Chapter 16

ADDITIONAL AIRBORNE EQUIPMENT

LIST OF CONTENTS

	Para.
DESCRIPTION	
Introduction	1
Cooling system	
General	2
Water/glycol circuit	3
Reservoir	8
Pumps	9
Reservoir pressurisation	10
Cooling pack	
General	11
Condenser and ram air intake	19
Cooling operation	20
Control	21
Expansion valve	22
Pressure-maintaining valve	25
Condenser servicing valve	27
V.P.S.U. and hot gas by-pass valve	28
Time delay unit	31
High temperature switch	32
High pressure switch	33
Cooling pack mounting and hoists	34
Canister mountings	
General	35
Canister hoist	41
Socket plates and ballast	45
Access doors	49
Rear warning installation	
General	52
Pressurisation system	56
Cooling system	60
Louvre panel	63
Radome and mounting ring	64
Transportation panel	66
Turbo-alternator Type T.G.A.30	
General	69
Bleed valve cockpit controls	70
Turbine speed control	71
Mounting	72
Hoisting attachment	73
Charge air duct	74
Cooling	75
Access door and cooling air delivery ducting	76
Access panel	77
Air outlet duct	78
SERVICING	
Water/glycol system	
General	79
Draining	80
Flushing the system	82
Flushing the canisters and socket plates	83
Filling and bleeding	84
Charging and bleeding a canister	87
Pressure testing	88
Testing the pumps	92
Cooling pack	
General	94
Oil charging	104
Charging with refrigerant and nitrogen	105
Checking the refrigerant content	106
Periodic checks	108
Draining	109
Inhibiting	110
Drying out the condenser	111
Rear warning installation	
General	112
Pressure test	114
Turbo-alternator	
General	116
Lubrication	118
Setting the overspeed trip	119
REMOVAL AND ASSEMBLY	
Water/glycol system	120
Removal of cooling pack	121
Installation of cooling pack	122
Condenser removal	124
Installation of condenser	125
Canister removal	126
Installation of canister	127
Radar head pressurisation system	128
Removal of radar head	129
Installation of radar head	130
Removal of turbo-alternator	131
Installation of turbo-alternator	132

LIST OF TABLES

	Table
Pressure/temperature table of Arcton 11 plus nitrogen	1

LIST OF ILLUSTRATIONS

	Fig.
Cooling system	1
Cooling system diagram	2
Cooling pack installation	3
E.C.M. ballast and stowage - Part A, Mod.949	4
E.C.M. ballast and stowage - Part B, Mod.949	5
Rear warning cooling and pressurisation installation	6
Turbo - alternator installation	7
Cooling pack servicing diagram	8
Ground cooling adapters for turbo-alternator	9
Cooling pack removal	10
Condenser removal	11
Canister removal	12
Removal of radar head	13
Removal of turbo-alternator	14

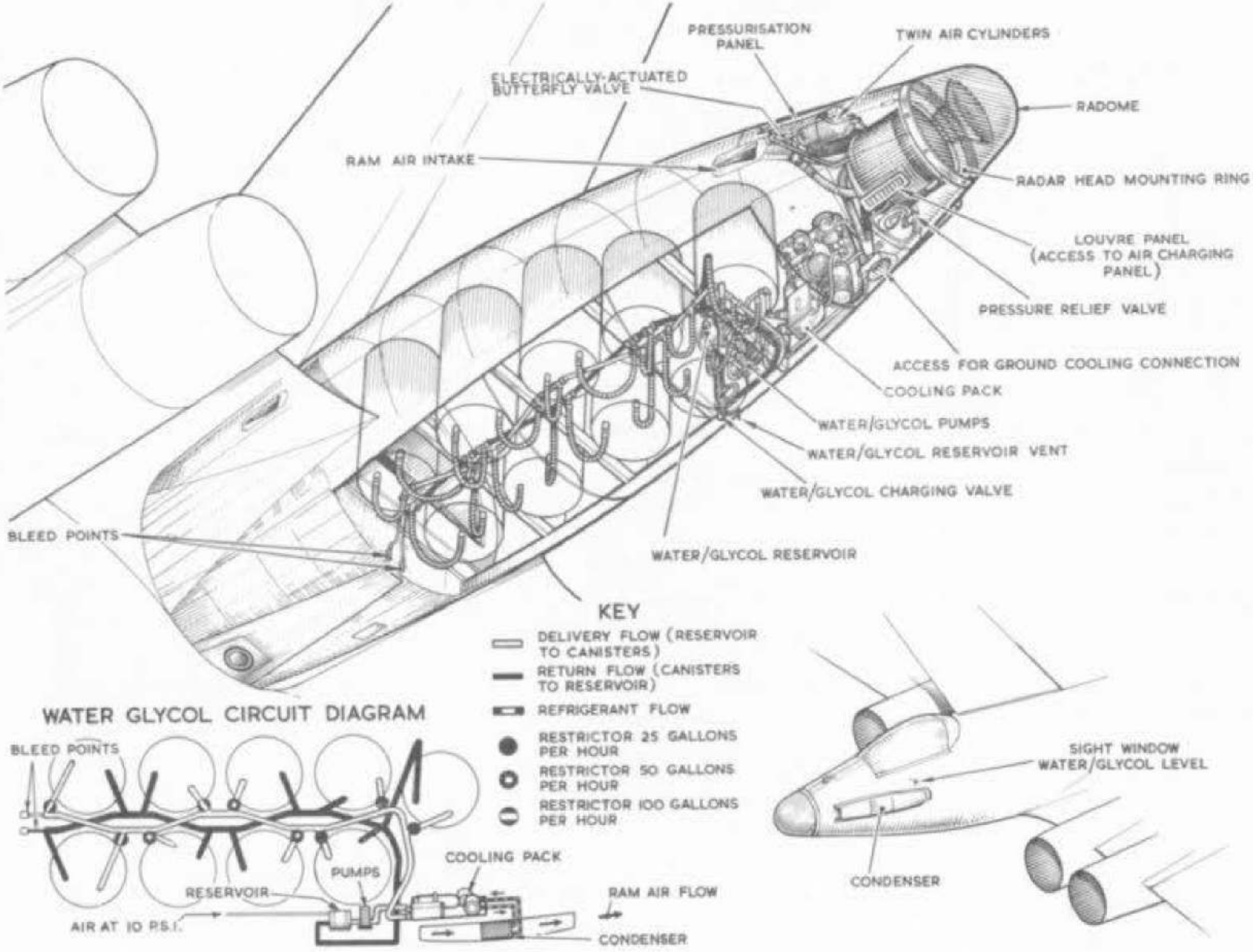


Fig. I. Cooling system

RESTRICTED

DESCRIPTION

Introduction

1. This chapter describes the water/glycol and vapour cycle systems used to control the operating temperature of the E.C.M. equipment in the rear fuselage, together with the procedures for servicing and removal of various units. Information is also given on the turbo-alternator, which supplies the electrical power to the equipment, and the cooling and pressurisation systems associated with the radar head. For detailed information on the turbo-alternator and the vapour cycle cooling pack refer to A.P.2240C, Vol.1, and A.P.4787A Vol.1 respectively.

COOLING SYSTEM

General

2. The system is designed to control the temperature, at which the E.C.M. units operate, under all aircraft operating conditions. This is achieved by circulating a mixture of water and ethylene glycol through the heat exchangers inside the canisters containing the E.C.M. equipment and controlling the temperature of the mixture by a Godfrey cooling pack. All units of the system are located in the rear fuselage. Cockpit controls consist of on and off push switches, a three position temperature indicator and a temperature gauge. For full details of these controls refer to Book 2 of this A.P.

Water/Glycol circuit (fig.1)

3. The water/glycol coolant (Ref.No. 34B/1407) is circulated by two pumps, arranged in parallel, which receive the fluid from a reservoir. The fluid is delivered from each pump, via non-return valves which prevent by-passing of the fluid back to the reservoir in the event of a failed pump, to the evaporator unit of the cooling pack and thence to the canisters. The circuit is normally pressurised from the aircraft pneumatic system to 10 p.s.i.g., to prevent evaporation of the coolant and cavitation of the pumps at high altitude. A pressure switch, connected to the delivery line from the pumps, switches off the pumps when the fluid viscosity is high and the delivery pressure reaches 30^{+2}_{-1} p.s.i.g. In this way the pumps are safeguarded should they be started when the system is at a very low temperature. In consequence of the pressure drop when the pumps 'cut out', the switch will remake, resulting in a further operation of the pumps and a further pressure rise. Thus the pumps will be intermittent in operation until such time as an input of heat reduces the viscosity of the water/glycol to normal.

4. The connections to the inlet and outlet of the evaporator are made by 1 in. Avery couplings and flexible pipes. The fluid is carried in a gallery of rigid pipes run between the two rows of canisters. Each canister is connected to the gallery by a pair of flexible hoses with stainless steel quick-release ¾ in. Avery bayonet couplings, (AVX 3520 and AVX 3522, inlet and outlet respectively). After circulating through the canisters, the fluid is returned to the gallery and thence to the reservoir. Two bleed screws are provided on the evaporator and two on the aft face of former 487·5 in.A.

5. As the maximum heat load from each canister is different, restrictors are fitted in the flexible delivery pipes to ensure that the flow of water/glycol is proportional to the heat load in the canister. The system can be operated with one or more canisters not fitted in the aircraft as the flow through the remaining canisters will be maintained.

6. A thermostat unit is positioned in the circuit. This unit operates the three position indicator at the A.E.O.'s station to read LOW when the temperature of the coolant reaches 34°F ± 1·8°F. The canisters should not be operated whilst the water/glycol temperature is below 32°F and so the indicator provides the operator with a warning to this effect. When the cooling pack and the water/glycol pumps are switched on, the low temperature indication is maintained until the water/glycol temperature rises 3°F above the low temperature setting of the thermostat. This causes the indicator to change to ON. With the pack inoperative the indication becomes OFF. The temperature of the coolant is also constantly monitored by a gauge positioned adjacent to the three position indicator. This gauge, calibrated from -80°C to +80°C, is operated by a sensing bulb fitted in the pipe-elbow, immediately downstream of the evaporator.

7. The system is charged through a combined charging and overflow valve (Dowty Pt. No.C.7335Y. A. 14). The charging connection is fed into the main pipe between the canisters and the reservoir and the overflow is piped from the side of the reservoir. The total capacity of the system is approximately 7·5 gallons.

Reservoir

8. The fluid reservoir (Dowty Pt. No. 100467.001) has a fluid capacity of 7½ pints and an air space of approximately 1½ pints. A sight glass, mounted in the rear face of the reservoir for observation of the fluid level, is viewed through a small perspex window in the rear fuselage skinning, just aft of station 71·25 in. A, starboard side. A lamp, to illuminate the sight glass, is fitted to the reservoir mounting bracket. The reservoir is pressurised through a combined non-return air inlet and pressure relief valve. This valve operates at 15-18 p.s.i.g. with a minimum reseat pressure of 7 p.s.i.g. A pipe, connected to the valve outlet, vents to atmosphere, at a point adjacent to the water/glycol charging valve.

Pumps

9. The two electrically driven pumps (Part No.SPE.16291), together deliver 520 g.p.h. ± 5 per cent at 20°C. They are connected in parallel and deliver fluid into a common line. In the event of failure of one pump the other will circulate fluid at approximately 90 per cent of the normal rate.

Reservoir pressurisation

10. Air, tapped from the pneumatic feed to the inflatable seal at the rear end of the bomb bay, pressurises the glycol system to 10 p.s.i.g. From a tee-piece in the feed line to the seal, at a point just before the unimatic valve, the glycol system pressurisation pipe is led across to the starboard roof structure, from where it runs directly aft to the air inlet connection on the reservoir.

COOLING PACK

General

11. The vapour cycle cooling pack (Godfrey, Type VCP-1 Mk.1) is introduced to control the temperature of the water/glycol mixture circulating through the heat exchangers of the E.C.M. canisters. The primary function of the pack is to absorb heat from the water/glycol at a low temperature level and then reject it to atmosphere at a higher level. This is achieved by using the heat removed from the water/glycol to evaporate the refrigerant at a low pressure and temperature, and then compressing the vapour to a higher temperature so that this heat and the heat of compression, is transferred to a flow of ram air which condenses the refrigerant. This liquid, which is at condensing pressures and temperatures, is then cooled by expanding it through a valve between the condenser and evaporator.

12. The secondary function of the pack is to put heat into the water/glycol when the aircraft is operating in cold ambient conditions and the temperature of that coolant is below, or tends to fall below, the level necessary for maintaining the fixed evaporating temperature of the refrigerant. This is approximately 15°C.

13. The transformation of the pack into a heater automatically comes about when the compressor can no longer maintain its normal delivery pressure to the condenser. This is in consequence of the fact that, with the pack operating in cold conditions, with no heat load to remove from the water/glycol, the evaporating pressure will fall; whilst the condenser will become overcooled and absorb the compressor output at an excessive rate.

14. The effect of the reduced pressure is to allow a pressure-maintaining valve to close and so prevent further delivery to the condenser. This valve operates in conjunction with a by-pass circuit, which opens on reduction of the evaporating pressure and allows the hot compressed vapour to be returned, directly, to the evaporator. In this way, the heat of compression is used to restore and maintain the temperature of the water/glycol.

15. In operation, the compressor is protected by high pressure and high temperature switches, whilst a time delay device guards against a restart being made during run down.

16. The cooling pack consists of the following main components which are contained on a panel secured to the starboard structure of the rear fuselage by quick release Pip-pins:-

(1) Compressor

(2) Vapour oil separator

(3) Liquid receiver (with level indicator).

(4) Filter drier

(5) Manual shut-off valve

(6) Expansion valve

(7) Evaporator

(8) Pressure-maintaining valve

(9) Hot gas by-pass control valve

(10) Vapour pressure sensing unit (V.P.S.U.).

(11) Oil container

(12) High temperature switch (with indicator)

(13) High pressure switch

(14) Time delay unit

(15) Vapour filter unit

(16) Compound gauge

(17) Skin temperature indicator (−80°C to + 80°C)

(18) Condenser servicing valve (on packs to Mod.1461 standard).

17. The only unit of refrigeration not contained within the pack is the condenser which is positioned in the airflow and connected to the pack by pipelines. The refrigerant used in the system is Arcton 11 or Freon 11 which, in the liquid state, is clear and water-white, giving a colourless vapour with a faint odour of ether. At normal atmospheric pressure it will boil at 23·7°C. The circuit, after evacuation of all air, is charged with 12 lb. ± ½ lb. of this refrigerant. In the circuit the charge will be in both the liquid and vapour state, the vapour pressure depending on the system temperature. The vapour pressure is increased by a small charge of nitrogen, introduced into the system to act as a datum pressure. Although lowering the efficiency of the pack as a cooler, the nitrogen charge assists the recovery of the pack, when, in cold ambient

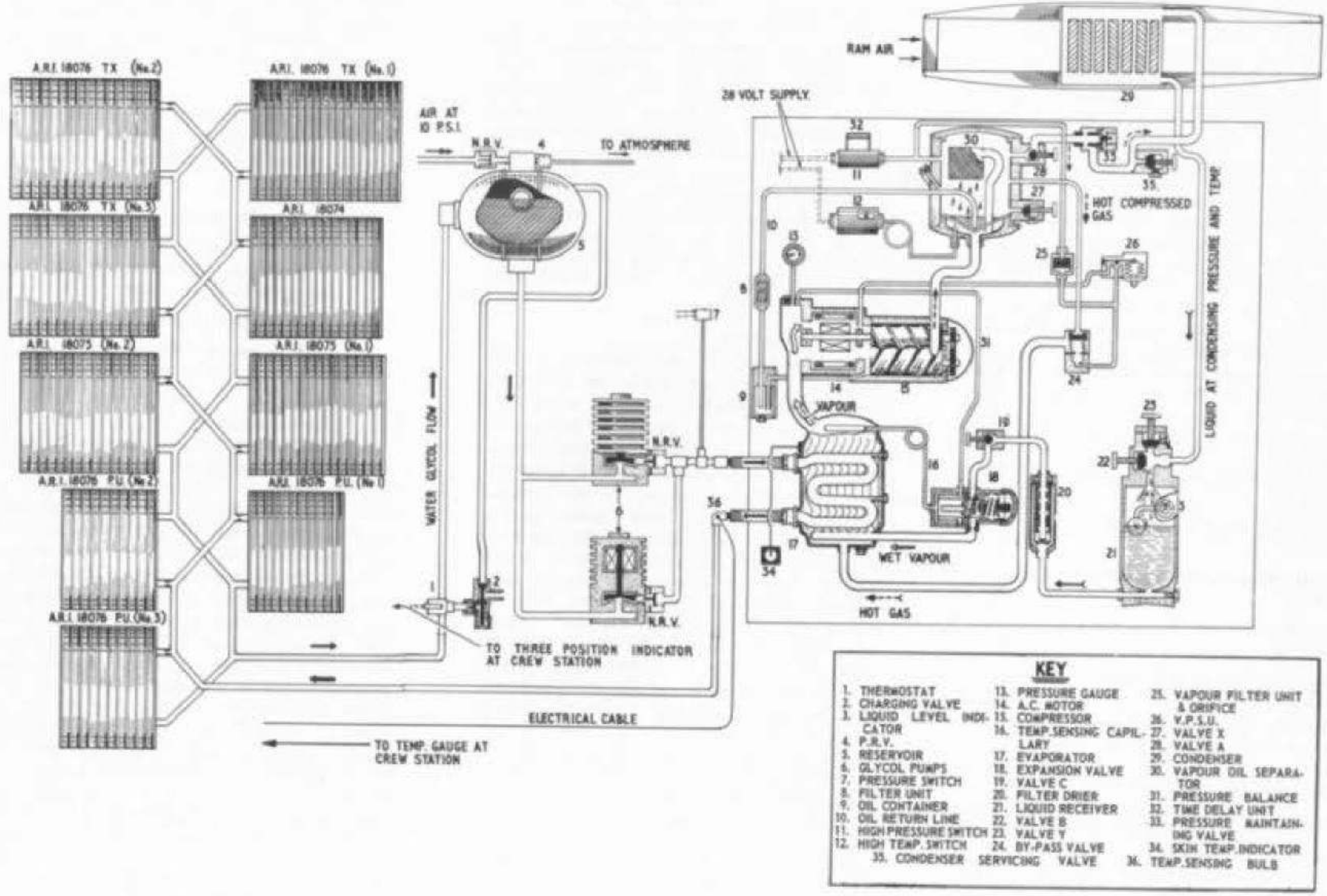


Fig. 2. Cooling system diagram
(◄ Mod. 1450 ►)

temperatures, it reverts to a cooler after a period of operation as a heater. Whilst the pack is acting as a heater, the nitrogen prevents the pressure in the condenser from falling to a very low value. An excessively low condenser pressure could so reduce the effect of the hot compressed vapour released when the pressure-maintaining valve opens, that the flow from the expansion valve would not be induced in sufficient time to counteract the heat load coming on the evaporator. This could result in a high temperature cut out.

