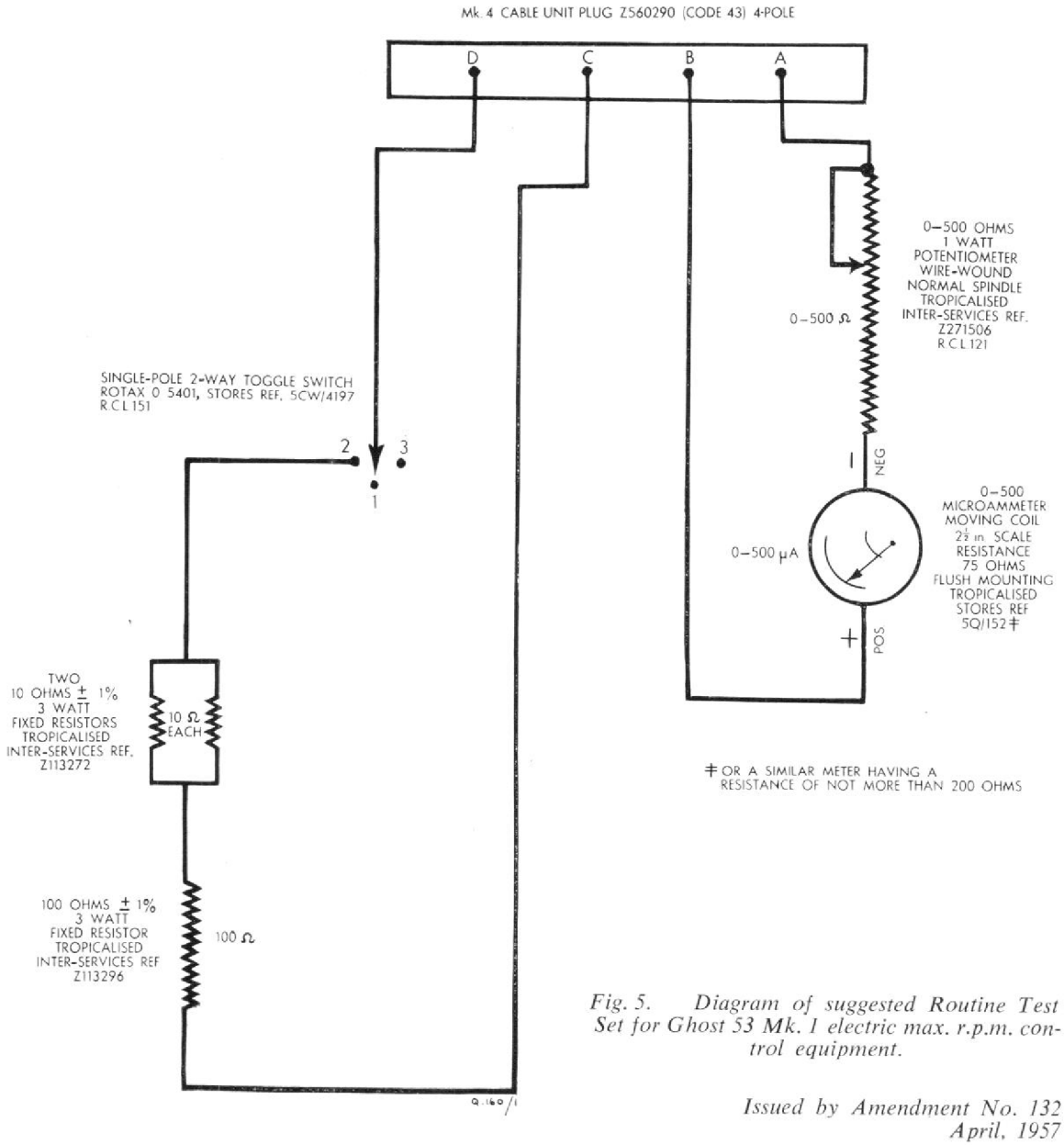

Fig. 5. Diagram of suggested Routine Test Set for Ghost 53 Mk. 1 electric max. r.p.m. control equipment.

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The components should be mounted on a suitable flat panel and wired up in accordance with the diagram, Fig. 5. The 0–500 ohms potentiometer should be mounted on the back of the panel so that, when boxed, its adjustment cannot be touched without unscrewing and separating the panel from the box. Before screwing the assembled panel into the box, this Test Set must be calibrated. A suitable Calibration Set can be made with materials as described in the next paragraph.

