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Chapter 3

C.S.D./ALTERNATOR MOBILE TEST RIG

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LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Type ..	*U.*1571
Ref. No. ..	4G/7242
Trailer ..	*Vernon No. G.S.*118
Dimensions	
Length ..	15 *ft.*
Length (including tow arm) ..	18 *ft.* 6 *in.*
Width ..	6 *ft.* 6 *in.*
Height (overall) ..	6 *ft.* 9 *in.*
Weight ..	6 *tons* 3·5 *cwt.*
Engine ..	*Dorman* 6 *KUD/AVR Diesel*
Fluid coupling ..	*Vulcan Sinclair Fluidrive SCR* 4 *Size* 23
Gearbox ..	*Angus No.* 135
Flexible coupling ..	*Crofts No.* 1½ *N.T.S.*
Tyre pressures ..	70 *lb. per sq. in.*
Max. towing speed ..	20 *m.p.h.*

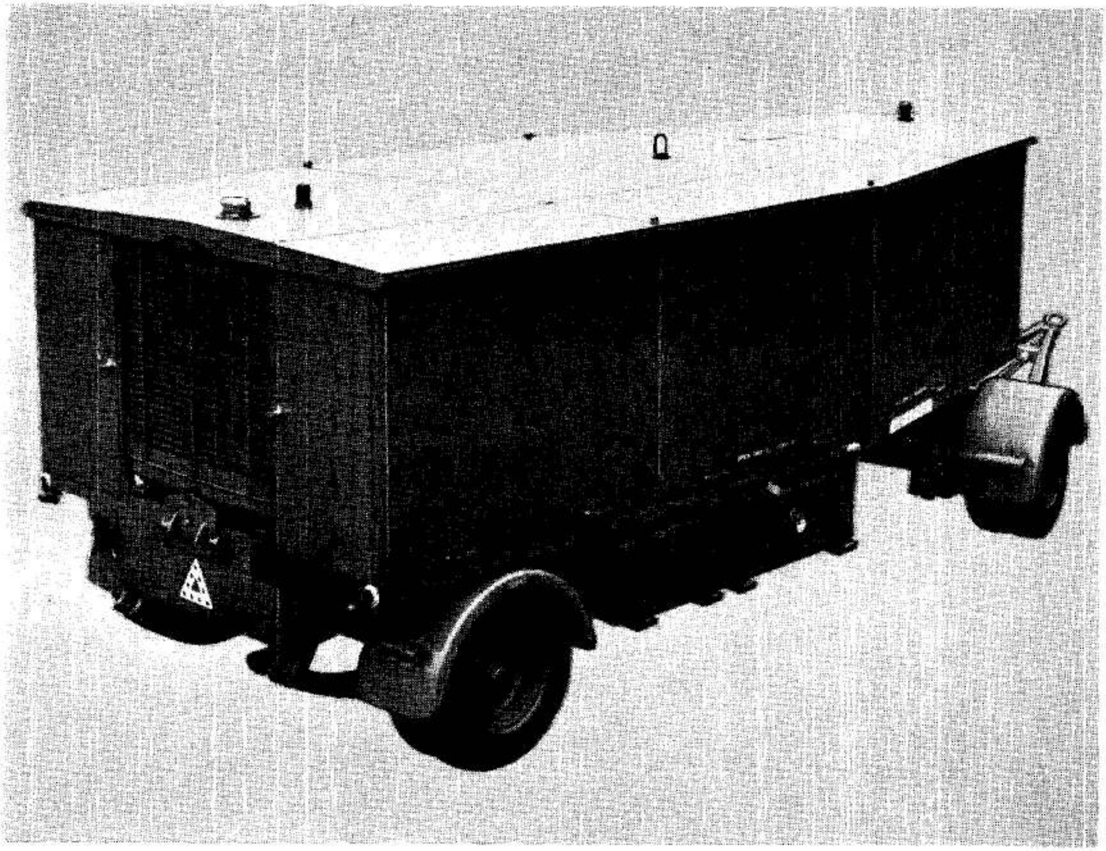

Fig. 1. C.S.D./alternator test rig

Introduction

1. The constant speed drive alternator test rig is designed for servicing the 40 KVA, 400 c.p.s. constant frequency a.c. systems installed in the Vulcan B Mk.2 and Victor B Mk. 2 aircraft. It provides a mounting and drive for a C.S.D./alternator unit, and incorporates a control and loading system for testing the units and associated control components, and for checking the aircraft circuits. The aircraft alternator circuits can be checked individually using one rig or synchronised using two rigs. For parallel operation two rigs can be interconnected.

2. A C.S.D./alternator unit is not supplied with the test rig, and for aircraft checks, a unit is removed from the appropriate circuit in the aircraft and installed in the test rig.

3. This chapter contains descriptive, operating and servicing information on the test rig, and circuit diagrams have been included to facilitate rectification of any faults which may occur in service. Information on the basic engine is contained in A.P.4382G.

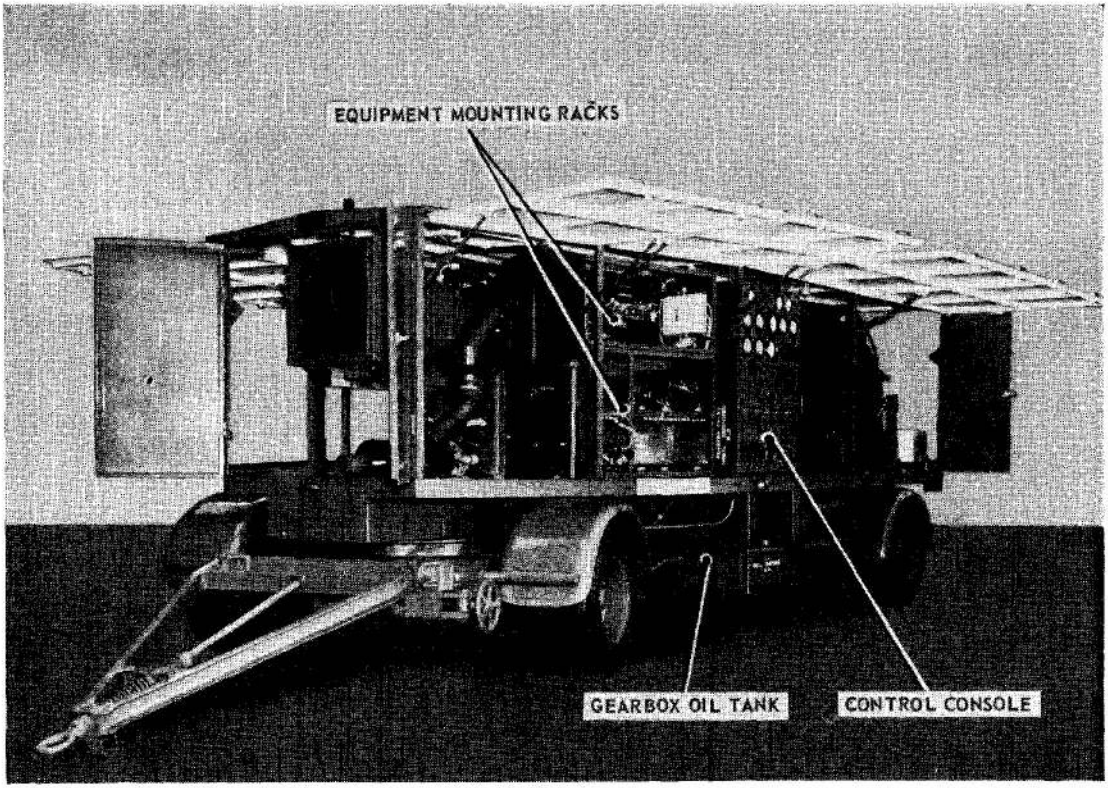

Fig. 2. L.H. side view of test rig

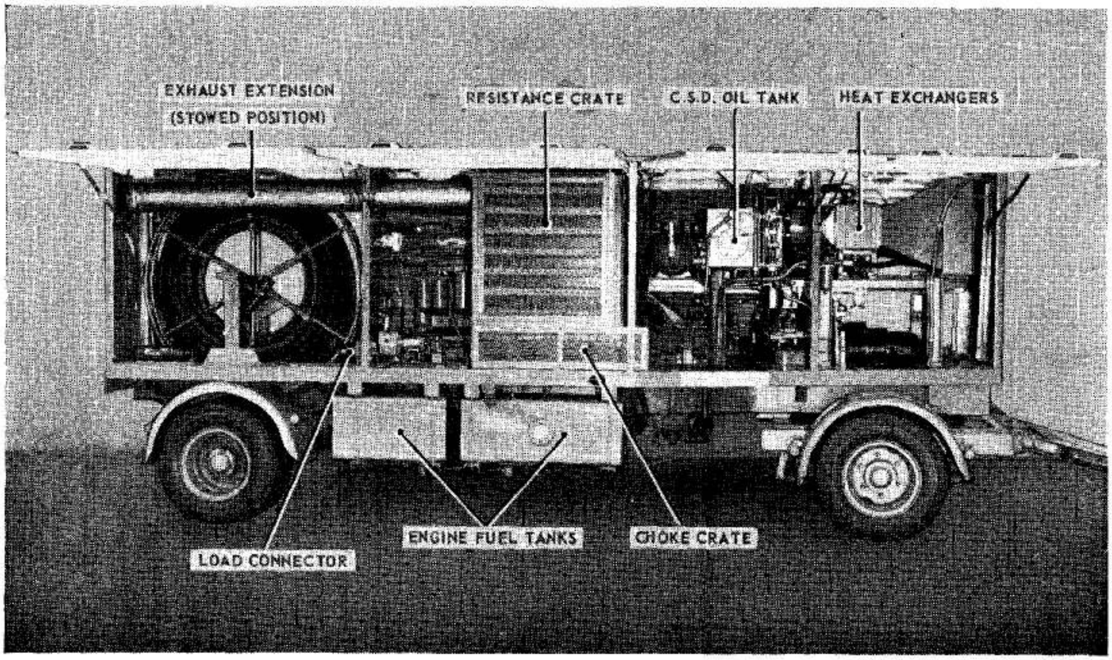

Fig. 3. R.H. side view of test rig

DESCRIPTION

General

4. The test rig consists of an engine and drive mounted on a trailer chassis, together with the necessary electrical control and fault simulation equipment and auxilliary systems for constant speed drive operation. The diesel engine is coupled to a fluid coupling, a speed increasing gearbox and a flexible coupling which is fitted with an output shaft to receive the C.S.D. / alternator unit. Alternative mountings are incorporated for the Vulcan and Victor units, and the rig installation can be adapted for either unit by an interchange of pipe assemblies and fittings in the drive oil system.

5. All controls and instruments for operation of the test rig are mounted on the front panel of a centrally disposed control console, and the electrical test system components are accommodated in the interior of the console and in the adjacent equipment racks. Two flexible cables are provided for connection of the test rig to the aircraft system, or for interconnection of two rigs for parallel operation. Protection for the equipment is provided by a detachable canopy fitted with hinged end doors and side panels to give access for operation and servicing.

CHASSIS

6. The chassis consists of a main frame pivoted to a sub-frame by a central pin and turntable, and mounted by leaf springs on two axles each carrying two twin wheel assemblies. A tow bar is attached to the sub-frame for towing purposes. Internal expanding Girling type brakes are fitted to the front wheels only, and are operated by an override device when the test rig is on tow and by a hand wheel when stationary. Mounting for the engine is provided by four bed plates attached to the longitudinal members of the main frame, and lateral members support the engine radiator, bell housing and flexible coupling. Channel section supports are fitted underneath the frame for mounting two engine fuel tanks, gearbox oil tank and two 12-volt batteries.

ENGINE

7. The engine is a 200 H.P. Dorman 6KUD/AVR diesel equipped with a tropical capacity radiator, heavy duty air cleaners, two belt-driven generators and an electric starter. Mounting brackets, fitted either side of the engine at the cooling fan and flywheel housings, support the engine on the chassis bed plates, each attachment being made by two bolts. A four-bolt flexible mount supports the radiator. Fuel for engine operation is supplied from two interconnected tanks mounted under the chassis. Total fuel capacity is 45 gallons, and a direct reading contents gauge is installed in the forward tank. Power for engine starting is supplied by the internal batteries, or when required, from an external 28-volt source. A fuel cut-off solenoid is provided for stopping the engine by means of a stop push-switch, or by protection devices which automatically operate if overspeeding, low oil pressure or excessive coolant temperature occur. A description of the engine electrical system and protection devices is contained in para. 37 to 55 inclusive. The engine instruments consist of a combined r.p.m. indicator and hours run meter, and oil pressure and coolant temperature indicators, which are mounted adjacent to the start/stop push-switch, and a fault indicator lamp at the lower end of the control panel.

Speed control

8. Engine speed is controlled by a centre-biased RAISE/LOWER switch SW20, which operates in conjunction with an actuator and two micro switches. Movement of the actuator is transferred by a cross shaft, link arm and control lever, to the fuel pump rack which varies the supply of fuel to the cylinders. The micro switches, actuated by the cross shaft, limit the range of control movement to obtain the idling and maximum r.p.m. speeds. Adjusting studs are provided in the cross shaft for setting the micro switches. The LOWER (rear) micro switch is initially set to provide an engine idling speed of approximately 700 to 750 r.p.m. and is finally adjusted so that the C.S.D. input speed under idling conditions is 2,800 to

2,900 r.p.m. The RAISE (forward) micro switch is set to obtain a maximum C.S.D. input speed of 8,100 r.p.m. under full load conditions.

Exhaust system

9. The exhaust outlet is fitted with a bayonet type adapter for the connection of a flame trap or an extension pipe, which are supplied with the test rig. The flame trap is provided for out-of-doors operation and the 30 foot long extension pipe is for use when the rig is operated in a confined space in a workshop or hangar.

FLUID COUPLING

10. The fluid coupling is scoop controlled, and is mounted in a bell housing attached to the engine flywheel housing and supported in the chassis by a Metalastick anti-vibration mounting. Connection to the engine is made by an adapter plate which is bolted and dowelled to the flywheel and to the resilient driving plate of the coupling. A centre spigot attached to the coupling back casting, engages a bored recess in the adapter plate to radially locate the coupling. The drive to the gearbox is formed by two half couplings and a multi-disc flexible assembly is located between the half couplings, one of which is keyed to the coupling main shaft, and the other is splined to the gearbox input shaft and secured by a nut and tab washer. The coupling is charged with oil through a tundish mounted on the outer casing, and for cooling purposes the oil is passed through external pipes to two cooling elements mounted on the left hand side of the engine. Access to the tundish and the output drive assembly is provided by two hinged panels in the bell housing, and to the adapter plate connections, by detachable panels in the flywheel housing.

11. Operation of the coupling is controlled by a lever connected to the scoop control and extending through the right hand side of the bell housing. With the lever fully IN, the scoop control is ENGAGED, and oil is transferred from the reservoir to the working circuit resulting in a through drive to the gearbox. In the fully OUT position, the scoop control is DISENGAGED, oil returns to the reservoir and drive to the gearbox is interrupted. For normal operation of the test rig, the control lever is retained in the IN position, and setting to the OUT position is only required for checking and replenishing the coupling oil content.

GEARBOX

12. The gearbox assembly is bolted and dowelled to the bell housing, and incorporates a 1:4·25 speed increasing gear unit to obtain the speed range at the output shaft necessary for operation of the constant speed drive. A secondary gearbox, attached to the main unit by studs and dowels, provides a mounting and drive for an oil pump and a Smiths M series tachogenerator. The speed is recorded as C.S.D. input speed on indicator S1 mounted on the control panel.

13. A 14-gallon capacity tank, mounted under the chassis, supplies the oil for lubrication of the gear assemblies. Oil is delivered by the pump through a relief valve with combined pressure adjusting valve, an Auto Klean filter and a heat exchanger, to the gearbox inlet connection, and is directed by internal feed pipes and jets to the gears and bearings. A supply for lubrication of the flexible coupling is provided by oil passing through the hollow output shaft. Drainage oil collects in the base of the gearbox, and is returned to the tank through an external pipe. A filler adapter through which oil can be supplied for priming the gearbox is mounted on the chassis platform, and an indicator for recording gearbox oil pressure is provided on the control panel.