18. The compressor is lubricated with 350 c.c. of dehydrated Aeroshell Turbine oil 300. The correct quantity for one charge is supplied in a sealed container (Ref.No.34B/1430) which can be screwed into the filler orifice in the vapour/oil separator. This enables a measured quantity to be squeezed into the separator without spillage. Drain plugs are provided in the base of the oil container, liquid receiver and evaporator. Servicing and shut-off valves are marked and positioned as follows:-

	Marking
Shut-off valve on the vapour oil separator	A
Shut-off valve on the liquid receiver	B
Shut-off valve on the expansion valve	C
Servicing valve on the vapour oil separator	X
Servicing valve on the liquid receiver	Y

Condenser servicing valve on the pressure-maintaining valve (Mod. 1461).

Condenser and ram air intake

19. The Marston condenser (Part No. D1177/2A) is positioned in the ram air intake on the starboard side of the rear fuselage at former 120·25 in. A. The intake is constructed in three sections of which the front and rear are riveted to the fuselage skin. The centre section, attached by screws and anchor nuts, is removable to give access to the condenser which is secured to three fuselage brackets by shackle pins. The fore and aft ends of the condenser butt against the front and rear sections of the intake, where the joints are made by P-section rubber seals. Short inlet and outlet pipes, integral with the condenser, pass through two holes in the fuselage skin to connect with the refrigerant return and delivery pipes. The nose portion of the ram air intake is removable and embodies an electrically-heated anti-icer which is operated in conjunction with the aircraft anti-icing system. Provision is made for checking the anti-icer by a push switch on relay panel 44P in the E.C.M. bay. The switch is labelled, DE-ICING TEST SWITCH FOR FREON COOLING INTAKE. MAX TIME 'ON' 60 SECS.

Cooling operation

20. The cooling pack operates on the principle of vapour cycle refrigeration, that is, compression, cooling, expansion and heating. Heated, vaporised refrigerant at low pressure is drawn from the evaporator into the compressor where it is raised to condensation pressure. In the process of compression it also gains further heat. Oil for lubrication of the compressor rotor and bearings is also drawn through the compressor from the oil container. The oil is discharged from the compressor with the refrigerant vapour and both are passed into the vapour oil separator. The separated oil is piped back to the oil container for re-circulation. The vapour is passed to the condenser mounted in the air flow. The cooling action of the ram air extracts the heat of evaporation and compression and the refrigerant is converted to a liquid which, at condensing pressures and temperatures, is piped back to the liquid receiver mounted on the pack. The liquid refrigerant is then passed through a filter drier and a manual shut-off valve to the expansion valve. On passing through the expansion valve the refrigerant drops in pressure and temperature and changes to a wet vapour. The expansion valve controls the rate of refrigerant flow to the evaporator where, under conditions of superheat, complete vaporisation takes place, the latent heat of vaporisation being given up to the refrigerant by the water/glycol mixture. The heated gas at low pressure now passes from the evaporator and the cycle is repeated.

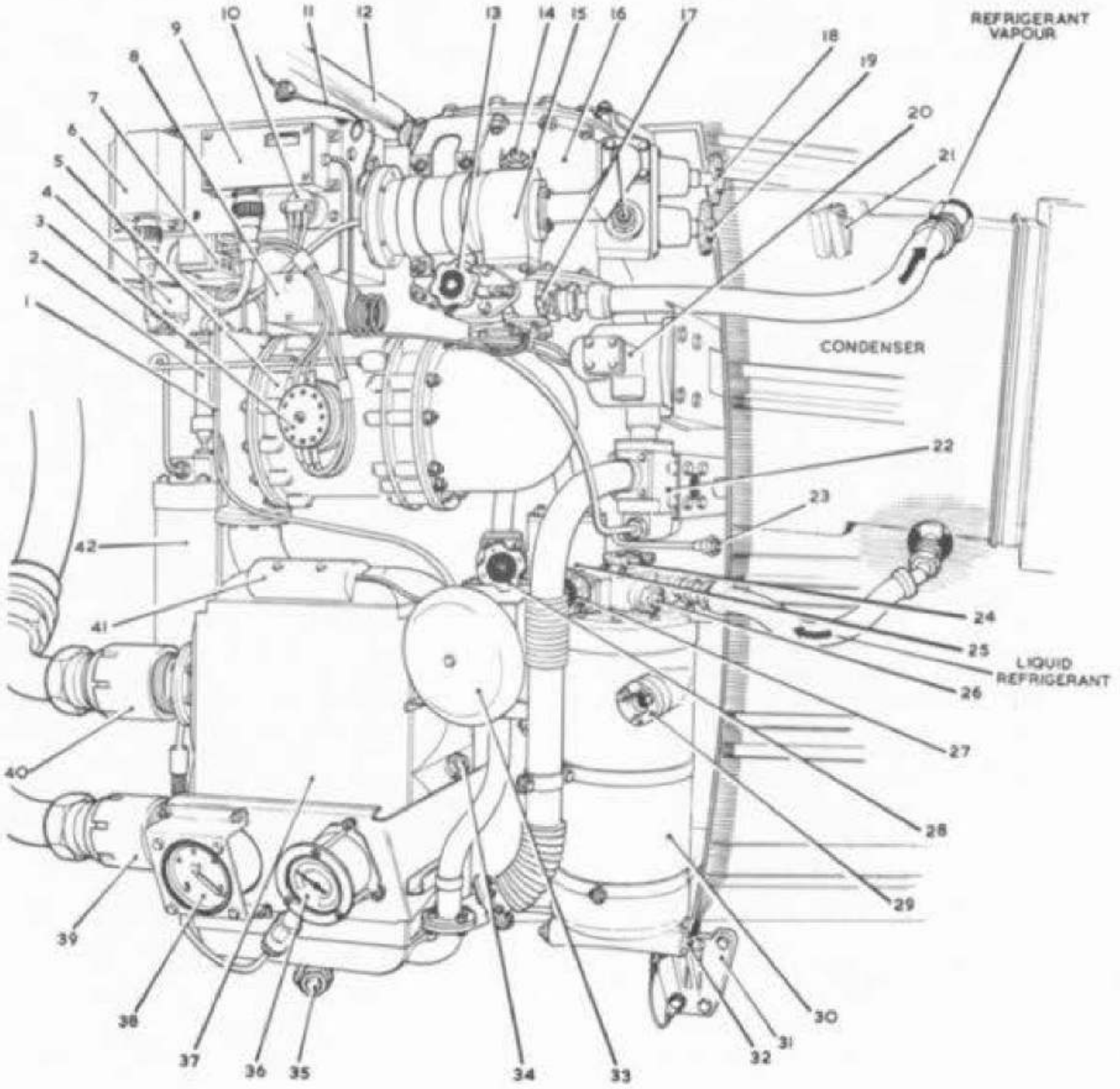
Control

21. Operating control of the cooling pack is carried out by the following components, all of which are contained on the pack.

(1) Expansion valve.
(2) Pressure-maintaining valve.
(3) Vapour pressure sensing unit and hot gas by-pass valve.
(4) High temperature switch
(5) High pressure switch

Expansion valve

22. The expansion valve, by controlling the rate of flow of the wet vapour available to the evaporator, determines the evaporating temperature. This is effected by a mechanism regulating the flow through the expansion valve orifice, the mechanism being controlled by a temperature sensing device mounted at the outlet of the evaporator. If the amount of refrigerant passing into the evaporator is insufficient to deal with the heat given up by the circulating water/glycol, then the consequent rise in temperature at the evaporator outlet will cause the fluid in the sensing device to expand. This will open the expansion valve orifice to pass a greater quantity of refrigerant. The expansion valve will eventually stabilise itself to hold the evaporator outlet temperature at the required constant evaporating temperature. Conversely, any reduction of the heat load in the evaporator will reduce the flow from the expansion valve, which will again stabilise at the reduced orifice setting.



KEY

1. PRESSURE BALANCE PIPE
2. OIL FILTER
3. TERMINAL BLOCK
4. FILTER UNIT
5. MOTOR COMPRESSOR
6. TIME DELAY UNIT
7. TERMINAL BLOCK (A.C. SUPPLY CONNECTOR)
8. RELAY
9. HIGH TEMPERATURE SWITCH
10. TRIGGER UNIT
11. EARTHING WIRE
12. SUPPORT ROD
13. CONDENSER SERVICING VALVE
14. OIL FILLER PLUG
15. PRESSURE MAINTAINING VALVE
16. VAPOUR OIL SEPARATOR
17. SERVICING PLUGS
18. SHUT-OFF VALVE (A)
19. SERVICING VALVE (X)
20. VAPOUR PRESSURE SENSING UNIT
21. CONDENSER SUPPORT BRACKET
22. BY-PASS VALVE
23. INSTRUMENTATION POINT
24. SERVICING VALVE (Y)
25. FILTER DRIER
26. SERVICING PLUG
27. SHUT-OFF VALVE (B)
28. SHUT-OFF VALVE (C)
29. LIQUID LEVEL INDICATOR
30. LIQUID RECEIVER
31. ATTACHMENT BRACKET
32. DRAIN PLUG
33. PROTECTOR FOR EXPANSION VALVE CAPILLARY
34. WATER/GLYCOL BLEED SCREW
35. DRAIN PLUG
36. COMPOUND GAUGE
37. EVAPORATOR
38. TEMPERATURE INDICATOR
39. SELF-SEALING COUPLING (WATER/GLYCOL OUTLET)
40. SELF-SEALING COUPLING (WATER/GLYCOL INLET)
41. INSULATOR OVER TEMPERATURE SENSING ELEMENT
42. OIL CONTAINER

NOTE:
LAGGING WHICH NORMALLY ENCLOSES ITEMS 15, 16, 20 AND 22 HAS BEEN OMITTED IN ORDER TO SHOW COMPONENT DETAIL

Fig. 3. Cooling pack installation.

23. The evaporating temperature is such that the vapour at the outlet side of the evaporator is subjected to slight superheating. This is brought about by pre-regulating the temperature control mechanism of the expansion valve to give a small reduction of the refrigerant flow in relation to the vaporising heat available from the water/glycol. After vaporis-ation has taken place, this excess heat, or superheat, positively ensures that complete vaporisation takes place and that liquid droplets of refrigerant do not enter the compressor.

24. A pressure balance line is connected between the compressor inlet and the expansion valve to counteract the influence of the variable pressure drop across the evaporator on the action of the expansion valve.

Pressure-maintaining valve

25. This valve, positioned in the delivery line to the condenser, maintains a compressor delivery pressure that will, in low ambient temperatures when no heat load is being given up by the water/glycol, ensure the pack operates to heat the water/glycol. The maintenance of the pressure is also necessary for the rapid recovery of the pack, from a heater to a cooler.

26. The valve is spring-loaded to the closed position and operated to open the delivery line when its bellows are compressed by delivery pressure. When the pack is cooling, the compressor delivery pressure is normal and the valve is maintained fully open, allowing the hot vapour to pass to the condenser. As a result of the heat load coming off the evaporator, the compressor delivery pressure will fall and allow the valve to move to the closed position. The delivery pressure will then be maintained at a value equivalent to the valve loading. At this pressure, the hot compressed gas will be diverted into the by-pass system to function the pack as a heater, whilst the vapour pressure in the condenser will fall and any flow from the expansion valve will stop. When it becomes necessary for the pack to revert to a cooler, the pressure build-up against the pressure maintaining valve will, when the valve opens, result in a pressure surge of hot vapour into the condenser. This, assisted by the nitrogen datum pressure, will counteract the extreme cooling effect of the condenser and start a flow through the expansion valve.

Condenser servicing valve

27. This valve, introduced by Mod.1461, is fitted to the outlet of the pressure maintaining valve to enable any moisture, that may have entered the condenser prior to that unit being connected to the pack, to be drawn off by a vacuum pump before valves A and B are opened.

V.P.S.U. and hot gas by-pass valve

28. As the heat load of the water/glycol reduces, the refrigerant flow from the expansion valve approaches the minimum and the rate of heat extraction from the water/glycol is correspondingly reduced. The point is reached when the water/glycol can no longer supply the heat necessary to maintain the evaporating temperature and in consequence the evaporating pressure will also fall. This pressure drop is sensed by the V.P.S.U. which, in turn, opens the by-pass valve.

29. The V.P.S.U. is a mechanism which operates to allow the pressure that maintains the by-pass valve on its seating, to escape. When the valve opens, hot compressed vapour, from the compressor delivery by-passes the condenser and returns directly to the evaporator to restore the evaporating pressure. In conditions where the condenser is subjected to excessive cooling, the flow to the condenser is cut off by the pressure-maintaining valve moving to the closed position. In this case, the full flow from the compressor will be diverted into the by-pass system and the evaporator will become flooded with hot vapour.

30. A pipe line, incorporating a vapour filter unit and orifice, is led from the oil separator to join the pipe connecting the vapour pressure sensing unit and the by-pass valve. This orifice bleeds hot compressed gas to pressurise the bellows of the by-pass valve and maintain the valve on its seating at all times when the pack is not operating on by-pass. The setting of the V.P.S.U. is such that the by-pass valve will be fully closed when the water/glycol temperature reaches 25°C.

Time delay unit

31. This unit is introduced to ensure that, when the compressor motor is switched off, either from the A.E.O.'s station or because of the operation of the high pressure or high temperature switches, a restart cannot be made until a period of one to two minutes has elapsed. The compressor runs down in reverse, and so, if a restart were achieved whilst this is happening, severe overloading of the compressor and motor would occur. Thus, the time delay affords protection to the compressor until its rotation in reverse has ceased. The reverse run down is caused by the back pressure set up against the compressor when the high pressure in the oil separator equalises with the low pressure in the evaporator.

High temperature switch

32. The system is safeguarded against excessive temperature by an automatic switch incorporating a temperature indicator. The switch is mounted on a panel adjacent to the oil separator to which it is connected by a sensing line. When the temperature in the oil separator increases beyond the specified maximum, the switch is operated to break the "hold on" circuit and stop the compressor. At the same time the indicator at the A.E.O.'s station will be de-energised to OFF and the action of the time delay unit will be started. Thus, in order to make a re-start, three conditions must be satisfied: the temperature in the pack must drop below the specified minimum

to allow the temperature switch to re-make, the time delay period of one to two minutes must have elapsed and the ON push switch at the A.E.O.'s station must be pressed.

High pressure switch

33. Upon increase in pressure beyond the specified maximum, a spring-loaded plunger is depressed by vapour pressure piped from the oil separator. This plunger operates a micro switch and with the same effect as the high temperature switch, breaks the circuit to stop the compressor. When the pressure drops below the minimum level the switch will remake and provided the time delay period has elapsed a restart can be made by pressing the ON switch.

Cooling pack mounting and hoists

34. The cooling pack, mounted between the formers at 95·75 in. A and 120·25 in. A, is attached at its base by two lugs secured by Pip-pins to brackets on the starboard longeron. At the top is a single lug to which is bolted a short rod, the other end of which is attached by a Pip-pin to a bracket on the underside of the brake parachute compartment. A slot and recess, cut into the top lug, provides for the attachment of a mini-hoist cable when removing or installing the pack. The mini-hoist is attached to the roller on the underside of the cross beam at 95·75 in. A and the cable passed upwards through a hole in the cross beam, through a cable guide and over a pulley assembly. From the rear pulley of this assembly the cable is taken to the top lug of the pack.

CANISTER MOUNTINGS

General

35. The nine canisters mounted in the rear fuselage consist of six transmitter units grouped in two rows forward and three power units grouped at the rear. For a diagrammatic arrangement of the units refer to fig.1.

36. All the units are mounted upside down, with the coolant bleed plugs at the bottom. For this reason the canister's heat exchangers must be filled and bled before fitment. On no account should the bleed plugs be slackened once the units are mounted in the aircraft, for they will act as drains and tend to induce air into the system.

37. To provide access to the equipment in the rear fuselage, three doors are positioned on the underside, between formers 487·5 in.A and 120·25 in.A (for former positions refer to Sect.3, Chap.1A, Fig.1).

