

Chapter 16 EXPLOSION PROTECTION SYSTEM

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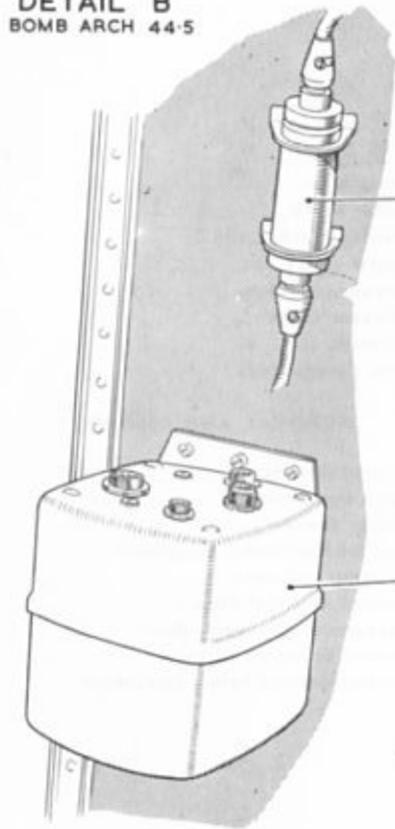
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DETAIL B
BOMB ARCH 44-5

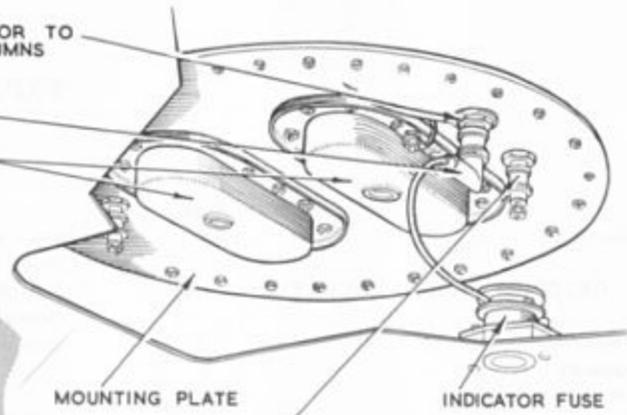


EXCESS VOLTAGE
TRIP UNIT
(PORT)

POWER PACK
MK.2
(PORT)

BULKHEAD CONNECTOR TO
SUPPRESSOR COLUMNS

EARTHING ELBOW
DETECTOR UNITS



MOUNTING PLATE

INDICATOR FUSE

TEST LAMP CONNECTION

DETAIL C

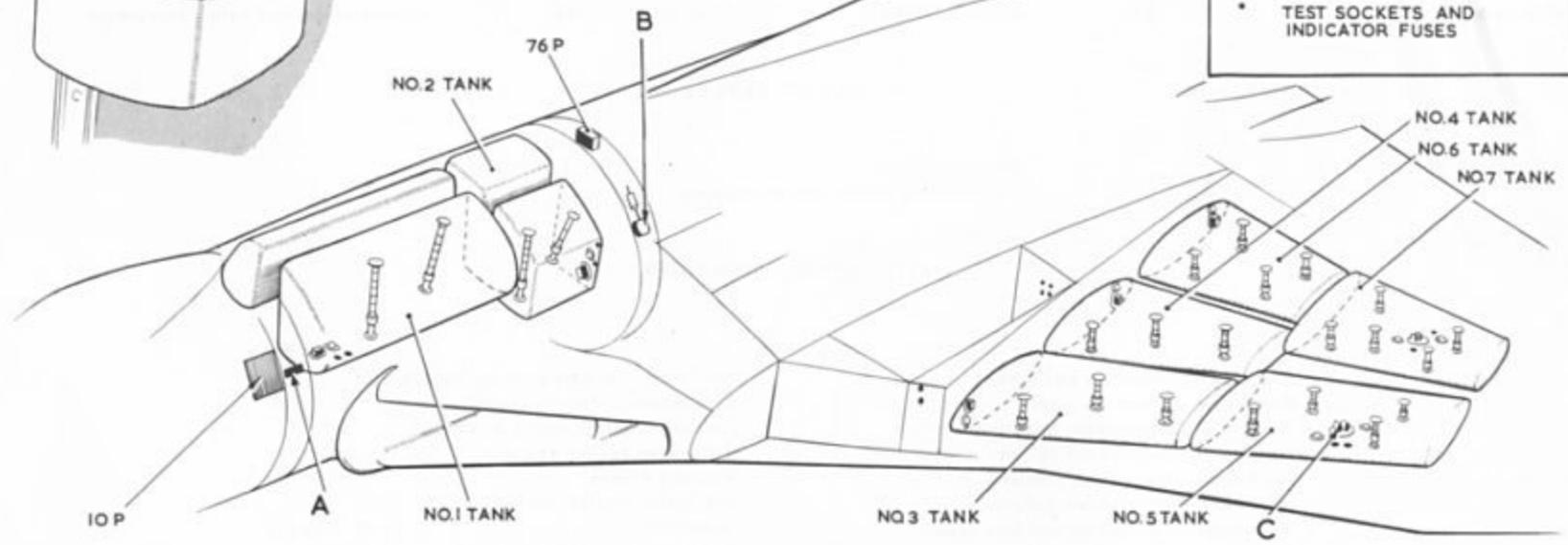
TYPICAL TANK MOUNTING PLATE
(NO.5 TANK)

EXPLOSION SUPPRESSION
CONTROL PANEL AT A.E.O.'S
STATION

DETAIL A

IO P

KEY TO TANK COMPONENTS	
	SUPPRESSOR COLUMNS
	TEST LAMPS
	DETECTOR UNITS
	TEST SOCKETS AND INDICATOR FUSES



NO.2 TANK

76 P

B

NO.4 TANK

NO.6 TANK

NO.7 TANK

IO P

NO.1 TANK

A

NO.3 TANK

NO.5 TANK

C

Fig.1 Explosion protection equipment

RESTRICTED

Introduction

1. This Chapter deals with the installation and general functioning of the Gravier explosion protection system for the wing and fuselage fuel tanks. A location of equipment illustration is provided in fig.1, and routing charts will be found at the end of the text. On aircraft where Mod.526 is embodied, connections are provided in the bomb bay for the bomb

Brief description

3. The explosion protection system is designed to prevent an explosion in the fuel tanks when it is in the most vulnerable condition, i.e., when partially empty, and containing a highly explosive mixture of fuel/air vapour above the fuel.

4. The system works on the principle that there is a time interval between the introduction of a flame into the explosive mixture in the fuel tank, and the development of the maximum explosive force. During the first 15 milliseconds the pressure in the tank rises at a comparatively slow rate, and, if detected during this time, an explosion can be suppressed before it progresses beyond control.

5. In this system, a photo-electric detector is used to visually detect the presence of a flame within the tank, and emit an electrical pulse to an explosion detonator. The pulse causes the detonator to explode, thus rupturing a suppressor tube containing a suppressing agent which is dispersed in mist form, thus arresting the explosion.

Components

6. The system as fitted to the Vulcan aircraft, consists of the following major components:-

- (1) Detector units Ref.27N/217
- (2) Power packs Mk.2
- (3) Overvoltage trip units V8282

F.S./2

bay fuel tanks. The explosion protection equipment fitted to the bomb bay fuel tanks (Mod.527) will be described in this Chapter at a later date.

2. The explosion protection system is described briefly in A.P.957C, Vol.1, 2nd. Ed., Part 1, Sect.2, Chap.3, and a more detailed description, including

DESCRIPTION AND OPERATION

- (4) Suppressor columns (comprising units and detonators).

The location and a brief description of these units, along with their necessary minor components is contained in the following paragraphs.

Fuel tanks equipment

7. Each fuel tank is equipped with the following components:-

- (1) Detector units, Ref.27N/205 with surge arrester Type E818 (Mod.843) or
Detector units, Ref.27N/217 (Mod.775).
- (2) Test lamp units Ref.27N/267.
- (3) Bulkhead connectors LF16.
- (4) Indicator fuses - see Table 1.
- (5) Test socket.
- (6) Suppressor units, Ref.26N/179
- (7) Dummy suppressors, Ref.27N/181
- (8) Detonators elect. 116 Mk.1
- (9) Conductors for dummy suppressors, Ref.27N/184.

Also included in each tank are terminal blocks, column mountings, spacers etc., which are essential for the build up of the tank columns.

circuit operation and testing, is given in A.P.4343, Vol.1, Sect.22, Chap.4. Electrical component details are contained in A.P.4343E, Vol.1, Sect.15, Chap.2, whilst the comprehensive test gear and its use will appear in A.P.4343S, Vol.1, Sect.17. Prior to reading the information contained in this Chapter, readers are advised to consult the various publications previously mentioned in this paragraph.

Detector units

8. Eighteen detector units are installed inside the fuel tanks in the following manner:-

- (1) Single units - a single unit is inside each No.1, 2, 3, 4 and 6 tank.
- (2) Double units - a double unit is inside each No.5 and 7 (outer wing) tank.

The detector units are each secured to a mounting plate, which also houses a test lamp and a bulkhead connector for the cable to the suppressor columns. Note that on No.2 (fuselage) tanks, the test lamps are mounted separate from the detector units.

9. Each detector unit comprises a highly sensitive photo-electric cell combined with a firing circuit, the whole assembly enclosed in a pressed steel case. The case is equipped with a window which allows the photo-electric cell to view the tank interior. Light falling upon the photo-electric cell causes a voltage to be supplied to the triggering electrode of a cold cathode valve which forms part of the detector firing circuit. The firing circuit comprises a cold cathode valve, capacitors, resistors, and is designed to 'fail safe' should the external wiring become short or open-circuited. On aircraft where Mod.843 is embodied, a surge arrester resistor is fitted in the black lead of each detector, but on aircraft where Mod.775 is embodied, a later type of detector is installed which has the surge arrester built into the detector case.

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Test lamps

10. A 28-volt test lamp is installed on each detector unit mounting plate, with the lamp inside the tank. On the No.5 and 7 (outer wing) tanks, two test lamps are provided for each tank, and on the No.2 (fuselage) tanks, the test lamps are secured to separate mounting plates from the detector units. Each test lamp enables a source of light to be deliberately introduced into the fuel tank to excite the photo-electric cell of the detector unit for test purposes. Further details of this feature are given under the heading 'Servicing'.

Indicator fuses

11. In order to have a permanent visual indication that the suppressor columns in a tank have been fired, an indicator fuse is included in each circuit. This fuse also eliminates the possibility of a spark occurring in the tank after an explosion has been suppressed. The indicator fuse is a replaceable item, which consists of a matchhead fuse surrounded by a red oxide powder, above which is a small piston. When the matchhead is ignited, the red oxide is spread over an integral window on the fuse-head, thus leaving a permanent indication of operation.

12. A shunt resistor is also incorporated in the fuse to ensure that the current passing through the fuse never exceeds that consumed by the detonators in one column of suppressors. Without this safety device, it is possible that, because the tanks are all equipped with more than one column, the fuse could rupture before the detonators fire. It is therefore essential that the correct indicator fuse for the appropriate tank is employed. The correct fuse for each tank is given in Table 1.

13. The indicator fuses are fitted in suitable holders, and the complete assembly for each tank is installed in a suitable position for ease of inspection. In the case of the No.5 and 7 (outer wing) tanks, the fuse and fuse holder assemblies are

fitted to the tank access panels, and visible from the undersurface of the wing. The indicator fuse assemblies for the 3, 4 and 6 (inner wing) tanks are fitted to separate mounting brackets in the main wheel bays; the fuselage tanks (No.1 and 2) fuses are fitted to separate mounting brackets, and visible from the nose-wheel bay.