FLEXIBLE COUPLING

14. A Crofts No. 1½ N.T.S. internal gear coupling is installed between the gearbox and the constant speed drive to compensate for mis-alignment which may occur in service or due to flexing of the trailer chassis. It comprises two geared hubs and a mating outer sleeve, the sleeve being axially located on the hubs by spacer washers and two steel circlips. The hubs are internally splined to receive the gearbox output shaft and an extension shaft respectively, and are each secured to their respective shafts by a nut and lock-washer. The extension shaft is the connection for the constant speed drive. The coupling assembly is supported at the extension shaft end by a double row ball bearing mounted in a flanged plate which is bolted and dowelled to the chassis structure. A bellows type outer cover secured to the gearbox housing and to the support plate by hose clips, completely encloses the assembly.

15. Lubrication for the coupling and the constant speed drive shaft splines is provided by oil from the gearbox system. The oil flows through the output shaft into the

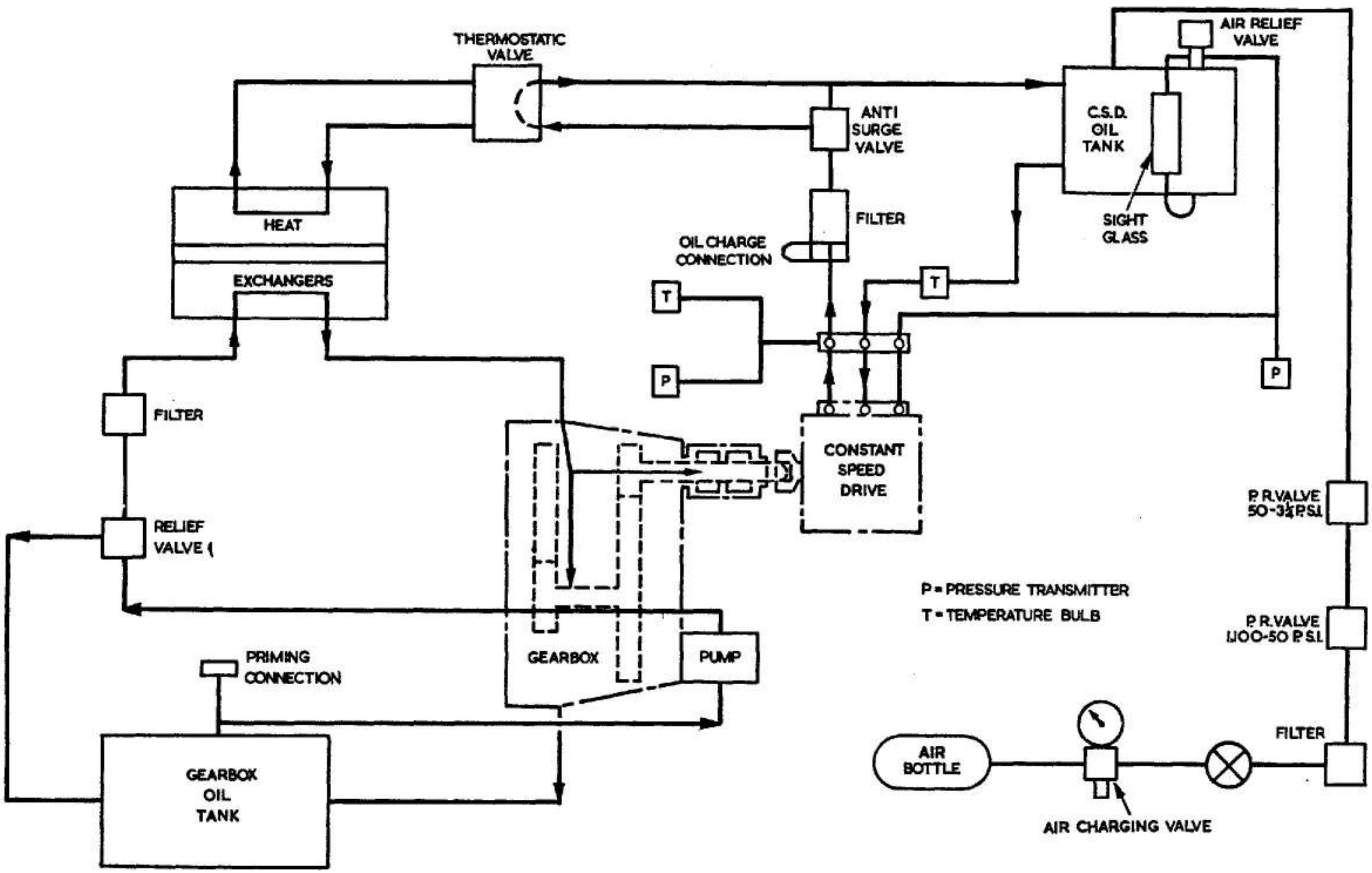

Fig. 4. Gearbox and C.S.D. oil systems

outer sleeve where it is retained by two Gaco type seals, and is fed to the shaft splines through the hollow extension shaft. Oil passing along the splines lubricates the support bearing and drains into the outer cover and back to the gearbox.

C.S.D./ALTERNATOR INSTALLATION

Unit mounting

16. A channel section steel framework, consisting of three vertical frames and two top longitudinal members, supports the C.S.D./alternator unit and the associated oil and cooling system components. Mountings for both types of unit are provided by three brackets which are attached to the cross strut and to the left and right-hand side struts respectively of the centre frame as shown in fig. 5. Alternative attachment holes in the top bracket are used in conjunction with the left-hand side bracket for mounting the Vulcan unit, and with the right-hand bracket for the Victor unit.

Handling equipment

17. To facilitate installation of the units to the rig, a sliding beam and loading carrier are provided. The beam operates in roller assemblies fitted in the support structure, and the carrier incorporates a mounting arm from which the respective units can be suspended by means of an adjustable arm assembly, or a shackle fitting. The Vulcan unit is suspended in an off-centre position in the adjustable arm assembly as shown in fig. 5. The adjusting screw fitted to the assembly is provided to centralise the unit. The Victor unit is suspended in the shackle fitting by bolt assembly 5U.1665 which is also used for attachment to the top mounting bracket. For ease of engagement, the constant speed drive shaft can be aligned to the flexible coupling by the knurled adjuster fitted to the carrier mounting arm.

Oil system

18. Oil for operation of the constant speed drive is supplied from a 2¾ gallon capacity tank equipped with a sight glass for visual indication of oil content and an air relief valve. The rig system delivery, return and pressurisation pipe runs terminate in flexible hoses from which alternative connections are made to the respective constant speed drives. For Vulcan application, the hoses connect to a transfer block attached to the rear face of the flexible coupling mounting plate. Flanged tubes, retained in the block by lock plates and fitted with 'O' ring seals, interconnect the block to the corresponding fittings on the constant speed drive. For Victor application the delivery and return pipes are connected to the constant speed drive by the flexible extension pipes 2U.1665 and 3U.1665. The pressurisation hose is connected to the constant speed drive vent pipe by a reducing adapter 15U.1665. When not in use the extension pipes and adapter are stowed in the loose equipment box. Self sealing couplings are used at the delivery and return connections to the transfer block and extension pipes to prevent oil loss from the system when the constant speed drive is not installed.

19. Oil from the constant speed drive is returned to the tank through a filter, anti-surge valve, thermostatic valve and heat exchanger. Flow through the heat exchanger is controlled by the thermostatic valve so that cooling commences when the oil temperature exceeds 92°C. A quick release coupling, AVX.2241, is fitted in the return line forward of the filter for charging the system with oil or for flushing through the system. A blanking cover is provided to prevent ingress of dirt and moisture into the rig drive and oil connections when a C.S.D./alternator unit is not installed.

20. For testing constant speed drives under conditions that would obtain in the aircraft system, provision is made for pressurising the system and for measurement of oil leakage through the drive output shaft seal. Leakage oil from the seal is fed through an external pipe to a graduated container mounted in the structure. Pressurisation air is supplied from an air bottle, through a control cock, filter and two pressure regulating valves which reduce pressure to the tank to 3¼ lb./in.^{2} The tank relief valve prevents the system pressure from exceeding 6 lb./in.^{2} during operation, and also vents the system during the cooling period after shutdown. Oil spillage, due to action of the relief valve, is drained to a drip tray mounted on the chassis. A pressure gauge and A58 inflation adapter are provided for charging the air bottle. The C.S.D. oil inlet and outlet temperatures, and oil and pressurisation pressures, are recorded on indicators mounted at the top of the control panel.

Cooling system

21. An inlet duct with Vokes air cleaner, two separate heat exchangers and a centri-

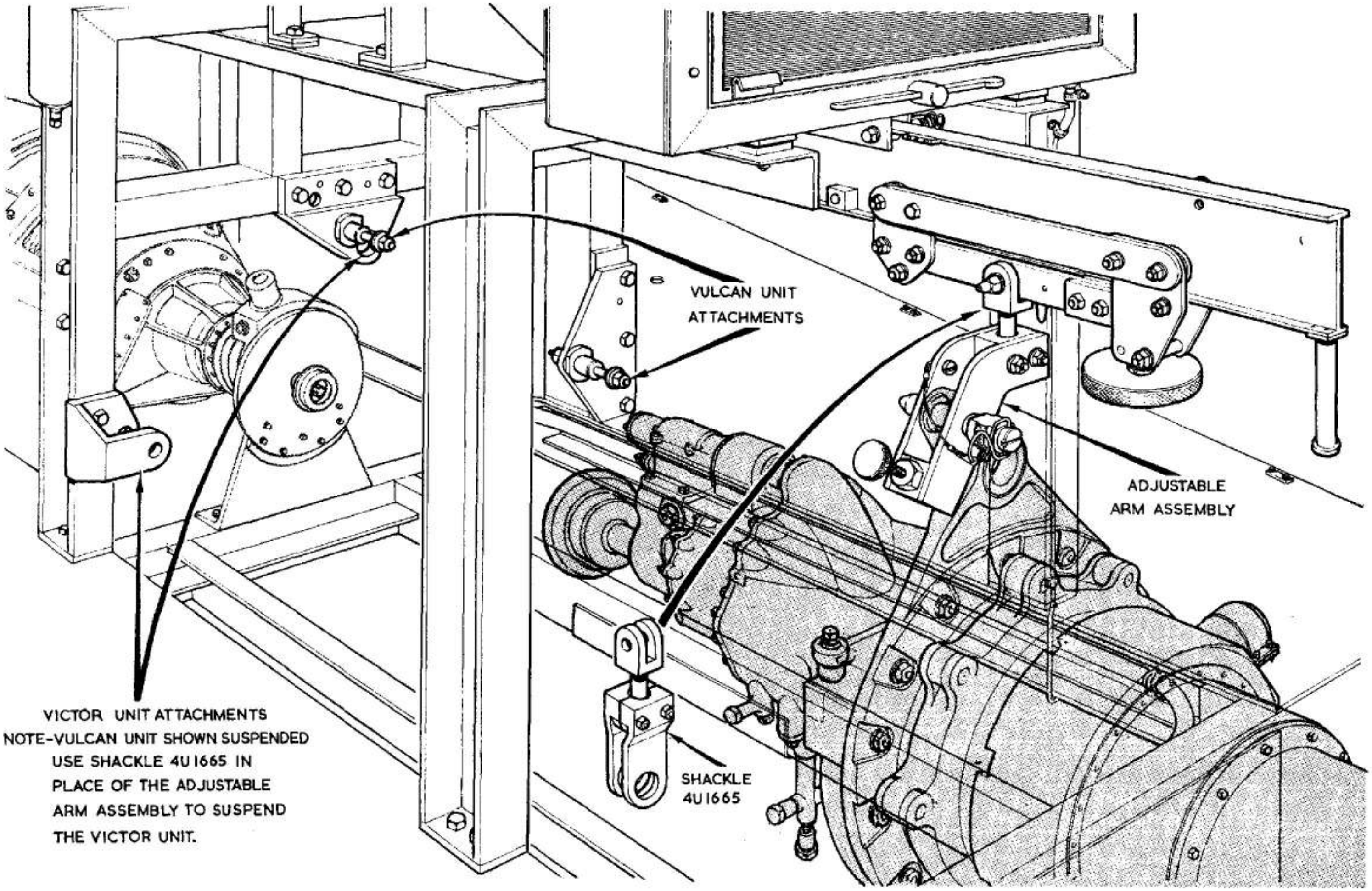

Fig. 5. C.S.D. mountings and handling equipment

fugal fan driven by a 24 volt d.c. motor, form a system for cooling the alternator and the oil from C.S.D. and gearbox systems. Power for operation of the motor is supplied by No. 2 engine driven generator through a starter unit, so arranged that cooling automatically commences when the engine is started. For a special test it may be desirable to delay cooling until higher operating temperatures have been obtained. This can be achieved by removing the link between the No. 1 and No. 2 terminals of the cooling motor starter. The functioning of the cooling system can then be controlled by the start push-switch SW.18. In these circumstances, great care must be exercised not to overheat the C.S.D. and alternator, and the link must be replaced immediately on completion of such tests. A green lamp, which gives indication when the cooling fan is operating, is mounted adjacent to the push-switch at the lower right-hand corner of the control panel.

CONTROL CONSOLE

22. The console is in the form of a steel cabinet attached to the chassis platform by four anti-vibration mountings and secured to the canopy roof structure by two similar mountings. The front panel is the control panel on which all the engine and electrical controls and instrumentation are mounted, arranged as shown in fig. 8. For access to the interior of the console, the upper portion of the control panel is hinged, and the arrangement is such that the engine controls, instruments, and the lighting switches are housed on the lower fixed portion. An interlock micro switch is incorporated so that if the control panel is opened with the rig operating, the switch is actuated to trip the 'G' breaker.

23. On the rear side panel are mounted the engine shut down panel, a standard type ground supply plug, a Santon rotary switch and three connecting sockets. The ground supply plug is the connection for a 28-volt d.c. supply which can be utilised for charging the batteries or for engine starting. The switch is the AIRCRAFT/TRAILER change-over control, and the two large sockets identified AIRCRAFT and SYNCH respectively, are the alternative connections for the trailing cable by means of which the test rig is connected to the aircraft system, or interconnected to another test rig. The smaller socket is for a hand inspection lamp.

24. On the inner side of the rear panel are mounted the No. 1 and No. 2 d.c. voltage regulators and bus-bars, the cooling fan motor starter, overspeed protection unit, and the associated system terminal blocks and fuses.

25. Mounted on the bottom panel are the a.c. bus-bars and the frequency meter resistance box. The arrangement of components in the interior of the console is shown in fig. 6.

EQUIPMENT MOUNTING RACKS

26. Two separate equipment mounting racks are provided, each consisting of an angle section steel framework covered on all sides, with the exception of the front, by 18 s.w.g. steel sheets. The racks are mounted one on top of the other, the attachments between the racks and to the trailer platform each being made by four bolts.

27. The lower rack is divided into two identical horizontal compartments, each fitted with mountings for an alternator switch box, a Mk.2 frequency and load controller and a voltage regulator, which are part of the test rig system. The duplicate mountings provide accommodation for installing similar components as required for checking purposes. The controller and regulator are mounted on a common plate supported in the structure by six equiflex anti-vibration mounts, and the switch box is mounted on a separate plate welded to the structure. Quick release clamps are fitted at the respective mountings for securing the components.

28. The upper mounting rack accommodates the Merz Price junction box and current transformers, load share junction box, the 'G' and 'S' breakers and relays, the synchronising monitor unit and the a.c. voltage pick-up box. The arrangement of components in the equipment racks is shown in fig. 7.