38. The canisters are supported at their bases by cross beams mounted on the two main longerons and at their tops to intercostals attached between the formers. On the top of each canister is a spider mounting, the arms of which are attached to three studs mounted on the ends of the canister. Bolted to the centre of each spider is an A.V. type flexible mounting carrying an eye-bolt and a cup-shaped spigot which locates in a cylindrical housing in the respective intercostal.

39. A mounting ring is bolted to the base of each canister and two plates are attached to the periphery of the ring, by an A.V. flexible mounting. Screw pins, carried in brackets on the cross beams, engage with holes in lugs on the plates to secure the whole assembly to the beams. Tufnol blocks, fixed to the base of the mounting rings, provide a stable support for the canisters during bay servicing and transportation, and also, prevent damage to the rings when the canisters are being moved along a rough surface.

40. Hinged thumb plates, at their heads, provide the means of tightening and locking the screw pins. After tightening, the plates are folded so that their edges butt against the face of the respective cross beams. The thumb plates are retained in the locked position by a spring on the screw pin head. In the case of the screw pins at formers 487·5in.A and 120·25in.A the locking arrangement varies in that the plates are folded to engage with a peg protruding from the flange of the screw pin bracket.

Canister hoist

41. Each canister has its own hoisting system, comprising pulleys and cables, incorporated in the aircraft structure. The system is used in conjunction with a mini-lift hoist. A typical arrangement consists of two single pulleys in the intercostal above the canister and a double pulley wheel mounted on an axle in a bracket attached to the cross beam. This bracket also contains the screw pins securing the base mounting of the canister.

42. The nipple end of the cable assembly is fitted into a recess in one of the outer flanges of the double pulley. The cable passes around the wheel and up to the two pulleys in the intercostal, and thence down to the eye-bolt at the centre of the canister top mounting spider. A further recess, cut into the other outer flange of the double pulley wheel, accommodates the nipple end of a mini-hoist cable, when the hoist is secured by a special adapter to the attachment roller at the base of the double pulley wheel bracket. A Pip-pin, which passes transversely through the pulley and bracket, locks the pulley against rotation after the canister has been installed.

43. On removal and assembly of a canister, the mini-hoist is hooked into position on the roller and the cable nipple-end inserted into the slot of the double pulley. The Pip-pin is removed from the pulley and the mini-hoist cable tensioned to take the weight of the canister through the aircraft cable. The canister may now be released by removing

the screw pins securing the base, then lowered. During lowering, the cable of the mini-hoist winds on to the wheel to which it is attached, whilst the aircraft cable unwinds to lower the canister.

44. During hoisting of the canister the action is a reversal of the above. When the canister is in position and secured by the screw pins, the mini-hoist is unhooked and its cable disconnected. The Pip-pin is then inserted through the bracket and pulley wheel to lock the wheel against rotation. The wheel should be locked to take up as much cable slack as possible.

Socket plates and ballast

45. Canisters are listed with the various items of 'service fit' equipment. Aircraft which are to become airborne without 'service fit' equipment require three ballast weights to be installed in the E.C.M. compartment. The three weights, together with stowage facilities for the air cooling pipes of the rear warning radar installation and for the E.C.M. water/glycol hoses and electrical cables in the rear fuselage, are installed in accordance with Part A of Mod.949. To meet the ballast requirements of aircraft which are to become airborne without the canisters, but with all other 'service fit' equipment present, six additional weights are to be installed in the E.C.M. compartment in accordance with Part B of Mod.949.

46. When incorporating Part A, three ballasted socket plates, containing lead and steel discs and weighing approximately 245 lb. each, are hoisted up, in the same way as the canisters, and installed at the positions normally occupied by the three rear canisters. In addition, six socket plates, manufactured from Jabroc and weighing approximately 9 lb. each, are installed at the positions normally occupied by the six forward canisters. Part A also introduces a transportation panel for fitting in lieu of the rear warning radar unit. For details of the transportation panel refer to para.66.

47. The socket and ballast plates are similar to the canister base mountings in size, shape and means of attachment. At the centre of each plate is an eye-bolt to which the canister hoist cable is attached for stowage or hoisting purposes. Cables attached to installed plates for stowage purposes, are made taut and the double pulleys locked against rotation. All the plates introduced by Part A incorporate stowage sockets and stowage couplings for the hoses and cables normally connected to the canisters. The couplings on each plate are linked by a bridge pipe so that the water/glycol circuit will be complete and ready to function at all times.

48. When incorporating Part B, six 245 lb. ballast plates are to be installed at the six forward positions; the three rear positions are to be occupied by the ballasted socket plates installed in accordance with Part A. There are no stowage facilities on the six ballast plates and so, the electrical cables are taped to suitable members, the fuses applicable to the cables are removed, the water/glycol system is drained and the flexible hoses at the six forward positions are disconnected from the gallery. With the exception of one, the hoses are removed to store. The retained hose, (Pt.No.123/Q2111), is used to link the gallery feed and return pipes at the forward end; all other open pipe connections on the gallery are blanked. The circuit is inhibited by filling with water/glycol in accordance with para.86 (2) to (11). During the filling operation, the pumps will circulate the fluid via the link hose and the bridge pipes of the ballasted socket plates, to all parts of the piping. After the filling operation, the fuses protecting the water/glycol pumps are removed. Periodic operation of the pumps, however, will prevent sludging of the water/glycol.

Access doors

49. Each rear fuselage access door, which is of honeycomb construction and curved to conform with the fuselage contours, opens downwards on two arm type hinges let into the port longeron. The doors are fitted with press-to-release type fasteners which engage with brackets recessed into the starboard longeron.

50. The doors, when closed, overlap from rear to front and must be opened in sequence commencing from the rear and closed in reverse order. An access panel, in the centre of the forward door, provides access to a connection for a ground heater which is used, when necessary, for pre-heating the equipment in the rear fuselage. Ground lighting is provided by a lamp fitted to the inner face of each door.

51. A latch beam on the centre door and a support strut on the front and rear door, make provision for securing the doors in the open position. The struts brace the front and rear doors to the fuselage and the centre door is held when the latch is hinged over and secured by a Pip-pin to a bracket on the rear door. The struts and latch are stowed on the inner face of the doors prior to closing.

REAR WARNING INSTALLATION

General

52. The tail warning radar unit and scanner with the mounting ring and radome, form a quickly detachable assembly known as the 6932 radar head. It is positioned at the extreme rear end of the fuselage where the mounting ring mates with the rear face of the former at 162·2 in.A. Four spigots, on the front face of the mounting ring, locate in corresponding holes in the former and the whole assembly is secured to the fuselage by four PRESS-TO-RELEASE type fasteners.

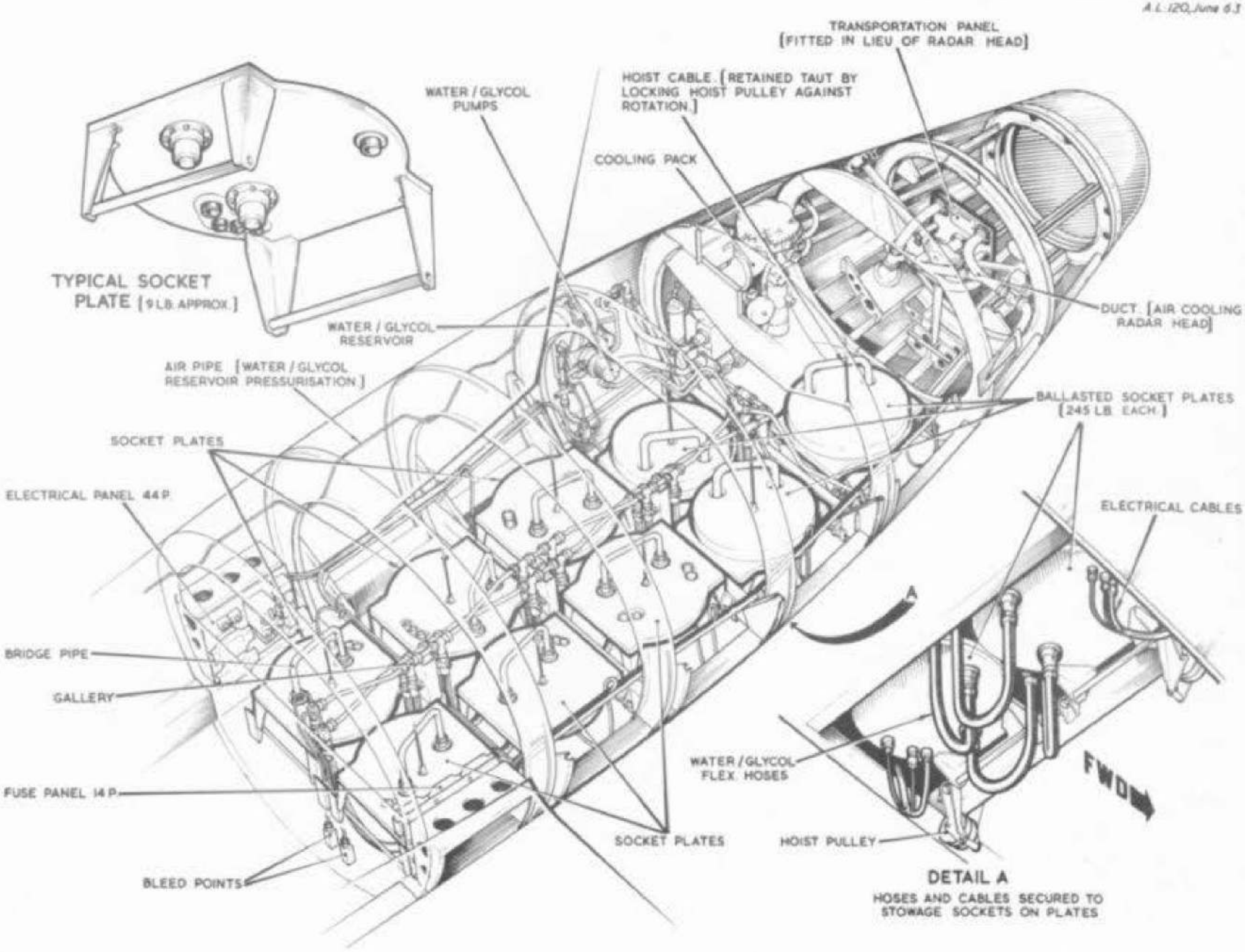


Fig. 4. E.C.M. ballast and stowage—Part A. Mod. 949

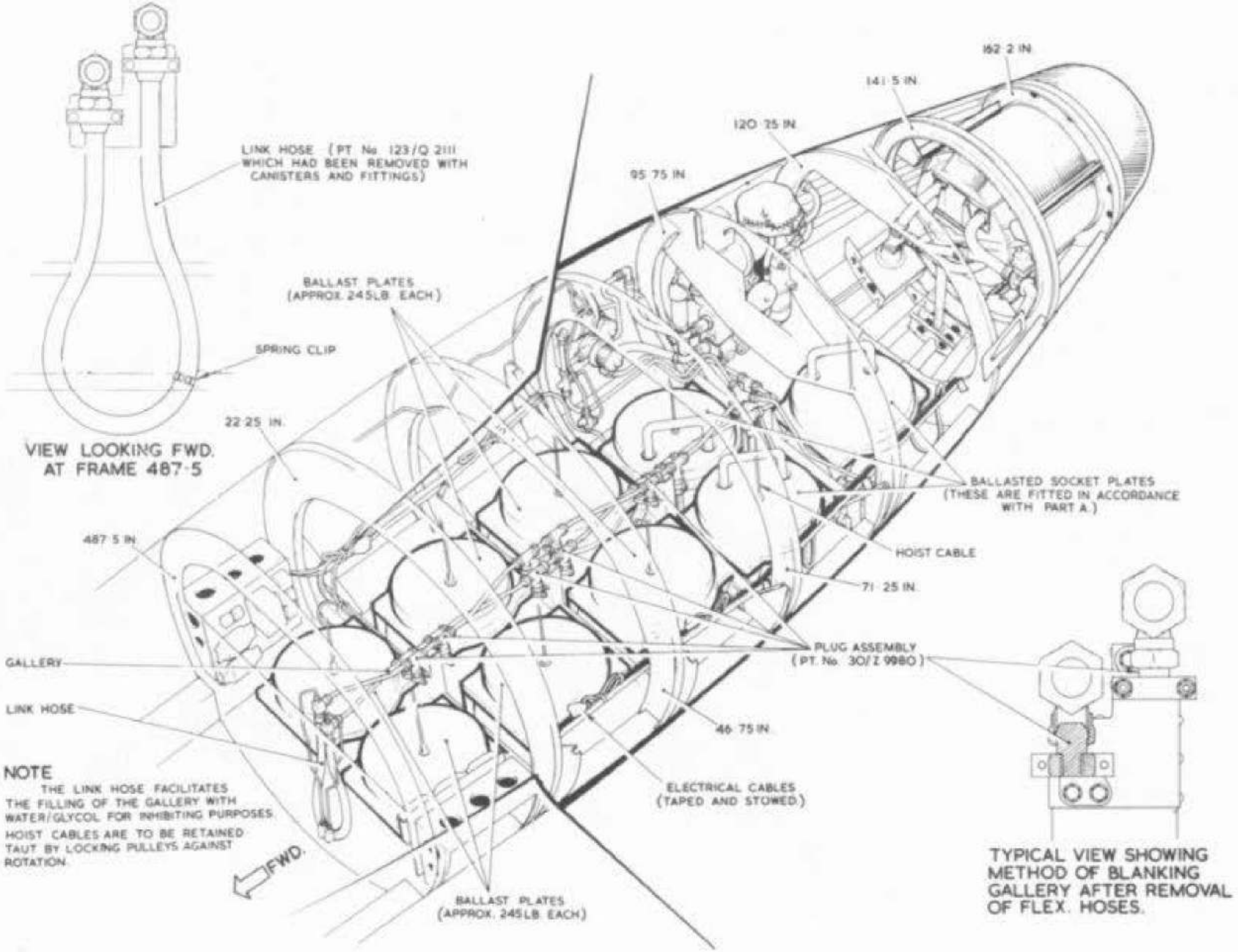


Fig. 5. E.C.M. ballast and stowage—Part B. Mod. 949

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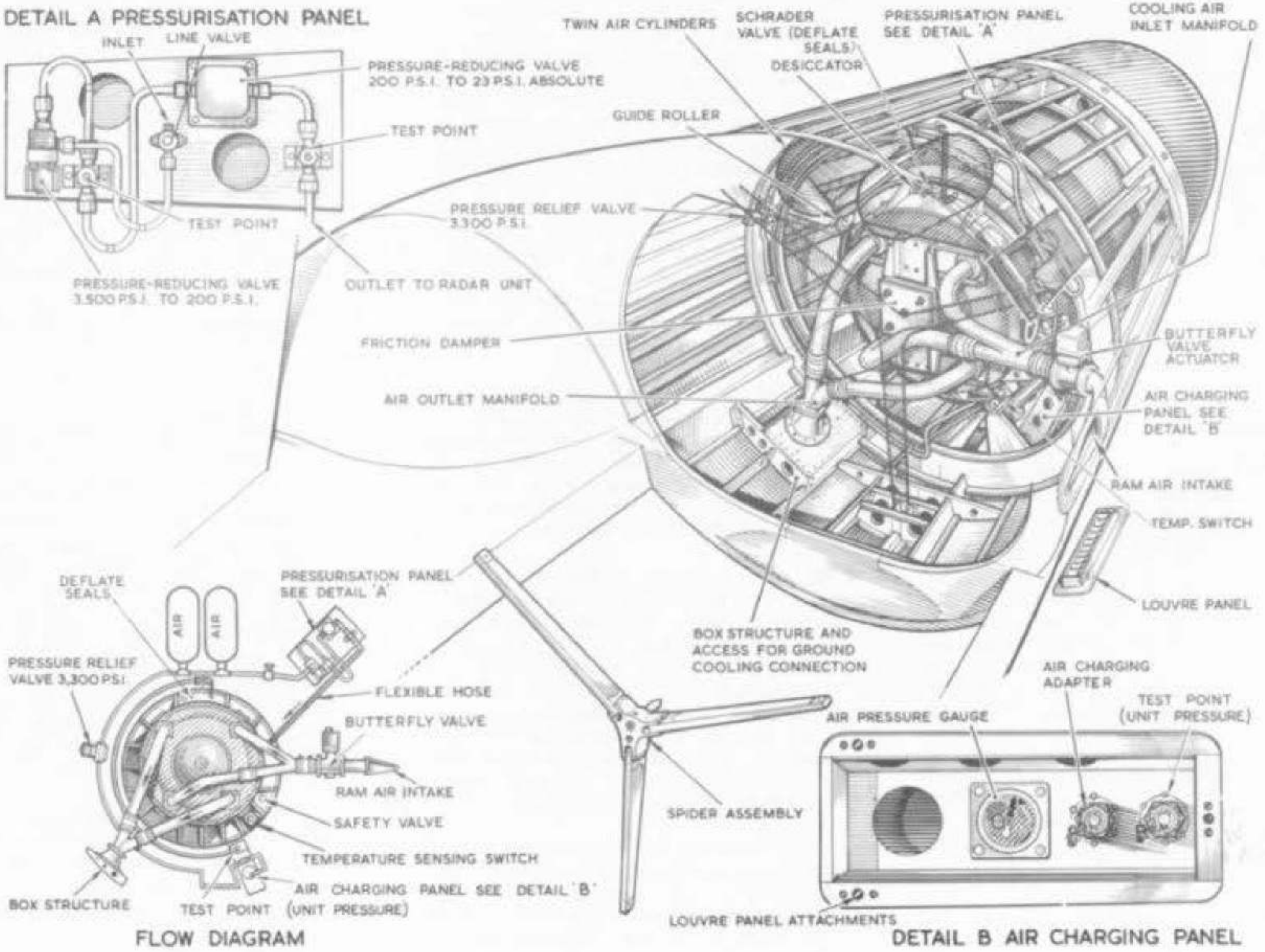

Fig. 6. Rear warning cooling and pressurisation installation

53. The radar head is normally pressurised to 20 p.s.i. absolute, by a system completely contained in the rear fuselage, this pressure being retained by inflatable rubber ring seals on the mounting ring and on the heat exchanger integral with the radar unit. The pressure in the seals is 23 p.s.i. absolute.