Test sockets

14. Test sockets, each equipped with a mating plug, are provided adjacent to the indicator fuse for each tank installation. The test socket mating plugs must be in place unless actual testing is taking place. Details of the use of the test sockets will be found under the heading 'Servicing'.

Suppressor units

15. The suppressor units contain the suppressing agent to be dispersed within the tank in the event of the detector viewing a flame. Each suppressor unit is basically a metal cylinder externally scored both lengthwise and circumferentially. On detonation, the scoring pattern enables the walls of the cylinder to fold back about the unscored ends, thus evenly distributing the suppressing agent.

Suppressor columns

16. On the Vulcan aircraft fuel tank installations, several suppressor units and dummy suppressor units are joined together forming a suppressor column, electrical continuity between the detonators being provided by special conductors, thus ensuring that all the detonators in the column are fired simultaneously when a firing pulse is received from the detector unit.

17. The suppressor columns are mounted vertically on shock absorbing spider plate mountings inside the fuel tanks, the number of columns inside a tank depending on the size and shape of the tank. Terminal blocks, each equipped with co-axial termination and protected by a disc-shaped deflector plate, are fitted to each column to enable groups of columns to be interconnected.

The build-up details and components of each tank group of columns is shown on fig.3 to 9. The electrical supply to the first column in each tank is conveyed by means of a bulkhead co-axial connector on each detector mounting plate.

Detonators

18. Each suppressor column contains a centre tube into which the detonators, and in the case of the dummy suppressor units, the conductor units are fitted. The detonator units are basically thin plastic tubes containing an explosive, with an incandescing wire bridged between a plug pin at one end and a socket at the other, passing through the centre of the detonator. Each detonator fits into the centre of each suppressor unit and the pins and sockets enable the suppressor columns to be built up with the detonators connected in series. Each detonator, Type Elect. 116 Mk.1, is 4.5 in. long and may be identified by its overall coating of pink varnish and band of lemon varnish around the base of the shoulder.

WARNING . . .

These detonators are explosive and must be handled with reasonable care. The safety precautions outlined under the general heading 'Servicing' must be observed at all times.

Shorting links

19. The co-axial cable feeding the suppressor columns in each tank is fed via a bulkhead connector on the detector unit mounting plate. On all aircraft, a shorting link, in the form of an elbow connector, is interposed between the co-axial cable and the bulkhead connector, which renders the detonators inoperative, thus the detector circuit will function to operate the indicator fuse, but the detonators will remain safe. On no account must the shorting links be removed for any flight without the appropriate Air Ministry authority.

Fuselage equipment

20. The controlling and power equipment

for the explosion protection system, fitted to the aircraft external from the fuel tanks, consists of the following components:-

- (1) Power packs Mk.2
- (2) Overvoltage trip units Ref.V8282
- (3) Indicator and resetting panel
- (4) Relay panel 76P

A brief description, and the location of the fuselage equipment is contained in the following paragraphs:-

Power packs

21. The Mk.2 power packs are installed on the aircraft, one for each half (port and starboard) of the explosion protection system. The power packs are installed in the bomb bay on the upper surface of the structure between the aft face of the front spar and bomb arch 44.5.

22. Each power pack converts the 115-volt 400 c.p.s. a.c. supply from the aircraft transformers into two voltage levels, namely +150 volts and -500 volts. Each power pack also incorporates a double-wound relay, which automatically trips should the supply be interrupted for any reason, or if the voltage level on the 150 volt side exceeds 158 volts.

Overvoltage trip units

23. An overvoltage trip unit is installed in the bomb bay adjacent to, and connected in the output line of each power pack. Each unit is in effect an electronic relay which operates to trip the power pack relay in the event of the power pack voltage exceeding the desired limit. The unit is also used for circuit matching, the output current of the power pack being maintained reasonably within the desired limits by the inter-connection of resistors within the unit. Note that the overvoltage trip unit is in fact a Graviner part, Ref.27N/163, but given an Avro Part No.V8282 by the introduction of the special cable terminations.

Indicator and resetting panel

24. A remote control panel for the explosion protection installation is provided at the air electronic officer's station (adjacent to 50P). The panel contains two neon indicators (one for each half of the system), and a push switch labelled PUSH TO RESET. The push-switch controls two relays in 76P, and the neon indicators provide indication that the system is operative. Further details are given under the heading "Circuit operation".

Relay panel 76P

25. This panel is installed in the bomb bay on the forward face of bomb arch 44.5. The panel serves to house the two relays (87 and 88) mentioned in para.24, along with current limiting resistors for the neon indicators, and forms part of the distribution system of the explosion protection circuit wiring. The remainder of the distribution is made by connector blocks in the bomb bay and adjacent to each fuel tank. The explosion protection wiring is isolated from the main electrical system, and all junction points are suitably labelled EXPLOSION SUPPRESSION - WARNING HIGH VOLTAGE. On aircraft where Mod.526 is embodied, provision is made for the carriage of bomb bay fuel tanks, and these are fitted with an explosion protection system. Two electrical sockets No.920 and 928 are provided in the bomb bay, to enable the bomb bay to be connected to the existing explosion protection system. It is important to note that when the bomb bay fuel tanks are fitted (Mod.527 and 924) and the wiring in the bomb bay connected up, that the links on T.B.464 and 465 are changed as outlined on the routing chart fig.13.

Power supplies

26. A.C. power supply to the power packs of the system, at 115-volt 400 c.p.s. single phase, is obtained from the 3kVA static transformers mounted on top of panels 27 and 28P on the aft face of the front spar in the bomb bay. The supply is directed via fuses 300 (Red phase) in 28P for the star-

board power pack, and 272 (Red phase) in 27P for the port power pack. Full details of the switching and control of the two secondary supply transformers, including emergency changeover operation in the event of one transformer failure are contained in Chapter 4 of this Section.

Circuit operation

27. The circuit operation outlined in the following paragraphs covers switching on and resetting operations only. Note that the port system is discussed, the starboard system being similar. Full circuit description for the explosion protection system, including details of the various units is contained in A.P.4343, Vol.1, Sect.22, Chap.3.

Switching on

28. Assuming that the port static transformer is switched ON, with its output at the correct level, referring to fig.2, it will be seen that a.c. supply via fuse 272R is connected to the power pack (pin A, 3-pole supply plug), but the transformer within the pack has no supply. The supply is however connected across the normally closed relay contacts RL1/1, through resistor R1 in panel 76P to energise the port neon indicator on the indicator and resetting panel at the air electronic officer's station. The neon indicator will continue to glow until the PUSH TO RESET switch is depressed.

Operation of PUSH TO RESET switch

29. When the PUSH TO RESET switch is depressed momentarily, the coils of relays 87 and 88 in 76P will be energised with a 28 volt d.c. supply via fuse 582, and the contacts of the push-switch. Closure of relay contacts 87/2 will connect the a.c. supply from fuse 272R to pin C of the power pack supply plug to energise the primary winding of the power pack transformer. At the same time, opening of relay contacts 88/2 will remove the shorting link from pins A & B (3-pole socket) on the power pack, thus inserting

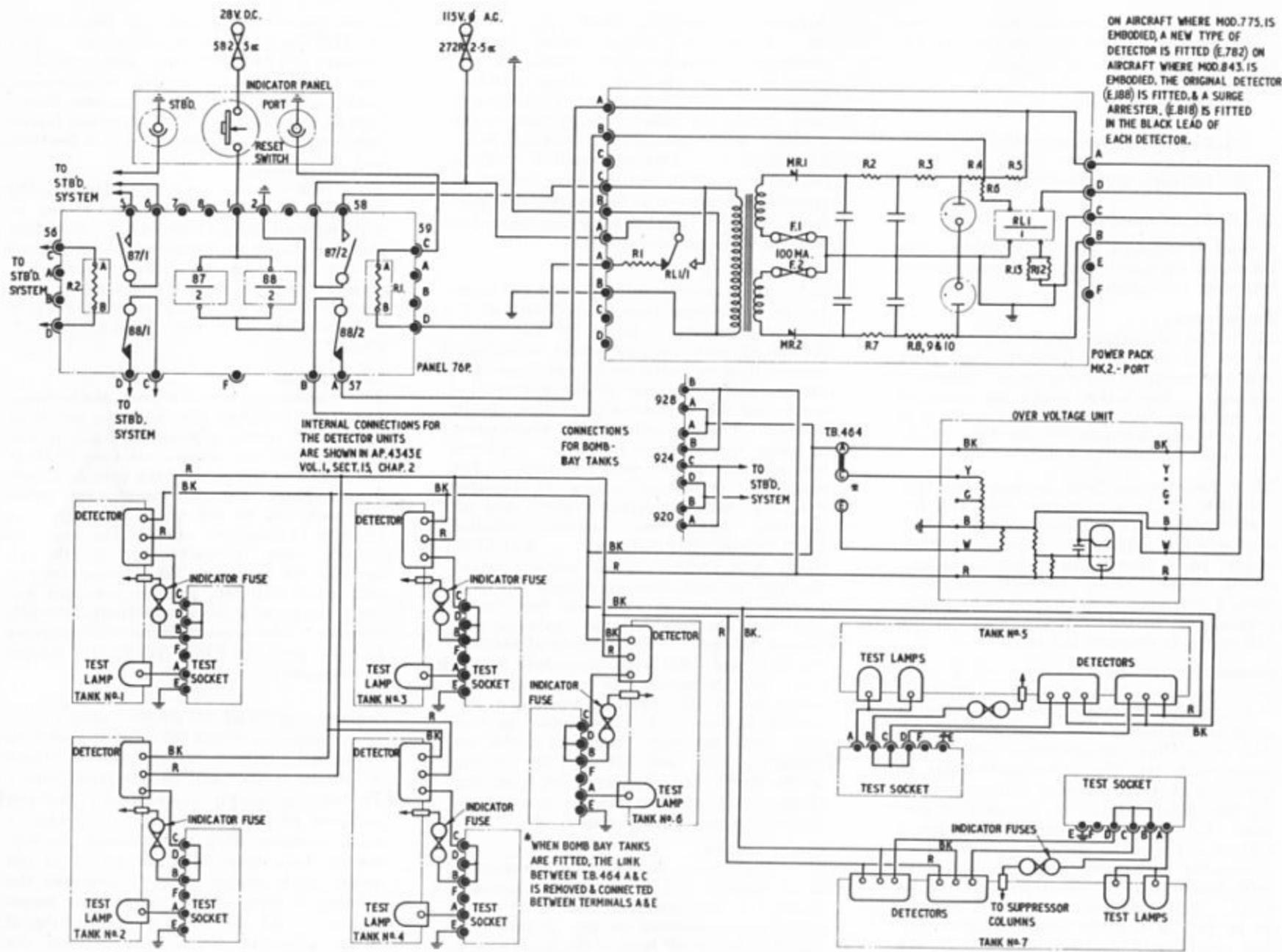


Fig.2 Explosion protection (port)

RESTRICTED

R5 in the 150 volt circuit. The resistor prevents the sudden surge of current which would otherwise result when switching on (due to the initial low impedance of the capacitors in the detector units).