Key to Fig. 6
(Interior of Control Console)

1. NO. 1 VOLTAGE REGULATOR
2. NO. 2 VOLTAGE REGULATOR
3. OVERSPEED PROTECTION UNIT
4. FAN MOTOR STARTER
5. GROUND (BATTERY) SUPPLY PLUG
6. AIRCRAFT/TRAILER CHANGE OVER CONTROL
7. FREQUENCY METER RESISTANCE BOX
8. D.C. FUSES
9. D.C. +VE BUSBAR
10. D.C. −VE BUSBAR

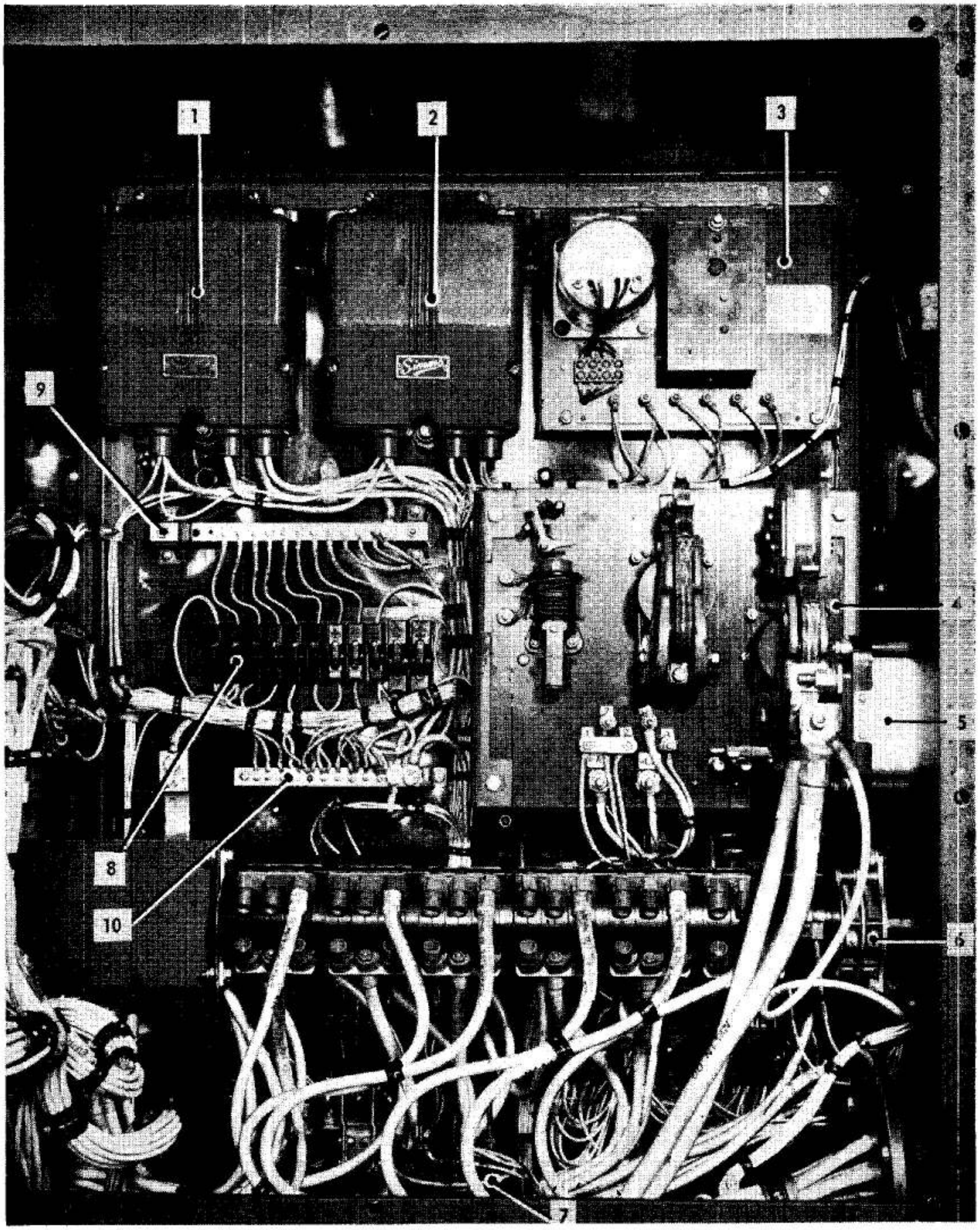

Fig. 6. Interior of control console

LOADING EQUIPMENT

29. The loading equipment consists of twenty-four heavy duty grid coil resistors and twelve single-phase chokes, housed in separate containers and mounted one on top of the other. Both containers consist of a rectangular framework covered by screened panels to assist in heat dissipation. The resistors are mounted in the upper container and are arranged horizontally in rows of four, each row being supported at either end by a rod secured to the front and rear vertical members of the framework. A single resistor installed below the loading units is for Merz Price circuit testing. A base plate is provided in the lower container for mounting the chokes.

30. The equipment provides for full loading of the alternator in four 10 KVA stages at 0·8 P.F., controlled by switches SW.6 to SW.9 inclusive, which are mounted on the control panel.

TRAILING CABLES

31. Two trailing cables are provided, and are stowed in separate reels mounted one either side of the engine. The 17-core aircraft cable is housed in the L.H. reel and serves two purposes. It interconnects two rigs for parallel operation via the SYNCH sockets on the respective control consoles, and is also used to connect the rig via the AIRCRAFT socket to the aircraft alternator circuit. The 3-core load cable is used to connect the rig loading equipment via the load connector, to the aircraft power panel. For connection to the Vulcan aircraft, the aircraft and load trailing cables are coupled to an aircraft plug connection and an extension cable respectively.

32. The aircraft plug connection is designed for mounting to the C.S.D./alternator attachments on the aircraft engine. A slave mounting is being developed for use in the engine

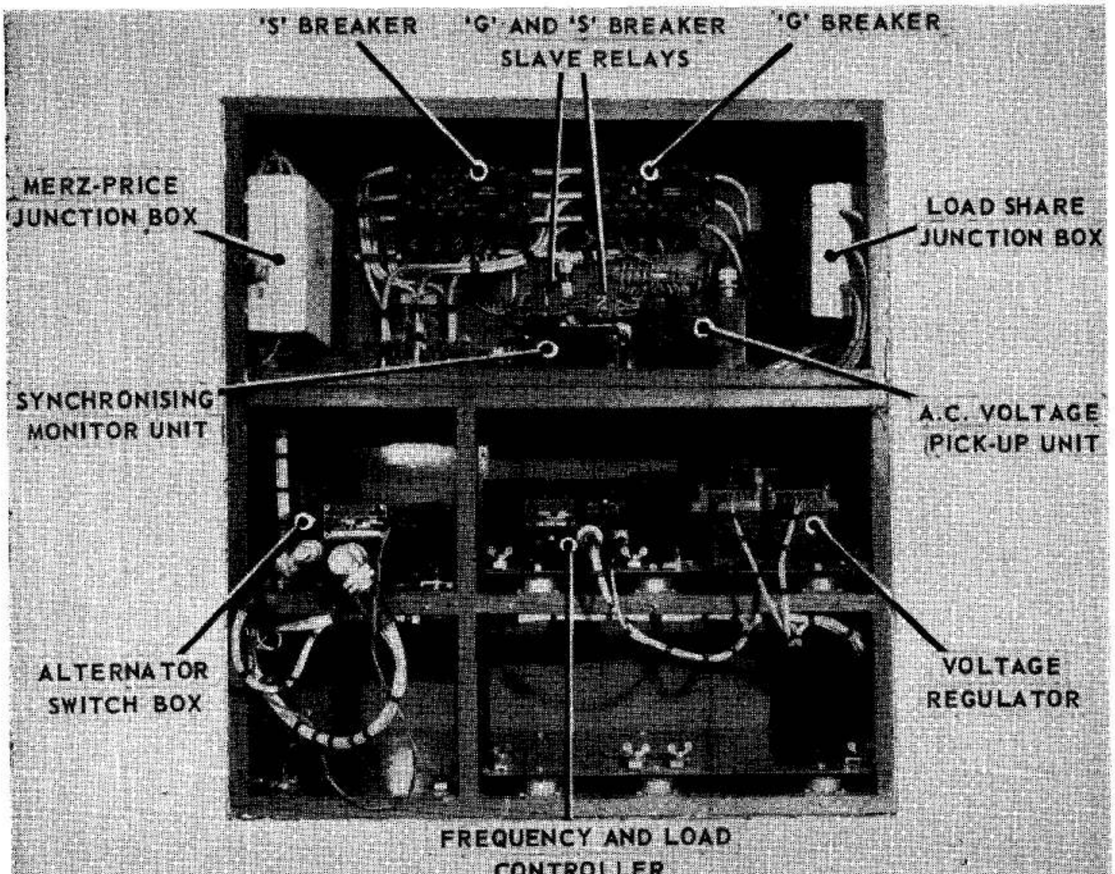

Fig. 7. Equipment mounting racks

removed condition. The plug connection is provided with three plugs, 17-pin, 4-pin and 3-pin, and a terminal block for connection of the aircraft trailing cable and the aircraft constant speed drive and alternator leads.

33. The extension cable is made up from three separate leads with a common socket at one end for connection to the load cable. At the other end each lead terminates in a forked lug. The lugs are identified RED, YELLOW and BLUE respectively and are the connections to the individual phases on the power panel. Details of the trailing and extension cables and the aircraft plug connection are contained in Table 1.

CANOPY

34. The canopy consists of an angle-section steel framework covered on the top by steel sheets, and fitted with hinged light alloy side panels and end doors. The canopy is mounted on the chassis platform and is secured to it by bolts passing through the vertical side members. Two red obstruction lamps and a clear power-on lamp are mounted on the roof, and eight lamps mounted in the framework provide illumination for the rig equipment. All canopy mounted lamps are fed via a plug and socket connection at the rear L.H. side of the chassis platform. Stowage for the engine exhaust extension pipe is also provided in the framework by two brackets attached to the rear R.H. side and cross members.

35. To facilitate major engine servicing the canopy can be removed as a complete unit. and four shackles are fitted to the roof for attachment of the lifting cables supplied with the rig. To retain the side panels in the closed position for ease of handling during removal, each side panel is drilled to accommodate two screws which engage threaded bosses in the side members of the framework.

LOOSE EQUIPMENT

36. Separate stowages are provided on the test rig for two Pyrene fire extinguishers, engine turning handle, flame trap, exhaust extension and the canopy lifting cables. A portable equipment box is also provided for storing the pipe assemblies, fittings, extension cable and connectors required to adapt the rig installation for the Vulcan and Victor units, and to connect the rig to the aircraft systems. The items contained in the equipment box are listed in Table 2.

ENGINE ELECTRICAL CIRCUITS

No. 1 and 2 generators

37. Supplies for the electrical circuits associated with engine operation are provided by two 24-volt, 1·2KW shunt wound d.c. generators, Simms Type 724.DQR. The generators are belt driven from the engine and are cradle mounted to the crankcase, No. 1 at the left-hand and No. 2 the right-hand position. No. 1 generator is used for charging two 12-volt batteries connected in series, and also to feed the 28-volt busbar. No. 2 generator is used for supplying the cooling fan motor only. Further details of the generators will be found in A.P.4343M.

38. The output from each generator is controlled by vibrating contact voltage regulators. No manual switching is provided, so that the generator outputs are automatically connected to their respective loads when their output levels have been attained. In order to provide full power for the fan motor at low engine speeds, separate excitation for the field of No. 2 generator is provided by No. 1 generator. Apart from this feature the generator. circuits function independently.

Voltage regulators

39. The voltage regulators, Simms Type EM.54X/1 and EM.58X/1, operate on the vibrating contact principle whereby a resistance is rapidly cut in and out of the generator shunt field circuit to give a constant terminal voltage as the generator speed increases, Each unit incorporates a cut-out or contactor which is operated by the contacts of a pilot relay at a pull-in voltage of 24·5V. A series coil on the pilot relay disconnects the battery from the generator with a reverse current of less than 10 amp. The voltage regulators are not interchangeable. Type EM.58X/1 which is fitted in the No. 2 position incorporates a modification to enable the field of No. 2 generator to be separately excited.

Batteries

40. Two 12-volt, 100 amp.hr. lead-acid batteries provide the power for starting the engine and also supply the circuits connected to the positive busbar. Battery charging current is indicated by an ammeter scaled 0-100 amps connected from a suitable shunt in the positive line from No. 1 generator. The batteries may also be charged from an external source via the ground supply plug.

Engine starter motor

41. A 24-volt axial type starter motor C.A.V.U624A/27 is fitted and connects direct to the batteries. Operation of the motor is controlled by an integral solenoid, the circuit being energized from the engine start push-switch on the control panel.

Speed control actuator

42. Movement of the engine speed controls is effected by an actuator incorporating a 24-volt shunt wound motor, Fracmo SH.336 and integral C70 gearbox, the operation of which is determined by the direction of current through the armature. Two micro switches limit the actuator travel either way and are set to operate at engine speed limitations. The circuit is controlled by the speed control switch SW20 via two relays BR5 and BR6.

Fan motor and starter

43. The 24-volt 1·1 H.P. fan motor is automatically controlled by a starter fed from No. 2 generator. The starter, Veritys Type 134-00-D5886, contains a main contactor, a starting contactor and starting resistance. Protection devices for overload conditions consist of terminals 1 and 2 to bypass the contacts of an overload coil and a blow out coil. Automatic starting is achieved by the linking of terminals 1 and 2 to bypass the contacts of the associated start push-switch. Indication that the fan motor is operating is given by a green lamp on the control panel.

CIRCUIT OPERATION

44. The following paragraphs describe the circuit operation for engine starting and control, and the function of the generator circuits as outlined in fig. 10.

Engine starting

45. The speed control switch must first be placed to LOWER. A supply from fuse F5 will then be made via contacts 6-4 and 1-3 of the speed control switch and contacts C-B of the lower micro switch, to energize relay BR5. This action will connect a supply from fuse F3 via contacts 6-5 of the relay to the armature of the speed control actuator, returning to the negative bus-bar via contacts 3-4 of the relay. At the same time, the supply will be made via contacts 2-1 of the relay to energize the actuator field. The actuator will move to depress the lower micro switch which will make across contacts A-D-E.

46. When the starter push-switch is pressed, a supply from fuse F5 will now be made via contacts E-D of the lower micro switch to the solenoid of the engine starter motor. With the engine started and running, the oil pressure will rise and the associated pressure switch in the engine shut-down panel will open. Note that the starter push-switch should not be held in for longer than 30 seconds.

No. 1 generator control

47. Reference to fig. 10 will show that the No. 1 generator output is fed via the ammeter shunt to terminal D+ on the voltage regulator. As the voltage increases, the pilot relay will be energized and its contacts will close. This action will energize the contactor which will close to deliver a charging current to the batteries via terminal B+. At the same time, the vibrator coil will be energized to actuate the vibrator contacts, which will insert the field resistance into the generator field to regulate the voltage.

No. 2 generator control

48. The control circuit for No. 2 generator operates in similar fashion to No. 1 except that the No. 2 generator field is excited from the No. 1 generator output and controlled via terminals J and F of the No. 2 voltage regulator.

Fan motor operation

49. The starting cycle for the fan motor will commence when the contactor in the No. 2 voltage regulator closes. The supply from No. 2 generator will then be fed from terminal L+ of the regulator, terminals L1, 1 and 2 of the fan motor starter, contacts 2-1 of the engine stop switch, terminal 3 of the starter, the trip contacts, the main contactor coil, resistance 3R and to earth via terminal L2. Closing of the main contactor will connect the supply to the fan motor field via terminal Z, and also to the armature via the starting resistance 1R, the overload coil and terminal A. At the same time the blower control lamp will light.

50. As the fan motor picks up speed, the back E.M.F. will cause the volts drop across the starting contactor coil to increase. The coil will then become energized via the auxiliary contacts of the main contactor and resistance 2R. Closing of the starting contactor will thus bypass resistance 1R, and full voltage will be applied to the armature.

Increasing speed

51. When the speed control switch is placed to RAISE, a supply from fuse F5 will be made via contacts 5-4-2-1 of the switch and contacts B-A of the raise microswitch to energize relay BR6. The supply will then be made via the relay contacts to the armature of the speed control actuator in the reverse direction, and to the actuator field. The actuator will then move the engine control to increase speed until the control switch is released to the NEUTRAL setting or until the raise microswitch is depressed. Under both these conditions relay BR6 will be de-energized to cut off the supply to the actuator.

Engine stopping

52. When the stop push-switch is pressed, a supply will be made to energize the fuel stop solenoid and light the engine fault lamp. At the same time the fan motor starter will be de-energized thus stopping the fan motor.

ENGINE PROTECTION CIRCUITS

53. An engine shut down panel and an overspeed protection unit are provided to stop the engine under conditions of high coolant temperature or low oil pressure, and overspeeding due to governor failure.

Engine shut down panel

54. The engine shut down panel, Dorman 16890B, incorporates two separate circuits each comprising a pressure switch, a latched relay and a trip switch. The trip switches extend through the front cover of the panel and are identified SW21 Low oil pressure and SW22 High water temperature respectively. The pressure switches are connected to the appropriate engine systems, and are set to operate at a coolant temperature of 205°F. and at oil pressures below 15 lb./in.^{2} Should either of these conditions occur, the associated pressure switch will close to energize the relay which will latch in, and a supply will be made via the relay contacts to operate the stop solenoid and to light the engine fault indicator. The defective system will be indicated by the trip switch moving to the upper FAULT position. The relay can only be reset by placing the trip switch in the lower NORMAL position.