54. Ram air, ducted through the heat exchanger, dissipates the heat given up to that unit by the pressurising air which is circulated inside the radar head by a built in fan. The ram air is admitted by a butterfly valve which is controlled by a temperature sensing switch fitted to the heat exchanger. This arrangement prevents overcooling of the radar equipment in cold ambient conditions, the ram air being shut off when the temperature in the heat exchanger drops below -20 deg.C. The valve is opened when the heat generated by the radar equipment raises the temperature to + 10 deg.C.

55. The radar head, which extends into the rear fuselage, is braced at its forward end by an anti-vibration structure consisting of a friction damper and spider assembly. The four feet of the damper are attached to the cooling air ports of the heat exchanger and the arms of the spider are bolted to three fuselage brackets. A spigot, protruding from the spider centre, locates in a hole in the centre of the friction damper to provide the point through which the loads are transmitted to the spider. To guide the radar head on installation or removal, radially disposed rollers, fitted to the unit, bear on Tufnol strips attached to the crown of four guide rails which are secured by brackets to the formers at 141·5 in.A and 162·2 in.A.

Pressurisation system

56. Twin air cylinders, Mk.5F, are secured by straps and tension rod turnbuckles to the roof structure between the formers at station 120·25in.A and 141·5 in.A. Each cylinder is charged with dry air to 3,000 p.s.i.g. through an air charging valve (Type D.C.22 or A.58) mounted below the rear warning radar unit. This charging valve is accessible through the louvred panel secured by Dzus fasteners to the port underside of the rear fuselage. A Mk.14 LL pressure gauge, connected to the charging valve by a short branch pipe, is visible on removal of the louvred panel. A relief valve, incorporated in the pipe line between the charging valve and the air cylinders, relieves at pressures in excess of 3,300 p.s.i.g. and re-seats at a minimum pressure of 3,000 p.s.i.g. Both cylinders deliver into a common line which is led across to a pressure-reducing panel secured to the port side of the fuselage, adjacent to the air cylinders.

57. Mounted on the panel is a hand operated line valve, two pressure-reducing valves and two test connections (Type D.C.22 or A.58), the latter for use when checking the output of the reducing valves. The line valve, normally open, is closed for servicing purposes.

58. The pressure air from the cylinders is reduced to 200 ± 10 p.s.i.g. by the first reducing valve (Pt.No.ACM.16368) and then further reduced to 23 ± ½ p.s.i.a. by the second valve (Pt.No.ACM.20154). At this absolute pressure the air is delivered to the radar head via. a flexible hose. The first reducing valve has a built-in relief valve set to open at a downstream pressure of 225 p.s.i.g. maximum and to re-seat at a minimum pressure of 205 p.s.i.g.

59. Within the radar head is an integral air circuit incorporating a pressure-differential valve and a non-return valve. The differential valve passes the air to inflate the seals to 23 p.s.i. absolute and the unit to 20 p.s.i. absolute. The non-return valve retains the pressure in the seals should the unit pressure fall due to leakage. In this way leakage past the seals is kept to a minimum. A safety valve is fitted to the casing of the radar unit to guard against excessive supply pressure. This valve is set to operate when the pressure difference between the unit air and the external air exceeds 26 p.s.i. A lamp lights on the indicator unit at the A.E.O.'s station when the radar head pressurisation is adequate and above 18·5 p.s.i. absolute. The equipment is automatically switched off when the pressure falls below 13·5 p.s.i. absolute. To facilitate checking the unit pressure, an extension pipe is run to a test point adjacent to the gauge and charging valve of the pressurisation system. A Schrader valve is provided on the top front face of the unit for deflating the seals. This valve is labelled DEFLATE SEALS.

Cooling system

60. The cooling air supply, admitted by the butterfly valve to the radar head heat exchanger, is ducted from a flush intake in the port side of the rear fuselage. The butterfly valve is an electrically actuated two position type (Teddington Pt.No.F.M.P.5091) mounted inside the fuselage, with its inlet connected to the throat of the intake. The outlet side of the valve is connected to two inlet ports on the forward face of the heat exchanger by a branched manifold assembly. With the butterfly in the open position the cooling ram air circulates through the heat exchanger to pass from two exhaust ports into an outlet manifold.

61. The common extension of the outlet manifold leads down and connects to a box structure on the inside of the rear fuselage, at the lower starboard side. The air is then dispersed from the lightening holes of the box, to circulate within the fuselage.

62. A removable round panel, let into

the fuselage skin, gives access to the inside of the box structure and the connection for the delivery hose of a ground cooling trolley. Thus during ground operation of the radar unit, the cooling air flow through the heat exchanger is reversed.

Louvre panel

63. Ventilation of the rear fuselage is provided by the louvre panel which is removed to gain access to the air charging point and gauge of the rear warning pressurisation installation.

Radome and mounting ring

64. The hemispherical radome is carried by the mounting ring to which it is attached by screws and anchor nuts. The ring is manufactured from aluminium alloy and fitted to it are the four spigots and fasteners which locate and secure the assembly to the rear fuselage. Two inflatable seals are also fitted to the ring, one on its outer circumference and the other on its inner. The outer seal provides for sealing the radome at its base and the inner for sealing the joint between radar unit and mounting ring.

65. The radome is made up of an expanded Hycar core overlaid with five layers of glass cloth on the outside and four layers on the inside, there being no lap joints in the scanned area. The inside surface is sealed by a Neoprene compound to D.T.D.926 and the outside finished in anti-flash white. Around the inside of the radome and concentric with the base, is an aluminium alloy ring of continuous section and a smooth finish. The inflatable outer seal presses around the lip of this ring to make the pressure tight joint.

Transportation panel

66. This is provided for attaching to the anti-vibration spider in order to blank and support the air cooling pipes, if the aircraft is flown without the rear warning radar unit. When it becomes necessary to use this panel the line valve of the radar head pressurisation system must be closed, the flexible supply hose blanked, the electrical leads taped and stowed and a radome and mounting ring fitted to act as a rear end fairing.

67. Fitted to the square Jabroc panel are three webbing straps, a positioning boss and a stowage compartment. The panel is secured to the spider arms by the straps and located to the spider spigot by the boss.

68. The panel is also fitted with nuts and bolts, for attaching the coupling adapters which are normally fitted to the cooling air ports of the radar unit heat exchanger. When mounted on the panel, the adapters provide the attachments for the air cooling pipes. Being aircraft parts, the couplings are not supplied with the radar unit and so, when a radar unit is eventually fitted these couplings are readily available for transfer. The locking wire, washers and special bolts, required for the fitting of the adapters to the radar head, are contained in the stowage compartment.

TURBO-ALTERNATOR TYPE T.G.A.30

General

69. The constant frequency alternating current necessary for the operation of the E.C.M. equipment is supplied by the turbo alternator. This unit, together with its associated frequency and voltage controllers, is mounted in the compartment aft of the starboard main-wheel bay. It comprises an inward flow radial turbine driving a 30kVA alternator through a speed reducing gear box. The turbine is driven by charge air ducted from the compressors of the starboard engines. The alternator, gear box and voltage control unit are cooled by ram air diverted from the airflow. Control of the output frequency of the alternator and protection against turbine overspeed is provided by automatically operated butterfly valves within the turbine unit. Provision is made for running down the turbine using an electrically actuated two-position butterfly type bleed valve, in the charge air ducting. Whilst this valve is in the closed position, the bleed provides a flow of hot air past the edges of the butterfly sufficient to motor the turbine and thus prevent "Brinelling" of the turbine bearings.

Bleed valve cockpit controls

70. The electrically actuated two position bleed valve in the charge air duct, is controlled from the A.E.O.'s station by a switch annotated RUN - STOP. An indicator adjacent to the switch, shows the OPEN and SHUT positions of the valve. When switched to RUN, the valve opens and the full flow of charge air is admitted to the turbine. When STOP is selected, the valve shuts and the turbine runs down, to be maintained at continuous idling r.p.m. by the hot air bleed.

Turbine speed control

71. Located in the air inlet to the turbine rotor is a throttle valve and a shut-off valve. A hydraulic servo, in conjunction with a control system which senses changes in the alternator output frequency, operates the throttle valve to vary the flow of charge air to the turbine, thus controlling the turbine speed and, therefore, the output frequency of the alternator. A hydraulic accumulator, in the oil system of the turbo-alternator, ensures that the hydraulic supply to the servo is not interrupted under negative G conditions of short duration. The shut-off valve, normally held in the open position against a coil spring, operates to cut off

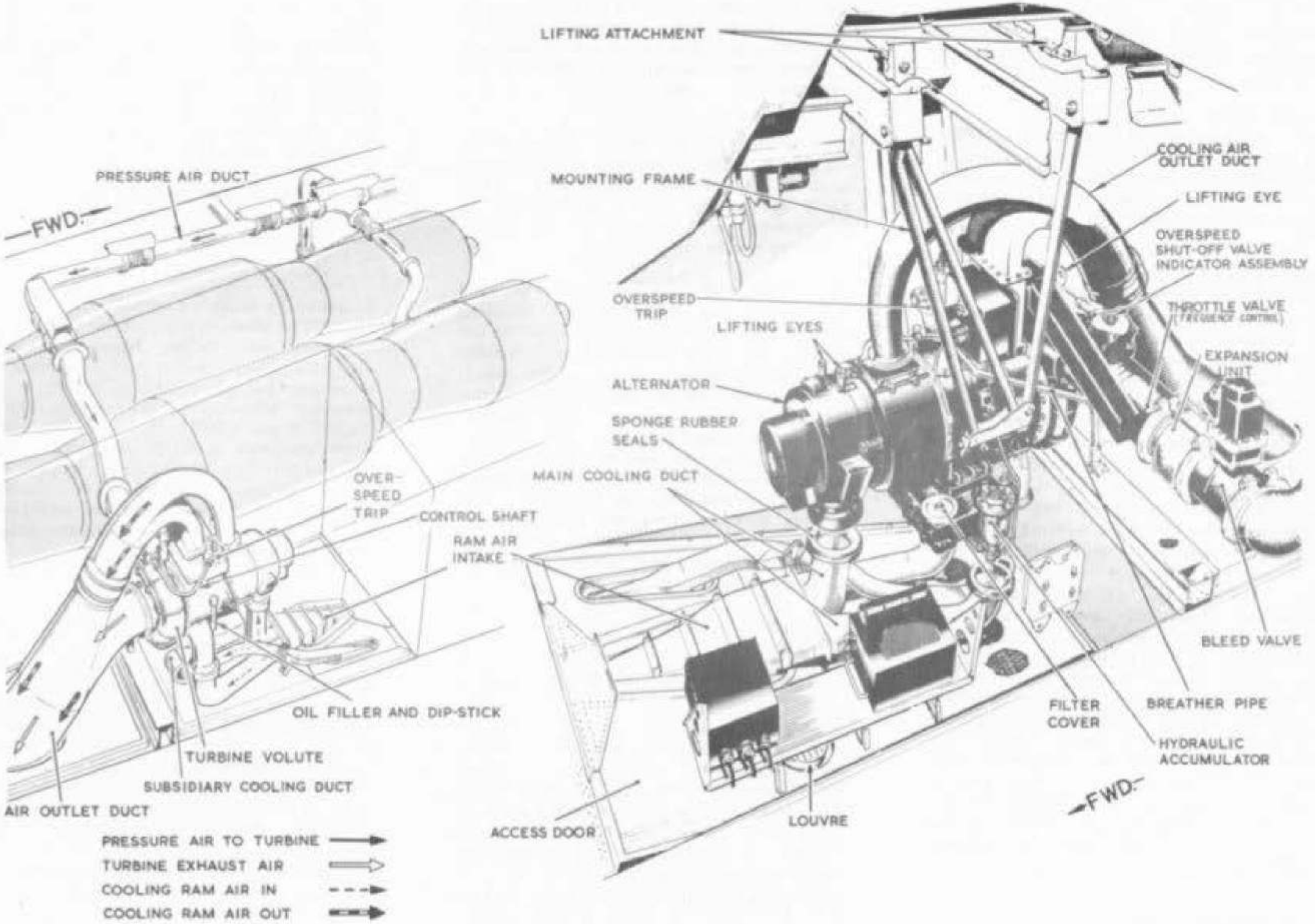

Fig. 7. Turbo-alternator installation

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the charge air supplies should a failure of the frequency control cause the turbine to overspeed. When overspeeding occurs, centrifugal action within the valve control mechanism breaks the spring lock and the valve closes under pressure to shut down the turbine. The trip mechanism of the valve can only be reset on the ground, consequently the E.C.M. equipment is rendered inoperative should overspeeding occur.

Mounting (fig.7)

72. The turbo-alternator is carried on four mounting lugs, two on each side of the gear box. Dowel located and bolted to the lugs are four brackets of which the outboard pair are bolted to reinforced brackets on the inner face of the outboard undercarriage rib. The inboard brackets are bolted to a tubular mounting frame secured to the roof structure aft of the starboard main-wheel bay.

Hoisting attachment

73. Three lifting eyes are bolted to the turbo-alternator, one on the turbine volute casing and two on the alternator. Two spacer bolts, positioned in the roof structure, provide attachment points for mini-hoists.

Charge air duct

74. The charge air required to drive the turbine is tapped from the fin anti-icing and bomb bay heating supply from No.3 and 4 engine. The air is delivered via a lagged 4 in. dia. stainless steel duct passing across both starboard engines, through suitably reinforced and sealed holes in the ribs at 113·3 in. and 162·5 in., to the turbine inlet. Expansion units interposed along the length of the ducting compensate for linear changes to which the ducting is subjected in operation. The two position bleed valve (Teddington Part No.FMP.A5092) is fitted in the ducting just upstream of the turbine inlet flange and connected to the latter by an expansion unit.

Cooling

75. The turbo-alternator is cooled by ram air ducted from two flush intakes, a main and a subsidiary, in the forward access door to the compartment. Air, from the main intake, is blasted across the turbine bearings and through the alternator to be discharged to atmosphere, together with the exhaust from the turbine, via a duct with its outlet in the rear access panel. Air from the subsidiary intake is directed on to the outside of the bearing casing to provide the additional cooling necessary for operation at high altitudes. An off-shoot duct, from the main delivery ducting, provides blast air for cooling the voltage regulator at altitude. At the diverging outlet of this off-shoot are two flaps which drop down, when no blast cooling is available, and so provide clearance for convection cooling of the voltage regulator during ground operation.

Access door and cooling air delivery ducting

76. The access door to the turbo-alternator is of honeycomb construction and is hinged, at its forward edge, to the bottom of the main-wheel bay rear bulkhead. The door is secured by Dzus fasteners along its flanges. Mounted on the inside of the door are two air delivery ducts, one of which has three outlets. This duct is connected to the larger of the two intakes in the door and has sponge rubber seals secured to the flanges of its three outlets by cold setting Araldite. On closing the door the sponge rubber is compressed against the flanges of the cooling air inlet ports ot the turbo-alternator to make an effective seal. A circular louvre assembly, incorporated in the door, provides the means of ventilating the compartment. Provision for securing the door in the open position is made by a catch on the undercarriage hinged fairing.

Access panel

77. The access panel, located immediately aft of the access door and secured by Dzus fasteners, incorporates an elliptical cut-out for the turbo-alternator air outlet duct.

Air outlet duct

78. This comprises an inner and outer duct welded together. The outer duct is connected by a rubber hose, to a further duct attached to the air outlet ports of the alternator and turbine bearing casing. The inner duct is connected to the turbine exhaust by a manacle clamp.

SERVICING

WATER/GLYCOL SYSTEM

General

79. When servicing the water/glycol system ensure that:-

The ground equipment, for use with the system, is clean.

The coolant is not contaminated and is of correct specific gravity (A.P.1464B, Vol.1, refers).

NOTE . . .
This coolant is a Sodium Benzoate inhibited glycol solution mixed with water in the volume ratio of 60 per cent glycol to 40 per cent water. It contains no dye.

Disconnected pipes are blanked.

New pipes, couplings and components are cleaned and flushed before fitting.

Distilled or de-mineralised water is used for all flushing operations. (Chlorinated water must not be used).

Coolant spilled on the aircraft structure or installations, is immediately removed.

Draining

80. Draining of the water/glycol should be carried out bearing in mind that if the canisters are drained in situ, they must be removed for filling and bleeding. If draining of the rest of the system is all that is required, then a lengthy servicing operation will be avoided if the quick release self-sealing couplings are disconnected from the canister before commencing the draining operation. However, it is possible that some fluid may be lost from canisters as the couplings are being disconnected, resulting in the ingress of air. This loss is less likely to happen if the system is at a pressure of 10 p.s.i. during the disconnecting operation. To improve accessibility to the water/glycol reservoir, pumps and cooling pack, it is necessary that the rear starboard canister be removed.