30. At this stage the 150 volt coil of relay RL1 in the power pack will be energised (via resistor R6), causing contacts RL1/1 to operate. This action will isolate the supply to the port neon indicator, thus indicating (neon out), that the system is set, and ready to detect

General

33. The servicing of the system consists of the regular testing of the electrical circuits and components, at the intervals stated in A.P.4505A, Vol.4. Complete servicing information, including the use of the minor and major test kits will be found in A.P.4343S, Vol.1, Sect.17. Until this information is available, the general servicing instructions contained in the ensuing paragraphs must be carried out at the correct inspection intervals.

Safety precautions

34. As the explosion suppression system uses explosive detonators, in a self-detecting system, it is important that all tradesmen involved in any aspect of servicing of the system must observe the necessary safety precautions outlined in this Chapter, failure to do so may endanger life.

Warning labels

35. The explosion protection system is wired on the aircraft as an isolated system, i.e., the various connection points are not common to any other in the electrical system, suitable labels, engraved EXPLOSION SUPPRESSION - WARNING - HIGH VOLTAGE, are provided. When electrical servicing or testing is being carried out on other services in the electrical system, care must be taken to ensure that any live test prods, leads, etc., are never brought into close proximity of any

any flame within the port tanks.

Overvoltage trip

31. Should the output voltage from the power pack exceed 158 ± 4 volts, the potential of the cold cathode trigger in the overvoltage trip unit is sufficient to enable the valve to strike and start conducting, thus causing a current to pass through the second coil of relay RL1 in the power pack. The effect of the current in this coil is to neutralise the current in the first coil, thus causing contacts

SERVICING

of the explosion protection system junction points.

Pre-testing precautions

36. At the present time, the aircraft are fitted with a shorting link fitted in the suppressor column supply cable at each tank bulkhead connector, thus rendering the detonators inoperative. Nevertheless, prior to any servicing being carried out on the explosion protection system, the system must be made 'electrically safe'. This may be carried out by removing fuses 272R and 300R in panels 27 and 28P and fitting the appropriate dummy 'servicing' fuses, or by disconnecting and isolating the input cables to both power packs in the bomb bay. The removed cable plugs and sockets should be suitably masked to avoid accidental connection during any servicing. This precaution must also be observed when work of any nature is carried out on, or in the vicinity of, the fuel tanks.

Storage of detonators

37. The explosion protection detonators, Elect.116 Mk.1 must be stored at temperatures of 55 deg.C or less, and kept apart from inflammable fluids and stores of an explosive nature.

Handling of detonators

38. The detonators must be handled as little as possible, and carried loosely in the fingers at arms length. Splinter-

RL1/1 to revert to their original position. This action causes the primary winding of the transformer to be open-circuited, and thus the system is isolated. At this stage, the neon indicator will again be energised, thus informing the crew that RESET action is necessary (circuit operation para.29 - 30).

32. Should a failure of the a.c. power for the system occur, the RESET operation must be repeated after power has been restored.

proof goggles of an approved pattern must be worn at all times when detonators are being handled. The detonators must be kept away from any heating appliances, electrical leads or sockets, and handled with reasonable mechanical care, i.e., never exposed to severe blows. Force must not be used when detonators are being fitted to their respective suppressor units during column build-up operations.

Electrical testing

Indicator fuses

39. As stated previously, shorting links are fitted to each tank suppressor bulkhead connector, which renders the suppressor column detonators inoperative: however, the detector circuit will still operate normally, and normal (or inadvertent) detection will cause the appropriate indicator fuse to rupture. To facilitate the removal of the inspection windows on the No.5 and 7 tank indicator fuses, a special spanner, Part No.Z9981, is available as part of the aircraft tool kit.

40. The indicator fuses must therefore be inspected daily, and any fuse window coloured red implies that the fuse has 'blown'. Table 1 must be consulted for the correct replacement fuses. Any case of blown indicator fuses must be reported to M.O.A. (R.D.1 Fires) who will arrange inspection of the aircraft to investigate the reason for the blown fuse.

Detector test kit

41. A Graviner detector test kit, Type T334, is available to functionally test the detector units, test lamps and firing circuit, and in conjunction with a safety ohmmeter (Max. current 13 mA), enables a continuity and resistance check of certain units to be carried out.

Resistance of suppressor columns

42. Using the safety ohmmeter, the resistance of each tank group of suppressor columns is checked in the following manner:-

- (1) Ensure that the system is 'electrically safe' (para.36).
- (2) Disconnect the co-axial cable and the shorting link from the bulkhead connector on the detector unit mounting plate.
- (3) Connect the safety ohmmeter to the co-axial bulkhead connector. (A special lead may be made up for this purpose, using a length of suppressor column interconnection cable with a co-axial connector at one end, and a safety ohmmeter connector at the other). The reading on the safety ohmmeter should agree with the resistance specified on the data plate attached to the detector mounting plate of the particular tank being checked.

NOTE . . .

The resistance of the indicator fuse must be added to the figure obtained prior to comparing values.

- (4) When all tanks have been checked, replace all disconnected cables.

Functional test of detectors

43. Using the Graviner detector test kit, Type 334, the operation of the detector

circuit and test lamps for each tank may be tested in turn, in the following manner:-

- (1) Switch on the port and starboard 3kVA static transformers, and depress the RESET push-switch on the indicator panel at the air electronic officers station. The push-switch may be released when both port and starboard neon indicators have ceased to glow.
- (2) Locate and remove the mating plug from the test socket of the tank circuit to be tested, and connect the test kit to the test socket.
- (3) Depress the test switch on the front of the test kit. This action will connect the battery inside the test kit to the test lamp within the fuel tank. The presence of light within the tank will cause the firing circuit of the detector to be triggered off, and one of the neon indicators on the test kit will glow. (Note that on the double detector tanks, No.5 and 7, both neon indicators on the test kit will glow).
- (4) The foregoing test should be carried out on each tank in turn, both port and starboard.

Detonator and indicator fuse test

44. The resistance of each tank group of detonators and associated indicator fuse may be checked at the same time as the detector circuit (para.43). The detector test kit is left plugged into the test socket, and the safety ohmmeter is connected to the outlet provided on the test kit. The resistance value of the detonators and fuses should be within the limits prescribed in Tables 1 and 2. At the conclusion of the tests, the test kit should be removed, the aircraft power switched off, and the mating plugs replaced in the test sockets at each tank.

WARNING . . .

An insulation resistance tester must never be used on any leads or components of the explosion protection system.

45. A circuit diagram of the Graviner detector test kit is contained in A.P.4343, Vol.1, Sect.22, Chap.4, and a full description will be found in A.P.4343S, Vol.1, Sect.17. A comprehensive test kit, Graviner Type T337, is available, which enables major testing on each unit to be carried out, both on the aircraft and in the servicing bay. Full details of this equipment will be found in A.P.4343S, Vol.1, Sect.17. Until this information is available, the major checks outlined in the ensuing paragraphs should be carried out at the period stated in A.P.4505B, Vol.4.

Major checks

46. The main components of the explosion protection system are repairable only by the manufacturer or at approved Maintenance Units, and any item of equipment which fails the major checks should be replaced by a serviceable item, and the unserviceable item returned to stores for despatch to the approved M.U. The major checks given here must all be carried out with the components removed from the aircraft, in a suitable servicing bay.

Power packs

47. The power packs should be bench tested in the following manner:-

- (1) Continuity checks
Using a testmeter, Type D1, check for continuity of pin C on 6-pin socket to power pack case. Check that pins A, B and C of the 3-pin supply plug are open circuit to the power pack case.

- (2) Trip test
Using the comprehensive test kit (T337), install the power pack into the test kit, following the instructions provided with the test kit. Ensure that the supply source is 115 volt 400 c.p.s. Observe that the neon indicator glows when the power supply is switched on, and extinguished when the reset switch is depressed. Operate the trip test switch, ensure that the relay trips (indicated by the neon indicator glowing until the reset switch is again depressed with the trip test switch released).
- (3) Differential trip test
With the power pack connected to the test kit following the instructions provided, check H.T. positive and H.T. negative supply from the power pack, and then inject overvoltage using the control provided. The H.T. positive and negative line voltage should fall to zero, and the neon indicator glow to indicate the need to reset when the relay has tripped out. Reset the power pack, and recheck output voltages for correct value.
- (4) Output voltage check
With the power pack connected to the test kit, check that the input frequency is correct to 400 c.p.s. $\pm 2\%$. Vary the input voltage between 105 and 125 volts, using the selector switches, and following the instructions provided with the test kit, check that the H.T. positive line voltage is within the limits 138 to 146 volts d.c. over the full range of input (105 to 125 volts). Check that the H.T. negative line voltage is within the limits 475 to 525 volts d.c. over the full range of input voltage (105 to 125 volts).

- (5) Input current check
Using a testmeter, type D1, and with the power pack connected into the test kit, check that the primary current is between 56 to 110 mA, following the instructions provided.
- (6) Hum check
Using a suitable cathode ray oscilloscope and with the power pack connected into the test kit, following the instructions provided, check that the hum level on the H.T. positive line is less than 2.35 volts P/P (0.5%). Check that the hum level on the H.T. negative line is less than 3.75 volts P/P (0.25%).

Detector units

48. The detector units should be bench tested in the following manner:-

- (1) Operating and sensitivity test
Install the detector in the comprehensive test kit, following the instructions provided, check that the detector triggers at between 2 and 5 volt test lamp illumination (relay operated green light).
- (2) Self-triggering check
With the detector unit installed in the test kit as in (1), increase the H.T. positive voltage to 165 volts, check that the unit does not trigger.

NOTE . . .

The applied voltage must not exceed 165 volts, nor be applied for a period longer than 30 secs. It is essential that extreme care be exercised when conducting this check, otherwise damage to the detector unit may result.

- (3) Capacitor test
With the detector unit installed in

the test kit as in (1), ensure that H.T. positive supply is at the correct level. Depress the test capacitor switch, and note that the time taken for the voltmeter reading to fall from $+150$ to $+50$ volts exceeds 35 secs.

Overvoltage trip units

49. The overvoltage trip units should be bench tested in the following manner:-

- (1) Trip voltage check
Install the overvoltage trip unit in the test kit according to the instructions provided, and increase the $+150$ line voltage until the supply voltage is tripped out (limits 158 ± 4 volts).
- (2) Resistance check
Using an insulation resistance tester (1,000 volt), check the following:- (detector end)
 - (a) Check that the resistance between the white and blue leads is 10 ± 0.5 megohms.
 - (b) Blue and yellow leads 3 ± 0.15 megohms.
 - (c) Yellow and green leads is 2 ± 0.1 megohms.
 - (d) Check that the resistance between the black lead and all other leads shorted together is greater than 20 megohms.
 - (e) Check that the resistance between the case and all other leads shorted together is greater than 20 megohms.
 - (f) At the power pack end, check that the insulation resistance between the white lead and the case is greater than 20 megohms.

Indicator fuses

50. The indicator fuses should be bench tested in the following manner:-

- (1) Continuity and resistance
Check for continuity and resistance using the safety ohmmeter (max. 13 mA), values should be within the following:-

E302	5.2 to 7.2 ohms.
E303	3.5 to 4.8 ohms.
E304	2.6 to 3.4 ohms.

Suppressor columns

51. The suppressor columns must be removed from each tank and broken down for the major checks. Note that the method of suppressor column removal and assembly, including the necessary safety precautions is given under the heading 'Removal and Assembly'.

52. The total resistance of each group of tank suppressor columns is provided on the respective tank data plate attached to the detector mounting plate and the total weight of each column is stamped on the deflector plate of each column, along with the tank No., column reference letter, and contractors part numbers. Reference should be made to fig.3 to 9 for the build-up details for each tank group of columns.