Overspeed protection

55. The overspeed protection unit, Smiths TRB.479, operates in conjunction with a Smiths M series tacho-generator driven from the gearbox. The unit employs two resistances, a bridge rectifier, a calibrated relay and a latched relay. In conditions of overspeed, an increased output from the tacho-generator will be fed via the resistances and bridge rectifier to energize the calibrated relay. Closing of the calibrated relay contacts will energize the latched relay from the +ve bus-bar, and a supply will be fed to operate the stop solenoid and to light the engine fault indicator. Two push-switches are incorporated, one for resetting the latched relay and the other for testing the unit. Engagement of the test switch isolates the resistances, so that at a testing speed of 6,000 r.p.m. the full output from the tacho-generator will be fed to the bridge rectifier to energize the calibrated relay.

ALTERNATOR CONTROL AND TEST CIRCUITS

General

56. The main electrical power supplies for the Vulcan B. Mk.2 and Victor B. Mk.2 aircraft are obtained from a constant frequency a.c. system. This system provides a 3-phase, 200-volt, 400 c/s a.c. supply from four alternators driven through constant speed units from the aircraft engines. Each alternator is controlled and fault protected under varying conditions, and provision is also made to maintain equal load sharing during parallel running.

57. To provide test conditions similar to those encountered during normal operation, it is essential that the test rig incorporates all these features. The control components which form part of an individual alternator circuit in the main system are therefore included in the test circuit. In addition, equipment is also provided for fault simulation and to enable the rig driven alternator to be connected into the aircraft system.

Control components

58. The components associated with control of the alternator and the constant speed drive comprise a voltage regulator Type 98B, an alternator switch box AE.450 Mk.3, a frequency and load controller AE.7507 Mk.2 and two heavy duty circuit breakers AE.5355. Information on the basic principles of these components and the constant frequency system is contained in A.P.4343, Vol. 1, Sect. 2, Chap. 6.

Load share junction box

59. A load share junction box provides the link between the alternator and its control components. It contains the current transformers used in the overvolt protection, real and reactive load share circuits, and the circuit control fuses. In addition, three fuses, connected one to each phase bus-bar, supply the Ekco test socket.

Merz Price junction box

60. The neutral lines from the alternator are connected to a neutral earth block via a Merz Price junction box. The junction box contains three current transformers which surround the neutral lines and which are connected to three current transformers surrounding the feeder lines of the alternator to form three loop circuits. Three relays contained within the alternator switch box are connected one across each loop. These circuits provide a system of differential protection in the event of line-to-line and line-to-earth faults across the alternator output.

Synchronising monitor unit

61. A synchronising monitor unit, Type AE.7508, prevents the incoming alternator from being connected to the synchronising bus-bar until circuit conditions are correct. It contains a bridge rectifier, two relays A and B each controlling a set of change-over contacts, and a capacitor. Operation of the unit is described in the paragraphs on circuit operation.

Voltage pick-up unit

62. The voltage pick-up unit, Type AE.7702, isolates the SYNCH. push-switch when its associated alternator is connected to the synch bus-bar. The unit contains two relays, the coils of which are energized from the red and blue phases of the synch bus-bar. The contacts of each relay are connected in series and for this application only one set of normally closed contacts is utilised. In the closed position the contacts provide a path for the supply to one side of the synch push-switch which can be pressed to close the 'S' breaker. With the alternator connected to the synch bus-bar, the relays in the unit will be energized and the contacts will open to break the supply to the synch push-switch. In this condition the alternator of the second rig can only be connected to the synch bus-bar via its own synchronising monitor unit.

Controls and indicators

63. The controls and indicators are mounted on the control panel of the console and are each identified to indicate the function they perform. These items can be classified into two groups: those required for normal operation of the system, and those provided for fault simulation. The former group comprises the following :—

(1) SW.1, an ON–OFF switch for alternator control.

(2) SW.3, 4, 5 and 16. Four push-switches labelled ISOLATE, RESET, SYNCH and VOLT REGULATOR TEST respectively.

(3) SW.6, SW.7, SW.8, SW.9. Four 2-pole switches spring loaded to the OFF position for alternator loading.

(4) R1 Voltage trimmer Type AEB. 417017 (5UC16105).

(5) SW.2, Voltmeter selector switch, Ferranti Type V20009. A three-way and OFF rotary switch which can be selected to connect any two phases to the voltmeter.

(6) V1 rectifier voltmeter, Ferranti Type V4822, which gives indication of the voltage across any two phases of the alternator output by selection of SW.2.

(7) W1. Wattmeter Ferranti V.4820 scaled 0-50. The indicator current coil is supplied by a current transformer looped around the alternator red phase, and the voltage coils are connected across the red phase and neutral earth.

(8) VAR.1. KVAR meter Ferranti Type V.4821 scaled 0-50. The indicator current coil is supplied by a current transformer looped around the alternator red phase, and the voltage coils are connected across the blue phase of the alternator output, and, via a dropper resistance, the yellow phase of the synchronising bus-bar.

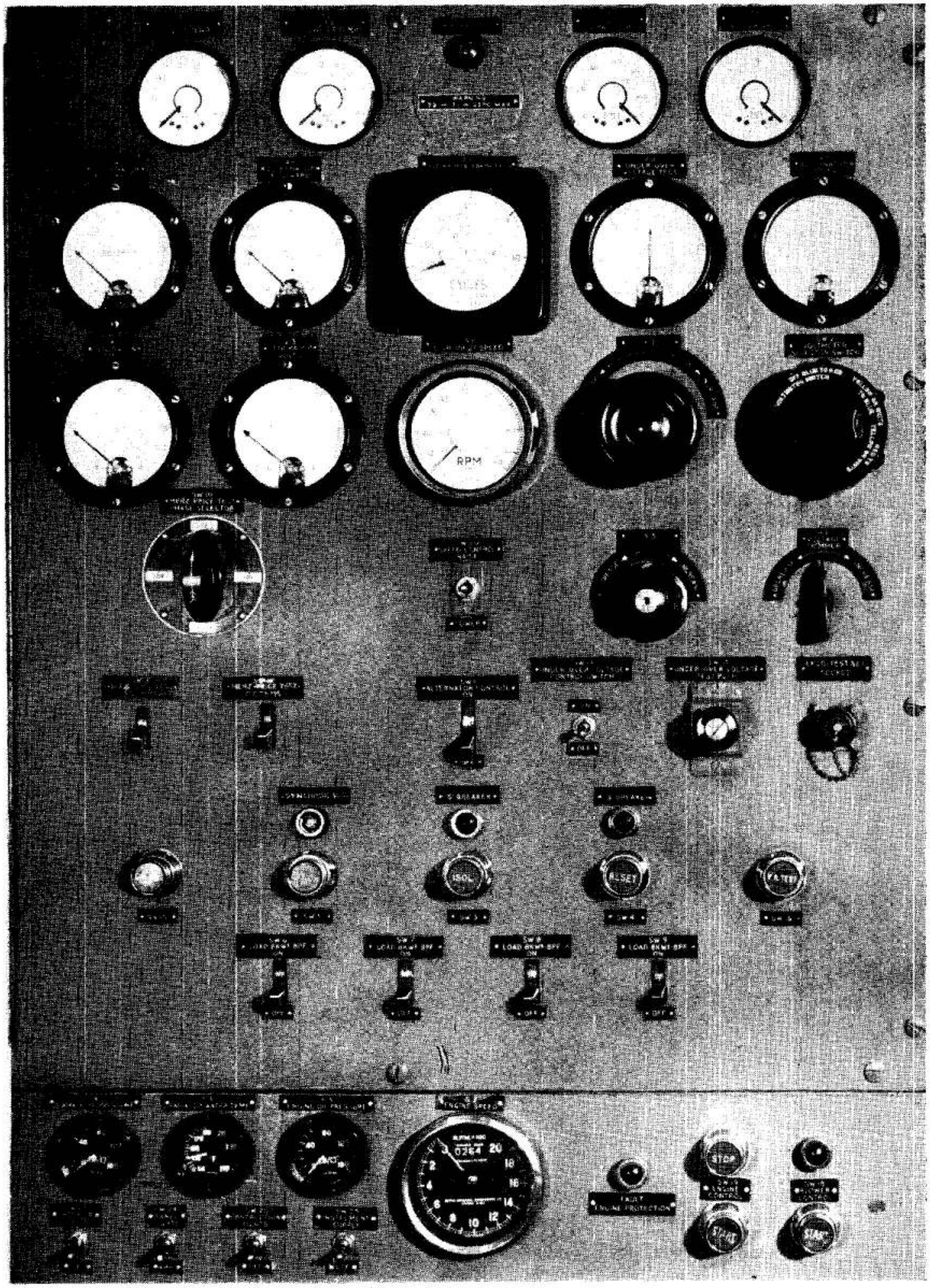

Fig. 8. Control panel

(9) F1. The frequency meter and its associated resistance box form a matched unit Ferranti Type V.20005. The meter is connected via fuse F.12 and the resistance box across the red and blue phases.

(10) Four indicator lamps, one clear, two red and one amber are identified SYNCHRONISING, 'G' BREAKER and 'S' BREAKER, and AIRCRAFT ON respectively. It should be noted that when the 'G' or 'S' breaker is closed, the supply to the associated indicator will be completed and the indicator will light.

(11) SW.17. A four-position 7-pole special sequence rotary switch, Santon Type SR.6746 BX4, mounted on the rear side panel of the control console and labelled TRAILER and AIRCRAFT. The switch is provided to set the conditions for trailer or aircraft operation.

64. The controls and indicators provided for fault simulation comprise the following: —

(1) SW.13. An ON–OFF switch for under/overvoltage control.

(2) SW.14. A manually operated solenoid switch, Rotax Type D.2208/2, labelled UNDER/OVER VOLTAGE TEST. Operation of this switch energizes the BR. 3 relay to isolate the voltage regulator carbon pile during under/over voltage tests. The switch is equipped with a locking guard to prevent inadvertent operation.

(3) R2 and R3. Rheostats of 25 and 500 ohm. rating respectively which are connected in parallel to provide a variable resistance for the under/overvolt test circuit. Rheostat R2 provides a means of fine trimming for the system.

(4) V2. A voltmeter scaled 30-0-30 and labelled UNDER/OVER VOLTMETER, which is connected into the alternator field circuit to provide indication of field balance during under/over voltage tests.

(5) SW.10. A three-way and OFF rotary switch, Santon Type SR.313C, for individual phase selection (Merz Price).

(6) SW.11 and SW.12. Two-way spring-loaded to OFF switches for control of the test resistances for protection circuit testing. (Merz Price).

(7) SW.15. A push-switch provided to check system function under crash conditions.

Note . . .

The function of these components is described in the paragraphs on circuit operation

CIRCUIT OPERATION

65. The following paragraphs describe the circuit operation and the function of the fault simulation circuits as shown in fig. 11. In the engine running condition the d.c. bus-bar is supplied from No. 1 engine-driven generator. With the instrumentation supply switch SW.25 set to ON, d.c. will be applied to the constant speed drive oil pressure and temperature indicators via fuse F9, and to the alternator switch box via fuse F10. A supply will now be made from the switch box via contacts 4-6 of the alternator control switch SW.1 and the normally closed contacts of the master relay within the switch box, to energize the 'G' slave relay. Relay contacts B1-B2 will close to connect the supply to the trip coil of the 'G' breaker and contacts A2-A3 will open to isolate the close coil. At the same time, the supply will be made via contacts 5 of the 'G' breaker, the master relay contacts and 'S' slave relay contacts B3-B2 to energize the close coil of the 'S' breaker. The 'S' breaker will close and latch in, and the associated indicator lamp, supplied from fuse F9 via 'G' breaker contact 3A and contacts 3 of the 'S' breaker, will light.

Switching on the alternator

66. The exciter control relay within the switch box will normally be latched in and the alternator will be self exciting. If conditions are otherwise, this relay will be closed by pressing the RESET switch. By this action a supply will be fed, via contacts 1-3 of the alternator control switch and the reset switch, to the close coil of the relay. The exciter field circuit will be completed from A+through contacts A2-A3 of relay PR4/1, the voltage regulator carbon pile, the exciter control relay contacts, contacts B3-B2 of relay PR4/1 and contacts A3-A2 of relay PR3 to F. On releasing the reset switch, the exciter control relay will remain latched in.

67. With the alternator control switch set to ON and the constant speed drive underspeed switch in the normal pressure position, the supply will be made via contacts 4-5 of the control switch and the underspeed switch contacts, to energize the switch box master relay. By this action the 'G' slave relay will be de-energized and its contacts B1-B2 will open and A2-A3 close. At the same time the 'S' slave relay will be energized and its contacts B3-B2 will open to isolate the close coil of the 'S' breaker and contacts A1-A2 will close to energize the trip coil. Contacts 5 of the 'S' breaker will now close to connect a supply via the 'G' slave relay contacts A2-A3 to the 'G' breaker close coil. The 'G' breaker will now be closed and its indicator, supplied via contacts 3A-3B, will light. Note that the same supply is also made to light the power ON indicator. The alternator is now connected to the No. 2 bus-bars via the 'G' breaker, and is isolated from the synchronising bus-bar by the opening of the 'S' breaker.

Loading the alternator

68. The load control switches SW.6, SW.7, SW.8 and SW.9 are connected between the loading units and the No. 2 bus-bars. Each switch controls a group of units consisting of three chokes and six resistors connected in parallel to provide a 8 KW load. By switch selection, loads of 8 KW, 16 KW, 24 KW or 32 KW can be applied to the alternator.

Under and overvoltage

69. Conditions of under and overvoltage are simulated by the adjustment of rheostats R2 and R3, which are switched into the exciter field circuit in place of the regulator carbon pile. The rheostats are first trimmed to a suitable value in conjunction with a fixed balancing resistance in order to balance the resistance of the pile. This will ensure that the alternator voltage will remain steady during the switching period. A zero indication will show on the under/over voltmeter when the two resistance paths are balanced.

70. When the under/over voltage control switch SW.13 is closed, the supply from the exciter A+ will be fed via rheostats R2 and R3, contacts B2-B3 of relay PR3 and terminal A of the field balancing resistance to one side of the under/over voltmeter. Since the other side of the voltmeter is already connected to the existing field path, via A2 of relay PR3, a zero indication will be obtained on the voltmeter by the adjustment of R2 and R3. Fine trimming is provided by R2.

71. When the under/over voltage test switch SW.14 is pressed, a hold-in circuit for the switch will be fed from fuse F1, and at the same time relay PR3 will be energized. This action will isolate the carbon pile by the opening of relay PR3 contacts A3-A2, and insert rheostats R2 and R3 into the field circuit via contacts B2-B1 and A2-A1. The alternator voltage can now be controlled by adjustment of R2-R3 to give under or overvolt conditions. In undervolt conditions, the undervolt relay within the alternator switch box will be de-energized. As a result, the 'G' slave relay will be energized to trip the 'G' breaker and bring the alternator off line. In overvolt conditions, a current induced by the overvolt current transformer in the load share junction box, will cause the overvolt relay in the switch box to be energized. This action will energize the 'G' slave relay and trip the 'G' breaker.

Line-to-earth faults

72. Line-to-earth faults on any phase of the system can be simulated by means of the Merz Price phase selector switch SW.10 and the test switches SW.11 and SW.12. With SW.10 selected to a phase position and SW.12 placed to ON, a fixed resistance of 2·2 ohms (*fig.* 12) will be connected across the selected phase of the alternator output, and the applied overload will cause differential currents to be induced by the respective Merz Price current transformers. As a result, the appropriate protection relay in the alternator switch box will be energized and the 'G' breaker tripped to bring the alternator off line. By placing SW.11 to ON, a 3·5 ohm. resistance will be connected across the selected phase. In this case however, the overload should be insufficient to operate the protection circuit and the alternator should remain on line.

Crash switch operation

73. When the crash switch SW.15 is operated, a supply from fuse F7 will be fed to trip the exciter control relay in the alternator switch box, which in turn will trip the 'G' breaker. Operation of the crash switch circuit will automatically occur if the control panel is opened during normal operation of the test rig. This is arranged through an interlock micro switch, the contacts of which will close to complete the crash circuit when the panel is opened.

Voltage regulator test

74. The supply from the alternator blue phase to the voltage regulator is made through the normally closed contacts of the voltage regulator test switch SW.16. When the switch is pressed, this supply will be broken, resulting in an overvolt condition and tripping of the 'G' breaker.