81. The following procedure deals with the draining of that part of the system exclusive of the canisters:-

(1) Disconnect the quick-release self sealing couplings from the base of the canisters.

(2) Attach suitable lengths of drain hose to the bleed screw nipples on former 487·5in.A, and lead the hoses into a suitable container. Open the bleed screws.

(3) Obtain two fixed-half bayonet couplings (Lockheed Pt.No.AVX 3521 and AVX3523) and, with the valve ends of the two flexible hoses at the forward end of the gallery directed into the container, mate the two fixed half-couplings with the union-half couplings at the ends of the hoses and allow the fluid to drain.

(4) Remove the protection cap from the system charging valve and depress the piston valve. This will allow any fluid in the overflow line to drain off and also vent the reservoir.

(5) When the fluid has ceased flowing from the two forward hoses and bleed screws, remove the fixed half couplings.

(6) In turn, insert the fixed half couplings into the ends of the remaining flexible hoses and drain the residual fluid.

NOTE...
Should it be considered necessary to drain the fluid trapped because of the U-tube effect of parts of the system, then the appropriate pipe couplings will have to be disconnected.

Flushing the system

82. The canisters are flushed (para.83) after their removal from the aircraft. The rest of the system is drained (para.80) and then filled with distilled or de-mineralised water in the same manner as for water/glycol filling, (para.84). Flushing will take place during the water filling operation as this entails running the pumps for approximately 5 min. As soon as possible, after stopping the pumps, the water should be drained and checked for contamination. Repeat the flushing operation until no contamination can be detected.

Flushing the canisters and socket plates

83. To flush a canister, a quantity of distilled or de-mineralised water is poured into the heat exchanger in the same way as for charging and bleeding (para.87). The heat exchanger is then rinsed by rocking and inverting the canister. Repeat this operation until the rinsing water is free of contamination. To flush the socket plates, open their self-sealing couplings and allow water to flow through the bridge pipes. Use appropriate hose-half couplings to open the socket plate couplings.

Filling and bleeding

84. In this operation it is assumed that the canisters, except for the one removed to give accessibility to the pumps, etc., are mounted in position having been filled and bled before fitment or are full from when previously isolated. The flexible hoses must not be connected to the canisters until the rest of the system has been filled and bled, and the bleed plugs in the base of the canisters must not be slackened. In order to charge and bleed the system, it is necessary to complete the circuit. To achieve this, when the flexible hoses are not connected to the canisters, each pair of flexible hoses are linked together by a coupling adapter (Part No.U1728) which consists of a short pipe with a fixed half bayonet coupling (Part No.AVX.3521) fitted to one end and a similar coupling (Part No.AVX.3523) fitted to the other.

85. The system is charged by a 10 gall. fluid replenishing can (Ref.No.4G/5378). This is pressurised with air and connected to the charging valve by an adapter (Pt.No.AVA1186C) and a reducing adapter (Ref.No.4G/5795). To avoid the pressure

air entering the system during the charging operation, the can must not be allowed to become empty of fluid. This is particularly important when topping up, after the system has been bled.

86. Ensure that the can is full of correctly mixed and tested fluid, then proceed as follows:-

(1) Fit a coupling adapter to each pair of flexible hoses. This will complete the water/glycol circuit normally made through the heat exchangers of the canisters.

(2) Isolate the cooling pack compressor motor from the electrical supply by disconnecting fuse No.1129 which is adjacent to panel 3P.

(3) Attach lengths of rubber hose to the nipples of the bleed screws on the evaporator and the rear face of former 487·5in.A. Lead the hose into suitable containers and open the bleed screws.

(4) Attach the replenishing can delivery gun to the system charging valve. This action will depress the piston valve and open the overflow to atmosphere.

(5) Pressurise the can, open its delivery valve and operate the charging gun to allow the fluid to fill the system. Continue to fill as the fluid runs from the bleed screws. Close the bleed screws.

(6) Switch on the water/glycol pumps and allow the coolant to circulate for about 5 minutes.

(7) In turn, open the bleed screws. Close the bleed screws when the flow from them becomes steady and air free.

(8) Slacken the union at the pressure switch, in order to break any air locks in the small bore pipe. Tighten the union.

(9) Slacken the union at the high point of the common delivery pipe from the pumps and bleed. Maintain the fluid at sight glass level to ensure a positive bleed. Tighten the union.

NOTE...
Rag should be placed under the unions to absorb the bled fluid.

(10) Top up the fluid to sight glass level.

(11) Pressurise the system to 35 p.s.i.g. and check for leaks (para. 88 to 91). If no leaks are detected and the fluid level remains visible the system is ready for connecting the flexible hoses to the canisters. If however the level is not visible and no leaks are detected, then the system is not completely bled. Release the air pressure and repeat operations (6) to (10). Again, raise the system pressure to 35 p.s.i.g. and confirm that the level remains on the sight glass.

(12) When the level check is satisfactory, reduce the pressure in the system to 10 p.s.i.g. and disconnect the coupling adapters from the flexible hoses. Lock all the bleed screws and pipe unions.

(13) Install the rear starboard canister with its heat exchanger full of coolant.

(14) Check that the system pressure is at 10 p.s.i.g. then couple the flexible hoses to the canisters. As each canister is connected into the system, check the reservoir fluid level. Provided the connections are made cleanly, any appreciable lowering of the level will indicate air in the heat exchanger of the particular canister. This will entail the removal of that canister for filling and bleeding.

(15) When all canisters are satisfactorily connected, increase the pressure in the system to 35 p.s.i.g. and check the quick-release couplings for signs of coolant leaks.

(16) Release the air pressure and remove all charging and test equipment. Ensure the removal of the blank from the pressure relief valve vent pipe. Fit fuse No.1129.

Charging and bleeding a canister

87. A canister is filled when supported so that the heat exchanger is uppermost. To facilitate filling, two union-half bayonet couplings (Pt.No.AVX3520 and AVX3522, 3 pin and 4 pin respectively) are fitted to the water/glycol inlet and outlet connection on the heat exchanger. This action will maintain the self-sealing valves in the open position. The bleed plug is removed and the unit is filled with the correct mixture of water/glycol until all air is expelled. Tilting the canister in various directions will ensure thorough bleeding. When correctly filled, the bleed plug is tightened and locked, the couplings removed and the canister inverted. In this position the self-sealing valves and bleed plugs are checked for seepage. If satisfactory, the unit is ready for mounting in the aircraft.

Pressure testing

88. A full pressure test entails checking the following:-

(1) Fluid and air leaks

(2) Inadequate bleeding

(3) The correct operation of the high pressure switch.

(4) The correct functioning of both valves in the reservoir combined air inlet and pressure relief assembly.

(5) The satisfactory pressurising of the reservoir from the ancillary supplies pneumatic system.

89. With the fluid at the correct level, the test pressure is introduced through the overflow outlet of the water/glycol charging valve, with the piston valve of that unit held in the open position.

90. The items of ground equipment necessary for pressure testing, are: a foot pump, a lamp and battery, a suitable means of blanking the reservoir pressure relief valve vent pipe and a test adapter (Ref.No.26DC/95457). This consists of a connector pipe fitted with a Schrader valve, a pressure gauge and a bayonet type coupling, the latter being attached to the pipe by a short chain. The coupling is fitted to the water/glycol charging connection in order to maintain the piston valve open, and the pipe, with its gauge and valve, is attached to the overflow outlet to indicate the test pressures and act as the air charging point.

NOTE...

To prevent flooding the test gauge, the overflow line should be drained by fitting the bayonet coupling before the pipe assembly. For the same reason no attempt should be made to top up the system or operate the water/glycol pumps whilst the pipe assembly is fitted.

91. Remove the rear starboard canister to give accessibility to the system, then proceed as follows:-

(1) Withdraw the electrical connection from the pressure switch.

(2) Connect a lamp and battery to the switch.

(3) Fit the pressure test adapter to the water/glycol charging valve. Connect the foot pump to the Schrader valve of the adapter.

(4) Blank the vent from the reservoir pressure relief valve.

(5) With the lamp and battery switch depressed (the light should be on), raise the pressure in the reservoir. When the pressure switch operates and the light goes out, the pressure in the system should be 29 to 32 p.s.i.g. Reduce this pressure, gradually, until the light comes on. This also should occur within this pressure range.

(6) Raise the system pressure to 35 p.s.i.g. and check the whole system for air and coolant leaks. Air leaks, as indicated by the pressure gauge, may be external from the reservoir and its overflow and pressure relief pipes, or internal to the ancillary supplies pneumatic system. An internal leak can be caused by the malseating of the non-return valve in the pressurisation air inlet on top of the reservoir. To check for an internal leak: disconnect, at the rear bomb-bay bulkhead, the line to the reservoir, and apply a soap solution to the pipe end. External leaks may also be detected with a soap solution.

(7) If no leaks have been detected, check the fluid level in the reservoir; this should still be visible. If it is not, the system requires bleeding. First, release the pressure on the system, then slacken the bleed screws and the union at the high point of the common outlet pipe from the pumps and release any air trapped at these points. Top up the fluid and pressurise to 35 p.s.i.g. Should this operation prove that air is elsewhere in the circuit it will be necessary to disconnect all the flexible hoses from the canisters and repeat the procedure in para.86 (6) to (16), first removing fuse No.1129 and the pressure test adapter.

(8) Assuming the level has remained visible, ease the blank from the pressure relief valve vent pipe so that the pressure reduces slowly to the reseat pressure of the relief valve. The pressure gauge should indicate not less than 7 p.s.i.g.

(9) Increase the pressure until the relief valve blows. This should be between 15 and 18 p.s.i.g.

(10) Reduce the pressure to zero.

(11) Inflate the ancillary supplies pneumatic system (Sect.3, Chap.7, para.54) and check that the reservoir pressurises to 10 p.s.i.g.

(12) Remove the lamp and battery and connect the electrical lead to the pressure switch. Ensure that all bleed screws and pipe unions are locked.

(13) Install the rear starboard canister. Following the procedure in para. 86 (14) to (16), connect the flexible hoses to this unit.

Testing the pumps

92. For the test it is necessary to ensure that the pressure switch is set to within 29-32 p.s.i.g. and that the canisters or socket plates are connected into the system. One pump at a time is operated, the other being disconnected electrically. This test, which enables the flow and the non-return valves to be checked simultaneously, depends on the fact that a pump operating with the correct performance will pass the required flow with a known pressure rise across the pump. The pressure rise across an operating pump is determined by increasing the reservoir pressure to an amount which is just sufficient to operate the pressure switch. The difference between the reservoir pressure and the switch setting pressure is, therefore, the pressure rise created by the pump.

93. When the pressure switch operates, the electrical supply to the pump will be interrupted, the pump delivery pressure will fall and the switch will remake. This action will be repeated with such rapidity that the pump will continue to run accompanied by a 'chattering' of the 'hold on' relay in the electrical supply circuit to the pump. A 230 volt lamp, plugged into the lead disconnected from the other pump, will give a flickering light indication when the pressure switch operates. If the reservoir is pressurised in excess of the minimum necessary to operate the pressure switch, a false result will be obtained. Excess pressures may be introduced unless the operator is aware that the indications of the interrupting action of the switch will continue with rising pressure, up to the point where the pump finally stops.

The test is as follows:-

(1) Isolate the cooling pack compressor motor from its electrical supply by removing Fuse No.1129.

(2) Disconnect the electrical lead from the pressure switch.

(3) Check the pressure switch for correct operation (para.91 (2) to (5)). Note the minimum operating pressure.

(4) Connect the electrical lead to the pressure switch.

(5) Reduce the reservoir pressure to 10 p.s.i.g.

(6) Disconnect the supply lead from the lower pump. Connect the lead to a 230 volt test lamp.

(7) Run the remaining pump.

(8) Slowly increase the reservoir pressure until the pressure switch operates. (Audible indication given by the relay in the pump electrical supply circuit: visual indication by the test lamp) .

(9) Note the reservoir pressure. This pressure subtracted from that noted in (3) should be $8{\cdot}5 \pm 1$ p.s.i.

(10) Repeat the test for the other pump.

(11) Connect both pumps and remove all test equipment. Replace Fuse No. 1129.

NOTE...
Reduced output may be due to the non-return valve of the other pump, malseating.

COOLING PACK

General

94. The satisfactory operation of the cooling pack depends upon all air being eliminated from the system. Therefore once the air has been evacuated, every precaution must be taken to prevent its entry, particularly during the refrigerant and nitrogen charging operation. Water vapour and dirt can also have a detrimental effect should they enter the pack and so, during servicing, blanks must always be fitted to valve ports and disconnected pipes. Charging lines must be purged with nitrogen before use.

95. The equipment necessary for charging and testing the pack whilst it is installed in the aircraft is:-

(1) Servicing trolley (Ref.No.4G/6582). This contains a motor driven vacuum pump, transparent plastic connecting hoses and a 0 - 760 mm. absolute pressure gauge.

(2) A refrigerant container fitted with a shut-off valve and charged with 12 lb. ± ½ lb. of Arcton 11.

(3) A spring balance suitable for weighing the container.

(4) A five-way charging manifold (Ref.No.4G/6634).

(5) Ground cooling trolley (Ref.No. 4F/2584 or 4F/2396).

(6) Adapter (Pt.No.U1655) which is used to connect the hose of the ground cooling trolley to the rear end of the condenser ram air intake.

(7) 350 c.c. of Aeroshell Turbine oil 300 in a sealed container.

(8) A nitrogen cylinder fitted with a fine-adjusting pressure regulator valve.

(9) Trolley, detector, leak, refrigerant, Ref.No.78AA/118.

(10) Reducing unit, nitrogen (Ref. No.6D/2184).

96. The shut-off valve on the refrigerant container will be referred to as valve G. The valves on the five-way manifold are marked as follows:-

	Marking
Vacuum pump connector valve	H
Nitrogen supply connector valve	N
Arcton 11 connector valve	R

97. The gauge on a pack is read off the outer scale, the inner scale being applicable to other refrigerants. A zero indication of the gauge denotes a pressure of one atmosphere at the compressor inlet. Below the zero, the outer scale has a calibration for depressions in inches of mercury, down to 30 inches. Thus a gauge indicating 10 in. denotes a depression of 10 in. Hg. below one atmosphere. Above the zero, the gauge is calibrated in p.s.i.

98. On charging with refrigerant the vapour pressure will be relative to the system temperature. At 15°C the refrigerant vapour pressure is such that a depression of approximately 9 in. Hg. should be indicated by the gauge. The nitrogen charge, which is introduced after refrigerant charging, is specified as the amount required to raise the pressure, in a system at 15°C, to 15 p.s.i. absolute (approx. zero gauge). Therefore, at 15°C, the pressure rise due to the nitrogen is 9 in.Hg. or 4½ p.s.i. As the pressure/temperature relationship of nitrogen and Arcton 11 is practically the same over the temperature range that charging is likely to be carried out, the temperature factor may be ignored, and the system is correctly charged when nitrogen is gradually introduced until the gauge indicates a pressure which is 4½ p.s.i. above the vapour pressure indicated after refrigerant charging.

99. Table 1 is used in conjunction with the skin temperature indicator in order that an additional check may be carried out on a pack which has soaked to an even temperature; for instance, after an overnight standing period. Outward leaks or air contamination can be suspected if the gauge indicates a depression or pressure which, when related to the system temperature, is not within the limits given in the table.

100. The skin temperature indicator, calibrated from -80°C to +80°C, indicates the temperature of the system for reference in conjunction with Table 1. The indicator sensing element, in the form of a resistance bulb, is wired to the indicator which is connected to the 28-volt d.c. supply. Because the evaporator remains relatively cool at all times the indicator will not record true system temperature until a considerable period has elapsed after a pack has ceased to operate. For this reason the use of the indicator is limited to systems at ambient temperature throughout.

101. An operating pack which develops a small leak on its pressure side will steadily loose refrigerant and nitrogen but should continue to operate satisfactorily for some considerable time. The pump down operation, (para.106) will eventually indicate this loss. If the leak is on the suction side, air will be induced and malfunctioning will rapidly ensue.

102. A standing pack, at a temperature whereby the system pressure is above ambient, will also lose refrigerant and nitrogen through a leak. Conversely, at system pressures below ambient, air could leak into the system. Inward leaks tend to zero the gauge fairly rapidly, therefore, a gauge indicating a lesser depression than that permitted in Table 1 is an indication that a leak has occurred.

103. It must not be assumed that inward leaks have occurred if the gauge records approximately zero when the system temperature is in the region of 15°C. At this temperature the relative system pressure is, in any case, near zero.

Oil charging

104. The charge of 350 c.c. of oil, in the sealed container (Ref.No.34B/1430), is introduced into the pack before charging with refrigerant. Before introducing the oil ensure that the pack is completely drained, otherwise this oil may be additional to a previous charge. Proceed as follows:-

(1) Open valve X. Introduce nitrogen, through the valve, at a rate just sufficient to maintain a nominal pressure above ambient, within the pack to prevent the ingress of air during the oil charging operation.

(2) Remove the plastic cap from the oil container.

(3) Remove the filler plug from the vapour/oil seperator on the pack.

(4) Screw the metal filler nozzle, supplied with the oil container, into the filler hole of the separator.

(5) Invert the container over the separator so that its plugged end is offered to the nozzle. Push the container hard into engagement. The plug will be forced into the container.