53. After the suppressor columns have been removed from the fuel tanks, and

broken down to the various assembly units, the major checks outlined in the ensuing paragraphs should then be carried out.

Suppressor units

54. Each suppressor unit should be weighed, and the weight checked that it is within + 2 or - 10 grammes of that etched on the end flange.

Detonators

55. Each detonator should be tested as follows:-

- (1) Life check
Check that all detonators have sufficient life remaining to allow re-installation for a further major inspection period. All life-expired detonators should be disposed of according to the relevant instructions. Attention is drawn to the Safety Precautions for handling detonators (para.38).
- (2) Resistance checks
Using the safety ohmmeter (max. current 13 mA), check that the resistance of all previously used detonators and new detonators used for replacement is within the limits 10 to 16 ohms.

NOTE . . .

After rebuilding the suppressors and detonators into columns, it is essential that each column be checked to ensure that all detonators are in circuit, by noting the column resistance value is within the limits determined by the number of detonators within the column. Details of these tests and values for built-up columns will be found under the heading 'Removal and Assembly'.

Dummy suppressors

56. Each dummy suppressor should be bench tested as follows:-

- (1) Leak check
Check by weighing that no leaks have occurred. The weight of each suppressor should be within ± 2 grammes of that etched on the mounting flange.

Component visual inspection

57. All components should be checked visually for external signs of damage or corrosion. Unserviceable components must be replaced, and the defective items returned to the appropriate M.U. for investigation.

REMOVAL AND ASSEMBLY

Safety precautions

58. During the removal or installation of any of the fuel tank components, it is recommended that the aircraft be cleared of all personnel except those actually working on the explosion protection system. All power supplied on the aircraft must be OFF, and tradesmen working on the system must wear the appropriate protective clothing and splinter-proof goggles.

Fuselage equipment

59. No difficulties should be experienced in the removal of the power packs or over-voltage trip units in the bomb bay. The power packs are attached to their mounting brackets by four attachment screws, and after disconnecting the plugs and sockets, and releasing the attachment screws, the power packs may be pulled inboard and removed from the aircraft.

60. The attachment clips for the over-voltage trip units form part of the unit casing, and four 2BA screws, hold the unit to the structure, with anchor nuts provided. It will be necessary to loosen the cable clip adjacent to T.B. 464 (port) and T.B. 465 (starboard), as well as releasing the cables from these two terminal blocks before the overvoltage trip units can be removed. It is important to note that upon re-installation of

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the overvoltage units, the connections at T.B. 464 and 465 are wired according to the routing chart fig.13, and the appropriate T.B. links must be correctly connected. Labels with a suitable warning are provided adjacent to the T.B.'s.

Indicator fuses

61. The indicator fuses are of the bayonet fitting pattern, and prior to removing a fuse, the domed inspection cover must first be removed. When replacing a fuse, it is imperative that the correct replacement type for the particular tank is used, (Table 1). The new fuse should have its resistance value checked using the safety ohmmeter (max. current 13mA), and the details of the tank total resistance altered on the data plate (detector mounting plate), if necessary. A special spanner, Part No.Z9981 is available for removal of the No.5 and 7 tank indicator fuse inspection windows.

Removal of fuel tanks equipment

62. When it becomes necessary to remove the detector units, suppressor columns and associated equipment from the fuel tanks, either for tank removal, or explosion protection system inspections, the particular fuel tank/s must first be drained of all fuel, using the procedure as laid down in A.P.4505B, Vol.1, Book 1, Sect.4, Chap.2, and access gained to the various units as stated in the same chapter.

63. Prior to removing any of the explosion protection components, the system must first be made 'electrically safe' (Para.36 refers), and the safety precautions outlined in para.34 to 38, and para. 58 must be observed.

Suppressor columns

64. After ensuring that the system is 'electrically safe', the suppressor columns

may be removed and conveyed to the appropriate servicing bay. Access to the columns is gained in every tank via the manhole made available by removal of the tank sump plate (A.P.4505B, Vol.1, Book 1, Sect.4, Chap.2 refers).

65. The cables interconnecting the tank suppressor columns should be disconnected first, and in the case of a tank removal, removed from their securing straps within the tank itself. Note at this stage that the interconnecting cables are all established lengths, and they should be suitably labelled for re-installation purposes in the new tank.

66. The columns are each held in position in the tanks by flexible spider mountings top and bottom, the mountings secured to the tank buttons by suitable metal spring clips, four top and bottom for each suppressor column. Once the clips have been removed, the suppressor columns may be carefully removed, and passed out through the tank manhole.

Detector and test lamps

67. These items are attached to suitable mounting plates which are secured to a flange on the tank structure by suitably anchored 2BA bolts and nuts. Prior to removing the mounting plates complete with their accessories, the earthing leads should be disconnected from their respective earthing bolts. Note that on the No.2 (fuselage) tanks, the test lamps are attached to separate mounting plates, which must be removed prior to tank removal. During the time that the detectors are removed from the tanks, their viewing window must be suitably masked to conserve the life of the photo-electric cell. Extreme caution must be exercised when handling the detector units as the leads are fragile and if damaged render the detectors useless.

Suppressor column break-down

68. After the suppressor columns have been removed to the servicing bay for major checks, they should be weighed, and the weight checked against that etched on the column deflector plate. This will give an indication of any leaking dummy suppressor units. The columns should then be broken down, and the necessary major checks carried out (para. 51 - 57).

Suppressor column build-up

69. When the components of the suppressor columns have been major checked, the columns should be built-up according to the details for each particular column as shown in fig.3 to 9.

70. When the columns are being assembled, the flanges of the units must be absolutely clean to ensure good electrical contact. On no account must any compounds such as yellow chromate be used. Note that the filler screws of the dummy units must on no account be removed, as these units have been evacuated.

71. The heads of the filler screws on the suppressor units stand proud of the unit, and on the top and bottom units of a column, the deflector plate, E186, could be fouled. To avoid any fouling it is necessary that these suppressor units be turned so that the filler screws face inwards, towards the centre of the column.

72. When assembling the columns it is important that detonators are assembled only to suppressor units, and the conductors assembled to dummy suppressors. When each column is assembled it must be weighed and its weight recorded on the space provided on the deflector plate. The column should then be placed behind a suitable blast shield and its resistance checked using the safety ohmmeter (max. current 13 mA). The total resistance of

all columns for a particular tank can then be calculated. This value should agree with that obtained on final check when the tank installation is completed, and this figure must be recorded on the data plate provided on the detector mounting plate. A suggested record sheet for the resistance value of the individual columns and complete tank installation is offered in fig.12.

73. When calculating the total resistance of a tank installation, the resistance of the particular indicator fuse must also be included, and the fact that the No.7 tank installation is connected in series-parallel must be considered. The fuse should then be kept with its associated column until the installation is replaced.

74. After the suppressor columns have been major checked and re-built they are installed in their respective fuel tanks, and again the necessary precaution must be observed. Installation is carried out in the reverse order for removal (para.62 to 67). When the installation is completed the system must be tested functionally as laid down to para.41 - 44.

TABLE 1
Indicator fuses

Fuse Type	Tank No. (Port & Starboard)							Resistance (Ohms)	Identification on brass holder
	1	2	3	4	5	6	7		
E.302	1	1	-	-	-	-	-	5.2 - 7.2	Two grooves
E.303	-	-	1	1	-	-	1	3.5 - 4.8	Three grooves
E.304	-	-	-	-	1	1	-	2.6 - 3.4	Four grooves

TABLE 2
Permissible tolerances and errors

• Internal tank resistance

Specified value	Tolerance
0 - 5 ohms	0.2 ohms
5 - 10 ohms	0.5 ohms
10 - 80 ohms	1.0 ohms
Over 80 ohms	2.0 ohms

Detonator resistance 10 - 16 ohms

Overvoltage trip unit - Trip setting 158 4 volts

Power pack

Output	Positive	142	4 volts
	Negative	500	25 volts

Input 56 - 110 milliamps

• Note . . .

Specified values are for internal tank circuit only and the resistance value of the indicator fuse must always be subtracted before determining the tolerance applicable.

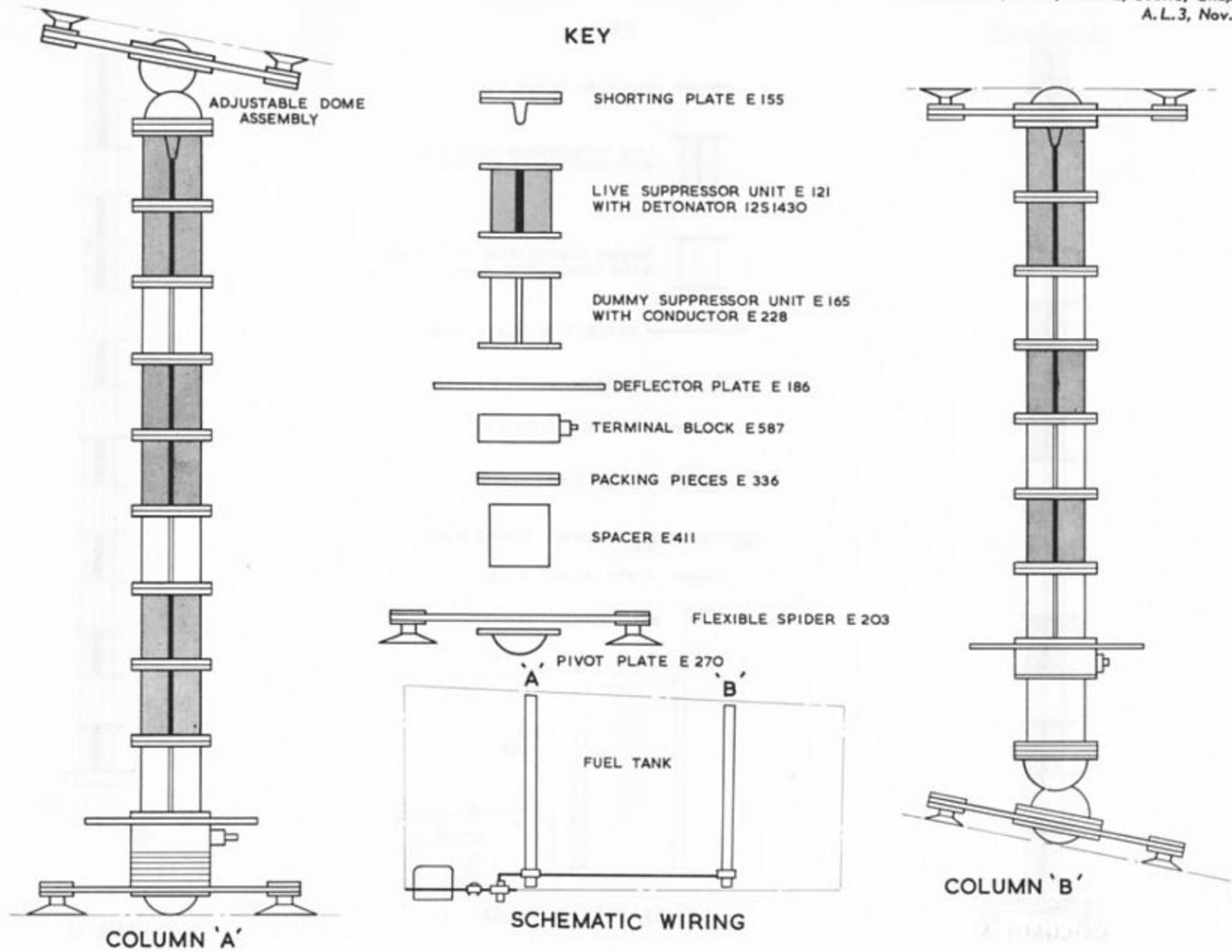
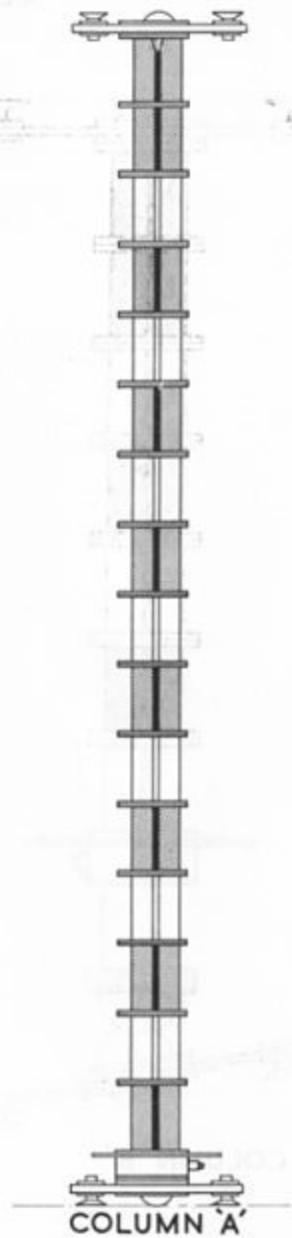