Synchronising the alternators

75. For parallel operation, two test rigs will be interconnected via the SYNCH sockets on each control console. With the rigs running and the alternators ON, the yellow phases of each alternator will be interconnected via the KVAR meter terminal V1, the dropper resistance, the synchronising indicator, fuse F16 and 'S' breaker contact T2. Both synchronising indicators will therefore light. The first alternator is connected to the synch. busbar by pressing its associated SYNCH. push-switch. A d.c. supply will then be fed from fuse F4, via the normally closed contacts of the voltage pick-up unit and the synchronising monitor unit, through the switch to the paralleling relay in the switch box. The relay contacts will close to supply the close coil of the 'S' breaker, and the alternator will now be connected to the synchronising bus-bar. The voltage pick-up relays will then be energized from the red and blue phases of the synch. bus-bar via fuses F15 and F17, and their contacts will open to break the supply to the SYNCH, push-switch.

76. The function of synchronising the two alternators is controlled from the No. 2 rig. The bridge rectifier of the synchronising monitor unit is connected across the yellow phase of its own alternator output via fuse F13, and the yellow phase of the synch. busbar, via fuse F16. Relay B, being connected across the output of the rectifier, will be energized when the two voltages are out of phase and de-energized when the voltages are synchronised. When energized, its contacts will change over to connect the capacitor across the rectifier and the capacitor will be charged. When de-energized, its contacts will revert to their normal position to connect relay A across the capacitor. The charge on the capacitor will energize relay A and its contacts will operate to connect a supply from fuse F2 to the associated synch, push-switch. By pressing the push-switch, the paralleling relay will be supplied and the 'S' breaker will close to connect No. 2 alternator to the synch. bus-bar. The indicator lamps will then be extinguished. The function of the real and reactive load share circuits is described in A.P.4343, Vol. 1, Sect. 2, Chap. 6.

Isolating an alternator

77. Either alternator can be isolated by pressing the associated ISOLATE push-switch. This action will cause a supply to be fed, via contacts 4-5 of the alternator control switch and the alternator switch box, to energize the 'S' slave relay. Relay contacts B3-B2 will open to isolate the close coil of the 'S' breaker and contacts A1-A2 will close to supply the trip coil. The alternator will now be disconnected from the synch. bus-bar.

Aircraft/trailer change-over system

78. The test rig is connected to the aircraft system by means of the 17-core aircraft and 3-core loading trailing cables. By setting the AIRCRAFT/TRAILER control switch SW.17 to AIRCRAFT, a supply will be made available from fuse F10, via the control contacts 7-G, to energize relays PR4/1, PR4/2 and PR4/3 and the relay contacts will change over. The AIRCRAFT ON indicator lamp, being supplied from fuse F2 via PR4/3 relay contacts C2-C1, will light. The rig mounted alternator and constant speed drive are now isolated from the rig control components and are connected to the aircraft control system. Alternator loading, under and over voltage and line-to-earth fault simulation, will still be controlled from the test rig as described in the previous paragraphs.

LIGHTING SYSTEM

79. The test rig is equipped with a power-on indicator, two obstruction lights, and nine fixed interior lamps all supplied from the 28-volt bus-bar, and four external lights, two side and two rear, supplied at 12 volts from the towing vehicle. Six of the interior lamps provide illumination for the rig equipment, and the remaining three illuminate the control panel. The interior and control panel lamps and the obstruction lamps are supplied from fuse F11, and can be switched on in their groups by means of switches SW.23, SW.24 and SW.26 respectively. The power-on indicator is supplied from 'G' breaker terminal 3B, and lights only when the 'G' breaker is closed.

INSTALLATION OF COMPONENTS FOR TEST

C.S.D./alternator unit

80. Prior to installing the C.S.D./alternator unit, check and, if necessary, fill the constant speed drive with the specified oil. The method of suspending the units during installation and the arrangements for mounting are shown in fig. 5.

Vulcan unit

81. To install the Vulcan unit: —

(1) Remove the loading beam lock-pin, withdraw the beam and set the carrier to the fully extended position.

(2) Support the unit and position the alternator mounting plate boss in the adjustable arm assembly. Align the suspension holes in the boss and arm, and insert the pip-pin.

(3) Set the knurled adjusting screws to steady and centralise the unit.

(4) Remove the locknut, washer and spacer from the mounting bolts fitted to the top and L.H. side brackets.

(5) Remove the blanking cover from the rig drive and secure to the stowage point on the chassis platform.

(6) Lightly lubricate the oil tube sealing ' O ' rings and the drive splines.

(7) Slide the loading beam inwards to enter the mounting bolts in the alternator mounting plate, and the oil tubes in the constant speed drive oil fittings. If necessary slacken off the drive oil fitting attachment nuts to facilitate entry of the oil tubes, and turn the engine drive to align the splines. Slide the beam fully inward to engage the constant speed drive with the flexible coupling.

(8) Fit spacer, washer, and locknut to each mounting bolt and securely tighten.

(9) Connect the oil delivery hose to the transfer block.

(10) Connect the external drain pipe 127U1595 to the constant speed drive and position the pipe outlet in the graduated container.

(11) Connect the alternator, and the constant speed drive pressure switch and governor to the rig system.

(12) Connect the cooling pipe to the alternator.

(13) Fit the alternator air inlet extension duct 46U1597.

Victor unit

82. Before initially installing a Victor unit the following action is necessary :—

(1) Remove the adjustable arm assembly from the loading carrier and fit shackle 4U1665.

(2) Remove the existing mounting bolt from the top mounting bracket.

(3) Remove the oil tube lock plates and remove the tubes from the transfer block.

(4) Disconnect the return and pressurisation hoses from the transfer block.

(5) Stow the items removed in sub-para. (1) to (3) above in the equipment box.

83. To install the Victor unit :—

(1) Connect the air outlet assembly AED2039140 to the alternator.

(2) Set the loading beam and carrier in the fully extended position.

(3) Support the unit and position the alternator mounting plate boss in the shackle. Align the holes and insert bolt 5U1665 with the flange rearwards. Fit the washer and locknut and securely tighten.

(4) Remove the blanking cover from the rig drive, and lightly lubricate the drive splines.

(5) Slide the loading beam inwards to enter the mounting bolt in the lower hole in the top bracket, and engage the constant speed drive with the flexible coupling.

(6) Fit spacer, washer, and locknut to the mounting bolt and securely tighten.

(7) Using the bolt assembly and fitting provided for unit installation in the aircraft, secure the unit to the R.H. side bracket.

(8) Connect extension pipe 3U1665 to the system return hose and to the constant speed drive return connection.

(9) Connect the pressurisation hose to the constant speed drive vent pipe using adapter 15U1665 and connection clamp 16U1665.

(10) Connect extension pipe 2U1665 to the constant speed drive feed connection and to the system delivery hose. Note that connection to the drive must be made first, otherwise oil will drain from the system.

(11) Connect the alternator, and the constant speed drive pressure switch and governor to the rig system.

(12) Connect the cooling pipe to the air outlet assembly on the alternator.

(13) Fit the alternator air inlet extension duct.

Control components

84. Duplicate mountings are provided in the lower equipment rack for installing a voltage regulator, frequency and load controller and an alternator switch box for checking purposes. To install the components :—

(1) Fit to the appropriate mountings and secure the retaining clamps.

(2) Disconnect the corresponding components from the rig system, and couple the connecting sockets to the components under test.

Note . . .

When installing alternator switch box, Type AE7007, use adapter cable 57U1640, provided in the equipment box, to couple the component to the test circuit.

Removal of C.S.D./alternator unit.

85. To remove the unit :—

(1) Check that the pressurisation valve is closed.

(2) Reverse the procedure detailed in para. 81 and 83.

(3) Fit the appropriate blanking covers to the rig drive and oil connections and to the unit.

OPERATION

General

86. The test rig should be sited on level ground so that airflow through the engine radiator is unimpeded. All canopy side panels and end doors which bear the instruction to do so must be kept open at all times during engine running. The aircraft and load trailing cables are 45 feet and 60 feet long respectively, and for aircraft system checks, the test rig must be positioned so that these cables will extend to the appropriate engine bay and to the power compartment in the aircraft.

PREPARATION FOR INITIAL USE

87. Prior to initial use prepare the test rig as follows :—

(1) Prepare the engine fuel, oil and coolant systems as detailed in A.P.4382G.

(2) Install the C.S.D./alternator unit.

(3) Fill the constant speed drive oil system and charge the pressurisation system as detailed in para. 114 and 115.

(4) Fill the gearbox oil tank to the maximum level mark on the tank dipstick.

(5) Prime the gear box oil pump through the priming connection located on the chassis platform.

(6) Fill the fluid coupling as detailed in para. 111.

(7) Install two fully charged 12-volt, 100 amp.hr. batteries in the crate provided, and connect the batteries in series as shown in fig. 10.

(8) Fit the flame trap or exhaust extension to the engine exhaust pipe as appropriate to the operating conditions.

(9) Check security of all equipment.

STARTING THE ENGINE

88. The internal batteries supply the power for normal starting. If starting from an external source, connect a 28-volt d.c. supply to the battery charging connection.

Note . . .

When starting from an external source with the batteries disconnected, ensure that the battery leads are properly insulated.

To start the engine :—

(1) Ensure that the fluid drive scoop control lever is set to the IN position.

(2) Ensure that the engine decompression levers are set to the compressed position, i.e. towards the engine radiator.

(3) Set the aircraft/trailer change over control switch SW.17 to the TRAILER position.

(4) Set all switches on the control panel to OFF.

(5) Switch ON instrumentation supply SW.25. The 'S' breaker indicator should light.

(6) Press the excess fuel device lever fitted on the fuel injection pump.

(7) Hold the speed control switch SW.20 in the LOWER position to set the throttle actuator in the idle position.

(8) Press the engine control start push-switch SW.19 and release as firing occurs.

Note ...

(1) *Do not engage the start push-switch for more than 30 seconds at a time, otherwise overheating of the starter may result.*

(2) *When starting a warm engine, fuel priming as in (6) above is not required.*

(9) Allow engine to idle and check the following instrument readings :

S2. Engine idling r.p.m.
P3. Engine oil pressure
V3. D.C. bus-bar voltage

(10) Check that the cooling blower indicator lamp is ON.

(11) Open the pressurisation valve.

Note ...

Pressurisation of the C.S.D. system should only be applied as an aid to leak detection during specific checks on constant speed drives.

STOPPING THE ENGINE

89. To stop the engine: —

(1) Hold speed control switch SW.20 in the LOWER position until engine idling speed is obtained.

(2) Close the pressurisation valve on the pneumatic panel.

(3) Press the engine control stop push-switch SW.19 and release as firing ceases.

(4) Switch OFF instrumentation supply switch SW.25.

OPERATING PRECAUTIONS

90. Throughout all running periods, the following points must be observed :—

(1) Operating temperatures and pressures must be maintained within the limits marked on the respective indicators.

(2) The maximum temperature difference between the C.S.D. oil inlet and outlet temperatures T1 and T2 must not exceed 25°C.

(3) Operation of the cooling blower must be confirmed by checking that the green indicator lamp is ON, and that an airflow is evident through the system inlet and exit ducts.

(4) When operating on load, the C.S.D. input speed must not fall below 3,000 r.p.m., or exceed 8,100 r.p.m.

(5) A maximum C.S.D. input speed of 8,300 r.p.m. must not be exceeded.

ENGINE AND DRIVE OPERATION

91. To check satisfactory operation of the engine, gearbox and constant speed drive system, proceed as follows :—

(1) Start the engine as detailed in para. 88. Allow to idle and check the following :

(a) Cooling blower indicator lamp is ON.

(b) Engine systems for leakage.

(c) No excessive vibration is evident.

(2) Run at idling speed until pick-up of the fluid coupling occurs and the constant speed drive commences to operate. Check that the C.S.D. input speed S1 is 2,800-2,900 r.p.m. and the C.S.D. oil pressure P1 is not less than 20 lb./in.^{2} or more than 50 lb./in.^{2}

(3) Continue to idle for 5 minutes and check that within this period a minimum gearbox oil pressure P4 of 10 lb./in^2 is indicated.

Note ...

If the specific pressure is not obtained within this time, stop the engine and prime the gearbox oil pump.

(4) Increase C.S.D. input speed to 5,000 r.p.m. and check C.S.D. systems for leakage.

(5) Increase C.S.D. input speed to 8,100 r.p.m. and maintain for 2 minutes.

(6) Reduce C.S.D. input speed to 6,000 r.p.m. Check operation of the overspeed protection unit as follows :—

(a) Open the control panel on the console and press the overspeed protection unit test button. The engine fault indicator should light, and the engine should stop.

(b) Press the overspeed protection unit reset button and close the control panel.

(7) Start the engine.

(8) Adjust C.S.D. input speed to 3,000 r.p.m. and allow engine to run at this speed for 15 minutes. Check that the test rig operating temperature and pressures are maintained within the following limits, as shown on the respective indicators.

P3 Engine oil pressure	20 lb./in.² MIN.
T3 Radiator water temperature	205°F. MAX.
P4 Gearbox oil pressure	10 lb./in.² MIN.
P1 C.S.D. oil pressure	20 lb./in.² MIN. 50 lb./in.² MAX.
T1 C.S.D. oil inlet temperature	96°C. MAX.
T2 C.S.D. oil outlet temperature	121°C. MAX.
P2 C.S.D. pressurisation	6 lb./in.² MAX.

(9) Hold speed control in LOWER position until idling speed is obtained, and allow engine to idle for 2 minutes.

(10) Stop engine by stop push-switch SW.19.

(11) Switch OFF instrumentation supply SW.25.

(12) Close the pressurisation valve.

(13) Examine thoroughly for system leakage and security of equipment.

Note ...

Under certain circumstances, it may be desirable to run the engine without a C.S.D. alternator unit installed. Prior to starting the engine under such conditions, the fluid coupling must be DISENGAGED *by setting the scoop control lever to the fully* OUT *position.*

TEST SYSTEM OPERATION

92. The procedures for operating a single test rig and two rigs in parallel are detailed in the following paragraphs. The checks specified are those necessary to prove satisfactory function of the test system, and can be used as a guide to the general test procedures and the use of the test equipment. For the complete range of checks a voltage and frequency test set 5Q.3198, and a frequency trim test set 5G.3393 will also be required.

WARNING ...

Under certain conditions a.c. or d.c. voltages in excess of 100 volts can be fatal and may also cause serious damage to the aircraft and equipment. It must be remembered that line-to-line voltage from the alternator is 200 volts and extreme care must be taken when working on the system.

Single test rig operation

93. (1) Start the engine as detailed in para. 88 and allow to idle for 5 minutes.

(2) Increase C.S.D. input speed to 5,000 r.p.m.

(3) Press alternator reset push-switch SW.4, and place alternator control switch SW.1 to ON. Check that the 'S' breaker opens, the 'G' breaker closes, and the power on indicator lamp is ON.

Phase rotation check

(4) Connect the test set 5Q.3198 to the test socket on the control panel and check that phase rotation is R.Y.B.

Voltage and frequency

(5) Run on no load for 20 minutes, then check that the frequency is 400 c/s and that the voltage is 200 volts, as indicated on the test set. The voltage may be trimmed if necessary.

(6) Apply 32 KW load (0·8 p.f.) in four stages of 8 KW each by means of switches SW.6, SW.7, SW.8, and SW.9. Check indications on W.1 and VAR.1 at each stage.

(7) Run for 15 minutes on full load, then switch OFF all load, and check voltage and frequency at the load terminals.

Basic governor setting and mechanical overspeed protection checks.

(8) (a) Apply 32 KW load, check for voltage variation and run until the C.S.D. oil inlet temperature T1 is 60±3°C.

(b) Set all load switches and the alternator control switch SW.1 to OFF.

(c) Disconnect the 2-pin plug from the frequency and load controller and check that frequency drops to 390±2 c/s.

Note ...

On constant speed drives with Mod. EEH/113 embodied, the basic governor setting is 390±4 c.p.s. independent of oil temperature.

(d) Disconnect the 12-pin plug from the frequency controller.

(e) Connect the test set 5G.3393 to the 2-pin and 12-pin plugs removed from the frequency controller.

(f) Apply a signal from the test set to reduce the frequency and check that frequency does not fall below that quoted in (8) (c).

(g) Apply a signal from the test set to increase the frequency and check that frequency rises to a value between 420 and 430 c/s.

(h) Disconnect the test set, reconnect the 2-pin and 12-pin plugs to the frequency controller, and check that frequency returns to 400±4 c/s.

Voltage trim range

(9) (a) Adjust voltage trimmer R1 to give 200 volts.

(b) Check that movement of the trimmer from this position gives a trimming range from 195 volts or less to 205-215 volts.

(c) Re-adjust voltage to 200 volts.

Line and phase voltage

(10) (a) Measure all line and phase voltages as indicated on test set 5Q.3198. These should be within 1% of their mean value.