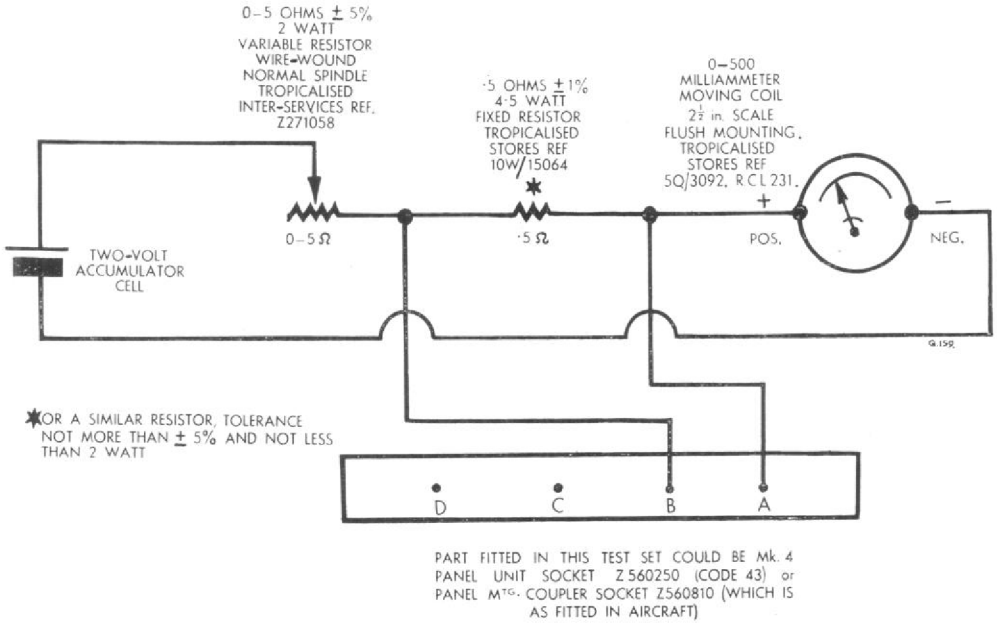

Fig. 6. Diagram of suggested Test Set for calibration of Ghost 53 Mk. 1 Routine Test Set.

CALIBRATION OF ROUTINE TEST SET

To make up a suitable Calibration Set, the following materials, or their equivalents, will be required:—

Quantity	*Description*	*A.M. Ref.*
1	Two-volt accumulator cell	
1	Wire-wound, variable resistor 0–5 ohms ± 5%, 2 watt, normal spindle, tropicalised	Inter-services Z271058
1	Fixed resistor, 0·5 ohms ± 1%, 4·5 watt, tropicalised (or a similar resistor, tolerance not more than ± 5%, and not less than 2 watt)	10W/15064
1	Moving coil milliammeter 0–500 m.A., 2½ in. scale, flush mounting, tropicalised, R.C.L.231 ..	5Q/3092
1	4-pole socket, Mk. 4 panel unit (Code 43)	Inter-services Z560250
	or alternatively Panel Mtg. coupler socket	Inter-services Z560810

Wire up these components as shown in Fig. 6 *(but do not connect up the 2-volt accumulator cell)* and connect this Calibration Set to the Routine Test Set. Set the 0–5 ohms variable resistor, and the 0–500 ohms potentiometer to their maximum values and connect up the 2-volt accumulator cell.

Adjust the 0–5 ohms variable resistor until the milliammeter reads 20 m.A. Adjust the 0–500 ohms potentiometer until the microammeter reads 250 μA.

Re-adjust the 0–5 ohms variable resistor until the milliammeter reads 125 m.A. The microammeter should now read 125 μA, if it does not, re-adjust the 0–500 ohms potentiometer until a reading of 125 μA is obtained.

Re-adjust the 0–5 ohms variable resistor until the milliammeter reads 500 m.A. The microammeter should now read 500 μA.

Taking care to ensure that the milliammeter reading never exceeds 500 m.A., ensure that the microammeter reads one-thousandth of the milliammeter for all settings of the 0–5 ohms variable resistor. Trim as necessary with 0–500 ohms potentiometer. Do not disturb the 0–500 ohms potentiometer once satisfactory conditions have been attained.

Disconnect the calibration equipment and screw the Routine Test Set into its box. The set is now ready for use.

D.C. TEST SET

To make up a suitable D.C. Test Set, the following materials, or their equivalents, will be required:—

Quantity	*Description*	*A.M. Ref.*
1	Breeze connector socket ..	5X/6374
1	Milliammeter 0 to 500 m.A., with scale graduated in 25 m.A. stages ..	5Q/3092
1	Variable potentiometer 0–50 ohms, 7·5 watt ..	10W/18131
1	A suitable panel and box	
1	24 volt direct current supply	

The milliammeter and the potentiometer should be mounted on the panel with the milliammeter visible and the potentiometer control accessible above the panel for subsequent operation. The components should be wired in accordance with the diagram, Fig. 7, and the panel then fixed to the top of the box. Allow sufficient lengths of flexible lead between the control panel and the Breeze connector socket to permit the operator to sit in the aircraft cockpit with the connector socket attached to the line pressure control unit, and with sufficient input lead to reach the external source of 24 volt direct current supply.

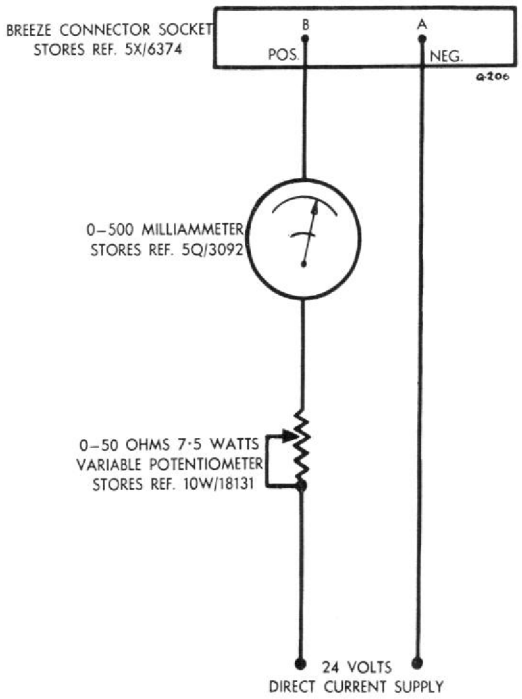

Fig. 7. Diagram of suggested D.C. Test Set for Ghost 53 Mk. 1 electric max. r.p.m. control equipment.