Fig.3 No.1 tank - suppressor column details

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KEY

-  SHORTING PLATE E 155
-  LIVE SUPPRESSOR UNIT E 121 WITH DETONATOR 125 1430
-  DUMMY SUPPRESSOR UNIT E 165 WITH CONDUCTOR E 228
-  DEFLECTOR PLATE E 186
-  TERMINAL BLOCK E 587
-  PACKING PIECES E 336
-  SPACER E 411
-  FLEXIBLE SPIDER E 203
-  PIVOT PLATE E 270
-  BALL JOINT E 273

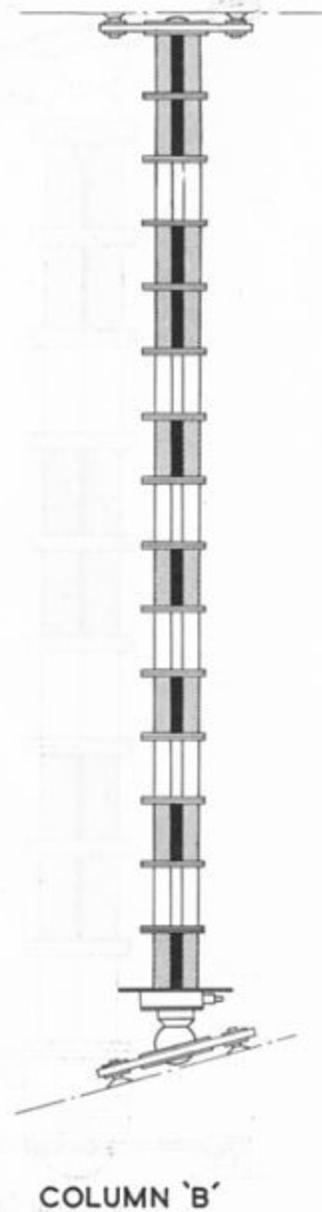
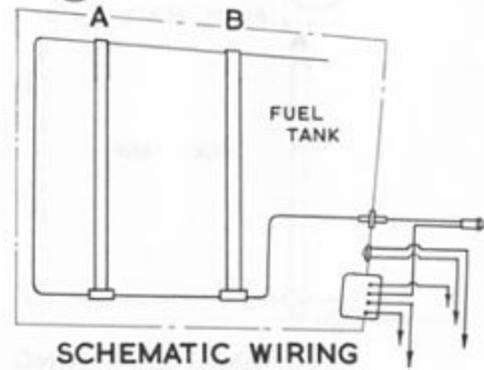


Fig.4 No.2 tank - suppressor column details

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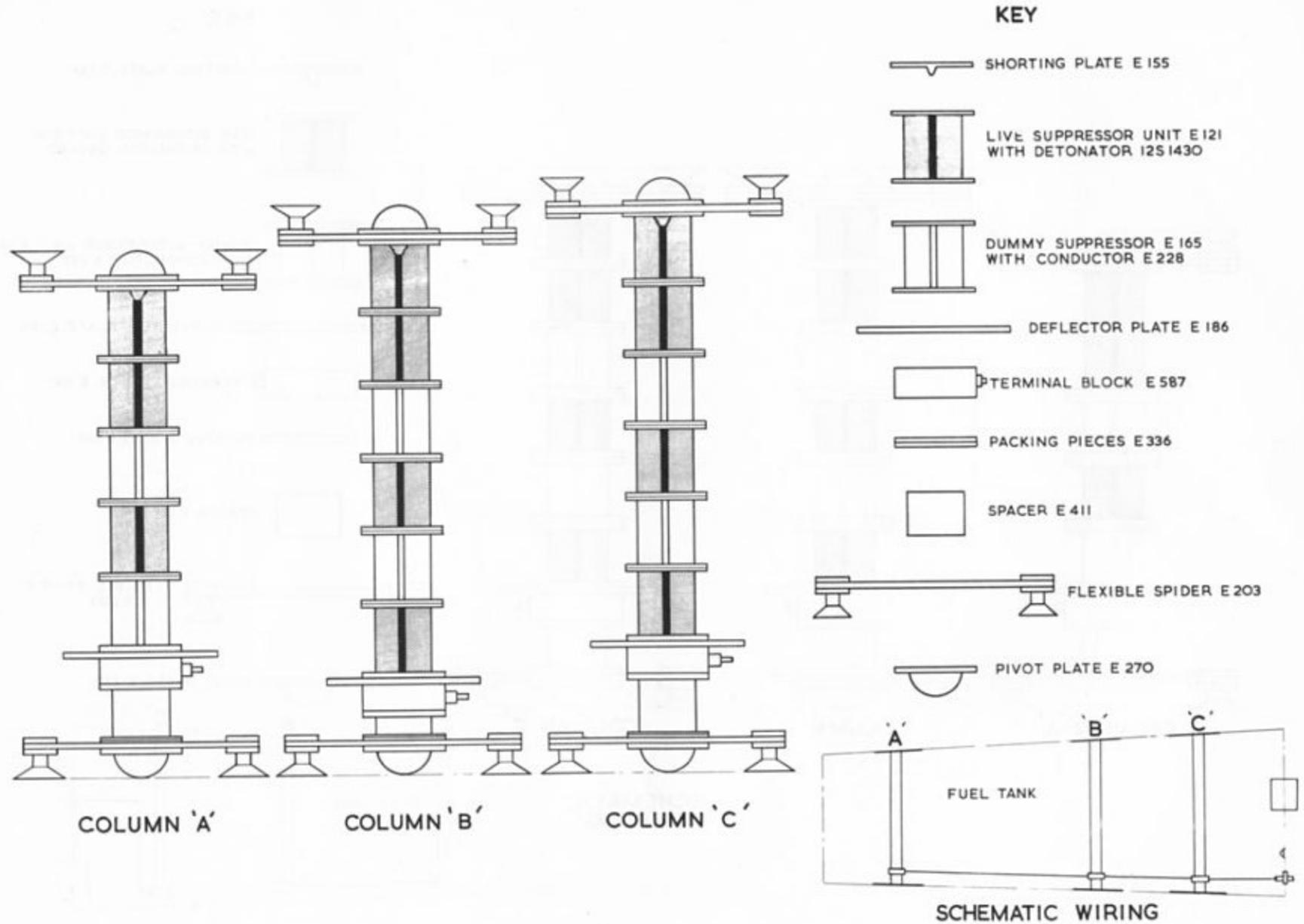


Fig.5 No.3 tank - suppressor column details

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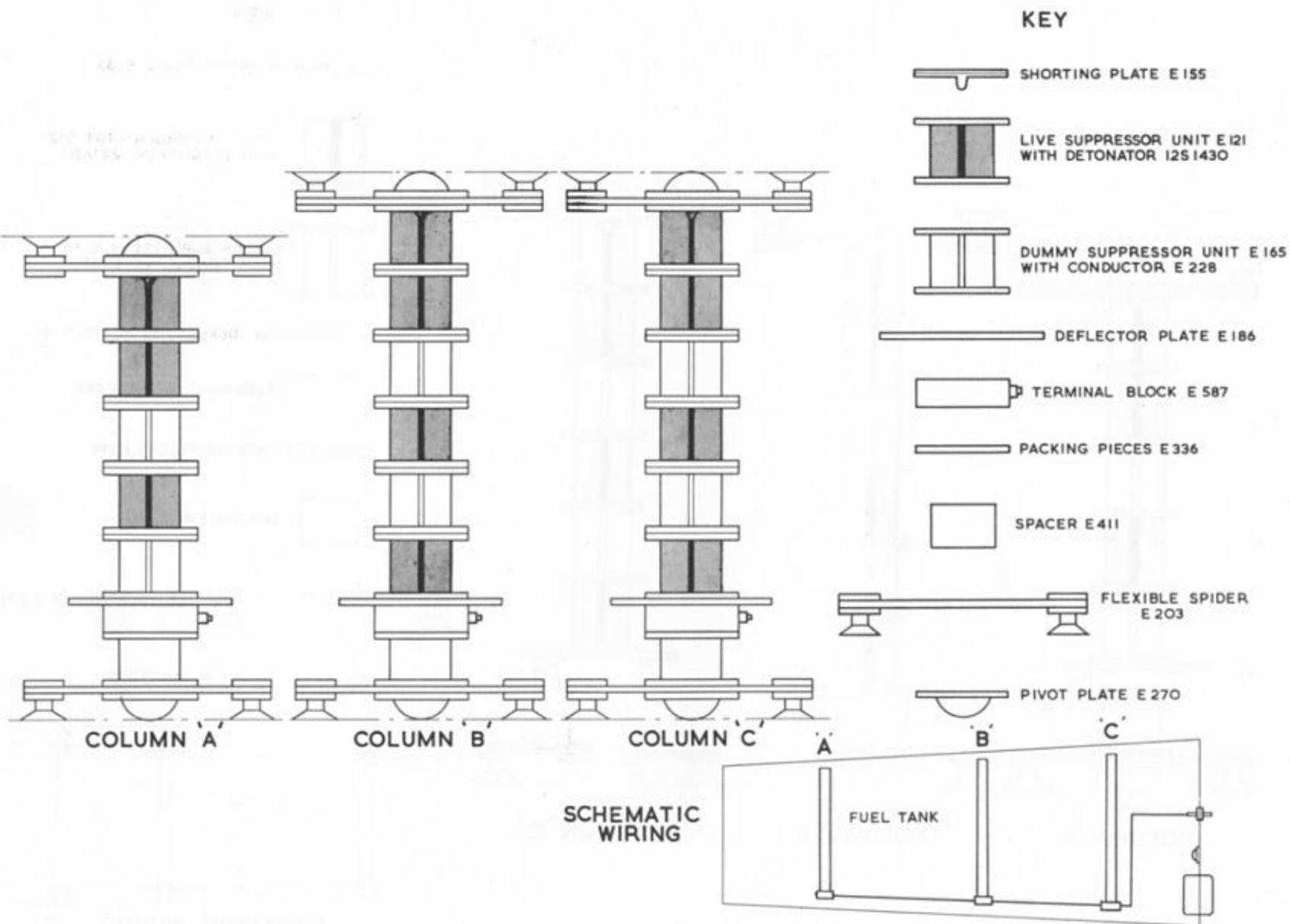