(b) Set alternator control switch SW.1 to ON. Press synchronise push-switch SW.5 and 'S' breaker should close. Apply 32 KW load in four stages and line voltage should fall to 185±1% volts.

(c) Press isolate push-switch SW.3, 'S' breaker should open and voltage should return to 200 volts.

(d) Switch OFF all load and reduce C.S.D. input speed to 3,000 r.p.m.

Crash circuit check

(11) (a) Open the hinged control panel on the control console and check that the alternator becomes de-excited, as indicated by a fall off in voltage V1.

(b) Close the control panel, alternator control SW1 to OFF, press reset push switch SW4 and switch alternator control SW1 to ON.

(12) Adjust C.S.D. input speed to 5,000 r.p.m.

Under voltage trip check

(13) Check the value at which the under voltage trip operates by increasing the resistance in series with the alternator field as follows: —

(a) Set rheostat R2 in the centre position.

(b) Set under/over voltage control switch SW13 to ON.

(c) Trim rheostat R3 to obtain a zero setting on the under/over voltage test indicator V2.

(d) Engage the under/over voltage test push-switch SW14.

(e) Re-trim rheostat R3 to obtain alternator voltage of 200 volts.

(f) Switch alternator control SW1 to OFF. Press reset push-switch SW4. Switch alternator control to ON.

(g) Gradually adjust rheostat R3 until 'G' breaker trips and check that voltage at point of trip is 172±5 volts.

(h) Trim rheostat R3 to obtain 200 volts.

(i) Switch alternator control SW1 to OFF. Press reset push-switch SW4. Switch alternator control to ON.

(j) Pull out under/over voltage test push-switch SW14.

(k) Switch under/over voltage control SW13 to OFF.

Over voltage trip check

(14) Check the value at which the over voltage trip operates by decreasing the resistance in series with the alternator field as follows: —

(a) Repeat the operations 13 (a) to 13 (f) inclusive.

(b) Gradually adjust rheostat R3 until 'G' breaker trips and check the voltage at point of trip is 220±1 volts

(c) Trim rheostat R3 to obtain 200 volts.

(d) Switch alternator control SW1 to OFF. Press reset push-switch SW4. Switch alternator control to ON.

(e) Pull out under/over voltage test push-switch SW14.

(f) Switch under/over voltage control SW13 to OFF.

Merz-Price protection system check

(15) (a) Apply 16KW load.

(b) Select each phase in turn on phase selector switch SW10. At each setting check that the 'G' breaker does not trip when SW11 (3·5 ohm) is ON, but does trip when SW12 (2·2 ohm) is ON.

(c) Switch OFF load switches and reset the alternator.

Voltage regulator test push check

(16) Press voltage regulator test push SW16, 'G' breaker should trip. Switch OFF alternator control SW1, press reset push-switch SW4, and switch alternator control to ON.

Crash switch operation

(17) Press crash switch SW15, 'G' breaker should trip. Switch OFF alternator control SW1, press reset push-switch SW4, and switch alternator control to ON.

Underspeed trip check

(18) (a) Hold speed control SW20 in the LOWER position and allow engine to idle.

(b) Press engine control stop push-switch SW19.

(c) During engine run-down check that the C.S.D. under-speed switch operates as indicated by the 'G' breaker opening at approximately 2,100 r.p.m.

(d) Switch alternator control SW1 and instrumentation supply SW25 to OFF.

(e) Disconnect the 5Q3198 test set.

Test rigs operating in parallel

94. The procedure for operating two rigs in parallel is as follows: —

(1) Mount the C.S.D./alternator units on the respective rigs.

(2) Set change over control SW17 on each rig to the TRAILER position.

(3) Couple the rigs by connecting an aircraft trailing cable to the SYNCH sockets on each control console.

(4) Start the engines on both rigs and allow them to idle for 5 minutes.

(5) Adjust C.S.D. input speed to 5,000 r.p.m. Set alternator control SW1 to OFF on each rig. Press reset push-switch SW4 and switch alternator controls to ON.

(6) Run for 20 minutes with no load, check that frequency is 400 c/s, and by means of trimmers R1, adjust voltages to 200.

Operation of 'G' and 'S' breakers

(7) (a) Set the alternator controls SW1 to the OFF position and check that the 'G' breaker opens, and the 'S' breaker closes.

(b) Set alternator controls SW1 to ON. Check that 'G' breaker closes and 'S' breaker opens.

Paralleling of alternators

(8) (a) Check that the SYNCH indicators on both rigs are pulsating.

(b) On No. 1 rig press the SYNCH push-switch SW5 and check that the 'S' breaker closes.

(c) On No. 2 rig, momentarily press the SYNCH push-switch when the synchronising indicator is in the middle of a dark period. Check that the 'S' breaker closes and the synchronising indicators on both rigs go out.

Note . . .

If the synchronising indicator on No. 2 rig remains bright for a lengthy period, or if the synch switch has to be pressed for several seconds, a load should be applied to No. 2 rig to reduce the time taken to synchronise.

Load sharing of alternators

(9) (a) With no applied load check that the indicators W1 and VAR1 are at the zero setting.

(b) Apply 8KW load on each rig and adjust C.S.D. input speeds to 3,000 r.p.m. Check load sharing. Increase loads to 16, 24, and 32KW, and check load sharing at each setting.

(c) Repeat (b) with C.S.D. input speeds set to 5,000 r.p.m. and 8,100 r.p.m. Check that the load sharing is within ±3KW and ±2·5KVAR of the mean values.

WARNING . . .

During full load checks with rigs operating in parallel, if one machine trips the excess load is to be shed within 5 seconds.

(10) Reduce C.S.D. input speeds to 5,000 r.p.m. and apply 16KW load on each rig.

(a) Set alternator control SW1 to OFF on No. 1 rig. Check that load is taken by No. 2 rig.

(b) On No. 1 rig, switch alternator control to ON, and re-synchronise.

(c) Set alternator control SW1 to OFF on No. 2 rig. Check that load is taken by No. 1 rig.

(d) Repeat operation (b) on No. 2 rig.

Acceleration and deceleration on load

(11) (a) Apply 16KW load to each rig and set C.S.D. input speeds to 3,000 r.p.m. Accelerate both rigs to 8,100 r.p.m. Decelerate both rigs to 3,000 r.p.m. Neither alternator should trip off line.

(b) Repeat (a) with 32KW load on each rig.

Under/over voltage checks

(12) (a) Adjust C.S.D. input speeds to 5,000 r.p.m. and apply 16KW load on each rig.

(b) Raise the voltage on No. 1 rig as in para. 93 sub para. (14) until alternator trips, and check that load is taken by No. 2 rig. Retrim to obtain 200 volts, reset the alternator and re-synchronise.

(c) Repeat operation (b) overvolting No. 2 rig, and checking that load is taken by No. 1 rig.

(d) Reduce voltage on No. 1 rig as in para. 93 sub para. (13) until alternator trips, check that load is taken by No. 2 rig. Retrim to obtain 200 volts, reset the alternator and re-synchronise.

(e) Repeat operation (d) undervolting No. 2 rig and checking that load is taken by No. 1 rig.

Merz-Price protection system check

(13) (a) Adjust C.S.D. input speed to 5,000 r.p.m. and apply 16KW load on each rig.

(b) Repeat the procedure detailed in para. 93 sub para. (15) on No. 1 rig, check that with switch SW12 (2·2 ohm) ON, the alternator trips and load is taken by No. 2 rig. Reset the alternator and re-synchronise.

(c) Repeat operation (b) on No. 2 rig checking that load is taken by No. 1 rig.

(14) Switch OFF all load.

(15) Hold speed controls SW.20 in the LOWER position and allow rigs to idle.

(16) Stop the engines as in para. 89.

(17) Disconnect the aircraft trailing cable from the control consoles, and fit blanking covers to the sockets and cable. Stow the cable in the mounting reel.

TEST RIG/AIRCRAFT OPERATION

95. For application to the aircraft systems the test rig is connected into an individual alternator circuit in the aircraft. To test two circuits in parallel, two test rigs are required. The C.S.D./alternator unit is driven by the test rig and is operated in conjunction with the aircraft control system. Loading of the alternator and fault simulation are controlled from the test rig. A three way intercommunication set is recommended for use by the operators stationed one at each test rig and one in the aircraft.

Pre-test requirements

96. (1) Remove the C.S.D./alternator unit from the appropriate engine in the aircraft and install it on the test rig.

(2) Release the cable reel locking clamps, and run out the aircraft and load trailing cables to the engine bay and power compartment respectively.

(3) Connect the aircraft trailing cable to the AIRCRAFT connection on the control console.

(4) Connect the load trailing cable to the load connector on the right-hand platform of the test rig.

(5) Connect the trailing cables into the aircraft system as detailed in para. 99 and 100.

(6) Connect the test rig into the ground earth system via the earthing socket at the rear of the test rig.

(7) Set the aircraft/trailer change-over control SW17 to the AIRCRAFT position.

(8) Switch instrumentation supply switch SW25 to ON, and check that the amber warning lamp positioned at the top centre of the control panel is illuminated to indicate AIRCRAFT ON

(9) Connect a 28-volt ground supply to the aircraft.

Test procedure

97. The specific test requirements for the aircraft systems will be found in Vol. 4 of the appropriate A.P.s. The method of operating the test rig is detailed in para. 93 and 94.

After test

98. (1) Disconnect the rig from the aircraft system by reversing the procedures detailed in para. 99 or 100.

(2) Disconnect the aircraft and load trailing cables from the console and load connector respectively and stow in the mounting reels.

(3) When applicable, stow the aircraft plug connection and extension cable in the loose equipment box.

(4) Fit the blanking covers to the trailing cable end connections and the test rig sockets.

(5) Remove the C.S.D./alternator unit from the test rig and refit to the aircraft.

(6) Fit the blanking cover to the test rig drive and oil connections.

Connections to Vulcan aircraft

99. The arrangement for connecting the test rigs to No. 1 and No. 4 circuits in the Vulcan aircraft is shown in fig. 9. The method of connection to any of the four alternator circuits is identical and is as follows: —

(1) Connect the aircraft trailing cable to the 17-pin plug on the aircraft plug connection U.1646.

(2) Using the alternator sling (aircraft ground equipment), hoist the plug connection and cable, and attach it to the C.S.D./alternator mounting on the engine. Tool 46U.1571 is supplied in the loose equipment box to facilitate fitting and removal of the attachment nuts.

Note . . .

A slave mounting is being developed for attachment of the aircraft plug connection in the engine removed condition.

(3) Connect the aircraft alternator cables, C.S.D. pressure switch and governor cables to their respective fittings on the plug connection.

(4) Remove all distribution fuses from the aircraft power panel.

(5) Connect the lugs of the extension cable 5U.1652 to the appropriate phases of the power panel, at the following positions, using existing fuse carriers each containing a 40 amp fuse.

No. 1 power panel 58P. Fuse Nos. 46, 47, 48.

No. 2 power panel 59P. Fuse Nos. 82, 83, 84.

No. 3 power panel 60P. Fuse Nos. 118, 119, 120.

No. 4 power panel 61P. Fuse Nos. 153, 154, 155.

(6) Connect the extension cable to the load trailing cable.

Connections to Victor aircraft

100. This information will be issued later.

SERVICING

General

101. To ensure satisfactory performance of the test rig, the mechanical and electrical test systems should be periodically checked for correct operation as detailed in para. 91 and 92. Cleanliness is of extreme importance, and oil, grease or water must not be allowed to accumulate. Particular care must be given to prevent the ingress of foreign matter to the constant speed drive and the associated oil system. The appropriate blanking covers must be fitted at all times when the CSD/alternator unit is not installed. The fuel, lubricants and fluids approved for servicing the test rig, and the system capacities are given in Table 3.

ELECTRICAL EQUIPMENT

102. Servicing instructions for individual components of the electrical test system will be found in the appropriate chapters of A.P. 4343A and 4343B. All components should be examined at regular intervals for security of attachment and electrical connections for tightness and freedom from corrosion. Cable runs must be kept firmly secured, and attention given to those areas where chafing may occur, to prevent damage to the outer coverings. Accumulations of dust and dirt, particularly in the vicinity of contacts, should be removed by the use of moisture free compressed air. Slydlock type fuses are used throughout the system, and labels indicating the correct size of fuse wire are mounted adjacent to the fuses in the control console and equipment racks. When not in use, the trailing cables must be stowed in the reels provided, and the blanking covers fitted to the end plugs and to the connecting sockets on the trailer to prevent ingress of dirt and moisture.

ENGINE

103. The procedures for servicing the engine and its components and the associated generators and voltage regulators will be found in A.P.4382G. Periodic examination must be made of the engine and radiator

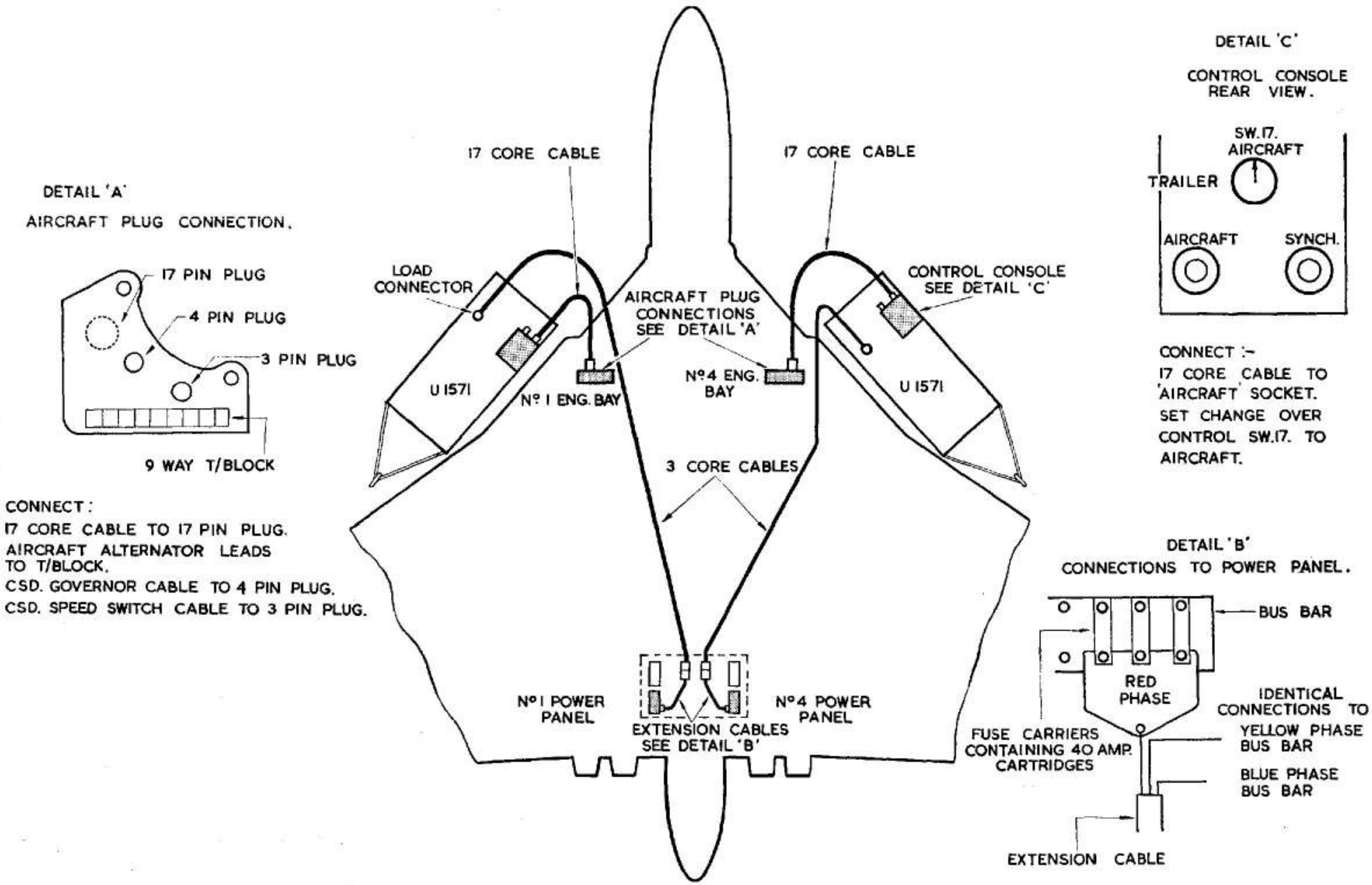

Fig. 9. Connectors to Vulcan aircraft

(b) Remove the tundish cover. If the system is completely empty, pour in approximately 7 gallons of the oil specified.