(6) Hold the bottle firmly in position, squeeze repeatedly to eject oil, down to level of nozzle opening, leaving a small amount of unused oil in the container.

(7) Remove nozzle with bottle attached, replace filler plug and wirelock. Close valve X.

TABLE 1

Pressure/temperature table of Arcton 11 plus nitrogen

Temperature indicator reading	Gauge reading in.Hg. depression			Gauge reading p.s.i.g.		
	A		B	A		B
-30	18	to	12			
-25	17	to	11			
-20	15	to	9			
-15	14	to	8			
-10	12	to	6			
- 5	10	to	4			
0	8	to	2			
5	6	to	0			
10	3	to ...	0	...	...	...
15				0	to	1
20				3	to	4
25				5	to	6
30				8	to	9
35				11	to	12

NOTE...
Select the nearest temperature reading to the temperature observed on the indicator then read off the corresponding pressure readings. The tolerances between the readings in columns A and B are permissible. Temperature readings are to be taken when temperatures throughout the system have become even.

Charging with refrigerant and nitrogen

105. This operation is carried out after the pack has been charged with oil. First ensure that all shut-off and servicing valves are closed except valve C then proceed as follows:-

(1) Check weigh a portable Arcton 11 container to ensure that the refrigerant content is 12 lb. ± ½ lb. Connect a charging line to the container.

(2) Position the container and charging line on a servicing platform placed adjacent to the condenser ram air intake.

(3) Pass the free end of the charging line through the access hole in the ram air intake fairing and the hole through which the condenser inlet pipe enters the fuselage skin.

(4) Remove the servicing plugs from valves X and Y and connect the 5-way manifold as shown in fig.6. Close valves R, H and N.

(5) Connect the line from the refrigerant container to valve R; connect the line from the servicing trolley vacuum pump to valve H, then connect the line from the nitrogen cylinder to valve N.

(6) Open valves X, Y, A, B, R and N.

(7) Start the vacuum pump, then open

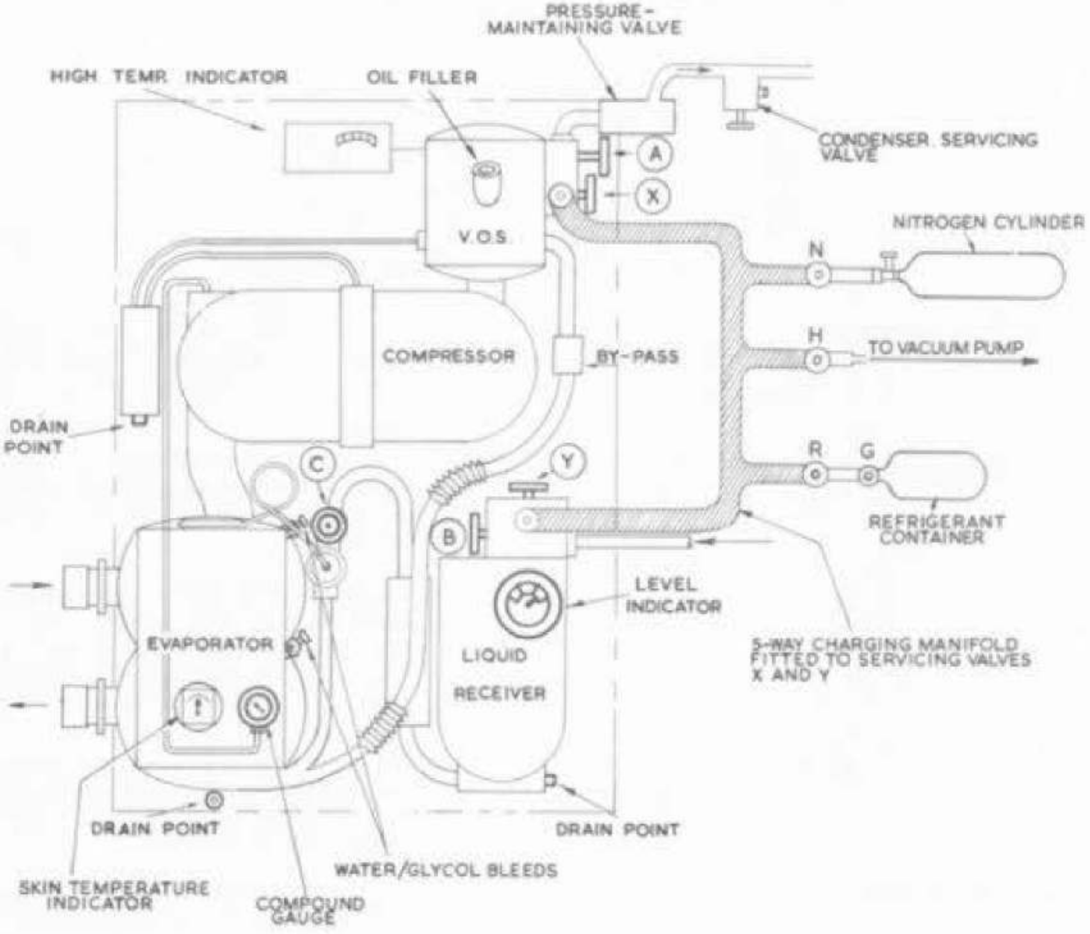

Fig.8 Cooling pack servicing diagram

valve H and evacuate the system until the servicing trolley vacuum gauge reads 8 mm.Hg. Leave the pump running for approximately 5 minutes after obtaining this reading, then close valve H, and disconnect the vacuum pump. Stop the vacuum pump.

NOTE...
If the pump is stopped before disconnecting, the oil in the pump will be sucked into the line.

(8) Check that the vacuum is holding by reference to the pack gauge.

(9) Ensure that the Arcton 11 container is inverted and the line connecting valves G and R has a continuous downward run. Shut valve X.

(10) Open valve G and allow the total contents of the container to drain into the pack.

(11) Close valve G and R and disconnect the container.

(12) Note the reading of the pack gauge. Establish the pressure the pointer will indicate when the system pressure is increased by 4½ p.s.i. (Allow 1 p.s.i. for every 2 in. Hg).

(13) Open valve X, then gradually open the nitrogen supply valve until pack gauge indicates the established pressure.

(14) Close valves X and Y and remove the 5-way manifold.

(15) Fit the servicing plugs to valves X and Y. Wire-lock all valves and servicing plugs, ensuring that valves A, B and C are open.

(16) Replace the cover plate on the access hole in the ram air intake fairing.

Checking the refrigerant content

106. The quantity of refrigerant in the pack is checked by the level indicator which has a dial with a green, yellow and red sector. When the pack cools, after a period of operation, the refrigerant that condenses in the condenser will gravitate into the liquid receiver. If the indicator pointer moves into the yellow or green sectors then the refrigerant content of the pack may be regarded as satisfactory. If however, the pointer remains at red, an outward leak may have occurred. To ensure that the refrigerant is not in the rest of the system it will be necessary to carry out a pump down. This entails closing valve C and running the compressor until the refrigerant is transferred to the receiver. If this operation does not cause the indicator to move to the green sector, check the system with the leak detector as soon as possible after the compressor has stopped. Unless a leak, which entails simple rectification, is detected, the pack should be removed and a replacement fitted. Leaks usually result in the loss of an unknown quantity of oil, therefore, after rectification, the system should be drained and completely recharged.

107. It is permissible to run the compressor for a period of two minutes, from a cold start, without ground cooling for the condenser. Within this period, a satisfactory pump down can be achieved. However, if the water/glycol temperature is very low, the pack will operate, initially with the pressure maintaining valve closed and the transfer may not be effected within the two minutes. After the pump down, lock valve C in the open position.

Period checks

108. At the specified servicing period, the pack is checked for leaks and correct operation. Ground cooling must be provided for the condenser unless the check can be concluded within two minutes (para.107). During the check the pointer on the high temperature switch should remain stationary. Proceed as follows:-

(1) Check the reading on the compound gauge and temperature indicator then refer to Table 1 to ensure that the pressure is correct for the observed temperature. (This check is only applicable if the system is at the same temperature throughout).

(2) Check that the level indicator is in the yellow or green sectors. If it is at red then carry out the pump down procedure (para.106).

(3) Start the motor compressor to check for free rotation and noise level (a continuous high pitched noise).

(4) Check the compound gauge. This should indicate a depression from 5·5 to 15·0 in. Hg.

(5) Check, during the run, that the liquid level indicator moves towards the red sector. This will indicate that the expansion valve is operating.

(6) Stop the compressor and check the complete system with the leak detector.

Draining

WARNING
The liquid refrigerant is injurious to the eyes; they must be protected while draining the system.

109. The system is drained as follows:-

(1) Remove the servicing plugs from valves X and Y and open these valves gradually. This will reduce pressures to ambient.

(2) Remove the drain plug from the liquid receiver and drain the refrigerant into a spare can. Replace the plug.

(3) Remove the drain plug from the oil container and drain the oil. Refit the plug.

(4) Remove the drain plug from the base of the evaporator and drain any liquid from this point. Replace the plug.

(5) Fit the five-way manifold and either completely charge the system with oil and refrigerant, or, inhibit with nitrogen (para.110)

Inhibiting

110. Drained packs are inhibited with nitrogen as follows:-

(1) Remove the servicing plugs from valves X and Y. Open these valves.

◄ (2) Fit a five-way manifold (fig.8).

(3) Connect a vacuum pump to valve H.

(4) Connect a nitrogen supply to valve N.

(5) Ensure valves R and N are closed then open valve H and evacuate the system to 8 mm Hg. absolute. Close valve H and disconnect the vacuum pump. Stop the pump.

(6) Open valve N, gradually, and allow the nitrogen to fill the system. Close valve N when the pack gauge indicates approximately 20-25 p.s.i.g.

WARNING . . .

On no account must a pressure of 30 p.s.i.g. be exceeded, otherwise the evacuated capsule of the V.P.S.U. will be damaged.

(7) Close valve X and Y, and remove the equipment

(8) Replace the servicing plugs in valves X and Y.

(9) Record the pack pressure, the ambient temperature and date, on a label. Attach the label to the pack.

Drying-out the condenser

111. For this operation it is assumed that Mod.1461 is embodied and that valves A and B have not been opened since the condenser was connected to the pack. Proceed as follows:-

(1) Remove the sealing plug from the condenser servicing valve.

(2) Connect a vacuum pump to the condenser servicing valve.

(3) Start the vacuum pump, open the condenser servicing valve and then blow warm air into the rear end of the condenser ram intake.

(4) Evacuate the condenser to at least 8mm. Hg. absolute. Close the servicing valve approximately 15 min. after the 8 mm. reading is attained and then discontinue the warm air. Disconnect the vacuum pump. Stop the vacuum pump.

(5) Replace the sealing plug.

REAR WARNING INSTALLATION

General

112. If a radome is removed to gain access to the scanner etc., care must be taken not to damage the dome portion in any way. It is also essential to ensure that the alloy ring, inside the radome, is kept perfectly clean and not scratched. The smooth finish of the ring is essential for ensuring a pressure tight joint; minute scratches can cause leakage.

WARNING

A damaged radome must not be used. Its reduced strength makes it a source of danger owing to the possibility of an explosive rupture. The strain imposed on a weakened radome will become greater and failure more likely to occur as the pressure difference becomes greater with increasing altitude. Before attempting to remove a radome, the pressure in the unit must be released before deflating the seals, otherwise the seals will be blown out by the unit pressure and jammed.

113. With the line valve, on the pressure reducing panel, closed, the unit pressure is released at the test point, adjacent to the system charging valve, under the louvre panel. After releasing the unit pressure, the seal pressure is released by depressing the Schrader valve marked DEFLATE, SEALS, on the top front face of the unit.

Pressure test

◀ 114. Over a thirty minute period there should be no apparent loss of pressure from a fully charged system. If a pressure drop is indicated on the gauge adjacent to the charging valve, the pipe joints should be checked for leaks, using a soap solution. Air, continuously escaping from the relief valve incorporated in the 3,000 - 200 p.s.i.g. reducing valve, indicates that valve to be faulty. The radar unit safety valve, the seal deflate valve and the pipe run to the unit test point on the air charging panel should also be checked for leaks. Air escaping from the safety valve will denote either a faulty safety valve, or, excessive output from the 200 - 23 p.s.i.a. reducing valve. Should no leaks be detected, close the line valve and, with a suitable gauge fitted to the unit test point, note the unit pressure. If, after half an hour, this pressure has dropped by more than 0·2 p.s.i., the radar head must be removed and a replacement fitted. The leakage rate from a serviceable system can be expected to be higher under vibration conditions at altitude than at the ground condition and charging the system becomes necessary when the cylinder pressure has fallen to 2,000 p.s.i.g. ▶

115. The output of the pressure-reducing valves in the pneumatic supply system to the radar head can be checked at the test points downstream of the valves. An absolute gauge should be used at the test point after the 200-23 p.s.i. absolute valve. The full tests applicable to the components in the supply system are contained in the A.P.4303 series.

TURBO-ALTERNATOR

General

116. The charge air necessary for ground testing the turbo-alternator should be provided by running No.4 engine. During ground testing, cooling air must be provided and engine r.p.m. must not exceed 80 per cent.

117. The turbo-alternator may be operated with its access door open or shut and in each case provision is made for connecting a ground cooling trolley (Ref.No.4F/2584 or 4F/2396). With the door open and secured to the catch on the undercarriage hinged fairing, the trolley is connected to the turbo-alternator cooling air inlets by an adapter (Pt.No.U1782) which is supported on the door frame by special attachments. This arrangement enables

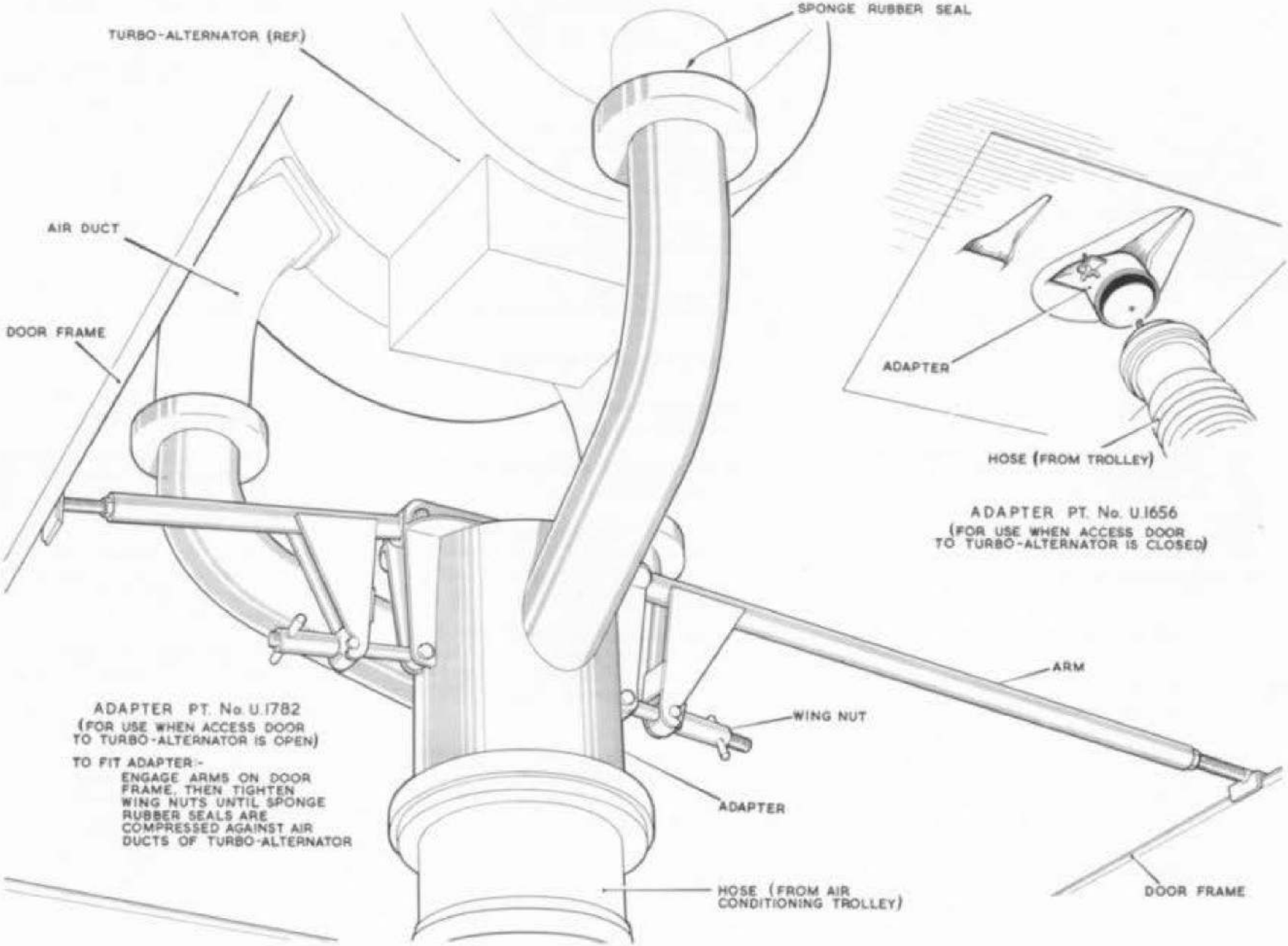

Fig. 9. Ground cooling adapters for turbo-alternator.

running checks and adjustments to be made. In the closed position of the door, the cooling trolley is connected to the ram air intake by an adapter Pt.No.U1656.