Fig.6 No.4 tank - suppressor column details

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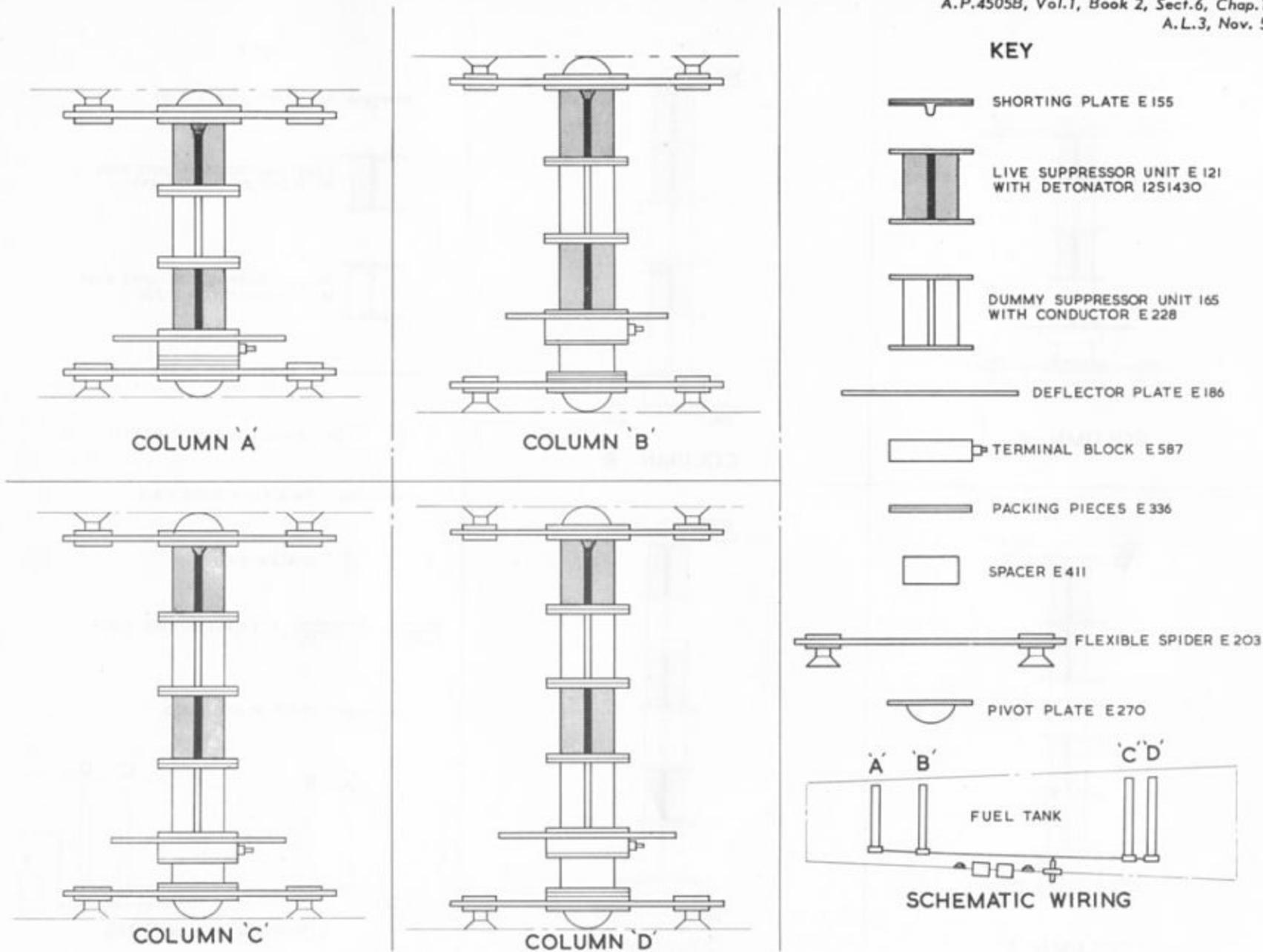
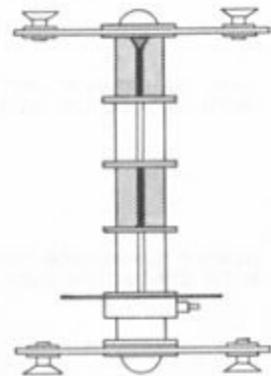
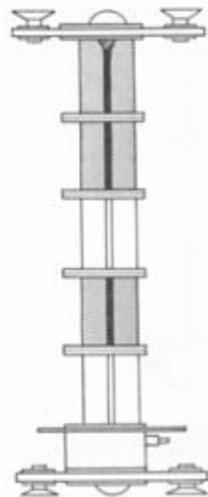


Fig.7 No.5 tank - suppressor column details

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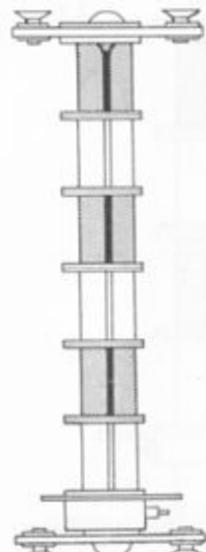
COLUMN 'A'



COLUMN 'B'



COLUMN 'C'



COLUMN 'D'

KEY

 SHORTING PLATE E155

 LIVE SUPPRESSOR UNIT E121
WITH DETONATOR 1251430

 DUMMY SUPPRESSOR UNIT E165
WITH CONDUCTOR E228

 DEFLECTOR PLATE E186

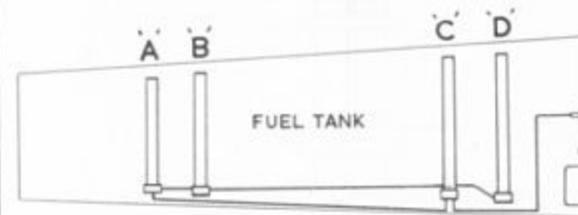
 TERMINAL BLOCK E587

 PACKING PIECES E336

 SPACER E411

 FLEXIBLE SPIDER E203

 PIVOT PLATE E270



SCHMATIC WIRING

Fig.8 No.6 tank - suppressor column details

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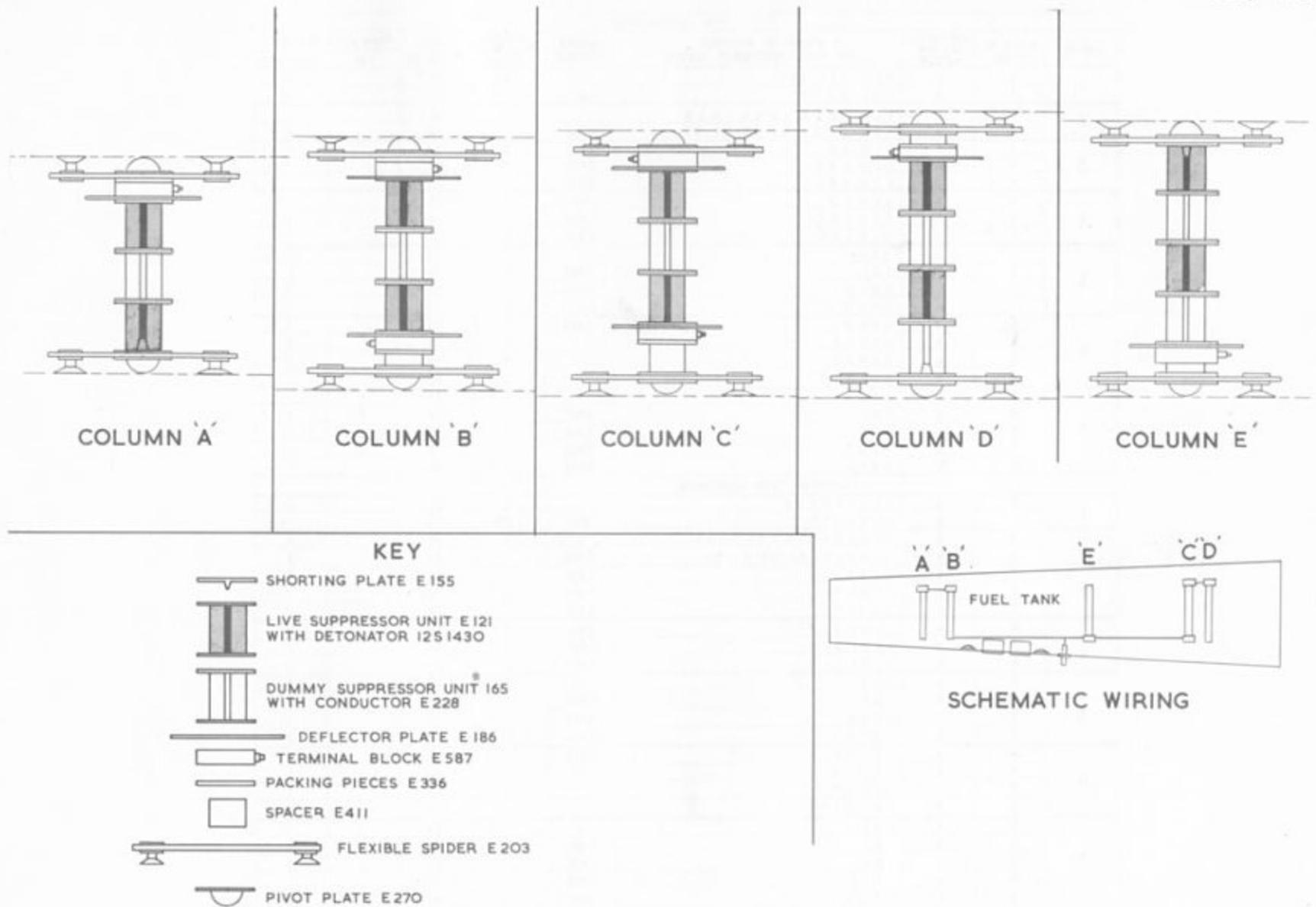