(c) Replace the tundish cover and securely tighten the retaining nut.

(d) Move the scoop control lever to the DISENGAGE (out) position and check that the output shaft is free to rotate.

(e) Start the engine.

(f) With the engine running at idle r.p.m. and with the scoop control lever in the ENGAGED (in) position, allow the oil to circulate through the system for a few minutes.

(g) Set the scoop control lever to the DISENGAGED position.

(h) Remove the tundish cover and pour oil in slowly until it wells up around the valve spindle in a definite flow.

(i) Replace tundish cover and securely tighten.

(j) Return the scoop control lever to the ENGAGED position and securely tighten the locknut.

(2) Checking the oil content: —

To check the oil content, the procedure detailed in the above sub paras. (1) (e) to (j) inclusive must be adopted. The following points must also be observed.

(a) The coupling must be in the cold condition i.e. at the commencement of a running period.

(b) The scoop control lever must be kept in the DISENGAGED position during checking. Movement to the ENGAGED position will result in oil being violently ejected from the tundish.

(c) The valve should be pushed right down after removing the tundish cover. Otherwise, if the system is over-filled the resultant pressure will prevent the valve from reseating.

(d) When satisfactorily filled there will be a definite flow of oil up around the valve spindle, not intermittent surging.

(e) If oil overflows from the tundish with the scoop control lever disengaged, the coupling is overfilled. Excess oil can be drained off by removing the drain plug at the base of the tundish and running the engine with the scoop control level disengaged.

(3) Draining the system: —

Oil can be drained from the system by removing the plugs fitted at the bottom of the reservoir casing.

GEARBOX ASSEMBLY

112. The gear unit will normally require little servicing between the major overhaul periods at which time a thorough internal examination should be made. A Gaco type oil seal is fitted to the input shaft, and this seal should be examined at intervals for oil leakage.

(1) Gearbox oil system:—

The system relief valve is set to obtain a minimum oil pressure of 12 lb/in^2. If the oil pressure fails to build up on starting after periods of non use, the oil pump should be primed by pouring approximately two pints of oil through the priming connection. If any variation in pressure occurs during service, the system must be thoroughly checked for leakage and the filters for cleanliness before further adjustment of the relief valve is made. The system oil should be changed after each 250 hours runnings, and can be drained by removing the plug in the base of the oil tank.

(2) Oil filters:—

During each daily running period, the central spindle of the Auto Klean filter should be rotated one turn in the direction indicated. Periodically the filter bowl should be removed and any accumulation of deposits cleaned out. A gauze element filter is fitted in the oil tank and is accessible through the detachable base plate. In conjunction with every fourth oil change, the filter should be removed and washed in clean fuel and the tank interior cleaned of sludge deposits. When installing the filter, ensure that the element engages the tank suction pipe and that the rubber jointing washer for the base plate is serviceable.

FLEXIBLE COUPLING

113. Periodic servicing of the flexible coupling is not required other than to ensure that the outer covering is maintained free from damage. When the coupling is removed in conjunction with engine overhaul, the gear teeth should be examined for evidence of wear, and the oil seals for serviceability.

C.S.D. OIL SYSTEM

114. Cleanliness of the oil system is of extreme importance. It is therefore recommended that the system be flushed through after each 100 hours rig running, or when 25 constant speed drives have been installed, whichever is the lesser period. This action should also be taken in the event of a mechanical failure of a constant speed drive. In conjunction with flushing, the oil filter element should be renewed. The system pressure transmitters and temperature bulbs will require no servicing other than ensuring the electrical connections are secure and free from oil contamination.

(1) To fill the system:—

(a) Connect an oil charging hose to the AVX2241 quick-release coupling fitted to the mounting block forward of the system filter.

Note . . .

If a CSD/alternator unit is not installed, the system delivery hose must be disconnected at the self-sealing coupling.

(b) Supply oil under pressure to the system until the oil reaches the maximum level on the tank sight glass.

(c) Disconnect the charging hose.

(2) To flush through the system:—

(a) With a suitable receptacle in position, reconnect the system delivery hose to the transfer block, or when adapted for Victor units, to extension pipe 2U1665. Allow the oil to drain off completely.

(b) Connect a suitable hose to the oil charging connection and flush through using oil OX-38.

(c) Remove the filter element and install a new element as detailed in sub-para. (3).

(d) Disconnect the delivery hose from the transfer block or extension pipe as applicable.

(e) Fill the system with oil OX-38 to the maximum level on the tank sight glass.

(3) To install a new filter element:—

(a) With the system drained, disconnect the return pipe, remove the pipe adapter and the oil charging connection from the mounting block on the filter.

Note . . .

Ensure that the restrictor is retained in the return pipe adapter.

(b) Unscrew the mounting block from the filter.

(c) Remove the filter end plate retaining circlip.

(d) Remove the lower attachment bolt from the forward mounting bracket of the filter, and position the bracket to permit withdrawal of the end plate and the element.

(e) Insert a new element Vokes No. E55265 in the filter body.

(f) Reassemble the system using the reverse procedure to that detailed above.

PRESSURISATION SYSTEM

115. At frequent intervals remove the plug at the base of the system air filter and allow any accumulation of moisture to drain off. The system pressure reducing valves are set to operate at 50 and $3\frac{1}{4}$ lb/in² respectively. When required, the valve setting can be checked by installing a pressure gauge in the valve outlet line and opening the control valve. The tank relief valve is set to relieve at 6 lb/in² outward and $\frac{1}{4}$ lb/in² inward and should be checked at intervals to ensure that these settings are maintained.

(1) To charge the pressurisation system:—

(a) Close the system control valve.

(b) Connect an air supply to the A58 air charging valve and charge the air bottle to 1000 lb/in².

(c) Disconnect the air supply.

(d) Check for leakage as indicated on the system pressure gauge.

COOLING SYSTEM

116. Servicing of the cooling system will be confined to the fan unit, inlet air cleaner and the system motor.

Fan unit

(1) Heavy dust or dirt deposits will affect the balance of the impeller. The impeller and internal surfaces of the casing should be periodically cleaned and if necessary washed with warm soapy water.

Air cleaner

(2) The air cleaner should be cleaned at frequent intervals. With the wedge shaped lock pins removed, the element can be withdrawn from the filter casing and lightly tapped to dislodge dirt or foreign matter. For heavier deposits the element should be blown through using a low pressure air supply in the reverse direction to normal air flow.

Cooling motor

(3) The system incorporates a Normand electric 24-volt d.c. motor of 1·1 H.P. The carbon brushes should be checked at regular intervals for freedom of movement and wear, and replaced as necessary. The motor bearings are initially packed with grease, which should be renewed at twelve monthly periods.

CHASSIS

117. Servicing of the chassis will normally be confined to maintaining the tyre pressures at 70 lb/in², examination of the tyres for damage, lubricating at regular intervals, and adjustment of the brakes as wear occurs. In addition to the turntable, brake linkage, and the handwheel bushes, which are provided with grease nipples, the turntable pivot, spring mounting pins, and the towing arm sliding and pivot joints should also be lubricated.

Brakes

118. Each brake unit contains two shoes faced with friction material, an expander and an adjuster. The expander and adjuster are positioned diametrically opposite between the end of the shoes. Adjustments for normal wear are to be made with the test rig standing on level ground and the handwheel in the fully OFF position. The adjuster wedge should be turned clockwise until resistance is felt, and then turned back two clicks. The brake should then be firmly applied to centralise the expander unit.

119. After fitting new shoes the adjuster unit must be centralised. When the brakes are ready for adjustment, slacken off the adjuster unit attachment screws one turn before the adjuster wedge is turned clockwise. The brakes should then be firmly applied, and the attachment screws securely tightened before turning the adjuster wedge back the two clicks.

Removing the canopy

120. The canopy can be removed as a complete unit to facilitate engine servicing. To remove the canopy :—

(1) Disconnect the control console attachments to the roof structure.

(2) Disconnect the lighting circuit cables at the plug connection at the rear of the left-hand side platform.

(3) Remove the eighteen attachment bolts securing the vertical members to the platform.

(4) Release the canopy roof drain pipes at the attachment to the chassis.

(5) Attach the lifting cables to the roof shackles. Secure the side panels and lift the canopy clear of the rig.

RESTRICTED

Trailing and Extension Cables

TABLE 1

Part No.	Designation	Cable	End A Test Rig	Connections	End B Aircraft	Length
2U.1652	Aircraft trailing cable	17-core Greengate and Irwell Co. 2/53817/65	Socket B.8837/R	(Red) Pin 1/Pin 1 (Yellow) Pin 2/Pin 2 (Blue) Pin 3/Pin 3 Pin 4/Pin 4 Pin 5/Pin 5 Pin 6/Pin 6 Pin 7/Pin 8 Pin 8/Pin 7 Pin 9/Pin 9 Pin 10/Pin 10 Pin 11/Pin 12 Pin 12/Pin 11 Pin 13/Pin 14 Pin 14/Pin 13 Pin 15/Pin 15 Pin 16/Pin 16 Pin 17/Pin 17	Socket B.8837/R Light and power accessories	45 ft. 0 in.
3U.1652	Load trailing cable	3-core Greengate and Irwell Co. 2/538/3/52	Socket 53J/INS/A36/17 in.	Pin A/Pin A Pin B/Pin B Pin C/Pin C	Plug 53S/INS/A36/17 Light and power accessories	60 ft. 0 in.
5U.1652	Load extension cable	Uninyvin AN.4	Socket 53J/INS/A36/17	(Blue) Pin A/Blue phase (Yellow) Pin B/Yellow phase (Red) Pin C/Red phase	Lugs 5X6523	15 ft. 0 in.

Table 1—Trailing and Extension Cables—(cont.)

Part No.	Designation	Cable	End A Test Rig	Connections	End B Aircraft	Length
4U.1652	Aircraft	Uninyvin	Plug			
	plug	AN.4	B8840/R	(Red) Pin 1/T.B. A.2	Lug 5X6525	
	connection	AN.4		(Yellow) Pin 2/T.B. B.2	,,	
	cable loom	AN.4		(Blue) Pin 3/T.B. C.2	,,	
		AN.4		Pin 4/T.B. A.1	,,	
		AN.4		Pin 5/T.B. B.1	,,	
		AN.4		Pin 6/T.B. C.1	,,	
		A.N.16		Pin 10/T.B. A+	Lug HC.602	
		A.N.16		Pin 12/T.B. F	,,	
		AN.16		Pin 15/T.B. A−	,,	
		AN.20		Pin 7/C.S.D. Governor plug D	Plug (Cannon) GS02-14S-2P-112	
		AN.20		Pin 8/C.S.D. Governor plug A		
		AN.20		Pin 9/C.S.D. Governor plug C		
		AN.20		Pin 16/C.S.D. Governor plug B		
		AN.16		Pin 11/C.S.D. Underspeed plug A	Plug (Rists wires and cables) B.A.87633	
		AN.16		Pin 13/C.S.D. Underspeed plug C		
		AN 16		Pin 14/C.S.D. Underspeed plug B		
		AN.20		Pin 17/Earth	Lug 5X6515	

TABLE 2

Loose Equipment

Item No.	Equipment
GENERAL	
587/2	Dorman tool kit
9007/H	Hand lamp
46U1597	Air filter
57U1640	Plug adapter
35U1571	10 amp fuse wire
36U1571	5 amp fuse wire
47U1571	Operating instructions
Vulcan	
5U1652	Cable extension
U1646	C.S.D. / alternator aircraft plug connection
127U1595	C.S.D. drain pipe
46U1571	Tool for removal of C.S.D./ alternator attachment nuts
A 74	Ratchet
A 98	'T' extension handle
Victor	
2U1665	Oil feed pipe extension
3U1665	Oil return pipe extension
4U1665	Shackle
5U1665	Attachment bolt
15U1665	Adapter
16U1665	Connection clamp
AE D2039140	Air outlet assembly

TABLE 3

Approved fuels and lubricants

Service	Specification	Inter-service designation	Capacity
Engine coolant	Clean soft water or 30/70 Glycol-water by volume DTD.779	A.L.—3	7 gallons
Engine fuel	DEF.2402A	47/20 Dieso.	45 gallons
Engine lubricant	DEF.2101A	OMD—110	7 gallons
Engine air cleaners	DEF.2101A	OMD—110	0·5 gallons per cleaner
Engine water pump	CS.1658D	L.G.—190	
Engine fan bearings	CS.881G	L.G.—280	
Gearbox lubrication	CS.2758	CEP.—220	12 gallons
Fluid coupling	DEF.2007	OM—33	7·5 gallons
CSD oil system	DERD.2487	OX.38	4·5 gallons
Batteries	Distilled water		
Chassis lubrication	CS.1656J	LG—320	
Cooling fan motor	G—382	XG—271	
Speed control actuator	G—354	XG—278	

924/8/2548/4142/506/6/61 J. T. & S.

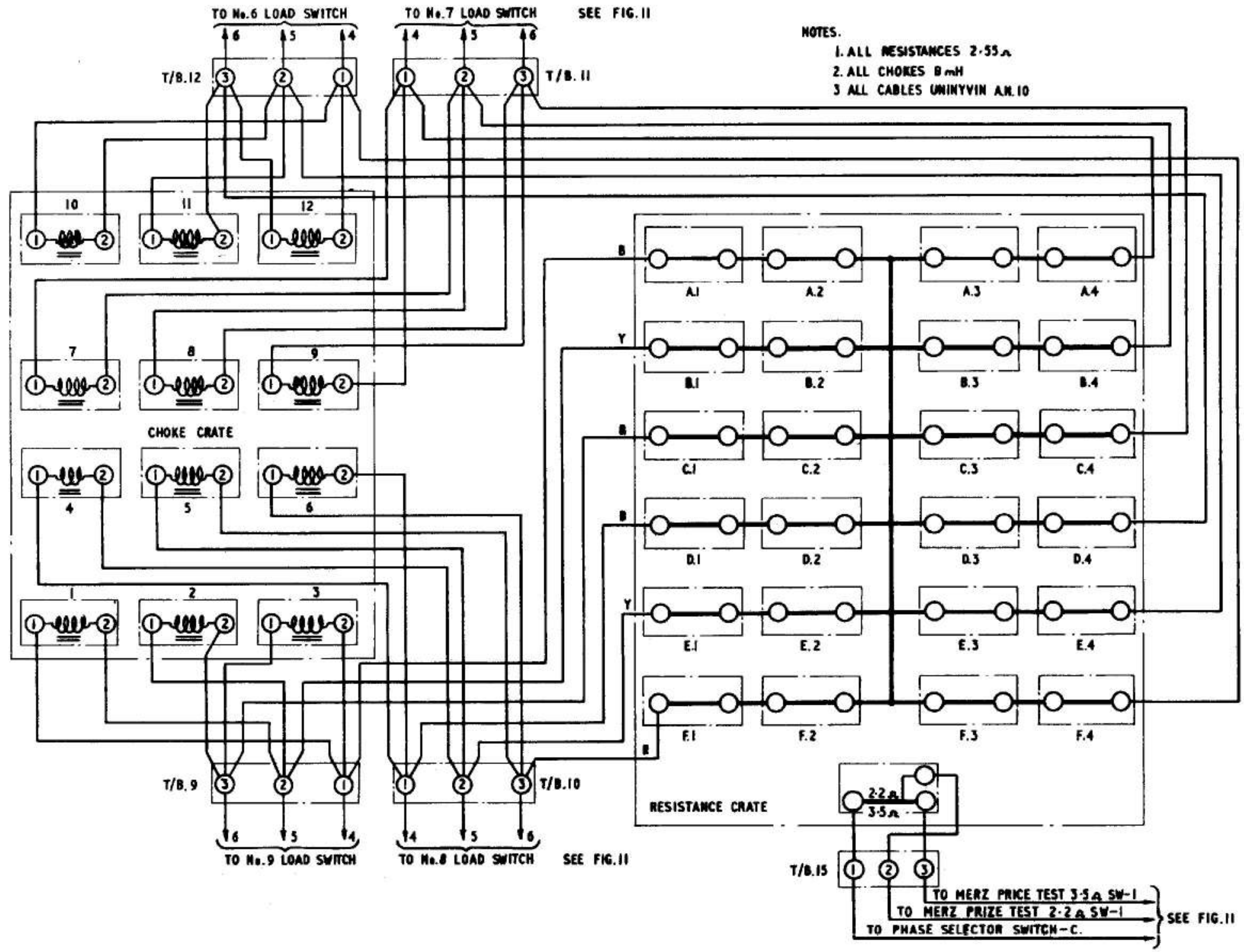

FIG.12. WIRING DIAGRAM FOR RESISTANCE AND CHOKE CRATES

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924/8/2546/4121/506/6/61 J. T. & S.