Lubrication

118. The sump of the turbo-alternator is filled with 4½ pints of oil OX-38 through the combined oil filler and dipstick assembly. A filter unit, retained in the sump by a cap and locknut, is removed for examination and cleaning with lead free petrol at the specified servicing periods. The sump is drained by removing the screwed plug in its base. To release the oil pressure prior to charging the hydraulic accumulator: remove the top cover of the servo and slowly reciprocate the pilot valve adjusting screw. The accumulator is charged to 350-375 p.s.i. using a standard inflation adapter and a regulated air supply.

Setting the overspeed trip

119. Once the overspeed trip mechanism has been operated it must be manually set before the turbine can be started. The setting procedure is as follows:-

(1) Remove the cover plate from the top of the overspeed trip.

(2) Using a spanner on the indicator assembly of the shut-off valve, turn the shut-off valve spindle anticlockwise until the pointer, of the indicator assembly, indicates SET.

(3) Hold the spindle steady in the SET position, then push the control shaft, from its end in the overspeed trip, to engage with the spring retaining mechanism of the shut-off valve.

(4) Engage the toggle arm of the overspeed trip with the end of the control shaft, to retain the shut-off valve in the open position.

(5) Replace the cover plate of the overspeed trip.

WATER/GLYCOL SYSTEM

120. No detailed instructions are necessary for the removal of any components in the water/glycol system. However, before attempting to remove a reservoir, ensure that the pressure relief valve vent pipe is disconnected at the reservoir bottom mounting bracket.

REMOVAL AND ASSEMBLY

REMOVAL OF COOLING PACK

121. For this operation the electrical power supplies must be isolated from the pack by removing the appropriate fuses. Refer to fig.8 and 10 and proceed as follows:-

(1) Close valves A and B.

(2) Disconnect from the liquid receiver and the outlet elbow of the pressure-maintaining valve, the refrigerant hoses to the condenser. Blank the open ends of the hoses, the inlet port of the liquid receiver and the outlet elbow of the pressure maintaining valve.

(3) Disconnect the a.c. and d.c. supply leads from the pack.

(4) Disconnect the coolant pipes from the evaporator.

(5) Disconnect the earthing lead, attached to the pack, from the earthing lead attached to the upper attachment bracket.

(6) Using the adapter head (Ref.No. 26DC/95374) attach a mini-hoist to the roller on the starboard underside of the cross beam at 95·75 in. A.

(7) Pass the hoist cable nipple-end through the cable guide and pulley assembly. Engage the nipple-end with the pack top mounting lug.

(8) Slightly tension the hoist cable and withdraw the Pip-pin from the upper attachment bracket.

(9) Remove the Pip-pins from the lower attachment brackets and ease the pack inwards until it is clear of the starboard longeron.

(10) Lower on the hoist and guide the pack out of the fuselage. Secure the pack bottom mounting lugs to the storage stand.

(11) Remove the support rod from the top mounting lug. Secure the lug to the top bracket of the stand and detach the hoist cable.

(12) Fit the protective caps to the self sealing couplings of the evaporator.

INSTALLATION OF COOLING PACK

122. Before preparing a pack for installation, check it for loss of inhibitor pressure. Packs are stored pressurised with nitrogen to approximately 20 p.s.i.g. The date of the pressurising operation, together with the indicated pressure and ambient temperature at the time, is recorded on a label attached to the pack. If leakage occurs during storage, the acceptable loss is not more than 2 p.s.i.g. per month determined by reference to the

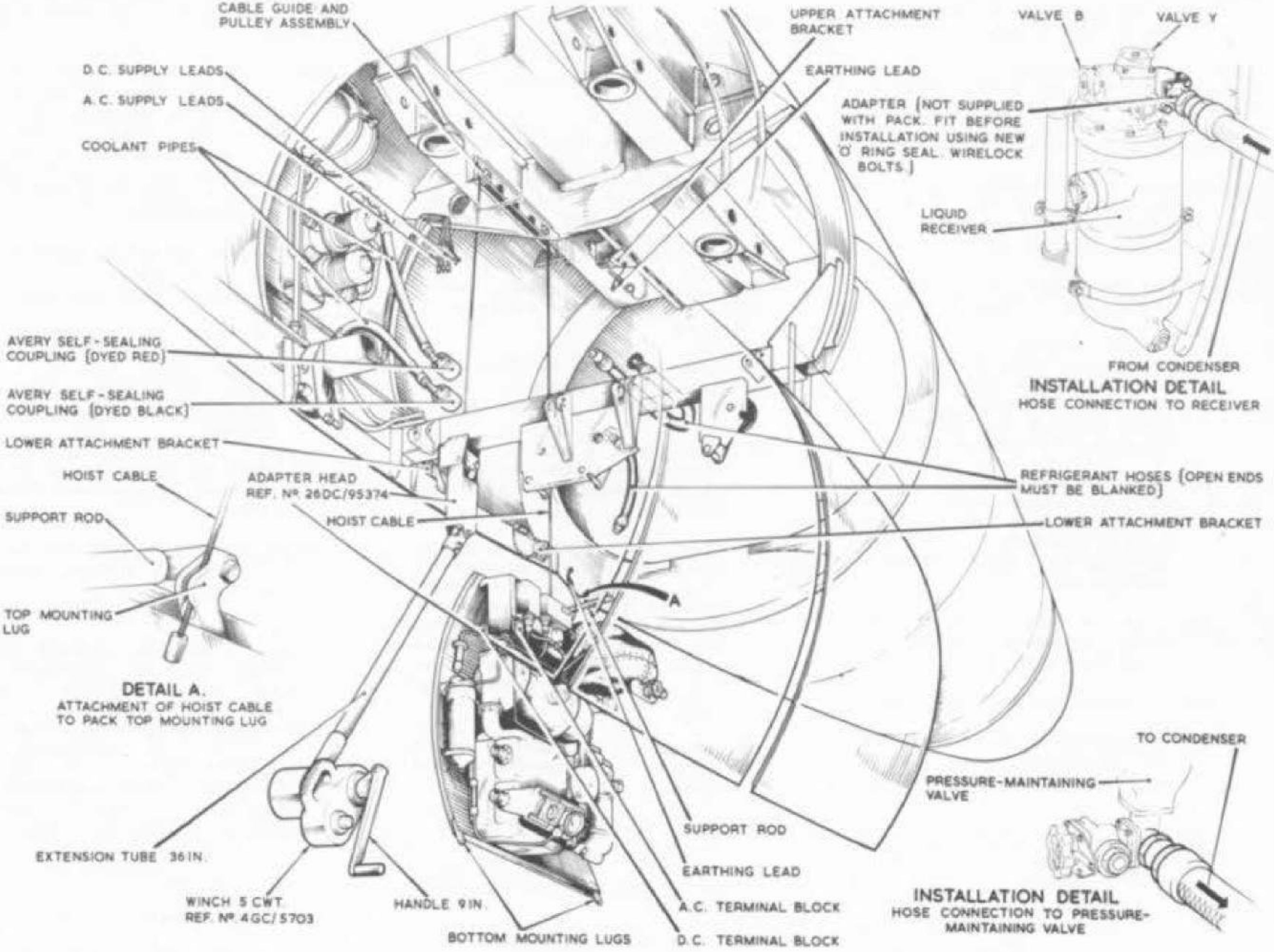

Fig. 10. Cooling pack removal.

pack gauge and the data on the label. Packs are not acceptable if the pressure has leaked to below 10 p.s.i.g.

123. With the mini-hoist attached to the roller on the underside of the cross beam at 95.75 in.A, remove the protective caps from the self-sealing couplings on the evaporator and proceed as follows:-

(1) Remove the blanking plate from the inlet port of the liquid receiver and fit the refrigerant hose adapter, using a new 0 ring seal.

(2) Bolt the support rod to the top mounting lug. (Detail A fig. 10).

(3) Position the pack below the compartment and insert the nipple-end of the hoist cable into the slot in the pack top mounting lug. Tension the cable to support the pack, then detach the storage stand.

(4) Hoist the pack into the aircraft until the bottom mounting lugs are in line with the lower attachment brackets. Align the lugs with the brackets and insert the Pip-pins.

(5) Align the support rod with the upper attachment bracket and insert the Pip-pin.

(6) Disconnect and remove the hoist.

(7) Connect the earthing lead from the top attachment bracket, to the earthing lead from the top of the pack.

(8) Remove the blanking caps from the two flexible hoses attached to the condenser.

(9) Direct a jet of nitrogen into one hose until it is flowing freely from the other. Before the purging effect of the nitrogen is lost, connect the hoses to the pack.

NOTE...

If the pack is to Mod.1461 standard, refer to para.111 and dry out the condenser before proceeding with the next operation.

(10) Open valves A, B and C. (fig.8)

(11) Remove the servicing plugs from valves X and Y and connect the five-way manifold as shown in fig.8, ensuring that valves R, H and N are closed.

(12) Connect a nitrogen supply to valve N. Regulate the supply to 30 p.s.i.g.

(13) Open valves N, R and H and purge the manifold, thoroughly. Close valves R and H and then valve N.

(14) Open valves X and Y. Using valve N to control the nitrogen supply, pressurise the system to 25 p.s.i.g.

(15) Check the compound gauge for indication of falling pressure and check all joints in the condenser hoses for leaks, using soapy water. Until all installation work has been completed, the pressure should be left in the system so that a later gauge check can be made.

(16) Connect the a.c. and d.c. supply leads to their respective terminal blocks.

(17) Attach suitable lengths of hose to the bleed screw nipples on the evaporator. Lead the hose lengths into a container used for draining purposes.

(18) Connect a replenishing can to the water/glycol charging valve.

(19) Connect the coolant pipe with the black Avery coupling to the water/glycol outlet of the evaporator.

(20) Open the bleed screws on the evaporator. Maintain the coolant level in the reservoir, (it is assumed that the rest of the system is complete and full of coolant), and, when the flow from the bleeds becomes steady and air free, close the bleed screws.

(21) Connect the coolant pipe with the red Avery coupling to the water/glycol inlet of the evaporator.

(22) Pressurise the reservoir to 35 p.s.i.g. and check for air in the coolant circuit, (para.88 to 91). Check the couplings and bleed screws on the evaporator for fluid seepage.

(23) Check the compound gauge for loss of system pressure since operation (15).

(24) Charge the system with oil, refrigerant and nitrogen, (para.104 and 105).

NOTE...

Packs to Mod.1461 standard may be charged with oil, refrigerant and coolant, before installation. This is carried out in accordance with the bay servicing procedures detailed in A.P.4787A. When installing a charged pack, operations (14), (15), (23) and (24) of the foregoing installation procedure will not apply. After installing a charged pack, introduce the nitrogen (para.105 (12) to (15)) and check the condenser-to-pack joints with a leak detector.

CONDENSER REMOVAL

124. Assuming the pack is mounted in

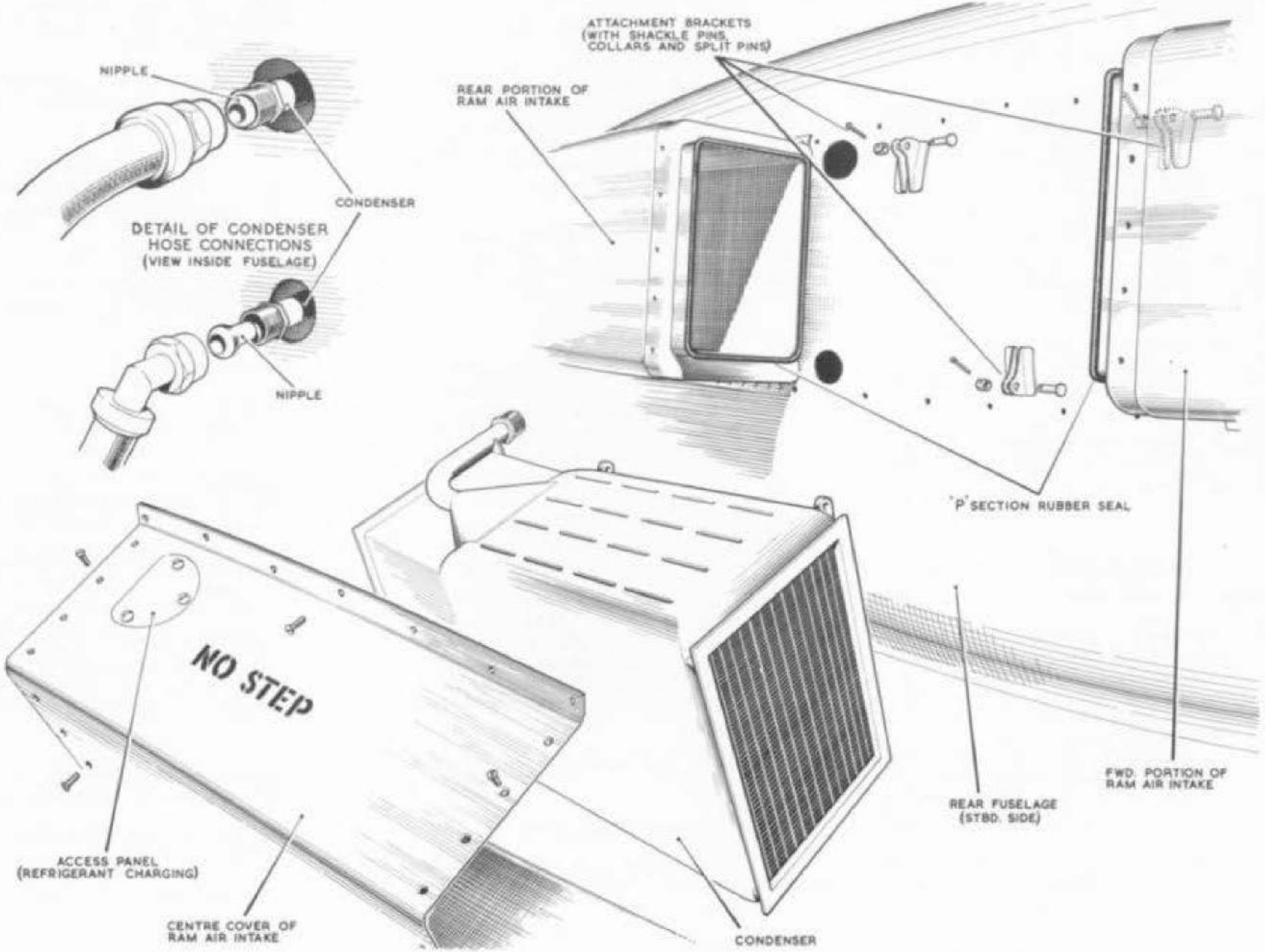

Fig. 11. Condenser removal.

the aircraft, the removal of the condenser is as follows:-

(1) Close valves A and B on the cooling pack.

(2) Disconnect, from the condenser, the two refrigerant hoses to the pack. Remove the nipple hose-adapters from the condenser stub pipes and wire them to the hoses, for security. Fit blanks to the hoses and stub pipes.

(3) Remove the securing screws and detach the centre portion of the ram air intake.

(4) Remove the split pins and collars from the shackle pins securing the condenser to the three fuselage brackets.

(5) Support the condenser, remove the shackle pins, then lift the unit clear.

INSTALLATION OF CONDENSER

125. This is carried out as follows:-

(1) Offer the condenser to the fuselage brackets taking care that when the condenser is positioned, the P section rubber seals, secured to the front and rear sections of the ram air intake, butt up to the flanges at both ends of the condenser. These rubber seals must not be allowed to enter the line of the condenser air inlet or outlet.

(2) Insert the shackle pins to secure the condenser to the fuselage brackets. Split pin the collars to the shackle pins.

(3) Replace the centre portion of the ram air intake.

(4) Remove the blanks from the condenser stub-pipes and from the two refrigerant hoses connected to the pack.

(5) Purge the condenser and the hoses, with nitrogen. Before the purging effect is lost, fit the nipple hose-adapters to the condenser stub pipes and couple-up the hoses.

NOTE . . .

If the pack is to Mod.1461 standard refer to para.111 and dry out the condenser before proceeding with the next operation.

(6) Open valves A and B.

(7) Remove the servicing plugs from valves X and Y, and connect a five-way manifold as shown in fig. 8. Close valves R, H and N.

(8) Connect a nitrogen supply to valve N. Regulate the supply to 30 p.s.i.g.

(9) Open valves N, R and H, and purge the manifold, thoroughly. Close valves R and H and then valve N.

(10) Open valves X and Y. Using valve N to control the nitrogen supply, pressurise the system to 25 p.s.i.g. If the system contains refrigerant, check the condenser joints with a leak detector, otherwise use soapy water.

(11) Drain and recharge the system.

CANISTER REMOVAL

126. This removal method is similar for all canisters. Pressurise the reservoir to 10 p.s.i., ensure that the electric supplies are OFF, refer to fig.7 and proceed as follows:-

(1) Disconnect the feeder cables and electric leads from the canister base. Release the cables from the support blocks attached to the base mounting ring.

(2) Disconnect the water/glycol flexible hose quick-release couplings.

(3) Using the special adapter (Ref.No. 26DC/95374),hook a mini-hoist to the roller attachment at the base of the pulley bracket. Ensure that the roller is free to rotate.

(4) Insert the nipple-end of the mini-hoist winch cable into the recessed slot in the pulley.

(5) Withdraw the Pip-pin.

(6) Tension the winch cable to take the weight of the canister.