Fig.9 No.7 tank - suppressor column details

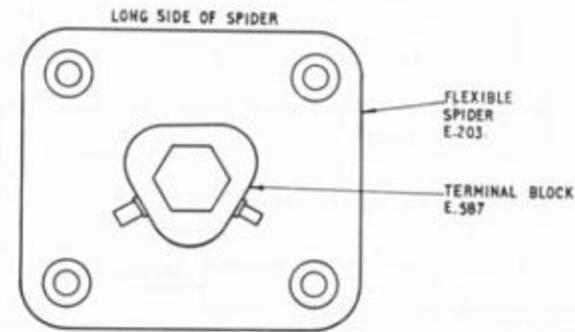
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PORT TANK INSTALLATION								
TANK N°	REFER TO FIGURE	SUPPRESSOR COLUMN LETTER	ORDER OF ASSEMBLY FROM TOP OF SUPPRESSOR COLUMN	SPACER ASSEMBLY	NUMBER OF PACKING PIECES	CABLE LENGTH INS.	TERM BLOCK POSITION	
							TOP	BOTTOM
1	3	A	LLD LLD LLD	-	4	36		2X
	3	B	LLD LD LD	E413	3*	72		3C
2	4	A	LLD LD LD LD LD LD LD L	-	2	36		1
	4	B	LLD LL DL DL DL DL DL	E406	1	54		2
3	5	A	LLD LD	E410	2	54		1
	5	B	LLD LD L	E407	2	72		1
	5	C	LLD LD L	E412	1	72		3
4	6	A	LLD LD	E411	1	54		1
	6	B	LLD LD L	E410	1	72		3
	6	C	LLD LD L	E412	2	36		2
5	7	A	LDL	-	1	72		1
	7	B	LDL	E407	2	54		1
	7	C	LDL D	E405	1	36		3
	7	D	LDL D	E411	2	72		2
6	8	A	LDL D	E405	2	72		2
	8	B	LLD LD	-	1	36		3
	8	C	LLD LD	-	4	36		3
	8	D	LDL D LD	-	1	72		1
7	9	A	LDL	-	2	54	1	-
	9	B	LDL	E407	-	36	2	3
	9	C	LDL	E410	1	36	1	1
	9	D	LDL D	E403	1	72	1	-
	9	E	LDL D	E402	2	36		1
STARBOARD TANK INSTALLATION								
1	3	A	LLD LLD LLD	-	5	36		1Y
	3	B	LLD LD LD	E413	3*	72		1b
2	4	A	LLD LD LD LD LD LD LD L	-	2	36		3
	4	B	LLD LL DL DL DL DL DL	E406	-	54		1
3	5	A	LLD LD	E410	1	54		3
	5	B	LLD LD L	E407	2	72		2
	5	C	LLD LD L	E412	1	72		1
4	6	A	LLD LD	E411	2	54		3
	6	B	LLD LD L	E410	2	54		2
	6	C	LLD LD L	E412	2	36		2
5	7	A	LDL	-	1	72		3
	7	B	LDL	E407	2	54		2
	7	C	LDL D	E405	1	36		1
	7	D	LDL D	E411	2	72		2
6	8	A	LD LD	E405	2	72		1
	8	B	LLD LD	-	1	54		1
	8	C	LLD LD	-	3	36		1
	8	D	LDL D LD	-	-	72		1
7	9	A	LDL	-	1	54	3	-
	9	B	LDL	E407	-	36	1	1
	9	C	LDL	E410	-	36	2	3
	9	D	LDL D	E403	-	72	3	-
	9	E	LDL D	E402	1	36		2

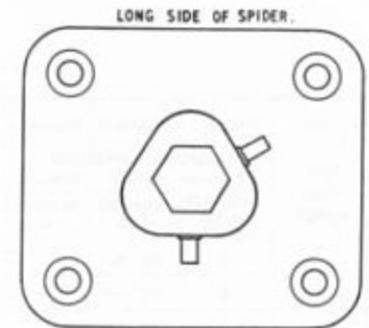
NOTES:-
 L — LIVE SUPPRESSOR UNIT.
 D — DUMMY SUPPRESSOR UNIT.
 * — 2 PACKING PIECES AT SPACER ASSEMBLY & ONE AT SPIDER.
 ALL PACKING PIECES GRAVINER PART N° E336.
 TERMINAL BLOCK POSITIONS SHOWN ON FIG.11

Fig.10 Suppressor column assembly

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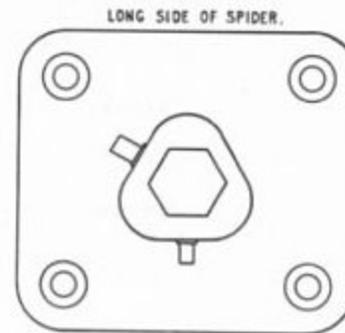


VIEWS SHOWN ARE LOOKING DOWN COLUMN FROM TOP WITH THE DEFLECTOR PLATE OR MOUNTING SPIDER REMOVED ACCORDING TO THE COLUMN.



POSITION 1.

USED ON		POSITION ON COLUMN
TANK N°	COLUMN	
2 PORT	A	BOTTOM
3 PORT	B	BOTTOM
3 PORT	A	BOTTOM
5 PORT	A	BOTTOM
5 PORT	B	BOTTOM
6 PORT	D	BOTTOM
7 PORT	A	TOP
7 PORT	C	TOP & BOTTOM
7 PORT	D	TOP
7 PORT	E	BOTTOM
1 STAR.	A	BOTTOM
1 STAR.	B	BOTTOM
2 STAR.	B	BOTTOM
3 STAR.	C	BOTTOM
5 STAR.	C	BOTTOM
6 STAR.	A	BOTTOM
6 STAR.	B	BOTTOM
6 STAR.	C	BOTTOM
6 STAR.	D	BOTTOM
7 STAR.	B	TOP & BOTTOM
4 PORT	A	BOTTOM



POSITION 2.

USED ON		POSITION ON COLUMN
TANK N	COLUMN	
1 PORT	A	BOTTOM
2 PORT	B	BOTTOM
4 PORT	C	BOTTOM
5 PORT	D	BOTTOM
6 PORT	A	BOTTOM
7 PORT	B	TOP
3 STAR.	B	BOTTOM
4 STAR.	B	BOTTOM
4 STAR.	C	BOTTOM
5 STAR.	B	BOTTOM
5 STAR.	D	BOTTOM
7 STAR.	E	BOTTOM
7 STAR.	C	TOP & BOTTOM

POSITION 3.

USED ON		POSITION ON COLUMN
TANK N°	COLUMN	
1 PORT	B	BOTTOM
3 PORT	C	BOTTOM
4 PORT	B	BOTTOM
5 PORT	C	BOTTOM
6 PORT	B	BOTTOM
6 PORT	C	BOTTOM
7 PORT	B	BOTTOM
2 STAR.	A	BOTTOM
3 STAR.	A	BOTTOM
4 STAR.	A	BOTTOM
5 STAR.	A	BOTTOM
7 STAR.	A	TOP
7 STAR.	C	BOTTOM
7 STAR.	D	TOP

Fig.11 Column terminal block positions

PRINT TO USE

COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6	COLUMN 7	COLUMN 8	COLUMN 9	COLUMN 10	COLUMN 11
FUEL TANK NUMBER	INDIVIDUAL SUPPRESSOR COLUMN VALUES (OHMS)			INDICATOR FUSE PART NUMBER	SUPPRESSOR COLUMN GROUP VALUES (OHMS)			INDICATOR FUSE VALUES (OHMS)		FUEL TANK COLUMN CIRCUIT
	SUPPRESSOR COLUMN LETTER	COMPUTED VALUE	MEASURED VALUE		COMPUTED VALUE FROM COL. 3	COMPUTED VALUE FROM COL. 4	MEASURED VALUE	MEASURED VALUE	LIMITS	
1	A	60 - 96		E302	24 - 38.7				5.2 - 7.2	
	B	40 - 64								
2	A	90 - 144		E302	45 - 72				5.2 - 7.2	
	B	90 - 144								
3	A	30 - 48		E303	12 - 19.2				3.5 - 4.8	
	B	40 - 64								
	C	40 - 64								
4	A	30 - 48		E303	12 - 19.2				3.5 - 4.8	
	B	40 - 64								
	C	40 - 64								
5	A	20 - 32		E304	5 - 8				2.6 - 3.4	
	B	20 - 32								
	C	20 - 32								
	D	20 - 32								
6	A	20 - 32		E304	6.66 - 10.66				2.6 - 3.4	
	B	30 - 48								
	C	30 - 48								
	D	30 - 48								
7	A	20 - 32		E303	10 - 16				3.5 - 4.8	
	B	20 - 32								
	C	20 - 32								
	D	20 - 32								
	E	20 - 32								

Fig.12 Suggested record sheet

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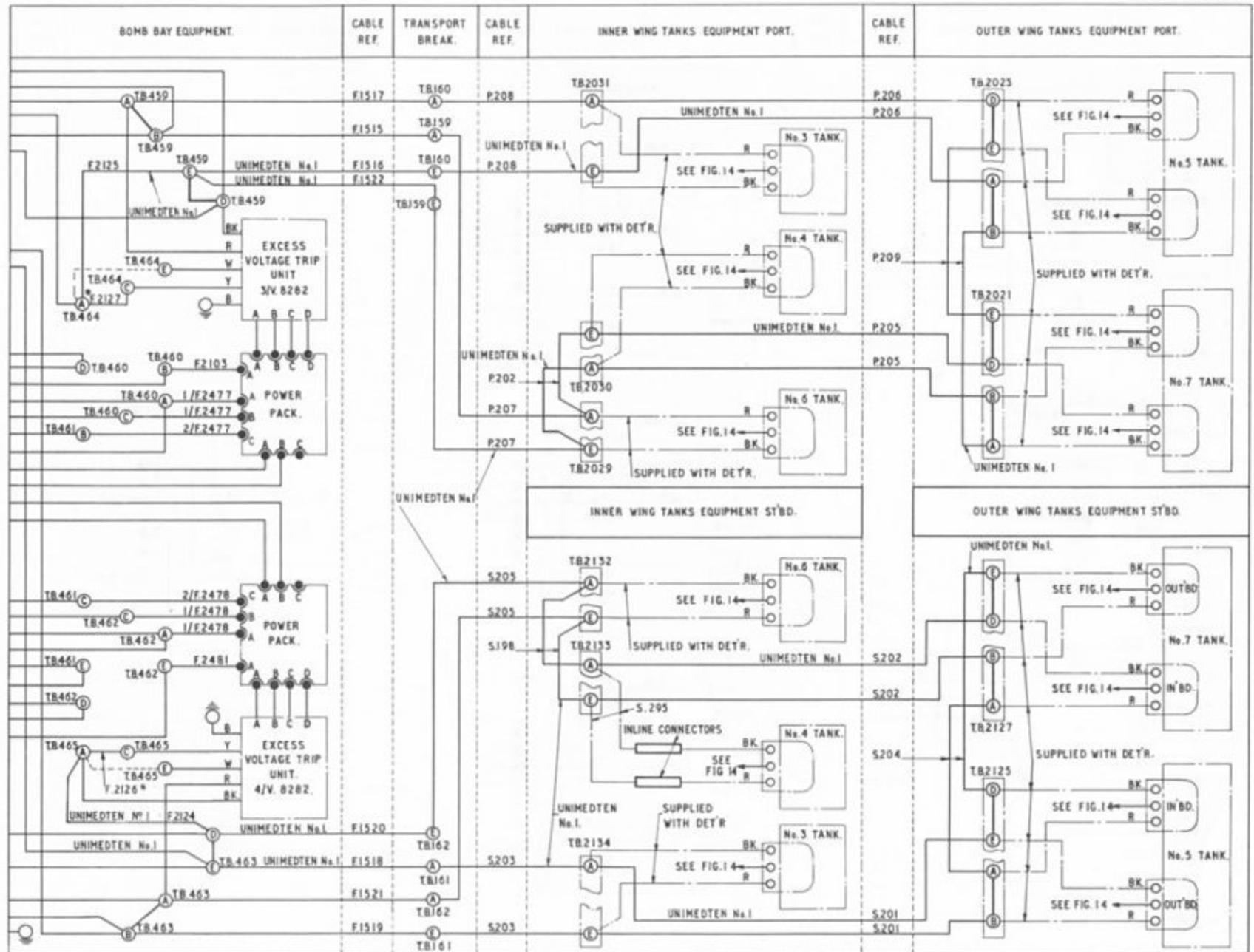