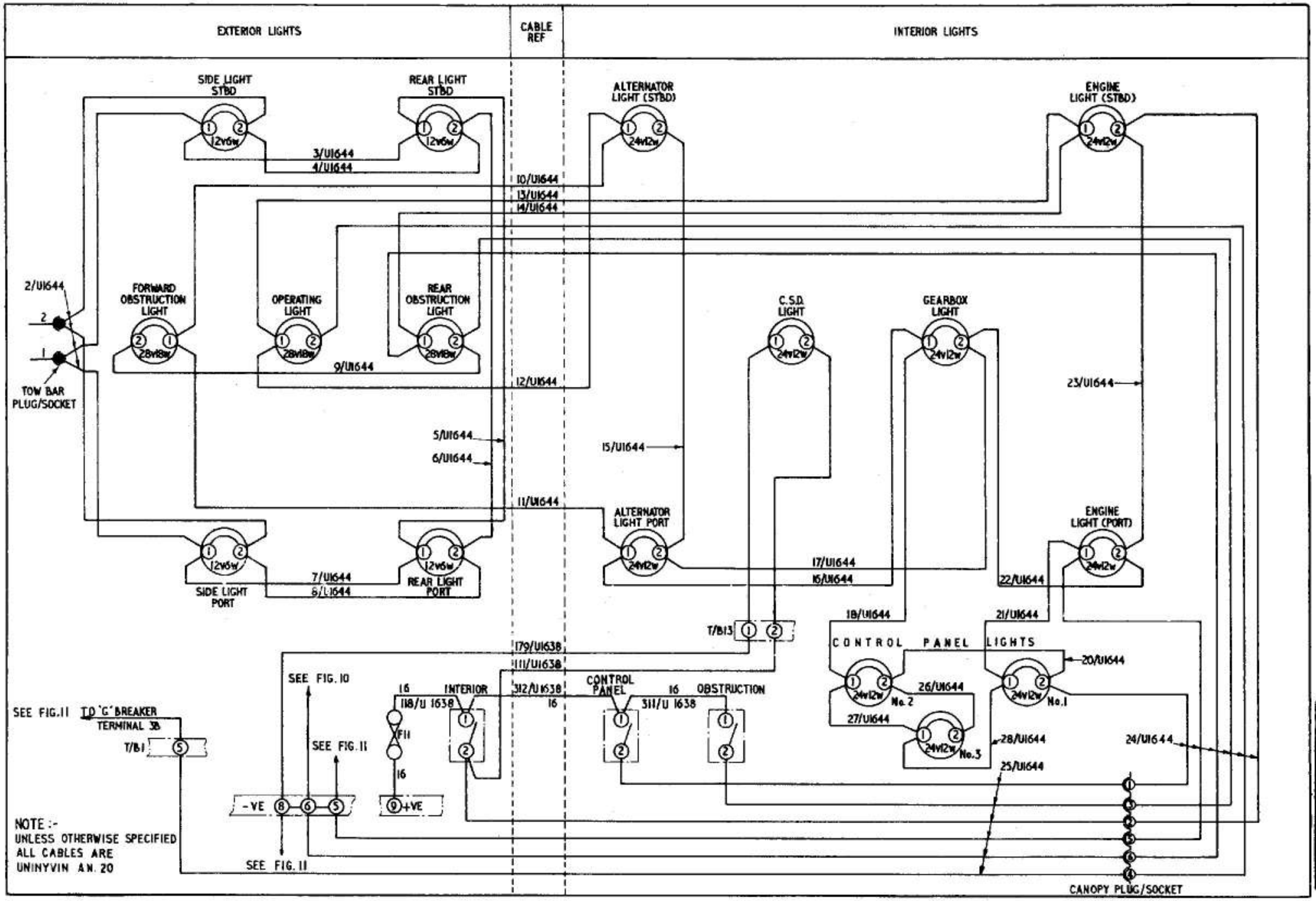


FIG. 13. LIGHTING CIRCUITS

[redacted]

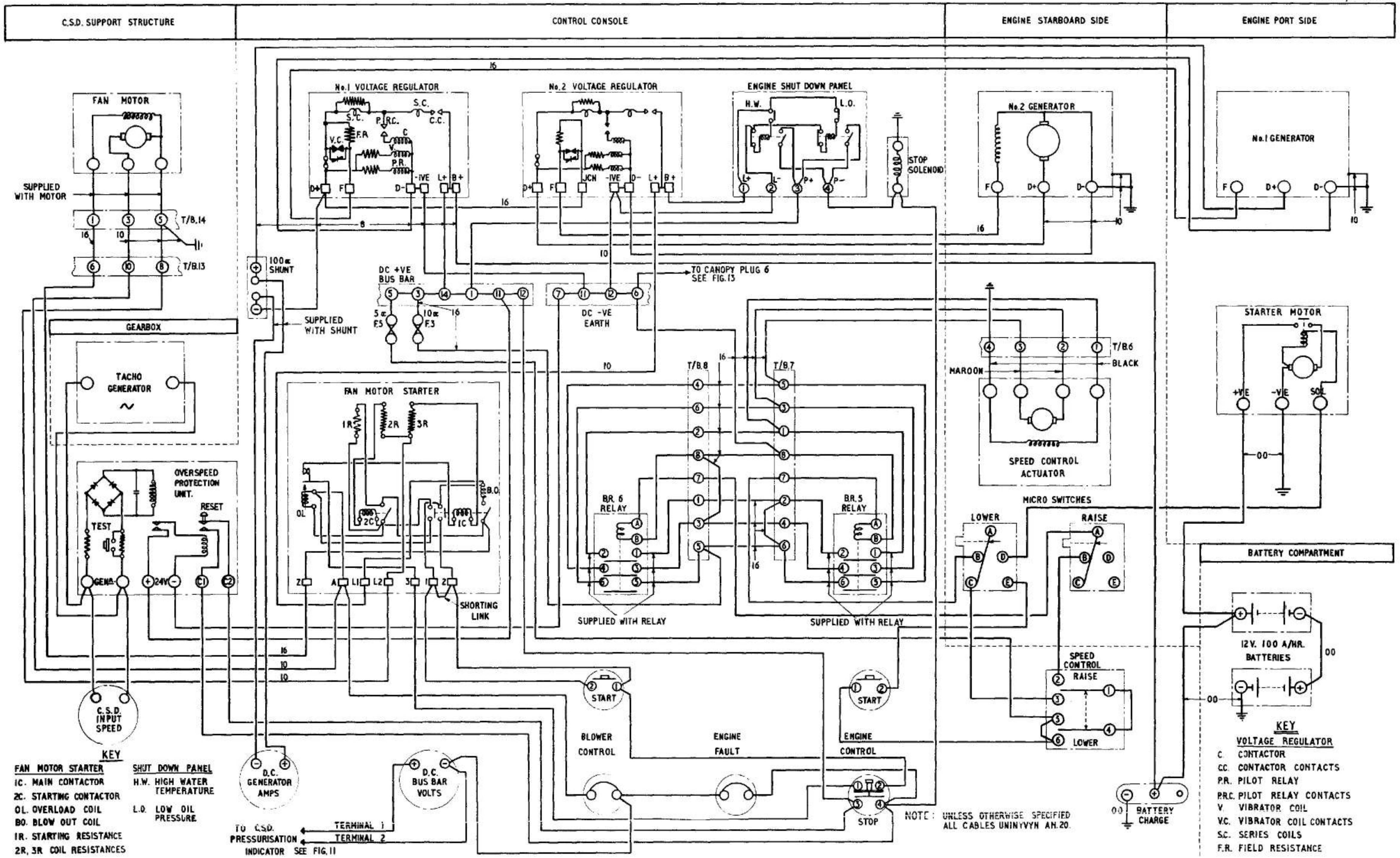


FIG. 10. ENGINE STARTING & GENERATOR CONTROL CIRCUITS

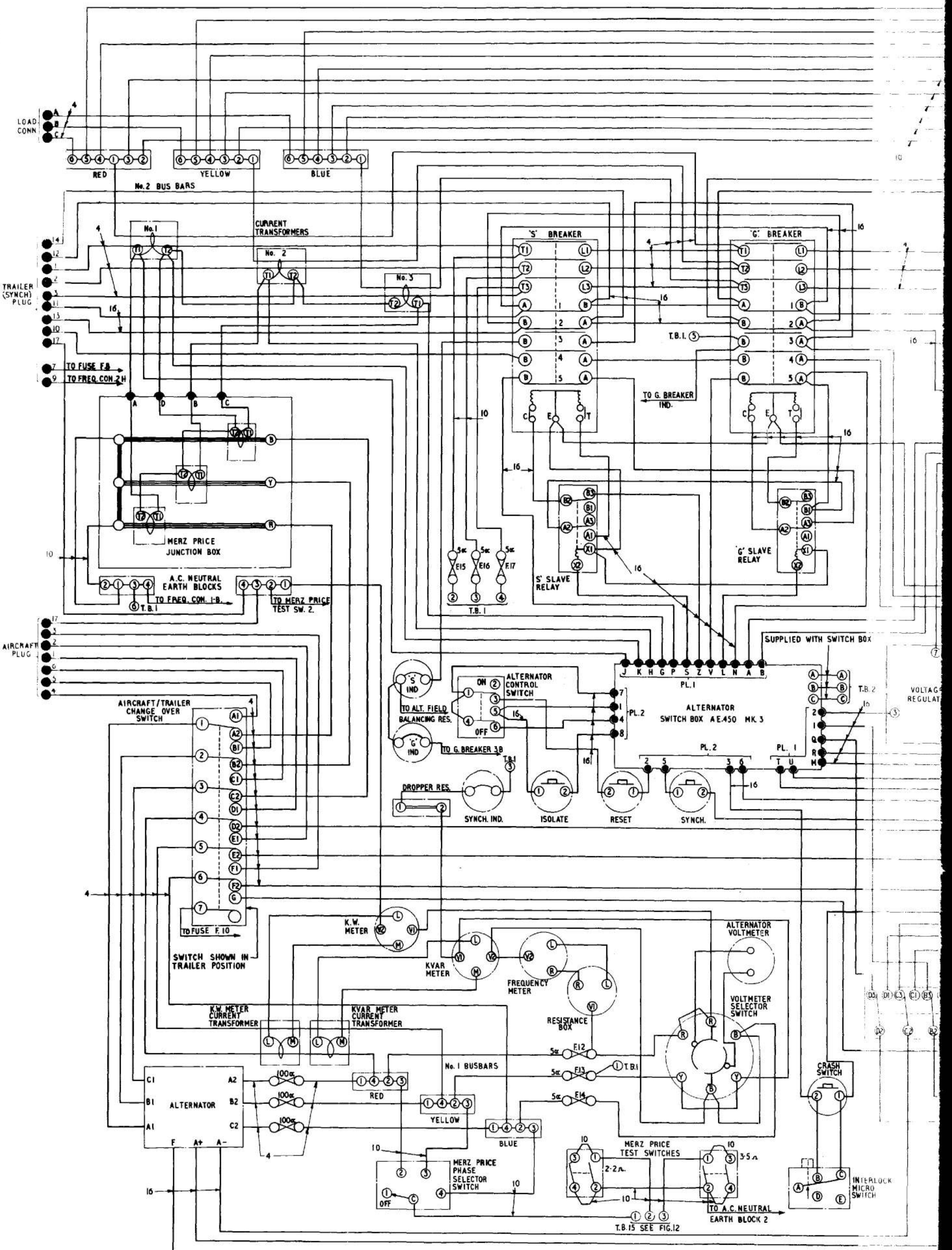
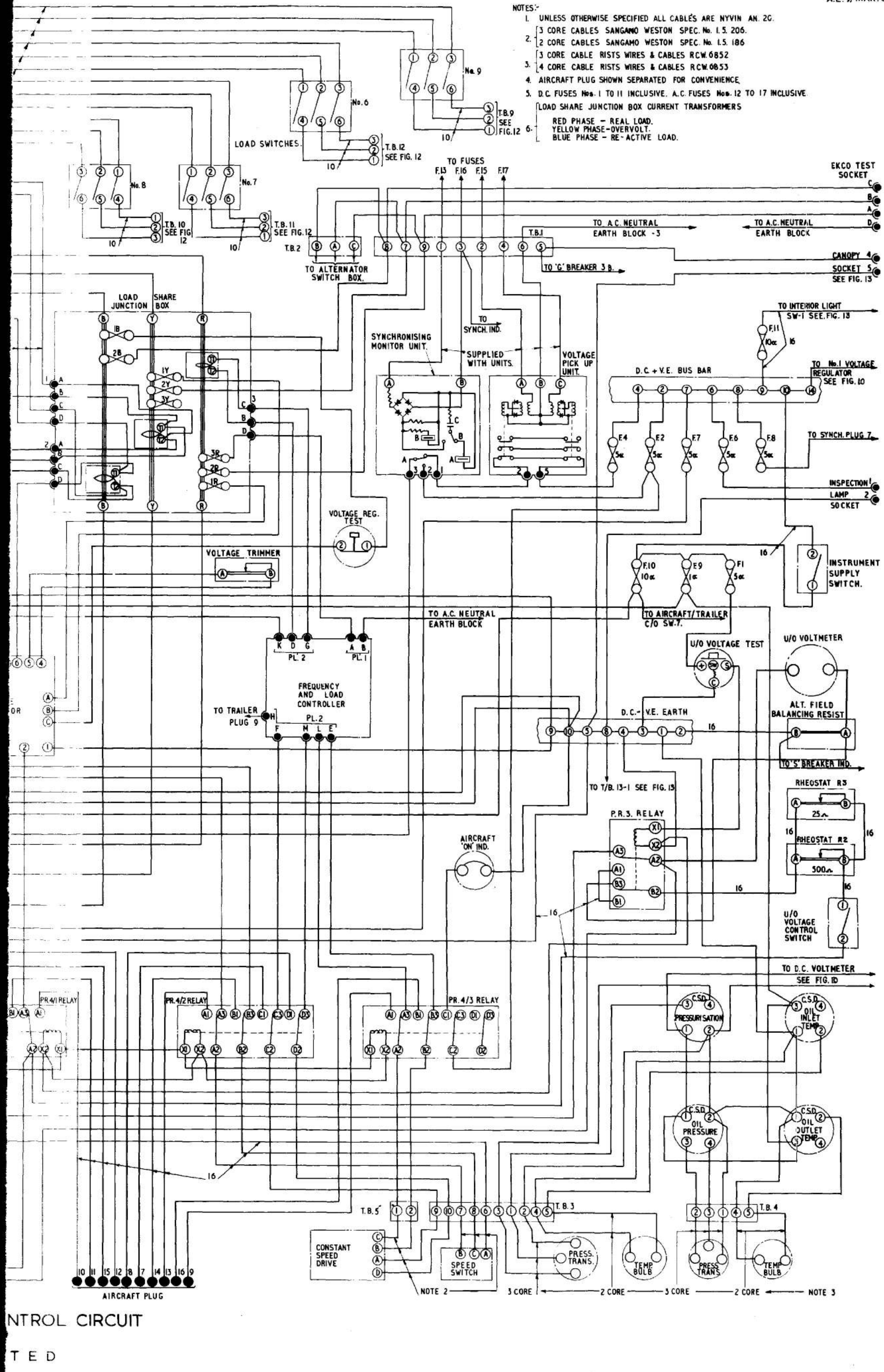


FIG. 11 ALTERNATOR CO

NOTES:-

1. UNLESS OTHERWISE SPECIFIED ALL CABLES ARE NYVIN AN. 20.
2. 3 CORE CABLES SANGAMO WESTON SPEC. No. I.S. 206.
   2 CORE CABLES SANGAMO WESTON SPEC. No. I.S. 186
3. 3 CORE CABLE RISTS WIRES & CABLES RCW.6852
   4 CORE CABLE RISTS WIRES & CABLES RCW.6853
4. AIRCRAFT PLUG SHOWN SEPARATED FOR CONVENIENCE.
5. D.C. FUSES Nos. 1 TO 11 INCLUSIVE. A.C. FUSES Nos. 12 TO 17 INCLUSIVE.
6. LOAD SHARE JUNCTION BOX CURRENT TRANSFORMERS
   RED PHASE - REAL LOAD.
   YELLOW PHASE - OVERVOLT.
   BLUE PHASE - RE-ACTIVE LOAD.



NTROL CIRCUIT

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