WARNING . . .

Do not excessively tension the winch cable, otherwise the swaged joint at the canister end of the aircraft cable, will be strained. Conversely, if the cable is too slack when the screw pins are removed, the resultant snatch load imparted to the cable may fracture its attachment assembly on the spider, allowing the canister to drop to the ground.

(7) Disengage the screw pins (4 off), from the canister base mountings.

(8) Position a transportation trolley below the unit.

(9) Lower the canister onto the trolley.

(10) Disconnect the aircraft cable from the lifting eye at the centre of the spider mounting.

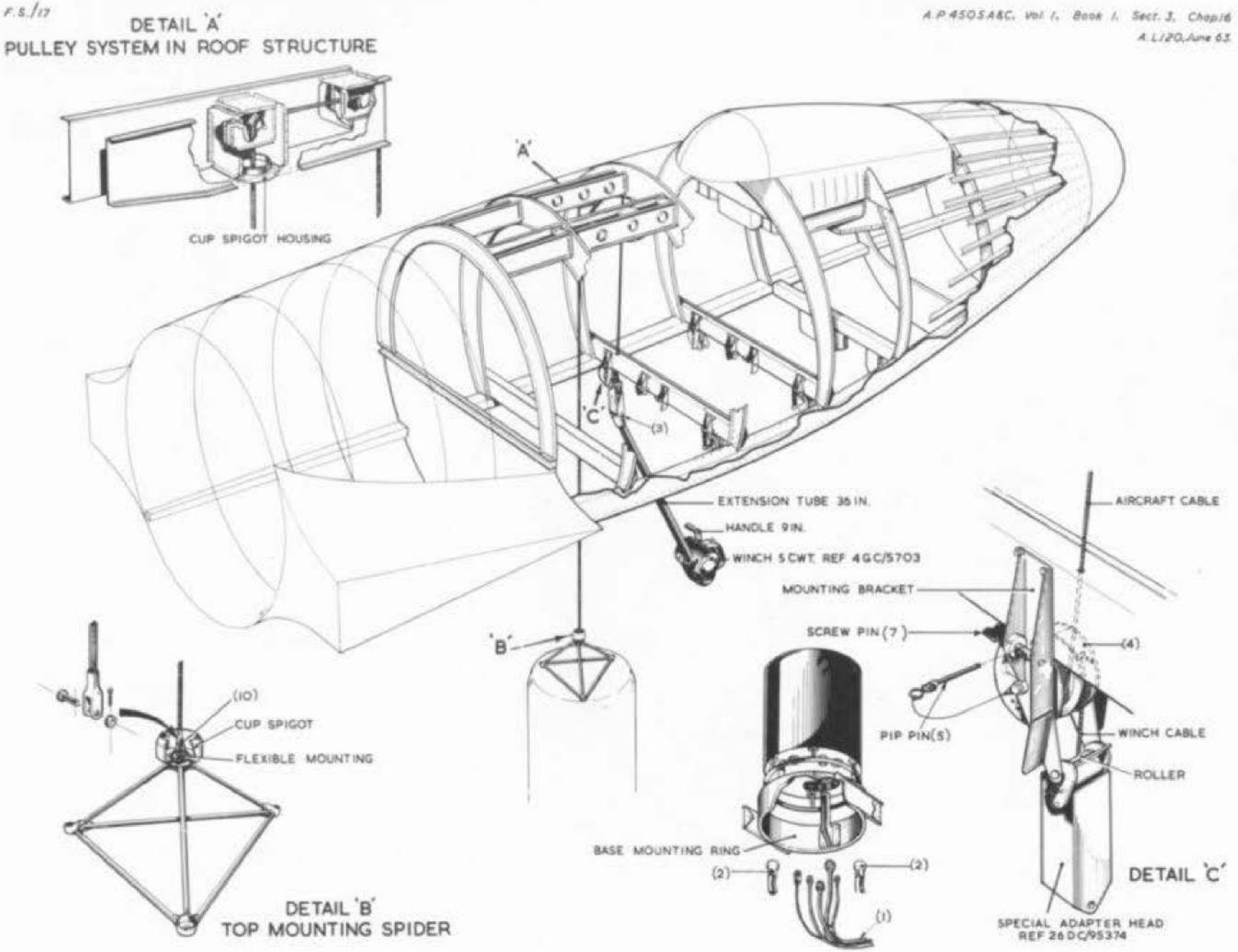

Fig. 12 Canister removal.

RESTRICTED

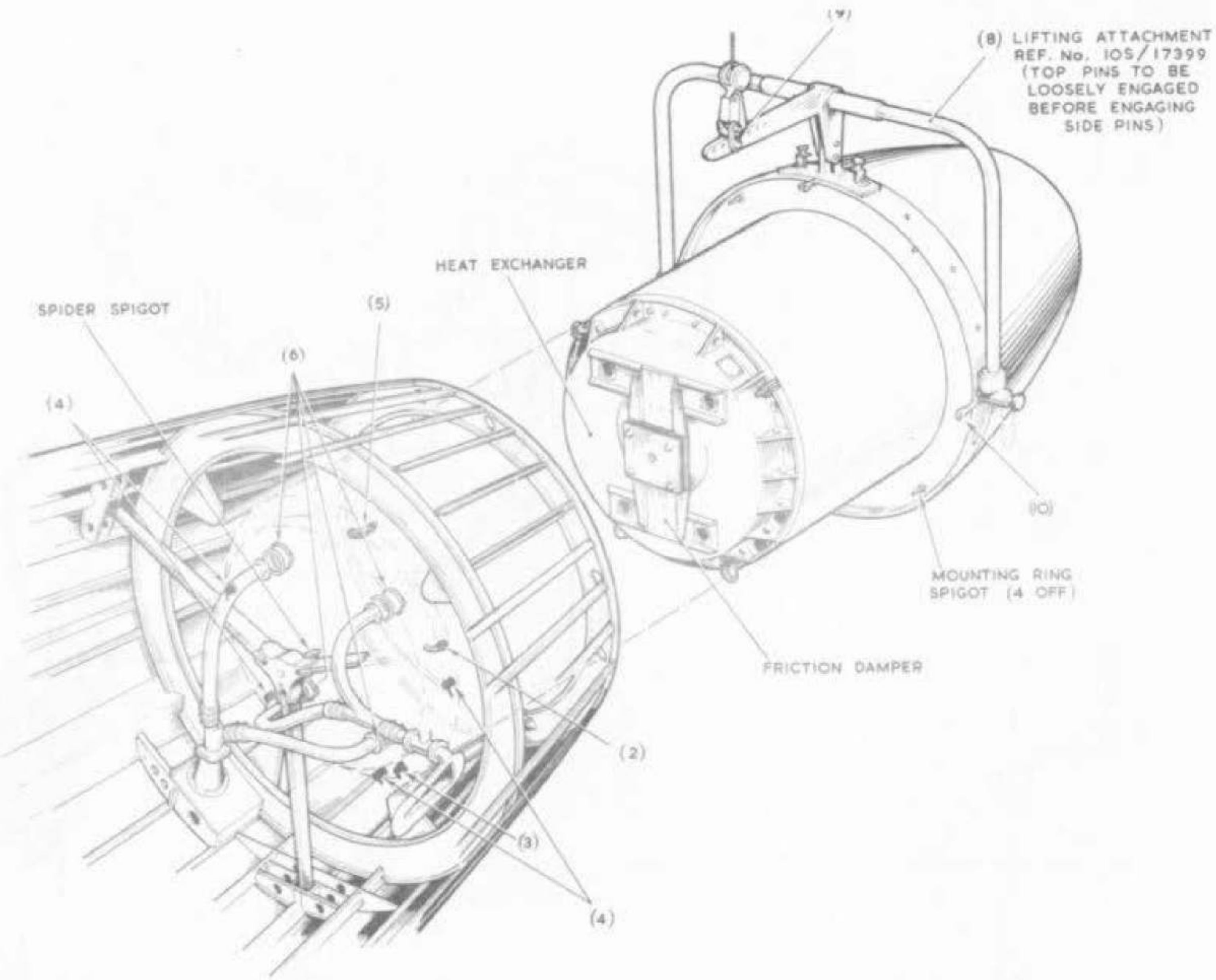

Fig. 13. Removal of radar head

RESTRICTED

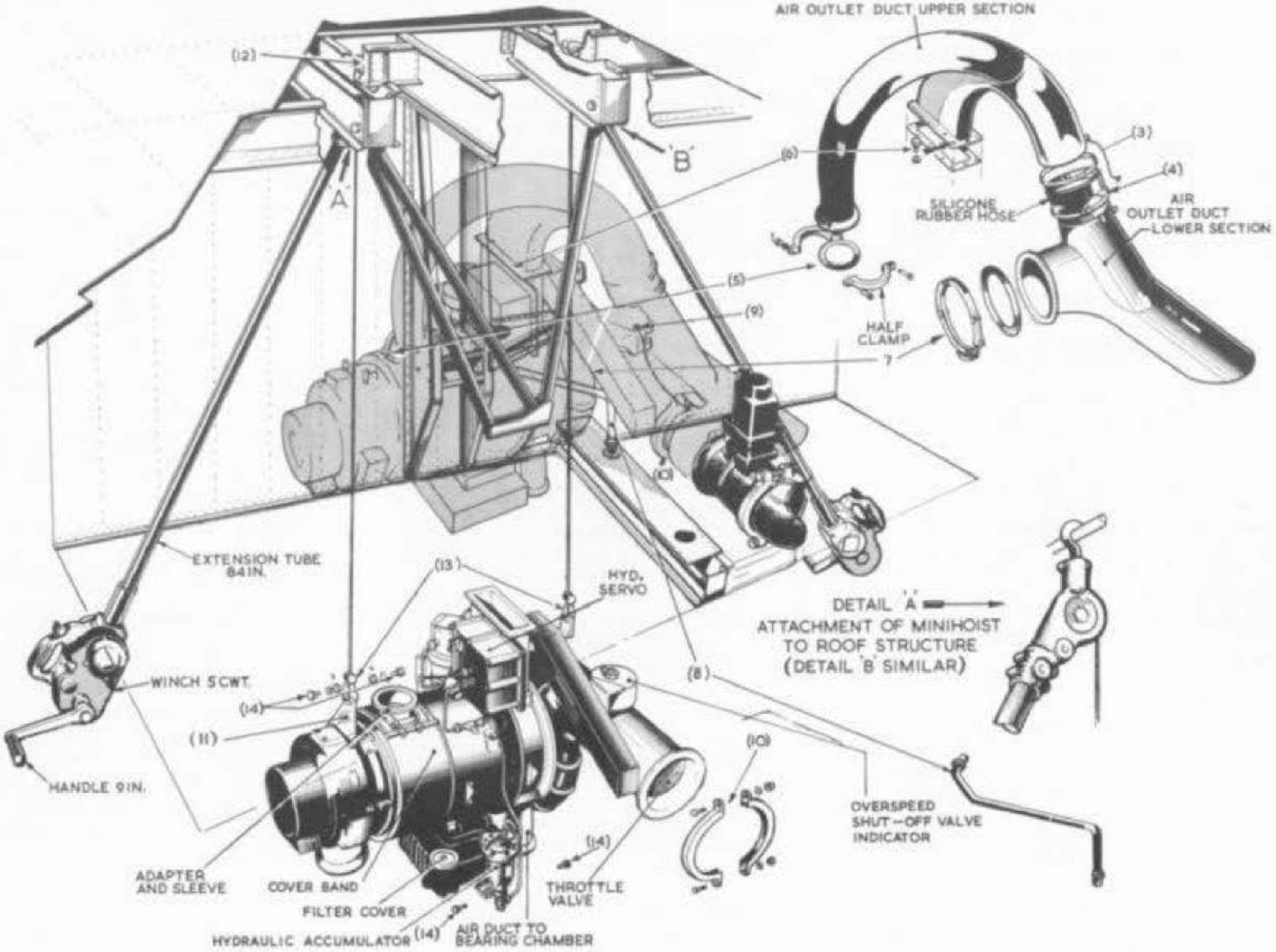

Fig.14. Removal of turbo-alternator

INSTALLATION OF CANISTER

127. The procedure for installation is the reversal of that for removal but, before hoisting, check the aircraft cable and pulley system for security. During hoisting do not allow the aircraft cable to be excessively tensioned (para.126 (6)). When the canister is secured in position, rotate the double pulley to take up the slack in the aircraft cable then lock the pulley with the Pip-pin. Connect the water/glycol flexible hoses to the canister following the procedure in para.86 (14) to (16).

RADAR HEAD PRESSURISATION SYSTEM

128. No specific instructions are necessary for removing and assembling components in the pressurisation system to the radar head. Before the release of any union upstream of the line valve, the air pressure in the cylinders must be discharged by using an adapter (Ref.No. 4G/4131), at the charging valve. The line valve must be closed before releasing unions downstream of the valve. After replacement of components, the system should be pressurised and the pipe unions checked for leaks.

◀ REMOVAL OF RADAR HEAD (fig.13) ▶

129. The radar head, i.e., the combination of the radar unit, heat exchanger, mounting ring and radome, is removed and installed as a complete unit. Ensure that all power supplies are OFF, then proceed as follows:-

1 Close the line valve on the pressure-reducing panel, to shut off the air supply to the radar head.

(2) Disconnect the air hose at the radar head.

(3) Disconnect the lead from the temperature sensing switch.

(4) Disconnect the four electrical connectors from the unit.

(5) Disconnect the flexible hose from the unit test connection, adjacent to the Schrader valve for deflating the seals.

(6) Disconnect the four quick-release clamps which attach the cooling air manifolds to the adapters fitted to the cooling air ports of the heat exchanger.

(7) Remove the screws indicated by the arrows stencilled on the radome.

(8) Fit the lifting attachment (Ref. No.10S/17399).

(9) Attach the hoisting equipment to the slinging link on the arm of the lifting attachment. Suitable equipment consists of a standard 5 cwt. mini-hoist with a 3 ft. extension tube, a jib (Ref.No. 4G/5708) and a servicing ladder (Ref.No.4G/5641). For details of the arrangement refer to A.P.1464G, Vol.1.

NOTE...
The link should be fitted in the third hole from the end of the arm.

(10) Slightly tension the hoist, then release the four fasteners securing the radar head to the fuselage.

(11) Manipulate the hoist and slide the unit free.

(12) Lower the radar head and secure it to the attachment ring (Ref.No. 10S/17398), which is fitted to the servicing trolley (Ref.No.10S/17400).

NOTE...
For field use this trolley is mounted on trolley Type E, (Ref.No.4F/1924).

INSTALLATION OF RADAR HEAD

130. The installation procedure is a reversal of that detailed in para.129. As the unit is offered up to the fuselage ensure that the rollers are aligned on the guide rails. When the four mounting ring spigots engage with the holes in the former, check that the spider spigot enters the hole in the friction damper plate. Do not use grease to effect the entry of the spigot; it will adversely affect the friction damper. Before securing the cooling air manifold to the adapters on the air ports of the heat exchanger, ensure that the ring seals are in position. When complete, open the line valve on the pressure reducing panel and pressurise the radar head.

◀ REMOVAL OF TURBO-ALTERNATOR (fig.14) ▶

131. This operation is carried out using a sling-plate (Part No.1/U1727) and two 5 cwt. mini-hoists with 84 in. extensions. Although the removal of the large panel aft of the access door improves accessibility, the unit may be removed with the panel in position, the rear hoist being inserted through the elliptical cut-out after the exhaust air ducting is removed from the unit. The procedure is as follows:-

1 Open the access door.

2 Disconnect the electrical supply leads from the alternator and the hydraulic servo box

(3) Disconnect the bonding lead between the two sections of the air outlet duct.

(4) Slacken the lower clip securing the hose connecting the two sections.

(5) Remove the half-clamp securing the upper section to the alternator cooling air outlet.

(6) Remove the screws securing the upper duct flange to the air outlet of the turbine bearing chamber and detach the upper duct, together with the joint seals.

(7) Remove the manacle clamp securing the lower duct section to the turbine exhaust. Remove the duct, taking care not to damage the seal at the elliptical cut-out in the large access panel.

(8) Release the clips at both ends of the breather pipe and remove the pipe.

(9) Disconnect the bonding lead from the cover of the overspeed trip mechanism.

(10) Remove the half-clamps securing the expansion unit to the turbine inlet flange.

(11) Attach the sling plate to the lifting eyes on the alternator.

(12) Attach the hoists to the lifting points in the roof structure.

(13) Attach the cable hooks to the lifting eyes on the turbine volute and the sling plate. Tension both cables to support the unit.

(14) Remove the four bolts from the turbo-alternator mounting brackets and lower the unit to a working height.

NOTE...
The inboard pair of bolts are screwed into the tubular mounting frame and wire-locked at their heads. The outboard pair are secured by nuts and split pins.

15 If a replacement unit is to be fitted remove the installation fittings, i.e., the adapter and sleeve on the alternator air outlet, the two duct fittings to the bearing chamber air inlet ports and the mounting brackets on either side of the gearbox.

16 Lower the unit on to its storage stand and secure. Blank all open ends.

INSTALLATION OF TURBO ALTERNATOR

132. Before installation of the turbo-alternator, remove all blanks and check that the overspeed valve and the throttle valve are in the fully open position. Ensure that the sump is filled with 4½ pints of oil OX - 38. The procedure is then a reversal of that detailed in para.131. When the unit is positioned in the aircraft, the outboard pair of mounting bolts should be inserted so that their heads are facing fore and aft, respectively.