Fig.13(2) Explosion protection power supplies

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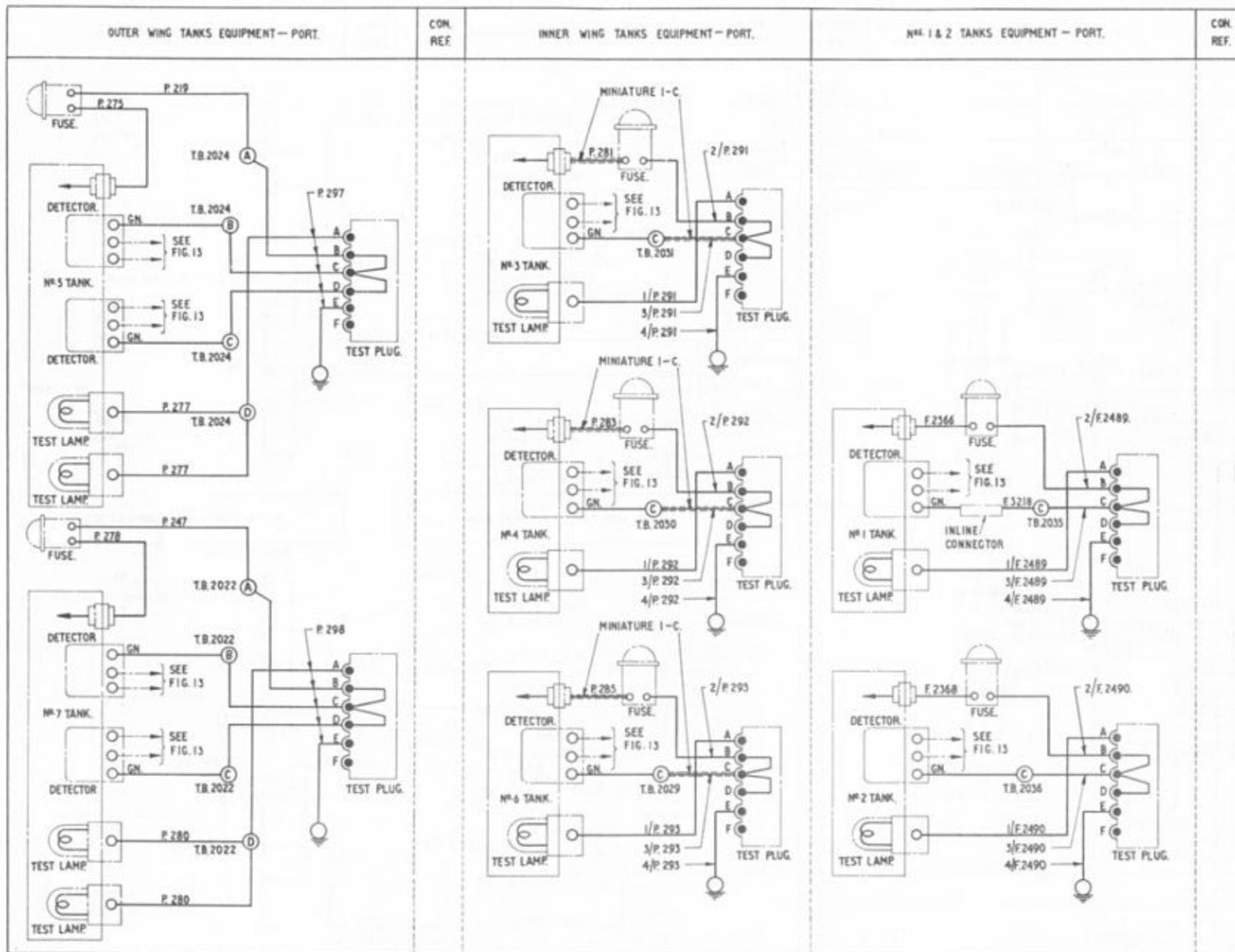


Fig.14(1) Explosion protection wiring

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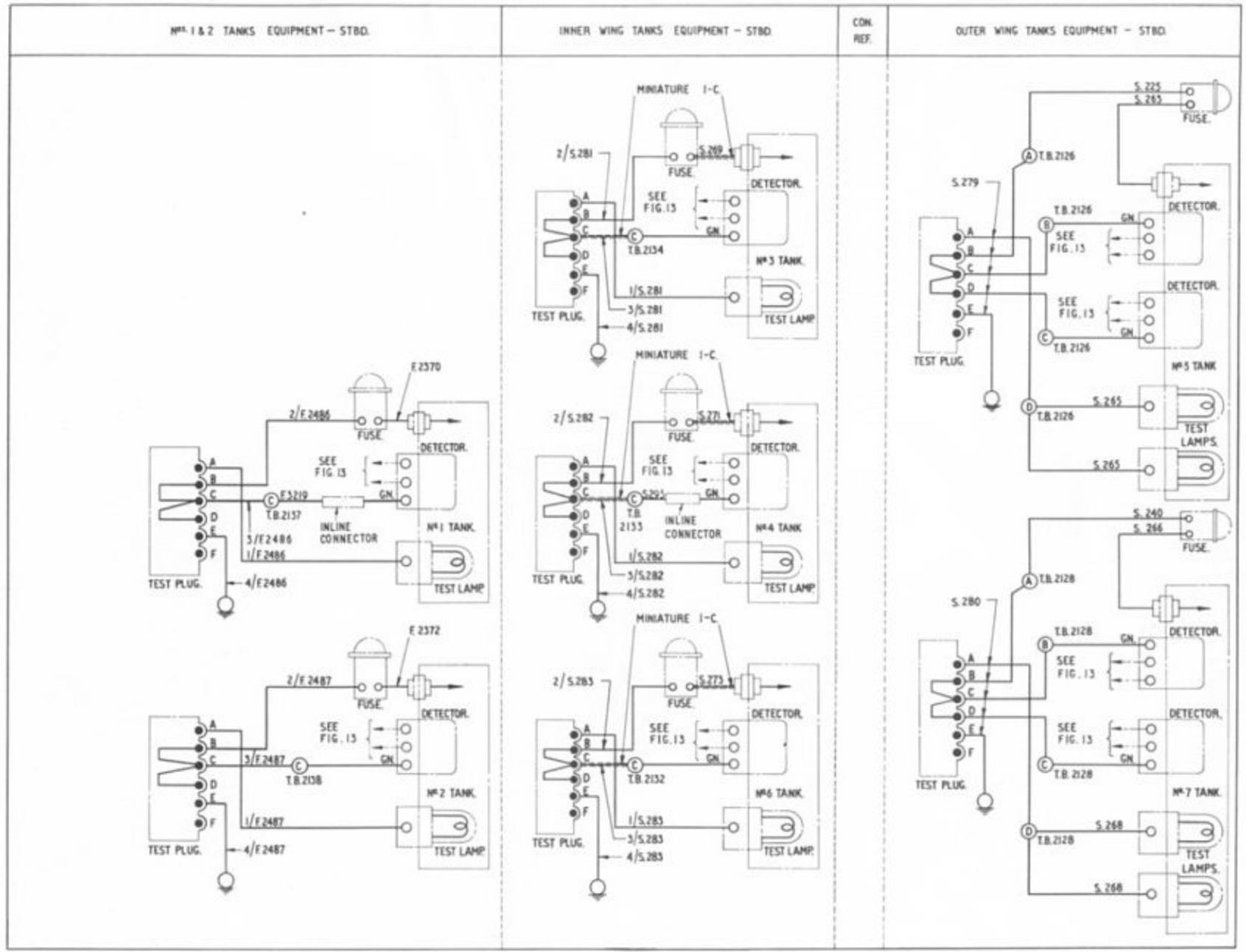
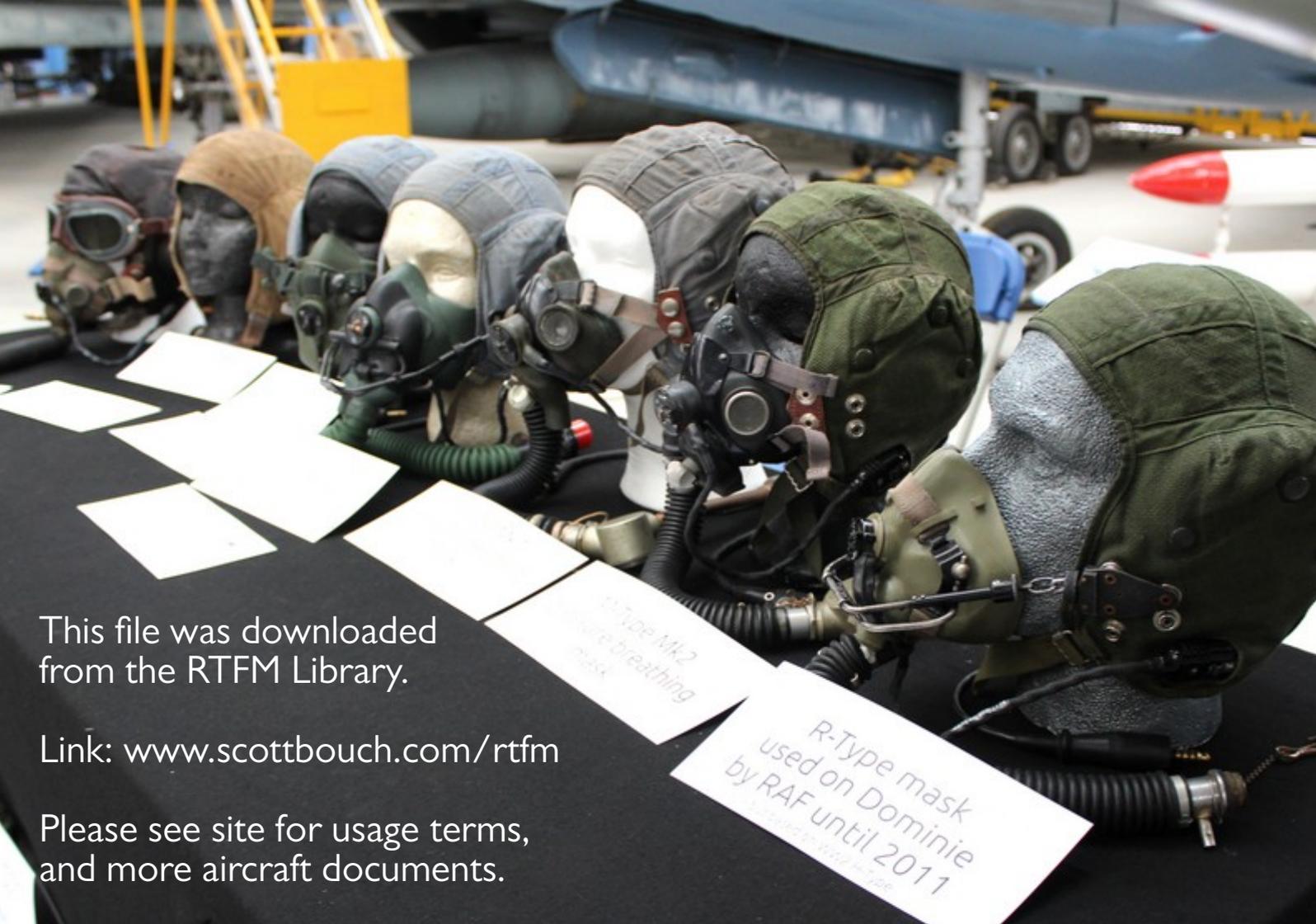


Fig.14(2) Explosion protection wiring

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